

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TESLA, INC.,

Petitioner

v.

GRANITE VEHICLE VENTURES LLC,

Patent Owner

Inter Partes Review Case No. IPR2025-01034
of U.S. Patent No. 12,037,004
(Claims 1-9, 29-39)

DECLARATION OF CHRISTOPHER WILSON

TABLE OF CONTENTS

I.	INTRODUCTION.....	27
A.	EDUCATIONAL BACKGROUND AND PROFESSIONAL EXPERIENCE	27
II.	METHODOLOGY; MATERIALS CONSIDERED	30
III.	OVERVIEW AND LEGAL STANDARDS	34
A.	PERSON OF ORDINARY SKILL IN THE ART	34
B.	OBVIOUSNESS	35
C.	ANALOGOUS ART.....	40
D.	CLAIM CONSTRUCTION	41
IV.	LEVEL OF A PERSON OF ORDINARY SKILL.....	41
V.	BACKGROUND OF THE TECHNOLOGY	43
A.	HISTORY OF AUTONOMOUS VEHICLES	43
B.	FAULTS	45
C.	DRIVING MODES	50
D.	ASSESSING COMPETENCE LEVELS.....	51
1.	<i>Driver Competence.....</i>	<i>51</i>
2.	<i>SDV Competence.....</i>	<i>53</i>
E.	SDV INFRASTRUCTURE.....	55
1.	<i>SDV Hardware</i>	<i>56</i>
a)	Sensors	57
b)	Displays	59
c)	Braking and Steering.....	60
2.	<i>SDV Software.....</i>	<i>61</i>
VI.	SHOWING OF ANALOGOUS, PRIOR ART	63
VII.	GROUND OF UNPATENTABILITY	65
VIII.	GROUND 1: CLAIM 1 IS OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, AND FRAZER	66
A.	THE <i>HAMPIHOLI-ATTARD</i> SELF-DRIVING VEHICLE	66
B.	CLAIM 1	68
1.	<i>Claim 1(Pre): “A computer program product for controlling a driving mode of a self-driving vehicle (SDV), the computer program product comprising a non-transitory computer</i>	

readable storage medium having instructions that, when executed, cause at least one data processing apparatus to perform operations comprising:.....68

a) *Hampiholi-Attard Teaches Controlling a Driving Mode 68*

b) *Hampiholi's Computer Program Product Comprises Non-Transitory Computer-Readable Memory and Processor 72*

2. *Claim 1(a): "receiving a plurality of sensor readings from a system of sensors, wherein the system of sensors comprises: a steering wheel sensor, a speedometer, a GPS sensor, and a camera;" 74*

a) *Hampiholi's System of Sensors 74*

b) *McNew's Steering Wheel Sensor.....77*

3. *Claim 1(b): "determining a competence level of a human driver using one or more of the sensor readings;" 79*

4. *Claim 1(c): "determining a competence level of the SDV using one or more of the sensor readings;" 83*

a) *'004 Patent's SDV competence level 83*

b) *Attard's SDV competence level – Capital Φ 84*

c) *Motivation to Combine Hampiholi-Attard-McNew 86*

5. *Claim 1(d): "comparing the competence level of the human driver to a first threshold;" 90*

6. *Claim 1(e): "comparing the competence level of the human driver to a second threshold, wherein the second threshold is different from the first threshold;" 91*

7. *Claim 1(f): "determining that no fault has occurred when the competence level of the human driver exceeds the first threshold and exceeds the second threshold;" 93*

8. *Claim 1(g): "determining that a first fault has occurred when the competence level of the human driver exceeds the second threshold and is below the first threshold;" 98*

9. *Claim 1(h): "determining that a second fault has occurred when the competence level of the human driver is below the first threshold and is below the second threshold;" 100*

10.	<i>Claim 1(i): “determining, using a fault remediation table, a first corrective action associated with the first fault, wherein the first corrective action comprises sounding a warning sound and displaying an icon on a display screen;”</i>	102
a)	<i>Hampiholi-Attard’s Corrective Actions</i>	102
b)	<i>Motivation to Combine Hampiholi-Attard</i>	104
c)	<i>Frazer Teaches a Fault-Remediation Table</i>	105
d)	<i>Motivation to Combine Hampiholi-Attard-McNew-Frazer</i>	108
11.	<i>Claim 1(j): “determining, using the fault remediation table, a second corrective action associated with the second fault, wherein the second corrective action comprises decreasing a speed of the SDV and transferring driver controls to manual control;”</i>	113
a)	<i>McNew Teaches Transferring Driver Controls to Manual Control</i>	114
b)	<i>Motivation to Combine Hampiholi-Attard-Frazer-McNew</i>	118
12.	<i>Claim 1(k): “autonomously controlling the driver controls without requiring the human driver to control the driver controls when no fault has occurred, wherein the driver controls comprise: engine throttle, steering mechanism, and braking system;”</i>	122
a)	<i>Motivation to Combine</i>	125
13.	<i>Claim 1(l): “taking the first corrective action when the first fault has occurred; and”</i>	127
14.	<i>Claim 1(m): “taking the second corrective action when the second fault has occurred.”</i>	127

IX. GROUND 2: CLAIMS 2-5 ARE OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, DERUYCK, GUNDERSON, AN, KANG, AND SCHUNDER.....127

A. CLAIM 2 127

1.	<i>Claim 2(a): “The computer program product of claim 1, further comprising: determining the competence level of the human</i>	
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driver comprises using a weighted voting system with a first plurality of inputs and a first plurality of weights, wherein:” 127

- a) *’004 Patent’s Weighted Voting*.....127
- b) *Hampiholi’s Inputs* 128
- c) *DeRuyck’s Inputs and Weights*.....131
- d) *Motivation to Combine with DeRuyck* 132
- 2. *Claim 2(b): “the first plurality of inputs comprises one or more of the sensor readings;”* 134
- 3. *Claim 2(c): “at least one of the first plurality of inputs is multiplied by a weight from among the first plurality of weights, wherein the first plurality of weights are based on first active learning data, the first active learning data comprising information about a first cohort of human drivers of other SDVs;”* 134
 - a) *Gunderson’s Active Learning Data*.....134
 - b) *Motivation to Combine Gunderson*.....136
- 4. *Claim 2(d): “determining the competence level of the SDV comprises using the weighted voting system with a second plurality of inputs and a second plurality of weights, wherein:”* 138
 - a) *Attard’s Weighting Teachings* 138
 - b) *An’s Teachings*.....139
 - c) *Motivation to Combine* 140
- 5. *Claim 2(e): “the second plurality of inputs comprises one or more of the sensor readings;”* 142
- 6. *Claim 2(f): “the second plurality of inputs comprises at least one sensor reading that is not in the first plurality of inputs;”* 142
- 7. *Claim 2(g): “the first plurality of inputs comprises at least one sensor reading that is not in the second plurality of inputs; and”* 142
- 8. *Claim 2(h): “at least one of the second plurality of inputs is multiplied by a weight from among the second plurality of weights, wherein the second plurality of weights are based on*

	<i>second active learning data, the second active learning data comprising condition data from a second cohort of other SDVs, wherein the condition data shares one or more traits with a current condition of a roadway on which the SDV is currently traveling.”</i>	142
	a) Kang’s Weights	143
	b) Motivation to Combine	144
	c) Schunder’s Weather Condition Data	148
	d) Motivation to Combine	149
B.	CLAIM 3	153
1.	<i>Claim 3(a): “The computer program product of claim 2, further comprising: when no fault has occurred, autonomously maintaining a buffer of space from other vehicles around the SDV without requiring the human driver to control the driver controls;”</i>	153
2.	<i>Claim 3(b): “obtaining the first plurality of weights by querying a database; and”</i>	153
3.	<i>Claim 3(c): “obtaining the second plurality of weights by querying the database.”</i>	154
C.	CLAIM 4	154
1.	<i>Claim 4(a): “The computer program product of claim 3, further comprising: tracking a number of times the first fault has occurred; and”</i>	154
	a) McNew’s Teachings	155
	b) Motivation to Combine	157
2.	<i>Claim 4(b): “determining the competence level of the human driver using the number of times the first fault has occurred.”</i>	158
	a) McNew’s Teachings	158
	b) Motivation To Combine	159
D.	CLAIM 5	160

1. *Claim 5(a): “The computer program product of claim 3, further comprising: tracking a length of time during which the first fault has occurred; and”* 160
 - a) *McNew’s Teachings* 160
 - b) *Motivation to Combine* 161
2. *Claim 5(b): “determining the competence level of the human driver using the length of time during which the first fault has occurred.”* 161
 - a) *McNew’s Teachings* 161
 - b) *Motivation To Combine* 162

X. GROUND 3: CLAIMS 6-7 ARE OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, AND SAKO 162

A. CLAIM 6 164

1. *Claim 6(a): “The computer program product of claim 1, further comprising: determining, using one or more of the sensor readings, whether the SDV is travelling on a first roadway type or a second roadway type of a plurality of roadway types;”* .164
2. *Claim 6(b): “determining the competence level of the SDV comprises determining whether the SDV is currently operating in a first autonomous mode of a plurality of autonomous modes;”* 164
3. *Claim 6(c): “determining that a third fault has occurred when the SDV is currently travelling on the second roadway type and the competence level of the SDV is below a third threshold; and”* 166
4. *Claim 6(d): “determining, using the fault remediation table, a third corrective action associated with the third fault, wherein the third corrective action comprises transferring the driver controls to manual control.”* 166

B. CLAIM 7 167

1. *Claim 7(a): “The computer program product of claim 6, further comprising, the first roadway type comprises a public highway;”* 167
2. *Claim 7(b): “the second roadway type does not comprise a public highway;”* 167

3. Claim 7(c): “operating in the first autonomous mode comprises autonomously controlling the driver controls without requiring the human driver to control the driver controls; and” 168
4. Claim 7(d): “determining the competence level of the SDV comprises determining that the competence level of the SDV is below the third threshold when the SDV is not currently operating in the first autonomous mode.” 168

XI. GROUND 4: CLAIM 8 IS OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, AND COELINGH 168

1. Claim 8(a): “The computer program product of claim 1, further comprising: sensing an operational state of a first camera sensor;” 168
2. Claim 8(b): “determining, using a weighted voting system with a first plurality of inputs and a first plurality of weights, whether the first camera sensor is currently experiencing an operational anomaly;” 169
3. Claim 8(c): “the first plurality of inputs comprises sensor readings from the first camera sensor;” 170
4. Claim 8(d): “at least one of the first plurality of inputs is multiplied by a weight from among the first plurality of weights, ...170
5. Claim 8(e): “wherein the first plurality of weights are based on first active learning data, the first active learning data comprising information about a cohort of other SDVs experiencing a camera sensor operational anomaly;” 170
 - a) Coelingh’s Teachings 171
 - b) The Combination Renders Obvious 8(e).....171
6. Claim 8(f): “determining that a third fault has occurred when the first camera sensor is currently experiencing an operational anomaly.” 174

XII. GROUND 5: CLAIM 9 IS OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, COELINGH, DERUYCK, GUNDERSON, AN, KANG, AND SCHUNDER.....174

1. Claim 9(a): “The computer program product of claim 8, further comprising: determining the competence level of the human

driver comprises using the weighted voting system with a second plurality of inputs and a second plurality of weights, wherein;” 174

2. *Claim 9(b): “the second plurality of inputs comprises one or more of the sensor readings;” 174*
3. *Claim 9(c): “at least one of the second plurality of inputs is multiplied by a weight from among the second plurality of weights, wherein the second plurality of weights are based on second active learning data, the second active learning data comprising sensor readings about a first cohort of human drivers of other SDVs:” 174*
4. *Claim 9(d): “determining the competence level of the SDV comprises using the weighted voting system with a third plurality of inputs and a third plurality of weights, wherein:” 174*
5. *Claim 9(e): “the third plurality of inputs comprises one or more of the sensor readings;” 175*
6. *Claim 9(f): “the third plurality of inputs comprises at least one sensor reading that is not in the first plurality of inputs and is not in the second plurality of inputs;” 175*
7. *Claim 9(g): “the second plurality of inputs comprises at least one sensor reading that is not in the first plurality of inputs and is not in the third plurality of inputs; and” 175*
8. *Claim 9(h): “at least one of the third plurality of inputs is multiplied by a weight from among the third plurality of weights, wherein the third plurality of weights are based on third active learning data, the third active learning data comprising sensor readings about condition data from a second cohort of other SDVs, wherein the condition data shares one or more traits with a current condition of a roadway on which the SDV is currently traveling.” 176*

XIII. GROUND 6: CLAIMS 29 IS OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, AND HADA.....176

- A. CLAIM 29 176
 1. *Claim 29(Pre): “A computer program product for controlling a driving mode of a self-driving vehicle (SDV), the computer*

	<i>program product comprising a non-transitory computer readable storage medium having program code embodied therewith, the program code readable and executable by a processor to perform a method comprising:”</i>	<i>176</i>
2.	<i>Claim 29(a): “receiving a plurality of sensor readings from a system of sensors, the system of sensors comprising:”</i>	<i>176</i>
3.	<i>Claim 29(a)(i): “a camera directed at a human driver;”</i>	<i>177</i>
4.	<i>Claim 29(a)(ii): “a camera directed away from the SDV;”</i>	<i>178</i>
5.	<i>Claim 29(a)(iii): “a sensor configured to detect input from a steering wheel;”</i>	<i>179</i>
6.	<i>Claim 29(a)(iv): “a GPS sensor;”</i>	<i>179</i>
7.	<i>Claim 29(a)(v): “a thermometer; and”</i>	<i>179</i>
8.	<i>Claim 29(a)(vi): “a speedometer;”</i>	<i>179</i>
9.	<i>Claim 29(b): “displaying, on a display screen, one or more sensor readings of the sensor readings;”</i>	<i>180</i>
	a) <i>Hada Teaches Displaying Sensor Readings on a Display Screen</i>	<i>180</i>
	b) <i>Motivation to Combine with Hada</i>	<i>181</i>
10.	<i>Claim 29(c): “determining, using one or more sensor readings of the sensor readings, a position of another vehicle currently on a roadway;”</i>	<i>183</i>
11.	<i>Claim 29(d): “determining a competence level of the SDV using one or more of the sensor readings, wherein the competence level of the SDV is a function of a degree of uncertainty in the determined position of the other vehicle;”</i>	<i>183</i>
	a) <i>Attard’s Teachings</i>	<i>183</i>
12.	<i>Claim 29(e): “autonomously controlling driver controls without requiring the human driver to control the driver controls, wherein the driver controls comprise: engine throttle, a steering mechanism, and braking system;”</i>	<i>184</i>
13.	<i>Claim 29(f): “autonomously maintaining a buffer of space between the SDV and the other vehicle;”</i>	<i>185</i>
14.	<i>Claim 29(g): “determining a competence level of a human driver using one or more of the sensor readings;”</i>	<i>185</i>

15. *Claim 29(h): “determining, using a fault remediation table, a first corrective action associated with a first human competence level, wherein the first corrective action comprises sounding a warning sound and displaying an icon on a display screen;”* 185
16. *Claim 29(i): “determining, using the fault remediation table, a second corrective action associated with a second human competence level, wherein the second corrective action comprises decreasing a speed of the SDV and transferring driver controls to manual control;”* 185
17. *Claim 29(j): “taking the first corrective action when the competence level of the human driver satisfies a first competence quota; and”* 185
18. *Claim 29(k): “taking the second corrective action when the competence level of the human driver satisfies a second competence quota.”* 186

XIV. GROUND 7: CLAIM 30 IS OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, HADA, AND TSIMHONI-647.....186

- C. CLAIM 30 186
1. *Claim 30(a): “The computer program product of claim 29, further comprising: displaying, on the display screen, a graphical representation of the position of the other vehicle relative to the SDV and a graphical representation of the competence level of the SDV.”* 186
 - a) *Hada’s Teachings*.....186
 - b) *Tsimhoni-647’s Teachings* 188
 - c) *Motivation to Combine* 189

XV. GROUND 8: CLAIMS 31-32 ARE OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, HADA, TSIMHONI-647, DERUYCK, GUNDERSON, AN, KANG, SCHUNDER.....191

- A. CLAIM 31 191
1. *Claim 31(a): “The computer program product of claim 29, further comprising: determining the competence level of the human driver comprises using a weighted voting system with a*

	<i>first plurality of inputs and a first plurality of weights, wherein:”</i>	191
2.	<i>Claim 31(b): “the first plurality of inputs comprises one or more sensor readings of the sensor readings;”</i>	191
3.	<i>Claim 31(c): “at least one of the first plurality of inputs is multiplied by a weight from among the first plurality of weights, wherein the first plurality of weights are based on first active learning data, the first active learning data comprising information about a first cohort of human drivers of other SDVs; and”</i>	191
4.	<i>Claim 31(d): “determining the competence level of the SDV comprises using the weighted voting system with a second plurality of inputs and a second plurality of weights, wherein:”</i>	192
5.	<i>Claim 31(e): “the second plurality of inputs comprises one or more of the sensor readings;”</i>	192
6.	<i>Claim 31(f): “the second plurality of inputs comprises at least one sensor reading that is not in the first plurality of inputs; and”</i>	192
7.	<i>Claim 31(g): “at least one of the second plurality of inputs is multiplied by a weight from among the second plurality of weights, wherein the second plurality of weights are based on second active learning data, the second active learning data comprising condition data from a second cohort of other SDVs, wherein the condition data shares one or more traits with a current condition of the roadway on which the SDV is currently traveling.”</i>	192
B.	CLAIM 32	192
1.	<i>Claim 32(a): “The computer program product of claim 31, further comprising: determining, using one or more sensor readings of the sensor readings, the position of a lane marking on the roadway;”</i>	192
2.	<i>Claim 32(b): “determining, using one or more sensor readings of the sensor readings, the position of a traffic signal; and”</i>	193
3.	<i>Claim 32(c): “displaying, on the display screen, a simultaneous graphical representation of the position of the other vehicle, the</i>	

position of the lane marking on the roadway, the position of the traffic signal, and the competence level of the SDV.”.....194

XVI. GROUND 9: CLAIMS 33-34 ARE OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, HADA, TSIMHONI-647, DERUYCK, GUNDERSON, AN, KANG, SCHUNDER, AND NAGASAKA 197

A. CLAIM 33 197

1. *Claim 33(a): “The computer program product of claim 32, further comprising: autonomously changing lanes without requiring the human driver to control the driver controls;” ..197*
2. *Claim 33(b): “autonomously engaging a turn signal of the SDV prior to autonomously changing lanes without requiring the human driver to control the turn signal;” 198*
3. *Claim 33(c): “determining, using the fault remediation table, a third corrective action associated with a first SDV competence level; and” 201*
4. *Claim 33(d): “taking the third corrective action when the competence level of the SDV is equivalent to or below the first SDV competence level.” 201*

B. CLAIM 34 201

1. *Claim 34(a): “The computer program product of claim 33, further comprising: the third corrective action comprises decreasing a speed of the SDV and transferring the driver controls to manual control; and” 201*
2. *Claim 34(b): “the competence level of the human driver is a function of a sensor reading from the camera directed at the human driver.” 202*

XVII. GROUND 10: CLAIMS 35-36 ARE OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, HADA, TSIMHONI-647, DERUYCK, GUNDERSON, AN, KANG, SCHUNDER, NAGASAKA, AND DUNCAN 202

A. CLAIM 35 202

1. *Claim 35(a): “The computer program product of claim 34, further comprising: retrieving a human driver profile from a database;” 202*

2.	<i>Claim 35(b): “determining, using the fault remediation table, a fourth corrective action associated with a first human driver profile quota, wherein the fourth corrective action comprises disabling an autonomous driving mode; and”</i>	204
3.	<i>Claim 35(c): “taking the fourth corrective action when the human driver profile is equivalent to or below the first human driver profile quota.”</i>	205
B.	CLAIM 36	206
1.	<i>Claim 36(a): “The computer program product of claim 35, further comprising: the human driver profile is a function of a previous sensor reading from the camera directed at the human driver;”</i>	206
2.	<i>Claim 36(b): “the human driver profile is a function of a previous sensor reading from the camera directed away from the SDV;”</i>	206
3.	<i>Claim 36(c): “the human driver profile is a function of a previous sensor reading from the sensor configured to detect input from the steering wheel; and”</i>	207
4.	<i>Claim 36(d): “the human driver profile is a function of a previous sensor reading from the speedometer.”</i>	208
XVIII.	GROUND 11: CLAIMS 37-39 ARE OBVIOUS OVER ATTARD, HAMPIHOLI, MCNEW, AND FRAZER	208
A.	CLAIM 37	208
1.	<i>Claim 37(Pre): “ A computer program product for controlling a driving mode of a self-driving vehicle (SDV), the computer program product comprising a non-transitory computer readable storage medium having program code embodied therewith, the program code readable and executable by a processor to perform a method comprising:”</i>	208
a)	<i>Attard’s Computer Program Product Comprises Non-Transitory Computer-Readable Memory and Processor</i>	209
2.	<i>Claim 37(a): “receiving one or more sensor readings from a system of sensors, wherein the system of sensors comprises one or more sensors that detect an operational state of the SDV, the one or more sensors comprising:”</i>	211

a)	<i>Attard's System of Sensors and Sensor Readings.....</i>	211
b)	<i>Attard's Sensor Readings Describe a Current Operational State of an SDV</i>	213
3.	<i>Claim 37(a)(i): "a camera directed away from the SDV;"....</i>	215
4.	<i>Claim 37(a)(ii): "a sensor configured to detect input from a steering wheel;"</i>	215
5.	<i>Claim 37(a)(iii): "a GPS sensor;"</i>	215
6.	<i>Claim 37(a)(iv): "a thermometer; and"</i>	215
a)	<i>Motivation to Combine Attard-Hampiholi.....</i>	215
7.	<i>Claim 37(a)(v): "a speedometer;"</i>	216
8.	<i>Claim 37(b): "determining a competence level of a control processor as a function of the operational state of the SDV;"</i>	216
9.	<i>Claim 37(c): "comparing the competence level of the control processor to a first threshold;"</i>	217
10.	<i>Claim 37(d): "comparing the competence level of the control processor to a second threshold, wherein the first threshold is higher than the second threshold:"</i>	218
a)	<i>Hampiholi's Teachings</i>	219
b)	<i>Motivation to Combine Attard-Hampiholi.....</i>	221
11.	<i>Claim 37(e): "autonomously controlling driver controls without requiring a human driver to control the driver controls when the competence level of the control processor is above the first threshold;"</i>	222
12.	<i>Claim 37(f): "determining a first fault has occurred when the competence level of the control processor is between the first threshold and the second threshold;"</i>	224
13.	<i>Claim 37(g): "determining a second fault has occurred when the competence level of the control processor is below the second threshold; and"</i>	226
14.	<i>Claim 37(h): "performing a corrective action listed in a fault remediation table, comprising:"</i>	227
a)	<i>Motivation to Combine</i>	228

15.	<i>Claim 37(h)(i): “displaying a warning message on a display screen when the first fault occurs; and”</i>	232
16.	<i>Claim 37(h)(ii): “sounding a warning sound, displaying a warning message, displaying an icon on the display screen, and transferring the driver controls to manual control when the second fault occurs.”</i>	233
a)	When the Second Fault Occurs	233
b)	Warning Sound	234
c)	Motivation to Combine	236
d)	Displaying a Warning Message	236
e)	Displaying an Icon	237
f)	Transfer to Manual	237
g)	Motivation to Combine <i>Attard-Hampiholi-Frazer-McNew</i>	237
B.	CLAIM 38	240
1.	<i>Claim 38(a): “The computer program product of claim 37, further comprising: comparing the competence level of the control processor to a third threshold, wherein the third threshold is between the first threshold and the second threshold; and”</i>	240
2.	<i>Claim 38(b): “determining a third fault has occurred when the competence level of the control processor is between the third threshold and the second threshold.”</i>	241
C.	CLAIM 39	242
1.	<i>Claim 39(a): “The computer program product of claim 38, further comprising: the operational state of the SDV comprises a current weather condition of a roadway on which the SDV is currently traveling; and”</i>	242
2.	<i>Claim 39(b): “autonomously altering a route being taken by the SDV when the third fault occurs.”</i>	243
a)	Motivation to Combine	243
XIX.	CONCLUSION	245

CLAIM LISTING APPENDIX
U.S. Patent No. 12,037,004 for Claims 1-9 and 29-39

Claim Designation	Claim Language
Claim 1(Pre)	A computer program product for controlling a driving mode of a self-driving vehicle (SDV), the computer program product comprising a non-transitory computer readable storage medium having instructions that, when executed, cause at least one data processing apparatus to perform operations comprising:
Claim 1(a)	receiving a plurality of sensor readings from a system of sensors, wherein the system of sensors comprises: a steering wheel sensor, a speedometer, a GPS sensor, and a camera;
Claim 1(b)	determining a competence level of a human driver using one or more of the sensor readings;
Claim 1(c)	determining a competence level of the SDV using one or more of the sensor readings;
Claim 1(d)	comparing the competence level of the human driver to a first threshold;
Claim 1(e)	comparing the competence level of the human driver to a second threshold, wherein the second threshold is different from the first threshold;
Claim 1(f)	determining that no fault has occurred when the competence level of the human driver exceeds the first threshold and exceeds the second threshold;
Claim 1(g)	determining that a first fault has occurred when the competence level of the human driver exceeds the second threshold and is below the first threshold;
Claim 1(h)	determining that a second fault has occurred when the competence level of the human driver is below the first threshold and is below the second threshold;
Claim 1(i)	determining, using a fault remediation table, a first corrective action associated with the first fault, wherein the first corrective action comprises sounding a warning sound and displaying an icon on a display screen;

Claim Designation	Claim Language
Claim 1(j)	determining, using the fault remediation table, a second corrective action associated with the second fault, wherein the second corrective action comprises decreasing a speed of the SDV and transferring driver controls to manual control;
Claim 1(k)	autonomously controlling the driver controls without requiring the human driver to control the driver controls when no fault has occurred, wherein the driver controls comprise: engine throttle, steering mechanism, and braking system;
Claim 1(l)	taking the first corrective action when the first fault has occurred; and
Claim 1(m)	taking the second corrective action when the second fault has occurred.
Claim 2(a)	The computer program product of claim 1, further comprising: determining the competence level of the human driver comprises using a weighted voting system with a first plurality of inputs and a first plurality of weights, wherein:
Claim 2(b)	the first plurality of inputs comprises one or more of the sensor readings;
Claim 2(c)	at least one of the first plurality of inputs is multiplied by a weight from among the first plurality of weights, wherein the first plurality of weights are based on first active learning data, the first active learning data comprising information about a first cohort of human drivers of other SDVs;
Claim 2(d)	determining the competence level of the SDV comprises using the weighted voting system with a second plurality of inputs and a second plurality of weights, wherein:
Claim 2(e)	the second plurality of inputs comprises one or more of the sensor readings;
Claim 2(f)	the second plurality of inputs comprises at least one sensor reading that is not in the first plurality of inputs;
Claim 2(g)	the first plurality of inputs comprises at least one sensor reading that is not in the second plurality of inputs; and

Claim Designation	Claim Language
Claim 2(h)	at least one of the second plurality of inputs is multiplied by a weight from among the second plurality of weights, wherein the second plurality of weights are based on second active learning data, the second active learning data comprising condition data from a second cohort of other SDVs, wherein the condition data shares one or more traits with a current condition of a roadway on which the SDV is currently traveling.
Claim 3(a)	The computer program product of claim 2, further comprising: when no fault has occurred, autonomously maintaining a buffer of space from other vehicles around the SDV without requiring the human driver to control the driver controls;
Claim 3(b)	obtaining the first plurality of weights by querying a database; and
Claim 3(c)	obtaining the second plurality of weights by querying the database.
Claim 4(a)	The computer program product of claim 3, further comprising: tracking a number of times the first fault has occurred; and
Claim 4(b)	determining the competence level of the human driver using the number of times the first fault has occurred.
Claim 5(a)	The computer program product of claim 3, further comprising: tracking a length of time during which the first fault has occurred; and
Claim 5(b)	determining the competence level of the human driver using the length of time during which the first fault has occurred.
Claim 6(a)	The computer program product of claim 1, further comprising: determining, using one or more of the sensor readings, whether the SDV is travelling on a first roadway type or a second roadway type of a plurality of roadway types;
Claim 6(b)	determining the competence level of the SDV comprises determining whether the SDV is currently operating in a first autonomous mode of a plurality of autonomous modes;
Claim 6(c)	determining that a third fault has occurred when the SDV is currently travelling on the second roadway type and the competence level of the SDV is below a third threshold; and

Claim Designation	Claim Language
Claim 6(d)	determining, using the fault remediation table, a third corrective action associated with the third fault, wherein the third corrective action comprises transferring the driver controls to manual control.
Claim 7(a)	The computer program product of claim 6, further comprising: the first roadway type comprises a public highway;
Claim 7(b)	the second roadway type does not comprise a public highway;
Claim 7(c)	operating in the first autonomous mode comprises autonomously controlling the driver controls without requiring the human driver to control the driver controls; and
Claim 7(d)	determining the competence level of the SDV comprises determining that the competence level of the SDV is below the third threshold when the SDV is not currently operating in the first autonomous mode.
Claim 8(a)	The computer program product of claim 1, further comprising: sensing an operational state of a first camera sensor;
Claim 8(b)	determining, using a weighted voting system with a first plurality of inputs and a first plurality of weights, whether the first camera sensor is currently experiencing an operational anomaly;
Claim 8(c)	the first plurality of inputs comprises sensor readings from the first camera sensor;
Claim 8(d)	at least one of the first plurality of inputs is multiplied by a weight from among the first plurality of weights,
Claim 8(e)	wherein the first plurality of weights are based on first active learning data, the first active learning data comprising information about a cohort of other SDVs experiencing a camera sensor operational anomaly;
Claim 8(f)	determining that a third fault has occurred when the first camera sensor is currently experiencing an operational anomaly.
Claim 9(a)	The computer program product of claim 8, further comprising: determining the competence level of the human driver comprises using the weighted voting system with a second plurality of inputs and a second plurality of weights, wherein;
Claim 9(b)	the second plurality of inputs comprises one or more of the sensor readings;

Claim Designation	Claim Language
Claim 9(c)	at least one of the second plurality of inputs is multiplied by a weight from among the second plurality of weights, wherein the second plurality of weights are based on second active learning data, the second active learning data comprising sensor readings about a first cohort of human drivers of other SDVs;
Claim 9(d)	determining the competence level of the SDV comprises using the weighted voting system with a third plurality of inputs and a third plurality of weights, wherein:
Claim 9(e)	the third plurality of inputs comprises one or more of the sensor readings;
Claim 9(f)	the third plurality of inputs comprises at least one sensor reading that is not in the first plurality of inputs and is not in the second plurality of inputs;
Claim 9(g)	the second plurality of inputs comprises at least one sensor reading that is not in the first plurality of inputs and is not in the third plurality of inputs; and
Claim 9(h)	at least one of the third plurality of inputs is multiplied by a weight from among the third plurality of weights, wherein the third plurality of weights are based on third active learning data, the third active learning data comprising sensor readings about condition data from a second cohort of other SDVs, wherein the condition data shares one or more traits with a current condition of a roadway on which the SDV is currently traveling.
Claim 29(Pre)	A computer program product for controlling a driving mode of a self-driving vehicle (SDV), the computer program product comprising a non-transitory computer readable storage medium having program code embodied therewith, the program code readable and executable by a processor to perform a method comprising:
Claim 29(a)	receiving a plurality of sensor readings from a system of sensors, the system of sensors comprising:
Claim 29(a)(i)	a camera directed at a human driver;
Claim 29(a)(ii)	a camera directed away from the SDV;
Claim 29(a)(iii)	a sensor configured to detect input from a steering wheel;
Claim 29(a)(iv)	a GPS sensor;

Claim Designation	Claim Language
Claim 29(a)(v)	a thermometer; and
Claim 29(a)(vi)	a speedometer;
Claim 29(b)	displaying, on a display screen, one or more sensor readings of the sensor readings;
Claim 29(c)	determining, using one or more sensor readings of the sensor readings, a position of another vehicle currently on a roadway;
Claim 29(d)	determining a competence level of the SDV using one or more of the sensor readings, wherein the competence level of the SDV is a function of a degree of uncertainty in the determined position of the other vehicle;
Claim 29(e)	autonomously controlling driver controls without requiring the human driver to control the driver controls, wherein the driver controls comprise: engine throttle, a steering mechanism, and braking system;
Claim 29(f)	autonomously maintaining a buffer of space between the SDV and the other vehicle;
Claim 29(g)	determining a competence level of a human driver using one or more of the sensor readings;
Claim 29(h)	determining, using a fault remediation table, a first corrective action associated with a first human competence level, wherein the first corrective action comprises sounding a warning sound and displaying an icon on a display screen;
Claim 29(i)	determining, using the fault remediation table, a second corrective action associated with a second human competence level, wherein the second corrective action comprises decreasing a speed of the SDV and transferring driver controls to manual control;
Claim 29(j)	taking the first corrective action when the competence level of the human driver satisfies a first competence quota; and
Claim 29(k)	taking the second corrective action when the competence level of the human driver satisfies a second competence quota.
Claim 30(a)	The computer program product of claim 29, further comprising: displaying, on the display screen, a graphical representation of the position of the other vehicle relative to the SDV and a graphical representation of the competence level of the SDV.

Claim Designation	Claim Language
Claim 31(a)	The computer program product of claim 29, further comprising: determining the competence level of the human driver comprises using a weighted voting system with a first plurality of inputs and a first plurality of weights, wherein:
Claim 31(b)	the first plurality of inputs comprises one or more sensor readings of the sensor readings;
Claim 31(c)	at least one of the first plurality of inputs is multiplied by a weight from among the first plurality of weights, wherein the first plurality of weights are based on first active learning data, the first active learning data comprising information about a first cohort of human drivers of other SDVs; and
Claim 31(d)	determining the competence level of the SDV comprises using the weighted voting system with a second plurality of inputs and a second plurality of weights, wherein:
Claim 31(e)	the second plurality of inputs comprises one or more of the sensor readings;
Claim 31(f)	the second plurality of inputs comprises at least one sensor reading that is not in the first plurality of inputs; and
Claim 31(g)	at least one of the second plurality of inputs is multiplied by a weight from among the second plurality of weights, wherein the second plurality of weights are based on second active learning data, the second active learning data comprising condition data from a second cohort of other SDVs, wherein the condition data shares one or more traits with a current condition of the roadway on which the SDV is currently traveling.
Claim 32(a)	The computer program product of claim 31, further comprising: determining, using one or more sensor readings of the sensor readings, the position of a lane marking on the roadway;
Claim 32(b)	determining, using one or more sensor readings of the sensor readings, the position of a traffic signal; and
Claim 32(c)	displaying, on the display screen, a simultaneous graphical representation of the position of the other vehicle, the position of the lane marking on the roadway, the position of the traffic signal, and the competence level of the SDV.

Claim Designation	Claim Language
Claim 33(a)	The computer program product of claim 32, further comprising: autonomously changing lanes without requiring the human driver to control the driver controls;
Claim 33(b)	autonomously engaging a turn signal of the SDV prior to autonomously changing lanes without requiring the human driver to control the turn signal;
Claim 33(c)	determining, using the fault remediation table, a third corrective action associated with a first SDV competence level; and
Claim 33(d)	taking the third corrective action when the competence level of the SDV is equivalent to or below the first SDV competence level.
Claim 34(a)	The computer program product of claim 33, further comprising: the third corrective action comprises decreasing a speed of the SDV and transferring the driver controls to manual control; and
Claim 34(b)	the competence level of the human driver is a function of a sensor reading from the camera directed at the human driver.
Claim 35(a)	The computer program product of claim 34, further comprising: retrieving a human driver profile from a database;
Claim 35(b)	determining, using the fault remediation table, a fourth corrective action associated with a first human driver profile quota, wherein the fourth corrective action comprises disabling an autonomous driving mode; and
Claim 35(c)	taking the fourth corrective action when the human driver profile is equivalent to or below the first human driver profile quota.
Claim 36(a)	The computer program product of claim 35, further comprising: the human driver profile is a function of a previous sensor reading from the camera directed at the human driver;
Claim 36(b)	the human driver profile is a function of a previous sensor reading from the camera directed away from the SDV;
Claim 36(c)	the human driver profile is a function of a previous sensor reading from the sensor configured to detect input from the steering wheel; and

Claim Designation	Claim Language
Claim 36(d)	the human driver profile is a function of a previous sensor reading from the speedometer.
Claim 37(Pre)	A computer program product for controlling a driving mode of a self-driving vehicle (SDV), the computer program product comprising a non-transitory computer readable storage medium having program code embodied therewith, the program code readable and executable by a processor to perform a method comprising:
Claim 37(a)	receiving one or more sensor readings from a system of sensors, wherein the system of sensors comprises one or more sensors that detect an operational state of the SDV, the one or more sensors comprising:
Claim 37(a)(i)	a camera directed away from the SDV;
Claim 37(a)(ii)	a sensor configured to detect input from a steering wheel;
Claim 37(a)(iii)	a GPS sensor;
Claim 37(a)(iv)	a thermometer; and
Claim 37(a)(v)	a speedometer;
Claim 37(b)	determining a competence level of a control processor as a function of the operational state of the SDV;
Claim 37(c)	comparing the competence level of the control processor to a first threshold;
Claim 37(d)	comparing the competence level of the control processor to a second threshold, wherein the first threshold is higher than the second threshold:
Claim 37(e)	autonomously controlling driver controls without requiring a human driver to control the driver controls when the competence level of the control processor is above the first threshold;
Claim 37(f)	determining a first fault has occurred when the competence level of the control processor is between the first threshold and the second threshold;
Claim 37(g)	determining a second fault has occurred when the competence level of the control processor is below the second threshold; and

Claim Designation	Claim Language
Claim 37(h)	performing a corrective action listed in a fault remediation table, comprising:
Claim 37(h)(i)	displaying a warning message on a display screen when the first fault occurs; and
Claim 37(h)(ii)	sounding a warning sound, displaying a warning message, displaying an icon on the display screen, and transferring the driver controls to manual control when the second fault occurs.
Claim 38(a)	The computer program product of claim 37, further comprising: comparing the competence level of the control processor to a third threshold, wherein the third threshold is between the first threshold and the second threshold; and
Claim 38(b)	determining a third fault has occurred when the competence level of the control processor is between the third threshold and the second threshold.
Claim 39(a)	The computer program product of claim 38, further comprising: the operational state of the SDV comprises a current weather condition of a roadway on which the SDV is currently traveling; and
Claim 39(b)	autonomously altering a route being taken by the SDV when the third fault occurs.

I, Christopher Wilson, declare as follows:

I. INTRODUCTION

1. I am over the age of 21 and am competent to make this declaration. I make this Declaration based on facts and matters within my own knowledge and on information provided to me by others.

A. Educational Background and Professional Experience

2. My complete qualifications and professional experience are described in my curriculum vitae, a copy of which is attached as Appendix A to this declaration. The following is a brief summary of my relevant qualifications and professional experience.

3. I have a bachelor's degree in Physics from Princeton University and one year of graduate school in Physics at the University of California, San Diego.

4. I am currently an independent consultant to the transportation industry focused on the use of vehicle data and analytics to provide cloud services in support of safety systems in automated and semi-automated vehicles.

5. I have 35 years of experience in the automotive telematics and safety technology field working for tier 1 suppliers (TRW and TomTom) and vehicle manufacturers (DaimlerChrysler), as well as working with other vehicle manufacturers and government in consortia developing pre-competitive technologies and performance metrics for vehicle safety systems, and consulting. At

TRW, I developed one of the first collision notification and off-board navigation systems, known as TRW's In-Vehicle Information System, in 1995.

6. I worked on the development of traffic management systems in San Francisco, Atlanta, and Houston where I advocated the use of vehicle data for managing the system. These systems often used a combination of vehicle systems with "brought-in" systems, such as cell phones. As part of this work I developed standards for sharing of vehicle probe data, such as weather information, between vehicles and infrastructure, and on methods for analyzing that data and providing the resulting information to vehicles for navigation and planning purposes.

7. At Fastline (Information Access Inc.), in or around 1996, I developed techniques for integrating a PDA (Sony Magic Link) with various vehicle telematics and display systems. The primary application was to collect speed data and display local traffic data to drivers, either through the "brought-in" device, or through an associated vehicle display.

8. From 1996 to 2008, I worked for DaimlerChrysler (under a number of different names, for most of this time this was the parent company of Chrysler, Jeep, Dodge, Mercedes cars and Freightliner trucks, among others) developing telematics systems for various safety and infotainment applications. Many of these systems involved collecting data from vehicles (e.g., camera data, speed, location, diagnostics) using wireless data links, processing the data in the infrastructure, and

providing synthesized information back to vehicles, infrastructure providers, and fleet managers. I worked on precision mapping systems for lane markings and roadside furniture for use in various safety and information systems. I also led a consortia of automotive manufacturers in developing protocols for sharing data between vehicles and infrastructure, known as the Vehicle Infrastructure Integration Consortium, where I worked very closely with transportation departments and other interested parties. I was specifically involved in the use of collected speed data to determine traffic conditions and identify the locations of stop signs, and to notify various parties if the speed data indicated “running” the stop sign. I was involved with the development, validation, and certification of various active safety systems, such as Adaptive Cruise Control (ACC), Forward Collision Warning and Automatic Emergency Braking (FCW and AEB), and Lane Keeping Assistance systems (LKW). In particular I was involved in developing regulatory standards for certification of these systems, the various failure modes of these systems, and with the hand-off between these systems and the driver. My work included research on driver distraction and how it can be detected, as well as the time it takes for an inattentive driver to orient to the vehicle situation if they need to take over quickly.

9. In 2008, I began to work for TomTom BV., a manufacturer of navigation systems. While at TomTom I worked on protocols for collecting data from vehicles to develop various map attributes, including the speed limit attribute

to support speed limit advisory applications. I was also involved with integrating TomTom aftermarket devices with vehicle interfaces.

10. Since 2012 I have been a consultant on various automotive projects- including several projects to support self-driving vehicles, including precision mapping and kinematic mapping. I worked extensively on profiling drivers to determine their capabilities (in order to apply the proper insurance premium). I have also served as an Expert Witness for several matters involving Intellectual Property related to active vehicle safety systems.

11. I am the named inventor on ten US and several international patents related to various aspects of navigation and active safety.

12. In summary, I have extensive familiarity with fields involving active safety systems and the operation, deployment, and regulation of self-driving vehicle technology. I am familiar with what the state of this field was at the relevant time.

II. METHODOLOGY; MATERIALS CONSIDERED

13. I have relied upon my education, knowledge and experience as well as the other materials discussed in this declaration in forming my opinions.

14. For this work, I have been asked to review U.S. Patent No. 12,037,004 (“the ’004 Patent”) (Ex. 1001) including the specification and claims, and the ’004 Patent’s prosecution history (“’004 File History”) (Ex. 1002). In developing my

Declaration of Christopher Wilson
U.S. Patent No. 12,037,004 (Claims 1-9, 29-39)

opinions relating to the '004 Patent, I have considered the materials cited or discussed herein, including those itemized in the Exhibit Table below.

<u>Exhibit</u>	<u>Description</u>
Exhibit 1001	U.S. Patent No. 12,037,004 (“ <i>the '004 Patent</i> ”)
Exhibit 1002	File History for U.S. Patent No. 12,037,004
Exhibit 1004	U.S. Patent No. 9,406,177 to Attard et al. (“ <i>Attard</i> ”)
Exhibit 1005	U.S. Patent No. 9,494,926 to Frazer et al. (“ <i>Frazer</i> ”)
Exhibit 1006	U.S. Patent No. 10,377,303 to McNew et al. (“ <i>McNew</i> ”)
Exhibit 1007	U.S. Patent Application Publication No. 2016/0267335 to Hampiholi (“ <i>Hampiholi</i> ”)
Exhibit 1008	U.S. Patent No. 9,063,543 to An et al. (“ <i>An</i> ”)
Exhibit 1009	U.S. Patent No. 9,688,145 to Kang (“ <i>Kang</i> ”)
Exhibit 1010	U.S. Patent No. 9,451,030 to Schunder et al. (“ <i>Schunder</i> ”)
Exhibit 1011	U.S. Patent No. 9,714,037 to DeRuyck et al. (“ <i>DeRuyck</i> ”)
Exhibit 1012	U.S. Patent Application Publication No. 2007/0268158 to Gunderson et al. (“ <i>Gunderson</i> ”)
Exhibit 1013	U.S. Patent Application Publication No. 2007/0219720 (“ <i>Trepagnier</i> ”)
Exhibit 1014	Gereon Meyer and Sven Beiker. <i>Road Vehicle Automation</i> . Springer. 2014. (“ <i>Meyer</i> ”)
Exhibit 1015	Jeff Wit et al. “Autonomous Ground Vehicle Path Tracking.” <i>Journal of Robotic Systems</i> 21(8), 439-449 (2004). (“ <i>Wit</i> ”)
Exhibit 1016	Keshav Bimbraw. “Autonomous Cars: Past, Present and Future.” <i>Proceedings of the 12th International Conference on Informatics in Control, Automation and Robotics (ICINCO-2015)</i> , pages 191-198, July 21-23, 2015. (“ <i>Bimbraw</i> ”)
Exhibit 1017	Xavier Mosquet et al. <i>Revolution in the Driver’s Seat</i> . The Boston Consulting Group. April 2015. (“ <i>Mosquet</i> ”)
Exhibit 1018	Steven E. Muldoon et al. “10.3: Vehicle Fault Diagnostics Using a Sensor Fusion Approach.” <i>IEEE</i> 2002. (“ <i>Muldoon</i> ”)
Exhibit 1019	U.S. Patent No. 8,825,258 (“ <i>Cullinane</i> ”)
Exhibit 1020	U.S. Patent No. 9,798,323 (“ <i>Tsimhoni-323</i> ”)
Exhibit 1021	U.S. Patent No. 9,884,631 (“ <i>James</i> ”)
Exhibit 1022	U.S. Patent No. 11,040,725 (“ <i>Scofield</i> ”)
Exhibit 1023	U.S. Patent No. 9,483,059 (“ <i>Caveney</i> ”)
Exhibit 1024	U.S. Patent No. 9,365,213 (“ <i>Stenneth</i> ”)

Declaration of Christopher Wilson
U.S. Patent No. 12,037,004 (Claims 1-9, 29-39)

Exhibit 1025	International Publication No. WO 2006/047297 (“ <i>Allard</i> ”)
Exhibit 1026	Rajesh Rajamani et al. “A Complete Fault Diagnostic System for Automated Vehicles Operating in a Platoon.” IEEE Transactions on Control Systems Technology, Vol 9, No. 4, July 2001. (“ <i>Rajamani</i> ”)
Exhibit 1027	U.S. Patent Application Publication No. 2013/0063336 (“ <i>Sugimoto</i> ”)
Exhibit 1028	Matthew McNaughton et al. “Motion Planning for Autonomous Driving with a Conformal Spatiotemporal Lattice.” 2011 IEEE International Conference on Robotics and Automation. May 9-13, 2011, Shanghai, China. (“ <i>McNaughton</i> ”)
Exhibit 1029	A. de la Escalera. “Traffic sign recognition and analysis for intelligent vehicles.” Image and Vision Computing 21 (2003) 247-258. (“ <i>Escalera</i> ”)
Exhibit 1030	“Surface Vehicle Information Report J3016.” SAE International. January 2014. (“ <i>J3016</i> ”)
Exhibit 1031	Intentionally Left Blank
Exhibit 1032	Intentionally Left Blank
Exhibit 1033	Intentionally Left Blank
Exhibit 1034	U.S. Patent No. 8,378,849 (“ <i>Chandra</i> ”)
Exhibit 1035	U.S. Patent No. 5,779,593 (“ <i>Takada</i> ”)
Exhibit 1036	U.S. Patent Application Publication No. 2013/0131907 (“ <i>Green</i> ”)
Exhibit 1037	Harding, J., Powell, G., R., Yoon, R., Fikentscher, J., Doyle, C., Sade, D., Lukuc, M., Simons, J., & Wang, J. (2014, August). “Vehicle-to-vehicle communications: Readiness of V2V technology for application.” (Report No. DOT HS 812 014). Washington, DC: National Highway Traffic Safety Administration. (“ <i>Harding</i> ”).
Exhibit 1038	Intentionally Left Blank
Exhibit 1039	Intentionally Left Blank
Exhibit 1040	U.S. Patent No. 10,139,824 (“ <i>Sako</i> ”)
Exhibit 1041	U.S. Patent No. 10,086,844 (“ <i>Coelingh</i> ”)
Exhibit 1042	U.S. Patent No. 9,475,491 (“ <i>Nagasaka</i> ”)
Exhibit 1043	U.S. Patent No. 8,305,444 (“ <i>Hada</i> ”)
Exhibit 1044	Intentionally Left Blank
Exhibit 1045	U.S. Patent Application Publication No. 2015/0158495 to Duncan et al. (“ <i>Duncan</i> ”)
Exhibit 1046	Intentionally Left Blank
Exhibit 1047	Intentionally Left Blank

Declaration of Christopher Wilson
U.S. Patent No. 12,037,004 (Claims 1-9, 29-39)

Exhibit 1048	Intentionally Left Blank
Exhibit 1049	U.S. Patent Application Publication No. 2016/0107655 (“ <i>Desnoyer</i> ”)
Exhibit 1050	U.S. Patent No. 9,242,647 to Tsimhoni et al. (“ <i>Tsimhoni-647</i> ”)
Exhibit 1051	California Vehicle Code 22108. https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=VEH&sectionNum=22108 . Enacted by Stats. 1959, Ch. 3. (“ <i>22108</i> ”)
Exhibit 1052	Gorelick Law Offices. https://www.gorelick-law.com/california-vehicle-code-22108-vc-failure-to-signal-and-dui-arrests . (“ <i>Gorelick</i> ”)
Exhibit 1053	Green Car Congress. https://web.archive.org/web/20121128045732/https://www.greencarcongress.com/2012/11/mb-20121122.html . 28 November 2012. (“ <i>GCC</i> ”)
Exhibit 1054	Tesla Model S Owner’s Manual (“ <i>Model S Manual</i> ”)
Exhibit 1055	Mercedes-Benz. https://web.archive.org/web/20121122040727/https://emercedesbenz.com/autos/mercedes-benz/s-class/top-20-mercedes-benz-assistance-programs/ . November 2012. (“ <i>Mercedes2013</i> ”)
Exhibit 1056	Intentionally Left Blank
Exhibit 1057	Mercedes S-Class Operator’s Manual (“ <i>Mercedes S-Class Manual</i> ”)

15. I have considered these materials from the viewpoint of a POSITA as of the priority date of the ’004 Patent. For the purposes of this declaration, I have been asked to assume that the priority date of the ’004 Patent is September 25, 2015. I note that my opinions provided in this Declaration are made from the perspective of a POSITA as of this priority date of the ’004 Patent, unless expressly stated otherwise. To the extent that I use any verb tense in this Declaration that is present tense (e.g., “a POSITA would understand” instead of “a POSITA would have

understood”), such verb tense should be understood to be my opinion as of the ’004 Patent’s priority date (again, unless expressly stated otherwise). I merely use the present verb tense for ease of reading.

III. OVERVIEW AND LEGAL STANDARDS

16. In formulating my opinions, I have been instructed to apply certain legal standards. I am not a lawyer. I do not expect to offer any testimony regarding what the law is. Instead, the following sections summarize the law as I have been instructed to apply it in formulating and rendering my opinions found later in this declaration. I understand that, in an inter partes review proceeding, patent claims may be deemed unpatentable if it is shown that they were anticipated or rendered obvious in view of the prior art. I understand that prior art in an inter partes review is limited to patents or printed publications that predate the priority date of the patent at issue. I understand that questions of claim clarity (definiteness) and enablement cannot be considered as a ground for considering the patentability of a claim in these proceedings.

A. Person of Ordinary Skill in the Art

17. I understand that the ’004 Patent, the record of proceedings at the Patent Office (which I understand is called the “File History” or “Prosecution History”), and the teachings of the prior art are evaluated from the perspective of a person of ordinary skill in the art (“POSITA”). I understand that the factors considered in

determining the ordinary level of skill in the art include: (i) the levels of education and experience of persons working in the field; (ii) the types of problems encountered in the field; and (iii) the sophistication of the technology. I may also consider, if available, the education level of the inventor, prior art solutions to the problems encountered in the art, the rapidity with which innovations are made in the relevant art.

18. I understand that a person of ordinary skill in the art is not a specific real individual, but rather a hypothetical individual having the qualities reflected by the factors above. This hypothetical person has knowledge of all prior art in the relevant field as if it were arranged on a workshop wall and takes from each reference what it would teach to a person having the skills of a POSITA.

B. Obviousness

19. I understand that a claim may be invalid under § 103(a) if the subject matter described by the claim as a whole would have been “obvious” to a hypothetical POSITA in view of a single prior art reference or in view of a combination of references at the time the claimed invention was made. Therefore, I understand that obviousness is determined from the perspective of a hypothetical POSITA. I further understand that a hypothetical POSITA is assumed to know and to have all relevant prior art in the field of endeavor covered by the patent in suit and all analogous prior art. I understand that obviousness in an inter partes review

proceeding is evaluated using a preponderance of the evidence standard, which means that the claims must be more likely obvious than nonobvious.

20. I also understand that an analysis of whether a claimed invention would have been obvious should be considered in light of the scope and content of the prior art, the differences (if any) between the prior art and the claimed invention, and the level of ordinary skill in the pertinent art involved. I understand as well that a prior art reference should be viewed as a whole. I understand that in considering whether an invention for a claimed combination would have been obvious, I may assess whether there are apparent reasons to combine known elements in the prior art in the manner claimed in view of interrelated teachings of multiple prior art references, the effects of demands known to the design community or present in the marketplace, and/or the background knowledge possessed by a POSITA. I also understand that other principles may be relied on in evaluating whether a claimed invention would have been obvious, and that these principles include the following:

- A combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results;
- When a device or technology is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or in a different one, so that if a POSITA can implement a predictable variation, the variation is likely obvious;

- If a technique has been used to improve one device, and a POSITA would have recognized that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill;
- An explicit or implicit teaching, suggestion, or motivation to combine two prior art references to form the claimed combination may demonstrate obviousness, but proof of obviousness does not depend on or require showing a teaching, suggestion, or motivation to combine;
- Market demand, rather than scientific literature, can drive design trends and may show obviousness;
- In determining whether the subject matter of a patent claim would have been obvious, neither the particular motivation nor the avowed purpose of the named inventor controls;
- One of the ways in which a patent's subject can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims;
- Any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed;

- “Common sense” teaches that familiar items may have obvious uses beyond their primary purposes, and in many cases a POSITA will be able to fit the teachings of multiple patents together like pieces of a puzzle;
- A POSITA is also a person of ordinary creativity, and is not an automaton;
- A patent claim can be proved obvious by showing that the claimed combination of elements was “obvious to try,” particularly when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions such that a POSITA would have had good reason to pursue the known options within his or her technical grasp; and
- One should not use hindsight in evaluating whether a claimed invention would have been obvious.

21. I also understand that an obviousness determination includes the consideration of various factors such as: (1) the scope and content of the prior art, (2) the differences between the prior art and the asserted claims, (3) the level of ordinary skill in the pertinent art, and (4) the existence of secondary considerations such as commercial success, long-felt but unresolved needs, failure of others, and so forth.

22. I am informed that it is improper to combine references where the references teach away from their combination. I am informed that a reference may be said to teach away when a person of ordinary skill in the relevant art, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the patent applicant. In general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the patentee. I am informed that a reference teaches away, for example, if (1) the combination would produce a seemingly inoperative device, or (2) the references leave the impression that the product would not have the property sought by the patentee. I also am informed, however, that a reference does not teach away if it merely expresses a general preference for an alternative invention but does not criticize, discredit, or otherwise discourage investigation into the invention claimed.

23. I am informed that even if a *prima facie* case of obviousness is established, the final determination of obviousness must also consider "secondary considerations" if presented. In most instances, the patentee raises these secondary considerations of non-obviousness. In that context, the patentee argues an invention would not have been obvious in view of these considerations, which include: (a) commercial success of a product due to the merits of the claimed invention; (b) a

long-felt, but unsatisfied need for the invention; (c) failure of others to find the solution provided by the claimed invention; (d) deliberate copying of the invention by others; (e) unexpected results achieved by the invention; (f) praise of the invention by others skilled in the art; (g) lack of independent simultaneous invention within a comparatively short space of time; (h) teaching away from the invention in the prior art.

24. I am further informed that secondary considerations evidence is only relevant if the offering party establishes a connection, or nexus, between the evidence and the claimed invention. The nexus cannot be based on prior art features. The establishment of a nexus is a question of fact. While I understand that the Patent Owner here has not offered any secondary considerations at this time, I will supplement my opinions in the event that the Patent Owner raises secondary considerations during the course of this proceeding.

25. Finally, I understand that obviousness in an IPR must be proven by a preponderance of the evidence.

C. Analogous Art

26. I have been informed that for a prior art reference to be proper for use in an obviousness analysis, the reference must be “analogous art” to the claimed invention. I have been informed that a reference is analogous art to the claimed invention if: (1) the reference is from the same field of endeavor as the claimed

invention (even if it addresses a different problem); or (2) the reference is reasonably pertinent to the problem faced by the inventor (even if it is not in the same field of endeavor as the claimed invention). In order for a reference to be “reasonably pertinent” to the problem, it must logically have commended itself to an inventor’s attention in considering his problem. In determining whether a reference is reasonably pertinent, one should consider the problem faced by the inventor, as reflected either explicitly or implicitly, in the specification. I believe that all of the references that my opinions in this IPR are based upon are well within the range of references a person having ordinary skill in the art would consult to address the type of problems described in the Challenged Claims.

D. Claim Construction

27. I understand that the claim terms in this IPR will be construed according to their ordinary and customary meaning as understood in light of the claim language, the patent’s description, and the prosecution history viewed from the perspective of a POSITA. I further understand that where a patent defines claim language, the definition in the patent controls, even if there are other definitions that might be understood by those working in the art.

IV. LEVEL OF A PERSON OF ORDINARY SKILL

28. Based on my review and analysis of the ’004 Patent, the prior art cited herein, and the ordinary skill factors described in this section, a POSITA in the field

Declaration of Christopher Wilson
U.S. Patent No. 12,037,004 (Claims 1-9, 29-39)

of the '004 Patent at the time of the earliest possible priority date (September 25, 2015) would have been knowledgeable regarding the field of vehicle telematics and safety systems. In my experience working in this field, most workers of ordinary skill in the art as of the earliest possible priority date of September 25, 2015, would have had a bachelor's degree in computer engineering, computer science, electrical engineering, mechanical engineering, physics, or a related field, with at least four years of experience in the field of vehicle telematics and safety systems, or a master's degree in the same fields with at least three years of experience in the field of vehicle telematics and safety systems. Additional education or experience might substitute for the above requirements. *See, e.g.*, the '004 Patent (Ex. 1001), 1:24-25 (describing the "Field of the Invention"). When I refer to the understanding of a POSITA, I am referring to the understanding of such a person as of September 25, 2015.

29. As of September 25, 2015, I had more than ordinary skill in the art. I am, however, familiar with the skills and knowledge possessed by those I would have considered to be of ordinary skill in the art as of that date. For example, I knew people working in the field while I was developing models for automated vehicle behaviors, and working to improve the reliability of automated vehicle systems in the 2015 timeframe.

30. My opinions provided in this declaration would not change in view of minor modifications to this level of ordinary skill.

V. BACKGROUND OF THE TECHNOLOGY

A. History of Autonomous Vehicles

31. In a non-autonomous vehicle, “the driver remains a critical component of the vehicle’s control system” and they are responsible for “steering, obstacle and hazard recognition, and avoidance thereof.” *Trepagnier* (Ex. 1013), [0004]. Autonomous or self-driving vehicles (SDVs) are attractive, for example, to improve driver safety. *Id.*, [0007] (describing the attractiveness of autonomous vehicles for “addressing human deficiencies in the control of a vehicle or whether in environmentally hazardous conditions where human control is not preferred...”); *see also, Meyer* (Ex. 1014), p. 72 (describing “[e]missions reduction”, “[c]ongestion avoidance”, and “supporting unconfident drivers” as additional benefits of SDVs). “An autonomous vehicle is one that is capable of automatic navigation. It is self-acting and self-regulating, therefore it is able to operate in and react to its environment without outside control.” *Wit* (Ex. 1015), p. 439. In general, an SDV may be capable of performing various functions, including “(1) perceiving and modeling the environment, (2) localizing the vehicle within the environment, (3) planning and deciding the vehicle’s desired motion and (4) executing the vehicle’s desired motion.” *Wit*, p. 439-440.

32. Autonomous vehicles were well-known and in development before the ’004 Patent (September 2015) as “[t]he timeline of autonomous cars begins in 1926

with world's first radio controlled car 'Linriccan Wonder'." *Bimbrow* (Ex. 1016), p. 191. "In the subsequent decades, we see fairly autonomous electric cars powered by embedded circuits in the roads" and "the 1980s saw vision guided autonomous vehicles, which was a major milestone in [SDV] technology..." *Id.* For example, "the vision guided Mercedes-Benz robotic Van in 1980" (which employed "LIDAR, radar, GPS and computer vision") laid the foundation for "autonomous technologies present in modern cars like adaptive cruise control, lane parking, steer assist etc." *Id.*

33. As shown below, various autonomous features were available in cars prior to the '004 Patent:

- *Adaptive cruise control*, introduced in 2006, monitors the speed of the vehicle directly ahead of it and maintains a safe distance.
- *Parallel-park assist*, also introduced in 2006, uses cameras and ultrasound sensors to guide the vehicle into a parking space.
- *Automatic emergency braking*, first available in 2008, activates itself when the vehicle risks colliding with another vehicle, a person, an animal, or an object.

Mosquet (Ex. 1017), p. 6 (excerpt). In fact, some of these features were available earlier than indicated by *Mosquet*; regardless, all were well-known prior to the '004

Patent. For example, automatic lane keeping was present in Nissan's 2014 Infiniti 150, which was released in 2013. *Bimbrow*, 195.

34. SDVs were in development by commercial automotive companies by 2015. "Audi, for example, presented its highly autonomous A7 model, which has highway-driving capability, at the 2015 Consumer Electronics Show in Las Vegas." *Mosquet*, p. 3. Additionally, "Volvo and various Swedish government bodies in 2014 launched the 'Drive Me' initiative, in which 100 self-driving cars navigate public roadways in everyday conditions in and around the city of Gothenburg." *Id.*

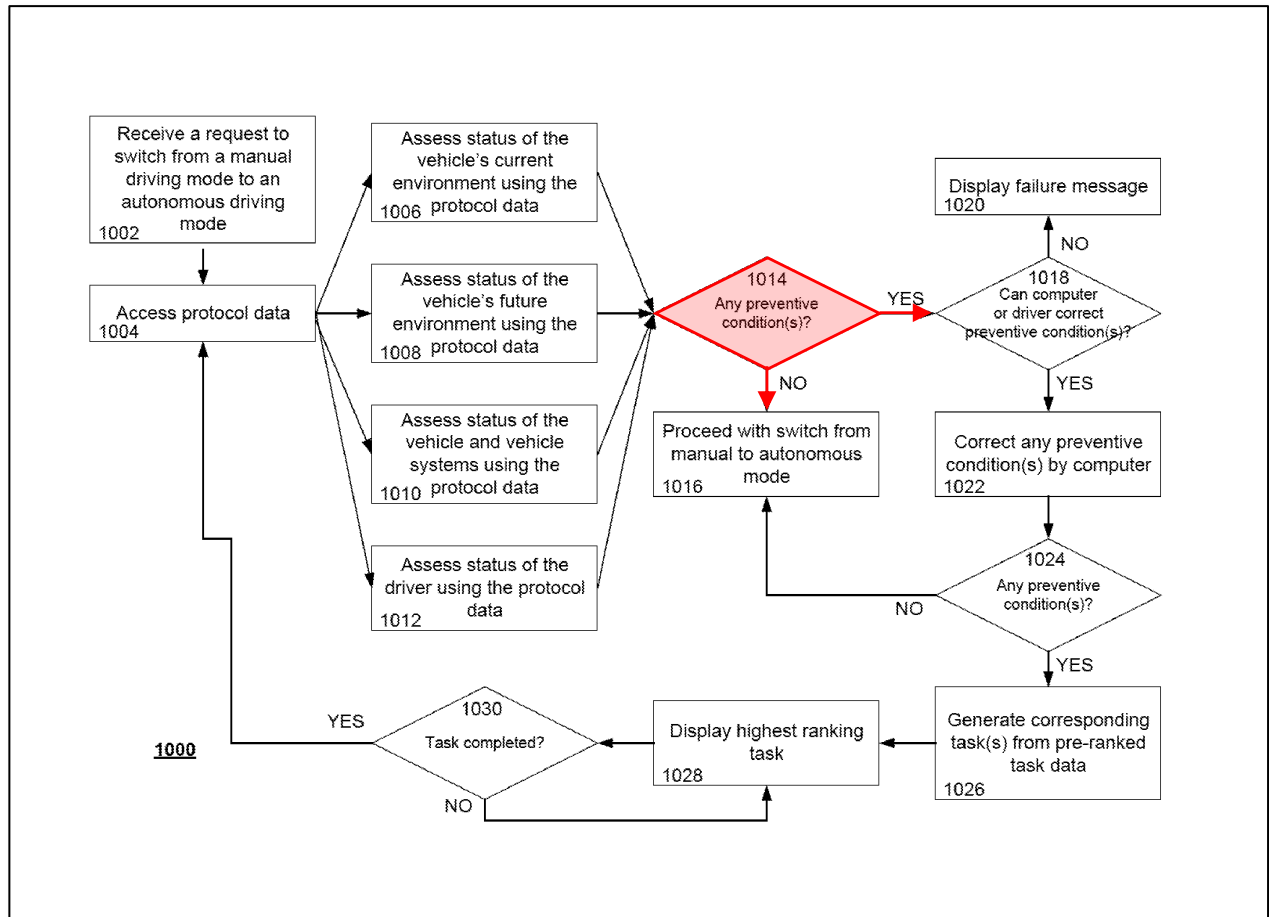
35. A key differentiator of SDVs is the conditions under which they may operate autonomously, and the amount of supervision required from the driver. That is, how quickly the driver may need to step in or intervene if the autonomous systems are not sufficiently capable. Production vehicles have been able to "drive" themselves for short periods, maintaining their lane and a buffer of space around themselves, since at least 2005 with the availability of Adaptive Cruise Control. I note the '004 Patent provides little indication of the conditions under which the alleged SDV can (and cannot) operate. '004 Patent, 1:29-31, 15:64-16:4, 28:38-40.

B. Faults

36. Vehicles were known to generally monitor "vehicle diagnostics" such as providing "a simple reminder to the driver that the standard maintenance (i.e., replacing filters and fluids) is required." *Muldoon* (Ex. 1018), 1591; *see also, id.*

(describing “Fault Diagnosis can be generally defined as the process that identifies the root cause of a failure.”). It was further understood that autonomous vehicles utilize additional “fail-safe architecture” “that keeps the vehicle in a safe state in the event of a **fault**” to ensure driver safety and continued confidence in SDVs. *Meyer*, p. 77 (emphasis added).

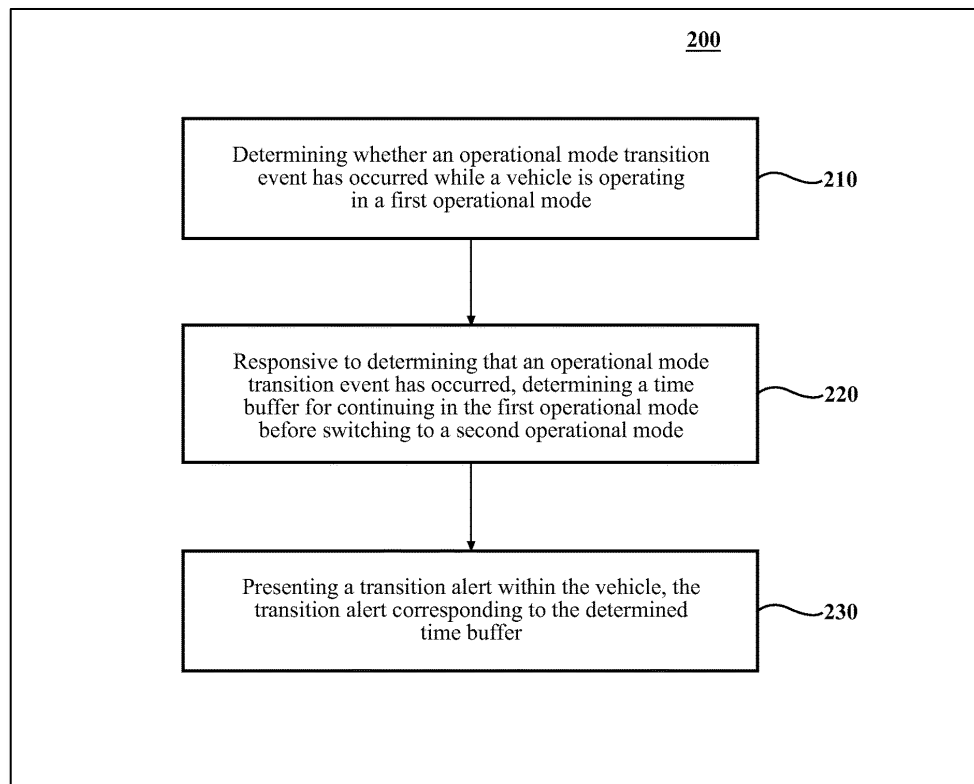
37. Prior to the '004 Patent, SDVs were capable of “switching between autonomous and manual driving modes. In order to do so, the vehicle’s computer may conduct a series of environmental, system, and driver checks to identify certain conditions.” *Cullinane* (Ex. 1019), Abstract, FIG. 10. Upon detecting “some emergency or some preventative condition such as a loss of communication with some component of the autonomous driving system, the computer 110 may immediately inform the driver of the need to switch to the manual driving mode.” *Cullinane*, 16:38-43; *see also*, *Tsimhoni-323* (Ex. 1020), Abstract (describing “[a]n automated vehicle [that] includes a control system configured to selectively transfer the automated vehicle from an automated control mode to a manual control mode based on a transfer-of-control criterion.” This “criterion is based on a current context of the automated vehicle and a dataset of previous transfer-of-control events and previous contexts” of other SDVs. Thus, SDVs were known to switch driving modes in response to detecting a fault (such as a “faulty braking system[,]” per the '004 Patent). *'004 Patent*, 5:57-6:6.



Cullinane, FIG. 10¹. FIG. 10 is annotated to demonstrate an SDV system “assessing the status of the vehicle’s environment (current and likely future), the status of the vehicle and the vehicle systems, as well as the status of the driver to identify any preventive conditions” (e.g., faults) which would inhibit a safe change in driving mode from manual to autonomous. *Cullinane*, 10:37-40; *see also*, *Id.*, 15:29-32.

¹ All emphasis and annotations added unless noted otherwise.

38. *James* further teaches “transitioning a vehicle between a first operational mode and a second operational mode” dependent on if “an operational mode transition event has occurred” (e.g., a fault). *James* (Ex. 1021), 1:30-38, FIG. 2. “Such an event may be indicative of a **problem** which is to be communicated to the driver to prepare to take a greater degree of involvement in the vehicle control.” *James*, 10:52-55 (emphasis added), 19:19 (describing adjusting the autonomous driving mode depending on if the “driver is asleep, distracted, etc.”). FIG. 2 below describes the process for transitioning driving modes:



James, FIG. 2.

39. Additionally, *Meyer* teaches “fault detection and handling” “maneuvers” during “coordinated automatic longitudinal control of a platoon of three Class 8 tractor-trailer trucks” as highlighted below:

- Level 1 faults: driver is alerted to take over control immediately;
- Level 2 faults: trucks will split to a longer distance and continue platooning;
- Level 3 faults: all three trucks will continue platooning unless another fault appears;

Meyer, pp. 247, 248, 255 (excerpt).

40. As another example, *Tsimhoni-323* teaches “an automated vehicle control system that utilizes crowdsourced data...to determine whether transfer-of-control from automated to manual (or vice versa) is likely and/or desirable.” *Tsimhoni-323*, 2:16-22. *Tsimhoni-323* teaches transferring modes in an SDV in response to differing environmental conditions (“e.g., ‘night time+rain’”). *Tsimhoni-323*, 2:16-22. For example,

dataset 114 might reflect that many automated vehicles have difficulty recognizing the lane markers on a particular stretch of highway when the **sun is at a particular position**. Subsequently, when vehicle 10 is driven on that stretch of highway under **similar conditions** (e.g., same time-of-day), the driver might be **notified that he or she should take manual control**.

Tsimhoni-323, 5:1-7 (emphasis added); *see also, Id.*, 5:46-48 (describing how calculating the likelihood of transferring driving modes depends on “a ‘context’ [of

an SDV] that is characterized by a vector of features f_i (e.g., ‘raining’, ‘night time’, geographical location, etc.”).

41. It was well-known to alert the driver when the SDV was transitioning driving modes. *See, e.g., James*, FIGs. 3-4, 15:39-41 (describing how the “transition alert can have any suitable form. For instance, the transition alert can be a visual transition alert, an audial transition alert, a haptic transition alert, and/or combinations thereof.”); *Cullinane*, 13:8-10 (describing how “computer 110 may generate and display a notification explaining that the autonomous driving mode is currently unavailable due to the weather conditions.”); *Tsimhoni-323*, 4:43-46 (“In some embodiments, the alert includes a visual representation (e.g., shown via display 25) of a reason for transferring from the automated control mode to the manual control mode.”).

C. Driving Modes

42. *James* teaches various levels of automation in the vehicle, including levels defined by National Highway Traffic Safety Authority (NHTSA) 2013 policy. *James*, 3:1-4:43. For example, a vehicle may have level 0 automation (*James*, 3:47-53), which indicates manual control is required. *James*, 3:47-53 (“The vehicle 100 can have a manual operation mode. ‘Manual operational mode’ means that a substantial majority or all of the navigation and/or maneuvering of the vehicle along

a travel route is performed by a human driver with minimal or no input from a computing system.”).

43. Similarly, at levels 1 or level 2, various semi-autonomous or autonomous features may be activated, such as adaptive cruise control. *James*, 3:1-46. *James* teaches a single vehicle may transition (including automatically) from a level with lower automation to a level with higher automation, or the reverse where the transition is from a level with higher automation to lower automation. *James*, 4:4-43. In general, in the manual mode, the driver must control the vehicle. *James*, 3:47-53. However, in higher levels of automation, a human driver may or may not need to operate various functions of the vehicle (e.g., controlling engine throttle, braking, or turning) as those features are handled by the self-driving vehicle. *James*, 3:1-4:43.

D. Assessing Competence Levels

1. Driver Competence

44. One of the primary features of SDVs is ensuring driver safety. *See* ¶ 31. Therefore, it was known prior to the '004 Patent to assess the capability of the driver to safely drive the vehicle in manual mode and further determine if instead engaging the autonomous driving mode is safer if driver competence is deemed low. Thus, SDVs were known to monitor driving habits. *See e.g., Scofield* (Ex. 1022), 6:31-51 (“Before generating a driver alert to assume manual vehicle control of the

vehicle 402, the driver alert component 404 may evaluate a cognitive load of the driver. For example, a camera may indicate that the driver is sleeping” and the SDV would therefore not transition to manual mode.); *Caveney* (Ex. 1023), 1:22-26 (“Partially-automated or monitored driving systems are designed to assist drivers in operating a vehicle safely and efficiently on the road. For example, they may use techniques such as eye-tracking of the driver to send a warning when the driver becomes inattentive....”).

45. One of the problems limiting the ability to deploy autonomous vehicles, and in fact making many doubt that “level 3” autonomy is even possible is the handoff from automated control to a driver. In level 3 autonomy it is assumed that the driver is always prepared to take over control on “short notice,” however, there is no established method for ensuring this is the case. Note that this has nothing to do with the skill of the driver, rather it is a measure of the driver’s cognitive focus and ability to orient and control the vehicle. Many tests have determined that this time is usually on the order of a few seconds, but can extend to excess of 15 seconds. *See, e.g., McNew* (Ex. 1006) 4:47-61 (1.5 seconds for driver response time). The possibility that a driver is incapacitated and cannot take over must also be considered. *See, e.g., Meyer*, 50 (describing driver out of the loop), 56 (describing driver handover), 204 (describing the need to surveil the driver for handover); *Scofield*, 6:31-51.

2. *SDV Competence*

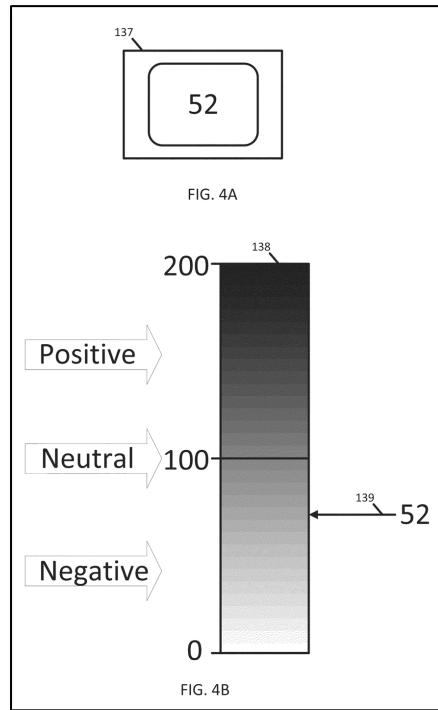
46. The term “Self-Driving Vehicle” (“SDV”) is a term of art that includes a large range of capabilities. The automated vehicle industry (and regulators) have tried to develop a set of definitions for levels of automated vehicles. *J3016* (Ex. 1030), 2-5; *James*, 3:1-4:43, 5:13-52, 6:31-64, 10:37-11:53). An SDV may correspond to at least the automated driving levels 2 to 5. While there can be subtle differences between and within the levels (and there have been some changes in the standard), the ’004 Patent is generally concerned with “level 2” automation as there is a clear disclosure that the driver may be required to take over on short notice. (*See, for example, ’004 Patent*, 8:32-40 (driver must take over while vehicle is hydroplaning)). Level 2 automation includes, at the bottom end, systems that have both lateral and longitudinal control of the vehicle. These can maintain a buffer space around the vehicle, at least for a short period of time on “good” roads. More sophisticated systems (still within the level 2 category) can operate on additional (“worse”) roads and for longer periods of time. The common attribute of level 2 systems is that the driver supervises the operation and must be ready to “take over” on short notice. It is my opinion that “SDV”, as used in the ’004 Patent, corresponds to “level 2” automation, but would also include levels 3-5 where disclosed in the prior art.

47. It was well-known prior to the '004 Patent to demonstrate to the driver how capable their SDV is of driving autonomously.

48. For example, *Stenneth* (Ex. 1024) teaches either a “numeric” (FIG. 4a, below) or “gradient” (FIG. 4b, below) “confidence score display” showing the “vehicle confidence level” that determines when an SDV transitions between autonomous and manual driving modes. *Stenneth*, Abstract (“[T]he driving mode command transitions the autonomous vehicle to the autonomous mode, if applicable, when the vehicle confidence score exceeds the confidence threshold.”), 9:65-10:4. *Stenneth* further teaches that

[t]he vehicle may calculate a vehicle confidence level based on the current external conditions the vehicle is facing. The vehicle confidence level may be compared to a threshold value to determine the appropriate mode for the vehicle. Alternatively, the vehicle confidence level may be compared to a geographic confidence level that describes the requisite confidence for the current geographic area.

Stenneth, 2:43-49.



Stenneth, FIGs 4a, 4b.

E. SDV Infrastructure

49. It was widely known that systemic infrastructure was utilized to support safe and functional SDVs. For example, *Meyer* teaches that information gathered by an SDV itself “will be supplemented by information from other vehicles (V2V communication), infrastructure (V2I communication) or a back-end server depending on availability.” *Meyer*, p. 55. *Mosquet* similarly teaches that

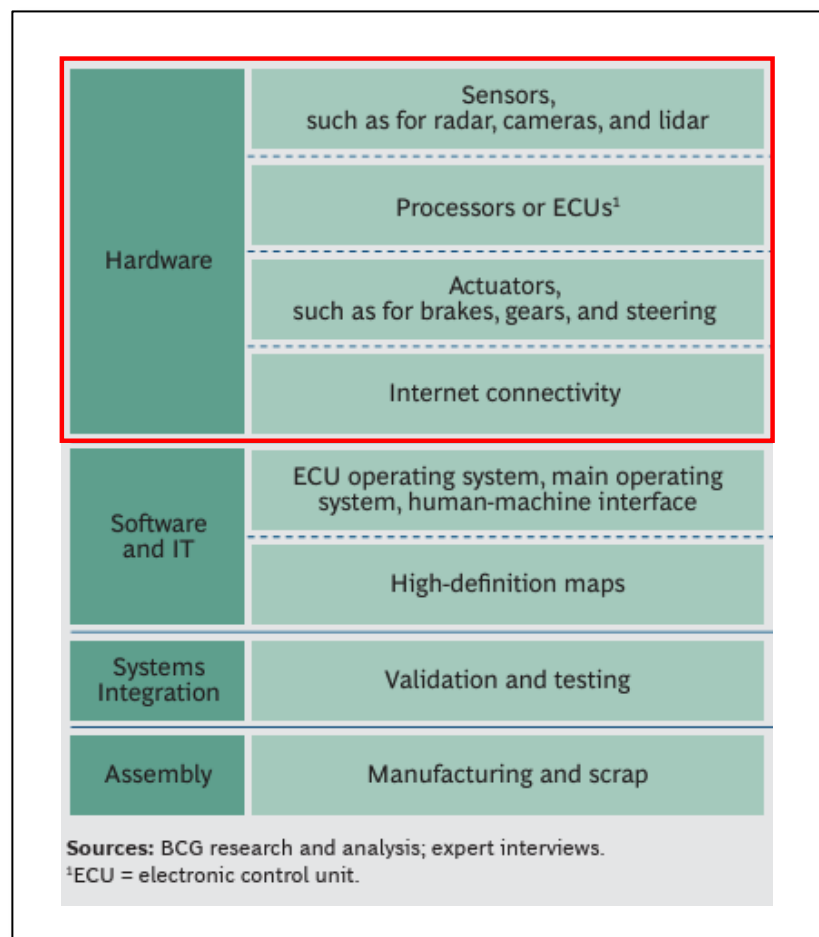
[s]hort-range communications technology—such as vehicle-to-vehicle and vehicle-to-infrastructure communication, collectively referred to as V2X—can be effectively applied to complex driving environments to enhance the safety of AVs [autonomous vehicles]. V2X technology can supplement on-board sensors to gather and transmit environmental

data, enabling the car to, for example, peer around corners and negotiate road intersections, just as—in fact, better than—a human driver would.

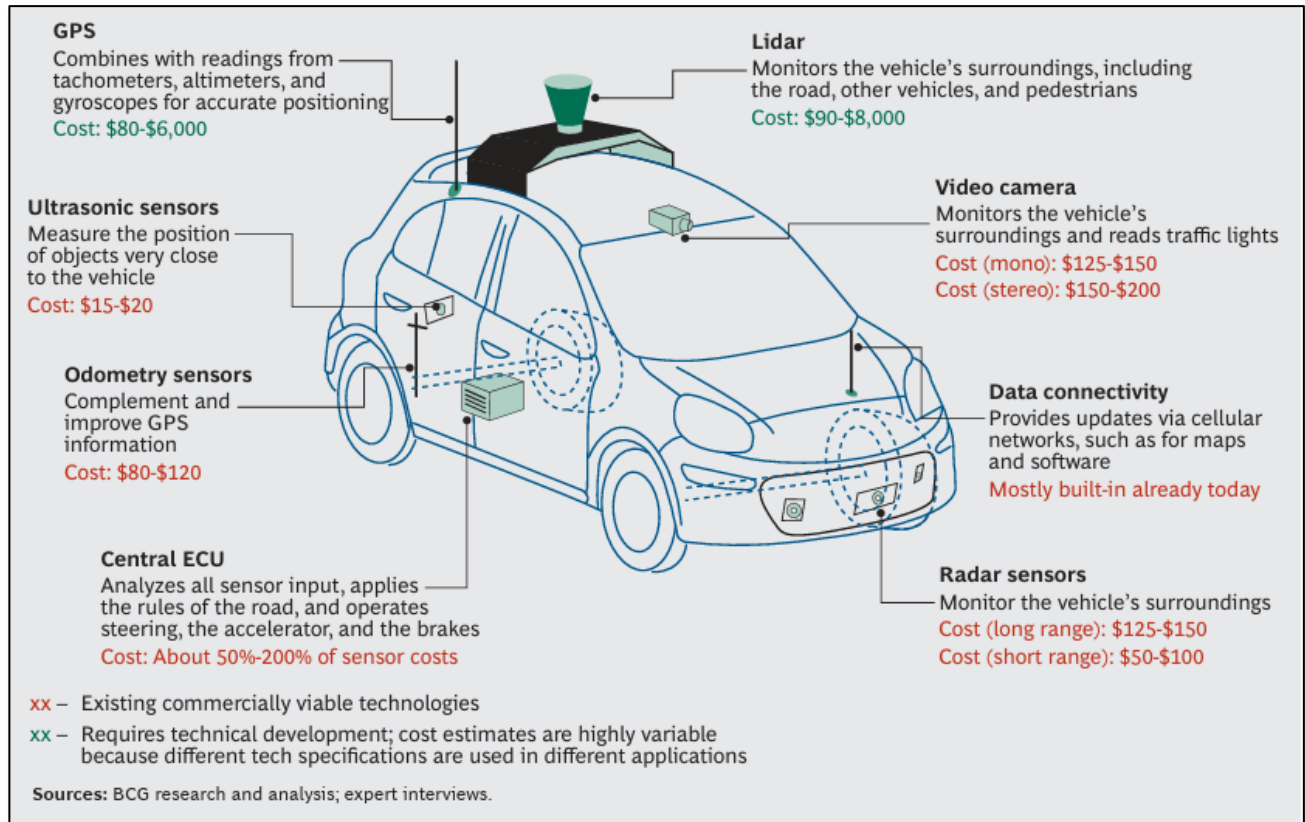
Mosquet, p. 14.

1. *SDV Hardware*

50. Like traditional vehicles, SDVs were known to include diverse hardware (e.g., displays, sensors, brakes, steering) before 2015.



Mosquet, FIG. 5 (excerpt, annotated to show hardware commonly associated with autonomous vehicles including sensors and processors/ECUs).



Mosquet, FIG. 6 (excerpt, demonstrating “crucial pieces of hardware” for autonomous vehicles).

51. In another example, *James* teaches vehicle 100 includes various levels of automation and hardware such as a processor, memory, and also including programming instructions for performing operations including switching between the automation levels. *James*, 3:1-4:43, 5:13-52, 6:31-64 (also teaching sensors), 10:37-11:53 (teaching transitioning between modes).

a) Sensors

52. SDVs included sensors for monitoring and navigating the environment. Additionally, sensors were used to monitor both the vehicle and the driver to ensure

competence for safe autonomous driving. *See e.g., Stenneth*, 4:8-11 (describing how “external vehicle sensor 115 may determine road status such as the shape or turns of the road, the existence of speed bumps, the existence of pot holes, the wetness of the road, or the existence of ice, snow, or slush.”), 4:52 (“One or more of the vehicle sensors 113 may detect a driver.”); *Allard* (Ex. 1025), [0023] (“While operating unmanned, the vehicle uses its onboard local area sensors and its perceptual context software to detect the presence of unsafe conditions.”); *Meyer*, p. 55 (“Surround sensing will require a combination of multiple sensors including radar and video sensors to generate a reliable and comprehensive 360° environment model of the vehicle environment.”). Examples of such sensors are provided below:

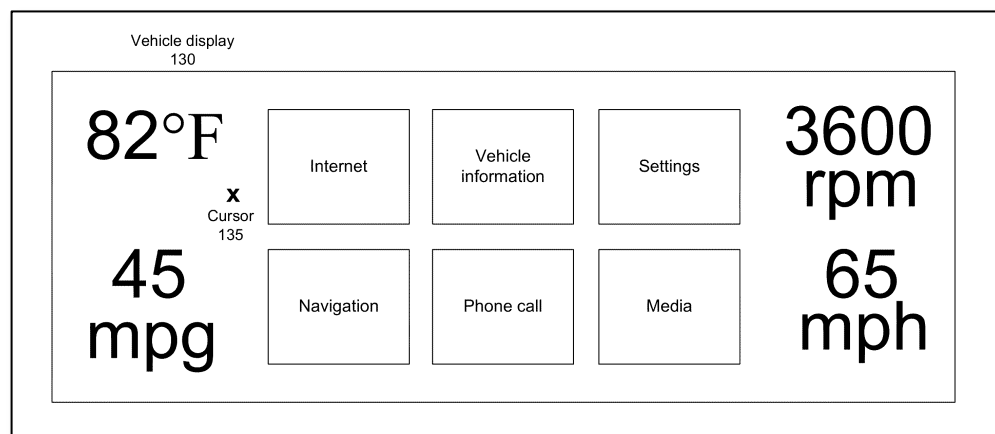
TABLE I COMPLETE SET OF SENSORS	
SENSOR FAULT	INFORMATION LOST
STEERING ANGLE SENSOR	Steering angle
YAW-RATE SENSOR	Yaw rate
MAGNETOMETER	Lateral displacement of car with respect to magnetic markers on the road
LATERAL ACCELEROMETER	Lateral acceleration of car
RADIO	Lead and previous vehicle's velocity and acceleration
RADAR	Distance and relative velocity from preceding car
LONGITUDINAL ACCELEROMETER	Acceleration (used by following cars in the platoon)
WHEEL SPEED SENSOR	Velocity
THROTTLE ANGLE SENSOR	Throttle angle
BRAKE PRESSURE SENSOR	Brake-line pressure
MANIFOLD PRESSURE SENSOR	Intake manifold pressure
ENGINE RPM SENSOR	Engine speed

Rajamani (Ex. 1026), Table 1, pp. 555-556 (Listing the required sensors for “longitudinal and lateral control systems” of platooning autonomous vehicles.) “The information lost due to a fault in any of these sensors is also indicated in the table.”
Id.

b) Displays

53. SDVs included displays for communicating with the driver. *See e.g., Cullinane*, FIG. 2; *James*, FIG. 1. These displays present relevant information to the driver, including vehicle speed, notifications, warnings, temperature, and

navigational tools. *See e.g., Sugimoto* (Ex. 1027), FIG. 1b, [0023] (“The display 130 in the embodiment of FIG. 1b displays internal and external vehicle information. For example, the display 130 displays the temperature outside the vehicle (82° F)...and the speed of the vehicle (65 miles per hour.)”); *Cullinane*, 3:6-9 (describing how “in response to an indication by the user that the user wants to return to manual mode, a warning may be displayed to the driver when switching to manual driving mode is not recommended.”).



Sugimoto, FIG. 1b.

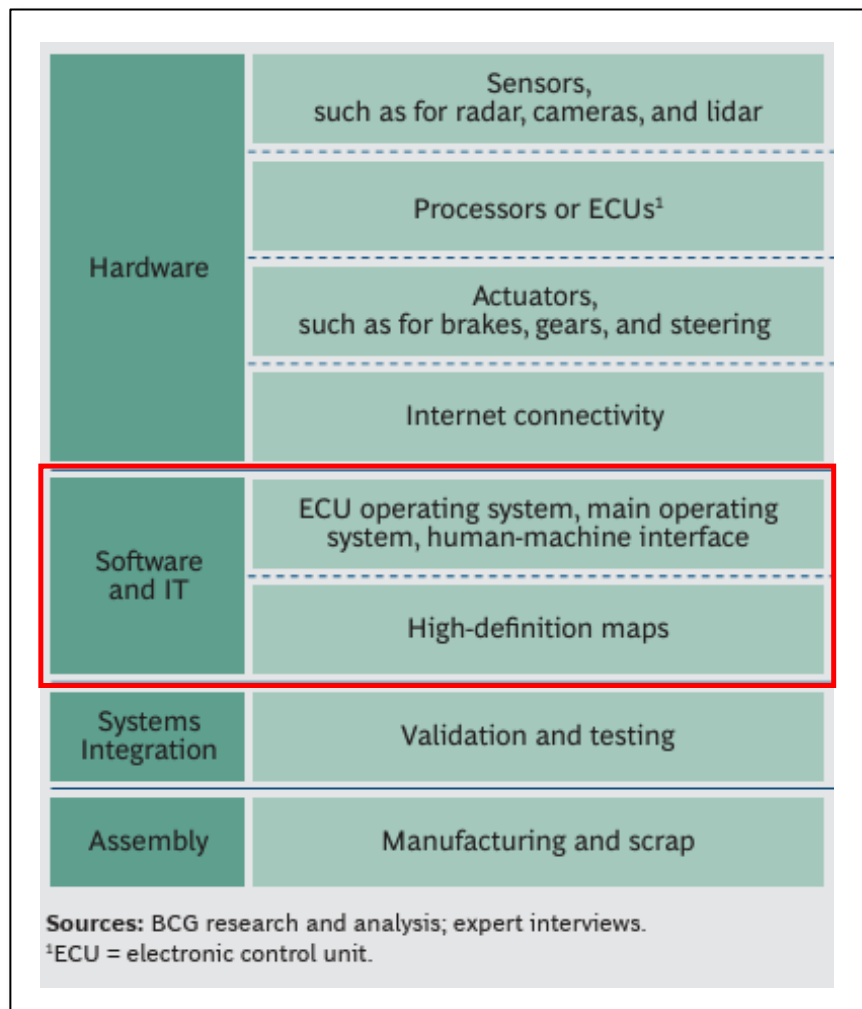
c) Braking and Steering

54. Like non-autonomous vehicles, SDVs were known to include additional hardware, such as braking and steering mechanisms, that the SDV system controls when driving. *See e.g., Caveney* (Ex. 1023) 5:60-64 (describing an autonomous vehicle with a “computing device 100 [which] can also be in communication with one or more vehicle systems 118, such as vehicle **braking**

systems, vehicle steering systems, vehicle propulsion systems, etc.”) (emphasis added).

2. *SDV Software*

55. It was well-known that software was required to support autonomous driving.



Mosquet, FIG. 5 (excerpt, annotated to demonstrate the general software required by SDVs).

56. It was understood that SDVs “must be able to plot a precise and safe trajectory through busy traffic while observing the rules of the road and minimizing risk due to unexpected events....” *McNaughton* (Ex. 1028), 4889. *Meyer* further teaches that autonomous vehicle

[s]oftware methods [] need to be further developed include methods for the highly dynamic modeling and simulation of the vehicle environment like e.g. electronic horizon, methods for sensor data fusion and for the communication and processing of big amounts of traffic and operation data, as well as for their fusion with sensor data. Furthermore, dynamic online maps, methods for prediction and decision finding will increasingly play a role as enabling technologies.

Meyer, p. 78.

57. Therefore, it was known that SDV software “must be able to produce a plan within a small fixed time window.” *McNaughton*, 4889. Therefore, *McNaughton* teaches “a motion planner for autonomous highway driving that adapts the state lattice framework pioneered for planetary rover navigation to the structured environment of public roadways” applicable to “an autonomous passenger vehicle.” *Id.* *McNaughton*’s planner uses a “search algorithm to systematically and efficiently explore both spatial and temporal dimensions in real time” to perform complex driving functions (e.g., “follow a leading vehicle, perform lane changes, and merge between other vehicles.”). *Id.*

58. It is also necessary for SDVs to identify and interpret objects in their environment, such as road signs. *Escalera* (Ex. 1029) teaches “an algorithm for the detection and recognition of traffic sign[s]” accounting for “difficulties that exist for object recognition in outdoor environments” such as “lighting changes.” *Escalera*, pp. 256-257; *see also Id.* (“The process is executed in two steps. First, the extraction of the information contained in the sign and second, its recognition by the NN [Neural Network].”).

VI. SHOWING OF ANALOGOUS, PRIOR ART

59. I have been informed by counsel that the prior art is analogous to the claimed invention of the '004 Patent. The prior art is from the same field of endeavor of the '004 patent, namely vehicles. '004 Patent, 1:24-25, 8:50-57; *Attard* (Ex. 1004), 1:15-24, 9:63-67; *Frazer* (Ex. 1005), 1:19-23, 21:20-22:22; *McNew* (Ex. 1006), 1:17-30, 3:5-52, FIG. 1; *Hampiholi* (Ex. 1007), [0050]-[0051], [0057]-[0058]; *An* (Ex. 1008), 1:15-23, 1:52-63, 4:34-45; *Kang* (Ex. 1009), 2:7-29, 9:32-49, Fig. 7C; *Schunder* (Ex. 1010), Abstract, 1:63-2:7; *DeRuyck* (Ex. 1011), 1:16-34; *Gunderson* (Ex. 1012), [0002]-[0004], [0025]; *Sako* (Ex. 1040), 1:55-2:3, 9:63-67; *Coelingh* (Ex. 1041), 1:53-2:15, 4:48-59; *Hada* (Ex. 1043), 1:5-10; *Nagasaka* (Ex. 1042), 1:5-39, 3:11-24; *Duncan* (Ex. 1045), [0023]; *Tsimhoni-647* (Ex. 1050), 1:12-24.

60. The prior art is also reasonably pertinent to at least one problem facing the '004 Patent's inventors, namely at least one of:

(A) evaluating a computer's ability to autonomously operate a vehicle and determining actions to take when faults are detected; *'004 Patent*, 1:24-57, 8:11-16; *Attard*, 1:15-24, 2:28-54; *An*, 1:15-23, 1:52-63, 4:34-45, 4:46-6:24, 15:1-60; *McNew*, 20:7-31, 4:3-5, 8:41-44; *Sako*, 34:15-35:21; *Tsimhoni-647*, 6:3-31;

(B) autonomously controlling a device's operational mode; *'004 Patent*, 1:24-57, 3:15-22; *Frazer*, 19:23-25, 21:20-22:22, FIG. 6; *Sako*, 1:24-57, 34:15-35:21;

(C) selecting appropriate corrective actions for a given driving situation; *'004 Patent*, 7:57-8:16, 9:11-35, 10:30-60; *McNew*, 20:7-31, 4:3-5, 8:41-44; *Frazer*, 19:23-25, 21:20-22:22, FIG. 6; *Sako*, 34:15-35:21;

(D) adjusting an operation of a vehicle based on driver competence; *'004 Patent*, 8:50-58; *Hampiholi*, [0001]-[0004], [0057]; *DeRuyck*, 1:16-34, 3:50-63; *Duncan*, [0007]-[0008].

(E) adapting to weather conditions to increase vehicle safety; *'004 Patent*, 7:42-56, 13:61-14:25, 15:33-50; *Kang*, 2:7-29, 9:32-49, 10:55-11:6, 13:3-18, Fig. 7C; *Schunder*, 1:63-2:7, 9:25-10:11, FIG. 4; and/or

(F) improving vehicle safety. *'004 Patent*, 9:11-17; *Gunderson*, [0062]; *Kang*, 17:58-18:7; *McNew*, 25:45-61; *Nagasaka*, 19:57-60; *Tsimhoni-647*, 6:3-31; *Hada*, 1:5-36, 3:17-21, 3:55-61, 5:23-36; *Duncan*, [0007]-[0008]; *Coelingh*, 1:22-50.

VII. GROUNDS OF UNPATENTABILITY

61. I have been informed by Counsel that the references used in the Proposed Grounds of Unpatentability are prior art and analogous art to the '004 Patent. See Section VI. Below is a table listing the Proposed Grounds of Unpatentability.

Proposed Grounds of Unpatentability
<u>Ground 1:</u> Claim 1 is obvious under 103(a) over <i>Hampiholi, Attard, McNew, and Frazer</i> .
<u>Ground 2:</u> Claims 2-5 are obvious under §103(a) over <i>Hampiholi, Attard, McNew, Frazer, DeRuyck, Gunderson, An, Kang, and Schunder</i> .
<u>Ground 3:</u> Claims 6-7 are obvious under §103(a) over <i>Hampiholi, Attard, McNew, Frazer, and Sako</i> .
<u>Ground 4:</u> Claim 8 is obvious under §103(a) over <i>Hampiholi, Attard, McNew, Frazer, and Coelingh</i> .
<u>Ground 5:</u> Claim 9 is obvious under §103(a) over <i>Hampiholi, Attard, McNew, Frazer, Coelingh, DeRuyck, Gunderson, An, Kang, and Schunder</i> .
<u>Ground 6:</u> Claims 29 is obvious under §103(a) over <i>Hampiholi, Attard, McNew, Frazer, and Hada</i> .
<u>Ground 7:</u> Claim 30 is obvious under §103(a) over <i>Hampiholi, Attard, McNew, Frazer, Hada, and Tsimhoni-647</i> .
<u>Ground 8:</u> Claims 31-32 are obvious under §103(a) over <i>Hampiholi, Attard, McNew, Frazer, Hada, Tsimhoni-647, DeRuyck, Gunderson, An, Kang, and Schunder</i> .
<u>Ground 9:</u> Claims 33-34 are obvious under §103(a) over <i>Hampiholi, Attard, McNew, Frazer, Hada, Tsimhoni-647, DeRuyck, Gunderson, An, Kang, Schunder, and Nagasaka</i> .
<u>Ground 10:</u> Claims 35-36 are obvious under §103(a) over <i>Hampiholi, Attard, McNew, Frazer, Hada, Tsimhoni-647, DeRuyck, Gunderson, An, Kang, Schunder, Nagasaka, and Duncan</i> .
<u>Ground 11:</u> Claims 37-39 are obvious under §103(a) over <i>Attard, Hampiholi, McNew, and Frazer</i> .

VIII. GROUND 1: CLAIM 1 IS OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, AND FRAZER

A. The *Hampiholi-Attard* Self-Driving Vehicle

62. Claim 1 is rendered obvious over a combined *Hampiholi-Attard* self-driving vehicle (SDV), operating according to *Hampiholi*'s disclosure and modified to incorporate *Attard*'s self-driving modes, functions, features, and CPCL, as well as any hardware and software necessary to provide an operable SDV practicing the techniques taught by both *Hampiholi* and *Attard*. The combined *Hampiholi-Attard* vehicle would have desirably been capable of self-driving and implementing corrective actions when appropriate, whether due to detected reduced human competence (per *Hampiholi*) or due to detected reduced processor competence (per *Attard*). A POSITA would have had the skill, found it obvious, and been motivated to configure the combined vehicle to intelligently blend the two systems, accounting for situations in which the human driver competence and the computer processor competence levels are both imperfect, choosing appropriate corrective actions (or no corrective action) in response to detected sensed conditions as a particular situation dictates.

63. A POSITA would have appreciated that the resulting vehicle would have thus furthered *Hampiholi*'s stated goal of increasing driver, passenger, and bystander safety by controlling a driving mode of an SDV to respond to faults such as hardware failures or weather conditions as well as decreased driver competence.

Hampiholi, [0002], [0017]. A POSITA would have recognized *Hampiholi*'s safety goal would have been additionally furthered by enabling the vehicle to detect and respond to faults in hardware components or weather conditions, per *Attard* – components that were already present in the *Hampiholi* vehicle, such as outward-facing cameras and external weather sources. *Attard*, 7:14-17, 14:63-15:4; *Hampiholi*, [0005], [0037]. This modification would have been combining prior art elements according to known methods to yield the predictable result of an SDV, specifically augmenting the automated systems and sensors disclosed in *Hampiholi* according to *Attard* to provide SDV functionality. Further, the modification would have been use of a known technique of implementing hardware and/or software features in a vehicle, resulting in an SDV, which were known in the prior art. See Claim 1(c) for additional motivation to modify *Hampiholi* per *Attard* to include features for self-driving functionality.

64. A POSITA would have had a reasonable expectation of success for combining the vehicles of *Attard* and *Hampiholi* because each describe vehicles configured to automatically take measures to increase the safety of the vehicle in response to detected danger. *Attard*, 5:44-53, 8:1-61; *Hampiholi*, [0002], [0057], [0065]-[0069]. Whether the source of the danger was hardware failure, weather conditions, or human incompetence, a POSITA would have appreciated that core functions of each of *Attard* and *Hampiholi* were to identify and mitigate that danger

to improve the safety of the driver and potentially nearby others. Further, a POSITA would not have had to personally fabricate an SDV to modify *Hampiholi* per *Attard*'s teachings as discussed herein.

B. Claim 1

1. Claim 1(Pre): “A computer program product for controlling a driving mode of a self-driving vehicle (SDV), the computer program product comprising a non-transitory computer readable storage medium having instructions that, when executed, cause at least one data processing apparatus to perform operations comprising:

65. To the extent the preamble is limiting, *Attard* teaches a computer program product that manages fault handling in an autonomous vehicle (“SDV”) including controlling a driving mode by changing from an autonomous driving mode to a manual driving mode (or semi-autonomous driving mode) in response to a detected fault (“controlling a driving mode of a self-driving vehicle”). Further, *Attard* teaches computer readable storage medium such as non-volatile memory and programming code stored thereon that is readable and executable by a processor.

a) *Hampiholi-Attard* Teaches Controlling a Driving Mode

66. The '004 Patent describes SDVs as vehicles “able to autonomously drive themselves through private and/or public spaces” and during some, but not all, weather conditions. '004 Patent, 1:29-31, 15:64-16:4, 28:38-40.

67. *Hampiholi*'s vehicle is capable of driving automatically. *Hampiholi*, [0057] (describing “**automatically** controlling the vehicle speed or braking” and

“**automatically** bringing the vehicle to a complete stop”), [0073], [0076] (“**automatic** adjustment of engine operation”), Fig. 4. A POSITA would have understood that a vehicle capable of driving automatically in at least some scenarios is a self-driving vehicle (SDV) per the ’004 Patent because the vehicle controls the three main components of driving: thrust, braking, and steering. Each of these would have been necessary for the vehicle to drive automatically, and are sufficient for automated driving, at least for short periods of time in simple private or public spaces, thus meeting the ’004 Patent’s description of “Self-Driving Vehicle.” *Id.* Similarly, *Attard*’s vehicle 101 is capable of driving autonomously. *Attard*, 1:15-52, 2:28-32, 9:63-67. A POSITA would have understood that a vehicle capable of driving autonomously is a self-driving vehicle (SDV). *See*, ¶46. Many such self-driving/autonomous vehicles were known. For example, *J3016* (Ex. 1030) is a document from SAE International that teaches various levels of automation for vehicles, including levels where a vehicle is capable of driving autonomously by using sensors to sense the environment and by autonomously steering, braking, and controlling engine throttle.

68. *Attard*’s vehicle 101 includes three driving modes: (1) an autonomous driving mode (in which autonomous driving module 106 of computer 105 controls vehicle 101’s functions such as steering, braking, and speed), (2) a semi-autonomous mode (in which the driver/operator controls one or more of vehicle 101’s functions

and computer 105 controls one or more of vehicle 101's functions), and (3) a manual mode in which a human driver is in "complete" control of vehicle 101. *Attard*, 1:15-52 (autonomous, semi-autonomous), 1:62-2:9, 2:55-3:4 (semi-autonomous, manual; "an alert may inform the vehicle 101 occupant of a need to resume partial or complete manual control of the vehicle 101."), 3:22-27 (autonomous, semi-autonomous), 3:56-67 (autonomous; "module 106 may control various vehicle 101 components and/or operations without a driver to operate the vehicle 101. For example, the module 106 may be used to regulate vehicle 101 speed, acceleration, deceleration, steering, braking, etc."), 7:39-46 (semi-autonomous, manual; "manual braking, to take complete control of the vehicle"), 9:60-67-10:12 ("all vehicle 101 operations, e.g., steering, braking, speed, etc., could be controlled by the module 106 in the computer 105."), 10:36-41. Thus, a POSITA would have understood or found obvious that *Attard* teaches or renders obvious (1) an autonomous driving mode, (2) a semi-autonomous mode in which both driver and computer each control one or more vehicle functions, and (3) a manual mode in which a driver has "complete" manual control over vehicle functions including steering, braking, and speed. A POSITA would have understood from *Attard's* teachings that vehicle 101 would have included all three of these modes, including because it was known for self-driving vehicles to have multiple possible levels of automation even within a single vehicle. *See*, Section V.C.

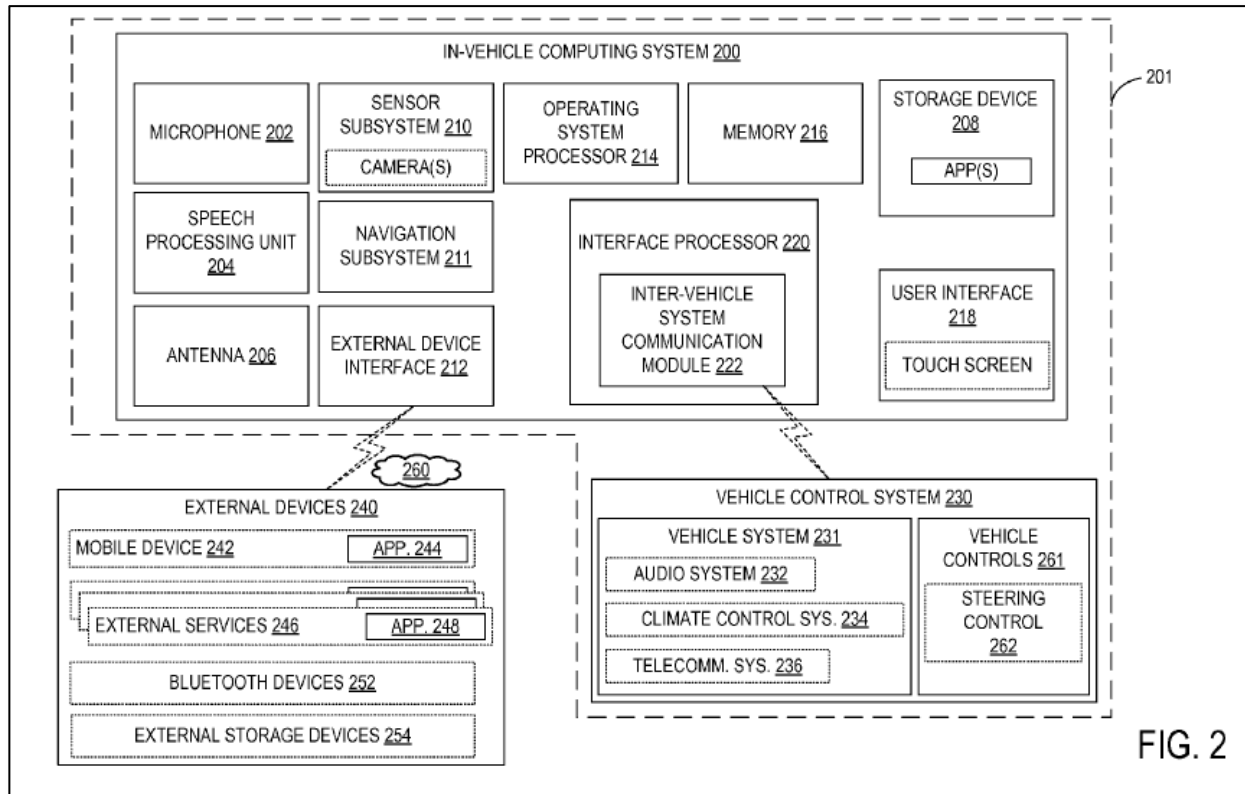
69. Regarding controlling a driving mode, Attard teaches disabling autonomous mode (that is, transitioning from autonomous mode to either semi-autonomous mode or manual mode) in response to a detected fault. *Attard*, 1:62-65 (“when a fault is detected in a vehicle 101, the vehicle 101 could cease and/or disable one or more particular autonomous operations dependent on a data collector 110 in which the fault was detected.”), 2:55-3:4 (“an alert may inform the vehicle 101 occupant of a need to resume partial or complete manual control of the vehicle 101.... e.g., immediate manual control is recommended ... manual control is recommended for mechanical reasons, manual control is recommended for environmental or weather conditions, manual control is recommended because of traffic conditions, etc.”). *Attard* expressly envisions “ceasing one or more autonomous operations” as an action to take in response to a detected fault. *Attard*, 3:5-13.

70. A POSITA would have recognized that *Attard*’s computer 105 (including autonomous driving module 106) controlling vehicle 101 to transition from autonomous mode to either of semi-autonomous or manual modes would have been *controlling a driving mode*. As I discussed above, it was known for a vehicle to have multiple levels of automation, including for a single vehicle to have multiple modes for driving autonomously, semi-autonomously, or completely manually. A POSITA would have understood that when disabling vehicle 101’s autonomous

functions such as braking, steering, and acceleration, a human driver would have taken over managing such functions, as is done in a typical non-self-driving vehicle (e.g., standard non-SDV car). That is, a vehicle in “manual” (i.e., non-autonomous) mode requires a human driver to manage functions such as engine throttle, braking, and steering just like in a typical non-SDV automobile that does not have self-driving capabilities. While *Attard* does not expressly use the phrase “manual mode,” a POSITA would have understood or found obvious that *Attard*’s driving mode in which the driver takes “complete control” of the vehicle teaches a “manual mode.” Manual mode here means a human driver manages functions such as engine throttle, braking, and steering. I refer to this as “manual mode” to describe the state of the vehicle in which the human driver is required to actively drive the vehicle. As I discuss above, vehicle 101 includes an autonomous mode, a semi-autonomous mode, and a manual mode, where in the manual mode the human driver manages the engine throttle, braking, and steering. Thus, the combined *Hampiholi-Attard* vehicle is an SDV.

b) *Hampiholi*’s Computer Program Product Comprises Non-Transitory Computer-Readable Memory and Processor

71. *Hampiholi*’s Fig. 2 below depicts vehicle 201 including vehicle storage device 208 including “instructions executable by processors 214 and 220 in non-volatile form[:.]”



Hampiholi, Fig. 2, [0029], [0032].

72. *Hampiholi* teaches storage device 208 may store instructions and/or code that, when executed by a processor (e.g., operating system processor 214 and/or interface processor 220), controls the in-vehicle computing system 200 to perform one or more actions. *Hampiholi*, [0032]. These instructions would have included those taught by both *Hampiholi* and *Attard* in the combined vehicle, including specifically the instructions for “controlling a driving mode” according to *Attard*’s disclosure. *Hampiholi*, [0003], [0032]; *Attard*, 3:22-27, 3:56-67, 9:60-10:12.

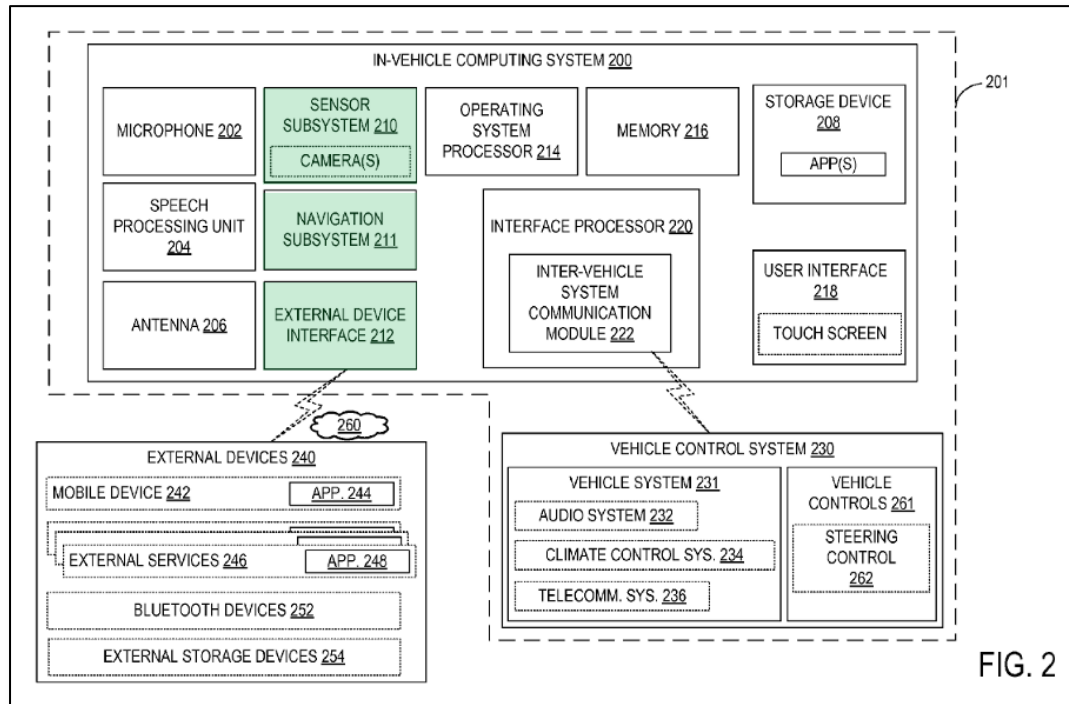
73. Particularly, a POSITA would have expected that the instructions described by *Attard* for controlling its vehicle systems in response to detecting a

fault, including instructions for performing methods regarding Φ and ϕ (and ϕ_i), would have been stored in the same memory as the instructions described by *Hampiholi* for controlling its vehicle in response to detecting driver distraction to provide an operable vehicle that would not have needed separate, duplicated memory locations. In either case, whether automatically adjusting the operation of the vehicle pursuant to *Hampiholi's* driver distraction or *Attard's* faults, the combined vehicle would have been configured to use these instructions to control its driving mode, as claimed. Thus, a POSITA would have understood or found obvious that *Hampiholi-Attard* teaches a computer program product for a vehicle including for controlling a driving mode and that the computer program product comprises non-volatile memory and a processor for executing programming instructions.

2. Claim 1(a): “receiving a plurality of sensor readings from a system of sensors, wherein the system of sensors comprises: a steering wheel sensor, a speedometer, a GPS sensor, and a camera;”

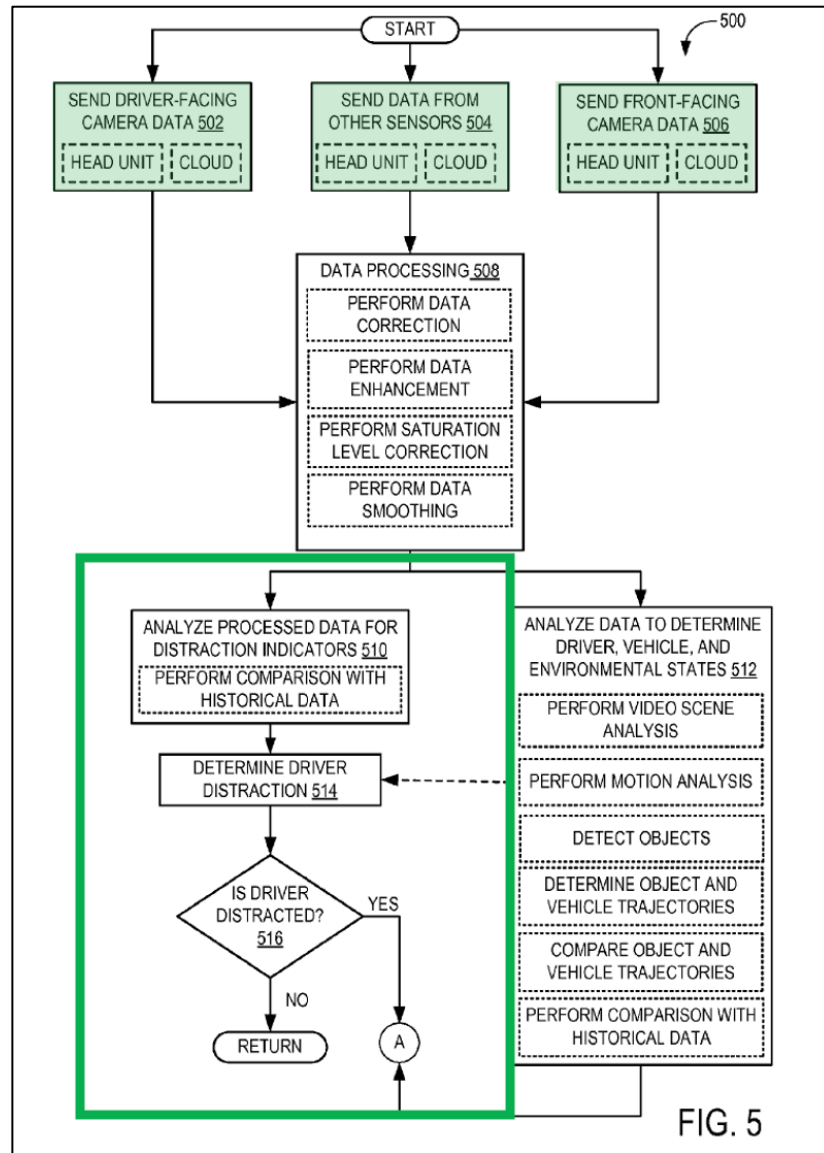
a) *Hampiholi's* System of Sensors

74. *Hampiholi* teaches receiving inputs from a plurality of sensors in sensor subsystem 210, external device interface 212, and navigation subsystem 211, including signals regarding gas pedal and brake inputs, temperatures, vehicle speed (*speedometer*), interior and exterior cameras (*camera*), and the vehicle's location (*GPS sensor*).



Hampiholi, Fig. 2, [0031], [0034], [0046]. *Hampiholi* teaches the vehicle's speed is needed to perform the disclosed process, thus a POSITA would have understood that *Hampiholi* teaches or renders obvious a speedometer. *Hampiholi*, [0050], [0057]. Additionally, a plurality of readings from these sensors would have been collected from across the vehicle for processing and analysis at the vehicles computing processor in order to provide the vehicle with a constantly-updating analysis of the vehicle's operating condition. Each of these sensors were well known prior to the '004 Patent for inclusion in SDVs, enabling the vehicle to operate safely and effectively. These sensors are collectively mapped as the *system of sensors*.

75. As illustrated in Fig. 5, *Hampiholi* teaches sending sensor readings from this *system of sensors* to determine the driver's distraction level (quantified as severity rank R, the mapped *competence level of the human driver* (HDCL)).



Hampiholi, FIG. 5. Sensor readings used to determine *Hampiholi's* severity rank R (competence level of the human driver) include driver's eyelid position as determined by the video from a driver-facing camera ([0062]) and speed and/or

location of the vehicle ([0057]). A POSITA would have recognized that a driver with drooping eyelids or closed eyes would have indicated that a driver is (or would be) less competent at operating the vehicle, particularly at high speeds or in known congested or difficult areas, such as major highway interchanges or steep mountain roads. *See*, VIII.A, 1(c) for motivation to combine *Hampiholi-Attard*.

b) McNew's Steering Wheel Sensor

76. First, I note that steering wheel grip sensors were well known in the prior art before the '004 Patent and that there were vehicles in production that used steering wheel sensors to monitor the driver's attention level. For example, it was known that the Mercedes 2013 S-class included sensors that "can detect whether the driver's hands are actually on the steering wheel. If they are not, a visual warning is issued first. Should the driver fail to react, a warning signal sounds and lateral lane guidance is deactivated." *GCC* (Ex. 1053), 3; *Mercedes2013* (Ex. 1055), 2.

77. *McNew* teaches monitoring a driver's behavior and level of attention and monitoring input from a *steering mechanism sensor*. *McNew*, 4:6-29 ("steering wheel grip sensor"), 3:26-52, 5:4-15. A POSITA would have found it obvious and been motivated to modify the *Hampiholi-Attard* SDV with *McNew*'s steering wheel grip sensor, improving *Hampiholi-Attard*'s fault handling system to make decisions based on additional information, such as the current position of the driver's hands. Having the current position of the driver's hands as data would have improved SDV

decision-making, such as whether to transition from autonomous mode to manual mode. If a driver's hands are not on the wheel at the current moment, it would likely not be safe to make such a transition, whereas if a driver's hands are on the wheel, that is a data point that may help indicate it is safe to transition to manual mode. The additional information would have predictably improved *Hampiholi's* severity rank R to more accurately assess when the human's driving competence was diminished, increasing vehicle/driver safety, furthering *Hampiholi's* express safety goal. *Hampiholi*, [0002]. In particular, *McNew's* teachings would have improved the *Hampiholi-Attard* SDV by monitoring whether a driver has his/her hands on the steering wheel, the location of the hands (e.g., is only one hand in a non-ideal location such as on the bottom of the steering wheel or are both hands on the wheel at 9 o'clock and 3 o'clock), and how hard or lightly the driver is gripping the steering wheel (which may indicate stress or lack of attention).

78. This modification combines known prior art elements according to known methods to yield predictable results, i.e., combining a steering wheel grip sensor with *Hampiholi's* driver distraction system's sensors to yield the predictable result of *Hampiholi's* severity rank R further being based on the driver's interaction with the steering wheel. As discussed above, *Hampiholi-Attard* SDV already includes numerous sensors, and sensors were well known for use in SDVs in the prior art. Modifying *Hampiholi-Attard* to include an additional sensor would have

simply been combining a known prior art element in an SDV. Further, the modification is use of a known technique of employing a steering wheel grip sensor that would have improved *Hampiholi-Attard* in the same way as *McNew*. Indeed, using a steering wheel sensor such as *McNew* teaches would have allowed the *Hampiholi-Attard* SDV to make more informed decisions regarding the state of the driver (e.g., attentive, not paying attention, hands not on the wheel) and corrective actions, such as transitioning to manual mode.

79. A POSITA would have had a reasonable expectation of success (REOS) because monitoring driver states was well-known in the art before the '004 Patent and further because such would have required only straightforward hardware and/or programming changes to the *Hampiholi-Attard* SDV, e.g., to detect driver input via a steering wheel sensor. A POSITA would have understood that adding a sensor would have been a straightforward process, and that adding or changing programming instructions to account for the sensor would likewise have been straightforward, including because using sensors, such as steering wheel sensors, was well known in the prior art.

3. Claim 1(b): “determining a competence level of a human driver using one or more of the sensor readings;”

80. *Hampiholi* teaches a system and method of determining a competence level of a human driver in controlling its vehicle via severity rank R, which is based

on *the sensor readings*. See, 1(a). Driver distractions include not looking at the road, being distracted by music, handling (e.g., providing user input to) infotainment units, being sleepy/tired, and/or other driver states. *Hampiholi*, [0001]-[0004], [0050]. Specifically, *Hampiholi* teaches that a severity rank R is determined, measuring the distraction level of the driver.

81. A low-level R includes short-lived driver distraction while the vehicle is not in immediate danger; a medium-level R includes a more serious driver distraction (e.g., droopy eyes indicating sleepiness) while the vehicle is in an otherwise safe environment (e.g., no objects within a trajectory/path of the vehicle, driving at a low speed); and a high-level R includes any driver distraction while collision risk is high. *Hampiholi*, [0057]. In these examples, the vehicle synthesizes data about the human driver's performance at piloting the vehicle (that is, the driver's competence level) and combines that data with context reflecting the current operational state of the vehicle itself, such as objects in the vehicle's path or the vehicle's speed. The method uses this information to determine the severity rank R of the driver's distraction. Fig. 7 depicts exemplary severity ranks R corresponding to detected human behaviors and road/vehicle conditions.

700

Distraction	Road/Vehicle Condition	Severity Rank (R)
Driver not looking ahead	Vehicle stopped at traffic signal	1
Parking light off	Vehicle parked in garage	1
Driver talking on the phone	Using hands free, freeway, no upcoming turns, medium speed	4
Parking light off	Vehicle parked on side of freeway	5
Driver not looking ahead	Vehicle not in reverse gear, high vehicle speed, upcoming turn within city limits	8
Driver talking on the phone	Not using hands free, upcoming turns within city limits, high speed	8

Less Distracted/
Higher
Competence

More Distracted/
Lower
Competence

FIG. 7

Hampiholi, FIG. 7. As is shown in Figure 7, *Hampiholi*'s severity rank R is higher for a more-distracted driver, such as a driver talking on the phone while driving at high speed in the city (rank 8), and lower for a less-distracted driver, such as a driver not looking ahead while stopped at a traffic signal (rank 1). *Hampiholi*'s severity rank R is a human driver competence level even though the severity rank R is higher for a more-distracted driver than a less-distracted driver because the severity rank still indicates the competence of the driver.

82. A POSITA would have been capable of using *Hampiholi*'s severity rank R as an indicator of the competence of the driver's ability to safely operate the

vehicle regardless of the directionality of scale being used, at most requiring mathematical treatment using known computer programming techniques to account for an inversion of the numerical scale (thus higher values would be better, indicating higher competence). Whether to make the severity rank R number larger or smaller for a more-distracted driver compared to a less-distracted driver is a mere design choice, and it would have been obvious to try an inverted scale. For example, a simple computer program that sets an HDCL “H” equal to 9-R would have yielded H=1 for severity rank R=8 and H=8 for severity rank R=1, effectively inverting the scale with at most a few lines of computer code. This is merely one example provided to show how simple it would have been to invert the scale and is not intended as being required for the *Hampiholi* vehicle and method to teach the HDCL of claim 1.

83. *Hampiholi’s* severity rank R teaches a competence level of the human driver. For example, a driver paying more attention is more competent at taking control of the vehicle if a transition to manual mode is required. For instance, if a wreck occurs in front of a driver, an attentive driver would have more time to react by slowing and/or swerving the vehicle than a distracted driver, who would not see the wreck as quickly and may possibly crash as well. Thus, the more attentive driver is the more competent driver. A distracted driver is more likely to veer out of their lane or cause a rear-end collision with a stopped vehicle. An attentive driver would

be more competent at avoiding unexpected obstacles in the road or adjusting the operation of the vehicle to account for inclement weather.

84. Additionally, a driver paying more attention allows for more possible corrective actions (e.g., transition to manual, disabling autonomous driving feature(s), automatically slowing to a stop) by allowing sufficient lead time to safely transition to manual mode or disable autonomous driving feature(s). For example, it was known that SDV drivers required sufficient lead time to accept the transition to manual mode. *J3016*, 4; *see* Claim 1(j) including *McNew*'s teachings of transitioning when it is safe to do so. In the case where the driver is severely distracted, the sufficient lead time may be insufficient such that the transition to manual mode is not sufficiently timely to avoid an unsafe condition, forcing the vehicle to transition to a minimal risk condition. If a driver is fatigued, asleep, or otherwise inattentive (lower competence level), transitioning to manual mode would be more dangerous, and corrective actions may be limited to automatically slowing/stopping the vehicle in the minimal risk condition.

4. Claim 1(c): “determining a competence level of the SDV using one or more of the sensor readings;”

a) '004 Patent's SDV competence level

85. The '004 Patent characterizes SDV competence level as “a competence level of the SDV control processor in controlling the SDV while the SDV experiences the current operational anomaly.” *'004 Patent*, 1:39-46, 10:7-13

(“Various approaches may be used to determine this control processor competence level.”), 10:30-50.

b) *Attard*’s SDV competence level – Capital Φ

86. *Attard* uses collected sensor data 115 to produce confidence assessments 118². *Attard* teaches vehicle confidence assessments generated in two coexisting forms:

(1) ϕ , a **vector**; “where each value in the vector relates to an attribute [] of the vehicle and/or a surrounding environment...such as vehicle speed, braking performance, acceleration, weather conditions, road conditions, etc. *Attard*, 6:4-13. *Attard* teaches determining a fault has occurred due to a particular sub-assessment ϕ_i falling below an associated threshold $\phi_{\min}$, triggering message generation specific to the particular sub-assessment ϕ_i ; and

(2) Φ , which may be “a **scalar** value, e.g., as a number [] in the range of 0 to 1.” *Attard*, 5:54-6:3. *Attard*’s Φ is mapped as the claimed *SDV competence level* (CPCL) because it “indicates an overall value that the vehicle 101 can and/or should be operated autonomously.” *Attard*, 5:54-63, 1:44-50 (“The computer 105 may

² Hereinafter, element “118” is omitted, and each confidence assessment is referred to as its specific type (i.e., overall, vector, sub-assessment) for clarity.

include instructions for determining that an autonomous driving module 106, e.g., included in the vehicle computer 105, may not be able to operate the vehicle 101 autonomously or semi-autonomously with acceptable confidence, e.g., confidence expressed numerically that is lower than a predetermined threshold.”) Thus, *Attard’s* Φ is a CPCL because it indicates whether the autonomous module 106 and, therefore, vehicle 101 can operate autonomously.

87. Though *Attard* does not provide detailed mathematical description regarding Φ , a POSITA would have known various approaches for its calculation. As I discuss below, there were numerous known mathematical methods for converting one or more vectors into a scalar quantity, and it would have been obvious to a POSITA to utilize such a calculation to generate Φ from a plurality of sub-assessments φ_i . For example, a POSITA would have understood or found obvious techniques for converting *Attard’s* **vector** confidence assessments φ directly to a **scalar** via a well-known mathematical method (e.g., computing magnitudes of φ^{PL} and φ^{AL} and summing or averaging their values or computing the dot product of φ^{PL} and φ^{AL}) to yield overall confidence assessment Φ (a scalar value). I note that *Attard* does not expressly teach a specific method for performing such conversion, but a POSITA would have understood or found obvious using any number of mathematical approaches for such a calculation. However, I note claim 1 does not require any particular mathematical relationship between Φ and φ . Any

mathematical approach for calculating *Attard's* Φ would have satisfied claim 1, including approaches in which Φ is not directly calculated using ϕ whatsoever. For instance, each of Φ and ϕ may, in some embodiments, have been independently calculated from sensor data. *Attard* is not specific on how each are calculated, and the difference does not matter to the claims of the '004 Patent. A POSITA would have understood any number of approaches for calculating each of the values, potentially using straightforward vector mathematics. A POSITA would have understood that an approach using ϕ to calculate Φ would have made sense within *Attard*.

c) Motivation to Combine *Hampiholi-Attard*

88. A POSITA would have been motivated and found it obvious to modify *Hampiholi* to implement *Attard's* known technique of determining a CPCL using sensor readings to assist *Hampiholi-Attard's* SDV in driving in an autonomous mode, which is reliant upon sensors (e.g., cameras/GPS/LIDAR) to perform autonomous driving actions (e.g., to avoid obstacles, maintain a safe distance in traffic, switch lanes or turn without wrecking). A POSITA would have recognized that a vehicle capable of detecting and responding to inclement weather, such as icy or wet road conditions would have been safer than the unmodified *Hampiholi* vehicle and would have furthered *Hampiholi's* goal of improving driver and bystander safety. *Attard*, 7:14-17; *Hampiholi*, [0002]. *Hampiholi's* safety goal would have

been additionally furthered by enabling the vehicle to detect and respond to faults in hardware components, per *Attard* – components that were already present in the *Hampiholi* vehicle, such as outward-facing cameras. *Attard*, 14:63-15:4; *Hampiholi*, [0005]. Further, the standard message set for sending weather data between vehicles was standardized before the '004 Patent. *Harding* (Ex. 1037), 79, 77 (discussing ambient air temperature, wiper status, and rain sensors). In an example, if a sensor such as a speed sensor needed for SDV functionality is malfunctioning, *Attard's* known technique would have provided for a corrective action in *Hampiholi-Attard*. *Attard*, 15:1-4. This use of a known technique would have improved *Hampiholi's* similar vehicle in the same way as *Attard's*.

89. The *Hampiholi-Attard* SDV would have thus resulted in an SDV operable to provide additional convenience and safety afforded by *Attard's* autonomous features, including determining CPCL, in *Hampiholi's* vehicle that is already intended to increase the safety of the driver. A POSITA would have recognized that a vehicle which is capable of taking over control and self-driving through dangerous situations, or when a driver is not sufficiently capable, would have been safer than a vehicle unable to do so and would have resulted in a more-desirable vehicle to consumers. *Hampiholi's* technique of monitoring user distraction including through *McNew's* steering wheel sensor would have coexisted with *Attard's* Φ technique for monitoring vehicle capabilities, and a POSITA would

have configured the combined SDV to operably mitigate any simultaneous automatic actions that the vehicle may have taken pursuant to the description of *Hampiholi's* responses to severity rank R and *Attard's* responses to Φ dropping below $\Phi_{\min}$.

90. For example, if the driver had a low severity rank distraction but the vehicle was experiencing multiple or critical hardware faults, a POSITA would have configured the modified vehicle to continue operating in a manual mode, in spite of the moderate reduction in human driver competence level. Conversely, if the driver was dozing off but the Φ remained high, the vehicle might transition to an autonomous mode to maximize safety for the driver and bystanders, even if Φ was not maximum (1). These are merely non-limiting examples of how a POSITA would have been skilled and motivated to combine the systems of *Hampiholi* and *Attard*, using their normal skill and intellect to overcome any obstacles to the combination and result in an operable vehicle that is safer for the driver and bystanders than the unmodified *Hampiholi* vehicle.

91. *Attard* expressly extols the benefits of incorporating its system utilizing a CPCL (Φ), explaining that “mechanisms are needed for evaluating a computer’s ability to autonomously operate the vehicle, and for determining an action or actions to take when one or more faults are detected” such as “determin[ing] a safe stopping location,” leading a POSITA to a motivation to combine *Attard's* methods and

supporting systems into *Hampiholi's* vehicle, to result in a self-driving vehicle. *Attard*, 1:21-24, 14:27-48. A POSITA would have been aware that SDVs provide desirable features to users, benefitting sales of the vehicles while improving safety. Autonomous driving functionalities allow users to be more relaxed while driving and reduce the likelihood of accidents borne of human error.

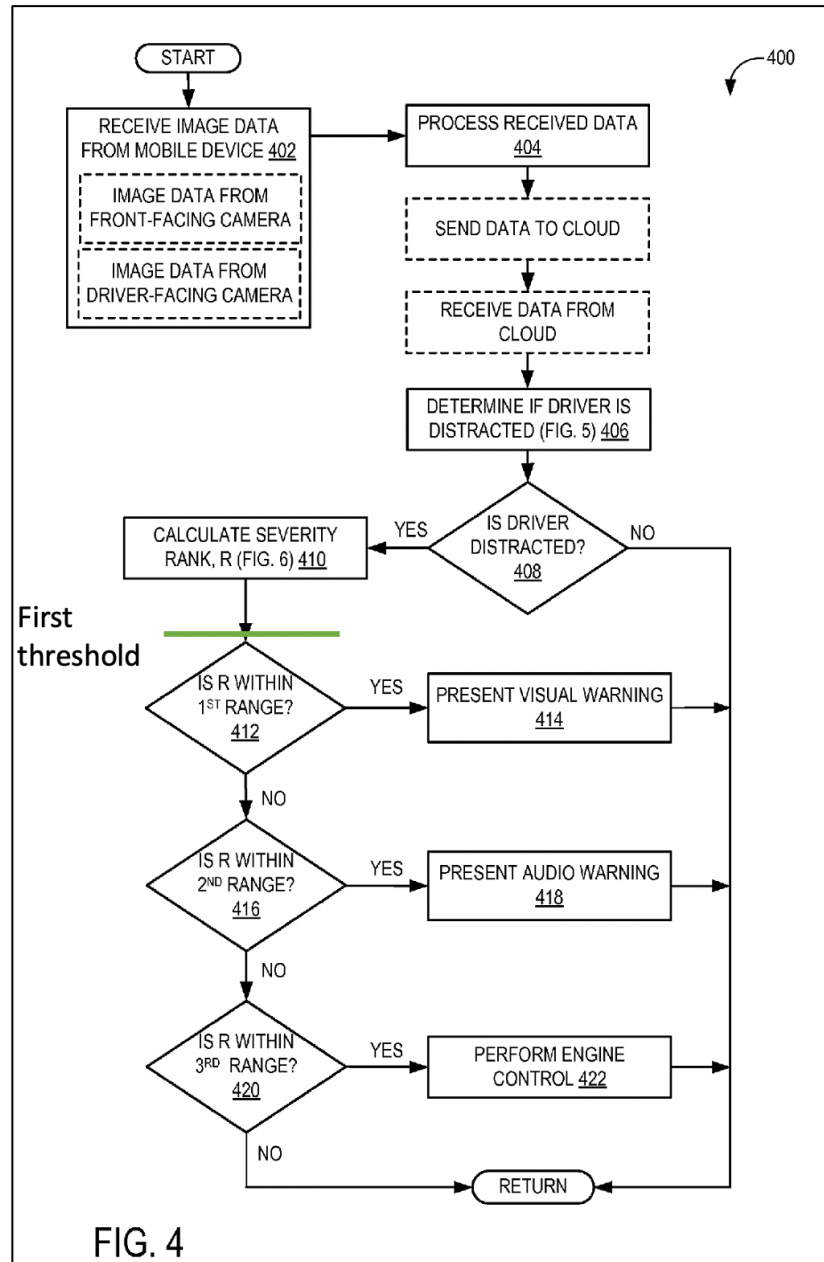
92. Incorporating *Attard's* technique of determining Φ (CPCL) would have resulted in a safer, more desirable SDV. This modification would have had a REOS because *Hampiholi* already teaches a vehicle and sensors, along with computer hardware and programming instructions necessary for performing automatic functions, as well as a system of sensors, to which any of *Attard's* sensors necessary for determining CPCL (if any) would have been added with a REOS. *Hampiholi*, Fig. 2, [0029], [0032]. Thus, *Hampiholi* already includes many of the same components that *Attard* teaches that are used in an SDV to perform *Attard's* functions. In particular, *Attard* teaches an autonomous vehicle, computer hardware, and programming instructions; thus, modifying *Hampiholi* would have required only straightforwardly modifying programming instructions and/or providing hardware (if necessary) to compute Φ . *Attard*, FIG. 1, 15:12-46.

93. Further, a POSITA would have had a reasonable expectation of success for the combination because *Hampiholi* already includes a processor and memory necessary for performing automatic functions, as well as a system of sensors, to

which any sensors described by *Attard* necessary for determining the competence level of the processor may have been added. Additionally, POSITAs would have had sufficient skills in hardware (*e.g.*, sensors, processors, memory), vehicle systems (*e.g.*, braking, engine control, steering, and navigation) and software programming necessary to combine the disclosed vehicles and methods. Without requiring bodily incorporation, POSITAs (likely a large team of POSITAs) would have had the skills and knowledge necessary to produce an SDV incorporating the concepts taught by each of *Hampiholi* and *Attard* to result in a safer SDV, capable of accounting for hardware faults, weather faults, and driver incompetence.

5. *Claim 1(d): “comparing the competence level of the human driver to a first threshold;”*

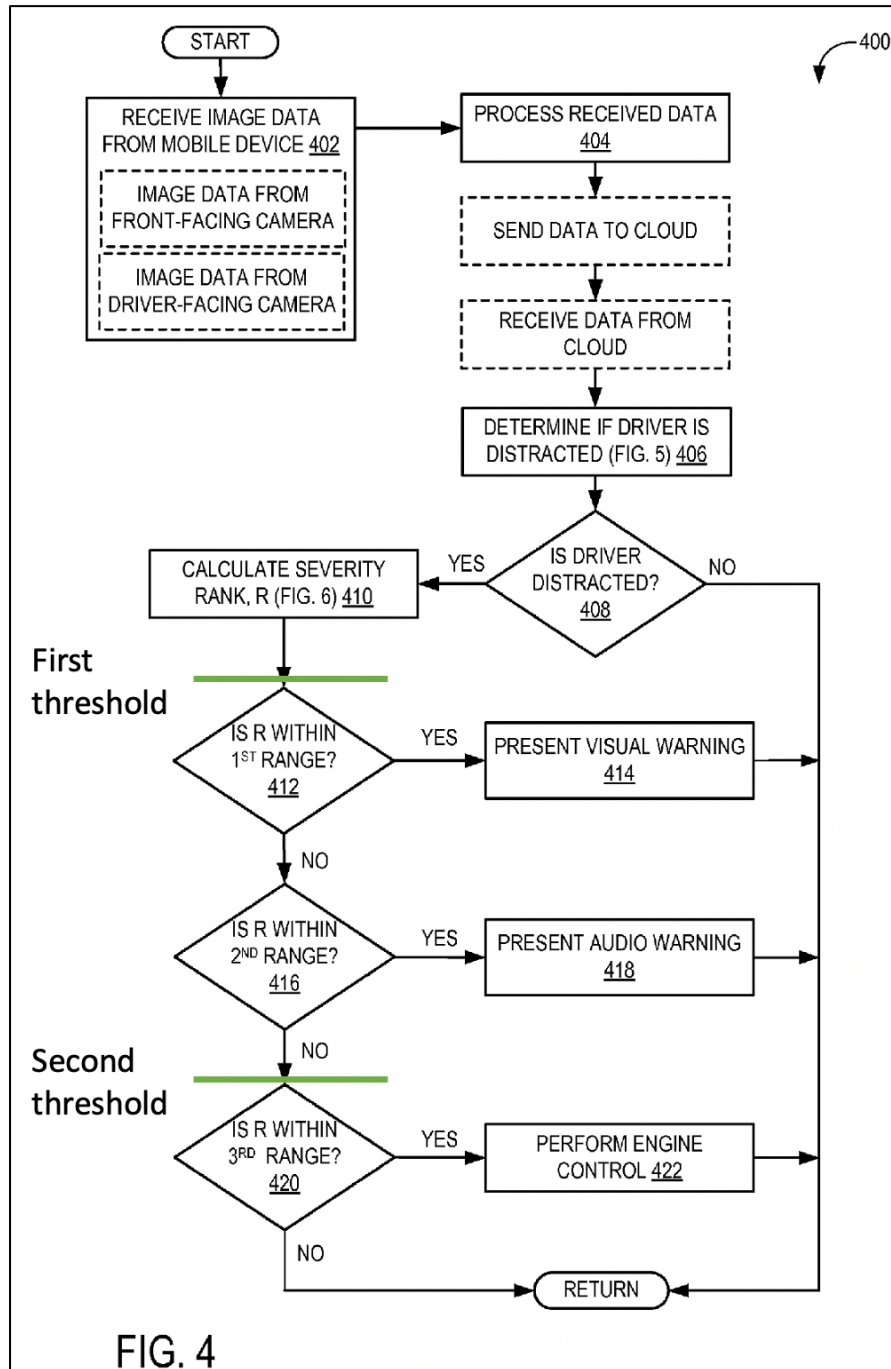
94. *Hampiholi* teaches comparing severity rank R of a driver’s distraction to several ranges for determining appropriate responses. *Hampiholi*, [0056]-[0057]. *Hampiholi* teaches that if R is outside the ranges, the vehicle foregoes corrective actions. *Id.* Thus, in the *Hampiholi-Attard* SDV, R is compared to *a first threshold* (*e.g.*, lower bound of 1st range).



Hampiholi, FIG. 4. See, 1(f).

6. Claim 1(e): “comparing the competence level of the human driver to a second threshold, wherein the second threshold is different from the first threshold;”

95. *Hampiholi* teaches severity rank R is compared to a *second threshold* (e.g., block 420 – “Is R within 3rd range?”) that is different from the *first threshold* because it is a higher-rank R, while the *first threshold* R is an R value below which no corrective action is taken. *See*, 1(f).

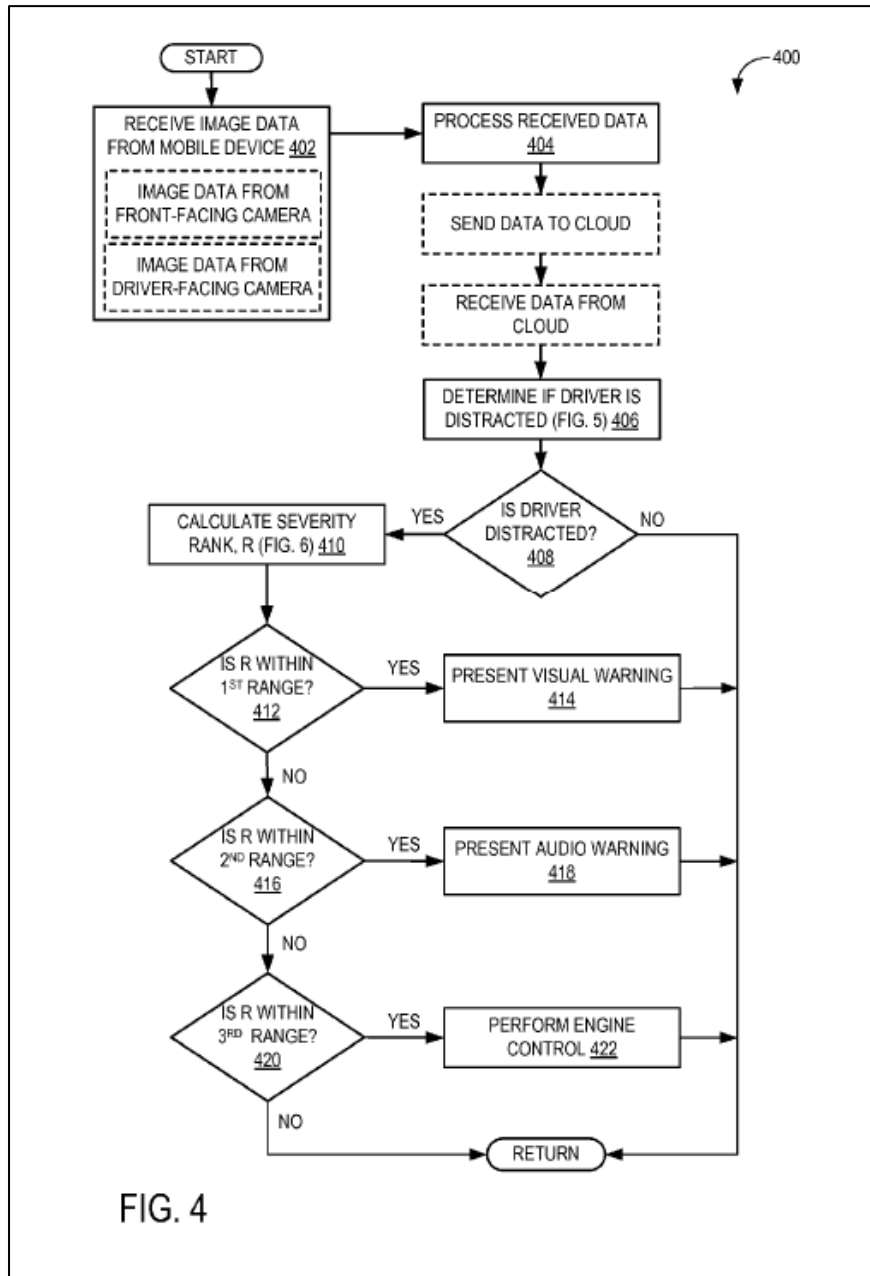


Hampiholi, Fig. 4, [0056]-[0057].

7. **Claim 1(f):** “determining that no fault has occurred when the competence level of the human driver exceeds the first threshold and exceeds the second threshold;”

96. As discussed above, when R is outside the three ranges indicated in the figure, in particular, when R is below the first threshold (i.e., high driver competence, corresponding to exceeding the '004 Patent's threshold) no corrective action is taken because there is no fault detected in the *Hampiholi-Attard* SDV, so the vehicle continues operating as before. *See*, Claim 1(d).

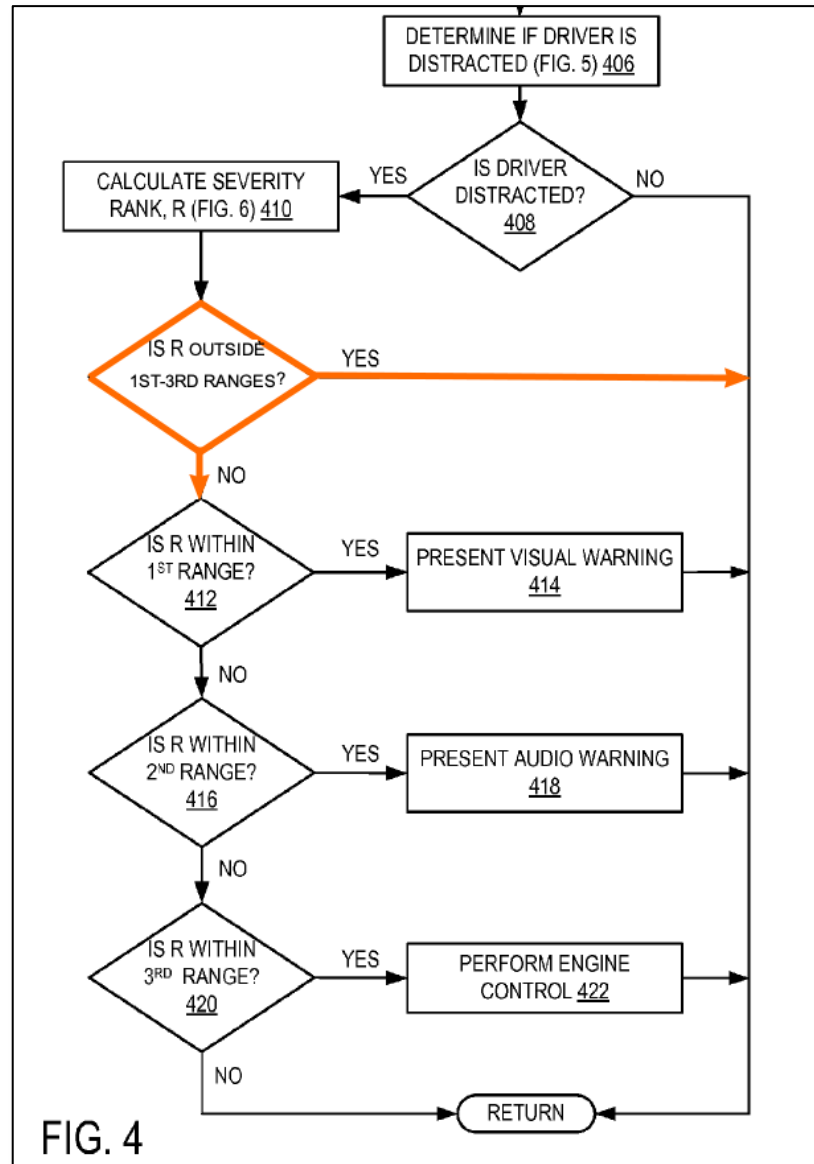
97. In more detail, a POSITA would have understood or found obvious that when the HDCL is outside the three ranges (e.g., the driver is not overly distracted), the *Hampiholi-Attard* SDV would have continued operating in whichever mode the SDV was in, including autonomous mode where the human driver is not required to operate the driver controls. That is, because in *Hampiholi* being *above a first threshold* corresponds to a state in which the driver is not overly distracted (i.e., *Hampiholi* 's severity index, R, is low) and no change occurs, in the *Hampiholi-Attard* SDV, a state in which no change occurs would be the continuation of autonomous driving, i.e., the SDV autonomously controls the drive controls without requiring the human driver to operate the driver controls. Specifically, *Hampiholi* teaches (with regard to Fig. 4) a severity rank R (*human driver competence level*) is calculated when it is determined the driver is distracted, which is then compared to various ranges to determine a corrective action (or no corrective action).



Hampiholi, Fig. 4. Specifically, *Hampiholi* states “[a]lthough three ranges are illustrated in FIG. 4, it is to be understood that any number of ranges...may be analyzed in the performance of method 400” and that “any severity rank outside of the three ranges may correspond to a **low enough severity rank to forego any**

warnings.” *Hampiholi*, [0057]. Logically this aligns with limitation 1(f), though it may not be immediately clear how it is shown in Figure 4.

98. Figure 4 is a flowchart representing how the *Hampiholi* method is performed. At step 406, it is determined that a user is distracted, but additional context regarding the severity of that distraction has not yet been determined. At step 410, the severity rank R is calculated, after which the severity rank is compared to a plurality of ranges for determining the appropriate corrective action. *Hampiholi*, [0057], Fig. 4. However, if the calculated severity rank R is below all of the ranges, the evaluations at each of steps 412, 416, and 420 will be NO, causing the method to proceed all the way down to RETURN at the bottom of the Figure. That is to say, when the competence level of the driver is sufficiently high (R is low, outside any of the ranges), the method returns to its initial state of continued self-driving without performing any corrective action because *no fault has occurred*, as recited in claim 1(f). A modified version of Fig. 4 is shown below, which represents precisely the same behavior as the unmodified, original Fig. 4 from *Hampiholi*, but more clearly shows how Fig. 4 teaches 1(f).



To be clear, this annotated Figure 4 does not directly appear in *Hampiholi* – it is presented merely for clarity and discussion. However, this Figure does represent an identical process to that illustrated in the unmodified Figure 4. If the level of distraction of the driver is “outside” any of the three ranges (where the third range extends all the way to the “maximum possible severity rank,” see *Hampiholi*,

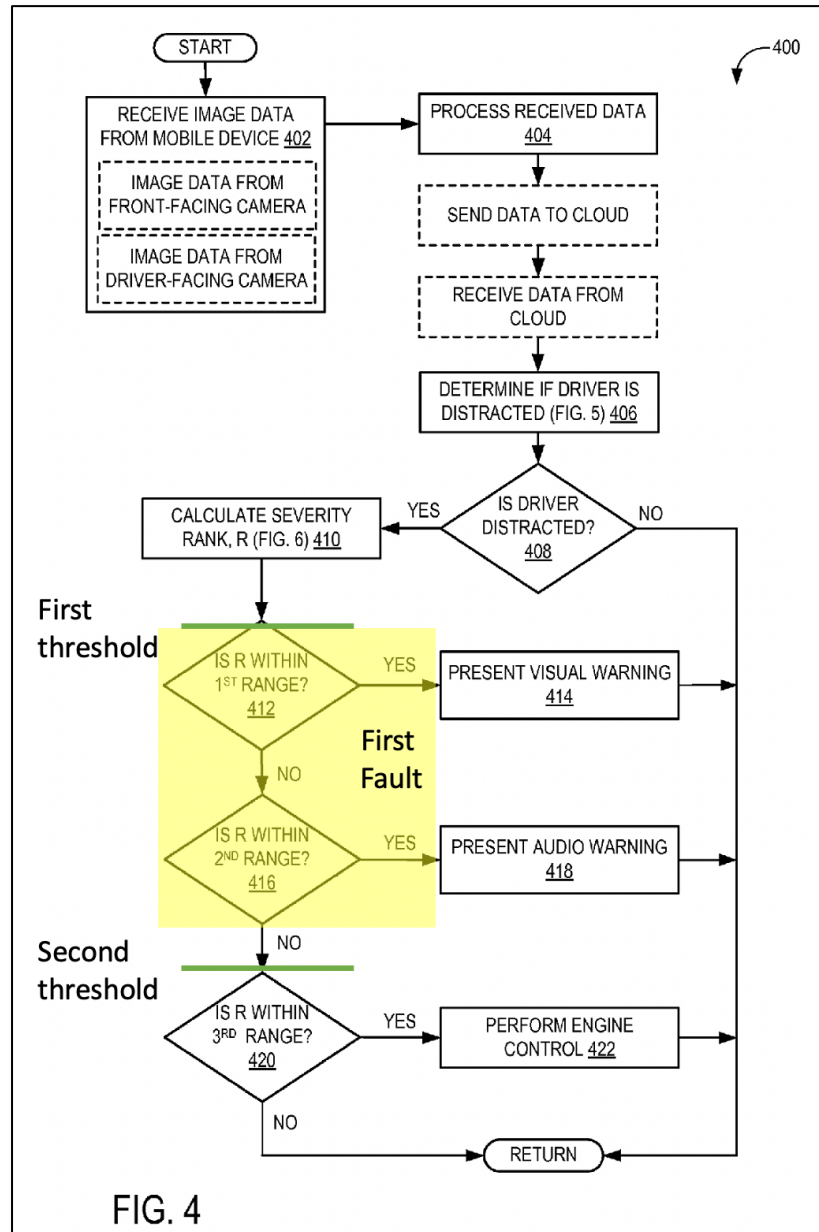
[0057]), the method does not perform any corrective action because no fault has occurred.

99. As discussed above at 1(b), the values in *Hampiholi's* severity rank scale are inverted relative to the '004 (where *Hampiholi's* severity rank R is higher for a less-competent driver and lower for a more-competent driver). However, *Hampiholi's* severity rank R teaches the concept of 1(f) – that no corrective action is performed when the driver is sufficiently competent to not require any corrective action because *no fault has occurred*, which would have specifically resulted in continued autonomous control of the driver controls in the modified *Hampiholi-Attard* SDV. At most, a POSITA would have done basic, straightforward reprogramming and mathematics to invert the internal scale of the vehicle to teach claim 1(f), as explained above regarding 1(b).

100. Thus, in the modified *Hampiholi-Attard* SDV, when the competence level of the human driver (R) is above a first threshold (low enough distraction to not even reach the first range of Fig. 4) the SDV will continue to autonomously control the driver controls without requiring the human driver to operate the driver controls (autonomous driving continues) because there is no fault.

8. Claim 1(g): “determining that a first fault has occurred when the competence level of the human driver exceeds the second threshold and is below the first threshold;”

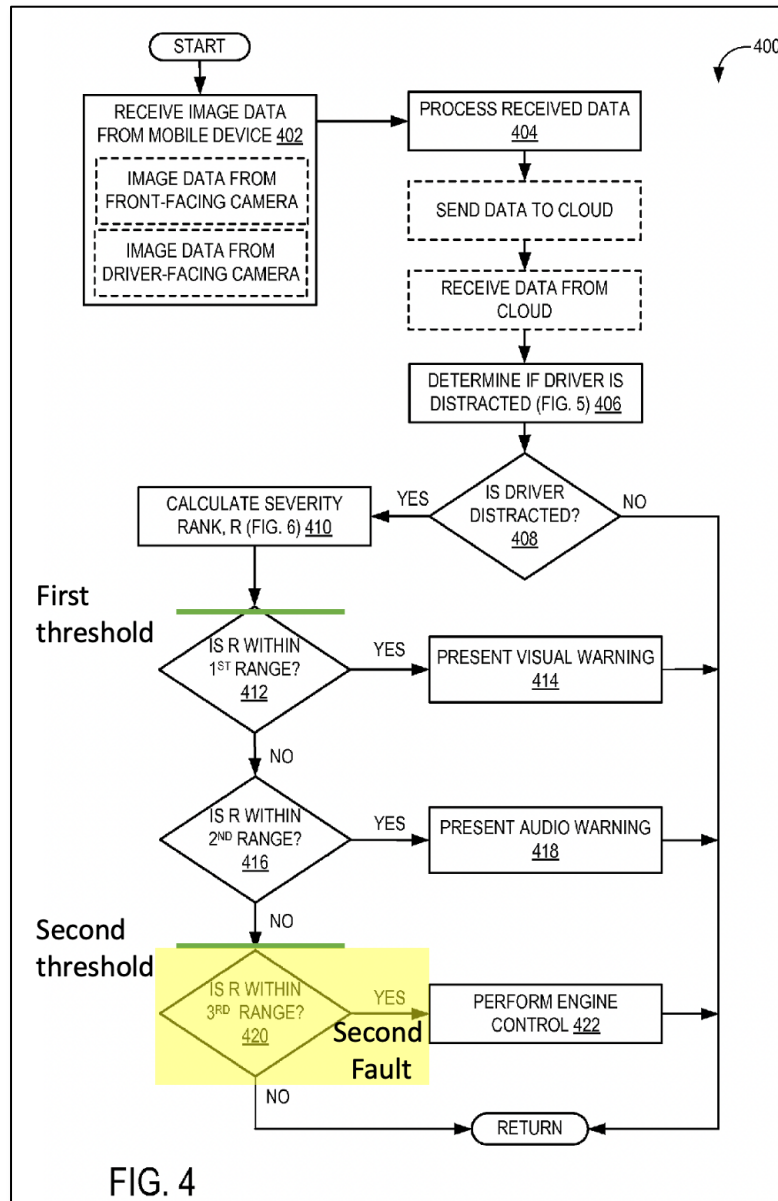
101. When R is between the first and second thresholds (i.e., *exceeds the second threshold and is below the first threshold*, as claimed), then it is determined that *a first fault has occurred* and a corrective action is taken (presenting visual warning AND audio warning 418). A POSITA would have understood that these corrective actions would have been to alert the driver to capture the driver's attention, and that the two ranges shown in the figure would easily have been combined by changing the range boundaries accordingly. The yellow range below indicates R values between the *first* and *second thresholds*.



Hampiholi, Fig. 4, [0056]-[0057].

9. **Claim 1(h):** “determining that a second fault has occurred when the competence level of the human driver is below the first threshold and is below the second threshold;”

102. When severity rank R is below the first and second thresholds (e.g., block 420 – “Is R within 3rd range? – YES”) it is determined that a *second fault has occurred*, and a second corrective action is taken (perform engine control 422).



Hampiholi, Fig. 4, [0056]-[0057].

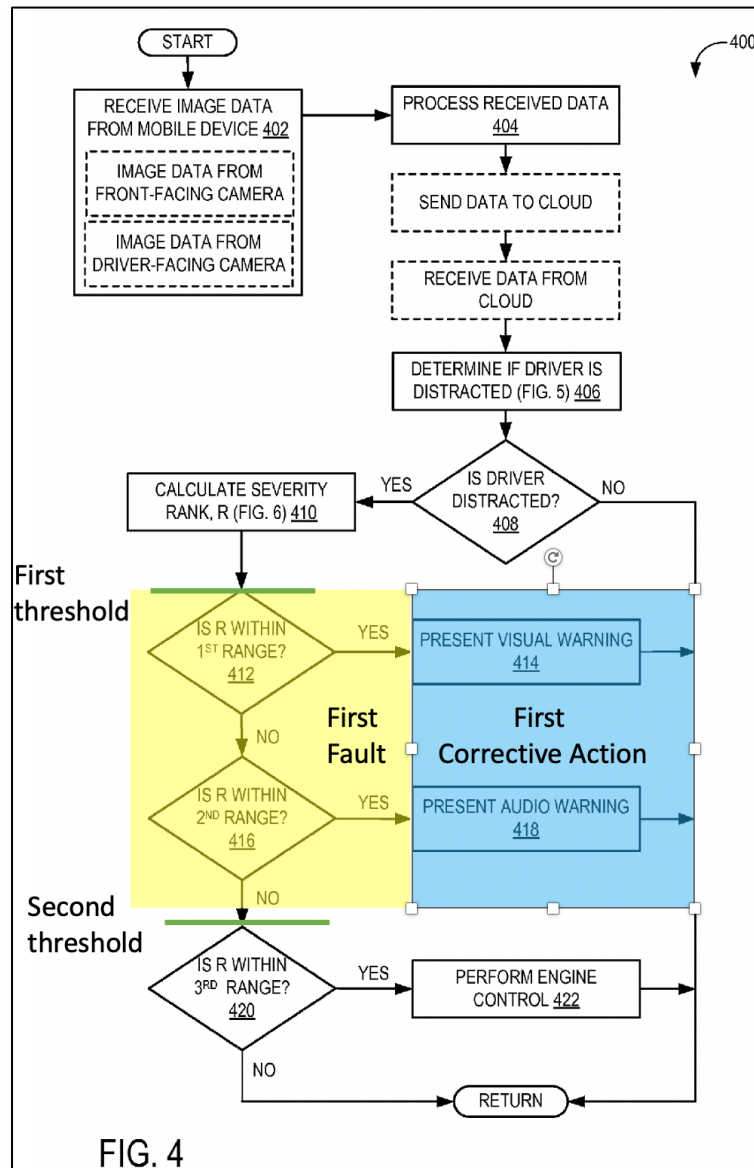
10. Claim 1(i): “determining, using a fault remediation table, a first corrective action associated with the first fault, wherein the first corrective action comprises sounding a warning sound and displaying an icon on a display screen;”

a) *Hampiholi-Attard’s* Corrective Actions

103. *Hampiholi-Attard* teaches faults based on R’s value in relation to various thresholds. See, 1(d)-(h). Further, *Hampiholi* teaches taking corrective actions based on faults. See, 1(g)-1(h) citing *Hampiholi*, Fig. 4, [0056]-[0057]. For example, in one embodiment, *Hampiholi* envisions implementing a visual warning message in response to determining a low R distraction level, an audio warning response to determining a medium R distraction level and controlling engine speed or braking response to determining a high R distraction level. *Hampiholi*, [0057]. However, a POSITA would have understood that *Hampiholi* is not so limited, and that various ranges may be combined or various corrective actions may be taken depending on how the vehicle is programmed. *Hampiholi* expressly teaches that “any number of ranges and associated types of actions may be analyzed in the performance of method 400.” *Hampiholi*, [0057].

104. For example, a POSITA would have understood that combining the first and second ranges into a single range (or reducing a range to 0) where two corrective actions are taken is well-within the scope of *Hampiholi’s* teachings. A POSITA would have been motivated to do so to have a more simplified system as compared to one with a higher number of ranges and separate corrective actions

corresponding to each range. Here, two of *Hampiholi's* ranges would have been combined, thus resulting in a lower total number of ranges. Thus, in this mapping, *Hampiholi's* corrective actions associated with the first fault are sounding a warning sound 418 and presenting a visual warning 414.



Hampiholi, Fig. 4, [0056]-[0057].

105. *Hampiholi* teaches a *display screen* for displaying visual warning 414. *Hampiholi*, [0020]-[0021], [0044], FIG. 1. Further, *Attard* teaches that displayed alerts may be “icons.” *Attard*, 7:33-38. *Attard* further teaches that alerts can be audio, “alternatively or additionally” a graphical interface may be used. *Attard*, 2:59-66. Thus, in the *Hampiholi-Attard* SDV, a first fault triggers a *first corrective action comprising sounding a warning sound and displaying an icon on a display screen*.

b) Motivation to Combine *Hampiholi-Attard*

106. A POSITA would have been motivated and found it obvious to modify *Hampiholi*’s visual warning to include *Attard*’s display icon and further to both display the icon and sound a warning, advantageously increasing the likelihood of obtaining the driver’s attention. A POSITA would have understood that there was a general level of progression for urgency extending from visual icons, to audio earcons, to haptic feedback, and that any (including in combination with each other) or all would be used as appropriate to the situation. For example, a driver may not notice only an icon, but if an alert sound is played and an icon is displayed, the combination of alerts would have been more effective at drawing the driver’s attention to the icon. Further, once the driver views the display to see the warning icon, a driver would have quickly understood the meaning of the warning icon. Additionally, icons conserve space on the display screen relative to purely-textual warnings, motivating the combination to a POSITA. Indeed, icons are utilized

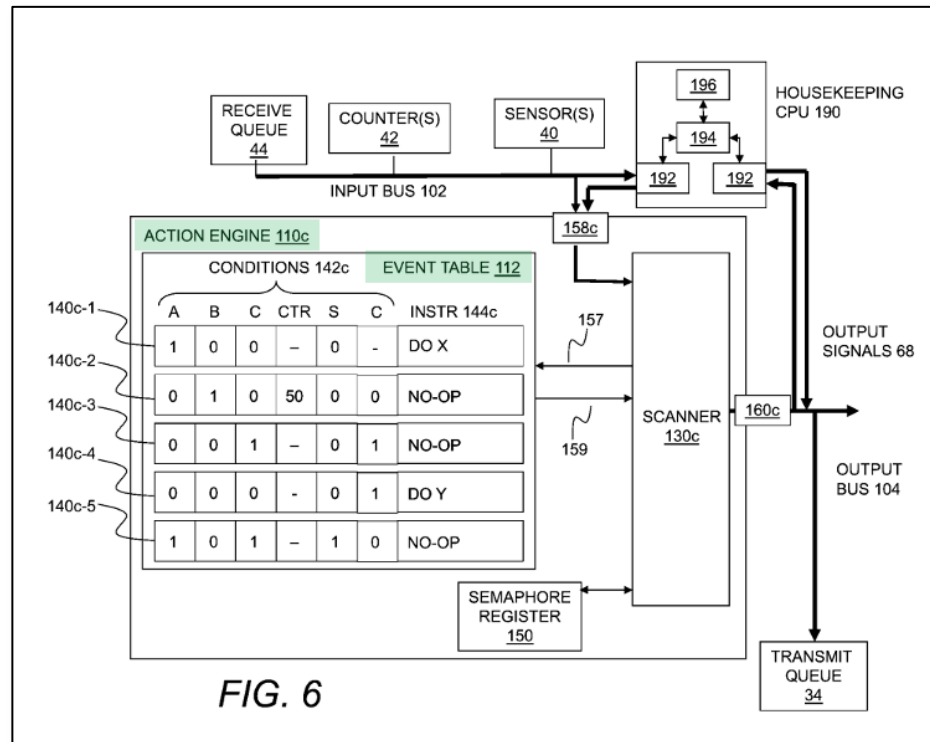
frequently in vehicles as a language-independent way to quickly convey a concept or warning. This use of a known technique would have improved *Hampiholi's* similar vehicle in the same way as *Attard's*.

107. The combination would have had a REOS because *Hampiholi* already teaches a display screen presenting visual warnings, as well as computer hardware and programming instructions. Thus, *Hampiholi* is ready for this improvement, and the modification would have yielded predictable results with a reasonable expectation of success. Similarly, *Attard* teaches an autonomous vehicle and computer hardware and programming instructions, such that modifying *Hampiholi* would have required only modifying programming instructions and/or a display to display an icon per *Attard*. This straightforward modification to programming instructions would have been well-within the skillset of a POSITA, further leading to a reasonable expectation of success.

c) *Frazer* Teaches a Fault-Remediation Table

108. *Frazer* teaches action engine 110c including event table 112 for use with autonomous or semi-autonomous vehicles. *Frazer*, 21:20-32. Event table 112 includes registers (rows 140c-1, 140c-2, etc.) containing sets of conditions 142c and instructions/actions 144c taken when conditions are met. *Frazer*, 21:20-22:22. In more detail, *Frazer* teaches sensors monitoring conditions of a “dynamic environment.” *Frazer*, 21:52-56. If input signals match a condition 142c in event

table register 140c, corresponding action(s) 144c in event table register 140c are executed. *Frazer*, 22:6-22. *Frazer's* event table 112 is depicted below:



Frazer, FIG. 6, 21:19-43.

109. A POSITA would have recognized *Frazer's* event table 112 mirrors the '004 Patent's description of a fault-remediation table. *See*, '004 Patent, 8:27-44 ("fault-remediation table, where each row refers to a fault condition, a first column refers to a condition that gets manifested by that fault, and a second column that refers to the mode in which the vehicle should be driven when that condition is manifested.") compared with *Frazer*, 21:19-43, FIG. 6. Specifically, *Frazer's* rows 140c represent fault conditions, a first column 142c refers to a condition manifested by that fault, and a second column 144c refers to the action to be taken when the

conditions are manifested (“DO X”). I note that *Frazer’s* event table 112 includes five exemplary rows 140c and similarly five instructions 144c (with each row having a corresponding corrective action/instruction), and six exemplary columns 142c. A POSITA would have understood that *Frazer’s* table is merely illustrative and that as many rows and/or columns would have been included as necessary to capture all the various scenarios for faults and corresponding corrective actions according to programming instructions. In some cases, the table may be streamlined with fewer scenarios; while in other scenarios, the table may be enlarged to include more conditions and corresponding corrective actions. It would have been well-within the skillset of a POSITA to modify programming instructions to suit such a design choice.

ACTION ENGINE 110c							
CONDITIONS 142c						EVENT TABLE 112	
	A	B	C	CTR	S	C	INSTR 144c
140c-1	1	0	0	-	0	-	DO X
140c-2	0	1	0	50	0	0	NO-OP
140c-3	0	0	1	-	0	1	NO-OP
140c-4	0	0	0	-	0	1	DO Y
140c-5	1	0	1	-	1	0	NO-OP

Frazer, FIG. 6 (excerpt). I note that here a condition column is annotated green, a fault is a row annotated red, and the column for corrective actions for each fault is annotated purple. In a *Hampiholi-Attard-Frazer* table, rows 140c would indicate particular faults, conditions 142 would indicate conditions related to the faults, and one or more corresponding corrective actions to be taken as a result of the fault occurring.

110. Therefore, because *Frazer's* event table 112 includes faults 140c specified by conditions 142c and actions 144c that are triggered when conditions are met, *Frazer's* event table 112 teaches a *fault-remediation table*. In particular, when a fault occurs, a corresponding corrective action (or multiple corrective actions) is taken per the table, where such a corrective action may be alerting a driver via an icon and/or audio alert and/or transitioning from an autonomous mode to manual mode.

d) Motivation to Combine *Hampiholi-Attard-McNew-Frazer*

111. A POSITA would have found it obvious and been motivated to modify the *Hampiholi-Attard* SDV's fault handling (including determining a corrective action) with *Frazer's* teachings of organizing faults, conditions, and action(s) to take for each fault in event table 112 (*fault-remediation table*), which would have resulted in *determining, using a fault-remediation table, a first corrective action associated*

with the first fault. Indeed, one advantage of utilizing an event table (“fault remediation table”), such as per *Frazer’s* teachings, is to have pre-programmed scenarios ready to go to address any desired scenario that may occur along with the proper action to take. A POSITA would have found it obvious and been motivated to determine which corrective action to take using *Frazer’s* event table to enable easy access and quick determination of actions to take in response to detected faults. Utilizing a well-known table for this operation means the vehicle does not need to come up with a corrective action on-the-fly; rather, the SDV determines there is a fault and looks up what correction action(s) should be taken. A POSITA would have recognized formatting data into a table was well-known to efficiently organize data for retrieval, reference, and potential modification. I note that tables are a widely utilized format for organizing data both electronically in computer systems and even on paper (such as in textbooks and academic journal articles).

112. A POSITA would have appreciated the if/then type of fault remediation data already present in the *Hampiholi-Attard* SDV would have been apt for organizing into a table, concisely and efficiently cross-referencing an array of detectable conditions to quickly determine appropriate responses, improving the safety of the vehicle while reducing its memory requirements compared to an otherwise unorganized list of fault responses. Here, a table is simply an efficient way to organize the faults, conditions, and corrective action(s) to take, where a computer,

e.g., *Hampiholi's* in-vehicle computing system 200, may quickly access the table and find the action that should be taken given the fault and conditions.

113. A POSITA would have understood *Frazer* provides an express teaching, suggestion, and motivation for the combination, stating its action engine “exhibits a significantly low latency...with respect to processing information relating to respective states of the dynamic environment and taking actions in response to same.” *Frazer*, 23:64-67. A POSITA would have been motivated to utilize a solution such as *Frazer's* event table to achieve such low latency for processing related to determining a corrective action to take. Indeed, when a driver is driving an SDV at high speed down a highway, for example, there may be little time before a particular corrective action needs to be taken (such as slowing the vehicle, switching to manual mode, alerting the driver, etc.). Thus, utilizing a fault-remediation table when driving in an SDV such as *Attard's* would have been advantageous for the driver, including by increasing safety.

114. The proposed combination thus applies a known technique (*Frazer* using a fault-remediation table) to *Hampiholi-Attard's* known fault handling method ready for improvement to yield predictable results. Modifying *Hampiholi-Attard* to utilize *Frazer's* table would have been use of a known technique of using a fault-remediation table to group data such as faults, conditions that indicate the faults, and actions to take when the fault conditions are met, and this known technique would

have improved *Hampiholi-Attard's* similar vehicle (including determining a corrective action in response to a fault) in the same way as *Frazer's* vehicle, by using a fault-remediation table, such as taught by *Frazer*. Based on *Hampiholi's* teachings that faults have associated actions (*see, e.g., Hampiholi*, [0056]-[0057]), a POSITA would have looked to references that describe specific ways to associate faults with actions and to store such information in computer memory. A POSITA would have understood that this would have been a well-known practice in the prior art, especially for use in SDVs. This known technique would have improved *Hampiholi-Attard's* SDV (including determining a corrective action in response to a fault) in the same way as *Frazer's* autonomous/semi-autonomous vehicle.

115. Modifying the *Hampiholi-Attard* SDV per *Frazer* would have had a REOS. For example, *Attard* and *Frazer* both teach SDVs, with *Frazer* expressly teaching using event table 112 in autonomous vehicles. *Frazer*, 19:23-30, 21:20-32 (“FIG. 6 shows a system configuration of various components, including an illustrative action engine 110c for monitoring, synchronizing, and/or controlling at least one aspect of a dynamic environment. Examples of such environments with which the system shown in FIG. 6, and particularly the action engine 110c, may be employed include, ... autonomous or semi-autonomous vehicle.”), 21:33-51 (“The action engine 110c includes an event table 112”), *generally* 21:52-22:22. *Hampiholi*, *Attard*, and *Frazer* teach implementing programs and functions using programming

instructions executed by a processor. *Hampiholi*, [0032], *Attard*, 15:12-46 (teaching computer-executable instructions, processor, memory); *Frazer*, 21:20-50 (“The event table 112 and event table registers 140c can be implemented in any suitable type of memory, including but not limited to computer readable storage media such as a volatile or nonvolatile computer memory.”). Modifying *Hampiholi-Attard* would have merely required straightforward changes to programming instructions. Indeed, *Hampiholi* already teaches computer hardware including a processor for executing instructions and memory that stores instructions. *Hampiholi*, [0032] (teaching examples of memory). Thus, a POSITA would have understood or found obvious that the *Hampiholi-Attard* SDV already has the necessary computer hardware for implementing an event table, such as *Frazer*’s.

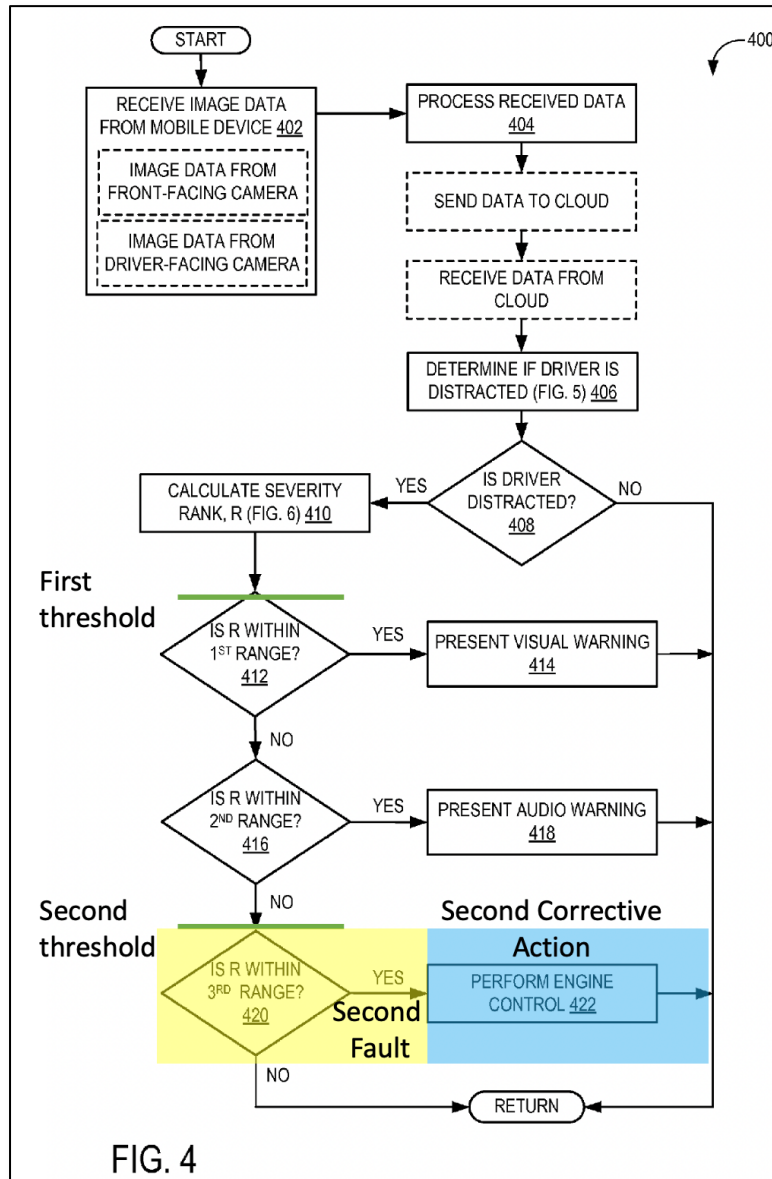
116. Further, a POSITA would have recognized the ease of modifying *Hampiholi-Attard*’s computer and memory to include an event table. *Hampiholi*, *Attard*, and *Frazer* are similar as each describe detecting faults/events based on sensor data. Compare *Hampiholi*, [0031], [0034], [0046] with *Attard* 1:50-52, 12:53-62 with *Frazer*, 21:52-56, 22:31-47. Additionally, both *Frazer* and *Attard* teach applying their systems and methods to an autonomous or semi-autonomous vehicle, such that a POSITA would have had a reasonable expectation of success when modifying *Attard* per *Frazer*’s teachings. See, e.g., *Frazer*, 21:19-22:47. Thus, there

would have been a REOS in modifying *Hampiholi-Attard* to utilize an event table per *Frazer*.

117. To the extent it is argued that *Hampiholi-Attard*'s hardware is insufficient for this modification, a POSITA would have understood that it would have been straightforward to modify the vehicle to include additional memory or processing power as needed, and that this would have been a tradeoff to capture *Frazer*'s advantages. Choosing a tradeoff of more powerful components at the expense of cost would have been a straightforward design choice for a POSITA. In this scenario, a POSITA would not have had to personally swap out hardware components, as that modification would be performed during a vehicle production or modification step by a technician, mechanic, or even a manufacturing robot, for example. In this example, a POSITA would merely select which components are to be used.

11. Claim 1(j): “determining, using the fault remediation table, a second corrective action associated with the second fault, wherein the second corrective action comprises decreasing a speed of the SDV and transferring driver controls to manual control;”

118. *Hampiholi*'s corrective action associated with the *second fault* is performing engine control.



Hampiholi, Fig. 4, [0056]-[0057]; *See*, 1(h). *Hampiholi* teaches engine control operations “include automatically controlling the vehicle speed or braking...” without driver/user intervention, teaching *decreasing a speed of the SDV*. *Hampiholi*,[0057].

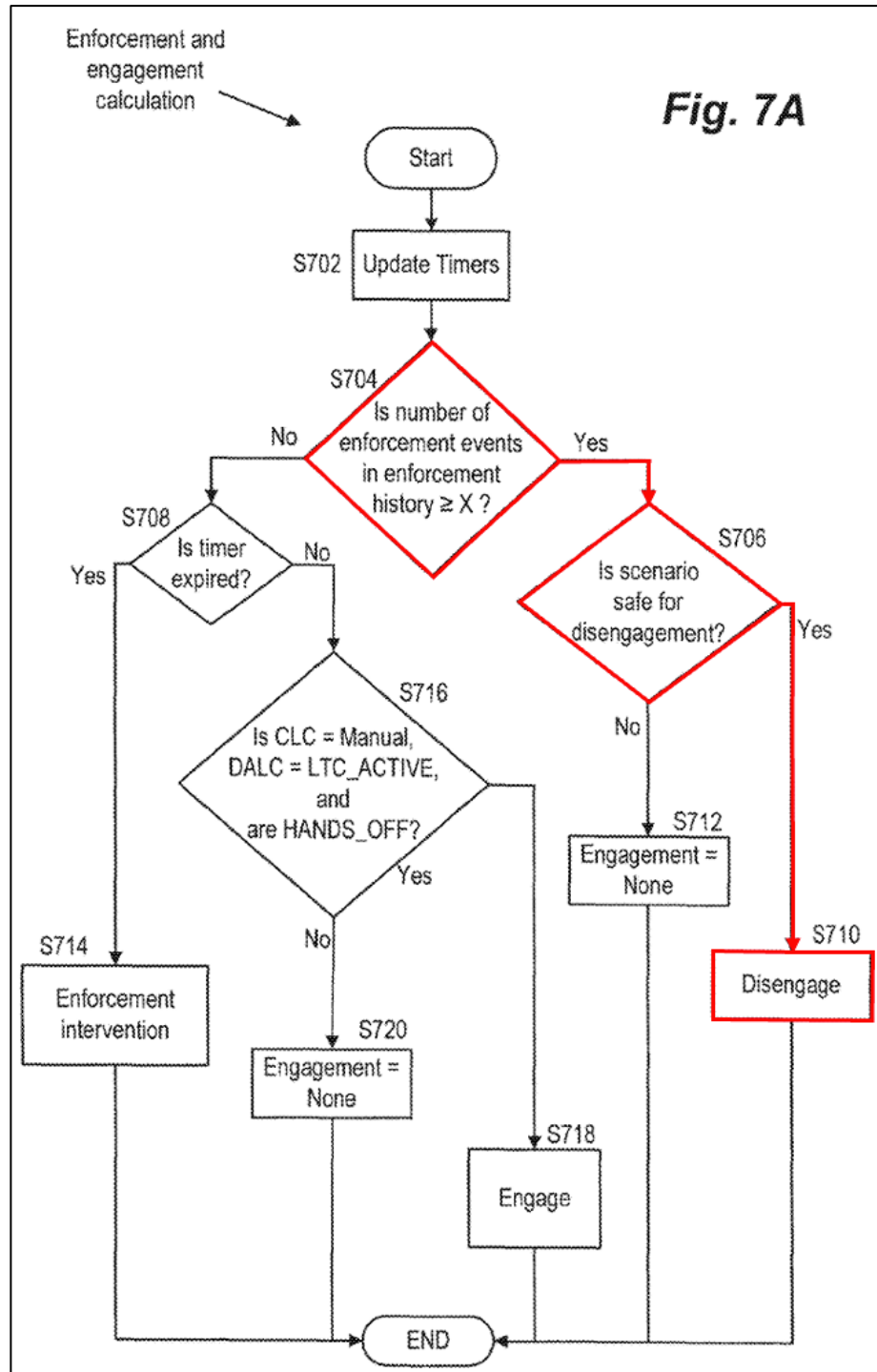
a) **McNew Teaches Transferring Driver Controls to Manual Control**

119. *McNew* teaches managing vehicle control states of a semi-autonomous vehicle (e.g., semi-autonomous, manual) while also managing a driver state (e.g., whether the driver is paying attention to the road). *McNew*, 1:17-21. *McNew*'s vehicle has a semi-autonomous mode manager (SAMM) to manage the control states, including control states of a lane trace control (LTC) system. *McNew*, 3:15-21. The LTC system includes several states, including MANUAL (LTC system is on and sensing, but the driver is in control) and OFF (LTC system is off). *McNew*, 3:59-4:5. *McNew* teaches monitoring driver states (e.g., attention) and taking actions if the driver is not paying sufficient attention, such as warning the driver or reducing vehicle speed, enhancing vehicle/driver safety. *McNew*, 1:17-30, 1:59-65, 6:15-28.

120. In one example, if a driver continues ignoring warnings, *McNew* teaches disengaging the semi-autonomous³ driving system if the current driving scenario is "safe enough." *McNew*, 20:7-31, 4:3-5, 8:41-44. Specifically, *McNew*'s system determines if the semi-autonomous mode should be disengaged due to a

³ *McNew* refers to its system as both "semi-autonomous" and "semi-automatic." *McNew*, 1:7-17, 1:59-65, 6:15-28 (referring to both "semi-autonomous" and "semi-automatic" driving system), 20:7-31. A POSITA would have recognized *McNew* uses these terms synonymously because *McNew* does not provide a distinction between the two terms. I note that "semi-autonomous" is used herein for simplicity.

factor such as driver inattention (Step S704), determines if it is safe enough to disengage the semi-autonomous mode (Step S706), and disengages the semi-automatic driving system by “shutting down the semi-automatic driving system...[where] the LTC system transitions through the CO-STEER and **MANUAL** settings before being turned off[.]” (Step S710). Fig. 7A below depicts Steps S704, S706, and S710, resulting in disengaging the vehicle’s semi-autonomous system and transferring the driver controls to manual control:



McNew, Fig. 7A. Here, annotated Fig. 7A depicts a scenario where the result of steps S704 and S706 are both “yes,” leading to disengaging autonomous operations at step S710. I again note that this disengagement of autonomous mode occurs when it is

safe to do so, as disengaging autonomous mode and transitioning to manual mode when a driver is not ready to take over control of the vehicle would potentially lead to crashes, collisions, or other undesirable outcomes.

b) Motivation to Combine *Hampiholi-Attard-Frazer-McNew*

121. General considerations for combining *McNew* are addressed above. *See*, 1(a). A POSITA would have been motivated and found it obvious to include decreasing a speed and transferring driver controls to manual control as a corrective action in the *Hampiholi-Attard* SDV's event table responsive to the second fault per *McNew*. Such a modification would have enhanced driver safety and increased driver confidence in using an SDV. A POSITA would have understood that in at least some situations, the best option is to decrease vehicle speed, disengage autonomous mode, and allow the driver to take over. Thus, the *Hampiholi-Attard* SDV would have been modified such that a corrective action is taken to decrease speed and transfer driver controls to manual, such as when one or more key sensors for autonomous driving are malfunctioning or severe weather occurs that renders the vehicle incapable of safely driving autonomously, and the vehicle speed is reduced and transitions from autonomous mode to manual mode as a corrective action. I note that braking, as taught by *Hampiholi*, was a highly effective method of alerting and orienting a driver that they need to pay attention and would serve as both an alert

and a notification that the driver needs to take over. *Hampiholi*, [0057] (braking as engine control); *Green* (Ex. 1036), [0037] (pulsing brakes to gain driver's attention), [0106].

122. A POSITA would have been motivated because *Attard* includes a specific suggestion to do so, repeatedly disclosing recommending transferring driver controls to manual. *Attard*, 2:55–3:4. Modifying the *Hampiholi-Attard* SDV in this way would have been use of a known technique of taking particular corrective action(s) (e.g., transition to manual control) responsive to fault(s) and would have improved the *Hampiholi-Attard* similar SDV in the same way as *McNew's*. I note that *Attard*, *Frazer*, and *McNew* all teach SDVs, such that modifying the similar *Hampiholi-Attard* SDV would have been straightforward, such as by making straightforward modifications to programming instructions. Thus, the *Hampiholi-Attard* SDV would have benefited from *McNew's* advantages in the same way as *McNew's* SDV.

123. Further, modifying the *Hampiholi-Attard* SDV per *McNew* would have allowed the SDV to advantageously alert a driver of a need to transition to manual mode, decrease the vehicle speed, and perform the transition to manual mode. Further, *Hampiholi* teaches performing “engine control” (e.g., slowing the vehicle) such that adding an additional corrective action of transitioning to manual mode would have simply been use of a known technique to extend *Hampiholi's* native

engine control teachings to further include transitioning to manual control in the *Hampiholi-Attard* SDV. A POSITA would have understood that in at least some scenarios where it is unsafe to continue autonomous operations, it would have been advantageous to warn the driver, decrease vehicle speed, and actually perform the transition to manual mode. Indeed, in such a scenario, if only a warning is issued but the vehicle does not actually transition out of autonomous mode into manual mode, such would have been unsafe for the driver. Further, slowing/stopping the vehicle alone may not be sufficient in some scenarios, such that transitioning to manual mode would have been advantageous in at least some scenarios, further motivating the combination.

124. A POSITA would have been motivated and found it obvious to include transferring driver controls to manual control as a corrective action for the situation where the driver's distraction level precludes a quick and safe intervention if required. Transitioning to manual mode would have made it clear to the driver that the driver was in control and had to take responsibility for being attentive, and would have allowed a driver to continue driving to their destination manually, or stop driving if the driver chose to stop. Indeed, this modification would have enhanced driver safety and increased driver confidence in using an SDV by knowing that the driver can take over if necessary, and would have enhanced safety for other vehicles on the roadway (indeed, an SDV driving "blindly" would endanger both the driver

and others on the road). Further, while some faults may cause the autonomous mode to be unsafe to utilize (e.g., sensor failures), the vehicle may still be operable in a manual mode, allowing a driver to continue driving in manual mode if the driver feels they are capable. I note this was a common scenario for automated systems even in the 2015 time frame. If the driver could not demonstrate that they were sufficiently attentive to take over on short notice (generally through handling the steering wheel or providing other feedback to the system) the automated systems would cut out for some period of time. For example, the 2013 Mercedes S class advertised that “sensors can detect whether the driver’s hands are actually on the steering wheel. If they are not, a visual warning is issued first. Should the driver fail to react, a warning signal sounds and lateral lane guidance is deactivated.” *Mercedes2013*, 2.

125. A POSITA would have understood that modifying the *Hampiholi-Attard* SDV to include a corrective action such as transferring driver controls to manual control would have had a REOS. *Hampiholi-Attard* and *McNew* teach similar SDVs, and *Hampiholi-Attard* and *McNew* teach SDV hardware (processor, memory) and programming instructions. This modification would have required only straightforward changes to programming instructions. Indeed, *McNew* teaches implementing its system in computer program instructions, and *Hampiholi-Attard*’s SDV includes native manual control, thus making the modification straightforward.

For example, the straightforward changes would have included modifying *Hampiholi-Attard-Frazer's* event table to include decreasing vehicle speed and transferring driver controls to manual control as a corrective action. Modifying programming instructions would have been well-within the skillset of a POSITA. Additionally, *Attard* expressly contemplates transition to manual control and teaches vehicle 101 is manually drivable, such that a POSITA would not have had to modify vehicle 101 to be able to drive using manual control. *Attard*, 2:55-3:4. In particular, I note the SDV already is capable of driving manually, such that modifying *Hampiholi-Attard* per *McNew* would not have required installing driver control mechanisms such as a steering wheel or brake pedal that are needed for a driver to drive in manual mode. Finally, *McNew* teaches it is advantageous to pump the brakes (decrease vehicle speed) to gain the driver's attention. *McNew*, 8:10-14. ("[T]he SAMM can send speed enforcement control signals to lower the ACC speed to a level that may be uncomfortable to the driver or pump the breaks [*sic*] in order to encourage the driver to acknowledge the warning."

12. Claim 1(k): "autonomously controlling the driver controls without requiring the human driver to control the driver controls when no fault has occurred, wherein the driver controls comprise: engine throttle, steering mechanism, and braking system;"

126. If no fault is detected in the *Hampiholi-Attard* SDV, it operates autonomously per *Attard*. See, 1(d), 1(f).

127. Specifically, *Attard's* SDV operates “steering, braking, and speed” autonomously via autonomous driving module 106 in computer 105. *Attard*, 9:63–10:12, 14:13-48. A POSITA would have understood or at least found obvious that controlling vehicle “steering” teaches controlling “steering mechanism;” controlling vehicle “braking” teaches controlling “braking system;” and controlling vehicle “speed” teaches controlling “It is established fact that the vehicle’s speed is controlled via the throttle, which controls the fluid flow into the engine, and in a typical non-self-driving vehicle, is controlled by the driver actuating the gas pedal.” *See, e.g., Takada* (EX. 1035), 1:13-25. A POSITA would have recognized or at least found obvious that controlling the vehicle’s “steering” teaches controlling its “steering mechanism.” Similarly, a POSITA would have recognized that *Attard's* description of controlling its “speed” teaches controlling its “engine throttle,” as claimed, because the vehicle’s engine throttle would have been adjusted to increase the thrust of the engine to result in an increase in the vehicle’s speed. Additionally, *Attard's* description of controlling its “braking” would have been done via its braking system at least including the vehicle’s brakes, and thus *Attard* teaches controlling its “braking system,” as claimed.

128. A POSITA would have understood or found obvious that because *Attard* teaches a vehicle operable in manual and autonomous modes and *Attard* defines an autonomous vehicle as being “operated wholly ... without human

intervention, i.e., ... autonomous” and its vehicle computer making “decisions concerning vehicle speed, course, etc.,” that *Attard’s* vehicle would have included autonomous control of vehicle controls performing these functions, including changing the vehicle’s speed (engine throttle and braking) and direction (steering mechanism). *Attard* expressly envisions that its vehicle “may be operated wholly or partly without human intervention,” relying on its central computer to “operate the vehicle, e.g. to make decisions regarding vehicle speed, course etc.” *Attard*, 1:15-24. A POSITA would have recognized that a vehicle operably performing this function would have autonomously controlled the engine throttle, steering mechanism, braking system, and navigation driver controls.

129. In specific examples, *Attard’s* vehicle may take autonomous actions such as a “slow to a stop,” “pull over and stop,” or “limp home” operation. *Attard*, 2:46-54. A POSITA would have recognized each of these autonomous operations would have required control of the engine throttle, steering mechanism, and braking system as recited in 1(k). Stopping requires control of the engine throttle, and braking system and pulling over requires control of the steering mechanism and brakes, while “limp[ing] home” would have additionally required controlling steering. Though *Attard* does not explicitly use the term “*engine throttle*,” a POSITA would have recognized *Attard’s* description of a vehicle autonomously controlling its speed to teach the claimed “*engine throttle*.”

a) Motivation to Combine

130. A POSITA would have been motivated to modify *Hampiholi* per *Attard's* teachings regarding autonomously controlling the *driver controls* in the *Hampiholi-Attard* vehicle to provide an SDV operable to provide additional convenience and safety afforded by *Attard's* autonomous features in *Hampiholi's* vehicle that is already intended to increase the safety of the driver, and this modification would have had a REOS. A POSITA would have recognized that a vehicle which is capable of taking over control and self-driving through dangerous situations would have been safer than a vehicle unable to do so and would have resulted in a more-desirable vehicle to consumers. *See*, Section VIII.A (Claim 1 introduction).

131. Such a modification is merely the combination of known prior art elements (*Attard's* sensors and controls) according to known methods to yield predictable results of a car autonomously performing corrective actions such as “limp home.” Further, these modifications would have been use of known technique of applying various vehicle hardware and software to enable additional self-driving functionality in the *Hampiholi-Attard* vehicle and would have improved *Hampiholi* and *Attard's* similar vehicles in the same way – by allowing the vehicle to autonomously drive when no fault has occurred, and to detect when such conditions occur. While this modification may add additional complexity to *Hampiholi's*

vehicle, a POSITA would have been motivated to make such a tradeoff to achieve *Attard's* benefits. A POSITA would have appreciated that self-driving vehicles increase driver, passenger, and bystander safety, furthering *Hampiholi's* intended purpose. *Hampiholi*, [0002]. *Attard* expressly extols the benefits of incorporating its system utilizing a CPCL (Φ), explaining that “mechanisms are needed for evaluating a computer’s ability to autonomously operate the vehicle, and for determining an action or actions to take when one or more faults are detected” such as “determin[ing] a safe stopping location,” leading a POSITA to a motivation to combine *Attard's* methods and supporting systems into *Hampiholi's* vehicle, to result in a self-driving vehicle. *Attard*, 1:21-24, 14:27-48. A POSITA would have been aware that SDVs provide desirable features to users, benefitting sales of the vehicles while improving safety. Autonomous driving functionalities allow users to be more relaxed while driving and reduce the likelihood of accidents borne of human error.

132. A POSITA would have had a REOS for the combination at least because *Hampiholi* already includes an engine throttle, steering, and braking, and the processor and memory necessary for performing automatic functions; *Attard* is merely used to teach autonomous control of these driver controls. *Hampiholi* calls out its GPS sensor, navigation system, brake input, gas pedal input, engine speed, and steering wheel controls. *Hampiholi*, [0031], [0041]. Methods of autonomously

controlling the *driver controls* were known, and the predictable result would have been an SDV better suited to respond to unsafe driving situations, including driver distraction, as taught by *Hampiholi. Id.*

13. Claim 1(l): “taking the first corrective action when the first fault has occurred; and”

133. *Hampiholi-Attard-McNew-Frazer* teaches this limitation. See, 1(g), 1(i).

14. Claim 1(m): “taking the second corrective action when the second fault has occurred.”

134. *Hampiholi-Attard-McNew-Frazer* teaches this limitation. See, 1(h), 1(j).

IX. GROUND 2: CLAIMS 2-5 ARE OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, DERUYCK, GUNDERSON, AN, KANG, AND SCHUNDER

A. Claim 2

1. Claim 2(a): “The computer program product of claim 1, further comprising: determining the competence level of the human driver comprises using a weighted voting system with a first plurality of inputs and a first plurality of weights, wherein:”

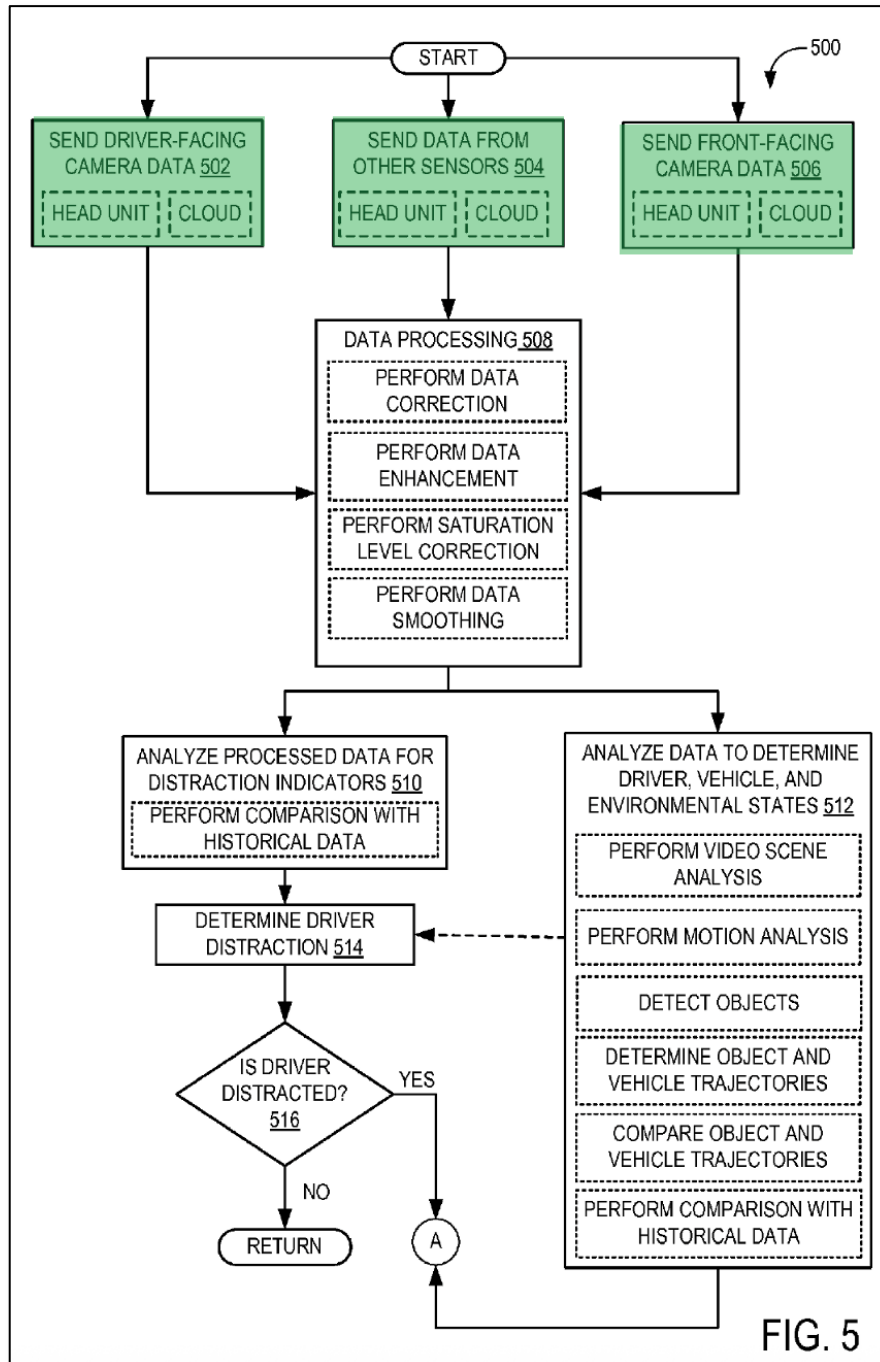
a) '004 Patent's Weighted Voting

135. The '004 Patent describes weighted voting with inputs, where an “input’s weight (w) is the number of ‘votes’ associated with the input.” *'004 Patent*, 8:58-9:1.⁴

b) *Hampiholi’s Inputs*

136. *Hampiholi* teaches sensors inputs, i.e., *a first plurality of inputs* for determining R (HDCL). *See*, 1(a)-(b). For example, these *inputs* would include the driver-facing camera data 502, the other sensor data 504, and/or/ the front-facing camera data 506.

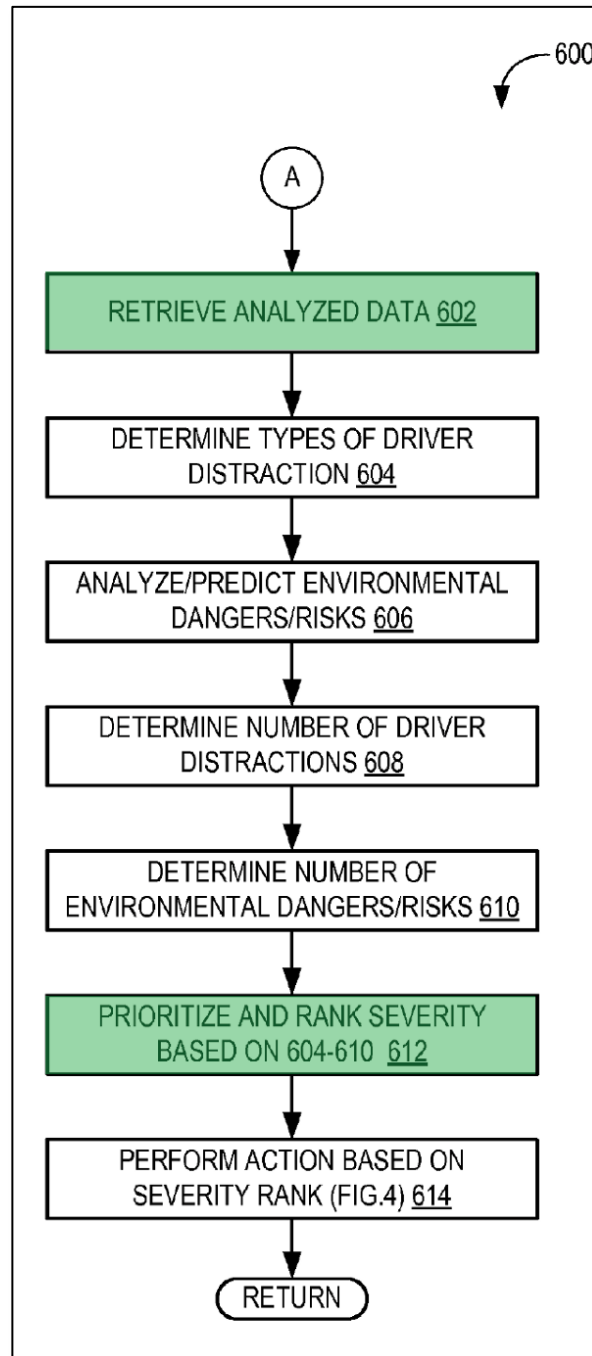
⁴ While the '004 Patent also describes a quota is sometimes utilized in a weighted voting system, “quota” is not recited in Claim 2. *'004 Patent*, 8:58-9:1, Claim 2.



Hampiholi, FIG. 5.

137. As shown in FIG. 6, *Hampiholi* teaches “the analyzed data from FIG. 5 may be retrieved” to determine severity rank R, and the analyzed data “may include the data from the driver-facing camera, the data from other sensors, and the data

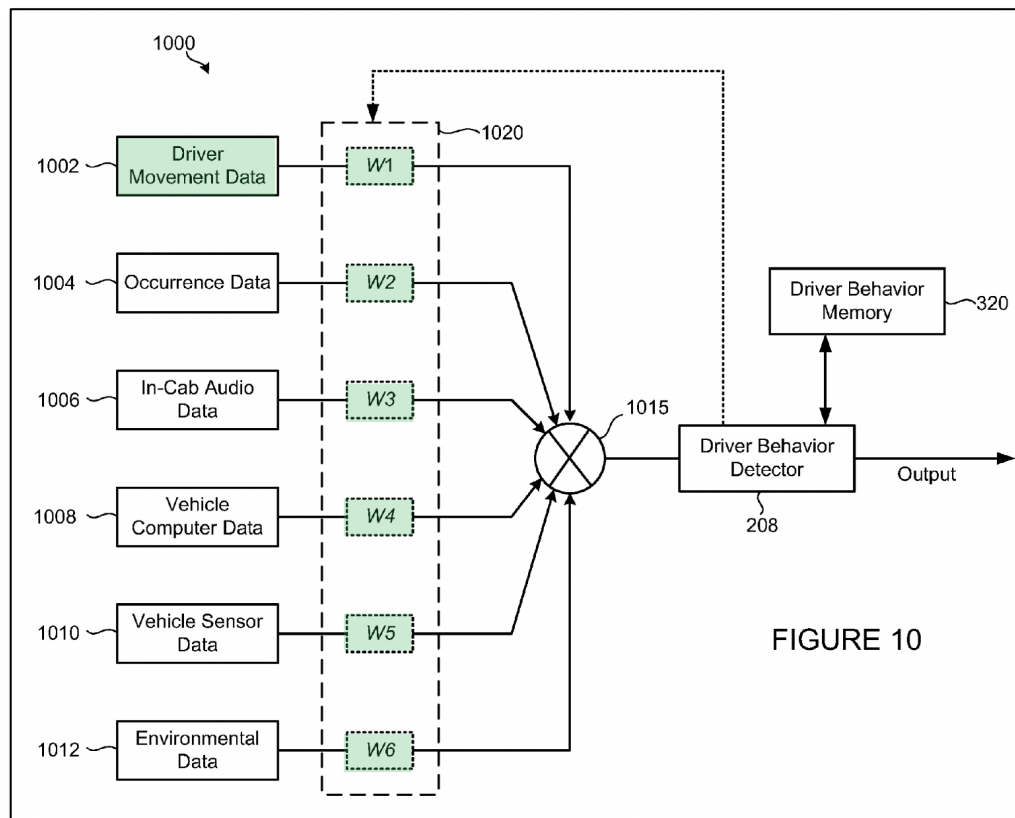
from the front facing-camera that are further processed and analyzed.” *Hampiholi*, [0065].



Hampiholi, FIG. 6. Therefore, because *Hampiholi*’s data 502, 504, 506 are used for computing R, this data is a *plurality of inputs*.

c) DeRuyck's Inputs and Weights

138. Like *Hampiholi*, *DeRuyck* teaches *determining a competence level of a human driver* by analyzing driver behavior. *DeRuyck*, 3:50-52. *DeRuyck* further teaches a *weighted voting system* to determine driver behavior that uses *a plurality of weights* to weigh data sources (e.g., *inputs*), including driver movement data 1002. *DeRuyck*, 13:21-41, 12:2-8, 14:9-31, 17:50-18:21, 18:58-19:2. The data sources are weighted, summed, and then passed to driver behavior detector 208:



DeRuyck, Fig. 10.

139. *DeRuyck*'s driver movement data 1002 comprises sensor readings from a camera sensor. For example, cameras 222 and/or 222a are positioned to monitor

driver behaviors. *DeRuyck*, 8:46-61, 20:7-34, 6:19-41, 6:57-67, 13:21-41, 15:2-7, 23:26-43, 24:21-56, 26:4-28, 3:20-22, Figs. 19, 21, 23. *DeRuyck* teaches “[o]ne or more second in-cab cameras 222a can be mounted...and directed toward the driver and/or passenger within the cab,” which can be used to detect “[e]vidence of a driver behavior event of interest” such as “driver movements that show an electronic device in view of, or being held by, the driver.” *DeRuyck*, 24:42-49, 15:55-62. Such “driver facing cameras” were a standard vehicle feature generally known as “driver monitoring systems.” Thus, driver movement data 1002 captured by a camera (e.g., 222a) is weighted by a weight 1020, summed by summer 1015, and analyzed by driver behavior detector 208. *DeRuyck*, 20:7-34.

d) Motivation to Combine with *DeRuyck*

140. A POSITA would have been motivated and found it obvious to modify the *Hampiholi-Attard* SDV per *DeRuyck*'s teachings of determining a competence level of a human driver using a weighted voting system including a plurality of weights to weight *Hampiholi*'s inputs to enable a more nuanced treatment of the driver's behavior to determine R. That is, a POSITA would have appreciated the benefits of applying weights to inputs for determining R such that data that is less important or pertinent to the driver's distraction is given a lesser weight than data that is more important or pertinent to how distracted the driver is. As such, modifying the *Hampiholi-Attard* SDV per *DeRuyck* would have advantageously provided

additional, more flexible functionality for determining R beyond *Hampiholi's* teachings focusing on eye and head position (although *DeRuyck* also teaches such). *Hampiholi*, [0050] (disclosing leveraging head and eye position for determining the level of distraction), [0062] (eyelids), [0063] (pulse); *DeRuyck*, 4:50-55, 5:36-51.

141. Indeed, modifying the *Hampiholi-Attard SDV* in this way would have enhanced *Hampiholi's* native driver distraction monitoring to include driver movements per *DeRuyck*. For example, a POSITA would have appreciated the benefits of leveraging data such as cell phone use, watching videos, or reading, per *DeRuyck*, in determining R. *DeRuyck*, 5:36-51. This would have been use of a known technique of determining HDCL using weighted voting and readings from cameras that would have improved the *Hampiholi-Attard SDV* in the same way as *DeRuyck's* vehicle, i.e., by improving driver safety and awareness, as *DeRuyck* teaches. *DeRuyck*, 3:50-63, 8:46-61. Further, this modification would have combined prior art elements according to known methods per *DeRuyck* to yield predictable results in the modified *Hampiholi-Attard SDV*. Specifically, this modification would have predictably improved the *Hampiholi-Attard SDV* by increasing the driver distraction data available for computing R, leading to a driver distraction system that can account for more distraction events, such as cell phone or other device use.

142. A POSITA would have had a REOS when modifying the *Hampiholi-Attard SDV* per *DeRuyck* because *Hampiholi* already teaches identifying various

driver characteristics using sensors such that modifying the *Hampiholi-Attard* SDV would have required straightforward changes to programming instructions. For example, each of *Hampiholi*, *Attard*, and *DeRuyck*, teach implementing their teachings in computer program products. *Hampiholi*, [0032]; *Attard*, 15:12-46; *DeRuyck*, 27:3-28.

2. Claim 2(b): “the first plurality of inputs comprises one or more of the sensor readings;”

143. See, 1(a).

3. Claim 2(c): “at least one of the first plurality of inputs is multiplied by a weight from among the first plurality of weights, wherein the first plurality of weights are based on first active learning data, the first active learning data comprising information about a first cohort of human drivers of other SDVs;”

144. *DeRuyck* teaches multiplying inputs by weights. See, 2(a). *Gunderson* teaches weights based on active learning data that includes information about a cohort of human drivers of other SDVs.

a) Gunderson’s Active Learning Data

145. *Gunderson* teaches vehicle 10 and event capture device 20 (e.g., camera) for determining driver behaviors. *Gunderson*, [0030]. Further, *Gunderson* teaches event detector 30 in combination with event capture devices 20 “identifies an event and stores certain audio and video data along with related information about the event.” *Gunderson*, [0032]. *Gunderson* focuses both on monitoring the driver as

well as sensors for detecting conditions outside of the vehicle. *Gunderson*, [0034], [0038]. Data regarding event 150 is stored locally until being provided to evaluation server 50. *Gunderson*, [0040]-[0045]. Evaluation server 50 includes insight module 270, which aggregates event data into a database and correlates the data to identify trends in driving behavior that relate to risk factors and generates a driver rating/score for a driver. *Gunderson*, [0056], [0059].

146. Insight module 270 compares correlations and driver safety trends with historical event information to provide a driver rating/score for an individual driver. *Id.* Insight module 270 includes individual module 400 and group module 410. *Gunderson*, [0060], Fig. 10. Individual module 400 analyzes event data for an individual, and scoring module 420 applies scoring regarding risk factors (e.g., changing lanes without signaling). *Gunderson*, [0061]. Group module 410 analyzes event data for a group of drivers and “assign[s] relative weights to the risk factors depending on their prevalence to the group as a whole.” *Gunderson*, [0060]. For example, a tendency of not utilizing a turn signal before changing lanes appears in only one driver out of ten, reducing that tendency by 90 percent when applied to the group. *Id.*

147. Group module 410 provides its information to scoring module 420, similar to the process done with individual module 400. *Gunderson*, [0062]-[0064]. The scoring module 420 “analyzes the various driver tendencies and risk factors and

correlates those tendencies and risk factors with aggregate information about driver tendencies and risk factors.” *Gunderson*, [0064]. Thus, scoring module 420 computes “an individual driver score or a collective driver score for a group of drivers based on individual driver tendencies and characteristics and other information about the drivers.”

148. A POSITA would have understood or found obvious that weighting driver behaviors in this way teaches *weights based on...information about a first cohort of human drivers of other SDVs*. Further, a POSITA would have understood such to advantageously allow for “a more granular and accurate group driving score.” *Gunderson*, [0007], [0062], [0079]. That is, a POSITA would have found it obvious that taking into account the behavior of a group of drivers (i.e., *a cohort*) to determine appropriate weights to apply to inputs would have provided a more accurate human driver competence level determination. Specifically, and as expressly envisioned by *Gunderson*, one driver may have a behavioral tendency not shared by other drivers in a group such that behavior is not as highly weighted because it has less importance to the driver cohort as a whole. *Gunderson*, [0062]. Thus, *Gunderson* teaches *weights based on first active learning data...comprising information about a first cohort of human drivers of other SDVs*.

b) Motivation to Combine *Gunderson*

149. A POSITA would have been motivated and found it obvious to modify the *Hampiholi-Attard* SDV per *Gunderson* to base a *first plurality of weights* on *active learning* data that includes information about *a cohort of human drivers of other SDVs*. A POSITA would have found it obvious, been motivated, and recognized the benefits of using a weighted voting system where the weights are based on data from other drivers, per *Gunderson*, to increase the accuracy/flexibility of the human driver competence computation. This use of a known technique would have improved the *Hampiholi-Attard* SDV in the same way as *Gunderson* by advantageously using more accurate weights when computing R. Further, by using weights from other drivers, the competence level computation would change over time if the behavior of the driver's changed over time, which would have been advantageous in ensuring the competence level is not determined based on dated information/driver trends. In addition, competency signals for a driver may change seasonally (lower speeds in snow) or geographically (e.g., people drive differently in Boston than Colorado). For example, *Gunderson* teaches negative tendencies may be relatively uncommon among drivers, and the *weights* may be set to account for such behaviors. Thus, driver behaviors trends among a group of drivers can be identified to accurately weight such trends. Further, with historical event information for a particular driver, a driver's behavior may be analyzed for safety issues over time and weighted accordingly as previously described.

150. Modifying the *Hampiholi-Attard* SDV per *Gunderson* would have had a REOS. *Hampiholi-Attard* already includes hardware necessary to perform *Gunderson's* steps, including *Hampiholi's* sensors, processor, memory, and programming instructions. *Hampiholi*, [0032], [0058]. *Gunderson*, likewise, teaches implementing its functionality using a processor and programming instructions. Specifically, *Gunderson* teaches computer executable code stored in a main memory 756 that “when executed, enable[s] the computer system 750 to perform the various functions of the present invention.” *Gunderson*, [0099], *see also*, [0088]-[0105] (detailing the computer system 750 including processors 752 and computer readable media), FIG. 14. Thus, modifying the *Hampiholi-Attard* SDV per *Gunderson* would have required only straightforward changes to programming instructions well-within the skillset of POSITA.

4. Claim 2(d): “determining the competence level of the SDV comprises using the weighted voting system with a second plurality of inputs and a second plurality of weights, wherein:”

a) Attard's Weighting Teachings

151. *Attard* teaches determining a CPCL Φ using collected data 115 from sensors 110, i.e., *a second plurality of inputs*. *See*, 1(c). *Attard* also teaches weighting sensor determinations when computing Φ , i.e., *a weighted voting system*. For example, *Attard* teaches weighting determinations of collected data 115 from sensors 110 based on factors including precipitation, road conditions, and

environmental conditions to generate confidence assessments about the ability of vehicle 101 to operate autonomously. *Attard*, 6:28-35. A POSITA would have understood or found obvious that “when weighting various determinations,” *Attard*’s weights would have been multiplied by *inputs* (e.g., collected data 115) to yield weighted results for generating confidence assessments. As discussed above, *Attard*’s confidence assessment Φ is a CPCL. *See*, Claim 1(c). Thus, a POSITA would have understood or found obvious that *Attard* teaches determining CPCL Φ using a weighted voting system. Furthermore, weighting sensor values to determine whether a vehicle should be driven autonomously (e.g., to determine a control processor competence level) was well known. For example, *An* (Ex. 1008) teaches computing an “autonomous driving state risk index” that indicates “whether basic autonomous driving is possible,” and that weights sensor readings, including “GPS reception error, a lane recognition error, an obstacle recognition error...” *An*, 5:66-6:17, Eq. 7; *see also*, *Chandra* (Ex. 1034), 2:25-3:19 (describing a weighted voting system for vehicles). To the extent it is argued *Attard* does not teach a *weighted voting system*, *An* teaches such.

b) *An*’s Teachings

152. *An* teaches “cooperative autonomous driving...between a vehicle and a driver.” *An*, 1:16-23. An “autonomous driving state risk index” is computed that

indicates “whether basic autonomous driving is possible in the driving environment.” *An*, 5:64-6:2.

$$\begin{aligned} \text{autonomous driving state risk index} = & W1 * \text{recognition} \\ & \text{error} + W2 * \text{determination error} + W3 * \text{control} \\ & \text{error} + W4 * \text{map data error} \end{aligned} \quad (7)$$

153. *An*, 6:4-8, Eq. 7. The index “is calculated by multiplying weights W1, W2, W3, W4” by the respective errors. *An*, 6:8-24. Each of *An*’s errors is an input because each is used (*input*) to the risk index equation to determine the index value. To state another way, each error is a parameter, i.e., an *input*, for the risk index equation. In the *Hampiholi-Attard* SDV, *inputs* include *Attard*’s camera sensor readings, which are weighted per *An*. Because *An* teaches multiplying inputs by weights, *An*’s index teaches a *weighted voting system*.

c) Motivation to Combine *An*

154. A POSITA would have been motivated and found obvious to modify *Attard*’s Φ computation, per *An*’s teachings of weighting inputs to determine whether to drive autonomously, thereby yielding the predictable result of Φ being computed by weighting the various inputs (sensor determinations). A POSITA would have recognized the similarities between the *Attard*’s Φ computation and *An*’s autonomous risk state index and, as such, would have been motivated to modify *Attard*’s Φ , per *An*, to gain the benefits of weighting inputs (i.e., improved

accuracy/flexibility) as taught by *An*. Compare *Attard*, 5:58-6:3 with *An*, 5:64-6:2. *Attard* provides an express teaching, suggestion, and motivation for combining with *An* by teaching “weighting various determinations” for computing Φ . *Attard*, 6:28-35. Using the known technique of weighted voting would have improved *Attard*’s similar system in the same way as *An*’s by providing greater accuracy in computing Φ . That is, based on *Attard*’s weighting disclosure, a POSITA would have been motivated to turn to references that detail how to weight a determination of whether to drive autonomously, e.g., *An*. This use of a known technique would have improved the *Hampiholi-Attard* SDV in the same way as *An*’s SDV.

155. A POSITA would have had a REOS at least because (a) weighting inputs was well-known prior to the ’004 Patent, and (b) modifying *Hampiholi-Attard* would have required only straightforward programming modifications to multiply *Attard*’s determinations by weights, per *An*. Further, it was well known to a POSITA to weight different equation inputs such that the inputs have more or less importance. For example, and while not expressly taught by *An*, a POSITA would have recognized that if *An*’s control error was a less important factor than the recognition error in the ability to drive autonomously, the weight W3 applied to the control error would have been less than the weight W1 applied to the recognition error. For example, it would have been a straightforward modification and within the skillset

of a POSITA to modify *Attard* to store weights, per *An*, in memory, such as in a lookup table.

5. Claim 2(e): “the second plurality of inputs comprises one or more of the sensor readings;”

156. See, 2(d). *Attard*’s second plurality of inputs comprises collected data 115 (sensor readings).

6. Claim 2(f): “the second plurality of inputs comprises at least one sensor reading that is not in the first plurality of inputs;”

157. The *first plurality of inputs* is from *Hampiholi*’s driver-related sensors, and the *second plurality of inputs* is from *Attard*’s SDV sensors such that the *second inputs* include a *sensor reading* not in the *first inputs*. See, 2(a), 2(e). For example, *Hampiholi*’s *inputs* include data from the driver-facing camera, while *Attard*’s *inputs* include data from external cameras; thus, the *sensor reading* from *Attard*’s external camera is not in the *first plurality of inputs*, i.e., is not used for computing *R*.

7. Claim 2(g): “the first plurality of inputs comprises at least one sensor reading that is not in the second plurality of inputs; and”

158. See, 2(f).

8. Claim 2(h): “at least one of the second plurality of inputs is multiplied by a weight from among the second plurality of weights, wherein the second plurality of weights are based on second active learning data, the second active learning data comprising condition data from a second cohort of other SDVs, wherein the condition data shares one or more traits with a current condition of a roadway on which the SDV is currently traveling.”

159. *An's* weights W1-W4 are not expressly taught as based on active learning data...compris[ing] condition data...wherein the condition data shares one or more traits with a current condition of a roadway on which the SDV is currently traveling. *Kang* teaches such.

a) *Kang's* Weights

160. *Kang* teaches vehicle 1 includes a road and weather information collecting unit 135 that obtains weather information (*weather condition data*) from an external source based on the vehicle's GPS information or using onboard sensors. *Kang*, 9:32-49. *Kang* teaches weather information collecting unit 135 obtains weather information from an external source (e.g., Internet) based on the vehicle's GPS information. *Kang*, 9:32-49 ("obtains rain or snowfall information from current location information transmitted from the GPS and weather information provided from the Internet."). Alternatively, *Kang* teaches vehicle 1 uses onboard sensors to obtain weather information. *Id.* ("obtains rain information based on detection information transmitted from the rain sensor.").

161. *Kang* teaches a plurality of weights based on the type of weather condition, such as weighting clear weather 1, rain 2, and snow 3. *Kang*, 5:26-29, 13:3-18. ("FIG. 7C is an exemplary diagram showing weights for each road type and weights for each weather condition that represent external environment information."), 9:32-49, 10:42-11:6, 13:3-18, 13:30-33. Fig. 7C is depicted below

with environment information including clear weather weighted as 1, rain weighted as 2, and snow weighted as 3.

FIG. 7C			
ENVIRONMENT INFORMATION (2)			
ROAD TYPE	WEIGHT	WEATHER	WEIGHT
LOCAL ROAD	1	CLEAR	1
UNPAVED ROAD	2	RAIN	2
GENERAL ROAD	3	SNOW	3
HIGHWAY	4		

Kang, Fig. 7C. *Kang* teaches multiplying weather weights by inputs to yield weighted results. *Kang*, 15:40-59. Specifically, *Kang* teaches computing a “driving condition” to determine a “function restriction level” to place on a terminal, where the driving condition is based on driving information, environment information (e.g., weather), and user information. *Kang*, 10:42-50. *Kang*’s computation also includes applying a priority weight. *Kang*, 12:34-39. Thus, *Kang* includes both a weight for the weather, and a weight applied to the weather (the “priority weight”). Thus, *Kang* teaches *weights based on active learning data* that is *weather condition data*, i.e., the clear/rain/snow weights. *Id.*

b) Motivation to Combine *Kang*

162. A POSITA would have been motivated and found obvious to further modify the *Hampiholi-Attard* SDV per *Kang* to provide *a plurality of weights based on...weather condition data* to weight inputs (e.g., collected data 115) to generate CPCL Φ . This modification would have advantageously improved the Φ computation to account for the severity of weather conditions in driving autonomously, thereby improving vehicle safety and desirability.

163. Indeed, this modification would have given more weight to inputs that indicate faults that are more likely to impede autonomous driving functionality. A POSITA would have clearly recognized the benefits of modifying *Hampiholi-Attard* to have weather-specific weighting in determining Φ as a POSITA would have understood that certain weather conditions may significantly impact autonomous driving functionality, while others would have little to no impact on such. This modification would have been use of a known technique of using weighted voting based on weather conditions and would have improved *Hampiholi-Attard's* similar computer program product and SDV in the same way as *Kang's* vehicle and computer program product.

164. That is, the *Hampiholi-Attard* SDV would have seen the same improvement in computing Φ as seen in *Kang's* computation of the driving condition by using weather specific weights in determining whether to restrict the function of a device (*Kang's* terminal) based at least in part on the specific weather condition

being encountered by a vehicle. Such a weighted voting system would have provided the *Hampiholi-Attard* SDV with a more accurate computation of Φ and, accordingly, a more accurate method by which to determine whether the SDV should be driven autonomously. This modification would have given more weight to inputs that indicate faults that are more likely to impede autonomous driving functionality. For example, icy road conditions are more dangerous than clear weather, so weighting icy weather higher, per *Kang*, would have improved *Hampiholi-Attard-An's* weighted voting system (which does not expressly teach weighting various weather conditions).

165. This modification would have been use of a known technique of using weights based on weather conditions and would have improved the *Hampiholi-Attard* SDV in the same way as *Kang's* vehicle. Combining these prior art elements (inputs and weights) according to known methods would have yielded the predictable result of a functional and advantageous weighted voting system.

166. A POSITA would have had a REOS for modifying the *Hampiholi-Attard* SDV per *Kang* to utilize *weights based on...weather condition data* in a *weighted voting system*. Again, as I discussed above, giving certain inputs a higher or lower importance by applying weights to the inputs is a process that has been done for many years, including in the field of vehicles and self-driving vehicles. As discussed above, *Hampiholi-Attard* already teaches weighting a plurality of

determinations (*inputs*). *Attard*, 6:16-35. *Hampiholi-Attard* and *Kang* teach implementing their methods using computer program instructions. *Hampiholi*, [0032]; *Attard*, 15:12-46; *Kang*, 6:10-21. A POSITA would have recognized that modifying *Hampiholi-Attard* per *Kang* would have required merely straightforward changes to programming instructions well-within the skillset of a POSITA. For example, the modification would easily have been implemented by storing a table, such as the table shown in *Kang*'s FIG. 7, in *Attard*'s memory. Look up tables were known prior to the '004 Patent such that a POSITA would have had a reasonable expectation of success in modifying the *Hampiholi-Attard* computer program product/SDV accordingly. *See*, 1(i).

167. As discussed above, *Kang* teaches a plurality of weights based on weather data and that said weather data may be either obtained via the vehicle's sensors or from an external source. *See*, 3(b)(i). *Attard* teaches vehicle-to-vehicle communications, including weather data (per the cited SAE specification), which necessarily comes from other vehicles, e.g., a cohort of other vehicles including SDVs, and receiving weather data from server 125. *Attard*, 6:61-7:5. However, neither *Attard*, *An*, nor *Kang* expressly teaches receiving *weather condition data from a cohort of other vehicles*. Arguably, *Attard* teaches this. Weather comes from 1) a data service (*Attard*, 6:64), which would be understood could include data from

vehicles per *Grimm, Schunder*; and 2) via V2V (*Attard*, 4:57-64 is expressly from other vehicles), as promulgated by the cited SAE specification. *Harding*, 77, 79.

c) *Schunder's Weather Condition Data*

168. *Schunder* teaches a vehicle receives weather condition data (*active learning data*) from a server, which receives weather condition data from other vehicles on the same roadway. *Schunder*, 5:31-38, 7:15-22. Thus, the combination would have utilized *weights* based on weather conditions, such as *Kang's* weather-based weights, and *Schunder's* weather condition data from other vehicles.

169. *Schunder* teaches vehicles include sensors for gathering *weather condition data*. *Schunder*, 1:63-2:58. *Schunder* teaches various weather-related conditions. *Schunder*, 5:12-15, 8:62-9:3. Weather data is “crowd-sourc[ed]” from “millions of automobiles,” which is “cataloged based on GPS coordinates associated with the vehicle’s position where the data reading was taken.” *Schunder*, 5:31-38, 7:15-22.

170. *Schunder* teaches a server receives weather data and GPS coordinates from vehicles, and either automatically or responsive to a request, the server transmits weather data to vehicles including based on their location along a route. *Schunder*, 9:4-24, 9:38-54. *Schunder* teaches utilizing this system to avoid certain weather conditions and/or to inform a driver weather conditions are unavoidable. *Schunder*, 10:17-22, 10:47-11:4. Thus, the weather report includes *active learning*

data from other vehicles including vehicles in the same area or roadway, i.e., *a cohort*, as the requesting vehicle.

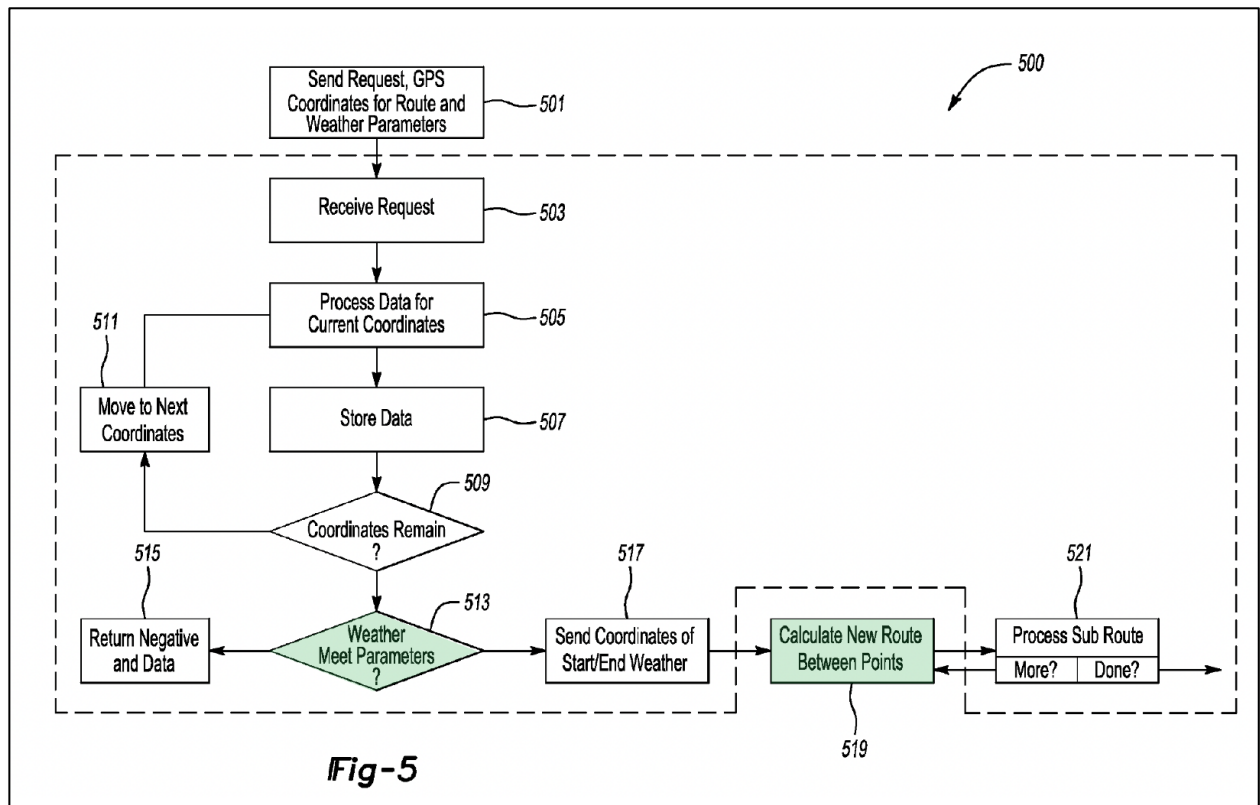
171. Further, *Schunder* teaches the weather condition data shares one or more traits with the current weather condition of the roadway on which the SDV is currently traveling. Namely, *Schunder* teaches prioritizing/weighting weather data sent to the requesting vehicle based on its location, including the roadway the requesting vehicle is traveling. *Schunder*, 9:38-54. For example, *Schunder* teaches that once the vehicle's location is known, "the server gathers a variety of data points surrounding the vehicle at different radii" and "may focus on points in a pattern," such as "more points in the heading of the vehicle." *Schunder*, 9:38-54, 10:3-16 (accounting for the change in vehicle's position while the server processes the request), 11:35-63 (describing a "blended area reporting" approach). *Schunder's* weather condition data "correspond[s] to weather data reported from other vehicles **at a time in close proximity to a present time**" such that it shares one or more traits with the current weather condition. *Schunder*, 2:14-21. Because vehicles on the same roadway as the requesting vehicle send weather data "at a time in close proximity to a present time," this weather data shares one or more traits with the current weather condition of the roadway.

d) Motivation to Combine *Schunder*

172. A POSITA would have been motivated and found obvious to modify the *Hampiholi-Attard* SDV per *Schunder* to utilize *active learning data* from other vehicles to receive more accurate weather reports for a vehicle traveling a roadway. *Attard* discloses collecting weather data to support CPCL assessment. *Attard*, 6:61-7:5. As I mentioned above, a POSITA would have appreciated the benefits of receiving weather data from other vehicles that are ahead of the *Hampiholi-Attard* computer program product/SDV in the same direction of travel, thereby enabling decision-making to be made based on future weather conditions that the SDV will encounter. The weather conditions experienced by a vehicle in one location may share one or more traits with another vehicle or cohort of vehicles (including other SDVs) along the same roadway. The weather conditions experienced by a vehicle in one location may share one or more traits with another vehicle or cohort of vehicles (including other SDVs) along the same roadway. *Schunder* teaches several advantages including more accurate weather data for weather reports because the weather data is gathered by many vehicles and informing other vehicles on the same roadway of future weather conditions on the road. *Schunder* also advantageously plots a route to avoid particular weather conditions or warns a driver when weather is unavoidable. *Schunder*, 10:17-11:4.

173. Modifying the *Hampiholi-Attard* SDV per *Schunder* to gather active learning data regarding weather conditions from other vehicles would have been use

of *Schunder*'s known technique to improve the *Hampiholi-Attard* SDV in the same way as *Schunder*. Indeed, modifying *Attard*'s server 125 per *Schunder*'s or simply substituting *Schunder*'s server and its functionality for *Attard*'s would have obtained predictable results of more accurate weather condition reporting. For example, *Schunder*'s FIG. 5, below, is a method "of a request process for requesting weather for a route, including adjusting the route based on weather." *Schunder*, 10:23-25.



Schunder, FIG. 5. As shown, *Schunder*'s method 500 involves, at 513, checking "to see if the projected weather data meets the 'avoid' parameters for any stretch of the route" and, if so, at 519, the system will "calculate 519 a new route avoiding the weather." *Schunder*, 10:43-51.

174. A POSITA would have had a REOS when making this modification.

Indeed, *Hampiholi-Attard* teaches receiving weather information and sensors to capture weather-related data. *Hampiholi*, [0043], [0063]; *Attard*, 4:42-45. The modification would have merely required straightforward changes to programming instructions of the vehicle and potentially adding sensors to capture additional weather-related data. Combining sensors with a vehicle according to known methods would have yielded predictable results. *Id.* To the extent *Attard's* server 125 would also need modification, such would have been straightforward. *Id.* Either *Attard's* server functionality would have been modified to include *Schunder's* server functionality or a simple substitution of *Schunder's* server for *Attard's* server 125 would have obtained the predictable results of *Schunder's* functionality. *Attard*, 6:61-7:5, 9:11-39; Further, *Schunder* teaches a similar computing system to *Hampiholi-Attard*. *Hampiholi*, [0032]; *Attard*, 15:12-46; *Schunder*, 4:23-32.

175. Further underscoring the REOS, *Schunder* teaches a vehicle-based computing system 1 (VCS) for vehicle 31 including a processor and program instructions stored in memory. *Schunder*, 4:23-42. As discussed above, *Attard-Frazer-McNew-An-Kang* also teaches similar vehicle-based computing system with processor and program instructions stored in memory. *See*, 1(d). Thus, modifying the *Hampiholi-Attard's* SDV functionality per *Schunder* would have required only

straightforward changes to programming instructions that would have been well-within the skillset of a POSITA.

B. Claim 3

1. Claim 3(a): “The computer program product of claim 2, further comprising: when no fault has occurred, autonomously maintaining a buffer of space from other vehicles around the SDV without requiring the human driver to control the driver controls;”

176. *See*, 1(k); *Attard*, 1:65-2-6. A POSITA would have understood that this claim element is met by any SDV and is inherent in the definition of “maintaining a buffer of space from other vehicles around the SDV.” Not maintaining a buffer of space is not acceptable for a vehicle under any conditions, regardless of whether the vehicle is manually or autonomously driven. A fault must occur somewhere for the buffer to be nonexistent. Further, a POSITA would have been motivated to maintain a buffer of space around the vehicle to prevent accidents caused by following too closely and not having sufficient time to stop, for example.

2. Claim 3(b): “obtaining the first plurality of weights by querying a database; and”

177. *DeRuyck* teaches a plurality of weights W1-W6 1020, and *Gunderson* teaches weights based on active learning data. *See*, 2(a)-(c). *DeRuyck* teaches “values W of the weights 1020 can be initially set to a default value and refined over time based on experience by the driver behavior detector 208.” *DeRuyck*, 13:21-41. A POSITA would have understood that *DeRuyck* would have stored weights in

memory to persistently use weights over time and because *DeRuyck* teaches setting initial values and refining the values over time. In order to set and refine the weights over time, a POSITA would have understood and been motivated to store the weights in memory (*a database*) for retrieval and future updating. Further, *DeRuyck* teaches implementing its system (including weights) using a computer system with memory for storage (e.g., storing programming instructions such as weights). *DeRuyck*, 27:3-28. Further, *Gunderson* teaches memory for storing weights. *Gunderson*, [0031]. Thus, in the *Hampiholi-Attard* SDV, the first plurality of weights would have been obtained by querying a database.

3. Claim 3(c): “obtaining the second plurality of weights by querying the database.”

178. For the same reasons discussed for 3(b), the modified *Hampiholi-Attard* SDV teaches this limitation. *See*, 3(b). A POSITA would have been motivated and found it obvious to use a well-known technique to organize data in memory (i.e., *database*) by storing and organizing *An*’s weights in memory, per *Gunderson*, thus meeting *obtaining the second plurality of weights by querying the database*. A POSITA would have understood that organizing and storing data in memory for later retrieval was a well-known technique.

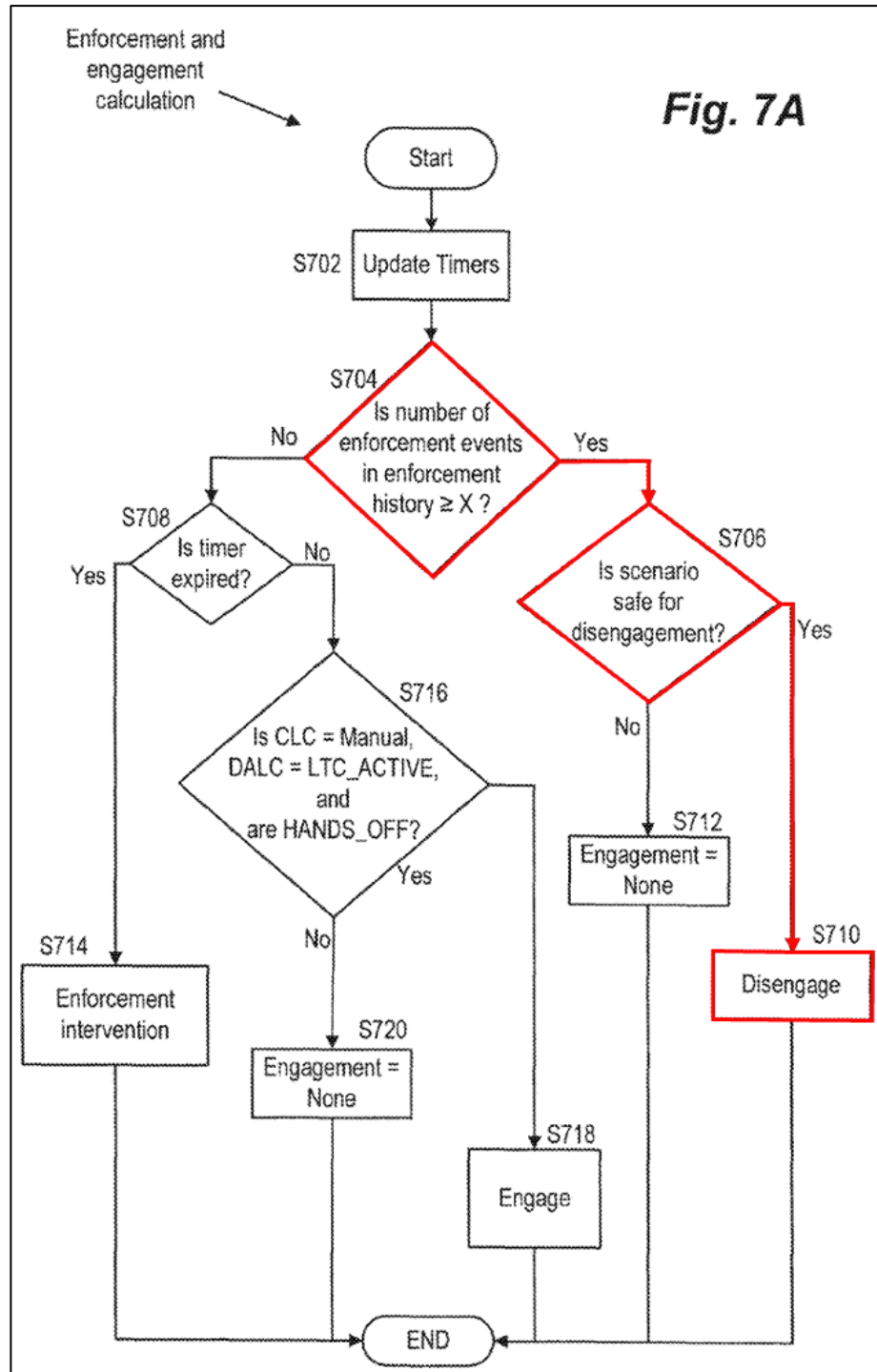
C. Claim 4

1. Claim 4(a): “The computer program product of claim 3, further comprising: tracking a number of times the first fault has occurred; and”

a) McNew's Teachings

179. *Hampiholi* teaches a first fault of the HDCL being below a first threshold. *See*, 1(g). *Hampiholi* does not teach recording a number of times the first fault has occurred. *McNew*, like *Hampiholi*, teaches faults related to driver distraction. As discussed further below, *McNew's* faults relate to a driver not responding to a warning, and *McNew* further teaches logging the number of times the driver does not respond. Thus, a POSITA would have found it obvious and been motivated to combine *McNew's* teachings of tracking the number of times a fault has occurred with *Hampiholi's* first fault teachings of severity rank R being below a threshold. A POSITA would have understood that this would have provided several advantages, which I discuss further below.

180. *McNew* teaches “generat[ing] warnings and/or requests to prompt the driver to interact with the steering wheel and/or pay attention to the road, and enforc[ing] driver attention or steering interaction when the driver is not responding to the warnings.” *McNew*, 3:15-21. Each warning is an “enforcement event” and, when “the number of enforcement events is greater than or equal to” a threshold, a corrective action of shutting down semi-autonomous driving occurs. *McNew*, 19:57-20:25, 6:9-28.



McNew, FIG. 7A.

181. The enforcement event is a *fault* because it is an event where the driver does not respond to a warning. As discussed below, a POSITA would have been

motivated to modify *Hampiholi* based on *McNew*'s teachings of tracking the number of times a fault has occurred to track the number of times *Hampiholi*'s first fault has occurred, e.g., the number of sequential times R is below the first threshold. Therefore, because *McNew* logs (*track[s]*) the number of enforcement events, *McNew* teaches tracking a number of times the first fault has occurred.

b) Motivation to Combine *McNew*

182. A POSITA would have found it obvious and been motivated to modify the *Hampiholi-Attard* SDV further with *McNew*'s teachings of tracking a number of times the first fault has occurred. Such a modification is merely the combination of known elements according to known methods to yield predictable results. A POSITA would have recognized the safety benefits of further modifying the *Hampiholi-Attard* SDV to address situations where “the driver may be purposely ignoring the semi-automatic driving system.” *McNew*, 6:15-20. For example, a POSITA would have found it obvious that drivers who are purposefully ignoring the driver monitoring system should be assigned a more severe R ranking based on this past behavior to reduce the likelihood of a class. It was well known that level 3 and below SDVs required driver supervision such that a POSITA would have understood and been motivated to track repeated attempts to respond to a distraction fault. *See, e.g., James*, 3:14-20. This use of a known technique would have improved the

Hampiholi-Attard SDV in the same way as the similar *McNew* SDV. Further motivations are provided with respect to 1(j).

183. There would have been a REOS because the modification merely would have required a straightforward software/programming change to track the number of times the HDCL drops below the first threshold. Such would have easily been implemented in programming instructions using, e.g., a simple counter. As another example, *McNew* teaches such a simple modification, i.e., a “log of enforcement events...that can be stored in memory” *McNew*, 19:62-65. It would have been straightforward and well-within the skillset of a POSITA to modify *Hampiholi-Attard* to log the enforcement events in, e.g., *Hampiholi*’s storage device 208.

2. Claim 4(b): “determining the competence level of the human driver using the number of times the first fault has occurred.”

a) *McNew*’s Teachings

184. *McNew* teaches “determin[ing] that the driver is abusing the system by purposely ignoring warnings and requests from the SAMM [semi-autonomous mode manager].” *McNew*, 20:7-9, FIG. 7A. Determining the driver is ignoring warnings is analogous to *determining* an HDCL, i.e., because it indicates the driver is not prepared to take over control of the SDV. Thus, the *Hampiholi-Attard* SDV modified by *McNew* teaches or renders obvious 4(b) because determining the driver is ignoring warnings and is purposefully not paying attention (*determining the*

competence level of the human driver) includes logging the number of enforcement events (*number of times the first fault has occurred*).

b) Motivation To Combine

185. A POSITA would have found it obvious and been motivated to modify *Hampiholi-Attard's* warning system with *McNew's* teachings of using the number of times a driver has not responded to an alert to determine *Hampiholi's* severity rank R, i.e., the HDCL. Using this historical information would have predictably improved the *Hampiholi-Attard* SDV by enabling a more accurate determination of R that accounts for both the current driver state and also the past driver behavior.

186. A POSITA would have been motivated to modify *Hampiholi-Attard* in this manner at least because of the obvious safety benefit such a modification would provide. For example, a POSITA would have found it obvious to upgrade *Hampiholi* from a lower severity rank R directly to the most severe rank R due to repeated drops into the lower severity rank R to ensure the vehicle is driven safely. As I discussed in the Claim 1 mapping, *Hampiholi's* severity rank R is used to determine an appropriate action to take, including sending an alert and escalating to performing automatic control of the vehicle. *See*, Claim 1; *Hampiholi*, [0057]. While *Hampiholi* considers driver's historical information in computing R, *Hampiholi* does not track how the driver has responded to prior warnings. *Hampiholi*, [0062]-[0063] (discussing use of historical data), FIG. 5. *McNew*, however, recognizes that

historical information relating to whether the driver has complied with warnings is beneficial for ensuring the vehicle is safely driven. Thus, such a combination is merely the application of a known technique to a known method ready for improvement to yield predictable results of determining R further based on the driver's compliance with previous corrective actions/alerts. A POSITA would have had a REOS for the modification as discussed in 4(a).

D. Claim 5

1. Claim 5(a): “The computer program product of claim 3, further comprising: tracking a length of time during which the first fault has occurred; and”

a) McNew's Teachings

187. *McNew* teaches “determin[ing] whether the timers that monitor how long it takes for the driver to respond to steering or attention requests have expired.”

McNew, 20:42-44. In more detail,

At step S702, timers that monitor how long it takes for the driver to respond to steering or attention requests are updated. In an implementation, **a steering timer monitors how long it takes a driver to put hands on the steering wheel or actively steer the vehicle after the driver receives a request or warning** at the HMI. An attention timer can monitor how long it takes the driver to place eyes on the road after receiving a warning to place eyes on the road.

McNew, 19:47-55. As discussed, *McNew* teaches a *fault* that is an attention/steering warning. *See*, 4(a). Therefore, *McNew*'s disclosure of a timer that tracks the response

time to this warning teaches *tracking a length of time during which a fault has occurred*. As discussed below, a POSITA would have been motivated and found it obvious to modify *Hampiholi*, per *McNew*, to track a length of time *Hampiholi's first fault has occurred*, i.e., a length of time R is below the first threshold.

b) Motivation to Combine

188. *See*, 4(a). Similar to the motivation for combine for 4(a), a POSITA would have been motivated and found it obvious to modify the *Hampiholi-Attard* SDV to track the length of time during which the first fault occurs for the same reasons I discussed above. This modification would have advantageously provided more information to the SDV on driver non-compliance with alerts. Additionally, this modification would have allowed the HDCL to be determined using the length of time, further improving the *Hampiholi-Attard* SDV by providing a more detailed profile of the human driver's competence level. This use of a known technique would have improved the similar *Hampiholi-Attard* SDV in the same way as *McNew's* SDV. Similar to above, this modification would have had a REOS because it would have required only straightforward changes to programming instructions. *See*, 5(a).

2. Claim 5(b): “determining the competence level of the human driver using the length of time during which the first fault has occurred.”

a) *McNew's* Teachings

189. *McNew* teaches “implement[ing] an enforcement intervention” when “one or more timers has expired due to the driver not complying with a warning.” *McNew*, 20:55-59, FIG. 7A. Determining the driver is ignoring warnings is analogous to determining an HDCL as I discussed above. *See*, Claim 4(b). Thus, the *Hampiholi-Attard* SDV modified by *McNew* teaches or renders obvious 5(b) because determining the driver is ignoring warnings includes tracking the length of time the driver has ignored the warning (*length of time the first fault has occurred*).

b) Motivation To Combine

190. *See*, 4(b), 5(a).

X. GROUND 3: CLAIMS 6-7 ARE OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, AND SAKO

191. As discussed regarding Claim 1, the *Hampiholi-Attard* SDV determines a CPCL, taking corrective actions when necessary. *See*, 1(c), 1(i). Claims 6 and 7 require taking the corrective action of transferring control to manual when the CPCL is below a threshold and the vehicle is not driving on a public highway. As mapped, *Attard* teaches taking corrective actions when its CPCL (Φ) falls below a threshold ($\Phi_{\min}$). Further, *Sako* teaches when an SDV moves “from the highway to a general road, it is possible to switch the driving mode to the manual driving mode.” *Sako*, 34:63-35:21.

192. A POSITA would have been motivated and found it obvious to modify the *Hampiholi-Attard* SDV to transfer from autonomous mode to manual mode when the vehicle exits a public highway, per *Sako*, teaching Claims 6 and 7. A POSITA would have recognized the SDV would have most safely operated autonomously on a public highway, where roads and driver behavior are the most predictable, and thus would have been motivated to cause the SDV to take *Sako*'s corrective action if the SDV's CPCL was low. SDVs that disabled autonomous mode upon exiting a highway were well known. For example, *Desnoyer* taught such an autonomous vehicle in which a "navigation unit identifies the end of [a] delegated driving zone, which corresponds to an entry into another zone in which traffic becomes more fluid or else in which the infrastructure alters: toll, **highway exit**..." *Desnoyer* (Ex. 1049), [0040]. Such a modification is merely the combination of known prior art elements (*Attard*'s self-driving, Φ , and $\Phi_{\min}$ and *Sako*'s functionality) according to known methods to yield predictable results of an SDV transferring to manual mode when exiting a public highway. Further, because the hardware necessary (including GPS) was already present in *Hampiholi-Attard*, these modifications would have required only straightforward modifications to programming instructions of the *Hampiholi-Attard* SDV using skills available to a POSITA, leading to a REOS.

A. Claim 6

1. Claim 6(a): “The computer program product of claim 1, further comprising: determining, using one or more of the sensor readings, whether the SDV is travelling on a first roadway type or a second roadway type of a plurality of roadway types;”

193. *Sako* teaches determining what roadway type an SDV is on using GPS readings. *Sako*, 34:62-35:21 (teaching detecting a public “highway” *first roadway type* vs “a general road” *second roadway type*). A POSITA would have understood *Sako*’s disclosure of a “highway” to be of the public type, i.e., a typical highway accessible to the general public, rather than, for example, a toll road. *See*, 7. The *Hampiholi-Attard* SDV already includes GPS (*one sensor reading*), processor, and memory. *See*, 1(a). A general motivation to combine the *Hampiholi-Attard* SDV with *Sako* is provided above. *See*, ¶¶191-192.

2. Claim 6(b): “determining the competence level of the SDV comprises determining whether the SDV is currently operating in a first autonomous mode of a plurality of autonomous modes;”

194. *Attard* teaches corrective actions including a “warning...to take over steering” that is triggered when Φ is below $\Phi_{\min}$. *Attard*, 7:18-51, 10:18-52. *Attard* explains Φ accounts for “attributes of a surrounding environment.” *Attard*, 10:24-27.

195. A POSITA would have been motivated and found it obvious to include *Sako*’s determination of moving from highway to general road (e.g. a road with tighter curves, shorter sightlines, smaller lanes and shoulders and generally less well

maintained pavement and striping) while in automatic mode as part of *Attard's* “attributes of a surrounding environment” incorporated into Φ , teaching or rendering obvious 6(b). *Sako*, 34:62-35:21; *Attard*, 10:18-52. Alternatively, or additionally, a POSITA would have found it obvious and been motivated to modify *Attard's* parameter 117 based on *Sako's* teachings to change when *Attard* would transfer to manual. A POSITA would have recognized the SDV's ability to operate autonomously (Φ) would have differed based on the roadway type, with “general roads” being more difficult for the SDV to traverse autonomously than “public highways.” For example, the Mercedes 2013 S-Class Active Lane Keeping Assist may not function if “the road is narrow and winding,” or “the lane markings are worn away, dark or covered up, e.g. by dirt or snow,” among several other warnings more associated with minor roads. *Mercedes S-Class Manual* (Ex. 1057), 370. In another example, unpaved roads or busy, narrow city streets would likely have been more difficult to traverse in automatic/autonomous mode than a smooth, well-maintained, and/or low-traffic highway. Thus, a POSITA would have found obvious from *Sako's* teachings that the modified *Hampiholi-Attard* SDV would have had a *first autonomous mode* for use with a first road type (e.g., public highways) and a second autonomous mode for use with a different road type (e.g., general roads). In addition, a POSITA would recognize that a vehicle in a second “autonomous mode” different than *Sako's* “automatic mode” (such as a longitudinal control only mode) would not

need to revert to a manual mode as this second mode is commonly utilized on all roads. Further motivation to combine the *Hampiholi-Attard* SDV with *Sako* is above.

3. Claim 6(c): “determining that a third fault has occurred when the SDV is currently travelling on the second roadway type and the competence level of the SDV is below a third threshold; and”

196. See, 6(b) describing a “general road” *second roadway type* and *third threshold* $\Phi_{\min}$. Note the *third threshold* is compared to the CPCL and not to the HDCL unlike the first and second thresholds of Claim 1. A POSITA would understand that the CPCL required for minor roads is generally higher than on a higher class road.

4. Claim 6(d): “determining, using the fault remediation table, a third corrective action associated with the third fault, wherein the third corrective action comprises transferring the driver controls to manual control.”

197. The *Hampiholi-Attard* SDV determines corrective actions using *Frazer’s* fault remediation table. See, 1(i). A POSITA would have been motivated and found it obvious to add *Sako’s* corrective action response (transferring to manual control upon exiting a highway) when necessary (*Attard’s* Φ is below $\Phi_{\min}$), improving the SDV by merely adding a row and perhaps columns to the table. For example, in the *Frazer* event table 112 this would look like adding a row with an action 144c that is transfer controls to manual controls and the conditions 142c in that row would be the CPCL being below a threshold and the detection of exiting

the highway. As discussed, *Frazer* contemplates event table including “tens, hundreds, or even thousands of entries” such that such a modification would have been met with a reasonable expectation of success. *Frazer*, 21:64-22:1 Further motivation to combine the *Hampiholi-Attard* SDV with *Sako* is provided above.

B. Claim 7

1. Claim 7(a): “The computer program product of claim 6, further comprising, the first roadway type comprises a public highway;”

198. *See*, 6(a). The ’004 Patent describes various roadways, including “public streets, public highways, and toll roads.” ’004 Patent, 6:15-23. A POSITA would have understood from this description that public highways are contrasted with toll roads. Regarding claims 6 and 7, a POSITA would have understood that *Sako* teaches a public highway rather than a toll road, as *Sako* uses the term highway, which is commonly used to refer to a public highway. To the extent it is argued that *Sako*’s highway would also have included toll roads, a POSITA would have understood that within the genus of highway, at least some highways would be public, thus meeting Claim 7.

2. Claim 7(b): “the second roadway type does not comprise a public highway;”

199. *See*, 6(a).

3. Claim 7(c): “operating in the first autonomous mode comprises autonomously controlling the driver controls without requiring the human driver to control the driver controls; and”

200. See, 1(Pre), 1(k), 6(b). This “first autonomous mode” is identical to *Sako*’s “automatic driving mode in which autonomous traveling is carried out.” *Sako*, 1:61-64.

4. Claim 7(d): “determining the competence level of the SDV comprises determining that the competence level of the SDV is below the third threshold when the SDV is not currently operating in the first autonomous mode.”

201. See, 6(b). A POSITA would understand that the CPCL is continuously evaluated in all driving modes in order to enable/require a transition if needed.

XI. GROUND 4: CLAIM 8 IS OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, AND COELINGH

1. Claim 8(a): “The computer program product of claim 1, further comprising: sensing an operational state of a first camera sensor;”

202. *Attard* teaches “a camera data collector 110 in a first vehicle 110 may be faulty,” which teaches *sensing an operational state* (“faulty”) *of a first camera sensor*. *Attard*, 14:46-48, 14:64-15:1. In further detail, *Attard* teaches that a vector φ_i can be compared to a corresponding $\varphi_{\min}$ to determine whether to send a message to the vehicle operator, i.e., to determine a fault. *Attard*, 7:65-8:4. φ_i is based on collected data 115 and “may...reflect a hardware fault.” *Attard*, 5:54-57, 7:14-16.

Thus, *Attard* teaches *sensing*, via collected data 115 and determined using ϕ_i , *an operational state of a first camera sensor*.

2. Claim 8(b): “determining, using a weighted voting system with a first plurality of inputs and a first plurality of weights, whether the first camera sensor is currently experiencing an operational anomaly;”

203. *Attard* teaches “weighting various determinations” from collected data 115 to generate confidence assessments 118. *Attard*, 6:28-35. Collected data 115 includes camera sensor readings. *Attard*, 4:1-17 (image capture devices), 4:67-5:3 (v2v data includes camera data), 14:36-15:1 (examples of faulty cameras). Collected data 115 from the first camera data collector 110 forms *a first plurality of inputs* because collected data 115 is used in computing ϕ , and a POSITA would have understood that each image captured by the camera is an *input*. Thus, with the camera data collector 115 obtaining multiple images throughout self-driving (e.g., “for determining road lane boundaries”), there is *a plurality of inputs* from the camera data collector. *Attard*, 14:44-48. *Attard* teaches weighting collected data from a plurality of distinct sensors, teaching or rendering obvious a *first plurality of weights*.

204. That is, a POSITA would have understood that weighting various determinations would have required a plurality of weights, one for each determination being weighted. Furthermore, because *Attard*’s weighting is used to

generate confidence assessments 118, ϕ_i , which as I discussed above, is used to determine whether a camera detector 115 is faulty and a message should be sent to the operator, *Attard teaches using a weighted voting system to determin[e] whether the first camera sensor is currently experiencing an operational anomaly (i.e., is faulty).*

3. Claim 8(c): “the first plurality of inputs comprises sensor readings from the first camera sensor;”

205. See, 8(b). The collected data 115 from first camera data collector 110 is a first plurality of inputs.

4. Claim 8(d): “at least one of the first plurality of inputs is multiplied by a weight from among the first plurality of weights,

206. See, 8(b). *Attard* teaches or renders obvious multiplying at least one of the sensor readings from camera data collector 110 by a weight from among the first plurality of weights. As discussed in 8(b), *Attard* teaches or renders obvious a plurality of weights. Because *Attard’s* various determinations that are weighted include the collected data 115 from a camera sensor 110, *Attard* teaches or renders obvious that at least one of the first plurality of inputs (i.e., one of the camera sensor readings/images) is multiplied by a weight from among the first plurality of weights (i.e., one of the weights applied to the camera sensor reading).

5. Claim 8(e): “wherein the first plurality of weights are based on first active learning data, the first active learning data comprising

information about a cohort of other SDVs experiencing a camera sensor operational anomaly;

207. *Attard* teaches receiving V2V (vehicle-to-vehicle) data, i.e., *active learning data*. *Attard*, 13:1-3 (“[T]he first vehicle 101 sends a v2v communication 112 that may be received by one or more second vehicles 101 within range of the first vehicle 101.”)

a) *Coelingh’s* Teachings

208. *Coelingh* teaches an autonomous vehicle sensor diagnosis system that is “arranged to retrieve from [a] database information on sensor performance levels for sensors in other vehicles.” *Coelingh*, 4:9-23, 7:23-38 (camera sensors). The sensor information includes “that the sensor performance is degraded,” i.e., information about a cohort of other SDVs experiencing a camera sensor anomaly.” *Coelingh*, 3:40-44.

b) The Combination Renders Obvious 8(e).

209. A POSITA would have been motivated and found it obvious to combine the teachings of *Attard* and *Coelingh* in the *Hampiholi-Attard* SDV such that *Attard’s* weights are based on *first active learning data*, i.e., *Coelingh’s* data regarding sensor performance levels from other vehicles. Specifically, a POSITA would have been motivated and found it obvious to leverage *Coelingh’s* data because a POSITA would have understood that the corresponding sensors in other vehicles

would be instructive to the performance of the same sensor in the *Hampiholi-Attard* SDV. This is taught by *Coelingh*, stating “any vehicle sensor diagnosis system in any host vehicle may have access to a large amount of comparable sensor data, an information on sensor performances in other vehicles.” *Coelingh*, 4:13-18. A POSITA would have recognized the desirability of being able to leverage such large amounts of data in making more accurate assessments regarding the performance of a camera in the *Hampiholi-Attard* SDV.

210. This modification merely applies known techniques according to known methods to yield predictable results. *Attard* teaches a known technique of weighting camera sensor data, while *Coelingh* teaches utilizing autonomous vehicle sensor data from a cohort of SDVs to determine sensor performance. A POSITA would have recognized the predictable result of such a combination/known technique, e.g., that *Attard* weights the sensor data based on a reliability thereof, per *Coelingh*. This modification would have predictably improved the *Hampiholi-Attard* SDV by providing for the weights to be based on *Coelingh*'s data of the same camera data sensors in other vehicles, leveraging “the estimated level of sensor performance” based on the sensor data from other vehicles. *Coelingh*, 4:54-59. Here, the sensor data may be transmitted to an SDV from a central server as in *Coelingh* or by V2V communications, such as present in *Attard*, and that either technique would have achieved the advantageous results discussed herein. Additionally,

Coelingh provides an express teaching, suggestion, and motivation for the combination teaching “both safety and comfort are increased” and the estimation of expected sensor performance “may be very accurate” utilizing *Coelingh*’s teachings. *Coelingh*, 2:16-24, 4:24-29. This use of a known technique would have improved the similar *Hampiholi-Attard* vehicle in the same way as *Coelingh*’s vehicle.

211. A POSITA would have had a REOS in the modification because *Coelingh*, like *Hampiholi*, teaches implementing its teachings in programming instructions such that the modification would have required a straightforward software change to *Hampiholi*. Compare *Coelingh*, 7:52-8:24 with *Hampiholi*, [0032]. For example, the modification would have involved modifying *Hampiholi*’s storage device 208 to include *Coelingh*’s database 8 that stores the sensor information. *Coelingh* teaches “at least a part of the database 8 is comprised in the host vehicle 2” or “the database 8 is a remote server (also referred to as the cloud).” *Coelingh*, 7:55-60. Likewise, *Hampiholi* teaches “storage device 208 may store application data to enable the in-vehicle computing system 200 to run an application for connected to a **cloud-based server**.” *Hampiholi*, [0032]. Thus, whether modifying the *Hampiholi-Attard* SDV to store data on the vehicle or in the cloud, per *Coelingh*, such a modification would have been met with a reasonable expectation of success because the *Hampiholi-Attard* SDV is already equipped for such a modification.

6. Claim 8(f): “determining that a third fault has occurred when the first camera sensor is currently experiencing an operational anomaly.”

212. *Attard* teaches a faulty camera data collector 110, i.e., determining that a third fault has occurred when the first camera sensor is currently experiencing an operational anomaly. *See*, 8(a), 8(f); *Attard*, 14:36-41.

XII. GROUND 5: CLAIM 9 IS OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, COELINGH, DERUYCK, GUNDERSON, AN, KANG, AND SCHUNDER

1. Claim 9(a): “The computer program product of claim 8, further comprising: determining the competence level of the human driver comprises using the weighted voting system with a second plurality of inputs and a second plurality of weights, wherein;”

213. *Hampiholi* teaches a second plurality of inputs, and *DeRuyck* teaches a second plurality of weights. *See*, 2(a).

2. Claim 9(b): “the second plurality of inputs comprises one or more of the sensor readings;”

214. *See*, 2(b).

3. Claim 9(c): “at least one of the second plurality of inputs is multiplied by a weight from among the second plurality of weights, wherein the second plurality of weights are based on second active learning data, the second active learning data comprising sensor readings about a first cohort of human drivers of other SDVs:”

215. *See*, 2(c).

4. Claim 9(d): “determining the competence level of the SDV comprises using the weighted voting system with a third plurality of inputs and a third plurality of weights, wherein:”

216. *See*, 2(d).

5. Claim 9(e): “the third plurality of inputs comprises one or more of the sensor readings;”

217. *See*, 2(e). *Attard’s* third plurality of inputs comprises collected data 115.

6. Claim 9(f): “the third plurality of inputs comprises at least one sensor reading that is not in the first plurality of inputs and is not in the second plurality of inputs;”

218. *Attard’s* collected data 115 includes non-camera data 115, e.g., radar data, which is *not in the first plurality of inputs* and is *not in the second plurality of inputs*. That is, the radar collected data 115 is both not camera data (*the first plurality of inputs*) used to determine a camera sensor anomaly nor is it *Hampiholi’s second plurality of inputs* used to determine R.

7. Claim 9(g): “the second plurality of inputs comprises at least one sensor reading that is not in the first plurality of inputs and is not in the third plurality of inputs; and”

219. *Hampiholi’s* sensor data (*second plurality of inputs*) used to determine the HDCL includes sensor readings not used for determining the camera anomaly (*first plurality of inputs*) nor for determining the CPCL (*third plurality of inputs*). Therefore, *Hampiholi’s second plurality of inputs* comprises at least one sensor reading (e.g., from the driver-facing camera) *that is not in Attard’s* camera data 115 and is *not in Attard’s* radar data 115 (*first and third plurality of inputs*).

8. *Claim 9(h): “at least one of the third plurality of inputs is multiplied by a weight from among the third plurality of weights, wherein the third plurality of weights are based on third active learning data, the third active learning data comprising sensor readings about condition data from a second cohort of other SDVs, wherein the condition data shares one or more traits with a current condition of a roadway on which the SDV is currently traveling.”*

220. *See, 2(h).*

XIII. GROUND 6: CLAIM 29 IS OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, AND HADA

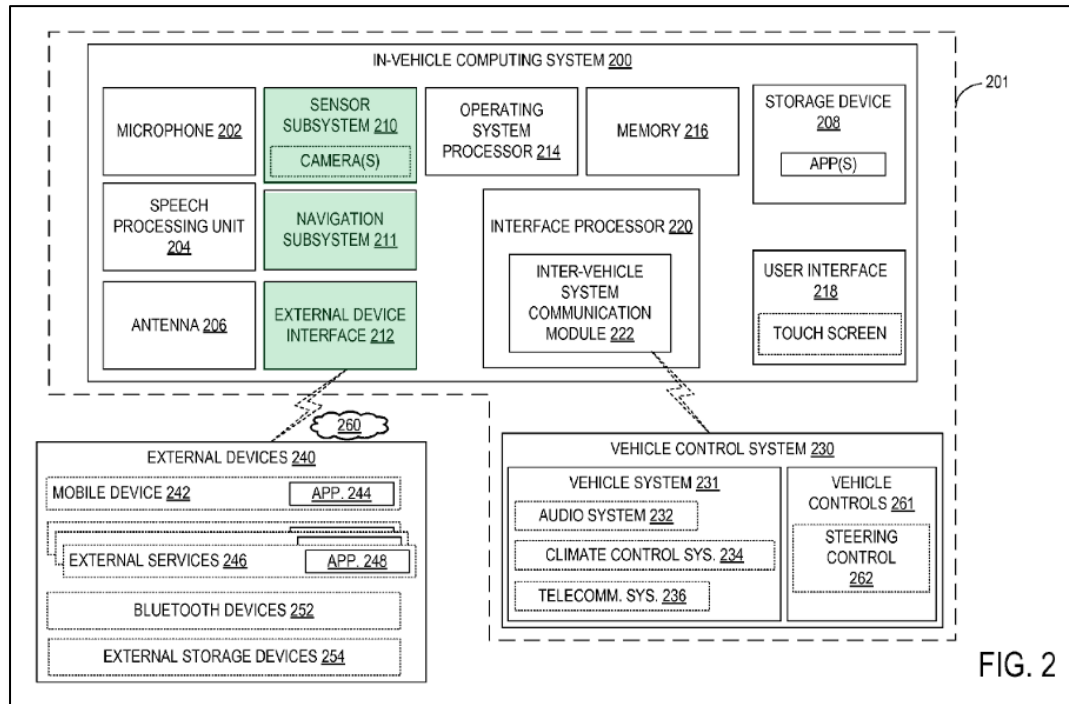
A. Claim 29

1. *Claim 29(Pre): “A computer program product for controlling a driving mode of a self-driving vehicle (SDV), the computer program product comprising a non-transitory computer readable storage medium having program code embodied therewith, the program code readable and executable by a processor to perform a method comprising:”*

221. *See, 1(Pre).*

2. *Claim 29(a): “receiving a plurality of sensor readings from a system of sensors, the system of sensors comprising:”*

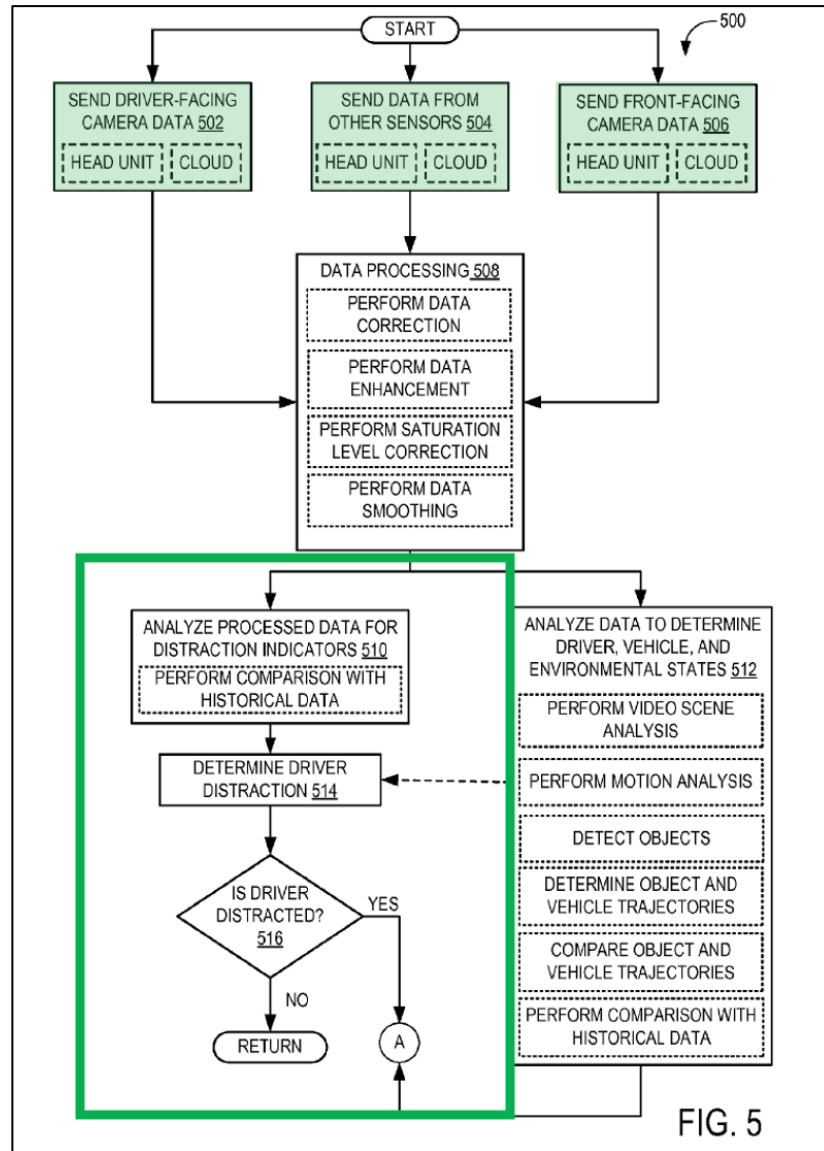
222. *See, 1(a). Hampiholi teaches receiving sensor readings from a plurality/system of sensors.*



Hampiholi, Fig. 2, [0031], [0034].

3. Claim 29(a)(i): “a camera directed at a human driver;”

223. See, 1(a). *Hampiholi* teaches a driver-facing camera included in mobile/wearable device 302, which communicates with the in-vehicle computing system. *Hampiholi*, [0058]-[0059], [0004], [0005], [0035]-[0036], [0046], [0055], [0061]-[0062], [0065].



Hampiholi, FIG. 5.

4. Claim 29(a)(ii): “a camera directed away from the SDV;”

224. *Attard* teaches or renders obvious a camera directed away from the SDV. Namely, *Attard* teaches “sensors...for detecting conditions outside the vehicle” including “image capture devices”, i.e., a camera. *Attard*, 4:8-17, 14:63-67. A POSITA would have understood that a camera that “detect[s] conditions

outside the vehicle” to teach the camera is *directed away from the vehicle*. That is, a camera detecting conditions outside the vehicle would have been directed away from the vehicle rather than, for example, on the dash and facing towards a driver to monitor driver conditions.

5. Claim 29(a)(iii): “a sensor configured to detect input from a steering wheel;”

225. See, 1(a).

6. Claim 29(a)(iv): “a GPS sensor;”

226. See, 1(a).

7. Claim 29(a)(v): “a thermometer; and”

227. See, 29(a). *Hampiholi* teaches or renders obvious a *thermometer*, teaching an “inter vehicle system communication module 22 that outputs data “provided by individual information sources” including “**thermometers.**” *Hampiholi*, [0031], [0034] (also teaching monitoring temperatures such as ambient temperature, intake air temperature, passenger compartment temperature, desired passenger compartment temperature), [0036], [0041]. A POSITA would have understood or found obvious that a sensor for monitoring temperatures such as taught by *Hampiholi* would have been a thermometer.

8. Claim 29(a)(vi): “a speedometer;”

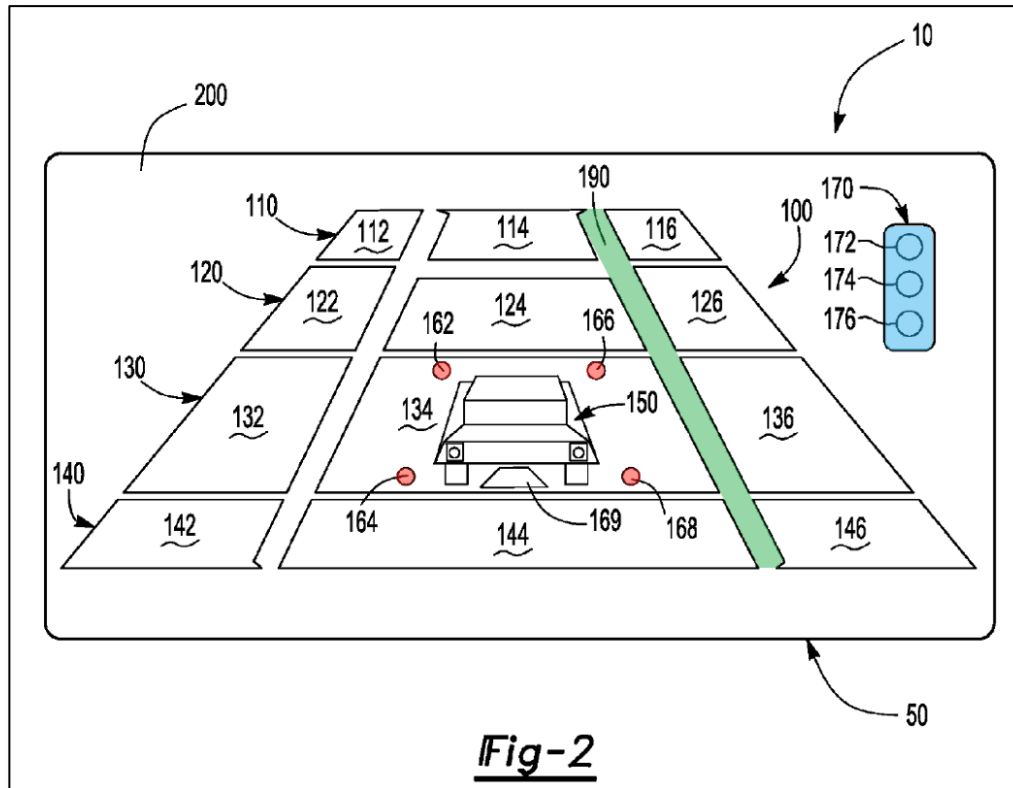
228. See, 1(a).

9. Claim 29(b): “displaying, on a display screen, one or more sensor readings of the sensor readings;”

229. See, 1(i). *Hampiholi* teaches an in-vehicle display. *Hampiholi*, [0020]-[0021], [0023], [0027], [0030], [0044], [0074], [0087], [0089]. Specifically, *Hampiholi* teaches displaying notifications, messages, and navigational assistance on the display of the vehicle’s user interface. *Hampiholi*, [0044]. To the extent it is argued that *Hampiholi*’s teachings are insufficient, a POSITA would have been motivated to modify *Hampiholi* per *Hada*’s teachings.

a) *Hada* Teaches Displaying Sensor Readings on a Display Screen

230. *Hada* teaches proximity sensors for detecting nearby vehicles, cameras for detecting lane markings, RADAR, and other sensors. *Hada*, 5:23-43. *Hada* teaches displaying sensor readings on a display screen 50. *Hada*, 9:18-36, 9:53-10:60, 6:28-42, 6:64-7:7, 7:35-54, generally 1:39-2:34, 3:17-4:59. *Hada*’s display 50 displays readings from sensors, including location and color of a stoplight, nearby vehicles, and lane markings:



Hada, Fig. 2.

b) Motivation to Combine with *Hada*

231. A POSITA would have been motivated and found it obvious to modify the *Hampiholi-Attard* SDV to display one or more sensor readings per *Hada*. A POSITA would have understood that displaying sensor readings would have provided valuable information to a driver. For example, displaying interior and/or exterior temperature from thermometer readings would have provided valuable information to a driver regarding the possibility of ice on the road, what climate control settings to utilize and whether the driver should put on a coat before exiting the vehicle, for example. Such was well known before the '004 Patent. For example,

the 2013 Tesla Model S displayed cabin temperature via a display. *Model S Manual* (Ex. 1054), 42, 62-63. *Hada* teaches displaying sensor readings advantageously improves vehicle safety at least for vehicles in manual mode, thereby motivating the combination. *Hada*, 1:5-36. In this example from *Hada*, displaying sensor readings such as obstacle detection in front of the vehicle would have enhanced driver safety to help a driver avoid colliding with an object (e.g., vehicle or other obstruction) in the roadway. This modification would have been use of a known technique of displaying sensor readings to improve the similar *Hampiholi-Attard* SDV in the same way as *Hada*'s vehicle. Indeed, displaying sensor readings allows for numerous safety systems such as collision detection, temperature warnings, traffic signal detection and warnings, pedestrian-in-the-roadway warnings, for example, to assist a driver by providing important information that can impact driver safety and the safety of others (e.g., other drivers, pedestrians).

232. A POSITA would have had a REOS modifying the *Hampiholi-Attard* SDV because *Hampiholi-Attard* already includes sensors, vehicle-to-vehicle (V2V) communications, a display, and other hardware for implementing *Hada*'s technique. Thus, a POSITA would have understood that any necessary hardware would have been present in the *Hampiholi-Attard* SDV. To the extent it is argued that hardware necessary for the modification is missing or insufficient, a POSITA would have been motivated to include such hardware in the *Hampiholi-Attard* SDV to achieve the

advantages discussed above. Because *Hampiholi-Attard* SDV already includes a display and other hardware such as sensors for taking sensor readings, a POSITA would have understood that modifying the *Hampiholi-Attard* SDV would have merely required straightforward changes to programming instructions. A POSITA would have understood that straightforward modifications to programming instructions would have been well-within the skillset of a POSITA.

10. Claim 29(c): “determining, using one or more sensor readings of the sensor readings, a position of another vehicle currently on a roadway;”

233. *See*, 29(b). *Hada* teaches determining a position of another vehicle currently on a roadway near the SDV.

11. Claim 29(d): “determining a competence level of the SDV using one or more of the sensor readings, wherein the competence level of the SDV is a function of a degree of uncertainty in the determined position of the other vehicle;”

234. *Hampiholi-Attard* teaches CPCL. *See*, 1(c). Further *Attard* teaches the competence level of the SDV is a function of a degree of uncertainty in the determined position of the other vehicle.

a) *Attard’s* Teachings

235. *Attard* teaches that confidence estimates can be based on “radar return signals [that] may be attenuated due to atmospheric moisture such that [a] radar module reports low confidence in estimating the range, range-rate or azimuth of

neighboring vehicles.” *Attard*, 6:57-60. The radar attenuation manifests itself as uncertainty (“low confidence”) in the estimation of the range or azimuth of neighboring vehicles (*determined position of the other vehicle*). Thus, *Attard* teaches or renders obvious *a degree of uncertainty in the determined position of the other vehicle*. A POSITA would have understood that uncertainty in the location of obstacles/vehicles directly affects the ability of an autonomous system to avoid those objects, and thus affects the competence level of the system in driving autonomously. Thus, the *competence level...is a function of a degree of uncertainty in the determined position of the other vehicle*.

236. I note that it was well-known to consider radar uncertainties when determining the ability of an SDV to drive autonomously well before the '004 Patent. For example, *An* teaches an autonomous driving state risk index equation to determine whether to drive autonomously that incorporated an obstacle recognition error, and in *An*'s vehicle, objects (e.g., vehicles) are detected using radar. *An*, 5:64-6:31. As discussed, *Attard*'s radar data is incorporated into Φ , which is the *competence level of the SDV*, such that the *Hampiholi-Attard* SDV teaches 29(d). *Attard*, 1:65-2:6, 6:45-60 (teaching radar for computing confidence estimates, Φ). A motivation to combine *Hampiholi-Attard* is above. *See*, 1(c).

12. Claim 29(e): “autonomously controlling driver controls without requiring the human driver to control the driver controls,

wherein the driver controls comprise: engine throttle, a steering mechanism, and braking system;

237. See, 1(k).

13. Claim 29(f): “autonomously maintaining a buffer of space between the SDV and the other vehicle;”

238. See, 3(a).

14. Claim 29(g): “determining a competence level of a human driver using one or more of the sensor readings;”

239. See, 1(b).

15. Claim 29(h): “determining, using a fault remediation table, a first corrective action associated with a first human competence level, wherein the first corrective action comprises sounding a warning sound and displaying an icon on a display screen;”

240. See, 1(g), 1(i).

16. Claim 29(i): “determining, using the fault remediation table, a second corrective action associated with a second human competence level, wherein the second corrective action comprises decreasing a speed of the SDV and transferring driver controls to manual control;”

241. See, 1(h), 1(j).

17. Claim 29(j): “taking the first corrective action when the competence level of the human driver satisfies a first competence quota; and”

242. See, 1(g), 1(i) including for discussion of thresholds.

18. Claim 29(k): “taking the second corrective action when the competence level of the human driver satisfies a second competence quota.”

243. See, 1(h), 1(j) including for discussion of thresholds.

XIV. GROUND 7: CLAIM 30 IS OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, HADA, AND TSIMHONI-647

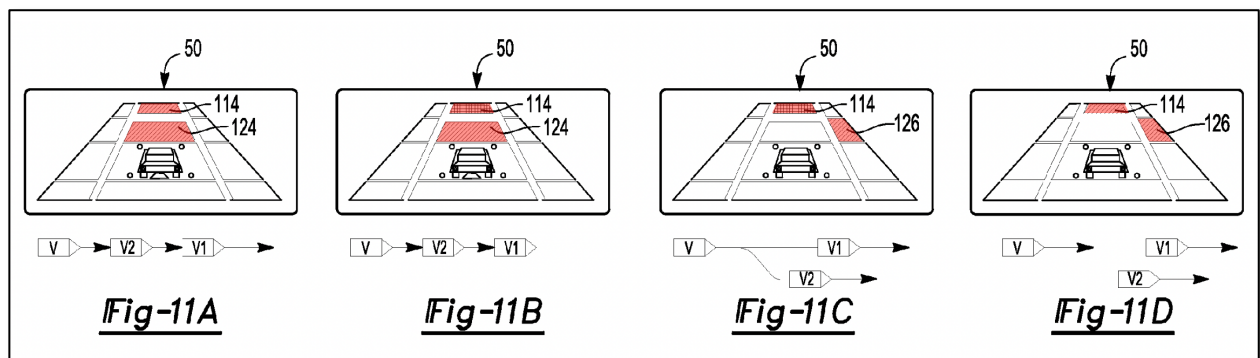
C. Claim 30

1. Claim 30(a): “The computer program product of claim 29, further comprising: displaying, on the display screen, a graphical representation of the position of the other vehicle relative to the SDV and a graphical representation of the competence level of the SDV.”

a) Hada’s Teachings

244. *Hada* teaches displaying proximity sensor information and/or collision warning information on a single display screen of a vehicle. *Hada*, 1:5-9. *Hada* teaches a display showing a grid for lane markings and illuminating at least one grid section as a function of the location of external objects. *Hada*, 1:41-2:34.

245. For example, *Hada* depicts the location of the user’s vehicle (V) and the positions of other nearby vehicles (V1, V2). The **hatched lines** in the grid indicate the position of the other vehicles.



Hada, Figs. 11A-11D. Thus, the *Hampiholi-Attard* SDV modified by *Hada* displays, on the display screen, a graphical representation of the position of the other vehicle relative to the SDV.

246. A POSITA would have been motivated to modify the *Hampiholi-Attard* SDV per *Hada* for the same reasons discussed above. *See*, 29(b). Further, displaying a graphical representation of the position of another vehicle on the display screen would have been use of *Hada*'s known technique to improve the similar *Hampiholi-Attard* SDV in the same way as *Hada*'s vehicle. A POSITA would have been motivated to make this modification for improved driver safety of informing a driver of the location of nearby vehicles and the position of those vehicles relative to the SDV. *Hada* provides an express teaching, suggestion, or motivation for implementing its technique, further motivating a POSITA to make this modification. *Hada*, 1:5-36, 3:17-21, 3:55-61, 5:23-36.

247. This modification would have had a REOS because it would have required only straightforward modifications to programming instructions, which would have been well-within the skillset of a POSITA. Specifically, the *Hampiholi-Attard* SDV already includes hardware including sensors, a display, a processor, and memory for performing *Hada*'s technique. To the extent it is argued that the *Hampiholi-Attard* SDV's display is insufficient, a POSITA would have known that commercially available, off-the-shelf displays capable of performing this displaying

were available, and a POSITA would have had a REOS in modifying the *Hampiholi-Attard* SDV to include such a display.

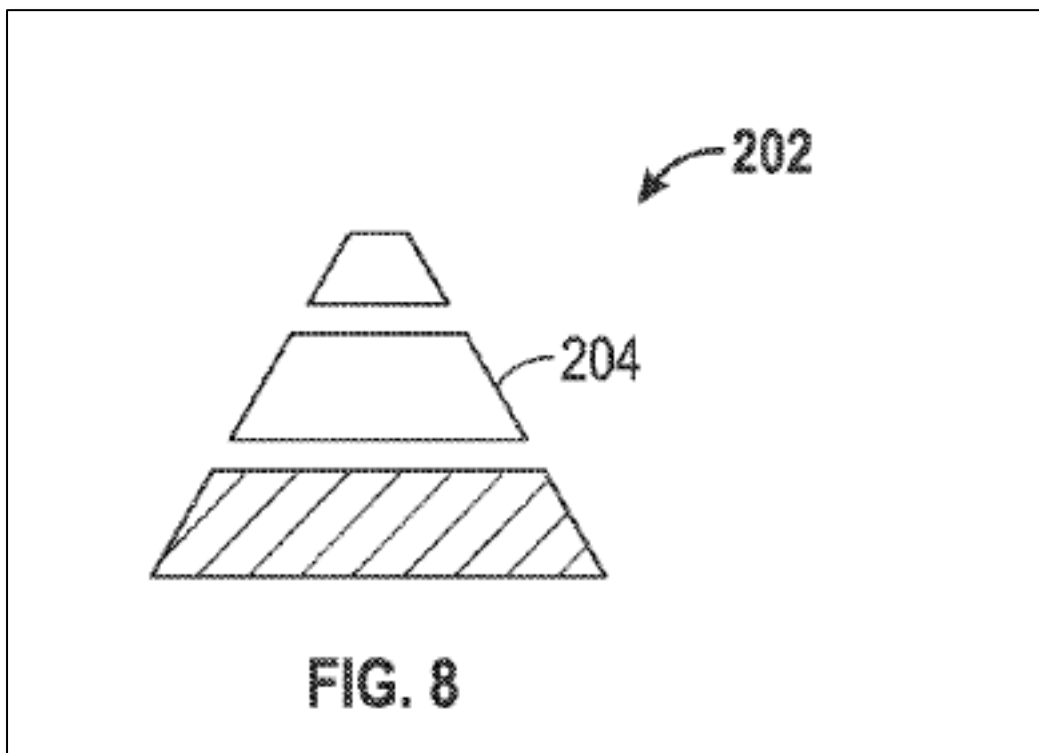
b) *Tsimhoni-647's* Teachings

248. *Tsimhoni-647* teaches a “control system...for automatically controlling operation of a vehicle.” *Tsimhoni-647*, 1:45-46. I note that *Tsimhoni-647* uses the word “automatic” interchangeably with “autonomous,” such that *Tsimhoni-647's* vehicle is an autonomous or self-driving vehicle per the '004 Patent's description. *Tsimhoni-647*, 1:19-21; '004 Patent, 1:29-31, 15:64-16:4, 28:38-40.

249. *Tsimhoni-647* teaches computing a “confidence value...relating to how ‘secure’ or ‘confident’ the control system 100 is” in controlling the vehicle. *Tsimhoni-647*, 5:16-21. The confidence value is “based at least partially on the sensed environment around the vehicle.” *Tsimhoni-647*, 1:48-54. Thus, *Tsimhoni-647's* confidence level is a *competence level of the SDV* because it indicates the ability of the vehicle to drive autonomously.

250. *Tsimhoni-647* teaches displaying the confidence value to the driver on a display 116 that “is configured to receive data from the processor and display information to the driver and/or other users of the vehicle 102.” *Tsimhoni-647*, 5:30-32. The display is “configured to display... a driving plan icon 202,” which “may include a trajectory icon 204.” *Tsimhoni-647*, 5:34-38. The trajectory icon 204 “indicate[s] the confidence level.” *Tsimhoni-647*, 6:3-7. Filled trapezoids represent

higher confidence, while unfilled trapezoids represent lower confidence. *Tsimhoni-647* also teaches that “the number of trapezoids included in the trajectory icon 204 may indicate the confidence level” and that “alternate shading, coloring, or other techniques of presentation may be utilized to convey confidence level to the driver or other user.” *Tsimhoni-647*, 6:3-17. Thus, regardless of how the confidence level is indicated, *Tsimhoni-647* trajectory icon 204 is a graphical representation of the competence level of the SDV.



Tsimhoni-647, FIG. 8, 6:12-14 (teaching low confidence because only one of the three trapezoids is filled).

c) Motivation to Combine

251. A POSITA would have been motivated and found it obvious to modify the *Hampiholi-Attard* SDV further with *Tsimhoni-647*'s teachings of *displaying a competence level*, which is merely the combination of known prior art elements according to known methods to yield the predictable result of the *Hampiholi-Attard* SDV depicting a confidence icon, per *Tsimhoni-647*. *Tsimhoni-647* provides an express teaching, suggestion, and motivation for the combination, teaching the display of the confidence informs the driver "as to the functionality of the automatic operation of the vehicle" such that the driver may be alerted "to an upcoming need to take over operation of the vehicle 102 from an automatic mode to a manual mode." *Tsimhoni-647*, 6:18-24. Thus, a POSITA would have recognized the benefits of such a modification, by visually indicating to the driver when they may need to take over driving, due to, e.g., Φ becoming low, which is expressly envisioned by *Tsimhoni-647*. *Tsimhoni-647*, 6:18-21 ("[T]he driver is informed as to the functionality of the automatic operation of the vehicle 102 by the control system."). This use of a known technique of displaying a graphical representation of the CPCL on a display would have improved the *Hampiholi-Attard* SDV in the same way as *Tsimhoni-647*'s vehicle by increasing the driver's awareness of when a takeover may be required.

252. A POSITA would have had a REOS because such a modification would have required a straightforward software/programming instruction change to the *Hampiholi-Attard* SDV to display information already being computed by the

system, i.e., *Attard's* Φ . The *Hampiholi-Attard* SDV already includes a touchscreen user interface, and *Tsimhoni-647* likewise teaches the display 116 can be a touch screen. *Hampiholi*, [0020]; *Tsimhoni-647*, 4:23-27. Additionally, *Hampiholi*, *Attard*, and *Tsimhoni-647* all teach implementations via processors executing programming instructions, further leading to a REOS. *Hampiholi*, [0032] (teaching processor executing computer instructions, memory); *Attard*, 15:12-46 (teaching computer-executable instructions, processor, memory); *Tsimhoni-647*, 3:11-15 (teaching processor executing program instructions).

XV. GROUND 8: CLAIMS 31-32 ARE OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, HADA, TSIMHONI-647, DERUYCK, GUNDERSON, AN, KANG, AND SCHUNDER

A. Claim 31

1. Claim 31(a): "The computer program product of claim 29, further comprising: determining the competence level of the human driver comprises using a weighted voting system with a first plurality of inputs and a first plurality of weights, wherein:"

253. *See*, 2(a).

2. Claim 31(b): "the first plurality of inputs comprises one or more sensor readings of the sensor readings;"

254. *See*, 2(b).

3. Claim 31(c): "at least one of the first plurality of inputs is multiplied by a weight from among the first plurality of weights, wherein the first plurality of weights are based on first active learning data, the first active learning data comprising information about a first cohort of human drivers of other SDVs; and"

255. *See*, 2(c).

4. Claim 31(d): “determining the competence level of the SDV comprises using the weighted voting system with a second plurality of inputs and a second plurality of weights, wherein:”

256. *See*, 2(d).

5. Claim 31(e): “the second plurality of inputs comprises one or more of the sensor readings;”

257. *See*, 2(e).

6. Claim 31(f): “the second plurality of inputs comprises at least one sensor reading that is not in the first plurality of inputs; and”

258. *See*, 2(f).

7. Claim 31(g): “at least one of the second plurality of inputs is multiplied by a weight from among the second plurality of weights, wherein the second plurality of weights are based on second active learning data, the second active learning data comprising condition data from a second cohort of other SDVs, wherein the condition data shares one or more traits with a current condition of the roadway on which the SDV is currently traveling.”

259. *See*, 2(h).

B. Claim 32

1. Claim 32(a): “The computer program product of claim 31, further comprising: determining, using one or more sensor readings of the sensor readings, the position of a lane marking on the roadway;”

260. *Hampiholi-Attard* teaches a fault when a lane-tracking system cannot “see the lane-markings.” *Attard*, 8:10-13. A POSITA would have understood that

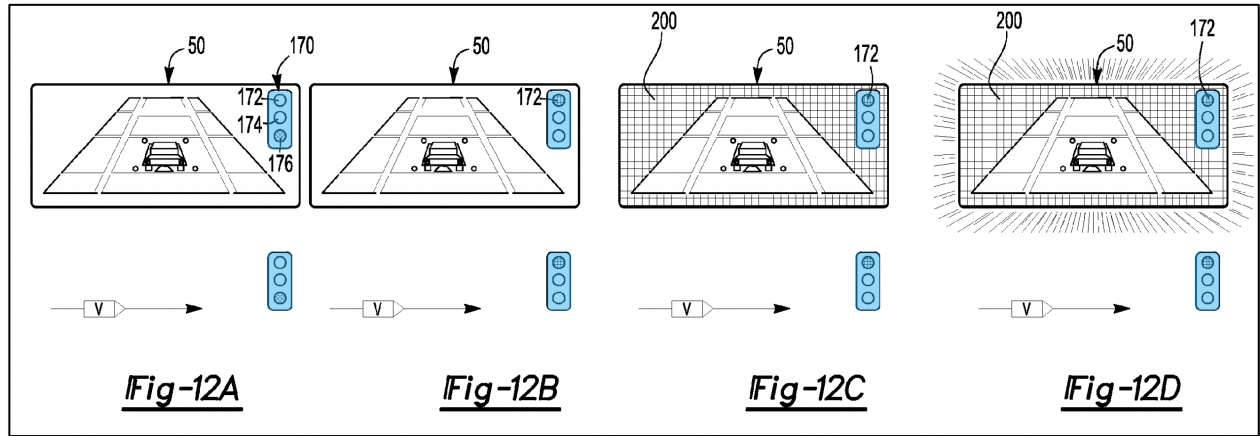
Hampiholi-Attard thus determines, using one or more sensor readings of the sensor readings, the position of a lane marking on the roadway. Indeed, a POSITA would have understood or found obvious that if a vehicle is able to determine that a fault has occurred because the vehicle cannot see lane markings, then in “normal” circumstances when the sensors are operational, the vehicle can detect lane markings.

261. To the extent it is argued that *Attard* does not teach a sensor detecting a lane marking, *Hada* teaches determining the position of lane markings on the roadway using sensor readings. *Hada*, 2:12-34, 3:17-30, 4:32-59, 5:37-43.

262. A POSITA would have been motivated to modify the *Hampiholi-Attard* SDV per *Hada*’s teachings and would have had a REOS for the same reasons discussed for Claim 29. *See*, Claim 29. Detecting lanes and utilizing a camera for a lane departure warning system would have been use of a known technique to improve vehicle safety in the *Hampiholi-Attard* SDV in the same way as in *Hada*. Lane departure systems were well-known in the prior art, including for use in SDVs. Further, an SDV unable to detect lane markings would have been dangerous for the driver and others on the roadway.

2. Claim 32(b): “determining, using one or more sensor readings of the sensor readings, the position of a traffic signal; and”

263. *Hada* teaches determining the position of a traffic signal using sensor readings. *Hada*, 6:19-27, 2:24-34, 3:17-30, 3:55-58, 6:64-7:7, 10:1-23.

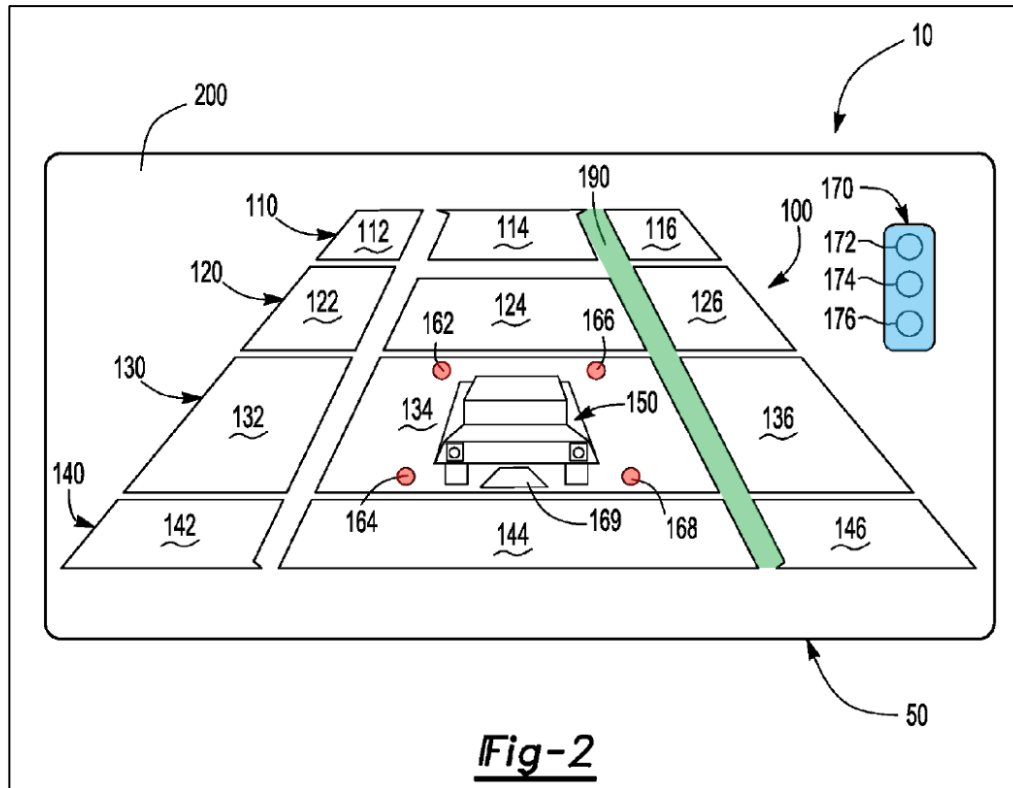


Hada, Figs. 12A-12D, Fig. 2.

264. A POSITA would have been motivated to modify the *Hampiholi-Attard* SDV per *Hada*'s teachings and would have had a REOS for the reasons discussed for Claim 29. *See*, Claim 29. I note detecting a traffic signal is advantageous for the benefits *Hada* teaches, such as alerting a driver to not drive through a red light, thus increasing driver and vehicle safety. *Hada*, 6:19-27, 7:1-7, 10:1-23.

3. ***Claim 32(c): "displaying, on the display screen, a simultaneous graphical representation of the position of the other vehicle, the position of the lane marking on the roadway, the position of the traffic signal, and the competence level of the SDV."***

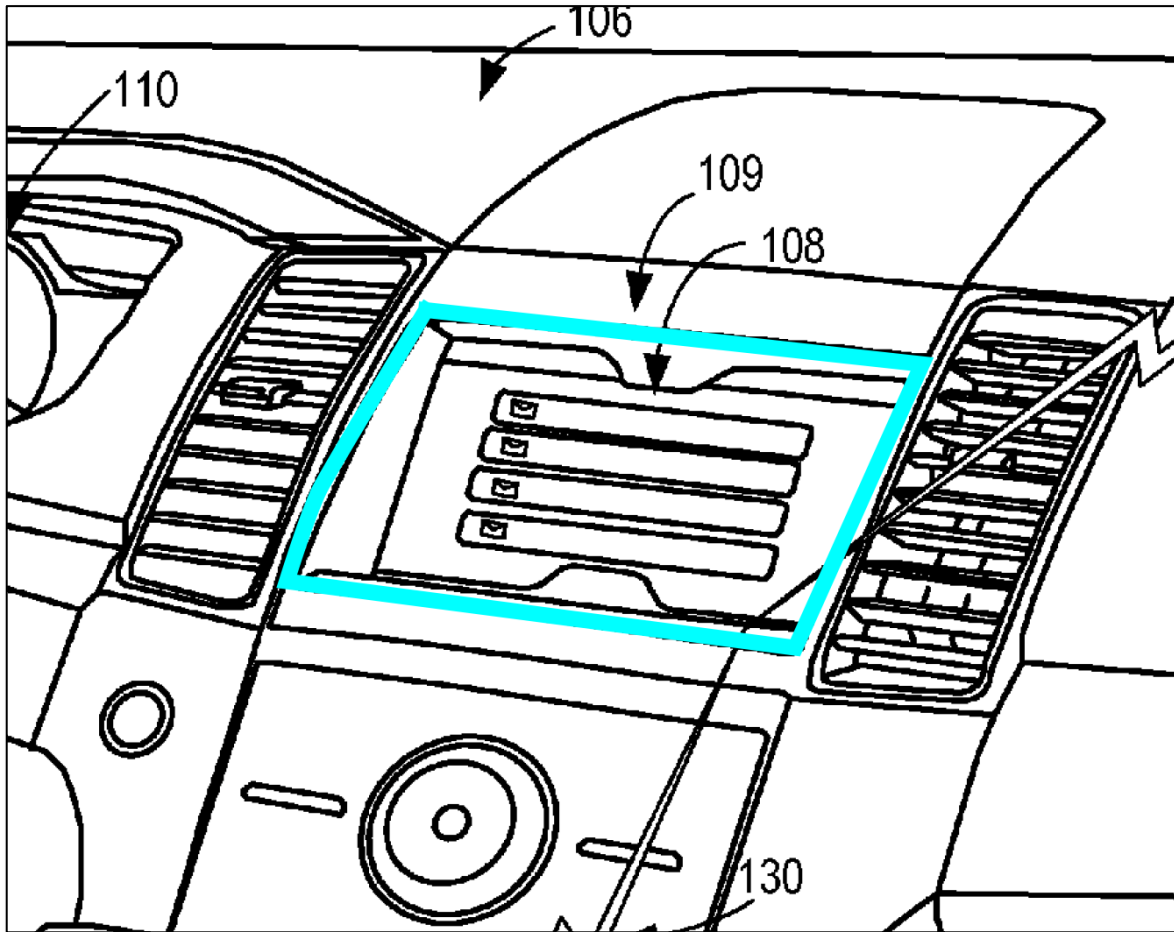
265. *Hada*'s display 50 displays a simultaneous graphical representation of the position of: *other vehicle[s]*; *lane marking[s] on the roadway*; and *a traffic signal*.



Hada, Fig. 2. As discussed, the *Hampiholi-Attard* SDV is modified per *Hada* and *Tsimhoni-647* so the CPCL is also depicted via *Tsimhoni-647*'s trapezoid icon 204. See, 30(a); *Tsimhoni-647*, 6:3-24, FIG. 8. A POSITA would have understood the *Hampiholi-Attard* SDV's display would have been capable of simultaneously displaying: the position of other vehicles; lane markings; a traffic signal; and the CPCL. Indeed, *Hada* teaches displaying such pieces of information simultaneously, and the *Hampiholi-Attard* SDV likewise would have displayed all these pieces of information when modified by *Hada*'s and *Tsimhoni-647*'s teachings. *Tsimhoni-647* likewise teaches its trajectory icon makes a display "less cluttered and less

distracting to the driver” leading to a reasonable expectation of success in the simultaneous display. *Tsimhoni-647*, 6:28-31.

266. Further, a POSITA would have understood that a vehicle display such as *Hampiholi-Attard’s* (where *Hampiholi* expressly teaches user interface 218 includes a touch screen 108) would have been capable of displaying numerous pieces of information simultaneously. Indeed, *Hampiholi* expressly teaches a graphical user interface (GUI) for displaying information to a user. *Hampiholi*, [0044]. A POSITA would have understood or found obvious that such a GUI would have been capable of displaying the aforementioned (and/or other) pieces of information either individually, simultaneously, or in combinations thereof. As an example, *Hampiholi’s* user interface 218 (which includes touch screen 108) natively displays at least four pieces of information simultaneously, as depicted in the enlarged excerpt of Fig. 1 below:



Hampiholi, Fig. 1 (excerpt).

267. A POSITA would have been motivated to modify the *Hampiholi-Attard* SDV per *Hada's* and *Tsimhoni-647's* teachings and had a REOS for the same reasons discussed for 29-30. *See*, Claims 29-30.

XVI. GROUND 9: CLAIMS 33-34 ARE OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, HADA, TSIMHONI-647, DERUYCK, GUNDERSON, AN, KANG, SCHUNDER, AND NAGASAKA

A. Claim 33

1. Claim 33(a): "The computer program product of claim 32, further comprising: autonomously changing lanes without requiring the human driver to control the driver controls;"

268. *Attard* teaches module 106 autonomously controls lane changing without requiring the human driver to control the driver controls. *Attard*, 9:63-10:8 (“All vehicle 101 operations, e.g., steering, braking, speed, etc. could be controlled by the module 106 in the computer 105.”), *id.* (“Likewise, the module 106 could control when a vehicle 101 changes lanes.”). Thus, *Attard*’s autonomous driving module 106 is a component that works with computer 105 to perform SDV functions, including deciding when to change lanes and changing lanes. *See*, Claims 1, 29 for motivation to modify *Hampiholi* per *Attard*.

2. Claim 33(b): “autonomously engaging a turn signal of the SDV prior to autonomously changing lanes without requiring the human driver to control the turn signal;”

269. *Hampiholi* teaches turn signals. *Hampiholi*, [0041]. *Attard* teaches autonomously switching lanes. *See*, 33(a). To the extent it is argued *Hampiholi-Attard* does not expressly teach 33(b), a POSITA would have understood that SDVs were required by driving laws⁵ to signal their intentions, including when driving in

⁵ *See*, California Vehicle Code 22108 (Ex. 1051 – “22108”), 1 “Any signal of intention to turn right or left shall be given continuously during the last 100 feet traveled by the vehicle before turning.”); *Gorelick* (Ex. 1052), 1 (“Violation of 22108 VC is an infraction punishable by a fine of up to \$238.”).

autonomous mode without human driver controlling signals, rendering 33(b) obvious. A POSITA would have understood that SDVs as well as non-SDVs need to signal their intention to change lanes before doing so. Failure to do so can result in receiving a citation from a police officer. A POSITA would have found it obvious that SDVs would need to signal their intention to change lanes to thus comply with driving laws and for ensuring safe driving, in particular because an SDV changing lanes without signaling is dangerous and can cause an accident with another vehicle on the road.

270. Additionally, or alternatively, *Nagasaka* teaches an SDV autonomously engaging a turn signal prior to autonomously changing lanes. *Nagasaka*, 9:64-10:3, 10:60-67 (Lane change module 137 activates a signaling system 175 to indicate lane change), 12:58-13:3, 17:61-67. A POSITA would have understood from *Nagasaka*'s teachings that such is done *without requiring the human driver to control the turn signal* because *Nagasaka*'s control of the turn signal is performed by lane change module 137 activating signaling system 175, which are part of the autonomous vehicle. Thus, the turn signals are controlled without human driver input. *Nagasaka*, 1:17-18, 3:11-17. A POSITA would have understood that *Nagasaka*'s SDV includes lane change module 137 and signaling system 175, and thus the SDV autonomously signals to change lanes.

271. A POSITA would have been motivated to modify the *Hampiholi-Attard* SDV per *Nagasaka* to autonomously utilize turn signals before the SDV switches lanes to improve safety for the occupant/driver of the SDV and nearby vehicles and to comply with driving laws that require a vehicle to signal its intention before changing lanes. As I discussed above, failure to utilize a turn signal can result in receiving a citation from a police officer. For both legal and safety reasons, a POSITA would have been motivated to implement autonomously utilizing turn signals in the *Hampiholi-Attard* SDV. Indeed, requiring a user to activate the turn signal while in autonomous driving mode would have been inefficient and not preferable in at least some circumstances. Modifying the *Hampiholi-Attard* SDV would have been use of known technique to improve the *Hampiholi-Attard* SDV in the same way as *Nagasaka*. Further, combining prior art elements according to known methods would have yielded predictable result of the *Hampiholi-Attard* SDV engaging a turn signal before switching lanes. Here, prior art elements such as an SDV, lane change module, and signaling system would have been combined to predictably result in an SDV that autonomously utilizes signaling, such as turn signals.

272. A POSITA would have had a REOS because modifying the *Hampiholi-Attard* SDV's programming instructions to achieve said autonomously engaging a turn signal would have been straightforward and well-within a POSITA's skillset.

To the extent it is argued that *Nagasaka*'s hardware would have been required to perform this modification, a POSITA would have been motivated to modify the *Hampiholi-Attard* SDV to include any hardware and/or programming instructions necessary to implement this modification.

3. Claim 33(c): “determining, using the fault remediation table, a third corrective action associated with a first SDV competence level; and”

273. See, Claims 1, 6, 29. The *Hampiholi-Attard* SDV includes a fault-remediation table, which includes corrective actions associated with a CPCL. As I opined above, at least some corrective actions in the *Hampiholi-Attard* SDV are associated with CPCL, such as lane-tracking system faults and weather-related faults. See, Claims 1, 2, 8, 29.

4. Claim 33(d): “taking the third corrective action when the competence level of the SDV is equivalent to or below the first SDV competence level.”

274. See, Claims 1, 6, 29. In the *Hampiholi-Attard* SDV, the third corrective action would have been taken when the programmed conditions are met, e.g., when the CPCL is equivalent to or below the first CPCL. See, 29(h)-(i) for exemplary corrective actions to take.

B. Claim 34

1. Claim 34(a): “The computer program product of claim 33, further comprising: the third corrective action comprises decreasing

a speed of the SDV and transferring the driver controls to manual control; and”

275. *See*, 1(j), 29(i). A POSITA would have understood the same corrective actions would also have been obvious to take *when the competence level of the SDV is equivalent to or below the first SDV competence level*. Indeed, a POSITA would have understood that these corrective actions would have been taken for the same/similar reasons as those discussed in Claims 1, 29. As discussed above, thresholds and corrective actions are determined by programming instructions, and a POSITA would have understood how to modify programming instructions.

2. Claim 34(b): “the competence level of the human driver is a function of a sensor reading from the camera directed at the human driver.”

276. *See*, Claims 1, 29(a)(i). *Hampiholi* teaches a camera directed at the human driver and determines the HDCL as a function of readings from said camera.

XVII.GROUND 10: CLAIMS 35-36 ARE OBVIOUS OVER HAMPIHOLI, ATTARD, MCNEW, FRAZER, HADA, TSIMHONI-647, DERUYCK, GUNDERSON, AN, KANG, SCHUNDER, NAGASAKA, AND DUNCAN

A. Claim 35

1. Claim 35(a): “The computer program product of claim 34, further comprising: retrieving a human driver profile from a database;”

277. A POSITA would have understood or found obvious that retrieving a human driver profile from storage in a persistent storage device would have met

retrieving a human driver profile from a database. Duncan teaches or renders obvious retrieving a human driver profile from a database. *Duncan*, [0101] (“The updated operator profile may be saved 1210 to a persistent storage device.”), [0103] (“The condition of the operator may be evaluated periodically, and a memory and/or storage device may be accessed to retrieve the most recent values”). A POSITA would have understood that organizing the data in a manner to be searched, modified, and retrieved would have been basic functions for a computer and for databases.

278. A POSITA would have been motivated to modify the *Hampiholi-Attard* SDV per *Duncan* to store/retrieve a driver profile in persistent storage. This use of a known technique would have improved the similar *Hampiholi-Attard* SDV in the same way as *Duncan*’s vehicle. Storing driver profiles allows for profile data to be collected over a longer period of time and allows for trends to be analyzed over that longer time frame, which a POSITA would have found advantageous. If a memory were not used, for example, then each trip would be like starting with a fresh driver profile, which would not allow for this longer-term analysis. Such a modification would have improved the *Hampiholi-Attard* SDV by tracking driver competence levels temporally and allowing for said driver profile data to be stored and retrieved from a database. I note that using a database to store and retrieve information was a common function of computers in general, with SDV computers operating similarly.

Storing and retrieving human driver profiles would thus have simply been utilizing known techniques for computers, and this modification would have improved the *Hampiholi-Attard* SDV in the same way as *Duncan*.

279. A POSITA would have had a REOS because the *Hampiholi-Attard* SDV already includes memory, storage, and a processor, and one of the basic functions of a computer is to store and access data in memory. Further, the *Hampiholi-Attard* SDV already collects driver information from sensors. Thus, a POSITA would have understood that the necessary hardware was already present in the *Hampiholi-Attard* SDV, and that only straightforward programming instructions would have needed to be modified to store a driver profile in memory for future retrieval. Thus, a POSITA would have had to provide only straightforward modifications to programming instructions to store and retrieve driver profile information that the *Hampiholi-Attard* SDV already collects.

2. Claim 35(b): “determining, using the fault remediation table, a fourth corrective action associated with a first human driver profile quota, wherein the fourth corrective action comprises disabling an autonomous driving mode; and”

280. See, Claims 1, 6, 29, 34. The *Hampiholi-Attard* SDV includes a fault-remediation table per *Frazer*, which includes any number of corrective actions associated with an HDCL. The patent defines “quota” as “quota (q) is the minimum number of votes required to "pass a motion." '004 Patent, 9:1-2. A POSITA would

consider the “quota” to be equivalent to a threshold – the value at which something “passes.” The corrective action would have been taken when the programmed conditions are met, i.e., when the HDCL is equivalent to or below the first human driver profile quota. Indeed, a POSITA would have understood that these corrective actions would have been taken for the same/similar reasons as those discussed in Claims 1, 29 regarding thresholds. As discussed above, thresholds and corrective actions are determined by programming instructions, and a POSITA would have understood how to modify programming instructions. *See*, 1(j), 29(h)-(i) for exemplary corrective actions to take, including disabling an autonomous driving mode.

3. Claim 35(c): “taking the fourth corrective action when the human driver profile is equivalent to or below the first human driver profile quota.”

281. *See*, 1(j), 29(i), 34(a), 35(a)-(b). A POSITA would have understood that a corrective action would have been obvious to take *when the human driver profile is equivalent to or below the first human driver profile quota*. Indeed, a POSITA would have understood that these corrective actions would have been taken for the same/similar reasons as those discussed in Claims 1, 29, 35(a)-(b). As discussed above, thresholds and corrective actions are determined by programming instructions, and a POSITA would have understood how to modify programming instructions.

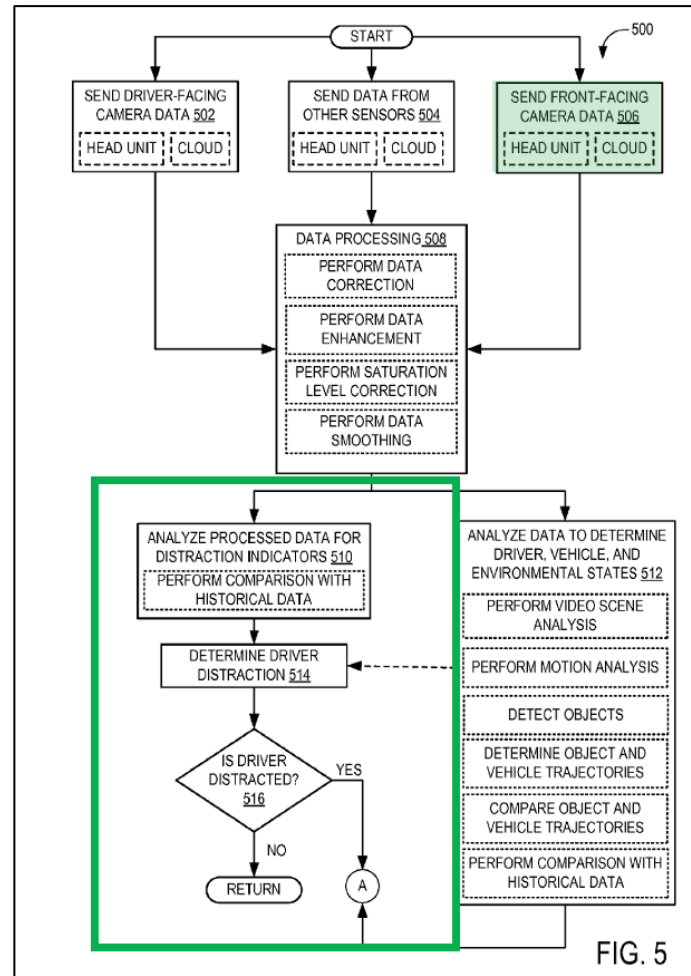
B. Claim 36

1. Claim 36(a): “The computer program product of claim 35, further comprising: the human driver profile is a function of a previous sensor reading from the camera directed at the human driver;”

282. See, Claims 34-35. It would have been obvious to a POSITA for a human driver profile to be a function of previous sensor readings from the driver-facing camera because the *Hampiholi-Attard* SDV already teaches determining R using said camera, and *Duncan* teaches storing and retrieving a driver profile from memory. Further, *Duncan* teaches the driver profile is based on prior sensor readings. *Duncan*, [0007], [0031], [0037], [0052], [0067], [0079], [0101]. See, Claim 35.

2. Claim 36(b): “the human driver profile is a function of a previous sensor reading from the camera directed away from the SDV;”

283. *Hampiholi* teaches collecting front-facing camera data for determining the HDCL. *Hampiholi*, [0061].



Hampiholi, FIG. 5. To the extent another camera is required, *Attard* teaches forward-facing cameras. *See*, Claims 1, 29.

3. **Claim 36(c): “the human driver profile is a function of a previous sensor reading from the sensor configured to detect input from the steering wheel; and”**

284. *McNew* teaches a steering wheel sensor, and its data is used in the *Hampiholi-Attard* SDV to determine R. Thus, the human driver profile is a function of a previous sensor reading from the steering wheel sensor. *See*, 1(b). As I discussed

above, the *Hampiholi-Attard* SDV would have been modified per *McNew's* teachings of using a steering wheel sensor. *See* Claim 1.

4. Claim 36(d): “the human driver profile is a function of a previous sensor reading from the speedometer.”

285. *See*, 1(Pre). *Hampiholi* teaches a speedometer. *Hampiholi* teaches determining driver distraction level. *See*, Claims 1, 29. A POSITA would have understood that speedometer data would also have been utilized when generating the human driver profile. *See*, 1(b). For example, speedometer data would have been utilized to determine when a driver is exceeding a speed limit or driving under a speed limit (for example, in conjunction with GPS data and/or other map data including speed limit information).

XVIII. GROUND 11: CLAIMS 37-39 ARE OBVIOUS OVER ATTARD, HAMPIHOLI, MCNEW, AND FRAZER

A. Claim 37

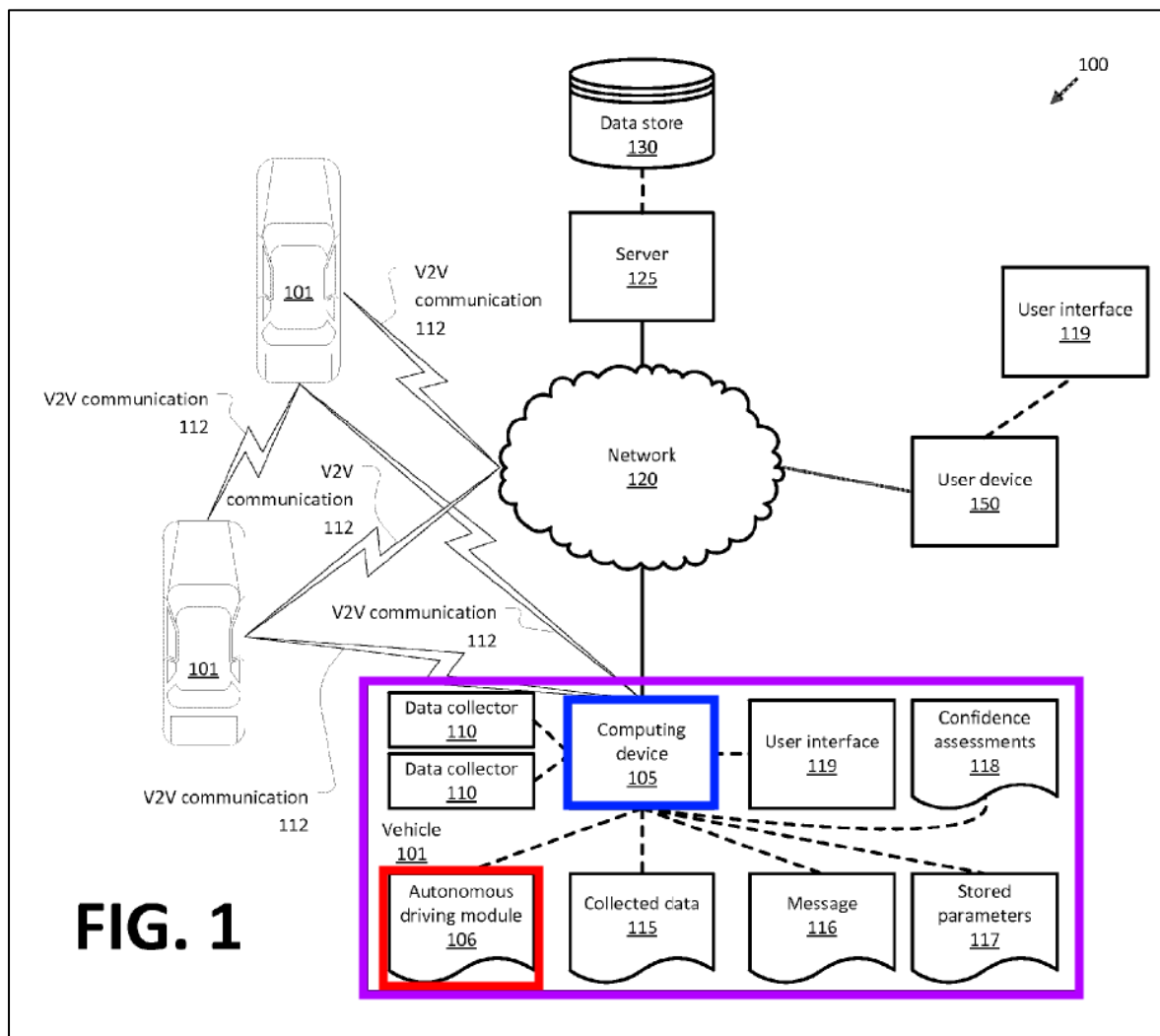
1. Claim 37(Pre): “A computer program product for controlling a driving mode of a self-driving vehicle (SDV), the computer program product comprising a non-transitory computer readable storage medium having program code embodied therewith, the program code readable and executable by a processor to perform a method comprising:”

286. To the extent the preamble is limiting, *Attard* teaches a computer program product that manages fault handling in an SDV including controlling a driving mode by changing from an autonomous mode to a manual mode (or semi-autonomous mode) in response to a fault. *See*, 1(Pre). Further, *Attard* teaches

computer readable storage medium such as non-volatile memory and programming code stored thereon that is *readable and executable by a processor*.

a) **Attard's Computer Program Product Comprises Non-Transitory Computer-Readable Memory and Processor**

287. Attard's teaches vehicle 101 includes computer 105 and autonomous driving module 106:



Attard, Fig. 1, 1:41-52.

288. *Attard* teaches autonomous operations of vehicle 101 are stored as a set of instructions in vehicle 101's memory *and executable by a processor* of computer 105. *Attard*, 2:27-32, 3:15-22. A POSITA would have understood or found obvious that *Attard* teaches a *computer program product* for *controlling a driving mode* of vehicle 101, which comprises non-volatile memory and a processor for executing programming instructions.

289. *Attard* teaches the autonomous operations of vehicle 101 may be stored as a set of instructions in vehicle 101's memory and executable by a processor of computer 105. *Attard*, 2:27-32 ("Autonomous operations of the vehicle 101, including generation and evaluation of confidence assessments 118, may be performed in an autonomous driving module 106, e.g., as a set of instructions stored in a memory of, and executable by a processor of, a computing device 105 in the vehicle 101."), 3:15-22 ("In any case, the vehicle 101 generally includes a vehicle computer 105 that includes a processor and a memory, the memory including one or more forms of computer-readable media, and storing instructions executable by the processor for performing various operations, including as disclosed herein."), 15:11-46 (teaching computer-executable instructions, processor, and computer-readable medium including non-volatile media). Thus, a POSITA would have understood or found obvious that *Attard* teaches a computer program product for vehicle 101 including for controlling a driving mode and that the computer program product

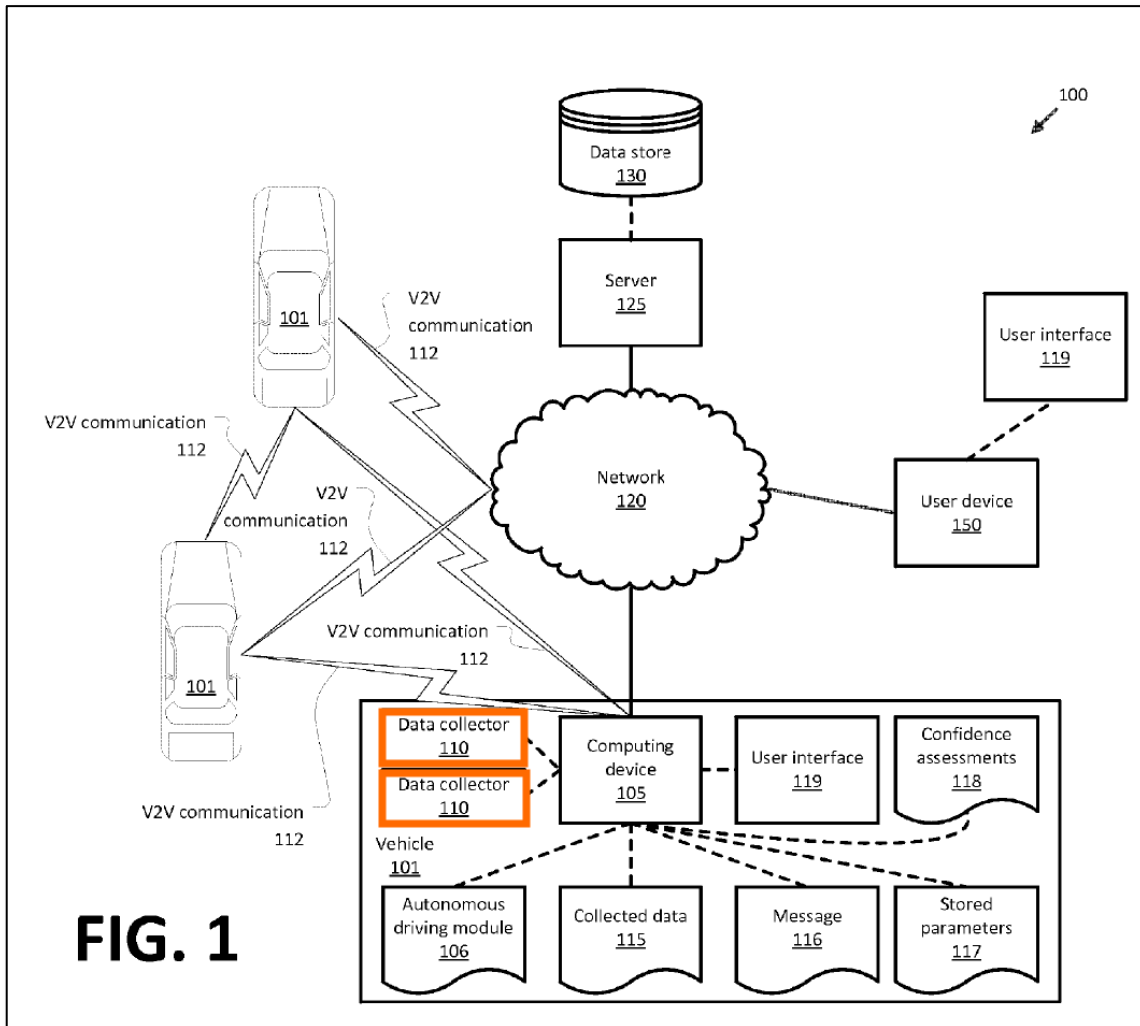
comprises non-volatile memory and a processor for executing programming instructions. I note that it was commonplace and well known for SDVs like *Attard's* vehicle 101 to include a processor, memory, and programming instructions to control various features of the vehicle including for controlling a driving mode. *See* V.E.

2. Claim 37(a): “receiving one or more sensor readings from a system of sensors, wherein the system of sensors comprises one or more sensors that detect an operational state of the SDV, the one or more sensors comprising:”

a) *Attard's* System of Sensors and Sensor Readings

290. *Attard's* computer 105 receives collected data 115 (*sensor readings*) from sensors 110 (*system of sensors*), which include cameras, GPS, LIDAR, etc. *Attard*, 4:1-31. *Attard's* sensors 110 transmit collected data 115 to computer 105. *Attard*, 4:32-45.

291. *Attard* teaches collected data 115 includes data gathered by sensors 110 and data derived from the sensor readings. *Attard*, 4:32-45.



Attard, Fig. 1.

292. A POSITA would have understood or found obvious that *Attard*'s sensors 110 are a *system of sensors* because *Attard* teaches a plurality of such sensors and the sensors work together with vehicle 101 including computer 105 and autonomous driving module 106 to collect data 115. *Attard*, 4:1-17, 1:61-2:6. I note that *Attard* teaches a plurality of data collectors 110, including depicting at least two in Fig. 1. Further, *Attard* refers to data collectors 110 as plural, also indicating to a

POSITA that *Attard* teaches a plurality of data collectors 110. One example is a plurality of cameras. *Attard*, 1:50-61 (“one or more data collectors 110, e.g., sensors or the like”), 2:6 (“data collectors 110”), 2:10-18 (“data collection devices 110 such as sensors”), 2:28-34, 3:60-65, 4:1-45, 6:36-44.

293. A POSITA would have understood or found obvious that *Attard*’s sensors 110 are a *system of sensors* because *Attard* teaches a plurality of such sensors and the sensors work together with vehicle 101 including computer 105 and autonomous driving module 106 to collect data 115. *Attard*, 4:1-17, 1:61-2:6. To the extent PO argues *Attard* does not expressly teach *sensor readings*, a POSITA would have understood or found it obvious that *Attard*’s cameras capture collected data 115, which are *sensor readings*. Compare *Attard* with ’004 Patent’s descriptions of sensors 153. For example, the ’004 Patent describes sensors 153 “are sensors that detect an operational state of an SDV, including anomalous states such as, but not limited to, a presence of snow tires mounted on the SDV during a first road condition of the roadway, an absence of snow tires ... tire pressure ... tire tread ...an inoperable headlamp ... a faulty braking system.” ’004 Patent, 5:57-6:6. In my opinion, *Attard*’s sensors are a system of sensors that detect operational states of the SDV, as I discuss in more detail below.

b) *Attard*’s Sensor Readings Describe a Current Operational State of an SDV

294. The '004 Patent describes an “operational state” of a vehicle including states (e.g. presence/absence of snow tires), conditions (e.g. road conditions), and measured parameters detected via sensors. *'004 Patent*, 5:57-6:6.

295. *Attard's* sensors 110 similarly “pertain[] to a particular vehicle 101 and/or vehicle 101 sub-system, environmental attribute, or condition.” *Attard*, 10:42-52. Because *Attard's* collected data 115 (*sensor readings*) detect conditions external and internal to vehicle 101, *Attard's sensor readings describe a current operational state of a SDV*. *Attard* teaches sensors which similarly “provide indicia related to collected data 115 pertaining to a particular vehicle 101 and/or vehicle 101 sub-system, environmental attribute, or condition,” where “an attribute or condition such as road conditions, weather conditions, braking capabilities, ability to detect a lane, ability to maintain a speed of the vehicle 101” are all taken into consideration and are related to collected data 115. *Attard*, 10:42-52. As described regarding Fig. 2, at block 210 the vehicle's sensors collect data, providing it to computer 105. *Attard*, 10:13-17, Figs. 1-2.

296. Because *Attard's* collected data 115 (“*sensor readings*”) detect conditions external to the vehicle (e.g., weather conditions, road attributes) and data internal to the vehicle (e.g., acceleration, speed) used to perform autonomous driving, *Attard's sensor readings describe a current operational state of a SDV*, as claimed. *Compare Attard*, 1:61-2:6, 4:1-17, 6:4-13, 10:13-27 with *'004 Patent*, 5:57-

6:6. Indeed, as I discussed above, the '004 Patent describes sensors indicating operational states such as presence or absence of snow tires and weather or road conditions. *Attard's* sensors 110 are similarly capable of indicating conditions on the roadway, weather, and also operational states related to the vehicle itself.

3. Claim 37(a)(i): “a camera directed away from the SDV;”

297. See, 29(a)(ii).

4. Claim 37(a)(ii): “a sensor configured to detect input from a steering wheel;”

298. See, 1(a), 29(a)(iii).

5. Claim 37(a)(iii): “a GPS sensor;”

299. See, 1(a).

6. Claim 37(a)(iv): “a thermometer; and”

300. See, 29(a)(v).

a) Motivation to Combine Attard-Hampiholi

301. A POSITA would have found it obvious and been motivated to combine *Attard* with *Hampiholi's* thermometer teachings as such is merely the combination of known prior art elements according to known methods to yield the predictable result of *Attard's* vehicle 101 including a thermometer to measure temperature, such as the interior cabin temperature. This use of a known technique would have

improved the similar *Attard* vehicle in the same way as *Hampiholi's* vehicle. It is common knowledge to a POSITA that thermometers have been present in cars for years such that a POSITA would have had a REOS in modifying *Attard* based on *Hampiholi's* teachings.

7. Claim 37(a)(v): “a speedometer;”

302. See, 1(a). See, 37(a)(iv) for the motivation to combine *Attard-Hampiholi*. A POSITA would understand that a speedometer is required on road vehicles sold in the USA.

8. Claim 37(b): “determining a competence level of a control processor as a function of the operational state of the SDV;”

303. *Attard* teaches *determining a CPCL*. See, 1(c). *Attard* further teaches *the operational state of the SDV*. See, 1(a), 37(a). Because *Attard's* CPCL, Φ , is determined based on data 115 from sensors 110, which are also used to determine *the operational state of the SDV*, *Attard* teaches Φ is *a function of the operational state of the SDV*. *Attard* teaches many operational states of the SDV, as I discussed with respect to 37(a). For example, per Claim 39, the *operational state* is a *current weather condition*, which is taught by *Attard* as incorporated into Φ such that Φ is *a function of the operational state* (weather condition).

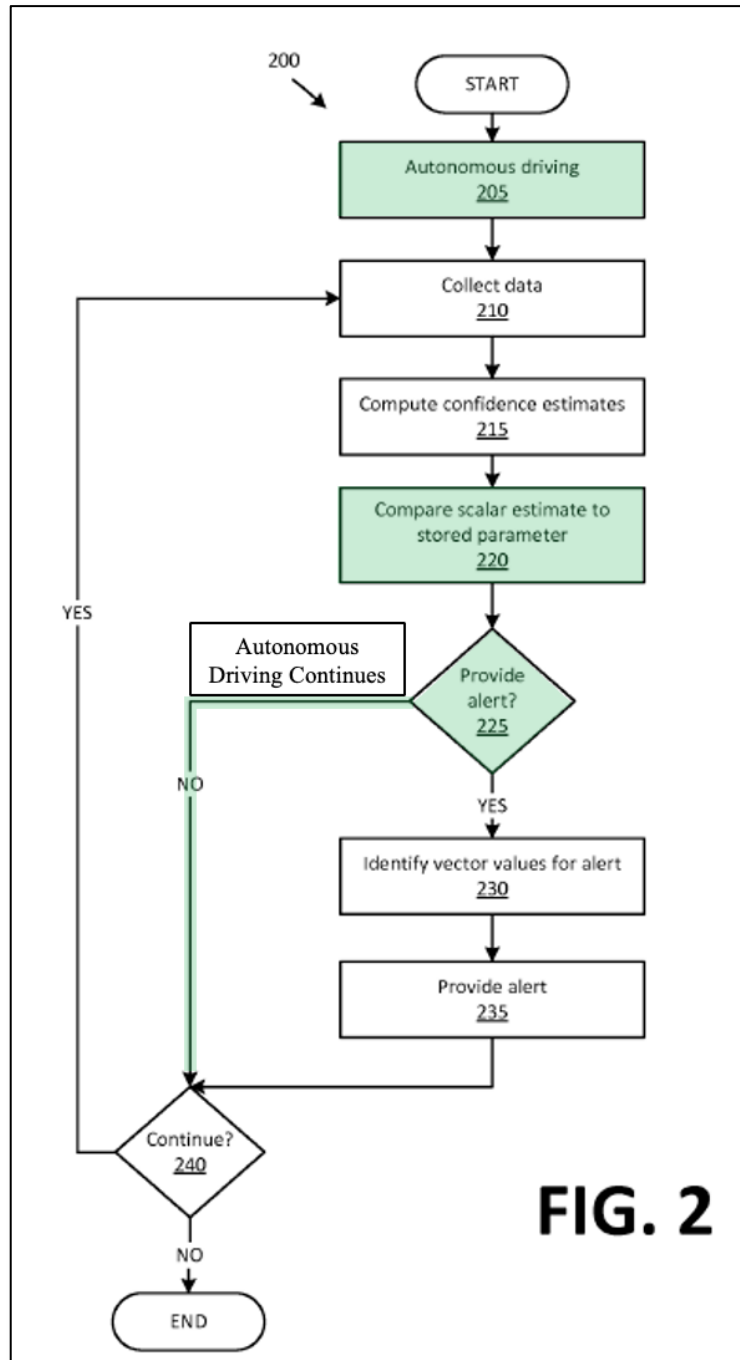
By assessing such collected data 115, and possibly weighting various determinations, e.g., a determination of a sensor data

collector 110 accuracy and one or more determinations relating to external and/or **environmental conditions, e.g., presence or absence of precipitation**, road conditions, etc., **one or more confidence assessments 118 may be generated providing one or more indicia of the ability of the vehicle 101 to operate autonomously.**

Attard, 6:4-35, 6:61-7:2 (basing confidence assessments on future weather conditions).

9. Claim 37(c): “comparing the competence level of the control processor to a first threshold;”

304. *Attard* teaches comparing Φ to $\Phi_{\min}$ to determine whether to activate an interface 119. *Attard*, 7:18-28, 5:21-29, 10:52-11:4. Per 37(e), when the CPCL is above the first threshold, the SDV drives autonomously. *Attard*, likewise, teaches or renders obvious vehicle 101 driving autonomously when Φ is above $\Phi_{\min}$. *Attard*, 10:18-27. For example, annotated FIG. 2 below illustrates *Attard*'s processing when there is no fault detected, i.e., Φ is above $\Phi_{\min}$.



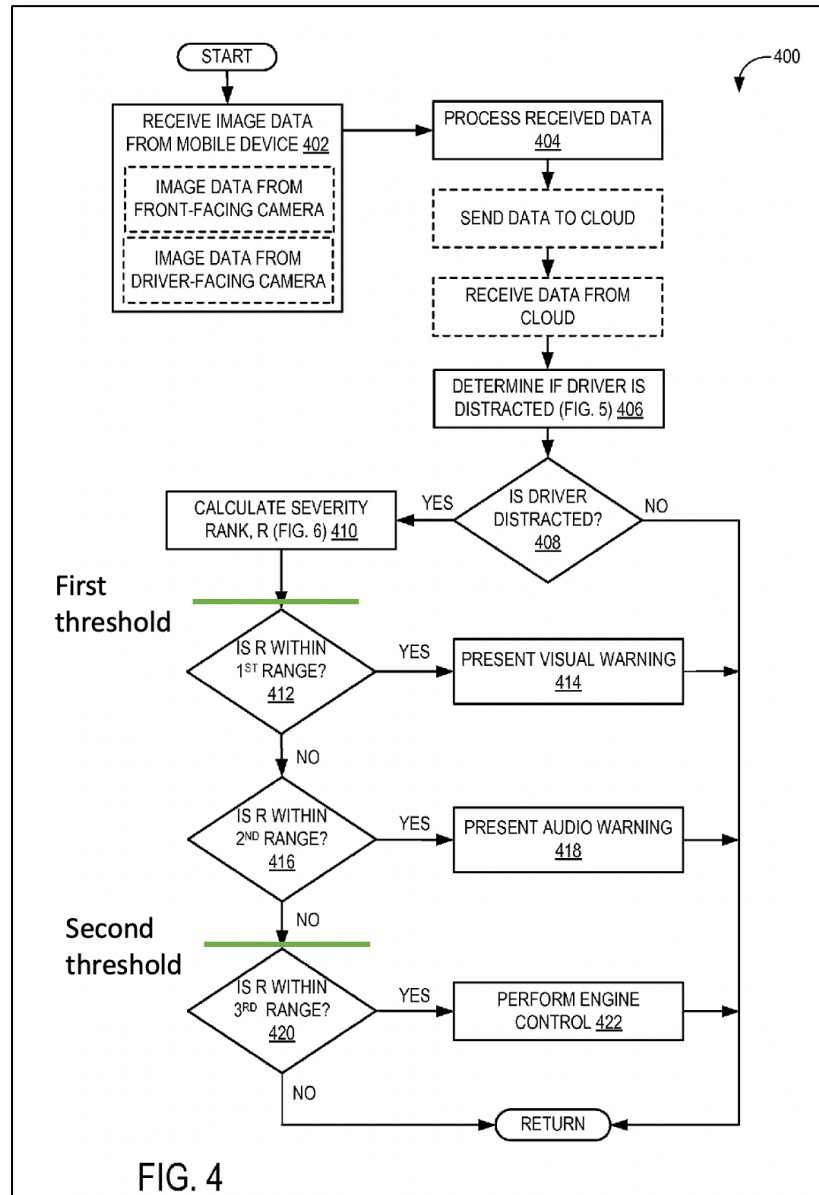
Attard, FIG. 2. Therefore, $\Phi_{\min}$ is a *first threshold* to which Φ is compared.

10. Claim 37(d): “comparing the competence level of the control processor to a second threshold, wherein the first threshold is higher than the second threshold:”

305. *Attard* teaches determining a confidence interval into which Φ falls. For example, *Attard* teaches that if “there were a lower likelihood that autonomous operations of the vehicle 101 should be ended, the affective interface 119 could be used to provide a message 116 with a lower degree of urgency.” *Attard*, 12:5-11, 10:53-61 (discussing intervals into which the scalar confidence assessment falls). However, *Attard* does not explicitly teach comparing Φ to a second threshold that is below $\Phi_{\min}$. *Hampiholi* teaches such threshold comparisons.

a) Hampiholi’s Teachings

306. As discussed with respect to Claim 1, *Hampiholi* teaches comparing R to different ranges to determine which range R belongs and a corrective action to take. *See*, Claim 1; *Hampiholi*, [0057]. Exemplary first/second thresholds are below:



Hampiholi, FIG. 4.

307. A POSITA would have found it obvious to modify *Attard* based on *Hampiholi's* teachings, yielding comparing the competence level...to a second threshold, wherein the first threshold is higher than the second threshold, where the competence level is of the control processor, per *Attard*. To the extent such is not

taught by *Attard* via its $\Phi_{\min}$ and confidence intervals, a POSITA would have found such a modification obvious based on *Attard*'s disclosure that "the nature of a fault may indicate an action directed by the computer" and would have looked to reference, such as *Hampiholi*, that teach with specificity ways to associated faults with actions. *Attard*, 14:63-64.

b) Motivation to Combine *Attard-Hampiholi*

308. A POSITA would have found it obvious and been motivated to modify *Attard* with *Hampiholi*'s decision making process of comparing a *competence level* to *threshold[s]* to determine a corrective action. Such a modification is merely the combination of known prior art elements (*Attard*'s fault handling system that associates faults with actions) according to known methods (*Hampiholi*'s thresholding/range teachings) to yield predictable results of specific actions being taken when Φ falls within a specific confidence interval, i.e., above or below a threshold. *Attard* expressly teaches Φ can be bucketed into different confidence intervals. *Attard*, 11:63-12:11, 14:63-15:4. However, *Attard* lacks an express teaching of which actions are taken when Φ falls within a specific confidence interval and the relationship between the various thresholds. *Hampiholi* teaches such, where *Hampiholi*'s severity rank R is analogous to *Attard*'s Φ ; i.e., both are competence levels. Therefore, in my opinion, based on the similarities of R and Φ ,

a POSITA would have been motivated and found it obvious to leverage *Hampiholi's* thresholding teachings with respect to a *competence level* for *Attard's* similar *competence level of the SDV*. This use of a known technique would have improved *Attard's* similar vehicle in the same way as *Hampiholi's* vehicle. Both R and Φ directly relate to the safety of the vehicle's driving. Thus, implementing the decision-making process for R in *Attard's* vehicle to compare against Φ would have been a straightforward modification with a reasonable expectation of success.

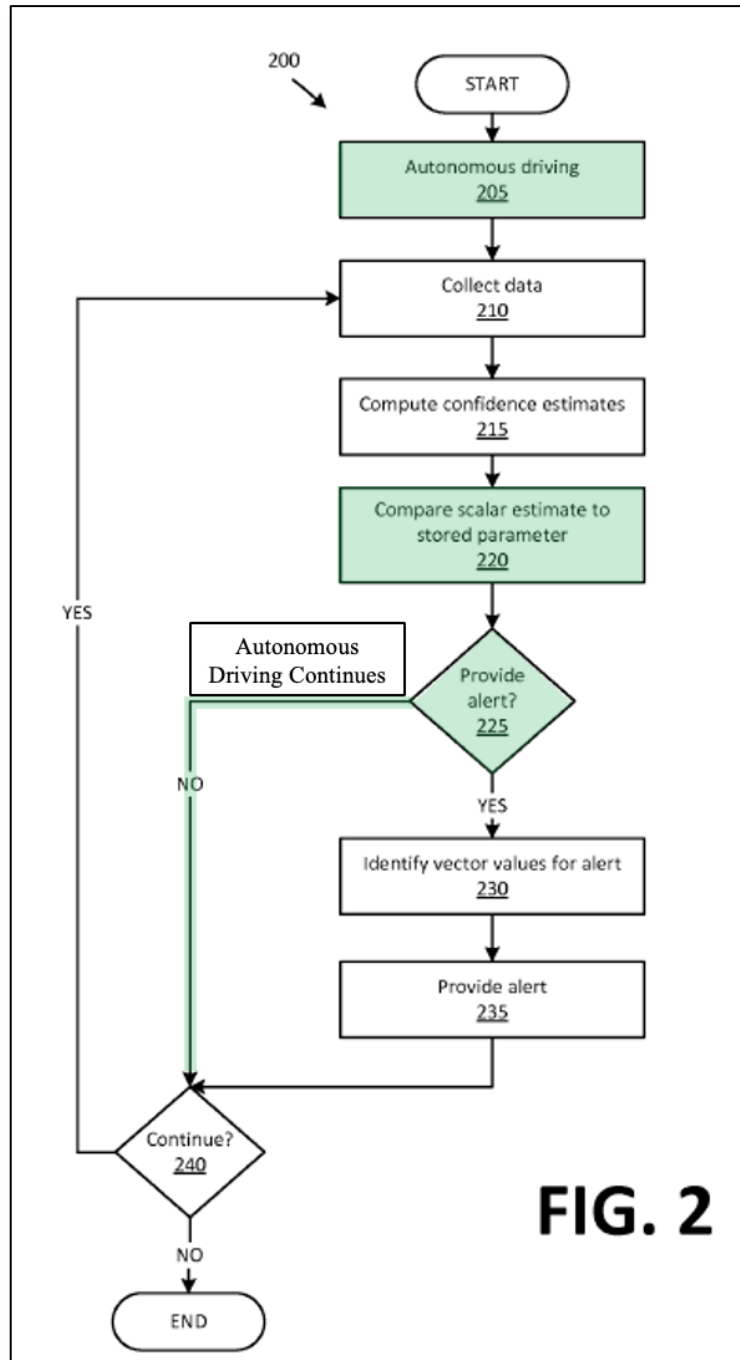
309. A POSITA would have had a REOS in modifying *Attard* per *Hampiholi* because decision making based on thresholding was well known prior to the '004 Patent. Further, *Hampiholi* merely provides implementation details for associating *Attard's* actions to specific confidence intervals for Φ . That is, *Hampiholi* provides a concrete way into which *Attard* would associate the confidence interval Φ fell into a specific action. Further, both *Attard* and *Hampiholi* teach implementing their methods in programming instructions. See, 1(Pre), 1(c); *Attard*, 15:12-46; *Hampiholi*, [0032].

11. Claim 37(e): “autonomously controlling driver controls without requiring a human driver to control the driver controls when the competence level of the control processor is above the first threshold;”

310. When Φ is above $\Phi_{\min}$, *Attard* does not send a message and autonomous driving continues. Specifically, the comparison of Φ to $\Phi_{\min}$ occurs at steps 220 and

225 and, if Φ is above $\Phi_{\min}$, the process loops and autonomous driving is maintained.

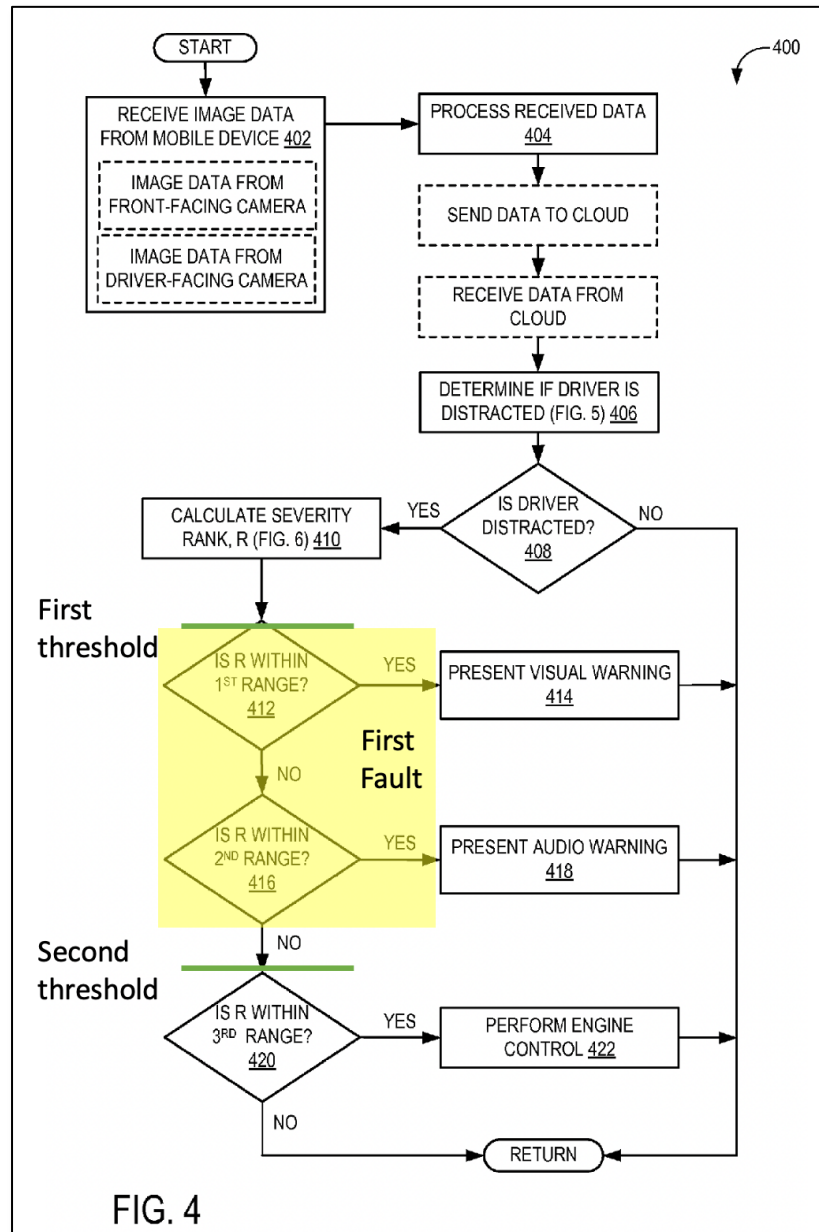
A POSITA would have understood that *Attard's* determination not to provide an alert at 225 (i.e., $\Phi > \Phi_{\min}$) would have resulted in autonomous driving continuing, as I show in the annotated FIG. 2 below.



Attard, FIG. 2.

12. Claim 37(f): “determining a first fault has occurred when the competence level of the control processor is between the first threshold and the second threshold;”

311. *Hampiholi* teaches determining a first fault has occurred when the competence level...is between the first threshold and the second threshold.



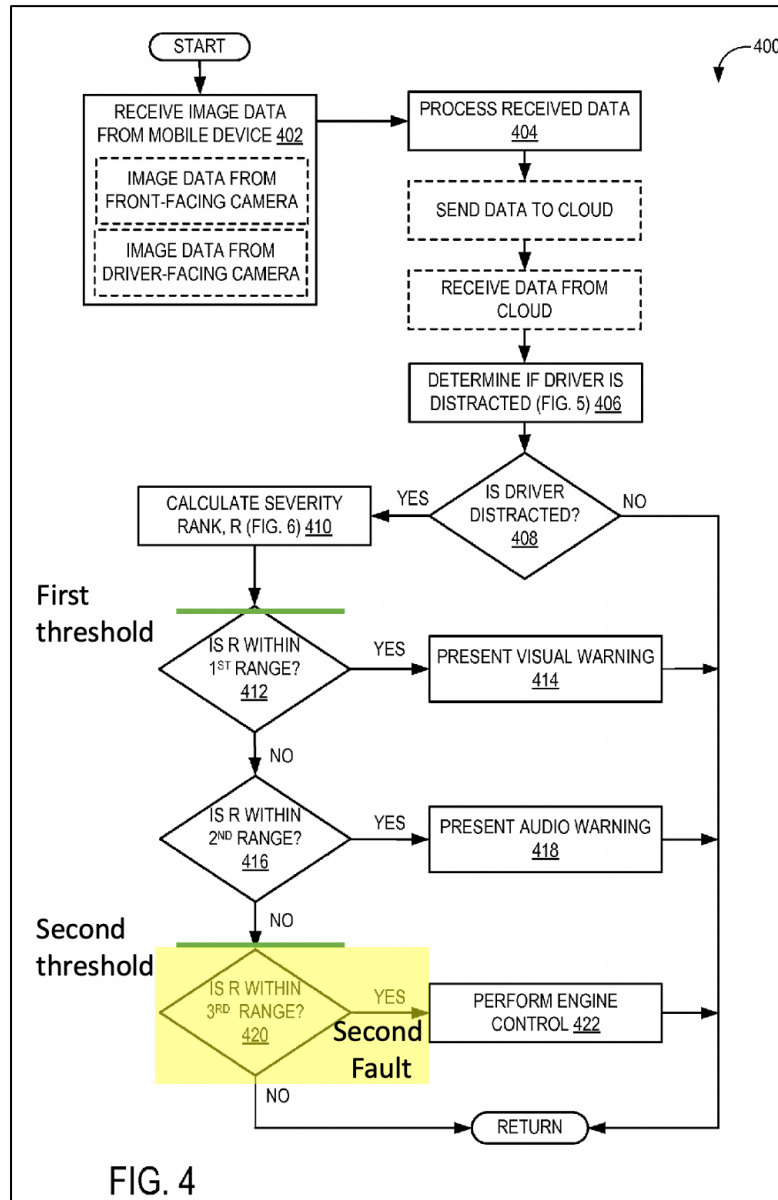
Hampiholi, FIG. 4.

312. *See*, 1(g). In the *Attard-Hampiholi* SDV, Φ is compared against *Hampiholi's thresholds* to determine actions to take, thereby rendering obvious

37(f). That is, Φ would be compared to the *first threshold* and to the *second threshold*, and per *Hampiholi*, if Φ is between the *first threshold* and the *second threshold*, it would be determined that *a first fault has occurred* in the *Attard-Hampiholi* SDV, and a corrective action would be taken.

13. Claim 37(g): “determining a second fault has occurred when the competence level of the control processor is below the second threshold; and”

313. When Φ falls below *Hampiholi*’s second threshold, it is determin[ed] that a second fault has occurred. *See*, 1(h).



Hampiholi, FIG. 4.

14. Claim 37(h): “performing a corrective action listed in a fault remediation table, comprising:”

314. *Attard-Hampiholi* in view of *Frazer* teaches 37(h), i.e., *Frazer*’s action 144c is a corrective action listed in a fault remediation table. *Frazer*’s teachings are discussed in 1(i)-1(j) and incorporated herein.

a) Motivation to Combine

315. A POSITA would have found it obvious and been motivated to modify *Attard's* fault handling with *Frazer's* teachings of organizing faults, conditions, and action(s) to take for fault in a *fault-remediation table*, yielding *performing a corrective action listed in a fault-remediation table*. Indeed, one advantage of utilizing an event table (“fault remediation table”), such as per *Frazer's* teachings, is to have pre-programmed scenarios ready to go to address any desired scenario that may occur along with the proper action to take. A POSITA would have found it obvious and been motivated to determine which *corrective action* to take using *Frazer's* table to enable easy access and quick determination of actions to take responsive to detected faults. Utilizing a well-known table for this operation means the vehicle does not need to come up with a corrective action on-the-fly; rather, the SDV determines there is a fault and looks up what correction action(s) should be taken. A POSITA would have recognized formatting data into a table was well-known and widely-used for efficiently organizing data for retrieval, reference, and modification. I note that tables are a widely utilized format for organizing data both electronically in computer systems and even on paper (such as in textbooks and academic journal articles).

316. A POSITA would have appreciated the if/then type of fault remediation data already present in *Attard's* vehicle would have been particularly apt for

organizing into a table, concisely and efficiently cross-referencing detectable conditions to quickly determine appropriate responses, improving the safety of the vehicle while reducing its memory requirements compared to an otherwise unorganized list of fault responses. Further, a POSITA would have understood the convenience provided by the table structure, enabling a user to quickly understand which corrective actions are taken when conditions are met without having to dig through lines of code.

317. A POSITA would have understood *Frazer* provides an express motivation for the combination, stating its action engine “exhibits a significantly low latency with respect to processing information relating to respective states of the dynamic environment and taking actions in response to same.” *Frazer*, 23:64-67. A POSITA would have been motivated to utilize a solution such as *Frazer*’s event table to achieve such low latency for processing related to determining a corrective action to take. Indeed, when a driver is driving an SDV at high speed down a highway, for example, there may be little time before a particular corrective action needs to be taken (such as slowing the vehicle, switching to manual mode, alerting the driver, etc.). Thus, utilizing a fault-remediation table when driving in an SDV such as *Attard*’s would have been advantageous for the driver, including by increasing safety.

318. The combination constitutes application of a known technique (*Frazer's* tables) to a known method (*Attard's* fault handling method) ready for improvement to yield predictable results. Based on *Attard's* teachings that faults have associated actions (*Attard*, 14:63–15:4), a POSITA would have looked to other references that describe specific ways to associate faults with actions and to store such information in computer memory, e.g., *Frazer*. This modification would have improved *Attard's* SDV by allowing the vehicle to essentially “pre-process” scenarios to simply look up the corrective action that should be taken by using a table instead of having to make a decision on-the-fly. For an SDV, there are many scenarios that a POSITA would have understood would have been advantageous to pre-process, such as ethical dilemmas of prioritizing the driver's safety versus a pedestrian's safety, for example. A POSITA would have understood that such difficult ethical decisions are better decided ahead of time where more time is available to arrive at a desired corrective action instead of having to make a decision in mere seconds, for example. In this way, using a fault-remediation table such as *Frazer's* would have been advantageous in *Attard's* SDV. Thus, this use of a known technique would have improved the similar *Attard* SDV in the same way as *Frazer's* SDV.

319. A POSITA would have appreciated that modifying *Attard* per *Frazer* would have had a reasonable expectation of success. For example, *Attard* and *Frazer*

both teach SDVs, with *Frazer* expressly teaching using event table 112 in autonomous vehicles. *Frazer*, 19:23-30, 21:20-32 (“FIG. 6 shows a system configuration of various components, including an illustrative action engine 110c for monitoring, synchronizing, and/or controlling at least one aspect of a dynamic environment. Examples of such environments with which the system shown in FIG. 6, and particularly the action engine 110c, may be employed include, ... autonomous or semi-autonomous vehicle.”), 21:33-51 (“The action engine 110c includes an event table 112”), *generally* 21:52-22:22.

320. *Attard* and *Frazer* teach implementing programs and functions using programming instructions executed by a processor. *Attard*, 15:12-46 (teaching computer-executable instructions, processor, memory); *Frazer*, 21:20-51 (“The event table 112 and event table registers 140c can be implemented in any suitable type of memory, including but not limited to computer readable storage media such as a volatile or nonvolatile computer memory.”). Thus, *Attard* already has hardware necessary for performing actions such as those taken by *Frazer*’s action engine 110c, such that only straightforward changes to programming instructions would have been needed to implement *Frazer*’s event table 112 in *Attard*. Indeed, *Attard* already teaches computer hardware including a processor for executing instructions and memory that stores instructions. *Attard*, 2:28-41, 3:15-27, 4:32-45, 5:21-30, 5:54-57, 15:12-46 (teaching examples of memory).

321. If it is argued that *Attard's* hardware is insufficient for this modification, a POSITA would have understood that it would have been straightforward to modify *Attard* to include additional memory and/or processing power as needed, which would have been a tradeoff to capture *Frazer's* advantages.

322. Further, a POSITA would have recognized the ease of modifying *Attard's* computer 105 (or other vehicle memory) to include a table per *Frazer*. *Attard* and *Frazer* are similar by both teaching detecting faults/events based on sensor data. Compare *Attard* 1:50-52, 12:53-62 with *Frazer*, 21:52-56, 22:31-47. Thus, there would have been a REOS in modifying *Attard* per *Frazer*. Additionally, *Frazer* and *Attard* teach applying their systems and methods to an autonomous or semi-autonomous vehicle, further leading to a REOS.

15. Claim 37(h)(i): “displaying a warning message on a display screen when the first fault occurs; and”

323. When Φ is below $\Phi_{\min}$, (*when the first fault occurs*), *Attard* teaches interface 119 formulates message 116 *Attard*, 7:24-28. The message 116 is a *warning message*, and the interface 119 is a *display screen*.

Further, confidence attribute sub-assessments 118, e.g., one or more values in a vector ϕ^{PL} or ϕ^{AL} , may relate to particular collected data 115, and may be used to provide specific content for one or more messages 116 via the interface 119 related to particular attributes and/or conditions related to the vehicle 101, e.g., **a warning for**

a vehicle 101 occupant to take over steering, to institute manual braking, to take complete control of the vehicle 101, etc.

Attard, 7:33-38, 3:53-55 (touch screen).

16. Claim 37(h)(ii): “sounding a warning sound, displaying a warning message, displaying an icon on the display screen, and transferring the driver controls to manual control when the second fault occurs.”

a) When the Second Fault Occurs

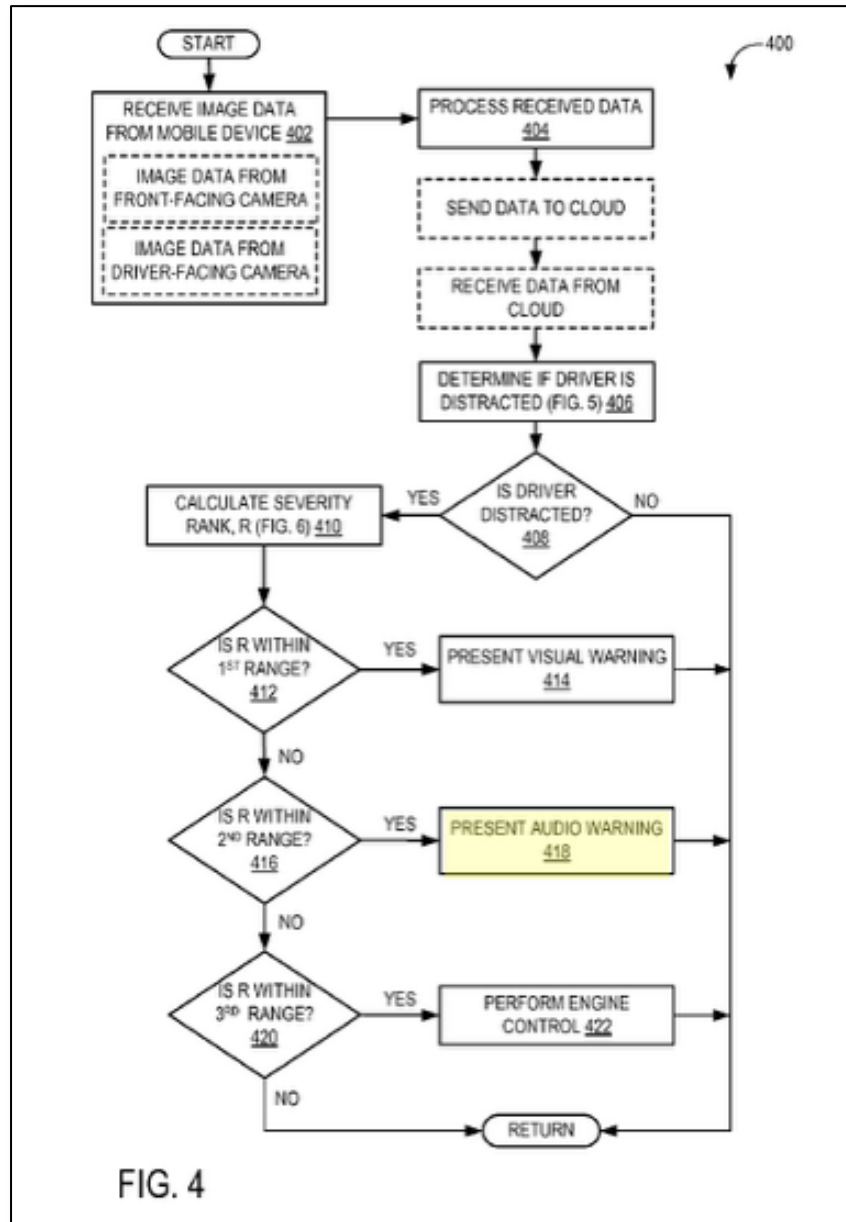
324. In the *Attard-Hampiholi* SDV, the *second fault occurs* when Φ is below the *second threshold*, per *Hampiholi*, and a transfer to manual is recommended per *Attard*. See, Claim 37(g). Specifically, *Hampiholi* teaches being in the 3rd range is the most severe range for R such that for “extreme cases, an engine control operation [is] performed at 422...” *Hampiholi*, [0057], FIG. 4. A POSITA would have found it obvious to modify the *Attard-Hampiholi* SDV to collectively (1) sound a warning; (2) display a message; (3) display an icon; and (4) transfer to manual to improve vehicle safety. Specifically, a POSITA would have been motivated to activate multiple alarms of differing modalities to increase the odds the driver responds when Φ is low and *Attard*’s vehicle should not be driven autonomously, thereby improving the safety of the SDV. It would have been obvious for a POSITA to have used as many options as possible when it is determined the SDV can no longer be driven autonomously to increase the likelihood the driver responds to the alert. Additional motivations to combine *Attard* with *Hampiholi*’s teachings of sounding a warning

sound and *McNew's* teachings of *transferring the driver controls to manual control* are below.

325. A POSITA would have had a REOS in modifying the *Attard-Hampiholi* SDV in this manner because, while *Attard* lacks an explicit teaching of performing all actions collectively, *Attard's* vehicle is equipped for all modalities. *Attard*, 7:30-38. Specifically, *Attard* teaches or renders obvious (1) warning sounds; (2) warning messages; (3) icons; and transferring to manual. *Attard*, 7:24-38, 2:66-3:4. It would have required a minor software change to the *Attard-Hampiholi* SDV to take these actions when Φ is below the second threshold, e.g., by modifying the *Attard-Hampiholi-Frazer* fault-remediation table accordingly. For example, an action in the event table 112 would be set to cause each action to occur, triggered when the CPCL is below the second threshold.

b) Warning Sound

326. *Hampiholi* teaches sounding an “audio warning” when R is in the second range.



Hampiholi, [0057].

327. While *Hampiholi* depicts the audio warning as occurring above the second threshold, *Hampiholi* teaches that “[a]ny suitable action may be mapped to any suitable severity ranking” such that *Hampiholi* is not limited to presenting an audio warning only when R is in the second range. *Hampiholi*, [0066]. Additionally,

Hampiholi expressly contemplates combining multiple warnings. *Hampiholi*, [0070] (“[A] combination of an audio and a visual alert.”).

c) Motivation to Combine

328. A POSITA would have found it obvious to modify *Attard*’s teachings of displaying a message (discussed below) further with *Hampiholi*’s teachings of sounding a warning sound when a fault occurs. The *second fault* occurs when the CPCL is below a second threshold, e.g., the SDV is encountering a situation it cannot handle and needs the driver to take over. Thus, a POSITA would have found it obvious to modify *Attard* per *Hampiholi* to sound a warning to grab the driver’s attention, predictably improving the safety of *Attard*’s vehicle. A POSITA would have understood the necessity to alert the driver and, therefore, would have been motivated to transmit multiple alert types to the driver to ensure the driver takes over driving as I discussed above. See, ¶¶324-325.

329. Such a modification would have had a REOS because (a) sounding audio alerts to alert drivers was well-known; (b) *Attard* and *Hampiholi* both teach associating faults with actions; (c) modifying *Attard* would have required a minor software change to sound a warning sound when the second fault occur; and (d) *Attard* already teaches audio messages. *Attard*, 7:30-33. For example, by modifying *Frazer*’s event table as I discussed above. See, ¶¶324-325.

d) Displaying a Warning Message

330. *See*, 37(h)(i).

e) Displaying an Icon

331. *Attard* teaches messages 116 can displayed icons: “interface 119...may display alerts, messages...to convey a degree of urgency, e.g....use of **icons**.” *Attard*, 7:33-38.

f) Transfer to Manual

332. *See*, 1(j).

g) Motivation to Combine *Attard-Hampiholi-Frazer-McNew*

333. A POSITA would have been motivated and found it obvious to include transferring driver controls to manual as a corrective action in the *Attard-Hampiholi* SDV responsive to particular faults per *McNew*. A POSITA would have understood that in at least some situations, the best option is to disengage autonomous mode and allow the driver to take over. Thus, modifying *Attard-Frazer* per *McNew* would have yielded an SDV where a corrective action is taken to alert a driver to immediately take over (in at least some scenarios, such as when a “Deadly” or “Danger” message is warranted, such as when one or more key sensors for autonomous driving are malfunctioning or severe weather occurs that renders the vehicle incapable of safely driving autonomously), and the vehicle transitions from autonomous mode to manual mode as a corrective action.

334. Further, a POSITA would have been motivated because *Attard* includes a specific suggestion to do so via repeated disclosures of recommending transferring controls to manual. *Attard*, 2:55-3:4. Modifying the *Attard-Hampiholi* SDV in this way would have been use of known technique of taking a particular corrective action (transition to manual control) responsive to a fault to improve the *Attard-Hampiholi* SDV in the same way as *McNew*'s. I note that *Attard*, *Frazer*, and *McNew* all teach SDVs, such that modifying *Attard-Hampiholi* SDV would have been straightforward, such as by making straightforward modifications to programming instructions. Thus, the *Attard-Hampiholi* SDV would have benefited from *McNew*'s advantages in the same way as *McNew*'s SDV.

335. Further, modifying the *Attard-Hampiholi* SDV per *McNew* would have allowed *Attard-Hampiholi*'s SDV to both (1) alert a driver of a need to transition to manual mode and (2) actually perform the transition. Another advantage would have been the increased safety and security provided by alerting the driver to assume control when computer is not competent at self-driving.

336. A POSITA would have been motivated and found it obvious to include transferring driver controls to manual control as a corrective action for numerous reasons. For example, if sensors for performing autonomous driving experience a fault but the vehicle is otherwise safe to drive, transitioning to manual mode would have allowed a driver to continue to drive to their destination. Similarly, if no

hardware fault exists, but adverse weather/road conditions are severe enough to prevent safe autonomous driving, alerting the driver and transitioning to manual mode would have allowed the driver to take over and continue driving to the destination.

337. A POSITA would have understood that modifying *Attard-Hampiholi* to include a corrective action of transferring controls to manual would have had a REOS. Modifying *Attard-Hampiholi* per *McNew* would have required only straightforward changes to programming instructions. In particular, a POSITA would have understood that the necessary hardware was already present in the *Attard-Hampiholi* SDV. Thus, the only necessary modification is altering the *Attard-Hampiholi* programming instructions per *McNew's* teachings. Indeed, *McNew* teaches implementing its system in computer program instructions, making the modification to *Attard-Hampiholi* straightforward, e.g., the changes would have included modifying *Attard-Hampiholi-Frazer's* table to include transferring controls to manual as a corrective action. Tables are well-known structures for organizing data, and modifying a table would have been a straightforward modification. Additionally, *Attard* expressly contemplates transition to manual control and teaches vehicle 101 is manually drivable, such that a POSITA would not have had to modify vehicle 101 to be able to drive using manual control. *Attard*, 2:55-3:4. In particular, I note the SDV already is capable of driving manually, such that modifying *Attard-*

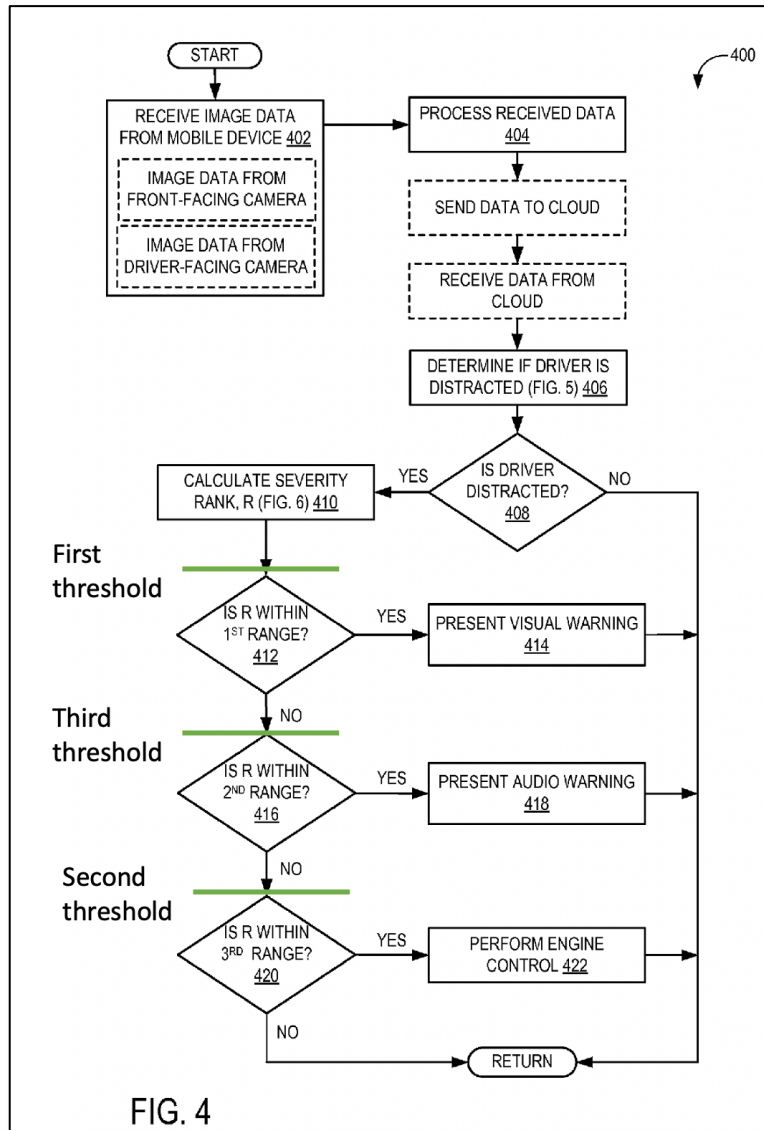
Hampiholi per *McNew* would not have required installing driver control mechanisms such as a steering wheel or brake pedal that are needed for a driver to drive in manual mode.

338. Additionally, *Attard* expressly contemplates transition to manual and teaches vehicle 101 is manually drivable, such that a POSITA would not have had to modify vehicle 101 to be manually drivable. *Attard*, 2:55-3:4.

B. Claim 38

1. Claim 38(a): “The computer program product of claim 37, further comprising: comparing the competence level of the control processor to a third threshold, wherein the third threshold is between the first threshold and the second threshold; and”

339. *Hampiholi* teaches comparison to a third threshold [that] is between the first threshold and the second threshold.



Hampiholi, FIG. 4. A POSITA would have understood that these thresholds and their associated corrective actions would have been determined by programming instructions, and a POSITA would have understood how to modify programming instructions. *See*, Claim 37.

2. **Claim 38(b): “determining a third fault has occurred when the competence level of the control processor is between the third threshold and the second threshold.”**

340. In the *Attard-Hampiholi* SDV, a third fault is determin[ed] when Φ is between the third threshold and the second threshold, i.e., when Φ is in the 2nd range. A POSITA would have understood that these thresholds, faults, and their associated corrective actions would have been determined by programming instructions, and a POSITA would have understood how to modify programming instructions. See, Claim 37.

C. Claim 39

1. Claim 39(a): “The computer program product of claim 38, further comprising: the operational state of the SDV comprises a current weather condition of a roadway on which the SDV is currently traveling; and”

341. *Attard* teaches sensors 110 determine road conditions. *Attard*, 4:42-56, 7:14-17. A POSITA would have understood *Attard*’s disclosures of detecting road attributes using sensors 110 to teach *determining a current condition of a roadway*. *Attard*’s road condition is a *current condition* because it is detected by *Attard*’s SDV, which is traveling on the roadway. Specifically, *Attard* teaches sensors that determine weather conditions and road conditions, and a POSITA would have understood that at least some of *Attard*’s sensors would have been sensing conditions near the SDV, thus determining the operational state of the SDV including *a current weather condition of a roadway on which the SDV is currently traveling*. See, Claims 29, 37.

2. Claim 39(b): “autonomously altering a route being taken by the SDV when the third fault occurs.”

342. *Attard* teaches actions responsive to a fault that include “pull over and stop” and “limp home” operations. *Attard*, 2:46-54. Either operation *autonomously alter[s] a route being taken by the SDV*. A POSITA would have understood that these actions would have altered a route being taken by the SDV because the original destination in at least some scenarios would have been somewhere other than the side of a road or “home.” Here, the SDV alters the route (e.g., to a grocery store) and instead the SDV pulls over to the side of a road and stops or “limps home” to a location such as the driver’s residence or perhaps a vehicle service center for repair.

a) Motivation to Combine

343. The *Attard-Hampiholi* SDV does not expressly teach performing the limp home or pull over operations *when the third fault occurs*. However, a POSITA would have found it obvious and been motivated to modify *Attard* accordingly because *Attard* teaches “the nature of a fault may indicate an action” thus suggesting that either the pull over or limp home operations would be an indicated action taken *when the third fault occurs*. *Attard*, 14:63-64.

344. Such a modification is merely the combination of known elements according to known methods to yield predictable results. *Attard* teaches (A) operations that *autonomously alter[] a route being taken by the SDV* and (B) association of faults with actions. *Attard*, 2:46-54, 14:63-64. While *Attard* lacks the

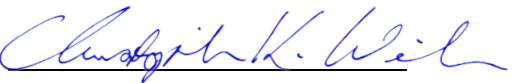
explicit connection between such actions and Φ being between a third threshold and a second threshold, a POSITA would have found it obvious to modify *Attard* to associate, e.g., a pull-to-shoulder operation with the *third fault*. For example, it would have been obvious to implement the pull-to-shoulder operation when vehicle 101 is driving in severe weather to eliminate the risk of crashing. A POSITA would have understood that in some scenarios, for example hail or perhaps high winds, the safer option would be to pull the SDV over to the side of the road and stop rather than trying to continue driving. This use of a known technique would have improved *Attard-Hampiholi* in the same way as *Frazer* by providing a robust fault-remediation table to reduce latency in performing corrective actions.

345. Such a modification would have had a REOS because it would have simply required reprogramming *Attard-Hampiholi* to associate the pull-to-shoulder operation with the third fault, e.g., using *Frazer's* table. Thus, this modification would have required only straightforward modifications to programming instructions, which would have been well-within the skillset of a POSITA. I opined regarding this same concept for claims 1, 29, and 37 above. *See*, Claims 1, 29, 37.

XIX. CONCLUSION

346. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: May 28, 2025

By: 

CHRISTOPHER K. WILSON

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Connected Vehicle & Telematics Consultant – Testifying Expert

I have been developing vehicle telematics and safety systems since 1991, mostly for safety and Advanced Driver Assistance Applications (ADAS). I participated in the early development of key connected vehicle telematics and safety technologies, including radar, positioning, communications, and mapping, worked with many automakers, suppliers, and government agencies, and was involved in the deployment and assessment of many telematics systems from Automatic Collision Notification to systems for Stability Control and Driver Assistance. I also helped set requirements and requirement testing methodologies for many ADAS systems.

I currently work as a consultant for Connected and Automated Vehicle applications (vehicle and infrastructure), and map databases. I am also an expert witness and have written over 100 reports regarding intellectual property and vehicle injury matters and testified over 25 times. I am an industry insider with a gift for explaining complicated ideas in a convincing and easy to understand manner.

Expertise in:

- Vehicle Safety & Safety Systems Assessment
- Navigation, Telematics, Data Science
- Radar, camera, & Lidar sensors
- Vehicle & infrastructure interaction
- Fleet Management Systems
- Remote diagnostics, Sensor & Software Management (OTA updates)
- Vehicle data collection, analysis & applications
- Positioning, communications & mapping technology
- Vehicle & traffic technology and deployment
- Accident Reconstruction

AREAS OF EXPERTICE (with representative dates)

Vehicle Telematics and Safety Systems

- Developed one of the first Automatic Collision Notification systems based on airbag deployment and biomechanical studies. Worked with first responders & ER physicians. 1994.
- Developed systems for the collection and processing of vehicle information for traffic assessment. 1995-2011.
- Algorithms for skid protection and dynamic vehicle control, braking & speed systems. 1999.
- Developed predictive safety systems based on map information, speed control. 1998.
- Developed metrics for regulatory evaluation of active safety systems including Forward Collision Warning, Blind Spot Monitoring, Stop Sign Warning, Curve Speed Warning. 2002.
- Usage Based Insurance scoring algorithms for multiple data sources. 2014.
- Telemetry analysis (missiles, spacecraft, ground vehicles). 1981-Present.

Sensors

Radar

- Designed and operated Over-The-Horizon radar. 1984.
- Synthetic Aperture Radar assessment and evaluation. 1989.
- Evaluation of radar algorithms for F16 radar systems (MTI). 1987.

- Automotive radar development for ACC & FCW systems. 1995.
- Assessed various radar-based safety systems. 2002-2017.

Image sensors & algorithms (camera and video)

- Image recognition & processing algorithms for various reconnaissance assets. 1986.
- 3D scene reconstruction from imagery, photogrammetry. 1987, 2017.
- Assessment of image based FCW, AEB and lane following systems. 2002-2016.
- Photogrammetry for HD mapping applications. 2018.

Lidar

- Evaluated and utilized Lidar systems for Forward Collision Warning. 2003.
- Developed Lidar processing applications for mapping. 2008-2018

Communications

- Developed Vehicle-to-vehicle technologies (DSRC). 1999-2016.
- Extensive use and evaluation of cellular communications for vehicles. 1995-2018.
- Use of paging network for emergency services. 1993.
- Developed various vehicle telematics and infotainment systems. 1993-2016
- Evaluation and development of satellite communications systems. 1984-2016.

Positioning

- Evaluation and use of GPS and many high precision enhancements. 1984-2018
- Requirements specification for GPS III and Galileo. 2004.
- Developed precision location techniques for vehicles. 1996-2018.

Maps

- Responsible for 2nd generation map concepts and specifications for industry (HD Maps). 2000.
- Functional safety for map databases. 2016-2018.
- Developed high precision maps for automated vehicles. 1999-2018.
- Developed tools for incremental updates and quality management. 2000-2018.

Vehicle Diagnostics

- Remote diagnostics of powertrains for warranty and repair planning. 2001.
- Monitored infotainment systems to assess driver preferences and system functionality. 2002.
- Diagnostics of driving style for safety and efficiency evaluations. 2012.
- Telemetry diagnostics of air and space vehicles. 1985.

Cooperative Systems

Insurance- Developed methods and tools for peer comparisons to assess driver risk. 2015.

Transportation Operations- Understanding vehicle movements and implications for traffic and signals based on vehicle probes. 1994-2018.

Outreach

- I was the primary instigator and public advocate for vehicle-to-vehicle communications and grew this effort from “can’t be done” to deployment based on my advocacy.
- I have raised money for 4 startups selling a technical vision.
- Park docent leading trips on various nature topics.

PROFESSIONAL EXPERIENCE

Consultant, Intellectual Property and Connected Vehicles.	2012 - Present
Mapper.ai , San Francisco, CA	2018 - 2019
Strategy & Bus Dev. Consultant (<i>Developing camera based mapping systems</i>)	
ATG Risk Solutions , Seattle, WA	2016 - 2016
VP Bus Dev. (<i>Developing telematics-based risk assessment for Insurance</i>)	
Vehicle Data Science Corporation , Redwood City, CA	2013 - 2016
CEO (<i>Start-up building kinematic maps for automated vehicle applications.</i>)	
TomTom BV , Redwood City, CA	2008 - 2011
Director of Program & Product Mgmt., Advanced Driver Assistance Systems (2009 – 2011)	
Director of R&D (2008 – 2009)	
DaimlerChrysler Research and Technology North America Inc. , Palo Alto, CA	1996 - 2008
Vice President, ITS Strategy & Programs (2002 – 2008)	
Group Manager, Telematics & Safety (1998 – 2002)	
Senior Research Scientist (1996-1998)	
Information Access Inc. , San Francisco, CA	1995 - 1996
Director of Product Development (1995-1996)	
TRW Inc. , Sunnyvale, CA	1986 - 1995
Program Manager (1991 - 1995)	
Senior Systems Engineer (1986 - 1991)	
GTE Government Systems Inc. , Mt. View, CA	1983 - 1986
Systems Engineer (1983 - 1986)	

EDUCATION/TRAINING

PhD Candidate (1982), Astrophysics, University of California, San Diego
BA (1981), Physics, Princeton University, Princeton, NJ
Advanced courses in business, strategy, & technology @ Harvard, Stanford, Berkeley, MIT
Training in **Software Forensics** (copyright infringement, software theft).
Accident Reconstruction. Certificate from Society of Automotive Engineers. ACTAR certified.
Currently seeking AA degree in Philosophy (San Mateo Community College).

PROFESSIONAL ASSOCIATIONS

Member, Institute of Navigation (ION); Society of Automotive Engineers (SAE); Institute of Electrical and Electronics Engineers, Senior Member (IEEE); California Association of Accident Reconstruction Specialists (CA2RS); Accreditation Commission for Accident Reconstruction (ACTAR) #3846, National Association of Professional Accident Reconstruction Specialists.

PATENTS AND PUBLICATIONS

10 US patents in vehicle positioning and vehicle data processing and analytics and numerous foreign patents.

McGraw-Hill *AccessScience* article on "Intelligent Vehicles and Infrastructure", 2017

Chapter on Probe Data in Springer-Verlag's *Handbook of Intelligent Vehicles*, 2012

Widely quoted in publications such as Scientific American and Telematics Update

Many presentations to industry groups, often as a representative of the automotive industry.

LITIGATION EXPERIENCE

25+ depositions, 40+ IPRs, 100+ expert reports, majority patent related (*partial listing*).

- Expert for Hyundai (Finnegan) in remote diagnostics case. Prepared technology tutorial and multiple IPR declarations. Case settled, 2014.
- Expert for Honda (Jones Day) in remote diagnostics case. Multiple IPR declarations. 2014.
- Expert for Toyota in Telematics/ navigation case. IPR declaration. 2015.
- Expert for BMW on remote data processing case. 2015.
- Expert for BMW (DLA Piper) in vehicle safety technology case (radar, occupant sensing). Invalidity and non-infringement reports, deposition testimony. 2015.
- Expert for Wavetronix (Workman Nydegger) in traffic radar case. IPR declaration, deposition. 2016.
- Expert for BMW (DLA Piper) on remote infotainment systems. 2017.
- Expert for Domino's (DLA Piper, Australia) on fleet monitoring systems. 2017.
- Expert for BMW (DLA Piper) on digital radio systems. 2017.
- Expert for Unified Patents on location-based services. 2017.
- Expert for Velocity v. FCA on vehicle management system. 2018.
- Expert for Unified Patents on map data management and display system. 2018.
- Expert for Blue Dot Systems against Omnitrac's on Fleet Management Trade Secrets. 2018
- Expert on vehicle safety for negligence in personal injury matter. 2019.
- Expert for BMW (DLA Piper) on location-based services patent. 2019.
- Expert for Unified Patents on pairing vehicles with remote devices. 2019.
- Expert for DEI (Cooley) v. ADS in vehicle remote starter patents. 2019.
- Expert for Unified Patents on navigation systems. 2020.
- Expert for BMW (DLA Piper) on connected vehicle systems. 2020.
- Expert for Equipmentsshare.com (DLA Piper) on rental equipment remote starter patents. 2021.
- Expert for Unified Patents on pairing vehicles with remote devices. 2021.
- Expert for Tesla (Arnold&Porter) on vehicle charging infrastructure. 2022.
- Expert for Unified Patents on infrastructure-based tracking systems. 2022.
- Expert for multiple pedestrian Automatic Emergency Braking liability related matters. 2023.
- Expert against Omnitrac's on Fleet management systems (King and Spalding). 2023.
- Expert in Patt v VW, liability matter related to seatbelt pretensioners. 2023.
- Expert for Honeywell in matter concerning aircraft docking systems (Crowell & Moring). 2024.
- Expert for Motive Technologies v Omnitrac's for driver scoring patents (King & Spalding). 2024.