

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HARMAN INTERNATIONAL INDUSTRIES, INC.
Petitioner

v.

ST CASESTECH LLC,
Patent Owner

Case IPR2024-01299

U.S. Patent No. 8,319,620

**DECLARATION OF DR. SAYFE KIAEI
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 8,319,620**

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I. INTRODUCTION

1. I have been retained by Harman International Industries, Inc., which I will refer to as “Harman” throughout this Declaration, to provide my opinions on certain issues related to U.S. Patent No. 8,319,620 (the “’620 patent,” which I understand has been designated as Exhibit 1001) in connection with the above-captioned *inter partes* review (IPR) proceeding. I have been asked to provide my insights, analysis, and opinions regarding whether claims 1-15 of the ’620 patent (“Challenged Claims”) are obvious over the prior art references identified below.

2. I understand the ’620 patent is titled “Ambient Situation Awareness System and Method for Vehicles,” identifies as its named inventors John Usher and John P. Keady, and is currently owned by ST CasesTech, LLC. I have considered the ’620 patent.

3. I understand that the file history of the ’620 patent has been designated as Exhibit 1002. I have considered this file history, and I will refer to it as the “’620 File History” or by its exhibit number.

4. I understand that the ’620 patent was filed as U.S. Patent Application 12/487,639 on June 18, 2009.

5. I have considered the following non-exhaustive list of references in preparing my declaration. I have been instructed to assume that each of these references qualifies as prior art.

- **Korean Patent Application Publication No. 10-2004-0091262** to Kim Hakgyu (“Kim”), titled “Horn Notification Device and Method for Other Vehicle,” filed on April 21, 2003 and published on October 28, 2004. I understand that a copy of this reference has been designated as Exhibit 1005, and a certified English translation has been designated as Exhibit 1004. Throughout my declaration, references to Kim are to Exhibit 1004.
- **Japanese Patent Application Publication No. H06-325291** to Okihiro Kobayashi et al. (“Kobayashi”), titled “Emergency Vehicle Detection and Alert Device and Location Display Device,” filed February 28, 1991 and published November 25, 1994. I understand that a copy of this reference has been designated as Exhibit 1007, and a certified English translation has been designated as Exhibit 1006. Throughout my declaration, references to Kobayashi are to Exhibit 1006.
- **German Patent Application Publication No. DE19749372** to Ralf Bergholz et al. (“Bergholz”), titled “Electronic Detection System and Method for Acoustic Signals,” filed November 7, 1997 and published May 12, 1999. I understand that a copy of this reference has been designated as Exhibit 1009, and a certified English translation has been designated as Exhibit 1008. Throughout my declaration, references to Bergholz are to Exhibit 1008.
- **U.S. Patent No. 6,360,187** to Thomas J. Hermann (“Hermann”), titled “Ambient Adjusted Volume Control for In-Vehicle Messages,” filed on June 28, 1999 and issued March 19, 2002. I understand that a copy of this reference has been designated as Exhibit 1010.
- **U.S. Patent No. 7,791,499** to Glenn Andrew Mohan et al. (“Mohan”), titled “Dynamic Siren Detection and Notification System,” filed on January 15, 2008 and issued September 7, 2010. I understand that a copy of this reference has been designated as Exhibit 1011.

6. I understand that there is a pending district court litigation between Petitioner and ST CasesTech, LLC (“Harman Litigation”) involving the ’620 patent.

7. I am being compensated by Harman at my standard hourly consulting rate of \$475 for my time on this matter. My compensation is not dependent on the outcome of this proceeding.

8. In forming my opinions, I relied on the documents cited in this declaration and the documents identified in the attached Appendix B. These documents comprise patents, file histories, printed publications, and other related documents. As discussed below, each document is a type that experts in my field would have reasonably relied upon when forming their opinions. Further, experts in my field would have had access to each document either through the applicable patent offices and/or well-known libraries, conferences, or publications in the field. My opinions are also based upon my personal and professional experience.

II. QUALIFICATIONS

9. I am qualified by education and experience to testify as an expert in the field of signal or acoustic data processing systems. Attached as Appendix A to this declaration is a copy of my curriculum vitae detailing my education and experience. Additionally, the following overview of my background pertains to my qualifications for providing expert testimony in this matter.

10. I earned a Ph.D. in 1987 from Washington State University in Electrical, Computer, and Energy Engineering. My M.S. and Ph.D. dissertation was in signal processing, digital signal processing, adaptive signal processing, video & audio and acoustic signal processing, adaptive audio array processing, audio and acoustic & speech processing.

11. From 1985 through 1987, while working toward my Ph.D., I worked with Boeing on the development of signal processing and control systems.

12. From 1987 through 1993, I was a tenured Professor at Oregon State University in the Electrical and Computer Engineering Department. During this time, I taught courses in audio and signal processing and performed research on the integration of signal processing algorithms on integrated VLSI.

13. From 1993 to 2002, I was a Senior Member of Technical Staff with the Wireless Technology Center and Broadband Operations at Motorola Inc. With the Wireless Integrated Technology Center (WITC) group of Motorola, I was responsible for the development of the “digital audio filtering IC” DAFIC at the LMPS 2-way radio group. Later, I joined the Broadband Operation and worked with the team on the development of OFDM Motorola Digital Subscriber Lines (DSL) transceivers named COPPERGOLD™. This chip performed FFT, OFDM and DSL parameter measurement for audio and multi-media system. I worked on the

development of broadband transceivers for MODEMS including DSL, SDSL, VDSL, and Optical communication systems. I also represented Motorola in the T`1E1 and ETSI, and cable MODEM DOCSIS standards. I later work with the Motorola Wireless Integrated Technology center on the development of baseband audio and signal processing, RF and communication modules for cellular applications.

14. Since 2001, I have held the position of Motorola Endowed Chair Professor in Analog and Radio Frequency Integrated Circuitry at the School of Electrical, Computer, and Energy Engineering at Arizona State University in Tempe, Arizona. I am also the Director of the National Science Foundation Center, Connection One. Connection One is an industry/university cooperative research center with focus on communication systems. The center has over thirty industrial members and five university members focused on developing communication systems, audio and acoustic sensors, electronics, bio-electronics, and networking technologies.

15. At Arizona State University, I have developed and taught courses on Communications, digital signal and audio processing, Wirelines and Wireless Transceivers, Electronics, VLSI, Analog IC design, RFIC, communications, and related areas. In my over thirty years of academic experience, I have taught

university courses and done research in audio and acoustic processing, electronics, RF and wireless system, bio-electronics, networking, communication systems, and sensors. I have graduated over 100 M.S. and Ph.D. students working under my supervision on their thesis, and many of them are professors in academia, or have senior positions in the industry. My research is funded by various sources, including industry, federal agencies including NSF, DARPA, ONR, DOE, and other, with an average total research funding of \$1M per year.

16. I have been conducting research, publishing papers, and supervising graduate students working on communication system, signal processing, acoustic and audio processing, and communication transceivers for the past 40 years. I have published over two hundred journal and conference papers covering topics such as wireless systems, power management, low-power electronics, sensors, radio frequency, integrated circuits (IC), filter design, and related areas. A list of my publications can be found in my CV, attached as Appendix A. I also have over 10 patents and patent applications in electronics, RF, and low-power bio-electronics.

17. I have received a number of research grants from the national science foundations, DARPA, DOD, and other federal agencies for research related to sensors, audio and acoustic sensors, hearing aid, bio-sensors, audio and acoustic amplifiers. These include the following grants:

- A grant from the National Science Foundation including projects related to adaptive audio and acoustic, glucose amp-meter and impedeometer (totaling \$400K); and
- A grant from the National Science Foundation, including projects related to MEMS implanted hearing aid and bio-sensors, micro-power multi-phase on-chip MEMS hearing aid, and adaptive hearing aid audio processors (totaling \$500K from 2007-2011).

18. I am an IEEE Fellow, a distinction and the highest level of IEEE membership awarded by the IEEE directors to recognize a high level of demonstrated extraordinary accomplishments. The IEEE is the Institute of Electrical and Electronics Engineers, the world's largest association of technical professionals whose objectives include the educational and technical advancement of electrical and electronic engineering, telecommunications, computer engineering, and related disciplines.

19. I am a member of the IEEE Signal Processing Society, IEEE Circuits and Systems Society, IEEE Solid State Circuits Society, and IEEE Communication Society, IEEE RF and Microwave committees, IEEE International Symposium on Low Power Electronics and Design (ISLPED), IEEE Fellow Selection Committee, and many other International Electrical Engineering societies. I was one of the key organizers to establish the IEEE Radio Frequency Integrated Circuits (RFIC) symposium in 1995, and IEEE International Symposium on Low Power Electronics and Design (ISLPED) in 1997. I have been on the executive committee, and

technical committee of ICASSP (IEEE International Conference on Acoustics, Speech and Signal Processing), RFIC and ISLPED for the last 16 years. The ICASSP, RFIC and ISLPED Symposia have grown and are now the premier international symposia in the world where the latest RF, low-power electronics, wireless, and bio-electronic circuits and components are presented.

20. I have received several awards including the Carter Best Teacher Award, the IEEE Darlington Award (which is given for the best technical paper on circuits and systems in the IEEE Circuits and Systems Society), and the Motorola 10X Rapid Design Cycle Reduction Award.

21. I have been one of the key organizers of the IEEE International Symposium on Low Power Electronics and Design (ISLPED) since 1997. I have published papers and organized sessions on techniques for low-power cellular phones at ISLPED. I have published a number of papers on the design and development of low-power RF, wireless transceivers, sensors, and low-power bioelectronics.

22. I have also been a consultant on various projects with Motorola, Intel (designing 2G, 3G mobile telephone transceivers, Internet-of-Things (IOT), and sensors), Texas Instrument (developing 3G cellular and Bluetooth technologies), Sony Wireless (developing GPS technologies), Tektronics (designing wireless

systems), and various other consultancies. During my work in industry, I have designed and contributed to the design of many wireless systems for commercial products. Many of my designs are still in use today in products manufactured by the companies I have worked for, including Motorola, Intel, Sony, and more.

III. LEGAL UNDERSTANDING

A. My Understanding of Claim Construction

23. I am not an attorney and offer no legal opinions, but in the course of my work, I have had experience studying and analyzing patents and patent claims from the perspective of a person skilled in the art.

24. I have been informed that patent claims are construed from the viewpoint of a person of ordinary skill in the art of the patent at the time of the invention. I have been informed that patent claims generally should be interpreted consistent with their plain and ordinary meaning as understood by a person of ordinary skill in the art in the relevant time period (*i.e.*, at the time of the purported invention, or the so called “effective filing date” of the patent application), after reviewing the patent claim language, the specification, and the prosecution history (*i.e.*, the intrinsic record).

25. I have further been informed that a person of ordinary skill in the art must read the claim terms in the context of the claim itself, as well as in the context

of the entire patent specification. I understand that in the specification and prosecution history, the patentee may specifically define a claim term in a way that differs from the plain and ordinary meaning. I understand that the prosecution history of the patent is a record of the proceedings before the U.S. Patent and Trademark Office and may contain explicit representations or definitions made during prosecution that affect the scope of the patent claims. I understand that an applicant may, during the course of prosecuting the patent application, limit the scope of the claims to overcome prior art or to overcome an examiner's rejection, by clearly and unambiguously arguing to overcome or distinguish a prior art reference, or clearly and unambiguously disavowing claim coverage.

26. In interpreting the meaning of the claim language, I understand that a person of ordinary skill in the art may also consider "extrinsic" evidence, including expert testimony, inventor testimony, dictionaries, technical treatises, other patents, and scholarly publications. I understand this evidence is considered to ensure that a claim is construed in a way that is consistent with the understanding of those of ordinary skill in the art at the time of the claimed invention. For example, this can be useful for a technical term whose meaning may differ from its ordinary English meaning. I understand that extrinsic evidence may not be relied on if it contradicts

or varies the meaning of claim language provided by the intrinsic evidence, particularly if the applicant has explicitly defined a term in the intrinsic record.

B. My Understanding of Obviousness

27. I understand that a claim may be invalid if the subject matter described by the claim as a whole would have been obvious to a hypothetical person of ordinary skill in the art in view of a 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 person of ordinary skill in the art and that the asserted claims of the patent should be read from the point of view of such a person at the time the claimed invention was made. I further understand that a hypothetical person of ordinary skill in the art is assumed to know and to have all relevant prior art in the field of endeavor covered by the patent in suit.

28. I have been informed that there are two criteria for determining whether prior art is analogous and thus can be considered prior art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed, and (2) if the reference is not within the field of the patentee's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the patentee is involved. I have also been informed that the field of endeavor of a patent is not

limited to the specific point of novelty, the narrowest possible conception of the field, or the particular focus within a given field. I have also been informed that a reference is reasonably pertinent if, even though it may be in a different field from that of the patentee's endeavor, it is one which, because of the matter with which it deals, logically would have commended itself to a patentee's attention in considering their problem.

29. I have also been advised 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.

30. I have also been advised that in considering whether a claimed invention would have been obvious over a combination of prior art references, 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 person of ordinary skill in the art. I 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 person of ordinary skill can implement a predictable variation, the variation is likely obvious;
- If a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond their 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 whether the claim is obvious;
- 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 person of ordinary

skill will be able to fit the teachings of multiple patents together like pieces of a puzzle;

- A person of ordinary skill in the art 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 person of ordinary skill in the art would have had good reason to pursue the known options within his or her technical grasp; and
- One should be cautious of using hindsight in evaluating whether a claimed invention would have been obvious.

31. I further understand that, in making a determination as to whether the claimed invention would have been obvious to a person of ordinary skill, the Board may consider certain objective factors if they are present, such as: commercial success of products practicing the claimed invention; long-felt but unsolved need; teaching away; unexpected results; copying; and praise by others in the field. These factors are generally referred to as “secondary considerations” or “objective indicia” of nonobviousness. I understand, however, that for such objective evidence to be relevant to the obviousness of a claim, there must be a causal relationship (called a “nexus”) between the claim and the evidence, and that this nexus must be based on a novel element of the claim rather than something in the prior art. I also understand that even when they are present, secondary considerations may be unable to

overcome primary evidence of obviousness (such as motivation to combine with predictable results) that is sufficiently strong.

IV. BACKGROUND OF THE TECHNOLOGY

32. The '620 patent is generally directed to a device that detects a sound—such as a siren—using an ambient microphone, and determines whether to notify a driver of the detected sound based on the volume inside of a vehicle, which is measured using an internal microphone. The driver is notified only if the measured volume inside the vehicle is too loud that the driver would not be able to hear the detected sound. *See, e.g.*, '620 patent, 9:12-29 (claim 1).

33. The Claims were allowed after being amended to recite a **notification device** “in the vehicle” configured to emit “an audio signal,” “an **internal microphone** configured to measure an internal acoustic signal in the vehicle,” “an **ambient microphone**...external to the vehicle,” and a **processor** “configured to[] determine an internal sound pressure level (SPL) in the vehicle based on the internal acoustic signal,” “identify” at least one sonic signature from the “ambient acoustic signal,” and when the sonic signature is identified, “determine whether to send an emit signal to the notification device to emit the audio signal based on the internal SPL.”’620 File History (“’620FH, Ex. 1002), 83-86.

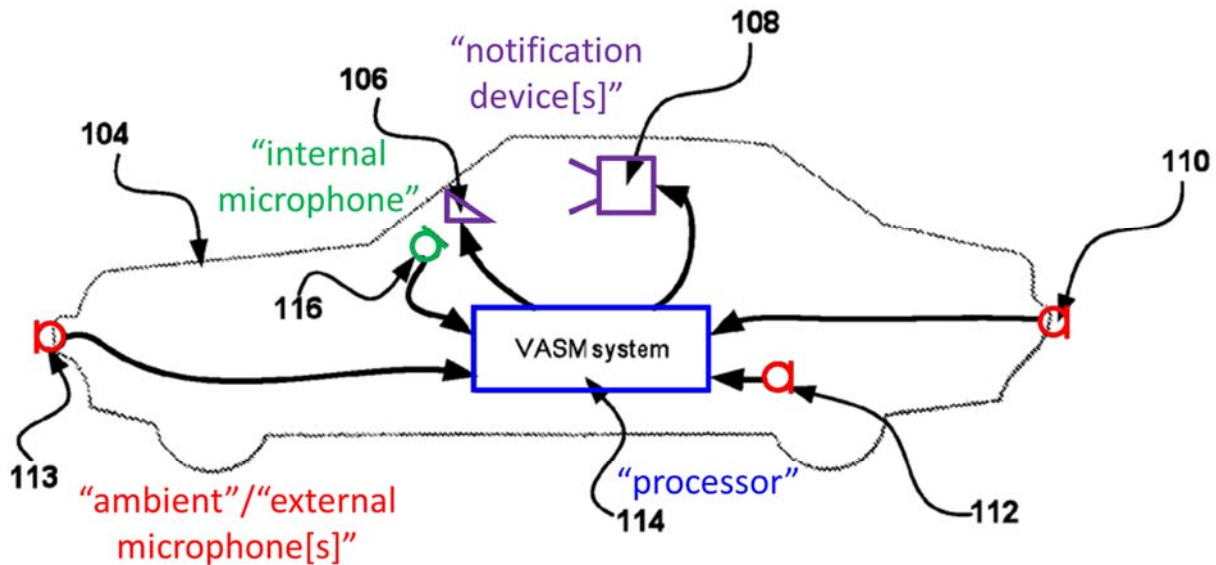
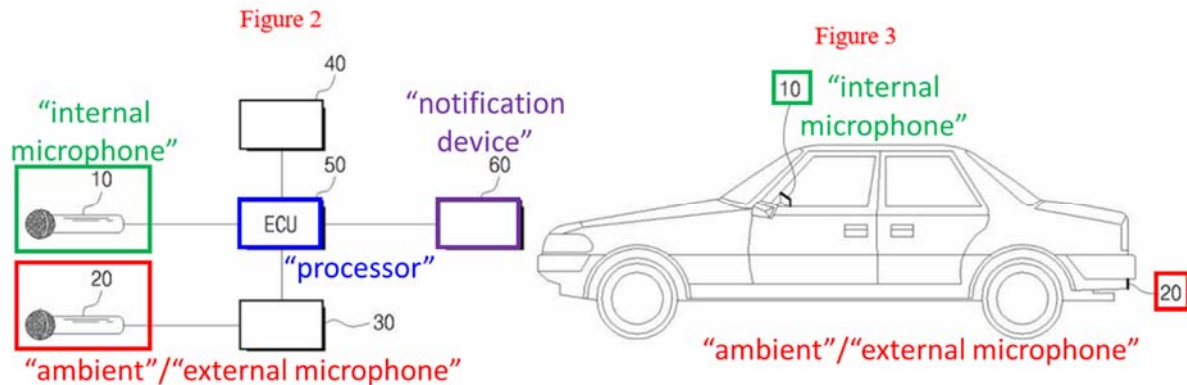


FIG. 1

'620 patent, Figure 1.

34. Based on my experience in the field, however, these concepts were already known in the art prior to the '620 patent's priority date. For example, Kim discloses **indoor microphone 10** that measures the volume inside the vehicle and **outdoor microphone 20** that measures the sound outside the vehicle. **ECU 50** detects a sound, such as a horn, received by **outdoor microphone 20** and outputs a warning message to **display 60** to the driver if the volume level measured by **indoor microphone 10** is greater than a certain level. Kim, 1-3.



Kim, Figs. 2-3.

35. In addition, Kobayashi discloses sending both **audio and visual notifications** to a driver when a particular sound is detected, such as a siren. Kobayashi, [0019]-[0021].

36. As I discuss below, the claims of the '620 patent are obvious over the prior art. Further, there were no technological barriers to combining these teachings from the prior art and a person of ordinary skill in the art would have been motivated to combine these teachings and would have understood that the combination would have yielded predictable results.

V. THE '620 PATENT

A. '620 Patent Overview

37. The '620 patent generally "relates to devices and methods for vehicle situation awareness." '620 patent, 1:14-15.

38. The '620 patent describes devices and methods that use microphones and a processor to detect target sounds and determine whether to send a signal to a notification device. '620 patent, Abstract, 1:14-15, 2:27-37, 4:30-42, 5:37-42. As depicted in Figure 1, the “[v]ehicle ambient sound monitoring system (VASM)” includes “at least one **Ambient Sound Microphone (ASM) 110, 112, 113** . . . mounted on the exterior of the vehicle and configured to detect sound around the vehicle 104” and an “**internal microphone sensor 116** . . . configured to detect the sound pressure level (SPL) . . . within the vehicle cabin.”¹ '620 patent, 3:37-41, 4:30-32. The vehicle ambient sound monitoring system comprises a “**signal processing unit**” to detect “signature sounds with the **ASMs**,” such as “sirens” or “car horns.” '620 patent, 3:51-63, 4:60-5:3, Figure 2. If a sound signature is detected, “the SPL in the interior cabin of the vehicle is determined . . . using [the] **internal microphone**.” '620 patent, 5:34-37, Figure 3. If “the SPL of the interior cabin of the vehicle is greater than a predetermined threshold,” then an alert is issued. '620 patent, 5:37-42, Figure 3. Such an alert includes “[a]n audible warning” using an “**internal loudspeaker**” and/or “[a] visual warning” using a “**visual display**.” '620 patent, 3:64-4:8, 4:13-21, 4:61-5:3, 5:37-42, Figure 3.

¹ Throughout my declaration, if I use colored font in the text of my declaration, this aligns with coloring I have had added to annotations in corresponding figures.

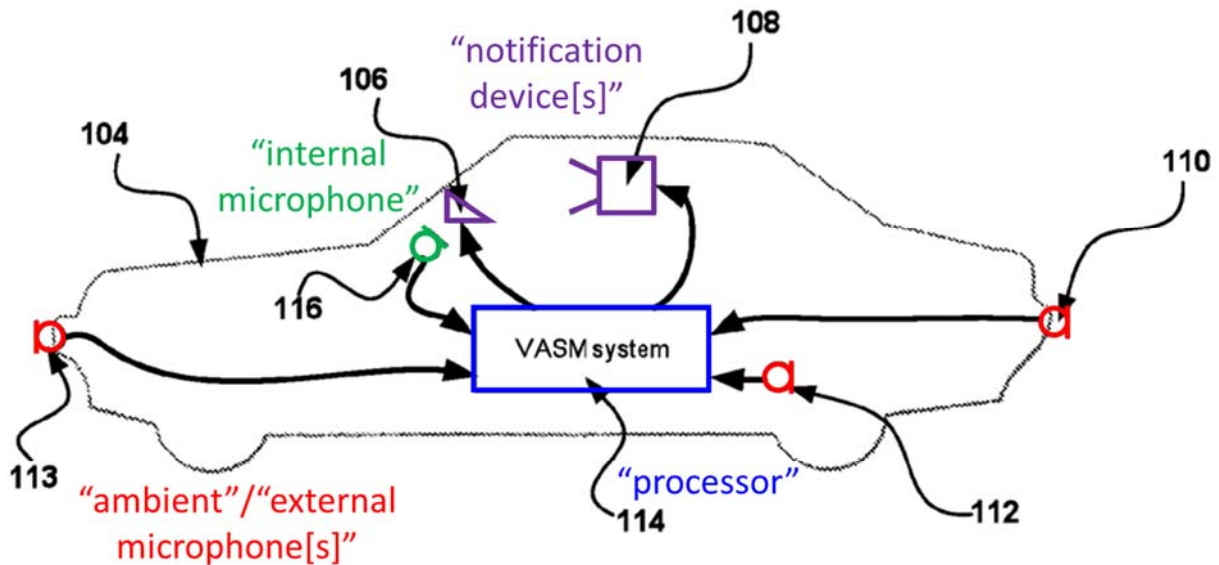


FIG. 1

'620 patent, Figure 1.

B. Prosecution History of the '620 Patent

39. In formulating my opinions, I considered the contents of the prosecution history of the '620 patent. See Ex. '620FH. The prosecution history shows that the Challenged Claims of the '620 patent were amended after a rejection, and then were allowed.

40. In particular, I understand that during prosecution, the Challenged Claims were rejected on February 23, 2012 based on U.S. Patent No. 6,150,927 ("Nesbitt," Ex. 1012). Ex. '620FH, 57-63.

41. On May 23, 2012, when responding to the rejection, the applicant amended the Challenged Claims. Ex. '620FH, 83-86. For example, applicant

amended Claim 1 to recite a notification device “in the vehicle” configured to emit “an audio signal,” “an internal microphone configured to measure an internal acoustic signal in the vehicle,” “an ambient microphone . . . external to the vehicle,” and a processor “configured to[] determine an internal sound pressure level (SPL) in the vehicle based on the internal acoustic signal,” “identify” at least one sonic signature from the “ambient acoustic signal,” and when the sonic signature is identified, “determine whether to send an emit signal to the notification device to emit the audio signal based on the internal SPL.” Ex. ’620FH, 83. Similar amendments were made to the other independent claims, including Claims 6, 11, and 15 (claims 6, 14, and 19, respectively during prosecution), with Claim 11 further amended to recite “the first processor used to modify an operation of the vehicle responsive to the alert signal.” Ex. ’620FH, 83-86.

42. After these amendments, the Claims were allowed on July 16, 2012. Ex. ’620FH, 123-127. The Examiner did not provide reasons for allowance. Ex. ’620FH, 123-127.

43. The Nesbitt reference discussed above discloses an “anti-vandalism detection and alarm system” that uses “[h]igh frequency microphone sensors . . . mounted on selected windows” to detect vibrations having “distinct characteristic[s]” to report vandalism. Nesbitt, Abstract, 4:43-65, 5:22-35, Figure 6.

However, Nesbitt does not teach a device including, for example, (1) an internal microphone, (2) an ambient microphone, and (3) a processor that determines the internal SPL in the vehicle and sends an emit signal to the notification device based on the internal SPL. Some combination of at least a subset of these three concepts appear in each of the independent claims of the '620 patent.

VI. THE '620 PATENT PRIORITY DATE

44. I understand the '620 patent was filed on June 19, 2008. I have not formulated any opinion about the correct priority date for the '620 patent. For purposes of this declaration, I was asked to assume, with respect to each of the prior art Grounds discussed in this declaration, that the '620 patent is entitled to the earliest claimed priority date of June 19, 2008. I have been instructed to consider the patent and the prior art from the perspective of a person having ordinary skill in the art as of June 19, 2008.

VII. LEVEL OF ORDINARY SKILL IN THE ART

45. In rendering the opinions set forth in this declaration, I was asked to consider the patent claims and the prior art through the eyes of a person of ordinary skill in the art at the time of the alleged invention. I understand that the factors considered in determining the ordinary level of skill in a field of art include the level of education and experience of persons working in the field; the types of problems

encountered in the field, the teachings of the prior art, and the sophistication of the technology at the time of the alleged invention. I understand that a person of ordinary skill in the art is not a specific real individual, but rather is a hypothetical individual having the qualities reflected by the factors above. I understand that a person of ordinary skill in the art would also have knowledge from the teachings of the prior art, including the art cited below.

46. With respect to all of the Grounds, I have been asked to assume that the '620 patent is entitled to the priority date of June 19, 2008. Upon consideration of these factors, in my opinion, on or before this priority date, a person of ordinary skill in the art relating to the technology of the '620 patent would have had a bachelor's degree in electrical or computer engineering, computer science, or a similar field, and at least two years of experience with signal or acoustic data processing systems. Additional graduate education could substitute for professional experience, or significant experience in the field could substitute for formal education.

47. I am qualified to opine concerning what a person of ordinary skill in the art would have known and understood during that time. Well before June 19, 2008, my level of skill in the art was at least that of a person of ordinary skill. I am qualified to opine concerning what a person of ordinary skill in the art would have known and understood at the time of the '620 patent's purported invention. My

analysis and conclusions herein are from the perspective of a person of ordinary skill in the art as of June 19, 2008.

VIII. CLAIM CONSTRUCTION

48. I have been instructed that the Challenged Claims of the '620 patent are to be given their ordinary and customary meaning as understood by one of ordinary skill in the art at the time of the alleged invention in light of the specification and the prosecution history pertaining to the patent. I have followed these principles in my analysis set forth in this document.

49. I understand that the parties have not proposed constructions for the '620 patent in the Harman Litigation.

IX. GROUNDS OF UNPATENTABILITY

50. As I explain above in Section IV, devices that detect sounds using an ambient microphone, such as a siren, and determine whether to notify a driver based on the volume inside of a vehicle, which is measured using an internal microphone, were well-known in the art.

51. In this section, I will explain why the teachings or combinations of teachings from the following references render obvious each of the Challenged Claims:

Name	Ex.	Publication/Title	Filed	Published/ Issued
Kim	1004-1005	KR10-2004-0091262	4/21/2003	10/28/2004
Kobayashi	1006-1007	JPH06-325291	2/28/1991	11/25/1994
Bergholz	1008-1009	DE19749372	11/7/1997	5/12/1999
Hermann	1010	US6,360,187	6/28/1999	3/19/2002
Mohan	1011	US7,791,499	1/15/2008	9/7/2010

I have been instructed to assume that each of these references qualifies as prior art.

52. As I explain below, the Challenged Claims are invalid based upon the following prior art grounds:

- **Ground 1:** Challenged Claims 1-4 and 15 of the '620 patent are rendered obvious by Kim in view of Kobayashi.
- **Ground 2:** Challenged Claims 1-4, 6-8, and 15 of the '620 patent are rendered obvious by Kim in view of Bergholz.
- **Ground 3-4:** Challenged Claim 5 of the '620 patent is rendered obvious by Ground 1 (Kim in view of Kobayashi) further in view of Hermann and Ground 2 (Kim in view of Bergholz) further in view of Hermann.
- **Ground 5:** Challenged Claims 6 and 9-14 of the '620 patent are rendered obvious by Mohan in view of Bergholz.

53. It is my opinion that Challenged Claims of the '620 patent are unpatentable as explained below. I note that in this discussion, I may focus on the particular language in the specific claims, but it should be understood that my analysis applies to the corresponding elements of all Challenged Claims containing identical or substantially identical language.

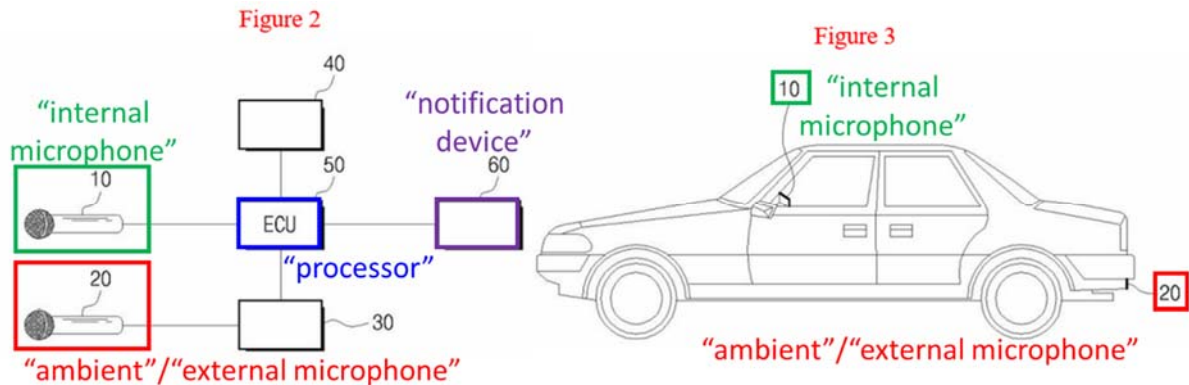
A. Ground 1: Kim in view of Kobayashi (Claims 1-4 and 15)

1. Overview of Kim

54. Kim generally relates to “a horn notification device of a counterpart vehicle, and in particular, to a horn notification device of another vehicle that visually informs the driver of the occurrence of the horn sound of the other vehicle by detecting the occurrence of the horn sound when the other vehicle generates a loud noise inside or outside the vehicle.” Kim, 1.

55. Kim provides a solution that “enhanc[es] the safety of the vehicle by visually warning the driver when the horn of another vehicle occurs” and the “music output from the [vehicle’s] audio speaker” is high such that “the horn of another vehicle cannot be heard,” risking “a major accident.” Kim, 1-3.

56. Kim discloses “[a]n **indoor microphone (10)** . . . installed inside . . . the vehicle” that “measures the volume inside the vehicle” and “an **outdoor microphone (20)** installed . . . outside the vehicle” that “measures the sound generated around the vehicle.” Kim, 2, Figures 2-3.



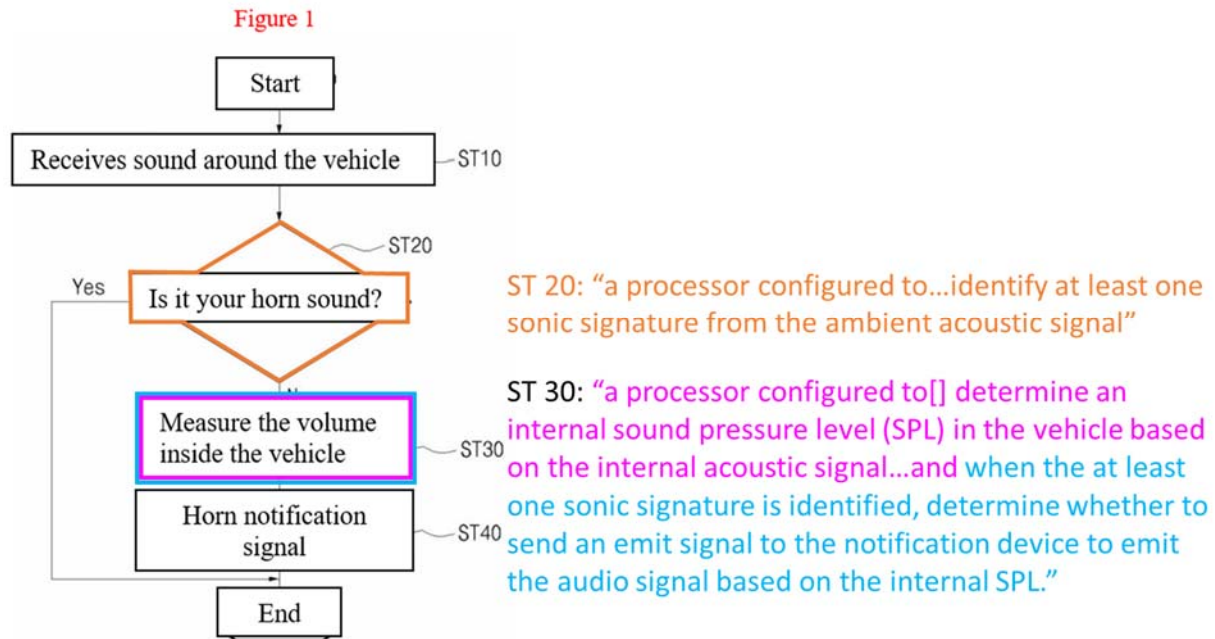
Kim, Figures 2-3.

57. Kim further discloses a horn notification method in which, at step ST10, frequency analyzer (30) measures “the frequency of the external sound received by the **outdoor microphone (20)**,” and “**ECU (50)** determines **whether the frequency measured by the frequency analyzer (30) includes the frequency corresponding to the horn (ST20)**.” Kim, 3.

58. The term “ECU” refers to an “electronic control unit,” which includes a central processing unit, or “CPU.” Ex. 1017 (U.S. Pat. Appl. Pub. No. 2006/0030987, “Akita”), [0033] (“The picture processing system according to the embodiment of the present invention includes the **electronic control unit ECU 1 including a CPU** for picture processing and frame memory. . . . Further, the electronic control unit ECU 2 is connected to the EPS motor MT via a motor drive circuit AC2, and is connected to a warning system WA for outputting warning messages and warning sounds via an **electronic control unit ECU 3** for warning

(shown in FIG. 2).”), Figure 2 (showing “ECU3” having a “**Warning CPU**,” “ROM,” and “RAM”).

59. After determining whether the measured frequency includes the frequency of a horn, **ECU (50)** determines whether “the horn sound [was] generated from vehicle” itself. Kim, 3. If the horn sound was not generated from the vehicle, at step ST30, “the **volume of the vehicle interior** using the **indoor microphone (10)**” is measured to determine if “the volume . . . is more than a certain level.” Kim, 3. If “the volume . . . is small,” the driver may hear the horn himself and a separate warning is not necessary. Kim, 3. If “**the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level, the ECU (50) outputs a control signal**” to “displayer (60)” to “present[] a warning message . . . to notify the driver” at step ST40. Kim, 3.



Kim, Figure 1.

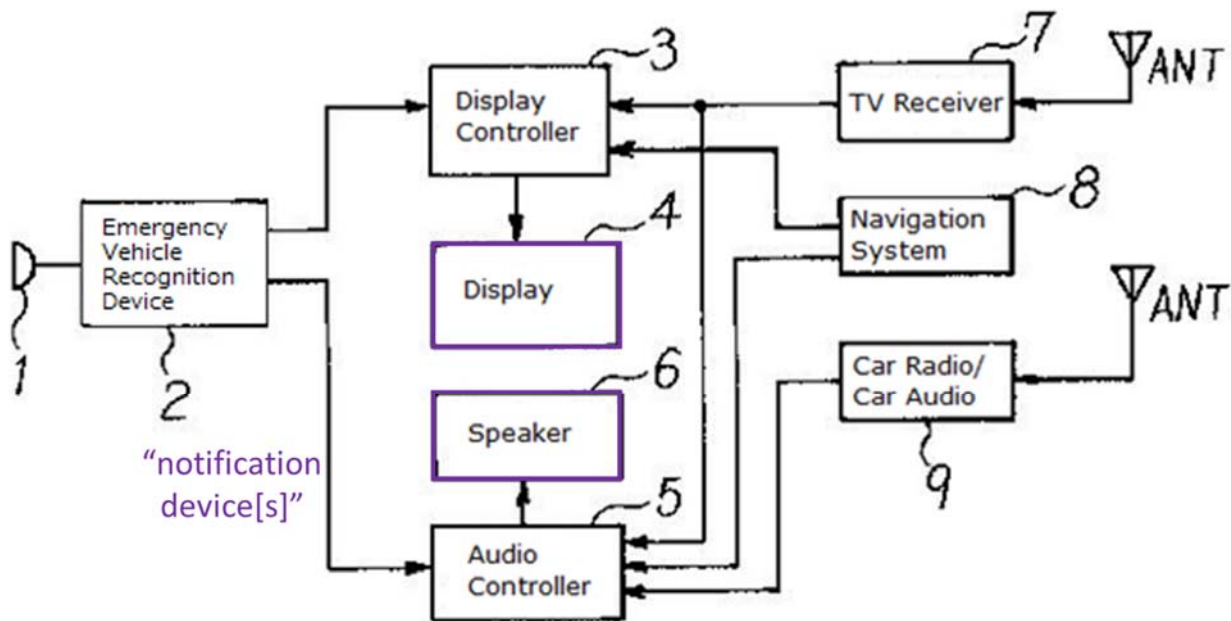
2. Overview of Kobayashi

60. Kobayashi is generally directed to emergency vehicle detection “[t]o notify a driver of an approaching emergency vehicle even when the windows of the vehicle are closed and the volume of the car stereo, etc., is turned up.” Kobayashi, Abstract.

61. Kobayashi discloses “an emergency vehicle detection and alert device that detects the approach of an emergency vehicle using a microphone and recognition device” and “plays the siren or announces the approach of an emergency vehicle on the speakers.” Kobayashi, [0003]. A “microphone located outside the car” supplies signals to “emergency vehicle recognition device 2,” which “compares

inputted signals with the patterns in [its] memory,” such as “emergency vehicle sirens.” Kobayashi, [0019]. Upon recognizing a match between a pattern and a sound detected by the microphone, “a signal is outputted to a display controller 3 and an audio controller 5” to generate both “alert screen video signals” for **display 4** and “an alert announcement” for **speaker 6**. Kobayashi, [0019]-[0020].

[Fig. 1]



Kobayashi, Figure 1.

3. Motivation to Apply Kobayashi’s Teachings to Kim

62. Kim and Kobayashi are in the same field as the ’620 patent and pertinent to the problems addressed by the ’620 patent. For example, the ’620 patent’s field includes situation awareness and the ’620 patent purports to address the problem of detecting sounds and responding thereto in vehicles. ’620 patent,

Abstract (“Methods and devices for situation awareness facilitation for a vehicle driver are provided. A method includes receiving a first acoustic signal from outside a vehicle that the driver is in and converting the first acoustic signal into a first acoustic electronic signal; sending the first acoustic electronic signal to a processor; matching the first acoustic electronic signal by the processor to stored reference electronic signals; and sending an acoustic message associated with a matched reference electronic signal to a speaker in the cab of the vehicle.”), 1:14-15 (“The present invention relates to devices and methods for vehicle situation awareness.”), 2:27-37 (“At least one exemplary embodiment is directed to a vehicle situation awareness device comprising: a notification device, where the notification device is configured to emit a first signal; a microphone, where the microphone is configured to measure a second signal, where the second signal is a measurement of at least a first portion of an ambient acoustic signal; and a processor, where at least one sonic signature is identified from at least a second portion of the second signal, and where when the at least one sonic signature is identified an emit signal is sent to the notification device to emit the first signal.”).

63. Kim’s field includes situation awareness as well, and Kim is pertinent to the problem of detecting sounds and responding thereto in vehicles. Kim, 1 (“This invention relates to a horn notification device of another vehicle, and it is sometimes

difficult to know the horn sound of another vehicle due to the use of audio inside the vehicle, so to solve this problem, it provides horn notification methods for other vehicles”), 2 (“This invention relates to a horn notification device of a counterpart vehicle, and in particular, to a horn notification device of another vehicle that visually informs the driver of the occurrence of the horn sound of the other vehicle by detecting the occurrence of the horn sound when the other vehicle generates a loud noise inside or outside the vehicle.”), 2 (“This invention was created to solve the above problems, and it is intended to provide a horn notification device for another vehicle that can prevent a traffic accident in advance by detecting when another vehicle sounds a horn in a noisy place and warning the driver.”), 3 (“As described above, according to the present invention, when it is difficult to know the horn of another vehicle due to the use of vehicle audio, etc., it has the effect of enhancing the safety of the vehicle by visually warning the driver when the horn of another vehicle occurs.”).

64. Kobayashi’s field also includes situation awareness as well, and Kobayashi is pertinent to the problem of detecting sounds and responding thereto in vehicles. Kobayashi, Abstract (“To notify a driver of an approaching emergency vehicle even when the windows of the vehicle are closed and the volume of the car stereo, etc., is turned up.”), [0001] (“The present invention relates to a safety device

for operating an automobile, and more specifically, to an emergency vehicle detection and alert device and a location display device that alerts the driver of an approaching emergency vehicle while driving.”), [0003] (“Therefore, in view of these circumstances, it is an object of the present invention to provide an emergency vehicle detection and alert device that detects the approach of an emergency vehicle using a microphone and recognition device, temporarily stops the car stereo or other audio equipment, plays the siren or announces the approach of an emergency vehicle on the speakers, or displays the type, bearing, and/or distance of the emergency vehicle on the indicator or display.”). *See also* Kobayashi, [0002], [0004]-[0005].

65. Further, the ’620 patent, Kim, and Kobayashi each contemplate detection systems comprising a microphone that detects a horn and/or siren from another vehicle and responds thereto, for example, by warning the driver of the sound. Abstract (“A method includes receiving a first acoustic signal from outside a vehicle that the driver is in and converting the first acoustic signal into a first acoustic electronic signal; sending the first acoustic electronic signal to a processor; matching the first acoustic electronic signal by the processor to stored reference electronic signals; and sending an acoustic message associated with a matched reference electronic signal to a speaker in the cab of the vehicle.”), 2:27-37 (“At least one exemplary embodiment is directed to a vehicle situation awareness device

comprising: a notification device, where the notification device is configured to emit a first signal; a microphone, where the microphone is configured to measure a second signal, where the second signal is a measurement of at least a first portion of an ambient acoustic signal; and a processor, where at least one sonic signature is identified from at least a second portion of the second signal, and where when the at least one sonic signature is identified an emit signal is sent to the notification device to emit the first signal.”); Kim, 1 (“an outdoor microphone (20) installed on both sides of the rear of the vehicle to receive sound generated around the vehicle . . . the ECU (50) that detects the horn of another vehicle . . . and outputs a control signal accordingly, and the displayer (60) of a warning signal to a driver by a control signal output from the ECU (50)”), 2 (“outdoor microphones (20) are installed on both sides of the rear of the vehicle to receive the horn of another vehicle”), 3 (“the frequency of the external sound received by the outdoor microphone (20) is measured using the frequency analyzer (30), and the ECU (50) determines whether the frequency measured by the frequency analyzer (30) includes the frequency corresponding to the horn”); Kobayashi, Abstract (“Signals from a microphone 1 are inputted to an emergency vehicle recognition device 2, which detects the sound of an emergency vehicle siren and outputs signals to a display controller 3 and audio controller 5.”), [0019] (“In the figure, 1 is a microphone located outside the car.

Signals outputted from the microphone 1 are inputted to an emergency vehicle recognition device 2. The emergency vehicle recognition device 2 has a memory that stores the sound patterns of emergency vehicle sirens and an arithmetic circuit that compares inputted signals with the patterns in the memory. When the inputted signals match a pattern in the memory, a signal is outputted to a display controller 3 and an audio controller 5.”). *See also* Kobayashi, [0001]-[0005], [0020].

66. A person of ordinary skill in the art would have been motivated to apply Kobayashi’s teaching of audio notifications in implementing Kim’s notification device. Both Kim and Kobayashi relate to the driver’s cognizance of his/her surroundings, including sounds from other vehicles, such as horns or sirens. Kobayashi discloses providing both audio and visual warnings to the driver, while Kim discloses warning drivers of detected horns using visual notifications on a display. Kobayashi, [0015] (“In the emergency vehicle detection and alert device described above, the display on the location indicator is combined with speaker sounds.”); Kim, 3 (“Upon receiving the control signal, the displayer (60) presents a warning message such as ‘Horn’ to notify the driver that another vehicle has sounded a horn.”).

67. A person of ordinary skill in the art would have been motivated to apply Kobayashi’s teachings of audio notifications in implementing Kim’s horn

notification device to advantageously make the driver's experience safer. A person of ordinary skill in the art would have understood that visual notifications divert a driver's attention to, for example, a dashboard or display, causing the driver to take his/her eyes off the road to assess the notification. An audio notification would have advantageously allowed the driver to maintain his/her focus and attention on driving while simultaneously assessing the notification. Such an implementation would have advantageously obviated the need for the driver to split his/her focus between driving and assessing the visual notification.

68. As described in Ito, *Visual Distraction While Driving: Trends in Research and Standardization*, 25 IATSS Research 20-28 (2001) (Ex. 1015), there were recognized “problems brought into focus by the development of navigation and other [Intelligent Transport Systems],” including “that the operation of such devices draws the driver's eye from the visual field where it belongs while driving and creates a visual distraction that may impede safety.” Ex. 1015, 20. Indeed, “the addition of voice-based guidance to car navigation systems reduces the frequency and duration of glances at in-vehicle instruments and alleviates physiological stress,” and “[s]upplementing visual warnings with warning sounds reduces the time to warning detection and increases the accuracy of reaction, regardless of the location of the visual display.” Ex. 1015, 24.

69. Kim discloses that the vehicle contains an “audio speaker.” Kim, 3. In view of Kobayashi’s teachings of providing both audio and visual warnings, a person of ordinary skill in the art would have been motivated to modify Kim’s horn notification device such that it provides visual warnings via displayer (60) and audio notifications using the vehicle’s “audio speaker.” Kim, 3; Kobayashi, [0019]-[0021]. Further, a person of ordinary skill in the art would have been motivated to use the vehicle’s already existing “audio speaker” as taught by Kim. Such an implementation would have advantageously simplified the system because it would have obviated the need to include an additional speaker solely for horn notifications. Indeed, Kobayashi teaches alerting the driver “by voice over the speakers of the car stereo system” such that using Kim’s “audio speaker” for such audio notifications would have provided predictable results. Kobayashi, [0018]; Kim, 3.

70. Further, Kobayashi teaches that when “the sound of the siren is recognized using the microphone 1 and the emergency vehicle recognition device 2,” “an alert is announced over the speaker 6.” Kobayashi, [0020]-[0021]. Further, Kobayashi explains that, when providing the alert over the speaker 6, it is still heard over other audio over the speaker, allowing the user to be warned of the other vehicle. Kobayashi, [0021] (“[E]ven when the volume of the sound equipment is turned up, the driver is able to reliably recognize the approach of an emergency

vehicle”). In applying Kobayashi’s audio warning teachings in implementing Kim’s notification device, a person of ordinary skill in the art would have been motivated to play an audio signal at a sound level above “the volume of the sound received by [Kim’s] indoor microphone,” to ensure the warning is heard. Kim, 3. It was understood that such an implementation would have advantageously ensured that the audio notification is played over the ambient noise in the vehicle so that the driver would hear the notification. See Hermann (Ex. 1010), 1:45-59 (“The high priority message signals are played at the adjusted programmable gain whereby the high priority message signals are heard at a sound level which is relatively greater than the ambient noise level by a predetermined target difference.”).

71. Kim teaches that the ECU sends a control signal to displayer 60 if “it is determined that a frequency corresponding to the vehicle horn is included, that the horn is the horn of another vehicle, and [] the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level.” Kim, 3. The decision to do so when the detected indoor sound level is high is because the driver cannot hear “other sounds,” for example, “due to music output from the audio speaker.” Kim, 3. In implementing Kobayashi’s teachings in Kim, a person of ordinary skill in the art would have understood that Kim’s ECU would send a control signal to play an audio notification if the internal SPL of the vehicle, measured by

the indoor microphone, is greater than or equal to a certain level, such that the driver would not hear multiple horn sounds. For example, taking the internal SPL into account when deciding whether to issue the control signal would have advantageously avoided distracting the driver with two sounds, including one from the original horn from the other vehicle and the other from a notification regarding that vehicle's detected horn sound. Issuing the notification would have been redundant when the driver heard the original horn from the other vehicle himself/herself because the internal SPL of the vehicle was low enough such that the horn could have been heard. Issuing the redundant notification would have distracted the driver and caused the driver confusion of whether there was another horn detected that the driver did not hear.

72. Accordingly, a person of ordinary skill in the art would have had a reasonable expectation of success in applying Kobayashi's teachings in implementing Kim's horn notification device. It was well-known in the art to give drivers audio and visual warnings. Kobayashi, [0019-0021]. Indeed, the '620 patent identifies US2005/0074131 (Ex. 1016) as known, background art, which discloses using both audio and visual alerts for the driver. '620 patent, 1:45-53, 1:66-2:8; Ex. 1016 (US2005/0074131), [0033] ("Display 310 and sound system 312 receive the EMERGENCY SOUND DETECTED signal and each produce a user recognizable

indication that an emergency sound has been detected; display 310 provides a visual indication (e.g. illumination of a dashboard mounted light) in response to the signal, and sound system 312 provides an audible alert (e.g. a prerecorded vocal announcement produced via the vehicle's speaker system)."). Further, Kim already discloses "sounds . . . output from the audio speaker" (Kim, 3). It would have been a straightforward application of Kobayashi's teachings to use the audio speaker to issue audio notifications to the driver.

4. Invalidity of Claims 1-4 and 15 Over Kim in view of Kobayashi

73. As I discuss below, the Challenged Claims are rendered obvious by Kim in view of Kobayashi. In addition to my discussion in Section IX.A.1, the following discussion identifies example disclosures followed by bulleted excerpts that each disclose the Challenged Claims.

(a) Element [1.pre]

74. **Element [1.pre] recites "A vehicle situation awareness device for a vehicle comprising."** This element is met by Kim.

75. Kim discloses a vehicle situation awareness device for a vehicle (*e.g.*, "horn notification device" in a "vehicle"). *See, e.g.*, Kim:

- 2: "This invention relates to ***a horn notification device of a counterpart vehicle***, and in particular, to a horn notification device of another vehicle that visually informs the driver of the occurrence of the horn sound of the

- other vehicle by detecting the occurrence of the horn sound when the other vehicle generates a loud noise inside or outside the vehicle.”
- 3: “As described above, according to the present invention, when it is difficult to know the horn of another vehicle due to the use of vehicle audio, etc., it has the effect of ***enhancing the safety of the vehicle by visually warning the driver*** when the horn of another vehicle occurs.”

76. Kim discloses a “horn notification device” that “enhanc[es] the safety of the vehicle” by warning the driver when another vehicle’s horn is detected. Kim, 2-3.

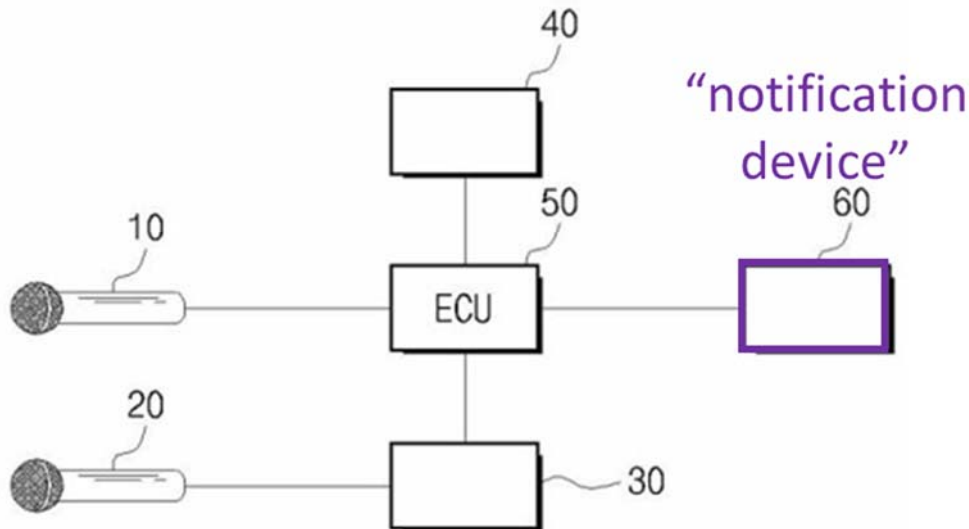
(b) Element [1.a]

77. **Element [1.a] recites “a notification device in the vehicle configured to emit an audio signal.”** This element is met by Kim in view of Kobayashi.

78. Kim discloses a notification device in the vehicle (*e.g.*, “displayer (60)”) configured to emit a signal (*e.g.*, “outputting a warning signal to a driver”).
See, e.g., Kim:

- **Figure 2:**

Figure 2



- 2: “This invention relates to a horn notification device of a counterpart vehicle, and in particular, to **a horn notification device of another vehicle that visually informs the driver of the occurrence of the horn sound of the other vehicle** by detecting the occurrence of the horn sound when the other vehicle generates a loud noise inside or outside the vehicle.”
- 2: “[A] **displayer (60) for outputting a warning signal to a driver by a control signal output from the ECU (50).**”
- 3: “As a result of measuring the frequency of the sound received by the outdoor microphone (20), when it is determined that a frequency corresponding to the vehicle horn is included, that the horn is the horn of another vehicle, and that the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level, the ECU (50) outputs a control signal so that the **displayer (60) operates**. Upon receiving the control signal, the **displayer (60) presents a warning message such as ‘Horn’ to notify the driver that another vehicle has sounded a horn.**”

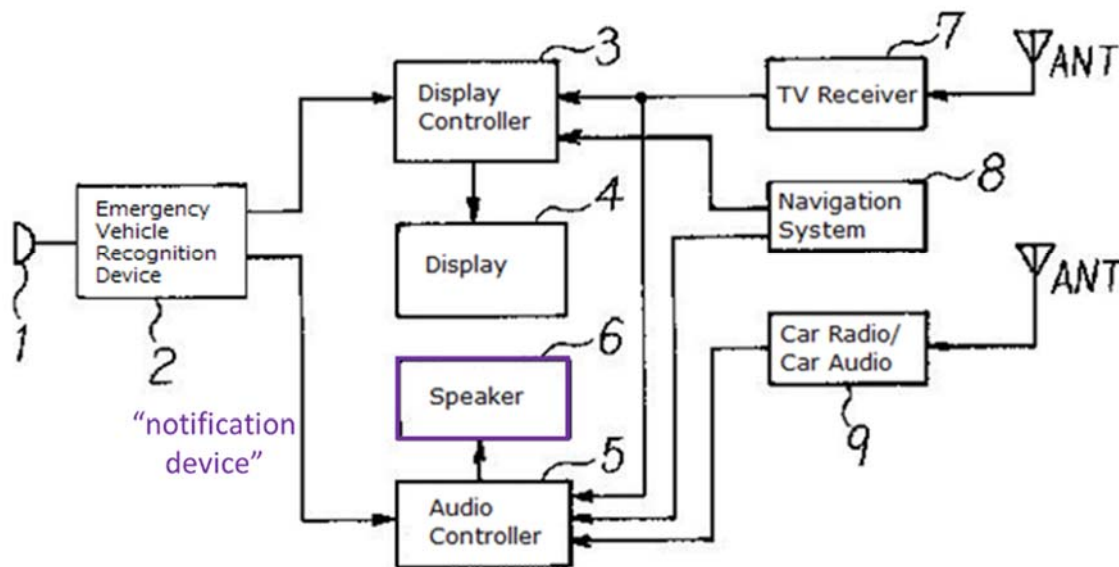
79. See my discussion of element [1.pre] above (Section IX.A.4.a).

80. Kim further discloses “displayer (60),” which provides notifications, such as a “warning signal to a driver.” Kim, 2-3.

81. Kobayashi discloses a notification device in the vehicle (e.g., “speaker 6” in “vehicle”) configured to emit an audio signal (e.g., playing “alert[s]” after a “siren is recognized”). See, e.g., Kobayashi:

- **Figure 1:**

[Fig. 1]



- **Abstract:** “[Purpose] To notify a driver of an approaching emergency vehicle *even when the windows of the vehicle are closed and the volume of the car stereo, etc., is turned up.* [Constitution] Signals from a microphone 1 are inputted to *an emergency vehicle recognition device 2, which detects the sound of an emergency vehicle siren and outputs signals* to a display controller 3 and *audio controller 5.* When the display controller 3 receives a signal from the emergency vehicle recognition device 2, it generates alert screen image signals from a built-in image signal generator and displays an alert screen on a display 4. *The audio controller 5 generates an alert announcement from a built-in speech synthesizer and operates a speaker 6.*”

- [0003]: “Therefore, in view of these circumstances, it is an object of the present invention to provide ***an emergency vehicle detection and alert device that detects the approach of an emergency vehicle using a microphone and recognition device***, temporarily stops the car stereo or other audio equipment, ***plays the siren or announces the approach of an emergency vehicle on the speakers***, or displays the type, bearing, and/or distance of the emergency vehicle on the indicator or display.
- [0005]: “The present invention is also an emergency vehicle detection and alert device comprising: a microphone that detects the sound of emergency vehicle sirens; an emergency vehicle recognition device that recognizes that signals outputted from the microphone are those of the sound of an emergency vehicle siren; and an audio controller that controls a speaker in a vehicle, ***wherein the emergency vehicle detection and alert device is configured to temporarily stop the operation of a sound reproduction device such as a radio or car audio system when the emergency vehicle recognition device confirms the sound of an emergency vehicle siren while the sound reproduction device is operating, and starts up the amplifier of the sound reproduction system and inputs the sound signals of the emergency vehicle siren to the amplifier of the sound reproduction system to output the sound signals from a speaker in the vehicle when the sound reproduction system is not in operation.***”
- [0007]: “The present invention is also an emergency vehicle detection and alert device comprising: a microphone that detects the sound of emergency vehicle sirens; and a recognition device that has a ROM memory with siren sound patterns by type of emergency vehicle and that identifies a type of emergency vehicle by comparing signals outputted from the microphone with the patterns stored in the memory, wherein the emergency vehicle detection and alert device is configured to display a type of emergency vehicle on a display unit based on signals from the recognition device, or ***announce the type of emergency vehicle by audio announcement.***”
- [0018]: “***The driver is alerted to the information obtained in this way by voice over the speakers of the car stereo system.*** The information is also displayed for the driver using a location indicator on the dashboard or a display such as a television.”

- [0020]: “The audio controller 5 usually receives audio signals from the television receiver 7, navigation system 8, or audio equipment 9, and these signals operate a speaker 6. When signals are inputted from the emergency vehicle recognition device 2, the **audio controller 5 generates an alert announcement using the built-in speech synthesizer and these signals operate a speaker 6.**”
- [0021]: “In this configuration, when an emergency vehicle approaches, **the sound of the siren is recognized using the microphone 1 and the emergency vehicle recognition device 2**, and an alert screen is displayed on the display 4 by signals from the emergency vehicle recognition device 2. In addition, **an alert is announced over the speaker 6**. Thus, even when the volume of the sound equipment is turned up, the driver is able to reliably recognize the approach of an emergency vehicle. When the emergency vehicle moves away from the car and the sound of a siren is no longer detected, the emergency vehicle recognition device no longer outputs signals and the television receiver 7, etc., returns to normal operation.”
- [0022]: “Fig. 2 is a block diagram showing the emergency vehicle detection and alert device in a second example of the present invention. In the figure, 1 is an omni-directional microphone located outside the car. Signals outputted from the microphone 1 are inputted to the emergency vehicle recognition device 2. The emergency vehicle recognition device 2 has a memory that stores the sound patterns of emergency vehicle sirens, and an arithmetic circuit that compares inputted signals with the patterns in the memory and outputs a detection signal to the audio controller 5 when the inputted signals match a pattern in the memory. **The audio controller 5 receives the detection signal from the emergency vehicle recognition device 2 and audio signals from the microphone 1, and outputs them to the audio equipment 9 to start up the amplifier, activate the amplifier input switch, and output the audio signals from the microphone 1 to the audio equipment 9.**”
- [0023]: “In this configuration, the speaker 6 is usually operated by audio signals from audio equipment (car radio/car audio) 9. When an emergency vehicle approaches, the sound of a siren is recognized using the microphone 1 and emergency vehicle recognition device 2, and the emergency vehicle recognition device 2 outputs a detection signal to the

- audio controller 5. ***The audio controller 5 switches the amplifier input of the audio equipment 9 to the audio signals from the microphone 1, and the sound of the emergency vehicle siren is played on the speaker 6.*** If the audio equipment 9 is switched off, the audio equipment 9 is switched on by the signals from the audio controller 5 and the sound of the emergency vehicle siren is played. When the emergency vehicle moves away from the car and the siren sound is no longer detected, the emergency vehicle recognition device 2 outputs a stop signal and the audio equipment 9 returns to its original state.”
- **[0026]:** “Fig. 4 is a pair of block diagrams showing the emergency vehicle detection and alert device in a fourth example of the present invention. Here, 1 is an omni-directional detection microphone located outside the car. Signals outputted from the microphone 1 are inputted to a preamplifier 10. The preamplifier 10 consists of an amplifier 10a, a filter bank 10b with narrow bandwidth filters arranged in parallel to match the frequencies of various sirens, an analog-to-digital converter 10c, and an interface 10d that converts the inputted audio signals into digital signals and output them to the recognition device 2. The recognition device 2 consists of interface 2b, CPU 2a, RAM 2d, ROM 2e, interface 2c, and memory 2f that contains siren sound patterns for each type of emergency vehicle in ROM. If inputted signals match a pattern in the memory 2f, ***a signal indicating the type of emergency vehicle is outputted to a speech synthesizer 12 and a display controller 13. The speech synthesizer 12 generates voice signals to inform the driver of the type of emergency vehicle based on the inputted signal and activates the speaker 6.*** The display controller 13 turns on a lamp on the vehicle type indicator 14 based on the inputted signal. The vehicle type indicator 14 is located on the dashboard and, as shown in Fig. 4 (b), has a panel marked with the types of emergency vehicles and lamps installed below it.”
 - **[0027]:** “In this configuration, when an emergency vehicle approaches, the type of emergency vehicle siren sound is identified by the microphone 1 and the emergency vehicle recognition device 2, and the type of emergency vehicle is displayed on the vehicle type indicator 14 and ***announced over the speaker 6.***”

82. Kobayashi discloses an “emergency vehicle recognition device 2” that, when “the sound of the siren is recognized,” an “alert is announced over the speaker 6” of the “car stereo system,” such as by “play[ing] the siren” or “announc[ing] the approach of an emergency vehicle” using a “built-in speech synthesizer.” Kobayashi, [0003], [0018], [0020]-[0021].

83. As I discussed in Section IX.A.3, a person of ordinary skill in the art would have been motivated to apply Kobayashi’s audio notification teachings in implementing Kim’s horn notification device such that upon detection of a horn, an alert is played using Kim’s audio speaker.

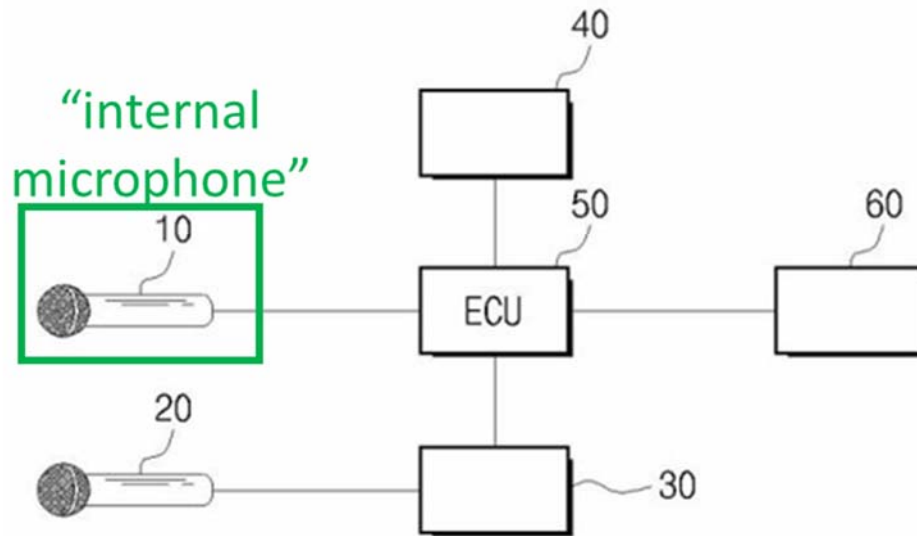
(c) Element [1.b]

84. **Element [1.b] recites “an internal microphone configured to measure an internal acoustic signal in the vehicle.”** This element is met by Kim.

85. Kim discloses an internal microphone (*e.g.*, “indoor microphone (10) . . . installed inside . . . the vehicle”) configured to measure an internal acoustic signal in the vehicle (*e.g.*, “for measuring the volume inside the vehicle”). *See, e.g.*, Kim:

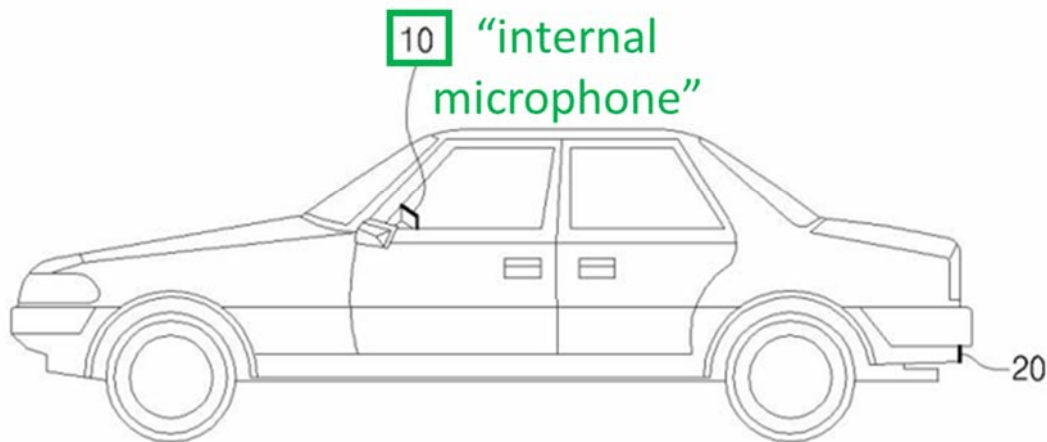
- **Figure 2:**

Figure 2



• Figure 3:

Figure 3



- 1: "... horn notification methods for other vehicles consisting of the **indoor microphone (10) that measures the volume inside the vehicle** ..."
- 2: "Figure 2 is a configuration diagram showing the configuration of an embodiment of a horn notification device of another vehicle according to the present invention, which includes **an indoor microphone (10) for measuring the volume inside the vehicle** ..."

- 2: “An **indoor microphone (10)** that measures the volume inside the **vehicle** and an outdoor microphone (20) that measures the sound generated around the vehicle are **installed inside** and outside **the vehicle**, respectively, to receive sound inside and outside the vehicle. **It is preferable that the indoor microphone (10) is installed at a position close to the driver’s position.** In addition, the outdoor microphones (20) are installed on both sides of the rear of the vehicle to receive the horn of another vehicle.”
- 3: “By performing step (ST30) of **measuring the volume of the vehicle interior using the indoor microphone (10)**, if it is determined that the volume received by the indoor microphone (10) is more than a certain level, that is, the driver is unable to listen to and recognize other sounds due to music output from the audio speaker, the ECU (50) outputs a control signal.”
- 3: “An **indoor microphone (10)** for measuring the volume inside the **vehicle . . .**”

86. See my discussion of element [1.pre] above (Section IX.A.4.a).

87. Kim further discloses “indoor microphone (10)” installed inside the vehicle for measuring the vehicle’s cabin volume. Kim, 1-2.

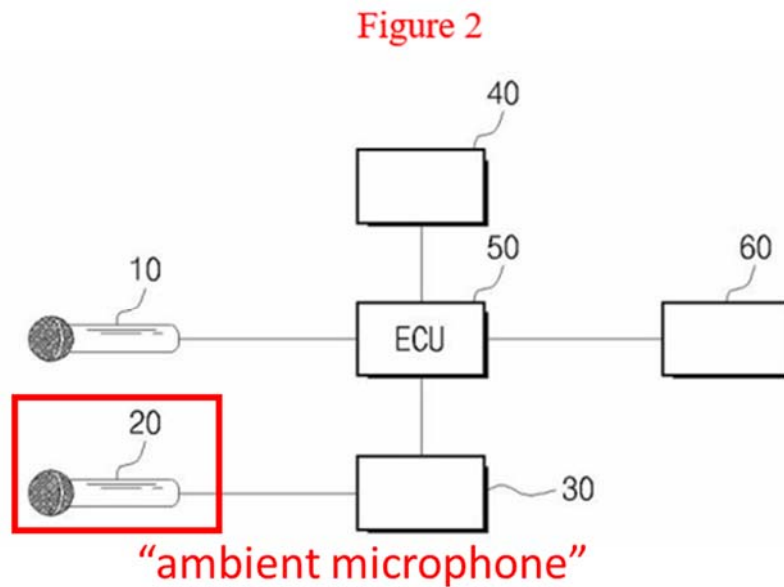
(d) Element [1.c]

88. **Element [1.c]** recites “**an ambient microphone configured to measure an ambient acoustic signal external to the vehicle.**” This element is met by Kim.

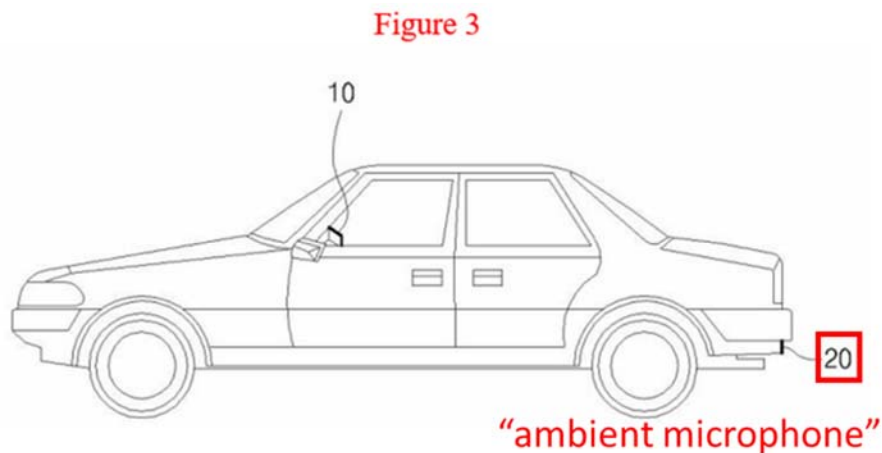
89. Kim discloses an ambient microphone (*e.g.*, “outdoor microphone (20) . . . installed . . . outside the vehicle”) configured to measure an ambient acoustic

signal external to the vehicle (e.g., “measures the sound generated around the vehicle”). See, e.g., Kim:

- **Figure 2:**



- **Figure 3:**



- 1: “an outdoor microphone (20) installed on both sides of the rear of the vehicle to receive sound generated around the vehicle, the frequency

- analyzer (30) that measures the frequency of the sound received by the **outdoor microphone (20)** and outputs a measurement result”
- 2: “Figure 2 is a configuration diagram showing the configuration of an embodiment of a horn notification device of another vehicle according to the present invention, which includes an indoor microphone (10) for measuring the volume inside the vehicle, **an outdoor microphone (20) installed on both sides of the rear side of the vehicle to receive sound generated around the vehicle**, a frequency analyzer (30) for measuring the sound frequency received by the outdoor microphone (20) and outputting the measurement result, a horn sensor (40) for checking the horn operation of the vehicle and outputting the operation signal thereof, an ECU (50) for detecting a horn of another vehicle and outputting a control signal accordingly, and a displayer (60) for outputting a warning signal to a driver by a control signal output from the ECU (50).”
 - 2: “An indoor microphone (10) that measures the volume inside the vehicle and **an outdoor microphone (20) that measures the sound generated around the vehicle are installed** inside and **outside the vehicle, respectively**, to receive sound inside and outside the vehicle. It is preferable that the indoor microphone (10) is installed at a position close to the driver's position. **In addition, the outdoor microphones (20) are installed on both sides of the rear of the vehicle to receive the horn of another vehicle.**”
 - 3: “The **sound around the vehicle is received using the outdoor microphone (20)** (ST10), the frequency of the external sound received by the outdoor microphone (20) is measured using the frequency analyzer (30), and the ECU (50) determines whether the frequency measured by the frequency analyzer (30) includes the frequency corresponding to the horn (ST20).”

90. See my discussion of element [1.pre] above (Section IX.A.4.a).

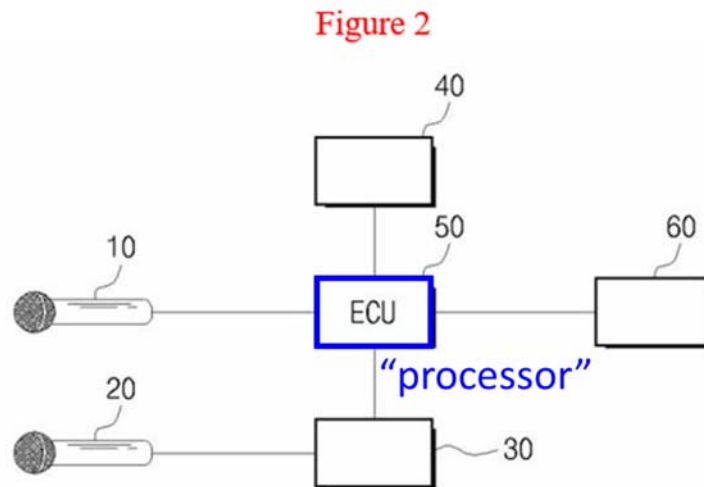
91. Kim further discloses “outdoor microphone (20)” installed outside the vehicle for measuring ambient sound around the vehicle. Kim, 1-2.

(e) Element [1.d]

92. Element [1.d] recites “a processor.” This element is met by Kim.

93. Kim discloses a processor (e.g., “ECU (50)”).

• Figure 2:

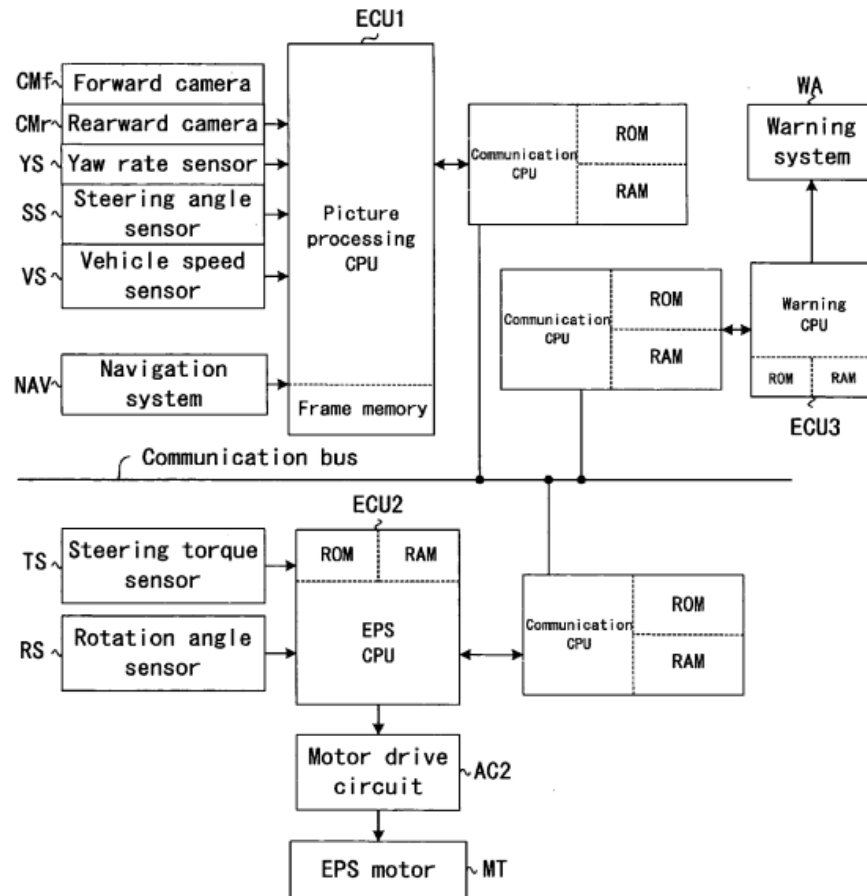


- 1: “ . . . the **ECU (50)** **that detects the horn of another vehicle** according to the output result of the frequency analyzer (30) and the operation signal of the horn sensor (40) and **outputs a control signal accordingly**, and the displayer (60) of a warning signal to a driver by **a control signal output from the ECU (50).**”
- 2: “ . . . an **ECU (50)** **for detecting a horn of another vehicle and outputting a control signal accordingly**, and a displayer (60) for outputting a warning signal to a driver by **a control signal output from the ECU (50).**”
- 3: “As a result of measuring the frequency of the sound received by the outdoor microphone (20), **when it is determined that a frequency corresponding to the vehicle horn is included, that the horn is the horn of another vehicle, and that the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level, the ECU (50) outputs a control signal so that the displayer (60) operates.**”

94. Kim discloses that an “ECU (50) outputs a control signal so that the displayer (60) operates” when “it is determined that a frequency corresponding to the vehicle horn is included, that the horn is the horn of another vehicle, and that the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level.” Kim, 3.

95. A person of ordinary skill in the art would have understood (or at least found it obvious) that the ECU advantageously comprises a processor to dynamically process warnings, which is how ECUs were implemented at the time. For example, Akita (Ex. 1017) discloses a “lane keeping assist device for a vehicle” containing an “electronic control unit ECU 1 including a CPU for picture processing and frame memory,” an “electronic control unit ECU 2 including a CPU for electric power steering control, ROM, and RAM,” and “an electronic control unit ECU 3 for warning (shown in FIG. 2)” that also includes a “Warning CPU.” Akita, Abstract, [0033].

FIG. 2



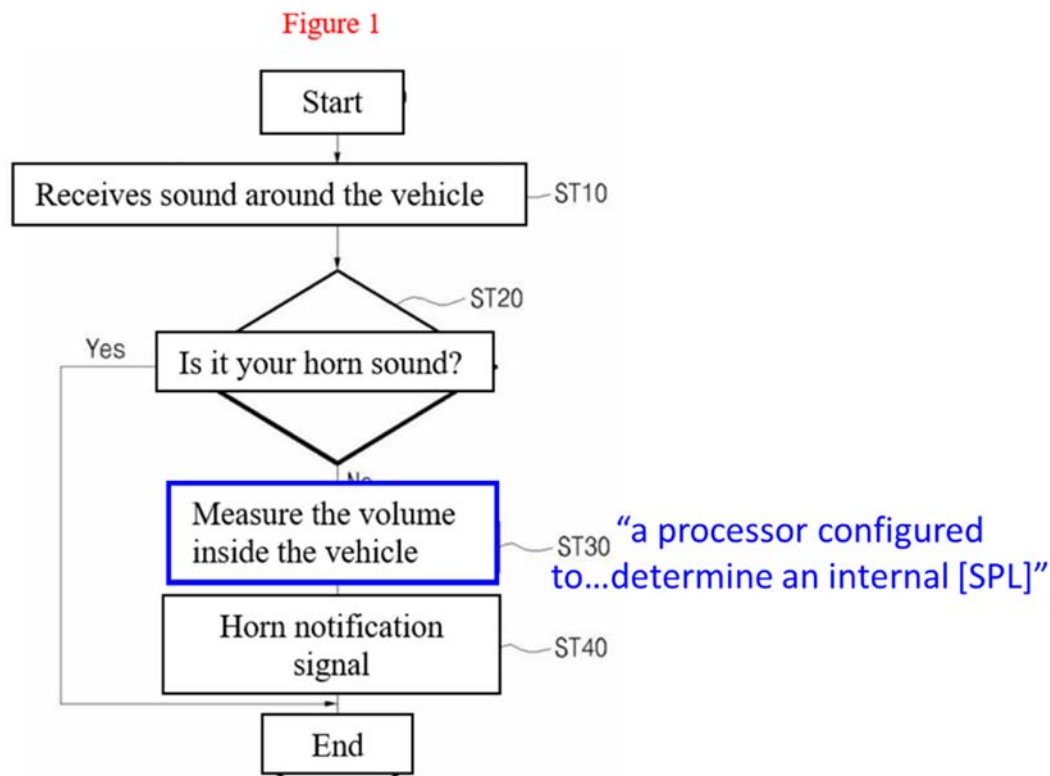
96. A person of ordinary skill in the art would have understood that an ECU implemented using a processor or CPU is dynamic and capable of being changed, such as by updating programming instructions executed by the processor or CPU. A person of ordinary skill in the art would have understood the benefits in using such a processor or CPU so that the warnings provided to the driver are capable of being updated whenever necessary.

(f) Element [1.d.i]

97. Element [1.d.i] recites “determine an internal sound pressure level (SPL) in the vehicle based on the internal acoustic signal.” This element is met by Kim.

98. Kim discloses a processor (see element [1.d]) configured to determine an internal sound pressure level (SPL) in the vehicle based on the internal acoustic signal (e.g., “determin[ing]...the volume of the sound received by the indoor microphone (10)”). See, e.g., Kim:

- **Figure 1:**



- 2: “Figure 2 is a configuration diagram showing the configuration of an embodiment of a horn notification device of another vehicle according to

the present invention, which includes ***an indoor microphone (10) for measuring the volume inside the vehicle...***

- 3: “As a result of measuring the frequency of the sound received by the outdoor microphone (20), ***when it is determined that a frequency corresponding to the vehicle horn is included, that the horn is the horn of another vehicle, and that the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level, the ECU (50) outputs a control signal so that the displayer (60) operates.***”

99. See my discussion of elements [1.b] and [1.d] above (Section IX.A.4.c, e).

100. Kim further discloses that ECU 50 determines “that the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level.” Kim, 3.

101. A person of ordinary skill in the art would have understood this reference to “volume” in Kim refers to the internal SPL of the vehicle. Kim discloses that “indoor microphone (10) . . . [is] installed inside . . . the vehicle . . . to receive sound inside . . . the vehicle” to “measure[] the volume inside the vehicle.” Kim, 2. In the audio processing field, “volume” typically refers to the power level of a sound source that generates sound at a certain transmit sound pressure level, but because Kim’s indoor microphone’s measurement is based on “receive[d] sound,” a person of ordinary skill in the art would have understood that Kim’s reference to “volume” is actually a reference to a sound pressure level measured by the indoor microphone

based on the received sound. When Kim refers to “volume,” it is referring to the intensity of the “sound” the indoor microphone receives inside the vehicle, not the power level of the sound source(s) emitting sounds. A person of ordinary skill in the art would have understood that the air channel between a sound source and microphone would cause some loss to the sound’s intensity such that the received sound pressure level is lower than the transmit sound pressure level. As an example using Kim, the “audio speaker” may output “music” at 60dB, but the sound pressure level measured by the indoor microphone based on the music would be less than 60dB at least because of air channel loss (e.g., 50dB). Kim discloses that the indoor microphone is receiving the music and measuring the sound pressure level inside the vehicle, which in this example, would be, e.g., 50dB. Therefore, Kim’s indoor microphone is measuring a sound pressure level of the inside of the vehicle based on received sounds.

102. A person of ordinary skill in the art would have at least found it obvious for indoor microphone 10 to measure SPL. Measuring SPL would reliably indicate if a notification is required as I discuss in element [1.d.iii] (Section IX.A.4.h). For example, while the volume of a speaker may be 60dB making it difficult for a driver to hear a horn, the indoor microphone may be measuring an SPL “close to the driver’s position” (Kim, 2) that is lower (e.g., 20dB) because of air channel loss

and/or physical obstructions within the vehicle. As I discussed in Section IX.A.3, it would have been advantageous to avoid distracting the driver with two sounds, including one from the original horn from the other vehicle and the other from a notification regarding that vehicle's detected horn sound. Moreover, there may be other sounds in the vehicle, like people talking, that would cause a higher SPL and would impact whether a user could hear a horn such that a notification was required. Therefore, a person of ordinary skill in the art would have understood the benefits in the indoor microphone measuring SPL close to the driver rather than the volume of a sound source.

103. While Kim discloses “[a]n indoor microphone (10) for measuring the volume inside the vehicle,” a person of ordinary skill in the art would have understood (or at minimum found it obvious) that the ECU performs the analysis to compare the “volume inside the vehicle” to “a certain level.” *See* Kim, 2-3. For example, Kim discloses “[b]y performing step (ST30) of measuring the volume of the vehicle interior using the indoor microphone (10), if it is determined that the volume received by the indoor microphone (10) is more than a certain level, that is, the driver is unable to listen to and recognize other sounds due to music output from the audio speaker, the ECU (50) outputs a control signal.” Kim, 3. As discussed in element [1.d] (Section IX.A.4.e), a person of ordinary skill in the art would have

understood (or at least renders obvious) that an ECU is implemented using a processor. Therefore, the ECU performs a set of instructions to determine whether to “output[] a control signal.” Kim, 2. Kim therefore discloses or at least renders obvious that one of those instructions would be to “determine[] that the volume received by the indoor microphone (10) is more than a certain level.” Kim, 2.

104. Indeed, Kim discloses the ECU “detect[s] the horn of another vehicle according to the output result of the frequency analyzer (30) and the operation signal of the horn sensor (40) and outputs a control signal accordingly,” and thus processes and analyzes the audio signal from the microphone 10. Kim, 1. It would have at least been obvious for the ECU to also “determine[] that the volume received by the indoor microphone (10) is more than a certain level” advantageously simplifying the system, such that another component need not make such a determination and provide a result to the ECU so that the ECU determines whether to output the control signal to the displayer 60.

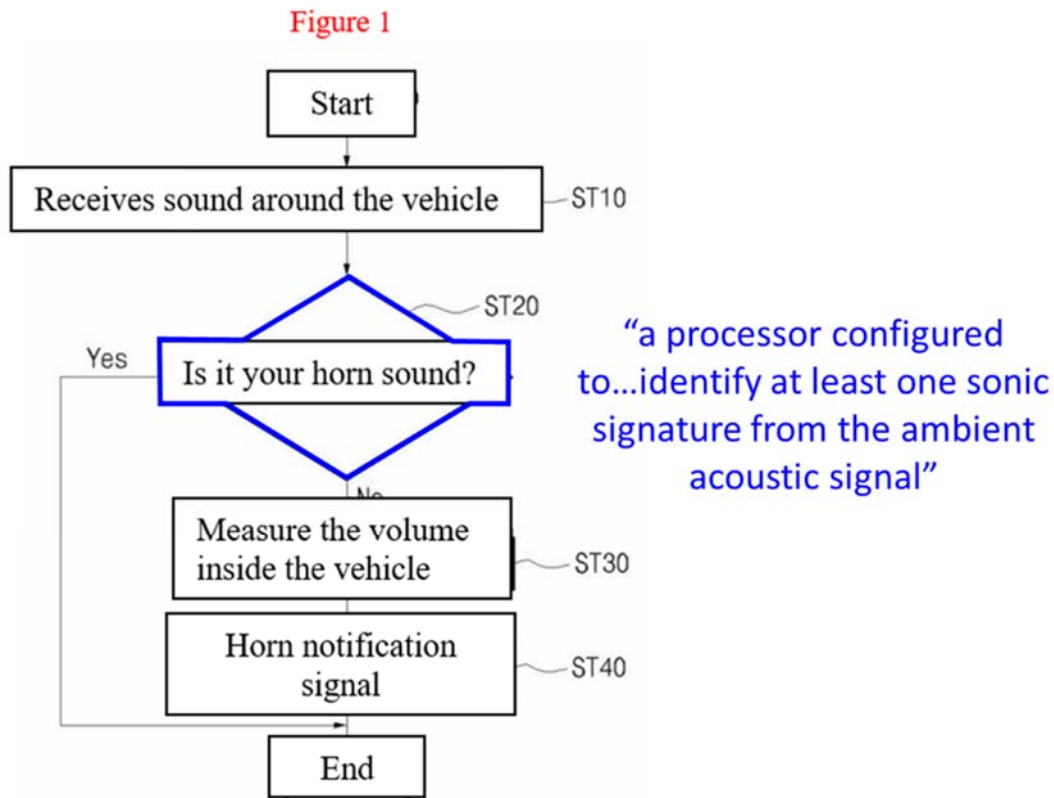
(g) Element [1.d.ii]

105. **Element [1.d.ii] recites “identify at least one sonic signature from the ambient acoustic signal.”** This element is met by Kim.

106. Kim discloses a processor (*see* element [1.d]) configured to identify at least one sonic signature from the ambient acoustic signal (*e.g.*, “determine[s]

whether the frequency” of “the external sound received by the outdoor microphone (20)” “correspond[s] to” a “horn sound”). See, e.g., Kim:

- **Figure 1:**



- 1: “...the *ECU (50)* that detects the horn of another vehicle according to the output result of the frequency analyzer (30) and the operation signal of the horn sensor (40) and outputs a control signal accordingly, and the displayer (60) of a warning signal to a driver by a control signal output from the ECU (50).”
- 3: “The sound around the vehicle is received using the outdoor microphone (20) (ST10), the frequency of the external sound received by the outdoor microphone (20) is measured using the frequency analyzer (30), and the *ECU (50)* determines whether the frequency measured by the frequency analyzer (30) includes the frequency corresponding to the horn (ST20).”

- 3: “Even when ***the frequency of the horn sound is detected by the ECU (50)***, if it is found that the horn sound generated from the vehicle is received using the signal output from the horn sensor (40), the operation of the next step is not performed. However, ***if it is determined that the frequency of the horn sound detected by the ECU (50) is not the horn sound generated by the vehicle, the next step is performed.***”

107. See my discussion of elements [1.c]-[1.d] above (Section IX.A.4.d-e).

108. Kim further discloses the ECU 50 determines whether the “frequency measured” of sound captured by outdoor microphone 20 is that of a “horn sound.” Kim, 3. Thus, Kim’s ECU identifies the sonic signature of a horn (in particular, its signature frequency) from the signal received from outdoor microphone 20. This is consistent with the ’620 patent, which discloses using the frequency spectrum of an audio signal as a sonic signature. ’620 patent, 5:65-6:18, Figure 5.

(h) Element [1.d.iii]

109. **Element [1.d.iii] recites “when the at least one sonic signature is identified, determine whether to send an emit signal to the notification device to emit the audio signal based on the internal SPL.”** This element is met by Kim in view of Kobayashi.

110. Kim discloses a processor (*see* element [1.d]) configured to, when the at least one sonic signature is identified (*see* element [1.d.ii]), determine whether to send an emit signal (*e.g.*, “control signal”) to the notification device (*e.g.*, “displayer”) based on the internal SPL (*e.g.*, “ECU (50)” emits the “control signal”

“when it is determined that . . . the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level”). See, e.g., Kim:

- 1: “. . . the **ECU (50)** that detects the horn of another vehicle according to the output result of the frequency analyzer (30) and the operation signal of the horn sensor (40) and **outputs a control signal** accordingly, and **the displayer (60) of a warning signal to a driver by a control signal output from the ECU (50).**”
- 3: “Even when **the frequency of the horn sound is detected by the ECU (50)**, if it is found that the horn sound generated from the vehicle is received using the signal output from the horn sensor (40), the operation of the next step is not performed. However, **if it is determined that the frequency of the horn sound detected by the ECU (50) is not the horn sound generated by the vehicle, the next step is performed.**”
- 3: “By performing step (ST30) of measuring the volume of the vehicle interior using the indoor microphone (10), **if it is determined that the volume received by the indoor microphone (10) is more than a certain level, that is, the driver is unable to listen to and recognize other sounds due to music output from the audio speaker, the ECU (50) outputs a control signal.**”
- 3: “However, **if the volume received by the indoor microphone (10) is small, the driver may listen to the horn sound of the external vehicle without using a separate device, so it is okay not to output a separate warning signal.**”
- 3: “As a result of measuring the frequency of the sound received by the outdoor microphone (20), **when it is determined that a frequency corresponding to the vehicle horn is included, that the horn is the horn of another vehicle, and that the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level, the ECU (50) outputs a control signal so that the displayer (60) operates.**”
- 3: “**Upon receiving the control signal, the displayer (60) presents a warning message such as "Horn" to notify the driver that another vehicle has sounded a horn.**”

111. See my discussion of elements [1.a] and [1.d]-[1.d.ii] above (Section IX.A.4.b, e-g).

112. Kim further discloses when ECU 50 detects a “horn sound,” ECU 50 sends a warning to displayer 60 if “the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level.” Kim, 3. On the other hand, if “the volume received by the indoor microphone (10) is small,” ECU 50 does not send a warning to displayer 60. Kim, 3. Thus, whether the warning is sent is based on the sound level measured inside the car—i.e., the internal SPL.

113. Kobayashi discloses a notification device emitting the audio signal (*e.g.*, “alert . . . announced over the speaker 6”).

114. See my discussion of element [1.a] above (Section IX.A.4.b).

115. As I discussed in Section IX.A.3, a person of ordinary skill in the art would have been motivated to apply Kobayashi’s teachings of providing both a visual and audio warning to Kim’s horn notification device.

(i) Claim 2

116. **Claim 2 recites “The awareness device according to claim 1, where the notification device includes a receiver.”** See my discussion of the elements of claim 1 above (Section IX.A.4.a-h). The additional limitation of this claim is met by Kobayashi.

117. Kobayashi further discloses the notification device includes a receiver (*e.g.*, “speaker 6”). The ’620 patent equates “receiver” to “speaker.” ’620 patent, 7:41-47 (“notification device can be a ***speaker (receiver)*** . . . an audio signal can be emitted from the ***speaker (receiver)*** . . .”).

118. See my discussion of element [1.a] above (Section IX.A.4.b).

119. As I discussed in Section IX.A.3, a person of ordinary skill in the art would have been motivated to apply Kobayashi’s teachings of providing both a visual and audio warning to Kim’s horn notification device. Moreover, as I explained in Section IX.A.3, when applying these teachings to Kim, the audio warning would be played over the vehicle’s “audio speaker.”

(j) Claim 3

120. **Claim 3 recites “The awareness device according to claim 1, where the notification device further includes a video display.”** See my discussion of the elements of claim 1 above (Section IX.A.4.a-h). The limitation added by this claim is met by Kim and, alternatively, Kobayashi. *See, e.g.*, Kim:

- 2: “This invention relates to a horn notification device of a counterpart vehicle, and in particular, to ***a horn notification device of another vehicle that visually informs the driver of the occurrence of the horn sound of the other vehicle*** by detecting the occurrence of the horn sound when the other vehicle generates a loud noise inside or outside the vehicle.”
- 2: “[A] ***displayer (60) for outputting a warning signal to a driver by a control signal output from the ECU (50).***”

- 3: “As a result of measuring the frequency of the sound received by the outdoor microphone (20), when it is determined that a frequency corresponding to the vehicle horn is included, that the horn is the horn of another vehicle, and that the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level, the ECU (50) outputs a control signal so that the **displayer (60) operates**. Upon receiving the control signal, the **displayer (60) presents a warning message such as ‘Horn’ to notify the driver that another vehicle has sounded a horn.**”

121. Kim discloses the notification device includes a video display (*e.g.*, “displayer (60)” “presents a warning message”).

122. Kim discloses “displayer (60) presents a warning message such as ‘Horn’” when a horn is detected. Kim, 3.

123. A person of ordinary skill in the art would have understood (or at least found it obvious) that Kim’s displayer 60 is implemented as a video display to advantageously allow for flexibility in the displayed warning, such as displaying the warning in different colors or font sizes. Further, a person of ordinary skill in the art would have understood (or at least found it obvious) that the displayer is used to display the warning message “Horn.” Kim, 3. Such an implementation would have advantageously simplified the system by obviating the need to add a separate device for notifying the driver of the warning message.

124. To the extent further disclosure is required, Kobayashi discloses a video display (*e.g.*, “video signals” displayed on “display 4”). *See, e.g.*, Kobayashi:

- **[0019]:** “. . . When signals are inputted from the emergency vehicle recognition device 2, *the display controller 3 generates alert screen video signals using its built-in video signal generator and outputs the signals to the display 4 to display an alert screen.*”

125. Kobayashi discloses a “display controller 3” that generates “video signals” and outputs them to “display 4 to display an alert screen.” Kobayashi, [0019].

126. A person of ordinary skill in the art would have been motivated to apply Kobayashi’s teachings of a video display in implementing Kim’s displayer 60 to advantageously provide flexibility in the warnings that can be provided to the driver. Kim, 3. For example, a notification display containing a light-up notification, such as a light that displays “Horn” when a horn is detected, would not provide flexibility in the type of warning (e.g., a horn versus a siren) or the style of the warning (e.g., color, font size, capitalization). Providing flexibility in the warnings provided to the driver would have advantageously enhanced the driver’s experience, allowing the driver to choose his or her preferred notification style for a given type. Moreover, using a video display allows more types of warning messages to be displayed in a smaller area, thereby allowing more information to be displayed on the Kim’s displayer 60. For example, instead of needing two separate locations to identify a horn versus a siren, both warnings could be dynamically displayed in a convenient location. A person of ordinary skill in the art would have recognized the importance

of providing this efficient display, as it was recognized that, “[w]hen the display area is enlarged to display more information, the visual field area decreases to hinder the driver's visual field, making the driver uneasy.” Ex. 1022 (U.S.2005/0154505), [0009]. Thus, it was recognized that it was helpful to “provide a vehicle information display system capable of allowing a driver of [sic] an occupant to visually confirm necessary information safely and reliably and of displaying much information without hindering a driver's visual field.” Ex. 1022 (U.S.2005/0154505), [0023].

(k) Claim 4

127. **Claim 4 recites “The awareness device according to claim 1, where the audio signal includes at least one of the ambient acoustic signal, a voice message or a non-voice message.”** See my discussion of the elements of claim 1 above (Section IX.A.4.a-h). The added limitation of this claim is met by Kobayashi.

128. Kobayashi discloses the audio signal (*e.g.*, “alert . . . announced over the speaker 6”) includes the ambient acoustic signal (*e.g.*, “play[ing] the siren”) or a voice message (*e.g.*, “alert announcement using the built-in speech synthesizer”).

129. See my discussion of element [1.a] above (Section IX.A.4.b).

(l) Element [15.pre]

130. **Element [15.pre] recites “A method of situation awareness facilitation for a vehicle driver of a vehicle, the method comprising.”** This element is met by Kim.

131. See my discussion of element [1.pre] above (Section IX.A.4.a).

(m) Element [15.a]

132. **Element [15.a] recites “receiving an internal acoustic signal from inside the vehicle and converting the internal acoustic signal to an internal acoustic electronic signal.”** This element is met by Kim.

133. Kim discloses receiving an internal acoustic signal from inside the vehicle and converting the internal acoustic signal to an internal acoustic electronic signal (*e.g.*, “indoor microphone (10) . . . installed inside . . . the vehicle” for “measuring the volume inside the vehicle”).

134. See my discussion of elements [1.b] and [15.pre] above (Sections IX.A.4.c, l).

135. A person of ordinary skill in the art would have understood (and at minimum found obvious) that a microphone is a transducer that converts sound into an electrical signal. For example, U.S. Patent No. 6,219,645 (“Byers,” Ex. 1021) discloses that when a user speaks a voice command, “[t]he microphones 70, 75, 80, 85 each individually and respectively pick up or transduce the voice command into a microphone signal,” such that the microphone converts the voice command into an electrical signal that is then relayed to a controller for processing. Byers, 5:2-7.

(n) Element [15.b]

136. **Element [15.b] recites “receiving an ambient acoustic signal from outside the vehicle and converting the ambient acoustic signal into an ambient acoustic electronic signal.”** This element is met by Kim.

137. Kim discloses receiving an ambient acoustic signal from outside the vehicle and converting the ambient acoustic signal into an ambient acoustic electronic signal (*e.g.*, “outdoor microphone (20)” installed “outside the vehicle” that “measures the sound generated around the vehicle”).

138. See my discussion of elements [1.c] and [15.pre]-[15.a] above (Sections IX.A.4.d, l-m).

(o) Element [15.c]

139. **Element [15.c] recites “determining, by a processor, an internal sound pressure level (SPL) in the vehicle based on the internal acoustic electronic signal.”** This element is met by Kim.

140. Kim discloses determining, by a processor (*see* element [1.d]), an internal sound pressure level (SPL) in the vehicle based on the internal acoustic electronic signal (*e.g.*, “determin[ing] that the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level”).

141. See my discussion of elements [1.d]-[1.d.i] and [15.pre]-[15.a] above (Sections IX.A.4.e-f, l-m).

142. A person of ordinary skill in the art would have understood that “ECU (50)” determines the volume based on the electronic signal it receives from “indoor microphone (10).” Kim, 1-2. As I discussed in element [1.d.i] (Section IX.A.4.f), Kim discloses that “indoor microphone (10) . . . [is] installed inside . . . the vehicle . . . to receive sound inside . . . the vehicle” to “measure[] the volume inside the vehicle.” Kim, 2. When Kim refers to “volume,” it is referring to the intensity of the “sound” the indoor microphone receives inside the vehicle, such that Kim’s indoor microphone is measuring a sound pressure level of the inside of the vehicle based on received sounds. The ECU (50) then determines the SPL based on the measured volume received from the indoor microphone 10.

(p) Element [15.d]

143. **Element [15.d] recites “matching, by the processor, the ambient acoustic electronic signal to one or more stored reference electronic signals.”** This element is met by Kim. See my discussion of the elements of claim 1 above (Section IX.A.4.a-h).

144. Kim discloses matching, by the processor (*see* element [1.d]), the ambient acoustic electronic signal (*e.g.*, “sound generated around the vehicle” supplied to “ECU (50)”) to one or more stored reference electronic signals (*e.g.*,

“ECU (50) . . . determine[s] whether the frequency” of the “sound generated around the vehicle” “correspond[s] to [a] horn sound”).

145. See my discussion of elements [1.d], [1.d.ii] and [15.pre]-[15.c] above (Sections IX.A.4.e, g, l-o).

(q) Element [15.e]

146. **Element [15.e] recites “determining whether to send an acoustic message associated with a matched reference electronic signal to a speaker in the vehicle based on the internal SPL.”** This element is met by Kim in view of Kobayashi. See my discussion of the elements of claim 1 above (Section IX.A.4.a-h).

147. Kim discloses determining whether to send a message (*e.g.*, “warning message”) associated with a matched reference electronic signal (*e.g.*, “ECU (50)”) sends “control signal” to the “displayer (60) for outputting a warning signal to a driver” if the “the external sound” “correspond[s] to [a] horn sound”) based on the internal SPL (*e.g.*, “outputs a control signal” if “the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level”). See my discussion of elements [1.a], [1.d], [1.d.ii]-[1.d.iii], and claims [2] and [4] above (Sections IX.A.4.b, e, g-h, i, k).

148. Kobayashi discloses sending an acoustic message (*e.g.*, “alert announcement”) to a speaker in the vehicle (*e.g.*, “speaker 6”). See my discussion of elements [1.a], [1.d.iii], and claims [2] and [4] above (Sections IX.A.4.b, h, i, k).

149. As I discussed in Section IX.A.3, a person of ordinary skill in the art would have been motivated to apply Kobayashi’s audio notification teachings in implementing Kim’s horn notification device.

B. Ground 2: Kim in view of Bergholz (Claims 1-4, 6-8, and 15)

1. Overview of Bergholz

150. Bergholz is generally directed to “an electronic detection system for acoustic signals . . . wherein the acoustic signals comprise, in particular but not exclusively, warning signals from other vehicles and unusual noises from one's own vehicle.” Bergholz, 1:2-6.

151. Bergholz discloses “an electronic detection system for . . . warning signals from other vehicles and unusual noises from one’s own vehicle.” Bergholz, Abstract, 1:2-7. The system includes “**microphones 1** that are attached to the outside of the vehicle” such that “they can pick up acoustic signals outside the vehicle,” including “vehicle malfunctions” (*e.g.*, “squealing tires, the sound of a flat tire, engine or exhaust defects”), “horn[s],” and “siren[s].” Bergholz, 3:19-24, 5:13-15, 7:7-10, 7:49-53, Figures 1-2. The acoustic signals are “convert[ed] . . . into

digital data” and “classification features” of the data are determined, including “the frequency response of the signal.” Bergholz, 3:37-40, 4:13-17, 4:25-27. The “**computing unit 5**” compares “the classification features . . . with predetermined and previously stored patterns.” Bergholz, 4:19-25. The computing unit outputs a “comparison result” as “an information and control signal” to “an **acoustic output device 15** for speech reproduction” via a “loudspeaker” and an **optical display device 16** for the visualization of the evaluation results” via “an LCD or an LED display.” Bergholz, 4:47-63.

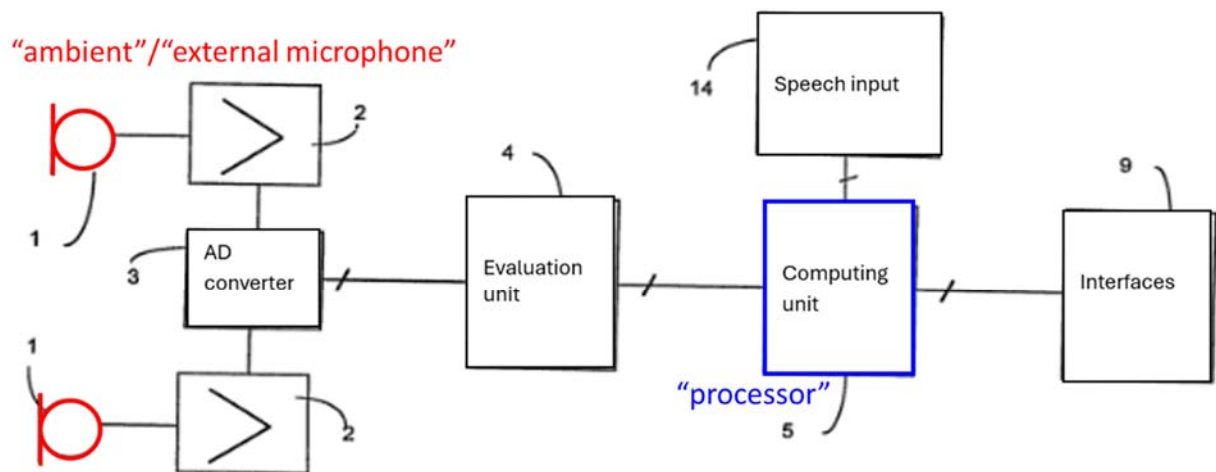


Fig. 1

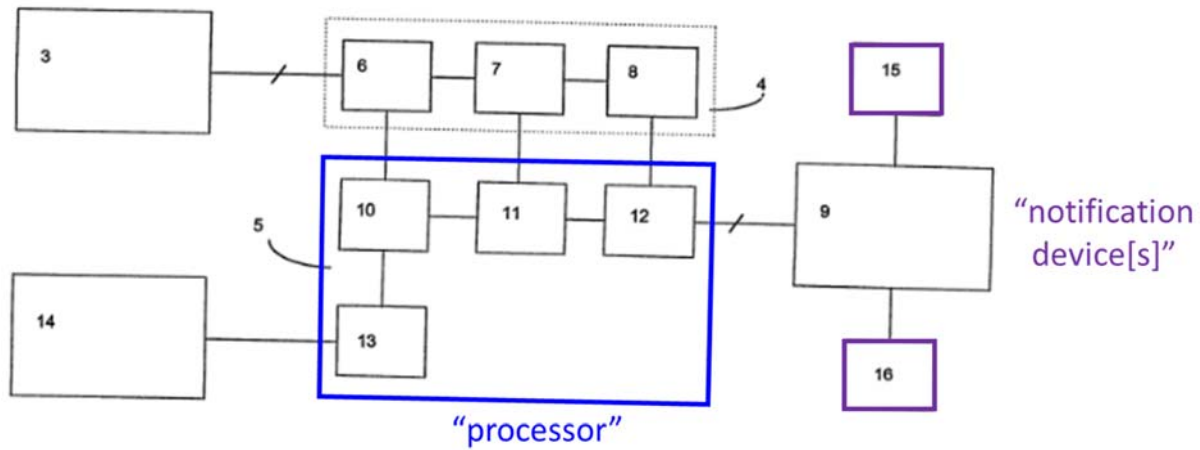


Fig. 2

Bergholz, Figures 1-2.

2. Motivation to Apply the Bergholz's Teachings to Kim

152. Like the '620 patent and Kim, Bergholz's field includes situation awareness, and Bergholz is pertinent to the problem of detecting sounds and responding thereto in vehicles purportedly addressed by the '620 patent. *See* '620 patent, Abstract, 1:14-15, 2:27-37; Kim, 1-3; Bergholz, Abstract ("The invention relates to an electronic detection system for acoustic signals, wherein the acoustic signals comprise, in particular but not exclusively, warning signals from other vehicles and unusual noises from one's own vehicle."), 1:2-7 ("The invention relates to an electronic detection system for acoustic signals according to the preamble of claim 1, wherein the acoustic signals comprise, in particular but not exclusively, warning signals from other vehicles and unusual noises from one's own vehicle."),

1:64-2:24 (“The detection system for acoustic signals according to the Invention, which comprises at least one receiver for detecting acoustic signals outside and inside the vehicle and at least one output unit for outputting information and control signals on the basis of the acoustic signals, is characterized by an analog-to-digital converter for converting the acoustic signals into digital data, an evaluation unit for detecting classification features from the data, and a computing unit with a storage device for storing comparison signals and a comparison device for comparing the detected classification features with previously stored classification features and for generating the information and control signals on the basis of the comparison result.”).

153. Like the '620 patent and Kim, Bergholz each contemplate detection systems comprising a microphone that detects a horn and/or siren from another vehicle and responds thereto, such as warning the driver of the sound. *See* '620 patent, Abstract, 1:14-15, 2:27-37; Kim, 1-3; Bergholz, Abstract (“The detection system for acoustic signals according to the invention, which comprises at least one receiver (1, 2) for detecting acoustic signals outside the vehicle and in the interior of the vehicle and at least one output unit (9) for outputting information and control signals on the basis of the acoustic signals . . . and at least one comparison device (10) for comparing the detected classification features with previously stored

classification features and for generating the information and control signals on the basis of the comparison result.”), 3:19-24 (“microphones 1 that are attached to the outside of the vehicle, or at least in such a way that they can pick up acoustic signals outside the vehicle”), 4:19-25 (“The classification features of the data correlated with the captured acoustic signals, which were determined by the evaluation unit 4, are fed into a computing unit 5. In the computing unit 5, the classification features are compared with predetermined and previously stored patterns or with temporarily stored previous data.”), 4:47-63 (“The comparison result of the computing unit 5 is output to an output via an interface 9 as an information and control signal. In the embodiment shown, an acoustic output device 15 for speech reproduction and an optical display device 16 for the visualization of the evaluation results are part of the detection system.”), 5:13-15 (“This way, a siren, for example, can be clearly identified via the audio frequency and its time characteristic.”), 7:7-10 (“the system detects a horn or other device for sound signals on road vehicles”), 7:49-53 (“the recorded acoustic signal can also be used to detect abnormal driving noises (squealing tires, the sound of a flat tire, engine or exhaust defects) and thus be used to detect vehicle malfunctions in a timely manner and to provide an early warning prior to scheduled maintenance”).

154. A person of ordinary skill in the art would have been motivated to apply Bergholz's teachings of audio notifications to Kim's horn notification device such that Kim's notification device includes both audio and visual capabilities, for the same reasons as described above for applying Kobayashi's teachings of an audio warning to Kim, such that Kim's horn notification device provides both visual notification via displayer (60) and audio notifications via the audio speaker. See Section IX.A.3. A person of ordinary skill in the art would have been further motivated to apply Bergholz's teachings of audio notifications in implementing Kim's horn notification device to advantageously "contribute to a comprehensive and more complete assessment of the current traffic situation than is possible by visual means alone." Bergholz, 1:47-50.

155. Further, a person of ordinary skill in the art would have been motivated to apply Bergholz's teachings of detecting vehicle malfunctions, such as squealing tires or flat tires, in implementing Kim's horn notification device to advantageously enhance Kim's device to "detect vehicle malfunctions in a timely manner and to provide an early warning prior to scheduled maintenance." Bergholz, 7:41-54. As Kim recognizes, "when the driver operates the vehicle while maximizing the audio volume of the vehicle," the driver cannot hear the horn of another vehicle, thereby risking an accident. Kim, 2. A person of ordinary skill in the art would have

understood that, when the driver's audio volume is too loud, the driver also cannot hear vehicle malfunctions that affect the car's ability to operate properly, thereby risking an accident. For example, if a driver cannot hear noises associated with defective tires himself/herself because the internal SPL of the vehicle is too high, the vehicle may not operate properly causing the driver to swerve or stop short, risking an accident. A person of ordinary skill in the art would have understood the benefits in enhancing Kim's device to recognize vehicle equipment signals, such as acoustic signals from the vehicle malfunctions. Such an implementation would have advantageously decreased the likelihood of an accident occurring by warning the driver of an issue such that that driver recognizes the warning and, for example, pulls over to avoid an accident resulting from the issue.

156. Bergholz teaches when the sound is recognized, an alert is announced via a "loudspeaker." Bergholz, 4:47-63. Providing an audio alert even when the vehicle's internal volume is high was known in the art. See Kobayashi, [0021] ("even when the volume of the sound equipment is turned up, the driver is able to reliably recognize the approach of an emergency vehicle"); In applying Bergholz's teachings of providing audio warnings regarding vehicle malfunctions in implementing Kim's notification device, a person of ordinary skill in the art would have been motivated to play an audio signal at a sound level above "the volume of

the sound received by [Kim's] indoor microphone.” Such an implementation would have advantageously ensured that the audio notification is played over the ambient noise in the vehicle so that the driver would hear the notification. *See* Hermann (Ex. 1010), 1:45-59 (“The high priority message signals are played at the adjusted programmable gain whereby the high priority message signals are heard at a sound level which is relatively greater than the ambient noise level by a predetermined target difference.”).

157. Kim teaches that the ECU sends a control signal to displayer if “it is determined that a frequency corresponding to the vehicle horn is included, that the horn is the horn of another vehicle, and [] the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level.” Kim, 3. In implementing Bergholz’s teachings of detecting vehicle malfunctions in Kim, a person of ordinary skill in the art would have understood that Kim’s ECU would send a control signal to play an audio notification if the internal SPL of the vehicle, measured by the indoor microphone, is greater than or equal to a certain level. For example, taking the internal SPL into account when deciding whether to issue the control signal would have advantageously avoided distracting the driver with two sounds, including one from the vehicle malfunction and the other from a notification regarding the detected vehicle malfunction. Issuing the notification would have been

redundant when the driver heard the vehicle malfunction himself/herself because the internal SPL of the vehicle was low enough such that the vehicle malfunction could have been heard. Issuing the redundant notification would have distracted the driver and caused the driver confusion of whether there was more than one vehicle malfunction.

158. For the same reasons as described above for applying Kobayashi's teachings of an acoustic warning to Kim, a person of ordinary skill in the art would have had a reasonable expectation of success in applying Bergholz's audio notifications teachings in implementing Kim's notification device, as it was well-known in the art to give drivers audio and visual warnings. *See* Section IX.A.3; *see also* Bergholz, 4:47-63 ("In the embodiment shown, an acoustic output device 15 for speech reproduction and an optical display device 16 for the visualization of the evaluation results are part of the detection system. . . . The acoustic output device 15 comprises a speech generator (not shown) for the composition of speech sequences depending on the evaluation result of the computing unit 5. In addition, the output device 15 comprises a loudspeaker, which can be part of an existing playback device in the vehicle. The display device 16 is preferably an LCD or an LED display").

159. A person of ordinary skill in the art would have also had a reasonable expectation of success in applying Bergholz's teachings of detecting vehicle

malfunctions in implementing Kim, as both references teach detecting sounds to perform an appropriate response. Further, both Kim and Bergholz disclose using frequency analyzers and computing units to carry out their respective functionalities. Kim, 3 (“The sound around the vehicle is received using the outdoor microphone (20) (ST10), the frequency of the external sound received by the outdoor microphone (20) is measured using the frequency analyzer (30), and the ECU (50) determines whether the frequency measured by the frequency analyzer (30) includes the frequency corresponding to the horn (ST20).”); Bergholz, 4:19-25 (“The classification features of the data correlated with the captured acoustic signals, which were determined by the evaluation unit 4, are fed into a computing unit 5. In the computing unit 5, the classification features are compared with predetermined and previously stored patterns or with temporarily stored previous data.”), 4:47-63 (“The comparison result of the computing unit 5 is output to an output via an interface 9 as an information and control signal. . . .”), 5:6-9 (“In the evaluation unit 4, a spectrum analyzer 6 performs a spectral analysis of the acoustic signal (more precisely, the corresponding data). Basically, this can be done by bandpass circuits or circuits for a Fourier transformation.”). Implementing Bergholz’s teaching of detecting vehicle malfunctions in Kim’s notification device would have required recognizing additional frequencies by Kim’s ECU. This would have been a straightforward

application of Bergholz’s teachings of detecting vehicle malfunctions in a manner that advantageously improves Kim’s device.

3. Invalidity of Claims 1-4, 6-8, and 15 Over Kim in view of Bergholz

160. In addition to my discussion in Sections IX.B.1-IX.B.2, the following identifies example disclosures followed by bulleted excerpts that each disclose and/or render obvious the Challenged Claims.

(a) Element [1.pre]

161. **Element [1.pre] recites “A vehicle situation awareness device for a vehicle comprising.”** This element is met by Kim.

162. See my discussion in Section IX.A.4.a regarding how Kim teaches element [1.pre].

(b) Element [1.a]

163. **Element [1.a] recites “a notification device in the vehicle configured to emit an audio signal.”** This element is met by Kim in view of Bergholz.

164. See my discussion in Section IX.A.4.b (element [1.a]) regarding how Kim teaches a notification device in the vehicle (*e.g.*, “displayer (60)”) configured to emit a signal (*e.g.*, “outputting a warning signal to a driver”).

165. Bergholz discloses a notification device in the vehicle (e.g., “loudspeaker . . . in the vehicle”) configured to emit an audio signal (e.g., reproducing “speech”). See, e.g., Bergholz:

- **Figure 2:**

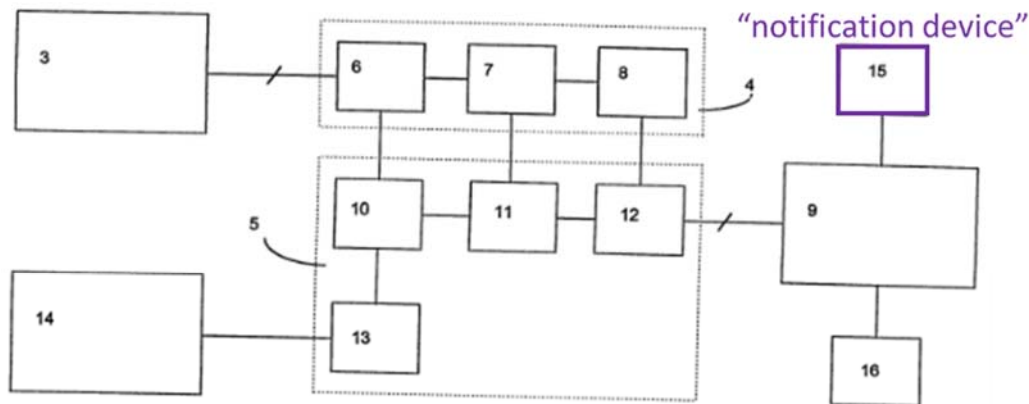


Fig. 2

- **4:46-55:** “The comparison result of the computing unit 5 is output to an output via an interface 9 as an information and control signal. In the embodiment shown, ***an acoustic output device 15 for speech reproduction*** and an optical display device 16 for the visualization of the evaluation results are part of the detection system. ***The output is used to inform the driver*** or to directly intervene in the control of the vehicle, particularly in the case of autonomously driven vehicles.”
- **4:56-60:** “***The acoustic output device 15 comprises a speech generator (not shown) for the composition of speech sequences depending on the evaluation result of the computing unit 5. In addition, the output device 15 comprises a loudspeaker, which can be part of an existing playback device in the vehicle.***”

166. Bergholz discloses “an acoustic output device 15” comprising a “loudspeaker . . . in the vehicle” “for speech reproduction.” Bergholz, 4:46-60. The

“acoustic output device 15 comprises a speech generator . . . for the composition of speech sequences,” such that it outputs an audio signal comprising the speech sequences via the loudspeaker. Bergholz, 4:56-60.

167. As discussed in Section IX.B.2, a person of ordinary skill in the art would have been motivated to apply Bergholz’s audio notification teachings in implementing Kim’s horn notification device such that upon detection of a horn, an alert is played using Kim’s audio speaker.

(c) Element [1.b]

168. **Element [1.b] recites “an internal microphone configured to measure an internal acoustic signal in the vehicle.”** This element is met by Kim.

169. See my discussion in Section IX.A.4.c regarding how Kim teaches element [1.b].

(d) Element [1.c]

170. **Element [1.c] recites “an ambient microphone configured to measure an ambient acoustic signal external to the vehicle.”** This element is met by Kim.

171. See my discussion in Section IX.A.4.d regarding how Kim teaches element [1.c].

(e) Element [1.d]

172. **Element [1.d] recites “a processor.”** This element is met by Kim.

173. See my discussion in Section IX.A.4.e regarding how Kim teaches element [1.d].

(f) Element [1.d.i]

174. **Element [1.d.i] recites “determine an internal sound pressure level (SPL) in the vehicle based on the internal acoustic signal.”** This element is met by Kim.

175. See my discussion in Section IX.A.4.f regarding how Kim teaches element [1.d.i].

(g) Element [1.d.ii]

176. **Element [1.d.ii] recites “identify at least one sonic signature from the ambient acoustic signal.”** This element is met by Kim.

177. See my discussion in Section IX.A.4.g regarding how Kim teaches element [1.d.ii].

(h) Element [1.d.iii]

178. **Element [1.d.iii] recites “when the at least one sonic signature is identified, determine whether to send an emit signal to the notification device to emit the audio signal based on the internal SPL.”** This element is met by Kim in view of Bergholz.

179. See my discussion in Section IX.A.4.h (element [1.d.iii]) regarding how Kim teaches a processor (*see* element [1.d]) configured to, when the at least one

sonic signature is identified (*see* element [1.d.ii]), determine whether to send an emit signal (*e.g.*, “control signal”) to the notification device (*e.g.*, “displayer”) based on the internal SPL (*e.g.*, “ECU (50)”) emits the “control signal” “when it is determined that . . . the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level”).

180. Bergholz discloses a notification device emitting an audio signal (*e.g.*, reproducing “speech” using the “loudspeaker . . . in the vehicle”).

181. See my discussion in element [1.a] (Section IX.B.3.b).

182. As discussed in Section IX.B.2, a person of ordinary skill in the art would have been motivated to apply Bergholz’s audio notification teachings in implementing Kim’s horn notification device such that upon detection of a horn, an alert is played using Kim’s audio speaker.

(i) Claim 2

183. **Claim 2 recites “The awareness device according to claim 1, where the notification device includes a receiver.”** See my discussion of the elements of claim 1 above (Section IX.B.3.a-h). The limitation added by this claim is met by Bergholz.

184. Bergholz discloses a notification device that includes a receiver (*e.g.*, “loudspeaker”). And as I note above, the ’620 patent equates a “receiver” to a

“speaker.” ’620 patent, 7:41-47 (“notification device can be a *speaker (receiver)* . . . an audio signal can be emitted from the *speaker (receiver)* . . .”).

185. See my discussion in element [1.a] (Section IX.B.3.b).

(j) Claim 3

186. **Claim 3 recites “The awareness device according to claim 1, where the notification device further includes a video display.”** See my discussion of the elements of claim 1 above (Section IX. B.3.a-h). The added limitation of this claim is met by Kim and, alternatively, Bergholz.

187. See my discussion in Section IX.A.4.j (claim [3]) regarding how Kim teaches the notification device includes a video display (*e.g.*, “displayer (60)” “displays a warning message”).

188. To the extent further disclosure is required, Bergholz discloses a video display (*e.g.*, “LED or LCD display 16”). *See, e.g.*, Bergholz:

- **6:19-26:** “In a first step, the signals processed by the preamplifiers are converted into digital data. In the following process step, the data is examined for classification features. This takes place in the evaluation unit 4. The results obtained from the classification are compared to predefined classification features in the computing unit 5. ***The results are then either displayed for the driver, for example on an LED or LCD display 16.***”

189. Bergholz discloses using “an LED or LCD display 16” to display warning results to a driver when a target sound is detected. Bergholz, 6:19-26.

190. For the same reasons I explain above for applying Kobayashi's teachings of a video display in implementing Kim's displayer 60 in Ground 1 for claim 3 (Section IX.A.4.j), a person of ordinary skill in the art would have been motivated to apply Bergholz's teachings of a video display in implementing Kim's displayer 60 to advantageously provide flexibility in the warnings that can be provided to the driver.

(k) Claim 4

191. **Claim 4 recites “The awareness device according to claim 1, where the audio signal includes at least one of the ambient acoustic signal, a voice message or a non-voice message.”** See my discussion of the elements of claim 1 above (Section IX.A.2.a-h). The added limitation of this claim is met by Bergholz.

192. Bergholz discloses the audio signal (*e.g.*, “speech sequences”) includes a voice message (*e.g.*, “speech reproduction” from “speech generator”).

193. See my discussion in element [1.a] (Section IX.B.3.b).

(l) Element [6.pre]

194. **Element [6.pre] recites “A vehicle situation awareness device for a vehicle comprising.”** This element is met by Kim.

195. See my discussion in element [1.pre] (Sections IX.A.4.a, IX.B.3.a).

(m) Element [6.a]

196. **Element [6.a] recites “a notification device in the vehicle configured to emit an alert signal including an audio signal.”** This element is met by Kim in view of Bergholz.

197. See my discussion in elements [1.a] and [6.pre] (Section IX.B.3.b, l). Bergholz’s “speech sequence[]” is an “alert signal” because it “is used to inform the driver.” Bergholz, 4:46-55.

(n) Element [6.b]

198. **Element [6.b] recites “an internal microphone configured to measure an internal acoustic signal in the vehicle.”** This element is met by Kim.

199. See my discussion in element [1.b] (Sections IX.A.4.c, IX.B.3.c) and [6.pre] (Section IX.B.3.l).

(o) Element [6.c]

200. **Element [6.c] recites “an external microphone configured to measure a vehicle equipment signal.”** This element is met by Kim in view of Bergholz.

201. Kim discloses an external microphone (*e.g.*, “outdoor microphone (20) . . . installed . . . outside the vehicle”) configured to measure an acoustic signal (*e.g.*, “measures the sound generated around the vehicle”).

202. See my discussion in element [1.c] (Sections IX.A.4.d, IX.B.3.d).

203. Bergholz discloses a vehicle equipment signal (*e.g.*, “acoustic signals outside the vehicle,” such as “squealing tires, the sound of a flat tire, engine or exhaust defects”). *See, e.g.*, Bergholz:

- **Figure 1**

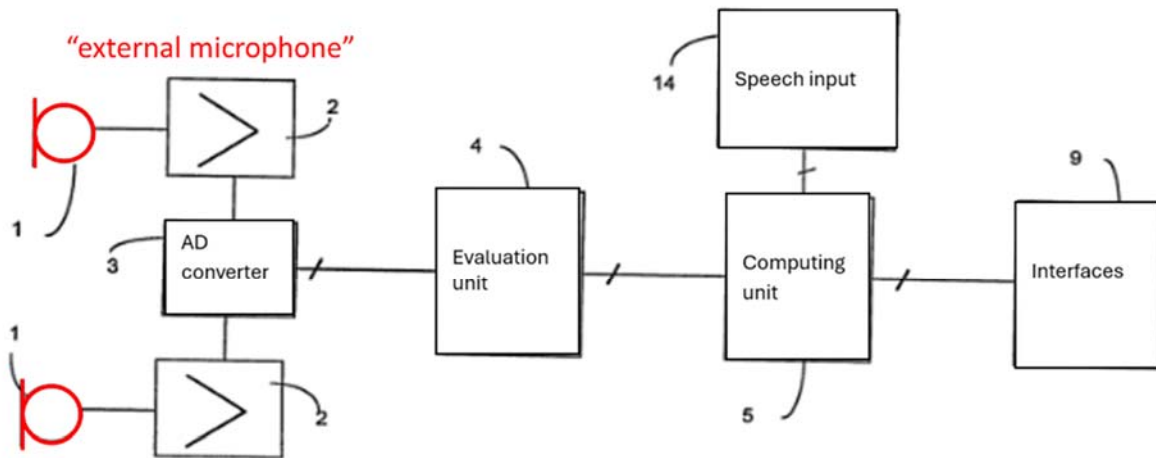


Fig. 1

- **3:11-17:** “The embodiment of an electronic detection system for acoustic warning signs and signals according to the invention shown in Fig. 1 comprises **microphones 1 for picking up acoustic signals**, each of which is directly connected to a preamplifier 2. The preamplifier 2 raises the signal picked up by the microphone 1 above a noise threshold and makes it available for further processing.”
- **3:19-36:** “For reasons of clarity, only two microphones 1 with a preamplifier 2 are shown in Fig. 1, but the detection system preferably has **four microphones 1 that are attached to the outside of the vehicle**, or at least in such a way that they can **pick up acoustic signals outside the vehicle**. The four microphones 1 cover the surrounding area of the vehicle from the corners of the vehicle and thus allow for a precise localization of sound sources in the surrounding area. However, with two microphones instead of four, the system can only distinguish sound sources in front of and behind the vehicle but cannot locate them when

coming from the side. In addition, **microphones 1** can be arranged inside the vehicle, either for monitoring the passenger cabin or **for monitoring the engine compartment or other vehicle regions**, such as radar and the like. Instead of the external microphones 1, existing microphones can also be used if they are sensitive enough in the corresponding frequency range.”

- **7:41-54:** “In a further preferred embodiment of the invention, the detection system can also be used for voice control purposes, i.e., human command words (calls for help, stop, code words) can be programmed into the system and used to trigger a command: (1) and (2) Execution of the command (such as “STOP”), but also a response to defined, possibly personal code words (e.g., to open the door, deactivate the anti-theft device and/or the immobilizer). Furthermore, **the recorded acoustic signal can also be used to detect abnormal driving noises** (squealing tires, the sound of a flat tire, **engine or exhaust defects**) and **thus be used to detect vehicle malfunctions in a timely manner and to provide an early warning prior to scheduled maintenance . . .** (2) **The driver is given a cause message by means of optical and acoustic output devices** 15 and 16.”

204. Bergholz discloses “microphones” that “pick up acoustic signals outside the vehicle” to “detect abnormal driving noises” and “vehicle malfunctions,” including “squealing tires, the sound of a flat tire, engine or exhaust defects.” Bergholz, 3:19-36, 7:49-54.

205. As I discussed in Section IX.B.2, a person of ordinary skill in the art would have been motivated to apply Bergholz’s teachings of detecting vehicle malfunctions in implementing Kim’s notification device.

(p) Element [6.d]

206. **Element [6.d]** recites “a processor.” This element is met by Kim.

207. See my discussion in element [1.d] (Sections IX.A.4.e, IX.B.3.e).

(q) Element [6.d.i]

208. **Element [6.d.i] recites “determine an internal sound pressure level (SPL) in the vehicle based on the internal acoustic signal.”** This element is met by Kim.

209. See my discussion in element [1.d.i] (Sections IX.A.4.f, IX.B.3.f).

(r) Element [6.d.ii]

210. **Element [6.d.ii] recites “identify at least one sonic signature from the vehicle equipment signal.”** This element is met by Kim in view of Bergholz.

211. Kim discloses a processor (*see* element [1.d]) configured to identify at least one sonic signature from an audio signal (*e.g.*, “determine[s] whether the frequency” of “the external sound received by the outdoor microphone (20)” “correspond[s] to” a “horn sound”).

212. See my discussion in element [1.d.ii] (Sections IX.A.4.g, IX.B.3.g) and element [6.c] (Section IX.B.3.o).

213. Bergholz discloses the vehicle equipment signal (*see* element [6.c], Section IX.B.3.o).

214. Bergholz discloses that “[t]he driver is given a cause message by . . . acoustic output device[] 15” when “vehicle malfunctions” are detected, including

“squealing tires, the sound of a flat tire, engine or exhaust defects.” Bergholz, 7:41-62.

215. A person of ordinary skill in the art would have understood, when applying Bergholz’s teachings to Kim, Kim’s ECU would perform sonic signature detection on the picked up acoustic signals to detect vehicle malfunctions. For example, a person of ordinary skill in the art would have understood that, when applying Bergholz’s teachings to Kim, Kim’s ECU would use sonic signatures to detect squealing tires and/or a flat tire.

216. As I discussed in Section IX.B.2, a person of ordinary skill in the art would have been motivated to apply Bergholz’s teachings of detecting vehicle malfunctions in implementing Kim’s notification device.

(s) Element [6.d.iii]

217. **Element [6.d.iii] recites “when the at least one sonic signature is identified, determine whether to send an emit signal to the notification device to emit the audio signal based on the internal SPL.”** This element is met by Kim in view of Bergholz.

218. See my discussion in element [1.d.iii] (Sections IX.A.4.h, IX.B.3.h) and element [6.a] (Section IX.B.3.m).

(t) Claim 7

219. **Claim 7 recites “The awareness device according to claim 6, where the notification device includes a receiver.”** The added limitation of this claim is met by Bergholz.

220. See my discussion in claims 2 and 6 (Sections IX.B.3.i, l-s).

(u) Claim 8

221. **Claim 8 recites “The awareness device according to claim 6, where the notification device includes a video display.”** The added limitation of this claim is met by Kim and, alternatively, Bergholz.

222. See my discussion in claims 3 and 6 (Sections IX.B.3.j, l-s).

(v) Element [15.pre]

223. **Element [15.pre] recites “A method of situation awareness facilitation for a vehicle driver of a vehicle, the method comprising.”** This element is met by Kim.

224. See my discussion in element [15.pre] (Section IX.A.4.l).

(w) Element [15.a]

225. **Element [15.a] recites “receiving an internal acoustic signal from inside the vehicle and converting the internal acoustic signal to an internal acoustic electronic signal.”** This element is met by Kim.

226. See my discussion in element [15.a] (Section IX.A.4.m).

(x) Element [15.b]

227. **Element [15.b] recites “receiving an ambient acoustic signal from outside the vehicle and converting the ambient acoustic signal into an ambient acoustic electronic signal.”** This element is met by Kim.

228. See my discussion in element [15.b] (Section IX.A.4.n).

(y) Element [15.c]

229. **Element [15.c] recites “determining, by a processor, an internal sound pressure level (SPL) in the vehicle based on the internal acoustic electronic signal.”** This element is met by Kim.

230. See my discussion in element [15.c] (Section IX.A.4.o).

(z) Element [15.d]

231. **Element [15.d] recites “matching, by the processor, the ambient acoustic electronic signal to one or more stored reference electronic signals.”**
This element is met by Kim.

232. See my discussion in element [15.d] (Section IX.A.4.p).

(aa) Element [15.e]

233. **Element [15.e] recites “determining whether to send an acoustic message associated with a matched reference electronic signal to a speaker in the vehicle based on the internal SPL.”** This element is met by Kim in view of Bergholz.

234. Kim discloses determining whether to send a message (e.g., “warning message”) associated with a matched reference electronic signal (e.g., “ECU (50)”) sends “control signal” to the “displayer (60) for outputting a warning signal to a driver” if the “the external sound” “correspond[s] to [a] horn sound”) based on the internal SPL (e.g., “outputs a control signal” if “the volume of the sound received by the indoor microphone (10) is greater than or equal to a certain level”).

235. See my discussion in element [15.e] (Section IX.A.4.q).

236. Bergholz discloses sending an acoustic message (*e.g.*, “computing unit 5” sends an “information . . . signal” to “acoustic output device 15”) associated with a matched reference electronic signal to a speaker in the vehicle (*e.g.*, “depending on the evaluation result of the computing unit 5” “speech generator . . . compos[es] . . . speech sequences” to be played by a “loudspeaker”).

237. See my discussion in elements [1.a] and [1.d.iii] (Sections IX.B.3.b, h) and claims 2 and 4 (Section IX.B.3.i, k).

238. As discussed in §IX.B.2, a person of ordinary skill in the art would have been motivated to apply Bergholz’s audio notification teachings in implementing Kim’s notification device.

C. **Grounds 3-4: Grounds 1 and 2 further in view of Hermann (Claim 5)**

239. **Claim 5 requires that the processor “adjusts a reproduction SPL of the audio signal based on the internal SPL.”**

240. Hermann discloses a processor (e.g., “microprocessor”) that adjusts a reproduction SPL of the audio signal (e.g., adjusts the level of “high priority message signal[s]” to be “heard” over “ambient noise level”) based on the internal SPL (e.g., “ambient noise level in a vehicle” measured by a “microphone”). *See, e.g.,* Hermann:

- **1:5-10:** “The present invention relates, in general, to mobile control systems for providing audible messages to a driver and, more specifically, to *adjusting the sound level of high priority messages from navigation systems, parking aid systems, and back-up warning systems, other high priority message sources based on ambient noise level in a vehicle.*”
- **1:39-59:** “The present invention has the advantage that *the sound level at which high priority message signals are heard is controlled relative to the ambient noise level* including any ambient noise produced by the low priority sound signals from the entertainment audio system and being generated using a shared amplifier. In one aspect of the invention, a method of producing audible voice messages from a priority message system in a vehicle, wherein the vehicle includes an entertainment audio system generating low priority sound signals, comprises the following steps. An ambient noise level is measured, including any sounds resulting from the low priority sound signals. A priority sound level is determined for generating high priority message signals from the priority message system in response to the measured ambient noise level. A programmable gain is adjusted for the high priority message signals in response to the priority sound level. *The high priority message signals are played at the*

adjusted programmable gain whereby the high priority message signals are heard at a sound level which is relatively greater than the ambient noise level by a predetermined target difference.”

- ***2:44-3:7: “A preferred apparatus of the present invention is shown in FIG. 3. A programmable gain controller 20 receives instruction audio signals from a navigation system 21, audible warning signals from a back-up warning system 22, and AM/FM/tape/CD/cellular phone audio signals from an entertainment/communication system 23. Audio signals from each source are operated upon by a programmable gain and then provided to inputs of an audio amplifier 24 for applying a fixed gain prior to reproduction by speakers 25. A microphone 26 picks up ambient noise signals which are amplified by an amplifier and converted to digital values by an analog-to-digital (A/D) 28. Digitized sound signals from A/D 28 are evaluated by a microprocessor 30 to determine average ambient noise over an averaging window. Microprocessor 30 provides control signals to programmable gain control 20 in order to select appropriate gain levels. Thus, a gain value for entertainment communication signals may be controlled by microprocessor 30 in response to a volume control knob which may be operated by the user. A programmable gain for instruction audio signals from navigation system 21 and warning signals from back-up warning system 22 (herein referred to as high priority message signals) are controlled by microprocessor 30 in response to the measured average ambient noise level using the method shown in FIG. 4. Thus, ambient noise level is measured in step 31. The programmable gain for the high priority message is set in step 32. In step 33, the microprocessor may disable other audio sources, if necessary, in order to reduce conflict with the high priority message. In step 34, the high priority message is played via the audio amplifier and speakers.”***

241. Hermann discloses a “programmable gain controller” that receives “high priority message signals,” such as from a “warning system,” and applies “appropriate gain levels” to the signals “prior to reproduction by speakers” so that the signals “are heard” over “the ambient noise level” in a vehicle. Hermann, 1:5-

10, 1:39-44, 2:44-3:7. A “microphone” measures the “ambient noise level in a vehicle” and a “microprocessor” controls the “programmable gain” “in response to the measured average ambient noise level” in the vehicle. Hermann, 1:5-10, 1:51-59, 2:44-3:7.

242. Like the '620 patent, Kim, Kobayashi, and Bergholz, Hermann's field includes situation awareness, and Hermann is pertinent to the problem of responding to detected sounds purportedly addressed by the '620 patent. *See* Hermann, Abstract (“The reproduction sound level of high priority messages such as navigation instructions, parking aid signals, and back-up warning signals is controlled based on the average ambient sound level in a vehicle. A sound level calibration table provides priority gain values for setting the programmable gain of a gain controller to ensure that messages are reproduced at a sound level which is relatively greater than ambient noise level by a predetermined target difference which is consistent for all levels of ambient noise. The target difference may be modified according to user preferences.”), 1:5-10 (“The present invention relates, in general, to mobile control systems for providing audible messages to a driver and, more specifically, to adjusting the sound level of high priority messages from navigation systems, parking aid systems, and back-up warning systems, other high priority message sources based on ambient noise level in a vehicle.”), 1:38-59 (“. . . In one aspect of the

invention, a method of producing audible voice messages from a priority message system in a vehicle, wherein the vehicle includes an entertainment audio system generating low priority sound signals, comprises the following steps. An ambient noise level is measured, including any sounds resulting from the low priority sound signals. A priority sound level is determined for generating high priority message signals from the priority message system in response to the measured ambient noise level. A programmable gain is adjusted for the high priority message signals in response to the priority sound level. The high priority message signals are played at the adjusted programmable gain whereby the high priority message signals are heard at a sound level which is relatively greater than the ambient noise level by a predetermined target difference.”), 2:44-3:7 (“... A microphone 26 picks up ambient noise signals which are amplified by an amplifier and converted to digital values by an analog-to-digital (A/D) 28. Digitized sound signals from A/D 28 are evaluated by a microprocessor 30 to determine average ambient noise over an averaging window. Microprocessor 30 provides control signals to programmable gain control 20 in order to select appropriate gain levels. . . A programmable gain for instruction audio signals from navigation system 21 and warning signals from back-up warning system 22 (herein referred to as high priority message signals) are controlled by

microprocessor 30 in response to the measured average ambient noise level using the method shown in FIG. 4. . . .”); *see* Sections IX.A.3, IX.B.2.

243. Like the '620 patent, Kim, Kobayashi, and Bergholz, Hermann contemplates notification systems comprising a processor that analyzes sound and responds thereto. *See* Hermann, Abstract, 1:5-10, 1:38-59, 2:44-3:7 (“A microphone 26 picks up ambient noise signals which are amplified by an amplifier and converted to digital values by an analog-to-digital (A/D) 28. Digitized sound signals from A/D 28 are evaluated by a microprocessor 30 to determine average ambient noise over an averaging window. Microprocessor 30 provides control signals to programmable gain control 20 in order to select appropriate gain levels. . . A programmable gain for instruction audio signals from navigation system 21 and warning signals from back-up warning system 22 (herein referred to as high priority message signals) are controlled by microprocessor 30 in response to the measured average ambient noise level using the method shown in FIG. 4.”); *see also* Sections IX.A.3, IX.B.2.

244. Kim identifies the problem of the driver having a difficulty noticing horns of other vehicles due to noise within the cabin of the car. Kim, Abstract (“This invention relates to a horn notification device of another vehicle, and it is sometimes difficult to know the horn sound of another vehicle due to the use of audio inside the vehicle, so to solve this problem, it provides horn notification methods for other

vehicles . . .”). A person of ordinary skill in the art would have been motivated to apply Hermann’s teaching of a microprocessor that adjusts the sound level of an audio signal based on the measured average ambient noise level inside a vehicle in implementing Kim’s horn notification device (as modified by Kobayashi or Bergholz). Such an implementation would have advantageously enhanced Kim’s ECU to increase the volume of audio notifications output from the speaker so that the warning “signals are heard” over the SPL in the vehicle. Hermann, 1:39-44, 1:45-59. For example, if the internal SPL of the vehicle is measured to be 60dB (e.g., because of audio playing or passenger voices), when applying Hermann’s teachings to Kim’s device, Kim’s ECU would instruct the speaker to play the audio notification above 60dB so that the driver would hear the notification over the SPL of the vehicle’s ambient noise.

245. A person of ordinary skill in the art would have had a reasonable expectation of success in applying Hermann’s teachings in implementing Kim’s notification device (as modified by Kobayashi or Bergholz). It was well-known in the art to raise the volume of a warning based on ambient noise. *See, e.g.*, Hermann, Abstract, 1:5-10, 1:38-59, 2:44-3:7. Further, both Kim and Hermann disclose using computing units and/or processors to carry out their respective functionalities. *See* Kim, 3; Hermann, 2:55-3:7 (discussing “microprocessor 30”). Implementing

Hermann's teaching in Kim would have required that Kim's ECU implement an additional instruction to amplify the warning messages above the measured ambient noise level so that the messages are heard. This would have been a straightforward application of Hermann's teachings of adjusting the volume at which a message is played based on an ambient noise level in a manner that advantageously improves Kim's notification device (as modified by Kobayashi or Bergholz).

D. Ground 5: Mohan in view of Bergholz (Claims 6 and 9-14)

1. Overview of Mohan

246. Mohan is generally directed to “signal processing systems, and in particular, to a system that detects a siren and provides a siren notification.” Mohan, 1:7-9.

247. Mohan discloses a “monitoring and notification system” that “detects a siren” and provides “audible and visual” siren “notification[s]” to “vehicle occupants.” Mohan, Abstract, 1:7-9. Mohan discloses “**microphones** . . . in the vehicle compartment” as “**input sources 418 and 420**” that provide a “**vehicle environment sound signal**” by “sampl[ing] the ambient sounds within the vehicle.” Mohan, 6:15-24, 7:48-8:26. **Processor 424** is “connected to a memory 426” that executes a “siren processing program 436” to “analyze[] **the vehicle environment sound signal 434** against the **siren models 428-430**.” Mohan, 6:7-14, 6:25-50.

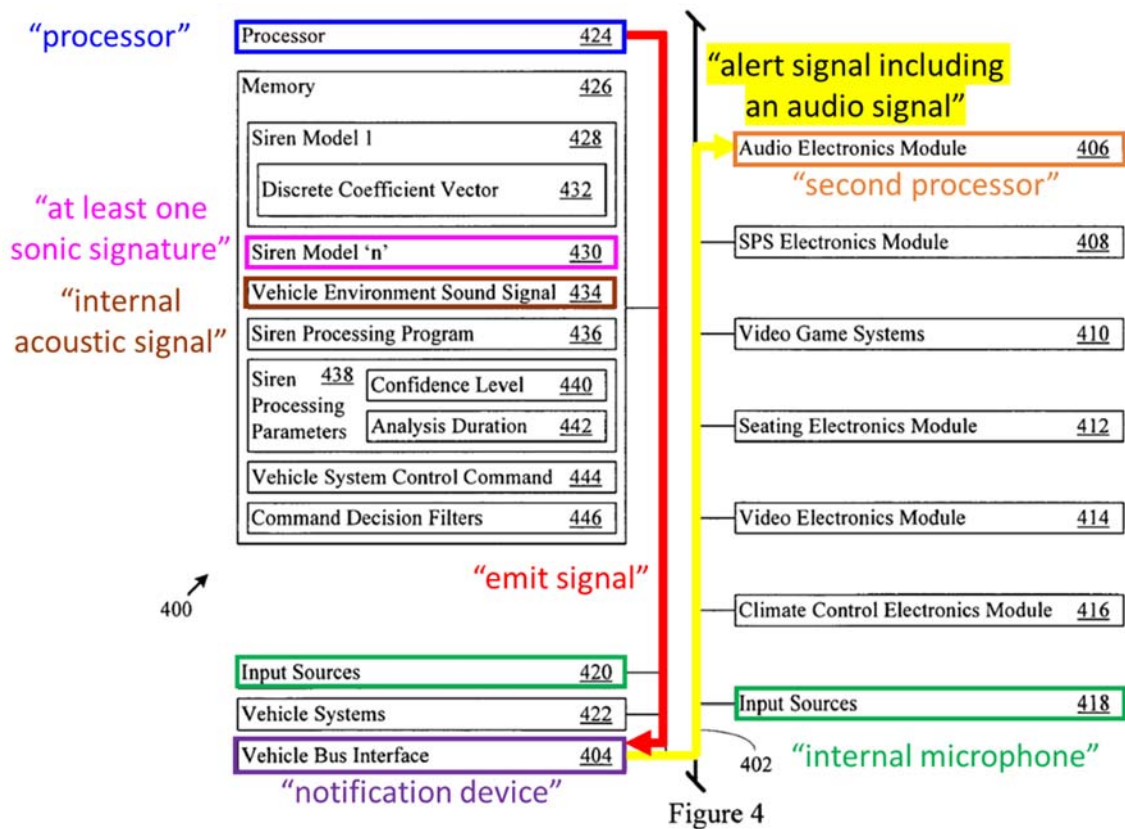


Figure 4

Mohan, Figure 4.

248. Mohan discloses that “if the siren processing program 436” executed by **processor 424** “detects a siren,” “one or more of the command decision filters” are applied, such as the “High Volume” filter, which “send[s]” “**vehicle system control command[s] 444**” to the **vehicle bus interface 404** “if the current ambient noise level (e.g., including audio generated by the stereo system) is above a pre-determine[d] threshold.” Mohan, 6:51-61, 7:24-47, 8:27-41.

249. **Vehicle bus interface 404** “process[es] data (e.g., **bus packets containing vehicle control commands**)” and “include[s] logic that sends or

receives information to and from the modules 406-418 and the system 400 through the vehicle bus 402,” where the “logic may be implemented with a microprocessor.” Mohan, 5:9-25, 10:58-61. The vehicle system control commands processed by bus interface 404 include an “[a]udible [a]nnouncement,” which is emitted to “audio electronics module 406” to “[g]enerate a specified audio signal.” Mohan, 5:9-25, 5:47-59, 6:51-61, 7:1-23. Audio electronics module 406 “include[s] media access, control, and sound reproduction logic,” which is “implemented with a microprocessor.” Mohan, 5:47-59, 10:58-11:6.

2. Motivation to Apply Bergholz’s Teachings to Mohan

250. Like the ’620 patent and Bergholz, Mohan’s field includes situation awareness, and Mohan is pertinent to the problem of detecting sounds and responding thereto in vehicles purportedly addressed by the ’620 patent. Mohan, Abstract (“A monitoring and notification system detects and informs vehicle occupants of sirens. The system may adjust radio, phone, or other device settings in the vehicle in conjunction with the notification. The notification may take an audible or visual form, and the monitoring system may perform its analysis across multiple types of sirens. In addition, the system may adapt its processing based on location to take into account locally expected siren formats.”), 1:7-9 (“This disclosure relates to signal processing systems, and in particular, to a system that detects a siren and

provides a siren notification.”), 1:37-58 (“A siren detection and notification system provides notification of nearby sirens. When used in a vehicle such as an automobile, the siren detection and notification system may adjust radio, phone, or other device settings in the vehicle. For example, the system may reduce the radio volume. In conjunction with the adjustment, the system may provide a notification of siren detection to the passengers. The notification may take an audible, visual, or other form, and the system may perform its analysis across multiple types of sirens. The system may engage in a dynamic analysis based on location. . . .”); see Section IX.B.2.

251. Like the ’620 patent and Bergholz, Mohan contemplates detection systems comprising a microphone that detects a siren from another vehicle and responds thereto, such as warning the driver of the sound. See Mohan, Abstract (“A monitoring and notification system detects and informs vehicle occupants of sirens. The system may adjust radio, phone, or other device settings in the vehicle in conjunction with the notification. The notification may take an audible or visual form, and the monitoring system may perform its analysis across multiple types of sirens. In addition, the system may adapt its processing based on location to take into account locally expected siren formats.”), 1:7-9 (“This disclosure relates to signal processing systems, and in particular, to a system that detects a siren and provides a

siren notification.”), 5:9-25 (“FIG. 4 shows a dynamic siren detection and notification system 400 (‘system 400’) connected to a vehicle bus 402 through the vehicle bus interface 404. The vehicle bus 402 may interconnect a diverse array of vehicle electronics modules. The vehicle bus interface 404 may include logic that sends or receives information to and from the modules 406-418 and the system 400 through the vehicle bus 402. The vehicle bus interface 404 may process data (e.g., bus packets containing vehicle control commands) transmitted over the vehicle bus 402. . . .”), 6:7-61 (“ . . . the input sources 418 and 420 may include microphones or microphone arrays, and may sample the ambient sounds within the vehicle. . . .”), 7:1-8:26 (“The siren processing program 436 samples the vehicle environmental sound using, for example, a microphone in the vehicle compartment (502). . . . Using the vehicle environment sound signal 434 obtained by sampling the vehicle environment sound, the siren processing program 436 analyzes sounds in the vehicle against the siren models 428-430 (506).”).

252. A person of ordinary skill in the art would have been motivated to apply Bergholz’s teachings of an external microphone in implementing Mohan’s system. Such an implementation would have advantageously increased the reliability of Mohan’s system. For example, a person of ordinary skill in the art would have recognized the benefits of using an external microphone to measure a sound external

to the vehicle's cabin, such as a siren. When the vehicle's cabin noise is loud, the internal microphone (Mohan, 6:19-21, 7:1-8:26) would have difficulty capturing the target sound outside of the vehicle over the noise in the vehicle's cabin. Using an external microphone would have improved the reliability of the system because the microphone would not have been capturing noise both inside and outside the car for detection of target sounds outside the car. *See Kobayashi, [0016]* (“The microphone for detecting the sound of an emergency vehicle siren is usually located outside the vehicle so that the siren sound can be inputted without being impeded, for example, by the sound of the car stereo in the cabin, etc.”). In addition, the external microphone would be less likely to inadvertently pick up false sound, such as a “siren” sound played on a radio. For example, from time to time, radio shows give out prizes and will play a siren sound such that this siren sound is not from an emergency vehicle. Placing the external microphone outside of the vehicle would decrease the likelihood that the system would detect the radio's siren sound as a genuine siren sound, such as from an emergency vehicle, requiring notification to the driver. Rather, the external microphone would capture sounds not influenced by the vehicle's cabin noise that are then analyzed by the processor to detect target sounds.

253. Further, a person of ordinary skill in the art would have been motivated to apply Bergholz’s teachings of detecting vehicle malfunctions in implementing Mohan’s system. Such an implementation would have advantageously enhanced Mohan’s system to “detect vehicle malfunctions in a timely manner and to provide an early warning prior to scheduled maintenance.” Bergholz, 7:41-54. As Mohan recognizes, “when the stereo system is playing at a high volume, it may be difficult to hear the warning[s],” thereby risking an accident. Mohan, 1:11-23. Similarly, when the driver’s audio volume is too loud, the driver cannot hear vehicle malfunctions that affect the car’s ability to operate properly, thereby risking an accident. For example, when the vehicle’s cabin noise is too loud, the driver cannot hear, e.g., “engine or exhaust defects” (Bergholz, 7:41-54), and the vehicle may not operate properly, causing the driver to swerve or stop short, risking an accident. A person of ordinary skill in the art would have understood the benefits in enhancing Mohan’s system to recognize vehicle equipment signals, such as acoustic signals from vehicle malfunctions. A person of ordinary skill in the art therefore would have recognized the benefits of providing the driver with an audio and/or visual warning related to these defects.

254. Further, a person of ordinary skill in the art would have been motivated to apply Bergholz’s voice commands teachings in implementing Mohan’s system.

Such an implementation would have advantageously enhanced the system to allow for a hands-free driving experience such that the driver could issue voice commands to control the car's operation, such as saying "lower audio" to lower the car's audio or saying "mute audio" to mute it. The system would advantageously provide drivers with a safer experience. For example, the drivers would have been able to speak voice commands while keeping their eyes on the road, whereas a system that would not enable voice commands would have required the drivers to divert their attention to, for example, a volume dial to lower or mute the car's audio. See Ito (Ex. 1015), 20 (using audio warnings instead of visual warnings "draws the driver's eye from the visual field where it belongs while driving and creates a visual distraction that may impede safety").

255. Indeed, processing voice commands to improve a person's ability to focus on other tasks—including driving—was known in the art. For example, U.S. Patent Application Publication No. 2003/0138118A1 ("Stahl," Ex. 1018) discloses "[t]o increase the user-friendliness and options for use of devices, in particular devices in the field of consumer electronics and thus to make the devices more attractive, an ever increasing number of devices are so equipped that control of the device is possible by means of acoustic command signals." Stahl, [0002]. Stahl further explains "As speech recognition systems develop, devices have also become

available which may recognize and accept various voice commands as command signals, so that complicated control of such devices is also possible. Such voice-controllable devices are highly convenient, since the operator may operate the respective device without having to use his/her hands. This control method consequently has considerable advantages wherever the operator needs his/her hands for other activities, for instance in the case of control of a car radio, where the operator must not take his/her hands off the steering wheel to change the volume or the channel. In addition, this method is also more generally attractive with regard to device operation, because such voice control enables the man-machine interface (MMI) to be shifted from the hitherto conventional plane of communication with machines, namely operation by buttons and controllers, to the communication plane normal to humans, namely information transfer via speech.” Stahl, [0002].

256. As another example, MICHAEL H. COHEN, VOICE USER INTERFACE DESIGN (2004) (“Cohen,” Ex. 1019) discloses that speech interfaces were being deployed in various applications because they “[i]ncreas[e] customer satisfaction” as “[n]umerous surveys and deployment studies have shown higher user satisfaction with speech systems.” Cohen, 9-10. Further, “there are many appealing advantages of using speech systems compared with other access modes” including that that they can be “[h]ands-free, eyes-free,” as “[a]ctivities such as

driving occupy the user's hands and eyes,” and “[s]peech is an ideal solution for accessing services while engaged in such tasks.” Cohen, 10-11.

257. As another example, U.S. Patent Application Publication No. 2006/0116175A1 (“Chu,” Ex. 1020) discloses that “[m]any cell phones also include a ‘hands-free’ or voice command setting that may be utilized when the user is . . . unable to manually operate the device.” Chu, [0003].

258. A person of ordinary skill in the art would have recognized, when applying Bergholz's voice commands teachings to Mohan's notification system 400, the sonic signatures of these voice commands would have been stored in Mohan's memory 426. A person of ordinary skill in the art would have also recognized that Mohan's processor 424 would perform the voice recognition using the voice commands stored in memory 426. Indeed, Bergholz teaches the commands are “store[d],” and memory 426 is the only memory included in notification system 400. Mohan, Figure 4; Bergholz, 4:40-43. At minimum, a person of ordinary skill in the art would have understood it was a straightforward design choice to place voice commands in memory 426. Indeed, “memory 426 stores one or more siren models” such that memory 426 stores multiple sound signatures. Mohan, 6:8-10. Including all sound signatures in a single memory would have advantageously reduced the number of components—and thus the complexity—of the system. For example, if

multiple memories with the various sound models, the processor would have needed an additional mapping to keep track of which memory device stores which sound model.

259. Moreover, a person of ordinary skill in the art would have recognized that processor 424 executing siren processing program 436 is the natural choice to detect voice commands by comparing detected audio against stored voice commands. The processor 424 is already programmed to detect other sounds, such as sirens, by comparing them against stored sonic signatures stored in memory 426. Mohan, 6:25-27 (“The siren processing program 436 analyzes the vehicle environment sound signal 434 against the siren models 428-430.”). In this regard, Mohan discloses a “voice recognition system[,]” and further explains that systems are implemented with a “microprocessor.” Mohan, 5:38-46, 10:58-11:6. This disclosure confirms it would have been straightforward to implement the detection of vocal commands in processor 424, already executing siren processing program 436. Mohan, 5:38-46, 10:58-11:6.

260. A person of ordinary skill in the art would have also had a reasonable expectation of success in applying Bergholz’s teachings of detecting vehicle malfunctions and voice commands in implementing Mohan’s notification system. Both references teach detecting sounds to perform an appropriate response, as I

discussed in Sections IX.B.1-2 and IX.D.1-2. Further, both Mohan and Bergholz disclose using computing units and/or processors to carry out their respective functionalities. Mohan, 6:7-14 (“The dynamic siren detection and notification system 400 includes a processor 424 connected to a memory 426. . . .”), 6:25-50 (“The siren processing program 436 analyzes the vehicle environment sound signal 434 against the siren models 428-430. . . .”), 6:51-61 (“In the event that the siren processing program 436 detects a siren, the siren processing program 436 may issue a vehicle system control command 444. . . .”), 7:24-47 (“The siren processing program 436 may also exercise control over whether or not to send a vehicle system control command. . . .”), 8:27-41 (“On the other hand, if the siren processing program 436 detects a siren, the siren processing program may then determine whether the confidence measure meets or exceeds the confidence level 440 established in the siren processing parameters 438. . . .”); Bergholz, 4:19-25 (“The classification features of the data correlated with the captured acoustic signals, which were determined by the evaluation unit 4, are fed into a computing unit 5. In the computing unit 5, the classification features are compared with predetermined and previously stored patterns or with temporarily stored previous data.”), 4:47-63 (“The comparison result of the computing unit 5 is output to an output via an interface 9 as an information and control signal. . . .”).

261. Implementing Bergholz’s teaching in Mohan would have required recognizing additional models by Mohan’s siren processing program. This would have been a straightforward application of Bergholz’s teachings of detecting vehicle malfunctions and voice commands in a manner that advantageously improves Mohan’s notification system. Thus, a person of ordinary skill in the art would have found it routine, straightforward and advantageous to apply Bergholz’s teachings of vocal command detection to Mohan’s teachings of a notification system, and would have known such a combination (yielding the claimed limitations) would yield predictable results and provide the expected functionality.

3. Invalidity of Claims 6 and 9-14 Over Mohan in view of Bergholz

262. In addition to my discussion in Sections IX.B.1-IX.B.2, the following identifies example disclosures followed by bulleted excerpts that each disclose and/or render obvious the Challenged Claims.

(a) Element [6.pre]

263. **Element [6.pre] recites “A vehicle situation awareness device for a vehicle comprising.”** This element is met by Mohan.

264. Mohan discloses a vehicle situation awareness device for a vehicle (*e.g.*, “siren detection and notification system . . . used in a vehicle”). *See, e.g.*, Mohan:

- **1:37-40:** “A *siren detection and notification system* provides notification of nearby *sirens*. When *used in a vehicle* such as an automobile, the siren detection and notification system may adjust radio, phone, or other device settings in the vehicle.”

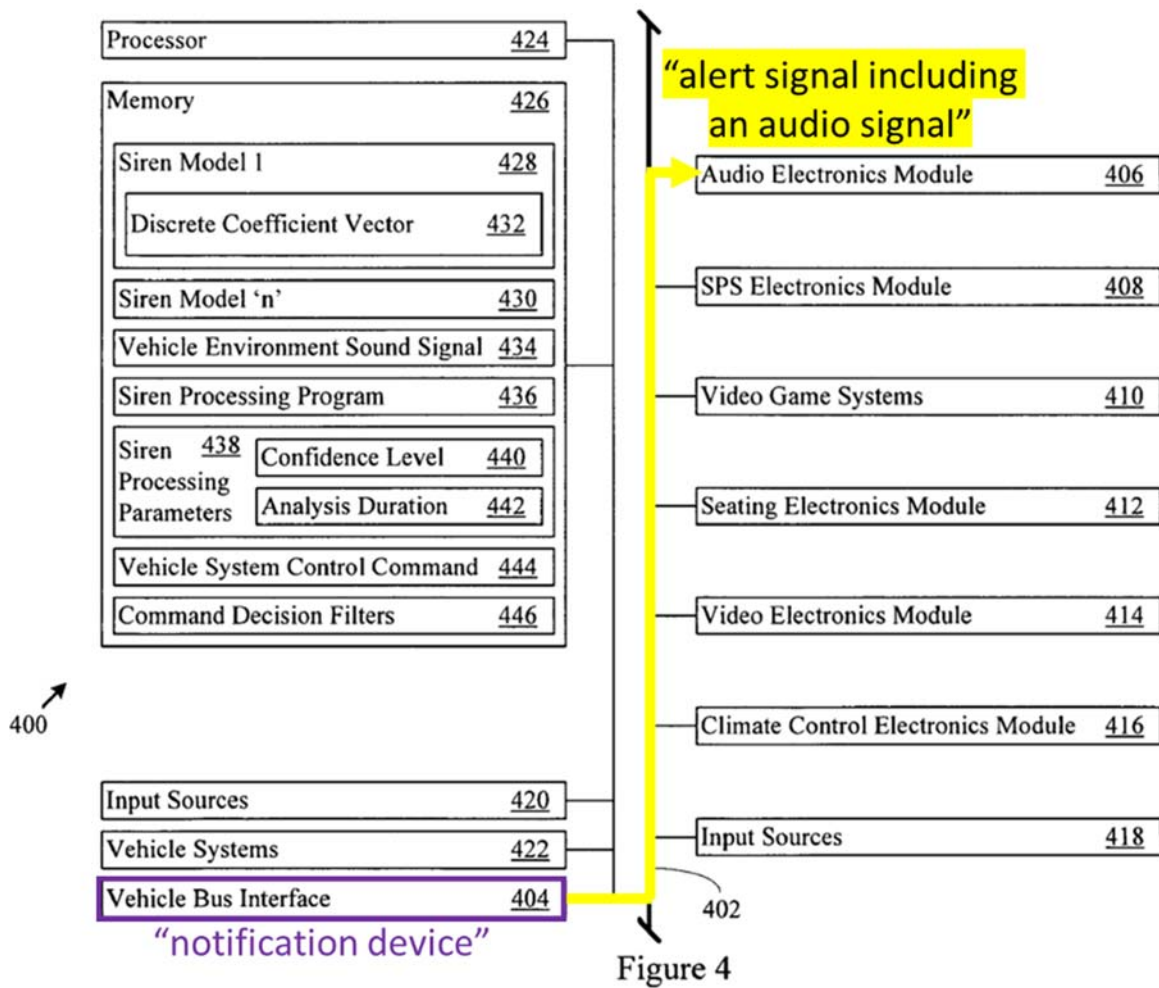
265. Mohan discloses “[a] siren detection and notification system . . . used in a vehicle” to “provide[] notification[s] of nearby sirens.” Mohan, 1:37-40.

(b) Element [6.a]

266. **Element [6.a] recites “a notification device in the vehicle configured to emit an alert signal including an audio signal.”** This element is met by Mohan.

267. Mohan discloses a notification device (*e.g.*, “vehicle bus interface 404”) in the vehicle configured to emit an alert signal (*e.g.*, “bus packets containing vehicle control commands”) including an audio signal (*e.g.*, “[a]udible [a]nnouncement”). *See, e.g.*, Mohan:

- **Figure 4:**



- 5:9-25: “FIG. 4 shows **a dynamic siren detection and notification system 400 (“system 400”) connected to a vehicle bus 402 through the vehicle bus interface 404.** The vehicle bus 402 may interconnect a diverse array of vehicle electronics modules. **The vehicle bus interface 404 may include logic that sends or receives information to and from the modules 406-418 and the system 400 through the vehicle bus 402.** **The vehicle bus interface 404 may process data (e.g., bus packets containing vehicle control commands) transmitted over the vehicle bus 402.** The vehicle bus interface 404 and vehicle bus 402 may adhere to bus architectures such as the Local Interconnect Network (LIN), Controller Area Network (CAN), J1939, ISO11783, FlexRay, Media Oriented Systems Transport (MOST), Keyword Protocol 2000 (KWP2000), Vehicle Area Network (VAN), DC-BUS, IDB-1394, or SMARTwireX architectures.”

- **5:47-59:** “The *audio electronics module 406 may include media access, control, and sound reproduction logic such as physical media access mechanisms, amplifiers and speakers for a CD player, SACD player, tape player, MP3 player, carphone (e.g., a hands-free car phone system), or other audio device.* The SPS electronics module 408 may include a satellite positioning information receiver, location determination logic, location displays, announcement logic (e.g., speakers and audio signal reproduction logic to announce upcoming turns or points of interest), or other SPS processing logic. The video game systems 410 may include audio/visual reproduction logic and operator inputs for controlling a video game.”
- **6:51-61:** “In the event that the *siren processing program 436 detects a siren*, the siren processing program 436 may issue a vehicle system control command 444. *One alternative is that the siren processing program 436 issues the vehicle system control command 444 through the vehicle bus interface 404 to one or more of the vehicle electronics modules 406-416.* However, the siren processing program 436 may instead issue the vehicle system control command 444 to locally connected vehicle system 422.”
- **6:62-67:** “*Table 2 shows examples of vehicle system control commands 444* that the system 400 may employ to directly or indirectly signal, notify, advise, or aid recognition by the vehicle passengers that a siren signal has been detected. The system 400 may send additional, fewer, or different vehicle system control commands.”
- **7:1-23:** “*Audible Announcement . . . [g]enerate a specified audio signal* – may be sent to audio electronics module . . . ”
- **10:58-11:6:** “Furthermore, the systems may be implemented with additional, different, or fewer components. As one example, a processor or any other *logic may be implemented with a microprocessor*, a microcontroller, a DSP, an application specific integrated circuit (ASIC), program instructions, discrete analog or digital logic, or a combination of other types of circuits or logic. As another example, memories may be DRAM, SRAM, Flash or any other type of memory. *The systems may be distributed among multiple components, such as among multiple processors and memories, optionally including multiple distributed*

processing systems. Logic, such as programs or circuitry, may be combined or split among multiple programs, distributed across several memories and processors, and may be implemented in or as a function library, such as a dynamic link library (DLL) or other shared library.

268. See my discussion in element [6.pre] (Section IX.D.3.a).

269. Mohan further discloses “bus interface 404” “process[es] data (e.g., bus packets containing vehicle control commands).” Mohan, 5:9-25. The “vehicle bus interface 404 . . . include[s] logic that sends or receives information to and from the modules 406-418 and the system 400 through the vehicle bus 402,” where the “logic may be implemented with a microprocessor.” Mohan, 5:9-25, 10:58-61. The vehicle system control commands processed by bus interface 404 and “transmitted over the vehicle bus 402” include an “[a]udible [a]nnouncement,” which is emitted to “audio electronics module 406” to “[g]enerate a specified audio signal.” Mohan, 5:9-25, 5:47-59, 6:51-61, 7:1-23.

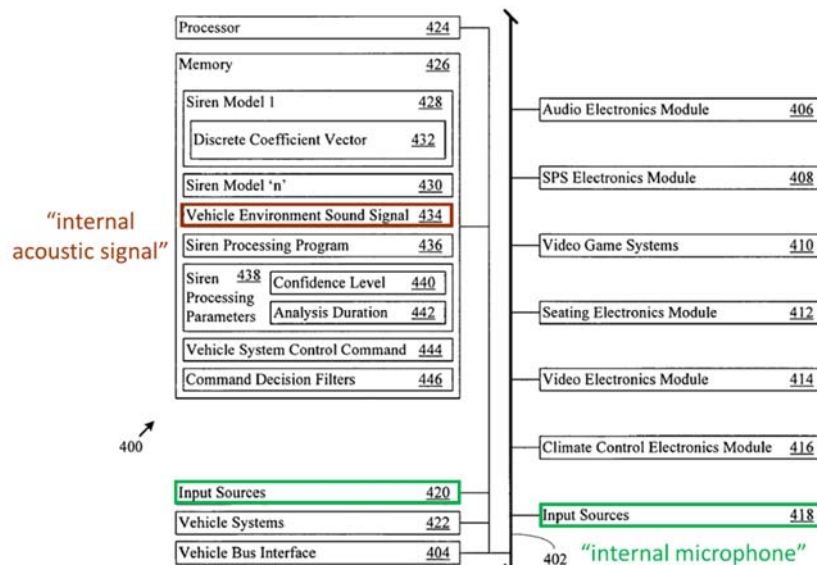
270. In the context of Mohan, a person of ordinary skill in the art would have understood that to “generate” an audio signal means that a speaker produces an audio signal to be heard inside the vehicle. For example, Mohan describes that the ambient noise level is impacted by sound “generated by the speaker system.” Mohan, 7:42-45 (“If the current ambient noise level (e.g., including audio generated by the stereo system)”).

(c) Element [6.b]

271. Element [6.b] recites “an internal microphone configured to measure an internal acoustic signal in the vehicle.” This element is met by Mohan.

272. Mohan discloses an internal microphone (e.g., “microphone in the vehicle compartment”) configured to measure an internal acoustic signal in the vehicle (e.g., “sample the ambient sounds within the vehicle” to produce “vehicle environment sound signal”). See, e.g., Mohan:

- **Figure 4:**



- **6:15-24:** “The memory 426 stores a vehicle environment sound signal 434. The input sources 418 and 420 may provide the **vehicle environment sound signal 434** in analog or digital form. As examples, **the input sources 418 and 420 may include microphones or microphone arrays, and may sample the ambient sounds within the vehicle.** The processor 424 or other sampling logic may convert an analog sound

signal to digital form and store the samples in the memory 426 as the vehicle environment sound signal 434.”

- 7:48-8:26: “FIG. 5 shows processing flow 500 for the system 400. The siren processing program 436 ***samples the vehicle environmental sound using, for example, a microphone in the vehicle compartment*** (502).”

273. See my discussion in element [6.pre] (Section IX.D.3.a).

274. Mohan discloses “microphones . . . in the vehicle compartment” that provide a “vehicle environment sound signal” by “sampl[ing] the ambient sounds within the vehicle.” Mohan, 6:15-24, 7:48-8:26.

(d) Element [6.c]

275. **Element [6.c] recites “an external microphone configured to measure a vehicle equipment signal.”** This element is met by Mohan in view of Bergholz.

276. Bergholz discloses an external microphone (*e.g.*, “microphones 1 . . . attached to the outside of the vehicle”) configured to measure a vehicle equipment signal (*e.g.*, “pick up acoustic signals outside the vehicle,” such as “squealing tires, the sound of a flat tire, engine or exhaust defects”).

277. See my discussion in element [6.c] (Section IX.B.3.o).

278. As I discussed in element [6.c] (Section IX.B.3.o), Bergholz discloses “microphones” that “pick up acoustic signals outside the vehicle” to “detect abnormal driving noises” and “vehicle malfunctions,” including “squealing tires, the

sound of a flat tire, engine or exhaust defects.” Bergholz, 3:19-36, 7:49-54. Moreover, Bergholz discloses the “microphones” are “attached to the outside of the vehicle.” Bergholz, 3:19-36.

279. As I discussed in Section IX.D.2, a person of ordinary skill in the art would have been motivated to apply Bergholz’s teachings of detecting vehicle malfunctions in implementing Mohan’s system.

(e) Element [6.d]

280. **Element [6.d] recites “a processor.”** This element is met by Mohan.

281. Mohan discloses a processor (*e.g.*, “processor 424” executing “siren processing program 436”). *See, e.g.*, Mohan:

- **Figure 4:**

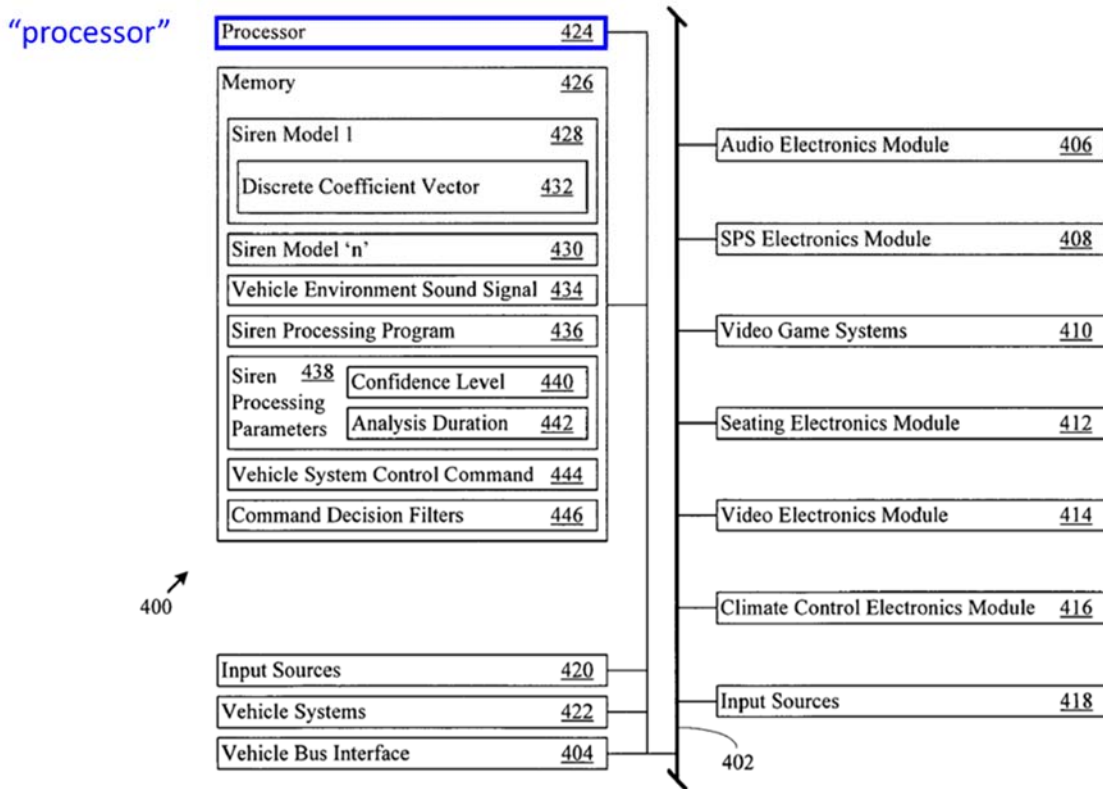


Figure 4

- **6:7-14:** “The dynamic siren detection and notification system 400 includes **a processor 424 connected to a memory 426**. The memory 426 stores one or more siren models, such as the siren model 428 and the siren model 430. The siren model 428 encodes a siren waveform in a discrete coefficient vector 432, however, other siren waveform representations may be employed additionally or alternatively.”
- **6:25-50:** “**The siren processing program 436 analyzes the vehicle environment sound signal 434 against the siren models 428-430.** In that regard, the siren processing program 436 may operate according to siren processing parameters 438”

282. Mohan discloses “a processor 424 connected to a memory 426” that executes a “siren processing program 436” to “analyze[] [a] vehicle environment sound signal 434 against the siren models 428-430.” Mohan, 6:7-14, 6:25-50.

(f) Element [6.d.i]

283. Element [6.d.i] recites “**determine an internal sound pressure level (SPL) in the vehicle based on the internal acoustic signal.**” This element is met by Mohan.

284. Mohan discloses a processor (see element [6.d]) configured to determine an internal sound pressure level (SPL) (e.g., “current ambient noise level”) in the vehicle based on the internal acoustic signal (e.g., “the ambient sounds within the vehicle”). See, e.g., Mohan:

- 7:24-31: “*The siren processing program 436 may also exercise control over whether or not to send a vehicle system control command. To that end, the siren processing program may employ command decision filters 446 that affect whether or not the siren processing program 436 sends the vehicle system control command.* The command decision filters 446 may take the form of logical tests. Examples of command decision filters 446 are shown below in Table 3.”
- 7:32-47: “High Volume . . . *If the current ambient noise level (e.g., including audio generated by the stereo system) is above a pre-determine threshold*, send multiple commands to multiple systems”
- 7:48-8:26: “*FIG. 5 shows processing flow 500 for the system 400. The siren processing program 436 samples the vehicle environmental sound using, for example, a microphone in the vehicle compartment (502). The siren processing program 436 also reads the siren processing parameters 438 (504). Using the vehicle environment sound signal 434 obtained by sampling the vehicle environment sound, the siren processing program 436 analyzes sounds in the vehicle against the siren models 428-430 (506).* The analysis may proceed in many different manners. In one implementation, the siren processing program correlates time or frequency content present in the vehicle environment sound signal 434 against each siren model 428-430. Other signal comparison

and matching techniques (e.g., spectrogram template matching) may be employed additionally or alternatively. The correlation over time updates a confidence measure (508), such as a degree of correlation between the discrete coefficient vector 432 and the vehicle environment sound signal 434. The analysis and updating of the confidence measure may extend over the analysis duration 442 established by the siren processing parameters 438. If no siren is detected the siren processing program 436 continues to sample the vehicle environmental sound and analyze the sound for sirens.”

285. See my discussion in elements [6.b], [6.d] (Section IX.D.3.c, e).

286. Mohan discloses “siren processing program 436 samples the vehicle environmental sound using, for example, a microphone in the vehicle compartment (502).” Mohan, 7:48-8:26. Mohan further discloses that “siren processing program 436 . . . exercise[s] control over whether or not to send a vehicle system control command” based on “command decision filters.” Mohan, 6:24-31. One exemplary “command decision filter” accounts for “the current ambient noise level” inside the vehicle (including audio “generated by the stereo system”). Mohan, 7:32-47.

287. A person of ordinary skill in the art would have understood that the processor 424 executing the siren processing program 436 determines the “current ambient noise level,” as the program employs the command decision filters to, for example, determine whether or not to send a vehicle system control command to vehicle bus interface 404 based on the determined ambient noise level. Mohan, 6:51-61, 7:23-47.

(g) Element [6.d.ii]

288. **Element [6.d.ii] recites “identify at least one sonic signature from the vehicle equipment signal.”** This element is met by Mohan in view of Bergholz.

289. Mohan discloses a processor (*see* element [6.d], Section IX.D.3.e) configured to identify at least one sonic signature (“siren processing program 436 analyzes the vehicle environment sound signal 434 against the siren models 428-430,” *see* element [6.d] , Section IX.D.3.e / “siren processing program 436 detects a siren,” *see* element [6.a], Section IX.D.3.b).

290. Bergholz discloses the vehicle equipment signal (*see* element [6.c], Section IX.D.3.d).

291. See my discussion in elements [6.a], [6.c]-[6.d] (Section IX.D.3.b, d-e).

292. A person of ordinary skill in the art would have understood, when applying Bergholz’s teachings to Mohan, Mohan’s processor would perform sonic signature detection on the picked up acoustic signals to detect vehicle malfunctions. For example, a person of ordinary skill in the art would have understood that, when applying Bergholz’s teachings to Mohan, Mohan’s processor would be implemented with a sonic signature (e.g., a model) to detect squealing tires and/or a sonic signature to detect a flat tire. As Mohan teaches, such a sonic signature includes the

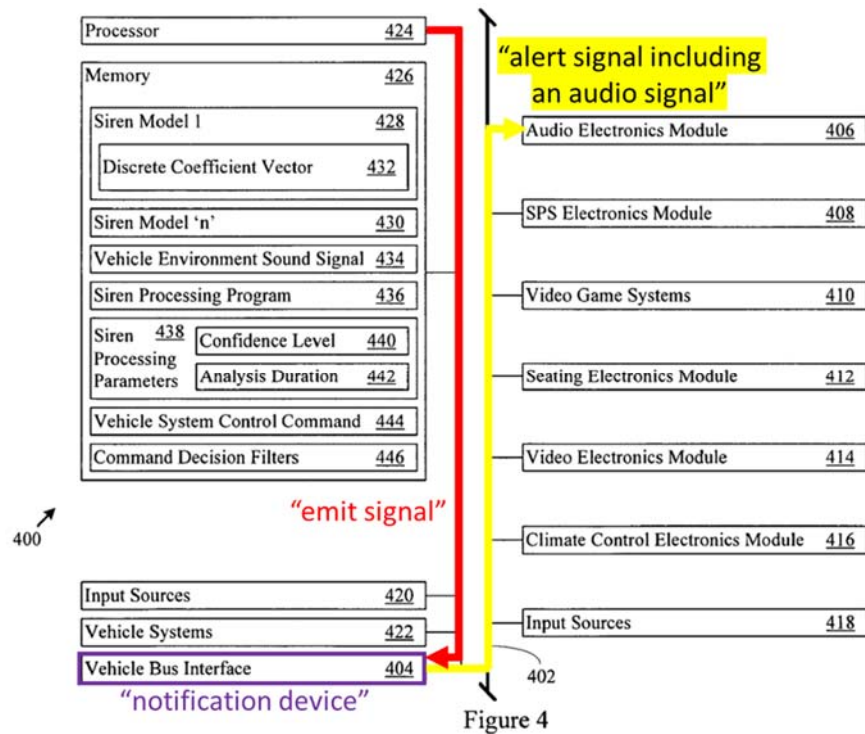
“frequency content” present in the picked up acoustic signal. *See* Mohan 2:54-65, 7:57-62. My explanation above in Section IX.D.2 with respect to why voice commands would be detected using Mohan’s processor when applying Bergholz’s teachings of voice commands to Mohan applies equally to vehicle equipment signals.

(h) Element [6.d.iii]

293. **Element [6.d.iii] recites “when the at least one sonic signature is identified, determine whether to send an emit signal to the notification device to emit the audio signal based on the internal SPL.”** This element is met by Mohan in view of Bergholz.

294. Mohan discloses a processor (*see* element [6.d], Section IX.D.3.e) configured to, when the at least one sonic signature is identified (*e.g.*, “siren processing program 436 detects a siren”), determine (*e.g.*, determine “[i]f the current ambient noise level . . . is above a pre-determine threshold”) whether to send an emit signal (*e.g.*, “vehicle system control command 444”) to the notification device to emit the audio signal (“[a]udible [a]nnouncement,” *see* element [6.a], Section IX.D.3.b) based on the internal SPL (*e.g.*, “current ambient noise level,” *see* element [6.d.i], Section IX.D.3.f). *See, e.g.*, Mohan:

- **Figure 4:**



- 7:32-47: ***“High Volume . . . If the current ambient noise level (e.g., including audio generated by the stereo system) is above a pre-determine threshold, send multiple commands to multiple systems . . .”***
- 8:27-41: “On the other hand, ***if the siren processing program 436 detects a siren***, the siren processing program may then determine whether the confidence measure meets or exceeds the confidence level 440 established in the siren processing parameters 438. If the confidence threshold is met, ***the siren processing program 436 may also apply one or more of the command decision filters 446 (510). If a siren is detected with the requisite confidence level and no command decision filter blocks sending a control command, then the siren processing program 436 may proceed by generating and sending a selected vehicle system control command (510).*** For example, the siren processing program 436 may send a Reduce Volume vehicle system control command to reduce the level of ambient noise in the vehicle cabin, thereby making the siren more noticeable.”

295. See my discussion in elements [6.a], [6.d]-[6.d.ii] (Section IX.D.3.b, e-

f).

296. Mohan discloses that “if the siren processing program 436 detects a siren,” “one or more of the command decision filters” are applied, such as the “High Volume” filter, which “send[s]” “vehicle system control command[s] 444” to the vehicle bus interface 404 “if the current ambient noise level (e.g., including audio generated by the stereo system) is above a pre-determine[d] threshold.” Mohan, 7:32-47, 8:27-41.

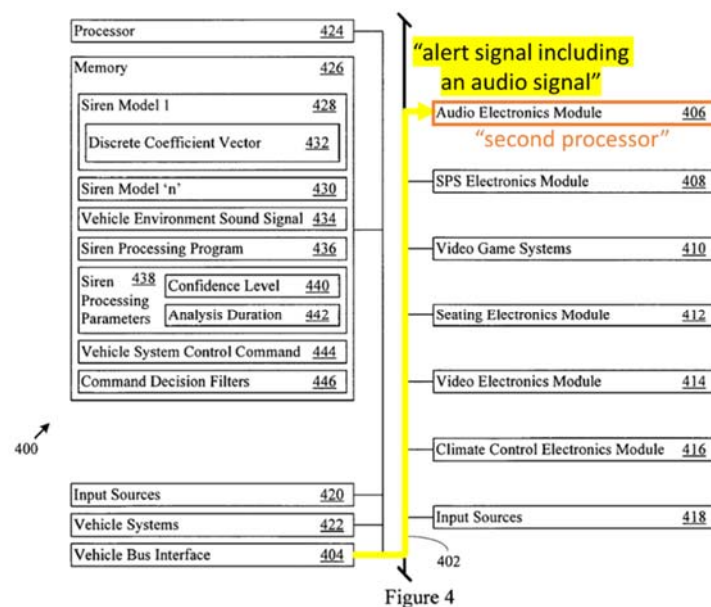
297. Moreover, a person of ordinary skill in the art would have understood, when applying Bergholz’s teachings of detecting vehicle malfunctions to Mohan, the audio warning need only be played if the sound inside the vehicle is above a certain volume. For example, the warning would have been sent from the vehicle bus interface if it was determined that “the current ambient noise level . . . is above a pre-determine[d] threshold.” Mohan, 7:32-47.

(i) Claim 9

298. **Claim 9 recites “The awareness device according to claim 6, where the alert signal is an input to a second processor, the alert signal used by the second processor to affect an operation of the vehicle.”** See my discussion of the elements of claim 6 above (Section IX.D.3.a-h). The added limitation of this claim is met by Mohan in view of Bergholz.

299. Mohan discloses the alert signal (*e.g.*, “bus packets containing vehicle control commands,” see element [6.a], (Section IX.D.3)) is an input to a second processor (*e.g.*, “microprocessor” of the “media access, control, and sound reproduction logic” of “audio electronics module 406”), the alert signal used by the second processor to affect an operation of the vehicle (*e.g.*, play the “specified audio signal”/“[l]ower audio output by a specified amount”). See, *e.g.*, Mohan:

- **Figure 4:**



- 5:47-59: “The **audio electronics module 406** may include media access, control, and sound reproduction logic such as physical media access mechanisms, amplifiers and speakers for a CD player, SACD player, tape player, MP3 player, carphone (*e.g.*, a hands-free car phone system), or other audio device. The SPS electronics module 408 may include a satellite positioning information receiver, location determination logic, location displays, announcement logic (*e.g.*, speakers and audio signal reproduction logic to announce upcoming turns or points of interest), or other SPS processing logic. The video game

systems 410 may include audio/visual reproduction logic and operator inputs for controlling a video game.”

- **7:1-23:** *“Reduce Volume...Lower audio output by a specified amount...may be sent to the audio electronics module...Audible Announcement...[g]enerate a specified audio signal – may be sent to audio electronics module...”*
- **10:58-11:6:** Furthermore, the systems may be implemented with additional, different, or fewer components. As one example, a processor or *any other logic may be implemented with a microprocessor, a microcontroller, a DSP, an application specific integrated circuit (ASIC), program instructions, discrete analog or digital logic, or a combination of other types of circuits or logic*. As another example, memories may be DRAM, SRAM, Flash or any other type of memory. The systems may be distributed among multiple components, such as among multiple processors and memories, optionally including multiple distributed processing systems. Logic, such as programs or circuitry, may be combined or split among multiple programs, distributed across several memories and processors, and may be implemented in or as a function library, such as a dynamic link library (DLL) or other shared library.

300. See my discussion in elements [6.a] and [6.d.iii] (Section IX.D.3.b, h).

301. As I discussed in element [6.a] (Section IX.D.3.b), Mohan discloses bus packets containing vehicle system control commands processed by bus interface 404 that include an “[a]udible [a]nnouncement,” which is emitted to “audio electronics module 406” to “[g]enerate a specified audio signal.” Mohan, 5:9-25, 5:47-59, 6:51-61, 7:1-23.

302. Mohan further discloses that such commands include, e.g., “multiple commands” to audio electronics module 406 to both “[l]ower audio output by a specified amount” and “[g]enerate a specified audio signal.” Mohan, 5:9-25, 6:51-

61, 7:1-23, 7:32-47. Mohan discloses that “audio electronics module 406 . . . include[s] media access, control, and sound reproduction logic,” which is “implemented with a microprocessor” and performs these commands issued by vehicle bus interface 404. Mohan, 5:47-59, 10:58-11:6.

303. A person of ordinary skill in the art would have understood that, when applying Bergholz’s teachings of detecting vehicle malfunctions to Mohan’s notification system, lowering the “audio output by a specified amount” would have allowed the user to better hear the audible announcement and hear the sound causing the vehicle malfunction that prompted the audible announcement. For example, by the audio electronics module lowering the audio output and playing the audible announcement, the driver would have been able to hear the audible announcement regarding the vehicle malfunction, such as an alert “check tires,” and hear the vehicle malfunction itself, such as hearing the squealing or flat tires himself/herself.

(j) Claim 10

304. **Claim 10 recites “The awareness device according to claim 9, where the operation is at least one of shifting gears, decreasing power usage, sending a remote signal, operating a windshield wiper, and changing a headlight illumination.”** See my discussion of claim 9 above (Section IX.D.3.i). The added limitation of this claim is met by Mohan.

305. Mohan discloses decreasing power usage (e.g., “[l]ower[ing] audio output by a specified amount”).

306. See my discussion of claim 9 above (Section IX.D.3.i) regarding Mohan’s disclosure of lowering audio output.

307. A person of ordinary skill in the art would have understood, and at least found it obvious, that lowering audio output would result in less power being needed to drive the speaker, thereby decreasing power usage. For example, as discussed in U.S. Patent Application Publication No. 2008/0117038 (“Stark,” Ex. 1023), “reduc[ing] power consumption of the [audio] system” includes “turning off one or more speakers (e.g., by muting the output of the amplifier, placing the amplifier in standby mode, reducing the voltage of the audio signal input to the amplifier to approximately zero, disconnecting the one or more loudspeakers from the amplifier, removing electrical power from the amplifier); reducing the gain in one or more of the signal paths; controlling the maximum output power level of the audio system (e.g., by dynamically adjusting the gain of a variable gain element as a function of a detected level of an audio signal); or changing one or more other signal processing operations in the first or second system configuration.” Stark, [0011]. Therefore, a person of ordinary skill in the art would have understood, or at least found obvious, that power consumption would be reduced by lowering the audio output of Mohan’s

audio electronics module 406 (by lowering the volume or muting) such that power usage is decreased.

(k) Element [11.pre]

308. **Element [11.pre] recites “A vehicle situation awareness device for a vehicle comprising.”** This element is met by Mohan.

309. See my discussion in element [6.pre] (Section IX.D.3.a).

(l) Element [11.a]

310. **Element [11.a] recites “a notification device in the vehicle configured to emit an alert signal to a first processor, the first processor used to modify an operation of the vehicle responsive to the alert signal.”** This element is met by Mohan.

311. Mohan a notification device (*e.g.*, “vehicle bus interface 404”) in the vehicle configured to emit an alert signal (*e.g.*, “bus packets containing vehicle control commands”) to a first processor (*e.g.*, “microprocessor” of the “media access, control, and sound reproduction logic” of “audio electronics module”), the first processor used to modify an operation of the vehicle responsive to the alert signal (*e.g.*, play the “audible announcement”/“[l]ower audio output by a specified amount”).

312. See my discussion in elements [6.a] and [11.pre] and claim 9 (Section IX.D.3.b, i, k).

(m) Element [11.b]

313. **Element [11.b] recites “an internal microphone configured to measure an interior vehicle acoustic signal in the vehicle.”** This element is met by Mohan.

314. Mohan discloses an internal microphone (*e.g.*, “microphone in the vehicle compartment”) configured to measure an interior vehicle acoustic signal in the vehicle (*e.g.*, “microphones . . . sample the ambient sounds within the vehicle”/“vehicle environment sound signal”).

315. See my discussion in elements [6.b] and [11.pre] (Section IX.D.3.b, c).

(n) Element [11.c]

316. **Element [11.c] recites “an external microphone configured to measure an external vehicle acoustic signal.”** This element is met by Mohan in view of Bergholz.

317. Bergholz discloses an external microphone (*e.g.*, “microphones 1 . . . attached to the outside of the vehicle”) configured to measure an external vehicle acoustic signal (*e.g.*, “pick up acoustic signals outside the vehicle,” such as “squealing tires, the sound of a flat tire, engine or exhaust defects”).

318. See my discussion in element [6.c] (Section IX.D.3.d).

319. As I discussed in Section IX.D.2, a person of ordinary skill in the art would have been motivated to apply Bergholz’s external microphone to Mohan’s system.

(o) Element [11.d]

320. **Element [11.d] recites “a second processor.”** This element is met by Mohan.

321. Mohan discloses a second processor (*e.g.*, “processor 424” executing “siren processing program 436”).

322. See my discussion in element [6.d] (Section IX.D.3.e).

(p) Element [11.d.i]

323. **Element [11.d.i] recites “determine an interior sound pressure level (SPL) in the vehicle based on the interior vehicle acoustic signal.”** This element is met by Mohan.

324. See my discussion in elements [6.d.i] and [11.d] (Section IX.D.3.f, o).

(q) Element [11.d.ii]

325. **Element [11.d.ii] recites “identify at least one sonic signature from at least one of the interior vehicle acoustic signal or the external vehicle acoustic signal.”** This element is met by Mohan in view of Bergholz.

326. Mohan discloses a second processor (*see* element [11.d], Section IX.D.3.o) configured to identify at least one sonic signature from the interior vehicle

acoustic signal (*e.g.*, “siren processing program 436 analyzes the vehicle environment sound signal 434 against the siren models 428-430”).

327. See my discussion in elements [6.d]-[6.d.i], [11.b] and [11.d] (Section IX.D.3.e-f, m, o).

328. Bergholz discloses the external vehicle acoustic signal.

329. See my discussion in elements [6.c] (Section IX.B.3.r) and [6.d.ii] and [11.c] (Section IX.D.3.g, n).

(r) Element [11.d.iii]

330. **Element [11.d.iii] recites “when the at least one sonic signature is identified, determine whether to send an emit signal to the notification device to emit the alert signal based on the interior SPL.”** This element is met by Mohan in view of Bergholz.

331. Mohan discloses a processor (*see* element [11.d], Section IX.D.3.o) configured to, when the at least one sonic signature is identified (*e.g.*, “siren processing program 436 detects a siren”), determining (*e.g.*, determining “[i]f the current ambient noise level . . . is above a pre-determine threshold”) whether to send an emit signal (*e.g.*, “vehicle system control command 444”) to the notification device to emit the alert signal (“bus packets containing vehicle control commands”)

based on the interior SPL (e.g., “current ambient noise level,” [6.d.iii], [11.d.i], Section IX.D.3.h, p).

332. See my discussion in elements [6.d.iii], [11.a], [11.d]-[11.d.ii] (Section IX.D.3.h, l, o-p).

(s) Claim 12

333. **Claim 12 recites “The awareness device according to claim 11, where the at least one sonic signature is a vocal command.”** See my discussion of the elements of claim 11 above (Section IX.D.3.k-r). The added limitation of this claim is met by Mohan in view of Bergholz.

334. Bergholz discloses where the at least one sonic signature is a vocal command (e.g., (“human command words”/“personal code words”). See, e.g., Bergholz:

- **4:35-46:** “In addition, the embodiment of the invention shown in Fig. 1 and Fig. 2 comprises a voice input device 14. The voice input device 14 can be used to specify patterns in the broadest sense, with which the classification features of the digitized signal are compared. In particular, ***the voice input device 14 can be used to store command or key words, the repetition of which, for example by the driver, causes a previously defined function to be executed by the detection system.*** Special sounds can be stored in this manner as well, however, and can, for example, be assigned to a malfunction of a component of the vehicle.”
- **7:41-48:** “In a further preferred embodiment of the invention, the ***detection system can also be used for voice control purposes, i.e., human command words (calls for help, stop, code words) can be programmed into the system and used to trigger a command:*** (1) and (2) Execution of the command (such as “STOP”), but also a response to

defined, possibly *personal code words (e.g., to open the door, deactivate the anti-theft device and/or the immobilizer) . . .*”

335. See my discussion in elements [11.d.ii]-[11.d.iii] (Section IX.D.3.q-r).

336. Bergholz discloses the “detection system” is “used for voice control purposes, i.e., human command words” and “personal code words” that are “programmed into the system” using “voice input device 14” to “trigger a command.” Bergholz, 4:35-46, 7:41-48. Such “command[s]” include “calls for help, stop,” “open the door,” or “deactivate the anti-theft device and/or the immobilizer.” Bergholz, 7:41-48.

337. As I discussed in Section IX.B.2, a person of ordinary skill in the art would have been motivated to apply Bergholz’s teachings of voice command recognition in implementing Mohan’s notification system.

(t) Claim 13

338. **Claim 13 recites “The awareness device according to claim 12, where the alert signal uniquely corresponds to the voice command.”** See my discussion of claim 12 above (Section IX.D.3.s). The added limitation of this claim is met by Mohan in view of Bergholz.

339. Mohan discloses where the alert signal (*e.g.*, “bus packets containing vehicle control commands” see element [11.a], Section IX.D.3.l) uniquely

corresponds to an audio signal (*e.g.*, “[l]ower audio output by a specified amount” / “[d]isable audio output,” *see* element [11.a], Section IX.D.3.l).

340. See my discussion in element [11.a] (Section IX.D.3.b).

341. Bergholz discloses the voice command (“human command words”/“personal code words”).

342. See my discussion in claim 12 (Section IX.D.3.s).

343. In addition, a person of ordinary skill in the art would have recognized, when applying Bergholz’s teachings of voice commands in implementing Mohan’s notification system, Mohan’s vehicle system control commands 444 would uniquely correspond to the voice commands. For example, upon recognition of the voice command “reduce volume,” Mohan’s system would send a command from the bus interface 404 to the audio electronics module to “[l]ower audio output by a specified amount, to a specified amount, or to no greater than a specified amount.” Mohan, 7:1-23. As another example, upon recognition of the voice command “mute,” Mohan’s system would send a command from the bus interface 404 to the audio electronics module to “[d]isable audio output.” Mohan, 7:1-23

344. As I discussed in Sections IX.B.2 and IX.D.3.s, a person of ordinary skill in the art would have been motivated to apply Bergholz’s teachings of voice command recognition in implementing Mohan’s notification system.

(u) Claim 14

345. **Claim 14 recites “The awareness device according to claim 11, where the operation includes one of at least opening a door, opening a trunk, opening a gas tank access panel, opening the hood, turning on headlights, turning on an audio alarm, and beginning an audio recording.”** See my discussion of the elements of claim 11 above (Section IX.D.3.k-r). The added limitation of this claim is met by Mohan in view of Bergholz.

346. Mohan discloses turning on an audio alarm (*e.g.*, “notification logic” to play an “alarm”).

347. See my discussion in element [11.a] (Section IX.D.3.l).

348. Mohan discloses that, upon detection of a siren, the driver is notified by an “alarm.” Mohan, 3:8-13 (“[T]he processing logic 104 may issue a siren detection notification using the notification logic 108. The notification logic 108 may be an indicator light, tone or alarm . . .”).

X. SECONDARY CONSIDERATIONS

349. I have seen no evidence in the ’620 patent’s prosecution history or elsewhere supporting any secondary considerations arguments, or evidence of nexus to any of the Challenged Claims. *See generally* ’620 File History. Indeed, per my discussion of the prior art referenced herein, any purported solutions to problems or unexpected results in the ’620 patent were already well known. To the extent ST

CasesTech, LLC asserts the existence of any secondary considerations in its responses, I reserve my right to address any such evidence.

XI. CONCLUSION

350. In summary, I have concluded that the Challenged Claims are rendered obvious over the prior art references as discussed above. Specifically, in my opinion, for at least the reasons above, the Challenged Claims of the '620 patent are disclosed and rendered obvious as follows.

Ground	Claims	Prior Art References
1	1-4 and 15	Kim in view of Kobayashi
2	1-4, 6-8, and 15	Kim in view of Bergholz
3-4	5	Grounds 1-2 further in view of Hermann
5	6 and 9-14	Mohan in view of Bergholz

351. To the extent it is argued that any further disclosure is required for an element in the Challenged Claims that I have identified as being disclosed, a person of ordinary skill in the art would certainly have found that element obvious to include based on the sample explicit disclosure or inherent disclosures and analysis I have identified above.

352. I reserve the right to supplement my opinions in the future to respond to any arguments that Patent Owner or its expert(s) may raise and to take into account new information as it becomes available to me.

353. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

354. I reserve the right to supplement my opinions in the future to respond to any arguments that Patent Owner or its expert(s) may raise and to take into account new information as it becomes available to me.

355. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further 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.

Executed this 2nd day of September 2024, in Bend, Oregon.

Respectfully submitted,

A handwritten signature in cursive script, appearing to read "Sayfe Kiaei".

Sayfe Kiaei, Ph.D.

APPENDIX A

Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

Sayfe Kiaei

Professor, Motorola Endowed Chair Professor

School of Electrical, Computer and Energy Engineering, Arizona State University, Tempe, AZ

FIELDS OF SPECIALIZATION

- **Integrated Circuits (IC), Radio Frequency**, Analog & Digital IC, Mixed-Signal IC, VLSI, Processor, ASIC, RFIC, Receiver, Transmitter, Synthesizer, RF system, VLSI, Processor, DSP processor
- **Power Management**: Power Management IC, Battery Management, Energy System, Energy Management, Solar Energy
- **Sensors & Bioelectronics**: RFID, ZIGBEE, Bluetooth, Biosensors, Hearing Aid sensors, Implanted devices electronics, Medical Implanted Communication System (MICS)
- **Signal Processing**: Digital Signal Processing, Adaptive Signal Processing, Video & Audio and acoustic Signal Processing, Adaptive Audio and acoustic Array processing, Audio and acoustic and Acoustic & Speech processing.
- **Communication Systems**: 1G-5G, 2-way radio, BT, WIFI, Sensors, ZIGBEE, wireless sensors, CABLE, DSL, Optical

DEGREES

- **Ph.D.**, Electrical and Computer Engineering, Washington State University, 1987
- **M.S.**, Electrical and Computer Engineering, Washington State University, 1984
- **B.S.E.E.**, Electrical Engineering, Northeastern University, Washington State University, 1982

ACADEMIC POSITIONS

Fall 2001-Present: Professor, Motorola Endowed Chair Professor in Analog and RFIC School of Electrical, Computer and Energy Engineering, Arizona State University, Tempe, AZ

- **Research Projects:**
 - Integrated Circuits: Analog and digital IC, Radio Frequency IC, RF transceiver, VLSI, Processor System Architecture, ASIC
 - Power Management IC, Battery Management & Sensing, Integrated Power Electronics
 - Sensors, Bioelectronics, Biosensors, Hearing Aid Electronics, Implanted devices electronics
 - Digital Signal Processing, Audio and acoustic processing, adaptive signal processing, Array processing, Adaptive Audio and acoustic Array processing, Audio and Acoustic & Speech processing,
 - Communication system, 1G, 2G GSM, 3G (UMTA, WBCDMA), 4G LTE, 5G, wireless mobile system, LTE, WiFi, Bluetooth, Wireless system standards, MODEM standards, CABLE MODEM DOCSIS, DSL
- Research Funded by NSF, USAID, DARPA, JPL, NASA, Motorola Inc., Intel Inc., Broadcom, Qualcomm, Raytheon, General Dynamics, Texas Instruments, and over 10 other industries.

Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

2004-2020, Director and founder of NSF IUCRC Center Connection One, School of Electrical, Computer, and Energy Engineering, Arizona State University, Tempe, AZ; <https://connectionone.org>

- The NSF Connection One Industry/University Cooperative Research Center was established the center in 2002 with focus on communication system, integrated Circuits and Systems, wireless system, RF, sensors, and related areas. The center has five university member with over 30 industrial members. Total funding over \$10M.

2021-Present, Director and PI, USAID, Center of Excellence for Energy (COE) in Egypt , Funding \$22.5M

- Director and PI: COE - Energy Center funded by the USAID.
 - USIAD Centers of Excellence for Energy (COE) - established the Center of Excellence for Energy (COE/E) in Egypt with funding and support from the United States Agency for International Development (USAID/Egypt) in November 2021. COE/E is a partnership between ASU-US and three Egyptian partner universities (EPUs): Ain Shams University (ASU-EG), Aswan University (AU), and Mansoura University (MU).

2014-2020, Director, USAID, US-PCASE: Center for Advance Studies in Energy, Funding \$18M.
<https://uspcase.asu.edu/>

- **Director and PI:** PCASE - Partnership Center for Energy systems, Energy Center funded by the USAID.
- USIAD Centers for Advanced Studies in Energy program (USPCAS-E) is a partnership between Arizona State University and two leading Pakistani universities: the National University of Science and Technology (NUST) Islamabad and the University of Engineering and Technology in Peshawar (UET).
- PCASE has developed two new Graduate schools of Energy. Within 5 years, the center has over 1000 MS and PHD Students, with 14 new energy degrees in MS and PhD, two new building with 20+ energy labs in the power system, grid, power electronics, renewable energy, PV, Wind, Hydro, bio-fuel, fuel cell, batteries and storage, and thermal areas.

2008-2012: Associate Dean of Research, Ira A. Fulton Schools of Engineering, Arizona State University

Responsible for leading the research infrastructure, promoting and developing research programs with industry and federal agencies, leading large multi-university proposals, investing and providing seed funding to foster new research areas, and promoting graduate program in the college of engineering. Research Enterprise support included:

- Increase College of Engineering research funding from \$50M to over \$80M.
- Working with Vice President for Research, Dean's, and directors on University-wide research initiatives.
- Established the first NSF Engineering Research Center (ERC) at the ASU on Solar Energy QESST. Managed, organized and planned the ERC proposal process. ASU is the lead school partnering with MIT, Georgia Tech, U of Delaware, Cal-Tech, U of New Mexico, and UA.
- Lead several trans-disciplinary 4M research projects (4M: multi-million, multi-investigator, multi-disciplinary, multi-university grants) in energy, security, and related initiatives.
- Oversight of over 20 existing research centers in the college of Engineering.
- Engage with industry and federal government to establish new research collaborations.
- Organized workshops and supported proposals for NSF, NIH, DOE, DOD, DARPA, etc.
- Organized workshops for new assistant professors to apply for NSF CAREER Awards. ASU CAREER awards grew from 3 annual awards in 2008 to over 15 CAREER awards by 2012.

Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

- Research Administration and pre-award proposal administration for the schools. Developed a decentralized research administration and advancement team for the Schools supporting 5 schools, 12 departments, over 220 engineering faculty, with funding over \$70M.
- Annual budget over \$7M for supporting research centers, seed funding for new center, cost sharing, proposal support, equipment and infrastructure support, graduate scholarships, and research administration.
- ADR Staffs included, Director of industrial and government liaison, Director of research administration, and 14 research advancement staff.
- Graduate Programs: Recruiting, Fellowships, marketing, outreach, coordination with departments

1997-2001, Adjunct Professor, Electrical and Computer Engineering Dept., The University of Texas, Austin, Texas, Taught graduate courses at UT Austin on Introduction to Telecommunication System and Digital Communications. Co-advised two Ph.D. program committees in IC design and Telecomm (while at Motorola)

1987-1993, NSF Center For Digital / Analog IC (CDADIC) Co-Director, NSF IUCRC Center director at Oregon State University. The CDADIC was established the center in 1987 with focus on integrated circuits at WSU, UW, and OSU with over 20 industrial members - <https://cdadic.oregonstate.edu/>

1987-1993, Assistant / Associate Professor (Tenured) Electrical and Computer Engineering Department, Oregon State University, Corvallis, OR

- Research and classes in Electronics, DSP, Communication system and networks, Wireless systems, MODEMS. Graduated 30 MS and Ph.D. students.
- Faculty Chair, Computer Engineering Program, Developed a new Computer Engineering Program at OSU in 1987

INDUSTRIAL POSITIONS

1993-2001: Motorola Inc., Senior Member of Technical Staff, Personal Communication Sector, Austin, Texas - Worked projects related to wireless communications, two-way push-to-talk radios, wireless networks, ADSL and MODEM RF, and related areas.

- **Motorola Cellular Division, Wireless Technology Center (WITC), 1997-2002.** Responsible for development of integrated circuits and systems for wireless handset. Lead number of projects including cellular (2G, 3G, 4G), wireless connectivity (Bluetooth and WIFI transceiver), GPS and location Receiver, wireless networks, 2-way radios and related areas. Worked on the development of various subcomponents including system design, link budget, RF front-end, RF receiver, RF transmitter, digital audio and acoustic processing, audio and acoustic processing, DSP, frequency synthesizer, ADC, DAC, filtering, analog front-end, power management, battery management, and baseband processor, baseband circuits and systems.
- **Motorola Semi-conductor products sector (SPS), Broadband Products Operations, 1995-1997,** Worked on the development of XDSL (ADSL, VDSL, G.lite), MODEM, and Optical broadband communication systems including OFDM, modulation, synchronization, equalization and the development of a single chip ADSL transceiver (*CopperGold[™]*). The transceiver contained Analog Front End (A/D, D/A, Hybrid), custom DSP, baseband processor, DMT, modulation/demodulation, FFT, IFFT, echo canceler, time

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Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

domain equalizer, front-end constellation mapping, Trellis code modulation, Viterbi decoder), audio and acoustic processing, DSP, signal processing, and an on-chip DSP core.

- **Land Mobile Products Sector LMPS 1993-1995**, Responsible for Wireless digital two-way radios, developed RFIC, RF receiver, RF transmitter, digital audio and acoustic processing, audio and acoustic custom IC, DSP, frequency synthesizer, ADC, DAC, hot spot wireless network, next generation of digital two-way radios, *"Talk about Radios"*, Japanese cellular systems (PHS).
- **Standards**, Represented Motorola in various standards including 2G-4G, GPS, Bluetooth working group, WiFi, 802.11, and DSL standards including T1E1, International Telecommunication Unit (ITU), T1E1, ETSI, 3GPPP, Universal ADSL Working Group (UAWG), Bluetooth working group, G.Lite working group, etc.
- **University relations**, Responsible for the development of collaborative research programs with several universities. Responsible for funding research in the areas of Wireless Transceiver IC Design, RF, and mixed-signal and baseband system architecture.

1985-87: Member of Research Staff, Boeing Co., Bellevue, Wa, Flight Systems Research and Technology Center, summer. Design Engineer, Hardware and CAD tool development for system control.

AWARDS

- IEEE Fellow 2004-Present
- IEEE Fellows CAS Committee Chair, 2009-2012
- Global Standards Award, For contributions in the International Telecommunication Unit (ITU) for Asymmetric Digital Subscriber Line (ADSL) G.Lite Standards. Motorola Inc., 1999.
- 10X Cycle Reduction Award, for development of new IC design process from DSP algorithm to IC layout, Motorola Inc., 1995.
- IEEE Darlington best paper Award, IEEE Circuits and Systems Society Best Paper Award, 1995. For "Characterization and Comparison of CMOS FSCL Circuits with Conventional CMOS for mixed-signal ICs," Published at: *IEEE Trans. on Circuits and Systems II*, Sept. 93.
- Carter Best Teaching Award, College of Engineering Best Teacher Award, Oregon State University, 1992. For "outstanding and inspirational teaching in the College of Engineering". Award is selected by the confidential vote of all of the undergraduate students in the College of Engineering among over 125 professors in the College.
- Industrial University Fellowship (IUF) Award, National Science Foundation, 1993.
- Research Initiation Award, National Science Foundation, 1990-93.
- Outstanding Graduate Student Scholarship, Azur-Data Inc. WSU, 1984

RESEARCH PROJECTS

Partial list of Research Awards (1987-Present):

Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

- **2021-2026 – COE – Center of Excellence for Energy, U.S. Agency for International Development (USAID)**
 - PI and Director, \$22.5M.
- **2020-2022 - Center for Next Generation Wireless Spectrum Sharing (5-6G Spectral sharing) The National Science Foundation (NSF)**
 - SII Planning, PI, \$300K.
- **2002-2020 – Industry/University Cooperative Research Center (IUCRC), The National Science Foundation (NSF) - Connection One**
 - NSF contribution \$1.5M.
 - Annual Industry Contribution: Total over \$7M.
- **2015-2016 – Integration of Smart Dynamic Optical Communication, The National Science Foundation (NSF)**
 - Integration of Smart Dynamic Optical Communication Networks for Intelligent Distribution of Power Workload and Data in Disaster, \$200K
- **2015-2020 – U.S. Agency for International Development (USAID)**
 - PCASE – Center for Energy systems, PI and Director, \$18M.
- **2013-2014 Arizona Space Grant Consortium, NASA**
 - Goddard Space Flight Center, RADHARD electronics, \$200K
- **2012-2015 – Solar Energy, Private Donor**
 - Solar Energy Development on international projects, \$2M
- **2011-2014 – Self-Characterization for Calibration MEMS Sensors, Semi-Conductor Research Corporation**
 - Self-Characterization for Calibration and Process Feedback of MEMS Devices, bio-sensor , \$300K
- **2011-2013 - Bio-Sensors for Vital Signs Monitoring Device Design, The National Science Foundation (NSF)**
 - Remote wireless Bio-Sensors for Vital Signs Monitoring Device Design, \$250K
- **2010-2011 – Adaptive Compensation of Analog circuits, The National Science Foundation**
 - Adaptive Compensation of Analog circuits imperfections using DSP methods, \$150K,
- **2010-2011 – Adaptive Self-Healing Wireless Sensor, The National Science Foundation**
 - Autonomous Self-Healing Sensor Network Radio and Mixed-Signal Readout System Design National Science Foundation (NSF), \$300K
- **2010-2020 – Solar Testbed, The National Science Foundation (NSF), \$45M (**
 - QESST NSF ERC Center on Solar Energy, Testbed Director
- **2010-2015 – REU, undergraduate research projects, The National Science Foundation (NSF)**
 - Research Experience for Undergraduate Students, projects: adaptive audio and acoustic, Glucose Amp-meter and impedance meter, total \$400K

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Arizona State University, Tempe, AZ 85287
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- **2008-2013 - Solar System, The Science Foundation of Arizona (SFAZ)**
 - PEPER- Photovoltaic Environmental Performance and Reliability for the Arizona-Wide Electric Grid, \$1.2M.
- **2008-2009 - Medically implanted bio-sensor, The National Science Foundation (NSF)**
 - Medically implanted bio-sensor, wireless implanted bio-sensors, Wireless Glucose sensors, MICS, \$200K
- **2007-2011 – MEMS implanted hearing aid and bio-sensors, The National Science Foundation (NSF)**
 - Micro-Power Multi-Phase on-chip MEMS Hearing Aid, Adaptive hearing aid audio processor, 2007-2011, \$500K.
- **2007-2009 – Implantable Bio-Sensors, The National Science Foundation (NSF)**
 - High Efficiency Power Delivery and Front-End Module Design for Implantable Bio-Sensors \$480K
- **2005-2009 - MIMO Wireless network, The National Science Foundation (NSF)**
 - Cognitive MIMO Communications for Dynamic-Spectrum Wireless Networks \$150K
- **2005-2009 - Radio Network, The National Science Foundation (NSF)**
 - Autonomous Self-Healing Sensor Network Radio, , \$250K
- **2005-2008 Integrated LiDAR on a chip, BAE Systems**
 - Integrated on-chip Time Measurement Circuits LiDAR; \$650K
- **2005-2008 – Power Management Circuits, Freescale Semiconductor**
 - PWM, Battery & Power management, \$150K
- **2005-2006 – RADHARD Electronics, DOD: Defense Advanced Research Projects Agency (DARPA)**
 - Radhard by Design - MRC/DARPA, Total funding \$1.5M
- **2005-2010 - Wireless Integrated Nano Technology Center, State of Arizona**
 - WINTECH- Wireless Integrated Nano Technology Center Support, 450K annually, total \$2.5M
- **2004-2005 – RFIC, NASA**
 - Integration of Ultra-Low power RF CMOS, \$127K
- **2004-2008 – Implanted Neural-Enabled Prostheses bio-sensor, Deference Advance Research Project Agency (DARPA)**
 - Implanted Neural-Enabled Prostheses biosensor with Sensorimotor Integration, \$500K
- **2004-2008 – NEMS RF Filters, Deference Advance Research Project Agency (DARPA)**
 - Nano-Mechanical RF Band pass resonator for 2GHZ RF Applications, with JPL, \$2.2 M,
- **2003-2005 - Imllanted Neuro-Sensor, DOD-ARMY-ARL: Army Research Office (ARO)**
 - Implanted Neuro-sensor, \$175K
- **2002-2005 – RFIC, WiFi, Intel Corporation**
 - Design of Multi-Standard RF Front-End Circuits for Cellular and WiFi, \$300K

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- **2002 – Geo-location, GPS, SRC**
 - LOW POWER ULTRA - WIDE BAND GEOLACTION SYSTEMS, \$65K.
- **2001-2003 – UWB, WIFI, SRC (Semi-conductors research Corp)**
 - Ultra-Wideband Transceivers for cellular and WiFi 802.11, \$225K
- **1987-1993 - Design of Analog/Digital IC's, The National Science Foundation**
 - Center for the Design of Analog/Digital IC's (CDADIC) 1987-1995, At Oregon State, \$1.5M
- **1992-1994 – RFIC, Motorola Land Mobile Products Sector, LMPS**
 - Low Power IF processing for Direct Digital Transceivers, \$100K,
- **1993 – Mixed-Signal IC, Hewlett-Packard**
 - Hewlett-Packard Faculty Chair position in Mixed-Signal IC, HP, \$500K
- **1992-1993 - Faculty industry Fellowships, The National Science Foundation**
 - National Science Foundation, Motorola Inc. Faculty Industry Fellowship, \$250K,
- **1992-1993 - Research Initiation Award (RIA) , The National Science Foundation**
 - National Science Foundation, Research Initiation Award (RIA) (same as current CAREER Award), Synthesis and Automatic Derivation of Multi-Rate VLSI Arrays for DSP Algorithms, \$320K.
- **1988-1992 – Center for the Design of Analog/Digital IC's (CDADIC)**
 - CDADIC, various projects on Low-Noise Source Coupled Logic (SCL), Mixed-Mode IC's, CDADIC \$350K.
- **1988- Spectrum and time analyzers, Tektronix Inc.**
 - Decimation Filters for A/D Noise Enhancements, Tektronix, Inc., \$100K,
- **1987-1993 – DARPA, MOSIS, Tektronix, IT, Motorola**
 - Various grants for IC Fabrication (DARPA/MOSIS, VLSI)
 - Testing equipment (Tek, HP)
 - DSP system development (TI, Motorola)

PROFESSIONAL RECOGNITION

- IEEE Fellow, 2004-Present
- IEEE Fellow Committee Chair, CAS, 2008-2010
- IEEE Fellow Committee member, 2007-2010.
- IEEE Senior Member, 1993-Present, IEEE Member 1987-1992.
- IEEE Faculty Advisor, Oregon State University, 1987-1990

IEEE Editorials

- IEEE Microwave Magazine, Editor,

Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

- IEEE System Journal, Associate Editor, 2010-2011.
- IEEE Transactions on VLSI, Associate Editor, Jan 2001-2008.
- IEEE Communication Magazine, Editor, Feature Issues on “Circuits for Wireless and Wireline Communications,” April 1999.
- IEEE Transactions on Microwave Theory and Techniques, editor, Special Issue on: "Radio Frequency IC Design," Dec. 1998.
- IEEE Transactions on Circuits and Systems-II, editor, Special Issue on: “Low-Power Wireless Communication Systems,” June 1997.
- Associate Editor, IEEE Transactions on Circuits and Systems-II, 1993-1996.
- *Editor and Reviewer for many IEEE journals and conferences*
- *Founding member of IEEE RF Integrated Circuits Symposium*
- *Associate Editor, IEEE Communications, Tutorial & Surveys Magazine, 2006-2009.*

Conference Organizations

- RFIC Executive Committee members, 2000-2017
- RFIC Steering Committee Member, RFIC symposium, 1996-2017.
- RFIC Founding member, 1995-96.
- Technical Program Chair, IEEE International Sym. on Circuits and Systems, Phoenix, AZ, 2002.
- ISSCC Admin Council, Conferences Committee 2000-2005.
- General Chair, Radio Frequency IC (RFIC) Symposium, Seattle, WA, 2002.
- Technical Program Chair, RFIC Symposium, Phoenix, AZ, 2001.
- Finance Chair, RFIC symposium, Boston, MA, 2000.
- Publicity Chair, RFIC symposium, Los Angeles, CA, 1999.
- Transactions Chair, RFIC symposium, Baltimore, MD, 1998.
- General Chair, Int. Sym. on Low-Power Electronics and Design (ISLPED), Bio-Sensors, Monterey, CA, 97.
- Executive Committee Member, Int. Symp. On Low-Power Electronics and Design, 96-2000.
- Technical Program Committee Member of the following conferences:
 - International Conference on Circuits and Systems: 1996, 2000, 2001, 2004-2008
 - RFIC Symposium, 1996-2018
 - Application Specific Array Processing (ASAP): 2000-2002
 - Technical Program Chair, Int. Sym. on Low-Power Electronics and Design, Monterey, CA, 96.
 - Arizona Telecom Comm (ATIC)
 - GLS VLSI 1998, Lafayette, Louisiana, 1998
 - VLSI Design 98, Chennai, India, Jan. 1998.
 - ICECS, Lisbon, Portugal, 98.

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Sayfe@asu.edu

- Application Specific Array Processing, 1995-97, 2000
- Vehicular Technology Conference, 1995-97.
- Inter. Conf. on Intelligent Information Systems, D.C., 1994-95.
- IEEE Pacific Rim Conference on Communications & Computers, Victoria, BC, Canada, 1991.

Invited talks, Panelist, Session Chairs, Workshop Speaker

- Conference chair, Technical Program committee chair and TPC member, tutorials, workshops, session chair, etc. in RFIC, ISSCC, ISCAS, VLSI, ICASSP, Low-Power Symposium, ICC, Application Specific IC's, IMS, MTT, etc.

CONSULTANT

- Medtronic's, Analog bio-sensors, MICS, 2005.
- Intel Inc. Chandler, AZ, 2002-2006: Development of 3G-4G Wireless transceiver.
- Sony Inc., San Diego, CA and Tokyo, Japan, 2002-2004: Review and development of various telecom cellular system architecture including 3G system architecture, and GPS system.
- Motorola Inc. 2002-2005: Supporting development of BT, WiFi, E911, GPS integrated circuits and systems for the cellular and mobile handsets.
- Hewlett Packard, Corvallis, OR – 1990-1993: Various project on development of custom analog and digital IC's for printer and inkjet system. Some of this work was under consultation, and some under various research grants with Oregon State University.
- Tektronix Inc, Beaverton, OR - 1988-1990: Design and Implementation of Data acquisition system for Spectrum analyzer, development of custom DSP algorithm for the Tektronix spectrum analyzer including system architecture, simulation, analysis, and design of oversampled data acquisition system.
- Boeing Commercial Aircraft, BCAC, Renton, WA - 1985-1987: Development of Airplane Controller Model, Simulation and Implementation of Flight control, Model reduction, and system control.

EXPERT WITNESS (Patent, IP)

Patent litigation, patent validity, infringement, IPR, expert reports, deposition, testimony, and trade secrets at ITC, District court, and USPTO in the following areas (Complete list of cases available):

- **Electronics:** Analog and Digital IC, Radio Frequency Integrated Circuits RFIC, Power Management, Battery Management, PMIC
- **Bioelectronics:** Bi-sensors, Glucose monitoring system, Heart monitoring system, Hearing AID
- **Wireless communication:** 3G, 4G, 5G, OFDM, WiFi, 802.11, Bluetooth, Wireless LAN, Wi-Fi, 802.11, Bluetooth, ZIGBEE, Wireless Standards (ITU, ETSI, 3GPP, LTE) including AMPS, GSM, CDMA, WCDMA, LTE, 1G, 2G, 3G, 4G, BT, WiFi (802.11), Satellite communications, Satellite Transceiver, ECHO and Multi-path cancellation
- **Wireline Communications:** MODEM, Digital Subscriber Line, ADSL, VDSL, MODEM, Wireline standards including DSL, MODEM and DOCSIS, and related standards ITU/ETSI
- **GPS & Location:** GPS system, GPS receiver, location determination

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Sayfe@asu.edu

- **MEMS:** MEMS, Bulk Acoustic Wave Filters, SAW, MEMS resonators, MEMS sensors, MEMS accelerometer
- **Signal processing & Communication:** Audio and acoustic signal processing, Audio & acoustic Array processing, adaptive signal processing, Communication networks, Communication system

PATENTS, PUBLICATIONS

Patents and Patent Applications

ID	title	assignee	inventor/author
AU-2003222007-A8	Oscillator frequency correction in gps signal acquisition	Motorola Inc	Sayfe Kiaei, Thomas M King, George J Geier
WO-03093858-A3	Oscillator frequency correction in gps signal acquisition	Motorola Inc	Thomas M King, George J Geier, Sayfe Kiaei
WO-2004048909-A3	Compressed vector-based spectral analysis method and system for nonlinear rf blocks	Univ Arizona, Shahin Farahani, Sayfe Kiaei, Nazanin Darbianian	Shahin Farahani, Sayfe Kiaei, Nazanin Darbianian
US-2006226909-A1	Monolithic supply-modulated rf power amplifier and dc-dc power converter ic	Siamak Abedinpour, Sayfe Kiaei	Siamak Abedinpour, Sayfe Kiaei
US-7218085-B2	Integrated ZVS synchronous buck DC-DC converter with adaptive control	Arizona Board Of Regents	Siamak Abedinpour, Sayfe Kiaei
US-7372333-B2	Monolithic supply-modulated RF power amplifier and DC-DC power converter IC	Arizona Board Of Regents, Acting For And On Behalf Of Arizona State University	Siamak Abedinpour, Sayfe Kiaei
US-7528754-B1	Finite impulse response digital to analog converter	Arizona Board Of Regents	Bertan Bakaloglu, Sayfe Kiaei, Shahin Taleie
US-2018049703-A1	Wireless in-shoe physical activity monitoring	Timothy W. Markison, Sayfe Kiaei, Gary McCoy	Timothy W. Markison, Sayfe Kiaei, Gary McCoy
US-10264996-B2	Method and apparatus for wirelessly monitoring repetitive bodily movements	Sayfe Kiaei	Sayfe Kiaei
US-2019231226-A1	Method and apparatus for wirelessly monitoring repetitive bodily movements	Sayfe Kiaei	Sayfe Kiaei
US-10653337-B2	Local object detection system	Timothy W. Markison, Sayfe Kiaei, Gary McCoy	Timothy W. Markison, Sayfe Kiaei, Gary McCoy
US-2020266708-A1	Electronic circuit and method of controlling three-level switching converters	Arizona Board Of Regents On Behalf Of Arizona State University	Parisa Mahmoudidaryan, Sayfe Kiaei, Bertan Bakaloglu
US-11108325-B2	Electronic circuit and method of controlling three-level switching converters	Arizona Board Of Regents On Behalf Of Arizona State University	Parisa Mahmoudidaryan, Sayfe Kiaei, Bertan Bakaloglu
US11129547B2	Wireless in-shoe physical activity monitoring	Sigmatasense LLC	Timothy W. Markison, Sayfe Kiaei, Gary McCoy

Standards Contributions

1. “Spectral Compatibility of ADSL: Frequency Overlap vs. FDM,” T1E1, Dec. 97.
2. “Echo Cancellation for G.Lite Universal ADSL,” OFDM, Universal ADSL Working Group, Atlanta, GA, Jan 98.
3. “8-bit QAM Constellation effects on reach for universal ADSL,” OFDM, Universal ADAL Working Group, Atlanta, GA, Jan 98.
4. “Trellis Code Modulation coding gain for OFDM,” Universal ADSL Working Group, Atlanta, GA, Jan 98.
5. “Monte Carlo Modeling and simulation of twisted pair wiring for OFDM,” Universal ADAL Working Group, Atlanta, GA, Jan 98.
6. “Overlap Upstream/Downstream spectral allocation for OFDM ADSL ,” International Telecommunication Unit, Chicago, March 98.
7. “Echo Cancellation for ADSL OFDM,” International Telecommunication Unit, Antwerp, Belgium, 98.
8. “Performance of Echo Cancellation ADSL in OFDM system in the presence of Near End Cross Talk (NEXT),” International Telecommunication Unit, Honolulu, Hawaii, June 98.
9. Presentations and editorials at various XDSL and OFDM standards: ITU, ETSI, UAWG, and T1E1, 97-99.
10. Presentations and editorials at various 3G and 4G and wireless standards including ITU, 3GPPP, 802.11, BT,

Books

“Design, Modeling and Testing of Data Converters, P Carbone, S Kiaei,” F Xu - 2014 – Springer, © Springer-Verlag Berlin Heidelberg 2014

Refereed Journal Papers

Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

1. CMOS Full-Duplex Mixer-First Receiver With Adaptive Self-Interference Cancellation S. -A. Ayati; A. Alizadeh; S. Kiaei, IEEE Transactions on Circuits and Systems I, Jan 2021.
2. A 10-W X-Band Class-F High-Power Amplifier in a 0.25m GaAs pHEMT Technology, A. Alizadeh; M. Yaghoobi; M. Meghdadi; A. Medi; S. Kiaei, IEEE Transactions on Microwave Theory and Techniques, Jan 2021.
3. An X-Band Class-J Power Amplifier With Active Load Modulation to Boost Drain Efficiency A. Alizadeh; S. Hassanzadehyamchi; A. Medi; S. Kiaei, IEEE Transactions on Circuits and Systems I: Sep 2020
4. In-Field Recovery of RF Circuits from Wearout Based Performance Degradation D. Chang; J. N. Kitchen; S. Kiaei; S. Ozev, IEEE Transactions on Emerging Topics in Computing, Jun 2020
5. A 50-V Isolation, 100-MHz, 50-mW Single-Chip Junction Isolated DC-DC Converter With Self-Tuned Maximum Power Transfer Frequency, C. Liu; D. Mandal; Z. Yao; M. Sun; J. Todsén; B. Johnson; S. Kiaei; B. Bakkaloglu, IEEE Transactions on Circuits and Systems II: Express Brief, May 2019
6. Wideband Hybrid Envelope Tracking Modulator With Hysteretic-Controlled Three-Level Switching Converter and Slew-Rate Enhanced Linear Amplifier, P. Mahmoudidaryan; D. Mandal; B. Bakkaloglu; S. Kiaei, IEEE Journal of Solid-State Circuits, 2019.
7. Low-Power/Low-Voltage Integrated CMOS Sense Resistor-Free Analog Power/Current Sensor Compatible With High-Voltage Switching DC-DC Converter, S. Singh; D. Mandal; B. Bakkaloglu; S. Kiaei IEEE Transactions on Circuits and Systems I, 2019
8. Adaptively Biased Output Cap-Less NMOS LDO With 19 ns Settling Time, D. Mandal; C. Desai; B. Bakkaloglu; S. Kiaei, IEEE Transactions on Circuits and Systems II: Express Briefs, 2019
9. Chirag Desai; Debashis Mandal; Bertan Bakkaloglu; Sayfe Kiaei, "A 1.66 mV FOM Output Cap-Less LDO With Current-Reused Dynamic Biasing and 20 ns Settling Time," IEEE Solid-State Circuits Letters Year: 2018, Volume: 1, Issue: 2, Pages: 50-53
10. Debashis Mandal ; Chirag Desai ; Bertan Bakkaloglu ; Sayfe Kiaei, Adaptively Biased Output Cap-Less NMOS LDO with 19 ns Settling-Time;; IEEE Transactions on Circuits and Systems II: Feb 2019
11. Ayati, Mandal, Bakkaloglu, Kiaei, "Integrated Quasi-Circulator With RF Leakage Cancellation for Full-Duplex Wireless Transceivers," IEEE Trans of Microwave theory and techniques, Dec 2017.
12. "A 50-mA 99.2% Peak Current Efficiency, 250-ns Settling Time Digital Low-Dropout Regulator With Transient Enhanced PI Controller", ChaiYong Lim ; Debashis Mandal ; Bertan Bakkaloglu ; Sayfe Kiaei; IEEE Transactions on Very Large Scale Integration (VLSI) Systems; Year: 2017, Volume: 25, Issue: 8; Pages: 2360 - 2370
13. Doohwang Chang; Jennifer N. Kitchen; Sayfe Kiaei; "Sule Ozev, In-field Recovery of RF Circuits from Wearout Based Performance Degradation", IEEE Transactions on Emerging Topics in Computing, 2017.
14. Edgar Martí-Arbona; Debashis Mandal; Bertan Bakkaloglu; Sayfe Kiaei, A High-Voltage-Compliant Current-to-Digital Sensor for DC–DC Converters in Standard CMOS Technology, IEEE Transactions on Power Electronics, 2017, Volume: 32, Issue: 3. Pp. 2180 - 2188
15. Michael Cheah ; Debashis Mandal ; Bertan Bakkaloglu ; Sayfe Kiaei, "A 100-mA, 99.11% Current Efficiency, 2-mVpp Ripple Digitally Controlled LDO With Active Ripple Suppression", Aug 2016.
16. Marti-Arbona, E.; Mandal, D.; Bakkaloglu, B.; Kiaei, S., "A High-Voltage Compliant Current-to-Digital Sensor for DC-DC Converters in Standard CMOS Technology," *IEEE Transactions on Power Electronics*, no. 99, 2016.
17. Chang, D.; Kitchen, J.N.; Bakkaloglu, B.; Kiaei, S.; Ozev, S., "Monitor-Based In-Field Wearout Mitigation for CMOS LC Oscillators," in *IEEE Transactions on Device and Materials Reliability*, vol. 16, no. 2, pp. 183-193, 2016.
18. Chang, D.; Kitchen, J.N.; Bakkaloglu, B.; Kiaei, S.; Ozev, S., "Design-Time Reliability Enhancement Using Hotspot Identification for RF Circuits," in *IEEE transactions on Very Large Scale Integration (VLSI) Systems*, -vol. 24, no. 3, pp. 1179-1183, 2016
19. Seungkee Min; Copani, T.; Kiaei, S.; Bakkaloglu, B., "A 90-nm CMOS 5-GHz Ring-Oscillator PLL With

Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

- Delay-Discriminator-Based Active Phase-Noise Cancellation," *Solid-State Circuits, IEEE Journal of*, vol.48, no.5, pp.1151,1160, May 2013
20. Junghan Lee; Tino Copani; Terry Mayhugh Jr.; Bhaskar Aravind; Sayfe Kiaei; Bertan Bakkaloglu.; , "A 280 mW, 0.07% THD+N class-D audio amplifier using a frequency-domain quantizer," *Analog Integrated Circuits and Signal Processing*, 173-186, 2012.
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Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

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Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

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Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

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Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

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Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

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Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

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Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

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Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

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Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

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Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

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Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

GRADUATE STUDENT ADVISEES & RESEARCH PROJECT

(Partial list of Students graduated, current employment to the best of my knowledge)

1. J. Durgam, VLSI Design of Dynamically Reconfigurable Array Processors, MSEE, 1988. Intel.
2. J. Gilbert, Minimization Techniques for PLAs, MSEE, 1988, Tektronix Inc.
3. L. Luo, CCA Methods for ARMA Spectral Estimation, MSEE, 1989. Berkeley Research Center
4. E. Zahl, Enhancement Methods for A/D Noise Reduction, MSEE, 1989. AT&T
5. L. Aihua, Synthesis of MRAs, MSEE, 1990. Intel.
6. F. Aslam, Image Restoration Methods, MSEE, 1990.
7. S.H. Chee, FSCL Circuits for Mixed-Mode IC's, MSEE, 1990. Linear Tech.
8. C. Dawson, MSEE, 1990. Boeing
9. A. Chow, Source-Coupled Logic ALU, MSEE, 1990. Intel
10. S. Maskai, Decimation Filters Using FSCL Circuits, MSEE, 1991. Intel
11. L. Louis, VLSI Implementation of Toeplitz Matrices, MSEE, 1991.
12. R. Badyal, Bit/Serial VLSI Design of IIR Filters, MSEE, 1992, HP
13. Lap Mui, Piece-Wise Linear Schedule for VLSI Arrays, MSEE, 1992. HP
14. S. Abdennadher, Adaptive Sigma-Delta Modulators, MSEE, 1992. Level One / Intel.
15. H. Bribech, Second Order Adaptive A/D Schemes, MSEE, 1992.
16. B. Hickman, MSEE, 92. Tektronix
17. M. Maleki, Current-Mode Flash A/D, MSEE, 1992. University of Oregon
18. Man Wong, Low-Noise Decimation Filter for Mixed-Mode ICs, MSEE, 1993, Motorola.
19. Anu Krishna Swamy, Low Noise IC Blocks for Mixed-mode IC's, MSEE, 1993, Ph.D., 1997.
20. Manu Srivastava, Comparison of Differential Logic (FSCL, CVSL, DSLL), MSEE, 1994, Intel.
21. Joel Oren, VLSI Design of Asynchronous FIR Filters, MSEE thesis, Feb. 1994. E-Systems.
22. Y. Zheng, VLSI Design and Synthesis of Multi-Rate Arrays, Ph.D. March 94, Hughes Research.
23. Satish Kulkarni, Low-Sensitivity Filters, MSEE, 1995, Motorola.
24. Amit Dutta, Multi-user Interference Cancellation, Ph.D, Dec. 97, Faculty, India.
25. Dwight Poplin, Multiplierless MPEG Decoder, MSEE, 1996. HP.
26. Maxim Scarpa, Adaptive I/Q Miss-match Correction for Direct Conversion Receivers, MSEE 1998.
27. Jeff McNeal, Sigma-Delta Frequency-to-Time Conversion, MSEE, 1998. Level One Comm.
28. Julia Vogel, Adaptive DC offset Cancellation, MSEE, 1998. Faculty in Germany.
29. Takao Inoue, MS, Echo Cancellation for ADSL, 1998. MSEE, The U of Texas at Austin.
30. Navid Lashkarian, Frequency off-set estimation and Synchronization of OFDM systems, Ph.D., June 1999. Broadcom Inc. & Faculty at UC San Jose.

Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

31. Guner Arslan, (co-advisor with B. Evans), "Fast Equalization for DMT systems, with applications to ADSL," Ph.D. The University of Texas at Austin, 2000
32. Salem Abdennadher, I/Q Mismatch Correction for RF Wireless transceivers, Ph.D., Level One Comm/Intel.
33. Can Sandalci, DSL Line Driver, Ph.D., 2001, Intel.
34. Dean Badillo, Low-Cost VCO Ring Oscillators, PhD, 2004, Intel, Chandler,
35. Siamak Abedinpour, PhD, 2005 Freescale, Tempe, Arizona
36. Hemanth Shivalingaiah, Multi-Band Low Noise Amplifiers, Ph.D., 2006, Intel,
37. Shahin Farahani, PhD, 2006, Qualcomm Inc,
38. Nazanin Darbanian, M.S. Freescale, Tempe, Arizona
39. *Joe Rutkowski, Joseph, MS, 2004, Phillips.*
40. *Chaudhuri, Bikram, Synthesizer, MS/PhD, MS 2004.*
41. *Zhang, Jiandong, MEMs, MEMS, December-04*
42. *Afsahi, Ali, MS/PHD, UC San Diego, QUALCOMM, Connection One*
43. *Chen, Xiaomin, UWB, PHD, 2007, SRC/Motorola*
44. *Jali, Hilda, Power Management, MS, June-05,*
45. *Xuejin Wang, RF Optimization, 2006 CAD tools, PhD, Neo-Linear*
46. *Umar Lyles, Power Amplifier, MS, 2006. Texas Instruments*
47. MS, Erika Munoz, RADHARD, 2007, Intel
48. Waleed Khali, (Co-Advisor), Professor at Ohio State
49. Jennifer Kitchen, PhD, 2009, Professor at ASU
50. Shahin Mehdizad Taleie, RFDAC, PhD, 2009, Qualcomm
51. Ilker Deligoz, PHD, 2009, Qualcomm
52. Hyung Kim, PhD, Jan 2010, Intel
53. Jung Le, PhD 2010, Intel, TI
54. Syed Naqvi, PhD, 2012, Intel.
55. Todd Martin, MS, 2011, TI
56. Seungkee Min, PhD, 2011, Intel
57. Ali Meamar, Post Doc, RFIC 2013
58. Hitesh Khunti, MS 2013, Qualcom
59. Debashis Mandal, Post Doc, Research faculty 2015-2018
60. Edgar Martinez, PhD, 2015, Qualcomm
61. Chirag Desai, MS, 2016, Qualcom
62. Sanjay Avasarala, MS, 2016

Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Sayfe@asu.edu

- 63. Li Ming, MS, 2017
- 64. Qirong Peng, MS, 2017,
- 65. Yu Geng, PhD, 2018
- 66. Amir Ayati, PhD Aug 2018; Qualcomm
- 67. Pasisa Mahmoudi, PhD, May 2019, Qualcomm
- 68. Chai Yong, MS: 2015, PHD: 2019, Qualcomm
- 69. Shrikant Singh, MS: 2016, PhD, 2019, Movandi
- 70. Amir Alizadeh, Research Faculty 2019-Present
- 71. Ata S. PhD, 2021, Ata Sarrafinejad, PhD, 2021

UNIVERSITY COMMITTEES

Various Committees at ASU, Oregon State University, etc.

INDUSTRY COMMITTEES

- Arizona Telecommunications and Information Council (ATIC), Board Member
- CAS Fellows Committee (ends December 31, 2006)
- *IEEE CAS Phoenix Chapter Organizers (the committee is in the process of determining new chair – current chair not active)*
- *Executive Committee, RFIC 2006.*
- *Technical Program Comm, IEEE RFIC 2006.*
- *Executive Committee, Conferences, International Solid State System's Conference.*
- *IEEE CAS Society, VLSI Technical Comm. Member*
- *Editorial Board, IEEE Communications Surveys & Tutorials*
- *Radio Frequency Integrated Circuits- RFIC 2006*
- *IEEE RF Integrated Circuits Conference, Committee Chair for two workshops*
- *International Microwave Symposium, IMS-MTT 2006*
- *Int. Symposium on Circuits and Systems - ISCAS 2006*
- *Wireless Networks & Emerging Technologies, WNET06*
- *Midwest Symposium on Circuits and System*
- *Arizona Governor IT Advisory Committee – GITA*
- *Arizona Telecom – ATIC*

INSTRUCTIONAL SUMMARY

- Digital IC Design, Analog IC Design, Advance CMOS Analog IC, VLSI, RFIC Design
- Wireless Transceiver Design, Wireless Communications, GPS, Telecomm Systems, Digital Communication

Dr. Sayfe Kiaei
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287

Sayfe@asu.edu

- Signal Processing, Advance digital signal processing, Communication, Digital Communication, Digital Processing, Adaptive array processing
- Computer Architecture, Microprocessor System Architecture, Pipeline Array Processing

APPENDIX B

Appendix B

List of Materials Considered

Exhibit No.	Description
1001	U.S. Patent No. 8,319,620
1002	File History of U.S. Application No. 12/487,639
1004	Certified Translation of Korean Patent Application Publication No. KR10-2004-0091262
1005	Korean Patent Application Publication No. 10-2004-0091262
1006	Certified Translation of Japanese Patent Publication No. JPH06-325291
1007	Japanese Patent Publication No. JPH06-325291
1008	Certified Translation of German Patent Application Publication No. DE19749372
1009	German Patent Application Publication No. DE19749372
1010	U.S. Patent No. 6,360,187
1011	U.S. Patent No. 7,791,499
1012	U.S. Patent No. 6,150,927
1015	Ito, <i>Visual Distraction While Driving: Trends in Research and Standardization</i> , 25 IATSS Research 20-28 (2001)
1016	U.S. Patent Application Publication No. 2005/0074131
1017	U.S. Patent Application Publication No. 2006/0030987
1018	U.S. Patent Application Publication No. 2003/0138118
1019	MICHAEL H. COHEN, VOICE USER INTERFACE DESIGN (2004)

Exhibit No.	Description
1020	U.S. Patent Application Publication No. 2006/0116175
1021	U.S. Patent No. 6,219,645
1022	U.S. Patent Application Publication No. 2005/0154505
1023	U.S. Patent Application Publication No. 2008/0117038