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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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INTUITION MACHINES, INC., AND CLOUDFLARE, INC.
Petitioners,

v.

HUMAN DIFFERENTIAL INTELLIGENCE, LLC,
Patent Owner.

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Case No. IPR2023-00631
Patent No. 8,752,141

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# DECLARATION OF DANIEL P. LOPRESTI, PH.D.

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I, Daniel P. Lopresti, declare:

## I. INTRODUCTION

1. I have been retained by Finnegan, Henderson, Farabow, Garrett & Dunner, LLP to assess U.S. Patent No. 8,752,141 ("the '141 Patent"). I previously submitted the same opinions presented in this Declaration in IPR2020-1627, where Google LLC filed a Petition for Inter Partes Review also challenging the '141 Patent. I have been asked to specifically focus on claims 1-5 and 7-14 of the '141 Patent (the "Challenged Claims"). I am being compensated for my time at my standard rate of $400.00 per hour, plus actual expenses. My compensation is not dependent in any way upon the outcome of the *inter partes* review of the '141 Patent.

## II. PERSONAL AND PROFESSIONAL BACKGROUND

2. My qualifications for forming the opinions set forth in this declaration are summarized below and explained in more detail in my current curriculum vitae, provided as Exhibit 1003. It also includes a list of my publications and patents.

3. I am a Full Professor in the Department of Computer Science & Engineering ("CSE") at Lehigh University in Bethlehem, PA, and have been since July 2009. From July 2009 through June 2019, I also served as Chair of the CSE Department. In July 2015, I was named Director of the Lehigh Data X strategic

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initiative focused on interdisciplinary data science, a role I held until June 2020. From July 2014 through June 2015, I served as Interim Dean of the P. C. Rossin College of Engineering and Applied Science at Lehigh. From 2003 to 2009, I was an Associate Professor in the CSE Department. The courses that I have taught at Lehigh include big data analytics, artificial intelligence theory and practice, AI for social good, software product management, issues in cybersecurity, data mining, research methods, and operating system design. My research areas include computer security, biometric security, pattern and optical character recognition, document image analysis, machine learning, and electronic voting systems.

4. From December 2002 to June 2003, I held a courtesy appointment as a Visiting Research Scientist at the Palo Alto Research Center, and from February 2003 to June 2003 I also held courtesy appointments as a Research Fellow in the Information Security Institute at Johns Hopkins University, and as a Visiting Research Associate Professor at Rensselaer Polytechnic Institute.

5. From October 1997 to December 2002, I was a Member of Technical Staff at Bell Labs/Lucent Technologies, conducting research in the areas of computer security, document image analysis, optical character recognition, and pen computing, and where I also collaborated with colleagues on the development of text-to-speech ("TTS") technologies. I also worked on audio CAPTCHAs, speech biometrics, and handwriting biometrics.

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6. From June 1991 to October 1997, I was a Principal Scientist at the Matsushita Information Technology Laboratory in Princeton, NJ, conducting research in the areas of optical character recognition, pen computing, document analysis, and document processing systems.

7. From September 1986 to May 1991, I was an Assistant Professor of Computer Science at Brown University in Providence, RI, conducting research in parallel computing and computer-aided design of VLSI. The courses that I taught at Brown included VLSI design, parallel computing, parallel computer architectures, discrete math, and computational molecular biology.

8. From 2009 through 2013, I served as Chair of Technical Committee 11 of the International Association for Pattern Recognition ("IAPR"). Technical Committee 11 is known as the "Reading Systems" committee and its goal is to understand and develop systems that can analyze media containing character symbols and return an encoded representation of the text content and structure. From 2018 through 2021, I served as Treasurer of IAPR, and in 2021, I was elected President of IAPR. In 2022, I transitioned to the role of Past-President. I have served as a member of the IAPR Executive Committee since 2018.

9. Since 2015, I have served as an appointed member on the Council for the Computing Community Consortium ("CCC") of the Computing Research Association ("CRA"). I assumed the role of Vice Chair of CCC effective July

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2020, and the Chair of CCC effective July 2022. CRA counts among its members more than 200 North American organizations active in computing research, including nearly all of the U.S. universities that offer PhDs in computer science or related fields. The role of the CCC is to catalyze the computing research community to pursue high-impact research, conduct activities that strengthen the research community, articulate compelling research visions, and align those visions with key national and global challenges. While on the CCC Council, I have served on, and co-chaired, the Cybersecurity and Cybercrime Task Force, and served on the Roadmap for Artificial Intelligence Research Steering Committee.

10. Since 2014, I have served as an Editor-in-Chief of the International Journal of Document Analysis and Recognition which is a scholarly journal published by Springer-Nature and generally concerns all areas related to document analysis and recognition. This includes research dealing with computer recognition of characters, symbols, text, lines, graphics, images, handwriting, signatures, as well as automatic analyses of the overall physical and logical structures of documents, with the ultimate objective of a high-level understanding of their semantic content. Over a period of more than 20 years, I have served as a technical program co-chair for many of the major international conferences in the fields of document image analysis.

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11. In May 2005, I co-chaired and organized the Second International Workshop on Human Interactive Proofs ("HIPs") at Lehigh University. This workshop brought together top researchers in the area, with proceedings that were published by Springer. HIPs are a similar, overlapping concept to Completely Automatic[ed] Public Turing Tests To Tell Computers And Humans Apart, or "CAPTCHAs," the subject matter of the Challenged Claims. Both HIPs and CAPTCHAs deal with entirely automated systems and methods to determine whether an entity interacting with a computing device is in fact human, or is instead a computer. This concept is also sometimes called a "Reverse Turing Test." This workshop was one of the very few conferences focused specifically on HIPs, CAPTCHAs, and related concepts.

12. I received a B.A. in Mathematics and Engineering Science from Dartmouth College in 1982, an M.S.E. in Electrical Engineering and Computer Science from Princeton University in 1983, an M.A. in Electrical Engineering and Computer Science from Princeton University in 1984, and a Ph.D. in Computer Science from Princeton University in 1987.

13. My areas of expertise encompass the fields of computer security and authentication, biometric security, document image analysis techniques, optical character recognition technology, and electronic voting systems.

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14. I have authored over 150 publications. I am also a named inventor on 24 United States patents, many of which are related to or in the field of document image analysis, and several of which cover audio CAPTCHA technology.

15. I have authored or co-authored several publications involving CAPTCHAs, HIPs, Reverse Turing Tests, and related concepts. These publications include "Leveraging the CAPTCHA Problem," D. Lopresti, *Proceedings of the Second International Workshop on Human Interactive Proofs*, May 2005, Bethlehem, PA, pp.97-110; "A Reverse Turing Test Using Speech," G. Kochanski, D. Lopresti, and C. Shih, *Proceedings of the Seventh International Conference on Spoken Language Processing*, September 2002, Denver, CO, pp.1357-1360 (Ex. 1011); *Human Interactive Proofs*, Lecture Notes in Computer Science Vol. 3517, H. Baird and D. Lopresti (editors), Springer-Verlag, May 2005; "Human Interactive Proofs for Spoken Language Interfaces," D. Lopresti, C. Shih and G. Kochanski, *Proceedings of the Workshop on Human Interactive Proofs*, January 2002, Palo Alto, CA, pp.30-34; and "Human/Machine Differentiation," H. Baird and D. Lopresti, *2005 McGraw-Hill Yearbook of Science and Technology*, pp.144-147. Two of my papers are listed as a prior art publication on the '861 patent. '861 patent at (56) (citing Kochanski, G., Lopresti, D. and Shih, C. "A Reverse Turing Test Using Speech," Seventh International

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Conference on Spoken Language Processing, Sep. 2002; Lopresti, Daniel, "Leveraging CAPTCHA Problem," Presented at the Second International Workshop on Human Proofs, Bethlehem, PA, 2005).

16. I have also received a grant to do research on CAPTCHAs: "Implicit and Multi-Modal CAPTCHAs," Co-Principal Investigator (with H. Baird), Avaya Labs Research, $30,000, 2005-2006. I also received a grant for biometric security: "Using Generative Models to Evaluate and Strengthen Biometrically Enhanced Systems," Co-Principal Investigator (with F. Monrose and M. Reiter), National Science Foundation, $287,950, 2004-2008.

17. I have also taught many courses that covered the basic technical concepts underlying CAPTCHAs, HIPs, Reverse Turing Tests, and related concepts, at both the undergraduate and graduate level, over the course of the past two decades.

18. I have been a member of the Institute of Electrical and Electronics Engineers ("IEEE") since 1982. I became an IEEE Senior Member in 2003. During my career, I have authored or co-authored approximately 20 refereed papers or proceedings that were published in IEEE technical publications.

19. I have also been active in other IEEE activities. For example, I served as program co-chair for the Eleventh International Conference on Document Analysis and Recognition in 2011, whose proceedings were published

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on the IEEE Explore website. I have received two awards from IEEE organizations. I was an Associate Editor of *IEEE Transactions on Pattern Analysis and Machine Intelligence* between 2005 and 2010. I have been a member of conference program committees for several IEEE conferences, I have served as an invited reviewer for a number of different IEEE journals and several IEEE conferences, all as listed in my CV.

20. I am also a member of several other technical associations, and have conducted various activities for them, attended their conferences, and published papers and proceedings in their technical publications. These include the Association for Computing Machinery ("ACM"), the International Association for Pattern Recognition ("IAPR"), the Association for the Advancement of Artificial Intelligence ("AAAI"), and the American Association for the Advancement of Science ("AAAS").

## III. MATERIALS REVIEWED AND CONSIDERED

21. My findings, as explained below, are based on my years of education, research, experience, and background in fields related to computer security and access control, as well as my investigation and study of relevant materials for this declaration. When developing the opinions set forth in this declaration, I assumed the perspective of a person having ordinary skill in the art,

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as set forth in Section V below. In forming my opinions, I have studied and considered the materials identified in the list below.

| Exhibit | Description |
|---|---|
| 1001 | U.S. Patent No. 8,752,141 ("the '141 Patent") |
| 1004 | File History for U.S. Patent No. 8,752,141 ("the '141 FH") |
| 1005 | U.S. Provisional Application No. 61/076,495 ("HDI's Provisional") |
| 1006 | U.S. Patent Appl. Pub. No. 2008/0127302 A1 ("Qvarfordt") |
| 1007 | von Ahn, *et al.*, "CAPTCHA: Using Hard AI Problems for Security" (2003). In: Biham E. (eds) Advances in Cryptology – EUROCRYPT 2003, pp. 294-311. Lecture Notes in Computer Science, vol 2656. ("vonAhn") |
| 1008 | von Ahn, "Human Computation," CMU-CS-05-193, Carnegie Mellon University School of Computer Science, December 7, 2005 ("vonAhn 2005") |
| 1009 | U.S. Patent Appl. Pub. No. 2009/0113294 A1 ("Sanghavi") |
| 1010 | U.S. Patent Appl. Pub. No. 2009/0313694 A1 ("Mates") |
| 1011 | Kochanski, Lopresti, et al., "A Reverse Turing Test Using Speech," Proceedings of the 7th International Conference on Spoken Language Processing, pp. 1357-60, September 16-20, 2002 ("Kochanski") |
| 1012 | U.S. Patent Appl. Pub. No. 2007/0201745 A1 ("Wang") |
| 1013 | U.S. Patent Appl. Pub. No. 2007/0192849 A1 ("Golle") |
| 1014 | U.S. Patent Appl. Pub. No. 2008/0066014 A1 ("Misra") |
| 1015 | U.S. Patent No. 6,195,698 ("Lillibridge") |
| 1016 | U.S. Patent Appl. Pub. No. 2009/0249477 A1 ("Punera") |
| 1017 | Datta, *et al.*, "IMAGINATION: A Robust Image-based CAPTCHA Generation System." In Proceedings of the 13th Annual ACM International Conference on Multimedia, pages 331–334, November 2005. ("Datta") |
| 1018 | U.S. Patent No. 8,510,795 ("Gargi") |
| 1019 | U.S. Patent Appl. Pub. No. 2009/0319270 A1 ("Gross") |
| 1020 | U.S. Patent Appl. Pub. No. 2007/0250920 ("Lindsay") |
| 1021 | U.S. Patent No. 5,578,991 ("Scholder") |
| 1022 | U.S. Patent No. 5,835,298 ("Edgerton") |

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| Exhibit | Description |
|---|---|
| 1023 | World Intellectual Property Organization International Publication No. WO 2006/060077 Al ("Clifford") |
| 1024 | U.S. Patent No. 7,059,182 ("Ragner") |
| 1025 | U.S. Patent Appl. Pub. No. 2006/0193113 A1 ("Cohen") |
| 1026 | U.S. Patent No. 7,142,385 ("Shimotono") |
| 1027 | U.S. Patent Appl. Pub. No. 2007/0259716 A1 ("Mattice") |
| 1028 | U.S. Patent Appl. Pub. No. 2007/0298751 A1 ("Wulff") |
| 1029 | U.S. Patent Appl. Pub. No. 2008/0108340 A1 ("Karstens") |
| 1030 | European Patent Application Publication No. EP 1845468 A1 ("Karrer") |
| 1031 | European Patent EP 2130159B1 ("Baker") |
| 1032 | Shirali-Shahreza, *et al*., "Bibliography of Works Done on CAPTCHA," 2008 3rd International Conference on Intelligent System and Knowledge Engineering, November 17-19, 2008 |
| 1033 | Merriam-Webster's Collegiate Dictionary, Eleventh Edition (2007), p. 840 (definition of "noise"), p. 1302 (definition of "threshold") |
| 1034 | Declaration of Rachel J. Watters, with attachments |
| 1035 | Declaration of Mary K. Bolin, Ph.D., with attachments |
| 1036 | Declaration of Jessica Benner, with attachment |
| 1037 | Declaration of Professor Kawahara Tatsuya, with attachment |
| 1039 | *Human Differential Intelligence LLC v. The Gap, Inc.,* Civil Action No. 6:20-cv-00307-ADA (W.D. Tex.), D.I. 14 (Corrected First Amended Complaint) |
| 1053 | U.S. Patent Appl. Pub. No. 2010/0077209 A1 ("Broder") |
| 1054 | U.S. Patent Appl. Pub. No. 2009/0055910 A1 ("Lee") |
| 1055 | U.S. Patent Appl. Pub. No. 2007/0150745 A1 ("Peirce") |
| 1056 | Declaration of Jessica Benner, with attachment (Feb. 17, 2023) |
| 1057 | Declaration of Rachel J. Watters, with attachments (Feb. 20, 2023) |
| 1058 | Declaration of Kelley Hayes Greenhill, with attachments (Feb. 22, 2023) |
| 1061 | *Human Differential Intelligence LLC v. Cloudflare*, Civil Action No. 1:22-cv-01334 (W.D. Tex), D.I. 1 (Complaint) |

## IV. MY UNDERSTANDING OF PATENT LAW

22. In developing my opinions, I discussed various relevant legal principles with Google's attorneys. I have also discussed these principles with

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Intuition Machine's (IM's) attorneys. Though I do not purport to have prior knowledge of such principles, I understood them when they were explained to me and have relied upon such legal principles, as explained to me, in the course of forming the opinions set forth in this declaration. My understanding in this respect is as follows.

23. I understand that "*inter partes* review" (IPR) is a proceeding before the United States Patent & Trademark Office for evaluating the patentability of an issued patent's claims based on prior-art patents and printed publications.

24. I understand that, in this proceeding, the Petitioners have the burden of proving that the Challenged Claims of the '141 Patent are unpatentable by a preponderance of the evidence. I understand that "preponderance of the evidence" means that a fact or conclusion is more likely true than not true.

25. I understand that, in IPR proceedings, claim terms in a patent are given their ordinary and customary meaning as understood by a person of ordinary skill in the art ("POSA") in the context of the entire patent and the prosecution history pertaining to the patent. If the specification and/or prosecution history provides a special definition for a claim term that differs from the meaning the term would otherwise possess, the special definition controls. I have applied these standards in preparing the opinions in this declaration.

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26. I understand that for an invention claimed in a patent to be patentable, it must be, among other things, new (novel—i.e., not anticipated) and not obvious from the prior art. My understanding of these two legal standards is set forth below.

**A. Anticipation**

27. I understand that, for a patent claim to be "anticipated" by the prior art (and therefore not novel), each and every limitation of the claim must be found, expressly or inherently, in a single prior-art reference. I understand that a claim limitation is disclosed for the purpose of anticipation if a POSA would have understood the reference to disclose the limitation based on inferences that a POSA would reasonably be expected to draw from the explicit teachings in the reference when read in light of the POSA's knowledge and experience.

28. I understand that a claim limitation is inherent in a prior art reference if that limitation is necessarily present when practicing the teachings of the reference, regardless of whether a POSA recognized the presence of that limitation in the prior art.

**B. Obviousness**

29. I understand that a patent claim may be unpatentable if it would have been obvious in view of a single prior-art reference or a combination of prior-art references.

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30. I understand that a patent claim is obvious if the differences between the subject matter of the claim and the prior art are such that the subject matter as a whole would have been obvious to a person of ordinary skill in the relevant field at the time the invention was made. Specifically, I understand that the obviousness question involves a consideration of:

- the scope and content of the prior art;
- the differences between the prior art and the claims at issue;
- the knowledge of a person of ordinary skill in the pertinent art; and
- if present, objective factors indicative of non-obviousness, sometimes referred to as "secondary considerations." To my knowledge, the alleged Patent Owner, Human Differential Intelligence, LLC ("HDI") has not asserted any such secondary considerations with respect to the '141 Patent.

31. I understand that in order for a claimed invention to be considered obvious, a POSA must have had a reason for combining teachings from multiple prior-art references (or for altering a single prior-art reference, in the case of obviousness in view of a single reference) in the fashion proposed.

32. I further understand that in determining whether a prior-art reference would have been combined with other prior art or with other information within

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the knowledge of a POSA, the following are examples of approaches and rationales that may be considered:

- combining prior-art elements according to known methods to yield predictable results;
- simple substitution of one known element for another to obtain predictable results;
- use of a known technique to improve similar devices in the same way;
- applying a known technique to a known device ready for improvement to yield predictable results;
- applying a technique or approach that would have been "obvious to try," i.e., choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;
- known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to one of ordinary skill in the art;
- some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior-art reference or to combine prior-art reference teachings to arrive at the claimed invention. I understand that this teaching, suggestion or motivation may come

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from a prior-art reference or from the knowledge or common sense of one of ordinary skill in the art.

33. I understand that for a single reference or a combination of references to render the claimed invention obvious, a POSA must have been able to arrive at the claimed invention by altering or combining the applied references.

## V. PERSON OF ORDINARY SKILL IN THE ART ("POSA")

34. For purposes of assessing whether prior-art references disclose every element of a patent claim (thus "anticipating" the claim) and/or would have rendered the claim obvious, I have been informed and understand that the patent and the prior- art references must be assessed from the perspective of a POSA to which the patent relates, based on the understanding of that person at the time of the patent claim's priority date. I have been informed and understand that a POSA is presumed to be aware of all pertinent prior art and the conventional wisdom in the art and is a person of ordinary creativity. I have applied this standard throughout my declaration.

35. The '141 Patent involves technology in the field of computer security and access control, and specifically "CAPTCHA," or "Completely Automatic Public Turing Tests To Tell Computers And Humans Apart." Ex. 1001, Title; 1:43-44. I have been asked to provide my opinions as to the state of the art in this field by mid- 2008 through mid-2009. I use this timeframe because

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the face of the '141 Patent indicates an earliest claimed priority date of June 27, 2008 based on the filing of a provisional application. Ex. 1001, (60). I understand that the Petitioners do not concede the priority claim; however, it does not affect the level of ordinary skill.

36. Whenever I offer an opinion in this declaration about the knowledge of a POSA, the manner in which a POSA would have understood the claims of the '141 Patent or its description, the manner in which a POSA would have understood the prior art, or what a POSA would have been led to do based on the prior art, I am referencing the mid-2008 through mid-2009 timeframe, even if I do not say so specifically in each case.

37. I understand that HDI may attempt to prove that the alleged invention recited in the Challenged Claims was conceived at some time prior to the earliest claimed priority date on the face of the patent. At the time of this declaration, I am unaware of HDI having alleged any earlier conception date or produced any evidence to establish any earlier conception date.

38. The '141 Patent purports to describe and claim techniques to accomplish access control in computer security via CAPTCHA. *See* §VI.B below. Computer security is a field in computer science.

39. In my opinion, a person of ordinary skill in the art in the mid-2008 through mid-2009 timeframe would have had at least a bachelor's degree in

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Computer Science or a related field, along with at least two years of work or research experience in computer security, and some experience with CAPTCHA. More education could substitute for less experience, and vice versa. This person would have been capable of understanding and applying the teachings of the '141 Patent and the prior-art references discussed in this declaration.

40. By 2008-2009, I held two different master's degrees in Electrical Engineering and Computer Science, a Ph.D. in Computer Science, and was a professor in Computer Science and Engineering at Lehigh University in Bethlehem, Pennsylvania. I had over twenty years of work and/or research experience in computer science, working as a Principal Scientist at the Matsushita Information Technology Laboratory and a technical staff member at Bell Labs/Lucent Technologies, as well as various visiting professorships and research fellowships at other universities. I also had over fifteen years of work and/or research experience in computer security and related areas, along with experience with CAPTCHA, including the experience listed in Section II above. Therefore, I was a person of more than ordinary skill in the art during the relevant timeframe. However, I worked with many people who fit the characteristics of the POSA, and I am familiar with their level of skill. When developing the opinions set forth in this declaration, I assumed the perspective of a POSA, as set forth above.

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# VI. OVERVIEW OF THE '141 PATENT

## A. Technology Background

41. The '141 Patent claims methods for presenting, and determining the efficacy of, image-based CAPTCHAs to protect websites and other networked devices from automated access, an area in the field of access control in computer security. Ex. 1001, Title, 1:43-45. CAPTCHAs were first developed in the late 1990s to control access to computers via the Internet and prevent automated hacking attacks from computer "bots." Ex. 1008, 13-14. A CAPTCHA prevents automated attacks by requiring users to perform tasks, or pass a test, that humans can perform well, but computers generally cannot perform well, before accessing the website or computer. Ex. 1008, 12-13. The '141 Patent notes that before the filing date it was "well-known" to use CAPTCHA challenges to control access to computers and resources on the Internet. Ex. 1001, 1:43-45.

42. Early CAPTCHA tests involved displaying distorted text and required the user to type the displayed word with few or no errors, as shown in the example below, from Figure 1 of Exhibit 1009.

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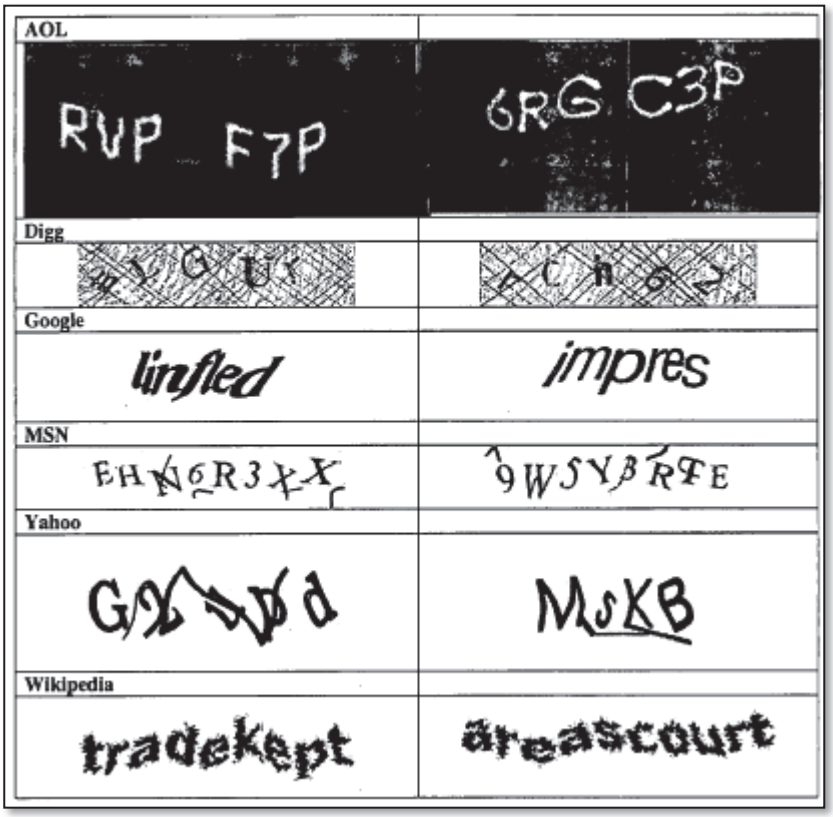


43. While distorted-text CAPTCHAs succeeded for a time, by the mid-2000s computers could solve certain text-based challenges with reasonable success, so the industry was developing CAPTCHAs based on other tasks computers could not perform well, such as non-text image recognition, audio recognition, and motion, orientation, and touch-based challenges. Ex. 1008, 15-17.

44. By the relevant 2008-2009 timeframe, various types of user inputs and interfaces were used to tell humans and computers apart. These were not limited to just visual recognition of text or numbers. Exs. 1008-1009. There were also CAPTCHAs relying on visual recognition of non-text images. Exs. 1006,

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1012. There were CAPTCHAs based on video clips. Ex. 1018. Some CAPTCHAs used text-to-speech interfaces. Ex. 1011. Other CAPTCHAs used touch interfaces using the motion of a user's hands or fingers. Ex. 1013. In short, many types of CAPTCHA interfaces, inputs, and implementations were known to those of skill in the art. Ex.1032.

**B. The '141 Patent**

45. I understand that the '141 Patent claims priority to a provisional application filed on June 27, 2008 ("HDI's Provisional"). That provisional application focuses primarily on an electronic Pictionary™-like game. In fact, in the 38-page provisional, CAPTCHA is mentioned in just one paragraph. Ex. 1005, 17-18. The specification of the '141 Patent likewise focuses on the pictorial game; and, as relevant to the Challenged Claims, only sparsely discusses CAPTCHA. Ex. 1001, 1:43-56; 4:36-5:62; 14:5-15:4.

46. The '141 Patent says that CAPTCHA was "well-known for controlling access to computers and resources on the Internet," and that "progressive" CAPTCHA challenges were known. Ex. 1001, 1:43-48. Sanghavi (Ex. 1009), which the '141 Patent incorporates by reference, discloses that "progressive" CAPTCHAs "do not reveal the entire captcha to the user at once, but rather do so slowly and/or in multiple pieces." Ex. 1009, [0026]. The '141 Patent characterizes Sanghavi's progressive CAPTCHA as using "conventional

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(distorted) text type challenges," and suggests that Sanghavi "fail[ed] to appreciate the potential for image[-]based challenges." Ex. 1001, 1:51-53. However, as discussed below (¶¶65- 78), image-based CAPTCHAs, including progressive image-based CAPTCHAs were known.

47. The '141 Patent states that, unlike text approaches, "recognition of images can be incorporated as part of a picture based game to develop appropriate challenges[.]" *Id.*, 1:53-56. The '141 Patent accordingly discloses "a CAPTCHA challenge system that…introduce[s] visual content to be reviewed by humans to determine what appropriate tags/concepts are presented for the image in question." *Id.*, 14:5-8.

48. The '141 Patent states that "a CAPTCHA challenge system (not shown) could introduce visual content to be reviewed by humans to determine what appropriate tags/concepts are presented for the image in question. This information can then be used to augment a library of challenge test images." Ex. 1001, 14:5-9. The '141 Patent further states that "the challenge system could determine that an (intentionally visually distorted) image A is nonetheless identified as either X or Y by 90% of the population," making it "suitable for inclusion in a CAPTCHA system." Ex. 1001, 14:9-13. "The image could be re-presented at various times to different participants/Internet viewers—and with different levels of degradation— until it is no longer recognized by a certain

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percentage of the population." *Id*., 14:13-17. To meet the CAPTCHA system's requirements, this process can repeat iteratively with "progressively degraded versions of the image," and correct answers and recognition times for each iteration can be measured. *Id*., 14:17-20. The patent states its alleged "invention can act as a form of testing ground for these types of challenge systems." *Id*., 14:21-22.

49. After this "testing" of the image to determine its suitability for inclusion in a CAPTCHA system, "[a]n optimized set of image challenges" could then be presented "as part of a CAPTCHA to gain access to accounts, data, computing resources, etc.," where "[t]he user would be asked to provide the identity of the image" through, for example, a keyboard. *Id.*, 14:23-27.

50. The '141 Patent accordingly discloses (and claims) both a method of ***testing*** image recognition for a CAPTCHA system, and a method of ***providing*** a visual CAPTCHA challenge.[11] Ex. 1001, 4:36-38, 4:58-60, claims 1, 5, 10.

51. In both methods, the CAPTCHA system/challenge automatically elects an electronic image—i.e., imagery other than words—for a participant. *Id.*, 4:36- 41, 4:60-63, claims 1, 5, 10. The image is associated with one or more

[1] In general, in this declaration, I add emphasis and highlighting and omit internal quotations and citations, unless I specifically state otherwise.

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"concepts," which the patent states "may be in the form of ideas, people, places, things, actions, emotions, etc." *Id.*, 4:41-42, 4:63-64, 6:36-40, claims 1, 5, 10.

52. Initially, ***not all*** the image information is presented. Instead, the image is presented in a state that includes only "a subset of said set of imagery data for said electronic image." *Id*., claim 1; *see also* claim 10 (referring to a state in which "only a first portion of the image information therein is perceptible"). The system then "progressively reveal[s] information over a first time period for the electronic image." *Id.*, Abstract, 4:42-45, 4:64-66, claims 1, 5, 10. The methods automatically process responses to determine if the user correctly guessed the concept(s). *Id.*, 4:45- 48, 4:66-5:3, claims 1, 5, 10. The methods further measure effectiveness by calculating or determining a percentage of participants able to correctly solve the CAPTCHA within a predetermined time. *Id.*, Abstract, 4:49-51, claims 1, 5, 10.

### C. Prosecution History

53. I have reviewed the prosecution history of the '141 Patent (Ex. 1004) in connection with interpreting the '141 Patent's claims. The Examiner originally rejected application claims 1-10, "drawn to a method for presenting and progressively revealing an image and determine [*sic*] accuracy of a response" (Ex. 1004, 217-220), as anticipated by U.S. Patent Application Publication No. 2009/0313694 A1 ("Mates," Ex. 1010). Ex. 1004, 226-227.

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54. In response to the Examiner's rejection, the applicant amended the claims to recite that the "automatically elect[ed]" electronic image "comprises a set of imagery data ***other than words***" and "is configured such that ***a subset*** of [the] set of imagery data…can be made perceptible in a first image state," and then progressively revealed. Ex. 1004, 261-264. The applicant argued that Mates did not disclose a method that "processes participant responses to the ***progressively-revealed electronic image*** to correlate their accuracy with the concepts (claim 1) or to detect if a guess meets a required threshold (claim 6)." *Id*., 265. The applicant argued that Mates instead "discloses an image CAPTCHA challenge in which a single, static image or images is transmitted to the user," such as a stereogram (akin to Magic Eye puzzles). *Id*. The applicant argued that for such images, although the viewer may not appreciate the full illusion at once, "all of the information must be viewed concurrently," and thus, does not disclose "progressively revealing information in the electronic image over a period of time." *Id.*, 265-266; *see id*., 266 ("in Mates, images cannot be revealed progressively").

55. The Examiner subsequently rejected the amended claims over Mates in view of Sanghavi (Ex. 1009). Ex. 1004, 285-287. The Examiner found that "Sanghavi teaches progressive CAPTCHAS including an electronic image [that] is configured such that a subset of set of imagery data for said electronic image

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can be made perceptible in a first image state" and "progressively reveal[ed]" over time. *Id.*, 286. The Examiner determined it would have been obvious "to employ the teachings of Sanghavi within the system of Mates in order to enhance the security of the system." *Id.*

56. In a summary of an in-person interview, the Examiner stated "Sanghavi teaches a progressive CAPTCHA, and…it would have been obvious to modify the teachings of Mates to deliver a progressive pictorial CAPTCHA," as claimed. *Id.*, 316. In finally rejecting the claims, the Examiner found "Sanghavi teaches progressive CAPTCHAS" as claimed and referred to Sanghavi's disclosure of "portions" of an image being displayed progressively over time as teaching "a subset of imagery data" "progressively reveal[ed]" over a first time period. *Id.*, 286; Ex. 1009, [0038], FIG. 6. The applicant did not dispute the Examiner's assertion that Sanghavi taught progressively revealing an image over time.

57. Rather, the applicant relied on the Examiner's finding that neither Mates nor Sanghavi disclosed the further limitation in dependent claims 2 and 24—"calculating an overall percentage of users who accurately guess the underlying concept within a predetermined time." Ex, 1004, 315-17, 322. The applicant amended the independent claims to include that feature, and the claims were allowed. *Id.*, 311-314.

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### D. The Challenged Claims

58. The '141 Patent has three independent claims: 1, 5, and 10. These claims share many limitations. I show them below with labels added before each limitation for reference and with the only differences highlighted.

| Claim 1 | Claim 10 | Claim 5 |
|---|---|---|
| **[1PRE / 10PRE[2]]** A method of ***testing recognition of images for*** a Completely Automatic Public Turing Test To Tell Humans And Computers Apart (CAPTCHA) ***system*** comprising: | | **[5PRE]** A method of ***providing a visual*** Completely Automatic Public Turing Test To Tell Humans And Computers Apart (CAPTCHA) ***challenge*** comprising: |
| **[1A]** a. automatically electing an electronic image for a participant with a computing system, wherein said electronic image comprises a set of imagery data other than words, and wherein said electronic image is ***configured such that a subset of said set of imagery data for said electronic image can be made perceptible in a first image state***; | **[10A]** a. automatically electing an electronic image for a participant with a computing system, wherein said electronic image comprises a set of imagery data other than words, and wherein said electronic image is ***presentable with differing amounts of data, including a first image state in which only a first portion of the image information therein is perceptible***; | **[5A]** a. automatically electing an electronic image for a participant with a computing system, wherein said electronic image comprises a set of imagery data other than words and wherein said electronic image is ***configured such that a subset of said imagery data for said electronic image can be made perceptible in a first image state***; |

[2] Claim 10's preamble is identical to claim 1's preamble, except that in claim 10 "CAPTCHA" is not enclosed in parentheses.

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| Claim 1 | Claim 10 | Claim 5 |
|---|---|---|
| **[1B / 10B / 5B]** b. associating said electronic image with one or more concepts; | | |
| **[1C]** c. presenting said electronic image in said first image state and progressively revealing ***information*** over a first time period within an interface for said participant using said computing system; | **[10C]** c. presenting said electronic image in said first image state and progressively revealing ***additional information in said electronic image*** over a first time period within an interface for said participant using said computing system; | **[5C]** c. progressively revealing ***information in said electronic image*** over a first time period within an interface for said participant using said computing system; |
| **[1D / 10D]** d. automatically processing responses from the participant with the computing system to ***correlate an accuracy of guesses*** from said participant for said one or more concepts associated with said electronic image; and | | **[5D]** d. automatically processing responses from the participant with the computing system to ***detect if a guess*** from said participant for said one or more concepts associated with said electronic image ***meets a required threshold***; and |
| **[1E / 10E]** e. ***calculating*** a percentage of participants ***able to decode and accurately guess said one or more concepts*** within a predetermined time. | | **[5E]** e. ***determining*** a percentage of participants ***with guesses meeting the required threshold*** within a predetermined time. |

59. As I discuss below, the challenged dependent claims add implementation details that were known in the art to a POSA. *See* Ex.1001, claims 2, 11 ("progressively revealing" "electronic image at different time intervals with differing levels of resolution, noise and/or pixelation"); 3, 13 (using the image-based CAPTCHA system to grant access to resources of "a second computing system"); claims 4, 14 (using the image-based CAPTCHA system to grant access

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to resources of "a second computing system" that is "associated with a portable electronics device"); claim 7 (CAPTCHA challenge implemented on a "portable computing device" with "motion and/or orientation sensors"); claim 8 ("physical CAPTCHA challenge requiring the user to manipulate the portable computing device"); claim 9 ("physical CAPTCHA challenge" requiring the user to "interact" with the electronic image and/or other objects in the user interface); and claim 12 ("automatically processing responses" when an electronic image is first presented and when progressively revealed).

## VII. CLAIM INTERPRETATION

60. I understand that determining whether a claimed invention is novel and non-obvious requires comparing the prior art to the claim. I also understand that there have been no prior determinations in civil actions or in International Trade Commission ("ITC") proceedings interpreting any of the '141 Patent's claim terms.

61. In my opinion, resolving the validity of the Challenged Claims does not require giving any claim terms any express interpretations beyond their ordinary and customary meaning as understood by a POSA in the context of the entire '141 Patent and its prosecution history.

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## VIII. GROUNDS FOR UNPATENTABILITY

62. I have been asked to provide my opinion concerning whether the Challenged Claims would have been obvious to a POSA in light of the prior-art references identified in the Petition. For the reasons explained below, it is my opinion that each of the Challenged Claims would have been obvious to a POSA.

63. The following table summarizes my opinions as to why the Challenged Claims are obvious:

| Ground Number and Reference(s) | | Claims | Basis |
|---|---|---|---|
| 1 | Qvarfordt | 1-5 and 7-14 | Obvious |
| 2 | Qvarfordt + vonAhn | 1-5 and 7-14 | Obvious |

### A. Ground 1: Qvarfordt Renders Claims 1-5 and 7-14 Obvious.

64. After reviewing Qvarfordt and claims 1-5 and 7-14 of the '141 Patent, it is my opinion that each of these claims would have been obvious to a POSA in view of Qvarfordt. Qvarfordt discloses every limitation of these claims, and to the extent the Board believes that Qvarfordt does not explicitly disclose every limitation, these limitations would have been met by the conventional and obvious implementation of the method Qvarfordt discloses. The basis for my opinion and the details of my analysis are set forth below.

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### 1. Qvarfordt (Ex. 1006)

65. Qvarfordt is a U.S. Patent Application Publication that was published on May 29, 2008, and was filed on August 22, 2006. I understand that Qvarfordt is therefore prior art to the '141 Patent.

66. Qvarfordt is one of over 100 references cited during prosecution of the '141 Patent. Ex. 1001, (56). The Examiner did not comment on Qvarfordt nor use it in a rejection. *See generally* Ex. 1004.

67. Qvarfordt relates to the field of internet security and, in particular, to validation of users accessing a website. Qvarfordt, [0002]. Qvarfordt, titled "Motion and Interaction Based CAPTCHA," teaches various image-based CAPTCHAs "that can be easily resolved by human sense of motion." *Id.*, [0010]. Qvarfordt provides CAPTCHAs based on "obscuring images in a way…easily perceived by humans while not by machines." *Id*., [0011].

68. Qvarfordt recognizes that for CAPTCHA systems using distorted text (to avoid recognition by OCR or other pattern recognition algorithms), there are limitations as to how much the letters in these CAPTCHAs "can be distorted and yet be recognizable to humans." *Id.*, [0005]. For example, because the human perceptual system varies greatly from person to person, the distorted letters can be hard to read for many people and lead to exclusion of these users." *Id.* An oft-cited threshold is that humans' success rate should be 90%, while computers'

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success rate should only be 0.01%. *Id*. But even with a 90% success rate, humans still fail one of ten trials, "which causes frustration towards the service provider." *Id*. Accordingly, Qvarfordt reasons that it is "***highly desirable*** to create CAPTCHAs that are ***as easy as possible*** to solve by humans yet preserve or increase the difficulty for computers to solve them." *Id*.

69. Qvarfordt describes animated CAPTCHAs "that can be easily resolved by human sense of motion." *Id.*, [0010]; *see also id.*, Abstract, [0011]-[0012], [0031]-[0032]. The animation includes at least two layers—e.g., a foreground layer and a background layer. *Id*., Abstract, [0012]. The background layer comprises a recognizable image to decipher, and the foreground layer partially obstructs that image. *Id*., Abstract, [0012], [0055], FIG. 10. When the CAPTCHA takes the form of a looped animation, for example, the foreground always obstructs part of the image, but the obstructed part changes over time. *Id*., [0031]. Thus, the user can "easily decipher" the encoded image when the entire animation is presented continuously, "as at each point in time the user will see part of the solution and will be able to easily integrate the parts to decipher the whole." *Id*. The image becomes easily identifiable as the animation reveals more of the image over time.

70. Based on the visual phenomenon known as anorthoscopic perception, Qvarfordt's animation-based CAPTCHAs "show how human visual

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systems excel at integrating low[-]resolution or conflicting images into apparently high[-] resolution and complete images over time." Qvarfordt, [0030]. An example of this phenomenon occurs when driving past a fence with vertical openings between the boards, where "the view of the scenery on the other side of the fence appears uninterrupted until the car is stopped." *Id*.

71. Qvarfordt's Figures 3a-3b, reproduced below, show an example of a motion-based CAPTCHA, where the letters "ABCD" are stationary, but vertical black lines move right-to-left. *Id.*, [0032]. As shown by these snapshots (and understood when set in motion), the vertical lines always cover part of each letter, so "none of the letters is ever shown completely exposed." *Id*. Like the scenery behind the picket fence, however, humans can easily perceive the background letters when the lines are moving. *Id*. That is, as the animation progresses, revealing more of the letters in the background, "at each point in time the user will see part of the solution and will be able to easily integrate the parts to decipher the whole." *Id*., [0031].

Figure 3a

Figure 3b

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72. Qvarfordt refers to the letters to be deciphered as the "encoded solution" (or "solution"). *Id*., [0032]. The "encoded solution" is not limited to letters, however, and encompasses any other characters that may be used in the CAPTCHA, such as numbers, shapes, symbols, etc. *Id.* Qvarfordt further teaches that "the solution need not necessarily be a typographical character, but can be any recognizable image, which also comes under the term 'encoded solution.'" *Id*.

73. Figure 10, reproduced below, shows a snapshot of an example animated CAPTCHA where "the encoded solution is an image"—here, a cat. *Id*., [0055].

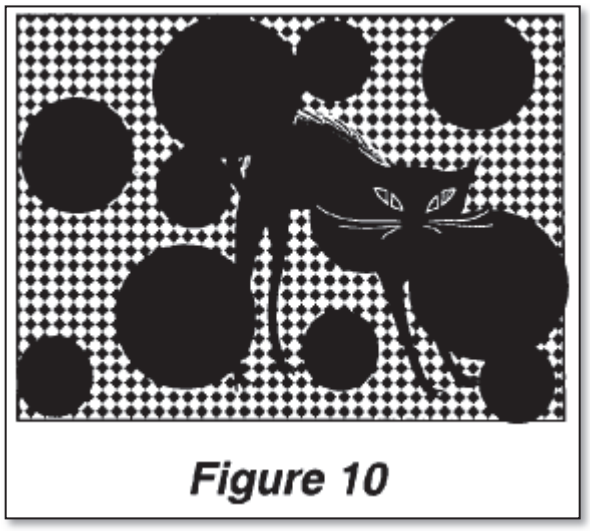

Figure 10

74. In Figure 10, one layer comprises a background (the wallpaper with a diamond-pattern wallpaper), another layer includes the encoded solution (the illustrated cat), and a further (top) layer comprises various obstruction elements (the "floating disks"). *Id.*, [0053], [0055], FIG. 10. As with other embodiments,

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the motion may be set automatically as in an animation clip, or in response to user input where a user may "pick and drag" any layer to expose the "encoded solution"—i.e., the cat image. *Id.*, [0055]. The animation can be configured such that "none of the encoded solution element is ever completely exposed or, conversely, it can be set that each element of the encoded solution is an incomplete element." *Id.*, [0053]. As explained with similar embodiments, "when the complete animation is presented to a user in a continuous manner, the user will be able to easily decipher the [image], as at each point in time the user will see part of the solution and will be able to easily integrate the parts to decipher the whole." *Id.*, [0031]. Once deciphered, "[t]he user is then required to enter a word corresponding to the image." *Id.*, [0055].

75. Qvarfordt explains that an OCR algorithm or other machine processing would not be able to decode the animated CAPTCHA, because the "encoded solution" is never shown in a complete form, even though over time all parts or portions of the image information may be eventually revealed. *Id.*, [0031].

76. Recognizing the difficulty of anticipating all reasonable human responses to CAPTCHAs "based on images, video, or interaction" (versus letter-based CAPTCHAs), Qvarfordt discloses an embodiment where "users are required to solve multiple CAPTCHAs consisting of two sets, one already vetted

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CAPTCHAs and a set of novel CAPTCHAs." *Id.*, [0052]. Regarding the first set of pre-vetted CAPTCHAs, the answers "determine whether the entity accessing the site is a human, and that information is used both to allow access to resources and to decide whether to use that entity's labels for the CAPTCHAs in the second set." *Id*. Regarding the second set of novel (unvetted) CAPTCHAs, the user's response helps determine reasonable human responses to that CAPTCHA and assess its vulnerability to attack. *Id*.

77. Once sufficiently vetted, CAPTCHAs in the second set move to the first set, where the method associates a solution (e.g., "cat") or a solution set (e.g., "cat" or "kitten") with them. *Id*. Such a move "can be made after a statistically significant number of solutions to the second test have been received." *Id*. At that point, "either the highest scoring solution is chosen as a correct solution, or a set of most commonly received solutions is chosen as the correct solution and a user entering any of the solution from the set, is granted access." *Id*.

78. Qvarfordt thus discloses both a method of testing recognition of images for a CAPTCHA system and a method of providing an image-based CAPTCHA challenge.

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### 2. Claim 1

#### a. Preamble [1PRE]

79. I have been informed by counsel that the preamble for a claim may or may not limit the claim, and I express no opinion on whether the preamble of claim 1 limits the claim. To the extent claim 1's preamble limits the claim, however, my opinion is that Qvarfordt meets the preamble because Qvarfordt discloses "[a] method of testing recognition of images for a Completely Automatic Public Turing Test To Tell Humans And Computers Apart (CAPTCHA) system," as recited by claim 1's preamble.

80. As explained above (¶¶76-78), in Qvarfordt's two-set CAPTCHA embodiment, where users must solve two sets of image-based CAPTCHAs, user recognition of the novel image is tested. *Id.*, [0052]. The received responses to the test are "used to determine reasonable human responses to that CAPTCHA and assess[] how vulnerable the CAPTCHA is for attacks." *Id.*, [0052]. For some challenges, the user is required to do more than type in an identifier for an image, and the user's actions (e.g., mouse movement and clicks) can be evaluated to assess a computer's ability to mimic them. *Id.*, [0038]-[0039], [0041].

81. Qvarfordt recognizes that "[o]ne problem with CAPTCHAs, particularly those based on images, video, or interaction, is that it can be hard to anticipate reasonable human responses." *Id.*, [0052]. Indeed, one of the reasons

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that letter-based CAPTCHAs are most used, as Qvarfordt observes, is that "the correct response is unambiguous." *Id*. But "[t]he desire for an unambiguous label for each CAPTCHA severely limits the design space and opens the possibility to easier break the CAPTCHA." *Id*.

82. In this respect, CAPTCHA systems that seek to, *a priori*, assign "an unambiguous label for each CAPTCHA" are disadvantageous. *Id*., [0052]. Qvarfordt's system takes a different approach, and tests human reaction to a novel image by collecting a "statistically significant number of solutions" that users provide for that novel image, and then using those solutions to "***determine reasonable human responses*** to that CAPTCHA." *Id.*, [0052]. Thus, Qvarfordt teaches a method of "testing recognition of images" in the novel CAPTCHA challenges by human users.

83. Indeed, Qvarfordt's "testing recognition of images," described above, is consistent with the '141 Patent's disclosure of "a CAPTCHA challenge system (not shown)" that "introduce[s] visual content to be reviewed by humans to determine what appropriate tags/concepts are presented for the image in question." Ex. 1001, 14:5-8. Like the system described in the '141 Patent, which "could determine that an (intentionally visually distorted) image A is nonetheless identified as either X or Y by 90% of the population, thus making is suitable for inclusion in a CAPTCHA system" (*id.*, 14:9-13), Qvarfordt similarly determines

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appropriate solution(s) for a novel CAPTCHA image after receiving "a statistically significant number of solutions." Qvarfordt, [0052].

84. Qvarfordt's resulting "vetted" CAPTCHAs, the answers to which "determine whether the entity accessing the site is a human" and, ultimately, allow access to resources (Qvarfordt [0052]), are similar to the '141 Patent's "optimized set of image challenges" that are used "as part of a CAPTCHA to gain access to accounts, data, computing resources, etc." Ex. 1001, 14:23-25.

85. To the extent HDI contends that claim 1, like claim 5 (discussed below, ¶¶147-172), is directed to providing a visual CAPTCHA challenge using images with pre-associated concepts (i.e., a known solution or solution set), Qvarfordt also discloses such a system at least with its vetted set of image-based CAPTCHAs, where answers to those CAPTCHAs "determine whether the entity accessing the site is a human, and that information is used [] to allow access to resources[.]" Qvarfordt, [0052].

**b. Limitation [1A]**

86. Qvarfordt discloses "a. automatically electing an electronic image for a participant with a computing system, wherein said electronic image comprises a set of imagery data other than words, and wherein said electronic image is configured such that a subset of said set of imagery data for said electronic image can be made perceptible in a first image state," as recited by limitation [1A].

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87. First, Qvarfordt discloses "automatically electing an electronic image for a participant with a computing system." The "CA" in CAPTCHA stands for "Completely Automated." Qvarfordt, [0004]. Qvarfordt repeatedly describes its CAPTCHA test as "automated," and teaches that it elects an image for a participant with a computing system. *Id.*, Abstract ("automated test to tell computers and humans apart"; "[t]he automated test may comprise displaying on a computer screen an image"), [0012] ("an automated test…which comprises: displaying on a computer screen an animation comprising … recognizable images"), claim 1 ("An automated method…comprising: displaying on a computer screen an animation comprising…a recognizable image[.]").

88. Alternatively, if the Board does not consider Qvarfordt to expressly disclose that its CAPTCHA steps are automated, that would have been the conventional and obvious way to implement a CAPTCHA method of the type Qvarfordt describes. A POSA would understand that any CAPTCHA method gains significant advantages from being completely automated. For example, in "Human Computation," Luis von Ahn describes how "CAPTCHA stands for '***Completely Automated*** Public Turing Test to Tell Computers and Humans Apart,'" and how such tests are automated "to prevent automated registrations" by bots on popular websites. Ex. 1008, p.13. A CAPTCHA method that was not completely automated, and instead required human intervention to function,

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would not protect against such automated registrations. For that reason, "[a] CAPTCHA is an *Automated* Turing Test." *Id.* (emphasis original). "CAPTCHAs are similar to the Turing Test in that they distinguish humans from computers, but they differ in that the judge is now a computer." *Id.* Indeed, "making the judge a computer allows CAPTCHAs to be useful for other practical applications" as well, including facilitating online polls, protecting free email services, barring search engine indexing bots, and preventing worms, spam, and dictionary attacks. *Id.*, pp.13-14. A CAPTCHA is therefore "an ***automated*** test that humans can pass but that current computer programs cannot." *Id.*, p.12. And the ability to do so in an automated way "has important applications in practical security." *Id.*, pp.12-14.

89. I myself discussed some of these issues in a paper titled "A Reverse Turing Test Using Speech" that I co-wrote for the Seventh International Conference on Spoken Language Processing in Denver, Colorado between September 16-20, 2002. Ex. 1011. In my paper (Ex. 1011), I describe how "hackers" have "written malicious programs to exploit online services intended for human users." Ex. 1011, p.1. These "bots" unfortunately were "already common" in 2002. *Id.* The bots "consume resources, harass users, make attempts to guess passwords, steal and re- purpose copyrighted content, and invade privacy." *Id.* "As a result, there is a need for ***automatic*** methods to tell whether

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the entity attempting to access a service is a human or a machine." Only such fully "automatic" methods, like Reverse Turing Tests or CAPTCHAs, can "prevent automated attacks on passwords." *Id.*, pp.1, 4.

90. As described in Exhibits 1008 and 1011, the threat automated "bots" posed was real, and could only be met via fully automated responses, such as CAPTCHA—which by definition is "completely automated." The practical security advantages of providing fully-automated CAPTCHAs were numerous, like preventing attacks on passwords, facilitating online polls, protecting free email services, barring search engine indexing bots, and preventing worms, spam, and dictionary attacks. A POSA would have known of both these problems and the advantages provided by fully automated solutions by 2008-2009. Making a CAPTCHA method fully automated in order to provide those benefits was well known to a POSA and conventional, as reflected in both my 2002 paper, the 2005 von Ahn dissertation, Qvarfordt itself, and the many articles available at the time stressing the importance of protecting websites from attack.

91. Second, Qvarfordt discloses that the "electronic image comprises a set of imagery data other than words." Qvarfordt explains that its "automated test may comprise displaying on a computer screen ***an image***." Qvarfordt, Abstract. Qvarfordt discloses that its "encoded solution"—i.e., "the characters that may be used in the CAPTCHA, such as letters, numbers, etc."—"need not necessarily be

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a typographical character, but can be ***any recognizable image***, which also comes under the term 'encoded solution.'" *Id.*, [0032]; *see also id*. ("Also, while the examples here are given in terms of letters, any typographical character can be used, e.g., ***numbers, shapes, symbols***, etc.), [0034] (observing that "[t]he set of characters may be a larger class than letters" and may include other symbols like "***easily recognizable items, for example, animals or fruits and vegetables***").

92. Figure 10, reproduced below, shows an electronic image comprising a set of imagery data (a cat) other than words.

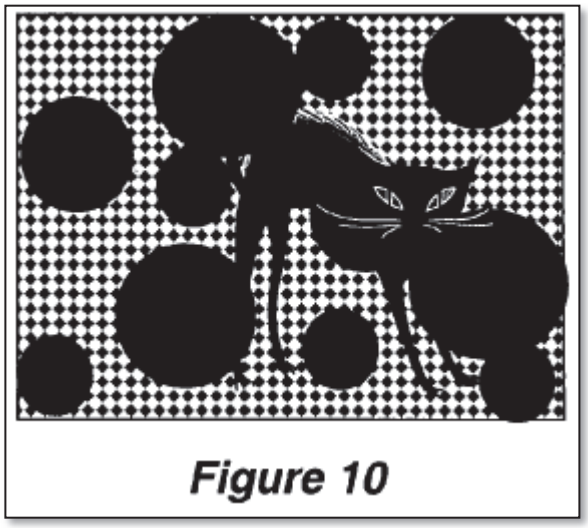

Figure 10

*Id.*, [0055] ("[I]n FIG. 10 the encoded solution is ***an image, rather than a typographical character***.").

93. Third, Qvarfordt's "electronic image is configured such that a subset of said set of imagery data for said electronic image can be made perceptible in a first image state." The electronic image in Qvarfordt's CAPTCHA test, like any

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other electronic image, is comprised of a set of imagery data—namely, a fixed number of rows and columns of pixels, which are the smallest individual element in an image, holding values that represent the brightness of a given color at any specific point.

94. When Qvarfordt's CAPTCHA takes the form of a looped animation, a foreground layer continuously obstructs part of the electronic image contained on a background layer. When the ***entire*** animation is presented continuously, the user can "easily decipher" the encoded image, "as at each point in time the user will see ***part*** of the solution and will be able to easily integrate the parts to decipher the whole." Qvarfordt, [0031]; *see also id.*, [0036] ("the sum of all frames can be set as not to give a complete image of the encoded solution" because "human perception is very good at 'completing the picture' even when elements are missing."). In this way, "[t]he portions of the encoded solution that are visible [are] changing over time" (*id*, [0036]), and, thus, only a subset of the electronic image's data is perceptible at any given time. *Id*., [0031] (only "***part*** of the solution" is visible "at each point in time"). At any given point in time, the obstructing objects in the foreground are in particular positions and only particular "part[s]" or "portions" of the encoded image are revealed. *Id*., [0031], [0036]. The exposed parts or portions of the encoded image at any particular point in time represent a "first image state" of the encoded image as claimed.

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95. Figure 10 demonstrates this limitation, as it presents a particular state of the cat image with certain portions obstructed by the "floating disks" and other portions "made perceptible" to the user as claimed. Qvarfordt, [0055]. As shown in Figure 10's snapshot of the animated CAPTCHA, the "floating disks" in the foreground layer are positioned so that the cat is not completely exposed; only a subset of the cat image is perceptible in the image state shown.

96. The prosecution history supports interpreting the "subset of said set of imagery data" made perceptible to the user in a manner that reads on Qvarfordt's disclosure of different portions of the image at different times. For example, during prosecution, the Examiner found that "Sanghavi teaches progressive CAPTCHAS including an electronic image is configured such that a subset of set of imagery data for said electronic image can be made perceptible in a first image state," citing to paragraph [0038] and Figure 6 of Sanghavi. Ex. 1004, 286. As shown in Sanghavi's Figure 6, reproduced below, "[a]t 600, a ***first portion*** of a captcha image is displayed on a display at a first time. At 602, a ***second portion*** of the captcha image is displayed on the display at a second time, wherein the second time is subsequent to the first time." Ex. 1009, [0038].

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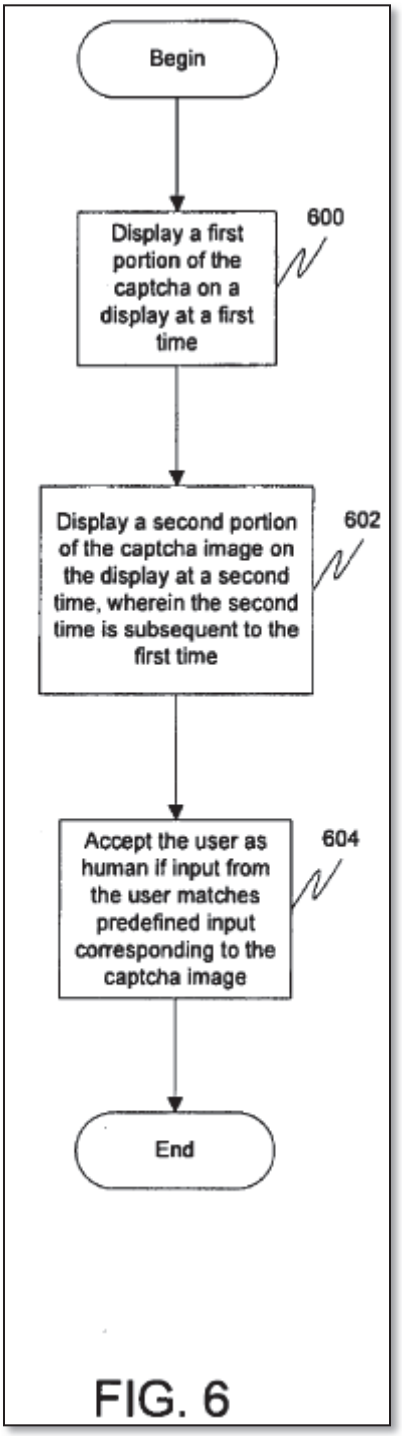


FIG. 6

Sanghavi thus similarly discloses revealing "portion[s]" of an image at different times, and the Examiner interpreted the "subset of imagery data" onto portions of Sanghavi's image. I understand that statements about a claim term made by the

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Examiner during prosecution may be evidence of how a POSA understood the term at the time the application was filed. The Examiner's interpretation is consistent with my opinion of a POSA's understanding that Qvarfordt's disclosure of different portions of the image at different times meets the claimed "subset of said set of imagery data" made perceptible to the user. Based on my review of the prosecution history, I did not see that the applicant specifically challenged that interpretation. *See generally*, Ex. 1004.

**c. Limitation [1B]**

97. Qvarfordt discloses "b. associating said electronic image with one or more concepts," as recited by limitation [1B].

98. Consistent with its plain and ordinary meaning, the '141 Patent states that "concepts" includes "ideas, people, places, things, actions, emotions, etc." Ex. 1001, 6:36-40. The solution (or a set of solutions) for each of Qvarfordt's image- based CAPTCHAs is thus a concept as claimed. As Qvarfordt explains, when a "statistically significant number of solutions" is received for a (second) set of novel image-based CAPTCHAs, "either the highest scoring solution is chosen as a correct solution, or a set of most commonly received solutions is chosen as the correct solution." Qvarfordt, [0052]. Once sufficiently vetted, novel CAPTCHAs in the second set are moved to the (first) set of vetted CAPTCHAs. *Id*. "When the CAPTCHA is moved to the first category, a

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solution or solution set is ***associated*** with it." *Id.* This association of one or more solutions with the newly vetted CAPTCHA challenge meets limitation [1B].

**d. Limitation [1C]**

99. Qvarfordt discloses "c. presenting said electronic image in said first image state and progressively revealing information over a first time period within an interface for said participant using said computing system," as recited by limitation [1C].

100. First, Qvarfordt presents the encoded electronic image in a first image state and progressively reveals information over a first time period. In Qvarfordt's looped animation CAPTCHA, a foreground layer (e.g., Figure 10's "floating disks") continuously obstructs different parts of the encoded electronic image (e.g., Figure 10's cat). As the animation runs, "at each point in time the user will see part of the solution and will be able to easily integrate the parts to decipher the whole." Qvarfordt, [0031]. As "portions of the encoded solution that are visible [are] changing ***over time***" (*id.*, [0036]), the animation progressively reveals more of the image over time. *Id*. [0031].

101. Qvarfordt teaches that "human visual systems excel at integrating low[-]resolution or conflicting images into apparently high[-]resolution and complete images ***over time***." *Id.*, [0030]. As described above in the context of Figures 3a and 3b, Qvarfordt observes that "when the lines are moving, human

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can perceive the letters easily." *Id.*, [0032], FIGs. 2a and 2b. This is further shown in Figures 2a, 2b, 3c, and 10. And, as noted in the context of Figure 10, "the various layers can be set in motion automatically, such as in an animation clip." *Id.*, [0055].

102. Thus, as demonstrated above, the time period during which Qvarfordt's animation completes a full cycle before repeating is a first time period as claimed, because additional information about the encoded image (e.g., Fig. 10's cat) is "progressively revealed" during that time period as claimed.

103. There is nothing in claim 1 that requires "progressively revealing information over a first time period" to be interpreted narrowly to require that "revealed" portions of the image remain visible and suffer no further obstruction once revealed. Indeed, the prosecution history shows that claim 1 is not so limited. As discussed above (¶96), Qvarfordt's disclosure of revealing "portions" of an image is consistent with Sanghavi's disclosure of revealing different "portion[s]" of images at different times, the Examiner found that this meets "progressively revealing information over a first time period" as claimed, and the applicant never specifically challenged that assertion. Ex. 1004, 286; Ex. 1009, [0038], FIG. 6.

104. Second, Qvarfordt's electronic image is presented and progressively revealed "***within an interface***" for the participant using a

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computing system. The '141 Patent neither defines nor discusses the claimed "interface." A POSA understood that in computing, a user interface enables a user to communicate with a computer. Here, since an electronic image is being presented in an interface, a POSA would further understand it to be a visual interface (e.g., a display screen), which is often referred to as a "graphical user interface." Qvarfordt discloses such an interface.

105. As explained above (¶¶87, 91-92), each of Qvarfordt's image-based CAPTCHAs involves displaying an image for a user to decipher, and a POSA would have understood that the image is displayed on a visual interface—namely, a display screen—which is a user interface. Hence the electronic image is presented in a "first image state and progressively reveal[ed] over a first time period within an interface."

106. Not only does Qvarfordt expressly disclose that its image is presented in an interface, but doing so would have been the conventional and obvious way to present an electronic image and/or CAPTCHA challenge to a user as Qvarfordt describes. As noted above (¶104), a user interface is the means by which the user and a computer system interact; and, as also noted above (¶41), a CAPTCHA is method of ensuring that a user accessing computer resources (e.g., websites on the Internet) is human. An interface is how the computer deploying

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the CAPTCHA (and controlling access to resources) communicates with the user (who is seeking access).

107. Numerous references disclose such an interface. For example:

- U.S. Patent Application Publication No. 2007/0201745 A1 ("Wang," Ex. 1012), published August 30, 2007 and filed January 30, 2007, expressly teaches an image-based CAPTCHA with "a two-step ***user-interface*** [that] allows quick testing for humans while being expensive for machines." Ex. 1012, [0015]; *see id*., [0017], FIG. 1.
- U.S. Patent Application Publication No. 2007/0192849 A1 ("Golle," Ex. 1013), published August 16, 2007 and filed February 10, 2006, expressly teaches a CAPTCHA "displayed on a ***user interface***." Ex. 1013, [0009], [0026]-[0027], FIGs. 1, 3-6.
- U.S. Patent Application Publication No. 2008/0066014 A1 ("Misra," Ex. 1014), published March 13, 2008 and filed September 13, 2007, expressly discloses "[t]he use of CAPTCHAs in web ***interfaces***." Ex. 1014, [0004]
- Sanghavi (Ex. 1009) teaches progressively revealing information about a CAPTCHA image within "a graphical ***interface***." Ex. 1009, [0034].

As the foregoing references show, presenting Qvarfordt's electronic image in a

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first image state and progressively revealing information over a first time period ***within an interface*** would have been a conventional and obvious way to present an electronic image and/or CAPTCHA challenge to a user as Qvarfordt describes.

**e. Limitation [1D]**

108. Qvarfordt discloses "d. automatically processing responses from the participant with the computing system to correlate an accuracy of guesses from said participant for said one or more concepts associated with said electronic image," as recited by limitation [1D].

109. First, Qvarfordt discloses "automatically processing responses." As discussed above (¶87), the "CA" in CAPTCHA stands for "Completely Automated," and Qvarfordt repeatedly describes its image-based CAPTCHA test as "automated." Alternatively, if the Board does not consider Qvarfordt to expressly disclose that its CAPTCHA steps are automated, that would have been the conventional and obvious way to implement a CAPTCHA method of the type Qvarfordt describes, as discussed above (¶¶88-90).

110. Second, Qvarfordt discloses automatically processing responses from a participant to correlate an accuracy of guesses for the concept(s) associated with the electronic image. Other than simply repeating the claim language (Ex. 1001, 4:45- 48), the specification of the '141 Patent does not describe "correlat[ing] an accuracy of guesses." Other intrinsic evidence (prosecution

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history) suggests that a guess may be characterized in a binary fashion as either correct or incorrect for the image. Ex. 1004, 286, 316-317. While the claim language and intrinsic evidence do not state what "an accuracy of guesses" should be correlated with, in the prior Google litigation, HDI maintained that the "accuracy of guesses" from a participant is correlated with the "one or more concepts associated with said electronic image" to determine if the participant successfully recognized the prompted concept, and thus, solved the CAPTCHA. Ex. 1039, ¶ 26. In the pending Cloudflare litigation, HDI similarly maintains that "responses are either deemed accurate … or inaccurate" to verify when the task is completed. Ex1061, 6-7 (¶17). Thus, to the extent correlating an accuracy of guesses relates to characterizing guesses as either correct or incorrect for the corresponding image, Qvarfordt does that.

111. I have not been asked to express an opinion as to whether HDI's interpretation of "correlat[ing] an accuracy of guesses" is correct or incorrect. I simply apply HDI's interpretation to show that Qvarfordt meets this limitation.

112. In Qvarfordt's two-set CAPTCHA embodiment, "[t]he user's response to the second [unvetted] set is used to [] determine reasonable human responses to that CAPTCHA." Qvarfordt, [0052]. When a "statistically significant number of solutions" is received for a (second) set of novel image-based CAPTCHAs, "either the highest scoring solution is chosen as a correct

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solution, or a set of most commonly received solutions is chosen as the correct solution" and that correct solution is "***associated*** with" the image. *Id.*, [0052].

113. Qvarfordt teaches adopting "CAPTCHAs that are as easy as possible to solve by humans" and that even the oft-cited threshold of 90% human success is lower than desired because 10% of users will fail, frustrating both users and service providers. *Id.*, [0005]. A POSA would have understood that in choosing "the highest scoring solution" or "set of most commonly received solutions…as the correct solution," Qvarfordt teaches choosing a "correct solution" that results in at least 90% of the "statistically significant number of solutions" received being correct. *Id.*, [0052]; *see also id*. [0005]. A POSA would have further understood this involves correlating the accuracy of guesses in the "statistically significant number of solutions" to ensure that the chosen "correct solution" achieves the desired goal of having at least 90% of users succeed. *Id.*, [0052]. For example, choosing multiple user guesses as the "correct solution" involves correlating a sufficient number of those guesses as "correct" for the image to ensure that the desired number of human users (e.g., above 90%) will correctly identify the image. *Id.*, [0052].

114. To the extent Qvarfordt is considered to not expressly disclose correlating the accuracy of the guesses included in the "statistically significant number of solutions" when choosing "the highest scoring solution" or "set of most

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commonly received solutions…as the correct solution," that would have been the conventional and obvious way to implement what Qvarfordt discloses, as this would have been the straightforward way to ensure that the chosen "correct solution" "associated with" the image results in at least 90% of human users succeeding. Qvarfordt, [0052].

115. Third, to the extent this limitation is read to require more than one response/guess to a CAPTCHA challenge from a single participant, Qvarfordt still meets this limitation. Qvarfordt discloses embodiments of "animation[s] comprising…***a plurality of recognizable images***." Qvarfordt, [0012]. For those embodiments, a participant is tasked with correctly guessing the concept or solution associated with each of the "plurality of recognizable images," and Qvarfordt's CAPTCHA system automatically processes those responses to choose a "correct solution" for ***each*** of the images in the manner discussed above.

**f. Limitation [1E]**

116. Qvarfordt discloses "e. calculating a percentage of participants able to decode and accurately guess said one or more concepts within a predetermined time," as recited by limitation [1E].

117. First, like Qvarfordt, the '141 Patent recognizes the conventional threshold of 90% human success rate to make a challenge "suitable for inclusion in a CAPTCHA system." Ex. 1001, 14:5-13. A POSA would have thus

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understood that limitation [1E] is concerned with "***measuring efficacy*** by determining a percentage of users who are able to solve the CAPTCHA correctly within a defined period of time." *Id*., Abstract.

118. As discussed in connection with [1D], Qvarfordt teaches (or alternatively it would have been obvious to implement Qvarfordt by) choosing a "correct solution" that results in at least 90% of the "statistically significant number of solutions" received being correct. Qvarfordt, [0052]. A POSA would have understood that this involves calculating the percentage of participants that provided the "statistically significant number of solutions" whose guesses satisfy the solution or set of solutions adopted as the "correct solution." *Id*.

119. To the extent that Qvarfordt is considered to not expressly disclose calculating such a percentage, that would have been the conventional and obvious way to implement what Qvarfordt discloses, as this would have been the straightforward way to ensure the chosen "correct solution" will result in (at least) 90% of human users succeeding. *Id*.

120. Indeed, Qvarfordt ensures the number of participant solutions used in determining the "correct solution" is "statistically significant." *Id*. If Qvarfordt did not calculate the percentage of those participants "able to decode and accurately guess said one or more concepts" as claimed by offering a guess that correlates with the "correct solution," it is difficult to imagine how Qvarfordt

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could ensure the "correct solution" chosen for the CAPTCHA would result in 90% of human users succeeding.

121. "[C]alculat[ing] a percentage of participants able to decode and accurately guess said one or more concepts" requires only knowing the number of participants who correctly guessed the concept(s) and the total number of participants who provided guesses. Qvarfordt has that information and the calculation itself is trivial: the number of participants who correctly guessed the concept(s) divided by the total number of participants provides "a percentage" of participants able to "decode" Qvarfordt's "encoded" solution and accurately guess the concept(s) associated with the image. A POSA would have had a reasonable expectation of success in implementing Qvarfordt to calculate this percentage.

122. Making such a calculation was the conventional and obvious way to measure efficacy of CAPTCHAs. As Qvarfordt notes and the '141 Patent confirms, an "often cited" threshold for CAPTCHA systems characterizes them, in part, based on ***percentage*** success rate (90%) for humans. Qvarfordt, [0005]; Ex. 1001, 14:5-13.

123. Second, a POSA would understand that calculating a percentage of users who are able to solve Qvarfordt's CAPTCHA correctly "***within a predetermined time***" would have been the conventional and obvious way to

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assess CAPTCHA responses. Initially, the '141 Patent says nothing about how long it should take a human user to solve its claimed CAPTCHAs. While Qvarfordt likewise does not expressly say how long it should take a human to solve its CAPTCHAs, Qvarfordt indicates the test should be "***easy for humans to solve*** but hard for computers, [so] the service providers can increase the likelihood that their users are humans." Qvarfordt, [0004]; *see also id*., [0005] ("it is highly desirably to create CAPTCHAs that are ***as easy as possible*** to solve by humans yet preserve or increase the difficulty for computers to solve them"), [0008] ("there is a need in the art for improved CAPTCHAs that are ***easy for human[s]***, but very difficult for a machine to solve"). A POSA would have understood that CAPTCHAs that are "easy" should be solved quickly.

124. It was conventional to place a time limit on CAPTCHA challenges within which the user must respond before the challenge is removed, because a challenge without a time limit risks vulnerability to bot attacks by giving a computer unlimited time to "crack" the CAPTCHA.

125. For example, U.S. Patent No. 6,195,698 ("Lillibridge," Ex. 1015), published in 2001, and filed in 1998, discloses a system for a "computer to be able to distinguish an ordinary user from an automated agent [i.e., a "bot"], so that access by the agent can be denied, and while still permitting access to real human users," that includes a timer. Ex. 1015, 2:60-64. More than ten years before the

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'141 Patent, Lillibridge teaches that "***[i]f the correct answer is not received within a predetermined amount of time***, the connection between the client and server computer is terminated by the server on the assumption an automated agent is operating in the client computer on behalf of the user." *Id*., Abstract, 3:29-34.

126. For further example, in "CAPTCHA: Using Hard AI Problems for Security" ("vonAhn," Ex. 1007), a 2003 publication (*see supra* ¶¶206-208), von Ahn et al. recognize that "it is preferable for humans to be able to solve captchas in a very short time" because "captchas which take a long time for humans to solve are probably useless for all practical purposes." vonAhn, 298. To that end, vonAhn provides an image-based CAPTCHA with a timer. *Id.*, 305.

127. For further example, Golle (Ex. 1013) discloses CAPTCHAs that must be solved within a predetermined time. "In one embodiment (at 208), the CAPTCHA token 102 remains in the active state once the interaction instructions [] are satisfied for a time interval on the order of one to two minutes. … Once the time interval expires, the CAPTCHA token 102 transitions to the inactive state, and re- transitions back to the active state only once the currently issued interaction instructions $i_t$, are re-satisfied." Ex. 1013, [0030]. Golle illustrates this in Figures 1 and 2, reproduced and annotated below.

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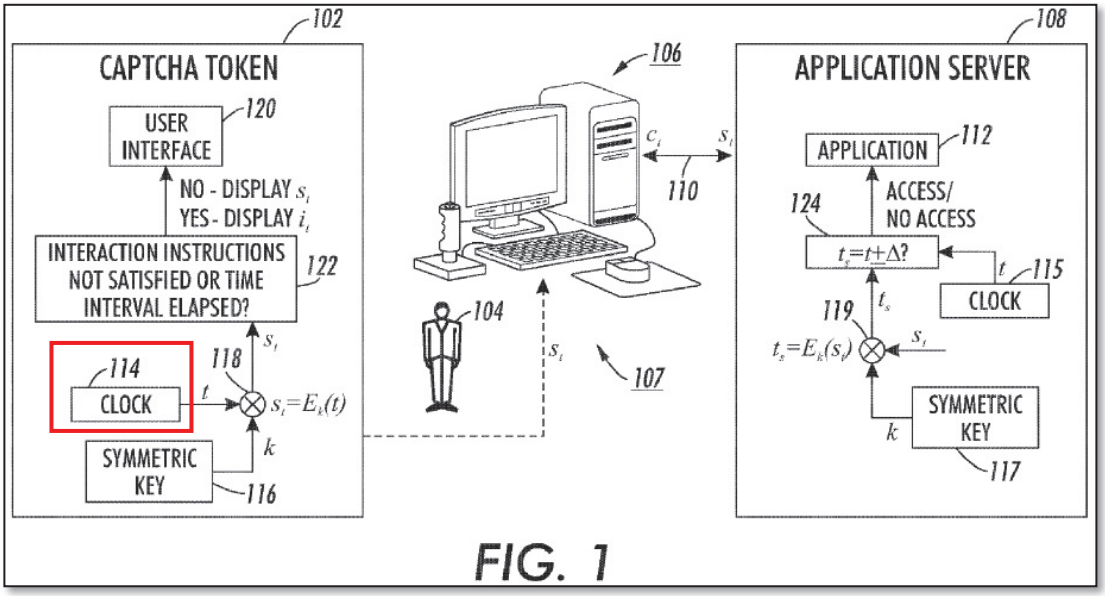


FIG. 1

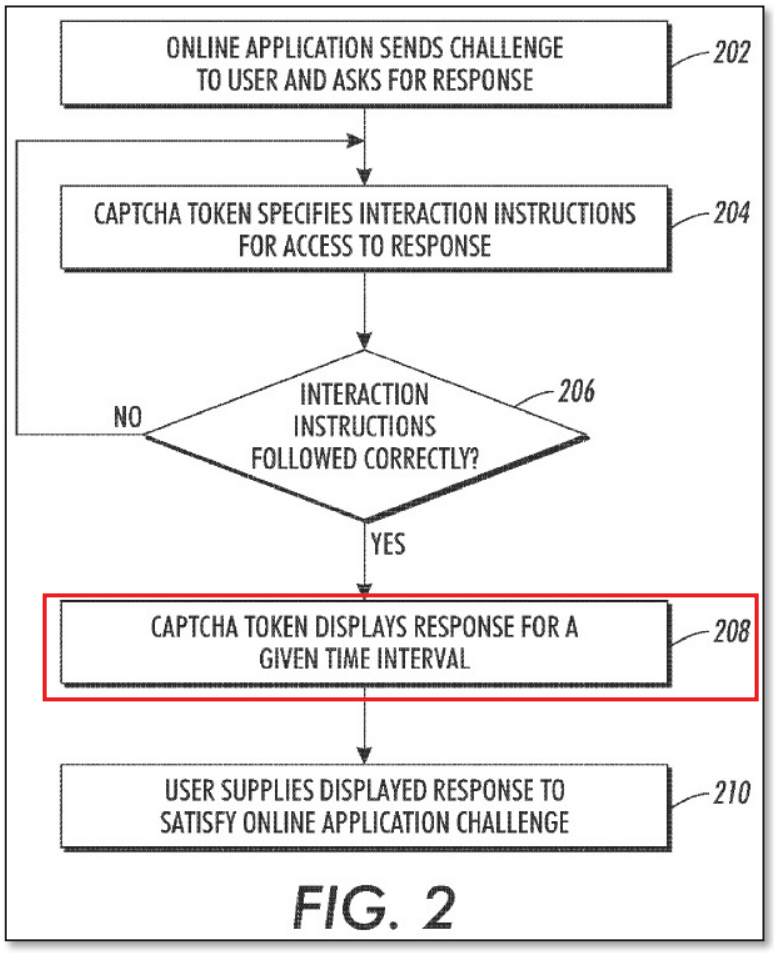


FIG. 2

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128. For further example, U.S. Patent Application Publication No. 2009/0249477 A1 ("Punera," Ex. 1016), published on October 1, 2009, and filed on March 28, 2008, discloses a CAPTCHA system that measures the user's response time in answering the question. Ex. 1016, Abstract. In particular, Punera teaches an embodiment where "the user 120 may have to ***provide the answer within a predetermined time***." Ex. 1016, [0026]. Punera explains that "[t]his may further help determine whether the user 120 is human because a human may be able to answer a question posed more quickly than a computer." *Id.* Punera's timer is shown in Figure 4, reproduced and annotated below. Punera states that "[t]he timer may be utilized to measure elapsed time between communicating the image to the user and receiving a response," and that the timer "may be stopped so as to measure the elapsed time between communicating the message at block 420 and receiving the response at block 425." *Id*., [0035]. Further, "[a]t block 435, if the response matches the registration data then at block 440 then, a computer…may determine whether the amount of time that may have elapsed between communicating the image to the user at block 420 and receiving the correct response from the user at block 425 is less than a threshold amount of time." *Id*., [0036].

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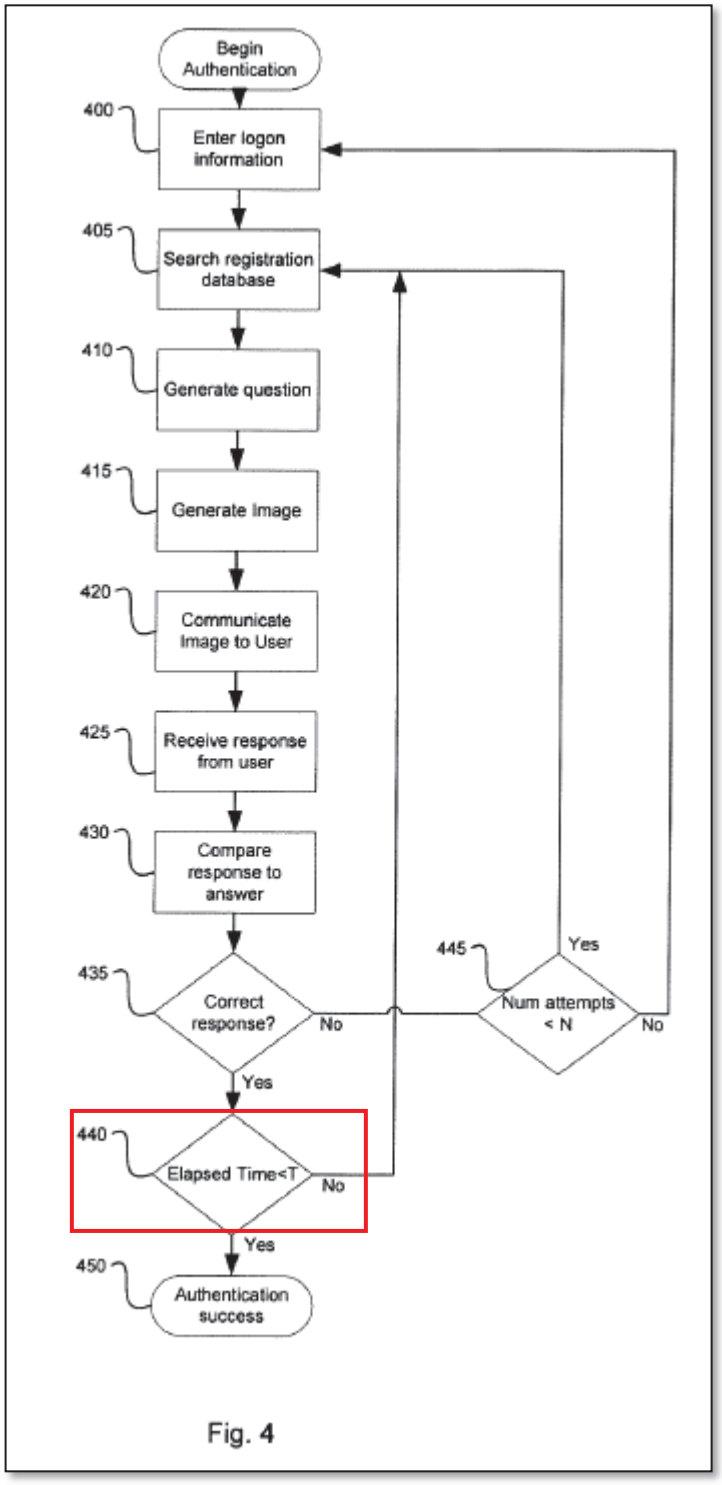


Fig. 4

129. The goal of using unvetted CAPTCHA's in Qvarfordt is to mimic use cases where the CAPTCHA will be deployed to grant/deny access, by collecting

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a statistically significant set of user responses. Qvarfordt, [0052]. A POSA would have understood that to make the user responses truly significant, they should be received from users under the same conditions that users will face when the CAPTCHA is deployed to control access, including a time limit. Thus, a POSA would have imposed a time limit on the participants responding to Qvarfordt's unvetted CAPTCHAs so that responses would be recognized as accurate guesses if they are provided "within a predetermined time" as claimed.

130. Implementing Qvarfordt to include a conventional timer would have been within a POSA's capabilities. For example, a POSA would have understood that operating systems provide a standard function that allows a program to set a timer (sometimes called countdown timer). Once the timer reaches 0, the operating system sends a signal to the program that set the timer. The program then knows that a certain amount of time has elapsed and can take action based on this. This is sometimes called a "timeout" event.

**3. Claim 2**

131. Qvarfordt discloses "[t]he method of claim 1 wherein said progressively revealing information comprises presenting said electronic image at different time intervals with differing levels of resolution, noise and/or pixelation," as recited by claim 2.

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132. First, I have been informed by counsel that "resolution, noise and/or pixelation" covers resolution alone, noise alone, pixelation alone, or any combination; it does not require all.

133. Second, Qvarfordt's "progressively revealing information" includes presenting the electronic image "at different time intervals with differing levels of…noise[.]" The '141 Patent states that "noise" may be ***added*** to an image, but does not define "noise" and thus gives it its ordinary meaning. Ex. 1001, 15:18-21. A POSA would have understood that the addition of "noise" to a CAPTCHA image means adding "irrelevant or meaningless data or output occurring along with desired information." Ex. 1033 (definition of "noise").

134. For example, consistent with this understanding, in "IMAGINATION: A Robust Image-based CAPTCHA Generation System" ("Datta," Ex. 1017), a printed publication dated November 2005, Datta et al. disclose an image-based CAPTCHA where "[c]ontrolled composite distortions on the images ***maintain visual clarity for recognition by humans while making the same difficult for automated systems***." Ex. 1017, 331. The distortions include, for example, "noise addition," which is clearly shown in Figure 5, reproduced below.

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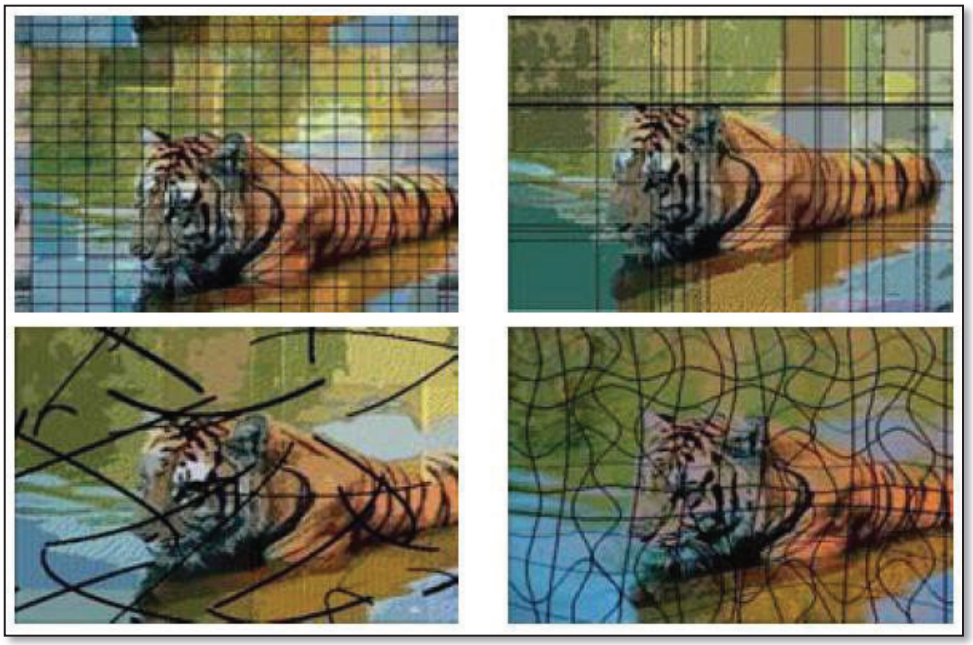

Ex. 1017, FIG. 5; *see id*., 334 (observing that "perceptual quality of the images have not deteriorated beyond recognition), FIG. 4 (illustrating framework for composite distortions where "choice of noise type and density" is added to the CAPTCHA image). The added noise (in the foreground) is clearly intended to partially obscure the background image (the tiger) and/or for the black noise lines shown to be confused with and confound recognition of the tiger's black stripes to make recognition "difficult for automated systems" while maintaining "visual clarity for recognition by humans." *Id*., 331.

135. A POSA would have understood that in Qvarfordt's looped animation, the foreground layer (e.g., Figure 10's "floating disks") introduces noise that obstructs the encoded electronic image (e.g., Figure 10's cat). As the animation is presented continuously, the levels of noise obscuring the encoded

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solution differ over time because different parts (and differing amounts) of the encoded image are obstructed at different points in time. Qvarfordt, [0031], [0036] ("portions of the encoded solution that are visible [are] changing over time"). To be sure, Qvarfordt's Figure 10, for example, shows additional noise in the form of the "wallpaper" layer with the "diamond shape pattern." Qvarfordt, [0053], [0055]. Again, a POSA would have understood that this noise is likewise meaningless data intended to make recognition of the solution more difficult for computers.

136. Qvarfordt also explains that its invention utilizes the ability of humans to process "low resolution" images. Qvarfordt, [0030]. While the '141 Patent does not discuss "resolution" outside of repeating the claim language (Ex. 1001, 2:26-28, 4:51-53), a POSA would have understood that the obscuring of portions of the encoded image in Qvarfordt reduces the "resolution" of the image, and that the level of resolution differs over time as different parts of the encoded image are revealed. Qvarfordt, [0031], [0036]. Thus, Qvarfordt's "progressively revealing information" also includes presenting the electronic image "at different time intervals with differing levels of resolution" as claimed.

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### 4. Claim 3

137. Qvarfordt discloses "[t]he method of claim 1 further including a step: using said electronic image within a CAPTCHA system for granting access to resources of a second computing system," as recited by claim 3.

138. For an image in a novel CAPTCHA challenge of the type relied upon to meet claim 1, after a "correct solution" is chosen, the CAPTCHA is "moved to the first category" and is used to control access so that "***a user entering any of the solution[s] from the set, is granted access***." *Id.*, [0052] ("answers to the first set determine whether the entity ***accessing the site*** is a human, and that information is used [] to ***allow access to resources"***). Qvarfordt discloses that "[t]he subject invention relates to…***validation of users accessing website[s]***." *Id*., [0002]; *see also id*. [0004] (CAPTCHA used to control access to information or services on the Internet). Websites are located within computing systems, namely, servers. A website is accordingly located within a "second computing system" as claimed.

### 5. Claim 4

139. Qvarfordt discloses "[t]he method of claim 3 wherein said second computing system is associated with a portable electronics device," as recited by claim 4.

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140. The '141 Patent does not discuss what it means for the second computing system to be "associated with a portable electronics device." Nevertheless, to the extent HDI maintains (in the pending litigation, in the prior litigation, or otherwise) that when the "second computing system" is a website, and the website is "***associated*** with a portable electronics device" (e.g., a laptop or mobile phone) by being intended for display on such a portable electronic device (and the portable electronic device is capable of displaying the website), then claim 4 is rendered obvious by an obvious use of Qvarfordt's system.

141. I have been asked to assume for purposes of my opinion in this proceeding that HDI maintains this position. I have not been asked to express an opinion as to such an interpretation of claim 4 is correct or incorrect. I simply apply this interpretation to show that Qvarfordt renders obvious claim 4.

142. A POSA would have understood that the claimed "portable electronics device" may be, for example, a laptop or a mobile phone. Qvarfordt does not mention a laptop in these words, but displays its animated CAPTCHA "on a computer screen" and receives user actions via a keyboard or mouse input. Qvarfordt, Abstract, [0012], [0041]. Thus, a POSA would have understood Qvarfordt to disclose that its system is used by laptop (and desktop) computer users.

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143. To the extent Qvarfordt is not understood to disclose the use of a laptop or other portable device, it would have been obvious to use Qvarfordt's system with laptop users, as laptops were ubiquitous and conventionally used to access and display websites of the type Qvarfordt describes.

144. For example, Sanghavi (Ex. 1009), which likewise teaches a progressive CAPTCHA, discloses that its invention may be "implemented in a network containing ***personal computers 1002***, media computing platforms 1003 (e.g., cable and satellite set top boxes with navigation and recording capabilities (e.g., Tivo)), ***handheld computing devices (e.g., PDAs) 1004***, ***cellphones 1006***, or any other type of ***portable communication platform***." Ex. 1009, [0045]. Figure 10, reproduced below, clearly shows that one of the "personal computers 1002" is a laptop. Sanghavi further teaches that "[u]sers of these devices may navigate the network and enter input in response to the displaying of captcha on local displays, and this information may be collected by server 1008," and that the CAPTCHAs may be "served up from a remote site, e.g., in a Web page (also represented by server 1008 and database 1010)." *Id.*

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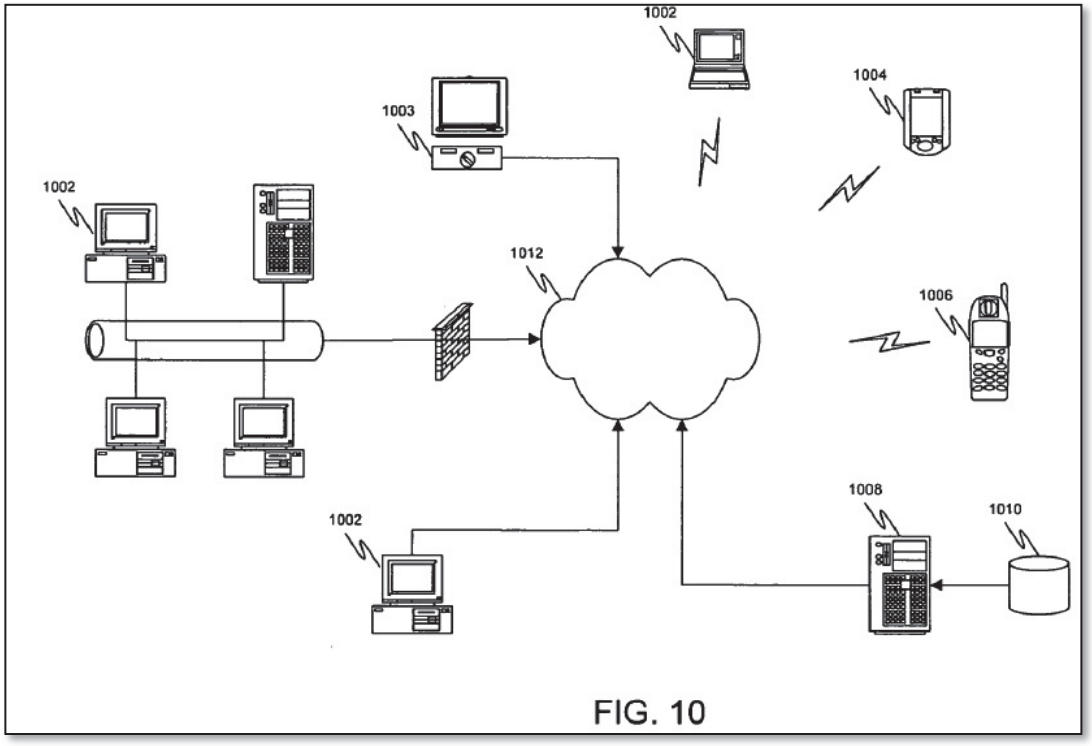


FIG. 10

145. For further example, as shown in Figure 1, reproduced below, Mates (Ex. 1010) teaches that "[t]he recipient computer 14 includes a browser 26, such as an Internet Web browser, to submit request for pages 18 to the request server 10 and display and render pages 18 returned by the request server 10, which may include a [CAPTCHA] challenge image 24, on an attached monitor 30." Ex. 1010, [0015]. Mates teaches that "[t]he recipient computer 14 may comprise a desktop, ***laptop***, telephony device, ***personal digital assistant (PDA)*** or other suitable computational device known in the art." *Id.*

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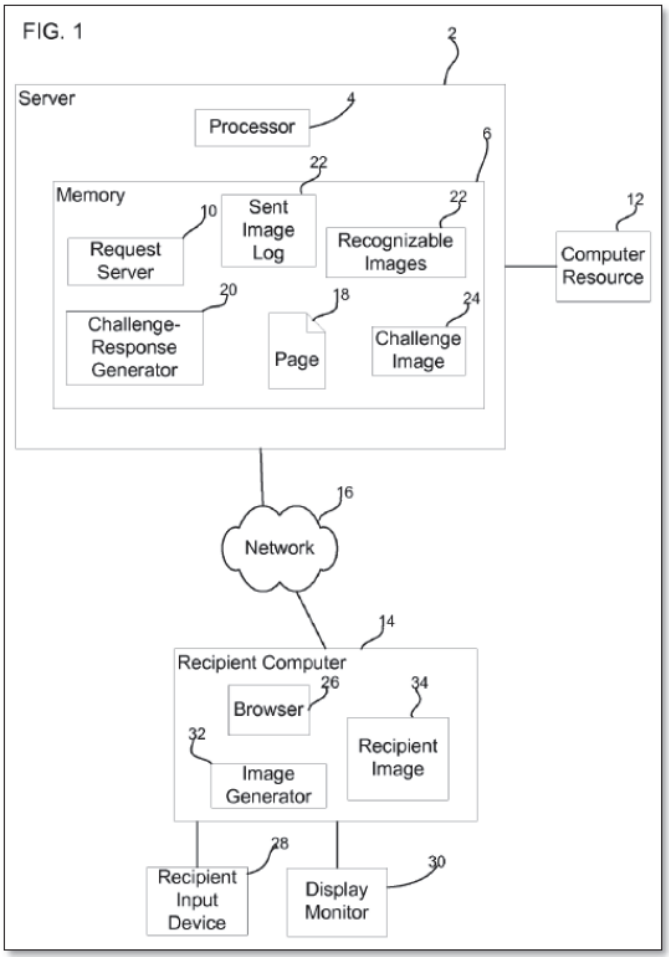


146. For further example, as shown in Figure 1, reproduced below, U.S. Patent No. 8,510,795 ("Gargi," Ex. 1018), published August 13, 2013 and filed September 4, 2007, discloses "a personal computer (PC) in one embodiment, or a mobile handset or any other electronic computing devices" that "communicates with the CAPTCHA server system 130 through the computer network 120." Ex. 1018, 3:28-31. "[I]n practice there can be thousands or millions of clients 110 using a CAPTCHA server system 130 in some embodiments." *Id*., 3:35-37. Gargi further discloses that a "web server 140 serves

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web pages to the clients 110, and can request a video test from the CAPTCHA server system 130 to be included in such pages," and "[t]he client 110 executes a web browser 115." *Id*., 3:37-45.

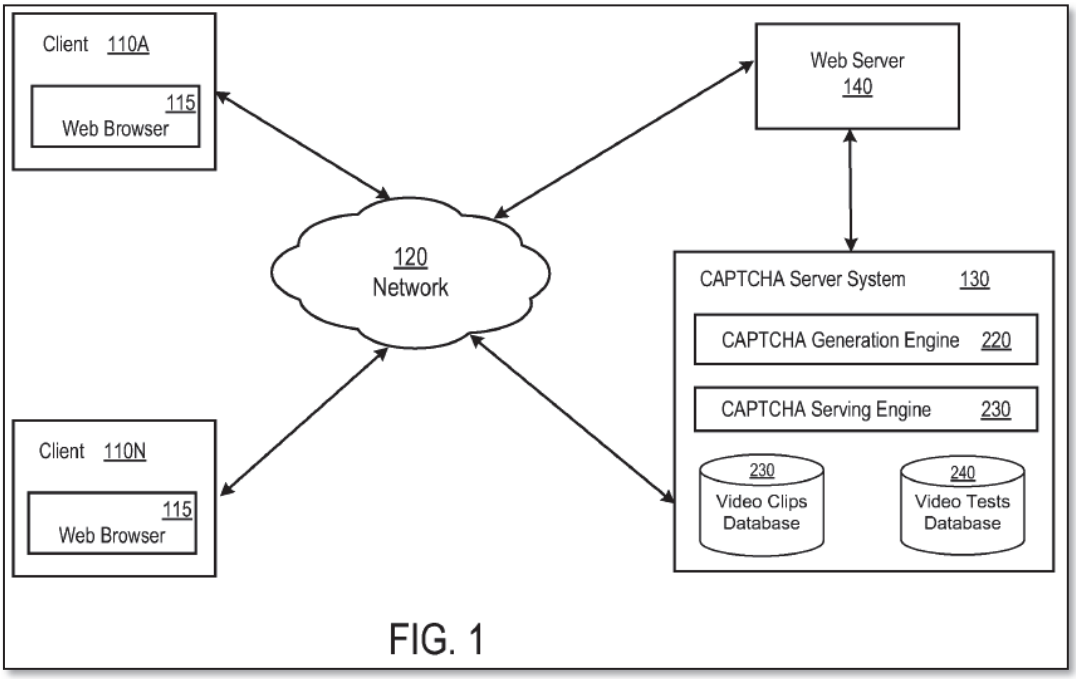


FIG. 1

### 6. Claim 5

#### a. Preamble [5PRE]

147. As with claim 1's preamble (¶79), I express no opinion on whether the preamble of claim 5 limits the claim. To the extent claim 5's preamble limits the claim, however, my opinion is that Qvarfordt meets the preamble because Qvarfordt discloses "[a] method of providing a visual Completely Automatic Public Turing Test To Tell Humans And Computers Apart (CAPTCHA) challenge," as recited by claim 5's preamble.

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148. Qvarfordt discloses a method of providing a visual CAPTCHA challenge at least with its vetted set of image-based CAPTCHAs, where answers to those CAPTCHAs "determine whether the entity accessing the site is a human, and that information is used [] to allow access to resources[.]" Qvarfordt, [0052]. The test Qvarfordt provides includes both a vetted CAPTCHA to control access and an unvetted CAPTCHA, and the user does not know which test controls access. *Id.*, [0052] ("[U]sers are required to solve multiple CAPTCHAs consisting of two sets, one already vetted CAPTCHAs and a set of novel CAPTCHAs.").

**b. Limitation [5A]**

149. The only difference between limitations [5A] and [1A] is that limitation [5A] refers to "said imagery data" whereas limitation [1A] refers to "said ***set of*** imagery data." The omission of "set of" in limitation [5A] appears to be a typo because both claims recite "set of imagery data."

150. In Qvarfordt's two-set CAPTCHA embodiment, "users are required to solve…one already vetted CAPTCHAs and a set of novel CAPTCHAs," and "[a] user does not know which is which and is required to attempt all elements of both sets." Qvarfordt, [0052]. The answers to the first set of (vetted) CAPTCHAs "determine whether the entity accessing the site is a human, and that information is used both to allow access to resources and to decide whether to use that entity's

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labels for the CAPTCHAs in the second set." *Id*. "The user's response to the [unvetted] second set is used to determine reasonable human responses to that CAPTCHA and assess[] how vulnerable the CAPTCHA is for attacks." *Id*. Thus, Qvarfordt's presentation of the unvetted CAPTCHA as part of its test meets limitation [5A] for the same reasons it meets limitation [1A]. *Supra* ¶¶86-96.

151. Qvarfordt's presentation of the vetted CAPTCHA also meets limitation [5A] as the vetted CAPTCHA automatically elects an electronic image for which a subset of the imagery data is made perceptible in a first state in the same manner as the unvetted CAPTCHA discussed in connection with limitation [1A]. *Supra* ¶¶86- 96.

**c. Limitation [5B]**

152. Limitation [5B] is identical to limitation [1B]. As discussed above (¶98), each image-based CAPTCHA in Qvarfordt is associated with a solution (or solution set), which is a concept as claimed. That is, "when the [previously unvetted] CAPTCHA is moved to the first category, a solution or solution set is ***associated*** with it." Qvarfordt, [0052]. This association of one or more solutions with the newly vetted CAPTCHA challenge meets limitation [1B].

153. I have been informed by counsel that while a method claim recites the steps of the method in a particular order, the claim is not limited to performance of the steps in the order recited, unless the claim explicitly or

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implicitly requires a specific order. Claim 5 does not impose any restriction on an order in which the recited steps must occur. Thus, for a vetted CAPTCHA presented in limitation [5A], limitation [5B] is met by the association of the solution with that CAPTCHA that occurred when the CAPTCHA was "moved to the first [vetted] category." Qvarfordt, [0052].

**d. Limitation [5C]**

154. The only difference between limitations [5C] and [1C] is that limitation [5C] recites "progressively revealing information in said electronic image over a first time period" whereas limitation [1C] recites "presenting said electronic image in said first image state and progressively revealing information over a first time period." During prosecution, the applicant treated these limitations as conveying the same subject matter—namely, progressively revealing an image. Ex. 1004, 265- 266, 316.

155. Qvarfordt meets limitation [5C] for the same reasons it meets limitation [1C]. *Supra* ¶¶99-107. The way Qvarfordt presents a CAPTCHA and progressively reveals the image does not change when the CAPTCHA is "moved to the first [vetted] category," so Qvarfordt's vetted CAPTCHAs meet [5C] for the same reason Qvarfordt's unvetted CAPTCHAs meet [1C].

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### e. Limitation [5D]

156. Qvarfordt discloses "d. automatically processing responses from the participant with the computing system to detect if a guess from said participant for said one or more concepts associated with said electronic image meets a required threshold," as recited by limitation [5D].

157. First, Qvarfordt discloses "automatically processing responses." As discussed above (¶87), the "CA" in CAPTCHA stands for "Completely Automated" and Qvarfordt repeatedly describes its image-based CAPTCHA test as "automated." Alternatively, if the Board does not consider Qvarfordt to expressly disclose that its CAPTCHA steps are automated, that would have been the conventional and obvious way to implement a CAPTCHA method of the type Qvarfordt describes for the same reasons discussed previously. *Supra* ¶¶88-90.

158. Second, Qvarfordt automatically processes responses from a participant with the computing system to detect if a guess from the participant for the concept(s) associated with the electronic image meets a required threshold. The '141 Patent does not discuss "threshold" beyond repeating the claim language (Ex. 1001, 4:66- 5:3); but describes embodiments where the processing of the user's guess is binary (it is either correct or not) with no degrees of correctness in between (e.g., the patent states that "a CAPTCHA challenge system (not shown) could introduce visual content to be reviewed by humans to determine what

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appropriate tags/concepts are presented for the image in question" and "[t]he content tags represent correct responses or answers that may be associated with the [image] in question"). *Id.*, 10:41-43, 14:5-8. Consistent with its plain and ordinary meaning the threshold is simply "a level, point, or value above which something is true or will take place and below which it is not or will not." Ex. 1033.

159. During prosecution, the Examiner (twice) found that Mates (Ex. 1010) met this limitation (and limitation [1D]) by teaching a CAPTCHA challenge where the system determines whether "recipient input" for the challenge image, "such as a description of the recognizable image [] embedded in the challenge image…***matches*** a descriptor associated with" and maintained for the image. Ex. 1004, 226, 285-286; Ex. 1010, [0023]. The applicant never challenged that interpretation.

160. Thus, a POSA would have understood the "required threshold" as claimed to be an indication of the solution to the CAPTCHA that the system recognizes as correct.

161. Each of Qvarfordt's vetted CAPTCHAs has been associated with a "correct solution" (see above ¶98) that is "either a highest scoring solution…or a set of most commonly received solutions" and "a user entering any of the solution[s] from the set, is granted access." Qvarfordt, [0052]. While Qvarfordt

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does not expressly use the word "threshold," a POSA would have understood that in Qvarfordt's CAPTCHA system, some user responses will be "correct," and others will "fail" to differentiate a human user from a computer. Qvarfordt includes the idea that different people may provide different answers when shown, say, an image of a cat. It collects all of these answers during the vetting process and employs a "set of most commonly received solutions." A POSA would have understood that this is very much like the concept of a threshold. For example, one user might give the same answer as some other previous user, but unless the answer was chosen for inclusion in the set of answers determined during the vetting process because it contributed toward attaining the 90% success goal, the user will be rejected. Thus, a POSA would have understood that when Qvarordt's system processes a participant's guess to determine whether it meets the "correct solution" so as to grant access to the user, it detects whether the guess meets a threshold as claimed.

162. Indeed, the '141 Patent's named inventor referred to such "thresholds" for identifying an acceptable response in a CAPTCHA system in another patent application filed the same week as HDI's Provisional in June 2008. Ex. 1019, [0119]-[0120], [0135], [0160].

163. Alternatively, if the Board does not consider Qvarfordt to teach a "required threshold," as claimed, using a threshold would have been the

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conventional and obvious way to implement the CAPTCHA method Qvarfordt discloses to differentiate human from computer input. It was well-known to implement CAPTCHA systems using a threshold to differentiate human versus computer input. For example, U.S. Patent Application Publication No. 2007/0250920 ("Lindsay," Ex. 1020), describes multiple "threshold value[s]" in the context of biometrics security, a closely related field. Ex. 1020, [0297] ("The user authentication apparatus includes a password input unit which determines whether a password has been input; a storage unit which stores a registered password[;]…a threshold value setting unit which sets a first threshold value if the input password matches with a registered password and sets a second threshold value if the input password does not match with the registered password."). The use of such thresholds to determine whether some user responses will be "correct," and whether others will "fail" to differentiate a human user from a computer, was the conventional and common way to generate results from a CAPTCHA.

164. Third, to the extent this limitation is read to require more than one ***response*** to a CAPTCHA challenge, Qvarfordt still meets this limitation. As noted above (¶115), some challenges present images with multiple objects the user is challenged to identify.

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**f. Limitation [5E]**

165. As discussed for limitation [5B], claim 5 does not impose any restriction on an order in which the recited steps must occur. Thus, for a vetted CAPTCHA presented in limitations [5A], [5C] and [5D], limitation [5E] is met by the earlier processing Qvarfordt performs when that CAPTCHA was still unvetted, including determining a percentage of participants that provided the "correct solution" that was later associated with that CAPTCHA when it was "moved to the first [vetted] category." Qvarfordt, [0052].

166. Thus, Qvarfordt meets or renders obvious "determining a percentage of participants with guesses meeting the required threshold within a predetermined time," as recited by limitation [5E] for substantially the same reasons discussed in connection with limitation [1E], which is substantively similar. During prosecution, the applicant treated limitations [1E] and [5E] as conveying the same subject matter with "similar language." Ex. 1004, 310, 315-317. A POSA likewise would not have discerned any substantive difference between "calculating a percentage of participants able to decode and accurately guess said one or more concepts" (limitation [1E]) and "determining a percentage of participants with guesses meeting the required threshold" (limitation [5E]).

167. As discussed in connection with [1E] and [5D] (¶¶117-130, 157-164 above), Qvarfordt teaches (or alternatively it would have been obvious to

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implement Qvarfordt by) choosing a "correct solution" that results in at least 90% of the "statistically significant number of solutions" received being correct within a predetermined time. *Id.*, [0052]. A POSA would have understood this involves calculating the percentage of participants (i.e., those that provided the "statistically significant number of solutions") whose guesses "meet[] the required threshold" (i.e., satisfy the solution or set of solutions adopted as the "correct solution") within a predetermined time. Qvarfordt, [0052]. Accordingly, Qvarfordt meets limitation [5E].

168. To the extent HDI argues that claim 5's method steps require a specific order, such that limitation [5E] must occur later in the method, Qvarfordt still meets or renders obvious this limitation. "[D]etermining a percentage of participants with guesses meeting the required threshold within a predetermined time" after the CAPTCHA has been deployed for access control would have been the conventional and obvious way to implement a CAPTCHA method of the type Qvarfordt describes because this would have been the straightforward way to ensure the CAPTCHA's efficacy on an ongoing basis. A POSA would have known—and, indeed, it would have been common practice—to implement monitoring of an access control system of the type Qvarfordt describes to measure its performance on an ongoing basis, since security measures such as CAPTCHA challenges are under constant attack by online adversaries. A measure that proves

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effective today may not be effective against attackers a month from now. The same was true at the time of the '141 Patent (and earlier).

169. For example, U.S. Patent Publication No. 2010/0077209 A1 ("Broder," Ex. 1053), filed on September 24, 2008, recognizes that bots (or "spammers") "have caught up with the captcha technology by developing programs that can 'break' the captchas with reasonable accuracy," and that it is thus "important to stay ahead of the spammers by improving the captcha mechanism and push the spammers' success rate as low as possible." Ex. 1053, [0005]. To that end, Broder discloses a CAPTCHA system that "assess[es] the answers to the captchas and track[s] correct and incorrect…answers, and classif[ies] the captchas that receive incorrect answers from a suspected robotic user for inclusion in a hard set." *Id.*, [0009]. Broder may also ultimately remove hard CAPTCHAs "that have an undesirable human failure rate." *Id.*, [0018]-[0019], FIGs. 1-2.

170. Additionally, U.S. Patent Publication No. 2009/0055910 A1 ("Lee," Ex. 1054), filed on April 15, 2008, discloses a "trend monitoring module" to "monitor the number of CAPTCHA tests issued to users, the number of tests solved and the number of successful authentications. The trend monitoring module may measure an impact on a flow of transactions in the example commerce system based on the total number of CAPTCHAs issued, the number solved and

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the number of successful transactions." Ex. 1054, [0027]; *see id*., [0063], FIGs. 1-2. According to Lee, an analysis of such data "may yield a number [of] malicious code attempts to gain access" to the protected resources. *Id.*, [0047].

171. Further, U.S. Patent Publication No. 2007/0150745 A1 ("Peirce," Ex. 1055), published June 28, 2007, and filed in December 2005, in the related field of biometric authentication, discloses an "authentication system" that includes "an audit module" "configured to monitor the authentication process and to provide one or more revised threshold scores which are based on an analysis of the performance of the authentication system over a predefined time period using current threshold scores." Ex. 1055, [0020]; *see id*., Abstract ("The system includes an audit function which is configured to monitor the performance of the system over a defined time period and to provide for an updating of the authentication criteria as required."), [0022], [0047]-[0050].

172. A POSA would have understood that an obvious way to implement such monitoring is to constantly measure the success rate of CAPTCHA guesses, and to signal a system administrator when the success rate becomes suspiciously high (since it must be assumed that some amount of the traffic to a website is always coming from bots programmed by attackers). This would necessitate "determining a percentage of participants with guesses meeting the required threshold within a predetermined time," acknowledging that some of the

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successful guesses are coming from bots programmed to defeat the CAPTCHA system.

**7. Claim 7**

173. Claim 7, which recites "[t]he method of claim 5 wherein the CAPTCHA challenge is embodied in a computer readable form and implemented as a routine executing on a portable computing device which also has motion and/or orientation sensors," would have been obvious over Qvarfordt.

174. The '141 Patent admits that it does not show or describe the details of "the various software routines, executable code, etc., required to effectuate the functionality" of the invention. Ex. 1001, 26:4-10. Indeed, the '141 Patent states that "the details of the various software routines, executable code, etc., required to effectuate the functionality discussed above in such modules ***are not material to the present invention***, and may be implemented ***in any number of ways known to those skilled in the art***." *Id*.

175. To the extent HDI maintains (in the pending litigation, in the prior litigation, or otherwise) that claim 7 covers a portable computing device (with motion and/or orientation sensors) capable of accessing a web-based CAPTCHA challenge that is located within a server accessed via the Internet, then claim 7 is rendered obvious by an obvious use of Qvarfordt's system.

176. I have been asked to assume for purposes of my opinion in this proceeding that HDI maintains this position. I have not been asked to express an

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opinion as to whether such an interpretation of claim 7 is correct or incorrect. I simply apply this interpretation to show that Qvarfordt renders obvious claim 7.

177. Qvarfordt displays its CAPTCHA on a computer. Qvarfordt, Abstract, [0012]. As discussed above (¶¶140-146), a POSA would have understood that Qvarfordt's "computer" encompasses portable computing devices, like laptops and mobile phones, or alternatively it would have been obvious to implement Qvarfordt's system so that it can be accessed by users of laptops, mobile phones and other portable computers. Because Qvarfordt's animated CAPTCHA is provided or displayed on a computer, a POSA would have also understood that it is embodied in a computer readable form (e.g., HTML, JavaScript, and/or other code) and implemented as a routine executing on the portable (or other) computer. A routine is a sequence of program instructions (e.g., code) that performs a specific task. A POSA would have understood that when a user of a portable computer seeks access to restricted resources on a website as disclosed in Qvarfordt, code associated with Qvarfordt's CAPTCHA routine is executed on the portable computing device.

178. Further, it would have been obvious to use Qvarfordt's system with portable computers like laptops or mobile phones that have motion and/or orientation sensors. Laptops or mobile phones, for example, with motion and/or orientation sensors were well-known. For example:

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- U.S. Patent No. 5,578,991 ("Scholder," Ex. 1021), published November 26, 1996, discloses a "portable computer" with "proximity sensor or a motion sensor." Ex. 1021, 2:18-48, 5:14-47, FIGs. 1, 2.
- U.S. Patent No. 5,835,298 ("Edgerton," Ex. 1022), published November 10, 1998, discloses laptops with accelerometers. Ex. 1022, 2:42-53, 4:1-4.
- World Intellectual Property Organization International Publication No. WO 2006/060077 Al ("Clifford," Ex. 1023), published June 8, 2006, discloses laptops with accelerometers. Ex. 1023, [0017], [0022]-[0023], [0055].
- U.S. Patent No. 7,059,182 ("Ragner," Ex. 1024), published June 13, 2006, discloses a "motion sensor" and an "acceleration sensor" for portable devices, such as laptops and mobile phones. Ex. 1024, 2:5-12, 6:17-51, 11:35-38, FIGs. 1, 1B, 7.
- U.S. Pub. No. 2006/0193113 A1 ("Cohen," Ex. 1025), published August 31, 2006, discloses a laptop with a "motion sensor." Ex. 1025, Abstract, [0025], FIG. 1.

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- U.S. Patent No. 7,142,385 ("Shimotono," Ex. 1026), published November 28, 2006, discloses a laptop with an "acceleration sensor" / "accelerometer." Ex. 1026, Abstract, 7:51-63; FIGs. 1-2, 4-5.
- U.S. Pub. No. 2007/0259716 A1 ("Mattice," Ex. 1027), published November 8, 2007 and filed July 6, 2007, discloses "portable computing devices," including mobile phones, with "accelerometers" and "motion sensors." Ex. 1027, [0038], [0060], [0078], [0084], [0160].
- U.S. Pub. No. 2007/0298751 A1 ("Wulff," Ex. 1028), published December 27, 2007 and filed June 21, 2006, discloses a laptop with "spatial orientation and motion" sensors. Ex. 1028, [0015], [0018].
- U.S. Pub. No. 2008/0108340 A1 ("Karstens," Ex. 1029), published May 8, 2008 and filed November 6, 2006, discloses a "laptop computer" with "orientation sensors." Ex. 1029, [0022]-[0024], [0031], FIGs. 1-3.

Notably, claim 7 does not require that the motion and/or orientation sensors be utilized in solving the CAPTCHA (or for any purpose). Rather, the claim merely requires that the "portable computing device" ***have*** motion and/or orientation sensors. The use of Qvarfordt's CAPTCHA software on conventional portable

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computing devices (e.g., laptops or mobile phones) with motion and/or orientation sensors renders obvious claim 7.

**8. Claim 8**

179. Claim 8, which recites "[t]he method of claim 7 wherein the visual CAPTCHA challenge is combined with a physical CAPTCHA challenge requiring the user to manipulate the portable computing device in a prescribed manner," would have been obvious over Qvarfordt.

180. I am informed by counsel that in litigation, HDI also asserts U.S. Patent No. 9,192,861 ("the '861 Patent"), which is a divisional of the '141 Patent and claims physical manipulation-based CAPTCHAs on a portable computing device. I am also informed by counsel that in litigation, HDI maintains that a physical CAPTCHA challenge requiring the user to manipulate the portable computing device in a prescribed manner encompasses ***any*** physical movement of the user interacting with the device's graphical interface, including moving a mouse or clicking on a checkbox. Ex. 1039, 7; Ex. 1061, 6 (¶18), 7. I understand that HDI alleges that only if "such movements and/or manipulation from the user meet a required threshold, the user is deemed human and granted access to the protected resource or content." *Id.* Based on HDI's reading of the term "manipulate the portable computing device," Qvarfordt renders obvious claim 8.

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181. Qvarfordt, titled "Motion and ***Interactive*** Based CAPTCHAs," discloses that the user is asked to perform an "operation on the image to resolve an encoded solution" in a combination of animated and interactive CAPTCHAs. Qvarfordt, Abstract, [0012]. Qvarfordt's "[i]nteractive CAPTCHA requires the user to perform some actions to view or construct a hidden message. The actions can either be mouse input or keyboard input (for example arrow keys)." *Id.*, [0038]. "An interactive CAPTCHA can, for example, ask the user to move the background/foreground to get a different view of the message." *Id.* In the Figure 10 embodiment, "the various layers can be set in motion…in response to a user input" such as dragging a layer or clicking the mouse or pressing "enter" on the keyboard. *Id*., [0039]; *see also id*., [0035] ("A manual motion can be, for example, the clip plays a number of frames in response to a user's mouse click, or motion is made in response to user's 'dragging' of selected layer using a mouse or other input device, or a specific motion that depends on the user's action, e.g., foreground moves to left upon left-mouse click and to the right upon right-mouse click."), [0055] ("[t]he user may also pick and drag any layer or one movable layer in order to properly expose the encoded solution.").

182. Further, as noted above (¶80), Qvarfordt also discloses that user actions, like mouse movement and click manipulation, can be tracked using conventional means, and based on this information, "the CAPTCHA can

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determine if the actions correspond to natural human behavior or if they could be computer generated." *Id.*, [0041].

**9. Claim 9**

183. Claim 9, which recites "[t]he method of claim 8 wherein said physical CAPTCHA challenge is used to interact with elements of said electronic image and/or other objects presented in said interface," would have been obvious over Qvarfordt.

184. Based on HDI's reading of physical manipulation-based CAPTCHAs (see above ¶180), Qvarfordt discloses that the physical CAPTCHA challenge can interact with elements of the electronic image and/or other objects presented in the interface. In Figure 10, for instance, Qvarfordt says that "[t]he user may also pick and drag ***any layer or one movable layer*** in order to properly expose the encoded solution." Qvarfordt, [0055]. Qvarfordt describes that the motion may respond to user's "dragging" of a selected layer using a mouse or other input device (e.g., dragging and moving a floating disk to expose a portion of the cat image), or a specific motion that depends on the user's action, e.g., "foreground moves to left upon left-mouse click and to the right upon right mouse click." *Id.*, [0035]. Alternatively, "the user may also be asked to move the encoded solution [e.g., the cat image in Figure 10] itself, so that the remainder appears through the openings in the foreground." *Id.*, [0038].

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### 10. Claim 10

#### a. Preamble [10PRE]

185. As with claim 1's preamble (¶79) and claim 5's preamble (¶147), I express no opinion on whether the preamble of claim 10 limits the claim. To the extent claim 10's preamble limits the claim, however, claim 10's preamble is identical to claim 1's preamble, and Qvarfordt meets it for the same reasons discussed above. *Supra* ¶¶79-85.

#### b. Limitation [10A]

186. Qvarfordt discloses "a. automatically electing an electronic image for a participant with a computing system, wherein said electronic image comprises a set of imagery data other than words, and wherein said electronic image is presentable with differing amounts of data, including a first image state in which only a first portion of the image information therein is perceptible," as recited by limitation [10A].

187. Much of limitation [10A] is identical to limitation [1A]—i.e., "automatically electing an electronic image for a participant with a computing system, wherein said electronic image comprises a set of imagery data other than words"—and met by Qvarfordt for the same reasons discussed above. *Supra* ¶¶86- 92.

188. As to the remainder of limitation [10A], Qvarfordt's "electronic image is presentable with differing amounts of data, including a first image state

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in which only a first portion of the image information therein is perceptible." As discussed above (¶93), the electronic image in Qvarfordt's CAPTCHA test, like any other electronic image, is comprised of imagery data (i.e., rows and columns of pixels).

189. In Qvarfordt's looped animation CAPTCHA, a foreground layer continuously obstructs different parts of the encoded image. "[A]t each point in time the user will see ***part*** of the solution." Qvarfordt, [0031]. "The ***portions*** of the encoded solution that are visible [are] changing over time" and "the sum of all frames can be set as not to give a complete image of the encoded solution." *Id*, [0036]. At any given point in time, the obstructing objects in the foreground are positioned such that only particular "part[s]" or "portions" of the encoded image are revealed. Qvarfordt, [0031], [0036]. The exposed parts or portions of the encoded image at any particular point in time represent a "first image state" of the encoded image as claimed wherein "only a first portion of the image information therein is perceptible."

190. Figure 10 demonstrates this, as it presents a particular state of the cat image with certain portions obstructed by the disks, so that the cat image is not completely exposed and only a portion of the cat image is perceptible. Qvarfordt, [0055].

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191. Further, limitation [10A] does not require actually presenting the image with "differing amounts of data." Instead, it only requires that the image be "presentable" with "differing amounts of data." In Qvarfordt, "the ***portions*** of the encoded solution that are visible [are] changing over time." *Id*., [0036]. Thus, a POSA would have understood that the encoded image is "presentable with differing amounts of data" as claimed because some configurations of the disks can reveal a greater amount of the solution in the encoded image (e.g., cat) than other configurations.

**c. Limitation [10B]**

192. Limitation [10B] is identical to limitation [1B]. Qvarfordt meets limitation [10B] for the same reasons it meets limitation [1B]. *Supra* ¶¶97-98.

**d. Limitation [10C]**

193. Qvarfordt discloses "c. presenting said electronic image in said first image state and progressively revealing additional information in said electronic image over a first time period within an interface for said participant using said computing system," as recited in limitation [10C].

194. Limitation [10C] is similar to limitation [1C]. Limitation [10C] recites "progressively revealing ***additional*** information ***in said electronic image*** over a first time period," whereas limitation [1C] recites "progressively revealing information over a first time period." The specification does not attribute any

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substantive difference between these limitations, and the applicant treated them as substantively identical during prosecution. Ex. 1004, 315-316.

195. Qvarfordt meets limitation [10C] for the same reasons it meets limitation [1C]. *Supra* ¶¶99-107. Specifically, the "information" identified as being progressively revealed above for [1C] (*supra* ¶¶100-103) is "additional information in said electronic image." That is, as the foreground objects in Qvarfordt's animation move while the animation completes a full iteration, the objects reveal different and "additional" portions of the encoded image and thus reveal "additional information in said electronic image." *Supra* ¶¶100-103.

**e. Limitation [10D]**

196. Limitations [10D] and [1D] are identical. Qvarfordt meets limitation [10D] for the same reasons it meets limitation [1D]. *Supra* ¶¶108-115.

**f. Limitation [10E]**

197. Limitations [10E] and [1E] are identical. Qvarfordt meets limitation [10E] for the same reasons it meets limitation [1E]. *Supra* ¶¶116-130.

**11. Claim 11**

198. Qvarfordt discloses "[t]he method of claim 10 wherein said progressively revealing additional information comprises presenting said electronic image at different time intervals with differing levels of resolution,

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noise and/or pixelation," as recited in claim 11, for the same reasons it meets claim 2. *Supra* ¶¶132-136.

**12. Claim 12**

199. Qvarfordt discloses "[t]he method of claim 10 wherein said automatically processing responses occurs during said presenting said electronic image and said progressively revealing additional information," as recited by claim 12.

200. Qvarfordt discloses presenting the unvetted CAPTCHA to the user along with a vetted CAPTCHA used to control access. Qvarfordt, [0052]. A POSA would have understood that CAPTCHA systems process user responses while the CAPTCHA is presented for a limited time and processes the user response in real time to grant or deny the user access. *Id.*, [0052], [0055]. A POSA would have understood that Qvarfordt thus processes the user responses to the vetted and unvetted CAPTCHAs while the electronic images are presented and additional information for them is progressively revealed as the animation (e.g., in Figure 10) runs.

201. Alternatively, to the extent Qvarfordt is not considered to expressly disclose processing user responses while the CAPTCHA challenge images are presented and its animations run, that would have been the conventional and obvious way to implement a CAPTCHA challenge of the type Qvarfordt

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discloses. For example, a POSA would have understood that when a CAPTCHA of the type Qvarfordt discloses is presented to a user, it would have been conventional and obvious for the user to provide responses when the image is presented and progressively revealed through the looped animation. In turn, it would have been conventional and obvious for the CAPTCHA system to then process those responses in real time to determine if a user is human and, if so, grant access. For example, a POSA would have understood that it was common to accept user input during the playback of, say, a digital video, or music file. Nothing suggests that the user should be forced by the system to wait until the end of the playback before the system will accept the user's input.

**13. Claims 13**

202. Qvarfordt discloses "[t]he method of claim 10 further including a step: using said electronic image within a CAPTCHA system for granting access to resources of a second computing system," as recited in claim 13, for the same reasons it meets claim 3. *Supra* ¶138.

**14. Claim 14**

203. Qvarfordt discloses "[t]he method of claim 13 wherein said second computing system is associated with a portable electronics device," as recited in claim 14, for the same reasons it meets claim 4. *Supra* ¶¶140-146.

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### B. Ground 2: Qvarfordt and vonAhn Render Claims 1-5 and 7-14 Obvious.

204. vonAhn, discussed more fully below, expressly discloses a particular technique for calculating the rate or percentage of humans able to successfully solve a CAPTCHA within a predetermined time. After reviewing Qvarfordt in view of vonAhn, it is my opinion that it would have been obvious to implement Qvarfordt by using vonAhn's technique for this purpose, which renders obvious claims 1-5 and 7-14. The basis for my opinion and the details of my analysis are set forth below.

#### 1. vonAhn (Ex. 1007)

205. vonAhn, titled "CAPTCHA: Using Hard AI Problems for Security," is a printed publication bearing a publication date of 2003. I understand that vonAhn is therefore prior art to the '141 Patent. vonAhn was not disclosed during prosecution.

206. As shown on its face, vonAhn appears in the following publication: *Advances in Cryptology – EUROCRYPT 2003: International Conference on the Theory and Applications of Cryptographic Techniques, Warsaw, Poland, May 2003, Proceedings* ("EUROCRYPT 2003"). Ex. 1008. Based on my review of the Declarations of Rachel J. Watters ("Watters," Ex. 1034; "Watters-2," Ex. 1057), I understand that the University of Wisconsin-Madison Libraries owned the publication EUROCRYPT 2003 and had it cataloged in their system as of

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August 6, 2003. Watters, p. 2, Ex. B; Watters-2, p. 2, Ex. B. I also understand that EUROCRYPT 2003 (and, thus, vonAhn) was publicly accessible by searching the public library catalog or requesting a search through Wisconsin TechSearch ("WTS"), an interlibrary loan department at the University of Wisconsin-Madison WTS. Watters, p. 1-2; Watters-2, p. 1-2. I further understand that EUROCRYPT 2003 was searchable by title, author, and/or subject key words, and members of the interested public could access the publication by locating it on the library's shelves or requesting it from WTS. Watters, p. 2; Watters-2, p. 2.

207. Further, based on my review of the Declaration of Mary K. Bolin ("Bolin," Ex. 1035) and the Declaration of Kelley Hayes Greenhill ("Greenhill," Ex. 1058), I understand that the subscription database SpringerLink indicates that vonAhn was first online on May 13, 2003. I also understand that vonAhn has been discussed and cited in the literature dozens of times before June 2007, as well as before June 2008. Ex. 1035, ¶¶ 26-28, Attachments 8-11; Ex. 1058, ¶¶ 24-32, Attachments 4-8. For example:

- Golle (Ex. 1013), published August 16, 2007 and filed February 10, 2006, specifically references vonAhn in the specification. Ex. 1013, [0007].

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- European Patent Application Publication No. EP 1845468 A1 ("Karrer," Ex. 1030), published October 17, 2007 and filed April 12, 2006, specifically references vonAhn in the specification. Ex. 1030, [0018].
- European Patent EP 2130159B1 ("Baker," Ex. 1031), published June 19, 2019 and filed February 28, 2008, specifically references vonAhn in the specification. Ex. 1031, [0005].

208. I am personally familiar with the vonAhn publication. Indeed, I still maintain a copy of this paper on my computer, in one of my older (archive) directories. The file is dated August 23, 2004.

209. vonAhn "introduce[s] CAPTCHA, an automated test that humans can pass, but current computer programs can't pass," and provides several new constructions of CAPTCHAs. vonAhn, 294. As vonAhn explains, "[s]ince captchas have many applications in practical security, our approach introduces a new class of hard problems that can be exploited for security purposes." *Id.* These CAPTCHAs present "a win-win situation: either the problems remain unsolved [by computers] and there is a way to differentiate humans from computers, or the problems are solved and there is a way to communicate covertly on some channels." *Id.*

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210. vonAhn explains the importance of establishing that a CAPTCHA can be passed by a certain portion of users:

> Intuitively, a captcha is a test *V* over which most humans have success close to 1, and for which *it is hard to write a computer program that has high success over V*. We will say that it is hard to write a computer program that has high success over *V* if any program that has high success over *V* can be used to solve a hard AI problem.

vonAhn, 297-98 (defining "*V*" as "the *verifier* or *tester*"). vonAhn explains "[a] test *V* is said to be (*α, β*)-*human executable* if ***at least an α portion of the human population has success greater than β over V***," and that "a statement of the form '*V* is (*α, β*)-human executable' ***can only be proven empirically***." *Id.* (un-bolded emphasis original).

211. Although vonAhn does not say precisely "how long it should take a human to solve a CAPTCHA, ***it is preferable for humans to be able to solve CAPTCHAs in a very short time***" because CAPTCHAs that take too long for humans to solve "are probably useless for all practical purposes." vonAhn, 298. vonAhn observes that most CAPTCHA applications "***require the tests to be answered within a short time after they are presented***." *Id*., 299. vonAhn recognizes an "impractical" CAPTCHA as one that "humans would take a long time to answer," and that CAPTCHAs instead should be "quickly answered by humans." *Id*., 303.

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212. vonAhn describes multiple CAPTCHAs based on "hard AI" problems. vonAhn, 303. For example, vonAhn discloses "PIX," a CAPTCHA where "pictures of simple concrete objects" are mapped to the object contained in the image. *Id.*, 305. According to vonAhn, the PIX verifier works as follow:

> Formally, a PIX instance is a tuple $X = (\mathcal{I}, \mathcal{T}, L, \lambda, \tau)$. The PIX verifier works as follows. First, $V$ draws $i \leftarrow \mathcal{I}$, and $t \leftarrow \mathcal{T}$. $V$ then sends to $P$ the message $(t(i), L)$, and sets a timer for $\tau$. $P$ responds with a label $l \in L$. $V$ accepts if $l = \lambda(i)$ and its timer has not expired, and rejects otherwise.
>
> **Theorem 2.** *If $\mathcal{P}2_{\mathcal{I},\mathcal{T},\lambda}$ is $(\delta, \tau)$-hard and $X = (\mathcal{I}, \mathcal{T}, L, \lambda, \tau)$ is $(\alpha, \beta)$-human executable, then $X$ is a $(\alpha, \beta, \delta)$-*CAPTCHA.

*Id.* Stated differently, according to the "PIX" CAPTCHA, a distorted image (e.g., a distorted picture of a monkey) is presented to a user along with a set of different labels (e.g., monkey, horse, cow, etc.); if the user responds with the correct label within a predetermined amount of time (i.e., before a timer has expired), the user is deemed human; otherwise, access is denied. *Id.*

### 2. Implementing Qvarfordt in View of vonAhn

213. Recognizing that "users will fail one out of ten trials" with the conventional 90% success rate for humans, Qvarfordt discloses image-based CAPTCHAs that are "***as easy as possible***" for humans to solve yet very difficult for computers. Qvarfordt, [0005]. vonAhn likewise recognizes the importance of establishing a CAPTCHA with a high success rate for humans ("close to 1") and a low success rate for computers, and provides a specific calculation to determine a CAPTCHA's efficacy: "A test *V* is said to be (*α, β*)-*human executable* if at least

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an α portion of the human population has success greater than $\beta$ over $V$." vonAhn, 297. vonAhn teaches that the "statement of the form '$V$ is ($\alpha$, $\beta$)-human executable' can only be proven empirically." vonAhn, 298. Such empirical data includes, *inter alia*, a percentage of users who accurately solve the CAPTCHA.

214. It is important to note that the "$V$" here is not a single test. It is an infinite set of tests which are administered one at a time. This explains the "$\beta$" (beta) in the "($\alpha$, $\beta$)" (alpha, beta). Of all the tests in $V$, a given human user will pass a certain number of them. Some users might pass none of them. Some might pass all of them. But vonAhn wants at least a certain predetermined percentage (alpha) of users to be able to pass at least a certain predetermined percentage (beta) of tests. For example, at least 90% of all users may be expected to pass 95% of the tests in $V$. Or, at least 90% of the users may be expected to pass all of the tests (100%) in $V$.

215. Also recognizing that it is preferable for humans to be able to solve CAPTCHAs in "a very short time" for CAPTCHAs to be "practical," vonAhn provides image-based CAPTCHAs that "can be quickly answered by humans" within a predetermined time. vonAhn, 298, 303.

216. A POSA would have had numerous reasons to implement Qvarfordt's image-based CAPTCHA system, in view of vonAhn ("Qvarfordt-

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vonAhn"), to determine or calculate the rate or percentage of humans able to successfully solve Qvarfordt's CAPTCHAs within a predetermined time.

217. First, Qvarfordt's desire to provide an effective CAPTCHA—i.e., one that at least meets a known threshold for human success (90%)—would motivate a POSA to calculate an overall percentage of participants able to correctly solve its image-based CAPTCHAs. vonAhn reinforces the desirability of determining the rate at which humans solve a CAPTCHA and provides a specific calculation for measuring such efficacy—namely, Qvarfordt's image-based CAPTCHA would "be ***(α, β)-human executable*** if at least an α portion of the human population has success greater than ***β* over *V***." vonAhn, 297. That is, at least 90% of the users are able to pass any/all of the tests (100%) in Qvarfordt's CAPTCHA challenge system.

218. Second, Qvarfordt desires "CAPTCHAs that are ***as easy as possible to solve by humans***," and, thus, quickly solvable. Qvarfordt, [0005]. vonAhn likewise indicates CAPTCHAs should be solved "in a very short time." vonAhn, 298-299 ("[m]ost applications of captchas require the tests to be answered within a short time after they are presented" because "captchas which take a long time for humans to solve are probably useless for all practical purposes.").

219. A POSA would have been motivated to implement Qvarfordt's CAPTCHA system with vonAhn's timer, where human users must provide a

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response to the CAPTCHA within a predetermined time. vonAhn, 305. Doing so would provide Qvarfordt's system with additional security, which Qvarfordt identifies as an important goal. For example, Qvarfordt desires to "preserve or increase the difficulty for computers to solve" its CAPTCHAs. Qvarfordt, [0005]; *see id*. [0008] ("very difficult for a machine to solve"), [0009] ("difficult for machines to resolve"), [0033]-[0037] (providing "guidelines" for making its animated CAPTCHAs more difficult for machines to solve), [0041] (tracking "user's actions (key board or mouse input)" to "determine if the actions correspond to natural human behavior or if they could be computer generated"). Because Qvarfordt seeks to provide "CAPTCHAs that … preserve or increase the difficulty for computers to solve them" (Qvarfordt, [0005]), a timer provides further protection against attacks by restricting the available time for bots to solve the CAPTCHA. To be sure, a POSA would have understood that web servers include a timer, because there is always a chance the connection to a user requesting access will be broken. Web servers cannot sit idle forever waiting for a user to respond; otherwise that would be an effective denial of service attack on the web server.

220. Third, the implementation would have involved no more than using known techniques (calculating a total percentage of users able to accurately associate the image with the concept(s) within a predetermined time) to improve

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similar devices (computers implementing CAPTCHAs) in the same way (ensuring efficacy and increased security) to yield a predictable result (an improved CAPTCHA system). In my opinion, such an improvement would have been obvious.

221. Finally, implementing Qvarfordt to calculate an overall percentage of users able to accurately guess the underlying concept within a predetermined time would have been within a POSA's capabilities. Implementing Qvarfordt in this manner would have involved nothing more than performing a simple calculation on certain datasets already discussed in Qvarfordt (i.e., dividing the number of participants who correctly guessed the concept(s) by the total number of participants) and using a timer or otherwise tracking how long it takes a user to solve the CAPTCHA. As vonAhn confirms, such timers were known. vonAhn, 305.

222. Qvarfordt-vonAhn is thus Qvarfordt's system implemented to calculate an overall percentage of users able to accurately guess the underlying concept of an unvetted CAPTCHA within a predetermined time as part of associating a "correct solution" with an unvetted CAPTCHA and moving it "to the first [vetted] category." Qvarfordt, [0052].

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### 3. Claim 1

#### a. Preamble [1PRE] and Limitations [1A]-[1D]

223. Qvarfordt-vonAhn meets claim 1's preamble and limitations [1A]-[1D] for the same reasons discussed in Ground 1 with respect to Qvarfordt alone, because the combination of Qvarfordt and vonAhn does not change any aspect of Qvarfordt relied on to meet claim 1's preamble and limitations [1A]-[1D].

#### b. Limitation [1E]

224. As explained above (¶¶213-222), a method performed by Qvarfordt-vonAhn includes "calculating a percentage of participants able to decode and accurately guess said one or more concepts within a predetermined time" and thus meets limitation [1E].

### 4. Claims 2-4

225. Qvarfordt-vonAhn meets claims 2-4 for the same reasons discussed in Ground 1 with respect to Qvarfordt alone, because the combination of Qvarfordt and vonAhn does not change any aspect of Qvarfordt relied on to meet claims 2-4.

### 5. Claim 5

#### a. Preamble [5PRE] and Limitations [5A]-[5D]

226. Qvarfordt-vonAhn meets claim 5's preamble and limitations [5A]-[5D] for the same reasons discussed in Ground 1 with respect to Qvarfordt alone,

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because the combination of Qvarfordt and vonAhn does not change any aspect of Qvarfordt relied upon to meet claim 5's preamble and limitations [5A]-[5D].

**b. Limitation [5E]**

227. As discussed above (¶153), claim 5 does not impose any restriction on an order in which the recited steps must occur. Thus, for a vetted CAPTCHA presented in limitations [5A], [5C] and [5D], limitation [5E] is met by the earlier processing Qvarfordt-vonAhn performs when that CAPTCHA was still unvetted, including determining a percentage of participants that provided the "correct solution" that was later associated with that CAPTCHA when it was "moved to the first [vetted] category." Qvarfordt, [0052].

228. To the extent HDI argues that claim 5's method steps require a specific order, such that limitation [5E] must occur later in the method, Qvarfordt still meets or renders obvious this limitation for the same reasons discussed above. *Supra*, ¶¶168-172.

229. As also discussed above (¶161), a POSA would have understood that when Qvarordt's system processes a participant's guess to determine whether it meets the "correct solution" so as to grant access to the user, it detects whether the guess meets a threshold as claimed. The "required threshold" (i.e., the solution or solution set adopted as the "correct solution") used in determining a percentage of participants with guesses meeting that threshold does not change in Qvarfordt-

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vonAhn, and, accordingly, is met in the same way discussed above. *Supra* ¶¶165-172.

230. Thus, Qvarfordt-vonAhn meets "determining a percentage of participants with guesses meeting the required threshold within a predetermined time," as recited by limitation [5E].

**6. Claims 7-9**

231. Qvarfordt-vonAhn meets claims 7-9 for the same reasons discussed in Ground 1 with respect to Qvarfordt alone, because the combination of Qvarfordt and vonAhn does not change any aspect of Qvarfordt relied on to meet claims 7-9.

**7. Claim 10**

**a. Preamble [10PRE] and Limitations [10A]-[10D]**

232. Qvarfordt-vonAhn meets claim 10's preamble and limitations [10A]- [10D] for the same reasons discussed in Ground 1 with respect to Qvarfordt alone, because the combination of Qvarfordt and vonAhn does not change any aspect of Qvarfordt relied on to meet claim 10's preamble and limitations [10A]-[10D].

**b. Limitation [10E]**

233. Qvarfordt-vonAhn meets limitation [10E] for the same reasons it meets limitation [1E]. *Supra* ¶224.

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### 8. Claims 11-14

234. Qvarfordt-vonAhn meets claims 11-14 for the same reasons discussed in Ground 1 with respect to Qvarfordt alone, because the combination of Qvarfordt and vonAhn does not change any aspect of Qvarfordt relied on to meet claims 11- 14.

## IX. AUTHENTICITY AND PUBLIC ACCESSIBILITY OF BACKGROUND ART PRINTED PUBLICATIONS

235. In forming my opinions, and as set forth herein, I rely on certain printed publications to corroborate what was known in the art in mid-2008 or mid-2009. As discussed below, I understand that each reference that I reviewed and relied on is a true and correct copy of the reference and that it was publicly accessible prior to June 2008.

### A. vonAhn 2005 (Ex. 1008)

236. vonAhn-2005 is the dissertation of Luis von Ahn, titled "Human Computation," and dated December 2005. I understand from the Declarations of Jessica Brenner ("Brenner," Ex. 1036; "Brenner 2," Ex. 1056) that vonAhn-2005 was publicly accessible by October 31, 2006. Brenner, p. 3; Brenner 2, p. 3. I also understand that the exhibit vonAhn-2005 is a true and correct copy of Dr. von Ahn's dissertation. Brenner, p. 3; Brenner 2, p. 3.

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### B. Kochanski (Ex. 1011)

237. "A Reverse Turing Test Using Speech" ("Kochanski") is a paper that I co-wrote for the Seventh International Conference on Spoken Language Processing in Denver, Colorado between September 16-20, 2002. Ex. 1011. Along with others, I drafted the paper in the months before the conference. Copies of the paper were available at the conference. In 2004, the parent organization of the conference (the International Speech Communication Association, or "ISCA") made a PDF of the paper available for download on its website, https://www.isca-speech.org/archive/. At the time, the papers on that website were keyword searchable, including by title and author, were indexed by author, and any ISCA member could download papers. The abstracts were free for anyone, not just ISCA members. The copy of the paper in Exhibit 1011 is a true, accurate, and authentic copy of the paper, and accurately represents the copies of the paper available at the conference itself in 2002, which a POSA would have known about and been able to attend. There was also a true and accurate copy of the paper on my university website by at least September 1, 2004, free for public download, not just to ISCA members. *See* http://www.cse.lehigh.edu/~lopresti/Publications/2002/icslp02.pdf and http://web.archive.org/web/20040901075237/http://www.cse.lehigh.edu/~lopresti/Publications/2002/icslp02.pdf. Further, in my opinion a POSA could have

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searched for and found this paper on ISCA's website shortly after it was uploaded in 2004 (and either would already be an ISCA member or could easily become so to download the paper), searched for the paper via Google and found and downloaded it from my university website in 2004, and in any event could have found and downloaded the paper well before June 2008.

**C. Datta (Ex. 1017)**

238. As shown on its face, the Datta exhibit bears a 2005 copyright date and was presented at "MM'05," which took place November 6-11, 2005, in Singapore. Datta, 331. I understand that Datta is a paper presented at the ACM conference on Multimedia in 2005. Bolin (Ex. 1035), ¶ 5, Attachment 3; Greenhill (Ex. 1058), ¶¶6, 18-22, Attachments 1-3. I also understand that Datta was publicly accessible at least by February 16, 2007. Bolin (Ex. 1035), ¶ 22; Greenhill (Ex. 1058), ¶23, Attachments 1-3. I further understand that the exhibit Datta is a true and correct copy of the paper.

239. Further, based on my review, Wang (Ex. 1012) appears to disclose the exact same subject matter as Datta, and, indeed, provides nearly verbatim disclosures. The named inventors of Wang (James Wang, Ritendra Datta, and Jia Li) are the same authors of Datta (Ritendra Datta, Jia Li, and James Z. Wang). As noted above (¶107), Wang published on August 30, 2007 and was filed January 30, 2007. This further corroborates the public accessibility of Datta prior

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to June 2008.

## X. CONCLUSION

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

I declare under penalty of perjury that the foregoing is true and correct.

Dated: 2/23/2023

DocuSigned by:
/Daniel Lopresti/
49AF96EFBD8E4BB...

Daniel P. Lopresti, Ph.D.