

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Al-Ali
U.S. Patent No.: 10,470,695 Attorney Docket No.: 50095-0004IP1
Issue Date: November 12, 2019
Appl. Serial No.: 16/226,249
Filing Date: December 19, 2018
Title: ADVANCED PULSE OXIMETRY SENSOR

DECLARATION OF DR. BRIAN W. ANTHONY

I, Brian W. Anthony, of Cambridge, MA, declare that:

1. My name is Dr. Brian W. Anthony. I am an Associate Principal Research Scientist at the Institute of Medical Engineering & Science at Massachusetts Institute of Technology (MIT). I am also a Principal Research Scientist at MIT's Mechanical Engineering department, Director of the Master of Engineering in Advanced Manufacturing and Design Program at MIT, a Co-Director of the Medical Electronic Device Realization Center of the Institute of Medical Engineering & Science, and Associate Director of MIT.nano. My current *curriculum vitae* is attached and some highlights follow.

2. I earned my B.S. in Engineering (1994) from Carnegie Mellon University. I earned my M.S. (1998) and Ph.D. (2006) in Engineering from MIT. My research focused on high-performance computation, signal processing, and electro-mechanical system design.

3. In 1997, I co-founded Xcitex Inc., a company that specialized in video-acquisition and motion-analysis software. I served as the Chief Technology Officer and directed and managed product development until 2006. Our first demo product was an optical ring for human motion measurement used to capture user hand motion in order to control the user's interaction with a computer. Many of the structural elements of our optical ring addressed the same system issues as those described and claimed in the patent at issue. For example, our optical ring included multiple light emitting diodes, multiple photodetectors, techniques for modulation and synchronization, and noise reduction algorithms. We estimated human hand-motion based on how that motion changed the detected light. In our application, we did not try to eliminate motion artifact, we tried to measure it. In developing our ring, we considered well-known problems such as ambient light and noise. Motion Integrated Data Acquisition System (MiDAS) was our flagship video and data acquisition product which relied upon precise synchronization of multiple clocks for optical sensor and video acquisition, data acquisition, and external illumination.

4. I joined MIT in 2006 and was the Director of the Master of Engineering in Advance Manufacturing and Design Program for over ten years. The degree program covers four main components: Manufacturing Physics, Manufacturing Systems, Product Design, and Business Fundamentals. Many of

the courses, projects, and papers my students undertake involve technologies relevant to the patent at issue, for example, sensor devices including non-invasive optical biosensors.

5. In 2011, I co-founded MIT's Medical Electronic Device Realization Center ("MEDRC") and currently serve as co-director. The MEDRC aims to create and deploy revolutionary medical technologies by collaborating with clinicians, the microelectronics, and medical devices industries. We combine expertise in computation; communications; optical, electrical, and ultrasound sensing technologies; and consumer electronics. We focus on the usability and productivity of medical devices using, for example, image and signal processing combined with intelligent computer systems to enhance practitioners' diagnostic intuition. Our research portfolio includes low power integrated circuits and systems, big data, micro electro-mechanical systems, bioelectronics, sensors, and microfluidics. Specific areas of innovation include wearable, non-invasive and minimally invasive optical biosensor devices, medical imaging, laboratory instrumentation, and the data communication from these devices and instruments to healthcare providers and caregivers. My experience with these devices is directly applicable to the technology in the patent at issue.

6. I am currently the Co-Director of the Device Realization Lab at the Medical Electronic Device Realization Center at the Institute of Medical

Engineering & Science at MIT. The Device Realization Lab designs instruments and techniques to sense and control physical systems. Medical devices and manufacturing inspection systems are a particular focus. We develop and combine electromechanical systems, complex algorithms, and computation systems to create instruments and measurement solutions for problems that are otherwise intractable.

7. The research of the Device Realization Lab focuses on product development interests cross the boundaries of computer vision, acoustic and ultrasonic imaging, large-scale computation and simulation, optimization, metrology, autonomous systems, and robotics. We use computation, and computer science, as methodology for attacking complex instrumentation problems. My work combines mathematical modeling, simulation, optimization, and experimental observations, to develop instruments and measurement solutions.

8. My record of professional service includes recognitions from several professional organizations in my field of expertise.

9. I am a named inventor on 10 issued U.S. patents. Most but not all of these patents involve physiological monitoring and other measurement technologies.

10. I have published approximately 85 papers, and have received a number of best paper and distinguished paper awards. A number of papers that I

have published relate to physiological monitoring and other measurement and instrumentation technologies.

11. I have been retained on behalf of Apple Inc. to offer technical opinions relating to U.S. Patent No. 10,470,695 (“the ’695 Patent”) and prior art references relating to its subject matter. I have reviewed the ’695 Patent and relevant excerpts of the prosecution history of the ’695 Patent. I have also reviewed the following prior art references and materials, in addition to other materials I cite in my declaration:

- U.S. Patent No. 8,998,815 to Venkatraman et al. (“Venkatraman” or APPLE-1005)
- U.S. Patent No. 6,343,223 to Chin et al. (“Chin” or APPLE-1006)
- U.S. Patent No. 9,392,946 to Sarantos et al. (“Sarantos” or APPLE-1014)
- Mendelson et al., *Skin Reflectance Pulse Oximetry: In Vivo Measurements from the Forearm and Calf*, Journal of Clinical Monitoring Vol. 7 No. 1, pp. 7-12 (January 1991) (“Mendelson-1991” or APPLE-1015)
- PCT Pub. No. WO 2011/051888 to Ackermans et al. (“Ackermans” or APPLE-1016)
- U.S. Patent No. 4,295,472 to Adams (“Adams” or APPLE-1018)
- U.S. Patent No. 7,415,298 to Casciani et al. (“Casciani” or APPLE-1019)

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