UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner

v.

IMMERSION CORPORATION
Patent Owner

U.S. Patent No. 8,773,356
Filing Date: January 31, 2012
Issue Date: July 8, 2014
Title: Method and Apparatus for Providing Tactile Sensations

Inter Partes Review No.: (Unassigned)

DECLARATION OF DR. RICHARD T. MIHRAN

EXHIBIT LIST

Exhibit No.	Description
1101	U.S. Patent No. 8,773,356 ("**'356 patent**")
1102	Reserved.
1103	Administrative Judge's Construction of Terms ITC Investigation No. 337-TA-1004
1104	File History of U.S. Patent No. 8,773,356
1105	U.S. Provisional App. No. 60/335,493 ("**First Provisional**")
1106	U.S. Provisional App. No. 60/399,883 ("**Second Provisional**")
1107	WO 2002/12991 A1 ("Fukumoto WO")
1108	Translation of WO 2002/12991 A1 Fukumoto WO
1109	U.S. Pat. App. Pub. No. 2002/0149561 ("Fukumoto US")
1110	Japanese Published Application No. H11-212725
1111	Translation of Japanese Published Application No. H11-212725 ("Tsuji")
1112	U.S. Pat. App. Pub. No. US2008/0068350 ("Rosenberg 350").
1113	IBM Model M Keyboard Release, April 1986 (available at http://www-01.ibm.com/common/ssi/ShowDoc.wss?docURL=/common/ssi/rep_ca/8/877/ENUSZG86-4008/index.html&lang=en&request_locale=en) ("**IBM Release**")
1114	IBM Model M Keyboard Photograph https://upload.wikimedia.org/wikipedia/commons/4/48/IBM_Model_M.png
1115	U.S. Pat. No. 5,575,576 ("**Roysden**")

I. INTRODUCTION

1. I have been retained by counsel for Apple Inc. as an expert witness in the above-captioned proceeding. I have been asked to provide my opinion about the patentability of claims 1-26 of U.S. Patent No. 8,773,356 (the "'356 patent").

2. I have been retained at my normal hourly rate of $600 per hour. No part of my compensation is dependent upon the outcome of this matter or the specifics of my testimony.

A. Background and Qualifications

3. My curriculum vitae ("CV") is attached as Appendix A.

4. I am a Professor Adjunct in the Department of Electrical and Computer Engineering at the University of Colorado at Boulder, where I have been on the faculty since 1990. I teach a wide variety of classes at the undergraduate and graduate level covering general electrical and computer engineering theory and practice, including circuit theory, microelectronics, signal processing, and medical devices and systems. Many of these classes incorporate both lecture and laboratory components that include hardware and software design.

5. Courses I have taught include topics such as analog and digital circuit theory and design, microelectronics, signal processing, radio-frequency identification devices, miniaturized implantable medical devices incorporating embedded systems, and optics and optical electronics, including semiconductor

laser diodes, Fourier optics, non-linear optics, optical sensors, and wave propagation in optical fibers. Many of these courses include components directly related to the design and implementation of portable electronic devices such as smartphones and computers, as well as subject matter relating to haptic feedback that may be used in such devices. These courses further include components and concepts directly relevant to electronic devices and systems and their interfaces with other devices, including communications networks, general principles of wired and wireless RF communications, and data signal modulation and encoding in a variety of applications.

6. The devices and methods claimed in the '356 patent encompass several technology areas, including the basic architecture of smart devices/embedded systems (controller, memory, display, data structures, etc.), general principles of tactile feedback (physiology of human tactile perception, such as sensitivity to vibration frequency/amplitude), haptic actuators and drive signals (e.g. piezoelectric and voice-coil actuators and control of their signal sources), and the integration of these elements within the context of the user interface.

7. With respect to basic embedded systems implementation, I have been involved in microcontroller-based designs of portable data acquisition, processing and computing devices for over 35 years, utilizing commercial microprocessors manufactured by Intel, Motorola, Zilog, Microchip, among others. These devices

generally included various forms of displays and user interfaces as part of their implementation, along with various sensors and actuators. Research projects I have directed involving microprocessor-based systems include the development of embedded system biosensor and immunoassay devices, radar signal processing devices, spread-spectrum data telemetry devices, and microprocessor-controlled drug infusion devices utilizing various mechanical actuators.

8. With respect to the integration of tactile feedback with electronic devices, I have an extensive background in neuroscience and electrophysiology, including performing research on the effects of various forms of mechanical stimuli on nerve cells. This research included the development of systems to deliver low-level mechanical stimuli to neural and other tissues using both direct mechanical/vibratory stimulation, as well as mechanical stimuli delivered using pulsed acoustic/ultrasonic stimuli. This work included the design and implementation of the mechanical actuators, including voice-coil and piezoelectric actuators, to deliver the mechanical stimuli to the neural tissue over a broad range of frequencies and amplitudes.

9. I have further taught courses at the undergraduate and graduate level in basic neuronal electrophysiology, as well as the development of implantable medical devices with neural interfaces, including cochlear and retinal implants, spinal cord stimulation devices, and motor neuron stimulation devices for

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