Michael Balourdas

Advisor: Dr. Erick Maxwell

Group: MedCap

Technical Review of Current Wearable Technology

Introduction

Wearable technology is rapidly becoming an integral part of modern society. Companies like Apple and Fitbit have developed wrist devices that contain a variety of functions from messaging and checking email to monitoring sleep cycles and heart rate [1].Professional sports teams in particular have embraced the idea of wearable technology to monitor and improve performance among their athletes. Wearable devices are also in development to aid with medical problems, such as muscle rehabilitation [2]. The number of patents filed under wearable technology has been increasing for the last couple of decades, with a very sharp rise in the past few years [1].This paper is a review of the current products and technologies in the wearable device market.

Commercial Applications of Wearable Technology

The most popular wearable device manufacturer on the market is currently Fitbit [1]. The Fitbit Charge 2 base model costs \$149.95, monitors heart rate, sleep patterns, cardio fitness levels, and provides call and text alerts. It has an OLED display and sends data to a smart phone which is then read by the Fitbit app. The battery is a lithium polymer battery that lasts up to 5 days and requires one to two hours to charge. It is not completely waterproof, but is resistant to small amounts of water such as sweat and rain [3].

Another, less popular wearable device is the LightBEAM Smart Hat. This hat costs \$99.90 and monitors heart rate, number of steps taken, and number of calories burned and can transmit that information to a smartphone app or even another wearable such as a smart watch. It is a one size fits all hat that functions in all weather conditions and is hand washable. It has sound and LED user interfaces, and provides 17 hours of continuous use [4].

A different Smart Hat website shows plans for the design of a smart helmet for cyclists. No price is listed, but the planned functionality includes a display with GPS and proximity sensing, as well as heart rate and temperature monitoring. It also has safety features such as brake lights and impact protection [5].

Caterpillar has filed a patent for a glove that can be used to monitor its position away from a fixed point, and can also detect impacts on the gloved hand [6].

Underlying Technology of Wearable Devices

Temperature sensors in wearable devices work by measuring the voltage across a diode that fluctuates with temperature. The sensor then transmits any measured differences from a pre-defined base value as an analog signal. Optical heartbeat sensors work by shining a light into the skin and measuring the scattered light, and transmitting that as an analog signal. In a wearable device, that information is fed through a microprocessor and then transmitted out through an antenna to an external device such as a smart phone [1]. Relevant measures of performance for wearable technology include speed of information transmission and accuracy of sensor measurements.

Building Blocks of Wearable Devices

Each wearable device usually contains some sort of sensor. In the case of the Fitbit and Smart Hat, this includes optical heart rate trackers and 3-axis accelerometers. Each device also usually uses Bluetooth technology to transmit information from the sensors to a smart phone app, where the information is analyzed and displayed. The batteries in both devices are lithium-polymer rechargeable batteries [3], [4]. The Fitbit also includes an altimeter and a vibration motor [3]. Devices also are made up of the actual wearable accessory itself, for which comfort, style, and durability are taken into account. Software is a consideration as well, because most devices are designed together with a smart phone app that is compatible with the device.

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