

CSS 535 - Advanced Topics

Android and iOS Sensors for Health Monitoring Robert Foskin

Introduction

Sensors are an integral part of any Android or iOS device. The knowledge and use of available device sensors is important in creating applications that can interact with and respond to the real environment.

Many people are familiar with the GPS capabilities of their device with over 1 billion kilometers driven every day using google maps.[1] However, both Android and iOS provide frameworks that support sensors that extend beyond common ones found on your phones and are also used on devices with a more diverse set of sensors than commonly found on a cellphone.

Through the Android Sensor Framework, Android supports three categories of sensors, motion sensors, environmental sensors, and position sensors. [2] Similarly, iOS uses the Core Motion framework to get data on motion and environmental data from onboard sensors.[3]

Sensors commonly found on hardware implementations that use either platform are gyroscopes, accelerometers, barometers and fingerprint scanners. Newer phones such, as the iPhone 15 pro have a LiDAR scanner, but typically in the case of cell phones the sensors are limited to those mentioned above.

Industry Trends and Needs

In 2009, the Fitbit was one of the first widely adopted health focused wearable. The Fitbit was an early sign of the industry direction, and Apple released the first smart watch in 2015. Samsung released their Galaxy watch in 2018. A main selling point of both offerings was on enabling a user to track their health metrics using inbuilt sensors. [4]

Since their introduction smart watches have offered an increasing number of sensors to track user health data. With the increasing number of sensors on smart watches, sensor miniaturization is also important to ensure that the smart watches will not have to sacrifice their small size for the increased amount of features. [5]

An obvious target for wearables is to try and detect blood glucose levels, these levels cannot be obtained with current minimally invasive wearable technology. [6] It is in this area that machine learning models could provide a solution as they can be used to interpret data obtained from wearable devices.[7]

Current Solutions

Early smartwatch models were limited to a heart rate sensor, along movement and light sensors. A software layer would then interpret this data and provide reports on heart rate and sleeping habits.

Wearable technology has progressed by decreasing the size of the sensors on the devices and by adding additional ones, such as Samsungs Bioelectrical Impedance Analysis Sensor which can relatively accurately estimate body fat composition.

Apple and Samsung have both obtained FDA approval detect and alert a user of atrial fibrillation, Samsung has obtained additional FDA approval for detecting sleep apnea in users. [8], [9] In obtaining FDA approval for interpreting sensor data in a specific manner, both companies are trying to expand their devices offerings without further hardware upgrades.

Critical Analysis

Modern smartwatches offer a wide range of health monitoring features that otherwise would not be easily accessible to the public.

Apple and Samsung have put a lot of effort into working with the FDA on developing their health monitoring systems, this results in validated and reliable results being available to the user.

Despite FDA approvals, there are still limitations to the sensors, and they shouldn't be used as a replacement for results taken clinically. This does present a risk if not fully understood by the user.

An increased number of sensors will be an ever-increasing draw on battery life. Additionally, increasing the number of sensors will increase the price point of the devices putting them out of reach of those with less disposable income.

Proposals

Assuming the number of sensors in smart watches will increase, several areas can be targeted to improve offerings.

Miniaturization of sensors – Similar to Samsung's BioActive sensors, increased investment in miniaturization will enable companies to provide smartwatches with more health monitoring features without increasing their size.

Integrating Sensors – An increasing number of sensors might enable more ways in which data can be combined to give better health insights.

Using AI to interpret sensor data could be promising and should be studied further.

Energy Efficiency – Developing sensors that use less power will be essential in providing a user-friendly product.

Citations

- [1] J. Lau, "Google Maps 101: How AI helps predict traffic and determine routes." [Online]. Available: <https://blog.google/products/maps/google-maps-101-how-ai-helps-predict-traffic-and-determine-routes/>
- [2] Google, "Developers, Core Areas, Sensors and Location." Google, nd. Accessed: May 19, 2024. [Online]. Available: https://developer.android.com/develop/sensors-and-location/sensors/sensors_overview
- [3] "Core Motion Framework Overview." Apple, nd. Accessed: May 19, 2024. [Online]. Available: <https://developer.apple.com/documentation/coremotion>
- [4] Apple, "Why Apple Watch."
- [5] Samsung, "Samsung Leads Holistic Health Innovation With Galaxy Watch5 and Galaxy Watch5 Pro." Accessed: May 19, 2024. [Online]. Available: <https://news.samsung.com/global/samsung-leads-holistic-health-innovation-with-galaxy-watch5-and-galaxy-watch5-pro>
- [6] FDA, "Do Not Use Smartwatches or Smart Rings to Measure Blood Glucose Levels: FDA Safety Communication." FDA, Feb. 21, 2024. Accessed: May 21, 2024. [Online]. Available: <https://www.fda.gov/medical-devices/safety-communications/do-not-use-smartwatches-or-smart-rings-measure-blood-glucose-levels-fda-safety-communication#:~:text=Additionally%2C%20the%20FDA%20is%20alerting,significant%20new%20information%20becomes%20available.>
- [7] Aziz, Sarah, "Estimating Blood Glucose Levels Using Machine Learning Models with Non-Invasive Wearable Device Data," *Stud. Health Technol. Inform.*.
- [8] Apple, "Apple Watch." Apple, nd. Accessed: May 19, 2024. [Online]. Available: <https://www.apple.com/healthcare/apple-watch/>
- [9] Samsung, "Samsung's Sleep Apnea Feature on Galaxy Watch First of Its Kind Authorized by US FDA." Accessed: May 19, 2024. [Online]. Available: 2.10.24