ECE4011 Project Summary

Project Title	Funky: An Unobtrusive Fingertip Health Tracker
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Project Abstract (250-300 words)	“Funky” is a finger pulse oximeter that monitors the heart rate and blood oxygen level of the user. The information is then sent to the user's smartphone via low powered bluetooth signals and is available there for display. A history of user logs are stored there for reference and a conclusion regarding the user's overall heart health can be drawn from this data. The prototype includes two parts, hardware finger pulse and blood oxygen level sensors as well as a mobile application that displays result and performs data analysis to draw recommendations. The device uses a pulse meter and photodetector to measure the heart rate and oxygen saturation of the blood. The prototype is designed to run mbed OS developed for IoT devices. This will provide a low cost interface to collect data through a serializer in a compact format for storage on the chip's local memory. The mobile application will read data from the hardware and medical recommendations will be provided to the user. In addition, iOS users will be able to store the data in the HealthKit and share the data to their private doctor for future health record usage. The prototype device will cost approximately $500 to build. We predict that this cost will reduce to $115 per unit during the production phase.

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List **codes** and **standards** that significantly affect your project. Briefly describe how they influenced your design.	(1) Bluetooth 4.0 low energy: BLE 4.0 is used as the main data transmission mechanism between sensor and data processing unit(Phone) in a ultra low power consumption situation. (2) FCC: FCC mark is a certification mark employed on electronic products manufactured or sold in the United States which certifies that the electromagnetic interference from the device is under limits approved by the Federal Communications Commission. (3) CE: The CE mark is a mandatory conformity marking for certain products sold within the European Economic Area since 1985. (4) Garbage can Symbol: The garbage can with an X through it, indicates compliance with the WEEE (Waste Electrical and Electronic Equipment) Directive. The WEEE Directive is upheld by 27 states in the European Union and represents their desire that electronic devices should be disposed of in an environmentally friendly way, rather than thrown in the trash as electronic waste. (5) Rohs: The definition and aim of the RoHS directive is to restrict certain dangerous substances commonly used in electronic and electronic equipment. (6) Programming Languages: On the embedded device, arduino programing language will be the main development language. On the smartphone, depends on our implementation choice, it could be java or Objective-C. On the server part, java will be the main development programming language.
List at least two significant **realistic design constraints** that applied to your project. Briefly describe how they affected your design.	(1) Sunlight is required for the photodetectors to work properly. Therefore, the placement of the device must be in an area that can get significant exposure. This makes any location underneath the user's clothing an invalid location for our device. (2) Low battery consumption is prefered because we don't want the user to constantly charge the phone. Therefore we need to choose a low-power consumption microcontroller as our main development board.
Briefly explain two **significant trade-offs** considered in your design, including options considered and the solution chosen.	(1) Our limited budget compel us to use large chemical sensors with limited functions in designing the printed circuit board for the prototype. It also prevents us from expanding functions and minimizing the size of the oral health monitor due to substantial cost and size for each distinct chemical sensor. We decide to select the most appropriate sensor which provides the most relevant odor data about user health to implement the design. (2) Data processing of the sensor data can happen in the wearable device part or the smartphone part. We decide to process data in the smartphone part in order to keep the wearable device power consumption low.

Briefly describe the **computing aspects** of your projects, specifically identifying **hardware-software** tradeoffs, interfaces, and/or interactions. *Complete if applicable; required if team includes CmpE majors.*	The software architecture of this project consists three parts, an embedded wearable system for sensor data collection and transmission, smartphone for data processing and a remote server for data mining using MapReduce. On the embedded wearable system, we choose to use mbed as the main development board because of its cost and appropriate functionality, low power consumption and easy programming interface. The mBed microprocessor will connects to a RedBearLab BLE Nano, a bluetooth low power module through serial interface. In addition, the microprocessor will also connect to pulse meter and photodetector via analog inputs. This device will have a instant-on activation mechanism to wake up and collect the analog input data and buffer it locally. Whenever the embedded device is nearby the previously paired smartphone, it will automatically discover, connect and transmit the data to the smartphone. On the smartphone part, we will write a mobile application for collecting the sensor data through the bluetooth low energy 4.0 wireless data transmission. Most recent smartphones come with bluetooth low energy 4.0 built-in, therefore the main effort will be mainly put in processing the data because the data passed in from the embedded device will be raw data. The mobile application will do signal processing to filter out the noise and present the data graphically to the user. In addition, the mobile application will also interpret the data to give user instant feedback on their heart health condition based on the sensor data. On the server part, there will be a server cluster running Hadoop to do data mining. Users can opt-in to share their data with us and the data transmission between the smartphone and our server will be encrypted and anonymized. Each user in our system will be assigned a randomized token ID. WIth abundant data, we hope we can predict users' future heart health condition based on a period of collected data.