ECE4012 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.This design 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.
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) In order to calculate the period of the heart rate signal, we run FFT on it. We decide to do software FFT because hardware FFT require extra modules and we want to keep the cost lower.

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 virtualization and analysis. On the embedded wearable system, we choose to use Nordic NDK-51 as the main development board because of its cost and appropriate functionality, low power consumption and easy programming interface. The board has a built-in bluetooth module and we will use it connect to the smartphone . In addition, the microprocessor will also connect to pulse meter and photodetector via analog inputs. We choose to run FFT in software at micro-controller because of the lower cost and negligible battery impact. Hardware DPS module should provide a better result at signal process, but it is more difficult to exam and debug during the development process. A software FFT implementation is a good alternative in development phase which we could confirm its result and develop hardware DSP in the future work. 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 visualizing and analyzing the data because the data passed in from the embedded device will be raw sensor data. The mobile application will 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.