ECE4011 Project Summary

Project Title	Wearable Oral Health Monitor
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Project Abstract (250-300 words)	The Wearable Oral Health Monitor is a device which will detect user breath odors, evaluate the malodor level and user's dental health. While using the oral health monitor device, user can recognize the breath smell and track dental health data to decrease dental risk. In the past research, oral dryness, oral sulfide levels and other chemical compounds levels are significant related with malodor and periodontal disease. The prototype includes two parts, hardware odor data detection, and UI interface to display analysis result at phone application. The device uses particle sensor, odor sensor and volatile organic compound sensor to detect malodor-related parameters in subjects with periodontal disease. The prototype is designed from Arduino Uno board, which will provide low-cost interface to collect data and transfer the data to phone system to do final analysis. Phone UI front-end will provide the data reading from the hardware, and Dental recommendation for users which can help user to reduce the cost to visit the dentist. Meanwhile, iOS users can connect data analysis with iOS Health Kit tool and send results to users' private dentist for future health records usage. The prototype device cost approximately $350 in parts, including device charging. We can predict that in the production phrase, the cost of device will reduce to $150. In the research phrase, more experience is needed to evaluated different sensors combination.

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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) Available chemical sensors in the market can be divided into three categories: Particle sensor, Odor sensor and VOC (Volatile Organic Compound) sensor. The typical size of these sensors is 5cm*5cm*10cm, which is too big to fit into a wrist band. Thus, wrist band won't be a promising platform to implement. (2) Bad smell results from various organic chemicals. Currently, only VOC sensor is available and it lacks the ability to differentiate various organic compounds. (3) 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	(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

the solution chosen.	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 Arduino Uno as the main development board because it has lots of I/O pins, low power consumption and easy programming interface. The Arduino Uno board will connects to a RedBearLab BLE Mini, a bluetooth low power module through serial interface. In addition, the Arduino Uno board will also connect to several chemical particle sensors through 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 oral 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 oral health condition based on a period of collected data.