ECE4011/ECE 4012 Project Summary

Project Title	MedCap
Team Members (names and majors)	Matthew Allen, EE Michael Balourdas, EE Nicole Barcori, EE Miheer Bavare, CmpE Tyler Nguyen, CmpE Raj Patel, CmpE
Advisor / Section	Dr. Erick Maxwell
Semester	Spring 2017 Circle: Either Intermediate (ECE4011) or Final (**ECE4012**)
Project Abstract (250-300 words)	Heat-related fatalities among athletes have more than doubled since 1975. The Centers for Disease Control (CDC) estimates that there is an average of more than 9,000 heat illnesses among high school athletes annually, making it the leading cause of death and disability among high school athletes [1, 2]. The MedCap is an athletic cap fitted with sensors capable of measuring core temperature and mean arterial pressure which are connected to an embedded microcontroller housed on the hat. The MedCap aims to detect an early heat illness related event. The data from these sensors would be transmitted to a smartphone application using the Bluetooth communication protocol. If an early heat illness event is detected, the mobile application shall alert the user. The data shall then be stored in a cloud database and remain available as historical data. This cap will be marketed to recreational athletes who want to monitor their body metrics and be alerted about potential heat illness. Additionally, the historical data can be used by the medical research field to better understand the physiological parameters and patterns of heat illness. The sensors monitor core temperature and mean arterial pressure. The software is also capable of capturing the ambient heat index in order to use it as an additional data point. This data shall be compiled and used by a software algorithm to calculate whether the wearer is experiencing an early heat illness event. The algorithm shall compare real-time sensor data to predetermined temperature and artery pressure thresholds based on wearer characteristics (e.g. age, height, weight). MedCap aims to reduce deaths due to heat-related events by identifying early heat illness events and notifying the user. Once the user is notified, he or she will be able to take steps to cool down including drinking water and leaving the direct sunlight. [1] M. Kinney, Hear-related deaths among athletes still on the rise, Theham.net, Aug. 2015. [Online]. Available: http://www.cnhinews.com/sports/article_19696d9c-4b55-11e5-8518-076ca3ac0074.html. [Accessed Jan. 17, 2017]. [2] E. Brady, Heat-related illness still deadly problem for athletes, USA TODAY, Aug. 2011. [Online]. Available: http://usatoday30.usatoday.com/sports/2011-08-15-heat-stroke-still-causing-death-in-athletes_n.htm. [Accessed Jan. 17, 2017].

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List **codes** and **standards** that significantly affect your project. Briefly describe how they influenced your design.	IEEE 802.15.1: for wireless communication between embedded processor and phone The Bluetooth standard allowed simultaneous data transfer to the external mobile device while the mobile device sends data to the cloud analytics platform. Since the Bluetooth standard is parallel to the WiFi standard, simultaneous local (offline) and global data transfer are possible.
List at least two significant **realistic design constraints** that applied to your project. Briefly describe how they affected your design.	The power consumption of the embedded processor should be minimized to decrease heat transferred to the hat and increase battery life. The communication protocol that's used must easily connect to a smartphone and also must have a large enough range to connect to smartphones hundreds of feet away. Physical size of the embedded circuit and battery module must be small enough to fit in the bill of a hat.
Briefly explain two **significant trade-offs** considered in your design, including options considered and the solution chosen.	There were two communication technologies that were considered in order to transmit data between the microprocessor and the external mobile device. These two communications were Bluetooth and Zigbee. Zigbee is able to transmit data over longer distances while Bluetooth is traditionally limited to 100m. Bluetooth connects to smartphones through a Bluetooth module that is pre-installed in most current smartphones. Zigbee connects to the smartphone through the WiFi adapter. If Zigbee is occupying the WiFi connection, the software will not be able to relay the data up to the cloud for data processing and storage through the WiFi communication. Bluetooth, on the other hand, can receive data from the MedCap while leaving the WiFi network open to transmit data to the cloud. Due to the connectivity constraints Zigbee would place on the design, Bluetooth was chosen even with its limited communication range. A tradeoff between the physical size of the microcontroller hardware and the amount of data the MedCap can collect from the wearer arises due to the available space in an athletic hat. While the algorithm will be more accurate with more input parameters, there is not enough space in the hat for the sensors nor are there are enough I/O pins in a small microcontroller for these sensors to connect to the microcontroller. Because smaller size is more important than a surplus of sensor readings, only a few sensors will be used.

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 MedCap will have an embedded microprocessor to read data from sensors and send the readings to the smartphone application via Bluetooth communication. The embedded microprocessor will serve as the interface between the analog signals read from the sensors and the digital signals that will be sent by the Bluetooth module. An external, Bluetooth capable mobile device will receive data from the microprocessor and send the data to a cloud analytics platform for processing. The mobile device will then retrieve the processed data from the analytics platform and display the results in a graphical user interface via a mobile web application.

ECE4011/ECE 4012: International Program

(Only groups with one or more International Program participants need to complete this page)

Project Title	

Global Issues (Less than one page)	(10 point font, single spaced)