ECE4011/ECE 4012 Project Summary

Project Title	Emory Sleep Patient Monitor
Team Members (names and majors)	Isabel Anderson (EE)
	Mauricio Builes Zapata (EE)
	Alan Grusy (CompE)
	Xavier Williams (CompE)
Advisor / Section	Whit Smith
Semester	Year/Semester Circle: Either I**ntermediate (ECE4011)**
Project Abstract (250-300 words)	The purpose of the project is to improve and design a leg sleep monitor that is capable of detecting and recording continuous movement measurements while the patient is sleeping. Movement is a notable identifier of sleep related disorders, and is specifically relevant to Restless Leg Syndrome. By obtaining leg movements clinical professionals will be able to effectively diagnose and treat patients without the added expense of having them sleep at a sleep clinic. Such measurements will be detected by the use of accelerometers and gyroscopes that yield high quality and precise measurements, in conjunction with a microcontroller to process the raw values and save them into an SD card. The system must be able to record measurements for prolonged periods of time while holding battery charges so that it is viable for the device to be sent to a patient's home and have the data examined. Furthermore, the device must incorporate the Bluetooth communication protocol to transfer the data recorded wirelessly in a convenient medical setting. In order to save battery life, the device will only do this when it detects battery charging, namely using the newly commercially available wireless charging method. The data will then be analyzed and displayed in a custom made GUI. The program will be capable of detecting relevant features in the collected waveforms such as peaks and throughs, duration of movement, strength and time of the movements. Moreover, an attempt at signal processing and machine learning will be implemented to help autodetect and auto-mark the relevant clinical data in order to help the physicians.

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List **codes** and **standards** that significantly affect your project. Briefly describe how they influenced your design.	Bluetooth Wireless Technology Standard: The Bluetooth standard determined the way in which data is transferred between the device and a computer, and it's requirements on package and message transmission yielded in the microcontroller and interface selection. The IEEE P360 Standard on wearable technology is a current working project by the Wearable Working Group that outlines basic safety and suitableness to wear wearable devices. It provides with technical requirements such as battery duration and optimization that help provide for guidelines in the project's technical considerations. Qi is an open interface Wireless Charging standard that was created by World Power Consortium and is commercially being used by manufacturers such as Apple, Motorola, Samsung and Sony. It outlines and describes wireless charging protocols, and will provide for an ease of development in the implementation of the device's wireless charging capability.
List at least two significant **realistic design constraints** that applied to your project. Briefly describe how they affected your design.	Size: The device must be worn all night for potentially weeks at a time. Thus the size of the device needs to be minimal to ensure patient comfort. Battery Life: The device needs to last 1 week on a charge, so the patient can dump their sleep data during a weekly visit. This will create constraints on the size of the device and the amount of processes the embedded devices will be running. Thus the embedded devices will need to only collect data on movement and not continuously.
Briefly explain two **significant trade-offs** considered in your design, including options considered and the solution chosen.	Significant trade-offs arise from the need to make a comfortable and lightweight device and have a long lasting battery to be able to withstand extended periods of time collecting data without interruptions. Tradeoff 1: Battery size and microcontroller power consumptions. Choosing the right pair between a low power microcontroller as well as one that has enough processing power to collect the data is of crucial importance and determines the overall size of the device. Options considered were the Teensy 3.2 microcontroller and the TI MSP430 microcontroller. Ultimately, the Teensy 3.2 microcontroller was chosen due to its easy of programmability. Tradeoff 2: Data collection:

	Collecting more data points will yield in higher fidelity data, however, it will drain the battery at a faster rate and reduce the amount of time the device can record data for. Therefore, options include lower data sampling with higher interpolation and error, or higher data sampling with less error but higher battery drain. An intermediary solution was chosen to design the sampling to allow the device to collect the data for up to 5 days, and adjust the sampling period to correspond to this limiting factor.
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.*	There are two computing interfaces in the project. There is an embedded device that will collect data. There is a computer program that will receive the data when the embedded device is within range. The computer program will display the results in a GUI. The embedded device will have multiple interfaces including an accelerometer, micro SD card, bluetooth, and wireless charging. The accelerometer will collect and record data to the micro SD card upon exceeding a certain threshold value. The wireless charging will be present with the data collection program and thus the wireless charging will activate a bluetooth data transfer. The computer program will collect all of the data and display it in a GUI.

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Leadership Roles (ECE4011 & Forecasted for ECE4012) (NOTE: ECE4012 requires definition of additional leadership roles including: 1.Webmaster 2. Expo coordinator 3. Documentation	Team Leader: Mauricio Builes Zapata Lead Backend Developer: Alan Grusy Lead Frontend Developer: Xavier Williams Lead Hardware Integrator: Isabel Anderson Lead Data Analyst: Mauricio Builes Zapata Webmaster: Isabel Anderson Expo Coordinator: Mauricio Builes Zapata Communications Chair: Xavier Williams Documentation: Isabel Anderson
International Program: Global Issues (Less than one page) (Only teams with one or more International Program participants need to	

complete this section)	