

Initial Project and Group Identification Document

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Advanced Sleep Management System

A system to monitor and aid the quality of sleep.



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Narrative Description

The goal of this project is to design a sleep monitoring system that will provide information on the sleeping habits of the user. One or more wearable devices equipped with sensors will collect data during sleep. This system will perform analysis on the collected data and include a display to report helpful information back to the user. The device is intended to improve the user's quality of sleep and overall health by detecting his or her stages of sleep and finding the optimal time to rouse the user. The device may also aid in identifying, but not officially diagnosing, potential sleep disorders.

Traditional polysomnography, or sleep study, monitors sleep through the use of electroencephalography (EEG), detecting muscle movement, electrocardiography (EKG), and electrooculography (EOG). The aim of this project is to monitor sleep less obtrusively by using comfortable, potentially wireless, wearable sensors that allow for the most natural sleep possible. We hope to accurately identify stages and quality of sleep using pulse oximetry, body temperature measurements, and accelerometers for detecting body motion.

The device will also incorporate an alarm system that helps the user obtain optimal sleep and wake up at the ideal time to minimize fatigue. Using cues such as body temperature to help determine circadian rhythm and body motion to help discern sleep stages, the device will aid individuals in getting the amount of rest they need personally.

Motivation for the Project

Sleep is very important to a person's overall health. Sleep deprivation is associated with a wide variety of physical and mental illnesses, and oversleeping may also be associated with health complications. Obtaining an optimal amount of sleep is not easily achieved by following simple strategies like allotting eight hours of rest with an alarm clock set at a deadline.

The sleep management system would be used to improve the quality of the person's sleep by providing them with useful information regarding their sleeping habits. Armed with this knowledge, an individual can make better decisions regarding appropriate times, places, climates, ambient light levels, or even body positions for sleeping and napping.

This system intends to combat sleep inertia, which is a feeling of grogginess and sleepiness often encountered when awakening. Awakening during certain sleep stages

or at the wrong time relative to one's circadian rhythm can worsen sleep inertia. By identifying the stages of sleep and circadian rhythm of users, this device could help them wake up feeling alert and refreshed.

Currently, there is also a large difference in the types of machines used to monitor sleep, ranging from the high-end medical devices used in professional sleep study down to simple mobile apps that claim to wake the user in a light stage of sleep. One of our main motivations is the creation of a sleep system that could be considered a consumer product, which would be in the middle of the spectrum of sleep systems.

Sponsor

There is currently no sponsor for this project. If no sponsor is found the project will be funded by the group.

Goals and Objectives

The sleep management system will be able to monitor the pulse, movements, and temperature of the user at a minimum. It must interpret this data to determine whether the user is in a light stage of sleep or a deeper stage of sleep, and wake the user with an alarm during the lightest stage of sleep within a window of time specified by the user.

The sensor devices must be comfortable enough for the user to sleep normally. Ideally the wearable device or devices should communicate wirelessly for maximum comfort. The sensors should also be able to survive nights of restlessness where they may endure some physical abuse.

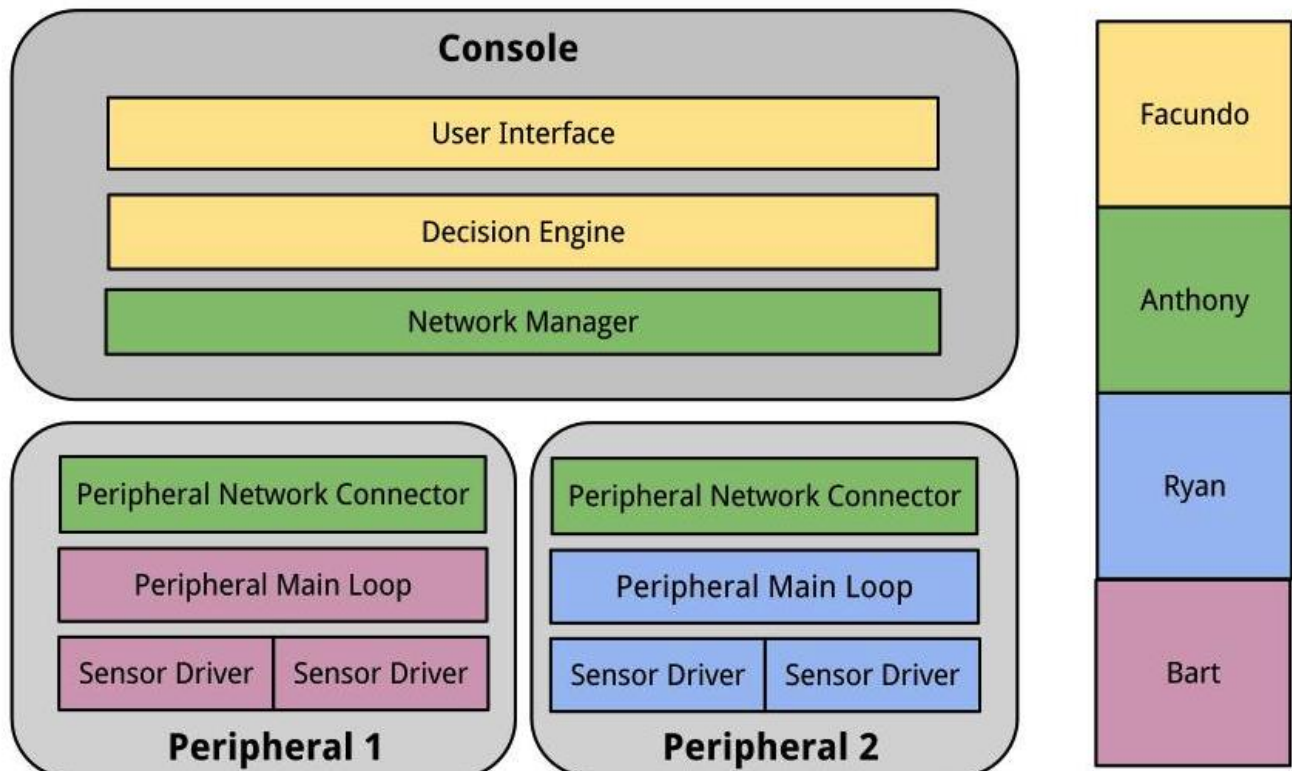
Function of the Project

The primary function of the project is to identify light stages of sleep and wake the user through an alarm. The project will also analyze biological data gathered throughout the night to provide the user helpful information regarding sleep habits and potential health issues.

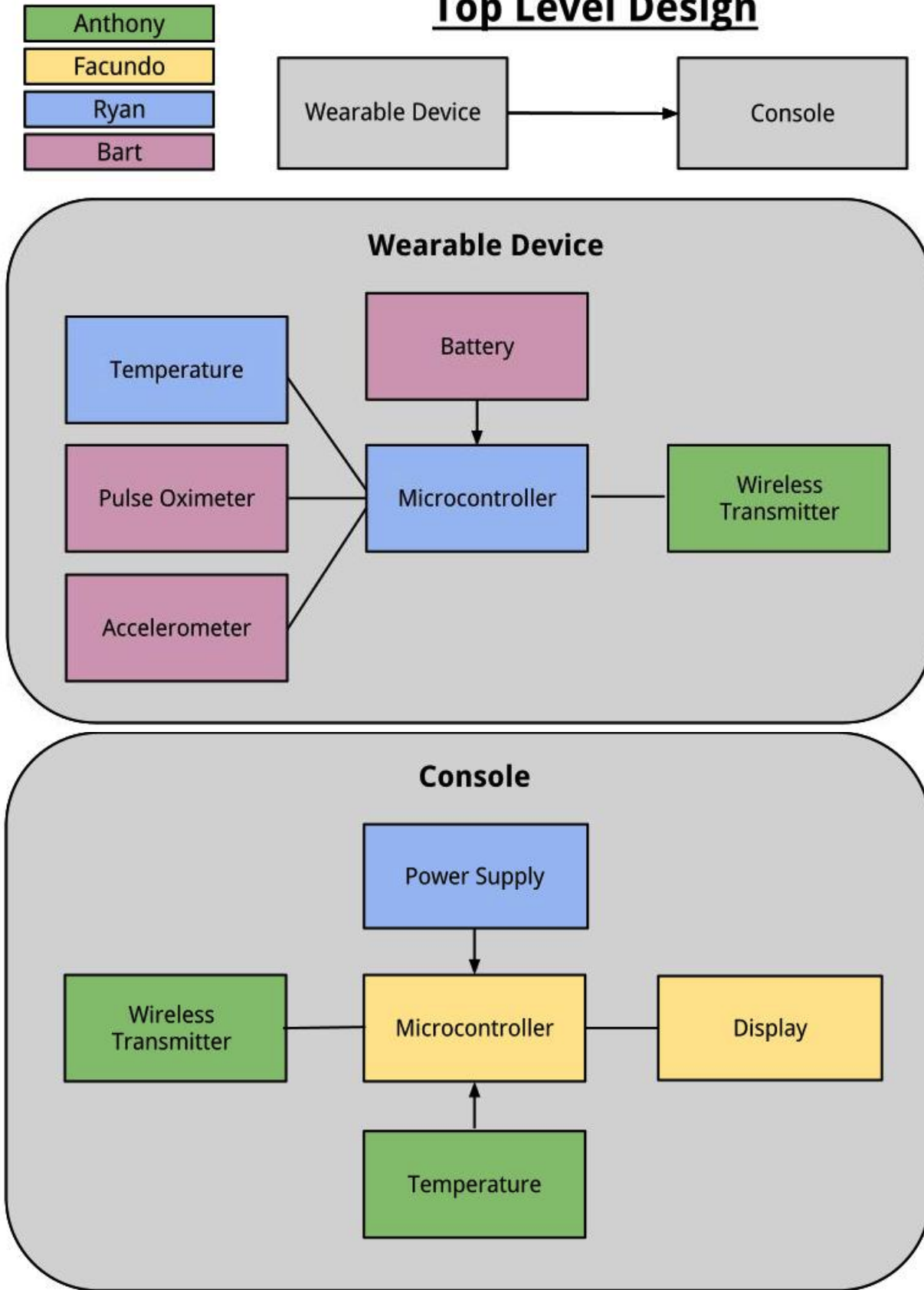
Specifications and Requirements

Power Supply Voltage	AC 110-230 V
Wearable Device Battery Life	8 hours+
Wearable Device Weight	< 10 lbs.
Temperature Sensor Accuracy	+/-25%
Pulse Oximetry Accuracy	+/-25%
Detect Sleep Stage Transitions	75% of transitions
Activate Alarm within Specified Time Frame	50-90 dB
Operating Temperature of System	50-100° Fahrenheit
Wireless Range	5 feet
Battery Recharge Time	< 24 hours for 100%

Software Block Diagram



Hardware Block Diagram



Budget and Financing

Parts	Projected
Touch Screen	\$150.00
Accelerometer sensors	\$30.00
Temperature sensors	\$30.00
Ambient Light sensors	\$15.00
Pulse Oximeter parts	\$50.00
Wireless Communication	\$100.00
PCB	\$50.00
Microcontrollers	\$300.00
Batteries	\$100.00
Total Projected Expenses	\$825.00

Milestones

Semester 1:

- Select Microcontrollers
- Create Sensor Schematics
- Determine Proper Battery Size for Portable sensors
- Prototype Sensors
- Acquire Materials
- Begin Programming
- Wireless communication
- Program Alarm Clock
- Research Paper

Semester 2:

- Combine Sensors into Wearable Device
- Communication Between Device and Console
- Test Performance During a Sleep Cycle
- Design GUI
- Order Printed Circuit Board(s)
- Populate Printed Circuit Board(s)
- Test Whole System