Rohan Harpalani, Tyler Hirsch, Walker Rickord
CS 437 – Final Project Proposal

Project Idea:
Our idea is a smart pillow that tracks a user's sleep. The basic premise is that the pillow will have a pressure sensor inside giving it the capability to:

- Track a user's time in bed, measure how long pressure was greater than some constant (i.e., the weight of the pillow)
- Track a user's movement, potentially measured by a pressure fluctuation of greater than, say, 10%
- Track disturbances experienced during a user's sleep, potentially measured by the duration that the pressure sensor detected the constant
- Compile all data and send in a sleep report to the user in the morning

Some other capabilities NOT in the original scope, but we are considering giving our device if time allows:

- Microphone, to capture sleep talking, noises, or other disturbances during sleep
- Speaker, to act as a hidden alarm
- Linear resonant actuator, to vibrate pillow if an auditory alarm is not enough to wake the user
- Temperature sensor, to track user temperature
- Cooling/Heating pad. Sleep studies have shown that one's body temperature drops a few degrees before waking. Inducing this temperature drop through a pillow could help one wake without an alarm
- Sleep recommendations. Based on specific sleep deficiencies the device identifies, the device could include specific recommendations in the sleep report to be delivered to the user, based on established medical practices

Motivation:
The idea of tracking sleep stems from the growing awareness of sleep's profound impact on overall health and well-being. With modern lifestyles often characterized by erratic sleep patterns and increasing rates of sleep disorders, there's a pressing need for accessible tools to monitor and improve sleep quality. Such a device could empower individuals to gain insights into their sleep habits, identify patterns affecting their restfulness, and make informed decisions to optimize their sleep routines. By leveraging technology to track sleep metrics such as duration, quality, and disturbances, this project aims to provide users with actionable data to enhance their sleep hygiene, leading to better physical health, cognitive function, and overall productivity.

While wearable devices such as an Apple Watch or Fitbit provide similar sleep-tracking functionality, these solutions may actually interfere with a user's sleep due to their bulky profile and shape, especially if they are not used to sleeping while having a wearable device on their wrist. This smart pillow device would provide a contactless monitoring solution, which could be especially useful for children, elderly, and other users uncomfortable with wearing an obtrusive bracelet while they sleep.

Timeline:

Date	Objective
02/25/2024	**Milestone 0** Order all required parts. While waiting for their arrival, start the organization of a Git repository. Additionally, map out steps to complete the communication network so the user can read the device's information.
03/10/2024	**Milestone 1** Construct a communication network between the Raspberry Pi and a computer/phone. The user's device will pull Raspberry Pi for data and will display data in a user-friendly manner. Develop a simple GUI to show relevant information for tracking one's sleep.
03/24/2024	**Milestone 2** Start testing with pressure sensors inside the pillow. Test how precise the data we can collect is and determine the optimal pressure sensor layout. Consider the trade-off between user comfort and optimal sensor output.
04/01/2024	**Milestone 3** The device can detect when a user's head is resting on the pillow and when they roll from side to side.
04/14/2024	**Milestone 4** The device can differentiate the previous conditions from the user removing its head from the pillow and waking in the morning; thus, the device can accurately track time in bed. Additionally, the device can track sleep disturbances.
04/28/2024	**Milestone 5** Final deliverable working and ready for submission. The device accurately tracks all metrics (time in bed, user movement, sleep disturbances). The device correctly transmits collected data to the user's device. The user interface displays all collected data in an easy-to-interpret manner.

Group:

Rohan Harpalani (rohanhh2)
Tyler Hirsch (thirsch3)
Walker Rickord (walkerr2)