Homework #6 – Modeling

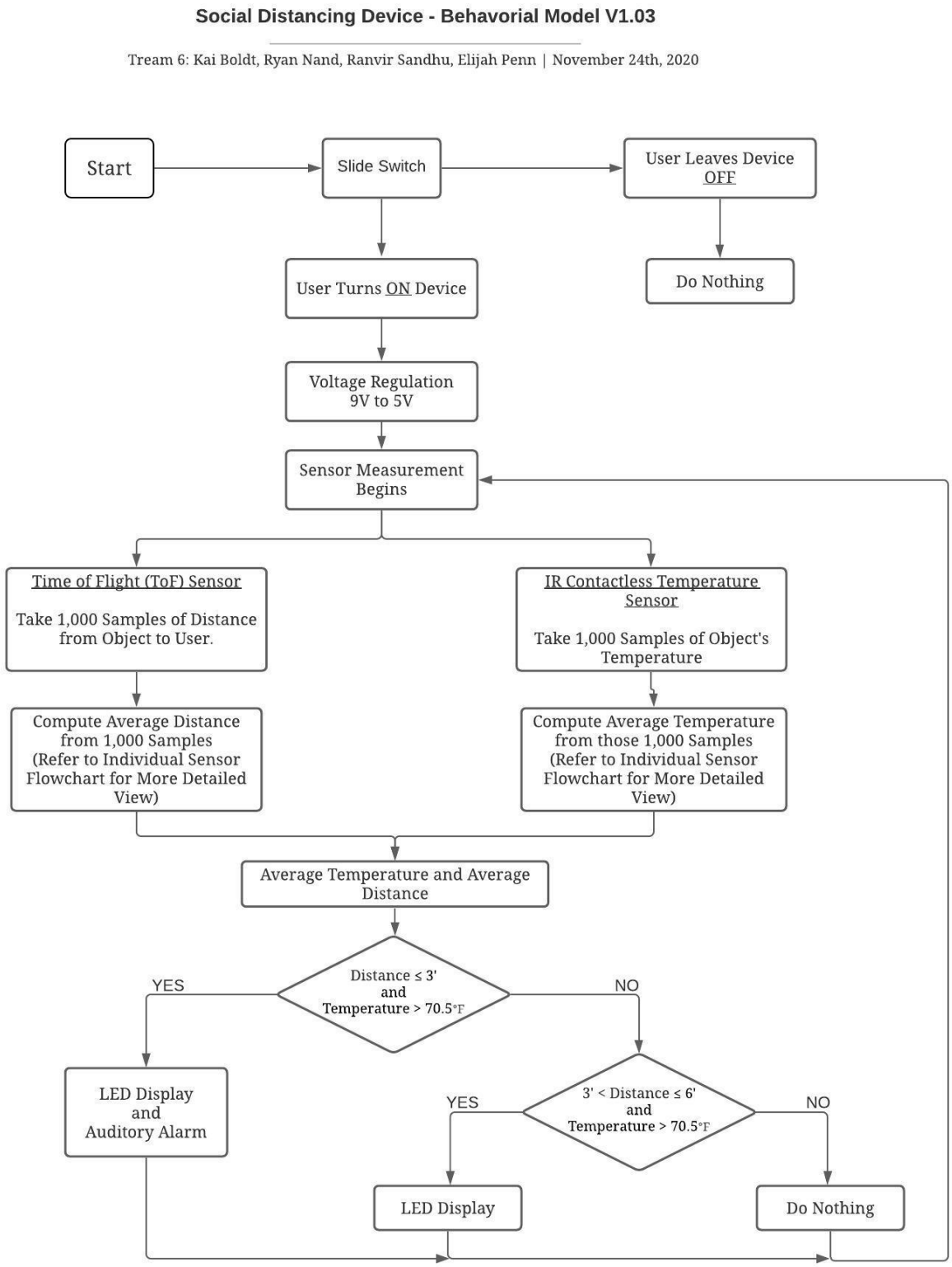
ECE 411 - Industry Design Processes

Team 6: Kai Boldt, Ryan Nand, Ranvir Sandhu, Elijah Penn

November 24th, 2020

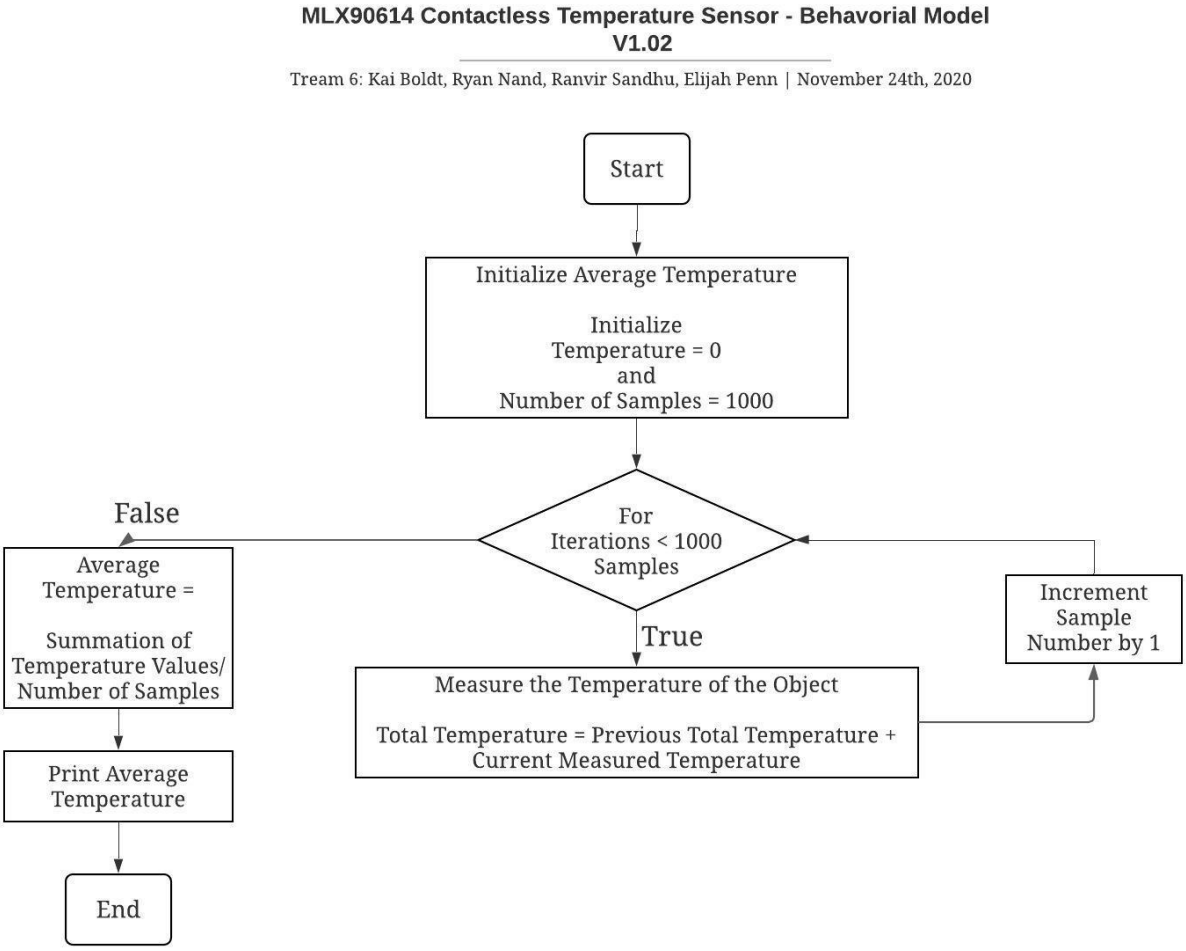
V1.02

Social Distancing Device



Module	Social Distancing Device
Inputs	- Power Supply: 9V DC - Analog Temperature Signal (Contactless Temperature Sensor) - 940nm IR Signal (Time of Flight Sensor)
Outputs	- LED Display (Visual Alert) - Low Power Audio Amplifier (Auditory Alert)
Behavioral Functionality	The Social Distancing Device detects people that are within the CDC recommendation of 6’ apart from another person to prevent the potential spread of COVID-19. <u>Behavioral Flowchart Model</u> The functionality of the model begins with a slide switch that the user can either input to leave the system OFF or turn the system ON. Once the system is ON, the system is powered by a 9V battery that is regulated to an operating voltage of 5V. From there the VCC of 5V powers the two sensors contained on the systems. Each sensor will take 1,000 samples through a FOR loop in the program and will summate each sample measurement into a total value. These are done to minimize any potential outliers in the dataset that can occur through system use. Then the system will compute an average value (temperature and distance) that’ll be used through two conditional statements (If-Else Statements) to determine if the system needs to alert the user based on if they’re currently failing to meet the CDC recommendation. Based on the average measurements the system can do one of three options. It can either display an auditory alert with an LED sequence, just the LED sequence, or nothing at all. The system will perpetually repeat these steps till the user decides to turn off the device.

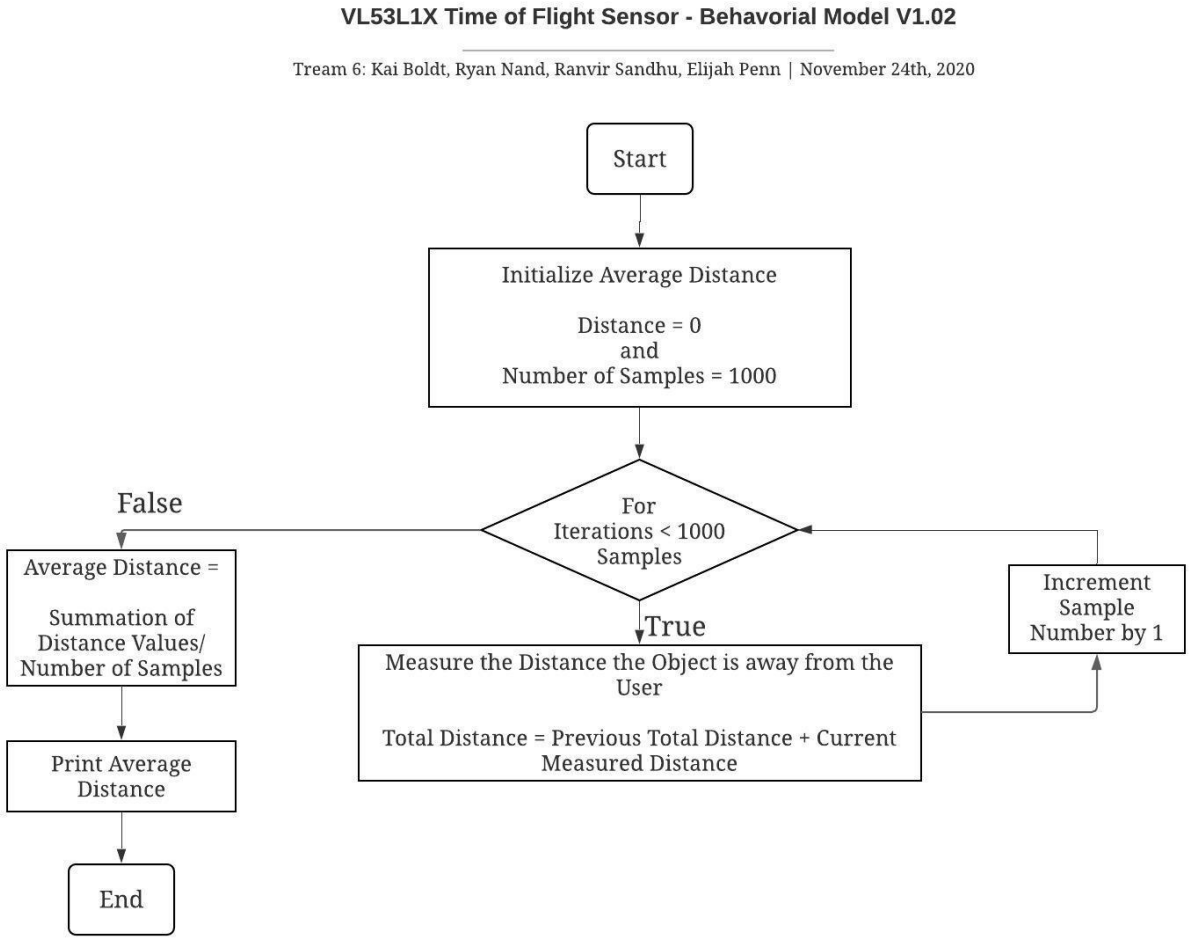
IR Contactless Temperature Sensor Flowchart



Module	IR Contactless Temperature Sensor
Inputs	- Power: 5V DC - Analog Temperature Signal (IR)
Outputs	- Digital Temperature Signal (Sends data to ATmega328p's I2C bus)
Behavioral Functionality	The IR Contactless Temperature Sensor measures the respective temperature of the object within the sensor's field of vision. Through testing, we determined that the sensor was accurate with single samples of measurements. However, we decided to take a summation of 1,000 samples of the measured temperature data through a FOR loop within our program. From there, the program takes the total summation of 1,000 temperature values and divides that by the total number of samples taken. This was done to remove potential outliers of data since the sensor has a 15° field of vision and the further the object's distance the sensor loses accuracy of the measured temperature.

	Testing Averages Room Temperature = ~69°F 0'= ~97-98°F 1' = ~78°F 2' = ~76°F 3' = ~74°F 4' = ~73°F 5' = ~72°F 6' = ~70-71°F

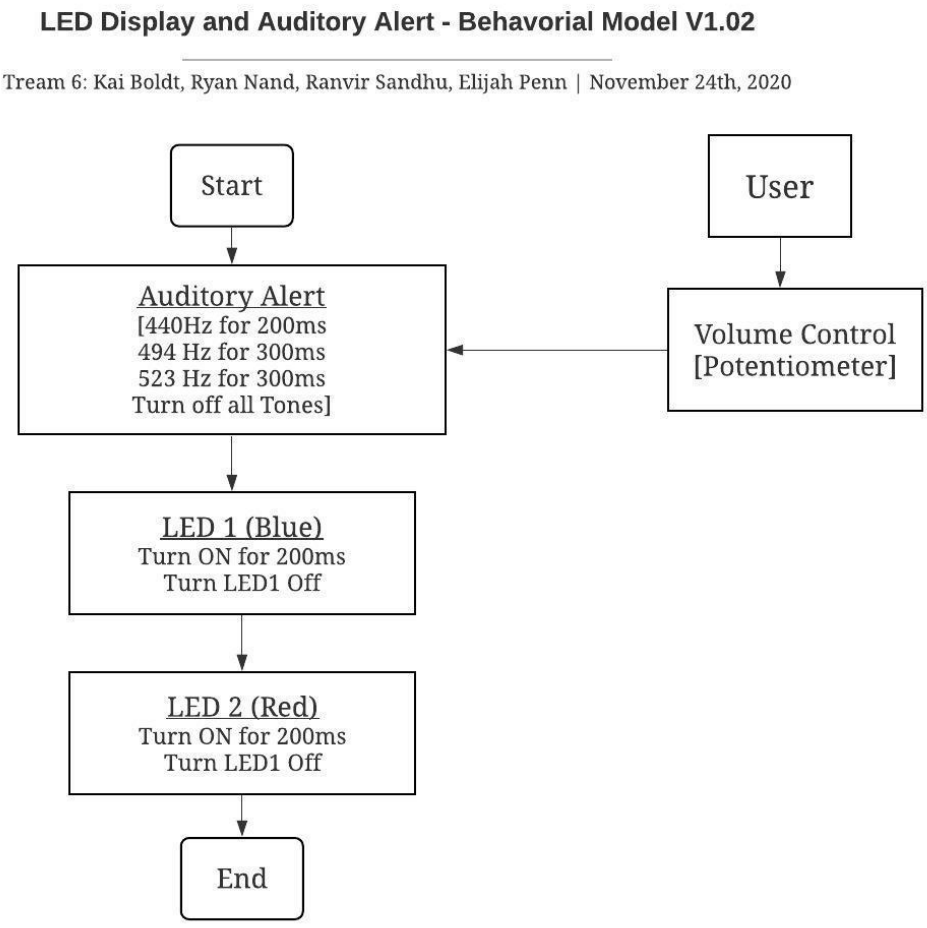
Tine of Flight (ToF) Sensor Flowchart



Module	Time of Flight (ToF) Sensor
Inputs	- Power: 5V DC Signal - 940nm IR Signal

Outputs	- Digital Distance Signal (Connected to ATmega328p's I2C bus)
Behavioral Functionality	The Time of Flight (ToF) measures the distance of an object from the IR sensor. The behavioral model is similar to what was observed with the Contactless Temperature Sensor. The behavioral model of this sensor begins by initializing 1,000 samples to be taken and summates all 1,000 samples of measured distance through a FOR loop. After the summation of all measured distances then the system will compute the average measured distance by dividing the total summation of measured values by the number of samples taken. This process was done for system stability by preventing potential outliers in the dataset from interfering with the conditional statements to determine if a notification type needs to occur.

LED Display and Auditory Alarm Flowchart



Module	LED Display and Auditory Alarm
Inputs	- Power: 5V DC Signal - Volume Control (10kΩ Potentiometer) Determined by user
Outputs	- Auditory Alarm (Tones with different frequencies) - LED Display (Light from two separate LED colors)
Behavioral Functionality	The LED Display and Auditory Alarm is the main form of notification for the user for failure to maintain 6’ of distance between other people. <u>LED Display</u> The LED display is a cycling function between two different colors of LED’s. The system is designed to initiate the first LED for 200ms and then the second LED for another 200ms. Once the 200ms duration has past then the program will turn off the respective LED that was on concurrently. The system is constructed to perform just one cycle of the LED sequence for overall program loop, but the system was designed to reduce all the apparent delays and processing time. Therefore, the LED’s will appear as a continuous function if the same condition is met between complete system loops <u>Auditory Alarm</u> The Auditory Alarm is a sequence of tones played at different frequencies to alert the user if the user fails to maintain at least 3’ of distance from another person. The alarm will always be the same through each iteration of the complete system loop. With this module the user has control over the volume at which the alarm will be played through each system iteration.