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MAE 334 L09 Group 3

Lab Project

1. Description of the Goal of the System

The goal of the system we created is to be a dispenser of a variety of (smaller) items. The way our project would dispense items is by using a sensor to detect a change in the environment to then actuate a response with a motor that opens a trapdoor at the bottom of our system. The goal of the sensor was to detect a “wave” like gesture, which would activate the servomotor, and then dispense whatever item was in the device. The system also notifies of the temperature and humidity so the items can be kept in optimum condition.

The basic overview is:

- recognises a quick hand-wave in front of an HC-SR04 ultrasonic sensor,
- unlocks an SG90 micro-servo for 5 s, then relocks,
- turns on LED while someone is nearby,
- shows live temperature, humidity, and distance on a 1602 LCD screen.

2. Selection of Sensors and Instrumentation

The sensor we used was the ultrasonic sensor, used to detect the distance of the environment change in a “wave” like gesture, that would then actuate the response to open the trapdoor and dispense whatever was previously placed in our system. The motor we used for the trapdoor was a servo motor, which would simply rotate 90 degrees whilst attached to the trapdoor, thus opening the bottom of the dispenser. We also had a series of instruments such as a humidity sensor to detect the humidity of the environment to see if the object in the dispenser would be affected by said environment, and we also had a led that would light up whenever the ultrasonic sensor detected the correct range for the “wave”, letting the user know they were correctly read. Tying all these instruments together, we had an LCD screen that read off both the distance and humidity to make the reading of information easier.

Overview:

- HC-SR04 ultrasonic sensor - range detection
- SG90 micro-servo motor - to actuate dispenser door
- DHT11 - temperature & humidity sensor
- 1602 LCD (parallel, 4-bit) - Panel to display live temperature, humidity and distance.
- Red LED
- Potentiometer - To control the contrast of the LCD Screen.

3. Controlled and Recorded Parameters

The independent parameters that were used as our control were the distance from our dispenser to the surface of the floor for toggling the counter in the wave sequence, and another control our system had was the low-pass filter attributes, like cutoff frequency, sampling time.

The dependent parameters that were recorded were the distance change of the dispenser to whatever object (human hand typically) that would come between the sensor and the floor. This distance change was both measured and recorded and would actuate a response if the correct series of movements was performed, allowing room for human interaction error.

Overview:

Independent	Sampling period T (20 ms) Low-pass, ω Gesture acceptance time Servo open time (5 s) LED hold time (3 s) Minimum and maximum Distance for toggles
Dependent	raw echo distance (calculated by formula) low-pass output (Calculated by formula) toggles – counter for gestures temp ($^{\circ}\text{C}$), hum (%) from DHT11 Other conditional states

4. Limitations of System and Practice

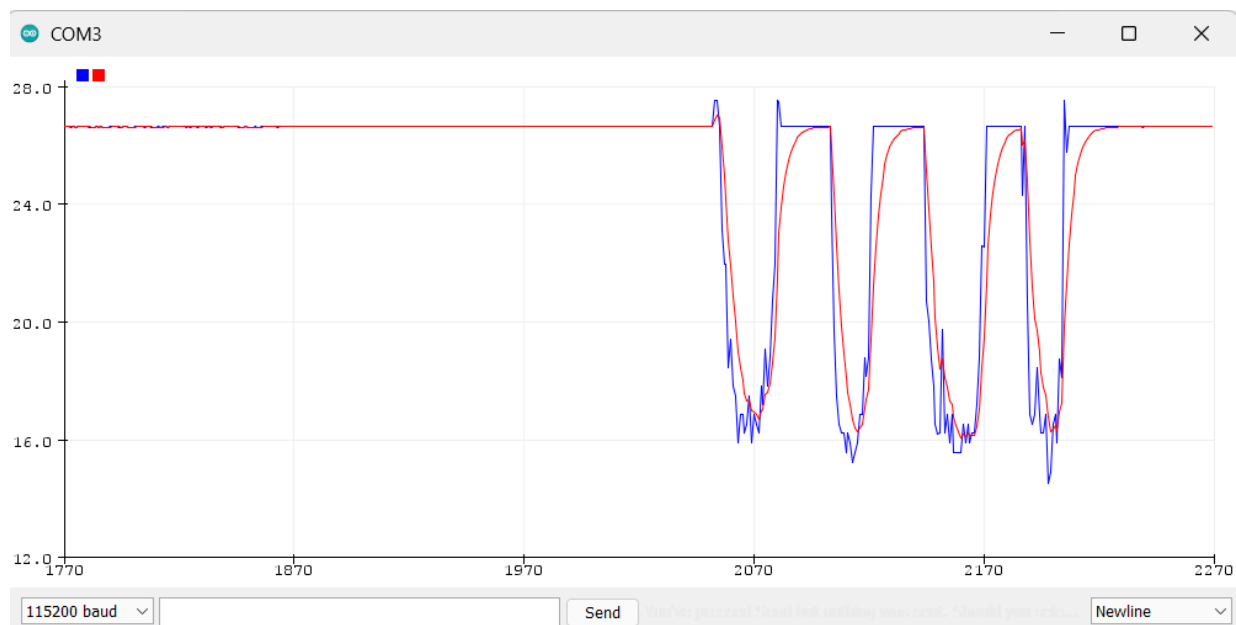
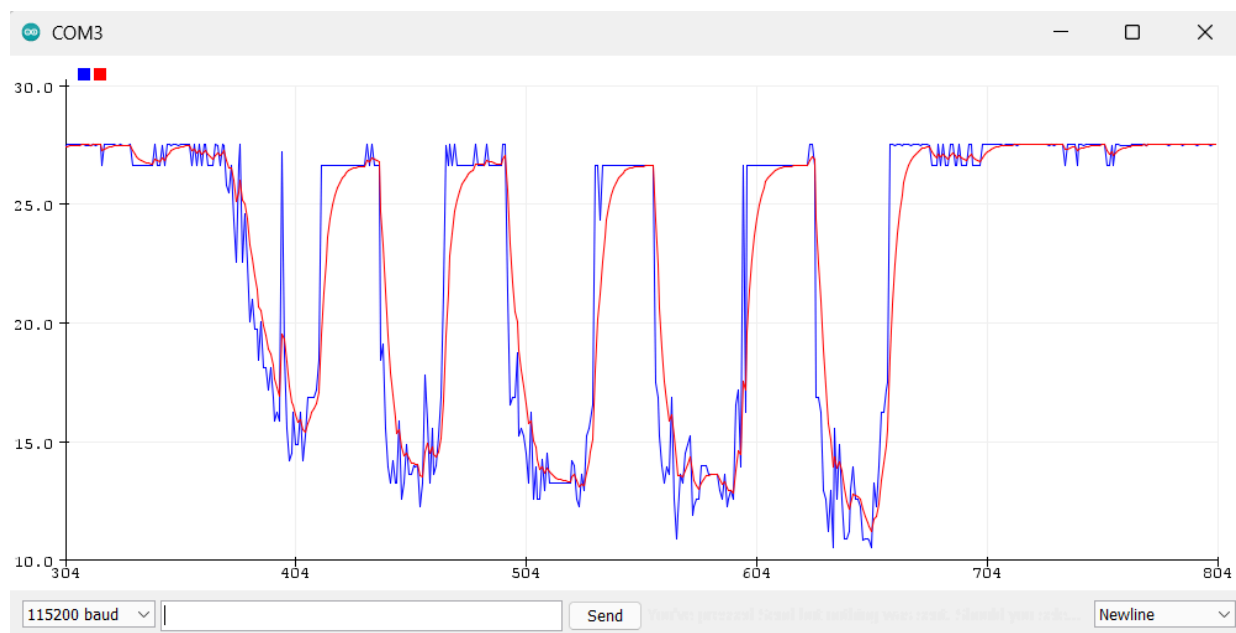
There are some limitations on our system however, both in general and in practice. For example, some limitations we have in general with our system is that we have to have the dispenser be facing a certain way due to both the sensor reading and the door opening a certain, we have to

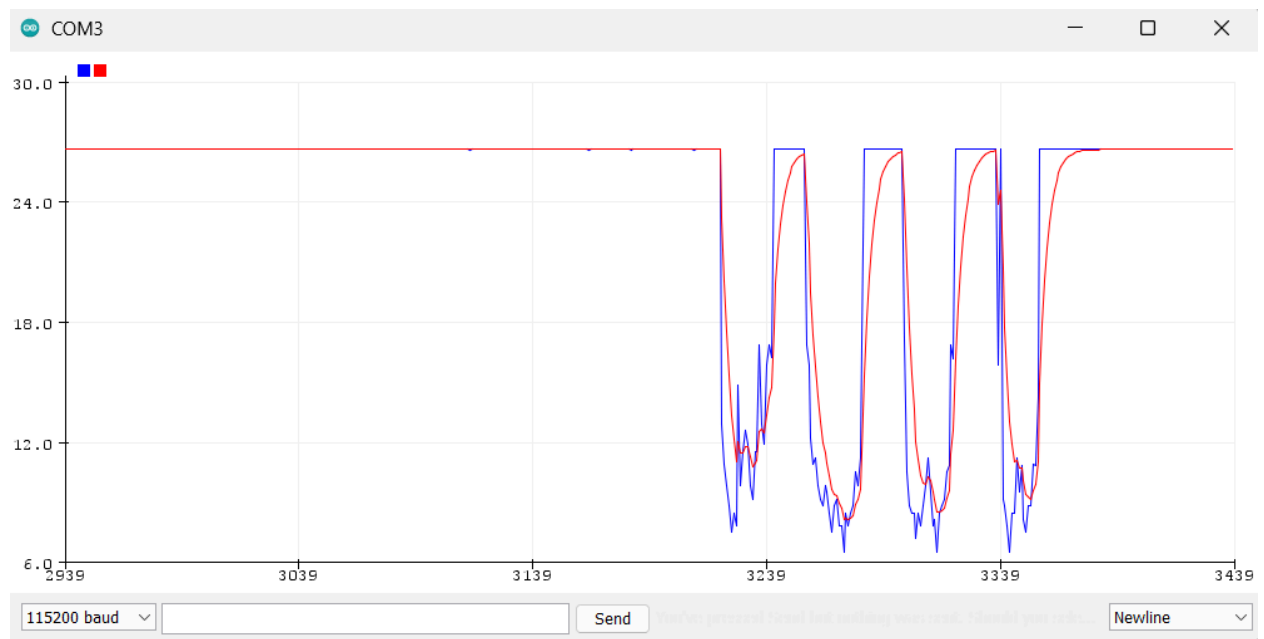
have the sensor be a certain distance from the floor to actuate properly, and the wiring has to be a very neat and concise so that the dispenser doesn't interfere with battery power.

Some limitations in practice are simply the wiring has to be a certain (close) distance from the operating system, and the “wave” like gesture has to be somewhat timed for the sensor to pick it up. The sensor is not capable of detecting very fast gestures, so they have to be paced properly.

5. Analysis of Parameter

Below is a plot of raw distance from the ultrasonic sensor (blue) and the low-pass filtered distance (red) while waving. The sensor is aimed at the floor.





6. YouTube Link to Video

https://youtube.com/shorts/mm_RbkvxnoA?feature=share