App Physics 185
Capstone Project

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Week of 6 May 2019: Update 1

Materials

Table 1: Items required and expenses so far.

Quantity	Item	Cost/pc (PhP)	Subtotal (PhP)
1	Velostat sheet	349.00	349.00
1	Heltec ESP32 LoRa Microcontroller	0.00*	0.00
1	Aluminum tape	0.00**	0.00
		TOTAL	349.00

**provided by Dr. Tapang*

***stock available in lab*

Tasks accomplished

- Familiarized ourselves with how to construct a sensor based on velostat pressure sheets
- Refreshed our knowledge of programming in C++ (for Arduino)
- Downloaded and installed drivers specific to the microcontroller and familiarized ourselves with its pinout
- Were able to construct a basic velostat sensor and display its analog input reading both on the serial monitor and the microcontroller LED

Results

- Analog input of microcontroller $\in [0, 4095]$ `int`
- Readings were scaled such that the range $\in [0, 5]$ V `float`
- Maximum reading is obtained when there is no applied pressure, reading decreases as pressure is increased
- Continuous serial plot shows a constant value when no pressure is applied, but changing the pressure shows that the analog reading is not continuous when pressure is applied: the reading constantly jumps between a certain value corresponding to the pressure and the maximum value, i.e. applying a constant force on the sheet at rest does not produce an expected step function, but rather, uneven spikes

Up next

- Find a way to stabilize pressure readings to get a proper constant reading when applying constant pressure
- Develop code for recognition of type of motion based on the appearance of voltage vs time graph by evaluating it for every time period τ
- Attempt to calculate time of flight based on voltage vs time graph

Listing 1: Inital code for familiarization of microcontroller.

```
#include <heltec.h>

float Vin = 0;
float Vscaled = 0;
int READPIN = 0;

void setup() {
    Serial.begin(9600);
    Heltec.begin(true, false, true);
    Heltec.display->flipScreenVertically();
    Heltec.display->setFont(ArialMT_Plain_16);
    pinMode(READPIN, INPUT);
}

void loop() {
    Heltec.display->clear();
    Vin = analogRead(READPIN);
    Vscaled = Vin/4095. * 5.;
    Serial.println(Vin);
    Heltec.display->drawString(0, 10, String(Vscaled));
    Heltec.display->display();
}
```

Week of 29 April 2019: Proposal

Objectives

- To be able to detect the force exerted by various locations on a person's foot.
- To be able to characterize, based on the force vs time graph, whether a person is standing, walking, running, or jumping.
- To be able to characterize the sport being played based on the force vs time graph.

Materials & Methodology

Table 2: Estimated cost of materials.

Quantity	Item	Cost/pc (PhP)	Subtotal (PhP)
1	Pressure-sensitive conductive velostat sheet	349.00	349.00
1	ESP8266 WiFi Microcontroller	325.00	325.00
2	9V Battery	79.00	158.00
		TOTAL	832.00

1. Pieces of the velostat sheet are attached to 3 locations on the insole of a shoe.
2. The velostat is attached to the microcontroller for real-time data acquisition.
3. Voltage vs. force calibration was done by applying different values of force to the velostat sheet.
4. A force vs. time is plotted in real-time for different motions.
5. A characterization of the different motions was done using the frequencies and magnitudes obtained from the force vs. time plot.

Predicted Results

Characterization of different motions:

- **Standing** - constant force observed over time
- **Walking** - a cascading motion from the three sensors will be observed
- **Running** - same as walking but with higher frequency
- **Jumping** - two sets of impulse will be observed from the take-off and landing.

Validation Scheme

- Compare the obtained force value from the sensor with the calculated calibration equation/curve, for standing motion.
- Through real-time analysis, compare a video of the motions to their force vs. time plot.