NORTHERN ARIZONA UNIVERSITY

To: Dr. David Willy

From: Martin Dorantes

Date: February 16, 2021

Re: Self-Learning Assignment

Introduction

Engineers are problem-solvers, making us always learning new content. Adapting to new obstacles is critical for successful engineers. This new self-taught skill memo contains proof, practice, and applications directly relating to the HPVC project. Using Udemy, the student enrolled into 2 courses about Arduino coding basics. The application directly relating to the capstone project is to program a turn signal for the HPV. The group is building an HPV for small kids, kindergarten to 8th grade, to teach and inspire young kids about the excitement behind engineering. Safety is a huge requirement building a vehicle for kids and adding a turn signal to the HPV will increase the safety for everybody when the people behind the operator knows the direction they are going. It will also familiarize the kids with operational skills, aiding for when the time comes to start learning how to operate a motorized vehicle such as a car or motorcycle. The student rented the Sparkfun Inventor's Arduino Uno R3 Kit from Cline Library to complete this assignment. [1]

New Skill

Arduino Programming for Beginners was the first enrolled course from Udemy. This course teaches the basics of building a simple circuit, C programming with Arduino, controlling hardware components, multitask programs, and making programs more dynamic. This course was used to familiarize the student with Arduino hardware and pin connections.

Arduino Programming and Hardware Fundamentals with Hackster was the second enrolled course from Udemy. This course teaches applications with LEDs and buttons, robotics, sensors, and shows how the student can create their own projects. This course is where a bulk of the LED applications came from for the turn signals. Figure 1 shows completion certificates validating the completion of both courses.

YouTube was another resource used to connect a second button to the same Arduino with a different function from the first. The video referenced shows the user how to connect multiple pushbuttons to one Arduino input. This was applied to include left and right direction turn signals. [2]

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Figure 1 – Course completion certificates

Application

After completion of the courses, the new coding skills were applied to create a prototype turn signal that can be mounted to the HPV. Figure 2 shows the Arduino and breadboard setup using LEDs, pushbuttons, 330-ohm resistors, 10k-ohm resistors, and jumper wires. Appendix A contains the Arduino code for the signals. Two separate half breadboards were used to replicate how each pushbutton would be on each handlebar. After building the prototype, the next steps would to battery power the Arduino board and mount it securely onto the HPV. Soldering longer wires would be necessary to connect the pushbuttons on the handlebars to the lights on the rear of the HPV. One button on the right handlebar would signal a right turn and one button on the left handlebar would signal a left turn. The lights are sequential to indicate the direction of the turn.

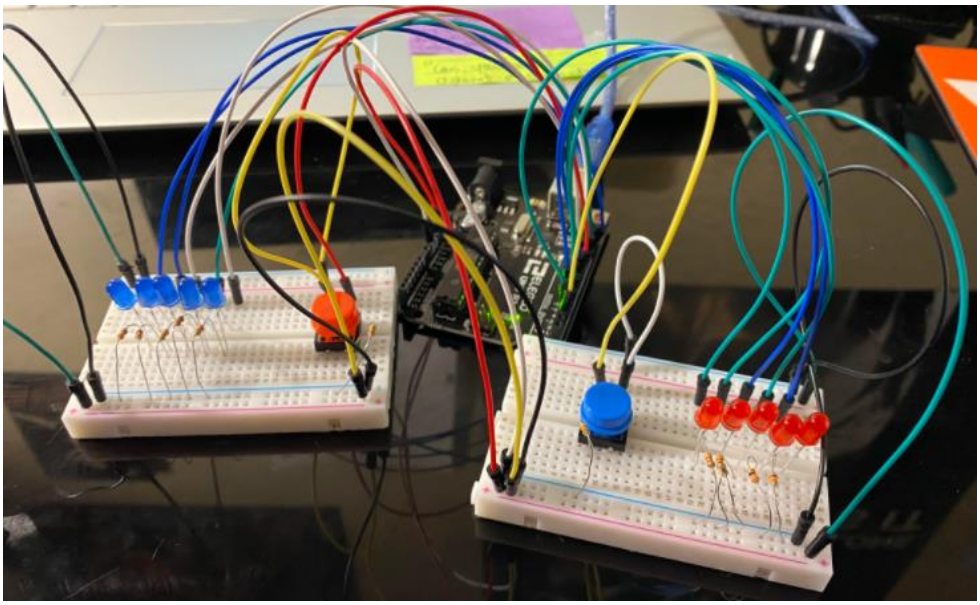

Figure 2 – Arduino & breadboard connections

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Conclusion

Included with the submission of this memo is a video demonstration to show what the signals look like when activated. It is important to include directional communication with any operational vehicle. As the team's primary requirement is safety for the HPV project, the use of turn signals communicates to others where the HPV will be going next. Showing children how to operate a turn signal on an HPV will help when it is time for them to start driving a car. It will familiarize them with the functionality of turn signals and the importance of visual communication on the road. Adding LEDs adds more aesthetic to the HPV, captivating inspiration to pursue engineering from a young age.

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References

[1] “SparkFun Inventor's Kit for Arduino,” KIT-11227 - SparkFun Electronics. [Online]. Available: https://www.sparkfun.com/products/retired/11227. [Accessed: 19-Feb-2021].

[2] M. Klements, “How To Connect Multiple Pushbuttons To One Arduino Input,” *YouTube*, Mar. 21, 2020. [Video Recording]. Available: https://www.youtube.com/watch?v=Y23vMfynUJ0. [Accessed: 19-Feb-2021].

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Appendix A – Turn Signal Arduino Code

```
// right signal
const int buttonPin = 2; // pushbutton pin
const int ledPin1 = 3;   // LED pins 3 thru 7
const int ledPin2 = 4;
const int ledPin3 = 5;
const int ledPin4 = 6;
const int ledPin5 = 7;

// left signal
const int buttonPin2 = 8; // pushbutton pin
const int ledPin6 = 9;   //LED pins 6 thru 10
const int ledPin7 = 10;
const int ledPin8 = 11;
const int ledPin9 = 12;
const int ledPin10 = 13;

int buttonState = 0;
int buttonPressCount = 0;
int numberOfLED = 5;

void setup() {
// LED pin as output
  pinMode(ledPin1, OUTPUT);
  pinMode(ledPin2, OUTPUT);
  pinMode(ledPin3, OUTPUT);
  pinMode(ledPin4, OUTPUT);
  pinMode(ledPin5, OUTPUT);
  pinMode(ledPin6, OUTPUT);
  pinMode(ledPin7, OUTPUT);
  pinMode(ledPin8, OUTPUT);
  pinMode(ledPin9, OUTPUT);
  pinMode(ledPin10, OUTPUT);

// pushbutton as input:
  pinMode(buttonPin, INPUT);
  pinMode(buttonPin2, INPUT);
}

void loop() {
  buttonState = digitalRead(buttonPin);   // reads pushbutton

  // Sequence of lights, signaling turn signal (left)
  if (buttonState == HIGH) {      // checks if button is pushed, turns on LED if it is
    digitalWrite(ledPin1, HIGH);
    delay(35);
    digitalWrite(ledPin1, LOW);
    delay(35);

    digitalWrite(ledPin2, HIGH);
    delay(35);
    digitalWrite(ledPin2, LOW);
```

```
  delay(35);

  digitalWrite(ledPin3, HIGH);
  delay(35);
  digitalWrite(ledPin3, LOW);
  delay(35);

  digitalWrite(ledPin4, HIGH);
  delay(35);
  digitalWrite(ledPin4, LOW);
  delay(35);

  digitalWrite(ledPin5, HIGH);
  delay(35);
  digitalWrite(ledPin5, LOW);
  delay(35);

  }

 // Sequence of lights, signaling turn signal (right)

buttonState = digitalRead(buttonPin2);
if (buttonState == HIGH) {
  digitalWrite(ledPin6, HIGH);
  delay(35);
  digitalWrite(ledPin6, LOW);
  delay(35);

  digitalWrite(ledPin7, HIGH);
  delay(35);
  digitalWrite(ledPin7, LOW);
  delay(35);

  digitalWrite(ledPin8, HIGH);
  delay(35);
  digitalWrite(ledPin8, LOW);
  delay(35);

  digitalWrite(ledPin9, HIGH);
  delay(35);
  digitalWrite(ledPin9, LOW);
  delay(35);

  digitalWrite(ledPin10, HIGH);
  delay(35);
  digitalWrite(ledPin10, LOW);
  delay(35);
}
}
```