MEAM 5100: Design of Mechatronic Systems Fall 2024

Lab 4.1 Solutions

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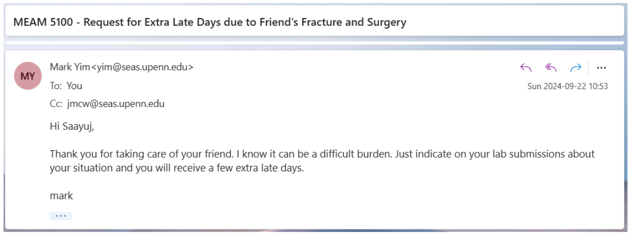
I had requested for extension/extra late days from Prof Yim due to some unforeseen circumstances. He told me to just mention in the lab report so I am attaching the proof here [1]. Thank you for the consideration.



MEAM 5100 - Request for Extra Late Days due to Friend's Fracture and Surgery

Mark Yim<yim@seas.upenn.edu>
To: You
Cc: jmcw@seas.upenn.edu
Sun 2024-09-22 10:53

Hi Saayuj,

Thank you for taking care of your friend. I know it can be a difficult burden. Just indicate on your lab submissions about your situation and you will receive a few extra late days.

mark

Figure 1: Proof of extra late days awarded

1 ESP32 and WIFI (individual work)

4. 1. 1.
- The commented code is submitted separately on Gradescope.
- 2 shows the circuit diagram for this question, with the switch, resistor, and LED, all connected to the ESP32-C3 board.
- The functions used for the ESP32 are different than the ones used in ATMega, but they have the same underlying objective. The following table summarizes the differences in the functions used for this question in the two microcontrollers:-

Functions	ATMega32U4	ESP32-C3
Set pin as input/output	clear/set(DDRx, PIN)	pinMode(PIN, INPUT/OUTPUT)
Check switch press	bit_is_set(PINx, PIN)	digitalRead(PIN) == HIGH
Turn on LED	set(PORTx, PIN)	digitalWrite(PIN, HIGH)

2\.
- The commented code is submitted separately on Gradescope. I chose a frequency of 20 Hz, along with a PWM resolution of 12 bits.
- 3 shows the circuit diagram for this question, with the potentiometer, resistor, and LED, all connected to the ESP32-C3 board.
- YouTube video link showing the LED duty cycle changing as I turn the potentiometer: https://youtube.com/shorts/tFB9HayiofQ?feature=share
- 4 shows the code used for this question. If we had to change the GPIO pin used to connect to the external LED to, say, pin 5, we would require changes in both

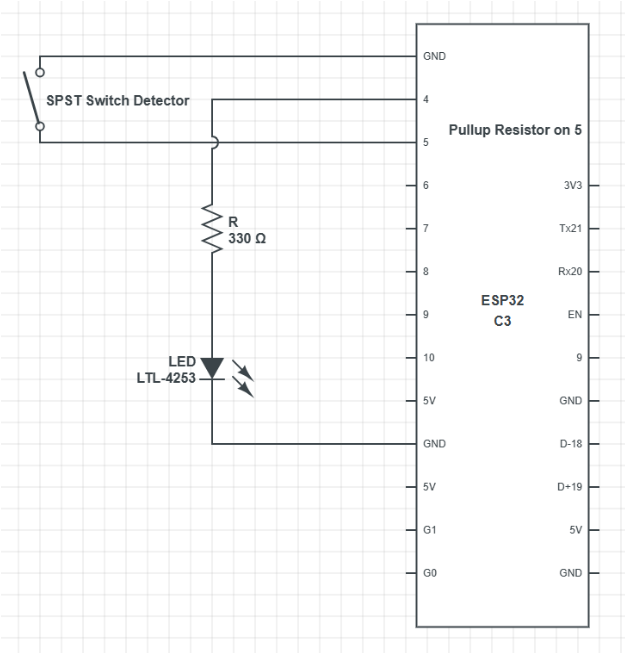


Figure 2: Circuit Diagram for 4.1.1

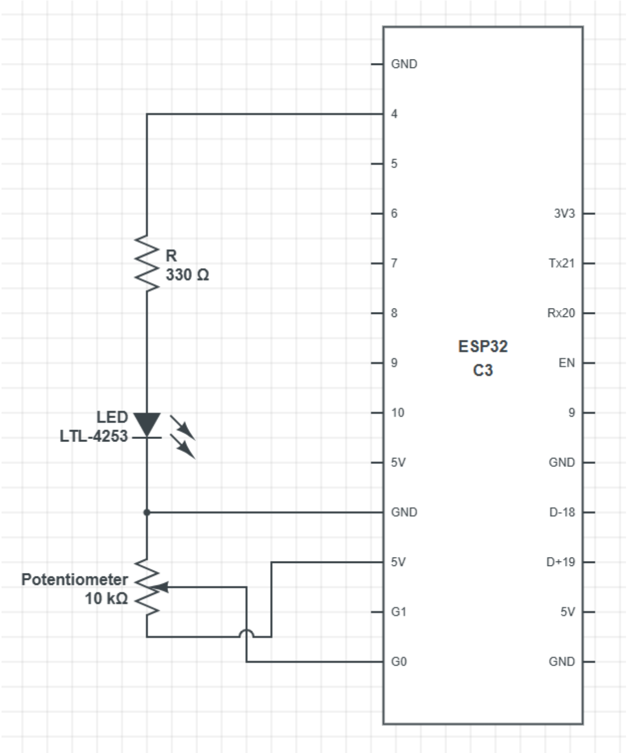
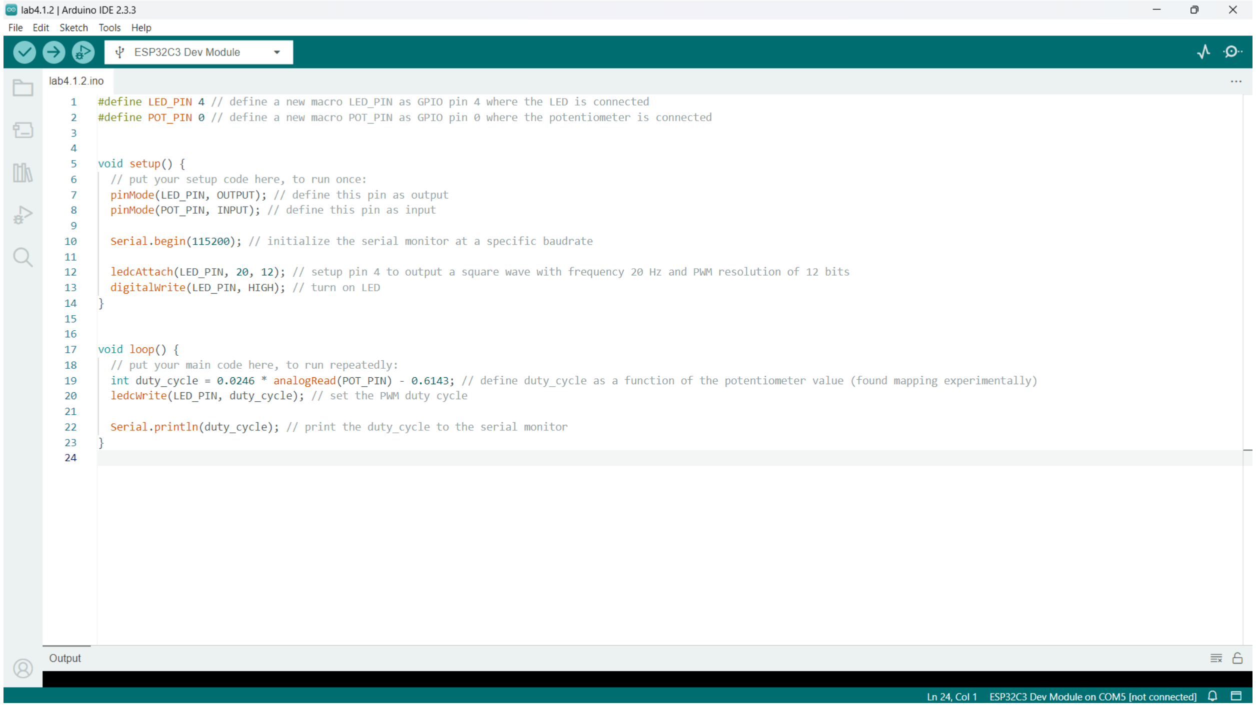


Figure 3: Circuit Diagram for 4.1.2


lab4.1.2 | Arduino IDE 2.3.3
File Edit Sketch Tools Help
ESP32C3 Dev Module
lab4.1.2.ino
Output
Ln 24, Col 1 ESP32C3 Dev Module on COM5 [not connected]

```
#define LED_PIN 4 // define a new macro LED_PIN as GPIO pin 4 where the LED is connected
#define POT_PIN 0 // define a new macro POT_PIN as GPIO pin 0 where the potentiometer is connected


void setup() {
  // put your setup code here, to run once:
  pinMode(LED_PIN, OUTPUT); // define this pin as output
  pinMode(POT_PIN, INPUT); // define this pin as input

  Serial.begin(115200); // initialize the serial monitor at a specific baudrate

  ledcAttach(LED_PIN, 20, 12); // setup pin 4 to output a square wave with frequency 20 Hz and PWM resolution of 12 bits
  digitalWrite(LED_PIN, HIGH); // turn on LED
}


void loop() {
  // put your main code here, to run repeatedly:
  int duty_cycle = 0.0246 * analogRead(POT_PIN) - 0.6143; // define duty_cycle as a function of the potentiometer value (found mapping experimentally)
  ledcWrite(LED_PIN, duty_cycle); // set the PWM duty cycle

  Serial.println(duty_cycle); // print the duty_cycle to the serial monitor
}

```

Figure 4: Code for this Question

the code and the circuit. The only change in the code would be to change the value of the macro LED_PIN to 5 in the first line of the code #define LED_PIN 4 → 5. In the circuit in 3, we would just have to change the top end of the resistor connection from pin 4 to pin 5.

3. a
   - I worked with Gia D'Costa for this question. She had already performed the question with someone, but I could not find anyone else so I did it with her again. I created the Station mode, UDP sender and receiver code to connect to her Access Point code. Note that both sending and receiving is happening in the same code.
   - The commented code is submitted separately on Gradescope.
   - YouTube video link showing my partner's LED duty cycle changing as I turn the potentiometer, and my LED duty cycle changing as my partner's potentiometer is turned: https://youtube.com/shorts/KMyy1HrZ2go?feature=share

   b
   - The commented code is submitted separately on Gradescope. I have used Access Point mode for this question.
   - 5 shows the circuit diagram for this question, with the LED and resistor connected to the ESP32 board.
   - YouTube video link showing the webpage controlling the frequency and duty cycle of the LED: https://youtube.com/shorts/SbdFFV4pge0?feature=share

4.
   - The commented code is submitted separately on Gradescope.

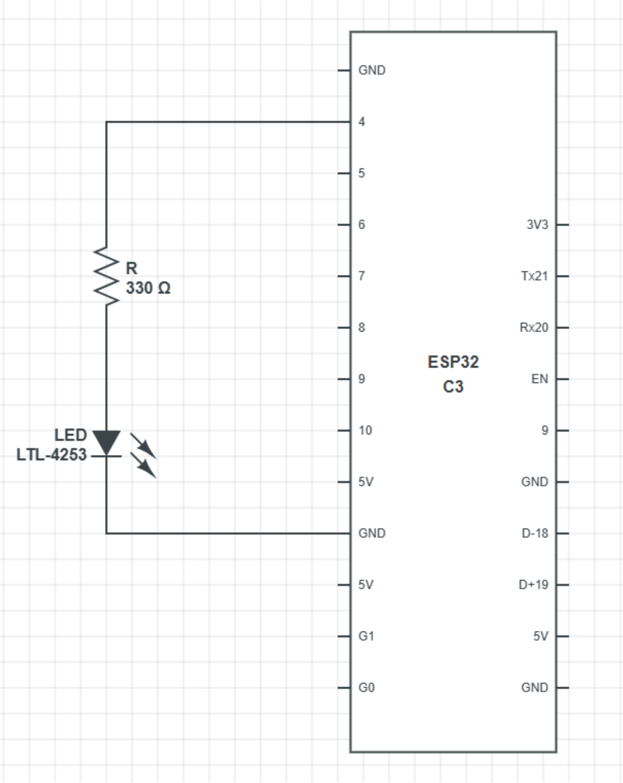


Figure 5: Circuit Diagram for 4.1.3b

- 6 shows the circuit diagram for this question. It shows the H-Bridge being used to control the TT motor. The motor has been given a power supply of 10V, as I found that the motor requires a voltage more than 5V to function properly.
- YouTube video link showing the motor speed and direction changing as the corresponding button/slider is changed on the webpage: https://youtube.com/shorts/cWpDkaHjNd8?feature=share

5. I have joined a team on Canvas: Group 26 consisting of Gia D'Costa, Samhitha Vedire, and I (Saayuj Deshpande).
6. EC1:-
   - I worked with Gia D'Costa for this question. I created the Station mode, UDP sender and receiver code to connect to her Access Point code. Note that both sending and receiving is happening in the same code.
   - The commented code is submitted separately on Gradescope.
   - 7 shows the circuit diagram for this question. The circuit is just the circuit for 4.1.4 plus the switch and potentiometer connections.
   - YouTube video link showing my motor speed and direction changing as the potentiometer and switch state is changed by the partner, and vice versa: https://youtube.com/shorts/OrdaYJSs86o?feature=share

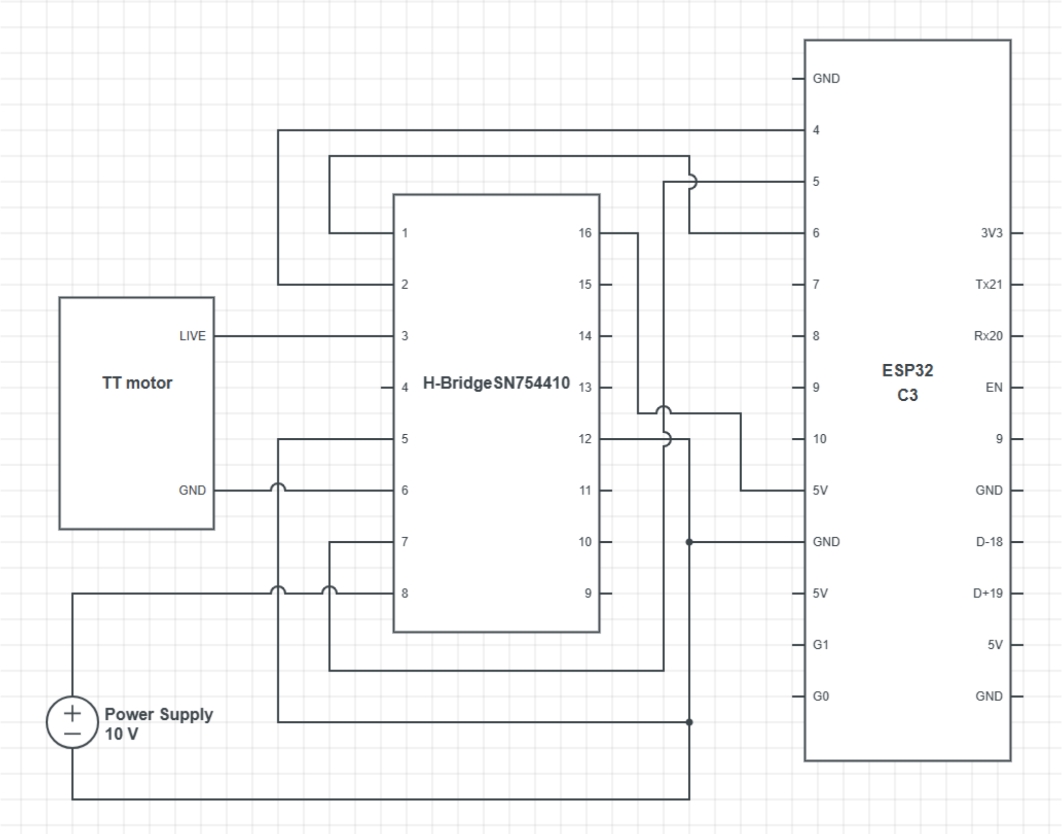


Figure 6: Circuit Diagram for 4.1.4

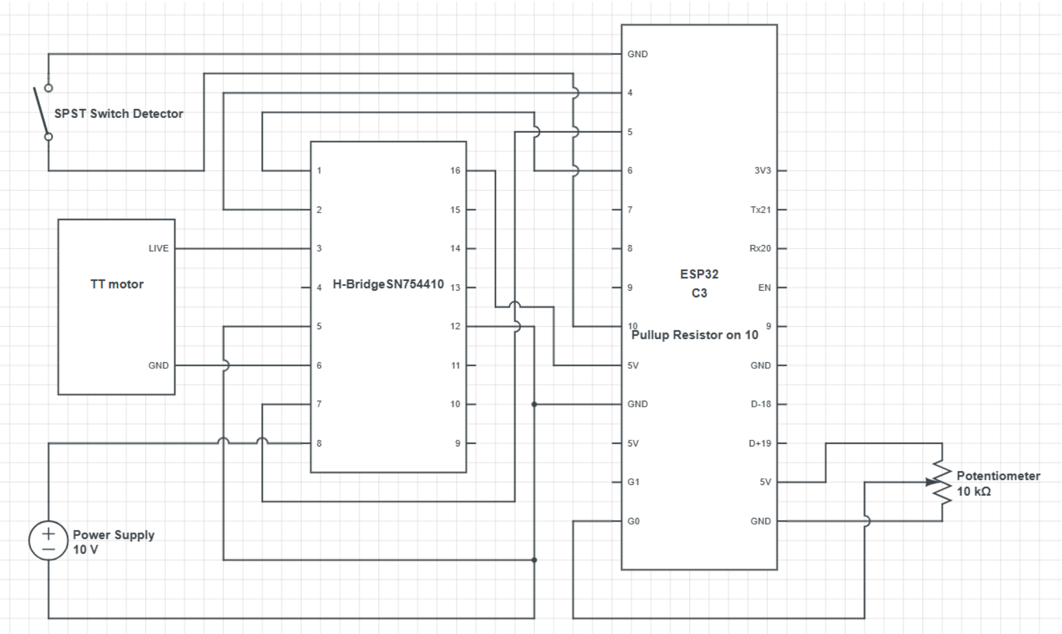


Figure 7: Circuit Diagram for EC1

2 References

1. Latex template from the course CIS 5190 taught this fall.

2. MEAM 5100 Fall 2024 Lecture Slides.

3. ESP32 documentation and examples.

4. Took help from ChatGPT for writing code for WIFI and HTML part.

5. Worked with peers Gia D'Costa and Samhitha Vedire in the lab, but we have submitted our own report, code, etc.