Project Deliverable E: Project Plan and Cost Estimate

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Abstract

The main purpose of the project planning and cost estimate is to realistically evaluate how the team will execute the project in the duration of the semester. The costs of all the hardware material should be analyzed and documented. A list of tasks should be outlined and determined for the development of the first prototype. A detailed design structure will be included of the assembly and integration of the product including the carbon monoxide, temperature, and motion sensors.

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Introduction

In order to prepare for the creation of the first prototype, a detailed drawing and prototype test plan must be made. A “detailed drawing” is a sketch that demonstrates precise geometric descriptions of a part. To be able to make the detailed drawing, first, all software and hardware components used must be defined. Then, they must be assembled accordingly with the understanding of how all the elements interact with each other. Next, a concise prototype test plan will need to be devised for the first prototype. The prototyping test plan should be able to answer the why, what , how and when.

Step 1: Assemble Hardware

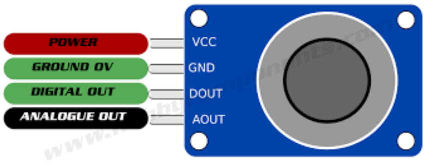
Materials used for hardware construction:

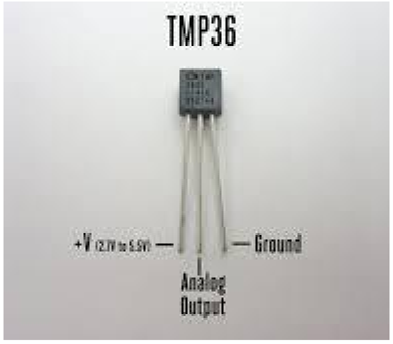
- 1 Arduino Uno
- 1 Small Breadboard (for prototypes)
- 1 Small Protoboard
- 1 MQ 7 Carbon Monoxide detector
- 1 TMP 36 temperature sensor
- 1 PIR HC-SR501 Motion Sensor
- 4 9V battery
- 11 generic wires
- 1 USB connector for external power source
- 1 9V Battery power cable plug clip for Arduino

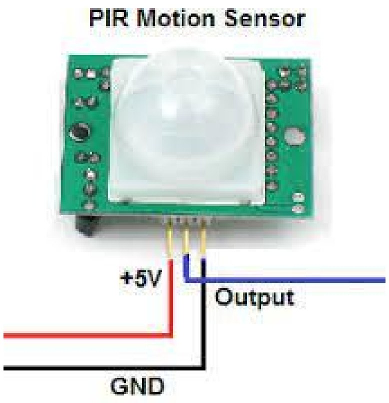
Device case materials:

- 4 long screws
- 2 small screws

Sensor pinout specifications







Sensor pinout specifications will be taken into account when assembling the hardware.

Assembling TMP36 with Arduino

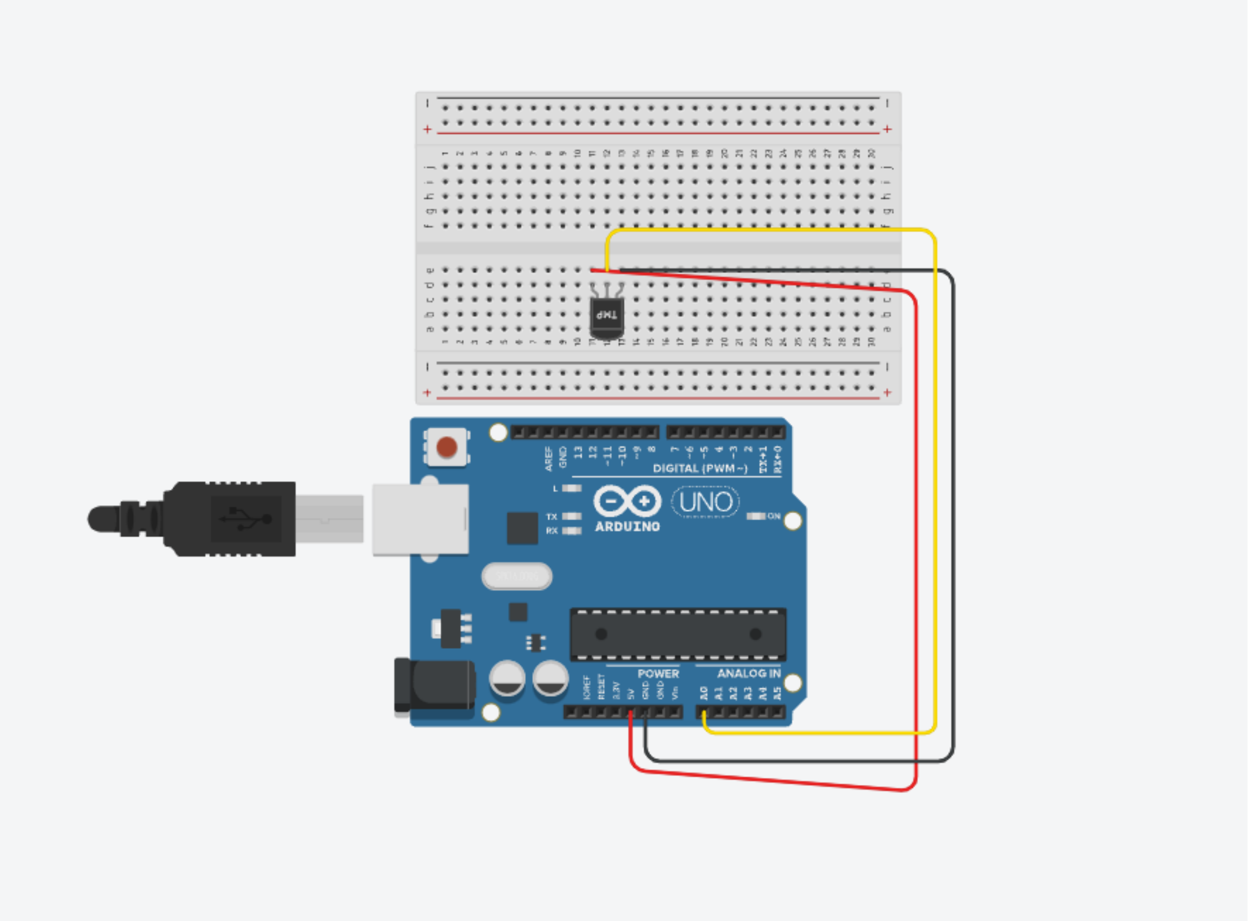


Figure 1.The temperature sensor used for the prototype will be TMP36 it will be assembled as shown above.

Assembling MQ7 with Arduino

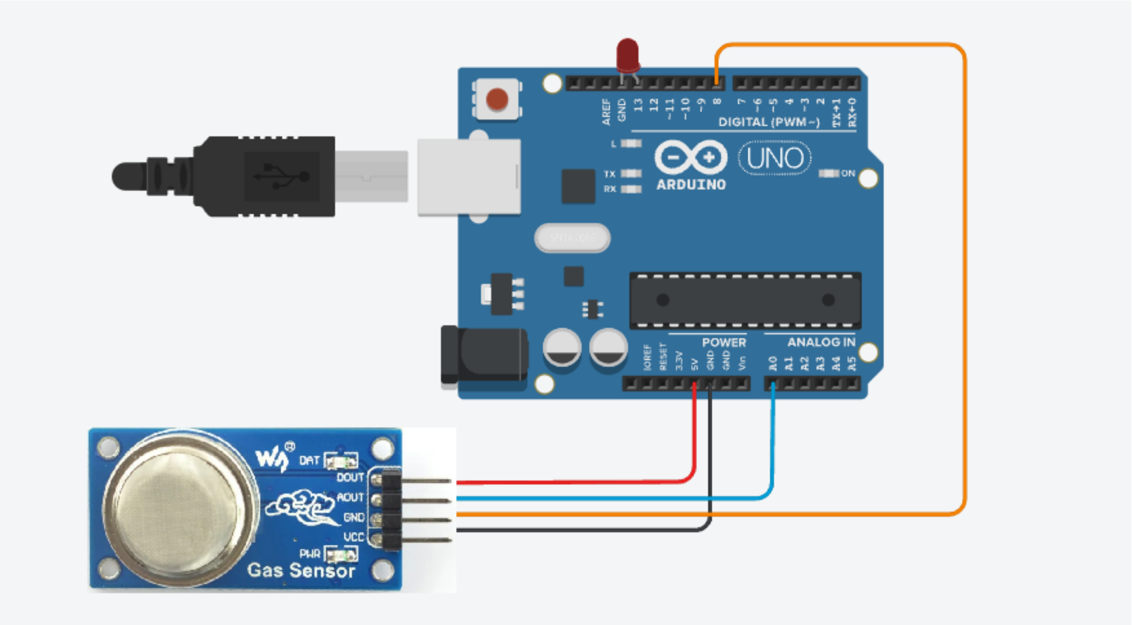


Figure 2. Four wires are required to contact the carbon monoxide with the arduino. The wires will be connected to 5V, GNG, A0 and 8 to guarantee functionality of the carbon monoxide detector.

Carbon Monoxide Detection

The MQ7 has high sensitivity for carbon monoxide within an area that is evenly spread out throughout any area the device is located. With smaller cars the detection of CO is faster because the space containing CO is compact. In larger vehicles since the CO would be more spread out the detection can take a few minutes to be triggered. The alert or tigger from the MQ7 is not only dependent on the area/space but also the levels of CO present. The MQ7 can detect any range from 20ppm-2,000ppm. The higher the level and exposure the faster the detector will be triggered. For instance, if the ppm in the vehicle is 50 the danger is low and the device takes longer to be activated, however, in a small car it will be triggered faster since the area is limited.

Similarly, if the ppm in a vehicle is 100 ppm or higher it's dangerous the detector will be triggered in seconds, but that might take longer in larger vehicles because of their size.

Assembling 9V battery with Arduino

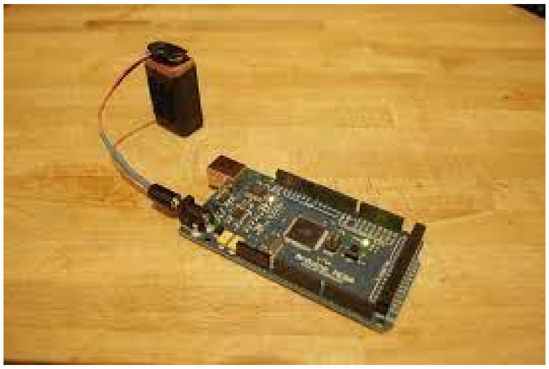


Figure 3a. The connection between 9V batteries and the arduino will be through the USB port.

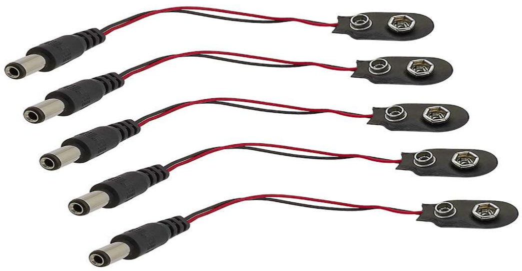


Figure 3b. The 9V batteries will be attached to the Arduino using its appropriate cable clip

Assembling Motion Sensor

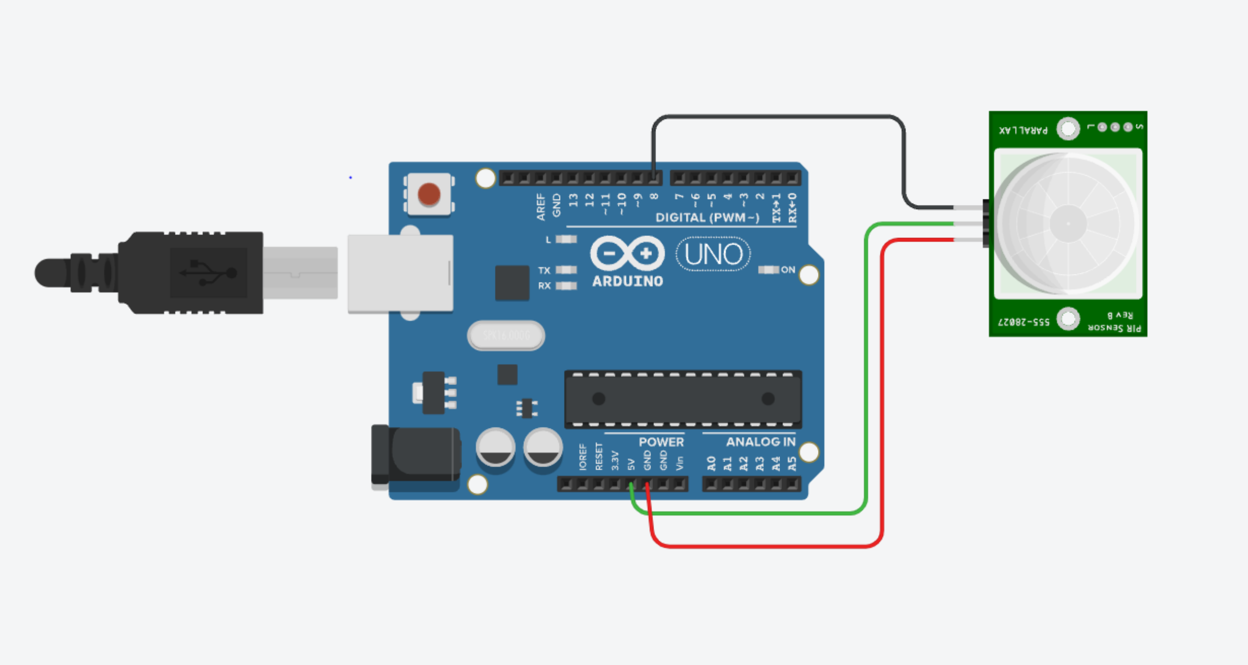


Figure 4. The motion sensor will also be included in the prototype to detect the movement of a child or pet in any type of vehicle.

Complete Assembly

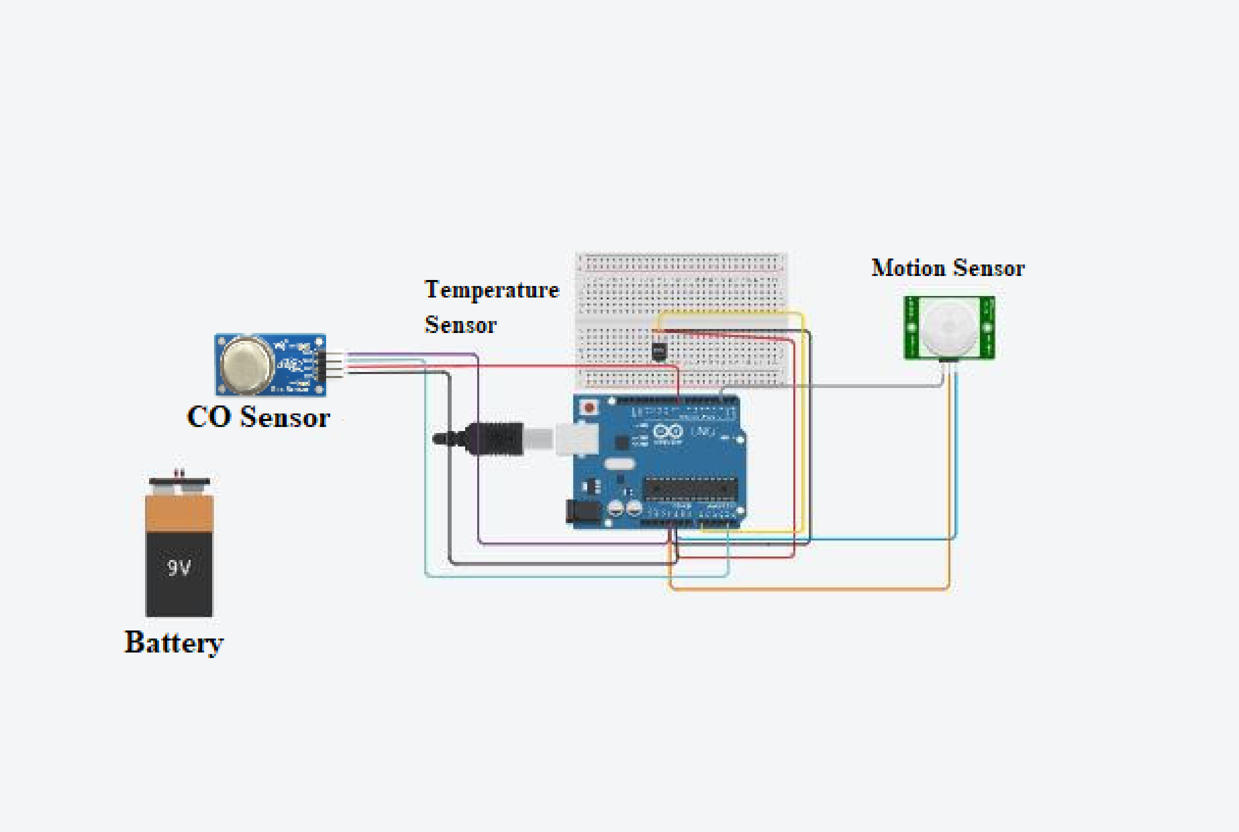
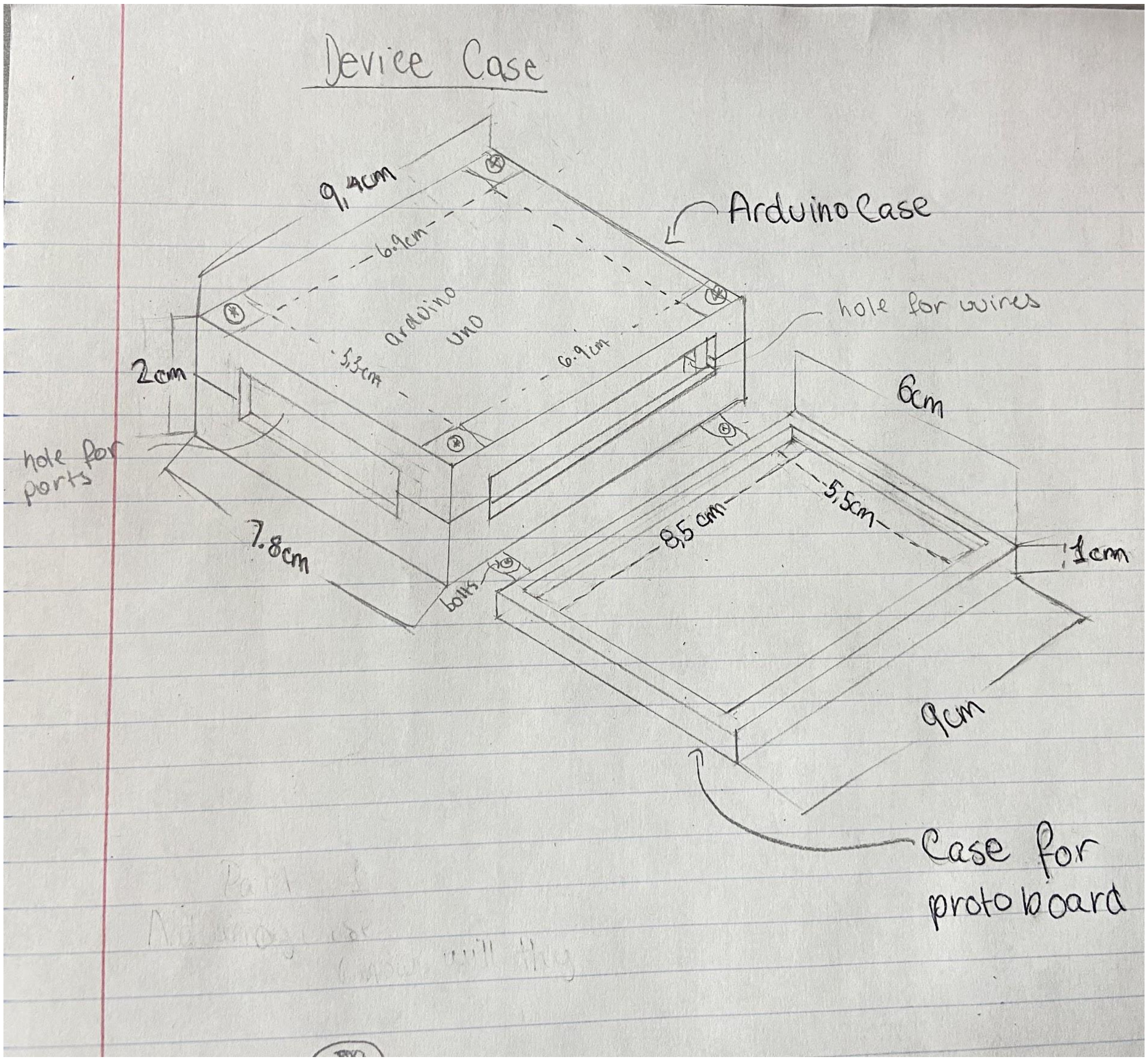


Figure 5. All the sensors are included to illustrate what the first prototype will look like and what hardware materials are going to be used like the wires and battery. There will be three wires connected to the 5V power pins and the Ground pin. They will be connected by striping the ends and twisting them together. A connector will be needed to attach the carbon monoxide sensor and motion sensor to the wires.

Device Casing Assembly:



Descriptions:

- The sensors will need to be outside of the case as performance might be hindered if inside
- There will be 4 bolts needed to attach the two arduino pieces together
- And two more to attach the arduino case with case for protoboard
- The material used to make the case is PETG, this is because it is able to resist temperatures as high as 70 C and it is an affordable option.

Step 2: Programming Arduino

CO Sensor Arduino Code	Program Temperature
	int sensePin = A0;

Code to test in Tinkercad

```
const int AOUTpin=0;
const int DOUTpin=8;
const int ledPin=13;
int limit;
int value;

void setup() {
        Serial.begin(115200);
        pinMode(DOUTpin, INPUT);
        pinMode(ledPin, OUTPUT);
}

void loop()
{
        value= analogRead(AOUTpin);
        limit= digitalRead(DOUTpin);
        Serial.print("CO value: ");
        Serial.println(value);
        Serial.print("Limit: ");
        Serial.print(limit);
        delay(100);
if (limit == HIGH){
        digitalWrite(ledPin, HIGH);
}
else{
        digitalWrite(ledPin, LOW);
}
}
```

Code 2 to test

```
int AOUTpin = A1;
int sensorValue;
void setup (){
    Serial.begin(9600)
}
void loop(){
     sensorValue=analogRead( AOUTpin) ;
     Serial.println(sensorValue);
     delay(1000); //for stability
```

```
int sensorInput;
double temp;

void setup() {

  Serial.begin(9600);
}
void loop() {

  sensorInput = analogRead(A0);
  temp = (double)sensorInput / 1024;
  temp = temp * 5;
  temp = temp - 0.5;
  temp = temp * 100;  // makes into degrees celcius

Serial.print("Current Temperature: ");
Serial.println(temp);

}
```

}	

Motion Sensor Code

```
int pirPin = 2;
int count;

void setup (){
Serial.begin (9600);
pinMode (pirPin, IMPUT);
count = 0;
}
void loop (){
int pirVal = digitalRead(pirPin);

if (pirVal==LOW){
    count++;
    Serial.print(“Motion Detected : “);
    Seral.println(count);
    Delay (2000);
}
```

App Structure

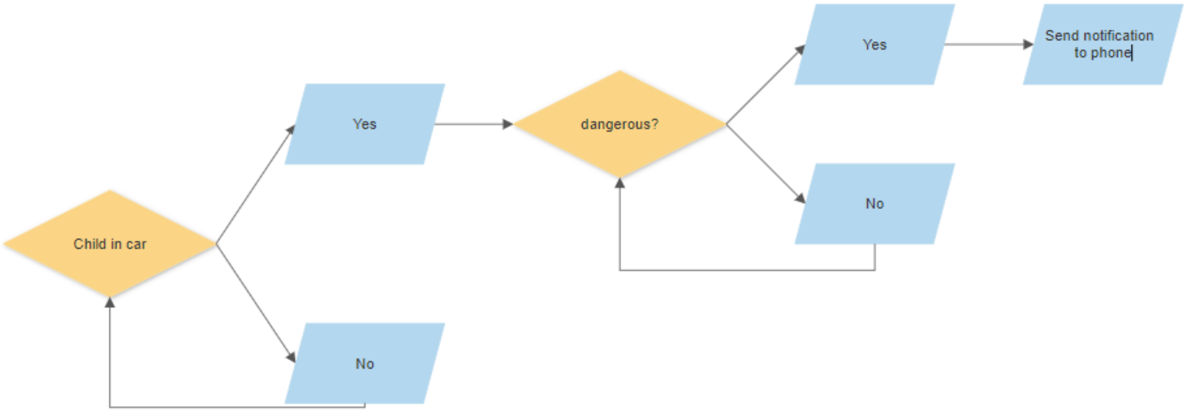


Figure 6. A visual representation of the app structure

Prototype I Test Plan (Improvised)

Prototype equipment:

- Arduino
- Breadboard
- TMP 36
- Jumper wires (5)
- 4 9V batteries

*we will replicate other missing components using cardboard for physical prototype
*other sensors will be tested on tinkercad if they don't come in before prototype 1 due date

Hypothesis: Apparatus must run within the vehicle and detect variations in temperature, CO levels, and motion.

Test 1, Compatibility verification: Check to see if all components work/interact with each other properly on initial start-up.

Test 2 Bluetooth connectivity:

This test consists of testing whether the program works well. We can quantify this by running the program and seeing if the output is what we expected. We will input test values into the arduino and see if we receive appropriate feedback through the HC-05, to the app.

Test 3 Sensors detection testing

We will test out the functionality of the sensors. We will check if the sensors can detect the CO level, the temperature and the presence of the kids based on their motion after being left alone in the car.

Test 4: Battery longevity testing

This test consists of testing if the device can stand on its own running on a battery without disrupting the functionality of the device.

After 4 main tests, obtain some valuable consumer input by employing some testers for the product. Gather the results in tabulated form, and analyze the results for potential improvements.

Conclusion

To conclude, a detailed design of the final solution is demonstrated using the best combination of subsystems previously evaluated during the benchmarking. There is a clear assembly process of every subsystem with the Arduino uno and the breadboard using wires. It will finish with a plan to test the prototype.

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