Q2:

The idea behind this task is to build a simulation of an earthquake happening in a platform using Accelerometer. The measurements are roll (rotation of front to back axis) and pitch (side to side axis) which from axis x, y, z. I will represent the motion of roll and pitch in a 3D simulator. The pictures below will show how roll and pitch work. Note that the simulation and the formulas for calculating roll and pitch are taken from Dejan (2019) How to Mechatronics tutorial. Here is how the roll and pitch work in 3D representation.
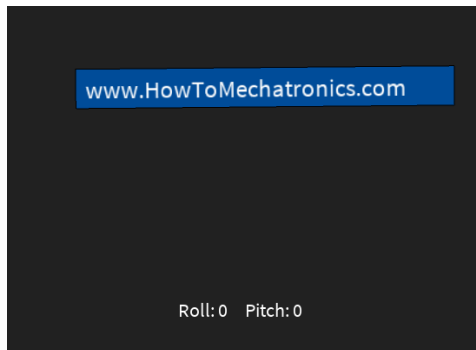


This is when the platform is stationary, meaning there is no movements.
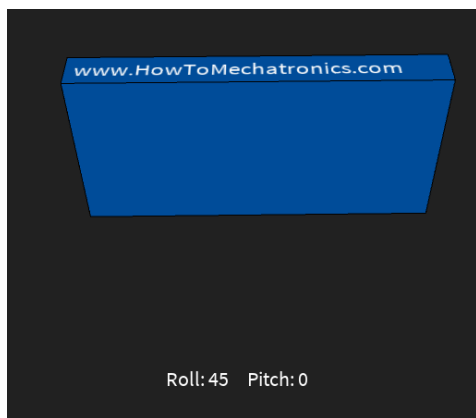


This is when the platform is in roll rotation or front to back axis.



This is when the platform is in pitch rotation or side to side axis.

If pitch or roll value is more than +-9, there will be warnings.


Q3:

From question 2, if pitch or roll value is more than +-9 alarms will set off. I will be explaining using code.

```cpp
void loop() {
  ArduinoCloud.update();
  // Your code here
  // read accelero data
  if (IMU.accelerationAvailable()) {
    IMU.readAcceleration(x, y, z);
  }

  // Default severe warning
  severe_level = false;

  // Calculation of roll and pitch (rotation around X-axis, rotation around Y-axis)
  roll = atan(y/sqrt(pow(x,2) + pow(z,2))) * 180/PI;
  pitch = atan(-1 * x/sqrt(pow(y,2) + pow(z,2))) * 180/PI;

  // Low-pass filter
  rollF = 0.94 * rollF + 0.06 * roll;
  pitchF = 0.94 * pitchF + 0.06 * pitch;

// Determine the level of eathquake based on rollF and pitchF
  if (abs(rollF) < 3 && abs(pitchF) < 3) {
    level = 1;
  }
  else if ((abs(rollF) >= 3 && abs(rollF) < 6) || (abs(pitchF) >= 3 && abs(pitchF) < 6)){
    level = 2;
    Serial.println(String(rollF) + ", " + String(pitchF) + ", " + level);
  }
  else if ((abs(rollF) >= 6 && abs(rollF) < 9) || (abs(pitchF) >= 6 && abs(pitchF) < 9)){
    level = 3;
    Serial.println(String(rollF) + ", " + String(pitchF) + ", " + level);
  }
  else if (abs(rollF) >= 9 || abs(pitchF) >= 9){
    level = 4;
    severe_level = true; // boolean to send warning to email
  }

  Serial.println(String(rollF) + ", " + String(pitchF) + ", " + String(level));
}
```

`roll`, `pitch`, `rollF` and `pitchF` are formulas from Dejan (2019) to calculate the pitch and roll measurements. Usually, the measurements of these never exceed 2 if the platform is stationary. I create a variable named `level` to show the different stages of earthquake. Level 1 is absolute value of `rollF` and `pitchF` smaller than 3. Level 2 is absolute value of `rollF` and `pitchF` larger or equal to 3 and smaller than 6. Level 3 is absolute value of `rollF` and `pitchF` larger or equal to 6 and smaller than 9. Level 4 is anything above or equal to absolute value of 9 of `rollF` and

`pitchF`. At level 4, I have a variable that will trigger 2 warnings. The Boolean variable will use the trigger function of Arduino cloud to send me a warning email and display the status to true in the dashboard.
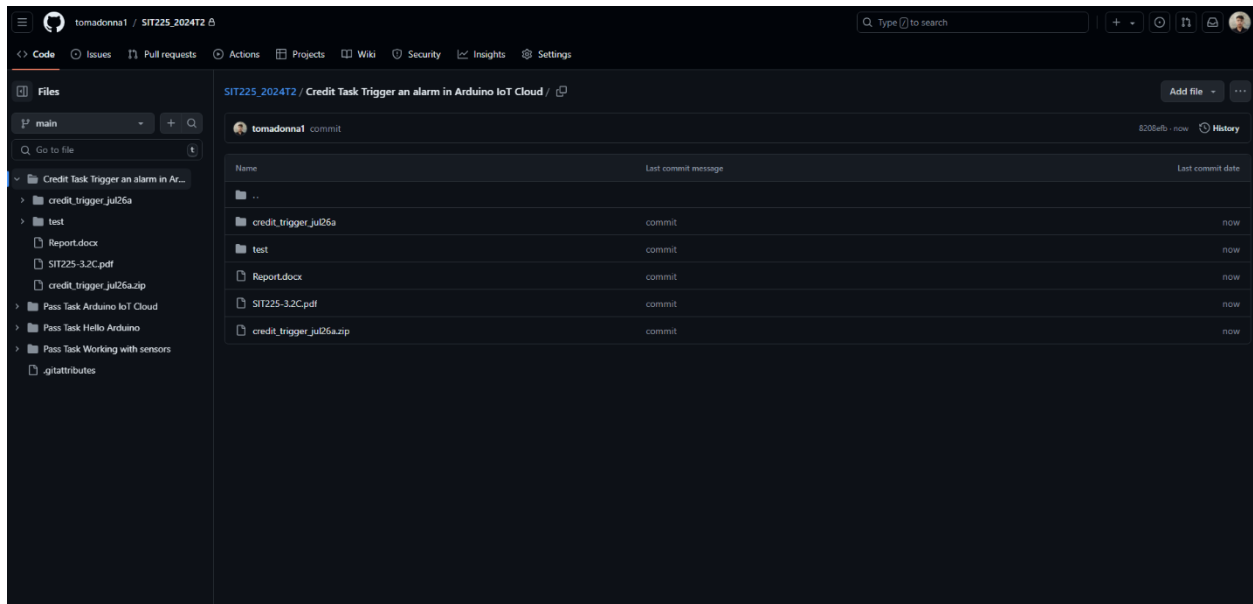
Here are the pictures of the two warnings:

Q4:

https://www.youtube.com/watch?v=X-UGxDqTn8M
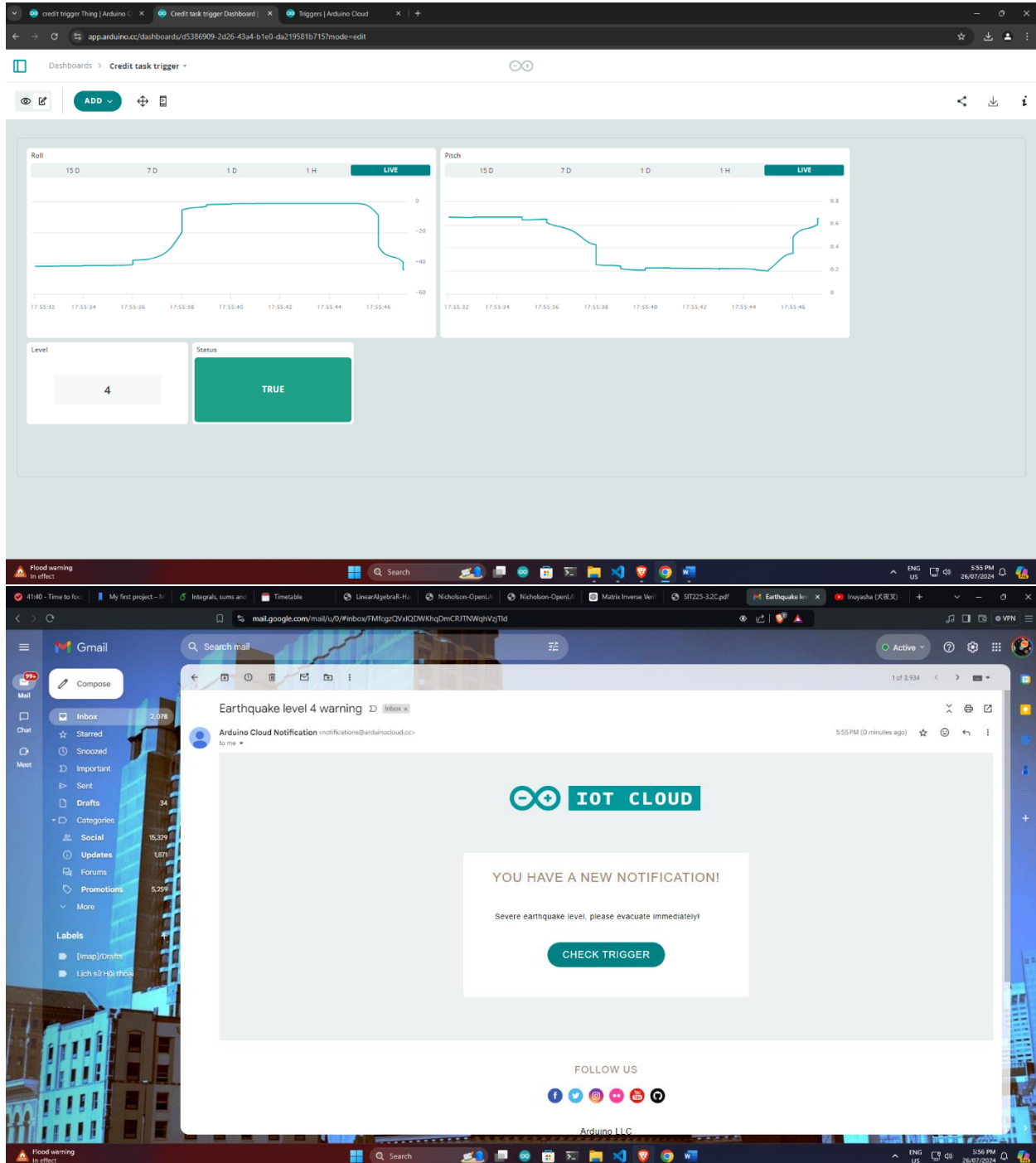
Q5:



https://github.com/tomadonna1/SIT225_2024T2/tree/main/Credit%20Task%20Trigger%20an%20alarm%20in%20Arduino%20IoT%20Cloud

References

Dejan (2019). *How To Track Orientation with Arduino and ADXL345 Accelerometer*. [online] HowToMechatronics. Available at: https://howtomechatronics.com/tutorials/arduino/how-to-track-orientation-with-arduino-and-adxl345-accelerometer/.