# Project Deliverable G: **Prototype II and Customer Feedback**
# GNG 1103 – Engineering Design

Faculty of Engineering – University of Ottawa
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# Introduction

Over the past several weeks, engineering students from the Engineering Design class at the University of Ottawa have been working collaboratively with JAMZ delivery in order to create an effective and consistent design for an anti-theft module. This anti-theft module will be built to deter potential thieves who may look to steal the drone. The developed anti-theft device will include an Arduino Uno board that will be connected to a motion sensor that will detect when the drone is moving unexpectedly. If the sensor detects unexpected movement, three different coloured LEDs (red/yellow/green) will be activated along with a speaker that will relay a voice-recorded message indicating that the drone is being tracked and that an operator is on the way.

This deliverable will focus on the further development of prototyping from the previous deliverable. More specifically the motion sensor will be simulated, the light will be tested in series as an LED strip would be, the CAD model of our Arduino case will be further updated to account for our updated needs (wire ports for the speaker and sensor), and voice message will be recorded and played back on the automated speaker. After this prototype has been completed, we should have a very solid, workable base for prototype III.

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# Prototype Test Plan

## **Why** are we doing these tests?

### ***What are the specific test objectives?***

One the objectives of this prototype is to test the motion sensor functionality and then run an LED strip simulation with RGB LEDs. This is so we can eventually have the lights turn on when the drone crashes. Also, we will be testing our ability to record messages on a speaker module and have it play out of a speaker. The final objective we have is to further update the Arduino case so we can assure that the sensors and speakers can be properly implemented into the next prototype.

### ***What exactly is being learned or communicated with the prototype?***

First off, the motion sensor must communicate with the lights. This is so the lights turn on based on the acceleration calculated by the accelerator in the motion sensor. In this first test, we will learn how the motion sensor needs to be coded to control the lights. Next, we will literally be communicating with the speaker by having a member of the team recording a pre-recorded message for the drone to repeat after it has crashed. Learning how to attach all the modules together will be the most difficult part, and will be started with this prototype, but will need more time to complete.

***What are the possible types of results?***

For the motion sensor and lights compatibility, results will show the lights turning on all at once with different colors. Our goal is to have one color turn on at a time. Additionally, the speaker might not work, be too loud, or not loud enough. Ideally, the speaker will have the perfect volume. Next, the Arduino case could be too big or too small. The measurements we used were given to us during our CAD lab at the start of the semester.

***What are the decisions made based on the results?***

If the motion sensor is not able to communicate that only one color needs to turn on, then we will have to rewrite the code for the motion sensor. The next test is to see if we can make the speaker the right volume. If it is not loud enough, we will try to make our automated message clearer and louder. Next, if the case does not fit the arduino board perfectly, we will continue to update the case in OnShape.

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## **What** is the prototype and **how** is the test being done?

***Results of Previous Prototype***

The previous prototype was pretty helpful overall. It gave us insight on how to progress forward for the next prototype. Even though it was a very simple and mostly virtual prototype, it served as the basis for this prototype.

That being said, we faced the need to change the motion sensor as per request, as well as a change in the speaker module due to a budget change. The case also had to be adjusted in terms of accommodating the arduino better.

***Description of Current Prototype***

The current prototype is a more physical prototype aspect compared to the first prototype. This physical prototype consists of an LED strip simulation using RGB LEDs providing different colours for different applied scenarios. In addition, the set up of the automated voice using the ISD1820 recorder speaker has been implemented by a group member's voice. We have also been updating the arduino case, as well as testing the motion sensor.

***Describe the testing process in enough detail to allow someone to build and test the prototype instead of you.***

When it comes to our prototype building stage the first key is to be sure you are in a safe environment without any hazards around. Concerning the components, the motion sensor is the most integral part of the module. Using a preset code, the MPU6050 was tested and simulated as a little plane (see Figures 6 and 7). The speaker was also tested and multiple recordings were replayed to understand the performance of the speaker. The RGBs were also implemented to simulate an LED strip that would change colors(Figures 1-3). Finally, the case was worked on Onshape and measured to the appropriate Arduino dimensions in order to be later used on the drone.

***What information is being measured?***

The information is measured by the accuracy in comparison to our goals. For example, the motion sensor which calculates acceleration was measured using online software(the serial monitor). The speaker was tested to see the volume levels, the lights were coded to simulate an LED strip. Finally, the case was reworked to satisfy our goals.

***What is being observed and how is it being recorded?***

We will be observing the accuracy of the motion sensor, as well as the capability to adjust a preset code to incorporate a light system and a speaker that turns on when needed. The case dimensions are also being assessed and modified.

***What are the required materials and cost?***

Materials such as batteries, RGB LEDs, the ISD1820 speaker, an MPU6050, arduino board, a 3D printed case and wires are what is being used. The cost of all of these is under the budget of $50 but is roughly $45 with tax. This estimate is including an LED strip that is yet to be obtained.

***What work needs to be done?***

The first thing that has to be done is that the arduino case needs to be aesthetically finalized in order to be 3D-printed. The different module codes must also be incorporated into one so that prototype function seemlessly. The whole prototype test

functionality will also be needed as we need to make sure everything we prootyped works together as a whole anti-theft module for our client JAMZ Drone Delivery Corporation.

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## **When** is the testing happening and how long will it take?

***How long is the test estimated to take and what are the dependencies (i.e. what needs to happen before the testing can occur)?***

The testing will be happening during a meet-up that we will have on March 13th. This will only take a few hours since we are mostly just assembling the motion sensor prototype and the speaker prototype and testing out the code that we've already made. The modules will still have to be incorporated with each other in the next prototype and tested.

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## Client Feedback

The client was overall pleased with our ideas and work we put together for the prototype. Majority of the feedback was positive. The clients loved the idea of the automated voice. Positive observations were made towards the casing of the arduino case as he loved the aerodynamics implemented in it.

The client also expressed the need for power and voltage differences to get power from the on board supply

## **Prototype II**

RGB LED Strip sample

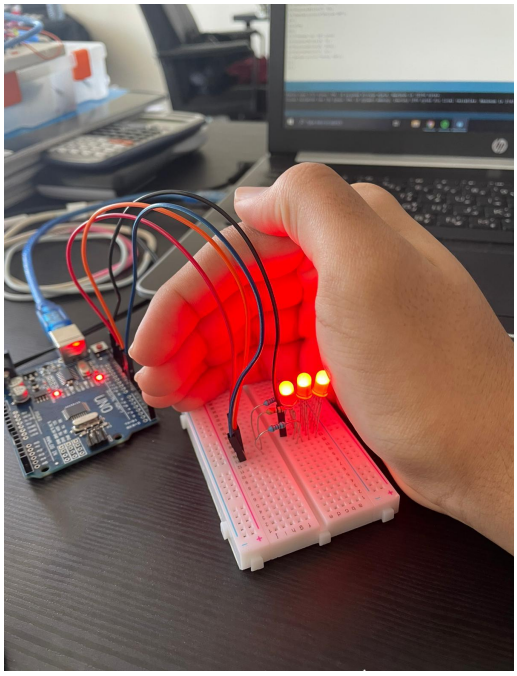


*Figure 1: RGB LED Lights Red Colour*

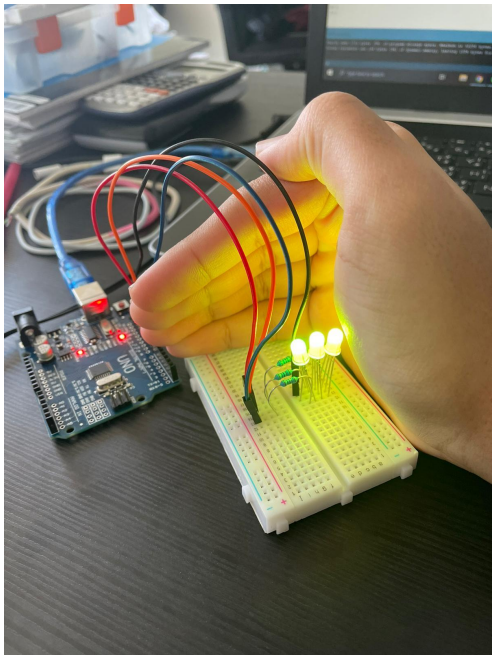


*Figure 2: RGB LED Lights Yellow Colour*

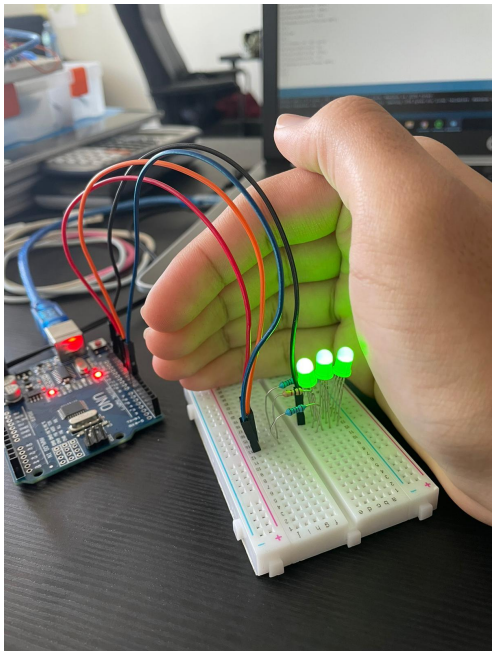


*Figure 3: RGB LED Lights Green Colour*

## Speaker Playback Module

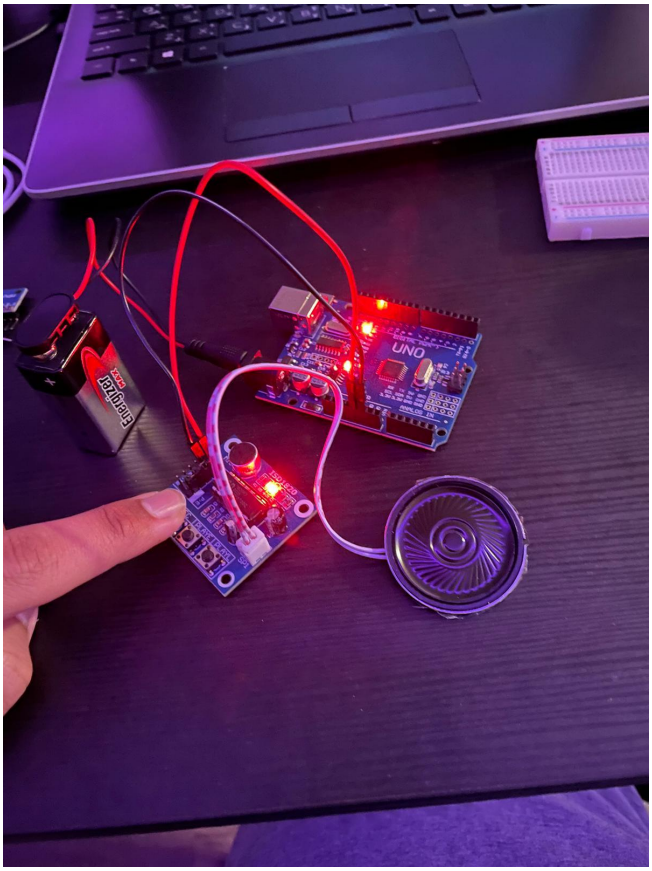



*Figure 4: Automated Speaker Module Recording*

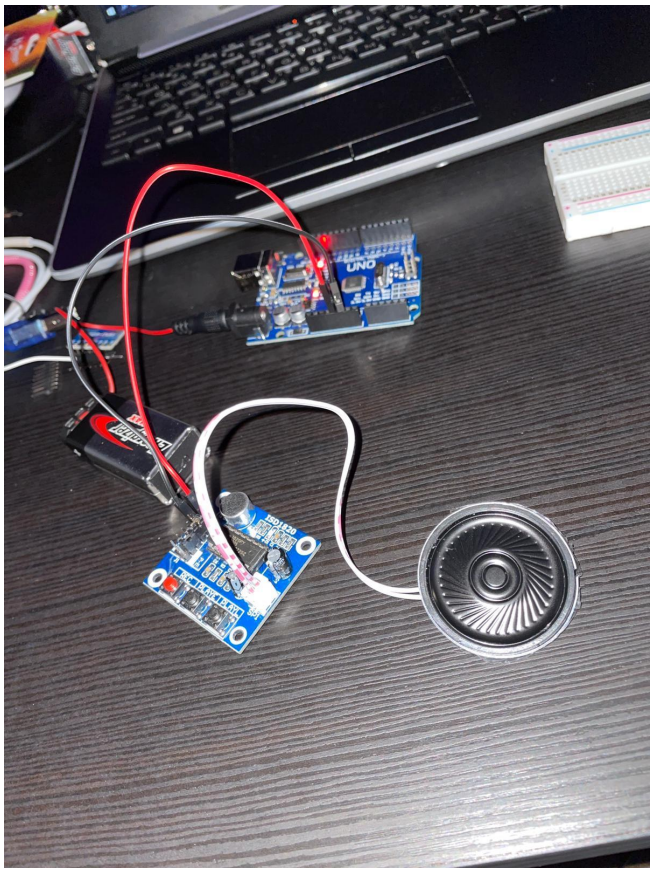
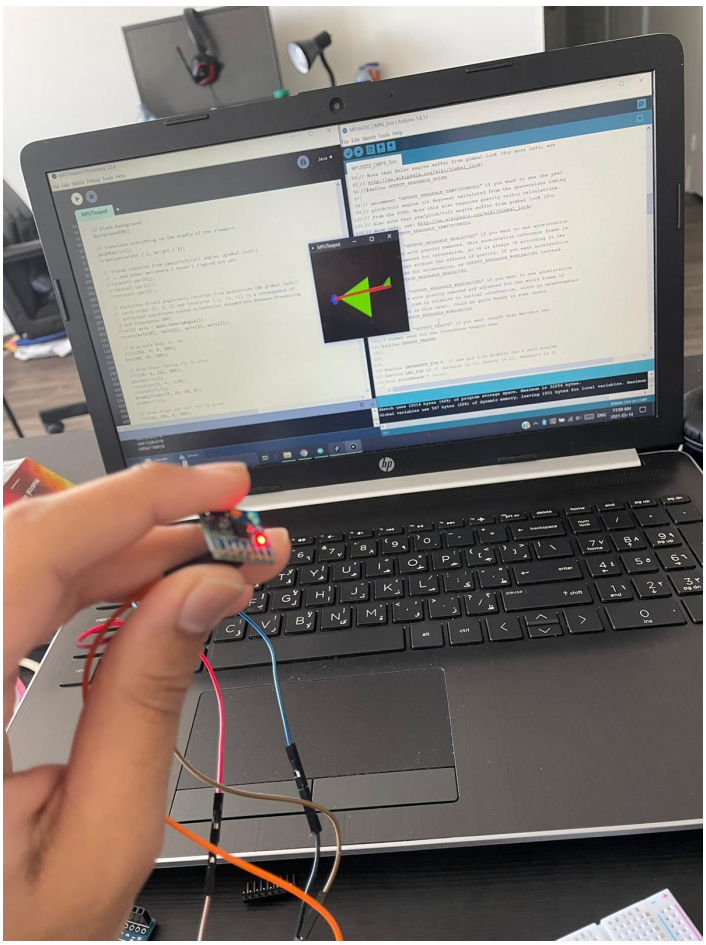
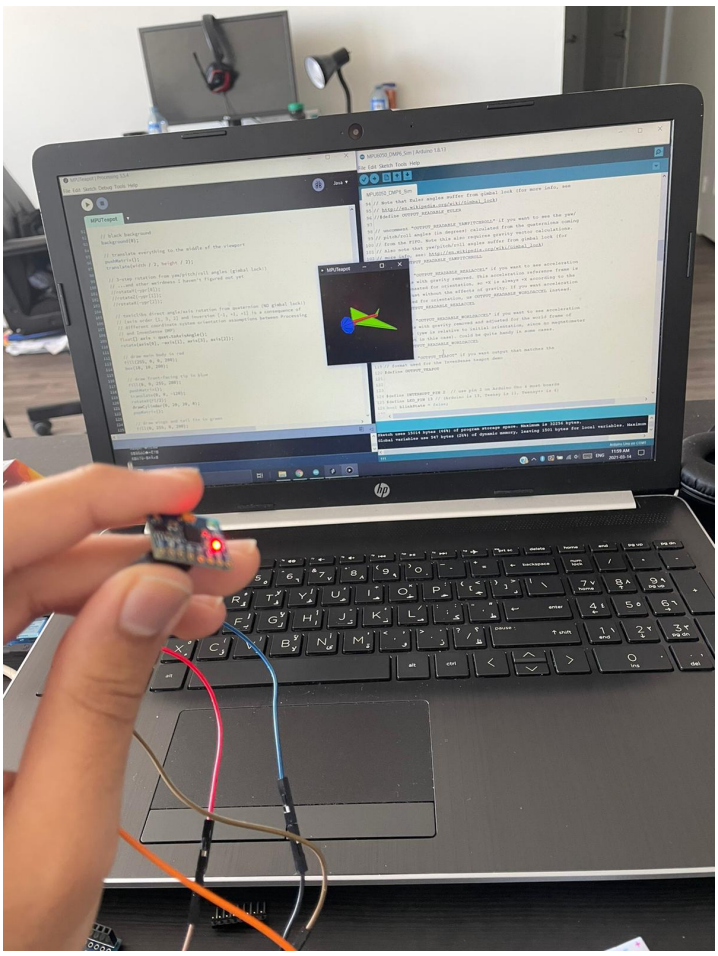



*Figure 5: Automated Speaker Module Playing Back*

## Motion Sensor Simulation and Code





*Figures 6 & 7: Simulation of The Motion Sensor Using Processing Tool (Airplane is the Motion Sensor)*

## CAD Arduino Updated Case

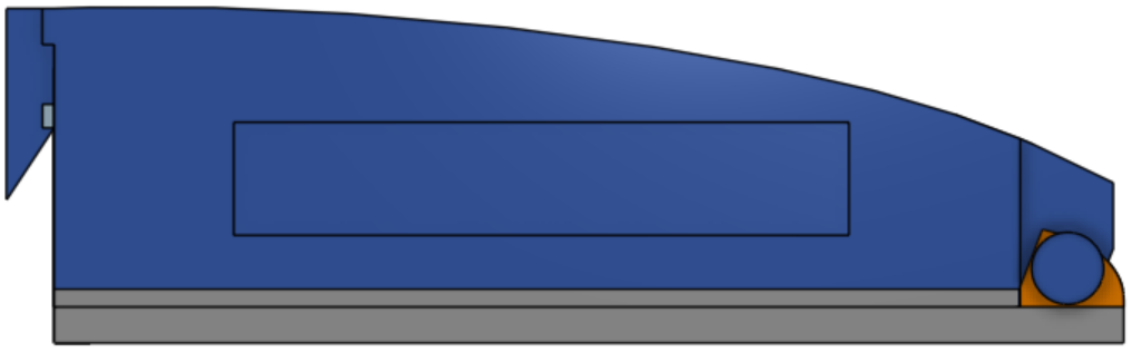


*Figure 8: Arduino case Closed*

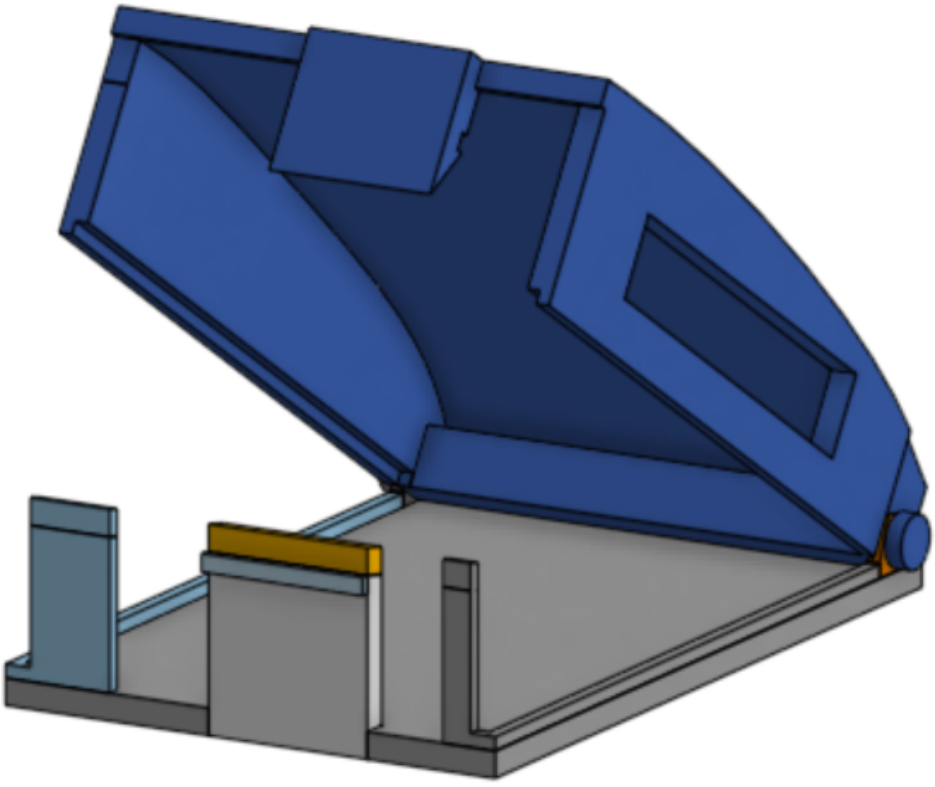


*Figure 9: Arduino Case Opened*

## Conclusion:

In this deliverable, students from group D2 in the uOttawa Faculty of engineering created and tested prototype 2 of the anti-theft module intended for JAMZ delivery. The members of our group arranged a meeting during which we could assemble the required pieces of the prototype. In this deliverable, the group was able to implement numerous parts of the prototype including coding the lights to turn the correct colour (red/yellow/green) based on the drone's condition, the recording and playback of the automated voice speaker, and an update to the functionality of the CAD model of the arduino case.

After having completed these important milestones towards our final prototype, we should easily be able to complete our final prototype for JAMZ by using the previous two prototypes as building blocks. In the final prototype, we will be polishing up the code, updating the Arduino case, and ensuring that all of the components are able to communicate with each other.