

GNG1103

Design Project User Manual



PROJECT 17

Presents

AIRE

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November 28th, 2019

University of Ottawa

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Figure 5- A photo of our user end website live stream of machine availability.

List of Acronyms

Acronym	Definition
PIR sensor	Passive InfraRed Sensor
TCP port	Transmission Control Protocol Port
HTTP	HyperText Transfer Protocol
IP address	Internet Protocol address
OBS streaming	Open Broadcasting Software Streaming
Arduino IDE	Arduino Integrated Development Environment
CEED	Centre for Entrepreneurship and Engineering Design

1 Introduction

In GNG1103, we were asked to solve a problem. We were to find a way to automate the CEED space using a specific software environment. We had three meetings with clients, two as a class and one meeting that was one on one to discuss their needs, our solutions, and how effective they were at correcting their problems. We followed the design thinking process to come up with design criteria, a problem statement, target specifications, and finally, a working prototype. In the end, our group was successfully able to devise a solution to the problems of the CEED space users while integrating the Ross Video Dashboard System into our solution. Over the course of three months, we were able to empathize with the client, define the problem, ideate solutions, as well as create and test a working prototype. Assumptions were made in order to complete the project.

The following manual is a report and summary of our work over the last three months in hopes that someone will be able to recreate, build on, and implement our work into other applications in the future. The structure of this report is designed to instruct a user to use, maintain, and implement our current design solution with the addition of our detailed project deliverables and some suggestions for further steps.

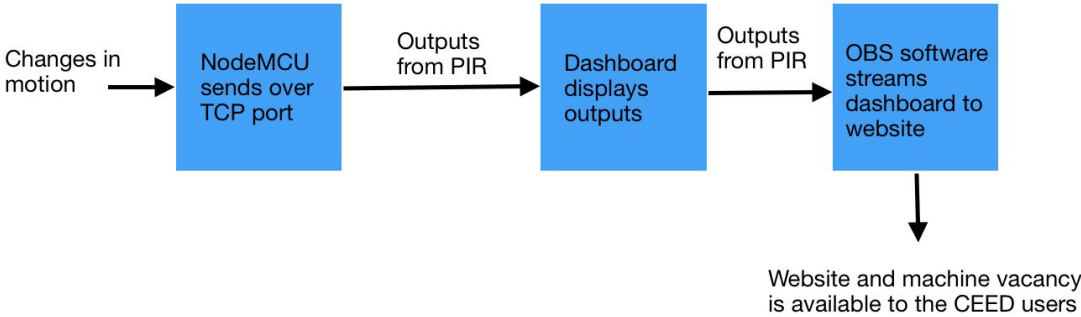


Figure 1

1.1 Problem

After speaking with our clients and users, we developed a list of user needs and design criteria which can be referenced in Deliverable B below in the appendices.

Project Group 17 used these criteria in the define stage of design thinking in order to come up with the following problem statement to describe the problem at hand:

The staff, students, and community that use the CEED space need an interactive system in order to time and inventory manage more efficiently.

We were then able to build our solutions around this clear statement of the problem.

1.1.1 How we reached the solution

We reached this solution by using the design thinking process and the user needs which we identified in the early stages of the process. We analyzed the needs of the client and through these needs, developed the final prototype we present today.

1.1.1.1 The Final Prototype

Our final product was a website for users. It is a one stop shop for all of the users needs. It includes 3D printer availability, time until the end of the day, an interactive map of the space, and other important information such as how to get in-touch and where to find the space. The main function of the product is to make the lives of the CEED space users easier.

Our prototype is effective not only because it solves multiple needs of the users but also because it is

- Inexpensive for user and client.
- It is accessible from anywhere.
- It contains all necessary information in one convenient location for the user.
- It is simple to edit and add to.

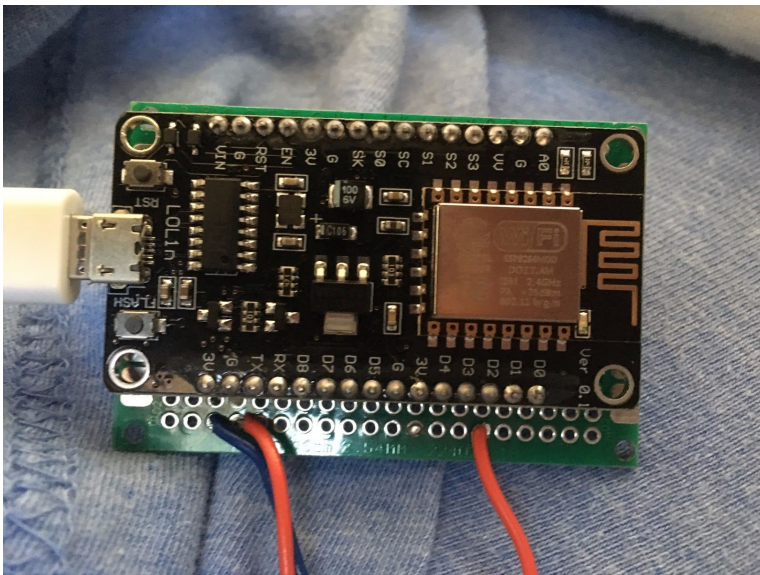


Figure 2

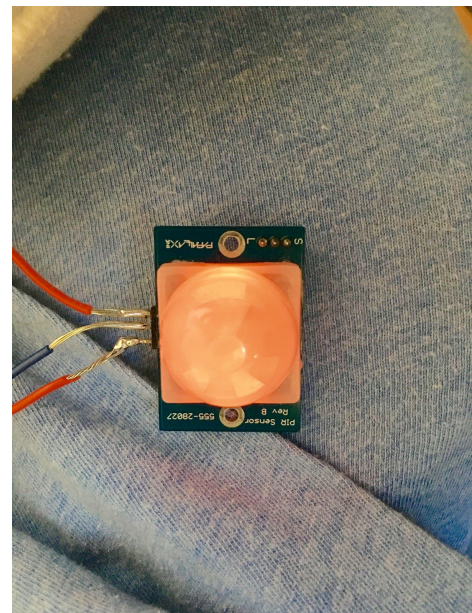


Figure 3

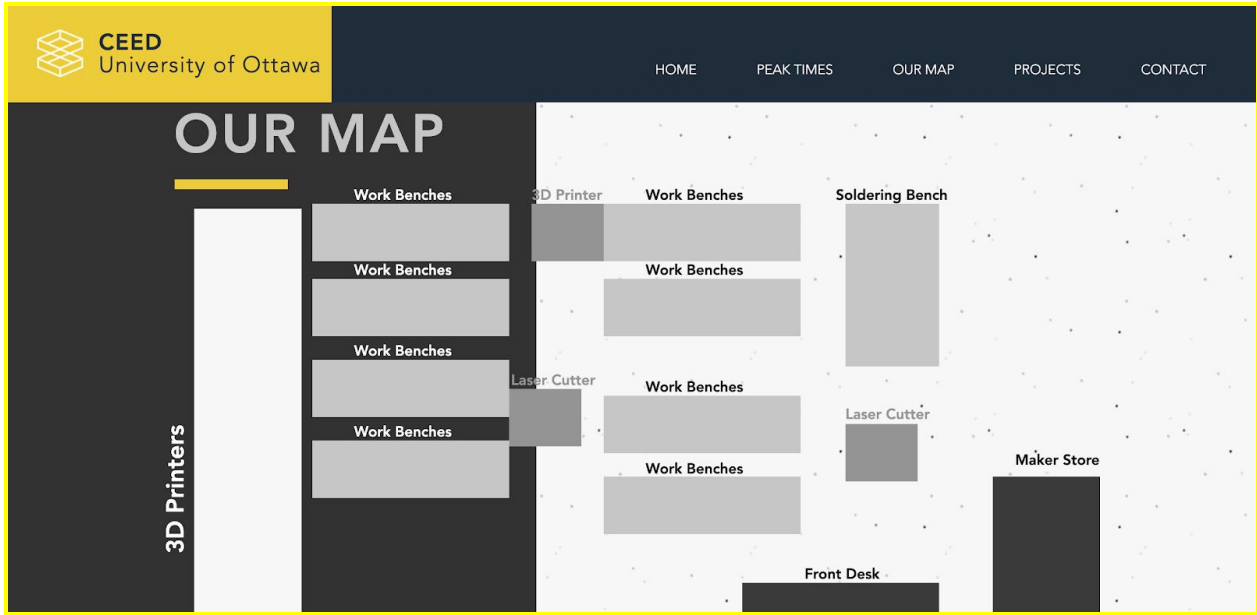


Figure 4

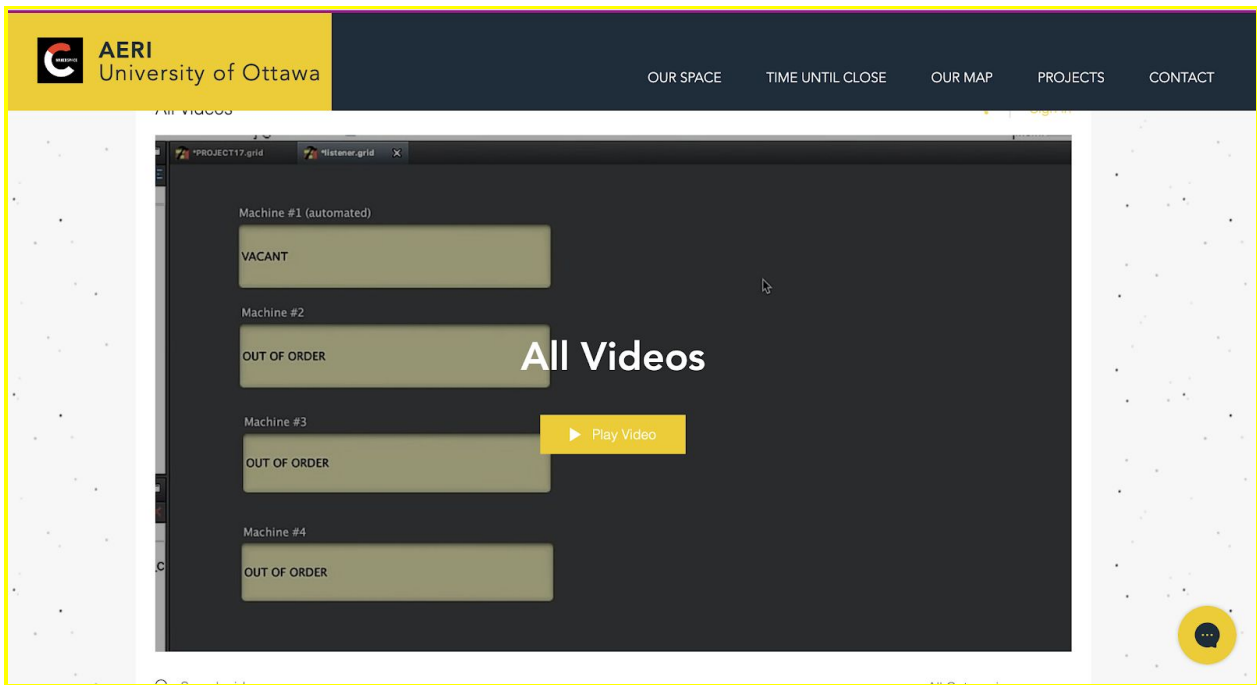


Figure 5

2 How the Prototype is Made

The final prototype was assembled by first connecting the PIR sensor to the NodeMCU board. The board was soldered into a protoboard and cables were soldered to the PIR sensor to connect the sensor pins to the ESP8266. The next thing that was connected was the NodeMCU to the dashboard. This was first accomplished using an HTTP server POST request, broadcasted over a mobile hotspot, but this was replaced with a listener server that would eliminate the need to manually update the output from the sensor. The last thing that was needed to finish the prototype was a connection with the website. Flint from Ross Video suggested using an HTTP Trigger Server Port however, after some testing, it was found that only button functionality would be accessible from the web, not data-readout. This was replaced with the OBS encoder. This software can stream the dashboard to our website with a tested delay time of less than 9 seconds.

2.1 Aspects of Our Design

2.1.1 Bill of Materials

These were borrowed from the lab and only used for our early stages of prototyping.

- Jumper Cables (4)
- Breadboard (1)

These were the actual materials used in our final prototype of the solution

- Protoboard(1)
(This was bought and given to us in our labs and were added to our running total)
- Ross Video Dashboard:\$0.00
- Wires (4)
- 3D Printed Box to Hold All Components
- NodeMCU: \$8.49:
<https://www.amazon.ca/s?k=node+mcu&gclid>
- The cost of putting up a website: \$0.00
<https://www.wix.com>
- PIR Motion sensors for the 3D printers/ machines : \$21.32 ea.:
https://www.robotshop.com/ca/en/parallax-mini-pir-motion-sensor.html?gclid=EAIaIQobChMI_vH75Mej5QIVAdbACh1IEg2WEAYYBiABEgK9zPD_BwE

TOTAL COST:

NodeMCU	\$8.49
PIR Motion Sensor	\$21.32

2.1.2 Equipment list

-Soldering Equipment

This was used to solder our wires to our protoboard and connect it to our PIR sensor. We were trained during our lab and used the soldering irons in the makerspace to accomplish this. This was done in our final stages of prototyping.

*Note: it is recommended to have basic training in this aspect in order to keep you and others safe, as well as to keep the materials from being damaged in the process.

-3D Printer

This was used to create many versions of the 3D printed box throughout our prototyping and testing stages. We used the basic training learned in the lab, solidworks environment, and ultimaker cura software, to design and print this specific component of our prototype.

*Ask someone with 3D printing experience for help or information on the 3D printers before using them if you are unsure. This will make the process go much smoother and avoid damage to your machine and need for multiple prints.

-Wix Website Builder

This was used to aid in the design and build of our online user environment. It is a free, easy to use, and edit, software which helped to create the website component of our final prototype.

<https://www.wix.com>

-Arduino IDE

This was the platform used to create the code which was used in our final prototype. This was an easy to use, free, downloadable, software which was compatible with many other aspects such as our nodeMCU and Dashboard (which were the most important to us for this design solution). We were trained to use this software in the labs.

-Mobile Hotspot

A mobile hotspot was used to set up the HTTP server (POST) as well as the listener server. This was required since the person setting up the prototype needs direct access to the IP address of the NodeMCU board. This would be much harder on a public wifi network, and would require cooperation with the University of Ottawa IT support and technology department.

3 How to Use the Prototype

To use this prototype, a few things need to be setup first. Before anything happens, a mobile hotspot must be setup from a local laptop and the name and password should be pasted into the arduino listener file. A TCP port scan should be run and the available port number needs to be pasted into the dashboard as well as the arduino code. From here, the arduino code can be uploaded to the NodeMCU board. The outputs will read on the screen when the sensor is detecting motion and when it is connecting to the dashboard via the TCP port. To fully complete this tutorial, on the dashboard computer, the live stream needs to be started. To do this, enter the wix editor, click “manage videos” and “Go live now - from desktop”. Copy the stream key and go to the OBS software. Under settings - live stream, there is a place to paste the stream key. Exit the settings and hit “start streaming” congrats, you are now live! Publish the wix page and open up the website on another computer.

Now that the prototype is all setup, it is ready to use, you can wave your hand in front of the PIR sensor and the website will display the motion. The containment box can be placed in the 3D printer and it will begin to record of the changes in motion.

In our prototype, there are no moving parts and no open circuitry at risk of burning people, the only thing the user needs to do to operate our product safely is obey the rules of the 3D printer. Very important to keep your eyes on the printer when you are working near it as it can get very hot.

4 How to Maintain the Prototype

- Life expectancy testing with the PIR sensors was not done in this project and so it would be a wise idea to perform basic tests of the sensors approximately once every month. These tests would consist of simply waving a hand in front of the sensor and making sure the output change is displayed on the website
- The website has a display of the hours remaining in the day. Although it updates automatically, if the hours of the MakerSpace change, which they often do, this would need to be recorded in the website.
- Extensive testing was done on the box to ensure it was not going to be affected by the heat of the printer, or the regular motion of the printer. This being said, if the printer is undergoing maintenance, the box should be checked every time to ensure there is no damage, as the box is quite thin and fragile.
- When the printers are moved the range of the sensors must also be retested. As the box could have shifted during the moving of the printer, it is important to check that the printing arm is still fully in the range of the sensor and the sensor is not picking up the motion from other sensors.

5 Conclusions and Recommendations for Future Work

The next steps for this project are primarily to, buy more sensors. If this were to be expanded over the entire MakerSpace, there would be a need for a sensor for each printer. Also, if it were determined to be useful by the CEED staff and clients, our system could also work for a laser printer. The containment box would need to be modified, and extensive testing would need to be done, but in theory it would work, as the laser printer also has a moving arm. The next thing that could be done to improve the product, is that seven sensors could be run off of one NodeMCU board. The boards could be plugged into the wall for power, eliminating the need for the serial monitor computer. In addition to this, the dashboard program and the OBS encoder could be run on a computer server anywhere at the University of Ottawa, as long as it was connected to the same wifi network as the NodeMCU. This would allow the project to be run on just the visible sensors, and the website (as well as a hidden computer server).

APPENDIX: Design Files

All Design Files as well as the various project deliverables that contain important information about the design, can be found on the Makerepo page:

<https://makerepo.com/escho036/gng1103-fall-2019-project-group-a17>

Our website is live (although no longer functioning now that we no longer have controls on the CEED space and 3D printers) and can be viewed at the following link:

<https://escho036.wixsite.com/ceedproject17>