



Automated Tardy Pass System Project Portfolio



DEFINE THE PROBLEM



DESIGN BRIEF

Client	Hopewell High School Staff and Administration Hopewell High school https://www.cmsk12.org/hopewellHS 980-343-5988 11530 Beatties Ford Road
Designer	TopTechnologies Jonathan Westly-Carlton Maye 704-960-3770
Problem Statement	Hopewell High School Staff and Administration currently have to manually write tardy passes for students every block, for nearly every weekday during the school year. Valuable time and resources are spent in this rudimentary task, being a unnecessary burden to teachers.
Design Statement	19+ Teachers and staff at Hopewell high school have to manually write an average of 350 tardy passes after the bell rings. This is a tedious task for staff, which takes away time from the teachers that are writing the overabundance of passes, and students that are trying to get back to class.
Criteria / Constraints	- Implementation (Ease of use/management for admin/staff) - Autonomy (Little human intervention) - Compatibility (With existing CMS databases and systems)
Deliverables	Engineers at TopTechnologies will design and fabricate a prototype Automated Tardy Pass System that will remove the need for teachers to manually write tardy passes, and report statistical data to administration about tardies to give valuable time back to staff at Hopewell.



GENERATE CONCEPTS

BRAINSTORMING

Sketches of Early Designs

Current tardy passes have to be handwritten

4 TITLE **PLTW** ATPS Brainstorm

10+ Teachers and staff at Hopewell High school have to manually write an average of 350 tardy passes after the bell rings. Wasting time and resources on this rudimentary task. *Maye*

Ike hurd Windows based Software for a teacher to scan barcodes and print out a pass for students. Cartesian robot to write passes automatically. <i>James L...</i> <i>2/9/2024</i>	Rachel Holleman Add a 5 minute grace period at the start of class to help semi-late students. <i>R. Holleman</i> <i>2-9-2024</i>	John Figueroa Stations at each hall to print out tardy passes from your phone. <i>John</i> <i>2-9-24</i>
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Solution	Time	Automation	Compatibility
Handwritten	1	1	2
Entrance lock at each classroom door	3	4	3
Windows software	2	2	3
4-6 kiosks that print a pass and save info to a database	5	5	4

DESIGNED BY: Jonathan Maye DATE: 2/9/2024

WITNESSED BY: Wayne & J... DATE: 2/9/2024

PROPRIETARY INFORMATION
All information is the property of, and solely owned by the Designer.



Embrace Excellence

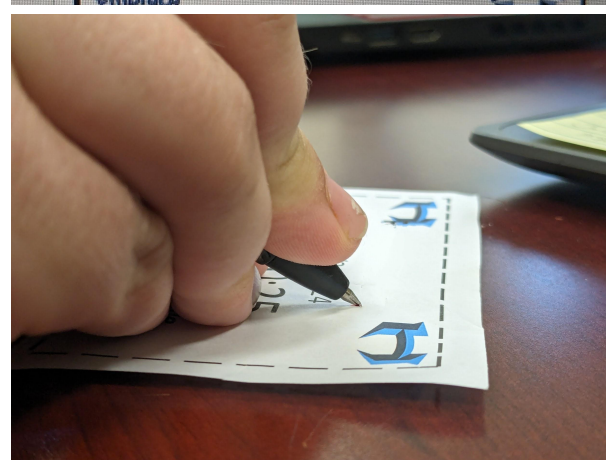
Tardy Pass

Monday, September 11, 2023

Time: _____

Approved by: _____

Embrace Excellence



Current tardy passes take around 20+ seconds to write per student. (Around 250 students per day request a tardy)

BRAINSTORMING

Sketches of Early Designs

Interviews of 3 teachers that have to manually write tardies.

PLTW		TITLE	3
Name		would like to change	# of tardies
Ms. Craig		- multiple areas for passes - kids getting lost	25-50

Each teacher is asked how many tardies they get in a day per period.

Mr. White	- more staff is bad - loss of teaching time - Available staff Every block that can do this, software on laptop	150-200 1st-150-200 2nd-25 3rd-10 4th-25~
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Some teachers recommended developing a better punishment for a student with an excess of tardies.

Ms. Thompson Thompson.	- Punishments are not good. - Janitorial punishment - kids get what they want with tardies, "lock out"	usually the same kids 80% of kids are repeats. 18-25 seconds
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DECISION MATRIX

Ideas	Criteria and Constraints				Totals
	Time (per pass)	Automation (Human interaction)	Compatibility (with existing databases)	Implementation (ease of use to change settings)	
Manually handwriting the pass.	1	1	5	3	10
Keypad at each classroom door	5	4	1	1	11
Software on Windows 10/11 that connects a barcode scanner to a teachers laptop in order to print out a pass	2	2	4	5	13
4-6 Kiosks that scans a students ID and prints out a tardy pass	4	5	3	4	16

Scoring Scale	Highest (Best)	Lowest (Worst)
	5	1

Summary of Findings / Reflection

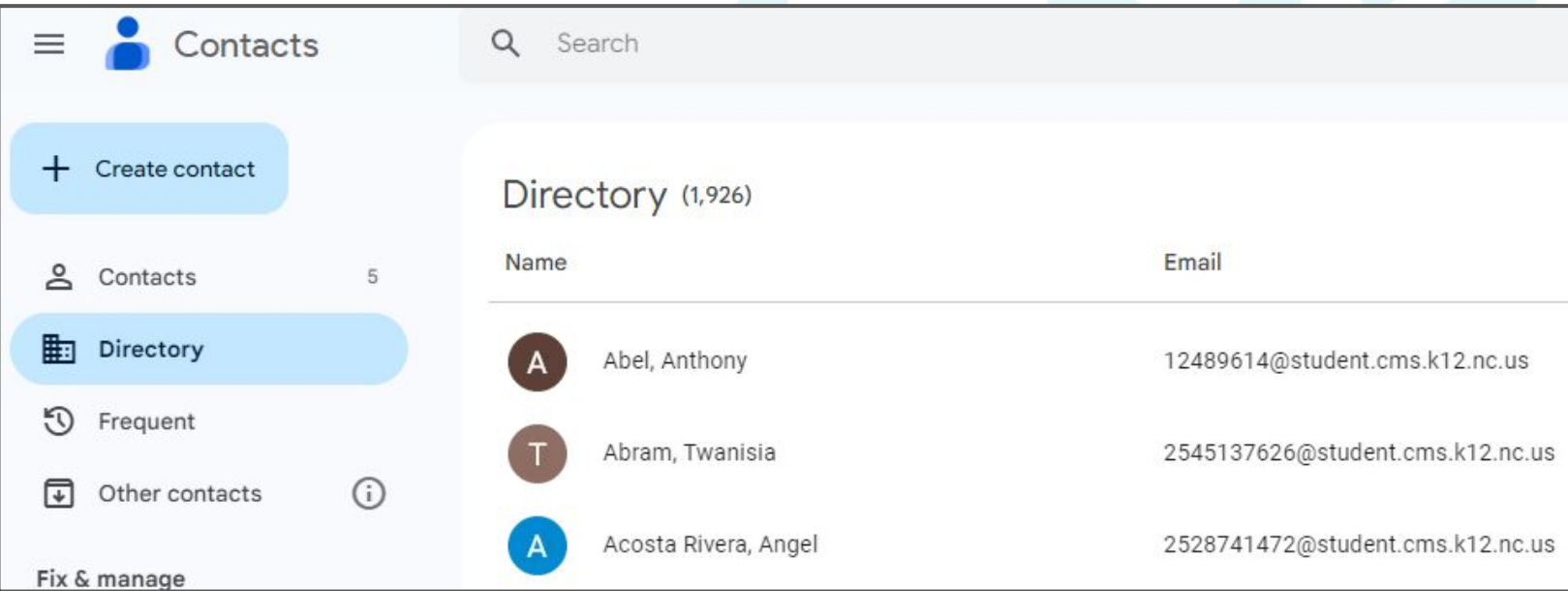
Hopewell High School needs a way to automate the tardy pass system, however implementation, autonomy and compatibility are the three main concerns. Therefore, designing a Kiosk that only requires a student to enter in their student ID fits all of the design criteria. The Kiosk does not require a teacher to monitor it, and is fully automated. The program can easily access google cloud API in order to check student information, and if programmed correctly the Kiosk can be easily modified by staff.



DEVELOP SOLUTION

SOLUTION DEVELOPMENT

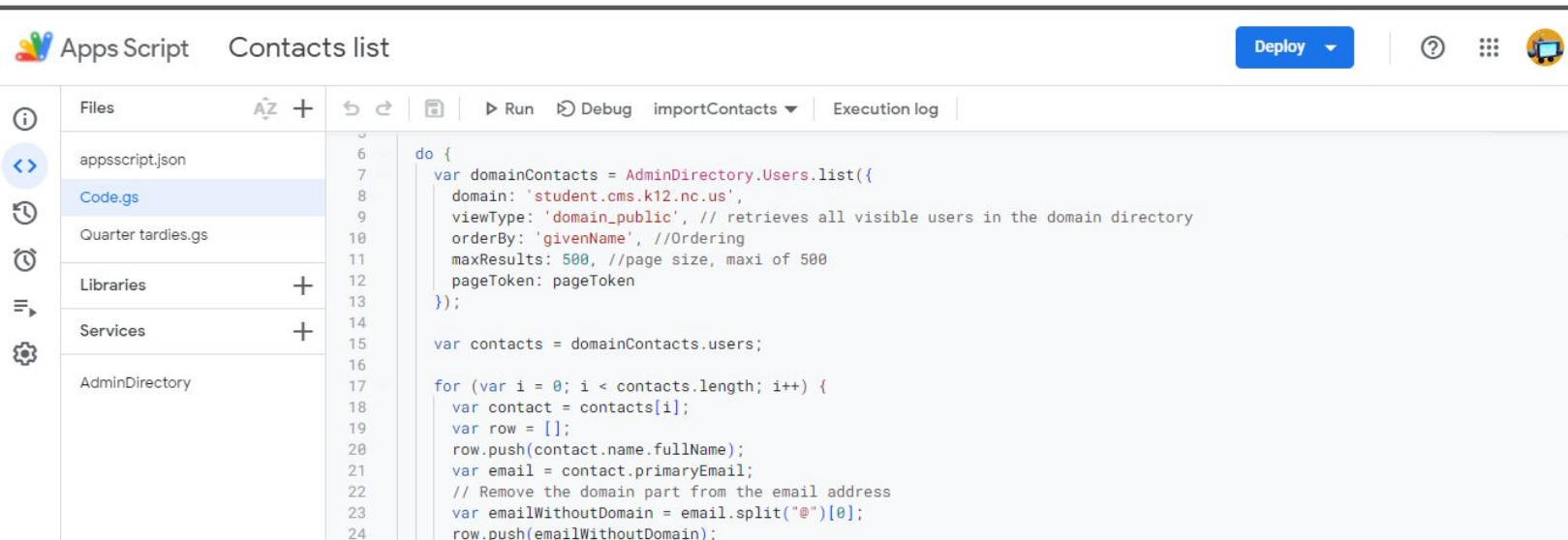
Google business school directory located in google contacts:



The screenshot shows the Google Contacts web interface. On the left, there's a sidebar with a 'Create contact' button and a list of contact groups: 'Contacts' (5), 'Directory' (selected), 'Frequent', and 'Other contacts'. The main area displays the 'Directory' group with 1,926 contacts. A table shows the first three contacts:

Name	Email
Abel, Anthony	12489614@student.cms.k12.nc.us
Abram, Twanisia	2545137626@student.cms.k12.nc.us
Acosta Rivera, Angel	2528741472@student.cms.k12.nc.us

Custom code made to pull student First&Last name, along with their student ID number (by removing the domain '@student.cms.k12.nc.us' and putting it into a spreadsheet as a mock database.



The screenshot shows the Google Apps Script editor interface. The file 'Code.gs' is open, displaying the following JavaScript code:

```

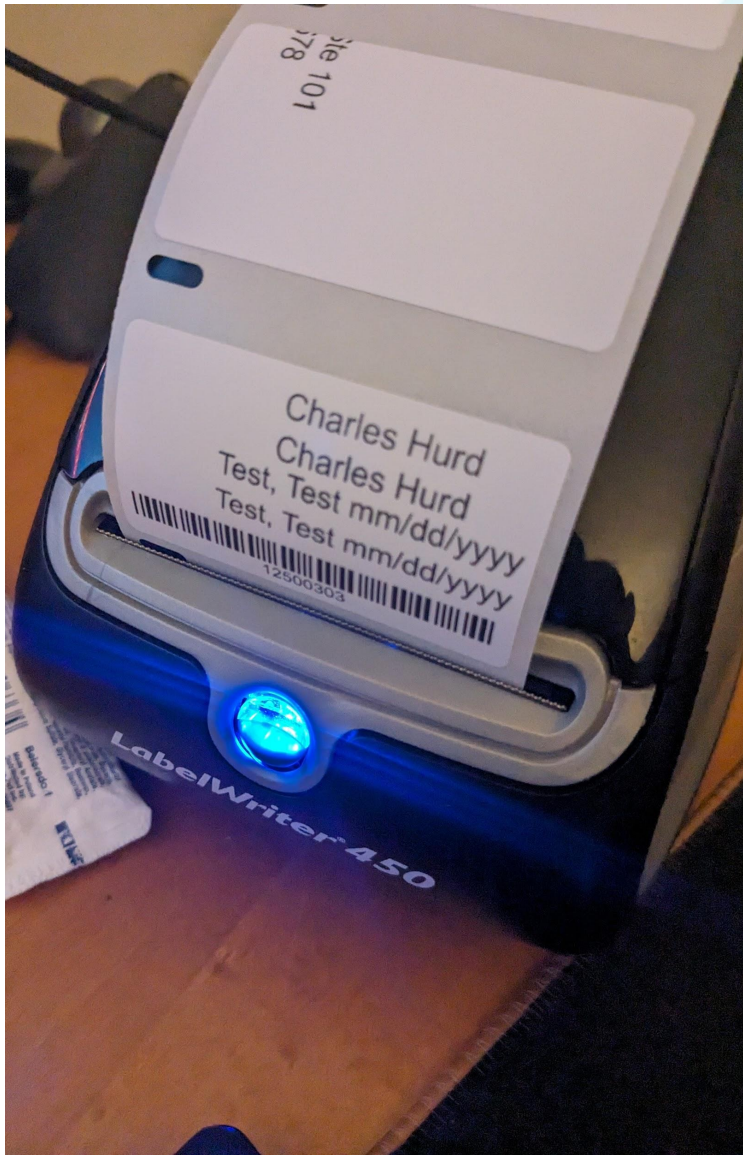
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do {
  var domainContacts = AdminDirectory.Users.list({
    domain: 'student.cms.k12.nc.us',
    viewType: 'domain_public', // retrieves all visible users in the domain directory
    orderBy: 'givenName', //Ordering
    maxResults: 500, //page size, max of 500
    pageToken: pageToken
  });

  var contacts = domainContacts.users;

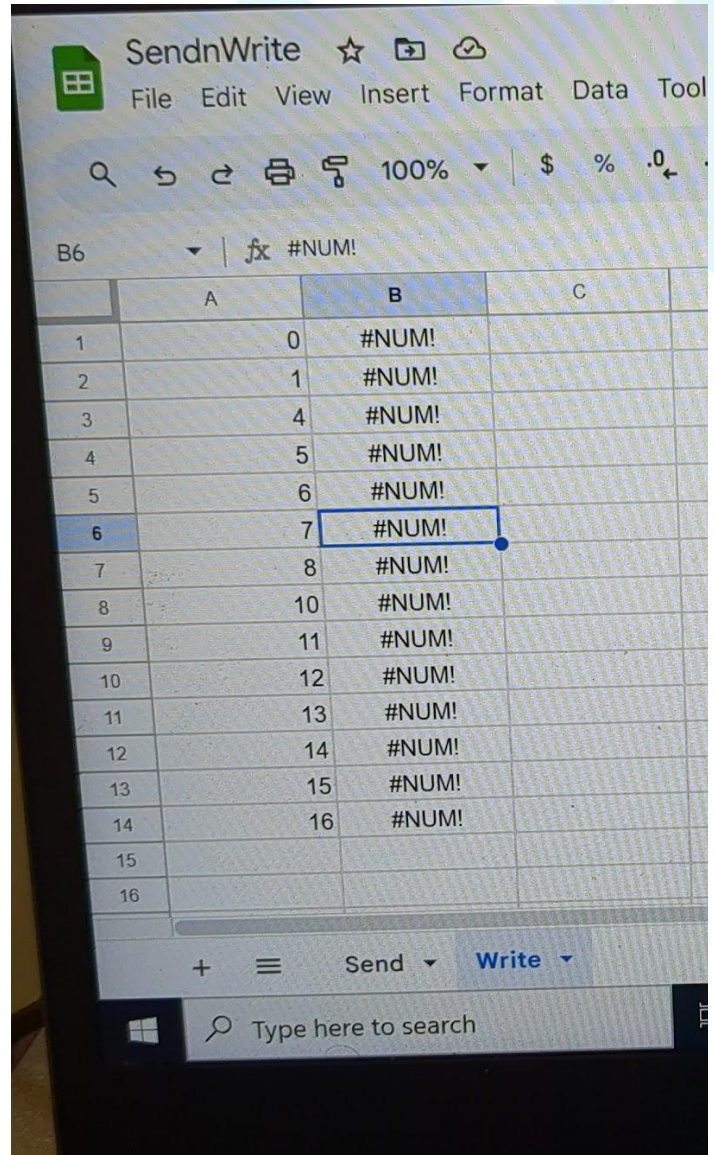
  for (var i = 0; i < contacts.length; i++) {
    var contact = contacts[i];
    var row = [];
    row.push(contact.name.fullName);
    var email = contact.primaryEmail;
    // Remove the domain part from the email address
    var emailWithoutDomain = email.split("@")[0];
    row.push(emailWithoutDomain);
  }
}

```

SOLUTION DEVELOPMENT

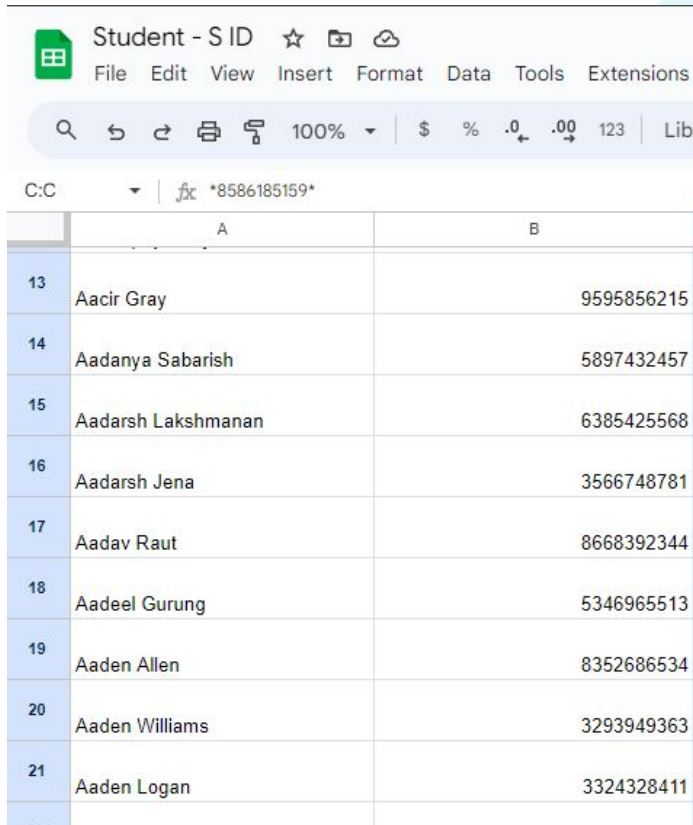


Custom code made in Python to ask for an input (Student ID number typed on a keypad), check the database for the ID, then print out a tardy pass with a Dymo printer



Logging data to google sheets automatically.

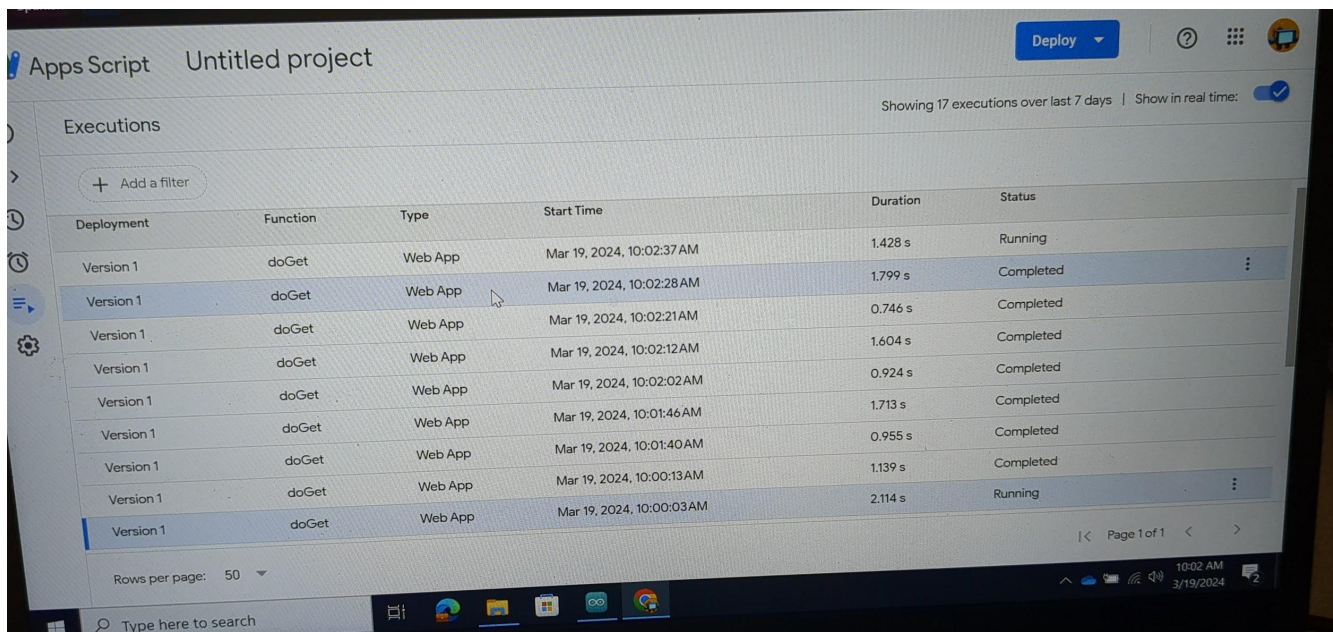
SOLUTION DEVELOPMENT



	A	B
13	Aacir Gray	9595856215
14	Aadanya Sabarish	5897432457
15	Aadarsh Lakshmanan	6385425568
16	Aadarsh Jena	3566748781
17	Aadav Raut	8668392344
18	Aadeel Gurung	5346965513
19	Aaden Allen	8352686534
20	Aaden Williams	3293949363
21	Aaden Logan	3324328411

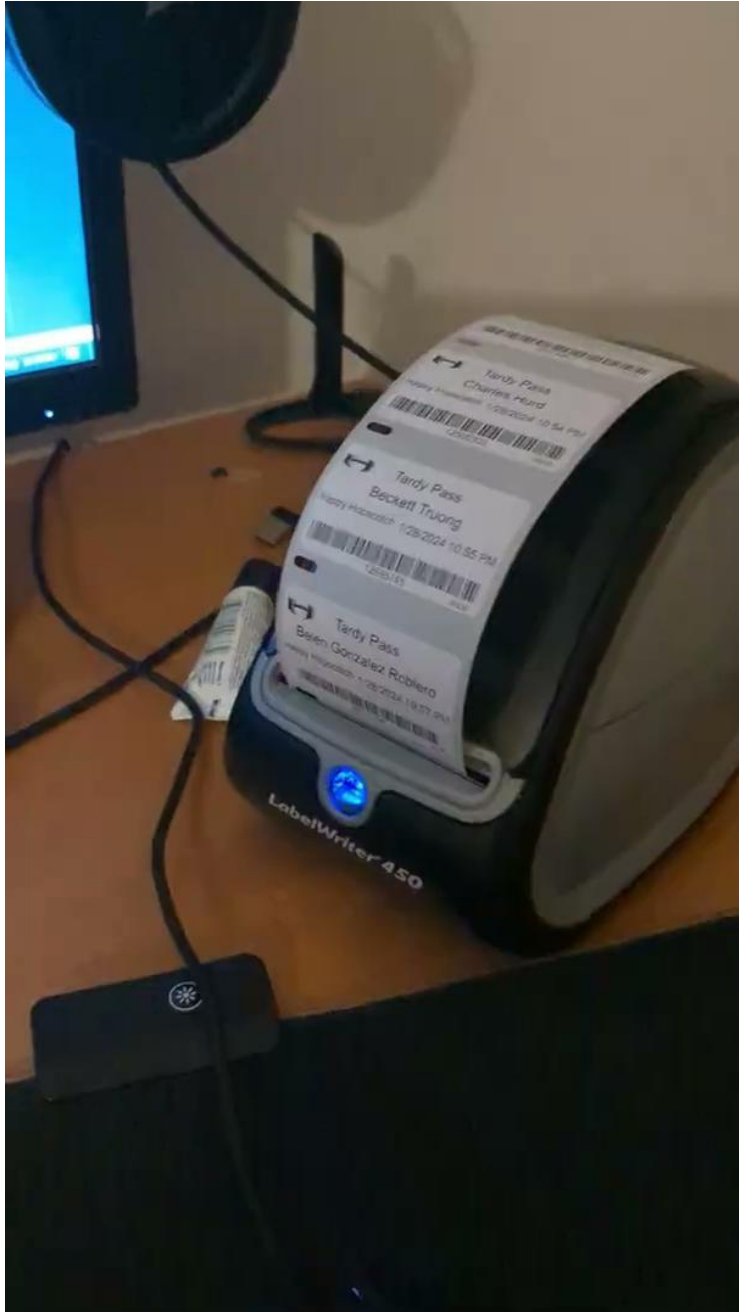
Student Name and ID databases protected under CMS encryption. **No personal or private information is stored in this spreadsheet.** Compatible with the google cloud API.

Automatic Trigger for the google script to update all students in the database every week, or in case the database is tampered with.



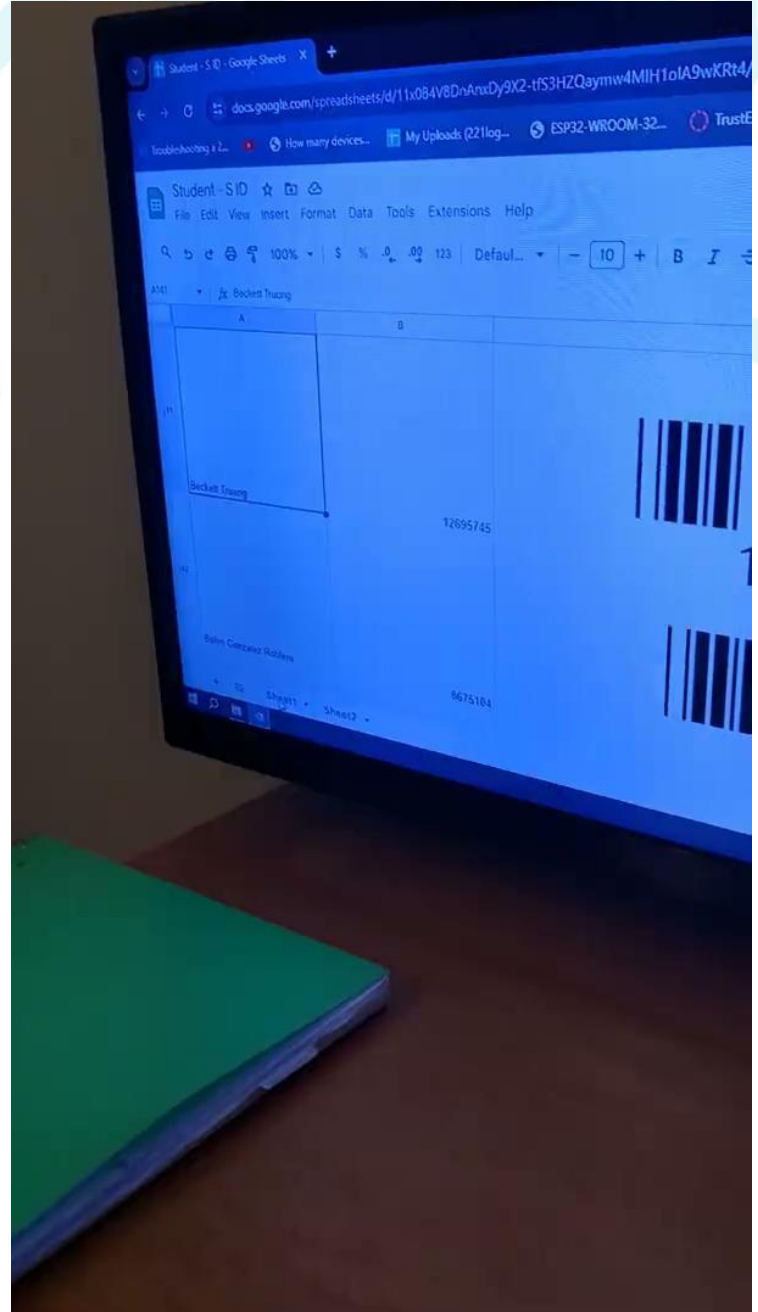
Deployment	Function	Type	Start Time	Duration	Status
Version 1	doGet	Web App	Mar 19, 2024, 10:02:37 AM	1.428 s	Running
Version 1	doGet	Web App	Mar 19, 2024, 10:02:28 AM	1.799 s	Completed
Version 1	doGet	Web App	Mar 19, 2024, 10:02:21 AM	0.746 s	Completed
Version 1	doGet	Web App	Mar 19, 2024, 10:02:12 AM	1.604 s	Completed
Version 1	doGet	Web App	Mar 19, 2024, 10:02:02 AM	0.924 s	Completed
Version 1	doGet	Web App	Mar 19, 2024, 10:01:46 AM	1.713 s	Completed
Version 1	doGet	Web App	Mar 19, 2024, 10:01:40 AM	0.955 s	Completed
Version 1	doGet	Web App	Mar 19, 2024, 10:00:13 AM	1.139 s	Completed
Version 1	doGet	Web App	Mar 19, 2024, 10:00:03 AM	2.114 s	Running

SOLUTION DEVELOPMENT



^Video^

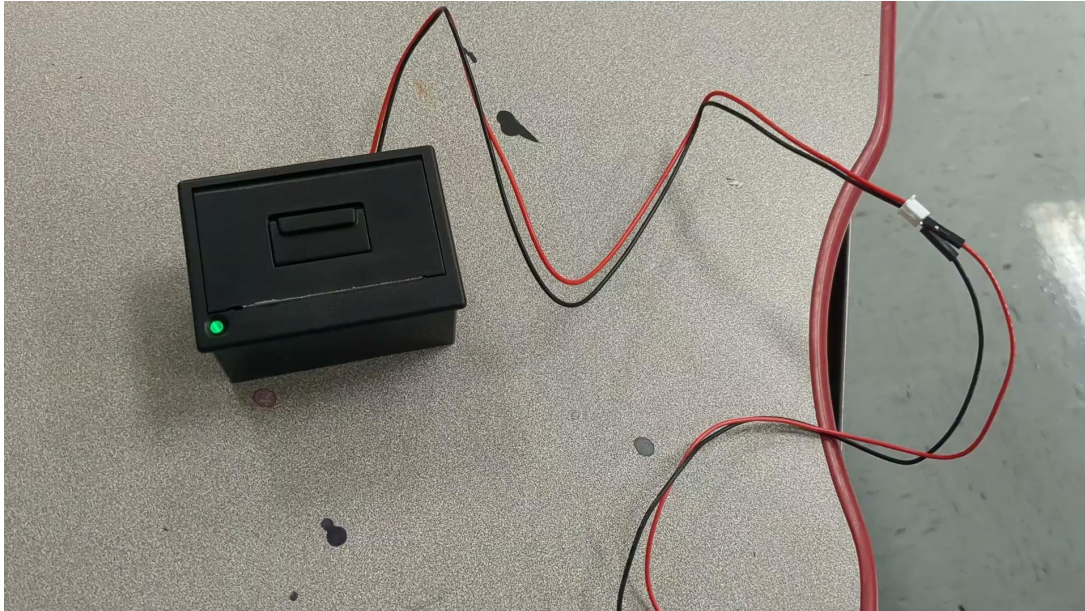
Python code working with Google Sheets Cloud API to print out a paper tardy pass with the Dymo API.



^Video^

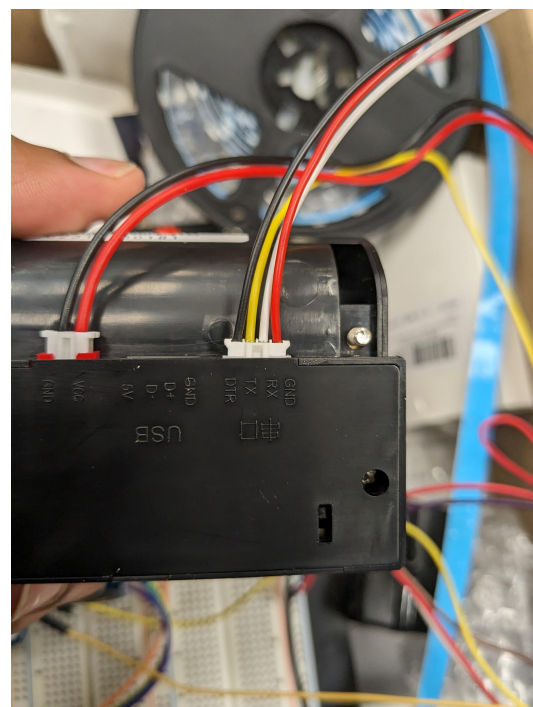
Google Sheets auto-updating database and tamper protection. Data logging back to the database.

SOLUTION DEVELOPMENT



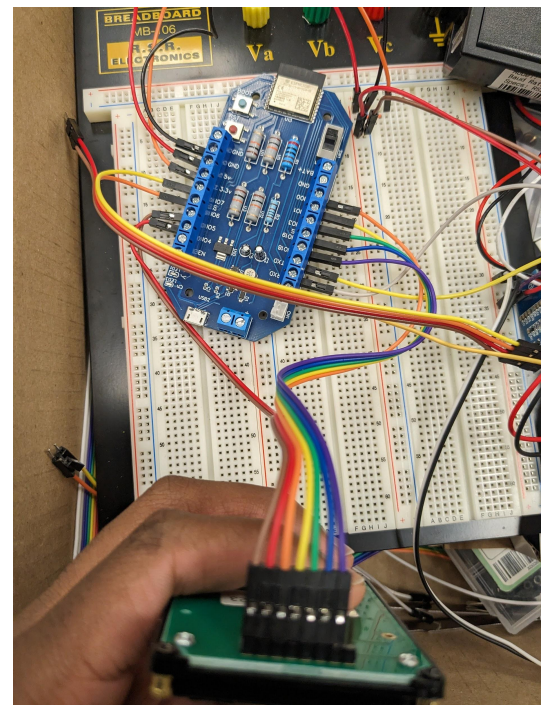
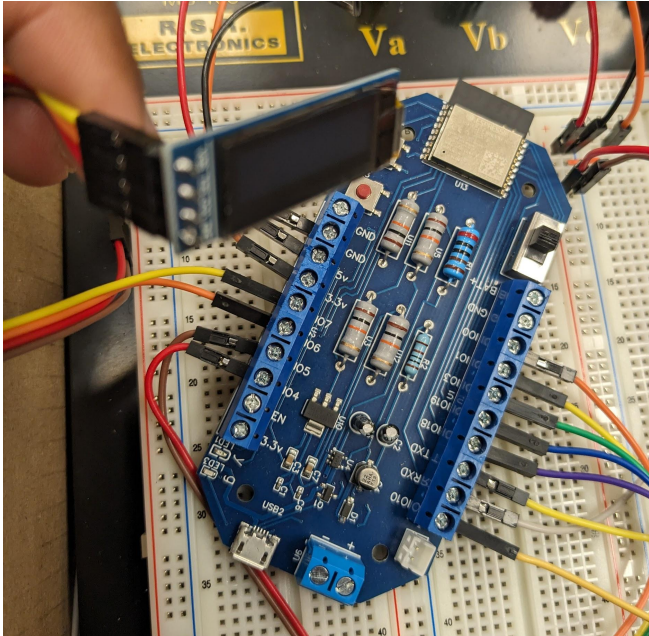
^Video^

The Dymo printer had limited functionality, was expensive, hard to find brand new without proprietary rolls, and had no serial port for easy communication. Therefore a small TTL receipt printer was purchased for prototyping.



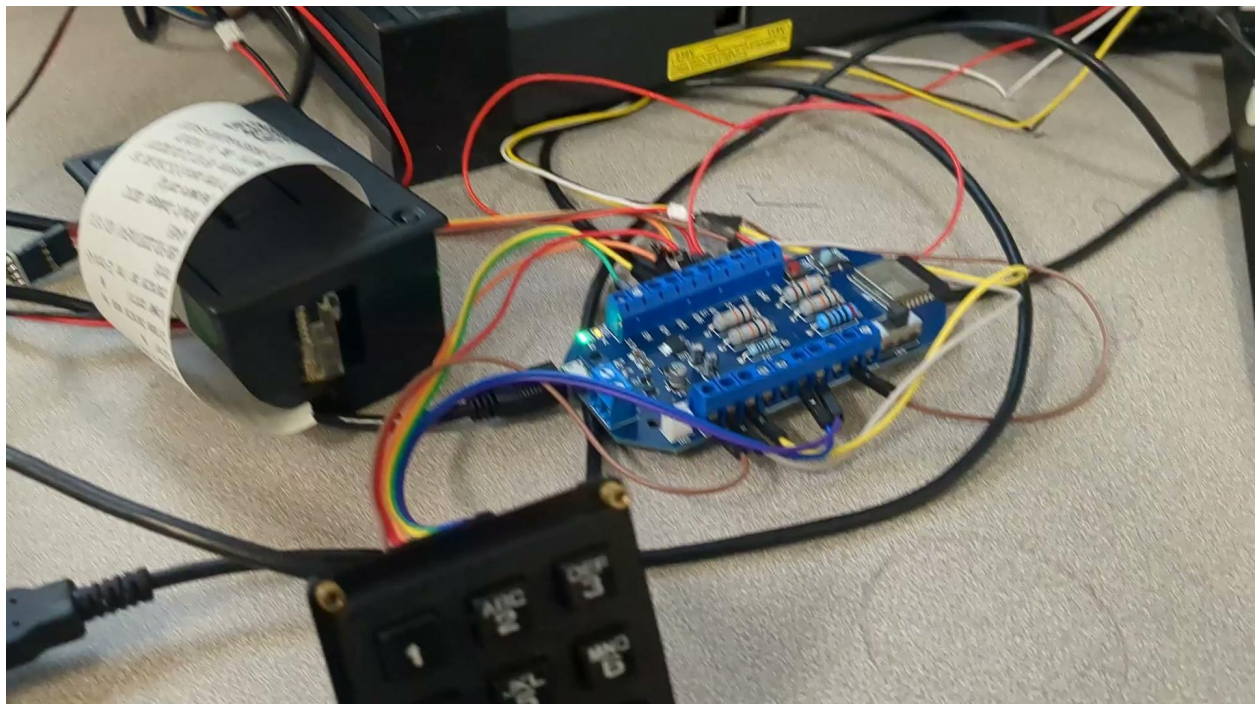
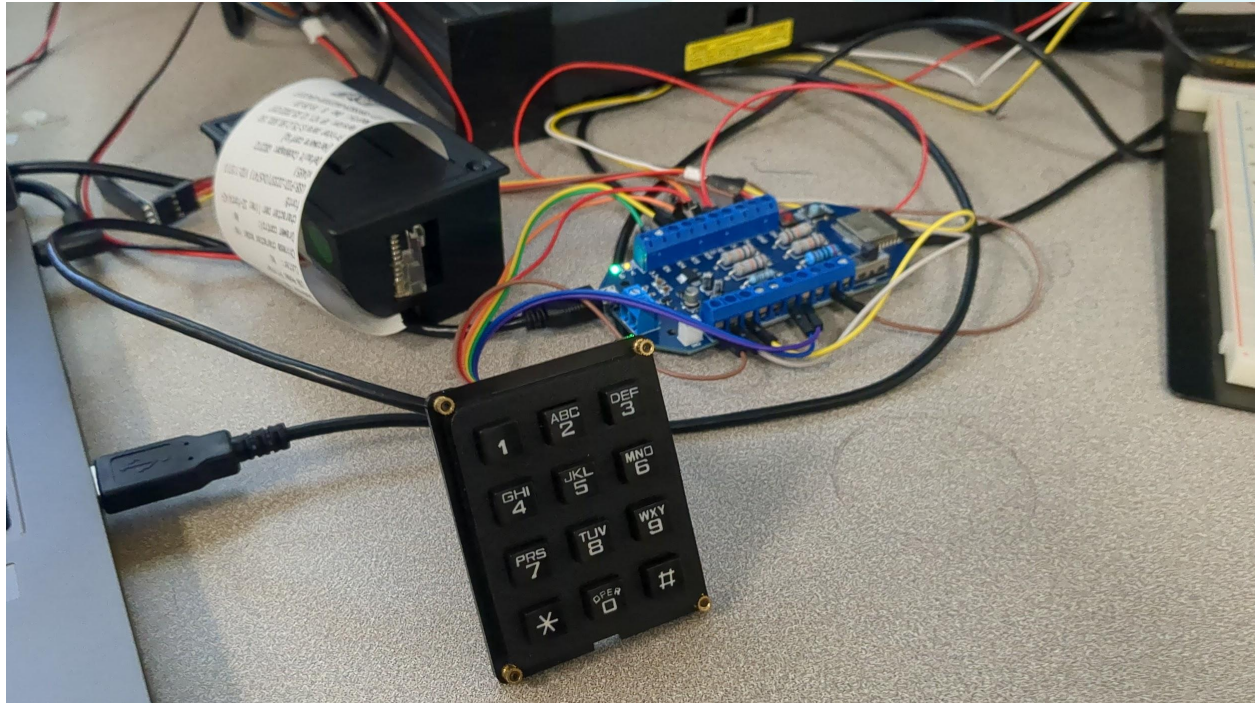
SOLUTION DEVELOPMENT

Using a dedicated desktop, would require teacher intervention, more expensive equipment (computer parts) and make it more difficult to expand the system with multiple Kiosks in the future. Therefore my custom designed ESP32-C3 printed circuit board was chosen for its low cost, wifi/database connectivity, IIC compatibility with screens & keypads, direct compatibility with serial devices like a thermal printer, and can be easily control a LED strip to display errors/loading/completed tasks.



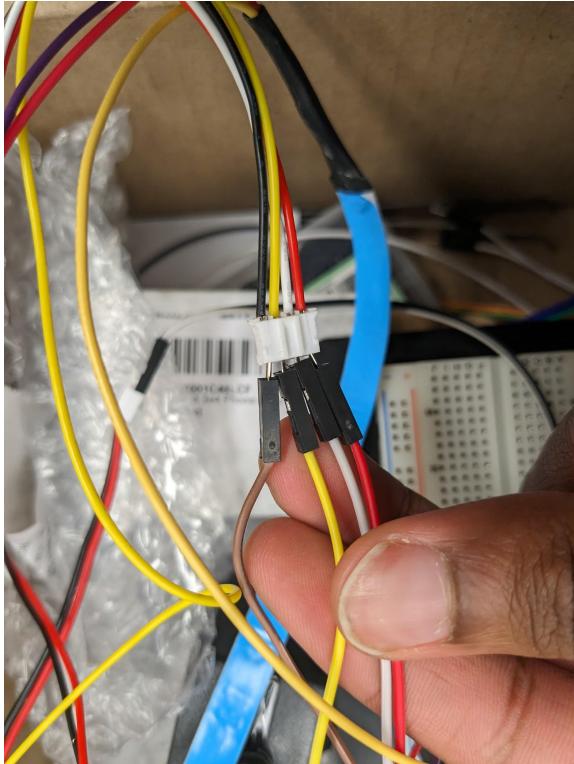
SOLUTION DEVELOPMENT

ESP32-C3 working with the keypad and logging data to Google Sheets. **Unable to log anything other than numbers.**

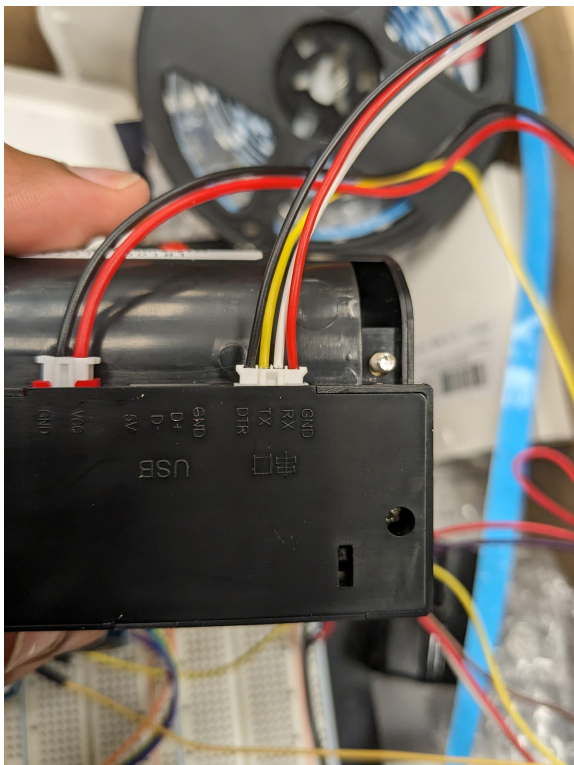


^Video^

SOLUTION DEVELOPMENT



Serial Port Line



Manufacturer made an error, and indicated that the DTR port was a 5v power line (The wire should have been blue, but was instead a bright red, indicating a “+” power connection) This error caused the wire to melt, and the printer to become inoperable.

SOLUTION DEVELOPMENT

An attempt was made to fix the printer, to get a working prototype, however several dimensions were incorrect, and the printer still remained inoperable. The video displays the ESP32-C3 board successfully checking the database (downloaded as a CSV file and saved to the device) and displaying if the student exists (green) or if there is no record of that ID number (red)



^Video^

Multiple interfaces



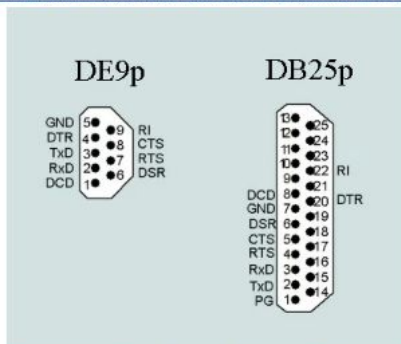
It was later found out that any receipt printers with a serial port (RS232 port) can work with the ESP32-C3 if you purchase a UART to RS232 converter.

SOLUTION DEVELOPMENT

A UART/TTL to RS232 Connector was purchased, and tested with another receipt printer. (lent by a nearby business) [Resources page:](#)

Resources:

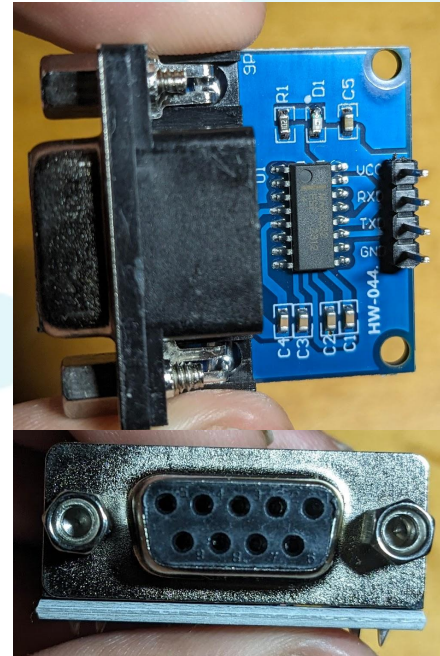
- Printer programming:
 - [Printing with Arduino](#)
- Esp32 C3
 - The default UART0 pins for the ESP32-C3-Zero are GPIO20 for RX and GPIO21 for TX.
 - https://docs.espressif.com/projects/esp-at/en/latest/esp32c3/Get_Started/Hardware_connection.html
- Serial information:
 - <https://www.virtual-serial-port.org/article/what-is-serial-port/#:~:text=Types%20of%20serial%20ports,-There%20are%20several&text=Serial%20data%20interface%20include%20CAN,most%20reliable%20and%20common%20ones.>



- <https://www.beaglehardware.com/howtoserial.html>

D-Sub 25P(TM)		D-Sub 9P(PC)	
Pin	Signal	Signal	Pin
1	PG	DCD	1
2	TXD	TXD	3
3	RXD	RXD	2
20	DTR	DTR	4
6	DSR	DSR	6
4	RTS	RTS	7
5	CTS	CTS	8
7	GD	GD	5
25	RESET	RI/RESET	9

- <https://trandi.wordpress.com/2017/11/16/thermal-printer-remotely-controlled-through-an-esp32/>
- <https://github.com/qdsports/print-pics>

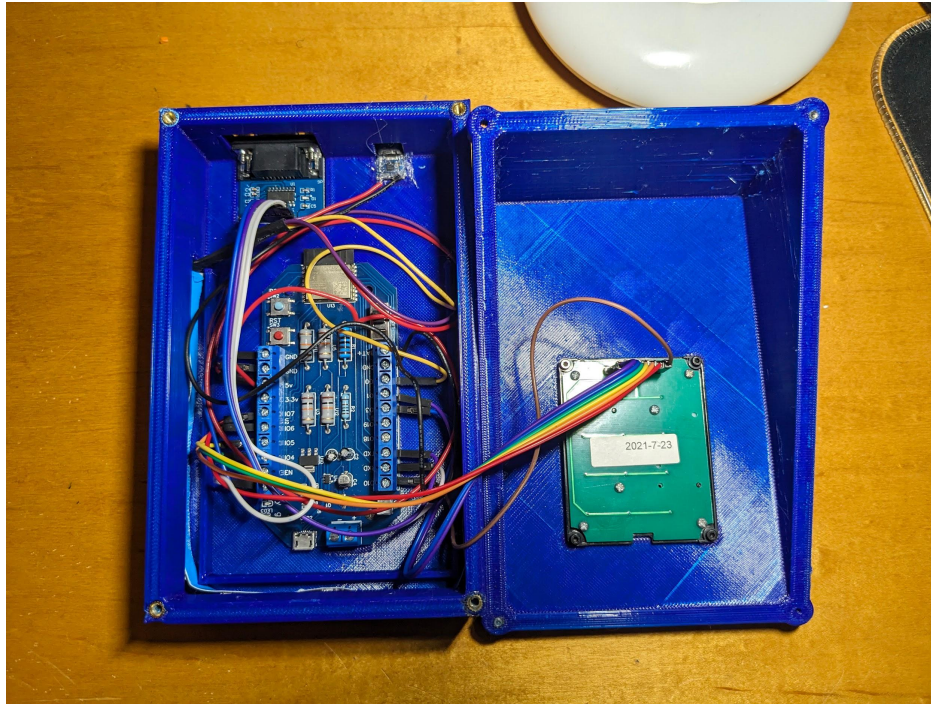


The RS232/Serial port has less pins than a standard VGA cable-(Commonly used for video output)



SOLUTION DEVELOPMENT

A 3rd case was designed and 3D printed, which incorporated the keypad, the custom ESP32-C3 board, 18x WS2312B Addressable RGB LED's, UART/TTL to RS232 Serial module, and a USB Type-C power connector to power everything.



Thinner wall to let LED's shine through

Holes for power and data transmission.





CONSTRUCT AND TEST

FINAL IMAGES

Photos of the Final Prototype

A “plug-and-play” Kiosk that connects to any receipt printer over a serial/RS232 plug, and can print out student tardy passes every 10 seconds without teacher intervention.



3 pilot tests were conducted with a ~80% success rate. (Many students who were freshman/new to the school did not show up in the database)

FINAL VIDEO

Photos of the Final Prototype

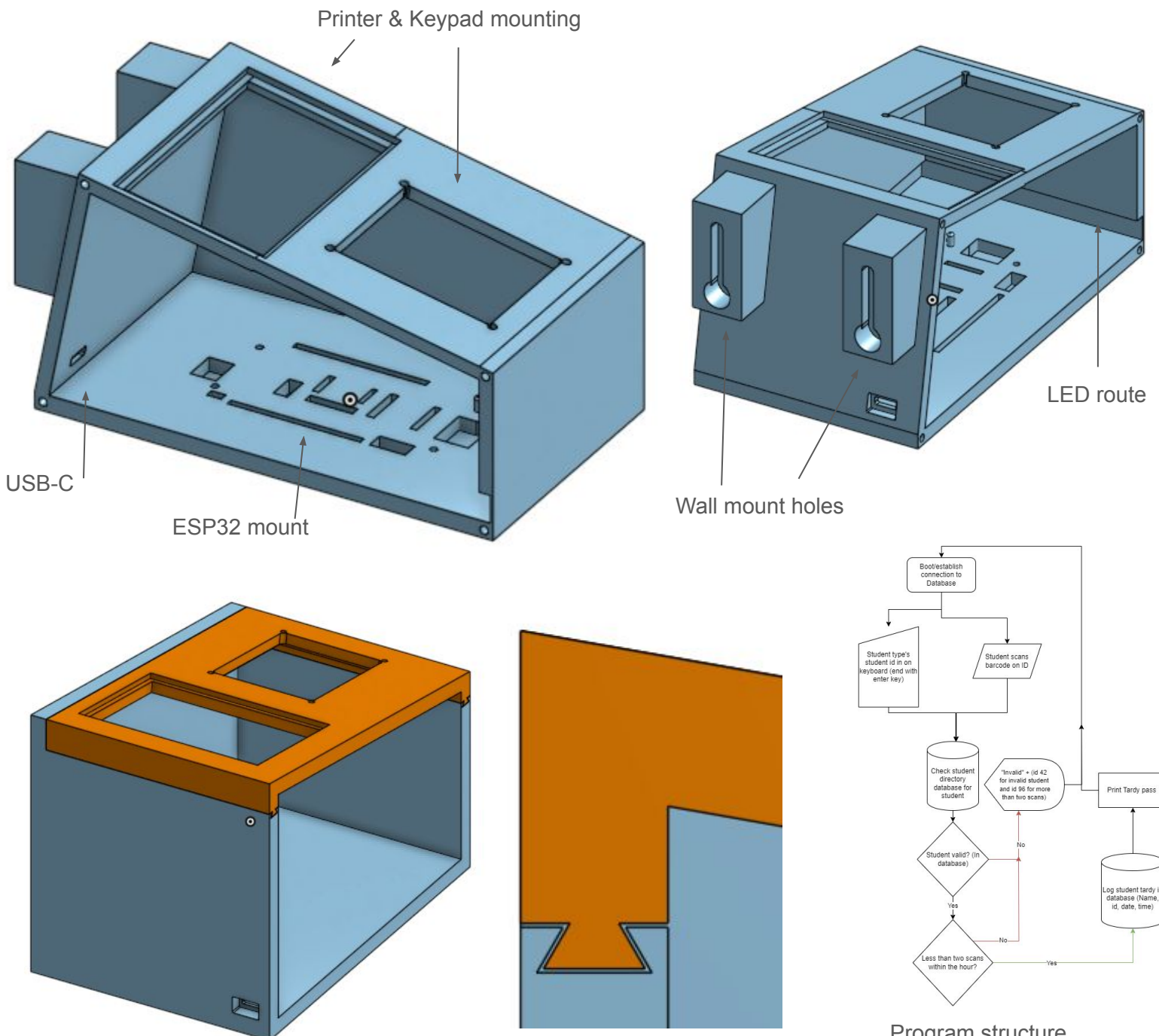
A “plug-and-play” Kiosk that connects to any receipt printer over a serial/RS232 plug, and can print out student tardy passes every 10 seconds without teacher intervention.



^Video^

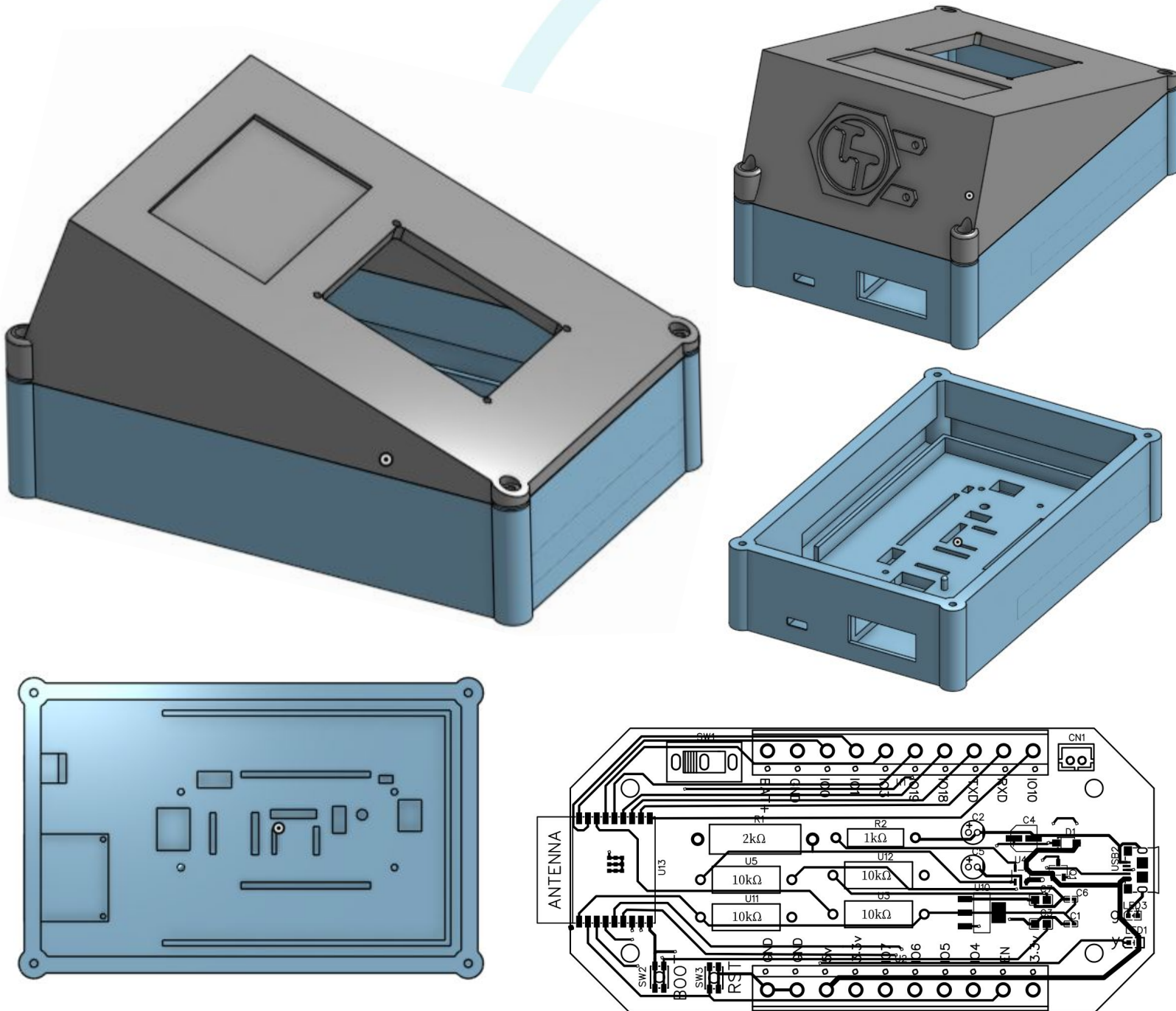
TESTING, MATHEMATICAL MODELS AND/OR DATA

A.T.P.S Case V1 and V2 had several design flaws that caused them to be scrapped. V1 had weak mounting holes and failed to hold the LED's and printer securely. V2 was scrapped when the DTR pin on the printer melted.



TESTING, MATHEMATICAL MODELS AND/OR DATA

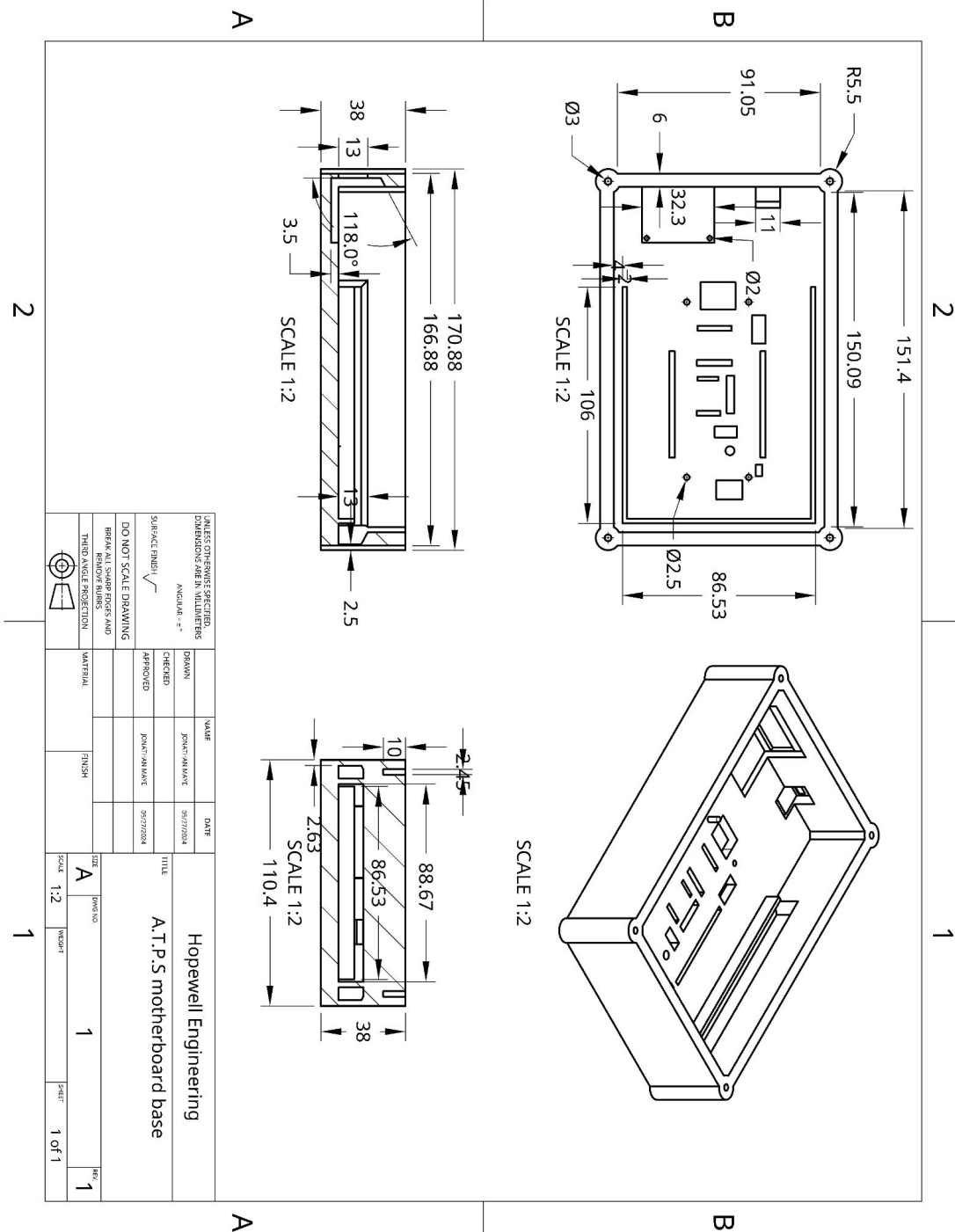
The V3 case was a massive improvement, incorporating a two-part design, making assembly substantially easier, and allowing parts to be properly secured.



Custom designed ESP32-C3 circuit board

TESTING, MATHEMATICAL MODELS AND/OR DATA

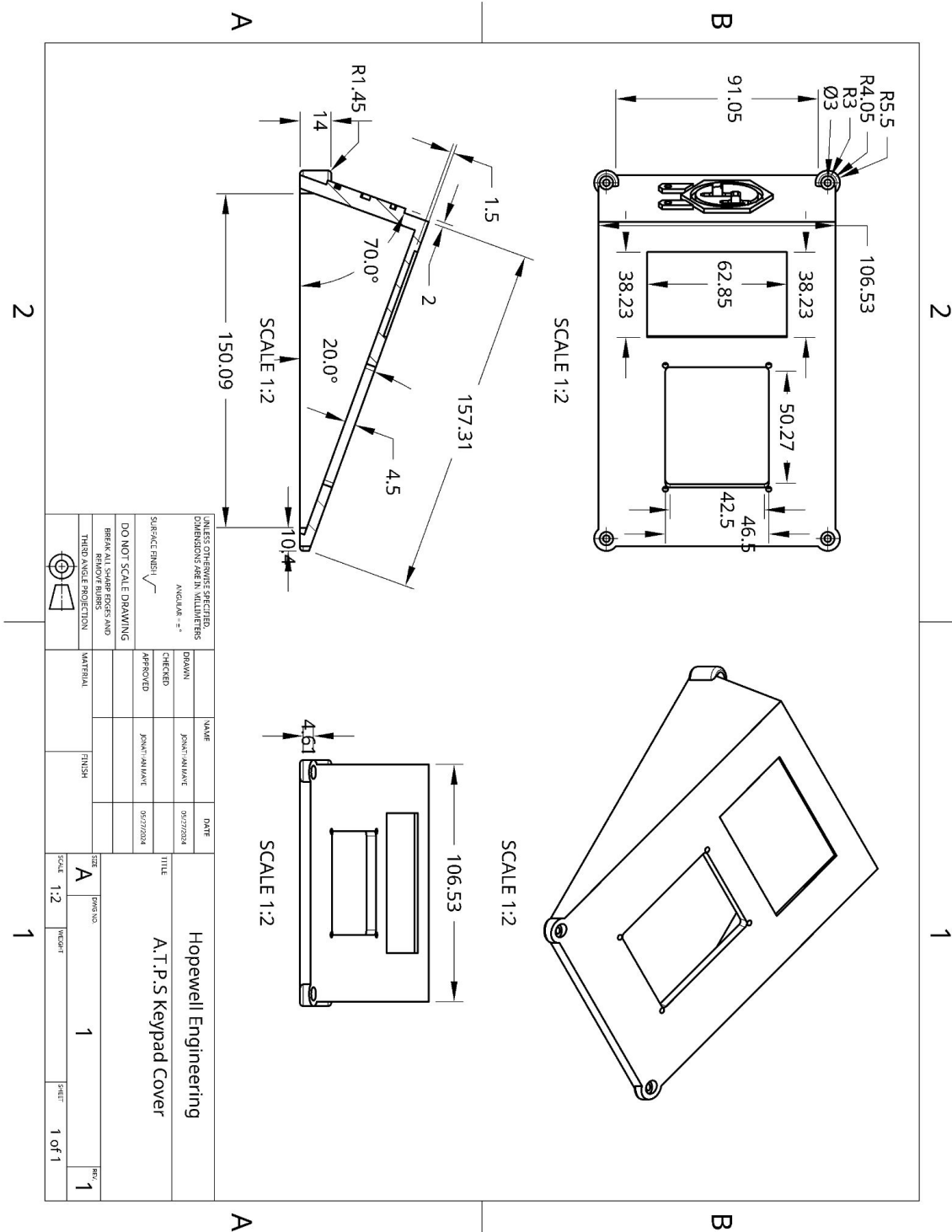
The V3 case was a massive improvement, incorporating a two-part design, making assembly substantially easier, and allowing parts to be properly secured. Below is the drawing view for the Motherboard case.





TESTING, MATHEMATICAL MODELS AND/OR DATA

The V3 case was a massive improvement, incorporating a two-part design, making assembly substantially easier, and allowing parts to be properly secured. Below is the drawing view for the Keypad Lid:





EVALUATE SOLUTION



EVIDENCE THAT PROJECT CRITERIA WERE MET

Hopewell High School needed a way to automate the current tardy pass system, as it took away valuable time from teachers to manually write an excess of passes every day. The A.T.P.S solves this by not only being relatively simple and easy for admin and staff to use and manage with its structured spreadsheet data output and wifi connectivity allowing it to be modified over the secured CMS wifi network, and with its wifi capabilities it logs data to a database, and can provide administration and staff with valuable student tardy information over the year. It also remains almost completely autonomous negating the need for a teacher to manually write passes, and only requiring a paper refill once every two weeks. The system is also compatible with the CMS Google API and directory, allowing the A.T.P.S to remain up to date with student information, and may be able to sync with Powerschool's api in the future. Lastly, the system is easy to implement and install, and has been proven through testing that students are able to easily understand how to use the kiosk, and print out a tardy pass quickly.

REFLECTION AND RECOMMENDATIONS

If I could start this project over, I would've initially purchased a more robust, trustworthy, and bigger capacity receipt printer (now that I know the UART to RS232 module can work with those printers) to allow the A.T.P.S to work with different sizes of printers, and last longer on a single roll of paper. Furthermore, I would have used a touch screen with LVGL instead of a mechanical/membrane keypad in order to display instructions for the student, show the current digits they have typed in, allow them to delete digits, and allow them to see their total amount of tardies. Lastly, I would provide administrators with more database functionality, allowing them to easily see statistical data of student tardies throughout the school year, to use this data for making important decisions.

I decided to do this project in order to use my electronic engineering knowledge about PCB fabrication and design to learn more about microcontroller programming (In Arduino IDE C++/Machine language), Firmware development (in Python & lvgl), database/SQL setup/management, product development in CAD, and communication protocols for electrical devices (Serial, RS232, UART, USB, IIC, ttl, etc). I have gained valuable experience and knowledge in how these systems work in tandem with each other, and how to more effectively program these devices for future projects. In addition, I learned more about product development and data management, for not only making a system like this to work, but to organize and display this data for different needs (total amount of tardies, tardies for each quarter, tardies during each period, and more). This experience will help me in future projects, and allow me to develop more advanced and useful devices that can eventually be turned into full scale products.

Overall this was both a fun, informative, and stressful project. However, I am happy that I was able to face what seemed to be impassable walls, and pivot my mindset and efforts to achieve success, and a working prototype.



PRESENT SOLUTION



Video

The A.T.P.S

Automated Tardy Pass System
Instructions

Jonathan W-C Maye

^Video^