Smart Mail Automated Center
S.M.A.C

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***Abstract* — The Smart Mail Automated Center (S.M.A.C) makes use of modern technology in order to solve a modern issue. The project includes a system for accepting deliveries in a secure box at a residence without the requirement of physically being there. The device is primarily made up of a lockbox with multiple unlocking options, and a mobile application. When the delivery is made, the delivery driver simply scans the item and places the item in the box, then closes the lid. The box will automatically lock itself and notify the homeowner that their package was delivered. At this point, the package receiver has peace of mind that when they can retrieve their package, it will be there waiting for them. Today most packages are just left in front of your door or within a delivery room within your apartment complex which has the risk of the package being stolen, damaged by a person, taken by the wrong person, and even by bad weather if you're in a state like Florida and storm hits. With our system we want to ensure such situations are prevent and allow for customers to never have to be present to receive a package in the event that they are not there to receive.**

I. Introduction

For our senior design project, we will be developing a smart delivery system named Smart Mail Automated Center otherwise known as S.M.A.C. We wanted to create such a device because within today modern-day world no one yet has truly develop a viable delivery system yet that is automated and allows for any tenant or home owner to receive a package in a safe manner. Today most packages are just left in front of your door or within a delivery room within your apartment complex which has the risk of the package being stolen, damaged by a person, taken by the wrong person, and even by bad weather if you're in a state like Florida and storm hits. With our system we want to ensure such situations are prevent and allow for customers to never have to be present to receive a package in the event that they are not there to receive. Most people have a normal job that they work 5 days out the week, leading to risks that can occur when they are not present at home. Within this report we will detail and outline exactly how we will design such a system to meet the requirements and criteria that will allow for such a system to be made. We will detail all the hardware and software requirement necessary.

The paper is divided mainly into two sections, mainly research and then the actual implementation of the design. The first half of the paper is where we did our research section. In the research section we outlined the project into sections. We outlined the first half of the paper into two sections Project Description and Research. Within the project Description we outline what exactly was the motivation of the project and as well the criteria and specifications to it. Then in the research section we dive deep into all the of the possible hardware components we could potentially use for implementation and the software side to our design. The second half of the paper is the dedicated to the formal implementation of the Smart Mail Automated Center. We divided the second half of the paper into these main sections, Hardware Design, Microcontroller, Software Design and the mobile application design. In these sections we go over software and hardware component choices but as well we detail exactly how we implement those choices we chose from our research such as software language choice, hardware component choice and schematic design.

II. Hardware Components

In this section, we investigate previous projects, available parts, and the different technologies available to meet the needs of our project. Significant research must be done so that when we build out the project many of the potential roadblocks will have already been seen and worked through. A large portion of the total time for this paper time was devoted to researching all aspects of this project.

A. Microcontroller

The ATmega2560 is both a high-performance and low-power microcontroller. Most UCF senior design projects we researched use some version of the ATmega, and for good reason. It is a multipurpose chip which has a good mix of low-level functions and libraries. The ATmega2560 is a RISC-based microcontroller with 86 general purpose I/O pins and 32 general purpose registers. The program memory size comes in at 256KB with 8KB of SRAM. The ATmega2560 may be programmed in Assembly, C, or C++. (Arduino, 2010). The ATMega2560 provides many digital communication peripherals. 4-UART, 5-SPI, and 1-I2C will allow us to connect many peripherals and sensors. On the chip there are 2 8-bit timers, and 4 16-bit timers. The default clock source is an internal RC oscillator at 8.0MHZ. This can be calibrated by the user, but for higher accuracy, a crystal oscillator may be connected.

B. UV Light

Ultraviolet (UV) light is a form of electromagnetic radiation which is shorter than visible light but longer than X-rays. UV radiation is mostly present on sunlight but can also be produced by electric arcs and specialized lights, such as mercury vapor lamps, tanning lamps, and black lights. UV does not have the power to be considered an ionizing radiation however, it can cause chemical reactions and cause many substances to fluoresce. Consequently, the chemical and biological effects are more than just simple heating effects and many of its uses derive from its interaction with organic molecules like germs and viruses. Short wave ultraviolet light damages DNA and sterilizes surfaces. Ultraviolet light scrambles and damages the nuclear material of germs and viruses causing their DNA to mutate and prevent them from reproducing properly. However, not all ultraviolet light kills germs. The electromagnetic spectrum of ultraviolet radiation (UVR), defined most broadly as 10–400 nanometers, can be subdivided into a number of ranges. Ultraviolet A or UVA is ultraviolet radiation in the wavelength of 400-315 nanometers. UVA is mostly emitted by black lights and is the sort of radiation not absorbed by the atmosphere. UVA is known as soft UV.

C. Power System

To talk about the power system, we must be able to talk about the design a little bit and its components. The power system is what is going to make all this possible and be able to bring all the components to work in unison. Each component has different voltage ratings specially for the microcontrollers and sensors which normally operate either under 5 V or 3.3 V. Aside from voltage disparities between sensors another issue is the current consumption. All components won't be able to be powered by just the Arduino as we would exceed the max rated current of 500 mA over USB power or 800mA over wall wart power. Sensors would require extra external power to be able to power all of them at the same time. Not having the correct current requirements or being too close to reaching the max current draw can impact sensors ability to work properly. All these power requirements must be compounded into a single power outlet cable and power everything in unison for ease of the user. All of our power will be supplied by a single feed of 120 V. The main power will have to be split into different voltage regulators like a wall wart to output more manageable voltages into our components. S.M.A.C essentially will need to connect in series 3 120V power sources to power its components. The first component to power is the UV light enclosure which has its own integrated power converter and regulator. However, between the 120V source and light a 5V relay module as switch and will be used to control it from the Arduino to turn it on and off with commands from it.

D. Wi-Fi Module

The ESP32 is a variant of the ESP8266 Wi-Fi module. The ESP 32 is a generational upgrade of its predecessor the ESP8266. The ESP8266 looks primitive compared to the feature set this little guy carries. The ESP32 has Wi-Fi and Bluetooth capabilities giving us an extra feature to play with. It earned the name of ESP32 due to its 32-bit architecture and clock speed of up to 160 MHz on a dual core processor allowing. This allows the device to pack more features and achieve a higher data transfer speed. This module can achieve 150 mbps in an 802.11 n (2.4 GHz) configuration. That is double the ESP8266. The fact that it already operates in a 5V range made it extremely easy to integrate in comparison with the ESP8266. Its price increase is minimal in comparison to the features it packs and the extremely useful pin multiplexing a commodity that the CC3200 had but for a luxury price. This module should give a look into the future with Bluetooth integration if we were to include in a future update or use it to enhance features. The ESP32 will easily integrate into our Arduino IDE and pair well with the ATMega2560.

E. NFC RFID Module

One of the options we could use for the NFC's hardware is the module named PN532 NFC RFID, with this module it is one of the most used ones and affordable. With the module it is created around the NXP PN532. With the NXP532 chip all the I/O pins exist on the module so it compact and small. When implementing the module Arduino provides open source libraries for the PN532 module. To get the module to work you just need an Arduino that can work with it. On the module the I2C and the HSU both share the same exact pins with the HSU mode being set on default mode. After you implement the HSU interface onto an Arduino. Now we can use the ISO1443A smart card as a form of an authentication method for the delivery man only allowing him to have access to that card. When the mailman waves the card over the NFC tag the box will open and only then will they be allowed to store the clients package within the box, so they feel assured it was a safe transaction.

F. Barcode Scanner

A barcode scanner will be used to scan the packages for a user. When a package has been scanned by the delivery driver, the box will open, which will allow the delivery driver to place the item inside. The overall goal for this design is to notify the user when there verified package had been scanned and delivered. Barcode scanners record and translate barcodes that have a striped image with alphanumeric digits underneath it. Scanners can read different types of barcodes that provide various types of properties and functionalities. The barcode scanner that we will be using, will send information to a database through a wireless connection. The digits that are below the striped patterns refer to a particular item. When a delivery driver scans the package, examining the numbers will pull up entry into a user's database. If the item or package is verified in a user's database, then the box will open for the driver to leave the package inside. There are various types of standardized tag scanners, a few scanners use lasers, while others use lights or cameras, to catch the standardized tag picture and transform it into an electronic code.

G. Fingerprint Sensor

A fingerprint sensor will act as one of secondary ways for the user to unlock the device if they do not have access to their smartphone. As a result, this is not intended to be a method of access for a delivery driver. Our main goal is to find a fingerprint sensor which is both secure and fast. The two products that we investigated were Adafruit 751 and Sparkfun SEN-1418. The Sparkfun SEN-14518 is a high-performance fingerprint module that can be woken up by a finger touching the metal frame of the sensor. The sensor includes a high performance, low power ARM Cortex M3 MCU.

H. Camera

A camera is a safety feature that would allow a user to receive a picture of the area around the S.M.A.C. The idea for the camera would be for a picture to be taken anytime the box is attempted to be opened. Our goal for this research is to find a balance between high resolution and low cost. The larger the pictures are, the more time and space required for transfers. The lower quality the picture is, the less useful they are to the user. In this section we will explore the Waveshare OV5640, The ArduCAM, and the OV7670. The ArduCAM is a 2MP general purpose SPI data camera which is compatible with Arduino. This device communicates with the microcontroller through both SPI and I2C. I2C for configuration settings, and SPI for data transfer. Since the ArduCAM communicates over SPI, we have the ability to connect multiple cameras to the same microcontroller. The device takes a maximum of 2 Megapixel image (1600 x 1200).

This camera uses an older image sensor (OV2640) as the previous camera researched (OV5640). The manufacturer of this chip is ArduCam. Some of the important features of this camera include single capture mode, multiple capture mode, JPEG compression, image sensor control, and low power mode. The ArduCAM has open source code libraries for the Arduino family which will make prototyping the camera seamless.

III. System Concept

The goal for our smart box is to provide the utmost security for a user's package. A user will be at ease to know that their packaging will be safe if they are not at home. Our smart box design will offer many features to inform users about the state or status of their package. It is effortless to make purchases online in today's society and have them delivered to your doorstep. On average, the waiting time for a package to be delivered is roughly two to four days. Unfortunately, there has been an increasing number of package theft cases from individuals who spy on the homeowner. (Security, 2019) The delivery of a package can be unpredictable as there can be cases of delays due to holidays or events. These events can sometimes be out of the control of a user. Because of this unpredictability, a residential user may not be home when their package gets delivered. This uncertain case makes a user vulnerable for a package thief to steal their package from their front door. The SMAC idea was created to safely and securely store a residential user's package from any thieves nearby. The SMAC protection system will allow a delivery driver to scan the barcode of a user's package, which will unlock the box, for the driver to place the item inside. Once the package is placed inside, it will keep the package secured and protected from any attackers. Additionally, after the package is secured in place, a notification will be sent to a user, letting them know that their package has been delivered.

A. Member Responsibilities

Each person has a key part which forms the foundation to our project. The group members and their responsibilities are given in the table below. We have colored coded each group members responsibilities for the project design. Our job is to partake in the venture, follow course, explore and plan careful work, fulfill time constraints, convey as essential, and meet all the necessities of the undertaking. We perceive the uncommon parts of other gathering individuals, and give them our help. We energetically take an interest in the gathering cycle and creation of substance. We should be positive, and add to (not bring down) the gathering capacity in general. In the event that contentions emerge, you work to determine the issue before it turns crazy. You are focused on the gathering cycle until the last undertaking has been finished. You comprehend your job and the parts of others inside the gathering and backing all gathering individuals

Group Member	Main Responsibility
Tyler Guerrero	Mobile Application
Andre Villaran	Housing and WIFI
Shane Bramble-Wade	PCB and Lock
Tyler Rothenberg	Microcontroller

Table 1: Group Members and Their Responsibilities

B. Block Diagram

Although each one of us is responsible for researching specific parts, we must all have a good understanding of the entire project so that when we build S.M.A.C. we may help each other out. The block diagram for the project is included below.

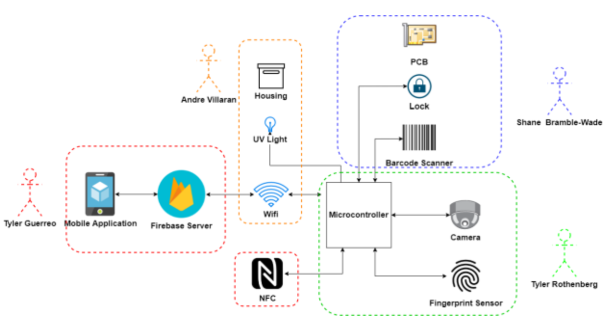

Figure 1: S.M.A.C. Block Diagram

C. Design Constraints

For all systems we require ardent design constraints to effectively execute the design we are trying implement for our project. For the paper the research for the constrains section will take into considerations all the possible constraints and possible dilemmas with the implementation and designs of the smart mail automated constraint. With our project we will try to carefully exam each possible constraint individually and examine them.

Once done when that we will then we will use the constraints on all aspects of our design. The constraints must be in the realm of reason so we can complete a proper analysis of all aspects of the design. As well when analyzing we must not forget to take into considerations when analyzing a constraint does this constraint affect any other constraints within the design and project.

IV. Hardware Design

This section will cover how the projects components come together. It will focus on physical hardware design and implementation. As we have already researched the main components S.M.A.C. will use now we will draw up a PCB and schematics to show how they will interact together to achieve their intended functions. This section will explore all the possible conflicts and options for a successful pairing and use of the components. The design methodology and topology are vital for a complete and robust design experience.

A. Housing Design

The first part we are covering is the false bottom which will house most of our equipment and wiring for the project. This section which will be made at the base of the box and will house our PCB, AC to DC transformer, and any excess wiring needed for our box to operate. This compartment will be about 1.5 inches in height so that our AC to DC transformer could fit comfortably. We decided to go with a false bottom instead of a boxed section or ward inside the box as it will disrupt the space where packages will be placed. The packages could also hit on this enclosure and maybe damage it which is why we thought this would be the most secure and safe environment for the most critical components of

S.M.A.C. On the corners of this false bottom there will be a small hole to be able to run cables to the components that will be in the outside of the box.

The components that will be exposed in the box will be placed in the top right corner of the box in the front panel. This section will include the fingerprint scanner, barcode scanner, camera module, and the latch sensor. I wanted to keep all components close to each other to have the least amount of wires going to multiple places of the box. The fingerprint sensor, barcode scanner, and camera module will all be arranged in a row starting at the top right corner of the box's front panel. Holes of the appropriate size will be made for each component to pear thru the box so it can interact with the outside world. The latch sensor will be attached to the front most part of the right panel instead of the front to reserve the front panel space for critical components that will be interacting with the outside world.

We now move to the last critical part of the box's design, the lid. The lid will open upwards and will be held by hinges that are attached to the inside of the back panel of the box. The lid will have two components attached to it. These components include the UV light and the solenoid lock. The wiring for this part will come from the false bottom just like it did for the front panel components through a small hole made at one of the corners of the false bottom. The wiring will ride through the back side of the box up to the lid through were the hingers are located to create the least stress possible on the cables. Towards the area closest to the hinges the UV light will be located. This area was chosen as it will not cause the bulb and its housing to be hit by incoming packages into the box maximizing its life span. The solenoid lock will be centered and position toward the front of the box where it will act just like a door latch mechanism. A small depression on the wood will be made to the box on the front panel to allow the lock to close and secure the box properly. This will all nicely fit into our design and will also allow for the box to serve as a bench and be inconspicuous to potential thieves. The top side of the lid can be equipped with a cushion for extra comfort and appearance.

Dimensions for the box were researched carefully and thoroughly to be able to fit most package sizes from most carriers. With amazon, USPS, UPS, and Fedex all having a plethora of custom box sizes we had to find a common ground for S.M.A.C. to be able to fit most common boxes and then some. Information was pooled from each carrier most common packages which include flat rate boxes of USPS, the express box from UPS, and the One Rate boxes from FedEx. For amazon we had to pool all the data from their different boxes and get the average dimensions for length, width, and height. After a tedious research we concluded that the following dimensions were the most representative of each of the major carriers. Table 2 shows the dimensions and volume of most common boxes in each carrier.

Carrier	**Length (in)**	**Width (in)**	**Height (in)**	**Volume (in^3)**
USPS	24-1/16”	12-1/4”	6”	1769
UPS	N/A	N/A	N/A	1728
FedEx	15-3/4"	14-1/8"	10-3/4"	2392
Amazon	23.45	12	7.65	2153
Largest dimensions	24-1/16”	14-1/8”	10-¾"	3696

Table 2: Overall Dimensions

Using the largest dimensions allows for the introduction of the largest most common boxes to fit inside S.M.A.C. comfortably. However, the dimensions of the box itself cannot be the exact as the box to be put in. There needs to be room for components and materials used for the box itself. After research of dimensions of the material used for the box and leaving some room for components adding about 4 inches to each dimension should create a box with enough space to fit either a couple of small boxes or the largest common size box comfortably with leaving space for components and box materials to fit. This creates the following dimensions for our box to be:

Name	**Length (in)**	**Width (in)**	**Height (in)**	**Volume (in^3)**
S.M.A.C	28”	18”	15"	7560

Table 3: Final Dimensions

Last part of the of the housing design was picking a material to make the box out of. The material used on the box will be crucial for the performance of its functions but more importantly for the security and longevity of the product. Wood was a clear winner in this choice. The malleability and aesthetic incorporation into the environment make it a perfect choice for this project. The material fits more in line with our design goals and vision for the product. We do not want S.M.A.C. to be an eyesore or disturb the peace of the environment it is in. Considering current events accessing certain machinery is harder than usual making malleability a huge design choice for the prototyping stage.

B. PCB Microcontroller

The microcontroller is the brains of the operation essentially. It will control all components in the project. The design choice essentially came down to which controller could support all our components and any potential for expansions that we may have in the future. The ATMega2560 fulfilled all the requirements we had for this project. This microcontroller also synergies with well with most of the components that were chosen for the project. many of the components we have selected have open source libraries which work with the ATmega2560. The ATmega2560 has 4-UART, 1-I2C, and 5-SPI peripherals. UART is our most important communication peripheral as we will have many devices which communicate with the microcontroller through UART. The custom PCB we designed included ports for each individual component connected to the microcontroller on its dedicated and correct voltage source as many modules have different voltage requirements and needed external power taking the guessing work out of the user.

C. WI-FI Module

Most microcontrollers do not include an integrated Wi-Fi module. This was no exception with the ATMega2560. It was critical that our peripherals had a way to communicate with the outside world. For this very reason is why the ESP32 was picked to be the bridge between our closed box and the outside world. It was imperative that the Wi-Fi module will implement the 802.11 standard protocols into our MCU allowing it to transmit and receive packets, gain access to networks, and process wireless signals. This is no small task for such a small chip. One could say this will be the most important part of the project's functionality. The ESP32 will have to run in tandem with the ATMega2560. They will communicate using UART. The only issue present is that the ATMega2560 and the ESP32 do not operate at the same voltage. The ATMega2560 operates at a 5V logic level and the ESP32 I/O pins operate at a 3.3V logic level. This will require the use of a logic level converter to be able to safely communicate between both boards. The ESP32 board will be responsible to connecting to the internet and in turn our mobile application. This connection will require a two-way street for the ATMega2560 and the ESP32 to communicate. Each will have to send commands to each other which is why we re quire UART. Using UART we can send serial commands over the TX and RX pins to be able to send data back and forth. This board can be powered with either 3.3V or 5V. This will allow us to run the ATMega2560 and the ESP32 on the same voltage rail.

D. Relay Modules

Two simple relay modules were added to the project for control of two peripherals. The UV light which disinfects packages and the solenoid lock are both "dumb" peripherals which have no smart features or directly communicate with the microcontroller. There was a need for the components to interact with the project and give them more functionality. The Relay works as a switch turning on and off the devices power. In this case the lock would unlock and the light would turn on giving the user total control of the box's peripherals.

The UV light will disinfect packages for extra protection for the user. In these trying time with COVID-19 being a real threat to users and with averages consumers moving towards a more online shopping world there needs to be steps to add extra protection down the delivery chain to increase safety and handling of packages. A UV light operating in the UVC range, which stands between 184-254nm wavelength range, breaks down viruses and other germs DNA in the vicinity creating a barrier between the shipping chain and the user.

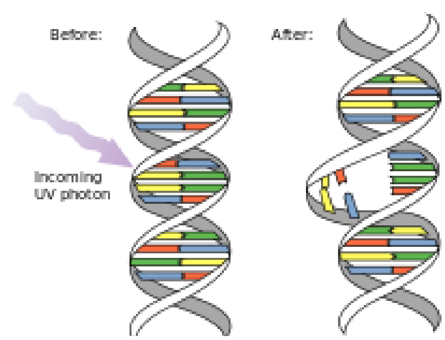

Figure 2 UVC Breaking Down DNA

The lock and its granular control from both the microcontroller and the app is imperative for security and ease of access to the components in the box. The solenoid lock that S.M.A.C is equipped with unlocks its bolt when 12V with a current of 650mA is put through its rail. The relay helps the microcontroller have dominance over the flow of electricity. When a fingerprint, RFID, or unlock request is confirmed the box must open. This is the cornerstone of the security integrity of the box. Having a "dumb" lock in this day and age would be a great disservice to the user and the projects functionality.

E. Barcode Scanner

The DYScan Barcode Scanner module can scan both 1D and 2D alphanumeric digits that appear on packages. We will be able to locate and match different package information against our database through image recognition. A supply voltage of 3.3V will be needed to function the barcode module. Additionally, the DYScan module has specific communication interfaces that we need to consider. Embedded within this module's infrastructure are the interfaces of UART and USB. Together as a group, we concluded that we would be using the UART connection to combine this module with our selected microcontroller.

The design of the DYScan module, contains a high brightness and dark environment setting which are used to scan packages during low lighting. Because of its mini size, this barcode module is widely used in wireless machines and self-service terminals. PIN 9 will have the VCC function attached to it. Whereas PIN 5 is used for the GND functionality. Lastly, this barcode module uses a CMOS scan type mechanism to read different barcode digits.

F. Fingerprint

Biometrics is an important security feature for S.M.A.C. given the consideration of the flaws other methods of authentication produce. The box needed a quick and secure way for the user to unlock the box without the need of a mobile device or access card. The answer laid in the tip of your finger. Fingerprints are almost unique to every human making it an almost unique signature in ones body that can be scanned and matched against a record. For this task the Sparkfun SEN-14518 was chosen for its all terrain design, price, and sensing capabilities. The chosen module also stored fingerprint records in its memory making it extra secure by keeping the authentication method away from the cloud. A design hurdle is that the fingerprint scanner cannot be directly connected to our project's main PCB. The reason is that the scanner will need to be placed in a custom location on the box. For this reason, we will integrate two Molex 4 x 1 headers within our PCB design so that we may make all connections from the scanner and the ATmega2560.

G. Camera

Essentially now a days most security devices contain a camera to record strange activity going on around the device. Its like having an eye everywhere essentially. Therefore a camera was a natural extension and addition to the security features incorporated into the project. The camera chosen was the ArduCAM 2MP OV2640. This little device was mainly chosen for its open source libraries and its dynamic resolution that is can achieve. While also only using 120mA on the 5V rail. The camera uses an SPI connection to interface with the microcontroller making it perfect for the project and able to transfer an image the size of 1600 by 1200 pixels. Its low profile allows it to meld with the box and its environment adding enhanced security.

The camera cannot be directly connected to our projects main PCB as it will need to be placed in a custom location on the box. For this reason, we will integrate one Molex 8 x 1 header within our PCB design so that we may wire the camera to the ATmega2560.

V. Software Design

This section will cover the software design choices and flow of information in the system. Understanding how each piece of hardware communicates with each other is vital to having a full understanding of the intricacies the system as a whole presents. It is a harmony of many moving parts and in contrast very different parts being able to talk the different languages and still understand each other. The design hierarchy stems from taking a look from the group up beginning with the microcontroller and ending in the highest level of code written, the mobile app.

A. Microcontroller software design

The ATmega2560 uses the Arduino Software (IDE) as suggested by Arduino. It is a compact software which allows users to write code and upload it to the device through USB. To assist in the development process, Arduino includes many libraries which make coding more straightforward. One of the other benefits is that the serial data being sent from the Arduino board is done directly within the IDE. This is a huge help when dealing with the UART protocol.

Once initialized, the microcontroller sits in a loop where it lives. The loop continuously checks to see if any peripherals have contacted the MCU. This is the most straight forward approach to checking for input, but it is unreliable and uses the most energy. Adding interrupts remedied the power consumption and allowed for precedence. When an important signal is detected, the processor immediately handles the task, then resumes the original task. This strategy allows precedence to be given to specific peripherals.

B. ESP32 (WI-FI Module)

The ESP32 module will be Configured with a Rest API. This Rest API will contain a series of functions which will read information from the database, listen for requests from the app and to update information on the database. When anything happens on the box the ESP32 should know.

The device will also need to listen and receive information from the ATMega2560. Once the ESP32 has checked the database for changes it essentially turns to the microcontroller. Using serial port commands the board checks for any information or update from the peripherals and distributes it to the correct HTTP function within its programming.

The ESP32 will never act alone to control any function or peripheral of the box. It is merely a carrier of information. Even without being the main actor the director of the show is equally as important for a successful performance.

C. Database

The database will be the main point of communication for the ESP32 and the mobile application used on the project. It will store status indicators for all peripheral including the door sensor, lock status, barcode information, and the ability to enroll new fingerprints to the scanner. Firebase was a natural home for this system as it gave the project great tools and versatile access to the project from multiple sources like the ESP32 through HTTP request and the mobile app.

Through "status" indicators the ESP32 will know whether a certain function of the box is being called to activate. Most peripheral status will remain in "IDLE" position when not in use. Once a peripheral is needed an arbitrary number or indicator will change the "IDLE" status and the ESP32 will realize that it needs to act and supply the information from the peripheral which status changed. Through those indicators the mobile app will also have an indication what is going on with the box and notify the user accordingly.

The database will also be the main location where information such as pictures from the camera or barcode information is stored. Once information is received from either the mobile app or ESP32 it is sorted and stored accordingly on the database. Items will be able to be deleted from the app as needed.

changes on the database, or initiate communications with the microcontroller. The ESP32 will essentially be the king of information as it will be constantly connecting with all aspects of the project.

The main library we use for the code is the HTTPrequests library. This library allows us to have an open communication through POST and GET commands to the database. That is essential to knowing if there are

D. Mobile Application

For this section of our paper we will dive into the actual design, format, layout of our application. We want for our app to have a great client-side experience for the user to feel secure with their package whenever it gets delivered, it should have ease of access with all the tools that will be available to them. As well it should have great performance for whenever the user uses the application for any action or events that happen. With it we want user the be able to register an account with the application, be able to securely login and use their password, be to unlock their smart box from their mobile application, view their pictures, see the tracking number, have account settings and see their delivery history.

VII. Conclusion

The main goal of S.M.A.C. is to create a system in which packages are more securely and safely delivered to customers. Package theft has been on the rise in the last few years posing a real threat to consumers trying to find a safer way to shop in the current state of the world. To do that we had to combine all knowledge learned throughout our undergraduate career and create a multilevel system combining software, hardware, and cloud services to cater to this ever-growing world. Hopefully, S.M.A.C. can help the end of package theft and COVID-19 though a safe and secure delivery system.

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Even through COVID-19 and all the challenges experience due to stay at home orders, online courses, and shear state of the world. I want to extend my admiration to all the groups involved in Senior Design this past 2 semesters that have made it work. Its an honor to have been part of this group of engineers.

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References

03, G. (2019, August). A Porch Package Protection System. Retrieved from BLACK BOX: http://www.eecs.ucf.edu/seniordesign/sp2019su2019/g03/index.html

08, G. (2019, May). Secure Outside Package Box. Retrieved from SOPBOX: http://www.eecs.ucf.edu/seniordesign/fa2018sp2019/g08/

ArduCAM. (2019, March 23). Quick Start Guide. Retrieved from ArduCAM: https://www.arducam.com/docs/spi-cameras-for-arduino/software/quick-start-guide/

Arduino. (2010, October 20). ATmega640/1280/1281/2560/2561 Datasheet. Retrieved from Microchip: http://ww1.microchip.com/downloads/en/DeviceDoc/ATmega640-1280-1281-2560-2561-Datasheet-DS40002211A.pdf

Arduino. (2012, January 13). Arduniogetstarted. Retrieved from Arduniogetstarted: https://arduinogetstarted.com/tutorials/arduino-door-sensor

Banggood. (2016). GM65 1D 2D Code Scanner BarCode Reader QR Code Reader Module. Retrieved from Banggood: https://www.banggood.com/GM65-1D-2D-Code-Scanner-BarCode-Reader-QR-Code-Reader-Module-p-1440532.html?cur_warehouse=CN

Circuits, P. (2019). What is a Printed Circuit Board (PCB)? Retrieved from Printed Circuits: https://www.printedcircuits.com/what-is-a-pcb/

Cricuit Basics. (2016, January). TURN ANY APPLIANCE INTO A SMART DEVICE WITH AN ARDUINO CONTROLLED POWER OUTLET. Retrieved from Cricuit basics: https://www.circuitbasics.com/build-an-arduino-controlled-power-outlet/

Espressif Systems. (2020, January). ESP32 Datasheet. Retrieved from Expressif: https://www.espressif.com/sites/default/files/documentation/0a-esp8266ex_datasheet_en.pdf

FedEx. (2020). Retrieved from FedEx: www.FedEx.com

Freeman, J. (2019, October 25). What is JSON? A better format for data exchange. Retrieved from Info World: https://www.infoworld.com/article/3222851/what-is-json-a-better-format-for-data-exchange.html

G2. (2015). Best PCB Design Software. Retrieved from g2: https://www.g2.com/categories/pcb-design

United States Postal Service. (2020). Retrieved from USPS: USPS.com

Waveshare. (2016, November 3). OV7670 Camera Board. Retrieved from Waveshare Wiki: https://www.waveshare.com/wiki/OV7670_Camera_Board

Waveshare. (2017). Waveshare- share awesome hardware. Retrieved from WAVESHARE: https://www.waveshare.com/barcode-scanner-module.htm

Waveshare. (2018, October 10). OV5640 Camera Board . Retrieved from Waveshare Wiki: https://www.waveshare.com/wiki/OV5640_Camera_Board_(C)

ZhianTec. (2008, September). ZFM user manual. Retrieved from Adafruit: https://cdn-shop.adafruit.com/datasheets/ZFM+user+manualV15.pdf

Freeman, J. (2019, October 25). What is JSON? A better format for data exchange. Retrieved from Info World: https://www.infoworld.com/article/3222851/what-is-json-a-better-format-for-data-exchange.html

G2. (2015). Best PCB Design Software. Retrieved from g2: https://www.g2.com/categories/pcb-design

Hall-Effect Sensor - US1881 (Latching). (2015, May 14). Retrieved from Spark Fun start something new: https://www.sparkfun.com/products/9312

Health, N. I. (2020, March 24). Study suggests new coronavirus may remain on surfaces for days. Retrieved from National Institutes of Health: https://www.nih.gov/news-