Mail Gobbler 9000 (MG9K)

Team 31: Brendan Truong, Adam Cytrynowski, Luan Vo, Jackie Chan; 16 November 2020
Individual Roles and Presentation Overview

**Brendan Truong**
Team Leader and Backend Developer

**Jackie Chan**
Budget Management and Front-end Developer

**Luan Vo**
Hardware and Circuit Designer

**Adam Cytrynowski**
Communication Specialist and Box/Website Designer
Mail Gobbler 9000 (MG9K)

- Smart drop-box for postal security
  - Barcode Authorization
- Quality of Life
  - Delivery notifications
  - Multiple unlocking mechanisms
  - Historic logs
- Power-efficient & low cost
Product Statement and Specifications
System Block Diagram

Power Supply System
- Charger
- 12V Rechargeable Battery
- 3.3V Regulator

Smart Mailbox Hardware
- WiFi Module (ESP-12F 03)
- Wake-Up Push Button
- LED Indicator
- Microcontroller
- Pressure Plate
- Solenoid
- Barcode Scanner

AWS
- AWS Identity and Access Management
- AWS DynamoDB
- AWS Lambda
- AWS IoT
- AWS Simple Notification Service
- Amazon Cognito

iOS Application
- Notifications
- Unlock Request
- Store Package Barcodes
- Table Views

User Interface

User
Hardware Functionality Block Diagram

UPDATED

Sleep Mode
1. uC always on
2. ESP on standby
3. Pressure Pad and Solenoid Latch off to reserve power.

LED indicator initially red, indicating sleep

On button pushed

2 min. timeout

Wake Up:
1. Power on sleeping systems.
2. ESP establish connections.
3. LED blinks white when ready.

If mail weight detected.

Mail Compartment
1. Measures change in pressure pad.
2. Sends to ESP to update in backend.

Forwards update

Mail Compartment

ESP
Establishes connection with AWS IoT core

Returns barcode query results

Returns unlock requests

 Package Dropoff Compartment
1. Sends barcode to ESP
2. If barcode query is valid, solenoid unlocks, or
3. If unlock request received, solenoid unlocks.

Hinge will cause lid to close eventually by its own weight

Forwards barcode info

AWS
Service used to handle our backend functionalities

Open with Key

Backdoor
User may open the both compartment via key and lock.
MDR Accomplishments Overview

1. Set up subsystem’s various hardware functionalities.
2. Program ESP for data reception and communication.
3. Develop AWS Backend for cloud computation and data storage.
4. Code Mobile Application for user interaction

Success in each subsystem allowed complete end to end communication, from ESP through the backend to the Mobile Application.
Brendan’s Subsystem (Backend AWS)

Detailed Responsibilities
1. In charge of communication between the team and faculty, monitoring the team’s progress, and keeping the team on track and productive.
2. In charge of developing system’s backend with AWS, and ensuring full end to end connection.

Subsystem entails the AWS backend functionality for the project, which encompasses services for data storage, manipulation and cloud computing. Main services are as follows:

1. **AWS IoT Core**
   Set up “Thing” in AWS with proper policies and rules for specific topics.

2. **AWS Lambda**
   Coded dynamic javaScript functions to communicate with IoT Core and manipulate tables.

3. **AWS DynamoDB**
   Created three essential tables to hold data. Includes barcodes, package logs, and mailing logs.

4. **AWS AppSynch**
   Designed and programmed a GraphQL API for queries and mutations.
Jackie’s Subsystem (Front End Application)

Detailed responsibilities:
1. Front-end developing of an application that allows the user to upload barcode, send unlock request, receive historic logs.
2. Ensuring team’s expenses do not exceed allocated budget and serving as liaison between the team and purchasing coordinators.

App Creation:
1. **xCode**
   IDE created by Apple for the development of iOS Apps.
2. **Google Drawing**
   Allows for the use of shapes to create charts and diagrams.
3. **Github**
   Hosting service that offers source code management.
Adam’s Responsibility (Hardware Communication)

Detailed responsibilities: In charge of ensuring the smooth communication between ESP and AWS IoT. Brainstorming mailbox’s mechanic for the actual production phase, and oversees the functionality of the mailbox, and scanner's physical interactions with its surroundings. Assists in website development

Demo Showcases:
1. MCR12 Barcode Scanner - Scanner Functionality
2. ESP to Backend Interaction - MQTT communication with AWS
Adam's Subsystem (Hardware Portion 2)
Adam’s Subsystem (Hardware Portion 2) contd.
Luan’s Subsystem (Hardware Mechanics and Behaviors)

**Detailed responsibilities:** Design circuit foundation and proposes hardware components that will be used to meet the required specifications listed by the team.

**My subsystems consist of the followings:**

1. Power button (push button) - Waking the system up from initial stage, during wake up mode, output HIGH voltage on all required pins.

2. **Force Sensing Resistor (mail compartment trigger)** - Detects incoming mail via a change in resistance of the pressure pad.

3. Switching Solenoid (package compartment locking mechanism) - lock the box during initial stage (off mode) and unlock the box once the box wakes up (on mode).

4. Dc/Dc converter - converting 12VDC into 3.3VDC
Luan’s Subsystem (Hardware Demo Push Button)
Luan’s Subsystem (Hardware demo FSR)
Luan’s Subsystem (Hardware demo Solenoid)
## Luan's Subsystem (Power Specification)

### Power Source

<table>
<thead>
<tr>
<th>Power Source</th>
<th>Voltage (V)</th>
<th>Current (Amp)</th>
<th>Power (Wh)</th>
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<td>Rechargeable Lithium Battery</td>
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<td>7.2</td>
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### Average Operational Power (continuously)

<table>
<thead>
<tr>
<th></th>
<th>Min Total Power (W)</th>
<th>Max Total Power (W)</th>
<th>Average Total Power (W)</th>
<th>Average Hours (Hours)</th>
<th>Days (Days)</th>
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</thead>
<tbody>
<tr>
<td>Min</td>
<td>7.73</td>
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<td>12.054417</td>
<td>7.167675575</td>
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<td>Max</td>
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<td>10.38</td>
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<tr>
<td>Average</td>
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<td>10.38</td>
<td>12.054417</td>
<td>7.167675575</td>
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<tr>
<td>Hours</td>
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### Average Idle State

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<th>Min Total Power (W)</th>
<th>Max Total Power (W)</th>
<th>Average Total Power (W)</th>
<th>Average Hours (Hours)</th>
<th>Days (Days)</th>
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<tr>
<td>Min</td>
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<td>0.039435</td>
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<td>Max</td>
<td>0.0027</td>
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<tr>
<td>Average</td>
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<td>0.01617</td>
<td>0.039435</td>
<td>2190.947120</td>
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<tr>
<td>Hours</td>
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### Principle: Hour = Battery Power (Wh) / Target Power Consumption (W)

<table>
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<tr>
<th>If Box operate for X amount</th>
<th>Times Box opened 1 month</th>
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<tr>
<td>Input Box operate hour (Hour)</td>
<td>0.1</td>
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<tr>
<td>Power consumed by Box in operation (Wh)</td>
<td>1.2054117</td>
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<td>Remaining hours (Hour)</td>
<td>2160.3000/6</td>
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<tr>
<td>Power consumed by idle state (Wh)</td>
<td>65.195883</td>
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<tr>
<td>Remaining Power Check (Wh)</td>
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<tr>
<td>Total Usable Hours</td>
<td>2160.3000/6</td>
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<tr>
<td>Days</td>
<td>90.020000/17</td>
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</table>

Since we define a wake up cycle will take 2 minutes, however, Solenoid will only be unlocked once.

For additional assumption, each package delivery will take 10 minutes.

Operation cycle (minutes) = 2

Operation cycle (hrs) = 0.0333333333

Let’s define the number of times that box opened = the number of times package goes in or out (or more simply, the number of usage).

Full spreadsheet: https://docs.google.com/spreadsheets/d/1X-PXSN7Y21ZjLVsWIBEaUqzN06b_FOBv/edit#gid=2117688693
Hardware/Software List

Current

Hardware Modules:
1. ESP8266
2. MCR12 Barcode Scanner
3. 12 - V Solenoid
4. ATMega328P
5. Pressure Plate

Front-End Modules
1. xCode
2. Google Drawing
3. Github

Backend Modules
1. AWS (Amazon Web Services)
   a. IoT Core
   b. Lambda
   c. AppSynch
   d. DynamoDB
   e. EC2
   f. Cognito

Future

Website Modules:
1. HTML and CSS
2. Github Pages

Hardware Modules:
1. Atmel Studio
2. PCB
3. Buck Converter
4. Wii Fit Board Sensor / Ultrasonic Sensor
Hardware Plans for FPR - 1 Hardware Components

- PCB
- Atmega328P
- Vocomo Lid Support Hinge
- MCR12 Barcode Reader/Scanner Module
- Solenoid Pull 1512
- ESP8266 Wifi Module
- Pressure Sensor Development Tool
- Tactile “Wake up” Switch
- 3.3V Buck Converter
- 12V 7.2Ah battery
Hardware Plans for FPR - 2 Design Schematic

We still have a lot of spare pins!

possibly using SPI instead
Hardware Plans for FPR - 3 DC/DC converter
### Project Expenditures

<table>
<thead>
<tr>
<th>Budget</th>
<th>Current Project Total Cost</th>
<th>Remaining Budget</th>
<th>Projected Future Total Cost</th>
<th>Remaining Budget</th>
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<tr>
<td>$500.00</td>
<td>$127.56</td>
<td>$372.44</td>
<td>$102.02</td>
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#### Necessary Parts

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<th>Parts</th>
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<th>Status</th>
<th>Costs</th>
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</thead>
<tbody>
<tr>
<td>Arduino Uno Rev3 SMD</td>
<td><a href="https://store.arduino.cc/usa-arduino-son">https://store.arduino.cc/usa-arduino-son</a></td>
<td>Owned</td>
<td>$36.17</td>
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<tr>
<td>Rechargeable Lithium Battery</td>
<td><a href="https://www.homedepot.com/p/MIGH">https://www.homedepot.com/p/MIGH</a></td>
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<td><a href="https://www.adafruit.com/product/120">https://www.adafruit.com/product/120</a></td>
<td>Bought</td>
<td>$4.50</td>
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<td>Battery Charger</td>
<td><a href="https://www.amazon.com/FeliusTech">https://www.amazon.com/FeliusTech</a></td>
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<td>Pressure Plate</td>
<td><a href="https://www.mouser.com/ProductDetail">https://www.mouser.com/ProductDetail</a></td>
<td>M5</td>
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<td>ESP8266</td>
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<td>3.3V Regulator</td>
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<td>Tactile Switch (Wake Up Button)</td>
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**Total Cost: $127.56**

#### Estimated Future Expenditures

<table>
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<th>Parts</th>
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<td>Friction Lid Support</td>
<td><a href="https://www.amazon.com/YOCOMO-">https://www.amazon.com/YOCOMO-</a></td>
<td>Need to Buy</td>
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<td>Corner Braces</td>
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<td>Drop box Material</td>
<td><a href="https://www.lowes.com/pd/Royal-Bulding-F">https://www.lowes.com/pd/Royal-Bulding-F</a></td>
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<td>Tools and Power Tools</td>
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**Total Cost: $102.02**
### Gantt Chart

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<tr>
<th>Task Name</th>
<th>Start Date</th>
<th>End Date</th>
<th>Team Member</th>
<th>February 5th</th>
<th>February 12th</th>
<th>February 19th</th>
<th>February 26th</th>
<th>March 5th</th>
<th>CDR March 12th</th>
<th>March 15th</th>
<th>March 26th</th>
<th>April 2nd</th>
<th>April 9th</th>
<th>April 16th</th>
<th>FPR April 23rd</th>
<th>Demo Day April 30th</th>
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<td>A.C.</td>
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<td>L.V.</td>
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<td>Wiring Arduino to breadboard</td>
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<td>Migrate Arduino code to breadboard</td>
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<td>March 5th</td>
<td>L.V. &amp; A.C.</td>
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<td>Integrate Working Circuitry to Box</td>
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<td>J.C. &amp; B.T.</td>
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<td>Gather Materials</td>
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<td>Construct Box</td>
<td>February 19th</td>
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<td>Construct Box with All Physical Interactions</td>
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</tbody>
</table>

**Initial Key:**
- B.T. Brendan Truong
- L.V. Luan Vo
- J.C. Jackie Chen
- A.C. Adam Cytrynowski
Thank You! and Questions?