

Hwa Chong Institution

Project Work

Category 3 Inventions Log Book

| |
|---|
| Title of Project: Project Security Flap |
| Group Name: Project Security Flap |
| Group Members: 1) Seah Yuheng (Leader) 2) Lee Yuan Zhe Anzac 3) Lim Xiang Joshua 4) Marcus Tan Yee Yong |

1. Problem Finding

At the start of the year, we identified 9 problems at the start of the year that were affecting large groups of society.

Some of the initial problems we identified included:

- Unattended parcels are being stolen from porches
- Dog flaps that are susceptible to burglars crawling through it
- Locked pet flaps do not allow pets to escape in the case of fire
- An umbrella that can collect and filter rainwater.

From there, we narrowed down to three problems by eliminating those that did not affect that many members of society. Then, we used a decision-making matrix to select our eventual problem based on the number of people who were affected by the problem, the effectiveness of the products which are already on the market and the feasibility.

The three problems that we considered:

- Dog flaps are susceptible to burglars crawling through it
- Unattended parcels are being stolen from porches
- Locked pet flaps do not allow pets to escape in the case of fire

| Considerations for Selection | Problems | | |
|------------------------------|--|---|--|
| | Dog flaps are susceptible to burglars crawling through them. | Unattended parcels are being stolen from porches. | Locked pet flaps do not allow pets to escape in the case of fire |
| Feasibility of solution | 4 | 4 | 3 |
| Severity of problem | 2 | 4 | 2 |
| Need for a new solution | 2 | 3 | 4 |
| Total Score | 8 | 11 | 9 |

We have decided to choose this problem to tackle: Many packages are being stolen because they are left unattended. Besides, because of Covid-19, many people have switched to online shopping due to the pandemic. Thus, our invention will be more beneficial due to the increasing numbers of people who need it. The solution we are looking at is also feasible (does not require too expensive materials) and there are not many existing solutions out in the market which can solve the issue at hand, allowing our product to have a greater impact on society.

The reason why we did not choose the first problem to solve is that very few people in Singapore have a dog flap due to the absence of a yard. Thus, if we decide to choose to invent something that will prevent burglars from entering a dog flap, it will not benefit many people in Singapore as not

many people have pet flaps. We also have a solution to combat the last problem. Nevertheless, the solution we thought of required too many advanced parts and it is not feasible to mass-produce it and make it affordable for citizens.

2. Define the Problem

2.1 Elaboration and explanation on identified problem

The problem we have identified is that many packages are being stolen because they are left unattended (when no one is at home and parcels are left at doorsteps). According to the [New York Times](#), an estimated 1.7 million packages are stolen every day worldwide.



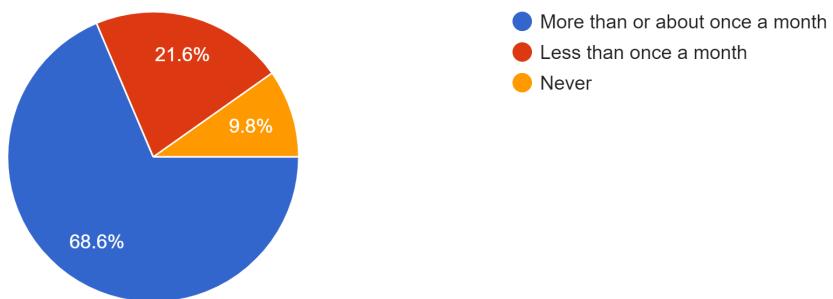
(Prevent Package Thefts (Foster City Police Department) — Nextdoor, 2021) ("Package Theft Free Shipping Concept Stock Photo (Edit Now) 1328051741", 2021)

Besides, COVID-19 has forced people to stay at home, people have switched to deliveries in order to continue their commercial shopping, exacerbating the issue as there are now more parcels to be targeted by "porch pirates". Many consumers are also unwilling to switch back to traditional physical shopping methods, even after the pandemic, due to convenience online shopping has to offer. With consumers not switching back to traditional physical shopping even after the pandemic, parcel thefts will remain high. Due to this, stolen parcels will remain as a long-term problem that we need to fix. [In Singapore, 37% of Singaporean consumers have switched to online shopping, and 76% of them have indicated they will not be changing back to pre-covid levels.](#) This clearly shows that the problem is even more relevant in our post-COVID-19 world, justifying a need to invent a product to prevent parcels thefts.

In a survey we conducted, out of 51 participants, 80.4% of respondents shopped online at least once a month and 72.5% of respondents had their parcel arrive while they were not at home, resulting in their parcels being left on their doorstep unattended. The above two statistics prove that this issue is pertinent in our day and age, with the sheer amount of unattended parcels, and requires our attention. In addition, most people specified in the survey conducted that they will definitely want a product that will ensure the safety of their parcels.

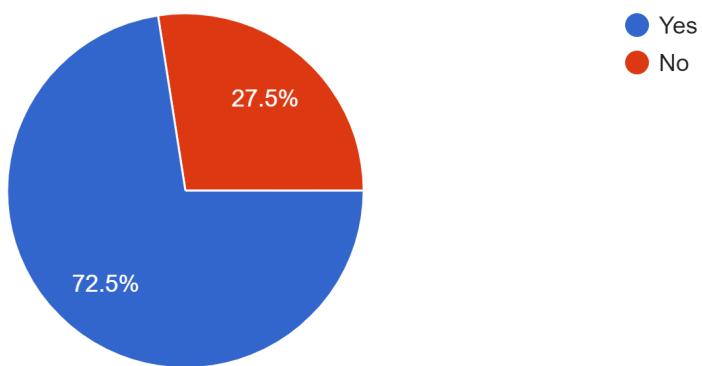
How often do you receive deliveries?

51 responses



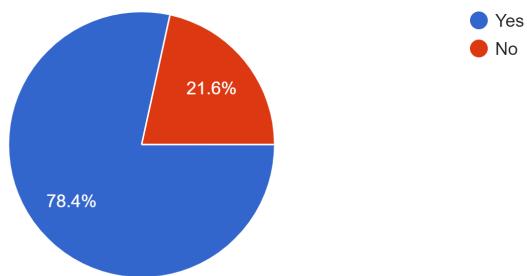
Have you ever had your parcel arrive while you were not at home?

51 responses



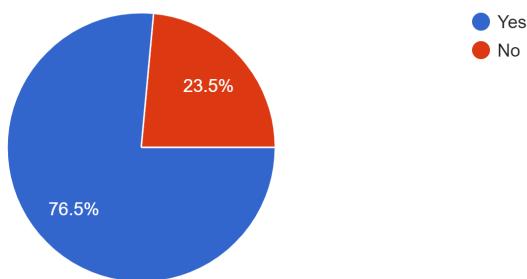
Would you like something to ensure that your parcels are safe from burglars who steal unattended parcels?

51 responses



Do you think parcel lockers are inconvenient?

51 responses



2.2 Analysis of current products in the market

A current solution is parcel lockers such as blu and locker alliance and Amazon Hub locker. It is a self-service pick-up kiosk where your deliveries will be placed. Deliveries are delivered to the respective lockers where customers can pick up their parcels. There will also be a unique password sent to the respective customers to ensure that no one can steal the parcels in the lockers. Many companies have adopted this method to tackle the problem of parcel theft. While there are many over the country, it is still inconvenient to have to leave the comforts of your home to collect your parcel. Hence, such parcel lockers defeat the purpose of online shopping, which is the convenience of products being delivered to your doorstep, making it ineffective solutions. To support this claim, we asked surveyees if they felt that parcel lockers were convenient. Majority of the respondents (76.5%) felt that these lockers were inconvenient and would not use them.



(Wong, 2021)

3. Our Idea

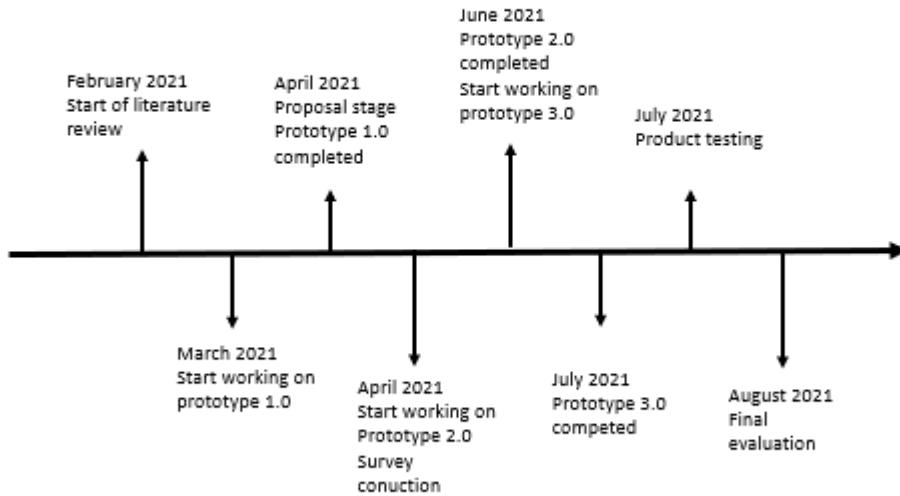
The cause of many of these cases is that the parcels are left unattended. More often than not, deliveries arrive when the recipient is not at home. Thus, delivery personnel will leave the parcels at the porch of houses. This results in the parcels being unsecured and unattended, making it vulnerable to burglars.

To prevent stolen parcels, we can ensure that the parcels are placed inside the locked house instead of leaving them lying around outside. Our solution is a flap in the door where delivery men can insert parcels through. The flap can only be unlocked and opened by the owner and authorized people (delivery men). It will close after the parcel has been inserted into the flap, ensuring that burglars cannot steal the parcel as it is now safely locked inside the house. The product will be marketed as an entire door, where young couples can purchase the entire set of doors and install it by themselves.

The purpose of our invention is to prevent people from stealing packages while maintaining the comforts of online shopping - that there is no need to step outside your house to obtain the items you need. Users will no longer have to face the dilemma - their deliveries being stolen or needing to go all the way to the closest hub locker to receive their goods.

A current solution (which is the only one we can find) is the Amazon Hub locker and parcel lockers such as blu and locker alliance, as mentioned earlier in section 2.2. This causes consumers to need to go out of their way to parcel lockers, just to collect their parcels. Our invention, however, can allow you to get your goods without having to step out of the comforts of your house and at the same time ensure its safety.

4. Our project Timeline



5. Construction Process

5.1.1 Materials used to build our invention (Hardware)

We have decided that the actual product (flap) will be made of reinforced steel. This is so that the flap will not be easily broken into as reinforced steel is incredibly strong and resistant to force, thus being able to prevent forced entries into the house. However, due to the shortage of reinforced steel, we will make use of corrugated boards to complete our prototype.

Besides, we will also be making use of the NodeMCU board from Arduino to control the system along with some servo motors. NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware, which is based on the ESP-12 module. The model we are using is the NodeMCU ESP-8266 microcontroller. It has 17 GPIO pins. The board can be powered through the USB port and runs on little electricity, making it ideal for users due to less power consumption and less needing to recharge it.



(Components 101, n.d.)

(Apoorve, 2015)

5.1.2 Materials used to build our invention (Software)

1. MIT App Inventor

MIT App Inventor is an online platform designed to teach computational thinking concepts through the development of mobile applications. Users create applications by dragging and dropping components into a design view and using a visual blocks language to program application behaviour. Using such interfaces, our group will create an application that allows us to interact with other software like Arduino and firebase.



(Lulcheva, 2017)



(Albritton, 2018)

2. Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. Users can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so users use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.



(VectorLogoZone, N.D.)

3. Firebase

The Firebase Realtime Database is a cloud-hosted NoSQL database that lets users store and sync data between their users in real time. Data is stored as JSON and synchronized in realtime to every connected client. When users build cross-platform apps with iOS, Android, and JavaScript SDKs, all of their clients share one Realtime Database instance and automatically receive updates with the newest data.



(Protalinski, 2020)

5.2.1 Prototype 1.0

We will be making use of Arduino, a coding language. The specific board we will be using to control the flap is the NodeMCU (Node MicroController Unit). Upon receiving a signal from the website we have programmed, the NodeMCU will unlock the flap by rotating the servo motor in the flap. After receiving the signal to close, the NodeMCU will lock the flap by rotating the servo motor back to its original position.

5.2.2 Flaws of prototype 1.0

Virtually anyone can access the website, allowing everyone to have full access over the flap, rendering the flap useless. Besides, it is inconvenient for delivery men to keep on typing in different website addresses into a browser as different customers have different website addresses.

5.3.1 Prototype 2.0

This version of the prototype is essentially the same as the previous version, just that the various websites will be accessed through an application we have programmed using MIT app inventor, allowing delivery men to access the unique websites through an app instead of keying in website addresses. Besides, only delivery personnel can download the app, preventing unwanted people from using the app.

5.3.2. Flaws of Prototype 2.0

It is very difficult to update the website addresses of new clients as that requires every single delivery personnel to update their app every time a new client registers or that a new deliverymen is hired. This is very cumbersome for large businesses which have millions of new users a day.

5.4.1 Prototype 3.0

The new version of the app allows a master account to change the usernames and passwords of the delivery men's account and the website addresses of the clients. This will save much hassle as everything can be changed from one device instead of having to change the data of every single application of every single personnel.

5.4.2 Flaws of Prototype 3.0

Water and bugs may enter the house through the flap. To combat this issue, we sealed the flap with rubber.

Video of final prototype.

7. Modification and Evaluation (product testing)

| Test Iteration: 3 | Tick | | | Remarks |
|--|------|------|---|---|
| Test Date: 1 August 2021 | Pass | Fail | Potential Failure | NIL |
| Can unwanted people access the app? (Pass-unwanted people cannot access the app) | ✓ | | Unwanted people gain access to the QR code. However, they will not have the passwords to even log-in to use the app. | Only delivery personnel can have the QR code to download the app. The QR code resets every hour. |
| Can the app work smoothly even with many people using the same app? (Pass-the app can support many multiple different users) | ✓ | | A major server disruption. To combat this, we set-up a backup database. So, in the event of one crashing, there is still a back-up to use | NIL |
| Can the flap be forced open? (Pass-the flap cannot be forced open) | | ✓ | NIL | To combat this issue, we use two servo motors to lock the door instead of one. After using two motors, the flap could not be forced open. |
| Is the app user-friendly and is easy to use with clear instructions on how to use? (Pass-family members who were approached could operate the app without prior training) | ✓ | | NIL | NIL |

References

- ElcoTeam. (2021). The Distributor of Professional Electronics just one click away. Retrieved 4 April 2021, from <https://www.elcoteam.com/index.php/azienda>
- Greenberg, K. (2017). Preventing package thefts. WMTV. Retrieved from <https://www.nbc15.com/content/news/Preventing-package-thefts-460516443.html?jwsource=cl>
- Koh, C. (2019). Locker Alliance all set to deliver. Infocomm Media Development Authority. Retrieved from <https://www.imda.gov.sg/news-and-events/impact-news/2019/02/Locker-Alliance-all-set-to-deliver>

- MIT App Inventor | Explore MIT App Inventor. (2021). Retrieved 4 April 2021, from <https://appinventor.mit.edu/>
- Nellis, S. (2019). Amazon launches new in-store pickup option with Rite Aid as first partner. Reuters. Retrieved from <https://www.reuters.com/article/us-amazon-com-rite-aid-idUSKCN1TS0RL>
- Neo, P. (2020). 'New and lasting habits': Singapore's online shopping surge will persist after COVID-19. FoodNavigator-Asia. Retrieved from <https://www.foodnavigator-asia.com/Article/2020/04/29/New-and-lasting-habits-Singapore-s-online-shopping-surge-will-persist-after-COVID-19>
- Package Robbery - Stock Illustration [73313827] - PIXTA. (2021). Retrieved 4 April 2021, from <https://www.pixtastock.com/illustration/73313827>
- Schoolov, K. (2020). With package theft at an all-time high, Amazon and others are fighting back. CNBC. Retrieved 4 April 2021, from <https://www.cnbc.com/2020/01/10/package-theft-how-amazon-google-others-are-fighting-porch-pirates.html>
- Tumblr. (2020). 5 Ways To Manage Remote Employees For Improving Work Engagement and Productivity:. Retrieved 4 April 2021, from <https://instantmonitoring.tumblr.com/post/617435512395923456/5-ways-to-manage-remote-employees-for-improving>
- Wright, M. (2021). A third of Americans will have a package STOLEN during the holidays. Retrieved 4 April 2021, from <https://www.dailymail.co.uk/news/article-7717685/Roughly-Americans-package-STOLEN-porch-pirates-holiday-season.html>
- NodeMCU ESP8266 Detailed Review Specifications, Overview and Setting Up Your NodeMCU. Retrieved 3 August 2021, from <https://www.make-it.ca/nodemcu-arduino/nodemcu-details-specifications/>
- Apoorve, A. (2015). What is a Servo Motor? - Understanding the basics of Servo Motor Working. Retrieved 3 August 2021, from <https://circuitdigest.com/article/servo-motor-working-and-basics>
- Hour of Code with MIT App Inventor. Retrieved 3 August 2021, from <http://appinventor.mit.edu/explore/hour-of-code>
- Protalinski, E. (2020). Google updates Firebase with new emulator and data analysis tools. Retrieved 3 August 2021, from <https://venturebeat.com/2020/10/27/google-updates-firebase-with-new-emulator-and-data-analysis-tools>
- Jay, G. (2019). GitHub - gupta jay/NTUOSS-ArduinoWorkshop: Workshop on Arduino Basics for NTU Open Source Society. Retrieved 3 August 2021, from <https://github.com/guptajay/NTUOSS-ArduinoWorkshop>