

IoT Base Parcel Drop Box

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ABSTRACT – The aim of the research is to solve the issue of receiving parcels at any time for working adults who have the same working time as delivery men. Questionnaire surveys were used to collect customers' voices, Quality Function Deployment (QFD) was to translate customer requirements to the technical specification and a prototype was designed and fabricated. The solution has adopted internet of things technology which detects and secures the received parcels in real time. At the end of the research, the product has been tested and evaluated in which the result indicates that it can help the working adult to collect and secure their parcel safely.

1. INTRODUCTION

Online shopping has become a very common method used to purchase items online in this world, including in Malaysia. When the Covid-19 pandemic started to invade the world, some products had a high impact on online shopping, such as medical face masks and hand sanitiser (Andrienko, 2020). Most people started to buy online because of the lockdown, which prevented people from going out every day like normal. When people started purchasing online, the frequency of parcel delivery also started to grow. A parcel drop box is introduced to help people collect the parcel when no one is around or when during the pandemic they prefer not to contact outsiders.

In the previous design, the parcel drop box does not contain or use an IoT system as a design idea. However, a new design IoT system will be implemented in the design with the name “IoT Base Parcel Drop Box”. The purpose of implementing the IoT system is to notify the user when there is a coming parcel. The notification will send to the user's phone through the “Blynk” apps that can be installed on the user's phone.

2. METHODOLOGY

The development of the IoT base parcel drop box started with identifying the customer needs. A questionnaire survey has been carried out and collected 60 responses. All of them have experience with online purchases and facing the problem of cannot receiving the parcel on time due to working not around. Next, the process continues with translating customer requirements to technical specifications. The method used was Quality Function Deployment (QFD). All of the requirements will be collected and proceed to concept generation. Pugh Concept Selection method

was applied to choose the best design from the two conceptual designs and finally, a prototype will be fabricated based on the design. After choosing the best design, the detailed design drawing has been constructed by using SolidWorks as shown in Figure 1.

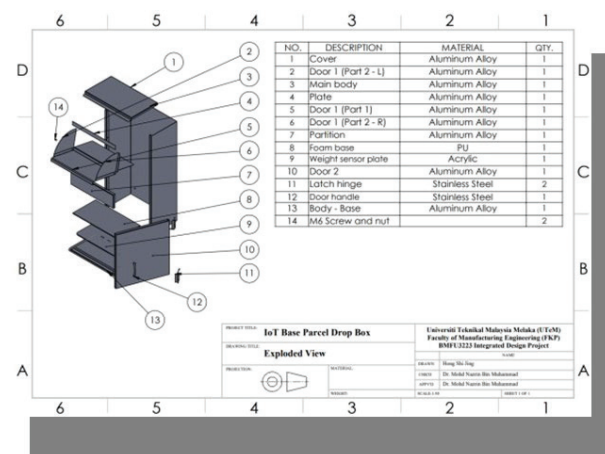


Figure 1 Exploded view of IoT base parcel drop box

Table 1 shows parcel drop box parts and electrical parts with the respective functions. Figure 2 shows the prototype for IoT base parcel drop box and Figure 3 describes the operation process of the IoT base parcel drop box.

Table 1 Function of parts for parcel drop box

No.	Part	Function
1.	Body	Receive and store parcels.
2.	First compartment door	To inserting the parcels
3.	Second compartment door	To store and safeguard the parcels
4.	Electronic door lock 12v/ Solenoid lock	To lock and unlock the second compartment door
5.	NodeMCU ESP32	Allow the system to connect Wi-Fi and Bluetooth functionality. All data from other electronic parts is send here before signaling to user smartphone
6.	Load cell sensor 10kg	Convert tension and compression forces into a corresponding electrical signal



Figure 2 Prototype of IoT base parcel drop box



Figure 3 IoT base parcel drop box operation process flow chart

3. RESULTS AND DISCUSSION

3.1 User Requirements

The survey result shows that 30 respondents (50%) experienced having nobody at home to receive the parcel on time and the others 30 respondent experienced parcel stealing problems, parcels missing due to human mistakes and product damage due to no timely delivered. Based on the problem above, 34 respondents (56.7%) agreed to have an IoT base parcel drop box to solve the problem. 8 features have been listed in the survey questionnaire as the design criteria to let the respondents choose. Table 2 below shows the result of the design criteria:

Table 2 Design criteria of IoT base parcel drop box

No.	Design Criteria	Requirements (%)
1.	Safety	90
2.	Large storage	75
3.	Privacy	68.3
4.	Weatherproof	61.7
5.	Durable	55
6.	Easy to install	41.7
7.	Foam base to soften drop	36.7
8.	Appearance	11.7

3.2 IoT System Development

Figure 4(a) shows the electric circuit for generating the IoT system for the parcel drop box. The purpose of implementing an IoT system is to detect the presence of the parcel to notify the user and also lock the second compartment door to secure the parcel. The notification will be sent to the user's phone through “Blynk” app which was an application that allows users to control the system remotely. Figure 4(b) shows the configuration of the system.

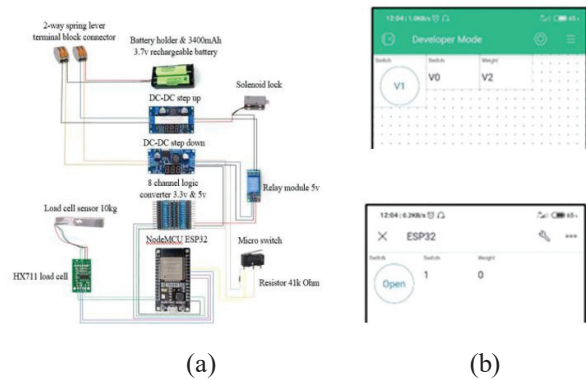


Figure 4 (a) Electric circuit for IoT system and (b) configuration for “Blynk” apps

3.3 Structure Analysis

Figure 2 illustrates the results of the structural analysis for the first compartment door associated with stress and strain as shown in Figure 5(a) and (b) respectively. The assumption force or maximum weight of parcel that can be place on the door is 49.05N which is equal to 5kg . By running the simulation, the maximum von Mises can support by the door is about $3.303 \times 10^8 \text{ N/m}^2$ and the yield strength is $4.136 \times 10^7 \text{ N/m}^2$.

$$\begin{aligned} \text{Force, } N &= \text{Weight} \times 9.81 \\ &= 49.05N \end{aligned} \tag{1}$$

Stress refers to the internal force, while strain refers to the physical effect on the object due to that force. The amount of the strain is about 1.405×10^{-6} .

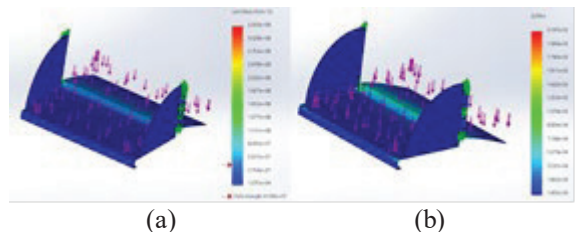


Figure 5 (a)Stress and (b) strain analysis for first compartment door

4. CONCLUSIONS

The prototype has been tested with “Blynk” app on phone and finally, the IoT parcel drop box gets to receive the parcel and send a notification to the user's phone after the load cell sensor is actuated by the parcel. Finally, the research objective has been achieved.

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