

# Development of Smart Mailbox - Internet of Things (SM-IoT) System

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**ABSTRACT** – The question of the entry of letters into the mailbox is a common issue in mailbox management, causing mailbox owners to have to commute frequently to the mailbox to check. The SM-IoT System emerged as a solution to develop an IoT-based product capable of detecting the presence of mail on mailboxes and providing notifications to mailbox owners through Android applications developed based on the Prototyping Model to achieve a usability level. It is envisaged that the proposed SM-IoT System would significantly contribute to the idea of sustainable use in mailbox management.

## 1. INTRODUCTION

Smart Mailbox-Internet of Things (SM-IoT) System is a product that is designed to detect letters in the mailbox, send notifications, and calculate the number of letters into the form of a calendar in the application. This product is a step in digitizing the mailbox into a smart mailbox with the adaptation of IoT and android applications in an intelligent way.

The IoT-Android Smart Mailbox system was developed using NodeMCU ESP8266 and HC-SR04 ultrasonic sensor. AAA batteries power is used as a source of energy, programmed with the Arduino IDE platform, assisted by a webcam with the ability to connect to Wi-Fi to ensure flexibility in platform use. It involves coordination with the user's Android phone, allowing users to be informed of the presence of mail in the mailbox without the user having to check the mailbox regularly. Refer to Figure 1 to see the design of the SM-IoT System.

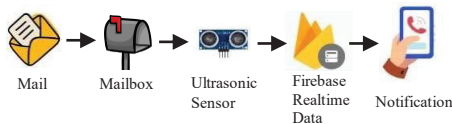


Figure 1 Design of SM-IoT System

Aiming to facilitate mailbox management, the main goal of SM-IoT System development is to ensure that the prototype reaches a sufficient level of usability for the development this prototype to continue to the actual product development phase. Theory in Software User Experience is applied to the physical development and interface of the prototype, with the formula Usability x Utility = Useful being the core to the development and evaluation of the SM-IoT System prototype [1][2].

## 2. METHODOLOGY

This section outlines the research process to accomplish the objectives of this research. The methodology chosen for this project is Prototyping Model - a software development model in which a prototype is built, tested, and reworked until an acceptable prototype is achieved; to produce the final system [3][4]. It is an iterative, trial and error method that takes place along the development process [5]. The SM-IoT System's block diagram showing the system's flow is shown in Figure 2.

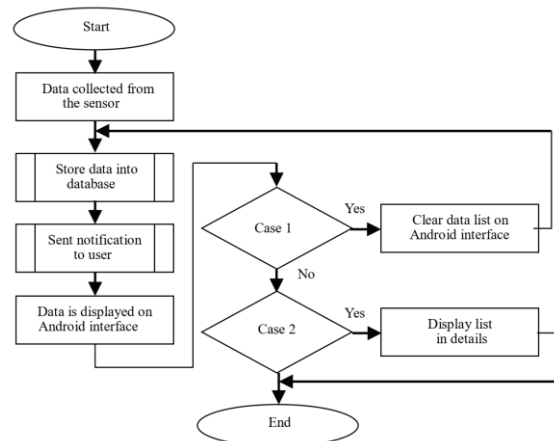


Figure 2 Block Diagram for the developed Prototype of the SM-IoT System

Figure 3 shows the U5 HCSR04 Ultrasonic Sensor used in developing the SM-IoT System prototype aimed at detecting mail received in the mailbox. Nodemcu V3 NMCU1 ESP 8266 is a microcontroller, a Wi-Fi module for communication between the mailbox and the user's Android device intended to notify when the sensor detects incoming mail. Figure 4 shows the physical model of the SM-IoT System that is ready to be installed.

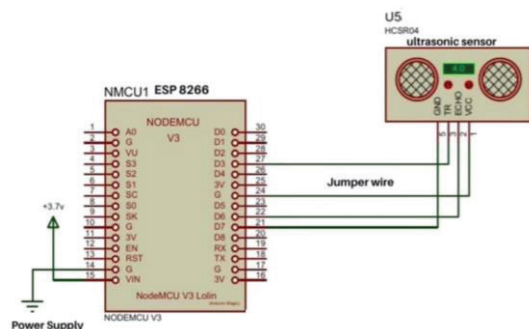


Figure 3 Physical design of SM-IoT System

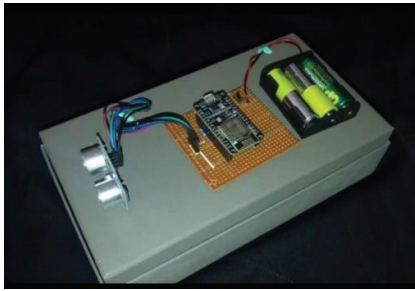


Figure 4 Physical model of SM-IoT System

### 3. RESULT AND DISCUSSION

To achieve the Usability and UX Value Equation (UX-ValuEQ) level in determining the Useful level for the developed product, Utility Test and Usability Test were conducted on SM-IoT System products. Utility Test is run in the form of a functionality test on a developed prototype on the functionality of three modules: Database, Notification, and Android application. The usability test is conducted on a selected group of users to get the final view of usage.

Figure 5 shows the detection of the letter in the mailbox, and the data is then entered into the Database. Notifications are then sent to the Android application, and this functionality is shown in Figure 6, showing the perfect integration between the three modules. Figure 5, Figure 6, and Figure 7 are part of the Utility Test.

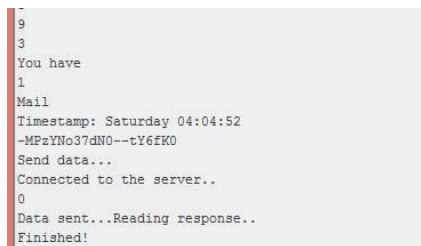


Figure 5 Ultrasonic response test

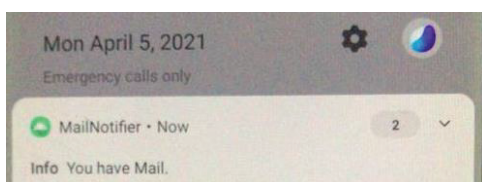


Figure 6 Notification test

Figure 7 shows the testing results of two SM-IoT System interface screens - (i) main screen displays notification of the number of letters received mailbox with two menu options Clear Mail and Details and (ii) screen when user selects Details to view mail list. The SM-IoT System usability test was delivered to 15 individuals around Melaka from three different types of accommodation-multi-story housing (A), terrace housing (B), and dormitories of higher learning and manufacturing institutions (C). This test shows an average acquisition of 80% of the usability value for all usability elements (effectiveness, efficiency, learnability, error prevention, and memorability). The evaluated user experience element (satisfaction, enjoyment, pleasure, fun, and value) also exceeded 90%

for all user experience parameters, allowing the conclusion that SM-IoT System is highly accepted and essential to assist users in mailbox management.

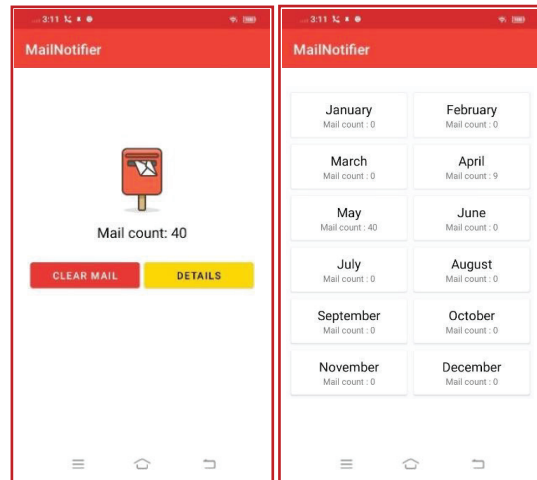


Figure 7 Interface of SM-IoT System

### 4. CONCLUSIONS

This research paper covers the SM-IoT system's analysis, development, and testing phases. The project will contribute to the mailbox management, with the intelligent ability that fulfills the functionality of life in the modern age of 'mobile' with features that help users manage their time efficiently. This project will be a benchmark for intelligent mailbox system. The next stage will be continued with the enhancement of sustainability elements to achieve the objectives outlined by the United Nations [6].

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