Web Based Smart Mailbox System

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Abstract

This paper is concerned with the issue of smart mail boxes that are used for shipment of courier items with or without the existence of person in the house. The main aim of this paper to build a web based Smart Mailbox System. This proposed system reduces the work of human in their absence. The vital part of the system is to receive the arrived courier in a safe and secured way such that no other person can open the mailbox without the required technology. The web based smart mailbox is implemented using the hardware developed. The software coding give commands to operate the developed hardware. A low cost environment is built using Raspberry pi. All the hardware part of the system ensures to have the appropriate components that satisfy required functions and the software part assures correct operations of hardware components.

Keywords: Smart mailbox; Raspberry PI; Hardware; NOOBS Software.

1. Introduction

   Alongside the progression of time, individuals become busier with regular issues because of their own particular reasons and responsibility; however some of them are not have the option to rest at all which lead them to stretch. As per the examination, stress frequently impacts center and consideration more than memory. Be that as it may, this can reduce men capacity to review new data. Indeed, the brain will be diverted with different concerns and musings afterwards neglect[1]—[5]. Therefore obviously an unfriendly effect on people and could have the results on different things. Because of carelessness propensity, men need be reminded at record-breaking and as a rule individuals need a great deal of pushing from the start yet ultimately gather sufficient speed that doing what necessities doing turns into a propensity not an exemption. The conventional technique house to house mail conveyance implied a ton of remaining around and looking out for the piece of the mailman, it shows the shortcomings conveyance organizations. Additionally, conventional letter drop presented to flighty climate design which could harm the sends and torn particularly in Malaysia the environment is tropical; it's blistering, muggy and blustery consistently. Precipitation is bountiful and successive; indeed it is hard to track down a region where it is lower than 2000 millimeters (79 inches) each year, or a month when it is lower than 100 mm (4 in). This situation has driven house to house mail conveyance reaching a conclusion. Also, conventional letter boxes were not planned with the present conveyances real factors. As online business has blast, more significant things conveyed to your entryway[6]-[10]. It very well may be irritating if sends, reports and etcetera to turn up missing or it were taken. Messengers lose time and cash on rehashed conveyance endeavors, merchants need to manage furious clients or supplanting taken property and need to adapt to more conveyance drivers out and about adding the traffic around the city. Concerning a few group, old school letter drops are fitting their necessities fine and dandy. Notwithstanding the issue expressed, it urge the advancement to complete an exploration to plan a post box or framework, named smart mail box. This letter drop is appropriate to those that have a bustling plan for getting work done that doesn't permit them to be home during conveyances, keep neglecting to beware of their post box and truly into high innovation things. Brilliant letter box is the new and the most recent innovation that have been included

from late occasions[11]-[15]. The utilization of letter enclose are to a great extent discover government post box, dispatch framework, and home letter confine framework social orders. Such letter box are use to post the letter. In this keen letter box framework it includes five gatherings: the administrator who has the most noteworthy power. The region director, pick-upper, administrator and client. The territory supervisor is given various zones. Pick-upper and administrator are under zone supervisor. Pick-upper is assume to get the letters from the letter box and administrator introduces the letter box on the equipment pack. The equipment pack incorporate deterrent sensor. Impediment sensors has IR transmitter and IR receiver.IR transmitter communicate the beams. At the point when the beams fall on to the item then it gets reflected to IR beneficiary, it results that the article is recognized. At that point the warning is ship off client utilizing web association on android application.

There are numerous advantages with a smart post box over a straightforward box. The greatest benefit is that it will save time for the buyers and help them track their conveyances. Also, it will enhance the result of the producer. For the turn of events and achievement of a business item, there are a few obstacles to surpass. The greatest test is to make an item that is both expense productive and strong. Also, it ought to be easy to introduce so a layman can introduce it without help from anyone else on the post box. Following are the other significant difficulties recorded in the advancement interaction of a shrewd letter drop. Significant distance correspondence isn't an issue if the gadget is furnished with sufficient force[16]-[20]. We can take as the model FM radios that can communicate voice over air to extremely significant distances. FM communicating stations as a rule have colossal recieving wires with power utilizations of thousands of Watts. The test is to adjust the force utilization and scope of the radio connection. Recieving wire plan and heading likewise influences the reach. In any case, in this undertaking, just those reception apparatuses were inspected here were viable with the chosen remote module. To make market progress, a shopper gadget should focus however many clients as could be allowed. This builds the business possibilities of the item and makes it monetarily reasonable. Distinctive letter drop producers have various plans for their post boxes which makes it harder for a solitary gadget to fit on all letter drop types. It is critical to discover arrangements that can work with all post boxes. Notwithstanding, there is one regular attribute of Finnish post boxes that every one of them are top stacking. This makes it simpler for the gadget maker to create arrangements that are chipping away at comparable standards.

People are accustomed to sending valuable documents in a secure and reliable way. This includes documents like deeds, contracts, bids, subpoenas, summons, etc. Regular mail has no security provisions and senders rely on the assumption of a correct and successful delivery. This is where Registered Mail and Certified Mail come into play. Registered mail is a useful vehicle in the postal world for secure mail delivery by providing extended tracking possibilities. The certified mail service provides the sender additional proofs of submission and receipt. Nowadays, more and more people are using electronic communication means. However, standard communication systems like Internet electronic mail (e-Mail) have a poor evidential quality[21]-25]. They can rather be compared to sending a postcard,which lacks confidentiality, authenticity, integrity and non-repudiation. Extensions like S/MIME (Secure Multipurpose Mail Extensions) or PGP (Pretty Good Privacy) enhance the e-Mail protocol with additional cryptographic functionalities like confidentiality, integrity and authenticity. Nevertheless, the shortcoming of a non-repudiable fair exchange still remains. The Internet community tried to address this issue by introducing the four receipting mechanisms of Message Disposition Notifications (MDN) specified by RFC 3798, Delivery Status Notifications (DSN) specified by RFC 3461, SMTP service extensions for message tracking specified by RFC 3885 and signed S/MIME receipts specified by RFC 2634. Due to the open nature of Internet e-Mail, all these extensions rely on the assumption of a fairly acting recipient. This means the recipient actually returns a receipt after having received the message. Due to this gap, the research community has provided many protocols for secure messaging over the last two decades. They have been published as fair non-repudiation protocols. The aim was to design security extensions for asynchronous communications providing similar added value as registered or certified mail do in the postal world. The terms certified mail systems (CMS) or certified electronic mailing (CEM) are used when applying such protocols in the context of electronic mailing systems, for example Internet e-Mail. CEM is a quite young research discipline starting in the early 1990s. Due to an increasing demand by governments, postal operators and the industry, various CMS have been put into operation over the last five years. Popular examples of governmental systems are the Italian Posta Elettronica Certificata (PEC), the Austrian Document Delivery System (DDS) for the public sector and the German De-Mail system. Particularly the justice sector relies on the secure and evidential document delivery and started to introduce such systems several years ago with the Austrian ERV (Elektronischer Rechtsverkehr) or the German EGVP (Elektronisches Gerichts- und Verwaltungspostfach) , which is based on the Online Services Computer Interface (OSCI) standard . In the private sector mainly postal operators, which are continuously shifting their postal services into the electronic world, have identified a gap in the market and provide certified electronic mailing as value-added service. The Belgian CertiPost, the German E-Postbrief, the Swiss IncaMail or the Slovenian Secure Mailbox6 are popular representatives of European postal operator CMS. CMS are also largely deployed within enterprises,mainly for

certified communications with external entities. These systems are mostly based on commercial off-the-shelf products. All mentioned CMS are closed systems and thus only accessible by certain user groups. In order to address a particular recipient, senders have to be registered in the same system. It is currently not possible to send certified mailings from one system to another one. Especially businesses, which operate in multiple countries and take part in competitive tendering procedures or communicate with foreign public agencies, are forced to register accounts with multiple CMS. Like accustomed to e-Mail, users may want to have one mailbox and not to be faced with additional costs or getting familiar with new systems serving the same purpose. As being normal for e-Mail communications, there is a strong need for global certified electronic mailing. This issue has become more important with the expansion of the European Economic Area (EEA) and the creation of a European Digital Single Market aiming at increasing the growth potential within the European Union (EU) by removing legal and administrative barriers for businesses when they want to provide services abroad. A major objective in this context is to establish interoperability across different EU Member States, so that citizens and businesses can use domestic infrastructures abroad. This also includes CMS infrastructures[26]-[28].

Most of the postal delivery is done by cycle, bike. More amount of physical effort is taken by the courier man to deliver the post. This method of delivery may lead to more accidents during the travel for a long distance in bike. The increasing technology that helped the online business and couriers raised the demand of smart delivery techniques. These resulted in number of tracking systems that track our courier right from packaging to delivery through mobile applications [21]. But once the courier is arrived at the door step it requires human concern to safeguard the courier. At present, the postal services are facing a severe issue where there is no person in the house and the delivery boy needs a confirmation from the recipients so the courier remains back at the delivery point[22][23]. In this text there are many solution proposed to increase the efficiency of the delivery system. The main aim of these papers are to notify the house owner about the presence of the mails in the box using IR sensor and IOT that are a contribution to home automation. The number of packages sent daily is increasing due to the increase of population. The postal is not delivered by the post man if any person not available at home. In order to improve the present system, there are some international organizations made this as one of the main discussion topic. Some of the international organizations are doing research to develop new innovative method to deliver couriers.

2. System Structure

Smart mail box system is continually developing in the area of the delivery systems. Smart mail box is finding applications and are implemented in many countries. There are new modifications, improvements and developments made in the mail box system. There were many innovative features that were added to the smart mail box recently. The electronic mail box system is implemented with keypad and alarm system. The research on this method is carried out with an aim to reduce the human effort in many different ways. The web based smart mail box here is to deliver the courier with or without the presence of a person in the house. It consists of the following main components. Radio Frequency Identification (RFID) is the main technology used as a lock and a code that should match with the unique number fed though keypad on the mailbox. RFID scanner on the mailbox will scan the RFID tag. Raspberry Pi as the microcontroller that consists of the software where the mailbox opens only if the scanned code matches with the fed code into the microcontroller. LCD on the mailbox to show the error message if the code does not match that result to be not the correct address of the courier. Micro SD card is used to store the information in the cloud and transfer to company website.

Table 1. Comparision between existing and proposed system

Feature	Existing System	Proposed System
Shipment	Mails	Mails and Couriers
Locking	Keys	Automatic
Notification of mails	No	Through message and also notifies to company website
Presence of human	Required for courier	No
Threats or Thefts	Highly possible	Highly resisted

The website consists of the delivery status and once the status is attained the numbers respective to the order are sent a delivery message. Substituting the old method of mail boxes with the assured, connected and open

plat form will definitely raise the standard of innovation regarding delivery services. The RFID based smart mailbox system will give a secured and reduces the human effort either it can be recipient or the delivery boy. While still many delivery companies require the signature of the recipient for the delivery status and that requires the human presence in the house.

3. Scrutiny of ongoing systems

There are different modern solutions in the market that give solution for smart mail box systems. They are Gate, Ucella, Receva and other modern systems as a contribution to mailbox systems[25]-[27].

Fig.1 Gate

Fig.2 Ucella

Fig.3 Receva

The existing system consists of features like a)Gate as shown in fig.1 does not consist any mobile application but the other systems like Ucella as shown in fig.2 and Receva as shown in fig.3 [28] have this feature. b)All the systems run on battery. c) Gate has a higher possibility of damaging the couriers and theft while the others have good security. This requires a common simple method to check the presence of mail in the mailbox. Another aspect of these systems is to give an alert message to the house owner. But the proposed system does not require the recipient confirmation and gives a message directly to the recipient when the website gets uploaded. The website gets automatically uploaded when the courier is paced inside the mailbox.

4. Proposed System

Every courier company gives a tracking system from where we can attain a RFID code that can be fed to the microcontroller using the keypad on the system. The software embedded in the microcontroller that is the Raspberry Pi is used to check if the code that is obtained by scanning the RFID tag[9] matched with the unique numbers fed then the dc motor gets activated and the mail box gate opens. Once the mail or courier is kept inside the mailbox the raspberry pi consists of micro SD card where the information is obtained and fed to the cloud server. This information is further processed and uploaded in the website. The numbers present in the

website are automatically sent the received status. If the code does not match the unique digits fed then an error message is displayed on LCD screen.

5. Methodology

In this methodology, it is necessary to assure that the mail box is closed unless until the code fed matches and the presence of the courier is uploaded in the website and the message is sent to the recipient. The design of the system is done using the NOOBS software and is integrated in Raspberry Pi [10]. There are many theoretical and practical methods of implementation of mailbox system in the present delivery system by the researchers. The normal method of delivering the collecting the post, moving it to the required place and then delivering it to the correct address is very tedious process. Sometimes it is delivered in a wrong address also which produces a lot of confusions. This require a lot of human work without any logical thinking. In order to provide simple method for this huge work, smart mail box system was implemented. This can be implemented using a simple hardware part operating using the control of programmes.

6. Hardware Implementation

This segment is loyal implementation plan of smart mailbox which is used to receive letters and packages. Our foremost aim of this implementation is to suggest a cheap result that is upgraded further. The key part of the application is the prototype development convenient to the customers. All the functions of the mailbox system is controlled using the programmes developed for this purpose. Once the system is developed it is necessary to verify its functions of the prototype developed by conducting some sample delivery. The recognition of the qualities and the characteristics of the proposed developed system has to be analyzed. The features of the system are:

- To identify the presence of the mails and couriers.
- To identify from which company the courier has arrived.
- To crosscheck if the courier belongs to the particular house or not.
- To permit only the person belonging to the house.
- To ensure communication between Raspberry Pi and cloud.
- To display error message if the courier does not belong to the house
- To update the status in the website

The characteristics of the proposed system is based on the mistakes already happened with the human error. This will ensure that the courier is delivered with less effort and to correct address.

6.1 Block diagram

The general block diagram of the web based mail box is shown in fig.4. To provide smart functions we decided to choose Raspberry pi as the basic component. Raspberry pi is used to do some logical operations easily by connecting it to keyboard. Raspberry pi is used to do some logical operations easily by connecting it to keyboard. It has central processing unit and memory unit to store the data. The hardware components used for the proposed web based system is shown in fig.5. The overall system circuit diagram is shown in fig.6.
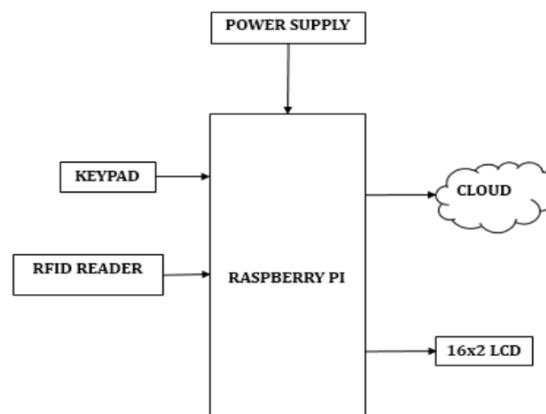

Fig.4 General Block Diagram

6.2 Hardware Description

Fig.5 Hardware components of web based Smart Mailbox System
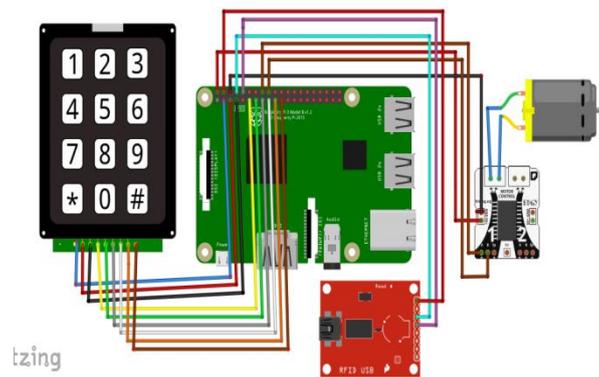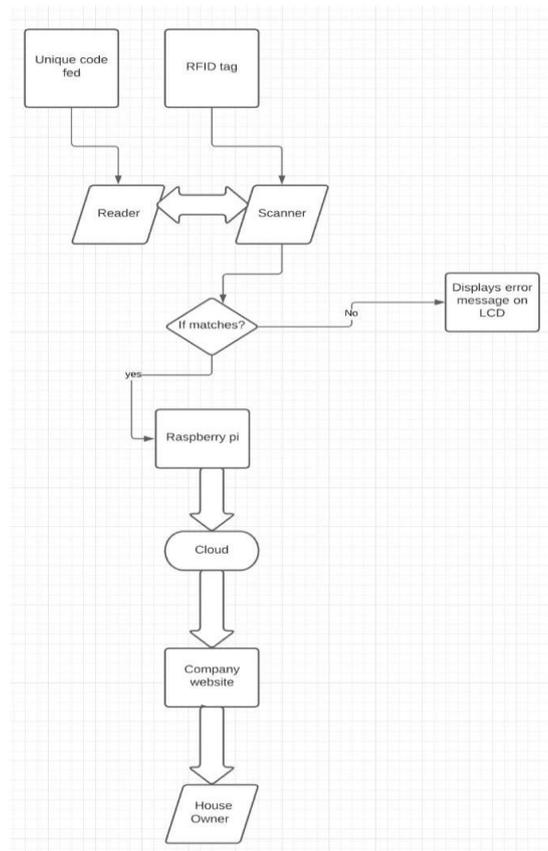

Fig.6 overall Circuit Diagram

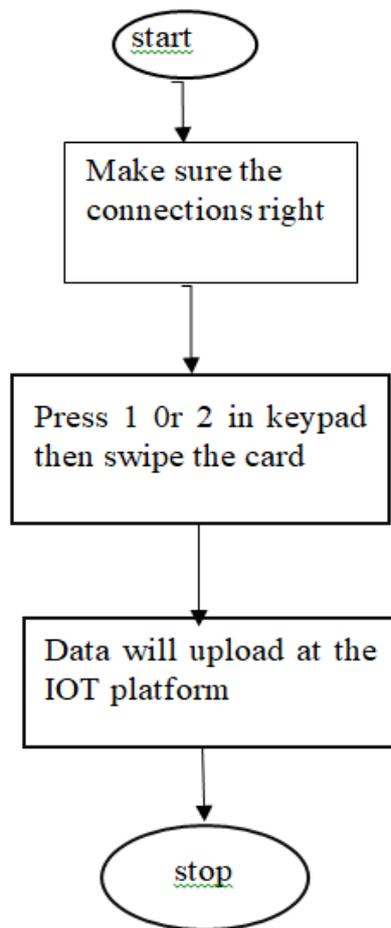Hardware compnents of web based Smart Mailbox System

6.3 Software Design

Fig.7 Process of Web based Smart Mailbox System

The various process taking place in the proposed web based smart mailbox is shown in fig.7. The operating system of Raspberry pi is connected with stable digital cards. Linux ARM is one of the operating used in Raspberry pi. Python language can be used to programme in the Raspberry pi. Ethernet adapter can be connected in the USB port. The speed of the processor is chosen between 700MHz and 1.4GHz. LCD is used to display a "received" or "error message". The main component is RFID tag. The tag is detected using electromagnetic field. RFID is used to identify the item using the transmitter and receiver. Radio signals are used to for identification. The reader emits radio signals which are identified by the tag. The coding in the smart mail box is done using Raspberry pi. The NOOBS software is used in the microcontroller. Using the software the program is written such that only if the unique numbers fed to the microcontroller matches with code scanned on the RFID tag then the DC motor gets activated and the gate gets opened. The data is further stored in a cloud server. The data is converted into information which is required for further processing is stored in the website.

6.3.1 Raspberry Pi program

```
        ┌─────────┐
        │  start  │
        └─────────┘
             │
             ▼
   ┌──────────────────────┐
   │ Make sure the        │
   │ connections right    │
   └──────────────────────┘
             │
             ▼
   ┌──────────────────────┐
   │ Press 1 0r 2 in keypad│
   │ then swipe the card  │
   └──────────────────────┘
             │
             ▼
   ┌──────────────────────┐
   │ Data will upload at the│
   │ IOT platform         │
   └──────────────────────┘
             │
             ▼
        ┌─────────┐
        │  stop   │
        └─────────┘
```

Fig.8 Flow chart for process

The flow chart for the process is shown in fig.8. The coding required for the operation of the smart mail box are written in the Raspberry pi. The flow of the program is to deliver the things to the mailbox using the unique code. If the unique digit code fed to the microcontroller matches with the code that is obtained by scanning the RFID tag on the courier then the mailbox opens. Else it would display "Wrong mail" on the LCD screen.

6.3.2 Data Storage

A micro SD card is a hard drive that is integrated with Raspberry pi and usedto store analyzed information. SD cards are largely classified based on the size and the capacity of the memory storage. The Raspberry Pi in easy cases uses standard micro SD card size that is B + 51 2 version. The micro SD card is supported by both Raspberry Pi 2 and 3.The electronic goods that required a hardware tool that helps in storing information is the SD card. The data of the received status of the couriers is stored in the micro SD card attached to the Raspberry Pi. The data is stored in cloud server that is further uploaded in the web page.

7. Results and Discussion

An IoT connected smart mailbox system is proposed, developed, and tested. The hub in the proposed system connects with the home Wi-Fi and can send a notification to the user's smart phone to any place in the world in real-time when mail arrives. Here the mailbox status can also be viewed from a web browser from any place of the world. The keypad and the SD Card used for the mailbox operation is shown in fig. 9.

Fig.9 Keypad and micro SD card

The mailbox used for the implementation of the system is shown in fig.10 along with the keypad placed at the front of the box to enter the code. The control circuit used for the operation of the mail box is shown in fig.11. The overall circuit of the proposed mailbox along with the motor to open the circuit is shown in fig.12. The web page developed for the display of the required parameters is shown in fig.13.
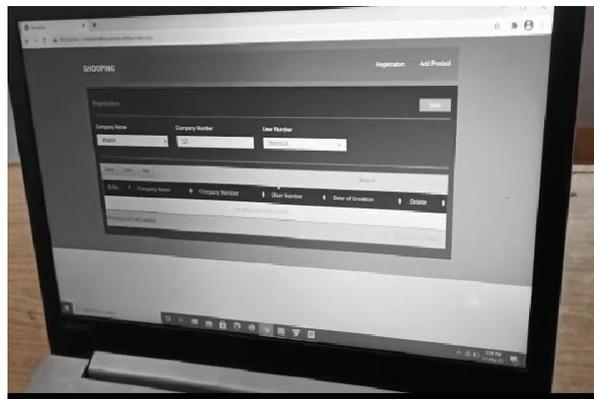

Fig.10 Mail box

Fig.11 Control circuit
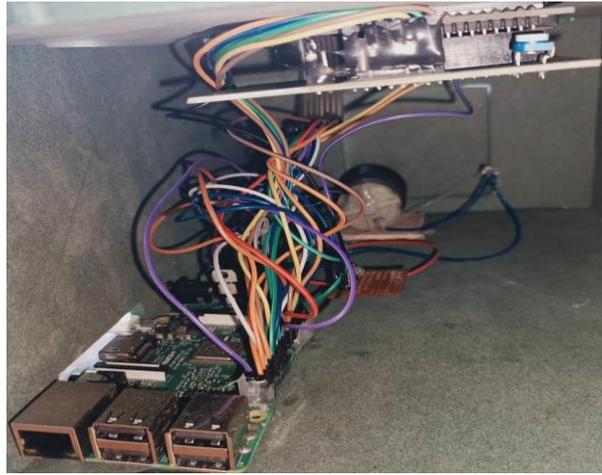
Fig.12 Overall Hardware

Fig.13 web page

8. Conclusion

Now-a-days, the contribution towards the society by the young minds like engineers keeps increasing with technologies and implementation of technology in many different ways. In this system we have studied a web based smart mailbox system that reduces the human effort and increases the efficiency of the delivery system. It gives an added human effort to check the mailbox every day for the courier therefore we proposed this system where the system notifies the user by sending information of the letter arrival. Even if there is no person in the house the courier is received in a safe and secured way. We tried to develop a minimized cost model of smart mailbox that would helpful to deliver important mails and parcels. The results bring a feasibility to know about the courier that is delivered from which company. This theory of web based smart mailbox system might have a huge benefits and few setbacks .But from the efficiency point of view the system has a greater possibility of development and influence among customers. The courier department views and estimates that the web based smart mailbox might bring drastic changes in the development of mailbox systems, for instance reducing the work of postal couriers, increasing the efficiency the collecting the feedback from the customers, accumulating of data in one place it can be a prime step for fore most analysis which would be aimed to increase efficiency of shipment of courier.

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