MAILBOX DETECTOR

An Undergraduate Research Scholars Thesis

by

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ABSTRACT

Mailbox Detector

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Many rural and transient communities rely on central mailbox services for their mail delivery. The location of the facility may present difficulty to patrons in checking their mailboxes regularly, and otherwise also result in a 'wasted trip when there is no mail. This project builds a mailbox sensor which communicates to the owner of the mailbox when mail arrives. We reviewed the different patents and products that currently exist and found several problems with them such as being large in size, and with limited capabilities like lacking long distance communication. Our proposed solution to this problem is to design a compact device that can detect the presence of mail, communicate over long distances with the user and alert the user when the mailbox is tampered with by text or email. In addition, we give the option of using an app to receive the information faster and more conveniently. The app would give the option of live information, and other miscellaneous information such as how full the mailbox is and whether or not you have packages. The device will make use of a photo resistive or weight sensor, a microcontroller unit to process the information from the sensor and wirelessly communicate to a central server that will then alert the user through either email or text. This device will demand compaction and long-distance wireless communication in order to be viable.

ACKNOWLEDGEMENTS

KEY WORDS

MCU   Microcontroller

RF   Radio Frequency

INTRODUCTION

Many people live in rural areas whose mailboxes are located far away requiring a large time commitment to check it, and often times in vain. Additionally, the contents in the mailboxes could be stolen without immediate alarm leading to consequences such as identity theft [4]. Our goal is to make it easier by connecting the mailbox service to their mobile devices. In an increasingly connected world, we are bringing these two together to provide convenience to people. A full overview of our system in the form of a block diagram can be seen in the appendix.

Subcomponent Outline

The objective is to design a compact device that fits in the mailbox without interfering with its main utility. The proposed device will consist of sensors for detection of the contents placed in the mailbox as well as a microcontroller for processing the data received from the sensors.

Data Center

This well-secured server shall contain the more sensitive data about the user such as their address and phone number. Once a signal is received from the mailbox device, it will notify the user at a frequency determined by the user.

Hardware

This section contains various sensors for accurate detection of change in mailbox status. The sensors utilized in this device include load cell along with load cell amplifier, light sensor, and camera module for bar code detection. All the data or information collected by sensors will be sent and processed in the MCU. The final output from MCU shall contain information on

sender of the package, potential contents in the package, the door status of the mailbox and

potential theft alarm. The data center receives these data through WiFi.

CHAPTER I

BACKGROUND STUDY

We studied the patents of similar mailbox products. We discovered some ideas that could adopted into our solution, and improve on their shortcomings.

Mailbox Status System and Method (US20030134620)

This patent introduces key ideas in terms of having a device that communicates with the user's personal device. When the mailbox is opened it informs the user by sending a notification in the form of a text message. However, one major drawback of this patent is that it doesn't specify details about the specific methods of communication with the device and the phone. It also only notifies if the mailbox is opened, not if any mail has been placed inside [1]. It also does not convey any information about the mail.

Electronic Mailbox System (US20130147626 A1)

This patent introduces a mailbox device that notifies the user about the presence of an object (mail or otherwise) with the use of an LED device on the mailbox. However, a limitation with this idea is that it would only work if the mailbox is within sight; if it was further away and out of sight then it won't prove to be of much utility [2].

System and Method for Remote Mail Delivery Notification (US8643511)

This patent discusses the use of a RF tag scanner, which notifies the user when the mailperson places mail in their mailbox. While it does give good ideas on how to communicate between two devices, its application is limited, as it isn't designed to communicate over long distances [5].

CHAPTER II

MAILBOX DEVICE

Our proposed device shall consist of multiple sensors with multiple tasks. One of the sensors would detect whether or not the mailbox is open. The light sensor is capable of translating different light intensity value into corresponding voltage output. By using analog to digit converter, the microcontroller will be able to decide whether the door is open or closed. In addition to that, another detector sees if there is mail in present in the box. The first detector, constructed from light sensors, detects whenever a large amount of light enters the mailbox notifying the device that the mailbox is open. Another detector, a load cell weight cell sensor, detects if there are objects present within the mailbox by comparing the reading from the sensor with a preset threshold. Accomplished using microcontrollers, which would have wireless communication capabilities to transmit data to the data servers. The microcontroller used in this project is capable of receiving information from the sensors and transmitting processed information via Wi-Fi to communicate with the database [4]. The power consumption on this device is minimal due to the use of various low-current device as well as energy-saving mode whenever the user is not requesting the information from their phone. Under this mode of operation, the microcontroller should still be able to receive information from the light sensors since this signal can trigger potential alarms.

CHAPTER III

DATA SERVERS

The data server shall consist of a database that would include the information about the user such as their address, phone number and email. Security would be of paramount importance, as we would not want to leak personal information in this case.

Database

The database is an amalgamation of the entire user's information (most importantly the address, phone number). Once the database receives a signal from the device it shall find the corresponding information about the user and send a notification to them accordingly. The database shall be hosted using a VAMPserver which is a secure online server that works well with android studio.

Security

All the information will be stored on a secure server that would be password protected and only authorized owners shall have access to the information on it.

CHAPTER IV

PHONE APPLICATION

The application (or app in short) shall be the main interface for the user. The app will contain information about status of the mailbox. This will let the user know if the mailbox is opened, or if there is mail present within the mailbox. It is modifiable to be more convenient for the user. The interface shall be easy to user and be able to communicate with the servers easily. It can keep track of how much mail is in the mailbox, alerting the user if there is a high volume of mail in the mailbox. It will also notify the user the difference between the letters and packages. The app is designed in android studio and can be run on nexus 4 devices.

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Force

Light

Bar Code

Load Cell

Light Sensor

Camera Module

Light Intensity Value

Power

Power

Load Cell Amplifier

Weight Reading

Bar Code (Image Format)

Power

MCU

Mail/Package Sender Info

Mailbox Door Open/Closed

Mailbox Content Removed/Added

Database

Communication/updates

Online Server

User Data requests

Retrieval of data

Android Studio Application

UI output