

**THE HERALD: A POST BOX NOTIFICATION SYSTEM FOR
NAMPOST**

A DESIGN PROJECT PROGRESS DRAFT

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Abstract

NamPost prides itself with a very rich history that tells of its beginning and rise in postal services. A company which could only afford foot-postmen that received wage in meat and rice now solely runs a modern postal system for the whole of Namibia. However, with the advancement in technology, especially in telecommunication and the world-wide web, the postal service has been presented with some challenges. Primarily, the relevance of the postal service is under question and doubts are posed on how it will survive the technological era as Electronic mail just seems to be a more efficient choice for receiving and sending mail. The postal service lacks the technology that electronics mail boasts. One of which is the lack of an adequate notification system for notifying the recipient of mail when it is delivered in their mail box. Currently, recipients are required to frequently commute and manually check the mail boxes for any new mail. The recipient of the mail is not guaranteed to find any mail and may make unnecessary trips. There is need for implementation of a system capable of notifying recipients whenever mail is delivered in their mail boxes. This will eliminate the recipient's problem of making unnecessary trips to the mail box.

A Design project was done for such a notification system. The system is designed to uniquely identify each mail box with a QR code that can be scanned using a Digital Image scanner to establish a trigger and send an Email and SMS to the owner of the mail box for every time they receive mail.

The project includes a PHP/MySQL system administrator dashboard for registering mail box owners, Database server (raspberry Pi), a *PHP* application for generating unique QR codes for each mail box, GSM/GPRS module for connecting the system to the mobile network, an Android digital image scanner and an Android application for handling the scanner. A prototype was implemented to demonstrate the system's capability to scan and send an email notification to a registered email address. In the prototype, a raspberry Pi was used as a server and a smartphone as the scanner.

Nonetheless, the postal culture is still there, of course, for occasions – happy and sometimes sad – when one wants to show that their message and the words they use are special and chosen with particular care. It's also true that everyone loves getting letters. Hand-written letters, light weight

parcels and authentic documents. These items are best sent through the postal service for its affordability [2] and theme of tradition (keeping the romance alive - campaign). This directly means that the postal service is still within a fighting chance and NamPost should exploit this fact. Currently, the postal service is at a stagnated stage in terms of efficiency, it needs to improve and catch up to the efficiency standard which this era demands – minimized time, money and energy wastage.

Introduction

Overview

NamPost postal services include 140 post offices across the country and a total of 119,010 active mail boxes in 2016. Every year NamPost handles over 1 million mails and parcels both local and international. A local mail or parcel transfer begins when a customer *posts* either one at their nearest post office, usually situated in town centers of most towns. The mail and parcels are sorted according to their destinations and sent off. The requirements of the service are that the sender must address the mail or parcel by at least indicating the full names, mail box number and town of the recipient. The mail box number and town guide the postman to know the recipient's post office. At the recipient's post office, the mail is manually inspected, sorted and each slotted into the recipient's mail box corresponding with the address on the mail. The parcels are inspected similarly and for each one, a slip is issued and slotted into the recipient's mail box. For NamPost the service ends here for ordinary mail. The recipient needs to keep visiting the mail box and hope to find either mail or a parcel slip. In today's world where technology has come of a certain age, it is oddly out of place and inefficient not to have a notification system intended for the recipients of mail and parcels to eliminate the unnecessary visits to the mail box when there is no mail at all. There is need to put in place a notification system.

Most mail box owners own mobile phones and have access to email, all 140 post offices have Wi-Fi internet and situated within an active mobile network services. This case can be taken advantage of and used to design a notification system that can be integrated into the mail and parcel transfer. This can then enable NamPost to notify the mail box owners whenever they receive mail or parcels. Both an email and SMS can be sent to their email addresses and mobile phones respectively.

Problem statement

In a developing country, there is need to employ systems that promote efficiency. A variety of such systems will eventually add up to facilitate The postal system

There is a lot of ancient systems that do not evolve and are still inefficient. Developing countries struggle to develop because they run many inefficient systems which collectively become a complex problem that end up affecting other seemingly good systems. For Namibia a system like the postal system is such a one, among others like the police system, education system many to mention but a few. NamPost has existed for over 50 years yet there has been no major transformation to employ technology and reinvent the system into an efficient system.

This design project focuses on solving the problems of lack of an adequate communication paradigm between NamPost and the mail box owner. Whether active or not a mail box owner may need to be kept apprised about their service directly. owner and the Service provider when there is mail to be collected. Because of this, many postal users suffer time, money and effort wastage when they commute to and from their post boxes to check for mail. Particularly when they find no mail at all. Postbox owners also miss time-critical mail which usually cost them unfortunate consequences. Most NamPost post offices also get filled up and congested with uncollected mail and there is no adequate means of communicating to the addressed users of the uncollected mail. This directly increases the cost of storage and mail handling for NamPost.

Site Analysis

A survey was carried out to investigate, from a sample of NamPost mail box owners, their experiences with the current postal system. The results demonstrated that more than 74% of the sample members visit an empty mail box once for every 3 visits, 45% of them once every 4 visits and 55% of the members, once every 10 visits on average. A new problem was also found that a group of members that rarely visit their mail boxes miss time critical mail - mail that contain due dates and deadlines but are collected passed these dates or rather too late. Eviction notices, job interview invitations, collage acceptance letters etc. are some of the example.

Two major post offices where visited, Oshakati and Windhoek Central. The different groups of mail box owners could be noticed by how some mail boxes where completely empty and others overstaffed with mail and requiring extra storage.

Problem statement

The current postal system is still in a primitive and inefficient phase where mail is sorted into the recipients' mail boxes and left in piles waiting to be collected by owners. Each mail box owner in this system, is required to visit the mail box and check if any mail was sent to them. The owners visit the mail box with no guarantee of finding any mail and for a significant amount of time, most find their mail boxes empty. For every time the mail box owner finds their mail box empty, they experience waste of effort, time and money. For a mail box owner, this experience is both frustrating and discouraging and visiting the mail box would become less urgent. If the mail box owner doesn't visit their mail box for too long, the mail box may become overstocked and would need extra storage for overflowing mail.

After a survey was carried out to find out about the experience of the visiting two major post offices, It was confirmed tha

without any communication to alert the mail box owner of the delivered mail.

Solution

This document proposes that NamPost integrates the postal service into the **mobile phone**, now man's favorite messenger. Since most postal service users own mobile phones, the postal service can incorporate communication between the service and its users through the ubiquitous device. A system that sends a notification to the postbox owner informing them when they have mail in their postboxes is proposed. If it must communicate to a postbox owner's mobile phone, it should be able to use either a GSM or GPRS protocol and communicate via SMS or/and email. This system is likely to introduce undeniable efficiency to the postal system and lessen loss of time, money and effort on unsuccessful commutes to the post box. It will furthermore, demonstrate prestige to the company for its engagement in technological innovation and indulgence. Also, the cost of extra storage and mail handling would most likely be reduced for the company.

System Design Concept

The system must ideally include a sensor at the post box, a server with a database of post box owners and a GSM or GPRS module.

Objectives

Scoring of system for most feasible and affordable concept

Design of an administrator dashboard for registering mail box owners

Design of a sensing mechanism at the mail box

Design of the Email and SMS notification system

Importance of project

The importance of this project can be realized in its various applications. It can be implemented in many ways in which the goal is to notify individuals belonging to a certain context. This system can assist in places where individuals are required to physically commute to get a status inquiry. Some places are responsible for processing the public's documents, items and property. Sometimes these processes take long and are unpredictable on when they complete. Because of this, expectant owners may commute to these institutions in vein. However, the email and SMS notification system can assist these institutions to notify them only when collection is definite. This system will eliminate the inconvenience of unnecessary visits, that may result in lose of effort, time and money. The system will greatly improve the efficiency in such institutions and employ a transparent connection with affiliated members of the public.

Deliverables

The system block diagram design

Prototype of trigger and messaging mechanism

Project cost estimate

Requirements

User requirements

The email and SMS notification system should be able to:

Have a dashboard for registering mail box owners into a database including their Names, mail box number, email address and mobile phone number.

Have a sensing mechanism at mail box for triggering the system to identify the owner and send them an email and SMS.

Have a module that can send an email and SMS to the mail box owner when the sensing is triggered

Use affordable and accessible equipment

Require less maintenance cost

System requirements

Functional requirements

The *email and SMS* notification system is required to:

Accept records of mail box owners including names, email addresses, mobile phone numbers and mail box number.

Sense when there is mail in a mail box and point the sensor signal to the records of the mail box owner.

Identify the mail box owner of any triggered sensor, get their email address and mobile phone number and send an email and SMS to them.

Non-Functional Requirements

The system should incur minimum failures

The system should work in different environments and temperature ranges

The system should be easy to setup, maintain and user friendly

Design project outline

This design project consists of 5 chapters. Chapter 1 looks at the background of NamPost and the currently employed postal system. It outlines the problem statement and describes the proposed notification system. It also explains significance of the project, the objectives and the project

requirements i.e. User and system requirements. In chapter 2, the focus is placed on the most effective alternative method to be used to carry out the project. Chapter 3 Discusses the design concept and the relevant calculations used to obtain the desired system. The prototype and test results and cost estimates of the project are discussed in chapter 4. Finally, chapter 5 concludes and recommends the design.

Chapter 2.

This chapter will look at the best design alternatives and selection of the most appropriate effective alternative that will enable the design of this project with minimal setbacks. There are three components of this design, with each having different concepts. These components are the server, the sensor and the messaging components.

Database and Server

NamPost already has a database management system which is typically MySQL. They follow the Model-View -Controller architecture. An integral interface will be required to integrate to this already existing architecture. There are many possible technologies that can be used to implement such an interface. Popular programming languages like Java, C#, Ruby, PHP are few possible tools that can be used to build such an interface. The assumption is that the proposed design project will require mail box owners to register for the notification services, therefore, a new GUI that will capture the required and appropriate information for this system must be implemented.

NamPost also has an existing server that hosts their databases. However, the proposed design project will need to implement a separate server that will operate as a buffer to the main server. It will handle dynamic data for SMS and email transactions. Because of this, there will be no interference to the main server. To handle SMS and email transactions, this server must interface with GSM and Wi-Fi modules. GSM configured to a mobile network and Wi-Fi to internet connection. GSM will need an operational SIM card with SMS credit and Wi-Fi, Wi-Fi internet (All NamPost post offices guarantee this).

Server

In this design project, there is a need for a server to handle SMS and email transactions for sending the notifications. Any functioning computer is capable of being a server.

Wi-Fi enabled Desk Top computer

A Desk top computer running either Linux or Windows operating system can be used as a server. Open source MySQL database management software can be installed to work with a PHP application and interface the database with the GSM and Wi-Fi modules. This application would also integrate the sensing mechanism from the mail box.

Advantages

PD desktops are generic computer which people are familiar with. The better they are, the mostly they are. A good Desktop for a server would be estimated at

Availability

Stability

Framework and support

Disadvantages

Cost

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PHP is a server-side, HTML-embedded scripting language that may be used to create dynamic Web pages. It is available for most operating systems and Web servers, and can access most common databases, including MySQL. PHP may be run as a separate program or compiled as a module for use with a Web server[1]. It is the best option for this design project keeping in mind that NamPost employs MySQL servers.

Small single-board computer (Raspberry Pi)

A raspberry or similar computer can be used as a server for the proposed project. A raspberry pi would require Raspbian OS and MySQL database, either nginx and PHP or flask (a python micro framework). All software above is open source. In this case a PHP or Python application, respectively, can be implemented to handle the system's functions from the sensing, owner identification and notification process.

Advantages

Cost

The Raspberry Pi Model B is an extremely affordable computer with prices ranging between 59.95 USD and 39.95 USD from popular suppliers like Amazon and Adafruit.

Size

The raspberry Pi is portable and small with the following dimensions; 85.60 mm × 56.5 mm, excluding protruding connectors weighing about 31 g [1].

Specifications

It includes a quad-core Cortex-A7 CPU running at 900 MHz and 1 GB RAM. The Raspberry Pi may be operated with any generic USB computer keyboard and mouse [1]. It may also be used with USB storage, USB to MIDI converters, and virtually any other device/component with USB capabilities.

The Raspberry Pi is no longer limited to home and science projects, but can be widely used as an Industrial IoT solution and achieve goals of Industry 4.0 [1].

Mail box sensor

The sensor must be able to trigger a signal and send it to the server, reporting the existence of new mail in the particular mail box. Initially the sensors that were picked are the *reed switch*, the *PIR motion sensor* and the semi manual *QR code and scanner mechanism*. The details of the concepts are outlined below;

- Reed switch

The **reed switch** is an [electrical switch](#). It consists of a pair of [contacts](#) on [ferromagnetic](#) metal reeds. The contacts may be normally open, closing whenever a magnetic field is present, or normally closed and opening when a magnetic field is applied. An example of a reed switch's application is to detect the opening of a door, when used as a [proximity switch](#) for a [burglar alarm](#). In this concept, the reed switch would be mounted to the mail box door applying its proximity

switching capability and hence using it to detect the opening and closing of the mail box door whenever the postman delivers mail.

Suitable specifications of this sensor would be as follows:

Switching power: 10W

Switching Voltage: 170V

Switching current: DC 0.25A

- PIR Motion sensor (Passive Infrared)

A **passive infrared sensor (PIR sensor)** is an electronic [sensor](#) that measures [infrared](#) (IR) light radiating from objects in its field of view. It simply detects motion. In this concept, the sensor would be used to sense motion inside of the post box, when the postman slots mail in it. The sensor will sense the motion of delivered mail and send a signal to the server to report new mail. A typical practical choice for this design project would have the following specifications.

Voltage: DC 4.5V – 20V,

Quiescent current: less than 60uA,

Detection distance: 3-7M adjustable,

Detection angle: 110 degrees,

Size: 3.2*2.4*2.4cm

- QR code and scanner Mechanism

QR code is a matrix bar code. It contains information about the object on which it is attached. In this concept, a QR code would be attached on the mail box, it will contain a unique key to represent each mail box. This QR code can be scanned to send a signal with the unique key to the server. In the server, a specific mail box can be identified using the assigned unique key encoded in the QR code. The specifications to suit this mechanism would be as follows:

QR code Version 4, 50 character long Alphanumeric key,

QR code scanner with 2-D digital image sensing and

Wi-Fi access to server.

Messaging modules

GSM/GPRS

GSM/GPRS module is used to establish communication between a computer and a **GSM-GPRS system**. **Global System for Mobile communication (GSM)** is an architecture used for mobile communication in most of the countries. **Global Packet Radio Service (GPRS)** is an extension of GSM that enables higher data transmission rate. **GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces** (like RS-232, USB, etc) for computer. [] In this design project, this module will be employed to connect the server computer via RS 232 or USB to a mobile network and the internet. Through this module, the server can relay notification messages to the mail box owners' mobile phones and emails.

Wi-Fi router

This is a devices meant to provide additional forms of wireless connectivity to devices (such as [Wi-Fi](#) or [Bluetooth](#) support), often over [USB](#) connections. If there is availability of internet wifi, this device can be used to access the internet. For this design project the device can be connected to the server computer and allow it access to the internet through with notification messages can be send to the mail box owner. Note that, this concept will relay on the internet channel to send both SMSs and email notification. It does not allow for a direct connection into the mobile network, an SMS service provider such as *bulksms* and *textglobal* would be used instead.

Conclusion of the concept selection

There are three components of this design, with each having different concepts. These components are the server, the sensor and the messaging components.

To make a conclusion on the final concept for this design, there is a need to follow the criterial of cost and availability.

A raspberry Pi server is picked because it is cheaper, smaller and versitile. The raspberry pi can be powered by a 9V lithium battery and can be packaged in customized cases. A desktop computer is instead more expensive, bigger and rigid in shape. It can only be powered via a power socket and is not so flexible due to its size.

The Qr code and scanner mechanism is selected as the most ideal because it is cheaper to setup and maintain. This sensing mechanism will require a printed QR code sticker for each mail box, a maximum of 2 QR code scanners for each post office and an extra employer to do the scanning.

Meanwhile, both the PIR and Reed Switch sensor mechanisms will require individual sensors for each mail box, 119010 active mail boxes [], all running wires from the mail box to expensive high-end multiplexes. This will bring about complications and high cost in setting up the system and a need to put up extra measures for monitoring and maintaining of each sensor. QR codes stickers will be used for each mail box and hence the complication and expense on sensors and wires is eliminated. Few scanners, not more than 2 will be required for each post office and lastly a single employee to carry out the scanning. Maintenance using this QR code and scanner concept will cost nothing much and the cost of setting up will be only on the printing of QR code stickers, the scanners and a minimum wage salary of the scanning employee. All other costs on setting up and maintenance that would be incurred if the other sensing mechanisms are employed are eliminated.

Messaging mechanism

The Wifi adaptor was picked on this concept. The wifi adaptor is cheaper and easy to setup onto a server. The GSM/GPRS is expensive, requires a SIM card and more complex to interface with the server and the networks to which it must connect, internet and mobile network.

Chapter 3: Design concept

The previous chapter looked at the design alternatives whereby different components of the system were discussed, and the most effective ones selected for the project. This chapter will look at the way the design was carried out, sizing of components, flow charts for programming the display and do relevant calculations.

The project can be classified into hardware and software units. The hardware comprises of:

Hardware

Server

- Computer (Raspberry Pi)

Sensor mechanism

- Smart Scanner
- QR code

Messaging component

- Wi-Fi adapter

Software

Rasbian OS

Server Dashboard

Flask server application

MySQL Database

Scanning Application

Block diagram

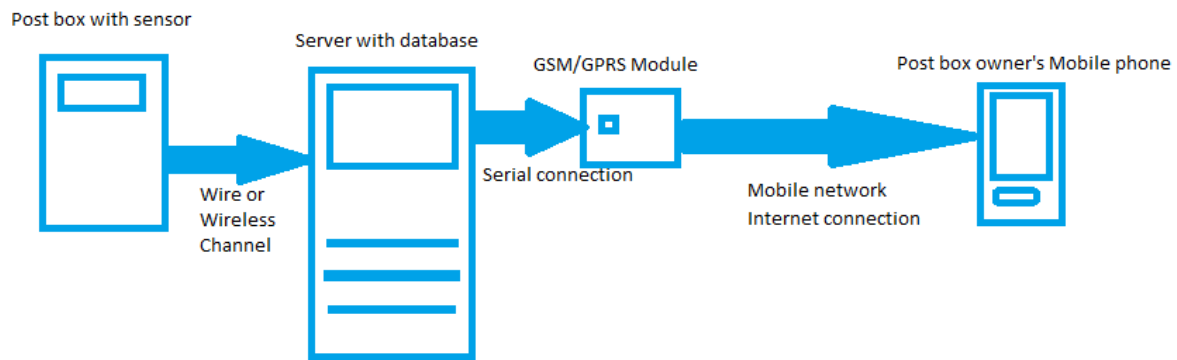


Figure 1. The block diagram of the Herald post box notification system

	Sensor	Server	GSM/GPRS	Postbox owner's mobile phone
Static detail	The sensor is mounted at the post box.	The server hosts a database of post boxes, the post box number and location of post office. It also includes records of post box owners, their post box number, phone number and email addresses.	GSM and GPRS. These are telecommunication modules. They are mounted onto the server. They include a SIM card and internet access respectively.	The post box owner must have a functioning mobile phone connected to internet and any mobile network with the same phone number and email as in the database.

Dynamic detail	The sensor must send a signal to the server when there is mail in the post box	After receiving a signal, the server must use the database to identify the post box, the post box number and search for the owner. When the server finds the owner, it sends the contact details of the owner (Phone number or email) to a program that communicates with GSM and GPRS module.	The GSM module receives AT commands from the Server instructing it to send a Notification SMS to the retrieved phone number of the post box owner whose post box sensor sent a signal. Similarly, the GPRS receives the email address of the post box owner and sends a notification message to the email.	Through the GSM, they must be able to receive an SMS message whenever they get mail in their post box. Through the GPRS, the post box owner must be able receive a notification on their email whenever they get mail in there post box.

Concepts and concept analysis

Three concepts are presented for this design proposal. The concepts are all based on the sensing mechanism of the system because there exist many alternative concepts and may require evaluating them. The concepts suggest the use of a Reed switch, PIR motion sensor or a QR code and scanner. The table below explains a little about each concept and a brief discussion on either the advantages or disadvantages of using each specified concept.

Sensors Name	usage	Specification	Discussion
Reed switch	It is usually mounted on doors and windows to sense whenever they open	Switching power: 10W Switching	Requires many cables, may be very expensive to multiplex the different sensors from all the post boxes at

	or close. In this concept, they will be mounted to post boxes to sense every time the postman delivers mail in a post box. A signal will then be sent to the server to trigger the system to send a notification the owner of the post box.	Voltage: 170V Switching current : DC 0.25A	each post office. This may bring about high cost of maintenance since every post box will need this sensor each. Most NamPost post boxes do not have doors on the side of the postman. These sensors may be used for only a few post boxes.
PIR Motion sensor (Passive Infrared)	Used for sensing movement. In this concept, the sensor will be used to sense motion inside of the post box, when the postman slots mail in it. The sensor will send a signal to the server to report the existence of mail in the specific post box then have a notification sent to the owner of the post box.	Voltage: DC 4.5V – 20V. Quiescent current: less than 60uA Detection distance: 3-7M adjustable. Detection angle: 110 degrees. Size: 3.2*2.4*2.4cm	May be prone to errors. The sensors may not be so accurate. They may pick up motion that is not from a mail and report that as if mail was delivered in the post box. It may require many cables; bringing about high cost of maintenance.
QR code and scanner	QR code is a matrix bar code. It contains information about the object on which its attached. In this concept, it will contain a unique key to point the scanner to a database record in the	QR code: Version 4, 50 character long Alphanumeric key. QR code scanner: Customized software/app with	A customized app needs to be developed for a 2-D digital image scanner (Android PDA or smart Phone) to read the unique QR codes and interpret the Code into a key code. It must be capable of interfacing the scanner to the server and use the Key code to identify the

	server and trigger the system to send a notification to the specific owner of the post box.	2-D digital image sensor.	post box number that is associated to the scanned QR code, identify the owner of the post box and finally send them a notification through GSM and GPRS. This concept requires no cables. QR codes are easy to maintain if printed on good material and only a few scanners (one or two) would be needed for each post office.
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First a database of all post box owners is made, each owner record associated to a unique qr code. A qr code generator is used to generate the physical unique qr codes. These qr codes are then pasted on each associated post box. A qr code scanner scans each qr code on the post box that has mail. The scanning triggers the database server to search for the record in the database associated to the unique qr code. Then sending a notification to the owner's mobile phone via GSM SMS or GPRS e-mail. Notifying them that they have new mail in their box.

Summary of the score

After understanding the structure of NamPost's postal system and the infrastructure, a few concepts were eliminated and the best fitting picked. The use of wires and wire sensors would be too cumbersome and require expensive multiplexers. Wireless sensors would invite high maintenance costs since each post box needs a sensor. A GSM/GPRS module will be used for the SMS notifications. The concept of using QR codes and scanner is the most affordable and low maintenance cost approach. This concept will require no individual sensor for each different post box, rather, one scanner will be used and each post box will be printed with a unique QR code that will be scanned each time a post box gets mail. The cost of sensors and maintenance are greatly reduced.

Design Material

- A Database server
- An Android digital image (QR code) scanner
- An Android digital image scanner software (App)
- QR code generator program
- GPRS/GSM modules
- Post box model

Design

This this design will first need a server to host a database of post boxes, including the post box number, post office name, owner's name, owner's email and owner's mobile phone number. Each post office maybe required to have an own server and database with access to GPRS/GSM (internet and mobile phone network).

A QR code scanner that will be on the same network with the server will be programmed with customized android software (App). This software will have the capability of accessing the database server through HTTP.

QR codes will be pasted on each post box of every post office. The QR codes will contain an HTTP address to the database server concatenated with an encrypted key that uniquely identifies each QR code on the post boxes. A QR code on a post box will be scanned with the customized scanner every time it has mail in it. The software App on the scanner will be designed to use the Unique identifier key in the QR code to generate an access key to the database record of the specific post box. In the database, a field will be altered to indicate (flag) that the post box owner will need to be sent a notification. Using PHP, JSON and AT commands, the server will have the capability to detect the owner's mobile phone number and email address and send a notification to them through SMS and email.

Concerns and discussions

Extra employee

For big companies, less cost and profits are usually a priority. After analysing most of the options and concepts of how to incorporate a notification system in NamPost's postal service, the use of

an extra employee with a scanner was the better choice than others. During a study and tour to NamPost Oshakati branch and Windhoek Main branch, it was found out that there are about 140 NamPost post offices and a total of 119010 post boxes. Ordinary mail is sorted into post boxes only twice every week. This concept introduces extra work of scanning but looking at the number of post offices, post boxes and sorting frequency, it seems to be less work than imagined. It also means that there would be a clearly biased trade-off between employment cost verses better and improved postal service for customers. The latter would obviously be favourite. Furthermore, the extra employee, QR code and scanner act as the sensors at the post box. Instead of purchasing and installing several sensors with running cables and multiplexers, a single employee with a scanner and QR code stickers are all that is needed. This reduces the cost and effort of setting up the system and maintaining it.

Speed

For any system, efficiency is always a big concern. This concept will be designed to use a smart scanner with possible Quad-core 1.4GHz processor and high definition camera for super-fast scanning. No internet connection is required at scanning. The server and the scanner will need to be on the same WLAN network. Each scan will be buffered on the scanner software to allow super-fast multiple scans even when the WLAN is interrupted or slow.

Security

Today QR codes can be scanned by any smart phone. There is need to make sure that no application can interpret the QR codes of the proposed project and hack into the server to alter the database. The QR code will be designed to contain the HTTP address of the database server plus a unique identifier to distinguish the different post boxes. The address of the server will be used to redirect illegal scanners to a default error message. The unique identifier key can only be decrypted by a secret algorithm in the custom android software which uses it to generate an access key into the database to make legal alterations i.e. flag the post boxes whose owners must be sent notifications.

Prototype Design

An Android digital image (QR code) scanner

An Android smart phone will be used in the prototype to demonstrate the scanner. This will correspond with the smart scanners that are already available and run on android operating system. The smart scanner below is an example such.

Smart Scanner HT380A Handheld Terminal Quad-Core, Android 4.2.2 OS



Figure 6 Smart Scanner HT380A Handheld Terminal Quad-Core, Android 4.2.2 OS

Product Features Performance and Endurance

Samsung Quad-core 1.4GHz processor, 1G DDR3 memory, Android 4.2.2 system, 4 times faster than traditional single-core products. Using high-capacity 4000mAh lithium polymer battery, standby time of more than 250 hours, sustainable using for more than 12 hours. And optional 6000mAh large-capacity lithium battery, has an incomparable endurance time.

Data Acquisition

Fast, accurate 1D or 2D barcode scanner, which can read all common barcodes on market; support NFC or RFID, with infrared, 8 million pixel high-definition camera and other data acquisition modules.

Data Transmission

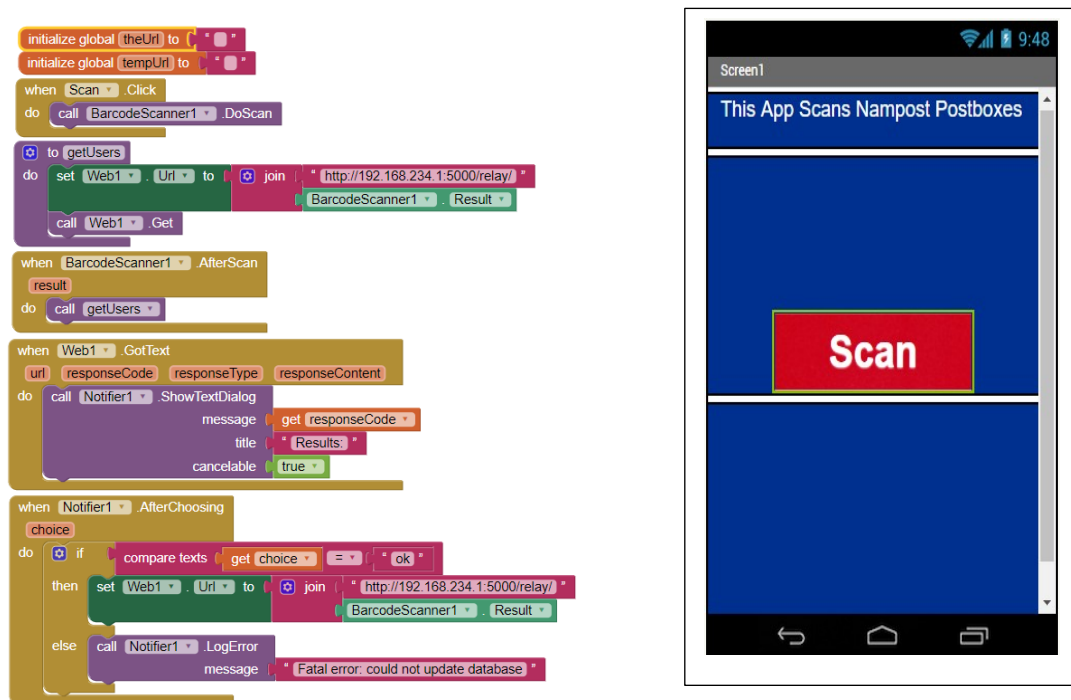
Wi-Fi support Dual-band 2.4GHz and 5GHz IEEE 802.11a/b/g/n, PHY layer rates up to 150 Mbps. Equipped with high-speed 3G communication module and Bluetooth 4.0. Bottom with multi touch interface, support USB 2.0 cable for charging and data transfer, support RS232, RS485 and other data transmission.

Operating System

Android 4.2.2. With update availability Stable and Clear Conversation Quality Using high-quality audio output module, stereo surround technology, loud speaker volume up to 90dB, with noise suppression microphone, suitable for using in noisy environments.

An Android digital image scanner software (APP)

The android software App is designed using **MIT App Inventor**. It will demonstrate a scanner software that reads a QR code from the post box, decode the unique key on the QR code and decrypt it into an access key. It will use the access key to point and flag a post box recode whose owner must be sent a notification. The initial code-block design and look of the software app is shown below.



The software App above will be able to read the QR code and parse the key through a PHP file on the database server, the raspberry Pi. The key will under-go decryption into an access key that identifies the scanned Post box recode and flags the specific recode.

QR code generator program

To generate the QR code first the Unique identifier key must be produced then encoded into the QR code. In this design, a 7-digit random key of alphanumeric characters is generated. It is then

converted into a decimal number and encrypted into a unique key using a secret salting algorithm. This process is done such that the chances of getting a duplicate key would be extremely small. This key is then recoded into the database and encoded into a QR code for a post box. The encoding will be done using a PHP library for QR code generation.

The algorithm of changing the 7-digit random alphanumeric string into decimal is no secret, the criteria used is the simple array position of the character in the defined alphanumeric array. Below is the preliminary PHP program that is used for generating the random string and converting it into a decimal number.



GPRS/GSM module

A PHP program will be developed to forward AT commands to the GSM module whenever there is need to send a notification to a post box owner through SMS. To achieve this there is need for a

- A concept was chosen
- Database server was purchased (Raspberry PI 2) and configured
- Database is designed and set up on the server
- Scanner software is almost done
- PHP random string generator and string to decimal program for the QR code encryption is done
- The Post box prototype model is made

Pending

- Finishing with the encryption (salting) algorithm for the QR code Unique Key
- Finishing the decryption algorithm for scanner software app
- Developing a PHP program for QR code generation and data acquisition (inserting new post boxes and owners)
- Purchasing the GSM module
- Implementing and Testing the whole system prototype
- Final Design report