UGANDA INSTITUTE OF INFORMATION AND COMMUNICATION TECHNOLOGY

FINAL YEAR PROJECT REPORT

MAZE BAG

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DECLARATION

We solemnly declare that this final year project report is based on our own work carried out during the course of study under supervision of Mr. Muhwezi Amos

We further certify that;

i. The work in this report is original and has been done by us under general supervision of our supervisor.
ii. The work has not been submitted to any other institution for award of the any other degree, diploma or certificate.
iii. We have followed the guidelines provided by the by the institution in writing project report.
iv. Whatever materials used (data, theoretical analysis and text) from other sources, a credit is given to them through citation and giving their details in the reference.

APPROVAL

The project report has been checked and submitted with approval of the academic supervisor MR. MUHWEZI AMOS**.**

Signature: …….

Date: ……...

DEDICATION

The report work is dedicated to our families, lecturers, friends and sponsors who have been a constant source of support and encouragement during the challenges of school and life. We are truly thankful for having you all in our lives. Your unconditional love and good examples have taught us to work hard for the things that we aspire to achieve.

ACKNOWLEDGEMENT

First and foremost, we would like to thank the Almighty God for the gift of life especially during the course period. It has been Gods guidance and protection until this point for the report submission and course completion at large.

Secondly, we wish to extend our gratitude to our supervisor Mr. MUHWEZI AMOS for allowing the team to take the project, his continued supervision, support and guidance has led to the successful completion this research proposal on time.

Great thanks to the team members for their tireless efforts, advice, financial support and positive critics which have led to the completion of the project.

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LIST OF ACRONYMS

ICs- integrated Circuits

AC_ Alternating Current

DC_ Direct Current

REV_ Revision

PIN_ Personal Identification Number

SMS_ short Message Services

GSM_ Global system for Mobile Communication

GPS _ Global Positioning System

CAGR _ Compound Annual Growth Rate

SRAM_ Static Read Only Memory

EEPROM_ Electronically Erasable Programmable Read Only Memory

I/O_ Input and Output

SCL_ Serial Clock

SDA_ Serial Data Line

ABSTRACT

This research project report is intended to show how we developed a maze bag which is an electronically and biometrically controlled safe box for transit of goods. The maze bag uses tracking and monitoring system to track location of the goods in the bag, two security mechanisms which include finger print scan and PIN, Lastly an SMS system. The second chapter contains what different scholars have done as far as safe delivery is concerned, different problems they face, discuss their vulnerabilities incurred, criticize some of the similar systems strengths and weakness, and lastly make a review on which components we used. The third chapter is about how we came up with the prototype, collected different information and citations.

CHAPTER ONE: INTRODUCTION

1.1 INTRODUCTION.

This research was intended to develop an electronic box of edge cutting technology with GSM tracking and monitoring system which gives timely location updates of package box.

The system also utilizes finger print sensor and PIN key pad for authentication and SMS for alerts to ensure security in transit.

1.2 PROJECT BACKGROUND.

The delivery of goods and packages is a vital component of various industries, including e-commerce, logistics, and supply chain management. The global logistics market is projected to reach $15.3 trillion by 2025, growing at a compound annual growth rate (CAGR) of 7.5% from 2020 to 2025 (Grand View Research). This growth is driven by the increasing demand for fast and reliable delivery, particularly in the e-commerce sector.

However, the delivery process is vulnerable to various security threats, including:

1. Tampering: Unauthorized access or manipulation of packages during transit.
2. Theft: Pilferage or stealing of valuable goods or packages.
3. Fraud: False or misleading information regarding package contents or delivery status.

These security breaches can result in significant financial losses, damage to reputation, and compromised customer trust. According to a report by the National Cargo Security Council, the estimated annual loss due to cargo theft in the United States alone is approximately $30 billion (National Cargo Security Council).

Traditional tracking systems rely on manual scanning and updates, which can lead to delays, inaccuracies, and a lack of real-time visibility. Moreover, these systems often fail to provide adequate security features, making it challenging to detect and prevent tampering, theft, and fraud.

To address these challenges, there is a growing need for a secure, transparent, and reliable tracking and monitoring system that can ensure the integrity of deliveries and maintain stakeholder trust. This need has driven the development of Maze bag, a cutting-edge system that leverages advanced technologies to provide real-time monitoring, tracking, and security features for the delivery of goods and packages.

[1]

1.3 PROBLEM STATEMENT

The problem of parcel tempering during transit affects various stakeholders in the delivery system such as customers who are at risk of receiving damaged, incomplete or entirely missing parcels, leading to frustration, inconvenience and potential financial loss.

For businesses especially those reliant on timely and secure deliveries, tempering incidents can result in reputation damage, loss of customer trust and financial repercussion due to the need for placements or refund. Delivery companies also suffer from increased operational costs, potential legal liabilities and damage to their brand image.

1.4 OBJECTIVES

1.4.1 Main Objective

To design a secure delivery box that helps in delivery of free tampered goods by use of fingerprint and PIN mechanisms respectively.

1.4.2 Specific Objectives

1. To study available delivery systems taking kin interest in their security measures and analyse their weaknesses that bring about tampering.
2. To construct a secure and tamper free delivery box named “Maze Bag” that utilizes cutting edge technologies such as finger print sensor and PIN.
3. To test and modify the Maze box ensuring that all features are correctly functional as expected eliminating any possibilities of tampering with goods during delivery.

1.5 SCOPE

The scope of the project was to develop a system that could help delivery companies and their clients to receive goods with transparency. The prototype of our maze box is a cube of 30cm. With this size, the box can be used to deliver small items like phones, Jewelry, money, small toys and things of the sort.

The goods to be carried in our maze box shouldn't be perishable since it doesn't have the ability to keep those goods from going bad.

The maze box contains a pin and fingerprint sensor that make the system safe.

1.6 SIGNIFICANCE

For businesses especially those reliant on timely and secure deliveries, tempering incidents can result in reputation damage, loss of customer trust and financial repercussion due to the need for placements or refund. Delivery companies also suffer from increased operational costs, potential legal liabilities and damage to their brand image.

The innovation involved integrating biometric authentication and SMS technology into the parcel delivery systems to enhance security and minimize risk of tempering during transit. Biometric authentication that enables the system to verify the identity of individuals involved in the delivery process such as delivery personnel and recipients, using unique biological characteristics such as finger prints.

We aimed to increase customer trust while minimizing the risk of losses.

We also incorporated a PIN that the customer gets when they order for the delivery and get to use the PIN when the delivery person delivers the good.

1.7 **JUSTIFICATION**

1.4.3 The Need:

Loss Prevention: Package theft and cargo pilferage are significant problems in the delivery industry. This leads to financial losses for businesses, frustration for customers, and potential safety hazards for sensitive materials.

Increased Value Deliveries: The rise of e-commerce and the growing demand for secure delivery of high-value goods (electronics, pharmaceuticals, etc.) necessitates robust security measures.

Regulatory Compliance: Certain industries (e.g., healthcare) have strict regulations regarding shipment integrity and tamper-evident packaging.

1.4.4 Economic Impact:

Reduced Losses: A secure tracking and monitoring system deters theft attempts and minimize financial losses associated with stolen or damaged goods.

Improved Efficiency: Real-time tracking allows for route optimization and faster delivery times, leading to cost savings.

Enhanced Customer Satisfaction: Increased transparency and peace of mind for customers translates to higher customer loyalty and repeat business.

1.4.5 Competitive Advantage:

Differentiation: Businesses offering tamper-free delivery solutions gain a competitive edge by attracting customers who prioritize security and reliability.

Market Expansion: This system facilitates the secure delivery of sensitive materials, opening new market opportunities.

Increased Insurance Potential: Insurance companies offer lower premiums for shipments protected by a secure tracking and monitoring system.

1.4.6 Social Benefits:

Public Trust: A more secure delivery system builds trust in the logistics industry and reduces the risk of counterfeit goods entering the marketplace.

Safety Enhancement: For deliveries containing hazardous materials, tamper detection ensures they reach their destination safely.

Environmental Impact: Reduced losses due to theft may lead to lower production needs and contribute to a more sustainable supply chain.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

Several researchers embarked on development of anything that they believed could aid a safe delivery, tamper free and transparent delivery of items using various transport systems. Their research was intended to solve the same problem with different solutions. They thought of several systems that they hoped would solve this particular problem but at the end of it all, the systems had loop holes. The common loop hole that most of the researchers left unattended to was actually the tamper alerts of the delivery systems.

2.2 THEORETICAL REVIEW.

Pre-colonial era: Goods delivery in Uganda was primarily done through manual means, such as head-loading and using animals like donkeys and oxen.

Colonial era (1890s-1962): The British colonial government introduced modern transportation infrastructure, including roads, railways, and ports. This enabled the use of motor vehicles and trains for goods delivery. Post-independence (1962-1980s): Uganda's transport infrastructure declined due to political instability and economic mismanagement. Goods delivery became unreliable and expensive.1990s-2000s: The government invested in rehabilitating transport infrastructure, and the private sector introduced courier services like DHL and UPS.2010s-present: E-commerce growth and technological advancements led to the emergence of digital logistics platforms and ride-hailing services like Jumia and Safe Boda, FedEx.

Present day: Goods delivery in Uganda is a mix of traditional and modern methods, with a growing trend towards digitalization and e-commerce.

We explored the security gap within these companies and built our system that aids them in tracking and alerting unauthorized access to the delivered goods.

2.3 STATE OF PRACTICE

Few of the available delivery companies are discussed below.

JUMIA

Jumia is an e-commerce platform that was founded in 2012 by Sacha Poignonnec and Jeremy Hodara. It is headquartered in Lagos, Nigeria, and operates in several African countries, including Nigeria, Egypt, Morocco, and Uganda.

History:

In 2012, Jumia was founded as an online retailer for electronics and fashion products.

In 2014, Jumia expanded its product offerings to include more categories such as home appliances, kids' products, and health and beauty products.

Operations:

Jumia operates as an online marketplace, connecting buyers and sellers. The platform offers a wide range of products, including electronics, fashion, home appliances, and more. Jumia has partnered with various local and international brands to offer a diverse selection of products, its logistics arm, handles delivery and logistics services.

GLOVO:

Glovo is a Ugandan e-commerce platform that specializes in delivering groceries and fast-moving consumer goods founded in 2019 by Conrad Akinyemi and Wale Ayodele.
Glove aims to make shopping convenient and accessible for consumers in Uganda.
They partner with local retailers and suppliers to offer a wide range of products.
Glovo uses a network of riders and drivers to make deliveries.

DHL:

DHL (Deutsche Post DHL Group) is a German logistics company founded in 1969.

DHL operates in over 220 countries, including Uganda.

DHL offers a range of logistics services, including parcel and express delivery, air and ocean freight, and supply chain management.

In Uganda, DHL provides services such as door-to-door delivery, customs clearance, and warehousing.

DHL has partnered with various local businesses and e-commerce platforms to offer delivery services.

They use a network of vehicles, aircraft, and logistics facilities to manage deliveries.

2.4 STATE-OF-THE-ART

For our Maze Bag, we used some of the most high-end technologies to provide security to the goods in transit as explained below.

2.4.1 PIN Security

PINs are a widely used authentication method (Bishop, 2013). PINs are vulnerable to brute-force attacks and shoulder-surfing (Smith, 2015)

To mitigate this, we implemented a PIN entry system with a limited number of attempts (3) and a timeout period of 10 minutes. (ISO/IEC 30136-2018)

2.4.2 Fingerprint Authentication

Fingerprint recognition is a reliable biometric authentication method (Jain et al., 2016) though they can be vulnerable to spoofing attacks (Marasco et al., 2017)

To address this, we used anti-spoofing measures such as liveness detection and fingerprint image quality assessment (ISO/IEC 30136-2018)

2.4.3 SMS Tamper Alerts

SMS-based alerts are a common method for notifying users of potential security breaches (Kumar et al., 2017)

However, SMS can be vulnerable to interception and spoofing attacks (Zhang et al., 2018)To mitigate this, use end-to-end encryption for SMS communications.

2.4.4 System Security

A multi-factor authentication approach, combining PIN, fingerprint, and SMS-based alerts,

provides robust security (NIST Special Publication 800-63B)

Regular security audits and penetration testing are essential to identify vulnerabilities and ensure system security (ISO/IEC 27001:2013).

2.5 COMPARATIVE EVALUATION.

	PRINT SECURITY	PIN	TRACKING	TAMPER ALERT SMS	PRODUCT RANGE
MAZE BAG	YES	YES	YES	YES	WIDE
GLOVO	NO	NO	YES	NO	LIMITED
JUMIA	NO	NO	YES	NO	LIMITED
DHL	NO	NO	YES	NO	LIMITED

Table 1 comparative Advantage

Conclusion.

Despite all the previous interventions available, it is still very relevant to have our system is in place to eliminate all risks relating to tampering.

CHAPTER THREE: METHODOLOGY

3.1 INTRODUCTION

In this chapter, the methodology deals with techniques and tools that were used to execute and develop the system that secures, tracks and monitors goods during transit. Analyze and design an electronically controlled delivery box.

3.2 SYSTEM STUDY

3.2.1 To study available delivery systems taking kin interest in their security measures and analyze their weaknesses that bring about tampering.

RESEARCH

We researched about existing package delivery systems and this helped us gather literature. From the related literature, we were able to develop our system.

During our research, we collected data using questionnaires, interview guides, observation checklist, document review checklist, software especially Google.

GROUP DISCUSSIONS

We always met as a group to discuss the project and allocated each of the group member a responsibility on what part of the system they were to handle. We also held meetings to plan on how we could meet our research budget and each member contributed a suggested fee so as we could be able to get all the required components to build our prototype

CONSULTATION

We always made consultations with our project supervisor and other lecturers in order to get some technical support from them. We also made consultations with other people that have a great knowledge in electronics to ensure we got technical advice.

3.2.2 To construct a secure and tamper free delivery box named “Maze Bag” that utilizes cutting edge technologies such as finger print sensor and PIN.

SIMULATION

We used Multism simulator as a projection and test program for our system. This gave us preliminary results from which our design was first tested before it was implemented.

COMPONENTS USED.

a. Wooden Box

The box is the main architecture of our project because most of the components are embedded in it as well as the goods being delivered.

b. Electronic Lock

This a complete digital safety solution equipped with advanced safety features including a fingerprint access and a pin code. This is run by an incorporated Finger Print sensor and a relay-run electronic lock.

c. Arduino

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328 microcontroller and is developed by Arduino.cc.

d. Power Supply Unit

One power supply unit was designed in order to supply power to the Arduino and other units of the system.

e. Gsm Module (Sim800l)

This is a compact, wireless cellular module that supports GSM, GPRS and EDGE communication.

We used this for SMS alerts and GPRS tracking of our maze box.

It is compatible with the Arduino Uno boards hence a major factor for its choice.

f. Touch pad (4x4)

This is used for PIN entry by the receiver during authentication.

g. LCD Display (16x2)

This provides an interface for a user to get instructions and any other information from the system.

TOOLS

- Soldering wire
- Soldering gun
- Pliers
- Glue
- Screw Driver
- Bread Board
- Multimeter

SYSTEM DESIGN

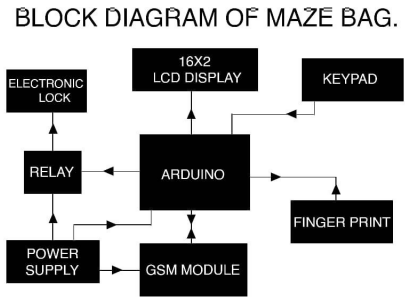


Figure 1 Block Diagram Of The Maze Bag.

Chapter 4 SYSTEM DESIGN

4.1 Introduction

In this chapter, we shall explain how we came up with the prototype and how all the connections were made.

We first made connections on the bread board to test the connections and later transferred it to a development board for the final prototype.

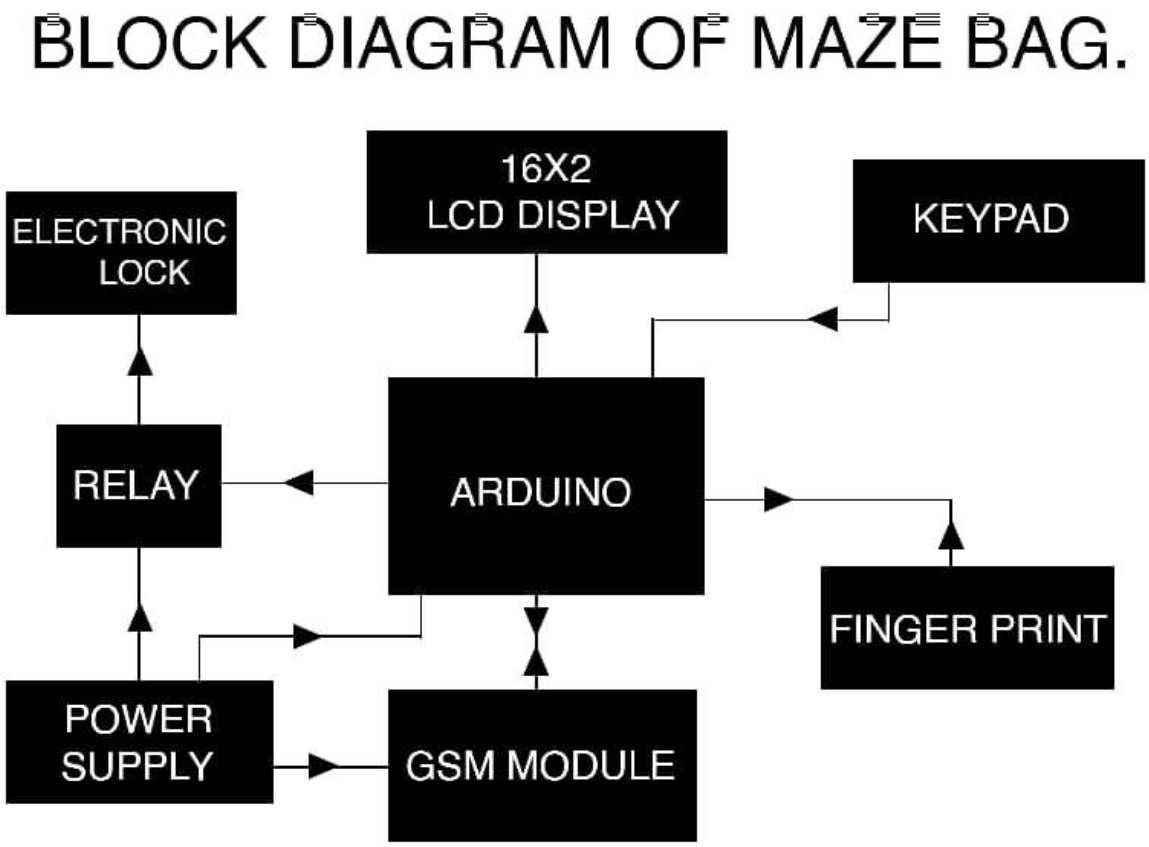


Figure 2 Block Diagram of Maze bag.

Figure 2 Block Diagram

4.2 FUNCTIONS OF EACH BLOCK.

a. Wooden Box

The box is the main architecture of our project because most of the components are embedded in it as well as the goods being delivered.

b. Electronic Lock

This a complete digital safety solution equipped with advanced safety features including a fingerprint access and a pin code.

PROPERTY	SPECIFICATION
Voltage	12V
Current	0.43A
Unlock time	1 second
Physical Dimensions	54mm* 28mm *24mm
Tongue lengths	7mm
Tongue height	10mm
Lock Dimension	10mm *10mm

Table 2 electronic lock characteristics

c. Arduino

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328 microcontroller and is developed by Arduino.cc, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices

and interactive objects that can sense and control both physically and digital which can be programed to design any system with additional sensors.

It has 14 digital input/output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack, and a reset button. This contains all the required support needed for the microcontroller. It is used as the brain of the automatic system.

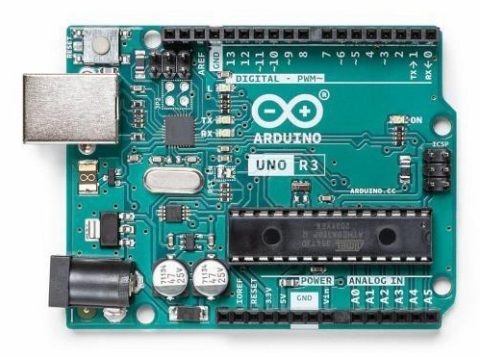


Figure 3 Arduino UNO R3

Table 3:specifications Of Arduino

PROPERTY	**SPECIFICATION**
Microcontroller	ATmega328
Operating voltage	5v
Input voltage recommended	7-12v
Input voltage limits	6-20v
Digital I/O pins	14(of which 6 provide PWM)
Analog input pins	6
DC current per I/O pin	40Ma
DC current for 3.3 V pin	50Ma
Flash memory	32 KB(ATmega) of which 0.5 KB is used by Bootloader

SRAM	2 KB(ATmega328)
EEPROM	1 KB (ATmega328)
Clock speed	16MHz

e. Power Supply Unit

One power supply unit was designed in order to supply power to the Arduino and other units of the system.

h. GSM MODULE (SIM800L)

This is a compact, wireless cellular module that supports GSM, GPRS and EDGE communication.

We used this for SMS alerts and GPRS tracking of our maze box.

It is compatible with the Arduino Uno boards hence a major factor for its choice.

[2] 

Figure 4 GSM Module

Table 4GSM Module Specifications

PROPERTY	**SPECIFICATION**
Operating voltage	3.4-4.4 V
Peak current	2A

Frequency bands	Quad-band: GSM 850, EGSM 900, DCS 1800, PCS 1900
Interface	UART (max. 2.8V) and AT commands
- SIM card socket:	Micro SIM card socket
Network Status Indicator	LED
Antenna connector	-: U.FL connector and Header Pin
Working temperature range	-40 to + 85 ° C
Module size	25 x 23 mm
Power consumption	1mA in sleep mode
Quad-band	GSM/GPRS solution in LGA type

g. Finger Print sensor.

This is an R307 finger print identification model. It uses the model of semi duplex synchronous serial communication.

Finger print processing includes two parts namely, Fingerprint enrollment and Fingerprint matching.

TOOLS

- Soldering wire
- Soldering gun
- Pliers
- Glue
- Screw Driver
- Bread Board
- Multimeter

4.3 CIRCUIT DIAGRAM

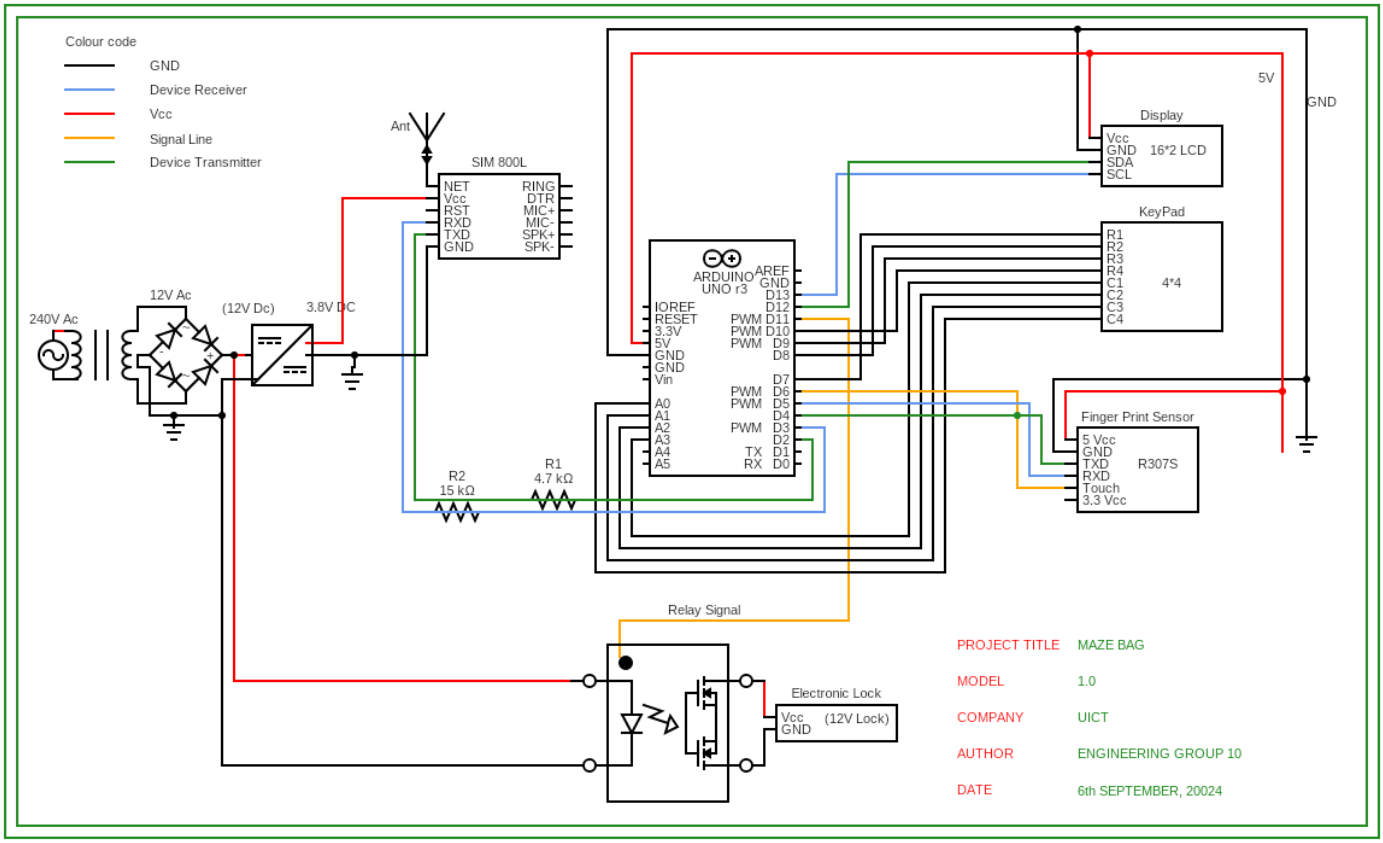


Figure 5 Circuit Diagram

4.4 FLOW CHART

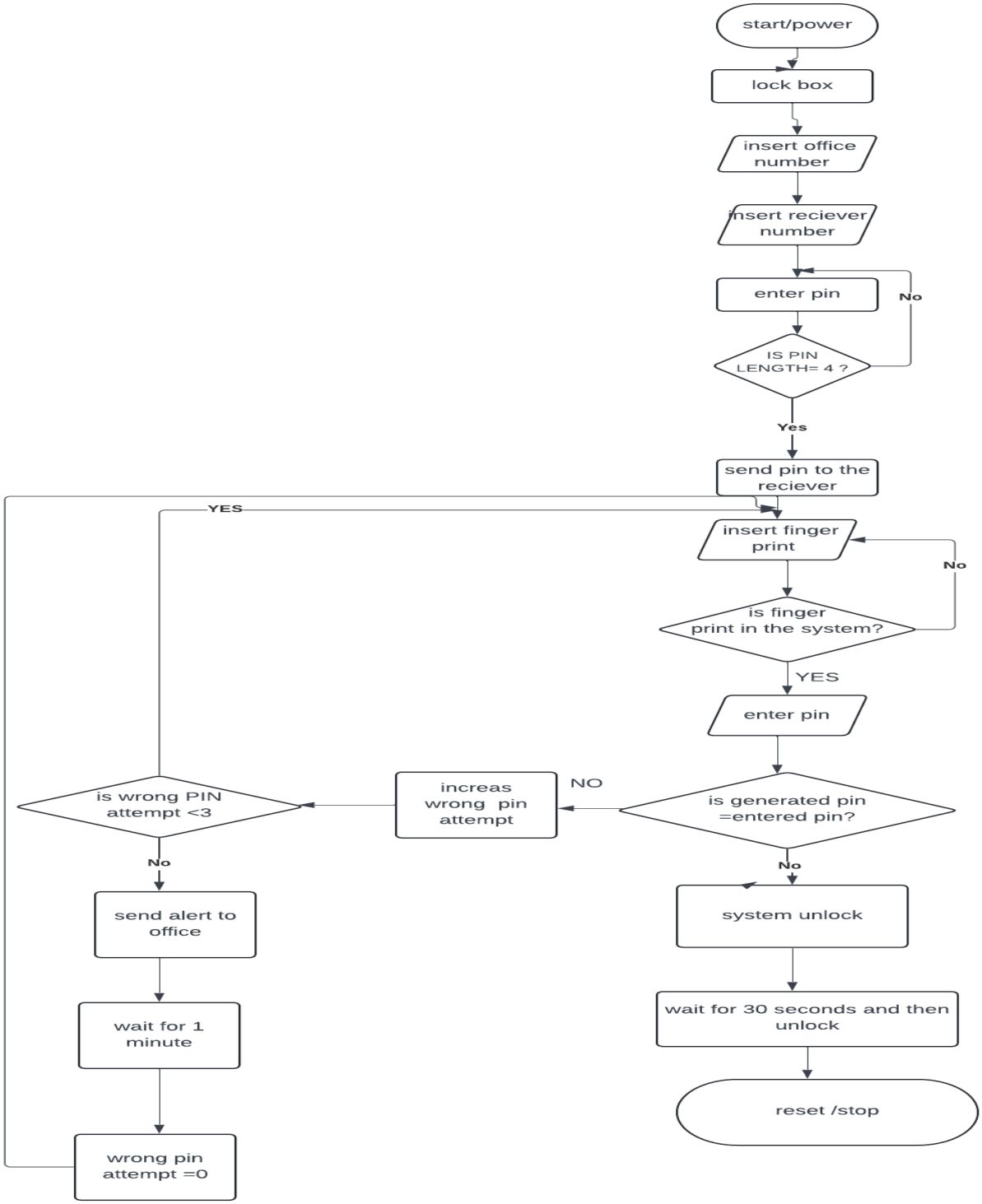


Figure 6 Flow Chart

CHAPTER 5 SYSTEM TESTING AND VALIDATION.

5.1 Introduction

In this chapter, we shall explain how we implemented and tested our project in the final stage. We carried out component testing, block testing, and final integral testing.

5.2 Component Testing.

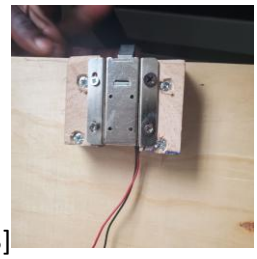
[3] 

Figure 7Electronic Lock

As the basic security measure, we tested for the functionality of the relay controlled 12V lock.

To do this, we connected the Lock's VCC to a +12V power supply positive and its ground to the power supply ground.

This resulted in the lock tongue getting pulled in indicating that it was open.

FIGURE 7: ELECTRONIC LOCK.

Keypad.

To ensure the keypad was operational. We connected its Rows and columns to an Arduino board ports. We also wrote a piece of code linking the individual rows and columns to form a keypad with each switch assigned a particular character as shown below.

R1,R2,R3,R4,C1,C2,C3,C4 were connected to Arduino ports 7,8,9,10,A3,A2,A1and A0 respectively.

Looking from the Arduino IDE serial monitor, each of the switches worked as expected.

Figure 8 KEYPAD.

Display.

To test the functionality of the display, we converted its serial ports to I2C ports. We then connected the display's SDA and SCL ports to Arduino SDA and SCL ports. We also connected the display VCC and ground to the Arduino 5V output and ground respectively.

We used a program we developed to test it and its operation was as expected.

Figure 9 LCD DISPLAY.

To test the functionality of the display, we converted its serial ports to I2C ports. We then connected the display's SDA and SCL ports to Arduino SDA and SCL ports. We also connected the display VCC and ground to the Arduino 5V output and ground respectively.

We used a program we developed to test it and its operation was as expected.

[4]

Figure 10 Finger Print Sensor.

GSM MODULE.

To test for the functionality of the GSM, we connected its TX and RX pins to pins (2,3) respectively of the Arduino. we also connected its VCC and common ground pins to the 3.8v port of the power supply and ground respectively.

We used a program we developed to test it and its operation was as expected.

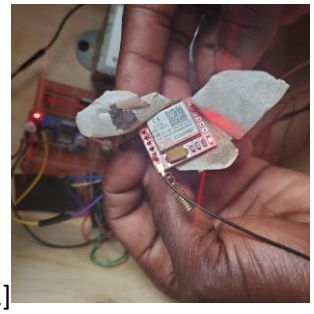
[2] 

Figure 11 GSM Module

5.3 BLOCK TESTING.

This was carried out to test the validity of each block of the complete circuitry.

Power Supply Block.

We developed a power system that provides 12v and 3.8v respectively. It consists of a Transformer that steps down the 240V AC at the input to 12V AC , Capacitors and diodes that form a rectifier circuit where the 12v AC is converted to 12v DC used and the back convertor that steps down the 12v DC to 3.8v DC. We confirmed this by testing at each stage using a digital Multimeter where corresponding values of 12V and 3.8V were attained.

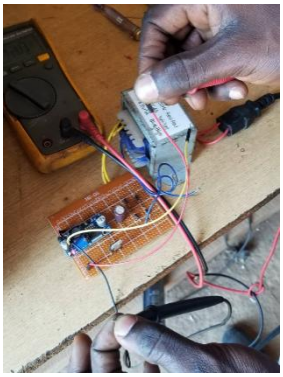


Figure 12 Power Supply.

The Security Block.

Under this we connected the relay to port 11 of the Arduino and to the lock at the other end. Once authentication is done and its' successful the Arduino port 11 activates the relay which in turn sets up the lock to high .once the authentication fails nothing happens and after 30 seconds the Arduino port11 activates the relay that in turn sets the lock to low.

Authentication Block.

We stored some finger prints in the system and to test this we checked for several finger prints and once a matching fingerprint with that stored in the system ID was found a message was displayed on the screen requesting for a pin.

A pin was typed in using a touch pad and once a correct one is typed the lock is set free and the box opens. If a wrong pin is inserted 3 multiple times an alert message is sent to the main office and a time delay of 1minute is established.

5.4 FINAL PROTYPE TESTING.

This was aimed at validating the prototype with the users to ensure that it works for further development of the project.

After assembling the system we enclosed it in a box and placed a book in it and then closed the box. We went through the whole process of authentication and at the end the box opened and we were able to remove the book.

CHAPTER SIX DISCUSSION, CONCLUSION AND RECOMMENDATIONS.

6.1 Discussion.

In our discussion, the following are some of the challenges that we faced.

We were delayed at coming up with the final prototype since some of the components failed to function at the early stages of the project for example the GPS MODULE NEO 6M.

Inadequate funds for the project as the project fee seemed to exceed the previously estimated budget and this created a delay in buying the individual components of the project.

Time allocated to us for the project was limited.

6.2 Conclusion.

This report has discussed the Maze bag as a successful demonstration of a secure delivery parcel system integrating key technologies like fingerprint recognition, GSM communication and keypad access. Through the combination of these components, the maze bag provides reliable, user-friendly solution for secure deliveries, ensuring that only authorized recipients can access the parcel. The use of the R307S fingerprint sensor guarantees a high level of security, while the GSM module allows real-time communication and location tracking. Additionally the inclusion of the keypad adds an extra layer of access control, making the system both robust and adaptable to various use cases. The projects' implementation proved that such a system can enhance parcel delivery security and reduce theft or unauthorized access during transit.

Future improvements could focus on enhancing power efficiency, reducing system size, and exploring advanced encryption methods to further secure data communication. Overall, the Maze bag represents a significant step forward in creating smarter, safer delivery solutions for the logistics and e-commerce sectors.

All the objectives have been achieved despite of a few challenges we faced during research.

6.3 Recommendations.

Basing on the research we made, we came up with the following recommendations to improve both the technical aspects and user experience of the maze bag.

Optimize power efficiency, as the maze bag relies on multiple electronic components, it is important to explore ways of minimizing power consumption. Integrating a more efficient power management system or low-power modes for the GSM and other modules could extend battery life.

Improve Security Protocols, while the maze Bags fingerprint sensor and keypad provide solid security measure, implementing data encryption for communication between maze bag and the server cloud enhance security further. This would protect sensitive information like location data and user credentials from potential interception during GSM transmission.

Enhance user interface, a more intuitive, possibly through a mobile app, could provide users with a clearer understanding of the systems status. Features such as parcel tracking, fingerprint enrollment, and access logs would give users greater control and transparency.

6.4 Future work.

Software Development

Code optimization; improve the efficiency and robustness of the fingerprint, PIN, GPS and GSM integrations. This may involve error handling, retries, and response time optimizations.

Security Enhancements; Implement encryption for the PIN code and communication over GSM to prevent hacking.

User Interface; Refine the display message on the 16*2LCD to make the process more intuitive for users.

Hard ware Optimization.

Battery Life Improvement; Explore more efficient power supplies or larger batteries to extend the operation time of the box.

Testing and Iteration

Field Testing: Test the Maze Bag in real-world conditions to ensure that the GPS, GSM, and lock mechanism work as expected.

Edge Cases: Test for cases like network failure, GPS inaccuracy, or incorrect user input to improve the system's reliability.

Integration with Cloud

Cloud Storage: Implement cloud-based data logging for GPS locations, delivery times, and access history.

Mobile App: Develop a smartphone app for tracking parcels and remote control (e.g., unlocking the bag).

Scalability and Production

Prototype to Production: Once the system is finalized, plan for mass production, considering factors like cost, component availability, and manufacturing processes.

Custom PCBs: Design custom printed circuit boards (PCBs) to integrate all components neatly.

6.5 References

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6.6 Appendix

Brief Introduction.

1. **Business/Personal Background**
    - Can you tell me about your business and how you currently manage deliveries?
2. **Delivery Challenges**
    - What challenges do you face with your current delivery system?
    - Have you experienced security breaches or issues like theft or package tampering?
3. **Interest in Secure Delivery Solutions**
    - What interests you most about using a secure delivery system like Maze Bag?
    - Which features of Maze Bag (fingerprint authentication, GPS tracking, or GSM notifications) appeal to you?
4. **Current Security Measures**
    - What security measures do you currently use to protect your deliveries?
    - How effective have these measures been for your business?
5. **Client Expectations**
    - What would a successful delivery process look like for you using the Maze Bag?
    - How would you prefer to interact with the system (e.g., mobile notifications, web monitoring)?
6. **Budget and Investment**
    - Do you have a budget in mind for improving your delivery security system?
    - How much are you willing to invest in securing high-value deliveries?
7. **Timeline and Scale**
    - What's your timeline for implementing a solution like this?
    - Would you be interested in testing the Maze Bag on a smaller scale before full adoption?
8. **Logistics and Integration**
    - Would the Maze Bag system need to integrate with your existing delivery systems or third-party services?
    - How would you like the delivery confirmation process to work?
9. **Challenges and Risks**
    - What risks or challenges do you foresee in using a new system like the Maze Bag?
    - How would you handle any technical or operational issues during the transition?
10. **Closing Questions**

- Is there anything we haven't covered that you think is important?
- When would you like to move forward with testing or adopting the Maze Bag system?

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POWER SUPPLY