ANALYSIS OF ARTIFICIAL INTELLIGENCE SYSTEMS IN ENHANCING HOME SECURITY. CASE STUDY OF ZIMBABWE SMART HOMES

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ANALYSIS OF ARTIFICIAL INTELLIGENCE SYSTEMS IN ENHANCING HOME SECURITY. CASE STUDY OF ZIMBABWE SMART HOMES

BY

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A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELORS IN COMPUTER SCIENCE IN THE FACULTY OF BUSINESS, PEACE, LEADERSHIP AND GOVERNANCE

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Abstract

The analysis examined the use of artificial intelligence systems in enhancing home security in Zimbabwe. The country has faced a variety of security challenges namely, armed robberies that have put residents at psychological and physical risk. Artificial intelligence systems mitigate the risks by providing advanced monitoring and detection capabilities. The theoretical framework covered the use of internet protocol cameras, facial recognition software, sensors and alarm systems in security systems.

The study made use of interviews, questionnaires and observation tools to build the primary data while the literature review and data analysis made up secondary data. The questions asked by the researcher were in line with the research questions to meet the objectives. The study concluded that artificial intelligence addresses the weakness of traditional security systems and highlighted how it can be implemented within Zimbabwe.

Additionally, the study examined the barriers to the adoption of AI-based security systems in Zimbabwe such as power cuts, data costs and privacy concerns. The findings from the research can be used to educate homeowners on modern home security systems and highlight the policies and laws surrounding it

Keywords: Artificial Intelligence, security system, smart homes

Declaration

I declare that this research proposal is my original work except where sources have been cited and acknowledged. The work has never been submitted, nor will it ever be submitted to another university for the award of a degree.

…… ……30/3/2023……

TATENDA MARUTA Date

(Student)

…… ……30/3/2023……

MRS L. TEMBANI-FUNDISI Date

(Supervisor)

Copyright

Acknowledgement

For who I am and the woman I am becoming, I give thanks to my family for their support and love in the darkness and light. I thank my lecturers for their faith in me and to my mentors, Mrs Tembani-Fundisi, Mr Magwagwa and Mr Kandiero your constant push towards my academic excellence and social life balance has meant to me more than words can express. I give thanks to my friends, you have become a second home, a family I wish to never lose.

Above all, I thank the Lord almighty for giving me the tools I needed to succeed and the courage to carry on.

Dedication

To Mum

List of Acronyms and Abbreviations

AI – Artificial Intelligence

CCTV – Closed circuit television

IoT – Internet of Things

IP – Internet protocol

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CHAPTER 1 INTRODUCTION

1.1 Introduction

Over the decades the definitions of a home have changed from defining a home as a simple shelter from the harsh weather to a place where a person feels most comfortable (Cf. Home n.d.). With various interpretations of the word home, it is seen often paired with a sense of safety. People have improved the structure of their homes to protect their loved ones and their most treasured belongings. Traditional home security has been seen as the basic form of securing one's territory i.e. Fencing borders, locking doors, having guard dogs and regular patrol. With the birth of Artificial intelligence (AI) and its adoption of the internet of things has significantly improved home security systems.

AI has given security systems the ability to fend off offenders with minimal human intervention, thus giving the homeowner the comfort of safety from the outside world and giving them time to relax and bond with the family. Home security has become a highly discussed topic due to the rise of armed robberies in Zimbabwe. Homeowners have been forced to find ways to mitigate their chances of being part of the statistics. The study brought to light how artificial intelligence-based security systems, often referred to as modern security systems can be applied within the country to reduce the number of home invasions and bring back the comfort of home within the country.

1.2 Background to the Study

The study presented how artificial intelligence has been used to reinvent home security and how modern security systems can be used by Zimbabwean residents to reduce the risk of

armed robberies. Before the pandemic, the average Zimbabwean survived on side hustles i.e. Selling in tuck-shops, partaking in peace jobs etc. However, the pandemic led to a halt of small contracts and peace jobs which increased the poverty rate within the country. According to the most recent economic analysis for the nation by the World Bank, the COVID-19 (coronavirus) pandemic and its effects caused the number of severely poor people to increase to 7.9 million in 2020 *(Cf. World Bank Group 2021)*.

The country has not fully recovered from the effects of the pandemic and the increasing inflation rates have worsened the situation. These factors have contributed significantly to the rise of crime within the country thus citizens need to be secure to prevent being robbed or injured. People have placed various security systems over the decades from fences to door locks, over time these security systems have grown to be smarter, more adaptable and more efficient when it comes to alerting the owner and police in the event of unwanted entry or destruction of property. Artificial intelligence has been the foundation of modern home security systems as the internet of things has prompted more data to be fed into the system. Modern security systems will reduce the number of robberies within the country and bring back the sense of safety in homes.

1.2 Statement of the Problem

Within the country, crime has risen in wake of the Covid19 pandemic and the unpredictable inflation rates *(Zimbabwe: Armed Robbery Cases Increased in 2021 2021)*. Residents have been faced with armed robberies, where most of their possessions are stolen and at times

their physical health is being compromised. Traditional security systems are the most common line of defense that these households and communities adopt i.e. Having physical barriers, locking doors and windows and at times employing a security guard or forming a neighborhood watch group.

These defense systems are not reliable and can easily be disarmed. Residents need to find modern solutions that enable them to be informed in real-time if there is the suspicious activity within their property and alert the police or security company. Modern security systems resolve most of the issues that traditional systems do not through the use of artificial intelligence and IoT (The internet of things).

1.3 Research Objectives

1. To assess the importance of modern home security systems.
2. To analyze the weakness of traditional home security systems in Zimbabwe.
3. To identify how artificial intelligence can be used to solve and address the weakness of the traditional home security systems.
4. To provide recommendations on how home security can be implemented within the country.

1.4 Research Questions

1. How effective are modern home security systems?
2. What are the disadvantages of traditional home security systems in Zimbabwe?
3. How can artificial intelligence be use used to solve the weakness of traditional home security systems?
4. How can modern home security systems be implemented in Zimbabwe at an affordable price?

1.4 Assumptions/ Hypotheses

The key presumption in conducting this qualitative study is that participants answered truthfully and express their opinions without jeopardizing data. Participants are asked to express their worries in this regard while also noting the present COVID-19 pandemic-related issue that the nation is dealing with. The second presumption is that the political and economic atmosphere would remain unchanged.

1.5 Significance of the Study

1.5.1 Significance of the study to the researcher

The researcher aimed to improve their understanding of artificial intelligence and how it has been adopted within the security sector. The researcher gained an appreciation of the importance of creating a secure environment for their loved ones while pursuing their interest in security.

1.5.2 Significance of the study to the business industry

The study revealed the needs of the community and the service they expect from various security solution companies. This information improves customer relations and boosts revenue.

1.5.3 Significance of the study to the residential sector

Often professional consultation for a security system is expensive and recommended installations maybe I'll advised to push sales. This study educates homeowners and be a reference point when purchasing or structuring a security system.

1.6 Delimitation of the Study

The study focused on how modern home security systems can be adopted within Zimbabwe. The study therefore only looks into the evolution of security systems and how they can be implemented effectively and efficiently within the country.

1.7 Limitation of the Study

The desired target audience comprises primarily of residents within Zimbabwe and security solution companies. Residents were questioned about their ideal security systems while sales representatives of companies that offer security solutions were queried about the solutions they offer.

CHAPTER 2 REVIEW OF RELATED LITERATURE

2.1 Introduction

Zimbabwe's high unemployment rate has left its citizens working in the informal sector, having to make a living through vendors and peace jobs. However, the pandemic irradiated most of the vendor sites and has pushed people to find unorthodox methods to survive and gain basic commodities. Zimbabwe is an underdeveloped country it has taken time for their economy to recover from the pandemic thus influencing a rise in robbery cases within the residential areas.

Therefore, this chapter examined the research on artificial intelligence-based home security systems and how it address issues that traditional systems are unable to, as well as how it aids in the reduction of armed robberies in Zimbabwe.

2.2 Theoretical Framework

In research from Suzanne Elly, In-House Writer, OGS Group (2018) traditional home security systems are security measures taken by an individual in the form of three mechanisms namely, employing a security guard, having a basic surveillance system and installation of physical locks. Over the years traditional home security has protected thousands of homes that are still being implemented. It offers community dependability and low-cost installation. While great at promoting good relations within the community traditional home security systems are costly to maintain due to the ever-evolving nature of technology, furthermore human error cannot be ignored. A security officer may not be able to protect all corners of the property, may be corrupt or may simply fall asleep. Artificial intelligence steps in to solve these matters.

Web 3 paved the way for more efficient hustle-free methods to protect homes and communities. Modern home security systems ride on the backbone of web 3, this includes various sensors, IP cameras and alarm systems (Cf. Suzanne Elly, In-House Writer, OGS Group 2018). Artificial intelligence is defined as the capability of a digital computer to carry out functions often performed by people (Copeland 2022). AI has been successfully integrated in various security devices to increase productivity and reliability. Cameras can be integrated with an inbuilt AI system to identify individuals that come and go through the home. Intruders will be identified by the system and alert the homeowner or ring an alarm in real-time without human intervention.

Sensors such as heat, smoke and motion detectors can be added to a central system that will record and analyze normal behavioral patterns within the home, if any anomalies are detected the owner or a security company are alerted to investigate the matter. Artificial Intelligence has brought on a number of convenient functionalities into home security, for both families and security companies, however, its most used functionality is a remote control or viewing of the household. A parent can observe what the children are doing at home while they are at work and can receive alerts of any threats or breaches into the home from where ever they are.

(C.F Smart Homes: Impact of Artificial Intelligence in Connected Home 2022) predicted a significant increase in the purchase and installation of modern home security systems in the year 2023. Smart home security companies have been noted to work with companies with digital assistants within the smart home to provide a more customized experience. The author also noted that AI is a good power saving tool as it will regulate the amount of power needed by a sensor and as well only turn on certain features e.g. An alarm when need be.

The author noted that the for the system to function at peak it requires a large bandwidth and it may affect efficiency in the absence of internet connectivity.

Zimbabwe is on a path of adopting artificial intelligence into its security systems. This move greatly influences surveillance to adopt AI into their systems as well and remove any doubts seeded about the system. The country in collaboration with a Chinese organization aim to modernize the economy through the use of high-end security systems (Standard 2018). According to (Chinese firms are driving the rise of AI surveillance across Africa 2019) China is a leading competitor in the security department, with Hikvision being a trusted and well-known brand and Huawei the project of introducing and enhancing traditional security systems with artificial intelligence is predicated to be a success.

2.3 Relevance of the Theoretical Frame to the Study

Previous studies have given the researcher more depth and understanding towards the bridge between traditional and modern home security systems. The divide between the systems gave the researcher an indication of when Zimbabwe will have the needed capacity to adopt modern systems and as well anticipate the draw backs that maybe faced by the nation. The theoretical frame highlighted various advantages and disadvantages of the systems that were not taken into initial account at the beginning of the study.

Summary

The second chapter gave a thorough analysis of both traditional and modern security systems by reviewing relevant literature. The chapter continued by explaining Zimbabwe's

goal of adopting contemporary security measures and partners with access to readily available equipment.

CHAPTER 3 METHODOLOGY

3.1 Introduction

This methodology chapter describes the procedures to be followed to research the current home security systems in use across the country. The chapter covered the usage of particular techniques or strategies used to categorize, process, and interpret the data. The focus is gathering information through open and honest communication while utilizing qualitative analysis. This chapter also covers the integrity and validity of concerns related to data gathering, data analysis, and data collection methodologies.

3.2 The Research Design

The study required an approach that provides a rich and detailed understanding of how the security systems are used within Zimbabwe and as well understand the techniques being used by armed robbers within the country. The researcher chose to pursue a qualitative approach and adopt the case study research design. *(Cf. Jansen 2022)* found that for case study research it is crucial to include the social context and culture.

The researcher chose the case study design because it allowed various data collection methods which include referring to previous literature, interviews, observation and physical data collection. To fully understand how many houses use modern home security against traditional security systems the researcher made use of previously published records. In order to understand how willing people are to migrate to modern home security the researcher shall conduct interviews and perhaps hand out questionnaires. Often data presented can be misleading or slightly ignorant of what may be happening from the ground thus observation is essential in any research.

3.3 Population and Sampling

Population refers to the group of people to whom this research applies (Find the source of this). This study focused on the general residents of Zimbabwe, however, not all areas are affected the same by armed robberies thus the study focused on the hot spots of crime. McCombes (2022) defined a sample as a specific group of individuals where data or information is collected from. The sample of the study focused on Harare and Bulawayo residential areas, as they have been identified as the most affected by robberies within the year of 2021 according to a report done by a local security company *(Safeguard Crime Report – May 2021 2021).*

The researcher focused on the major security companies that provide home security surveillance and solutions in both modern and traditional aspects as they have a better understanding of their cliental and how their systems may or may not have aided in the reduction of armed home robberies within the country.

The researcher made use of probability sampling, which involved a random selection of participants which prompts strong statistical inferences about the residents *(McCombes 2022)*. Probability sampling comprises of four main techniques, simple sampling, systematic sampling, stratified sampling and cluster sampling. The research was conducted through simple sampling as it selects a random group of people from the entire population thus ensuring every group is represented.

3.4 Data Collection Instruments

1. Questioner's

The researcher handed out forms and created a digital form that was shared throughout the community and provide a better statistical graph when it comes to compilation.

2. Secondary sources

Secondary data sources include journals, blogs, websites, and materials gathered from previous research. The secondary sources were used to add flesh to the research in general and build the literature review. However, the researcher mainly relied on the statistics published by security companies.

3. Observation

In observational research, people and events are observed in their most natural environments. Instead of using organized environments like study labs or focus groups, this allows researchers to observe how their participants make decisions and respond to circumstances in their everyday lives (Cf. H 2022).

4. Interviews

(Cf. Clements 2022) found that interviews allow the researcher to gather information from a topic easier as they are able to read nonverbal forms of communication such as body language. Often people may be coerced into giving false information on questioner's or respond without much thought. Face to face communication acts as an affirmation tool to the information provided.

Interviews were done virtually on various platforms i.e. Phone calls, zoom meetings etc. This allowed the researcher to gather more information without being

physically present. The interviews comprised of the same questions highlighted on the questioner.

3.5 Data Collection Procedure

In order to find out the answers to specific research questions, test theories, and evaluate results, the data collection method is crucial. The researcher created an online survey using google forms, due to its provision of anonymity required by the respondents and as well increase the sampling area.

3.6 Analysis and Organization of Data

The researcher made use of Google forms to create an online survey. This survey depicts the responses given in the form of graphs and charts and highlight the frequent response. Information gathered from interviews were noted down in Microsoft Excel for further analysis. Secondary sources utilized were referenced accordingly throughout the study and observations were noted as such.

3.7 Ethical Consideration

1. Respondents were provided with sufficient information about the study. Respondents are free to withdraw their consent.
2. The researcher did not ask for any personal information or information that may endanger the interviewee
3. The researcher did not disclose the name of companies that provided statistical information and did not ask for any confidential information but rather kept it general
4. The information collected by the researcher was not be used for anything other than the purpose of completing this dissertation.
5. The researcher did not alter any gathered information in any manner.

3.9 Summary

This chapter highlighted the research design that would be carried out during the study. The study carried out utilized the case study qualitative design that provides a flexible data analysis method. The researcher also highlighted the key questions that were asked during interviews and the questioners and as well highlighted the ethical considerations for the research.

CHAPTER 4 DATA PRESENTATION, INTERPRETATION AND ANALYSIS

4.1 Introduction

The primary objective of the chapter is to present the data collected in a neat and readable manner and interpret the given data. Data collection was done in relation to the research objectives stated at the beginning. The researcher made use of two questionnaires, one for installation technicians and another for the public mainly targeting two main residential cities. The findings are presented in chart format, color coded, and clearly labelled for accurate interpretation.

4.2 Data Presentation and Analysis

4.2.1 Survey 1: Security Installation Technicians

The survey sample consisted of traditional and modern security installation technicians from different companies within the country. The study aimed to compare the two security methods while developing an appreciation of modern security systems.

4.2.1.1 What security systems do you offer?

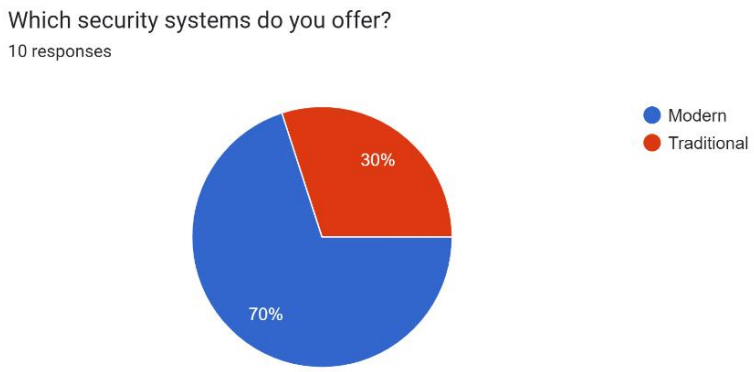

Figure 1.1

All research participants had a working understanding of modern security systems however 70% of respondents offer modern systems while 30% offer traditional systems. Corporations within the country value their security thus the need for reliable remote security tools. Traditional security methods alone are not enough to fully protect businesses within the country, due to the high response time and unreliability. Offering both systems will guarantee a continuous stream of income from both sectors of security within the cooperate world.

4.2.1.2 How many installations of artificial intelligence-based home security systems have you done within the country?

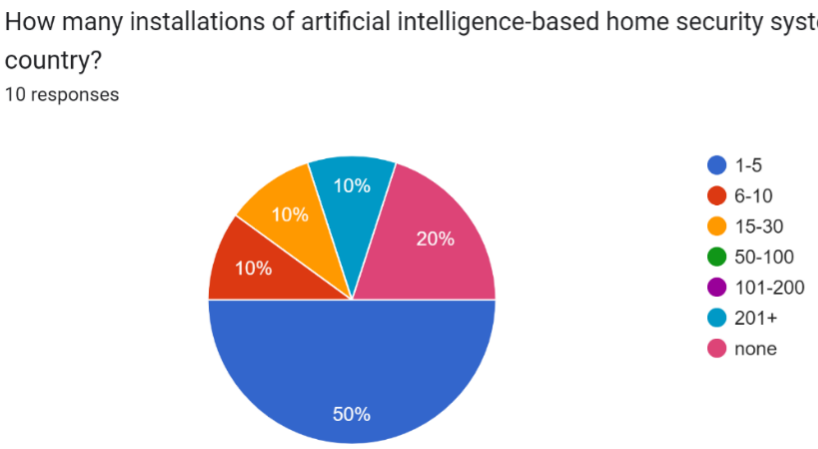

Figure 1.2

Their respective organizations offer different security plans and payment methods to cater for every customer. However, modern security systems are mostly installed in cooperations and very few in residential areas. 50% of installation technicians have installed modern security systems in one to five households within their professional life and 20% of technicians have not installed modern security systems.

4.2.1.3 Are customers satisfied with AI based security systems?

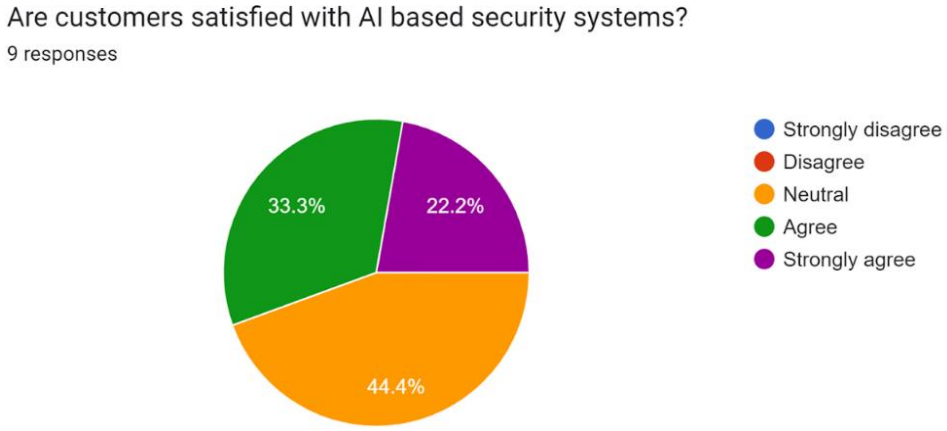

Figure 1.3

A satisfied customer is more likely to recommend a product and continue purchasing more solutions or upgrading an existing system. Customers who returned a positive review deemed it a worthy investment, however, due to the country's current poor electricity supply, traditional security systems are highly recommended. Modern security systems require a constant electricity supply and a reliable internet connection to reach optimum functionality.

Apart from the country's lack of adequate power supply technicians face challenges in educating their customers on various systems and good security practices. Technicians have noted that potential clients find modern security systems very costly and are highly skeptical of the technology, due to Hollywood fiction. After a walk-through of the various security systems they have to offer, a few are convinced to consider a future investment.

4.2.1.4. What are the challenges faced when presenting AI based home security systems?

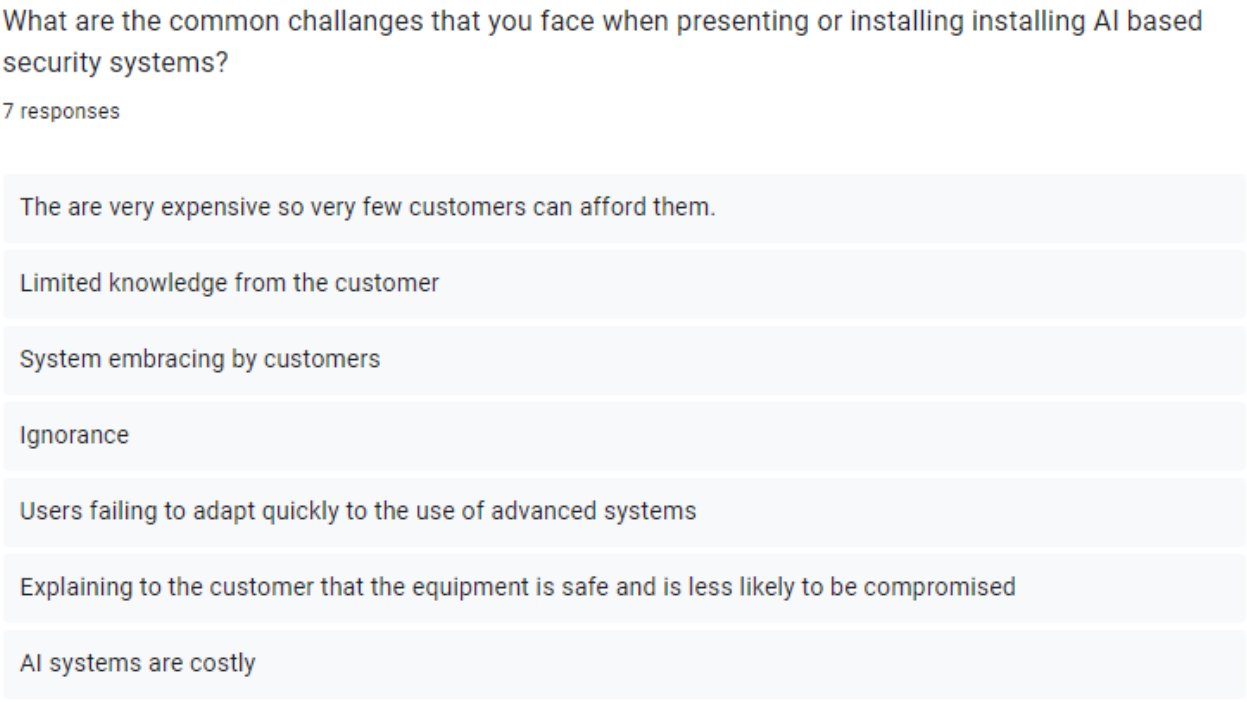

Figure 1.6

4.2.1.5 Do you agree AI based home security systems reduce the impact of armed robberies within the country ?

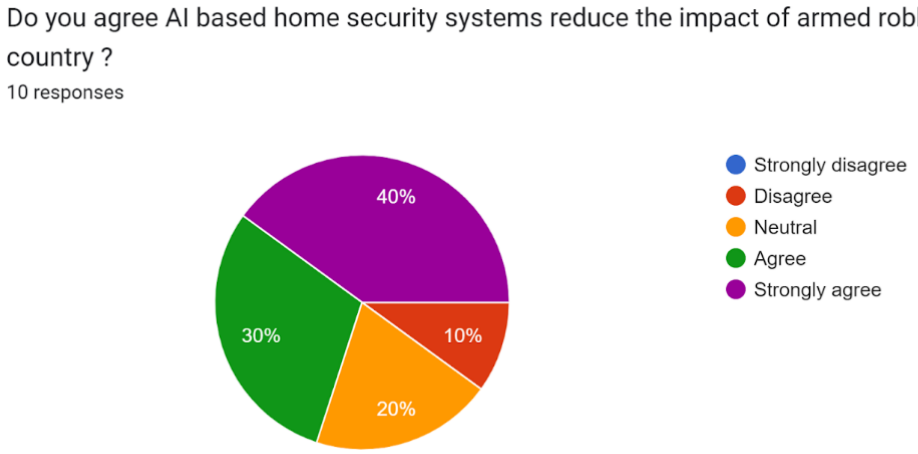

Figure 1.5

Technicians were asked if they thought that modern security systems would reduce the impact of robberies in the area and 70% were inclined to agree while 20% were not certain and 10% believed it would not make a difference due to the resilience of robbers.

4.2.2 Survey 2: Zimbabwean residents

4.2.2.1 Age of Participants and gender

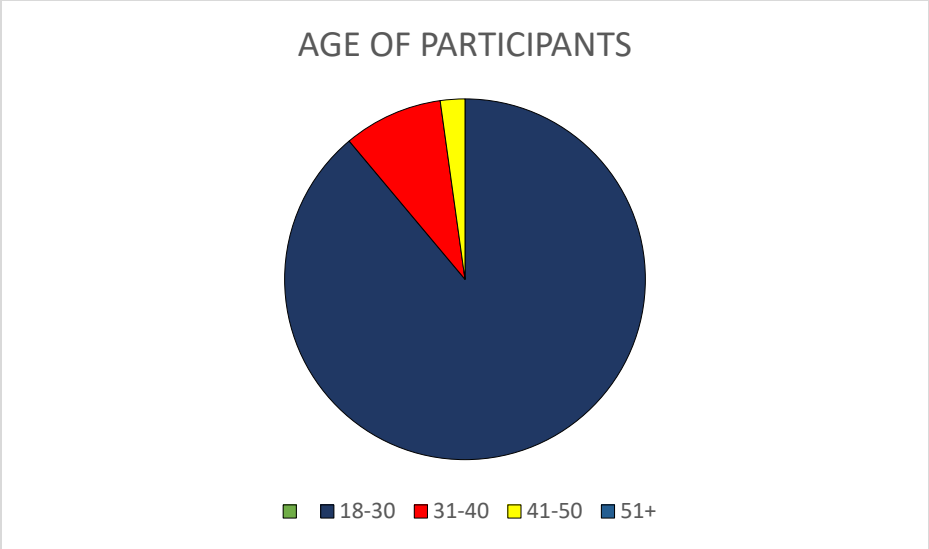

Figure 2.1.1

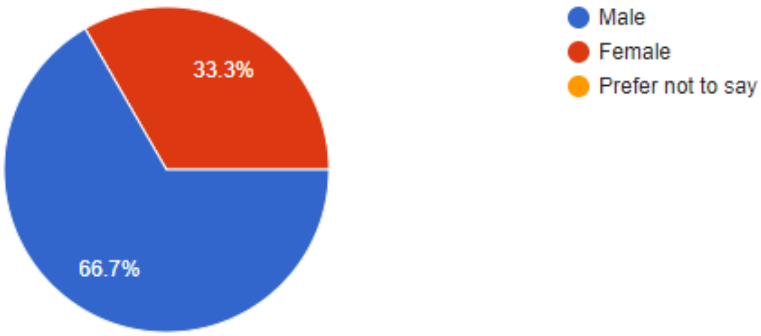

Figure 2.1.2

In order to give the researcher an accurate depiction of the generation of the homeowners, the participants were asked about their age over 88% are between eighteen and thirty years old while 8.9% are between thirty-one and forty years old and 2.2% of respondents were between forty-one and fifty years old. With the majority of respondents being male and 33.3% being female respondents.

4.2.2.2 Area of residency and rate of robberies within the past year

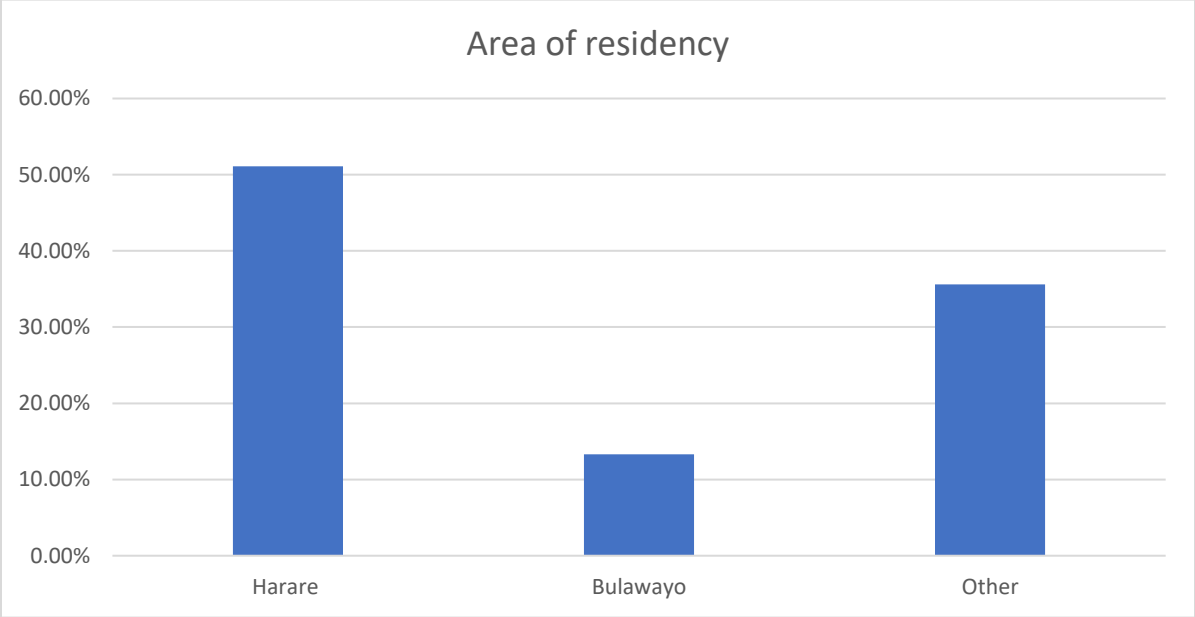

Figure 2.2

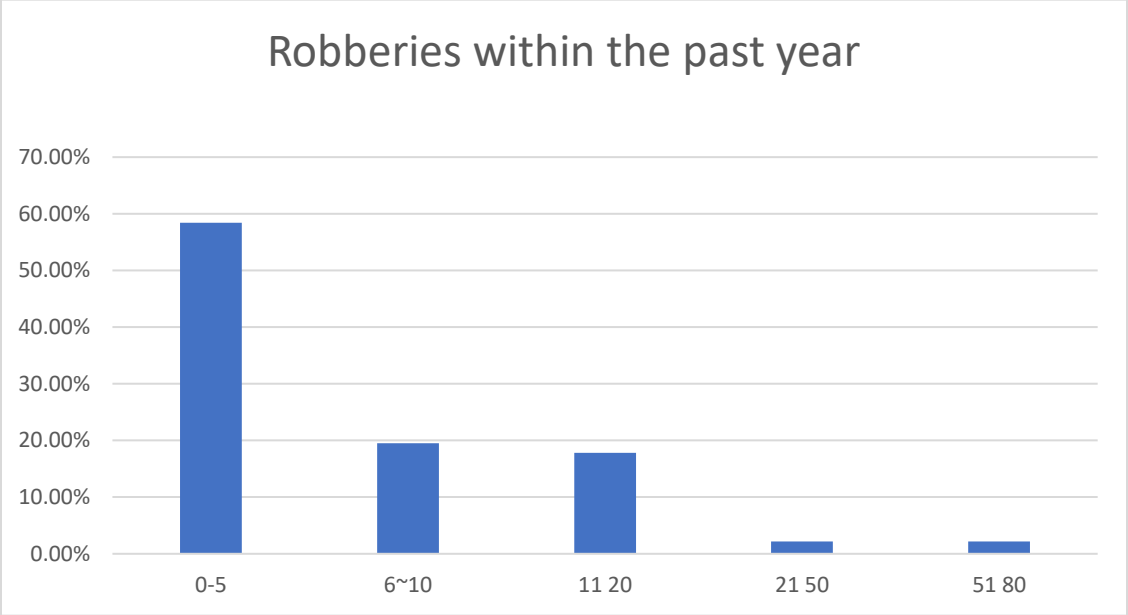

Figure 2.3

51.1% of respondents live in Harare, the capital city which holds the highest crime rate and 13.3% of respondents live in Bulawayo. The researcher mostly focused on the two cities,

however respondents from other parts of the country were allowed to participate in the research as shown in the figure above. 77.8% of the respondents faced 0-10 robberies in the past year and 17.8% received 11-20 robberies in the last year.

4.2.2.3 Home security measures implemented

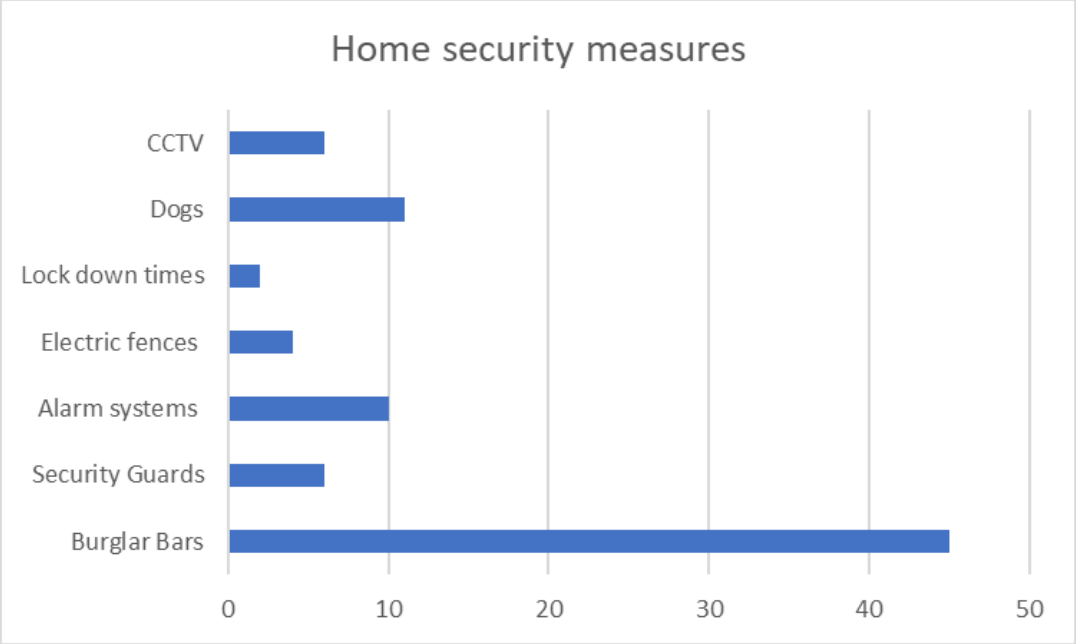

Figure 2.4

The above graph shows the steps taken by the respondents to protect themselves and their homes from theft. Respondents use traditional systems such as burglar bars, fences, external guards, locks, and security dogs around their property. While a smaller percentage have included modern security systems such as CCTV, alarm systems, and motion sensors connected to flood lights.

4.2.2.4 Are you familiar with AI home based security systems

Although the number of respondents with modern security systems is few, over 91.1% of respondents are aware of artificial intelligence and 75.6% are aware of AI-based home security. 24.4% of respondents were not aware of AI-based home security however 88.9% showed interest to learn more about these systems.

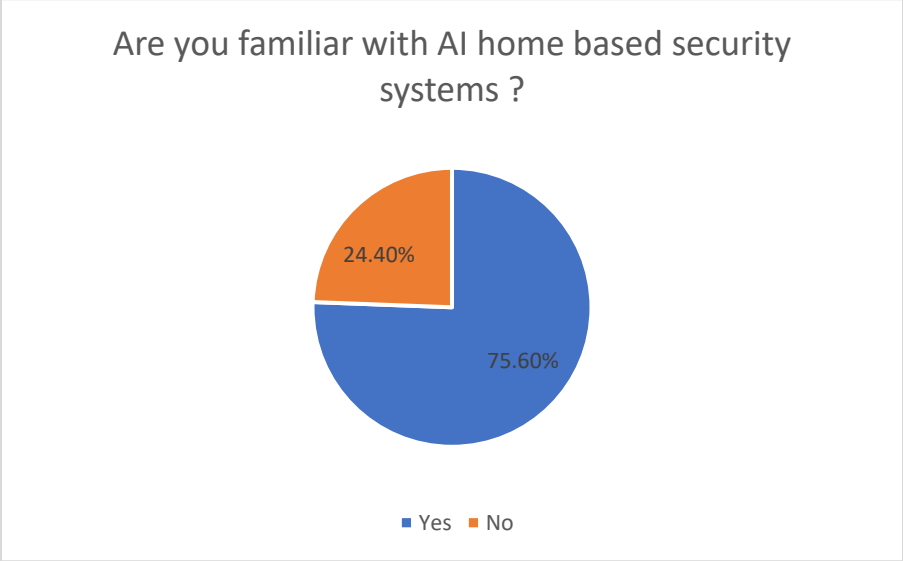

Figure 2.5

4.2.2.5 Do you think artificial AI based home security systems will aid in the reduction of robberies

The majority of the respondents were familiar with technical aspects such as the Internet of Things and its applications, however upon being asked further why they did not implement these functions in their homes the main reason was cost and unreliable resources such as network and electricity. The researcher asked the respondents if modern security

systems can be implemented in the residential areas of Zimbabwe and 71.1% agreed provided the needed base resources were provided while 28.9% did not agree.

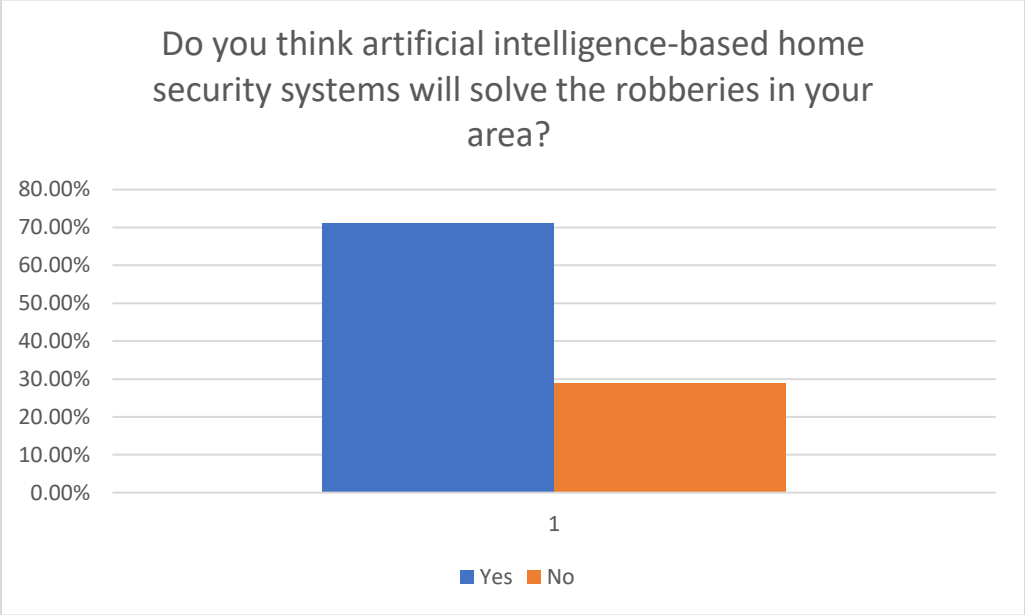

Figure 2.6

4.2.3 Secondary Data

The secondary gathered aims to highlight the current and future use of artificial intelligence based systems within the country's residential area. The study aims to bring to light the current concerns relating to the use of modern security systems and the type of modern system in use.

Zimbabwe has been working towards the implementation of artificial intelligence-based security systems within the police force. The police installed CCTV cameras for traffic monitoring in Harare and Bulawayo through Huawei solutions, a company based in China.

The use of modern security cameras within the city provides, a quicker response to the scene while producing real-time evidence of the crime as opposed to traditional systems that rely solely on eye witnesses. Police resources will no longer be stretched through patrol as centralized monitoring will require a few officers at a time. (Dyson, 2022)

The government of Zimbabwe in partnership with Mulk International, a Dubai-based company have begun a Zim Cyber city residency project in Harare. The project aims to create a technologically advanced city with a reduced carbon footprint and a safe city through the use of artificial intelligence-based security systems. The project has raised various concerns among the public highlighting the high cost of living within the city and privacy concerns as it is stationed within the suburban area. Artificial intelligence-based security systems with the smart residency will provide over 6000 security cameras with 24/7 surveillance monitoring. Although this may offer a reduction in the crime rate, the citizens are concerned about the use of the data as the country has a poor human rights record. (Gilbert Nyambabvu, 2023)

4.4 Summary

The chapter reviewed the findings from the study questionnaires, interviews and secondary data. The research questions asked by the researcher aimed to present the adoption of modern security systems within Zimbabwe and the public understanding and acceptance of artificial intelligence within the country. The researcher as well engaged with installation technicians to highlight the disadvantages of traditional security systems and how to aid in the adoption of modern-based security systems at an affordable margin within the country.

4.3 Discussion and Interpretation

4.3.1 What are the weaknesses of traditional home security systems in Zimbabwe?

The research was able to note the weakness of traditional home security systems within the country. The researcher noted that the participants who used modern security systems, such as CCTV and electric fences and alarm systems reported they received 0-5 robberies in the past year as opposed to those who only relied on traditional systems reported that they received 5-20 robberies within the area (figure 2.3).

4.3.2 How artificial intelligence can be used to solve and address the weakness of the traditional home security systems

The study was able to identify the advantages of artificial intelligence over traditional home security systems. Secondary research has shown that modern security systems have various advantages over traditional systems. Using the Zim Smart city as a case study, the government has used artificial intelligence-based security systems within the city, to provide:

1. A quick response time due to alarm systems
2. A tracking platform for criminals due to the use of facial recognition
3. An understanding of the potential use of artificial intelligence.

However the study noted that modern security systems can be used hand in hand with traditional security systems. In scenarios where there is no electricity and modern security systems are offline, the traditional locks work as an efficient back up ensuring the house is always protected.

4.3.3 Assess how modern home security systems can be implemented within the country at an affordable price.

The study was able to asses how modern home security systems can be implemented within the country at an affordable price. In order to fully understand how security systems can be successfully implemented within Zimbabwe the researcher asked technicians within the security sector about the challenges faced when pitching modern home security systems. The participants have revealed that there is not enough knowledge from the public on how the systems work and the resources needed to power the system. Modern home security systems need a constant internet connection and power to function, however, currently, the country is facing inflated data charges and severe load shedding thus to successfully implement the system the two constraints will need to be resolved.

4.3.4 Assess the importance of modern home security systems.

Artificial intelligence has been used in home security systems to improve the safety of homes, through the provision of monitoring, detection and alarm tools. The IoT devices send the data collected to an artificial intelligence program that can analyze potential home security issues continuously, through the use of a variety of features, including threat analysis, facial recognition, and smart home integration.

These various features give homeowners a sense of control over the activities that occur within their homes. According to Gartner, a global research and advisory firm, by 2021, artificial intelligence will become one of the top five investment priorities for at least 30% of CIOs within Zimbabwe.

CHAPTER 5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a summary of the findings in chapter four while highlighting the conclusion and recommendations from the data interpretation. The recommendations stated in this chapter are based on the limitations of the current study. The chapter will further more show the implications of artificial intelligence in home security.

5.2 Discussion

The study aimed in highlighting the weakness of traditional home security methods, educate the public on various modern security technics and present how modern security systems can be used to reduce the crime rate while being affordable to the public. The researcher was able to use the data gathered to answer the research questions stated in Chapter 1 of the study.

The researcher observed that modern home security tools were able to secure homes and give them the peace of mind they deserve however in order to provide the solution at a cheap cost the country will need to have a reliable power grid and cheaper data costs.

5.3 Conclusions

5.3.1 To assess the importance of modern home security systems.

The study was able to note that modern home security systems provide twenty-four-hour monitoring and alert homeowners of any suspicious activity around their property at any given point. In the event of theft before the police are able to view how the intruder entered the property and what was taken. This information can lead to a quick arrest and recovery of goods, thus quick capture of criminals will reduce the crime rate within the city.

5.3.2 To analyze the weakness of traditional home security systems in Zimbabwe.

The researcher noted that households that were solely protected by traditional home security systems experienced higher attempts and break-ins in comparison to those who use modern security systems. Traditional security systems are cheaper in comparison and can be applied in various ways to protect the household. However to successfully protect the home more than one type of security system must be used ie. The participants highlighted that in order to protect their homes effectively they needed burglar bars, locks, guard dogs, fences etc. The solutions combined offer protection. Whereas those that made use of modern security systems only used one solution.

5.3.3 To identify how artificial intelligence can be used to solve and address the weakness of the traditional home security systems.

Artificial intelligence can be used to further secure households by alerting the homeowner and the police of any unusual activity around their household before the breach and while also alerting the neighbors by use of an alarm. Traditional security systems rely on

eyewitness accounts to find the intruder thus in scenarios where there are no witnesses the crime takes longer to solve. Artificial intelligence makes use of IoT devices such as cameras and sensors around the home to give an accurate description of the intruder thus leading to a quick arrest. Artificial intelligence has shown that it can be used to address the weaknesses of traditional systems.

5.3.4 To assess how modern home security systems can be implemented within the country

During the study, the researcher noted that modern security systems do not cost a lot, however, in order to maintain their efficiency the owner has to ensure that there is a stable internet connection and a stable source of power. Currently, Zimbabwe is facing massive power cuts where residents can go for more than twelve hours without power, thus secondary power is needed. Alternative power solutions are expensive and thus increase the cost of the security solution.

5.4 Implications

Artificial intelligence has improved home security through monitoring, quick detection and alert. Modern home security systems offer various advantages over the use of traditional systems, however, there are risks and ethical concerns in regard to privacy, and the collection of personal data. Modern home security systems are less likely to be attacked however the risk of being breached exists. However less likely all precautions must be taken.

5.5 Recommendations

5.5.1 Recommendation to the researcher

Artificial intelligence is a fast emerging tool that will be implemented across the globe in various sectors. During the course of the study, participants had a working understanding of what artificial intelligence is, in terms of smart assistance but where not aware of the other current applications e.g. Facial recognition software, auto text generation etc. The research can be conducted in a manner that will allow both data collection and education on technology.

The study was centered on smart homes across Zimbabwe however during the course of the study the researcher noted that the scope can be narrowed down to one city and divided according to the suburbs. The division will provide a more accurate description on how the type of location and housing fascilities as well as the generic cost of living of the area. The data will aid in identifying who can afford the modern security systems and at what cost.

5.5.2 Recommendation to security solution technicians

Artificial intelligence is a fast-emerging tool that will be implemented across the globe in various sectors. During the course of the study, participants had a working understanding of what artificial intelligence is, in terms of smart assistance but were not aware of the other current applications eg. Facial recognition software, auto text generation etc. The research can be conducted in a manner that will allow both data collection and education on technology.

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5.5.2.1 Managing power outages

Companies that provide modern home security systems should partner or provide back up power solutions. The study highlighted that the lack of electricity within the country has affected the efficiency had marketability of modern home security system, however if back up or alternative sources of power are presented it may improve the situation.

5.2.2.1 Marketing to existing clients

It is important not only to educate new clients on modern security systems within their smart homes it is also important to update the existing clients on the new security solutions being offered, clearly highlighting the advantages and needs of each solution.

5.5.3 Recommendation to the Ministry of Information Communication and technology

5.5.3.1 Reduction of power outages

Modern security systems require constant provision of electricity to function optimally. By insuring that residents have electricity in the evening and have a guideline of loading

shedding hours, this will allow residence to make informed decisions on back up power solutions to fully secure their household.

5.5.3.2 Educating the public security systems

The study has shown that citizens are not aware fully aware of modern security systems and their knowledge of Artificial intelligence is largely from Hollywood content. By educating people on how security systems have improved over the decades and the laws surrounding the use of surveillance footage, the public will then be equipped with the necessary tools to make informed decisions about their security.

5.5.3.3 Data Policies and regulations

The Ministry of ICT should establish policies and regulations on how CCTV footage captured near or surrounding smart homes should be used and who should have access to it. The citizens of Zimbabwe believe that there are not enough policies in regards to their privacy. Privacy regulations will guarantee that each residents privacy is guaranteed while insuring that those who breach the policy are met with fines and penalties. The Ministry of ICT should work with the stakeholders to ensure the policies are implemented successfully..

5.5.4 Conclusion

The recommendations provided in this chapter aim to address the challenges identified by the study and aid other researchers who will carry on the study. The recommendations highlighted include addressing power cuts, addressing alternative power sources, mass education and potential business expansion.

5.5 Suggestions for Further Research

Further research should take into account the following areas surrounding the application of artificial intelligence:

1. The privacy and data protection policies surrounding artificial intelligence-based security systems. This research will bring to light the various security protocols and policies surrounding the security system.
2. AI-based security systems can be used in conjunction with renewable energy. The research aims to show how security devices can have a constant power source without connecting to the main power supply.
3. The accuracy of modern security systems in detecting unusual activity and reducing the number of false alarms.
4. Comparison of the effectiveness of different modern security systems in enhancing home security.

5. How Artificial intelligence can be used to improve building performance and optimize resource consumption. This research will highlight how smart meters, energy usage data and weather data can be used to improve resource utilization.
6. The use of artificial intelligence in analyzing data collected from multiple buildings, to improve building design and construction for future urban planning.

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APPENDICES

Informed consent

My name is Tatenda Maruta, a final year Computer Science student from Africa University. I am kindly asking you to participate in this study by filling in the questionnaire or participating in a short interview.

The purpose of the study is to show how home security systems integrated with artificial intelligence can aid in the reduction of robberies within Zimbabwe. You were selected for the study because you are a resident of the major affected area. The study aims to reach 150 participants.

If you decide to participate, you will answer questions or participate in the interview. It is expected that this will take about 10 minutes.

There is no harm or risk whatsoever expected from this practice. The research aims to inform the public about home security systems and how they may aid in the reduction of robberies within the country

No personal detail or name of the participant shall be disclosed to anyone unless one is willing to let it be disclosed. Sensitive information will be confidential and treated with secrecy.

Participation in this study is voluntary. If a participant decides not to participate in this study, their decision will not any relationship. If they chose to participate, they are free to withdraw their consent and discontinue participation without penalty.

Before you sign this form, please ask any questions on any aspect of this study that is unclear to you. You may take as much time as necessary to think it over.

If you have decided to participate in this study please sign this form in the space provide below as an indication that you have read and understood the information provided above and have agreed to participate.

---------- ----------

Name of Research Participant (please print) Date

Signature of Research Participant or legally authorised representative

If you have any questions concerning this study or consent form beyond those answered by the researcher including questions about the research, your rights as a research participant, or if you feel that you have been treated unfairly and would like to talk to someone other than the researcher,

please feel free to contact the Africa University Research Ethics Committeeon telephone (020) 60075 or 60026 extension 1156 email aurec@africau.edu

Name of Researcher: Tatenda Maruta

Questionnaire

For residents

- How many robberies have been in your area?
- Age of participant:
  - 20-30
  - 31-40
  - 41-50
  - 51+
- Gender:
  - Male
  - Female
- What steps have you taken to protect your home?
- What steps have you taken to protect your neighborhood?
- Please rate your understanding of the IoT environment
  - Advanced
  - Intermediate
  - Novice
- Are you familiar with Artificial intelligence?
  - Yes
  - No
- Are you familiar with artificial intelligence-based home security systems (modern security systems)?
  - Yes

- No

- Would you be open to using artificial intelligence-based home security systems?
  - Yes
  - No
- How well do you think artificial intelligence-based home security systems will solve the robberies in your area?
- What is your city of residency?

The questions asked to the security companies will be:

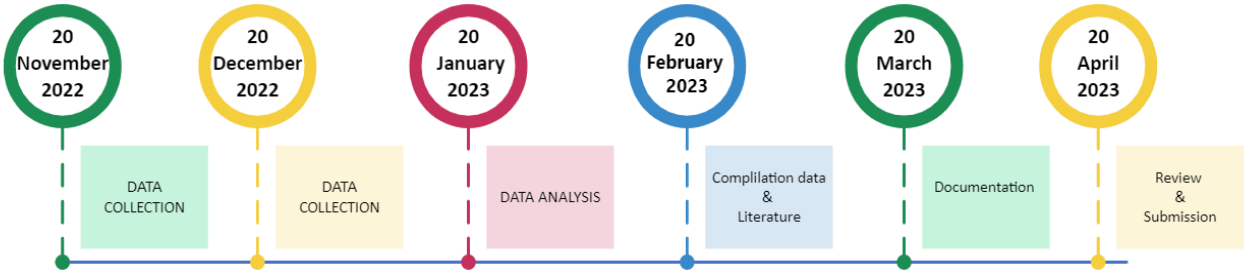
- Which security systems do you offer?
  - Modern
  - Tradtional
- Are you familiar with artificial intelligence-based home security systems?
  - No
  - Yes
- How many installations of artificial intelligence-based home security systems have done within the country?
  - 1-5
  - 6-10
  - 15-30
  - 50-100
  - 101-200
  - 201+

- Do you recommend the installation of these systems?
    - Yes
    - No
- What are the challenges faced when installing or pitching modern security systems?

Project Budget

	ACTIVITY	**COST (USD$)**
1	Designing of Questionnaire	**10**
2	Printing of Questionnaire (if need be)	**5**
3	Library resources	**30**
4	Cab Fare (If need be)	**30**
5	Data for online interviews	**25**
		100

Project Timeline



	November 2022	December 2022	January 2023	February 2023	March 2023	April 2023
Data Collection						
Data Analysis						
Compilation of Data & Literature						
Documentation						
Review and Submission						

Approval note from AUREC

AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE (AUREC)

P.O. Box 1320 Mutare, Zimbabwe, Off Nyanga Road, Old Mutare-Tel (+263-20) 60075/60026/61611 Fax: (+263 20) 61785 website: www.africau.edu

Ref: AU2387/22 10 November, 2022

TATENDA MARUTA
C/O CBPLG
Africa University
Box 1320
MUTARE

RE: ANALYSIS OF AI SYSTEMS IN ENHANCING HOME SECURITY. CASE STUDY OF ZIMBABWE SMART HOMES

Thank you for the above titled proposal that you submitted to the Africa University Research Ethics Committee for review. Please be advised that AUREC has reviewed and approved your application to conduct the above research.

The approval is based on the following.

a) Research proposal

- **APPROVAL NUMBER** AUREC 2387/22
  This number should be used on all correspondences, consent forms, and appropriate documents.
- **AUREC MEETING DATE** NA
- **APPROVAL DATE** November 10, 2022
- **EXPIRATION DATE** November 10, 2023
- **TYPE OF MEETING** Expedited
  After the expiration date this research may only continue upon renewal. For purposes of renewal, a progress report on a standard AUREC form should be submitted a month before expiration date.
- **SERIOUS ADVERSE EVENTS** All serious problems having to do with subject safety must be reported to AUREC within 3 working days on standard AUREC form.
- **MODIFICATIONS** Prior AUREC approval is required before implementing any changes in the proposal (including changes in the consent documents)
- **TERMINATION OF STUDY** Upon termination of the study a report has to be submitted to AUREC.

AFRICA UNIVERSITY
RESEARCH ETHICS COMMITTEE (AUREC)
APPROVED
P.O. BOX 1320, MUTARE, ZIMBABWE

Yours Faithfully

MARY CHINZOU
ASSISTANT RESEARCH OFFICER: FOR CHAIRPERSON
AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE