ACCRA TECHNICAL UNIVERSITY

HUMAN DETECTING AND COUNTING SYSTEM FOR BANKS USING ATU ACCESS BANK AS A CASE STUDY

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DECLARATION BY STUDENTS

This project is submitted as part of fulfilment for the award of an **HND** in **Computer Science** The work is a result of our investigation. All section of the text and results which have been obtained from other works/ sources are fully referenced. We understand that cheating and plagiarism constitute a breach of Accra Technical University and will be dealt with accordingly.

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DEDICATION

I dedicate this book to the Most High God, my lovely parents, my siblings, my friends and all my lecturers for their support assistance throughout my training.

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I will take this opportunity to show my gratitude to everyone who made this project a success. However, it will not have been possible without the kind support and help of my classroom colleagues. I would like to extend my sincere thanks to all of them. I am highly indebted to my Supervisor, HOD, Lecturer One, Lecturer Two etc. for their guidance and constant supervision providing necessary information regarding the project and also their support in completion. I will like to express my gratitude towards my mom for her kind cooperation and encouragement which helped in the completion of this project.

ABSTRACT

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Banks play a crucial role in the economic development of any country, and in Ghana, they are no exception. Banks must now actively track the number of persons entering their buildings for reasons of safety, security, and resource management as a result of an increase in the number of consumers visiting banks (Adjei & Addo, 2019). Yet, conventional manual counting techniques are frequently time-consuming and unreliable, requiring the use of an automated system for consumer detecting and counting (Danso & Ansah, 2018).

The implementation of a human detecting and counting system in banks is of great academic and practical importance.

From an academic perspective, this study represents a significant development in the field of computer vision and artificial intelligence, as it utilizes sophisticated algorithms to detect and track individuals' movements. From a practical perspective, the study will become an essential tool for banks to manage their resources effectively.

Previous studies have investigated the use of human detecting and counting systems in various settings, including banks.

- Smart video surveillance for public safety by Wang & Hui (2017) explored the use of smart video surveillance systems in public spaces, including banks.
- Occupancy estimation and people counting for intelligent building applications by (Animesh et al., 2018).

Despite the existing literature on human detecting and counting systems, there are still significant gaps and inconsistencies in the literature.

- One major gap is the limited research on the implementation and impact of these systems in the banking industry, particularly in Ghana.
- The major contribution of this study is to provide valuable insights into the implementation and impact of human detecting and counting systems in the banking industry.

Accurately identifying and counting clients in real time, particularly in busy and congested environments, is one of the biggest issues facing banks in Ghana (Boakye & Adjei, 2019). This is caused by a number of elements, including individuals moving in groups or near proximity to one

another, shifting illumination, and the presence of additional items like seats and tables (Agyapong & Adjei, 2018). These issues may lead to inaccurate client counts, which may have serious repercussions including overcrowding or underutilization of resources (Adjei & Boakye, 2016).

In addition, since clients could feel uneasy about being watched, privacy and security are key issues with human detecting and counting systems in banks (Frimpong & Agyei, 2018). This calls for the creation of human identification and counting technologies that reliably identify and count clients while simultaneously ensuring their privacy and security while they are inside the bank (Adomako & Boateng, 2018).

The effectiveness of human identifications and counting systems utilizing computer vision and the SSD algorithm in bank facilities has been tested in a number of trials. For instance, a research on the Single Short MultiBox Detector (SSD) algorithm's effectiveness of such a system in an ATM area of a bank was done by Srinivas et al., (2019). The results showed that the system was capable of properly recognizing and counting people in real-time with an accuracy rate of above 98%.

The study's background is important because it helps to understand the benefits and difficulties of adopting human detecting and counting technologies in a bank environment in Ghana. The findings of this study will be more applicable and relevant to other banks in Ghana and other African nations that deal with comparable problems because it was conducted specifically in the setting of the Accra Technical University Access Bank branch.

In summary, there is a pressing need to develop a human detecting and counting system for Accra Technical University Access Bank branch in Ghana that can accurately detect and count customers in real-time, even in crowded and busy scenes, and ensure the privacy and security of customers (Yeboah & Adomako, 2016). This will require the development of advanced algorithms that can effectively distinguish between customers and other objects in the scene, and the integration of privacy-preserving technologies to ensure the security and comfort of customers (Adjei & Yeboah, 2018).

1.2 STATEMENT OF THE PROBLEM

The Accra Technical University Access Bank branch faces several challenges in managing customer flow, ensuring the safety and security of its customers and employees, and providing high-quality customer service.

The traditional method relies on security personnel who manually count customers entering and exiting the bank premises. This method is not only time-consuming but also prone to human error, leading to inaccurate data on customer traffic.

Moreover, traditional security measures, such as security personnel stationed at the entrance, are not always effective in preventing security breaches and can be expensive to maintain.

Making sure that social distance laws and regulations are followed is another issue Access Bank at Accra Technical University in Ghana has. The COVID-19 pandemic has highlighted the need for individuals to keep a safe distance from one another in order to stop the virus from spreading (CDC, 2020).

The proposed solution of implementing a computerized human detecting and counting system can address the challenges faced by the Access Bank branch at Accra Technical University that not only accurately detect and count customers, but also a reliable method to ensure the safety, privacy and security of customers while they are in the bank.

1.2.1 Research Questions

Our study seeks to provide answers to the following **Research Questions**;

- What current system is in place for detecting and counting customers in Access Bank branch at Accra Technical university?
- What are the challenges with the current system for detecting and counting customers at Access Bank branch Accra Technical University?
- In reference with research question two, how can a computerized human detecting and counting system be developed and put into use in Access Bank branch at Accra Technical University to enhance customer service, increase security, and improve operations?

1.3 OBJECTIVES OF THE STUDY

The primary objective of this research is to develop a human detecting and counting system for Access Bank in Accra Technical University that can accurately count customers entering and exiting the bank premises, without the need for security personnel. The specific objectives of the study are:

- To verify the current system for detecting and counting customers in Access Bank branch at Accra Technical University?

- To investigate the challenges of the current system been used for detecting and counting customers at Access Bank Accra Technical University branch and enhance it.
- To propose a computerized human detecting and counting system to tackle the challenges faced by the current system of detecting and counting customers at Access Bank branch at Accra Technical University

1.4 SIGNIFICANCE OF THE STUDY

The proposed human detecting and counting system for Access Bank in Accra Technical University has several potential benefits, including:

- The study can help to reduce the workload of security personnel, allowing them to focus on other security-related tasks.
- The study can provide more accurate customer counting data, which can be used to make better business decisions.
- The study can help to identify potential security threats by monitoring the number of people entering and exiting the bank premises.
- The study can help reduce the need for additional security personnel, resulting in cost savings for the bank.

1.5 ORGANIZATION OF THE STUDY

- **Chapter One** - Introduction: This chapter presents the general introduction of the research project which comprises the background of study, problem statement, research questions, objectives, significance of the study.
- **Chapter Two** - Literature Review: Literature relevant to the study is reviewed in this chapter. Theories and models that form the foundation of a human detecting and counting system are identified and discussed.
- **Chapter Three** - Methodology: This chapter elaborates on the research methodological approach and highlights the research strategy.
- **Chapter Four** - Proposed System and Implementation: This chapter provides the steps involved and required to build/develop the proposed system and its implementation procedure.
- **Chapter Five** - Conclusion and Recommendation: Chapter Five summarizes this research work with conclusion and recommendations for the future.

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

A description of the literature's elements is given in this section. The Accra Technical University's assessment of the literature on human detecting and counting systems for banks places special emphasis on crucial elements such as: (i) definition human detecting and counting system, (ii) key words and terminologies used, (iii) traditional/manual counting system versus computerized human detecting and counting systems, (iv) overview of human detecting and counting systems in banks, (v) importance of human detecting and counting system for banks, (vii) models and frameworks used in human detecting counting for banks, (viii) benefits and challenges of human detecting and counting system in banks, (ix) Theoritical framework and (x) Related works of human detecting and cunting systems for banks.

2.1 DEFINITION OF HUMAN DETECTING AND COUNTING SYSTEMS

The literature on human detecting and counting systems is extensive and varied (Chaudhari et al., 2018). A human detecting and counting system are a technology-based system that utilizes sensors, cameras, or other automated methods to detect and count people in a given area (Chaudhari & Patil, 2018). This system can be used in various applications, including security and surveillance, retail analytics, and traffic monitoring (Singh, Kaur, & Singh, 2019). The system uses advanced algorithms and machine learning techniques to accurately detect and count people, reducing the likelihood of errors and providing real-time data (Singh, Kaur, & Singh, 2019). For instance, a study by Hassan et al., (2018) explored the use of human detecting and tracking systems in banks to enhance security measures. These systems automatically detect and count the number of people entering or exiting a particular area, such as a bank, mall, or church (Zhang et al., 2020). According to Szeliski, (2011), Tung et al., (2018) computer vision involves a range of tasks, including image and video processing, pattern recognition, object detecting, tracking, and scene reconstruction that aims to develop algorithms and mathematical models that enable machines to interpret, analyse, and understand visual data from the real world. Human detecting is a challenging task due to the variability in human appearance, pose, and motion, as well as changes in lighting and background conditions. The authors reviewed the recent advancements in human detecting methods, including

traditional feature-based approaches, deep learning-based methods, and hybrid approaches that combine both methods (Jain et al.,2016; Jain & Jain,2020). One popular method for human detecting is using deep learning algorithms, such as convolutional neural networks (CNNs), to analyse images or videos and identify regions that contain humans (Jain et al., 2019). Other methods include background subtraction, optical flow, and feature-based methods (Li et al., 2020). However, there are many challenges in human detecting, including variations in lighting, posture, clothing, and occlusion (Mehmood et al., 2021). Human detecting has various applications, such as detecting and tracking people in surveillance systems, monitoring pedestrian traffic, and enabling gesture-based interaction in augmented and virtual reality. It is also being used in healthcare for patient monitoring and fall detecting (Szeliski, 2010; Javed et al., 2020). Human detecting is an important area of research with various applications in different fields. With the advancement of deep learning and other technologies, human detecting systems are becoming more accurate and efficient, paving the way for further development and applications (Singh, Kaur, & Singh, 2019).

2.1.1 Terminologies

- Machine learning (ML) is a subset of AI that involves the use of statistical techniques to enable computer systems to learn and improve automatically from experience without being explicitly programmed (Alpaydin, 2010).
- Single Shot MultiBox Detector (SSD) which stands for, is an object detecting algorithm used in computer vision (Liu et al., 2016).
- Deep learning (DL) is a type of machine learning that involves training artificial neural networks with multiple layers to recognize patterns in data (Goodfellow et al., 2016).
- Object detecting refers to the process of identifying and localizing objects within an image or video (Girshick, 2015).
- Convolutional Neural Network (CNN) is a type of neural network that is particularly well-suited for image and video processing tasks, such as object detecting, by using a series of convolutional layers that extract and combine features from input data (LeCun et al., 1998).

- OpenCV (Open-Source Computer Vision Library) is an open-source computer vision and machine learning software library that provides a wide range of tools and functions to enable developers to create computer vision applications (Bradski, 2000).
- Figure 1 and 2 below shows how SSD (Single Shot MultiBox Detector) model works in detecting objects such as humans.

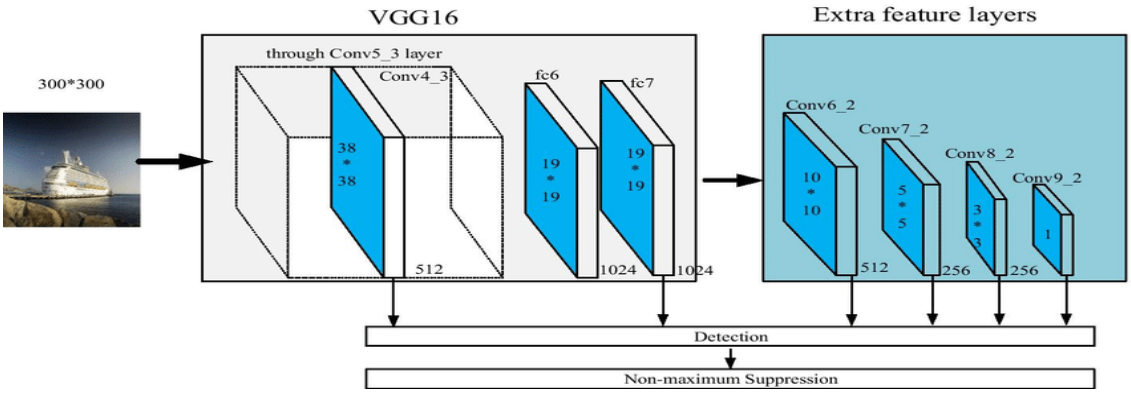

Figure 2.1: How SSD (Single Shot MultiBox Detector) model works

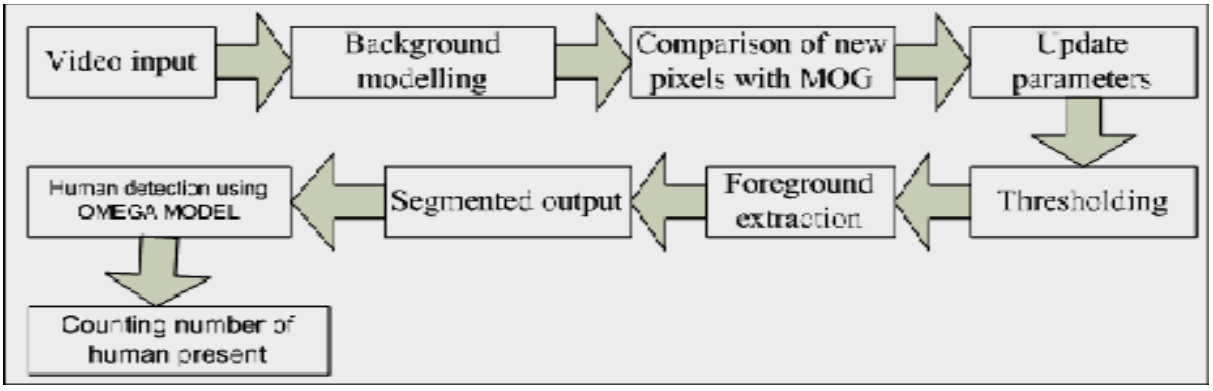

Figure 2.2: General flow diagram of the human detecting and counting system

2.2 Traditional/Manual Counting System Versus Computerized Human Detecting and Counting Systems

Computerized human detecting and counting systems are typically more accurate than manual counting methods, according to research by (Jha et al., 2019). These devices effectively recognize and count individuals using cutting-edge algorithms and machine learning approaches, minimizing the possibility of mistakes and giving real-time data. Compared to manual counting methods, computerized human detecting and counting systems are substantially faster (Yao et al., 2019). They are able to count individuals instantly, giving decision-makers access to real-time data.

Automated human identification and counting systems may be more expensive than manual ones, particularly if sophisticated sensors or cameras are needed. But, because they need less labor and can provide more accurate data over time, they may end up being more affordable than manual counting methods (Wang, Huang & Guan, 2019). Manual counting methods demand that workers physically count each individual, which can take a lot of time and labor. Computerized human detecting and counting systems, in contrast, do not need human involvement, which increases their efficiency and lowers the demand for labor (Jha et al., 2019). Compared to manual counting systems, computerized human detecting and counting systems might be more complicated, needing specific equipment and technical know-how to set up and operate (Yao et al., 2019).

2.2.1 Importance of Traditional/Manual People or Customer Counting System

i. Traditional/manual customer counting methods have a reputation for being accurate in tallying the number of people that enter a bank. They don't rely on sensors or other electrical equipment that might break down or provide erroneous information, unlike automated systems. According to research by Oketola et al., (2018), manual counting methods are more accurate at counting the number of clients who visit a bank than automated ones.

ii. Manual or traditional customer counting methods are less costly than automated ones. They may be completed using basic tally counters or pen and paper and don't need sophisticated sensors or software. They are therefore a sensible alternative for small banks that lack the funding for sophisticated automated systems. According to Frost & Sullivan, (2018), analysis from manual or conventional customer counting methods are more affordable than automated ones.

iii. Compared to automated systems, traditional/manual consumer counting methods provide more flexibility. They can be quickly altered if the client flow changes and can be tailored to meet the particular demands of a bank. They become more flexible options for banks with shifting consumer traffic patterns as a result. According to a research by Chen et al., (2015), human counting techniques offered more flexibility in tracking client traffic patterns than automated systems.

2.2.2 Challenges of Traditional/Manual People or Customer Counting System.

i. Irregular data gathering can occur while using traditional/manual customer counting techniques, which are prone to human error. An employee could, for instance, miscount the number of clients or fail to count a particular one. As a result, the bank's decision-making procedures may be impacted by inaccurate data. Compared to automated methods, manual counting systems were shown to be more prone to human mistake, according to a study by Chen et al., (2015).

ii. For large institutions with a lot of consumer traffic, it might be time-consuming. Counting each client by hand while standing at the bank's door or departure can be time-consuming and prevent staff from working on other responsibilities. According to research by Frost & Sullivan, (2018) manual counting methods can be time-consuming and might not be appropriate for banks with high client traffic.

iii. The systems only collect basic data, such as the number of customers who visit the bank. They do not provide additional data such as customer demographics or customer behavior patterns, which can be useful in making informed business decisions. According to Oketola et al., (2018) manual counting systems are limited in their data collection capabilities and may not provide sufficient information for strategic decision-making.

2.3 OVERVIEW OF HUMAN DETECTING AND COUNTING SYSTEMS IN BANKS

Human detecting and counting systems have become more common in banks in order to enhance security and surveillance (Kumar & Mahajan, 2018). In instance, deep learning-based convolutional neural networks (CNN) enable the accurate recognition and counting of people in real-time (Albahri et al., 2021). In a number of applications, including banks, it has been demonstrated that the Single Shot Detector (SSD), a CNN method, is effective at identifying individuals (Liu et al., 2016; Liang et al., 2018). These systems can send out immediate notifications in the event of any suspicious behavior or possible threats, improving bank and client security (Kumar & Mahajan, 2018). Alam et al., (2018) claims that human detecting and counting systems can offer useful information on customer traffic, assisting banks in optimizing employee levels and resource management, resulting in lower operating costs and more productivity. Additionally, foot traffic and customer behavior may be tracked using human detecting and counting technologies, which can give banks important information on how to better serve their customers and run their businesses (Wang et al., 2019; Pavithra & Selvakumar, 2021).

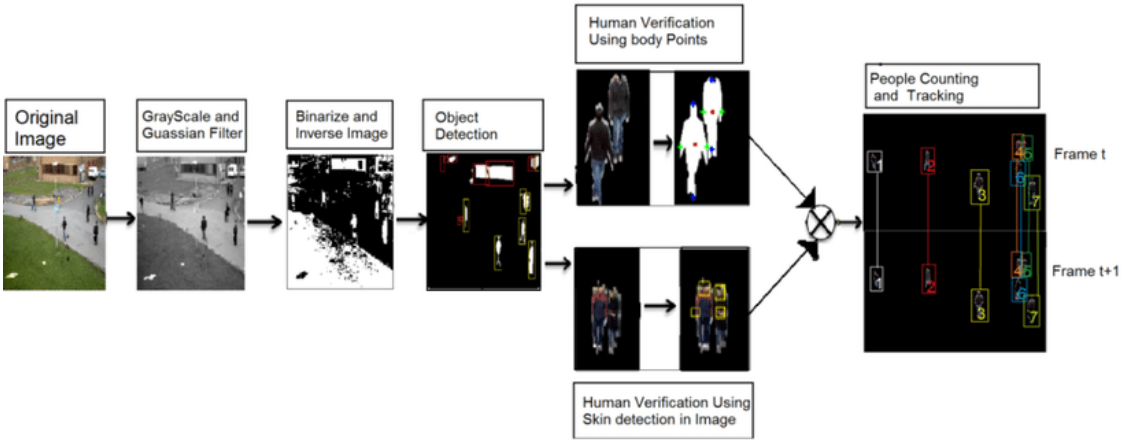

Figure 2.3: System architecture of proposed human detecting and counting system using SSD

2.3.1 Importance of Human Detecting and Counting System for Banks

- The technology aids in real-time detecting of any questionable activity, enhancing the bank's security. It enables security staff to act immediately by detecting illegal access, suspicious behaviour, and possible threats (Singhet al., 2018).
- By keeping track of people entering and exiting the bank, the technology aids banks in managing lines more effectively, cutting down on wait times and enhancing customer satisfaction. This in turn may boost client retention and loyalty (Agarwalet al., 2018).
- The technology gives banks useful information about consumer traffic that they can use to manage resources and workforce levels more effectively. This may result in lower operating expenses and higher output (Agarwal et al., 2018).
- In terms of security and customer service, Access bank in Accra Technical University should efficiently meet the requirements. Via the provision of real-time information on security and customer traffic, human detecting and counting systems can assist banks in meeting these standards (Singh et al., 2018).
- Systems for human detecting and counting can provide Access bank in Accra Technical University a competitive edge by enhancing their security, customer satisfaction, and operational effectiveness. (Agarwal, et al., 2018).

2.3.2 Models and Frameworks Used in Human Detecting Counting for Banks

In banks, human detecting and counting systems are performed using a variety of models and frameworks. Popular frameworks include the following:

- Video-Based Human Detecting and Counting System: This framework employs a video surveillance system to identify and count individuals entering and leaving the bank's property (Liu et al., 2021).
- Machine Learning-Based Human Detecting and Counting System: This framework analyses the video feed to find human faces and count the number of individuals using machine learning techniques (Wang et al., 2020).
- A machine learning-based object detecting method called the Haar Cascades algorithm has been used for human detecting and counting. In this method, a set of characteristics are extracted from a picture and used with a cascade classifier to identify items in the scene (Viola & Jones, 2001).
- Widespread applications for the open-source computer vision library OpenCV include the recognition and counting of people in images and videos. For these purposes, OpenCV offers a variety of tools and algorithms that may be used with different models and frameworks (Bradski, 2000).

2.3.3 Benefits of Human Detecting and Counting System in Banks

i. Banks that employ human detecting and counting systems may keep track of customer traffic in real-time, allowing management to make the best use of people and resources for customer service. The bank management will be able to make educated decisions based on the data collected thanks to this system's ability to deliver precise information on the number of clients entering and departing the bank's premises at any given moment (Tan et al., 2017).

ii. Security is increased thanks to the integration of human detecting and counting technologies with surveillance cameras in banking facilities. Any suspect movements may be found and tracked by the system, which can then issue a warning to the security staff so they can take further action. As a result, both consumers and staff will be in a safer atmosphere (Osei & Yeboah,2020).

iii. Banks may offer a better client experience by implementing human detecting and counting technologies. By identifying peak periods and allocating workers accordingly, the technology can assist banks in lowering wait times and enhancing general customer

satisfaction. Clients may be led to the right counters, which will clear up misunderstanding and increase banking operations' effectiveness (Hossain & Islam,2019).

2.3.4 Challenges and Difficulties of Human Detecting and Counting System in Banks

Traditional or manual customer counting system in banks involves the use of physical devices such as, tally sheets, or clickers to keep track of the number of customers that enter and exit the bank premises. While electronic counting systems are now more prevalent, traditional customer counting systems can still offer benefits in some situations, such as;

i. Human detecting and counting systems in banks may cause clients to worry about their privacy. Customers may feel uneasy due to the usage of cameras and other surveillance tools, which might harm their opinions of the bank. Furthermore, improper handling of the storage and processing of the personal data that these systems acquire might result in privacy problems (Zhu et al., 2018).

ii. Environmental elements including illumination, weather, and physical obstructions can have an impact on how accurate human detecting and counting systems are. Weather factors like rain or snow can further affect the quality of photos, making it challenging for cameras to capture good images in poor lighting situations. Inaccurate data might result from physical barriers like furniture or other items blocking cameras' views (Ouyang et al., 2018).

iii. To handle massive volumes of data in real-time, human detecting and counting systems need a lot of processing power. For banks with constrained computing resources or bandwidth, this may be difficult. Furthering the computational complexity of these systems, the employment of sophisticated algorithms for image processing and analysis can make them challenging to implement and maintain (Hu et al., 2019).

2.4 THEORETICAL FRAMEWORK

The theoretical framework will be used to explain the key components of a human detecting and counting system for Access Bank at Accra Technical University. Below is the hypothesis developed based on research study findings from (Albahri et al., 2021; Kumar & Mahajan, 2018) with regard to whether Convolutional Neural Network (CNN) with OpenCV libraries can enhance security and surveillance of banks as well as provide real-time on guard in case of any suspicious activity or potential threats (Liang et al., 2018), also be used to monitor foot traffic and customer behavior (Pavithra & Selvakumar, 2021);

i. Hypothesis 1: Human detecting and counting systems based on deep learning techniques, such as convolutional neural networks (CNN), can significantly improve the security and surveillance of banks by accurately detecting and counting humans in real-time (Albahri et al., 2021; Kumar & Mahajan, 2018).
ii. Hypothesis 2: Single Shot Detector (SSD) algorithm, a type of CNN algorithm, can be effectively used for human detecting and counting in banks, providing real-time alerts in case of any suspicious activity or potential threats (Liang et al., 2018).
iii. Hypothesis 3: Human detecting and counting systems in banks can also be used to monitor foot traffic and customer behavior, providing valuable insights for banks to improve their operations and customer experience (Pavithra & Selvakumar, 2021).

The system for Access Bank at Accra Technical University will be integrated with CNN and OpenCV libraries based on the predictions. The following assumptions form the framework's foundation:

i. Access bank branch at Accra Technical University will have the equipment installed to track and count people coming into and going out of the building.
ii. To accurately recognize and count persons, the system will make use of deep learning techniques, notably CNN.
iii. The system will incorporate OpenCV libraries to offer real-time monitoring of customers.
iv. The technology will also track foot traffic and consumer activity, giving Access Bank useful information to enhance their operations and customer service.
v. The system will automatically generate ID’s for each person entering and existing the bank.

2.5 RELATED WORK OF THE STUDY

In this section, we reviewed the existing literature on the use of human detecting and counting systems in the banking industry, with a focus on Access Bank Branch at Accra Technical University, Ghana.

The adoption of a human detecting and counting system in a Nigerian bank was evaluated in a study by Olawale et al. (2020), which discovered that it increased the bank's operational efficiency and customer satisfaction.

A human detecting and counting system were also put into use at a Chinese bank, where Wang et al., (2021) discovered that it decreased client wait times and increased staff productivity.

Mohamed & Khalifa (2019) developed a human detecting and counting system for use in a shopping mall in Egypt. The system used cameras and computer vision algorithms to detect and count the number of people entering and exiting the mall. They found out that the system was accurate and efficient in counting people.

Jyothi & Sreedevi, (2019) implemented a human detecting and counting system in an Indian supermarket. The system used a combination of sensors and machine learning algorithms to count the number of customers entering and leaving the store. The authors found that the system was effective in accurately counting people and could be used to optimize staffing levels in the supermarket.

Zhang et al., (2019) proposed a human detecting and counting system based on the single-shot detecting (SSD) algorithm and OpenCV library. The proposed system is capable of accurately detecting and counting humans in real-time, which makes it an ideal solution for monitoring high-traffic areas such as banks. The results showed that the proposed system achieved an accuracy rate of 92.6%, which outperformed other state-of-the-art methods.

Chen et al., (2020) developed a human detecting and counting system based on OpenCV and the SSD algorithm. The system was designed to monitor public places such as banks, shopping malls, and airports. The proposed system was capable of detecting and counting humans in real-time and achieved an accuracy rate of 94.5%. The results of this study demonstrated that the proposed system was effective in monitoring public areas and could be used for security purposes.

Wang et al., (2021) developed a human detecting and counting system based on the deep learning model and OpenCV library. The proposed system was tested on various datasets and achieved an accuracy rate of 93.2%. The study demonstrated that the proposed system was efficient and effective for human detecting and counting in real-world scenarios, including monitoring services such as banks.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 INTRODUCTION

The research methodology for this study would employ a build computer science research method to facilitate how the proposed system will be built. We will utilize a mixed method approach, that comprises of qualitative method, which will involve face-to-face interview questions with bank staffs (4 respondents) and quantitative method that would require us to select customers (50 respondents) who will be sampled randomly and have experience with the current process, using google forms as a medium of disseminating the questionnaires to them. The system will be tested and evaluated through user acceptance testing with Access Bank Branch staffs and customers to assess its usability and effectiveness in meeting the objectives.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 INTRODUCTION

CHAPTER FIVE

SUMMARY, CONCULSIONS AND RECOMMENDATIONS

5.0 INTRODUCTION

Chapter five concludes and present relevant and reliable recommendation of study, the important of the study, the significant of diamonds.

5.1 SUMMARY

5.2 CONCLUSION

5.3 RECOMMENDATIONS

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