IPRC HUYE
Integrated Polytechnic Regional College
RWANDA POLYTECHNIC
P.o.Box 575 Huye-Rwanda
Tel:(+250)255119248
Email:info@iprchuye.rp.ac.rw
www.iprchuye.rp.ac.rw

DEPARTMENT OF INFORMATION COMMUNICATION TECHNOLOGY

PROJECT

Secure child pickup system using facial recognition and IoT for Nursery schools

Submitted in partial fulfillment of the requirements for the Bachelor of Technology in Information Communication Technology at IPRC HUYE

Prepared by:

HANYURWIMFURA Dieudonne

Reg no: 23RP01895

Supervised by:

Dr. Egide NKURUNZIZA

August-2024

DECLARATION (A)

I do hereby declare that this project, entitled **secure child pickup system using facial recognition and IoT for Nursery schools** submitted in partial fulfillment of the requirement for the bachelor of technology in information communication technology at integrated polytechnic regional college Huye, is my original work and has not previously been submitted elsewhere. Also, I do declare that a complete list of references is provided, indicating all the sources of information quoted or cited.

Done by: HANYURWIMFURA Dieudonne **(23RP01895) ……...**

DECLARATION (B)

I confirm that the work reported in this research project was carried out by the candidate under my supervision and it has been submitted with my approval as the supervisor.

Name of school Supervisor: Dr. Egide NKURUNZIZA
Date:
Signature:

DEDICATION

I dedicate this project to the almighty God, whose guidance and strength have been with us from the beginning through the completion of our one-year courses at IPRC HUYE. I also dedicate this hard work to my classmates, parents, family, brothers, friends, lecturers, and the school administration, with special gratitude to my supervisor, **Dr. Egide NKURUNZIZA**. To everyone who has contributed to the realization of this study, may God bless them all abundantly. May their relentless efforts continue to make the world a better place.

ACKNOWLEDGEMENT

First and foremost, I sincerely thank almighty God for giving me strength throughout the preparation of this final year project. I am truly blessed by His grace and blessings throughout my life.

I wish to express my deep gratitude to my supervisor, **Dr. Egide NKURUNZIZA**, for his unwavering support and guidance during this project. His professional insights, patience, courage, and encouragement were invaluable in the successful completion of this work. My sincere thanks are also due to the entire administration of IPRC Huye, particularly the department of information technology. The knowledge and skills I acquired from this institution were crucial to the success of this project. Without their assistance and education, this work would not have been possible. I would also like to extend my heartfelt appreciation to my dear elder brothers and their families for their unwavering support throughout my studies, leading to the completion of this work.

Finally, a special thanks to the lecturers and staff of IPRC Huye for equipping me with the knowledge and skills that enabled me to conduct this research and compile my final year project successfully.

God bless you all.

ABSTRACT

The need for enhanced child safety during school pickup times has become a growing concern for parents, educators, and policymakers. Traditional methods of verifying the identity of guardians during pickup times are prone to human error and security breaches, which can lead to unauthorized pickups and potential safety risks. To address these issues, this project proposes a **secure child pickup system utilizing facial recognition and IoT technologies** specifically designed for nursery schools. The system automates the verification process, ensuring that only authorized individuals can pick up children, thereby significantly reducing the risks associated with manual methods.

Facial recognition technology is employed to accurately identify and match the guardian's face with pre-stored data, providing a higher level of security than traditional methods. Meanwhile, IoT devices facilitate real-time monitoring and immediate alerts to school administrators, enabling quick responses to any potential security threats. The study will be implemented at MUGINA HOPE SCHOOL in Kamonyi district, Rwanda, serving as a practical case study to evaluate the effectiveness of the system in a real-world setting.

TABLE OF CONTENTS

LIST OF ACRONYMS ABBREVIATIONS

API: Application Programming Interface

CSS: Cascading style sheet

ERD: Entity-Relationship Diagram

GSM: Global system for Mobile Communication

HTML: Hyper-text Markup Language

IDE: Integrated Development Environment

IoT: Internet of Things

IPRC: Integration Polytechnic Region College

NCMEC: National Center for Missing & Exploited Children

OpenCV: Open Source Computer Vision Library

RFID: Radio Frequency Identification

SCPS: Secure child pickup system

LIST OF FUGURES

LIST OF TABLES

CHAPTER ONE: INTRODUCTION

1.1 INTRODUCTION

In recent years, the security of child pickup systems in nursery schools has become a growing concern for parents, guardians, and school administrators. Ensuring the safety of children during pickup times is crucial, as it is a vulnerable moment when unauthorized individuals could potentially gain access to the premises. Traditional methods, such as manual sign-in sheets and personal identification badges, have shown limitations in effectively verifying the identity of individuals picking up children.

With advancements in technology, the integration of facial recognition and Internet of Things (IoT) devices presents a promising solution to enhance the security and efficiency of child pickup systems. Facial recognition technology can provide a reliable and quick method of verifying the identity of authorized guardians, while IoT devices can facilitate seamless communication and monitoring within the school environment.

This chapter introduces the concept of a **secure child pickup system using facial recognition and IoT for nursery schools**. It outlines the motivations behind this research, the significance of implementing such a system, and the potential benefits it offers in terms of safety, efficiency, and peace of mind for parents and school staff.

1.2 BACKGROUND OF THE STUDY

Globally, the safety and security of children during pickup times at nursery schools are critical concerns for parents, staff, and administrators. Traditional methods of identification and pickup management have shown significant vulnerabilities, leading to numerous incidents that demand more secure and reliable solutions. In the United States, for example, systems like KidGopher have been implemented to improve security during school pickups by using RFID technology to verify the identity of guardians (Juniper Systems, Inc. 2007).Similarly, in Malaysia, RFID-based school bus security systems have been developed to track children during their commute and ensure they are handed over to authorized guardians (Cloudnotte, 2004).

Despite these efforts, many of these solutions still face challenges in achieving optimal security and efficiency. Locally, nursery schools often depend on manual verification processes, which are susceptible to human error and potential security breaches.

As its known primary identification for any human is its face because its take eyes, noise, eye blows to recognize face. By using secure child pickup system utilizing facial recognition and internet of things (IoT) technologies specifically tailored for nursery school environments reduce the risks associated with unauthorized pickups and improve the overall safety and convenience for both parents and nursery schools. By integrating advanced technologies, the proposed solution provide a robust and reliable method for ensuring child safety during pickup times, thereby offering peace of mind to parents and enhancing the operational efficiency of nursery schools.

1.3 STATEMENT OF THE PROBLEM

Current child pickup procedures in MUGINA HOPE SCHOOL nursery schools are predominantly manual and reliant on staff recognition or physical verification methods, which are susceptible to human error and security vulnerabilities. These methods often fail to provide adequate security, leading to potential risks such as unauthorized pickups or abductions. While some schools have attempted to incorporate basic technological solutions, these are often insufficient and lack the integration of advanced security measures.

Research by the national center for missing & exploited children (NCMEC) highlights that a significant number of child abductions occur during school pickup times. However, integrating facial recognition and IoT technologies for a secure child pickup system will help to address these challenges by ensuring that only authorized guardians can pick up children from nursery schools.

1.4 PURPOSE OF THE STUDY

The purpose of this study is to investigate and develop a secure, efficient, and reliable child pickup system for MUGINA HOPE SCHOOL nursery schools utilizing facial recognition and internet of things (IoT) technologies. This research seeks to address the limitations of traditional child pickup methods, which often rely on manual verification and are susceptible to human error and security breaches. By leveraging advanced technologies, the study aims to enhance the overall safety and operational efficiency of nursery schools during child pickup times.

1.5 PROJECT OBJECTIVES

1.5.1 General objective

The general objective of this research is to develop and evaluate “secure child pickup system for nursery schools” using facial recognition and internet of things (IoT) technologies. This system aims to enhance the security, efficiency, and reliability of the child pickup process, ensuring the safety and peace of mind for parents, guardians, and school staff

1.5.2 Specific objective

- Create a robust facial recognition system that accurately identifies both children and their authorized guardians during children pickup.
- Design and develop an intuitive interface for nursery school staff to register children and guardians, manage pickup process, and monitor the overall system.
- Develop a notification system to alert authorized guardians when a child leaves school

1.6 RESEARCH QUESTIONS

A. What are challenge for traditional method for child pickup

B. How effective is facial recognition technology in verifying the identity of children and guardians?

C. What are the key challenges in integrating IoT devices with a facial recognition system for child pickup?

D. How does the proposed system improve the overall security and efficiency of the child pickup process compared to traditional methods?

E. What are the privacy and ethical implications of using facial recognition and IoT technologies in nursery schools?

F. What training and support are necessary for nursery school staff to effectively use facial recognition and IoT systems for child pickup?

1.7. SCOPE OF THE PROJECT

Because of few resources available like equipment, knowledge and time to research, design and to develop this project will be limited Secure child pickup system using facial recognition and IoT for MUGINA HOME SCHOOL to verify face for child and guardian and maintaining their data

but some changes may be done later to it so that it may be used for all nursery schools in Rwanda and provide any other activities.

1.8 METHODOLOGY AND TECHNIQUES

1.8.1 Study Area

The project will be conducted in selected nursery schools within a specified region. The criteria for selecting these schools include diverse demographic profiles and varying levels of technological adoption to ensure a comprehensive evaluation of the proposed system.

1.8.2 Study Design

A mixed-methods approach will be employed, combining both quantitative and qualitative research methods. The study will include surveys, interviews, and system trials to gather comprehensive data on the effectiveness and user perception of the facial recognition and IoT-based pickup system.

1.8.3 Study Population

The study population will consist of nursery school students, their parents or guardians, and school staff. A representative sample will be selected to ensure that the findings are generalizable to a wider population.

1.8.4 Study Sample

A stratified random sampling technique will be used to select participants. This method ensures that subgroups within the population are adequately represented, providing a more accurate and reliable dataset. The sample size will be determined based on statistical power analysis to ensure sufficient data for meaningful analysis.

1.8.5 Sampling Strategy

The sampling strategy will involve selecting schools with different characteristics, such as urban and rural settings, varying sizes, and different levels of technology integration. This diverse sampling strategy aims to capture a wide range of experiences and outcomes.

1.9 ORGANIZATION OF THE PROJECT

The research project is organized into five chapters as follows:

- **Chapter one:** Discuss on problem statement, general and specific objectives and all necessary information for the understanding of the concepts that discussed in the later chapters
- **Chapter two:** Is literature review; this part of the work discusses the key concepts with description of different aspects relating to the research
- **Chapter three:** Contain System Analysis and design, it shows the limitation of the existing system, analysis and design of the proposed system to bridge the gap found in the existing system
- **Chapter four:** Focuses on the implementation of the system, technologies used and the results
- **Chapter five:** Conclusion and Recommendation

CHAPTER TWO: LITERATURE REVIEW

This chapter provides a comprehensive review of existing literature related to secure child pickup systems using facial recognition and IoT technologies for nursery schools. It includes an analysis of concepts, opinions, and ideas from experts, a discussion on theoretical perspectives, and an examination of related empirical studies. This review aims to identify gaps in current research and establish a foundation for the proposed study.

2.1 CONCEPTS, OPINIONS, IDEAS FROM AUTHORS/EXPERTS

The literature on secure child pickup systems reveals several key concepts and ideas from various scholars and experts:

2.1.1 Facial Recognition Technology

Facial recognition technology has been extensively studied for its potential in enhancing security systems. Researchers such as Turk and Pentland (1991) have laid the groundwork for facial recognition algorithms, which have since evolved significantly (Zhao et al., 2003). Contemporary studies highlight its application in diverse fields, including surveillance, access control, and identity verification (Jain, Ross, & Prabhakar, 2004).

2.1.2 Internet of Things (IoT)

The integration of IoT in security systems has gained substantial attention. IoT enables real-time monitoring and data exchange between devices, significantly enhancing system efficiency (Gubbi et al., 2013). In the context of school security, IoT can provide seamless connectivity between various components of the child pickup system, such as cameras, sensors, and databases (Atzori, Iera, & Morabito, 2010).

2.1.3 Child Safety in Schools

Child safety during school pickup times is a critical concern addressed by various studies. Research indicates that manual verification processes are prone to errors and security breaches, necessitating the adoption of more reliable technological solutions (Bacharach, Baumeister, & Furr, 2003). The use of technology in school security systems is seen as a promising approach to mitigate risks associated with unauthorized pickups and abductions (U.S. Department of Education, 2017).

2.2 THEORETICAL PERSPECTIVES

The theoretical framework for this study draws on several theories that underpin the development and implementation of secure child pickup systems:

2.2.1 Technology Acceptance Model (TAM)

The technology acceptance model (TAM) by Davis (1989) provides a basis for understanding user acceptance of new technologies. According to TAM, perceived usefulness and ease of use are critical factors influencing users' acceptance of technology. This model is relevant in assessing the adoption of facial recognition and IoT technologies by nursery schools and parents.

2.2.2 Routine Activity Theory

Routine Activity Theory (Cohen & Felson, 1979) posits that crime occurs when a motivated offender and a suitable target converge in the absence of a capable guardian. Applying this theory to child pickup systems, the presence of advanced security technologies can act as capable guardians, reducing the likelihood of unauthorized pickups.

2.2.3 Socio-Technical Systems Theory

Socio-technical systems theory emphasizes the interaction between technology and social factors in organizational settings (Trist, 1981). This theory is pertinent to understanding how facial recognition and IoT technologies can be effectively integrated into the existing social structure of nursery schools to enhance child safety.

2.3 RELATED STUDIES

Empirical investigations into secure child pickup systems have explored various aspects of technology implementation and effectiveness:

2.3.1 RFID-Based Systems

Several studies have examined the use of RFID technology in school security systems due to its ability to track student movements and enhance pickup procedures. For example, Li, Xu, and Zhao (2015) conducted a study demonstrating RFID's effectiveness in monitoring students' locations and ensuring secure pickups by notifying staff and parents when a child leaves school premises.

Similarly, a study by Cheng and Wang (2016) highlighted RFID's utility in streamlining attendance processes and providing real-time updates on students' whereabouts, thereby increasing security. However, while RFID systems are beneficial, they often lack the robustness and accuracy provided by more advanced technologies like facial recognition. Facial recognition systems, as discussed by Jain, Ross, and Prabhakar (2004), offer higher accuracy in identity verification due to their ability to analyze unique facial features, reducing the likelihood of errors.

RFID systems rely on tags that can sometimes be lost or damaged, leading to potential security breaches (Want, 2006). In contrast, facial recognition does not depend on physical objects, making it less susceptible to such issues. Moreover, RFID systems can only indicate the presence of a tag within a certain range but cannot verify the identity of the person carrying the tag, as noted by Savić and Perić (2011).

2.3.2 Facial Recognition in Schools

Research on facial recognition in educational settings underscores its potential to enhance security measures significantly. Kumar and Chellappa (2016) demonstrated that implementing facial recognition systems in schools led to a substantial reduction in unauthorized access incidents. This technology offers a reliable method for verifying identities and preventing unauthorized entries, making schools safer for students and staff. However, the deployment of facial recognition systems brings forth significant concerns regarding privacy and data security, as noted by Introna and Nissenbaum (2010). Ensuring the protection of biometric data and addressing ethical considerations is crucial for the widespread adoption of such technologies. Balancing security benefits with privacy protections remains a critical challenge for educators and policymakers.

2.3.3 IoT Integration

The integration of IoT with security systems has been explored in various studies. A comprehensive review by Miorandi et al. (2012) emphasized the benefits of IoT in providing real-time data and enhancing system interoperability. In the context of school security, IoT can facilitate seamless communication between different components of the child pickup system, thereby improving overall efficiency and reliability.

By synthesizing these concepts, theories, and empirical findings, this literature review identifies critical gaps in existing research and establishes the need for a secure, integrated child pickup system using facial recognition and IoT technologies for nursery schools.

CHAPTER THREE: SYSTEM DESIGN AND ANALYSIS

3.1 INTRODUCTION

This chapter deals with the methodology used to achieve the objectives of this new project. It represents tools, techniques and programming languages used in designing the system, and data dictionary developed and maintained is known as the software development life cycle (SDLC). It defines the phase, deliverable, and evaluation criteria of the software developed process.

3.2 AREA OF THE STUDY

The project will be conducted at MUGINA HOPE SCHOOL, focusing on the critical aspects of child pickup security. Mugina Hope School, located in a KAMONYI District, serves as an idea to assess the effectiveness of integrating facial recognition and IoT technologies in nursery school environments. By implementing this project at MUGINA HOPE SCHOOL we aim to enhance the safety of child pickups by providing a secure, automated system that minimizes the risks of unauthorized pickups and abductions. This study will evaluate the current manual verification processes at the school and measure the improvements brought by the new technology, ensuring practical applicability and generalizability of the findings.

3.3 METHODOLOGY AND TECHNIQUES OF RESEARCH USED

The satisfactory result obtaining is motivated by the good choice of method and techniques to use for the collection of data. For making that, in this we are going to put in clarified methods and techniques that we used to observe the reality and to reach objectives that we fixed ourselves.

3.3.1 Interview

The technique of interview is formal meeting in person used to gather information or facts about a specific subject. This technique has been helpful in terms of information gathering in some fields which has good target.

The school teacher explained that the manual verification process involves teacher recognizing or physically verifying the identity of guardians during child pickups. Interviews with the teacher highlighted specific issues such as the difficulty in verifying identities during busy pickup times,

the risk of unauthorized pickups, and the general lack of technological support to streamline the process.

In summary, discussions with various nursery schools, revealed that many still rely on manual verification processes for managing child pickups. These methods present significant challenges and vulnerabilities that can be addressed by integrating advanced technologies such as facial recognition and IoT to enhance security and efficiency.

3.3.2 Documentation

Documentation involved reviewing various sources such as articles, books, reports, websites, and class notes relevant to the study. This method was primarily used for gathering data related to nursery pickup systems from existing reports. The review focused on manual verification processes for guardians and children.

Through this technique, data was collected using multiple approaches, with a significant reliance on internet resources. Online searches were conducted to obtain information from different school websites and reports detailing their child pickup systems and practices.

3.3.3 Observation

As also been a tool so important in developing this research as it is in a scientific research one can not do anything without relying on observation as is among the tools that help us in mastering the existing system.

Participant Observation: In participant observation, the researcher actively joins the activities and environment of the group being studied. This approach helps the researcher gain a deeper, firsthand understanding of the setting. During studying child pickup systems in nursery schools, i might assist with pickup tasks and interact with staff and parents. This involvement provides valuable insights into the practical challenges and daily operations of the system.

Non-Participant Observation: In non-participant observation, the researcher observes the group or setting without directly engaging in the activities. This method helps the researcher remain objective and avoid influencing the environment. i might watch the pickup process from a distance, taking notes on how the system functions and how people interact without participating in the process. This approach provides a clear view of how things work in their natural state.

Using this technique, I visited various nursery schools to observe their child pickup processes firsthand. By examining how different schools implement their pickup systems, I was able to gather valuable information on their methods and practices. This direct observation allowed me to better understand the practical applications and variations in pickup systems, contributing to a comprehensive analysis of current system.

3.3.4 Surveys

The survey will be conducted to collect information from a sample of people who are known to be representative of a larger group, the target population. Data is collected through a specially designed questionnaire, and can be conducted on paper. Results are then analyzed to identify patterns or trends. This is useful when you want to measure or quantify certain attributes of a group of people.

3.4 SOFTWARE DEVELOPMENT PROCESS MODELS

Waterfall Model

The waterfall Mode refers to a linear-sequential life cycle model. In waterfall model, each phase must be completed fully before the next phase can begin. At the end of each phase, a review takes place to determine if the project is on the right path and whether or not to continue or discard the project. In waterfall model, phases do not overlap.

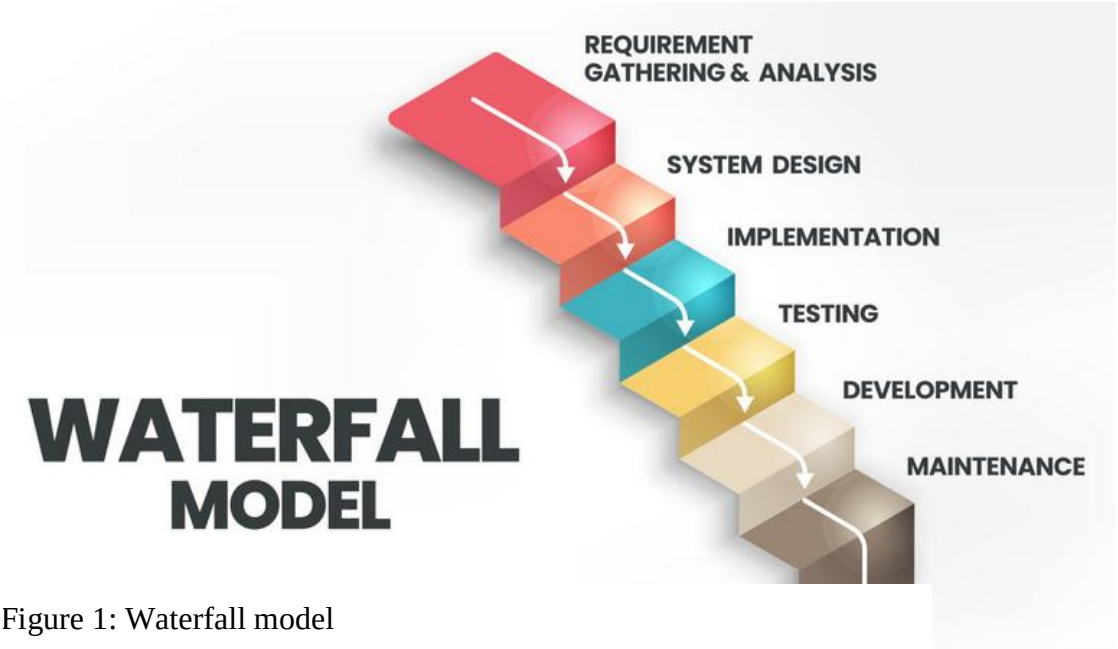


Figure 1: Waterfall model

The sequential phases in Waterfall model are −

- **Requirement Gathering and analysis** − All possible requirements of the system to be developed are captured in this phase and documented in a requirement specification document.
- **System Design** − The requirement specifications from first phase are studied in this phase and the system design is prepared. This system design helps in specifying hardware and system requirements and helps in defining the overall system architecture.
- **Implementation** − With inputs from the system design, the system is first developed in small programs called units, which are integrated in the next phase. Each unit is developed and tested for its functionality, which is referred to as Unit Testing.
- **Integration and Testing** − All the units developed in the implementation phase are integrated into a system after testing of each unit. Post integration the entire system is tested for any faults and failures.
- **Deployment of system** − Once the functional and non-functional testing is done; the product is deployed in the customer environment or released into the market.
- **Maintenance** − There are some issues which come up in the client environment. To fix those issues, patches are released. Also to enhance the product some better versions are released. Maintenance is done to deliver these changes in the customer environment.

Advantages of waterfall model

The Waterfall model is simple, easy to understand, and highly structured, which makes it straightforward to manage. Each phase in the model has specific deliverables and a review process, ensuring that the project progresses in a controlled and organized manner. Phases are processed and completed one at a time without overlap, allowing for a clear and linear progression.

This model works particularly well for smaller projects where the requirements are clearly defined and well understood. Its rigidity and clear structure make it ideal for projects with stable and unchanging requirements, ensuring that each stage is completed thoroughly before moving on to the next.

Disadvantages of waterfall model

When an application enters the testing stage, making changes to elements that were not thoroughly planned during the concept stage becomes quite difficult. This can lead to complications if critical aspects were overlooked earlier in the process.

Another challenge with this approach is that no working software is produced until late in the development cycle. This delay can introduce significant risk and uncertainty, making it harder to identify and address potential issues early on.

This model is particularly unsuitable for complex, object-oriented projects, as well as for long-term, ongoing projects. It also struggles to adapt to projects where requirements are at a moderate to high risk of changing, which can lead to further complications down the line

3.5. SYSTEM ANALYSIS

3.5.1 Current system

The current child pickup system in MUGINA HOPE SCHOOL relies on manual processes for verifying and managing child releases. Guardians typically present identification cards to nursery staff, who manually check these against a list of authorized individuals. Additionally, guardians are required to sign physical logbooks when picking up their child. This manual approach is prone to errors and inefficiencies, particularly during busy pickup times, and can lead to security risks if verification procedures are not strictly followed.

Furthermore, the system often involves limited technology integration, with nurseries using basic computer systems or physical records to manage data. This results in challenges with data accuracy and real-time tracking, as manual logs and records are cumbersome and not easily updated. The lack of automation can lead to inefficiencies and difficulties in managing and analyzing pickup information. Adopting more advanced technologies like facial recognition and IoT could significantly improve security, streamline operations, and enhance data management capabilities.

3.5.2 Proposed system description and improvement

The proposed solution introduces child pickup system utilizing facial recognition technology and IoT integration to overcome the limitations of current manual processes. Facial recognition will

automate the verification of guardians and children, enhancing security by ensuring that only authorized individuals can pick up the child. IoT devices will be integrated to provide real-time monitoring and automated data management, improving oversight and efficiency. Additionally, a user-friendly interface will be developed for nursery staff to manage registrations and track pickups, while a notification system will keep guardians informed about pickup status. This comprehensive approach aims to streamline operations, increase security, and enhance communication between the nursery and guardians.

3.6 USE-CASE DIAGRAM

A use case diagram is a graphical depiction of a user's possible interactions with a system. A use

case diagram shows various use cases and different types of users the system has and will often be accompanied by other types of diagrams as well. The below diagram illustrate how the users of MUGINA HOPE SCHOOL interact with the Secure child pickup system using facial recognition and IoT

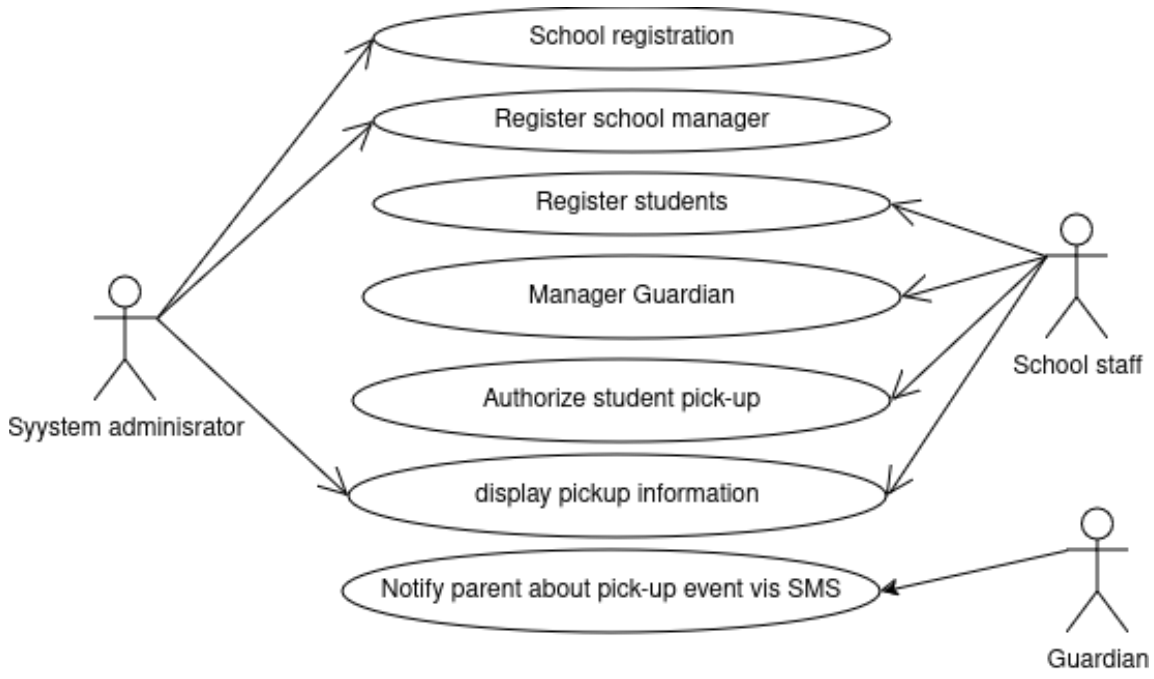
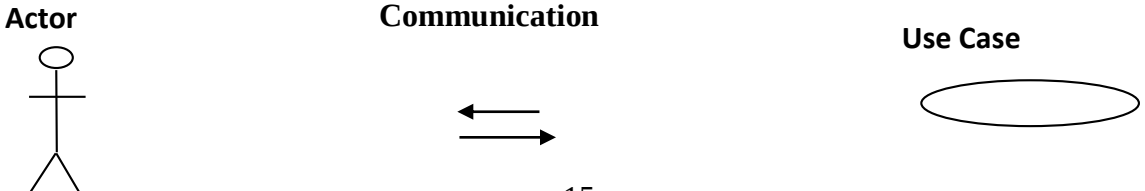


Figure 2: Use-case diagram

Use-Case Symbols used are:



3.7. DATA FLOW DIAGRAM

A data flow diagram is graphical tool used to describe and analyze movement of data through a system. These are the central tool and the basis from which the other components are developed. The transformation of data from input to output, through processed, may be described logically and independently of physical components associated with the system.

DFD-LEVEL 0 (Context level)

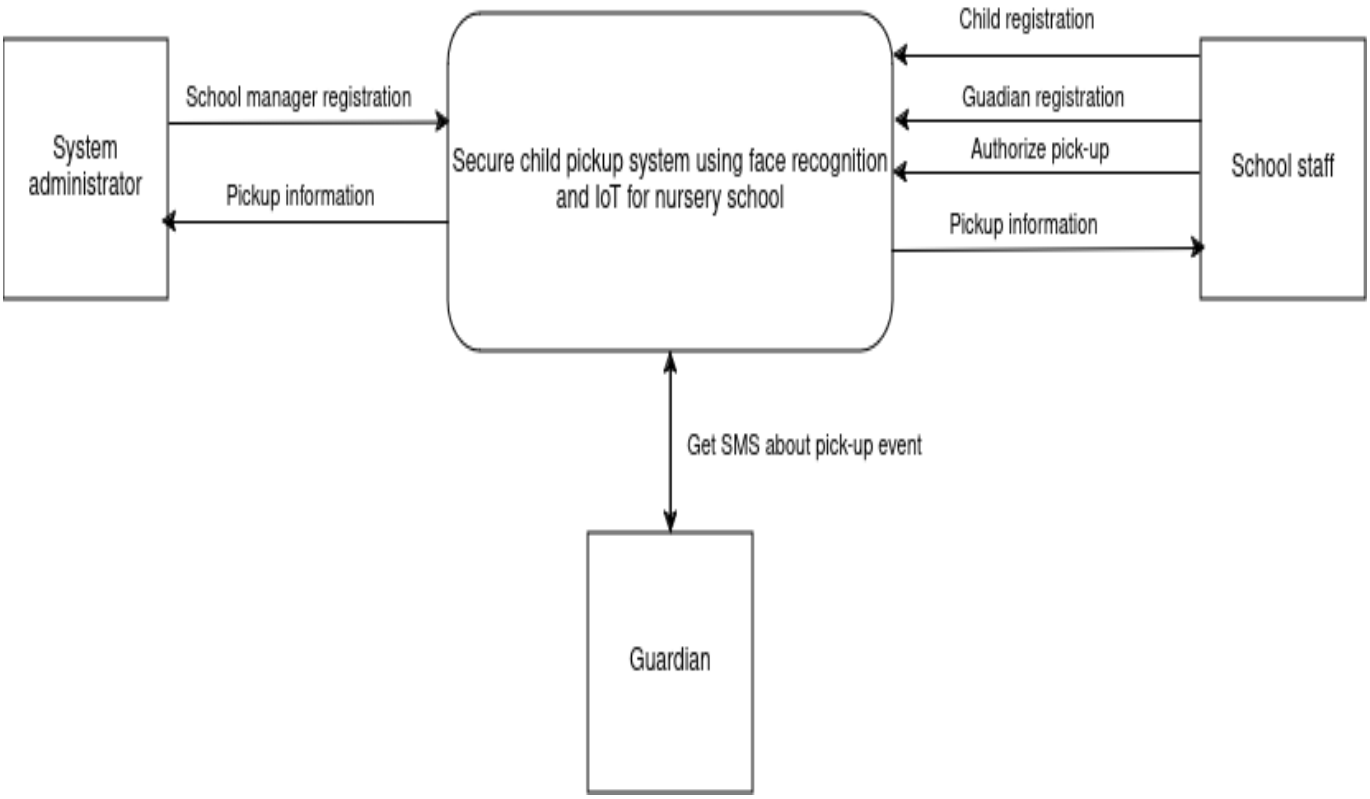


Figure 3: DFD Level 0

3.8 ENTITY-RELATIONSHIP DIAGRAM (ERD)

ERD is network model that describes stored data of a system at a high level of abstraction. For system analysis, ERD has a major benefit: it highlights the relationship between data stores on DFD which would otherwise only be seen in the specification process.

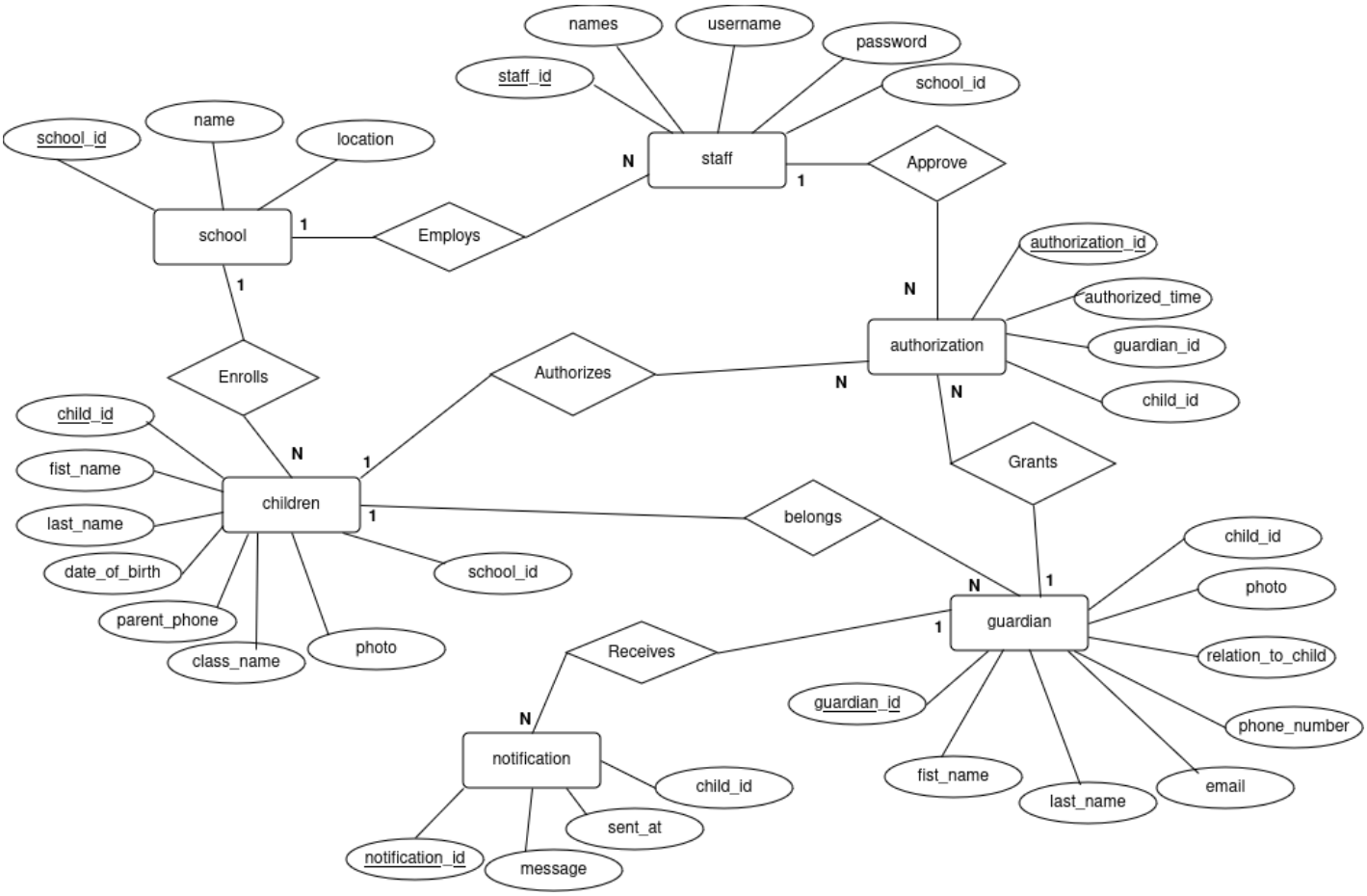
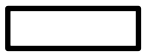
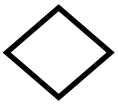


Figure 4: Entity Relationship diagram

The components of an ERD include:

- Entity: represented in rectangle 

Attribute: represented in ellipse 

Relationship: represented in diamond 

3.9 PHYSICAL DATA MODELING

This model diagram illustrates the organization of data in the database that stores data for the database system. It describes all the details and the relationship between the tables that make up the database.

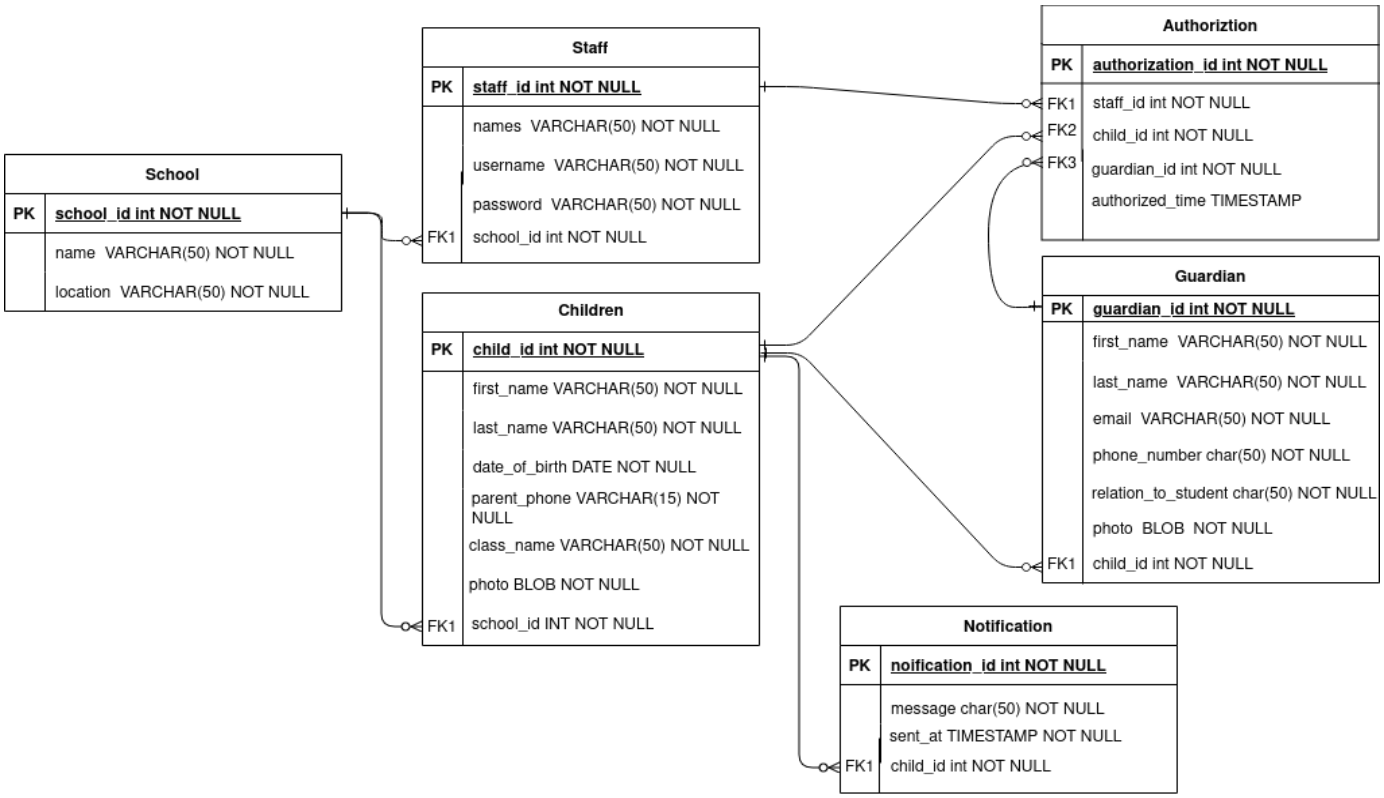


Figure 5: Physical data modeling

3.7 DATA DICTIONARY

A data dictionary is a collection of descriptions of the data objects or items in a data model for the benefit of programmers and others who need to refer to them. When developing programs that use the data model, a data dictionary can be consulted to understand where a data item fits in the structure, what values it may contain, and basically what the data item means in real-world terms.

Table 1: School

Attribute	**Data Type**	**Description**	**Constraint**
school_id	Integer	Unique identifier for each child	Primary Key
name	String	Name of the school	Not Null
location	String	Location of the school	Not Null

Table 2: Staff

Attribute	Data Type	Description	Constraint
staff_id	Integer	Unique identifier for each sraff	Primary Key
names	String	Name of the school	Not Null
username	String	Username for staff login	Not Null
password	String	Password for staff login	Not Null
school_id	Integer	Identifier linking to the school database	Foreign Key

Table 3: Children

Attribute	Data Type	Description	Constraint
child_id	Integer	Unique identifier for each child	Primary Key
first_name	String	Name of the child	Not Null
last_name	String	Surname of the child	Not Null
date_of_birth	Date	Birth date of the child	Not Null
parent_phone	String	Phone number of the parent/guardian	Not Null
class_name	String	The name of the class the child is enrolled in	Not Null
photo	Binary	Photo of the child	Not Null
school_id	Integer	Identifier linking to the school database	Foreign Key

Table 4: Guardian

Attribute	Data Type	Description	Constraint
guardian_id	Integer	Unique identifier for each guardian	Primary Key
first_name	String	First name of the guardian	Not Null
last_name	String	Surname of the guardian	Not Null
email	String	Email address of the guardian	Not Null
phone_number	String	Phone number of the guardian	Not Null
relation_to_student	String	The relationship of the guardian to the child	Not Null
photo	Binary	Photo of the guardian	Not Null
child_id	Integer	Identifier linking to the children database	Foreign Key

Table 5: Authorization

Attribute	Data Type	Description	Constraint
authorization_id	Integer	Unique identifier for each authorization record	Primary key
child_id	Integer	Unique identifier for the child	Foreign Key
guardian_id	Integer	Unique identifier for the guardian	Foreign Key
staff_id	String	The person or system that granted the authorization	Foreign Key
authorized_time	DateTime	The time when the authorization was granted	Not Null

Table 6: Notification

Attribute	Data Type	Description	Constraint
notification_id	Integer	Unique identifier for each notification record	Primary key
message	String	Message for notification	Not Null
child_id	Integer	Unique identifier for the child	Foreign key
sent_at	DateTime	The time when the notification was sent	Not Null

CHAPTER FOUR: SYSTEM IMPLEMENTATION

4.1 INTRODUCTION

This chapter deals with technical activities and the real system is designed, built in this part. It explains the flow of all steps involved in system development and the earlier design largely decides how well the software will be built. Often good designs lead to robust software and make the system so flexible to future changes. Then, it is up to us to choose a good design in order to build the exciting software.

4.2 DESCRIPTION OF HARDWARE TOOLS

4.2.1 Computers

Computers are essential hardware tools for the development and deployment of the Secure Child Pickup System. They are used for coding, testing, and running the software applications required for the system. In this project, computers are used to handle the computational tasks, such as facial recognition processing and managing databases.

4.2.2 Web Camera

A web camera is a crucial component of the system, used to capture real-time images of the children and guardians during the pickup process. The captured images are then processed by the facial recognition software to verify identities and ensure authorized pickups. The quality and resolution of the webcam directly affect the accuracy of the facial recognition system.

4.3 DESCRIPTION OF SOFTWARE TOOLS

4.3.1 Python

Python is a versatile programming language used for developing the backend of the Secure Child Pickup System. It is chosen for its simplicity, extensive libraries, and frameworks that support tasks like data processing, facial recognition, and integration with hardware devices.

4.3.2 Visual Studio Code (VS Code)

VS Code is a popular code editor used for writing and editing the project's source code. It provides features such as syntax highlighting, debugging, and integration with version control systems, making the development process more efficient.

4.3.3 SQLite DB

SQLite is a lightweight database used to store and manage data in the Secure Child Pickup System. It handles the storage of user credentials, child and guardian information, and authorization logs, ensuring the system's data is organized and easily accessible.

4.3.4 OpenCV

OpenCV (Open Source Computer Vision Library) is an open-source library used for image processing and computer vision tasks. In this project, OpenCV is utilized for capturing and processing images from the webcam, as well as implementing facial recognition algorithms.

4.3.5 JavaScript (JS)

JavaScript is used to add interactivity and dynamic behavior to the system's web interface. It allows real-time updates and responsiveness in the user interface, enhancing the user experience during the pickup process.

4.2.6 Tailwind CSS

Tailwind CSS is a utility-first CSS framework used for designing the frontend of the system. It simplifies the process of creating responsive and aesthetically pleasing user interfaces by providing pre-built utility classes that can be applied directly to HTML elements.

4.3.7 Face Recognition Pretrained Model

The Face Recognition Pretrained Model is an essential software tool used for identifying and verifying faces in the system. By using a pretrained model, the system can accurately compare live images captured by the webcam with stored images in the database, ensuring secure and reliable child pickups.

4.3 SCREENSHOTS OF THE SYSTEM

4.3.1 Login Page

This login pages concerned with users can log into a system. That users are System administrator and school staff for those users everyone has its own page.

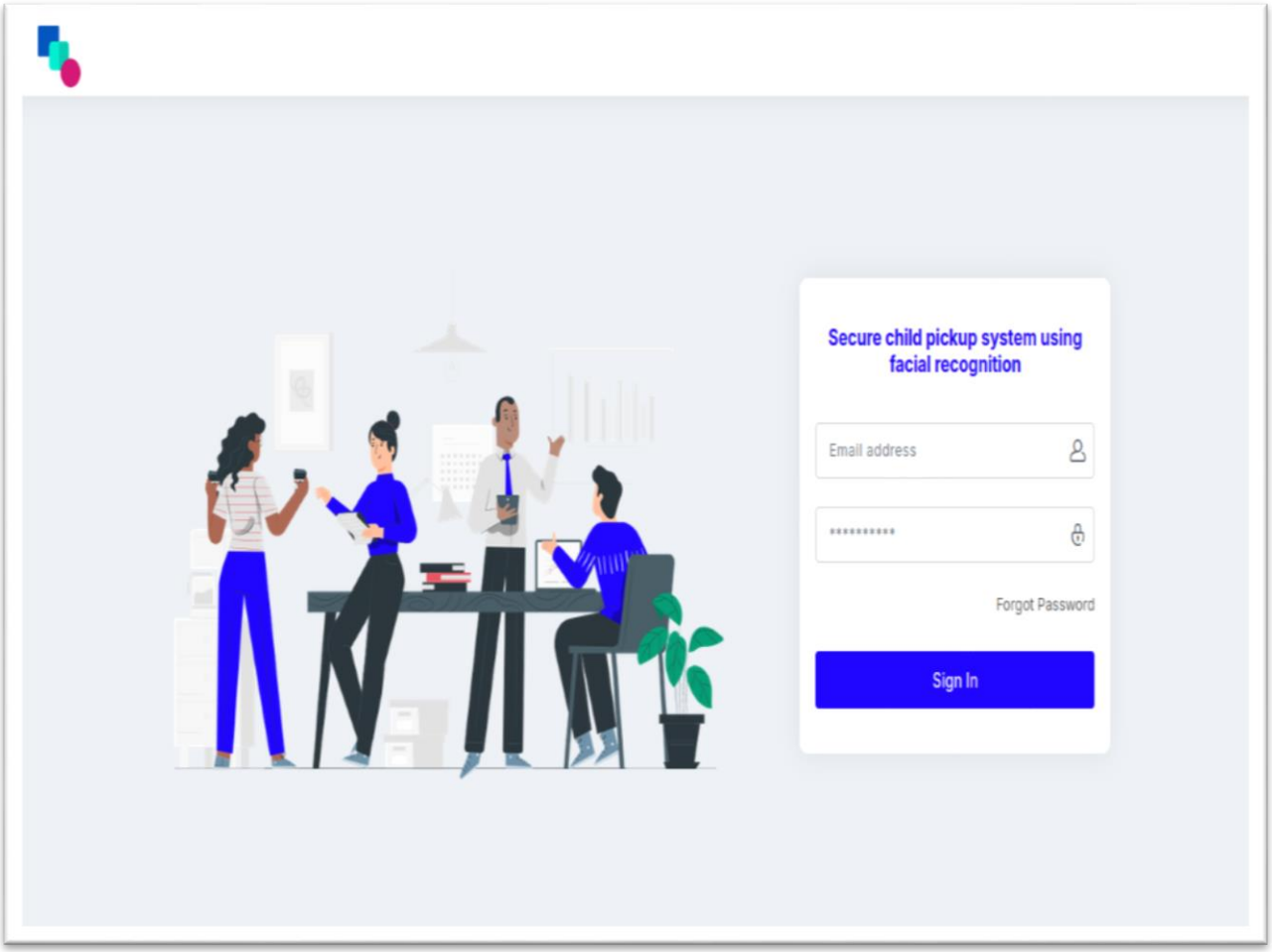


Figure 6: Login page

4.3.2 Student Registration Form

This is form used to register new student and capture image that is used for further face recognition.

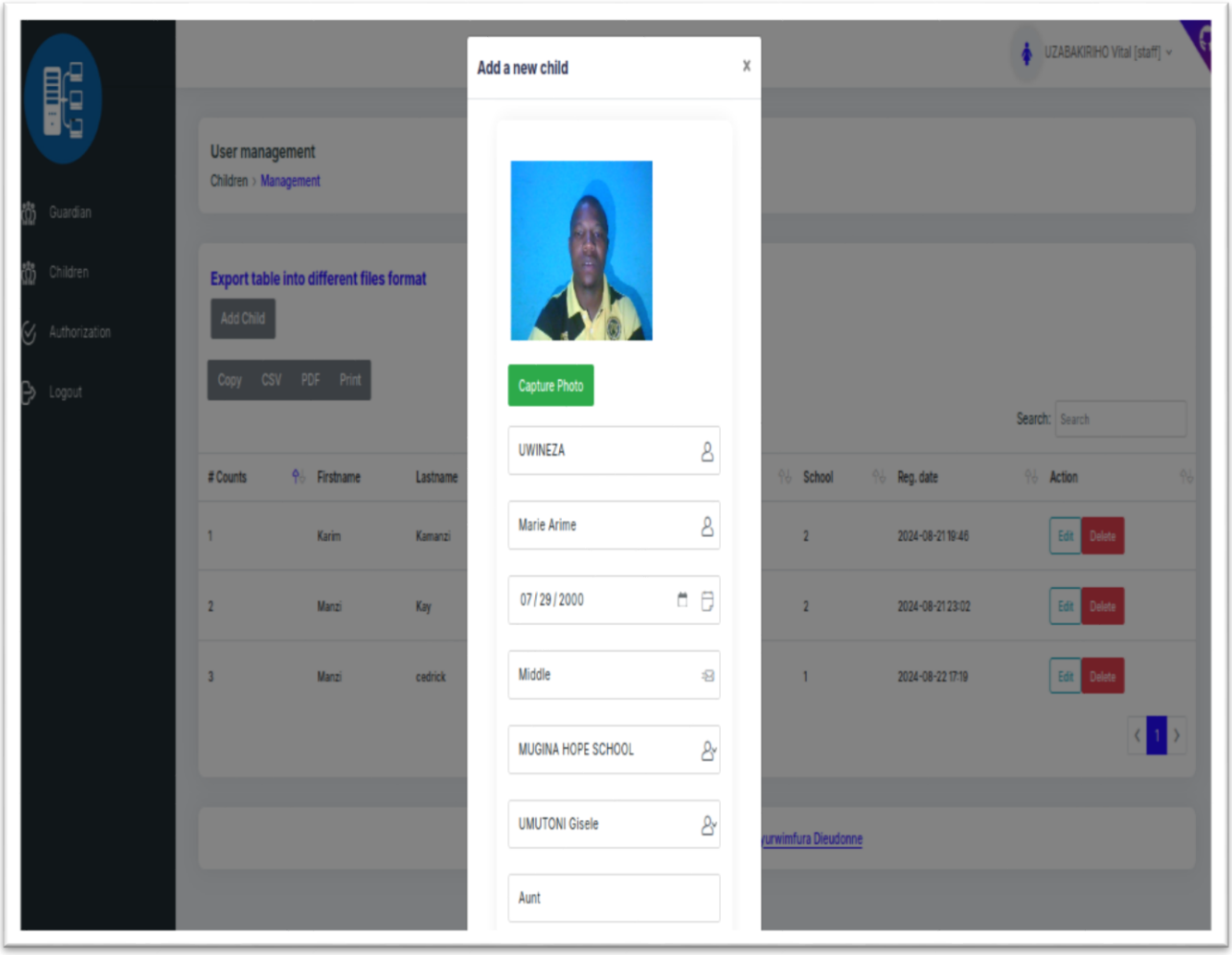


Figure 7: Student Registration Form

4.3.3 Guardian Registration Form

This is form used to register new guardian and capture image that is used for further face recognition.

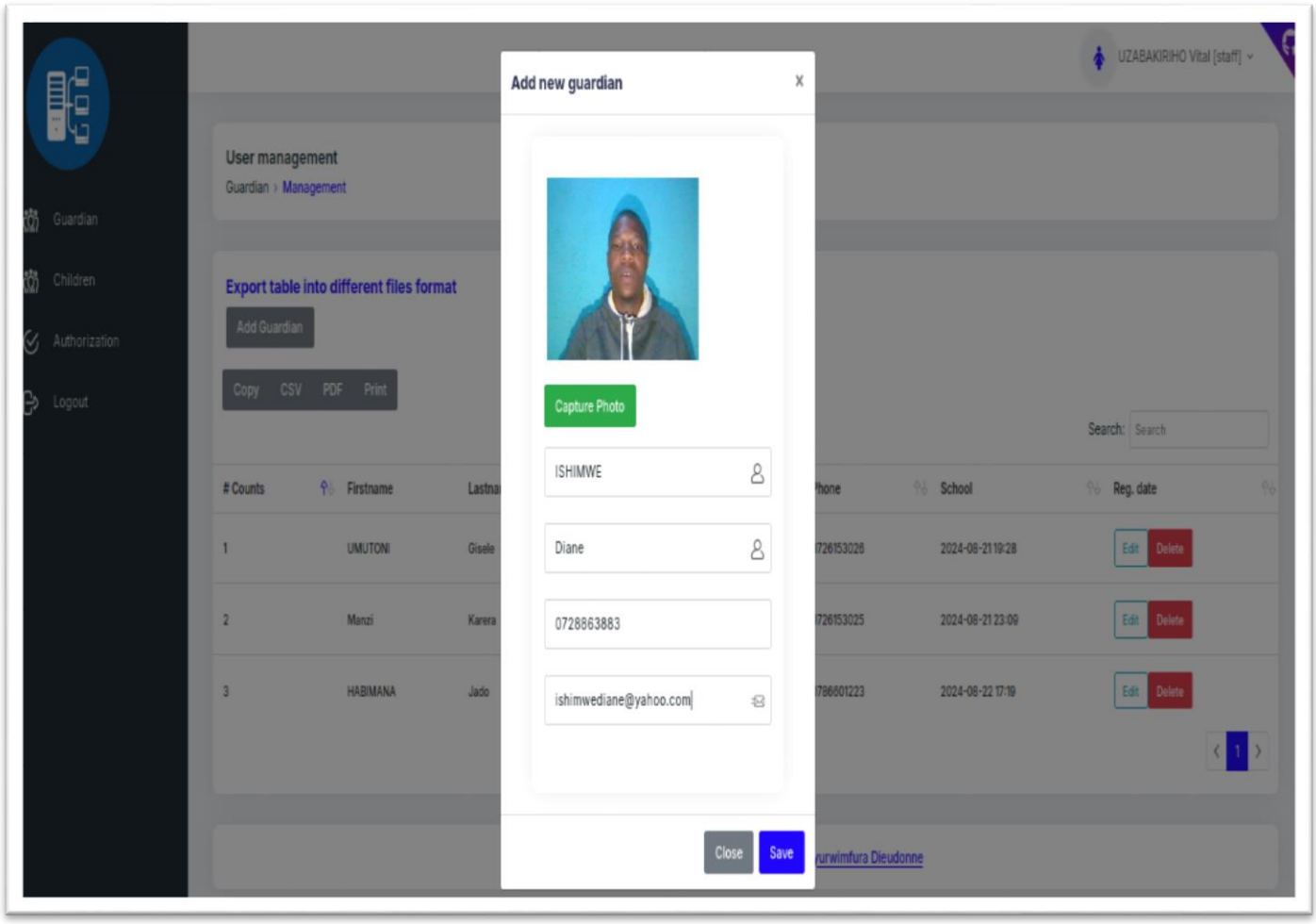


Figure 8: Guardian Registration Form

4.3.4 Authorization page

This page used by school staff during authorization process.

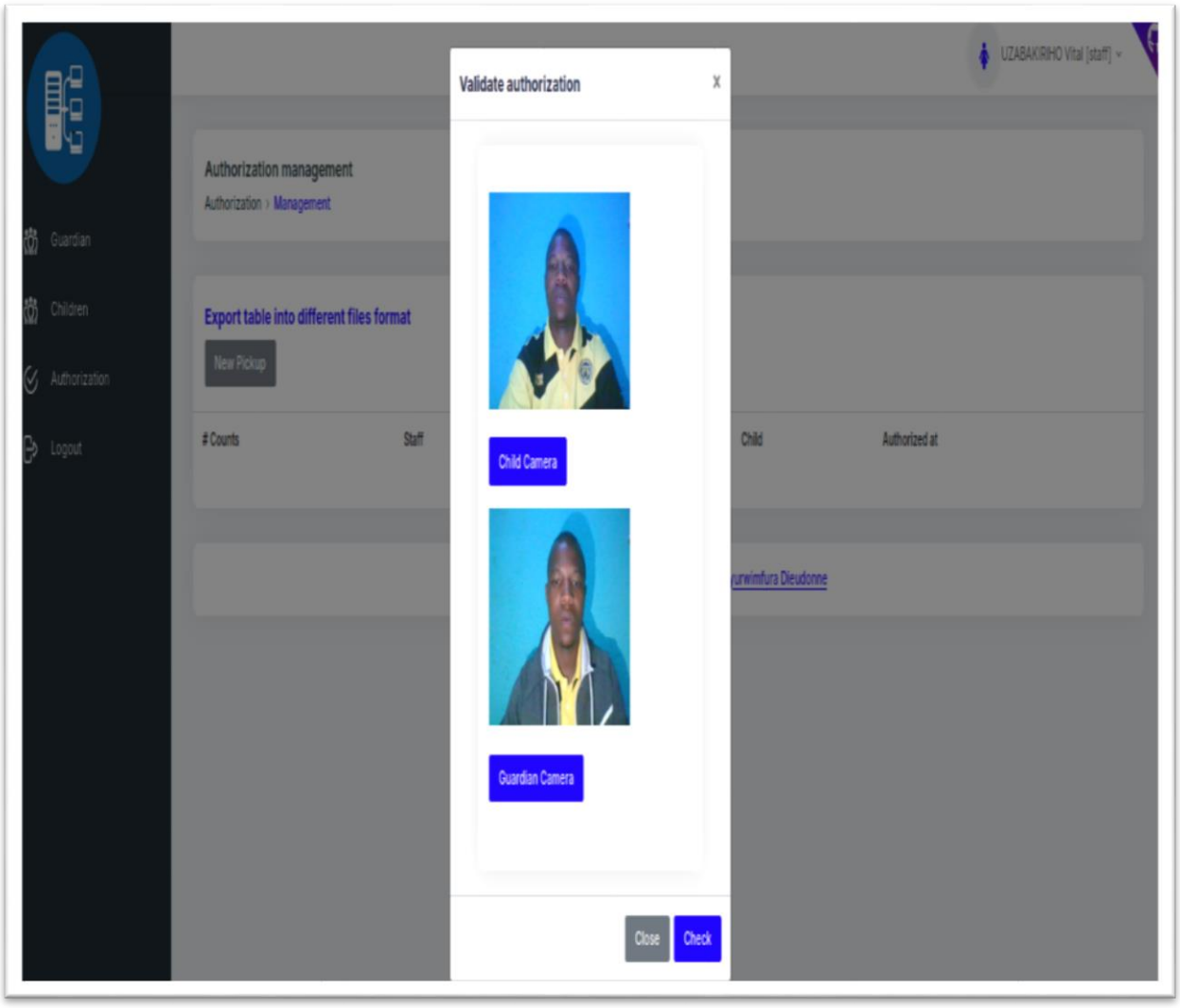


Figure 9: Authorization page

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter provides a comprehensive summary of the project's findings, presents the conclusions drawn from the data collected, and offers recommendations based on the results. It also includes suggestions for further studies that could build upon the findings of this research.

5.2 CONCLUSIONS

The implementation of a secure child pickup system using facial recognition and IoT technologies at MUGINA HOPE SCHOOL has demonstrated significant improvements in the safety and efficiency of child pickup procedures. The system effectively minimized the risks associated with unauthorized pickups by automating the identification process, ensuring that only authorized guardians could collect children. The study's objectives were successfully met, highlighting the potential for this technology to be scaled and adapted for use in other nursery schools. The system's real-time monitoring and alert features provided an additional layer of security, enabling swift responses to potential threats. The findings support the conclusion that integrating advanced technologies in school security systems is both feasible and beneficial in enhancing child safety.

5.3 RECOMMENDATIONS

Based on the conclusions, it is recommended that nursery schools adopt facial recognition and IoT-based systems to improve the security of child pickup procedures. Schools should also provide adequate training for staff to ensure the smooth operation of these systems. Additionally, measures should be taken to address any privacy concerns by implementing strict data protection protocols. Collaboration with technology providers is essential to ensure the systems are regularly updated and maintained.

5.4 SUGGESTIONS FOR FURTHER STUDY

Future research could explore using facial recognition and IoT technologies in school settings, particularly focusing on user acceptance, data privacy, and the cost-effectiveness of these systems. Additionally, studies could investigate the potential for integrating other biometric technologies, such as fingerprint or voice recognition, to further enhance security.

REFERENCES

[1] A Face Recognition System Based on Cloud Computing and AI Edge for IoT . (n.d.). SpringerLink." [Online]. Available: .

[2] Atzori, L., Iera, A., & Morabito, G. (2010). The Internet of Things: A survey. Computer Networks, 54(15), 2787-2805. (n.d.).

[3] Bacharach, S. B., Baumeister, R. F., & Furr, R. M. (2003). Child Safety and Security. Journal of Educational Psychology, 95(4), 7 vbv 61-774. (n.d.).

[4] Cohen, L. E., & Felson, M. (1979). Social Change and Crime Rate Trends: A Routine Activity Approach. American Sociological Review, 44(4), 588-608. (n.d.).

[5] Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (IoT): A vision, architectural elements, and future directions. Future Generation Computer Systems, 29(7), 1645-1660. (n.d.).

[6] Jain, A. K., Ross, A., & Prabhakar, S. (2004). An introduction to biometric recognition. IEEE Transactions on Circuits and Systems for Video Technology, 14(1), 4-20. (n.d.).

[7] Kumar, R., & Chellappa, R. (2016). Facial Recognition Technology for School Security. IEEE Transactions on Information Forensics and Security, 11(10), 2340-2352. (n.d.).

[8] Li, X., Xu, C., & Zhao, Y. (2015). RFID-Based School Security System. Journal of Internet Technology, 16(3), 503-511. (n.d.).

[9] Miorandi, D., Sicari, S., De Pellegrini, F., & Chlamtac, I. (2012). Internet of Things: Vision, applications and research challenges. Ad Hoc Networks, 10(7), 1497-1516. (n.d.).

[10] P. Hu, H. N. (Apr. 2018). "A unified face identification and resolution scheme using cloud computing in Internet of Thing. Future Generation Computer Systems, vol. 81

[11] Turk, M., & Pentland, A. (1991). Eigenfaces for recognition. Journal of Cognitive Neuroscience, 3(1), 71-86. (n.d.).

[12] U.S. Department of Education. (2017). School Safety Policies and Programs. Washington, D.C.. Zhao, W., Chellappa, R., Phillips, P. J., & Rosenfeld, A. (2003). Face recognition: A literature survey. ACM Computing Surveys, 35(4), 399-458. (n.d.).

APPENDICES

APPENDIX 1: GANTT CHART

Table 7: Gantt chart

ID	Start date	End date	Tasks	April	may	June	July	august
1	20/4/2024	27/6/2024	Data collection and design					
2	28/06/2024	20/7/2024	Implementation					
3	21/7/2024	14/8/2024	Writing report					

APPENDIX 2. PROJECT BUDGET

Table 8: Project budget

Nº	**ITEMS**	**AMOUNT IN RWANDAN FRANCS**
1	Accommodation	30000Rwf
2	Communication	10,000Frws
3	Transport& Foods	110,000Frws
5	Internet Connection	20,000 Frws
TOTAL		**170,000Frws**

APPENDIX 3: WORK PLAN

Table 9:Work plan

Nº	**Task to be performed**	**Date to be completed**	**Person assigned to task**
1	Project chosen and project proposal	On15 th Jun 2024-17th Jun 2024	HANYURWIMFURA Dieudonne
2	Project suggestion submission presentation	On 18th Jun -20th Jun 2024	HANYURWIMFURA Dieudonne
3	Data collection	On 24th Jun-26th Jun 2024	HANYURWIMFURA Dieudonne
4	Data analysis	On 28th Jun -10th Jun 2024	HANYURWIMFURA Dieudonne
5	Project design	On 11th July-14th July-2024	HANYURWIMFURA Dieudonne
6	Project testing	On 15th July- 18th July 2024	HANYURWIMFURA Dieudonne
7	Project submission	On 15th Aug 2024	HANYURWIMFURA Dieudonne