

PAYMENT AUTHENTICATION USING FACIAL RECOGNITION

by

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ABSTRACT

The exponential advancement in artificial intelligence (AI), machine learning, robotics, and automation are rapidly transforming industries and societies across the world. This piece looks at how we are trying to better the payment systems using facial recognition, we will also provide our challenges along the way and recommendations for future work. The payment authentication system will be used by employees to pay for their meals using facial recognition instead of using cash and pin cards which is not a hygienic practice in organizations with a lot of people. The system will be linked to the accounts that will be provided by the employee, once the employee pays their funds will be immediately deducted from the account. The payment authentication system will also help reduce the queuing time of employees before meals since it will automate all the work that was once done manually hence saving time for the company. The implementation of this system will also help the country at large in reducing the spread of diseases by reducing contact in work places.

KEYWORDS:

1. Artificial Intelligence: the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.
2. Payment system: A payment system is any system used to settle financial transactions through the transfer of monetary value.

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Chapter 1 Proposal

1.1 Introduction

Facial recognition technology has come a long way since its inception about 50 years ago, hence, the proposal of effective replacement to conventional solutions. These applications range from face recognition, to voice recognition. I will be concentrating on the facial recognition part since it is extensively used for biometric identification. Artificial Intelligence used in payment systems helps in automating most of the paperwork that is done when one pays manually, this in turn saves time and money. Facial recognition has been reported to have some of its draw backs some which include bias in terms of color, gender and race, we are going to find the appropriate algorithm that will give us some accuracy when it comes to identifying people. Our payment authentication system will help bring hygiene in work places as will deal away with the use of cash and pin cards, also the use of shared pens.

1.2 Motivation

In the age of big data, the sheer volume of data discourages manual screening, therefore, the use of artificial intelligence to replace the loads of work is the best practice. Given the current situation globally of the pandemic, we were driven to come up with a payment system that reduces or deals away with the culture of using cards, cash to pay. This helps reduce the spread of diseases, saves time and improves hygiene as a whole. In the food manufacturing industry I was working you would find that most workers wore overalls for hygiene purposes and having their wallets around them all the time was a hustle since their things are kept in lockers during work hours. So as a way to reduce the inconveniences of people missing meal times, we want to implement the use of facial recognition to pay.

1.3 Premises of Research

This payment system is meant to be used in the food manufacturing industry. This system accommodates the user and the administrator that monitors the finances. The platform can be monitored from anywhere as long as the machine is connected to the server.

1.4 Related Work

Smile to Pay: With this payment systems, customers can make purchases by just posing in front of the Point-of-Sale machines equipped with cameras, after linking an image of their face to a digital payment system or bank account.

Dermalog face recognition: this application is known for its high speed, around a billion matches per second on a single blade. Furthermore a module of spoof detection can be purchased, it will detect spoof attacks using photographs or masks. For ICAO (International Civil Aviation Organization) applications, such as facial registration for ePassports, DERMALOG provides an additional face module. The module ensures 100% ICAO compliance for photographs.

1.5 Problem Statement

The practice of manually paying for lunch at work places, which is time consuming because the whole process is done manually, wastes resources and is not hygienic when considering food manufacturing industries. You would find that carrying money or a wallet around when you have to be wearing overalls might not be as easy, so people end up skipping meals because they do not have money on them.

1.6 Aims

- To promote health and hygiene of workers by reducing contact in dealing away with the use of chip and pin cards and cash to pay for meals at work.
- To save company time by automating all the time consuming processes which come with manual payment method.

1.7 Technical Objectives

The main objectives of the proposed system are to:

- To reduce the queuing time of employees by automating the payment process.
- To be able to notify customers on how much is left in their account after a transaction.
- To improve on hygiene by dealing away with paperwork.

1.8 Justification

Improved security in terms of authentication, on one gets to eat on behalf of someone. The employees can eat without having to carry cards or money around. It also saves the company money and time since there will not be need to print receipts. As a result of all these advantages, it speeds up the process. It also improves the hygiene practice since there will be less contact.

1.9 Time table

The estimates for making the system is as shown on the Gantt Chart Below.

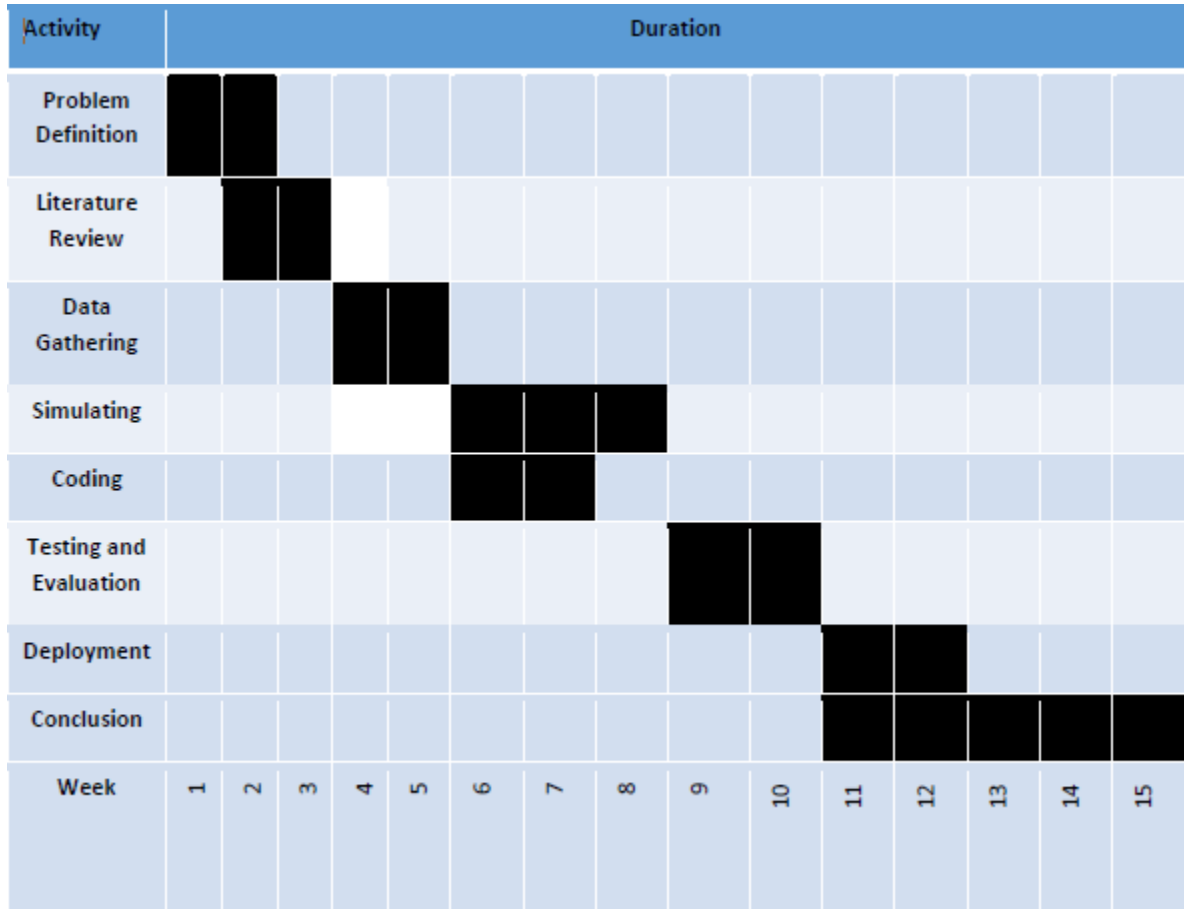


Figure 1: Time Table

Chapter 2 Literature Review

2.1 Introduction

This chapter introduces the existing systems, how they function and their weaknesses, with these weaknesses forming part of the reason behind the development of Facial recognition payment systems. Throughout the years many facial recognition systems have been developed that served different purposes. Due to the fact that industries are affected by different factors and they have different complexities a universal artificial intelligence payment system might prove to be a great need in other industry but not so beneficial to another.

2.2 Synthesis of Literature

2.2.1 Literature Review

Title: Gender Robustness: Robustness of Gender Detection in Facial Recognition Systems with variation in Image Properties

Summary: This paper explains some of the factors of bias based on the facial recognition systems these days. It explains that bias is observed on the basis of gender, color, ethnicity and other facial attributes. It also explains how disturbing it is that these systems are being used in big industries including criminal identification, logging in to sensitive information, making attendances, etc, with the bias still existing. It also presents findings on variations in gender detection of images when subjected to changes in image properties like brightness, sharpness, contrast as well as on a combination of these factors as opposed to just a single factor [1].

Title: FaceHack: Triggering backdoored facial recognition systems using facial characteristics

Summary: This paper describes how the recent advances of machine learning has opened up new avenues for its extensive use in real-world applications. It also explores vulnerabilities of facial recognition algorithms back doored using facial expressions/attributes, embedded artificially and naturally. It states how facial recognition is used from simple friend suggestions in social media platforms to critical security applications for biometric validation in automated immigration at airports. It explains how recent work demonstrated that Deep Neural Networks (DNNs)[2], typically used in facial recognition systems, are susceptible to backdoor attacks; in other words, the DNNs turn malicious in the presence of a unique trigger. This paper also explains how detection mechanisms have focused on detecting these distinct trigger-based outliers statistically or through their reconstruction. It demonstrates that specific changes to facial characteristics may also be used to trigger malicious behavior in a machine learning model. The changes in the facial attributes may be embedded artificially using social-media filters or introduced naturally using movements in facial muscles. By construction, their triggers are large, adaptive to the input, and spread over the entire image. They also describe how they evaluate success of the attack and validate that it does not interfere with the performance criteria of the model.

Title: Facial Emotion Recognition using Convolutional Neural Networks

Summary: The goal of this paper was to classify images of human faces into one of seven basic emotions by experimenting a number of different models, including decision trees and neural networks before arriving at a final Convolutional Neural Network (CNN) model [3]. They later came to a conclusion that CNNs work better for image recognition tasks since they are able to capture special features of the inputs due to their large number of filters. The shortcomings of this works are, while the model did attain near-state-of-the-art results, it also means that it did not achieve state-of-the-art. Additionally, the relatively lower amount of data for emotions such as "disgust" make the model have difficulty predicting it.

Title: Facial Expressions as a Vulnerability in Face Recognition

Summary: This work explores facial expression bias as a security vulnerability of face recognition systems. They explain that despite the great performance achieved by state of the art face recognition systems, the algorithms are still sensitive to a large range of covariates. This work presents a comprehensive analysis of how facial expression bias impacts the performance of face recognition technologies. Their work analyzes, facial expression biases in the most popular face recognition databases; and the impact of facial expression in face recognition performances. [4] Their experimental framework includes four face detectors, three face recognition models, and four different databases, and the results demonstrate a huge facial expression bias in the most widely used databases, as well as a related impact of face expression in the performance of state-of-the-art algorithms. This work opens the door to new research lines focused on mitigating the observed vulnerability.

Title: Artificial Intelligence (AI) Methods in Optical Networks: A Comprehensive Survey

Summary: This paper presents a comprehensive review of the application of AI techniques for improving performance of optical communication systems and networks. The use of AI-based techniques is first studied in applications related to optical transmission, ranging from the characterization and operation of network components to performance monitoring, mitigation of nonlinearities, and quality of transmission estimation [5]. The paper also presents a summary of opportunities and challenges in optical networking where AI is expected to play a key role in the near future.

2.3 Conclusion

In this chapter several concepts, architectures and systems were reviewed. The most common factors that affect face detection are, color, race and gender. We will use the information we found to improve the proposed system making facial recognition better. The literature presented will help guide the creation of the proposed system.

Chapter 3 Requirements Analysis

3.1 Introduction

Understanding system and user requirements is very important when it comes to developing Artificial Intelligence based systems. This chapters seeks to explain the existing system used at work places to serve employees during lunch breaks. A feasibility study is also carried out to see the constraints against creating the new system. It will help determine the success and minimize the risks related to the project. Lastly the requirements analysis will be carried out which encompasses those tasks that go into determining the needs or conditions to meet for our system, taking account of the possibly conflicting requirements of the various stakeholders.

3.2 Current System

Currently in Zimbabwe the manual payment system is used at work places. The practice of manually paying is time consuming and not the best when considering food manufacturing industries when considering hygiene. This has proved not to be the best method as some employees wear pocket-less overalls and they cannot carry their phones or wallets around to make payments for food resulting in most workers missing meals. The authentication payment system eliminates that problem as all you need to have a meal is your face and money in your account. More over the automation of the payment system will deal away with the use of paper and saves most resource thereby saving company money.

3.2.1 Weaknesses of the Current System

The use of current system is time consuming because the whole process is done manually, is not hygienic when considering food manufacturing industries and it also increases the spread of contact transmission diseases. By using the proposed system, the whole process is automated hence solving most of the weaknesses of the current system. The other problem with the current system is it wastes company resources.

3.2.2 Context Level Diagram

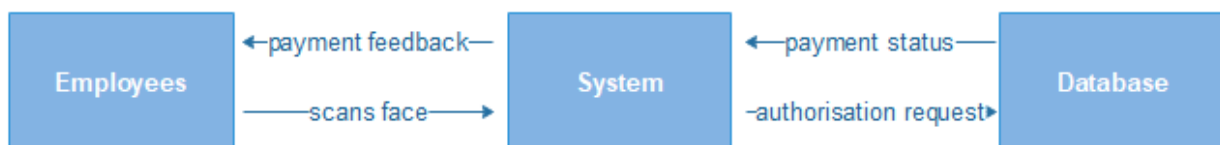


Figure 2: Context Level DFD

3.2.3 Process Flow Diagram

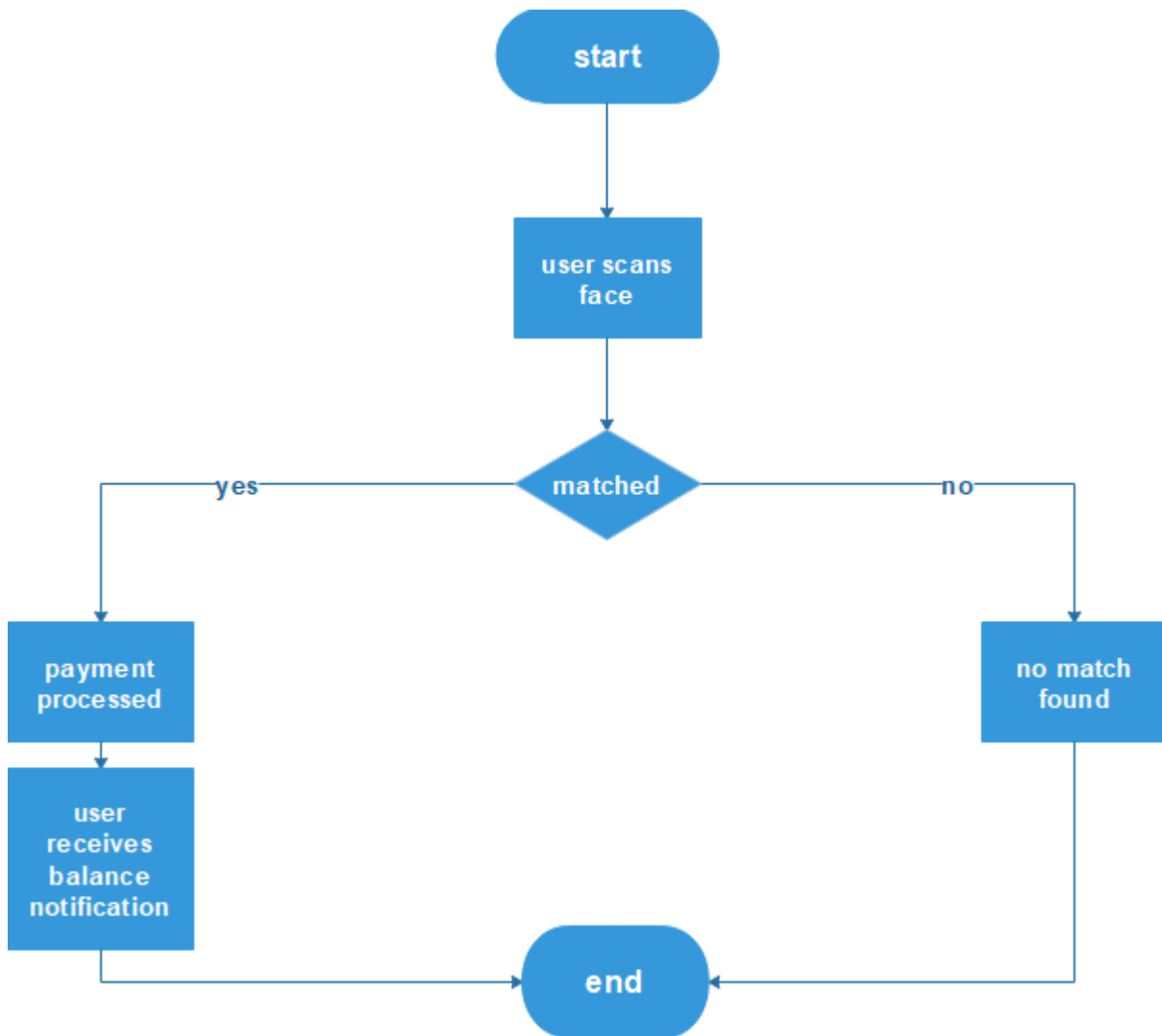


Figure 3: Process Flow Diagram

3.3 Feasibility Study

This chapter seeks to assess the practicality of the project. The goal is to find out which problems are most likely to be encountered during project development, how to mitigate these problems and evaluate whether it is a good idea to continue with the project.

The feasibility study will address the following questions:

- What are the skills required for the development of the proposed system?
- What is the cost of developing the proposed system?
- Will the software we are developing meet user requirements and which are the major participants that are most likely to adopt the system?
- To determine whether the software can be implemented using the current technology and within the specified budget and schedule.

3.3.1 Technical Feasibility

Technical feasibility is a study that is undertaken that will let us know whether the skills that we have are enough to develop the proposed system. In other words, technical feasibility assesses the current resources and technology, which are required to accomplish user requirements in the software within the allocated time and budget.

The technical skills required for the development of the proposed system are as follows:

- Python programming skills
- Laptop
- Webcam

3.3.2 Economic Feasibility

In this chapter the cost-benefit analysis is very essential. The Cost-Benefit analysis helps us to weigh the overall costs and benefits of the system. The Cost-Benefit analysis addresses the following issues:

- The time or period it will take to develop the whole system
- The developmental costs, operational costs and implementation costs
- The revenue that is expected to be attained from the system upon completion and successful implementation.

This project does not requires us to buy any hardware components, we will make use of open source technologies, in the development process and implementation stage thereby making it affordable.

The developmental costs are as follows:

Component	Estimated price (USD)
Additional 4GB	\$15.00
Total	\$15.00

Table 1: Estimated Budget

The developmental costs have been put in USD because the rates keep fluctuating due to unstable rates. These components are also to be purchased online and will take a duration of about two weeks to get to Zimbabwe.

3.4 Requirements Analysis

This chapter seeks to define user expectations for the project being built and the system requirements. This part is very crucial as it will determine the relevance and success of the project.

3.4.1 Functional Requirements

The proposed system shall have the following functionalities:

- The system should be able detect the user's face and match it to the one in the database.
- The system should be able to deduct the amount used by the user from the bank account.
- The system should be able to send a message showing the remaining balance to the respective user.

3.4.1.1 Context Level DFD

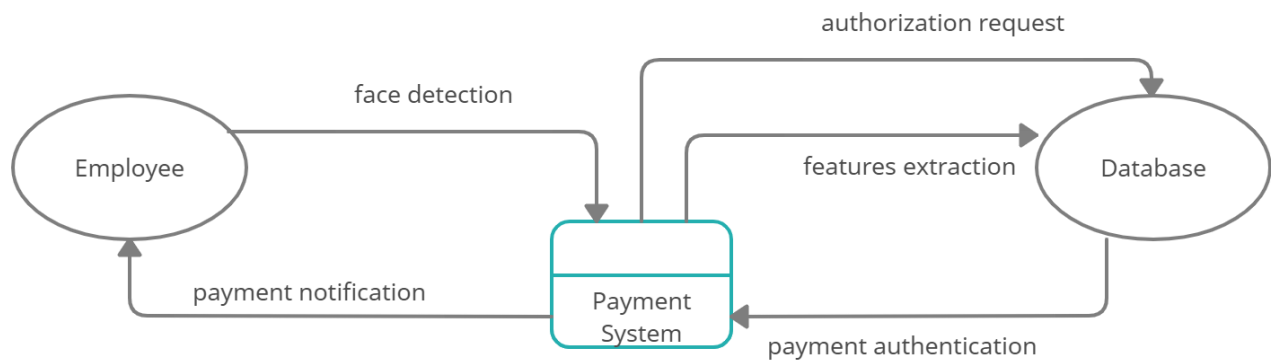


Figure 4: Context Level DFD Proposed System

3.4.1.2 Use-Case diagram

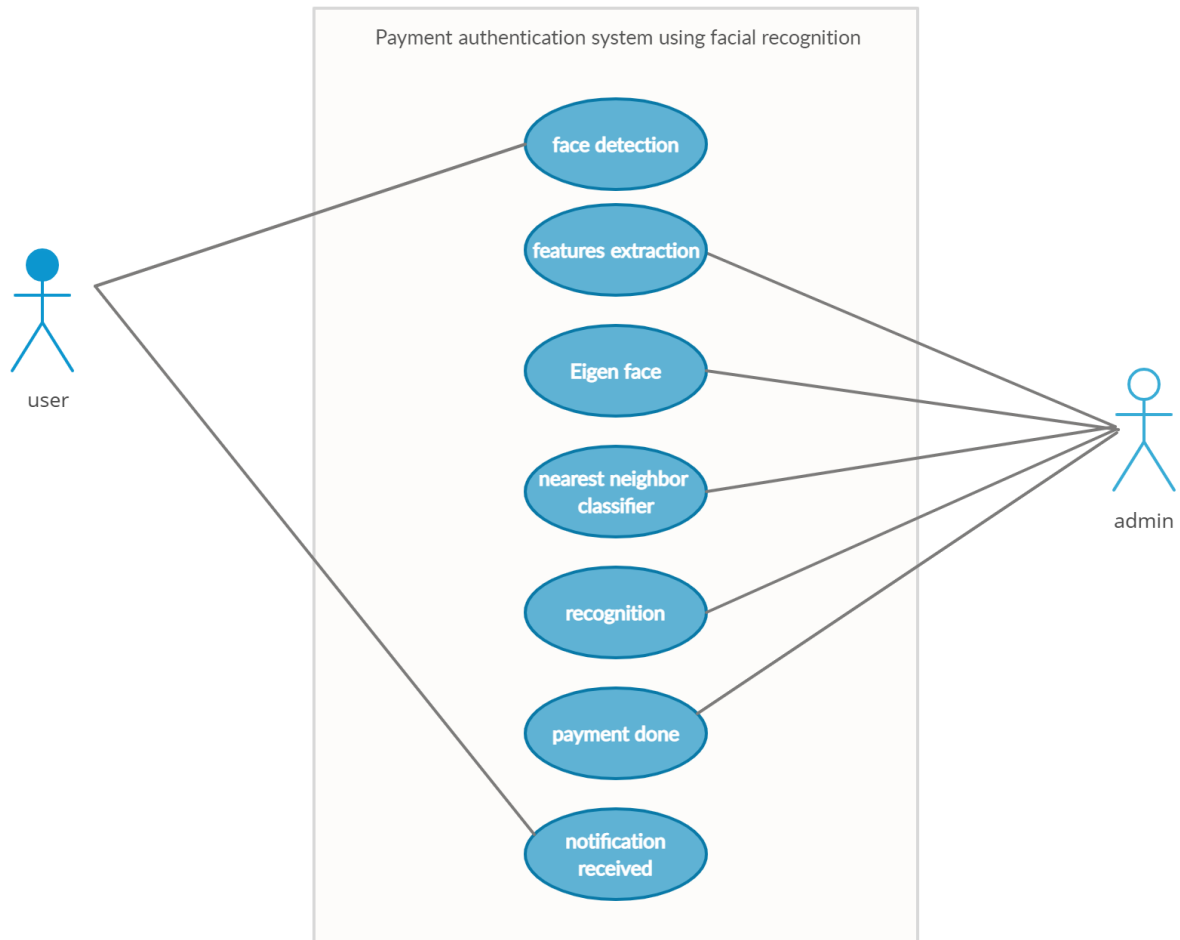


Figure 5: Use Case Proposed System

3.4.2 Non-Functional Requirements

3.4.2.1 Performance

The system will scan the face of the user and match it to the one stored in the database. When the matching is done there should be minimal time taken by the system to deduct money from the user's account.

3.4.2.2 Usability

- System must be able to scan the user's face.
- System must deduct money from account.

3.4.2.3 Security

The system decreases chances of miscalculation as the whole process is automated.

3.5 Interface Requirements

The interface requirements specify how the proposed system should interact to its users. The proposed system should have a simplistic, consistent user-friendly interface that is easy to use, that is reasonably responsive and that appropriately handles exceptions. The user-interface requirements for the proposed system are listed below.

- The payment interface should be user friendly and users should be able to clearly see change of movement and other factors so that they can take the appropriate action.
- The interface should be highly responsive, appropriately providing feedback after every user's action.
- A clear and visible LCD display

3.6 Technical Requirements

Technical requirements are crucial from every project to take place. Failure to identify such requirements may lead to the failure of the project as it would not produce the expected results.

3.6.1 Hardware Requirements

- Additional 4GB RAM
- Laptop

3.6.2 Software Requirements

- Webcam
- Visual Studio

3.7 Assumptions

The project has the below assumptions:

- The webcam can properly identify users.
- Every user who wants to have lunch has enough money in the account.

3.8 Conclusion

The chapter highlighted what information was needed for the feasibility study which determines whether the solution considered to accomplish the requirements is practical and workable. Information such as resource availability, cost estimation for project development, and cost to be incurred on the project. We also discussed the requirements analysis in which we outline all the user and system requirements.

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