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SAKARYA UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

A MOBILE APPLICATION FOR ATTENDANCE TRACKING BASED ON USER AUTHENTICATION

MSc THESIS

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Computer and Information Engineering Department

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Thesis Advisor: Prof. Dr. Devrim AKGÜN

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The thesis work titled “A mobile application for attendance tracking based on user authentication” prepared by Bawar Ali Abdalkarim ABDALKARIM was accepted by the following jury on 22/06/2023 by unanimously/majority of votes as a MSc THESIS in Sakarya University Graduate School of Natural and Applied Sciences, Computer and Information department.

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Bawar Ali Abdalkarim ABDALKARIM

Rahman ve Rahim olan Allah'ın adıyla, Rabbim! ilmimi artır" de (Taha: 114)

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No thesis could be written without being influenced by the thoughts of others. Most importantly, I would like to give God the glory for all my efforts in this report.

Bawar Ali Abdalkarim ABDALKARIM

TABLE OF CONTENTS

Page

ABBREVIATIONS

AtTrack	: Attendance Tracking Application.
API	: Application Program Interface.
ER	: Entity-Relationship.
IDE	: Integrated Development Environment.
APP	: Application.
UI	: User Interface.
UX	: User Experience.
RFID	: Radio Frequency Identification.
PIN	: Personal Identification Number.
QR	: Quick Response.
Wi-Fi	: Wireless Fidelity.
IP	: Internet Protocol.
GPS	: Global Positioning System.
ID	: Identification.
LBPH	: Local Binary Pattern Histogram.
CNN	: Convolutional Neural Network.
PCA	: Principal Component Analysis.
SVM	: Support Vector Machines.
CC	: Cloud Computing.
SMS	: Short Message Service.
DB	: Database.
HLD	: High Level Design.
JWT	: JSON Web Token.
REST	: Representational State Transfer.
Tflite	: Tensor-flow Lite.
ML	: Machine Learning.
Iff	: If and only If.

LIST OF FIGURES

Page

A MOBILE APPLICATION FOR ATTENDANCE TRACKING BASED ON USER AUTHENTICATION

SUMMARY

Attendance tracking is an essential aspect of organizational management that plays a significant role in employee productivity and performance management. It ensures that employees are present and accounted for during working hours, facilitates accurate payroll processing, and helps identify patterns and trends in attendance behavior. In recent years, the demand for automated attendance tracking has grown, driven by the need for more efficient and secure methods.

Traditionally, organizations have relied on manual methods such as paper-based sign-in sheets or punch cards. However, these methods are prone to errors, can be easily manipulated, and require significant administrative effort to maintain and process. As a result, organizations have turned to technology for more reliable and streamlined attendance tracking solutions.

One prevalent technology used for attendance tracking is biometric recognition, which includes fingerprint scanners and facial recognition systems. Biometric attendance systems offer a high level of accuracy and eliminate the risk of buddy punching (when one employee clocks in or out on behalf of another). However, these systems can be expensive to implement and maintain, and there are concerns regarding privacy and data security.

Another technology commonly used is RFID (Radio-Frequency Identification), which involves using tags or cards with embedded chips to track employee attendance. RFID systems are relatively cost-effective and provide quick and easy scanning. However, they also have limitations, such as the need for employees to carry their RFID cards at all times and the possibility of cards being lost or stolen.

Magnetic stripes and barcodes are other technologies used for attendance tracking. These methods require employees to swipe or scan their cards through readers, which record their attendance. While magnetic stripes and barcodes are less expensive than biometric or RFID systems, they are susceptible to wear and tear, and the process can be time-consuming, leading to queues and delays during peak hours.

To address the limitations of existing attendance tracking technologies, this study proposes the use of modern technologies, including Android's Flutter Framework, face recognition, and PIN codes, to provide an efficient and secure attendance tracking system. The implementation of a mobile attendance tracking app utilizing Flutter and open-source libraries is an innovative solution that offers several advantages.

The mobile attendance tracking app developed using Flutter provides a user-friendly and intuitive interface, allowing employees to easily clock in and out. The app's use of face recognition technology ensures that employees cannot manipulate attendance records, as their unique facial features are used for verification. This eliminates the

risk of buddy punching and other forms of time fraud, leading to improved accuracy in attendance tracking.

In addition to face recognition, the app also incorporates PIN codes as an alternative authentication method. This provides flexibility for employees who may have difficulties with facial recognition due to factors such as poor lighting conditions or temporary facial changes. By offering multiple authentication options, the app ensures accessibility and ease of use for all employees.

One key advantage of the proposed attendance tracking system is its multi-level access and authentication methods. The app incorporates three levels of privileges: Admin, Editor, and Viewer. This ensures that access to sensitive information, such as attendance records and employee data, is restricted to authorized personnel only. The multi-level access feature enhances data security and prevents unauthorized individuals from tampering with or accessing confidential information.

Furthermore, the mobile attendance tracking app utilizes open-source libraries, which facilitate maintenance and customization. The use of open-source libraries allows organizations to tailor the app to their specific requirements, integrate it with existing systems, and make modifications as needed. This flexibility ensures that the app remains adaptable to changing organizational needs and technological advancements.

Regular updates to the app enhance its features and security, ensuring that it remains relevant and effective. The development community behind Flutter and the open-source libraries continually address vulnerabilities and release updates, safeguarding the app against emerging threats and ensuring data security.

In conclusion, the mobile attendance tracking application built using Flutter and open-source libraries is an ideal solution for organizations aiming to enhance attendance tracking while maintaining data security. The app's multi-level access and authentication methods, together with its use of modern technologies, guarantee efficiency, accuracy, and security. As such, it offers a more efficient and secure alternative to traditional attendance tracking methods, making it an indispensable tool for modern-day organizations.

KULLANICI KİMLİK DOĞRULAMAYA DAYALI KATILIM TAKİBİ İÇİN MOBİL UYGULAMA

ÖZET

Katılım takibi, kurumsal yönetimin vazgeçilmez bir unsuru olup, çalışanların verimliliğini ve performans yönetimini önemli ölçüde etkiler. Bu takip yöntemi, çalışma saatlerinde çalışanların hazır ve hesapta olduğunu sağlar. Çalışanların düzenli olarak katılımını takip etmek, işyerinde disiplini ve düzeni sağlamada önemli bir rol oynar. Ayrıca, çalışanların belirlenen çalışma saatlerinde mevcut olmaları, iş süreçlerinin etkin bir şekilde yürütülmesini ve işbirliğini kolaylaştırır.

Bunun yanı sıra, katılım takibi doğru maaş işlemlerini kolaylaştırır. Çalışanların çalışma saatlerinin kaydedilmesi, doğru maaş hesaplamalarının yapılmasını sağlar. Böylece, işverenler çalışanların performansına uygun olarak adil ve doğru şekilde maaş ödemelerini gerçekleştirebilir. Aynı zamanda, çalışanların katılım davranışındaki kalıpları ve eğilimleri belirlemeye yardımcı olur. Bu takip sayesinde, çalışanların devamsızlık, gecikme veya izin kullanma gibi katılım alışkanlıkları izlenebilir ve bu verilerin analiziyle gelecekteki katılım davranışlarına ilişkin önemli bilgiler elde edilebilir.

Katılım takibi, bir kuruluş için çalışanların faaliyetlerini izlemek ve kaydetmek amacıyla kullanılan bir sistemdir. Bu sistem, çalışanların çalışma saatlerine bağlılığını gösterir ve işverenlerin işgücü yönetimini etkili bir şekilde yapmasına yardımcı olur. Otomatik katılım takibi, manuel yöntemlere kıyasla daha verimli ve güvenilir bir şekilde çalışan katılımını takip etmeyi sağlar.

Son yıllarda, otomatik katılım takibi talebi, daha verimli ve güvenli yöntemlere duyulan ihtiyaçla artmıştır. Geleneksel yöntemler, çalışanların giriş-çıkış saatlerini kaydetmek için zaman alıcı ve hataya açık olabilirken, otomatik takip sistemleri bu süreci kolaylaştırır. Biyometrik veriler, kart okuyucular veya diğer teknolojiler aracılığıyla çalışanların giriş-çıkış saatlerinin otomatik olarak kaydedilmesi, doğru ve güvenilir bir katılım verisi sağlar.

Otomatik katılım takibi, aynı zamanda çalışanların maaş işlemlerini kolaylaştırır. Doğru katılım verilerine dayanarak, işverenler çalışanların çalıştıkları saatleri ve ödenmesi gereken ücretleri daha hassas bir şekilde hesaplayabilir. Bu da maaş işlemlerinde doğruluk ve düzenlilik sağlar, yanlış hesaplamaların önüne geçer ve işgücü maliyetlerinin etkin bir şekilde yönetilmesine yardımcı olur.

Katılım takibi aynı zamanda katılım davranışındaki kalıpları ve eğilimleri belirlemeye yardımcı olur. Veriler, çalışanların devamsızlık oranlarını, gecikmelerini ve izin kullanımlarını analiz etmeye olanak tanır. Bu analizler, işverenlere çalışanların katılım performansını değerlendirmek, eğilimleri tanımak ve uygun önlemler almak için önemli bilgiler sağlar. Böylece işyerinde disiplin ve verimlilik artırılabilir.

Geleneksel olarak, kuruluşlar kağıt tabanlı kayıt yapma formları veya kartlar gibi manuel yöntemlere güvenmişlerdir. Bununla birlikte, bu yöntemler hatalara duyarlı

olabilir, kolayca manipüle edilebilir ve sürdürmek ve işlemek için önemli bir idari çaba gerektirir. Sonuç olarak, kuruluşlar daha güvenilir ve akıllı katılım takibi çözümleri için teknolojiye yönelmiştir.

Katılım takibinde yaygın olarak kullanılan bir teknoloji biyometrik tanımadır. Parmak izi tarayıcıları ve yüz tanıma sistemlerini içeren biyometrik katılım sistemleri yüksek bir doğruluk seviyesi sunar ve "buddy punching" riskini (bir çalışanın başka bir çalışan adına kayıt yapması) ortadan kaldırır. Bununla birlikte, bu sistemleri uygulamak ve sürdürmek pahalı olabilir ve gizlilik ve veri güvenliği konularında endişeler bulunmaktadır.

Katılım takibinde yaygın olarak kullanılan diğer bir teknoloji, çalışanların katılımını takip etmek için gömülü çiplere sahip etiketler veya kartlar kullanmayı içeren RFID (Radyo Frekansı Tanımlama) sistemleridir. RFID sistemleri nispeten maliyet etkin olup hızlı ve kolay tarama sağlar. Bununla birlikte, çalışanların RFID kartlarını her zaman taşıma gerekliliği ve kartların kaybolma veya çalınma riski gibi kısıtlamaları bulunmaktadır.

Manyetik şeritler ve barkodlar katılım takibinde kullanılan diğer teknolojilerdir. Bu yöntemlerde çalışanların kartlarını okuyucular aracılığıyla çekmeleri veya taranmaları gerekmektedir, böylece katılımları kaydedilir. Manyetik şeritler ve barkodlar, biyometrik veya RFID sistemlere kıyasla daha ucuz olmasına rağmen, aşınmaya ve yıpranmaya karşı hassastır ve işlem, yoğun saatlerde sıralara ve gecikmelere neden olabilecek kadar zaman alıcı olabilir.

Mevcut katılım takibi teknolojilerinin sınırlamalarını ele almak için bu çalışma, Android'in Flutter Framework'ünü, yüz tanıma ve PIN kodlarını içeren modern teknolojilerin kullanımını önermektedir. Flutter ve açık kaynaklı kütüphaneleri kullanarak geliştirilen bir mobil katılım takip uygulamasının uygulanması, birçok avantaj sunan yenilikçi bir çözümdür.

Flutter kullanılarak geliştirilen mobil katılım takip uygulaması, kullanıcı dostu ve sezgisel bir arayüz sunarak çalışanların kolayca giriş ve çıkış yapmasını sağlar. Uygulamanın yüz tanıma teknolojisi kullanarak çalışanların katılım kayıtlarını manipüle etmelerini engeller, çünkü benzersiz yüz özellikleri doğrulama için kullanılır. Bu, "buddy punching" ve diğer zaman dolandırıcılığı biçimlerinin riskini ortadan kaldırarak katılım takibindeki doğruluğu artırır.

Yüz tanıma yanında, uygulama aynı zamanda alternatif bir kimlik doğrulama yöntemi olarak PIN kodlarını da içerir. Bu, kötü aydınlatma koşulları veya geçici yüz değişiklikleri gibi faktörler nedeniyle yüz tanımadan zorluk yaşayan çalışanlar için esneklik sağlar. Birden fazla kimlik doğrulama seçeneği sunarak, uygulama tüm çalışanlar için erişilebilirlik ve kullanım kolaylığı sağlar.

Önerilen katılım takibi sisteminin önemli bir avantajı, çok seviyeli erişim ve kimlik doğrulama yöntemleridir. Uygulama, Admin, Editör ve Görüntüleyici olmak üzere üç ayrı ayrıcalık seviyesini içerir. Bu, katılım kayıtları ve çalışan verileri gibi hassas bilgilere sadece yetkili personelin erişimine izin verir. Çok seviyeli erişim özelliği veri güvenliğini artırır ve yetkisiz kişilerin gizli bilgilere müdahale etmesini veya erişmesini önler.

Ayrıca, mobil katılım takip uygulaması, bakım ve özelleştirme konusunda esneklik sağlayan açık kaynaklı kütüphaneleri kullanır. Açık kaynaklı kütüphanelerin kullanımı, organizasyonların uygulamayı özel gereksinimlerine uyarlamasını, mevcut sistemlerle entegre etmesini ve ihtiyaç duyulduğunda değişiklik yapmasını sağlar.

Mobil katılım takip uygulamaları, çalışanların işyerine veya projeye bağlı kalmaksızın çalışma saatlerini takip etmelerini sağlar. Bu uygulamalar, işverenlere esnek çalışma modellerine uyum sağlama ve uzaktan çalışma durumlarında bile katılımı etkin bir şekilde yönetme imkanı verir. Ayrıca, mobil uygulamalar, kullanıcı dostu arayüzleri ve kullanışlı özellikleri sayesinde çalışanların kolaylıkla giriş-çıkış saatlerini kaydetmelerini ve gerektiğinde izin taleplerini iletmelerini sağlar.

Bu esneklik, mobil katılım takip uygulamalarının açık kaynaklı kütüphaneleri kullanmasıyla birleştiğinde daha da artar. Açık kaynaklı kütüphaneler, organizasyonların uygulamayı kendi özel gereksinimlerine göre özelleştirmesine olanak tanır. Mevcut sistemlerle entegrasyon sağlayarak veri alışverişini kolaylaştırır ve işyerindeki diğer süreçlerle uyum içinde çalışmayı destekler. Ayrıca, ihtiyaç duyulduğunda açık kaynaklı kütüphaneler üzerinde değişiklik yapmak mümkündür, böylece uygulama sürekli olarak kurumsal ihtiyaçlara ve teknolojik gelişmelere uyum sağlayabilir.

Mobil katılım takip uygulamasının bu açık kaynaklı ve özelleştirilebilir yapısı, işverenlere daha verimli bir katılım takibi yöntemi sunar ve işgücü yönetimini iyileştirir. Aynı zamanda, çalışanlar için kullanımı kolay ve esnek bir araç oluşturur, çalışma saatlerini ve katılımı takip etmelerini daha da kolaylaştırır. Bu sayede, organizasyonlar hem katılımı etkin bir şekilde yönetebilir hem de iş süreçlerini daha verimli hale getirebilir.

Uygulamaya düzenli güncellemeler, özelliklerini ve güvenliğini artırarak, güncelliğini ve etkinliğini sağlar. Bu güncellemeler, Flutter ve açık kaynaklı kütüphanelerin geliştirme topluluğu tarafından gerçekleştirilir ve uygulamanın sürekli olarak iyileştirilmesini sağlar.

Flutter, mobil uygulama geliştirme için popüler bir çerçevedir ve açık kaynaklı kütüphanelerle birlikte kullanıldığında güçlü bir kombinasyon oluşturur. Flutter'ın aktif geliştirme topluluğu, uygulamanın zayıflıklarını ele alır ve güncellemeleri yayınlayarak güvenlik açıklarını kapatır. Bu güncellemeler aynı zamanda yeni özelliklerin eklenmesini sağlar ve kullanıcı deneyimini iyileştirir.

Açık kaynaklı kütüphanelerin geliştirme topluluğu da uygulamanın güvenliğini sağlamak için düzenli güncellemeler sunar. Bu topluluk, yeni güvenlik tehditleri ortaya çıktığında hızla harekete geçer ve güncellemeleri yayınlar. Bu sayede, kullanıcı verilerinin korunması ve uygulamanın güvenliği sağlanır. Veri güvenliği, özellikle katılım takibi gibi hassas bilgilerin işlendiği bir uygulama için büyük önem taşır.

Sonuç olarak, Flutter ve açık kaynaklı kütüphaneler kullanılarak oluşturulan mobil katılım takip uygulaması, veri güvenliğini korurken katılım takibini geliştirmek isteyen organizasyonlar için ideal bir çözümdür. Uygulamanın çok seviyeli erişim ve kimlik doğrulama yöntemleri, modern teknolojilerin kullanımı ile birlikte verimlilik, doğruluk ve güvenlik sağlar. Bu nedenle, geleneksel katılım takibi yöntemlerine kıyasla daha verimli ve güvenli bir alternatif sunarak, modern organizasyonlar için vazgeçilmez bir araç haline gelir.

Sonuç olarak, Flutter ve açık kaynaklı kütüphaneler kullanılarak oluşturulan mobil katılım takip uygulaması, veri güvenliğini korurken katılım takibini geliştirmek isteyen organizasyonlar için ideal bir çözümdür. Uygulamanın çok seviyeli erişim ve kimlik doğrulama yöntemleri, modern teknolojilerin kullanımı ile birlikte verimlilik, doğruluk ve güvenlik sağlar.

Mobil katılım takip uygulaması, kullanıcıların güvenli bir şekilde giriş yapabilmesi için çok seviyeli erişim ve kimlik doğrulama yöntemlerini kullanır. Bu sayede, yetkisiz erişimlerin önüne geçilir ve kullanıcı bilgileri korunur. Ayrıca, uygulama güncel verilerle çalışır ve hatalı veya eksik bilgileri önlemek için otomatik doğrulama ve kontrol mekanizmaları içerir.

Bu nedenle, geleneksel katılım takibi yöntemlerine kıyasla daha verimli ve güvenli bir alternatif sunarak, modern organizasyonlar için vazgeçilmez bir araç haline gelir. Mobil katılım takip uygulaması, işyerlerinde zaman ve kaynak tasarrufu sağlar. Otomatik kayıt ve hesaplama özellikleri sayesinde işverenler, çalışanların katılımını doğru ve hızlı bir şekilde takip edebilir, maaş işlemlerini kolaylaştırabilir ve verimliliklerini artırabilir.

Ayrıca, uygulama verilerinin güvenliği büyük önem taşır. Flutter ve açık kaynaklı kütüphaneler, güvenlik açıklarını hızla düzeltir ve düzenli güncellemeler sağlar. Bu sayede, kullanıcı verileri ve şirket bilgileri güvende tutulur. Mobil katılım takip uygulaması, modern organizasyonlar için veri güvenliği sağlayan, etkili ve kullanıcı dostu bir çözüm sunar.

1. INTRODUCTION

It is now more important than ever to implement information technology systems since they have generally offered a several range of application fields. Because it served as a valuable factor for nations to develop their economies in the fields of education and industry as well. To show and access their information, institutions all around the world have begun integrating technology. Numerous academic institutions and other organizations were digitizing their info to make their normal activities considerably simpler (Khan et al., 2015). As the area starts to improve in the use of technology and it is being employed in the public and commercial sector, making daily tasks simpler and more readily accessible by people has become a key aspect to the success of the nation.

The attendance authentication information at a place is a crucial component that lacks a uniform technology platform. In certain situations, there won't be sufficient knowledge about a single individual and their attitude to support them in their everyday work. Relatedly, there can be restrictions on authentication or gathering daily attendance data. Employers, employees, and younger generation members cannot effectively meet or fulfill their demands. Using an organization with a sizable staff as a sample. due to the scale of the company and the wide availability of individuals that work there. These employees visit there daily to carry out their duties. If there isn't a good attendance system in place to keep track of everyone's participation, it can be difficult for administrators to learn about their employees and their attitudes.

Given this situation, the software will be the ideal option because it can assist organize the systems, boost productivity, and most significantly, provide administrators with a platform they can rely on to make one of their everyday tasks go effortlessly and quickly. Since many other researchers have attempted to apply various technologies and applications in their works, numerous approaches to these problems have already been presented; hence, a unique and new solution will be established here by the use of Android's Flutter framework (Dagne, 2019).

1.1. Problem Statement

One of the time-consuming tasks in any place, whether it’s educational or not, is the monitoring and collecting of employee, staff or student attendance. In actuality, taking attendance is a time-consuming task that consumes the administrators, lecturer's energy and lecture or work time. The organizations and families, however, won't be aware whether their people are chasing the light of jobs if the administrators don’t do this. The problem has been addressed through a variety of methods and the technology that is now accessible.

Thus, one of the ethical values that companies admire is attendance. The majority of governmental and educational institutions in underdeveloped nations still keep attendance records on paper. Therefore, implementing an attendance management system is essential for evaluating the performance of organizations. A monitoring system for attendance and evaluation for specific personnel in various sectors, such as employees, university staff, and students, is helpful from an organizational standpoint. Not only does attendance play a role in education, but the act of managing attendance may also encourage students to attend classes on time and further their education. The attendance system, on the other hand, may be used in the manufacturing and industrial sectors as a tool for a variety of tasks, including measuring individual resources, managing the daily attendance process, recording overtime data and transferring it to the accounting system. The traditional attendance technique has several limitations, including time and energy consumption and the risk of students signing for their classmates while they are absent.

As a result, during the past several decades, numerous advancements have succeeded in bringing about an automated method of attendance tracking. The collection and processing of data are among the most important stages. Several well-known technologies, including biometrics, RFID, magnetic stripe, and black codes (Barcode, QR code), have been employed for this purpose. To conclude, this study intends to provide a solution that may effectively address such a problem by utilizing the most varied technologies available today, such as (Android's Flutter Framework, Face Recognition, and PIN code).

1.2. Aims and Objectives of the Thesis

The study will help Administrators to get daily information about the Time of Arriving and Leaving of employees, staff or students as well which was Tracked by the mobile app in the reception room's phone. Typically, the students' names are written on a piece of paper that is passed around, called out, or both during the attendance-taking procedure. The time-consuming process involves calling the individuals, filling out all the necessary paperwork, and having them provide proxies for their friends even when they are not there.

The main focus is on building a system that could help the users as long as Administrators get a more interactive experience just by scanning their faces to recognize and enter their PIN code then they will register as attended on that day. The aim is not to solve only a place's Problem but also to build a structure that can be used as a platform for any other place or college that built up or has related systems, also allowing for expansion and further advancements.

The main goals of the thesis include the following:

1. Providing a mobile-based system for attendance tracking to be installed in the reception room.
2. Connecting Face recognition and PIN code technologies together.
3. Improving the level of security by adding an extra layer to restrict the IP address of the wi-fi to which the mobile phone will connect to.
4. Solving a major problem of adding and modifying users' data (profiles).
5. Providing Admins (Administrators) with the ability that can maintain every data which are available inside the app.
6. Granting the ability to see attendance data and generate reports as well.
7. Building a well-kept infrastructure that will be a base for future expansion.

1.3. Structure of the Thesis

In the Background and Literature Review chapter, detailed info about other related researches will be introduced as well as the problems that were faced them. Along with how the choice of technological models will help in the tracking requirements and lead to analysis a good background will be defined.

In the Third Chapter which is about Methodology and Requirements, you will be introduced to the research methodology in detail and the problems that were faced. Also, how the choice of software model helped in the requirements gathering process and led to good risk management and testing strategy along with focusing on the gathering requirements, reading the related studies, and getting as much as necessary pieces of information that are required.

A fourth chapter is a place where the design of the entire system will be shown in detail, like UI (User Interface), UX (User Experience), implementation structure, and database wise. The design decisions are fatal in a high-quality software product.

The project's implementation passes in brief and will be discussed in the Fifth chapter. Details of the topics will be provided for each part of the thesis and how it all integrates into a single product.

A final chapter is a place where the Conclusion and Future Works are all documented.

2. BACKGROUND AND LITERATURE REVIEW

2.1. Background

Implementation of such an attendance system has a number of stages. The first step is to compile all of the existing concerns with the current attendance system. The manual or technological constraints of the current attendance system are just one issue. an accurate, effective, and dynamic design have been done for such an attendance system after gathering the issues and constraints.

The second step includes reading a variety of documents on attendance systems, biometric user identification techniques, and mobile platforms that support attendance systems. The information was found by doing an online or offline search for relevant studies/theses related articles, online journals, or other sources. In the third step, plans are made for the thesis tools. This step involves designing the UI/UX of the system, considering a suitable backend and database system as well, and then choosing one of the most recent frameworks to develop the coding part of the mobile application that the end users will use.

In order to inform the system that things will go properly and correctly, it is useful to ascertain whether the device already has a camera or not during the fourth phase before moving on to the following step. To assess the effectiveness of the integration of the attendance system with the backend side utilizing an effective API, simulations will be run using predetermined scenarios in the final phase. The performance of the attendance system and the authenticity of the data will be determined based on the simulation's findings.

2.2. Literature Review

Smart attendance control systems have become increasingly popular in recent years as organizations look for more efficient ways to manage their workforce. However, there are still relatively few systems that have been put into practice utilizing less intrusive methods, such as face recognition in addition to a different authentication method. It

is therefore encouraging to know that this thesis will concentrate on a practical architecture that uses face recognition and a PIN code to operate on mobile devices.

Several recent studies and projects have been undertaken to develop smart attendance systems based on user authentication. These projects have either been used with mobile applications or other portable devices, and have utilized a range of different authentication methods including fingerprint recognition, facial recognition, Black codes (Barcode or QR), and many others. Each method has its own strengths and weaknesses, and the suitability of each method will depend on the specific needs of the organization implementing the system.

Despite the concerns surrounding the use of different technologies, the benefits of smart attendance systems are clear. By automating attendance management, organizations can save time and money while reducing errors and fraud (Abbasi & Bamakan, 2022). The system proposed in this thesis offers a practical solution that combines the strengths of facial recognition and PIN code authentication, while minimizing the privacy and hygiene concerns associated with other methods.

In conclusion, this chapter has reviewed several recent studies and projects that have been undertaken to develop smart attendance systems based on user authentication. While each method has its own strengths and weaknesses, the proposed system offers a practical and effective solution that is well-suited to the needs of modern organizations.

2.2.1. Digitalizing the old approach

In the past, taking attendance in a traditional classroom setting involved a lot of roll-calling and record-keeping, which was time-consuming and tedious for both teachers and students. Fortunately, with the advent of online systems, this process has become more streamlined and efficient.

One such system was developed by Mendonca et al. (Mendonca et al., 2015) and involves using an online platform to take attendance. Instead of calling out each student's name and recording their response on paper, teachers can simply use the online system to mark attendance. This eliminates the need for paper-based records and saves time for both teachers and students.

Furthermore, the online system provides teachers with convenient and efficient access to attendance records. By storing attendance data in a centralized database, teachers can swiftly retrieve and analyze the information, which proves valuable in identifying patterns or addressing attendance-related concerns. Additionally, another study implemented the use of mobile devices in an attendance management system. They developed and implemented a mobile-based attendance management program specifically designed for Android systems, utilizing VB.NET and SQL Server.

This project enables the management of student attendance, calculation of attendance grades, and generation of reports. The system consists of five components: admin, registration, student, SMS, and an Android component. Through the Android part, students can send messages to inform their lecturers about their absence, while parents can receive SMS notifications regarding their children's behavior. (Somasundaram et al., 2016).

2.2.2. Fingerprint recognition based management systems

The majority of studies have shown that using fingerprint or hand gesture recognition is an extremely effective approach for an attendance management system. The process of electronically comparing one or more unidentified fingerprints to a database containing both known and unknown fingerprints is referred to as automated fingerprint recognition. The overall structure of this system can be observed in Figure 2.1.

Mohamed and Raghu described a specific device for fingerprint recognition that serves as an integral part of a dedicated fingerprint attendance system (Mohamed & Raghu, 2012). The students have the option to verify their presence by placing their fingertips on the sensor of the device. However, due to the occasional failure of fingerprint scanners to immediately identify individuals, the effectiveness of this system is limited.

Soewito et al. (Soewito et al., 2015) introduced a attendance system that utilizes smartphone GPS and fingerprint technologies. However, the utilization of fingerprint recognition in this method results in a significant amount of time consumption..

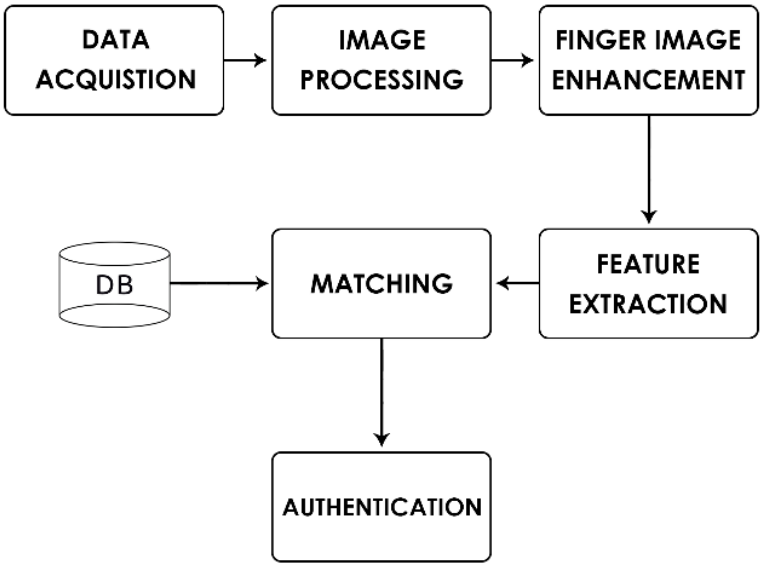


Figure 2.1. Universal structure of fingerprint recognition. (Yadav et al., 2015)

2.2.3. Black codes (barcode/qr code) based management systems

A barcode is a visual representation of data that can be read by machines to extract information about an item. On the other hand, a QR code, also known as a Quick Response Code, is similar to a barcode but has the ability to store data in two dimensions, allowing it to hold significantly more information. Noor et al. (Noor et al., 2015) introduced a system for automating student attendance, where each user is assigned a unique ID associated with a barcode that can be scanned using a mobile app. However, one limitation of this approach is that a student can deceive the system by using the IDs of other students.

Another approach discussed by Sutar et al. (Sutar et al., 2022) involves a centralized attendance system that utilizes QR codes to expedite the attendance process. The system operates through a mobile application and leverages QR technology. By generating and scanning QR codes, attendance can be efficiently recorded and data can be updated in a centralized location.

Furthermore, Sunaryono et al. (Sunaryono et al., 2021) propose an Android-based course attendance system that utilizes face recognition. In this system, course information is encoded into a QR code, which is displayed at the front of the class. Students simply need to capture a photo of their face using their phones and display a QR code. The image is then transmitted to the server to manage attendance and ensure student presence in the course.

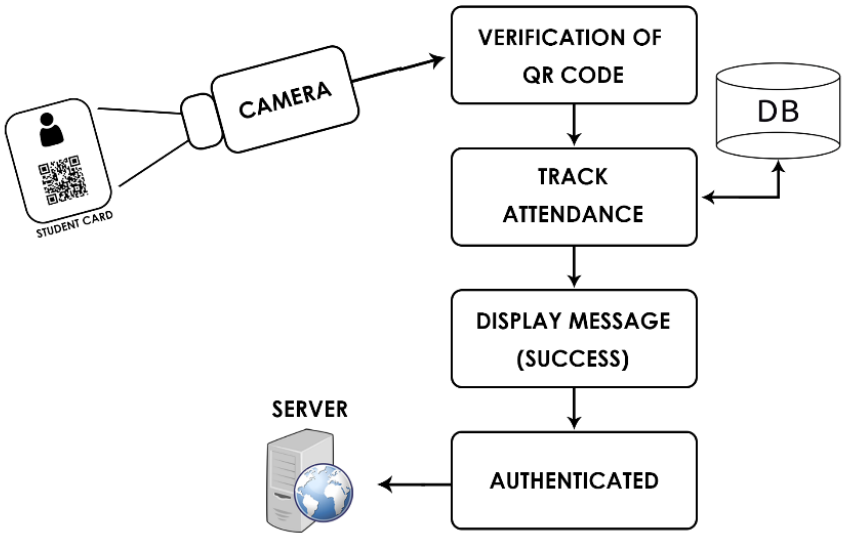


Figure 2.2. QR code-based architecture (Md Rizal Md Hendry, M. N. A. Rahman, 2017).

2.2.4. Face recognition based management systems

Face detection refers to the process of identifying human faces in photographs or videos. Face recognition systems are technological solutions that compare face images to a database of known and unknown faces. Smitha developed the Face Recognition-based Attendance Management System to establish a well-organized attendance system in classrooms using face recognition techniques. The system utilizes facial ID to record student participation. By employing a camera, the system detects and recognizes faces, dividing the process into two parts: facial recognition and detection. Utilizing the Local Binary Pattern Histogram (LBPH) algorithm, the system identifies the faces of students in the live-streamed video from the classroom. If a recognized face is found in the database, the system marks the student's attendance accordingly.

Varadharajan et al. (Varadharajan et al., 2016) also discussed face recognition technology in their paper, where they placed a camera inside the classroom to capture images. After identifying faces and matching them with the database, the attendance is recorded as present. In the case of an absent student, parents are notified about their child's absence.

Chandramouli et al. (Chandramouli et al., 2021) conducted a research project aimed at modernizing attendance management and time management parameters. They employed NVIDIA's Jetson Nano, a device placed in the classroom that stores students' names and photos. OpenCV is utilized to capture the photos, while the NVIDIA Jetson

Nano's Developer Kit serves as the processor board. Face identification is performed using a Haar classifier after image extraction, followed by identification using the LBPH Algorithm. An Excel spreadsheet is generated and regularly updated with data from the respective class teacher.

Ofualagba et al. (Godswill et al., 2018) proposed an Automated Student Attendance Management System Using Face Recognition that emphasizes the utilization of Cloud Computing (CC) concepts to enhance face identification methods. The suggested system, called FACECUBE, employs facial recognition technology for attendance management and provides online features for students, instructors, and administrators. However, implementing this system requires multiple steps, including acquiring new hardware and software.

Susanto et al. (Susanto et al., 2021) conducted research that focused on a slightly different aspect of face recognition, specifically detecting and recognizing the presence of lecturers in an application system via an Android device. They established a connection between face recognition detection and saved the data in a database to track the presence of teaching lecturers. To evaluate the facial recognition system, they utilized the local binary pattern histogram (LBPH) classifier approach, which can enhance the efficiency and productivity of the attendance system for lecturers.

In the study by Hava et al. (Hava et al., 2019), they proposed an open-source and versatile application for daily attendance assessment using face recognition on the Android platform. This application can be easily obtained by almost any institution at no cost. The suggested solution automatically generates Google Sheets, making attendance records effortlessly accessible to the institution. The system utilizes facial identification and recognition algorithms to identify individual students and record their attendance.

Prangchumpol (Prangchumpol, 2019), in his research titled "Face Recognition for Attendance Management System Using Multiple Sensors," acknowledged that there are still challenges in accurately identifying students' faces and rectifying data errors in the classroom. Consequently, he aims to enhance the efficiency of the face recognition-based attendance system and simplify its principles for students to understand. This validation process aims to explore the utilization of the Android Face

Recognition with Deep Learning approach to detect faces. The database is connected to a web server through cloud storage.

Alburaiki et al. (Alburaiki et al., 2021) devised a methodology that addressed three crucial components: Firstly, utilizing mobile phone cameras to automatically recognize and analyze faces. Secondly, incorporating a machine-learning-based facial recognition API. Lastly, incorporating a maps API. The results showed that face recognition achieved high accuracy in identifying students' faces, even under unfavorable conditions. The system provided practical examples of its functionality by marking students' attendance upon recognizing their faces and location. Moreover, the lecturer had the option to access a report containing the submitted attendance records.

Salac's study was motivated by the need for a portable attendance system that could be accessed from anywhere and at any time (Salac, 2018). This study aimed to eliminate the need for paper and PCs, allowing lecturers to conveniently verify attendance using an Android smartphone. Students could easily check their attendance information using their Android phones. The system also employed SMS technology to ensure student safety and notify families about their child's attendance. Face recognition technology was utilized to establish accurate attendance records. Each student's face was detected and recorded as present in the database using the camera of an Android device. Attendance reports could be generated when necessary. The generalized model of Face-Recognition based systems is depicted in Figure 2.3.

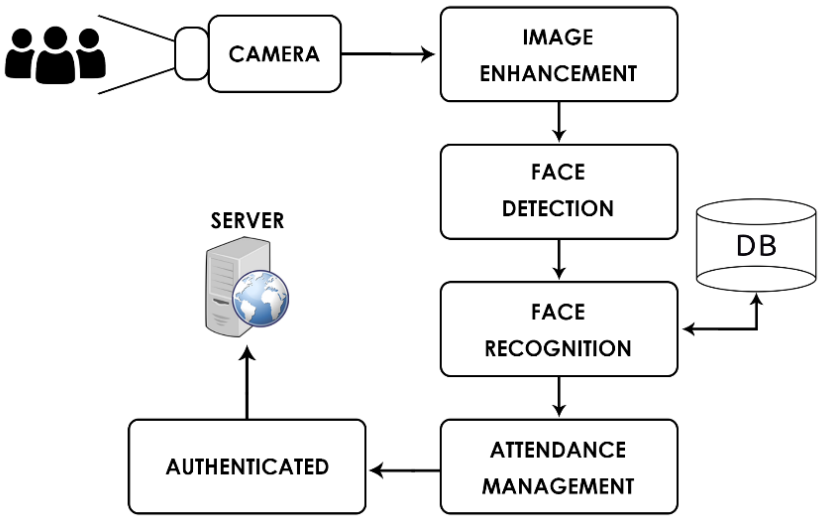


Figure 2.3. Model of face recognition technique (Smitha, 2020).

2.2.5. GPS based management systems

The Global Positioning System, commonly known as GPS, allows us to determine the precise location and direction of a person anywhere on Earth. This technology relies on satellites in the sky to provide information about human whereabouts and navigate to different areas.

In their research, Kumar and Kumar (S et al., 2021) introduced an innovative time and attendance monitoring system based on location. This system was implemented through an Android mobile app, leveraging the capabilities of smartphones to eliminate the need for additional biometric scanning devices. The system's components include a specific location, which can be determined using GPS. By utilizing the GPS functionality on mobile phones, the system can accurately track the whereabouts of each student, making location data integral to the time and attendance tracking process..

2.2.6. Android & RFID based management systems

RFID is sometimes described by certain researchers as a simpler version of NFC (Near field communication), which is widely used on Android devices for digital payments (Weinstein, 2005). In their research, Souza et al. (Souza et al., 2019) examined several frameworks for board participation using various advancements. In light of their discussion, the board is recommended to employ an alternative form of participation that is specifically tailored for ordinary level institutions.

Hence, the proposed model incorporates mobile applications and RFID components. The RFID element is suggested for recording student participation in the database backend, while the application component is designed to provide attendance information to their families. In cases where there is a lack of electricity or resources to transmit data through the RFID component, the application part can serve as a backup to track attendance.

2.2.7. Authorized id and password based management systems

The Android operating system was primarily designed for touch-based mobile devices (Gilski & Stefanski, 2015). It is built on a modified version of the Linux kernel and incorporates various open-source applications. When using an Android-based smartphone and accessing applications or websites, users are typically prompted to

sign up or sign in. During this process, they may be asked to create a login and password. As this procedure has become commonplace, some users may not pay enough attention to the strength of their password, considering it a routine task. Unfortunately, this casual approach can pose significant risks if weak credentials are chosen. To address this issue, Hameed (Hameed, 2017) developed and implemented an intelligent attendance system based on the Android platform. This technology automates the attendance data generation process, providing a faster, more cost-effective, and convenient solution for tracking student attendance online.

According to Islam et al. (Islam et al., 2018), instructors can easily manage attendance using Android OS smartphones, which are specifically designed to store attendance data both on the device and servers. The system developed by Islam et al. allows instructors to verify statistics, generate paper versions of attendance records, and perform various functions such as marking absentees, calculating attendance percentages, and sending emails and text messages to parents to keep them informed about their child's enrollment at the institution. The system provides internet access at any time and from any location, enabling instructors to efficiently manage student attendance.

Kumbhar et al. (Kumbhar et al., 2014) developed an attendance management system for addressing class attendance issues using Android devices. Both students and teachers are required to install APKs on their phones to access the system. Each user is assigned a unique ID and password. Students need to provide their personal information as well as their parents' information when filling out the application. Once the lecturer initiates the program and starts attendance checking, students can register their attendance with just one click. The system allows lecturers to access both weekly and monthly attendance records. Additionally, parents are notified about their child's attendance through SMS on a monthly basis.

3. PROPOSED SYSTEM AND METHODOLOGY

In recent years, the use of smart attendance systems has become increasingly popular in educational institutions, workplaces, and other organizations. These systems offer a range of benefits, from simplifying the attendance tracking process to providing real-time data for better decision-making. As a result, there has been a significant amount of research and development in this area, which has led to the availability of a wide range of information regarding such a topic.

One of the most significant challenges faced by everyone looking to implement a such a proposed system is choosing the right software model for the project's development process. There are several models to choose from, each with its strengths and weaknesses. For example, the waterfall model is a popular choice for projects that have well-defined requirements and a clear scope. On the other hand, the agile model is better suited for projects that require flexibility and adaptability.

Once the software model has been selected, it is essential to ensure that the software product is of high quality and functional. To achieve this, organizations need to invest in the right tools and resources, including a talented developers, robust testing infrastructure, and continuous improvement processes.

Fortunately, sources of information about smart attendance systems and efforts with such a topic are generally available for collecting requirements, either through internet sources, theses, journals, as well as conferences. These sources provide valuable insights into best practices, common pitfalls to avoid, and emerging trends in the field. By leveraging these resources, reasearchers can better understand what they’re going to reasearch about and develop with the best meet to the requirements.

3.1. Proposed System

AtTrack is a mobile application-based project that will be developed using Flutter framework along with libraries related to the image processing and some other calculations for specific purposes which its main objective will be authentication of arrived, and registered users then track attendance of them within the doors of a

company or any other places like (academic places, governmental organizations…etc.).

Authentication in a multi-step manner will be mainly focused on (Face Recognition, Pin code, and restriction of IP address of those requests that will arrive at the backend of the application) after recognizing users, it will automatically track some basic information and direct them to the database in which they will be hold there.

Because of having generic parts and using a mobile application, which is the most used device in today's world, the scope will not be just a place alone, therefore it will be developed in a way that most nowadays places take advantage of it.

For example, if we focus on a company, it will benefit from it in a way that all employees will authenticate themselves in a recipient room and the system takes all the information related to every employee and saves it in a database to be used and seen in any situation. General model of the proposed system demonstrated in Figure 3.1. below.

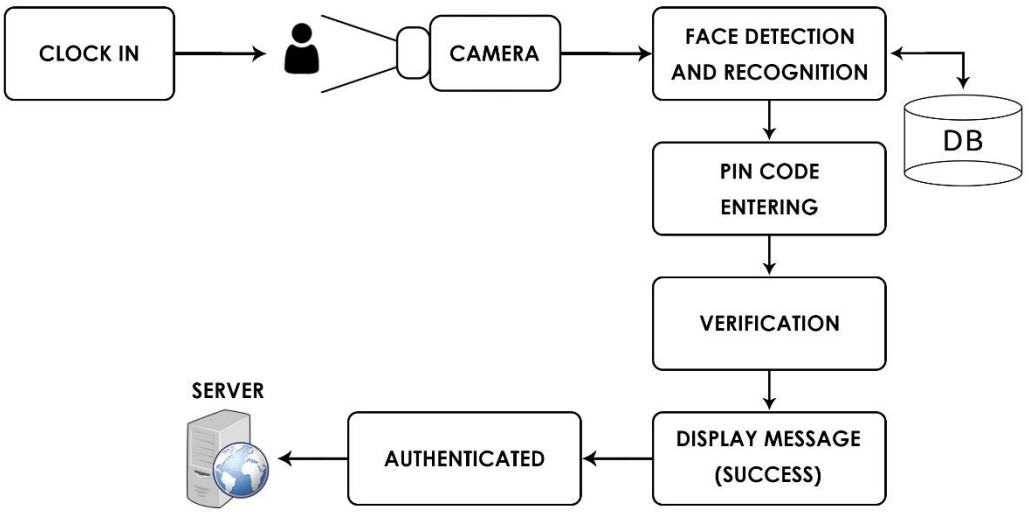


Figure 3.1. Generalized model of the proposed system.

3.2. Software Model

The utilization of the Agile Scrum process model can be highly beneficial for such a project due to its strict rules and guidelines. Scrum, as a framework, enables teams to collaborate more effectively when working on complex projects (P. Li, 2018). Agile Scrum, specifically, is a project management system that emphasizes incremental development through iterative cycles known as Sprints (Martin, 2003).

Each sprint, which typically spans 2 to 4 weeks, aims to prioritize the development of essential features and deliver a potentially usable product. Subsequent sprints then incorporate additional features based on feedback from stakeholders and customers received between sprints. Unlike other project management methods that focus on building an entire product in a single iteration, the Agile Scrum methodology emphasizes delivering multiple iterations of a product to provide stakeholders with the highest business value in the shortest possible time.

The Agile Scrum methodology offers several advantages. Firstly, it promotes faster product development by requiring each set of goals to be completed within the designated sprint timeframe. While each major task is generally assigned to a single iteration, some tasks may extend over multiple sprints. Additionally, the methodology emphasizes frequent planning and goal setting, enabling the Scrum team to focus on the current sprint's objectives and enhance overall productivity.Project scheduling is based on sprints, project progress is documented bi-weekly per sprint. For each issue, several required tasks are assigned to a member to complete. Rescheduling is done by reassigning a task, this is performed in two cases:

1. In case of problems, bugs or errors occur.
2. In case of changing requirements.

Issues addition or deletion to each sprint helps to provide a flexible and reliable project schedule. Hence, weekly meetings are arranged to evaluate the past week’s work and set up the next week’s work plan.

3.3. Implementation of Face-Recognition

Facial recognition technology has become increasingly popular in recent years as a biometric tool for automatically identifying and verifying individuals based on their facial features. This technology has a wide range of applications in areas such as security, law enforcement, marketing, healthcare, and entertainment (Çürükoğlu & Özyildirim, 2018).

The process of facial recognition typically involves three key stages: face detection, feature extraction, and face matching. In the face detection stage, sophisticated algorithms are utilized to locate and isolate faces within images or video streams.

Feature extraction involves analyzing various facial features, including the eyes, nose, mouth, and facial shape, and encoding them into a mathematical representation. During the face matching stage, these mathematical representations are compared against stored templates to identify and verify individuals.

To perform facial recognition with Flutter, developers use a combination of computer vision algorithms and machine learning techniques through third-party libraries and APIs that provide pre-trained models and tools for face detection and recognition. Flutter is a mobile app development framework that enables developers to create cross-platform apps using a single codebase.

3.3.1. Flutter libraries to implement face-recognition

Flutter is a well-known mobile app development framework that provides a variety of open-source libraries and third-party tools that can be used to implement face recognition techniques in mobile apps. These libraries simplify the process of implementing face recognition in Flutter by providing pre-built models and algorithms for detecting and recognizing faces (Hettiarachchi, 2021). Below are some of the popular open-source libraries for face recognition in Flutter:

1. Google ML Kit - This powerful library provides a variety of features for detecting faces, recognizing facial expressions, and estimating age and gender. It includes pre-trained models that can be customized for specific use cases to detect faces in images and videos.
2. TensorFlow Lite - This is a lightweight version of the popular machine learning framework, that is designed specifically for mobile and embedded devices. It provides a range of pre-trained models and tools that can be used for a variety of machine learning tasks, including face recognition.
3. OpenCV - This widely used computer vision library provides a range of pre-built algorithms for detecting faces, including the Viola-Jones algorithm and the Histogram of Oriented Gradients (HOG) algorithm.
4. FaceNet - This deep learning model generates a compact embedding of a face image using a neural network that can be used for face recognition tasks. It minimizes the distance between embeddings of matching faces and maximizes the distance between embeddings of non-matching faces, based on a triplet loss function.

3.3.2. Libraries used in the proposed system

An effective method for implementing face recognition in a proposed system developed with Flutter is to combine the Google ML Kit and TensorFlow Lite libraries. Both libraries offer pre-trained models and tools for detecting and recognizing faces, which can be adapted for specific use cases.

3.3.2.1. Google ml kit

Google ML Kit (Singh & Bhadani, 2020) utilizes on-device machine learning to detect faces in images and videos, including the identification of facial landmarks such as eyes, nose, and mouth. Additionally, it can recognize facial expressions and estimate age and gender. The library also offers custom model support, enabling developers to train their own models. it uses a variety of models and layers to implement face recognition. Some of the important models and layers used by ML Kit for face recognition are:

1. MobileNet - a widely-used convolutional neural network (CNN) architecture that has been optimized for mobile devices as shown in the Figure 3.2. ML Kit uses the MobileNet architecture to detect faces in images and videos.
2. Face Contour Detector - a model that is used to identify facial landmarks such as eyes, nose, mouth, and eyebrows.

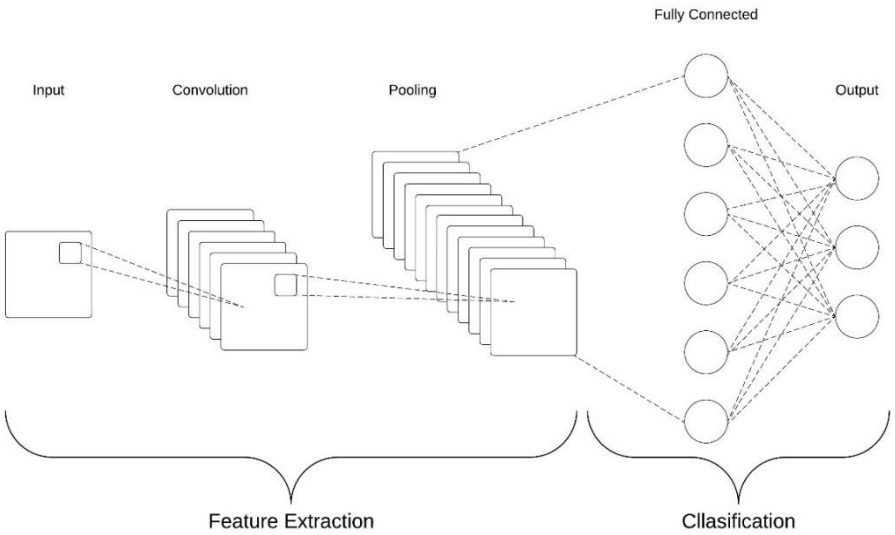


Figure 3.2. Basic model of the convolutional neural network (CNN) (Z. Li et al., 2021).

Face detection

Google ML Kit offers a variety of APIs for mobile developers to incorporate machine learning features into their applications. Among these APIs is the Face Detection API, which is specifically designed to detect faces in images and video streams. Using machine learning algorithms, it can recognize facial features like eyes, nose, and mouth, and can even estimate the age and gender of the faces detected.

To make use of the Face Detection API in Flutter, developers must include the (google_ml_kit) package in their project. This package includes a collection of classes and widgets that simplify the integration of ML Kit with Flutter. Once the package has been added, developers can begin using the Face Detection API by creating an instance of the (FaceDetector) class.

The (FaceDetector) class includes a (processImage) method that accepts an image file or a byte array as input. This method returns a (List<Face>) object, which contains information about all of the faces detected in the input image. With this information, developers can add bounding boxes around the detected faces, crop the image to highlight the faces, or apply filters to the faces.

Detecting landmarks and contours

Google ML Kit offers APIs for detecting landmarks and facial contours in images and videos, alongside face detection. These APIs utilize machine learning algorithms to recognize specific points of interest in the image, such as the edges of the lips, corners of the eyes, and tip of the nose. Flutter developers can integrate these APIs into their applications using the (google_ml_kit) package, which contains classes and widgets that facilitate ML Kit's integration with Flutter.

To detect landmarks and facial contours, developers can utilize the (FaceDetector) class provided by ML Kit. The (processImage) method of the (FaceDetector) class takes an image file or a byte array as input and returns a (List<Face>) object that contains information about all detected faces in the input image. Each (Face) object in the list includes a (getLandmarks) method that returns a (List<Landmark>) object. The (Landmark) class represents a specific point of interest in the image, such as the tip of the nose or corners of the eyes. It includes methods for retrieving the landmark's type and position in the image.

Moreover, the (Face) object also has a (getContour) method, which returns a (List<Point>) object. The (Point) class represents a specific point in the image and includes methods for retrieving its x and y coordinates.

Developers can use this information to draw shapes and lines on the image, such as circles around the tip of the nose or lines connecting the corners of the eyes, to highlight the detected landmarks and contours. These advanced features can enhance the overall functionality of their applications.

3.3.2.2. Tensorflow lite

TensorFlow Lite (Singh & Bhadani, 2020) is a compact edition of the TensorFlow machine learning platform designed specifically for mobile and embedded devices, with the goal of optimizing performance and resource usage. It includes pre-trained models and tools for various machine learning tasks, including face recognition. Combining TensorFlow Lite with Google ML Kit can enhance face recognition accuracy and performance. Flutter developers can integrate TensorFlow Lite into their applications using the (tflite) package, which contains classes and widgets that make it easy to use TensorFlow Lite with Flutter.

Feature extraction

To use TensorFlow Lite for feature extraction in a Flutter app, developers must first choose a pre-trained machine learning model that meets their needs. These models can be obtained from the TensorFlow website, or developers can create and train their own using TensorFlow.

Once a suitable pre-trained model has been identified, the developer can use the Interpreter class provided by TensorFlow Lite to load the model into their Flutter app. This class offers methods for providing input data to the model and retrieving the resulting output data.

Using the Interpreter class, developers can extract features from a variety of input data types, such as images, audio, and text. For instance, if the goal is to extract features from an image, the developer can load a pre-trained image classification model into their app and feed the image to the model. The model will then extract relevant features from the image and return them as output data, which the developer can utilize in their app.

The implementation of face recognition using a combination of Google ML Kit and TensorFlow Lite typically involves three stages, as shown in the Figure 3.3. below. First, Google ML Kit's pre-built models are used to detect faces. Next, TensorFlow Lite's pre-trained models are used for feature extraction, encoding facial features as mathematical representations. Finally, the face matching stage involves comparing these mathematical representations with stored templates to identify and verify individuals.

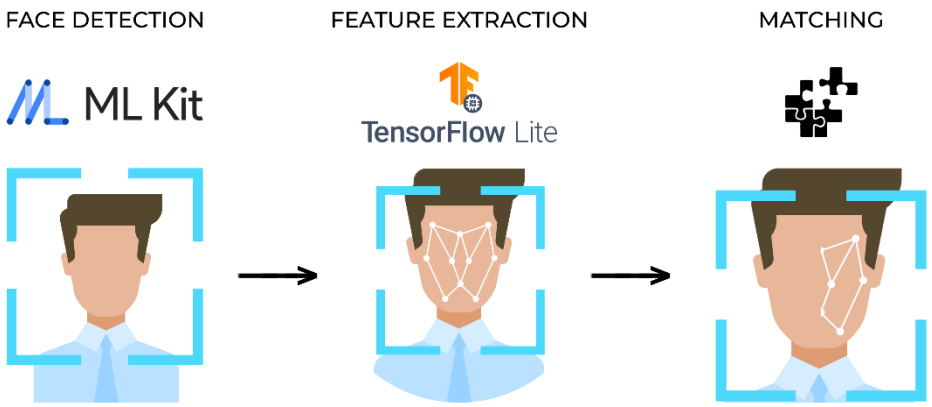


Figure 3.3. Working principle of the proposed system.

3.4. Requirement Analysis

3.4.1. Perspective

Attendance Tracking (AtTrack) is a Mobile Application project Which has been developed to serve the administrator and employers of a place in collecting attendance information point view. It contains:

1. Mobile App (with different Users)
2. Database
3. API (Which makes a connection between them).

3.4.2. Functional requirements

3.4.2.1. Mobile application

The main focus should be on developing a good, reliable and interactive mobile application that users can interact with it in an easy and efficient way, in this step the application would be split up into three different roles which are (Admin, Editor, and

Viewer), also some main and secondary features are required, between them (IP Restriction, PIN code, Face Detection and Recognition, Registration…etc.).

3.4.2.2. Admin (privilege)

In AtTrack, Admin Role(s) are some people who can control anything related to the system, regard of (Clocking, Data, Users, Reports, Data Entry…etc.).

3.4.2.3. Editor (privilege)

Is any user who can edit some of the contents regarding the attendance list.

3.4.2.4. Viewer (privilege)

Is any user who can view the attendance list and generate reports of it.

3.4.2.5. End-to-end users

Those users who are registered could be marked as attending or absence using their PIN code and taking a picture of their selves to be recognized.

3.4.3. Non-functional requirements

3.4.3.1. Performance

For AtTrack, performance is one of the most essential factors, there might be many users accessing the application one by one, so the performance of the system shouldn't be affected much. Thus, response time must be as quick as possible.

3.4.3.2. Reliability

Ensuring continuous and error-free operation is a critical non-functional requirement for most software products. It is essential for the system to be reliable in performing its operations and safeguarding sensitive information.

3.4.3.3. Security

Security requirements play a vital role in safeguarding the software by preventing unauthorized access to the system and protecting the integrity and confidentiality of its stored data. These requirements encompass various measures such as user authentication, encryption, access controls, and vulnerability assessments to ensure the software remains secure and resilient against potential threats and breaches.

3.4.3.4. Accuracy

The proposed system needs to maintain a high level of accuracy to ensure that operations are performed correctly and that the information received from the central source is reliable.

3.4.3.5. No redundancy

In the proposed system, it is essential to prevent any duplication of information. This ensures efficient utilization of storage space and maintains consistency in the stored data. The system should be designed to eliminate redundancies, promoting optimal storage usage and ensuring that each piece of information is unique.

3.4.3.6. Usability

The application should be easy to handle and navigate in the most expected way with a very user-friendly interface.

3.4.4. Function

General Functions of the project:

1. Making the API be a great, reliable bridge between the application (front-end) and the database as well as possible, ensuring privacy and security regarding all the data and information stored in the application.
2. Provide users with the ability to clock in and mark their selves as attending.
3. Users must clock-in, recognize their face and enter their own PIN to be marked.
4. AtTrack would be restricted by the connected wireless's IP address. Thus, responses from any other network cannot be received.
5. each role as well as users, has its unique information.
6. Viewers can easily view and generate reports of the attend or absence users.
7. If a new user comes, only admins can register him\her.
8. Admin must have the ability to add, delete or update every single information related to the general users.

9. Marking someone as attend or removing from one of the lists is another ability that must be granted to Admin.

10. Application should have a clear user interface.

3.4.5. User classes

The Application has different classes of users which are:

1. Admins: Maintain all data and information.
2. Editors: Edit attend, absence list, and modify some basic features.
3. Viewer: Viewing attend and absence list, generating reports.
4. Users: Default and common users of the application.

As depicted in the use case diagram illustrated in Figure 3.4.

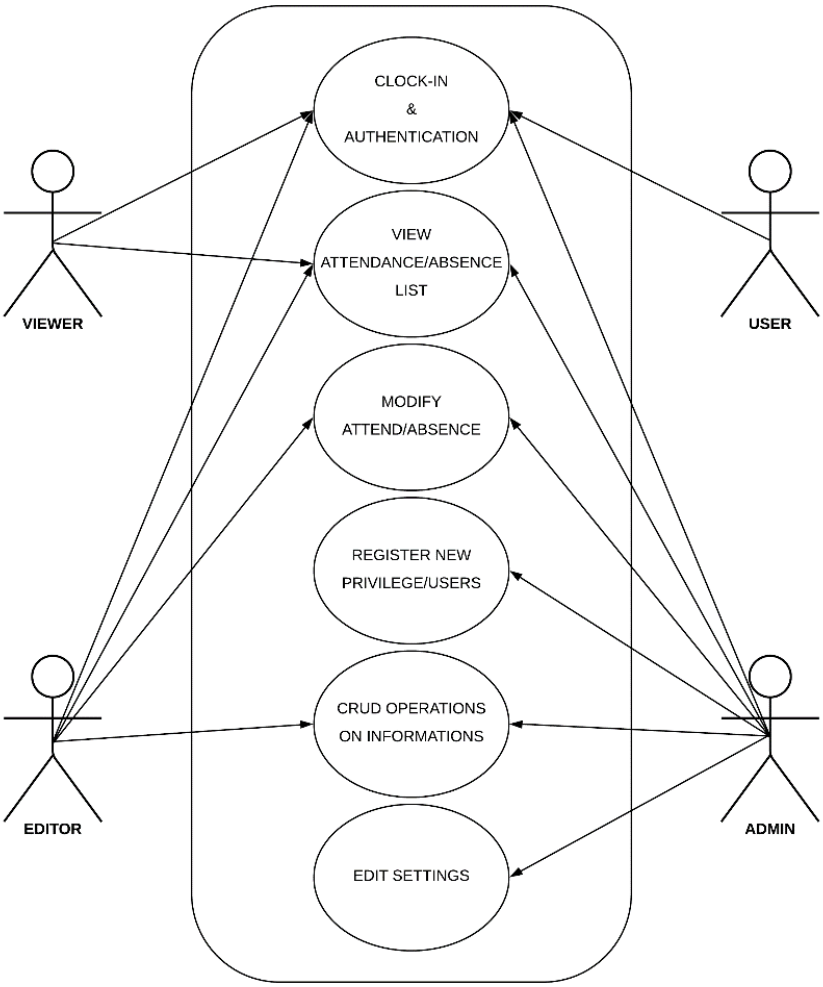


Figure 3.4. Application and roles use-case diagram.

As stated, use-case diagram is a powerful tool to represent the functionalities of a software application. The above use-case diagram in Figure 3.2. depicts four different classes of users. Each of these classes has different levels of access and permissions within the application. The Admins have complete control over all the data and information, while the Editors can edit the attendance and absence lists, and modify some basic features. The Viewers can view the attendance and absence lists, and generate reports only. Lastly, the End-Users are the default and common users of the application. The above use-case diagram clearly illustrates the various use cases and interactions between the different classes of users, helping to ensure that the application is developed to meet the requirements of all stakeholders.

3.4.6. Software design

1. The UI/UX should be User Friendly (Requires minimal Knowledge to use).
2. Use-case diagram and Flowchart of the project must be clear.

3.4.7. Implementation

Software and Tools that are needed to implement this project include:

1. IDE: Android Studio, Visual Studio Code.
2. Mobile App: Flutter Framework, Dart Language, Open-source Libraries.
3. Backend (API): Node.js, Express.js, Open-source Libraries.
4. Server (Host & Domain): Heroku.
5. Database: MongoDB (no SQL), Mongoose.
6. UI/UX: Adobe XD.

3.4.8. Risk management

Risk refers to any factor that has the potential to affect the timeline, performance, or budget of a project. Risks are possibilities, and when they materialize, they become issues that need to be addressed within the project management framework.

The use of Scrum inherently addresses risk management through the planning and review processes of sprints, which facilitate the identification and mitigation of risks.

3.4.9. Testing

The utilization of the Agile Scrum methodology greatly simplifies the testing plan for AtTrack. Within this framework, the team conducts testing in a straightforward

manner by assessing the product's performance from the customer's perspective. In an agile environment, testers actively participate in key events such as:

1. Sprint-planning sessions
2. Regular meetings
3. Sprint retrospectives.

Unlike traditional testing approaches, where testing is typically left until the final stages, in Agile Scrum, testers are involved throughout the entire process.

4. DETAILED DESIGN PROCESS

The education sector has seen a significant transformation in the past few years, with the adoption of digital technologies to streamline various academic processes. With the rise of automation and digitalization, educational institutions have realized the need for innovative solutions to manage their operations better. Attendance tracking is one of the essential components in the education sector, as it helps educators keep track of students' attendance and monitor their academic progress.

However, traditional methods of attendance tracking, such as paper-based registers, can be time-consuming, error-prone, and inefficient. Moreover, with the outbreak of the COVID-19 pandemic, educational institutions have had to adopt new ways to manage attendance, given the need for social distancing and remote learning.

To address these challenges, this chapter proposes the development of a mobile application for attendance tracking based on user authentication. The application aims to provide a reliable and convenient way for teachers to record students' attendance and generate real-time reports. The application will use multiple authentication methods to ensure the accuracy and validity of attendance records and protect the data from unauthorized access.

The proposed application's features will include an intuitive user interface that makes it easy for teachers to navigate and use. It will also have functionalities such as a dashboard for quick access to attendance data, notifications for absentees, and real-time reporting. Additionally, the application will be designed to integrate with the institution's existing infrastructure and management systems seamlessly.

The proposed mobile application for attendance tracking offers an efficient, reliable, and convenient solution for educational institutions to manage attendance. Its implementation will enhance the accuracy of attendance records, simplify the tracking process, and save time and resources for teachers and administrators..

4.1. Design Requirements

Beside the concepts of fundamental Structural and Functional designs of the mobile application for attendance tracking based on user authentication. The proposed project would require the following design elements:

User Registration: Users have to be signed up and create an account to clock in and mark their selves as attend. This would involve providing personal information such as name, email, PIN, face recognition, etc.

Login/Authentication: Once the account has been created, they would need to recognize their selves through the app by showing their faces to the camera and enter the personal PIN code. The authentication process would ensure that only authorized users have access to mark as attend.

IP Address Tracking: The application would use IP address restriction to track whether the response comes from a desired location when they mark their attendance. This would ensure that attendance can only be marked from a specific location, preventing fraud.

Attendance Marking: The user would mark their attendance by simply tapping a button within the application. The date and time of attendance would be recorded automatically based on the device's clock.

Attendance History: The application would keep a record of all attendance marks made by the user. The editors or viewers could view the attendance history at any time.

Admin Dashboard: The administrator of the application would have access to a dashboard that would allow them to alter every single detail of all users.

Security: The application would use encryption and secure authentication protocols to ensure the privacy and security of user data.

Overall, the mobile application for attendance tracking based on user authentication would be a simple, user-friendly tool for tracking employee attendance in real-time. Hence, the implementation details may vary based on specific requirements and constraints.

4.2. High-Level Design

The High-Level Design (HLD) is an essential phase in the software development life cycle, as it defines the overall structure of the system and its components. It outlines the system's architecture, modules, interfaces, and functionalities, providing a clear roadmap for the development team to follow. The architecture diagram presented in Figure 4.1. provides a bird's eye view of the proposed system, highlighting its key components and their interactions.

This visual representation of the system's design allows stakeholders to visualize the system's structure, understand its complexities, and identify potential issues or bottlenecks early on in the development process. With a well-defined HLD in place, the development team can proceed with the implementation phase with confidence, knowing that they are on the right track to deliver a robust, efficient, and scalable software product.

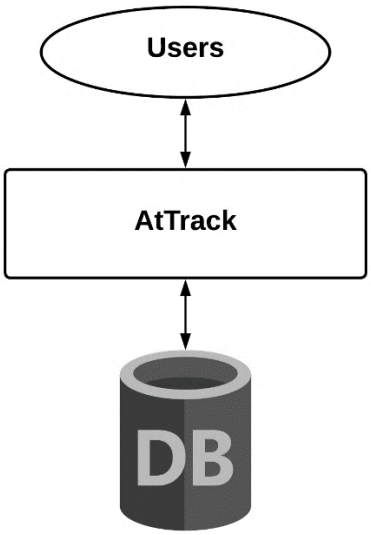


Figure 4.1. High level design.

4.3. Database Design

In the proposed attendance tracking system, a non-relational database is preferred over a traditional relational database for its enhanced flexibility and scalability. Non-relational databases, also known as NoSQL databases, use a document-based approach to store and retrieve data, making them ideal for handling unstructured or semi-structured data. This type of database design allows for greater flexibility in terms of

schema design, data organization, and querying, making it easier to adapt to changing business requirements (Mongo, 2015).

The database design for the proposed attendance tracking system includes several relationships between the various entities, such as users, attends, and images records as shown in the Figure 4.2. The table structures are designed to allow for easy expansion in the future, with the possibility of adding extra types of relationships and additional fields as needed. By employing a non-relational database, the attendance tracking system can scale efficiently as the volume of data grows, ensuring smooth performance and minimal downtime.

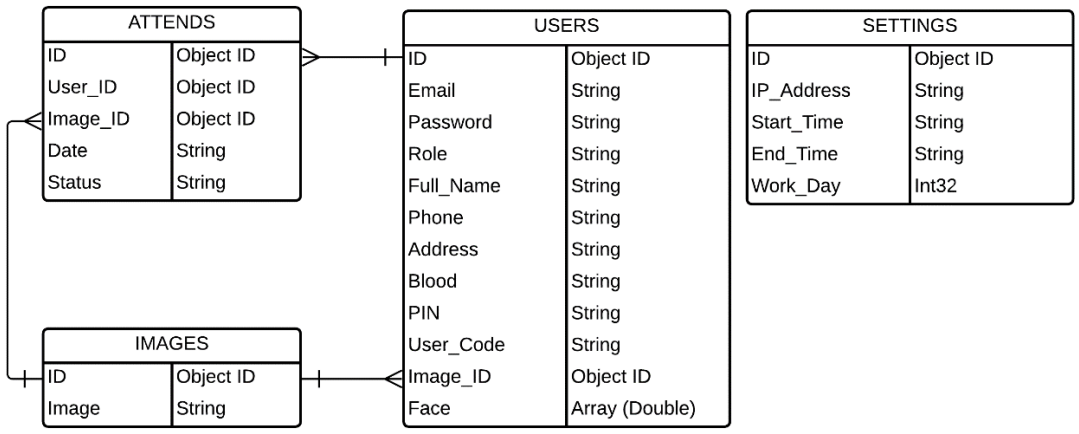


Figure 4.2.. Database design.

4.4. Structural Design

For a mobile application for attendance tracking based on user authentication, The components needed for the structural design, as sketched below in Figure 4.3. can be summerized as the following:

User interface: A visually appealing and user-friendly interface that allows users to clock-in, view attendance records, and perform other related tasks.

Authentication: A secure authentication system that uses JWT tokens to ensure only authorized users can pass through the application.

Database: A non-relational database to store user information, attendance records, and authentication information in a flexible and scalable manner.

API Server: A back-end server to manage the database and provide a RESTful API for the mobile application to interact with.

Mobile Application: A front-end mobile application that communicates with the server through the RESTful API and provides a user-friendly interface for attendance tracking.

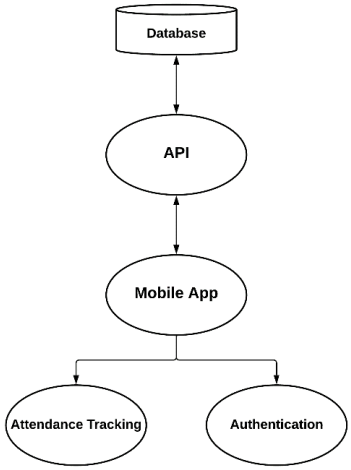


Figure 4.3. Structural design .

4.5. User Sequence Diagram

A user sequence diagram for a mobile application system as it can be seen in the Figure 4.4. would typically show the interactions between the user/admins and the application. The first step would involve the verification of the mobile's location to confirm that it is in the appropriate location to check-in by checking IP address of the internet connection. once the location is verified, users can perform clock-in process by recognizing their faces followed by entering their PIN codes. Once authenticated, the user will be marked as and his/her data would move from Absence list into Attend one. If the mobile phone is not in the appropriate location OR don't get the wireless network with the exact IP address, the application will not let anyone to make clock-in process by providing a message indicating that they are not in the right location.

At the end of the day or the end of a class, the administrators can view the attendance records as long as their complete details (time of clock-in, last photo...etc.) for that day or another specific day. The server updates the attendance record and sends a response back to the app.

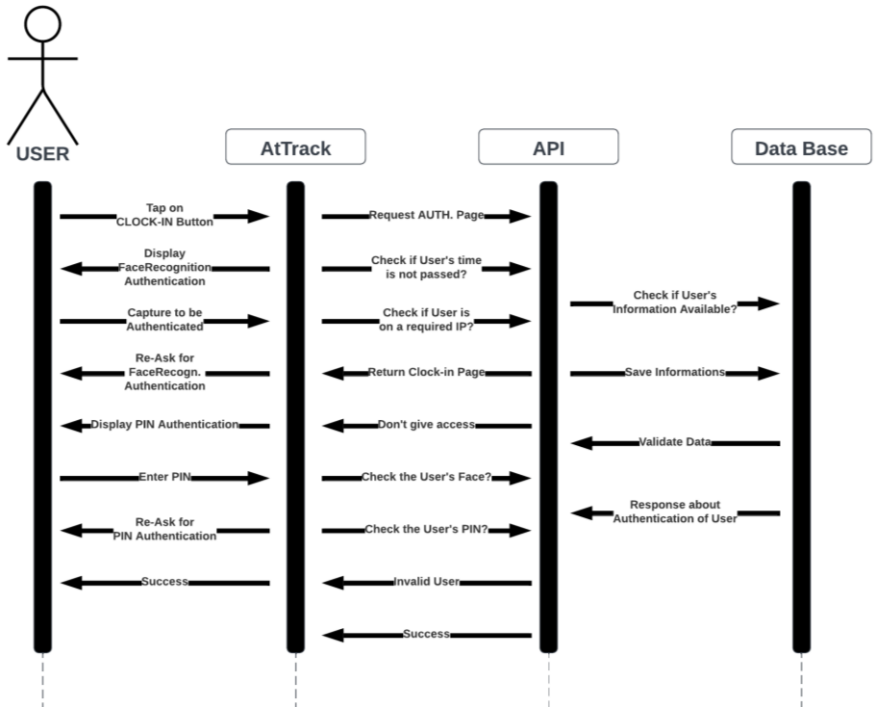


Figure 4.4. User sequence diagram.

4.6. UI/UX Design

In today's digital age, the importance of a well-designed UI/UX cannot be overstated. With the ever-increasing reliance on technology in our daily lives, users expect seamless and intuitive experiences when interacting with digital products or services. The UI refers to the visual elements of a system, including buttons, menus, icons, and overall layout, while the UX encompasses the user's entire experience, including their emotions, perceptions, and interactions with the system. A well-designed UI/UX not only makes a system more accessible and easier to use, but it also creates a positive perception of the brand or company behind it.

Additionally, a well-designed UI/UX can have a significant impact on a system's profitability. According to a study by Forrester, a well-designed UX can increase conversion rates by up to 400%. This means that investing in UI/UX design can have a tangible impact on a company's bottom line. Moreover, a system that provides a positive user experience can lead to increased customer loyalty, referrals, and positive reviews, all of which can lead to sustained growth and success. As such, it is essential to prioritize UI/UX design throughout the development process and consider it as a key component of any successful systems plan.

4.6.1. User interface (UI)

The graphical layout of an application known as the user interface (Eberts, 1994). UI is the first point of interaction for any user. It includes buttons for tapping, text to read, images, sliders, text entry fields, and all other elements the user interacts with. This encompasses the screen layout, transitions, animations, and all micro-interactions. All visual elements, interactions, and animations must be carefully designed to create a visually appealing experience for the user. The design should not be too light or too dark, but should be visually noticeable and friendly.

The components of the mobile app that require UI design are listed below:

- Based on Gathering Requirements and after much dedication, main colors were reached; which are (Blue, Light Bluish-Grey).
- Having a (White) background is an excellent choice that suits main colors.
- Texts with a black color on a white background are much clearer and readable.
- Images and list items should be embossed to give a smooth elevation to them.
- Unselected icons should be displayed in black color.
- Selected icons should be displayed in white color inside a blue round-rectangle.
- Vertical list views should be used in order to be more friendly.

4.6.2. User experience (UX)

According to Unger and Chandler (Unger & Chandler, 2012), the user experience of an app is shaped by how users interact with it. The experience can be either smooth or confusing, and it depends on how effectively users are able to complete their tasks. The ease of interaction with the elements of the user interface, designed by UI designers, determines the user experience. Hence, the placement and positioning of components play a crucial role in creating a positive user experience (UX).

5. IMPLEMENTATION

Implementing a mobile application for attendance tracking based on user authentication requires expertise in mobile app development, image processing techniques, back-end developing and database management as well. Overall, developing such a system requires a set of tools that work together to deliver a seamless user experience. The choice of tools will depend on the specific needs and requirements of the application.

5.1. Scope

A mobile application for attendance tracking based on user authentication has a wide scope of application, as it can be used in different settings, including educational institutions, corporate organizations, and events.

In educational institutions, the application can be used to track student attendance in classrooms and other academic activities. It can help reduce the administrative workload for teachers and staff, while also providing real-time attendance data to parents and other stakeholders with complete details.

In corporate organizations, the application can be used to track employee attendance for meetings, training sessions, and other events. This can help improve employee accountability, ensure compliance with company policies, and facilitate payroll processing.

For events such as conferences, workshops, and seminars, the application can be used to track attendance and manage registration. This can help event organizers to better understand attendance patterns and make informed decisions in planning future events.

In addition, the application can be useful in fitness and health facilities to track attendance for group fitness classes and personal training sessions. It can also be used in government and public organizations to track attendance for meetings and other official events.

5.2. Technologies

the tools that have been used so far in the development of such an application can be:

1. Programming languages: The mobile application can be developed using languages such as Java, Swift, or Kotlin for Android and iOS platforms, respectively.
2. Mobile Development Frameworks: for the proposed system, Flutter framework has been used due to its capability to working with both Android and iOS platforms, and using a newly developed framework is the core goal of the project.
3. User Authentication: For user authentication, google ML kit along with Tflite (Tensor-flow Lite). These open-source tools provide pre-built components and APIs for user authentication, making it easier to implement (Jason et al., 2022).
4. Database Management: To store attendance data, MongoDB (Mongo, 2015) along with Mongoose Framework were used in order to give the systems provide tools for storing and retrieving data efficiently.
5. Location Verification: The location of the user is verified using an IP Restriction library which is called (dart IPify) which is readily available and open-source library of flutter.
6. Integrated Development Environment (IDE): Android Studio and VS code, have been used to develop the mobile application.
7. Version Control System: A version control system (Git) used to manage the source code of the application (Loeliger & McCullough, 2012).

5.3. Back-End Side

The backend of an attendance tracking application would typically involve a server-side background that receives requests from the mobile application and manages the data storage and processing required to handle those requests.

One of the key considerations for the backend side of the proposed app is to ensure the security and integrity of the attendance tracking data, the backend application should implement robust user authentication mechanisms such as email/password login, biometric authentication face recognition and so on.

At the Data Storage point of view, the backend application should be designed to handle the storage and retrieval of attendance tracking data. The application should also have a database to manage user information and attendance records.Performance and Scalability is another factor that the backend application should be built on. As the application grows and more users join, the backend application should be able to handle the load without compromising on performance.

Security is a vital part of any application, and attendance tracking applications are no exception. The backend application should have measures in place to prevent unauthorized access to sensitive data, such as encryption of sensitive data and monitoring of suspicious activity.The backend application should be designed in such a way that it can be easily maintained and supported over time. This includes implementing regular updates, fixing bugs and providing user support.Overall, the backend side of a mobile application for attendance tracking based on user authentication is an essential part of the application. It needs to be designed and implemented with the user's needs in mind and provide a seamless and secure experience to the users.

5.4. API

An API, short for Application Programming Interface, is a collection of protocols, routines, and tools designed for constructing software applications (Gu et al., 2016). It acts as a mediator between various software components, enabling them to communicate and interact seamlessly. APIs offer a standardized approach for applications to exchange data and collaborate, regardless of the programming language, operating system, or platform they utilize. By abstracting the intricacies of underlying software components, APIs empower developers to construct sophisticated applications with greater ease.

In order to use an API, other components of a system need to make a request to the API to perform a specific function. The API then processes the request and returns a response, typically in the form of data or a message, which the requesting component can use to perform its task. to design the API for a mobile application for attendance tracking based on user authentication, the End-Points should be considered and methods needed to enable the desired functionality. Here is the basic structure of how such an API could be structured:

5.4.1. User endpoints

POST /user/login: such an endpoint typically used for privilege authentication and would allow users to log in and authenticate themselves in order to access attendance tracking features.

POST /user/create: it is used to grant access to the admins to create new user/privilege accounts by providing their personal information and credentials.

PATCH /user/update: this endpoint makes the use of updates for an existing user's information or profile and allows admins to modify personal informations of privileges/users or change their credentials, such as username, password, or email.

DELETE /user/delete: commonly utilized to provide admins with the ability to permanently delete user/privilege accounts along with all of its associated data from the system.

GET /user/users: gives the privileges right of retrieve and viewing a list of all registered user/privileges in the application.

5.4.2. Image endpoint

POST /image/save single image: used to save a single image to the application's database and allows privileges to upload a single image, such as a profile picture or saving a captured image of users at the time of authentication (Face Recognition).

5.4.3. Attendance endpoints

PATCH /attend/update: to modify a user's attendance status for a specific event, such an endpoint would be required. Privileges with appropriate permissions are able to record attendance as attend, absent, or late for a particular user.

GET /attend/attends: such endpoints commonly utilized to obtain attendance-related data. Here, the endpoint is divided into three different branches and worked to enable privileges to retrieve diverse attendance data types like:

1. GET all attends via date: allows privileges to retrieve attendance information for all users for a specific date.
2. GET user attends: allows privileges to retrieve all the attended user’s information for today (the day that privileges use the app).

3. GET user absence: allows privileges to retrieve all the absence user's information for today.

5.4.4. Settings endpoints

PATCH /settings/update: PATCH-related endpoints formally used to update an existing resource on a server, this endpoint will grant access the admins to update a specific setting that will apply on all the pre-registered users like (specifying number of working days, time of start/end attendance tracking...etc.).

GET /settings/: generally utilized to obtain and retrieve the existing settings set by a admins.

The exact endpoints needed will depend on specific requirement and features of the project. However, using best practices, an API that is intuitive reliable, and scalable would be developed.

5.5. Mobile Application

Flutter is a widely-used open-source framework for developing mobile applications, created by Google. It enables developers to construct applications that resemble native experiences for both iOS and Android platforms, all from a single codebase. Flutter provides an extensive range of widgets and resources that assist developers in creating visually appealing and high-performing mobile applications.

In the context of this project, the mobile application is designed to track attendance based on different paths of user authentication. There are three specific types of privileges inside the application, each with different levels of access and privileges.

Admin: This type of user has the highest level of access and can perform all the functions of a Viewer and an Editor. Additionally, an Admin can modify the Viewer and Editor Privileges, add new users to the system, and manage the permitted IP address that would give access to the plain users to clock-in.

Editor: These users have higher privileges than a Viewer and can edit and modify the attendance data of a particular user. They can mark attendance for students or participants, as well as add or remove attendees from the list.

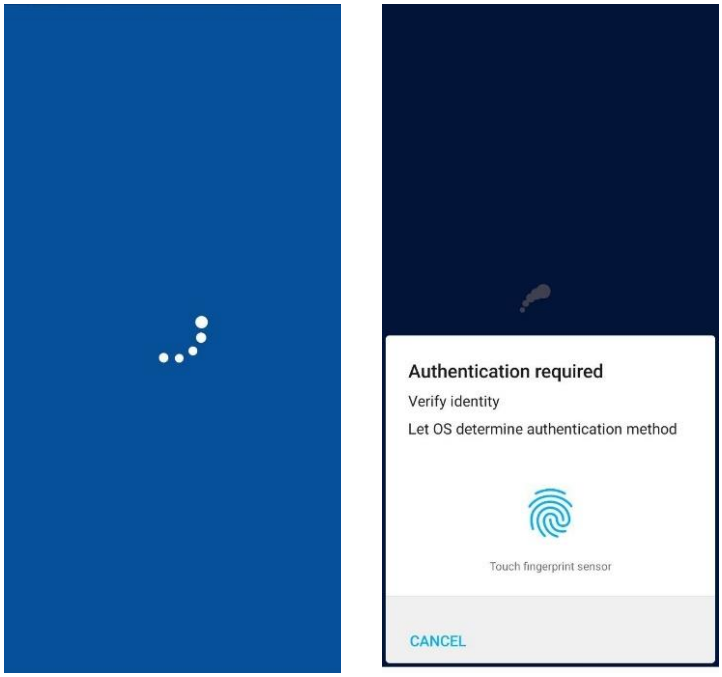
Viewer: This type of user has the lowest level of access and can only view the attendance data. They cannot edit or modify the data in any way.

The mobile application is designed to provide a user-friendly interface for all types of users. The authentication mechanism ensures that only authorized users can access the application and perform the desired actions.

5.5.1. Admin privilege

The below Figure 5.1.a. shows the waiting screen of the app which is a series of spinning circles. This type of loading animation is a common visual indicator that the application is processing data or waiting for a response from a server. The spinning circles provide users with a sense of progress and reassurance that the application is actively working to retrieve the necessary information.

The fingerprint authentication screen of the app provides a convenient and secure way for privileges to login without the need to remember and enter their email and password each time they access the app as shown below in Figure 5.1.b. This feature uses the unique biometric data of the user's fingerprint to authenticate their identity and grant access to the application. It not only saves time but also adds an extra layer of security to protect sensitive attendance tracking data.



(a) **(b)**

Figure 5.1. Waiting screen & fingerprint authentication of the mobile device screen.

The demonstrated situation shown below at Figure 5.2 asuures that, If a privilege bypasses the fingerprint authentication screen of the app, they will be prompted to log in by entering their email and password. This extra layer of security ensures that only authorized users have access to the application and its features. By requiring users to enter their login credentials, the app can verify their identity and provide access to only the privileges that they are authorized to use. This not only protects the sensitive attendance tracking data but also maintains the integrity and security of the application. Therefore, it is important for privileges to follow the proper authentication process and use the app responsibly.

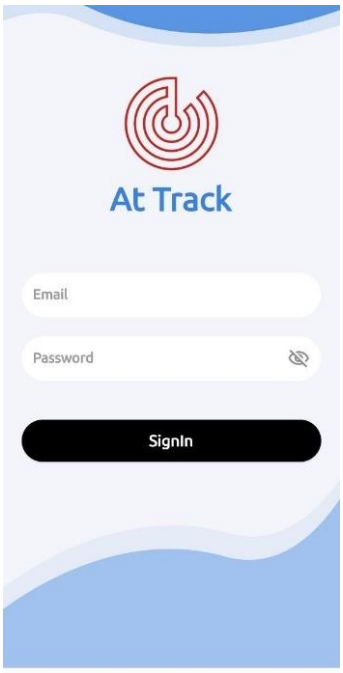


Figure 5.2. Privilege authentication using email & password screen.

The home page of the Admin Privilege of the app may not have the option to clock in if the user is not on the required IP address. This is done to ensure that attendance records are accurate and reliable. By limiting clock-ins to a specific location & IP address, the app can prevent users from clocking in when they are not physically present at the specified location. The home page of the ADMIN privilege may provide other features such as managing user accounts, generating attendance reports, or viewing real-time attendance data. Overall, the absence of the clock-in option on the home page does not hinder the app's functionality and helps maintain the integrity of attendance records Figure 5.3. shows the home page.

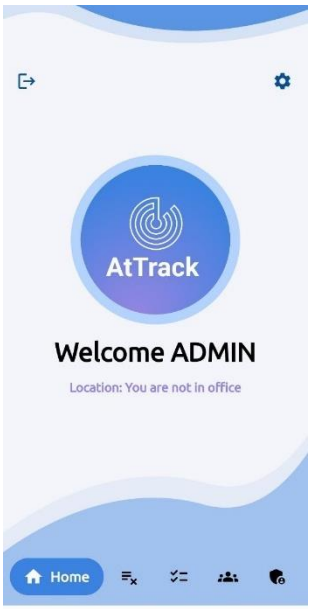


Figure 5.3. Admin privilege's home screen.

The settings page can be a crucial feature for managing attendance tracking data. This page contains options for configuring the IP address that will be granted clock-in permission, specifying the working days, and setting the start and end times for clock-ins as shown in the Figure 5.4. By specifying the allowed IP address, the app can ensure that users can only clock in from specific locations, ensuring the accuracy of attendance data. Additionally, setting the working days and clock-in times can help the app accurately calculate working hours and overtime for employees.

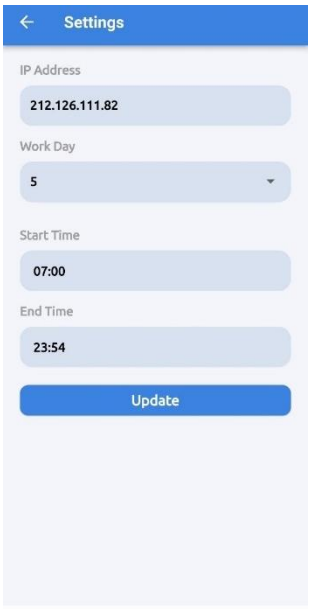


Figure 5.4. Admin's settings screen.

The app's homepage will provide a button to clock in, but only after specifying the required IP address to confirm the privilege. This measure is taken to ensure that attendance records are precise and trustworthy as shown in the Figure 5.5.

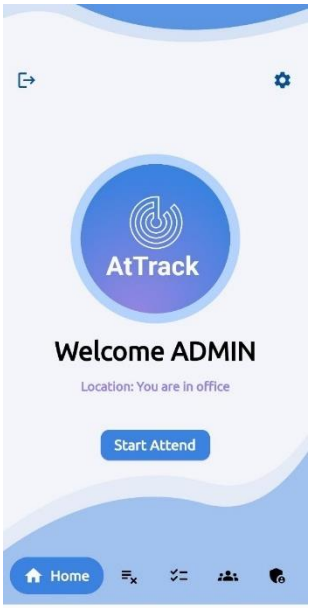


Figure 5.5. Admin’s home screen after specifying IP address.

The Absence Lists screen can be a helpful feature for managing employee attendance records. This page contains a list of absent employees, including their names and photos as shown in the Figure 5.6. Additionally, the page includes a button to mark absent employees as present and a calendar that provides admins with access to previous days' absence records.

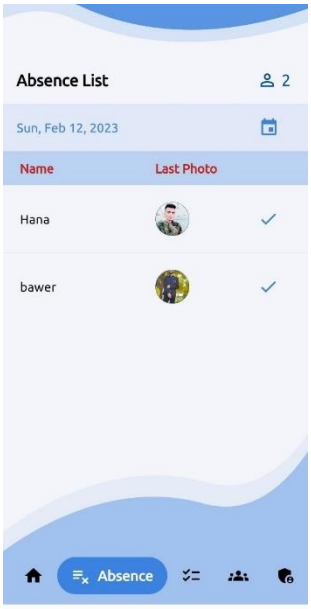


Figure 5.6. Admin’s absence list of the users screen.

The attendance lists screen can be a useful feature for managing employee attendance records. This screen can display a list of attended employees, including their names, clock-in times, and photos from the time of clock-in. The screen can also include a button to mark employees as absent and a calendar that provides admins with access to previous days' attendance records as shown in the Figure 5.7.

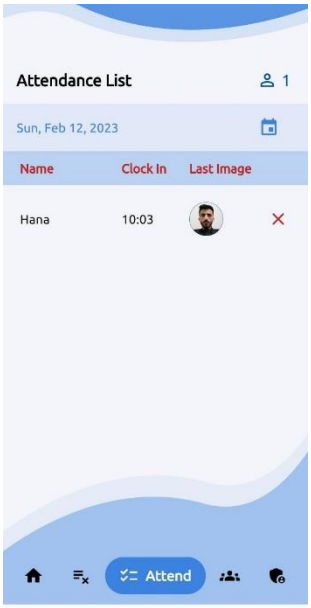


Figure 5.7. Admin’s attendance list of the users screen.

The Users lists screen is among one of the main pillars for managing employees. This screen displays a list of registered users as shown in the Figure 5.8. A blue button on the top-right corner on the screen appears to let admins register new employees.

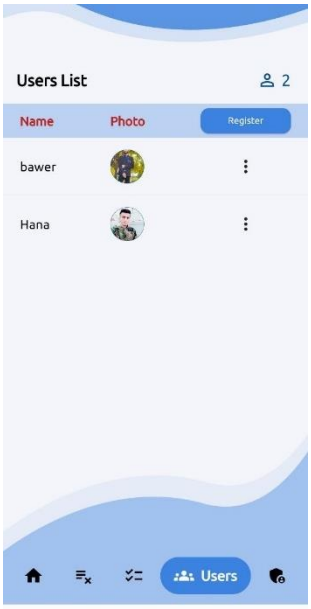


Figure 5.8. Admin’s users list screen.

The Privilege lists screen is one of the other private sectors that only Admins can edit it. This screen displays a list of registered privileges (only one Admin can included & not be removed at all), including their names, roles and pre-captured photo to be known as shown in the Figure 5.9. Register Button appears to let admins register new privileges.

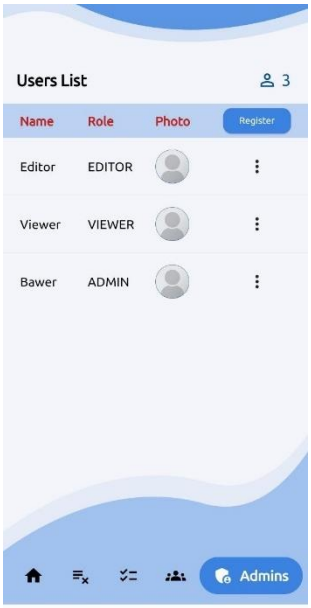


Figure 5.9. Admin's privilege list screen.

When pressing Clock-in button in the home page, below screen will appear as shown in the Figure 5.10. This screen displays a location which is bounded to the IP address, the allowed time of Clock-in and a Large-Circle to let users' clock-in .

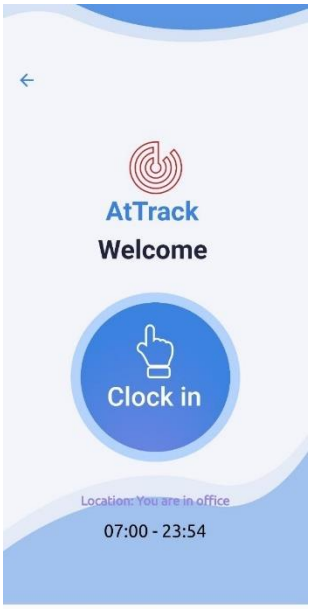


Figure 5.10. Clock-in screen.

After pressing Clock-in button, the camera of device will open and tries to capture a face to be recognized as shown in the Figure 5.11. The Authentication after processing face recognition will come over writing PIN code, which will finalize the Clock-in process and mark the attendance of a specific user. For sure, the captured photo will be saved in the database and could be seen whenever the admins want to view.

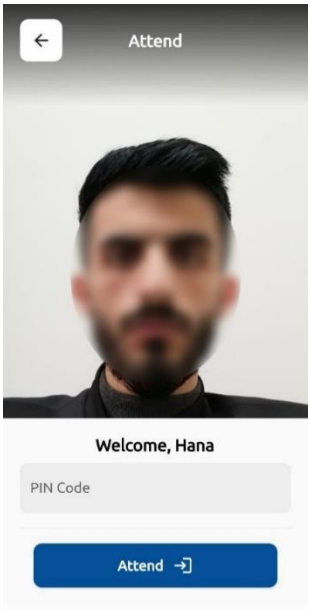


Figure 5.11. Authentication screen.

Successful authentication will bring the users to this screen, which popup a green round rectangle to demonstrate the success of the process as shown in the Figure 5.12.

Figure 5.12. Success authentication process.

As stated previously, the captured photo while authentication process will be saved in the database and could be viewed as can be seen below in the Figure 5.13. This process will prevent the illegal acts and give an extra layer of security .

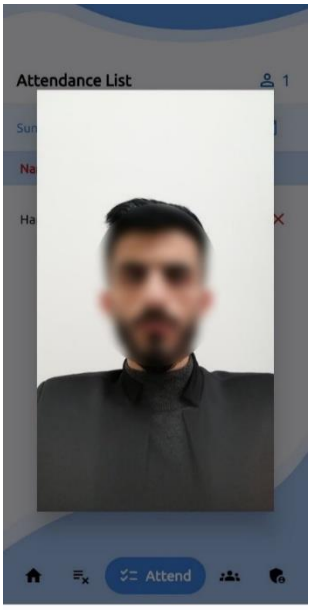


Figure 5.13. Captured photo when clock-in process occurred.

5.5.2. Editor privilege

The home page of the Editors privilege is providing some basic features, but can't do any modification with the privileges Figure 5.14. explains graphically.

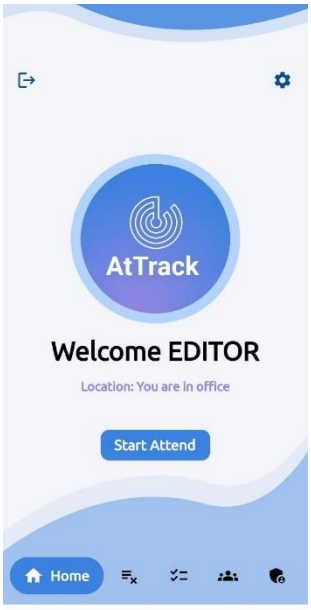


Figure 5.14. Editor's home page.

The Editor privilege's settings page is designed with limited access to certain features. While the editors cannot modify any information, they can view certain details regarding the Start and End Times and Working Days. However, as it can be seen in the Figure 5.15. the editors cannot view the required IP address for the app.

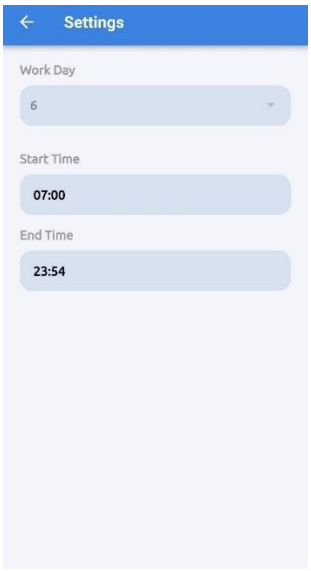
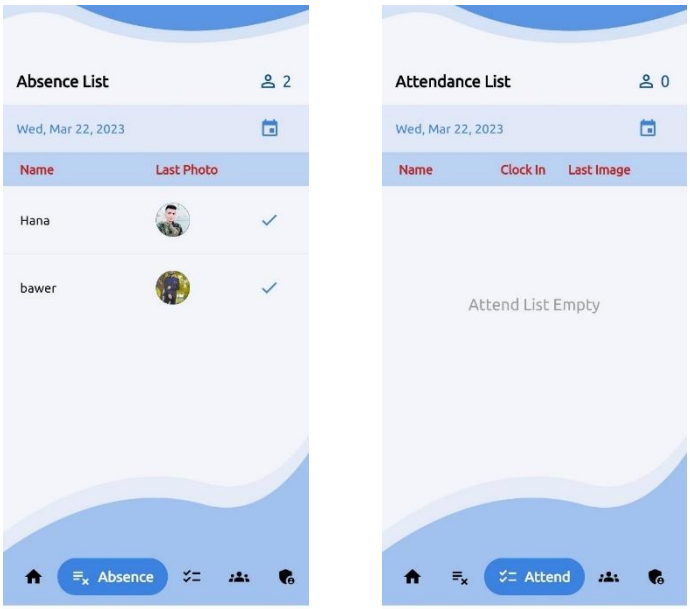


Figure 5.15. Editor's settings page.

The Absence and Attendance List pages of Editors provide them with full control over the information available. This level of access enables the editors to accurately monitor as its seen in Figure 5.16. (a, b), ensuring that all records are up-to-date and correct.



(a) **(b)**

Figure 5.16. Editor's absence-attend lists.

The Editors are provided with the ability to manage user accounts available inside Users List page fully. The editor can register new users, edit existing user profiles, and even register faces for facial recognition authentication. Figure 5.17. below is a screen-shot of the page.

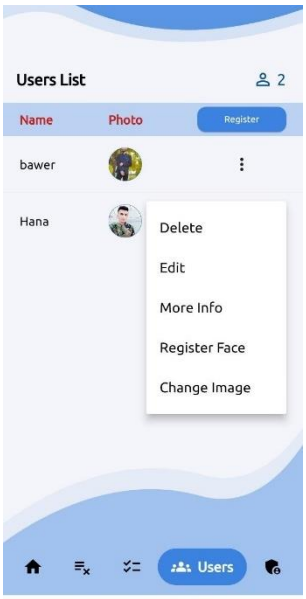


Figure 5.17. Editor's users list.

The Editor's Privilege lists pages that is shown in the Figure 5.18. provide the editors with a list of available privileges, unlike previous pages, the editor cannot make any modifications or changes on this page other than viewing the names of the available privileges, such as the admin, Editor, or Viewer privileges.

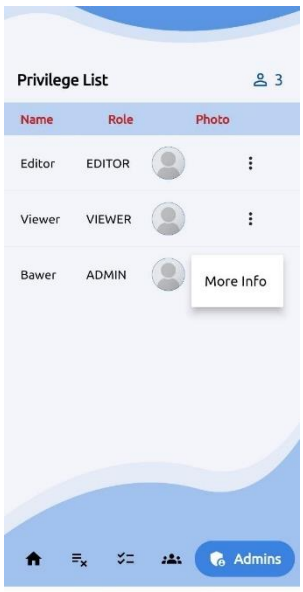


Figure 5.18. Editor's privilege list.

5.5.3. Viewer privilege

Simply, as the other Privilege, Home page of the Viewer Privilege will not have the option to clock in if the user is not connected to the required IP address. the main difference with others is that, Viewers doesn't have the rights to access the Settings pages, Figure 5.19. below shows the home page up.

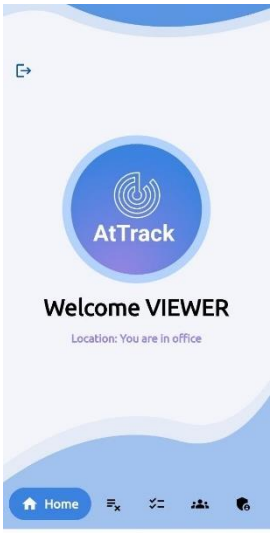
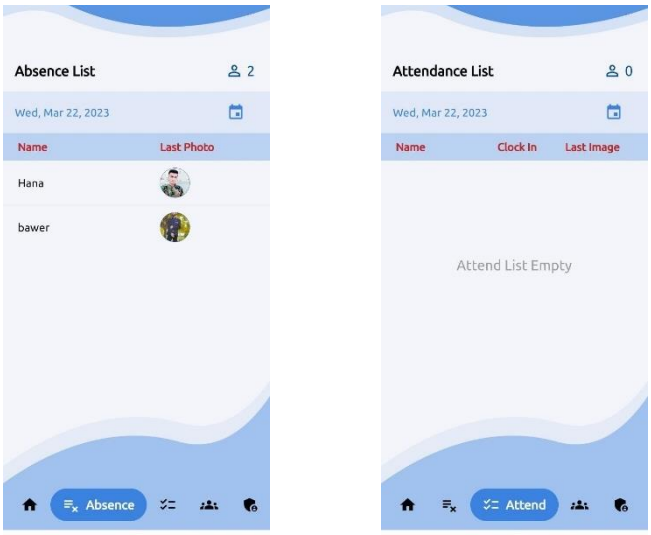


Figure 5.19. Viewer's home page.

The Absence and Attendance list pages as shown in the Figure 5.20. (a, b) provide the viewers with a very limited set of features. The viewers can access the lists of absence and attendance but cannot modify any information on the pages. Instead, they can generate reports and view the number of users available according to the dates.



(a) **(b)**

Figure 5.20. Viewer's absence-attend lists.

The Users pages give the Viewers a very restricted access. They can access the list of users, but unlike the admin/editor privileges, they cannot do anything with users information as shown in the Figure 5.21. below. the only thing that can do is just see the names of users available in the list.

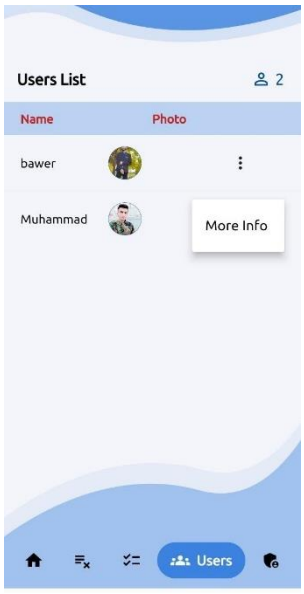


Figure 5.21. Viewer's users list.

The page that containing the list of privileges give viewers a very little access. Although viewers can view the available privileges, they cannot modify or edit the page. Their access is limited to simply viewing the names of the different levels of access such as admin, editor, or viewer privileges, as shown in the Figure 5.22.

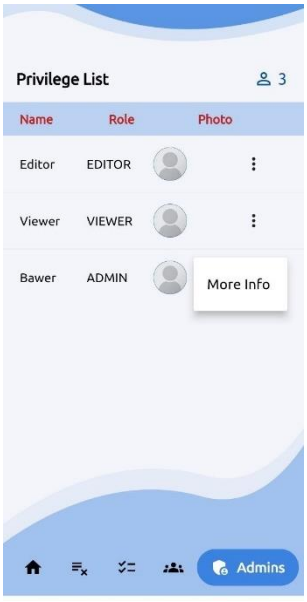


Figure 5.22. Viewer's privilege list.

6. CONCLUSION AND FUTURE WORKS

The development of a mobile application for attendance tracking is an essential solution for many organizations and individuals. While the project had many initial aims, various challenges arose during development and implementation, leading to the generation of new goals. Testing played a significant role in ensuring that the aims and objectives were met, resulting in a reliable and efficient mobile application.

The mobile application utilizes user authentication, ensuring that only authorized users can access and modify attendance records. This feature provides a secure and reliable way to manage attendance, minimizing the risk of unauthorized access or data breaches. The user-friendly interface and intuitive design of the application enable users to track their attendance easily, saving time and reducing the possibility of errors.

One of the benefits of the mobile application is its ability to generate real-time data analysis and reports. This feature makes it a valuable asset in decision-making processes, enabling organizations to monitor and manage attendance patterns. Additionally, the application's capabilities can be extended to integrate with other systems, providing a comprehensive attendance-tracking solution.

The attendance tracking mobile application is invaluable for organizations and individuals. It streamlines the recording and tracking of attendance, reducing the administrative burden and improving accuracy. Moreover, the application's capabilities can be customized to meet the unique needs of various events, workplaces, and educational institutions.

In conclusion, the mobile application for attendance tracking is a useful and light system that can significantly improve the efficiency and accuracy of attendance tracking processes. By leveraging user authentication, the app provides a secure and reliable way to manage attendance, reducing the risk of unauthorized access or data breaches. The user-friendly interface and intuitive design make tracking their attendance easy, saving time and reducing errors.

6.1. Future Works

The developer and the Supervisor both became more eager to add new and significant features throughout the project's lifecycle. The following goals will be worked on in the upcoming iterations of the project:

1. Improving Face recognition process utilizing different method and libraries.
2. Combining fingerprint recognition (which will replace PIN code) along with face recognition. Thus, an extra layer of security will be provided.
3. Providing a Block-chain technology and mixing it with the recognition techniques to give another layer of efficiency and security to the system.
4. Making a contact between other branches of a company or anywhere, to make the project’s scope wider in order to construct a united application that could hold users and recognize there informations from different sources.

Returning to the fact that goals can only be met when a project is put into action and officially utilized in people's everyday lives, this is one of the reasons why certain Future works were not available and included in this edition. of course, in the future, there will be new objectives and goals for the project, but one of the most crucial factors is that it won't stay in the same spot. Instead, it will work to keep becoming better so that it can best serve the common people and administrators in particula

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