EDUSCAN: AN ANDROID APPLICATION FOR DIGITIZATION OF WRITTEN INFORMATION

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Authors

Abstract

EduScan is a mobile app that's changing the way we handle documents and attendance. It's super easy to use and lets you convert text into PDF and DOCX formats effortlessly, thanks to its Optical Character Recognition (OCR) technology. This app isn't just about converting text – it's a complete toolkit for managing documents and keeping track of attendance. It quickly transforms text into files that can easily access and edit on the go. What's cool is that it can pull text from images accurately and convert it into the format anyone prefers. EduScan revolutionizes document management by significantly reducing paper usage through its efficient digital conversion tools, thereby promoting eco-friendly practices. Additionally, the app's optimized data compression techniques allow for the storage of extensive information in minimal storage space, ensuring users can access and manage a wealth of data without compromising device storage capacity. Plus, it's great at managing attendance by recognizing who's present or absent, generating detailed reports for easy tracking. Whether you're a student, teacher, or professional, EduScan simplifies document work and attendance tracking with its user-friendly interface and powerful features. It's all about making document tasks and attendance hassle-free in our digital world.

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1 Introduction

The main attraction of this project is to present a digitized form of hardcopy. Normally, when a software is planned, it's mainly focused on building up using fully modern technologies for which user need to change a habit or must learn new technology. Our approach is not to change the use of daily life but to reduce workload or making works less time consuming.

1.1 Background

Managing attendance and calculating continuous assessment (CT) marks can be a challenging but crucial task, especially for teachers. These processes play a significant role in monitoring student progress and assessing their performance. Maintaining accurate attendance records is fundamental for several reasons. Regular attendance is often linked to better academic performance, as it reflects a student's commitment to their studies. Additionally, it allows us to identify potential issues early on, enabling timely intervention to support students who may be facing challenges. To streamline the attendance tracking process, we employ attendance sheets in a digitized form. Unlike traditional exams, CT marks consider a range of assessments, including quizzes, projects, presentations, and class participation. Our approach to CT marks calculation is rooted in fairness and transparency. Our dedication to effective attendance tracking and CT marks calculation stems from a genuine commitment to providing our students with a meaningful and enriching educational experience. By carefully managing these aspects, we aim to create an environment that promotes learning, encourages participation, and ultimately contributes to the academic success of each student through reducing teachers' work.

1.2 Objectives

In the case of maintaining academic data of students, some basic objectives of this app are-

- Digitization of handwritten information
- Transition to a paperless academic system
- Presentation of information in convenient format
- Minimization of paper usage and maximization of data storage efficiency
- Enhancement of user accessibility and easy to handle documents

1.3 Scope

We understand that embracing technology can present its own set of challenges. Our commitment extends beyond implementation to ensuring a seamless experience for both teachers and students. Regular training sessions, user-friendly interfaces, and a dedicated support system are in place to address any concerns and ensure a smooth transition into our digitized approach. In conclusion, our digitized attendance tracking, and CT marks calculation represent a significant step forward in our quest for educational excellence. By harnessing the power of technology, we aim to create an environment that not only meets the demands of the digital age with transparent calculation but also maintains the hardcopy as sheet that is comfortable to use at regular works.

1.4 Unfamiliarity of the problem

Our project mainly presents a digitized form of hardcopy. Our approach is not to change the use of daily life but to reduce workload or making works less time consuming. While existing systems, as exemplified by [1], [2] and [3] leverage OCR models and pre-built ML kits, our innovation comes in the form of specially trained model's adept at recognizing both handwritten letters and digits. In addition to proficient image cropping and grid extraction capabilities, what truly sets our project apart is the convergence of these advanced functionalities within a single, user-friendly application — a milestone yet to be achieved by the referenced projects. Moreover, our project doesn't just stop at seamless digitization. It takes a step further by introducing features that significantly enhance user convenience, such as the dynamic conversion of recognized content into versatile PDF and Word file formats. This holistic approach ensures that users not only experience a reduction in workload but also witness a transformative shift in the efficiency and ease with which they handle and manage documents. By seamlessly integrating these cutting-edge technologies into an intuitive and comprehensive application, we're paving the way for a new standard in digitizing hardcopy documents while preserving the familiarity of existing workflows. All these features are merged in one app that hasn't done in the referenced projects.

1.5 Project planning

The workflow for the EduScan app spans over a 10-week period, systematically outlining the key tasks and milestones for its development. In the first week, the focus is on creating the foundational elements by setting up the sign-up and login functionalities. The second week involves designing a user-friendly interface (UI) for optimal user experience. Weeks three and four prioritize the implementation of OCR and machine learning (ML) models respectively, aiming to enable text extraction from images and initiate learning processes for attendance monitoring. Week five centers around data collection to train and refine the models. By the sixth week, the focus shifts to building the model to distinguish between present and absent individuals. Week seven involves refining the image processing by cropping and extracting relevant data. Implementation of these models begins in week eight, while week nine is dedicated to data calculation and analysis. Finally, by the tenth week, the UI undergoes final adjustments to ensure a polished and seamless user interface before the app's launch. This systematic breakdown ensures a methodical and comprehensive approach to creating a feature-rich and functional app for document handling and attendance tracking.

Table 1.1 describes our project's work details within week time after the topic selection-

Table1.1: Week Wise Project Planning with Work Description

	Week Numbers	Tasks	Start	End	Dur		2023		
							Sep	Oct	Nov
	Full Project	Backend + Frontend	9/2/23	11/29/23	61				
1	Week 1	Sign-up and Login with Email Authentication Also adding Forgotten Password options	9/2/23	9/11/23	6				
2	Week 2	App logo design and Overall UI design	9/12/23	9/20/23	7				
3	Week 3	OCR Model implementation	9/21/23	9/28/23	6				
4	Week 4	ML model learning	9/28/23	10/6/23	7				
5	Week 5	Data Collection for ML Models	10/6/23	10/12/23	4				
6	Week 6	Absent-Present and Digit checking model's implementation	10/12/23	10/19/23	6				
7	Week 7	Image extracting from sheet	10/19/23	10/27/23	7				
8	Week 8	Models' implementation on App	10/27/23	11/10/23	11				
9	Week 9	Extra calculations on app	11/10/23	11/19/23	6				
10	Week 10	Final touch to UI design	11/20/23	11/29/23	7				

2 Related Works

Related to this topic, there are few works on continuous attendance checking or marks collection, developed on fully software-based applications like [ref.1,2,3]. Accuracy of calculation is very high here, but the user needs to store data manually which is the basic problem we considered in our system project.

2.1 Existing solutions

The referenced projects leverage cutting-edge Artificial Intelligence (AI) techniques to address the challenges of converting handwritten attendance logs into a digital format efficiently. The software, designed to minimize human involvement, incorporates Google's TensorFlow platform for implementation. It harnesses Convolutional Neural Network (CNN) layers, fully connected layers, output layers, and classifiers for training and analysis. The model utilizes datasets from MNIST and custom-created data to enhance accuracy in recognizing and converting handwritten text. Furthermore, it automates the calculation of individual student attendance, overall attendance percentages, and identifies defaulters, streamlining the organizational process of attendance management.

2.2 Limitation in existing solutions

In case of limitations in existing projects, there are few reasons in consideration-

- Reliability and accuracy might vary based on the quality and consistency of handwritten entries in attendance logs.
- The model's performance could be affected by variations in handwriting styles and unconventional notations.
- Limited effectiveness in recognizing highly stylized or illegible handwriting, potentially impacting data conversion accuracy.
- Dependency on sufficient and diverse training data to handle various handwriting styles and scenarios effectively.
- Possible challenges in handling errors or inconsistencies in attendance logs, impacting the calculation of attendance percentages and identification of defaulters.

In our project, users don’t need to adapt with a new system. Besides, manual sheets will be calculated by only clicking on one image scanning which is very less time consuming.

3 System Design

The System Design phase is a pivotal step that bridges the conceptualization of project requirements with the actual development process. Going beyond the initial specifications identified in the requirements analysis phase, the System Design aims to craft a comprehensive blueprint that outlines the intricate details of the system's architecture. This involves a meticulous breakdown of the entire system into modular components, each designed to handle specific functions and features. During this phase, careful consideration is given to the interactions between these modules, ensuring seamless communication and collaboration to achieve the overall functionality defined in the project requirements. The high-level structure and behavior of the system are meticulously conceptualized, considering factors such as scalability, flexibility, and maintainability. System Design serves as the foundation upon which the development team will build the actual software. It involves making critical decisions about the choice of technologies, database structures, and system architecture. Additionally, the design phase sets the stage for the integration of essential elements like security measures and user interface components, ensuring a holistic and well-rounded system. Ultimately, a well-executed System Design not only streamlines the development process but also serves as a guiding document throughout the project lifecycle. It provides developers with a roadmap, fostering clarity and consistency in implementation. By breaking down the complexity of the system into manageable components and defining their relationships, the System Design phase plays a crucial role in translating abstract concepts into a tangible, functional reality.

3.1 Analysis of the System

System analysis is a critical phase in the software development life cycle that involves a comprehensive study of an existing system or a proposed one. The goal is to understand and document the system's requirements, functionalities, and constraints to provide a foundation for system design and implementation. For our system, Figure 3.1 DFD (Data Flow Diagram) diagram indicates the workflow of our app.

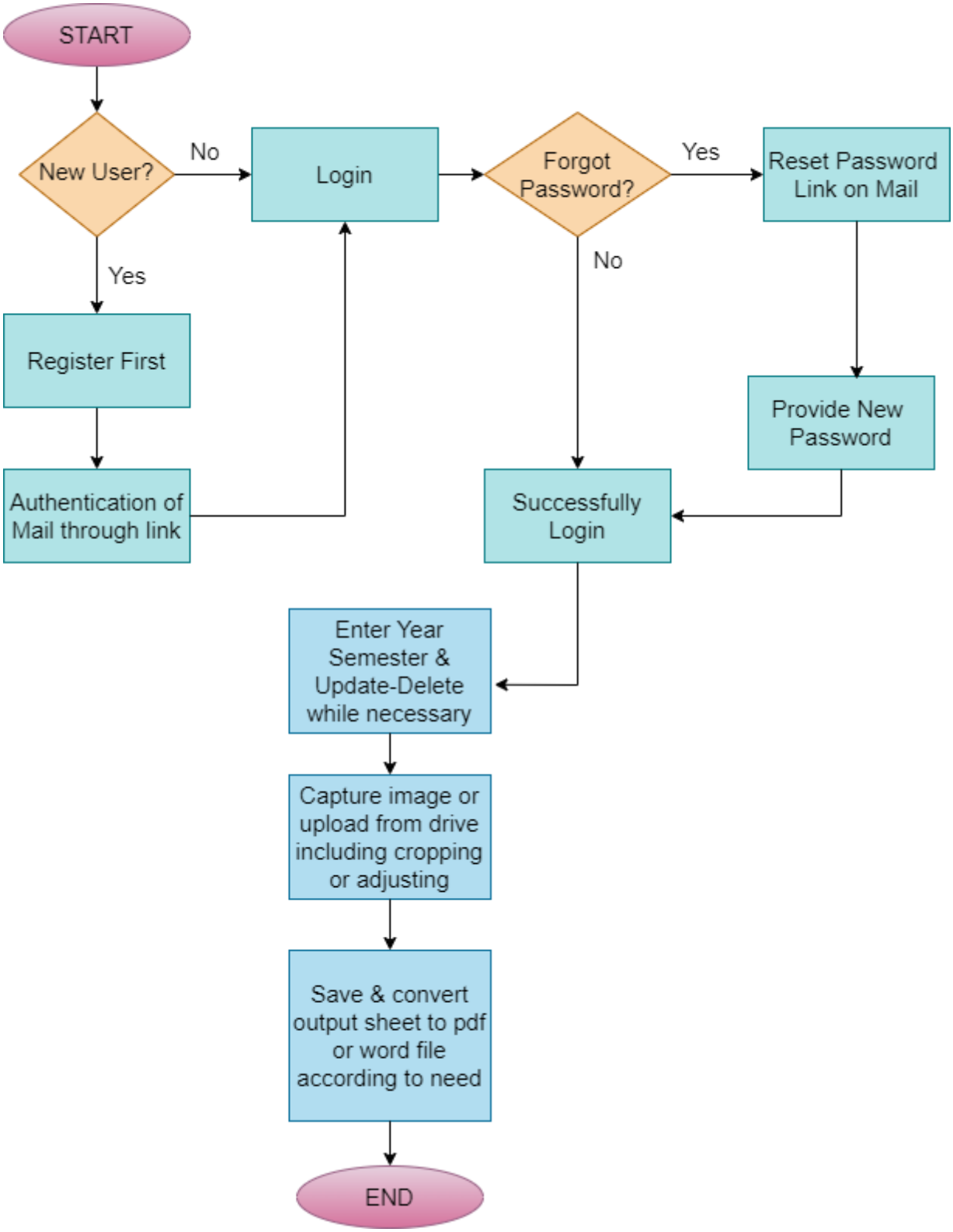


Figure 3.1: DFD of Edu Scan App

Our use case diagram visual represents the interactions between different actors (users or external systems) and the system under consideration. In the context of introducing a system, such as our digitized hardcopy application, a use case diagram illustrating the primary functionalities and interactions:

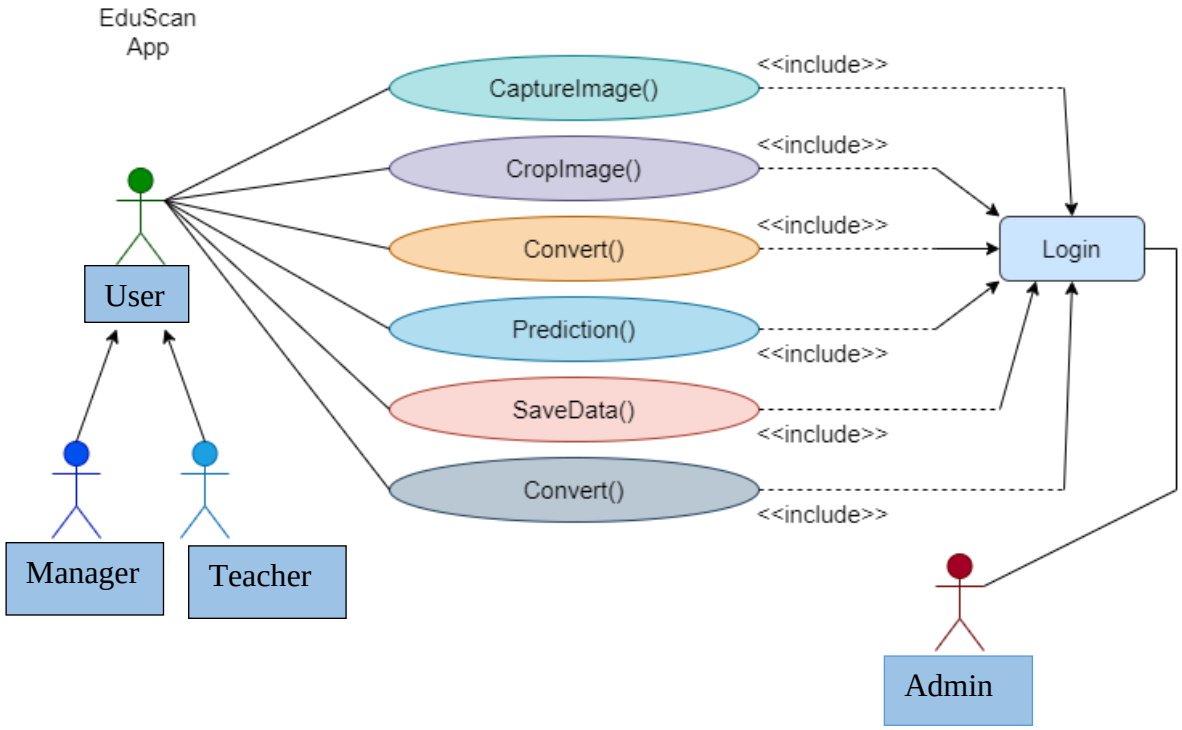


Figure 3.2: Use Case Diagram of App

3.2 System Architecture

System architecture is the conceptual structure and organization of a computer-based system. It encompasses both hardware and software components, their relationships, and the principles and guidelines governing their design and evolution. Our system network was at first structured through a UML diagram with all basic functions maintaining the public, protected and private properties. The structure is given here where (+) sign represents public property, (#) represents protected and (-) represents private property of objects and functions within specified classes.

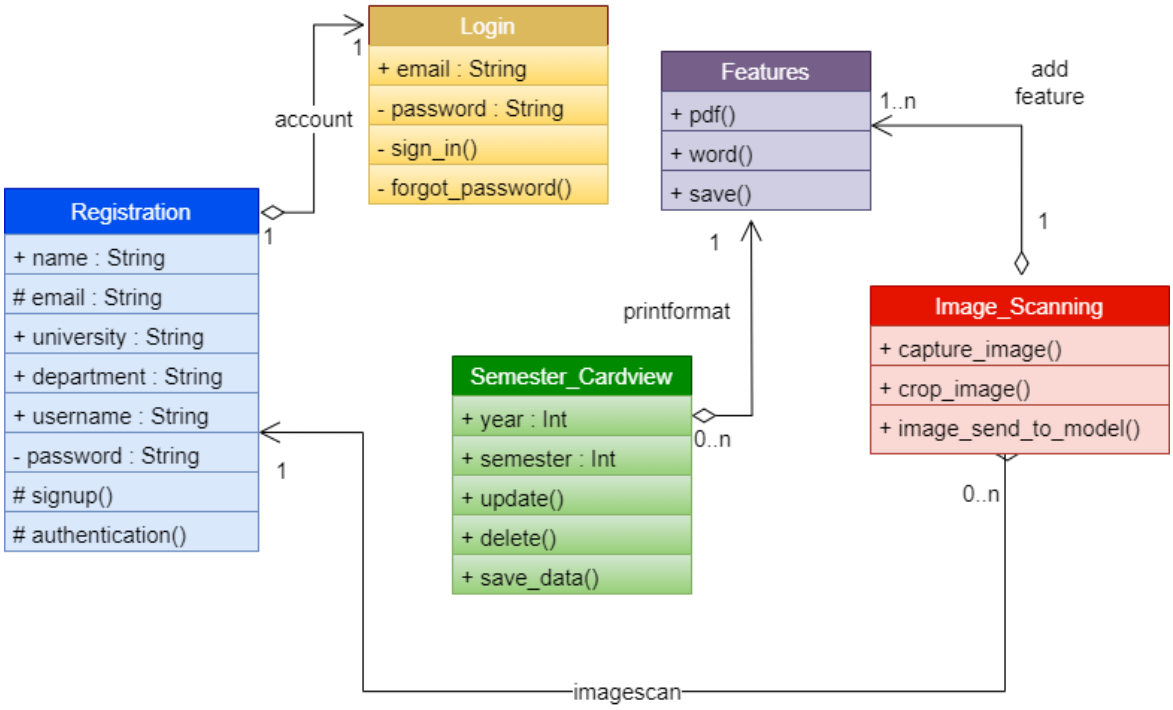


Figure 3.3: Basic UML Diagram of Edu Scan App

3.3 Tools Used

Tools used in a system project typically involves discussing the various software and hardware tools that are utilized throughout the project lifecycle. These tools play a crucial role in enhancing efficiency, collaboration, and overall project success. Tools used in our project are described with details -

3.3.1 Android Studio

Android Studio is the official integrated development environment (IDE) for Android app development. It provides a comprehensive suite of tools and features to streamline the entire Android application development process. Developed by JetBrains in collaboration with Google, Android Studio is built on the IntelliJ IDEA Community Edition. Used this software as it is continually updated to support the latest Android features and best practices. It remains an essential tool for Android developers, offering a rich set of features to enhance productivity and facilitate the development of high-quality Android applications.

3.3.2 Java

Java has been a foundational programming language for Android app development, chosen for its historical significance, robust ecosystem, and extensive developer community. Android Studio, the official IDE, seamlessly supports Java, providing a familiar environment for developers. The language's simplicity, compatibility across Android versions, and the ease of transition make it a practical choice. While Kotlin has gained popularity, Java remains widely used, especially in enterprises with established Java expertise. Its enduring relevance is underscored by its continued support, making it a comfortable and reliable option for developers crafting Android applications.

3.3.3 OCR Model

Optical Character Recognition (OCR) stands as a pivotal technology, facilitating the transformation of diverse documents—ranging from scanned papers and PDFs to images from digital cameras—into editable and searchable data. In the context of our application, OCR models played a crucial role in automating the extraction of text information, particularly in the image scanning phase for detecting names and rolls. This technology empowers the efficient digitization of textual content from various sources, streamlining tasks like information retrieval and document editing by enabling seamless integration between physical documents and digital workflows.

3.3.4 TensorFlow

TensorFlow, an open-source machine learning framework crafted by the Google Brain team, stands as a cornerstone in the realm of machine learning and deep learning. Renowned for its versatility, TensorFlow offers a rich ecosystem encompassing tools, libraries, and an active community. Its flexibility caters to both research and production demands, allowing seamless development and deployment of machine learning models. In the context of our application, TensorFlow played a pivotal role in constructing advanced models for attendance tracking and digit detection, showcasing its adaptability and robust capabilities in handling diverse machine learning tasks.

3.3.5 Firebase Database

Firebase Realtime Database is a cloud-hosted NoSQL database provided by Google as part of the Firebase suite of mobile and web application development tools. It is designed to store

and sync data in real-time across multiple clients, making it a powerful solution for building collaborative and responsive applications. As it is particularly well-suited for smaller to medium-sized projects and applications with real-time requirements, it’s integrated in our app for storing data and images.

3.3.6 Chaquopy

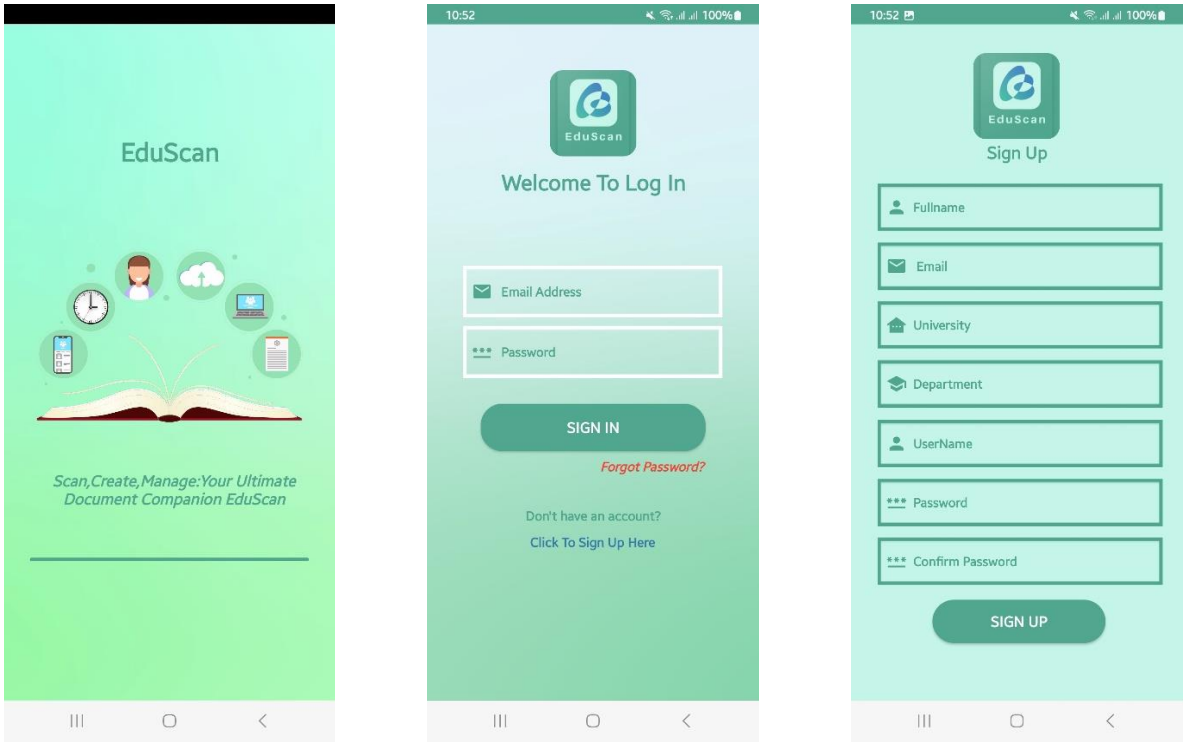
Chaquopy is a versatile and powerful tool designed to seamlessly integrate Python into Android applications developed using Java or Kotlin. It serves as a bridge between the robustness of Java for Android and the flexibility of Python, allowing developers to leverage. Python's extensive libraries, data processing capabilities, and rapid prototyping features within their Android projects. This tool simplifies the process of embedding Python code into an Android app by providing an intuitive interface and a smooth workflow. Chaquopy enables developers to write Python code directly in their Android Studio projects, offering the ability to mix and match Python and Java/Kotlin code effortlessly. With its comprehensive support for various Python packages, including scientific computing, machine learning, and data analysis libraries, Chaquopy empowers developers to build feature-rich and innovative Android applications that harness the strengths of both Java and Python seamlessly.

4 Project Implementation

Project implementation refers to the process of turning the plans and strategies outlined in a project proposal into reality. It involves putting into action the various components and activities that have been carefully designed to achieve specific objectives. This section includes the detailed project implementation of mockup design which is the UI (User Interface Layout Structures), System implementation process that includes the detailed sequential working of our app specifically backend implementation, morality or ethical issues include the protection giver user information through authentication and using of real-time firebase database. Next comes the socio-economic impact and sustainability part describing how our app is socio-economic and maintaining sustainability of nature as its target is to reduce the use of papers. Lastly, the financial analysis section where the cost of system design is estimated. As our app is developed using open resources, there’s no estimation part. Above all, it's a free of costing system project.

4.1 System Mockup Design

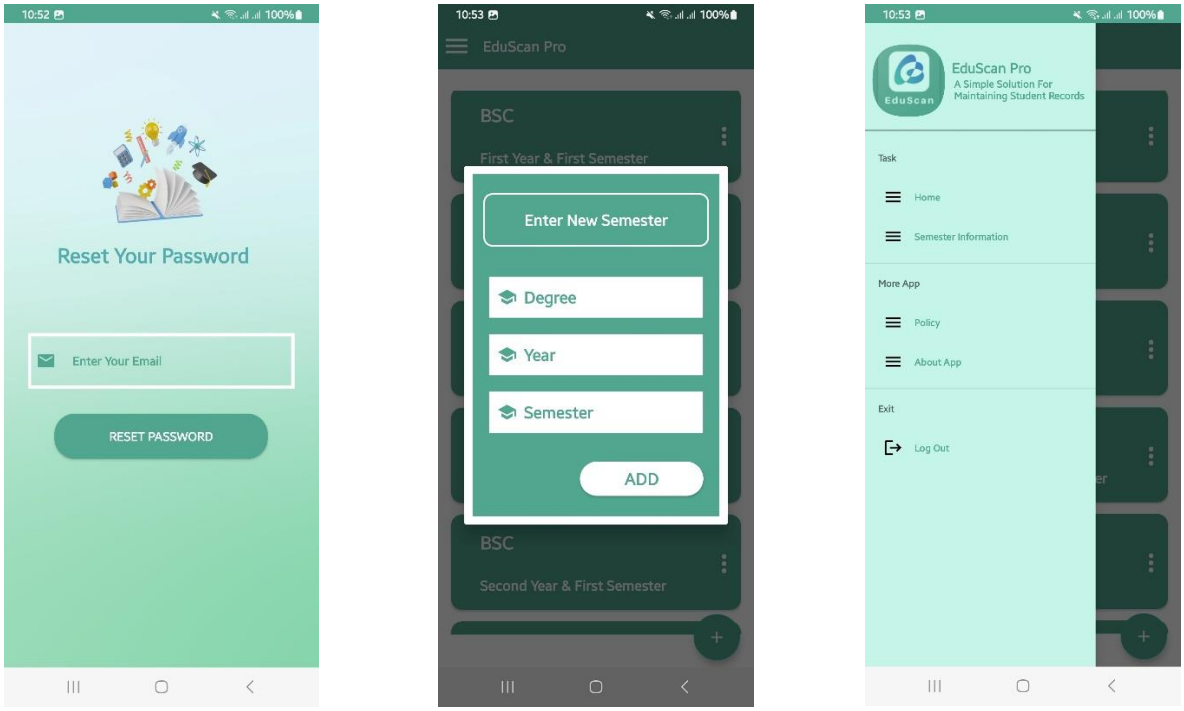
Creating a system mockup design is a crucial step in the development process, as it allows stakeholders to visualize the user interface and functionality of a system before it is built. Mockups serve as a blueprint, providing a tangible representation of the system's layout, features, and overall user experience. The mockup design of our app is given here with proper flow of xml layouts.



(a) (b) (c)

Figure 4.1: Mockup design of UI (a) Splash Screen (b) Login Page (c) Signup Page

Here, authentication has been done using firebase database system. When a new user wants to sign up, a confirmation mail will be sent to the provided valid mail. Only after the confirmation. User can login to this application. Another term is forgot password, it’s for resetting password, similar to authentication link will be sent to email.



(a) (b) (c)

(d) (e)

Figure 4.2: Mockup design of extra features layouts (a) Forgot Password Layout (b) Year Semester Layout (c) Navigation Drawer (d) Converter Layout (e) Image Capture Layout

4.2 System Implementation Process

The whole process can be categorized in different sections –

- **Model Training**

  Models have been implemented using TensorFlow. Different types of layers have been used Dense, Dropout, Activation, Flatten, Conv2D, MaxPooling2D layers for necessary training of that model. In total 1600 data images are collected for the dataset and used for training. All the images were at first gray scaled with a fixed size 50. Lastly, models were fitted with batch size=32, epochs=10 and validation split=0.3 and then saved those models. The only difference was in digit detection in using multiple classifiers rather than binary classifier like in attendance model. Attendance Model and Digit Detection Model with accuracy that have been got are given below:

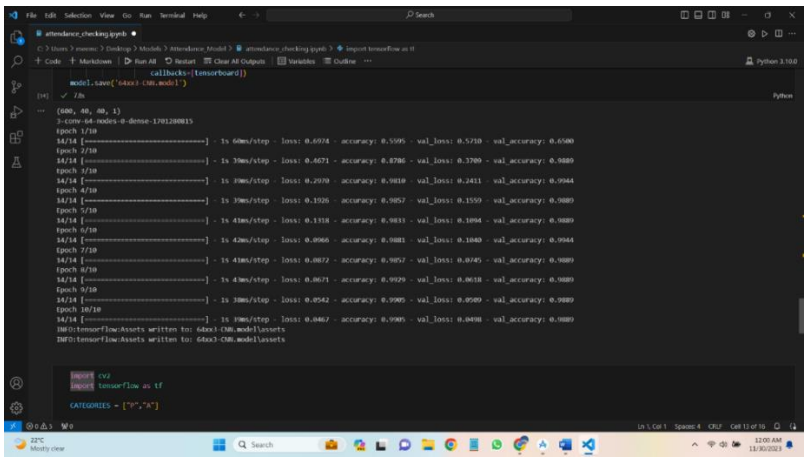


Figure 4.3: Attendance Model Accuracy

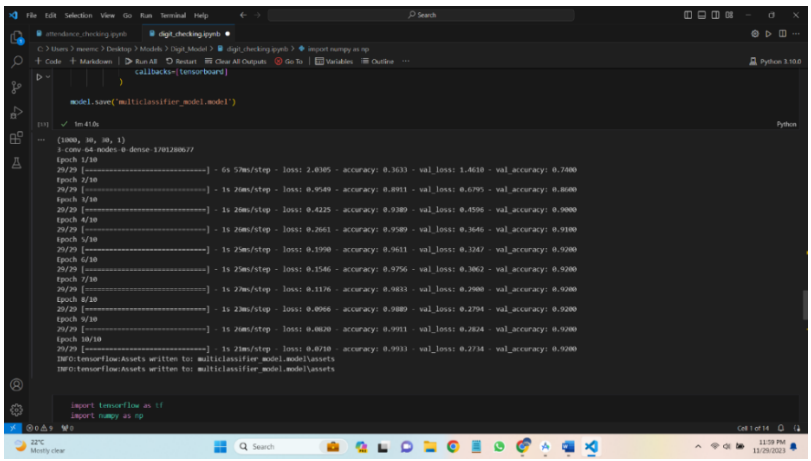


Figure 4.4: Digits Model Accuracy

- **Biggest Contour Detection and use of OCR Model**

Cropping input image as biggest contour and finding out the input document for our app that works in for PDF or WORD file. Then from that cropped image we used OCR Text recognizer v2 (Google developer) to convert the image text to written PDF and word file.

Figure 4.5: A simple image scanning

Department of Computer Science and Engineering
Khulna University of Engineering & Technology
Attendance Sheet of 3rd Year 2nd Term Term

Subject Code: Subject Name:
Session: 2021-2022 Class Starting Date: 27/08/2023

Sec - B

Sl. No.	Class Roll No.	Name
1.	1907061	Md. Rabby
2.	1907062	Mehedi Hasan
3.	1907063	Md. Kawsar Ahmed Kazol
4.	1907064	Syed Nafisur Rahman Shuvro
5.	1907065	Arnob Bhowmik
6.	1907066	Md. Safwan Zaher Asif
7.	1907067	Nusrat Jahan Jonaki
8.	1907068	Minhazur Rahman
9.	1907069	Swaraj Chandra Biswas
10.	1907070	Asifur Rahman
11.	1907071	Jobair Al Nahian
12.	1907072	Nishat Tasnim
13.	1907073	Sonjoy Roy
14.	1907074	Sajjad Hossen
15.	1907075	Pantho Haque
16.	1907076	Sumiya Islam Barsha
17.	1907077	Dhritisha Ghosh
18.	1907078	Samin Saiara
19.	1907079	Md. Sunzidul Islam
20.	1907080	Fyad Mohammed
21.	1907081	Md. Shahriyar Muqset
22.	1907082	Al-Mahamud
23.	1907083	Nushrat Tamin Meem
24.	1907084	Fahim Nazibul Haque
25.	1907085	Sagar Dutta
26.	1907086	Nakib Ahsan
27.	1907087	Anisa Walida
28.	1907088	Shovon Sharma
29.	1907089	Hasibul Hasan Hasib
30.	1907090	Israt Tasnim Esha

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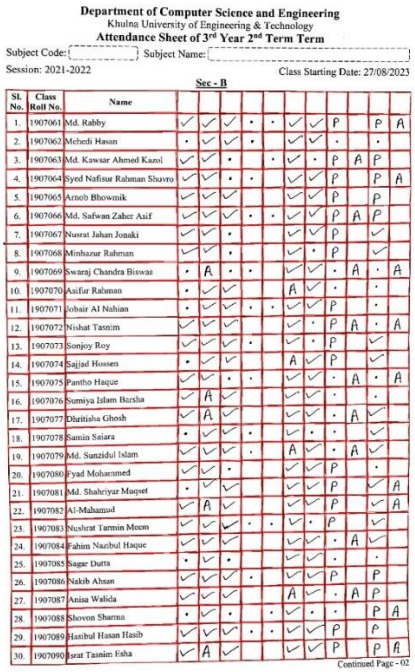
Figure 4.6: Input Image



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16.	1907076	Sumiya Islam Barsha
17.	1907077	Dhritisha Ghosh
18.	1907078	Samin Saiara
19.	1907079	Md. Sunzidul Islam
20.	1907080	Fyad Mohammed
21.	1907081	Md. Shahriyar Muqset
22.	1907082	Al-Mahamud
23.	1907083	Nushrat Tamin Meem
24.	1907084	Fahim Nazibul Haque
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Figure 4.7: Full Contour Image

- **Cropping of Input Image**

For attendance sheet, the detection of the image is found using the contours where we applied magic color at the first to increase the lightness and decrease the contrast and then found out all the box images from the grid image and cropped them. Here is the result of fetching box images from the grid image, this image is the input for AP model.

Figure 4.8: Outcome of Input Image

- **Firebase Data Handle**

After this, boxes are stored as images dataset and then sent for prediction using model. After prediction, it gives a corresponding value as “A” for absent and “P” for present. Using these values of rows sequentially stored in array are used for furthermore calculations. Moreover, it is converted to specific pdf or word file on given subject from drop down menu and stored to year-term wise section design in a card view.

4.3 Morality or Ethical Issues

System and app development, like any other field, can give rise to various ethical and moral considerations. It's important for developers and organizations to be aware of these issues and make informed decisions throughout the development process. In our project, in case of morality and ethical issues, privacy concerns have been maintained by providing authentication through email link. Even if anyone forgets password, he/she can reset it but

only using the valid email that has been provided by the user at the registration time. Users' personal information is saved to Realtime Firebase database that works as a secured storage of data. Besides these, user's personal password is handled by Google authentication. Our application upholds a commitment to user data protection by refraining from sharing any personal information with third-party entities. This non-disclosure policy not only safeguards user privacy but also adheres to ethical principles governing the responsible handling of sensitive data. The ethical considerations embedded in our digital attendance system underscore a commitment to user privacy, data security, and responsible information handling. By incorporating robust authentication mechanisms, secure database practices, and industry-standard protocols, our system seeks to set a high ethical standard within the domain of digital attendance applications.

4.4 Socio-economic impact and sustainability

The socio-economic impact and sustainability of our attendance digital system extend beyond the immediate benefits of efficient data management. The deployment of our technology holds substantial implications for various facets. The transition to a paperless digital workflow of our system directly contributes to environmental sustainability. The costless nature of our user-friendly system ensures accessibility for a wide range of users, regardless of financial constraints. The attendance digital system of our app incorporates robust data loss prevention mechanisms. Through regular backups, encryption, and secure storage practices, the system mitigates the risks associated with data loss, ensuring the reliability and integrity of attendance records. This not only preserves critical information but also minimizes potential disruptions in academic or organizational processes. The digitization of our attendance process brings about operational efficiency, reducing the time and effort traditionally invested in manual data entry and management. In an educational context, our system contributes to enhanced learning experiences. By streamlining attendance tracking, educators can allocate more time to teaching and student engagement. This positive educational impact resonates with long-term socio-economic sustainability goals by nurturing a well-educated and skilled workforce. Moreover, our attendance digital system not only addresses the immediate needs of efficient attendance management but also aligns with broader socio-economic sustainability objectives. From environmental conservation to cost-efficient accessibility and data integrity, our system is designed to make a positive and enduring impact on the socio-economic landscape it serves.

4.5 Financial analyses and budget

In conducting the financial analysis and budget assessment for our project, it's noteworthy that the utilization of open-source software has played a pivotal role in shaping a cost-effective and economically friendly application. Since the project relies on open-source tools and platforms, there are no direct costs associated with software acquisition or licensing fees. The financial analysis underscores our project's commitment to a cost-efficient and economically friendly model, where the utilization of open-source software minimizes financial burdens, making the app accessible to a broader user base and promoting sustainability in digital solutions.

5 Conclusion

The digitalization of an attendance sheet brings numerous benefits and opportunities for improvement. It's essential to carefully plan the implementation, considering the unique needs of the organization and its stakeholders, and continuously assess and adapt the system for ongoing optimization. In conclusion, our attendance digital system represents a groundbreaking solution in the landscape of attendance tracking, offering a comprehensive and user-centric approach to digitizing hardcopy records. Our app's journey from conceptualization to implementation has been marked by an unwavering commitment to innovation, environmental sustainability, and ethical considerations. By seamlessly integrating OCR models for handwritten recognition, image cropping algorithms, and versatile file conversion functionalities, our system demonstrates a keen understanding of technological complexities. Its user-centric design, characterized by an intuitive interface and ongoing responsiveness to user feedback, ensures a positive and efficient user experience. Our app's impact extends beyond the digital realm, contributing to environmental sustainability by promoting a paperless workflow and fostering cost efficiency through its accessible and costless nature. Ethical considerations, such as privacy-centric authentication and secure password recovery processes, underscore our system's commitment to safeguarding user data. Despite challenges in integration complexity and recognition accuracy, the iterative development process has resulted in a robust, adaptable, and scalable solution. Our app's potential to enhance educational and organizational efficiency aligns with broader socio-economic sustainability goals, positioning it as a transformative force in attendance management. As we navigate the future landscape of technological advancements,

our app remains a testament to our dedication to pushing the boundaries of innovation while prioritizing user needs and ethical principles.

5.1 Conclusion and Challenges Faced

While our attendance digital system offers a transformative solution for efficient data management, its development and deployment have not been without challenges. Integrating various components, such as OCR models, image cropping algorithms, and file conversion functionalities were difficult to handle that required extensive testing and iterative development for conduction to ensure seamless integration and compatibility among diverse system features. Achieving high accuracy in recognizing handwritten letters and digits posed challenges due to the variability in individual handwriting styles. Our system underwent rigorous training with diverse handwriting samples to enhance recognition accuracy. Ongoing improvements are being made based on user feedback and additional training data. Adhering to evolving data privacy regulations and ensuring that our system complies with legal and ethical standards. Regular updates to align with data protection regulations, clear communication with users about data handling practices, and ongoing legal compliance assessments are part of the resolution strategy. The overall challenges that have been faced throughout this project are –

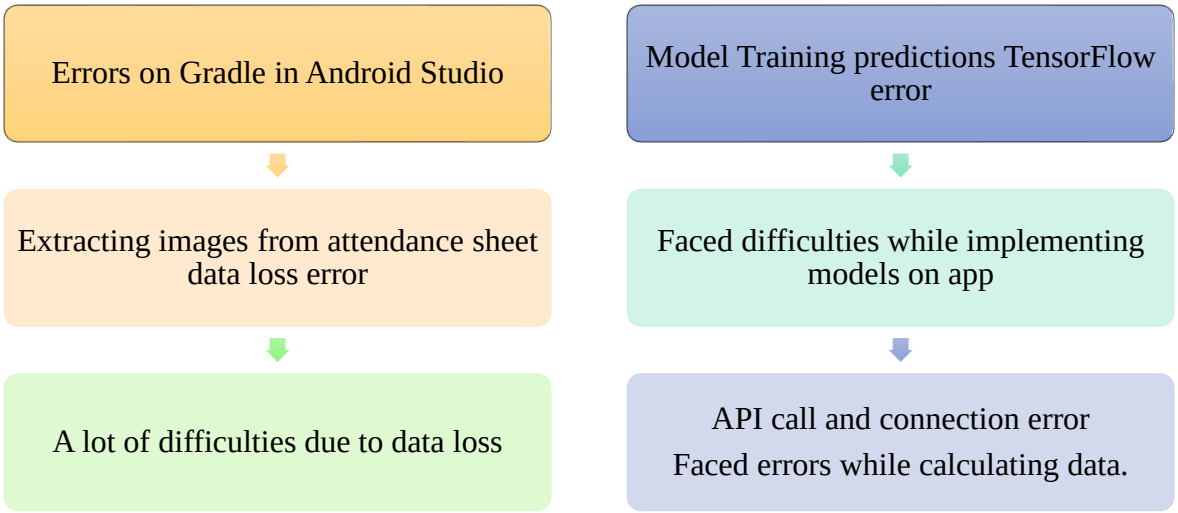

Figure 5.1: Overall Faced Challenges

Despite these challenges, the iterative nature of our development process and a commitment to addressing user feedback have been instrumental in refining the app and ensuring its continued effectiveness in meeting user needs. Ongoing monitoring and adaptation to emerging challenges remain integral to our app's success.

5.2 Future Study

In the future, parallel computing, and the optimal model for the design of the digit will be integrated. We have developed two models – one for attendance and the other for digit detection. Here, only the attendance sheet has been handled. In future –

- Digit detection model will be used.
- CT marks will be handled specially cropping of two digits.
- Handling of more data on dataset
- Plans to increase accuracy of models more.
- Reducing data loss
- Garbage Image handling

References

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