DELHI METRO RAIL CORPORATION LTD./Passenger Face Entry System for Delhi Metro

INTERNSHIP REPORT

A Journey through IT Innovations at Delhi Metro Rail Corporation

Submitted to:
Mr. Manu Bhardwaj Sir
Ms. Kavya Sharma Ma'am
(Our Mentors)

Submitted by:
Aniket Kumar
Aditya Kumar Jha
Nikhil Saxena
Achintya Gulati

ACKNOWLEDGEMENT

It is a great pleasure to present this report of Summer Internship about Delhi Metro Rail Corporation in partial fulfilment of Diploma Program under Delhi Skills & Entrepreneurship University.

At the outset, I would like to express my immense gratitude to my training guides, **Mr. Manu Bhardwaj & Ms. Kavya Sharma,** for providing me with the opportunities of studying, learning and gaining practical experience in various fields during the period of training. Her invaluable suggestions not only helped me to reach the successful completion of the tasks assigned, but also made me learn a lot. I am falling short of words for expressing my feelings of gratitude towards her for extending her valuable guidance, through critical reviews of project and the report and above all the moral support she had provided me with all stages of this training.

Aniket Kumar
Aditya Kumar Jha
Nikhil Saxena
Achintya Gulati

PREFACE

This report documents the work done during the summer internship at Delhi Metro Rail Corporation Limited, Mayur Vihar, Delhi under the guidance of **Mr. Manu Bhardwaj Sir & Ms. Kavya Sharma** Ma'am The report first shall give the overview of tasks performed during the period of training.

Report shall also elaborate about the introduction of Delhi Metro Rail Corporation Ltd. and project on the DMRC Passenger Fare System through Face Recognition.

I have tried my best to keep the report simple yet technically correct. I hope I succeed in my attempt.

One-Day Training at Delhi Metro Rail Corporation

As part of the internship program at Delhi Metro Rail Corporation (DMRC), I had the privilege of attending a comprehensive one-day training session **Shastri Park**. This training was aimed at providing interns with essential insights into the operations, technologies, and safety measures adopted by DMRC in managing one of India's largest and most efficient metro networks. The training proved to be an invaluable learning experience, further enhancing my understanding of the public transportation sector and the significance of IT projects in streamlining metro operations.

Orientation and Introduction

The training commenced with a warm welcome and orientation session conducted by senior officials from DMRC. The orientation included an overview of the organization's history, its vision for the future, and its commitment to sustainable and efficient transportation solutions. This introduction set the context for understanding DMRC's significant role in transforming urban mobility and providing world-class metro services to millions of commuters.

Metro Operations and Technology

The training delved into the core aspects of metro operations and the technologies underpinning the smooth functioning of the metro network. We were given insights into various operational departments, including station management, train operations, safety and security, and ticketing systems. Special emphasis was placed on the adoption of smart technologies, such as automatic fare collection, train control systems, and passenger information systems, which contribute to the seamless functioning of the metro.

Safety Protocols and Emergency Procedures

Ensuring the safety and well-being of passengers and metro staff is a top priority for DMRC. During the training, we received a comprehensive briefing on safety protocols, emergency procedures, and disaster management strategies. The session covered topics such as fire safety, evacuation procedures, and the importance of coordinated efforts during critical situations. This knowledge highlighted the dedication of DMRC to providing a secure and reliable metro experience for all passengers.

Maintenance and Infrastructure

Understanding the maintenance and upkeep of the vast metro infrastructure was another essential aspect of the training. We were given an overview of the rigorous maintenance schedules, routine checks, and modernization efforts undertaken by DMRC to ensure the smooth functioning of trains, tracks, and stations. The session emphasized the significance of regular maintenance in sustaining the longevity and efficiency of the metro network.

Tour of Metro Facilities

A guided tour of key metro facilities was an integral part of the training. We had the opportunity to visit a control center, a state-of-the-art metro station, and a maintenance depot. The tour provided practical insights into the day-to-day operations and the role of cutting-edge technologies in maintaining an organized and punctual metro service. It also allowed us to witness firsthand the dedication and professionalism of the DMRC team.

Interaction with DMRC Experts

Throughout the training, we had the privilege of interacting with experienced professionals from various departments of DMRC. These interactions provided a unique opportunity to seek advice, gain industry-specific knowledge, and discuss the challenges and opportunities in the realm of public transportation. The willingness of the experts to share their experiences and insights was inspiring and helped in broadening our perspective on the field of transportation management.

Conclusion of one day training at 24-06-2023

The one-day training at Delhi Metro Rail Corporation was a transformative experience. It not only deepened my understanding of the functioning and management of a complex metro network but also underscored the significance of technology-driven solutions in optimizing public transportation. The commitment to safety, efficiency, and sustainability demonstrated by DMRC has left a lasting impression on me as an intern, instilling a sense of pride and responsibility in contributing to the development of IT projects that further enhance the passenger experience.

I am grateful to the DMRC team for their hospitality, support, and mentorship during the training. The exposure gained from this training will undoubtedly prove to be valuable as I continue to contribute to the IT project for the Passenger Face Entry System. The knowledge acquired from this experience will undoubtedly shape my future endeavors in the field of transportation technology and management.

Internship at Mayur Vihar
In Information Technology Department

Introduction

During the 4–6-week internship at Mayur Vihar, I had the privilege of working in the Information Technology (IT) Department, where I was exposed to various facets of IT operations and projects within the organization. The internship provided me with valuable hands-on experience, allowing me to apply my theoretical knowledge to real-world IT challenges. This section outlines my internship experience, the projects I worked on, and the skills I acquired during my time at Mayur Vihar.

Overview of Mayur Vihar's IT Department

The IT Department at Mayur Vihar plays a pivotal role in the organization's digital transformation and IT infrastructure management. The department is responsible for designing, implementing, and maintaining various IT systems, networks, and applications to support the organization's day-to-day operations efficiently. Additionally, the department oversees cybersecurity measures, data management, and IT support services.

Projects Undertaken

During my internship, I had the opportunity to contribute to several IT projects that align with Mayur Vihar's objectives of enhancing productivity and optimizing processes. The key projects I worked on are as follows:

Passenger Face Entry System for Delhi Metro

Abstract

The Passenger Face Entry System is an innovative IT project developed for Delhi Metro Rail Corporation. The system enables seamless and contactless entry and exit for metro passengers using facial recognition technology. This report provides a comprehensive overview of the project, including its objectives, implementation, and future scope.

Introduction

He Delhi Metro Passenger Face Entry System aims to enhance passenger convenience and safety by eliminating the need for physical tickets or cards. This system enables registered passengers to enter and exit the metro stations using their faces as identification. The system also automatically deducts the fare from the passenger's metro card, making the entire process efficient and convenient.

Objectives

The primary objectives of the project are as follows:

- Develop a face recognition system to identify registered passengers.
- Create a database to store passenger information, including name, ID, metro balance, and facial data.
- Implement entry and exit gate opening mechanisms using Text-to-Speech (TTS) for voice announcements.
- Enable automatic fare deduction from the passenger's metro balance upon exit.
- Provide a user-friendly interface for passenger registration.

Technologies Used

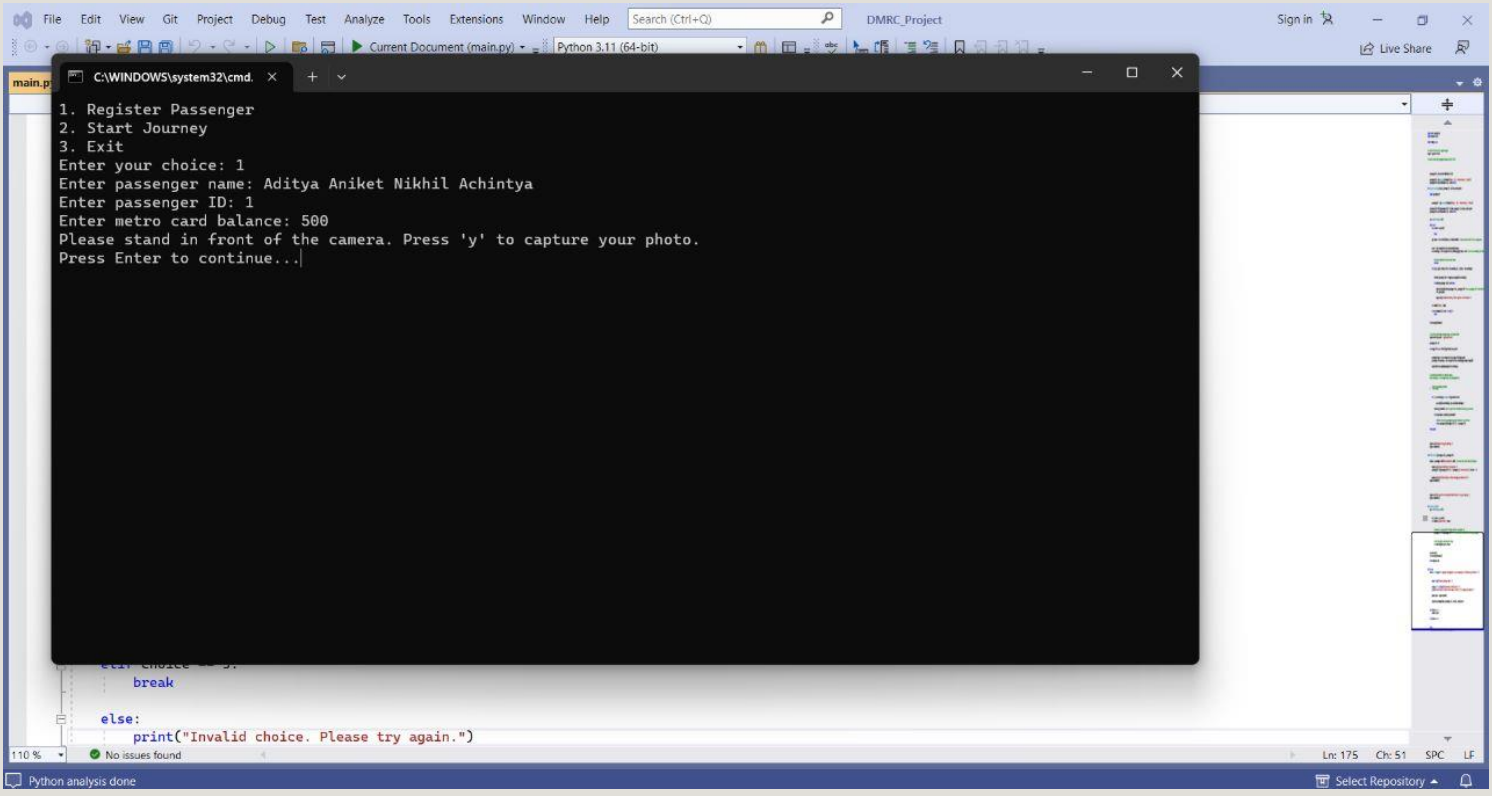
The Passenger Face Entry System utilizes the following technologies:

- Python programming language
- OpenCV for image processing and video capture
- Face recognition library for facial recognition tasks
- Pandas for handling passenger data in Excel
- Pyttsx3 for Text-to-Speech functionality

Implementation Details

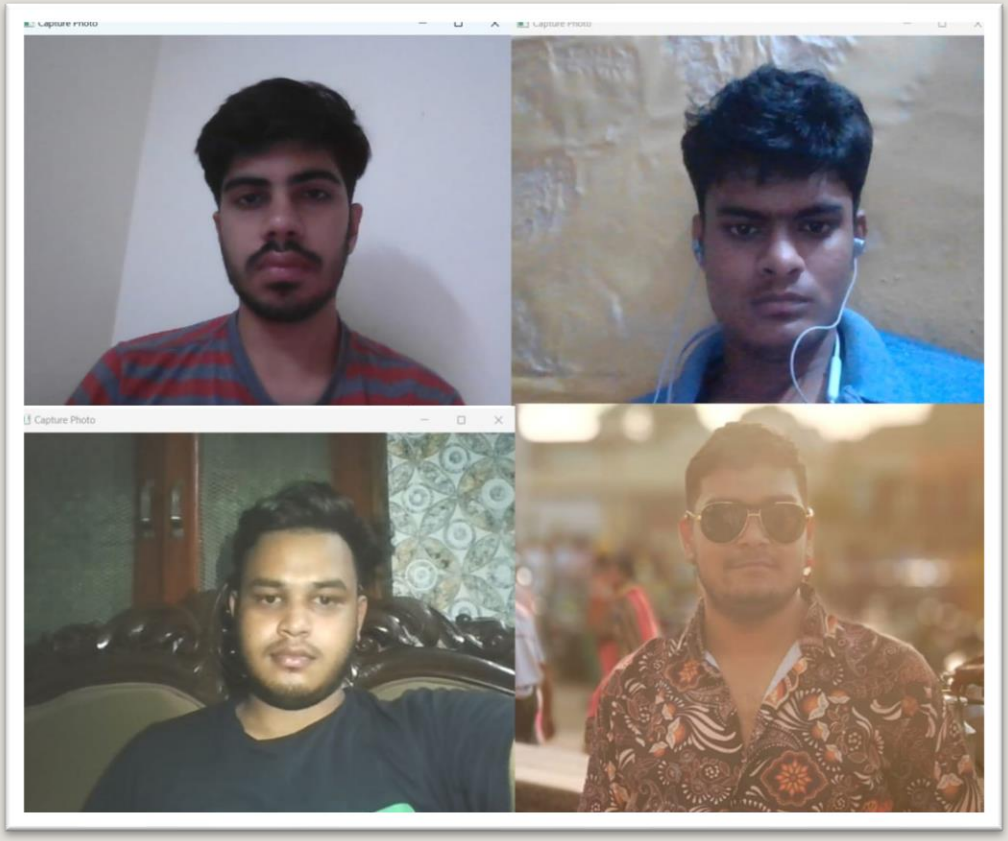
- ## Passenger Registration

The system allows passengers to register by providing their name, ID, metro card balance, and capturing a photo. The photo is then stored in the database alongside the other passenger details.



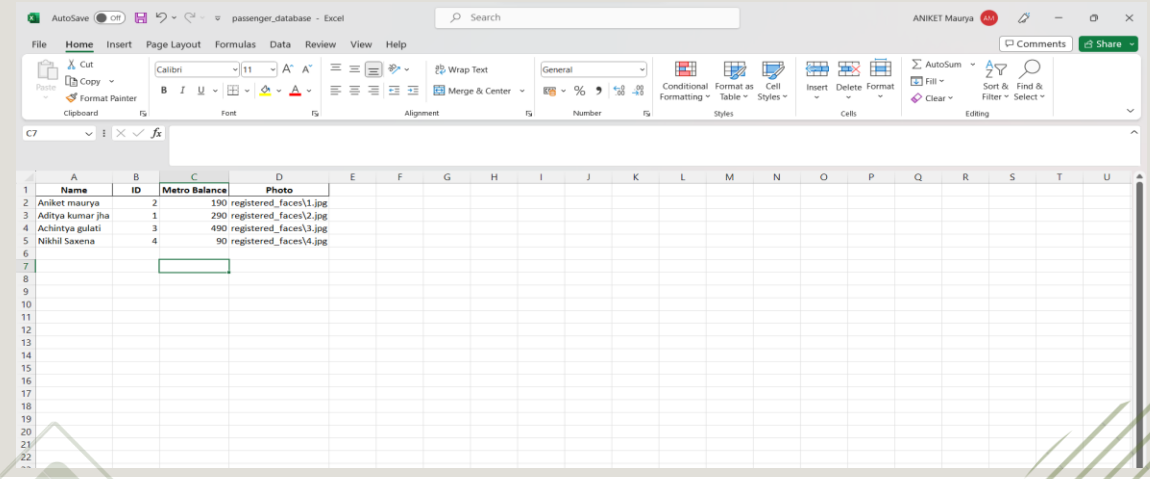
- **Face Detection and Recognition**

The system uses a webcam to capture live video frames. The face recognition library is employed to detect and recognize faces in the frames. When a registered passenger's face is recognized, the system opens the entry gate for them.



- **Automatic Fare Deduction**

Upon exit, the system deducts the fare for the journey from the passenger's metro balance. If the balance is insufficient, the passenger is prompted to recharge their metro.



• Future Scope

The project has significant potential for expansion and enhancement. Some future scope areas include:

- Introducing advanced face recognition models for improved accuracy.
- Integrating with the metro's central payment system for real-time fare deduction.
- Implementing a web or mobile application for passenger registration and balance checking.
- Enhancing security features to prevent unauthorized access.

• Conclusion

The Passenger Face Entry System is a successful IT project that brings modern and secure entry solutions to Delhi Metro Rail Corporation. The implementation of facial recognition technology has improved the passenger experience and reduced entry time. With further improvements and advancements, this system can serve as a model for other public transportation systems as well.

• Acknowledgments

We would like to express our gratitude to Delhi Metro Rail Corporation for providing us with the opportunity to work on this project. Special thanks to our mentors and supervisors for their guidance and support throughout the project.

• References

➢ face train Haar cascade file from GitHub.
➢ Book of Woodrow W. Bledsoe.
➢ python 3.11.4.

Mentorship on SAP and Networking at Delhi Metro Rail Corporation (DMRC)

During my 4–6-week internship at Delhi Metro Rail Corporation (DMRC), I had the privilege of receiving mentorship from experienced professionals in the Information Technology (IT) Department. One of the most valuable aspects of my internship was the guidance and knowledge shared by my mentors on two essential topics: SAP (Systems, Applications, and Products) and Networking.

SAP Training and Implementation

SAP is a widely used enterprise resource planning (ERP) software that integrates various business processes and functions within an organization. Under the mentorship of DMRC's IT experts, I had the opportunity to learn about SAP's capabilities and its significance in managing DMRC's complex operations efficiently.

Understanding DMRC's SAP Implementation

My mentors provided a comprehensive overview of DMRC's SAP implementation, emphasizing how the software streamlines various processes, such as procurement, finance, human resources, and maintenance. I gained insights into how SAP enables data-driven decision-making, improves transparency, and optimizes resource allocation.

Networking Fundamentals

As part of my internship, I also received mentorship on networking fundamentals, a critical aspect of modern IT infrastructure management.

Overview of DMRC's Network Infrastructure

My mentors introduced me to DMRC's extensive network infrastructure, including data centers, switches, routers, and wireless access points. Understanding the architecture and design of the network allowed me to appreciate its role in facilitating seamless communication and data transfer across various metro stations and facilities.

Network Troubleshooting and Maintenance

Throughout the internship, I had the opportunity to participate in network troubleshooting activities. My mentors taught me how to identify and resolve common networking issues, such as connectivity problems, IP address conflicts, and bandwidth management. Additionally, I gained insights into network maintenance practices to ensure the stability and security of the infrastructure.

Conclusion

The 4–6-week internship at Mayur Vihar's Information Technology Department was an enriching experience that significantly contributed to my professional development. The hands-on projects, exposure to diverse IT operations, and interactions with experienced professionals broadened my understanding of the IT industry and its role in organizational efficiency. I am grateful for the opportunity and support extended by Mayur Vihar, which has further ignited my passion for pursuing a career in the IT.

CODE OF THE PROJECT

```
import cv2
import face_recognition
import pandas as pd
import pyttsx3
import numpy as np
import os

# Initialize the Text-to-Speech engine
engine = pyttsx3.init()

# Load or create the passenger database (Excel file)
DATABASE_FILE = r"passenger_database.xlsx"


try:
    passenger_df = pd.read_excel(DATABASE_FILE)
except FileNotFoundError:
    passenger_df = pd.DataFrame(columns=["Name", "ID", "Metro Balance", "Photo"])
    passenger_df.to_excel(DATABASE_FILE, index=False)

def register_passenger(name, passenger_id, balance, photo_path):
    # Check if the DataFrame has columns, if not, create them
    global passenger_df

    if passenger_df.empty:
        passenger_df = pd.DataFrame(columns=["Name", "ID", "Metro Balance", "Photo"])

    passenger_df.loc[len(passenger_df)] = [name, passenger_id, balance, photo_path]
    passenger_df.to_excel(DATABASE_FILE, index=False)

def detect_face():
    cap = cv2.VideoCapture(0)

    while True:
        ret, frame = cap.read()
        if not ret:
            break

        rgb_frame = cv2.cvtColor(frame, cv2.COLOR_BGR2RGB)  # Convert BGR to RGB for
face_recognition

        # Detect faces using the face_recognition library
        faces = face_recognition.face_locations(rgb_frame)
        face_encodings = face_recognition.face_encodings(rgb_frame, faces)  # Get face encodings
for detected faces

        if not face_encodings:
            # No faces detected in the current frame
            continue

        for (top, right, bottom, left), face_encoding in zip(faces, face_encodings):
            cv2.rectangle(frame, (left, top), (right, bottom), (255, 0, 0), 2)

            detected_passenger_info = recognize_passenger(face_encoding)

            if detected_passenger_info is not None:
                entry_gate_open()
                deduct_balance(detected_passenger_info, passenger_df)  # Pass passenger_df to the
function
                exit_gate_open()
            else:
                engine.say("Unauthorized entry. Please register at the counter.")
                engine.runAndWait()

        cv2.imshow("Video", frame)
```

```
        if cv2.runAndWait(1) & 0xFF == ord('q'):
            break

    cap.release()
    cv2.destroyAllWindows()


def recognize_passenger(face_encodings):
    # Load the registered passenger images and encode them
    registered_faces_path = "registered_faces/"
    registered_faces = []
    passenger_ids = []

    for image_file in os.listdir(registered_faces_path):
        passenger_id = int(image_file.split(".")[0])
        image_path = os.path.join(registered_faces_path, image_file)
        passenger_image = face_recognition.load_image_file(image_path)
        passenger_face_encoding = face_recognition.face_encodings(passenger_image)[0]


 registered_faces.append(passenger_face_encoding)
        passenger_ids.append(passenger_id)

    # Encode the detected face from the camera
    #face_encodings = face_recognition.face_encodings(face)

    #if not face_encodings:
        # No face encodings detected
    #    return None

    for face_encoding in face_encodings:
        for i, face_encoding in enumerate(registered_faces):
            face_distance = face_recognition.face_distance(
                np.array([face_encoding]), np.array(face_encodings)
            )
            similarity_threshold = 0.4  # Adjust this threshold based on your dataset

            if face_distance < similarity_threshold:
                passenger_id = passenger_ids[i]
                # Return the entire passenger DataFrame instead of just the ID
                return passenger_df[passenger_df["ID"] == passenger_id]

    return None



def entry_gate_open():
    engine.say("Welcome! Entry gate opening.")
    engine.runAndWait()


def deduct_balance(passenger_info, passenger_df):
    passenger_id = passenger_info["ID"].item()  # Extract the scalar value of passenger ID
    balance = passenger_info["Metro Balance"].item()  # Extract the scalar value of balance
    if balance >= 10:
        engine.say("Balance deducted for the journey.")
        passenger_df.loc[passenger_df["ID"] == passenger_id, "Metro Balance"] = balance - 10
        passenger_df.to_excel(DATABASE_FILE, index=False)
    else:
        engine.say("Insufficient balance. Please recharge your metro card.")
    engine.runAndWait()



def exit_gate_open():
    engine.say("Thank you for traveling with Delhi Metro. Exit gate opening.")
    engine.runAndWait()
```

```
def capture_photo():
    cap = cv2.VideoCapture(0)

    while True:
        ret, frame = cap.read()
        cv2.imshow("Capture Photo", frame)

        if cv2.waitKey(1) & 0xFF == ord('y'):
            # Generate a unique photo filename based on passenger ID
            passenger_id = len(passenger_df) + 1  # Use the next available ID for new passenger
            photo_path = f"registered_faces\{passenger_id}.jpg"

            # Save the photo and break the loop
            cv2.imwrite(photo_path, frame)
            break

    cap.release()
    cv2.destroyAllWindows()

    return photo_path


while True:
    choice = int(input("1. Register Passenger\n2. Start Journey\n3. Exit\nEnter your choice: "))

    if choice == 1:
        name = input("Enter passenger name: ")
        passenger_id = int(input("Enter passenger ID: "))
        balance = float(input("Enter metro card balance: "))
        print("Please stand in front of the camera. Press 'y' to capture your photo.")
        input("Press Enter to continue...")
        photo_path = capture_photo()

        register_passenger(name, passenger_id, balance, photo_path)
        print("Passenger registered successfully.")

    elif choice == 2:
        detect_face()

    elif choice == 3:
        break

    else:
        print("Invalid choice. Please try again.")
```

THANK YOU