Project Proposal

Automated Train Platform Safety and Tracking System

Skill Development Project III – ICT3206
Bachelor of Information and Communication Technology (BICT) Degree Program

Department of Information and Communication Technology
Faculty of Technology

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Details of the Project

Project Title: Automated Train platform safety and Tracking System

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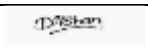
H.M.D.M Hearth	1661	ITT/2021/039	
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1. Introduction

Urban transportation options such as buses and trains are growing quickly these days among public people, and as a result, the public is in greater need of effective, secure, and easily accessible public transportation. An innovative way to deal with these issues is the Automated Train Accident Prevention and Tracking System, which improves passenger safety, save peoples time, and enhances the whole train travel experience.

This project is important Because train accidents and inefficiencies in railway operations create major threats to human lives and destroy their valuable time. The need for a more automated and accurate system is illustrated by many issues including accidents at railroad crossings and on train station platforms caused by hurried people, as well as ineffective train movement tracking that wastes time for passengers.

The suggested solution takes a variety of approaches to resolving these issues,

1. Allowing access only after trains have completely entered or stopped in order to ensure platform safety.

2. Automating railway crossing gates can help prevent accidents at railway crossings.

3. For the convenience of passengers, real-time GPS-based train monitoring and ETA are provided.

4. Using QR code-based access control for first- and second-class reservations to improve security when boarding trains.

This project not only solves important safety issues but also makes use of modern technology to provide a more efficient and reliable rail transportation experience by integrating automation, real-time tracking, secure train access, and security during train boarding.

2. Problem Statement

While being important for transportation, railway systems oftenly face often difficulties that risk passenger satisfaction, safety, and efficiency. These are the principal problem statements.

- Many train platforms are missing of safety features that would stop people from falling to the train track while they are waiting for the train. Passengers may be at risk for accidents as a result of passing trains and trains arriving at the station.

- Because road traffic control is either absent or delayed, collisions at railway crossings continue to be a huge problem. Accidents are frequently result from manual systems' inability to effectively stop vehicles in time.

- Train schedules, current locations, and estimated times of arrival (ETA) are often unclear to passengers. This causes disappointment and frustration, especially when there are delays.

- Unauthorized passengers entering reserved cabins like 1st class and 2nd class reservations is one safety issue associated with traditional boarding operations, and current systems do not provide automated, individualized access control to confirm that passengers are who they claim to be.

- In our system we are also working on lowering the accidents happen because of the rushes of passengers that are waiting for get into the trains.

3. Aim and Objectives

To develop an automated train accident prevention and tracking system aimed at improving safety, efficiency, passenger convenience by integrating platform gates, railway crossing gate automation, GPS tracking and computation of Estimated Time of Arrival or ETA, and QR code-based boarding access.

Enhancing railway transportation systems' safety, effectiveness, and dependability through automation and technology is the primary objective of this project. The additional objectives for the project are as below,

1. To develop a platform gate that will open when the train enters the station and stops completely or moves extremely slowly.

2. To build an automated railway crossing gate control system that will ensure smooth train travel and stop accidents from collision with vehicles.

3. A GPS tracking system that gives passengers real-time train location through a website
.

4. To develop an Estimated Time of Arrival or ETA System that will show ETA for the passengers through a website.

5. To develop a QR code-based door entry system for secure and fast train boarding.

4. Scope of the Project

By combining automation and technology, the Automated Train Accident Prevention and Tracking System aims to increase passenger convenience and railway safety. The project's scope is as below,

Our project includes,

1. Development of an automated train platform gate system that makes sure gates only open when a train stops at the station, entered completely, or is traveling very slowly in the train station platform area.

2. The traditional railway cross gates will be upgraded to automated ones, which will automatically close when a train approaches, protecting drivers and avoiding collisions.

3. train tracking in real time, giving passengers accurate location information and an estimated time of arrival (ETA) through a website.

4. Including a secure boarding system that allows users to access train doors of 1st class and 2nd class reservations by scanning a QR code they were given while making a reservation.

Our project excludes,

1. Integration with train counter ticketing systems in addition to the QR code boarding feature for passengers with first- and second-class reservations.

2. When a delay occurs, the website will display the reason behind it and also the time it takes to come to the train station.

3. Integrating the QR code door opening system to all classes because it will not be practical and also it will cause huge amount of traffics when boarding to the train.

Constraints and Limitations are,

1. Only first and second-class reservations are available for the automated door opening system. It is only integrated with the doors within the train cabin which means it will not integrate to outside doors of the train cabins.

2. Limited to use mobile networks like dialog, mobitel to communicate with the database and unable to use more secured and highly accurate communication methods like satellite technologies in GPS tracking system.

3. We have limited resources, such as GSM and QR scanning modules, for the low performance modules due to budget constraints.

4. Limit access to train tickets for mobile devices only. No actual tickets will be distributed.

5. Preliminary Literature Review

- ISP Data connection of train tracks

Dialog is the greatest Internet service provider (ISP) for the GSM module and Sri Lankan railway system because it offers the widest mobile network coverage throughout the country, particularly in rural and isolated locations. This makes Dialog perfect for railway crossings and

Figure 2 Dialog Coverage of Sri Lanka

train routes and compare to other networks as nperf website showing Dialog connection only will drop in Gampola to Hatton area. As shown in the figure 4 the coverage of dialog services is very low so for this part, we have to use some kind of satellite or other technologies like LoRa which is a data transmission service. [2]

Figure 1 Airtel Coverage of Sri Lanka

Figure 3 Hutch Coverage of Sri Lanka

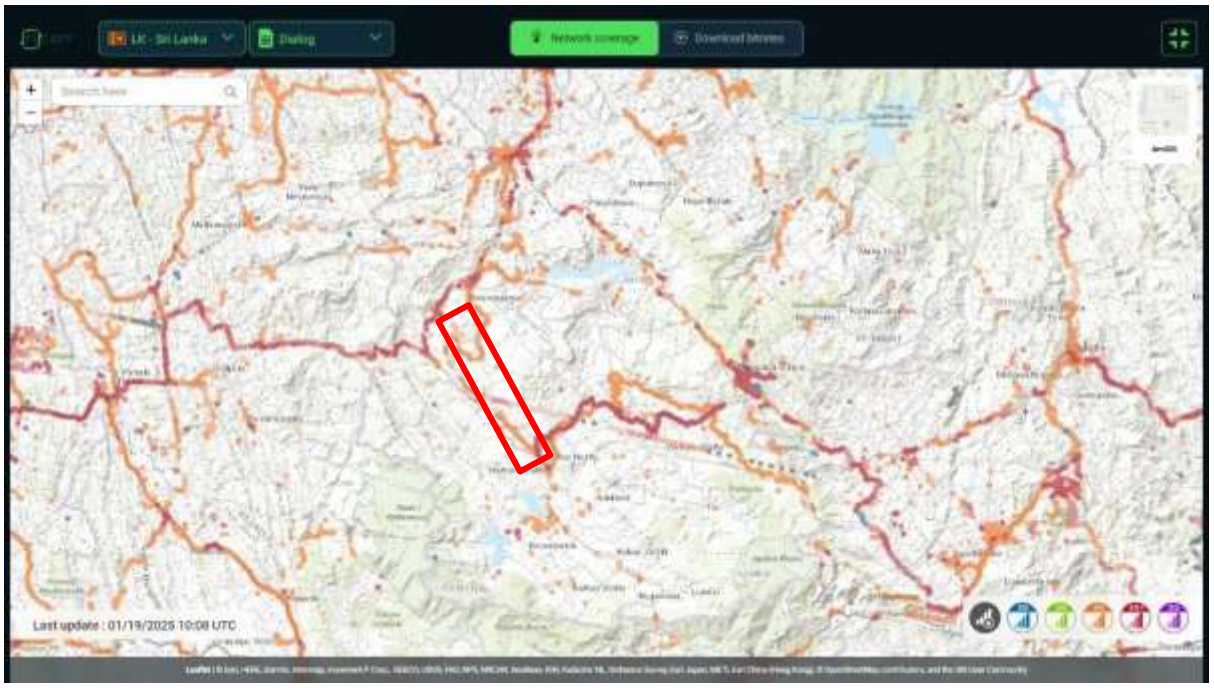


Figure 4 Gampola to Hatton Dialog network coverage issue

- GPS Smart locking system

In the International Research Journal of Innovations in Engineering and Technology (IRJIET), a study named "GPS Smart Location Tracking Mobile Application for Train Transportation" was released. This work introduces an advanced train tracking system that combines passenger behavior analysis, predictive maintenance, image processing for signal light detection, real-time GPS tracking, and dynamic ETA predictions. The system increases the effectiveness, dependability, and safety of train travel in Sri Lanka by utilizing IoT sensors, machine learning, and mobile applications. [3]

6. Methodology

The Waterfall Model, a sequential software development method with defined phases, was selected due to its structured, systematic approach, which is perfect for our clearly stated project needs. Its methodical approach ensures that every stage is finished in an organized way, lowering complexity and ensuring that the system fulfills all functional and safety requirements. Below is how we are going to implement the waterfall module to our system.

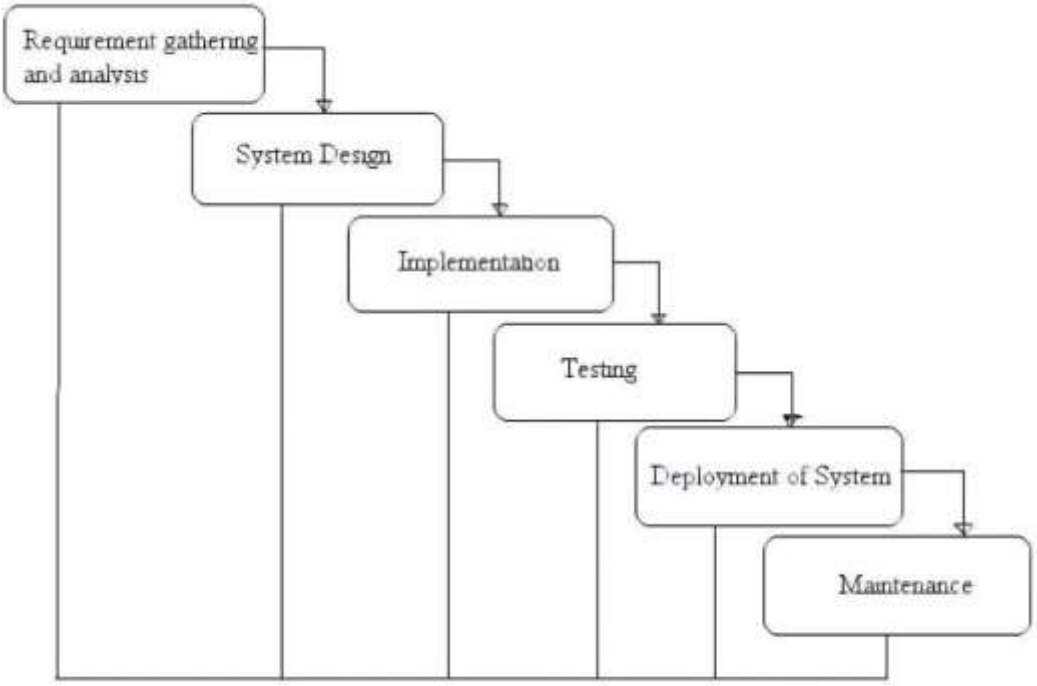


Figure 3 Waterfall Model

6.1 Requirement gathering and analysis

The process of requirement analysis involves identifying and documenting the goals that the project has to achieve. It ensures the system satisfies all important goals.

6.1.1 Defining System Functionalities

- Platform gate implement and automatically opening systems.
- Automated railway crossing gate opening and closing mechanism.
- GPS tracking and ETA system.
- QR code integrated boarding system.

6.1.2 Gathering Sensor Requirements

1. ESP 32 Dev Kit - Commonly used for automation, smart systems, and Internet of Things projects, the ESP32 is an effective, low-cost microcontroller with built-in Wi-Fi and Bluetooth. That we are using to send data to firebase and website for tracking process.

Figure 4 Esp 32 Dev Kit

2. GPS Module (NEO-6M) - A common GPS module for tracking, navigation, and location-based Internet of Things applications is the NEO-6M, which offers accurate location and timing data that is going to use for GPS tracking system of our system.

Figure 5 NEO-6M module

3. GSM Module (SIM 900A) - A GSM module is a communication device that allows devices to send SMS, make calls, and access mobile networks. We use this module to send GPS data to the firebase.

Figure 6 SIM 900A Module

4. Servo Motors - Robotics, automation, and applications involving accurate movement frequently use servo motors, which are efficient rotary actuators for controlling angular position. We are using these motors in platform gate opening system and also in the railway crossroad gates opening system.

Figure 7 Servo Motor

5. QR scanner module (GM 805) - A barcode and QR code scanning module called the GM-805 makes it possible to read barcodes and QR codes quickly and accurately. We are using this module in QR based boarding system and to scan the QR code ticket.

Figure 8 GM 805 Module

This phase includes Identify the financial, plan, and technological limitations as specified in the project's scope and also involves creating a thorough Software Requirements Specification (SRS) document.

6.2 System Design

The planning of the system's architecture, components, and connections is known as system design. It involves creating complex designs which serve as a development blueprint for both specific modules and the high-level system structure.

- Design the platform gate mechanism using control logic and sensors. In this section, servo motors will open the gates by pulling it to the ground. The servo motors will begin operating when the train is detected by ultrasonic sensors and the GPS shows the train stops moving on the website.

- Design how railway crossroad gates will open in response to an oncoming train. Here, we've designed the system such that the gates will close after a certain amount of time when the ultrasonic sensor detects the train. We choose time-based detection since a gate can open and close even if a bird flies past it if there is simply ultrasonic sensor detection.

- In order to transmit the data to the firebase through the ESP 32 module, the GPS tracking system will be built using GPS modules for tracking and GSM modules for establishing an internet connection.

- The first-class and second-class reservation doors will automatically open when the QR code scanning module scans them as part of the QR-based boarding system and this system will only implement in the doors inside the cabins.

6.3 Implementation and Testing

The Waterfall model's implementation phase involves writing code for each module and developing the system according to the design. Testing comes next, which makes sure the system functions as planned by identifying and fixing any errors or problems.

- Use IOT technology for exact ESP32 to control GPS data transmission, platform and railway crossroad gates opening and closing automatically and also QR based boarding system.

- Develop the database and web interface to control QR codes and GPS tracking. Here, Firebase will be used as our database, and the web interface will be developed using HTML, CSS, and JavaScript.

- Use the QR code scanning technology to gain access to train doors. Here, Python will be used to code the QR generating part, the Arduino IDE will be used to code the IOT part, and Firebase will be used for the database as normal.

- Complete the unit testing and assemble and test hardware parts such as sensors, motors, and communication modules separately.

- Verify that platform gates are operating correctly based on train detection. Check that railway crossing gates are activated and deactivated on time. Check the accuracy of the ETA estimates and GPS monitoring. Verify the QR code system's security and only correct QR codes have door access.

6.4 Deployment of the system

Deployment is the stage in the Waterfall model where the finished system is delivered, set up, and made usable by end users. We are just developing a prototype for our project. If we consider the actual deployment for a real train station,

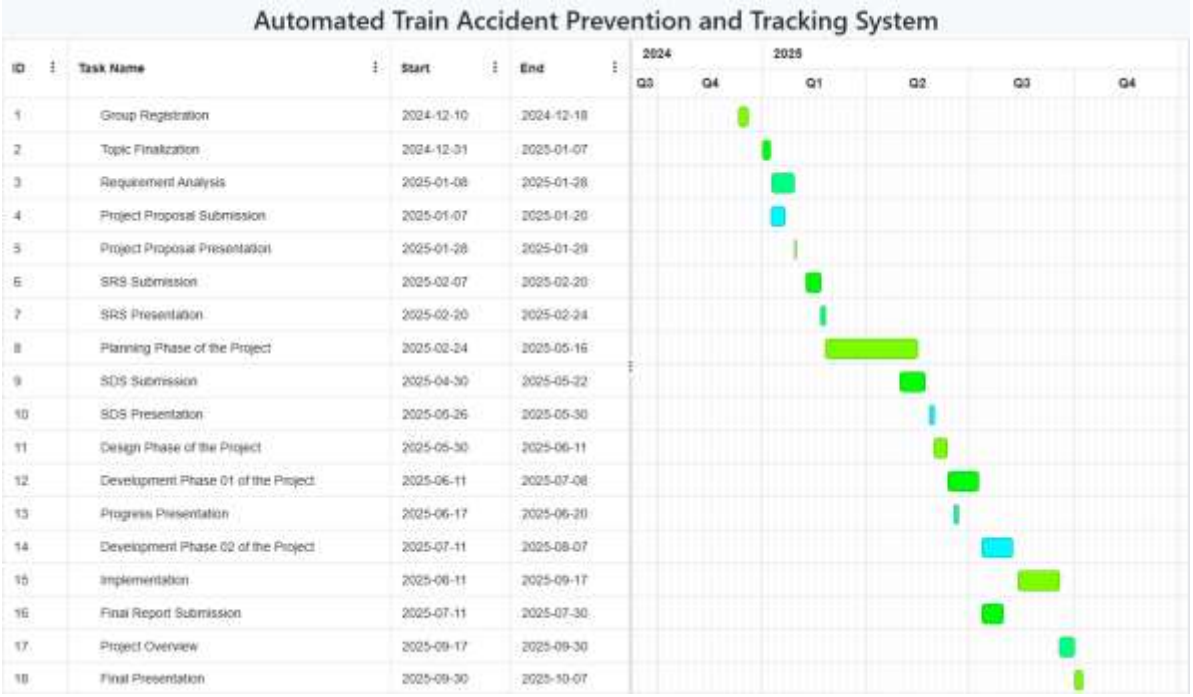
Install the platform gate system at train stations. Deploy railway crossing barriers and integrate them with sensors and train detection mechanisms. Launch the GPS tracking web application for passenger use. Implement the QR code boarding system on designated train routes. Provide training to railway staff and educate passengers on the new systems.

This system's deployment type is phased deployment, which involves setting the system in place gradually over time. This method reduces risks and ensures smooth operation by enabling the independent testing and optimization of each feature as platform gates, railway crossroad gates, GPS tracking, and QR code boarding. It is appropriate since it minimizes the effects of possible problems and facilitates slow adaptation for both passengers and railroad employees.

Deployment phases according to phase deployment
Phase 1: Involves installing platform gates at specific stations.
Phase 2: Railway barriers in locations with heavy traffic.
Phase 3: GPS tracking along a designated path.
Phase 4: Some trains will allow QR code boarding.

7. Project Work Plan

Table 1 Gantt Chart of the Project



8. Conclusion

By utilizing modern technologies including automation, GPS tracking, and QR code-based reading, the Automated Train Accident Prevention and Tracking System aims to improve railway safety, efficiency, and passenger convenience. In addition to guaranteeing a safer travel experience, this system makes use of modern technology to increase operational efficiency by solving major issues including platform safety, railway crossing accidents, and real-time train tracking. It is a secure and adaptable solution for the future of railway transport because of its phased deployment, which ensures smooth integration and adaptation for both passengers and railway employees.

9. References

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