TRAIN TRACKING AND DETECTION SYSTEM

TMP-23-302

Project Proposal Report

Wijewardene L.L

B.Sc. (Hons) Degree in Information Technology
(Specializing in Information Technology)

Department of Information Technology

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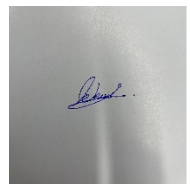
DECLARATION

I Wijewardene L.L IT20101824, declare that the research project report is my original work, and it has not been submitted in whole or in part for any other degree or qualification. Any ideas, data, or information obtained from other sources have been fully acknowledged by means of a citation or reference. I have followed the guidelines for academic writing and referencing provided by my university, and the project conforms to the required standard.

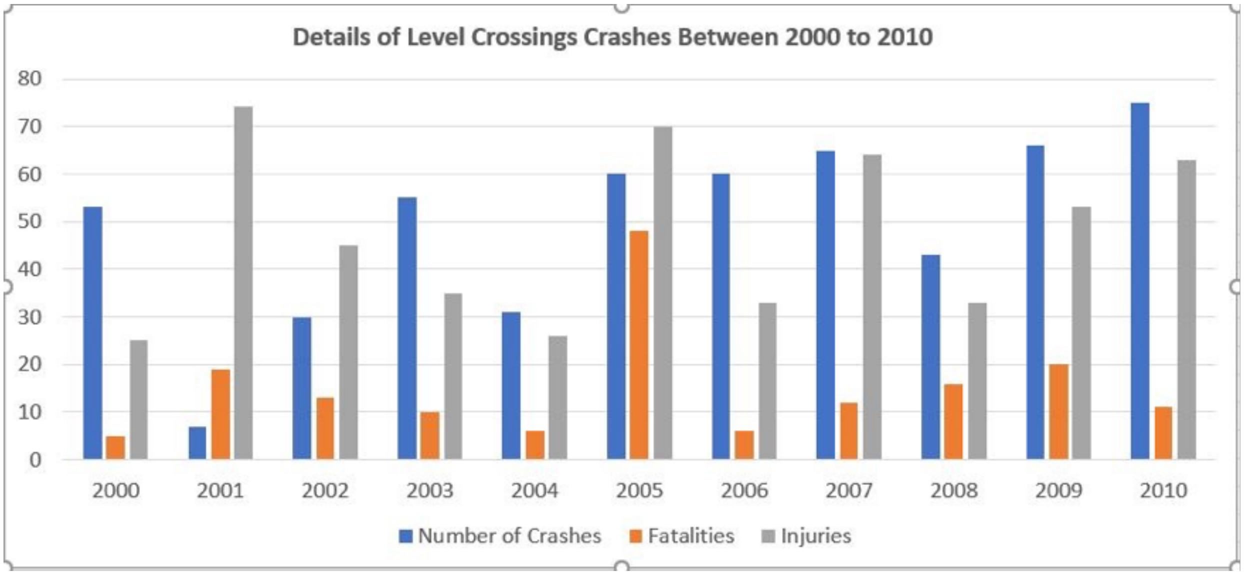
Name	Student ID	Signature
Wijewardene L. L	IT20101824	

The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor: Date: 05/05/2023

ABSTRACT

Railway crossing accidents are a significant safety concern in Sri Lanka. Many of these accidents are caused by drivers, pedestrians, and cyclists attempting to cross railway tracks when trains are approaching or crossing the tracks. According to statistics from the Sri Lanka Railways Department, there were 267 railway crossing accidents in 2010/2016/2019, resulting in 87 deaths and 93 injuries as shown in the below figures.



[3]

Figure 1: Number of Deaths Table

One major contributing factor to these accidents is the lack of proper safety infrastructure at railway crossings, such as barriers, warning lights, and audible warnings. Additionally, some drivers and pedestrians may not be fully aware of the risks associated with crossing railway tracks, or may not understand how to safely navigate railway crossings.

Another contributing factor is the high density of railway crossings in some areas, particularly in urban and suburban areas. This can make it difficult for drivers and pedestrians to avoid railway crossings altogether, Pedestrians and cyclists are also at risk of railway crossing accidents in Sri Lanka. In some cases, pedestrians and cyclists attempt to cross railway tracks when trains are approaching or crossing, leading to collisions and injuries. In other cases, individuals may accidentally fall onto the tracks while attempting to cross, leading to serious or fatal injuries. Especially, when there are limited alternative routes available.

Railway crossing accidents in Sri Lanka can take various forms and involve different types of vehicles and individuals. For example, some accidents involve motor vehicles, such as cars, buses, and trucks, colliding with trains at railway crossings. These accidents can be caused by factors such as driver error, lack of visibility, or failure of safety infrastructure.

One example of a railway crossing accident in Sri Lanka occurred in 2019, when a bus carrying schoolchildren collided with a train at a railway crossing in Polgahawela. The accident resulted in the deaths of six children and the bus driver and injured over 30 other passengers. An investigation into the accident found that the bus driver had ignored warning signals and attempted to cross the railway tracks despite the approaching train.

 [1]

Figure 2: Polgahawela Incident

Efforts are being made to address the issue of railway crossing accidents in Sri Lanka. This includes the installation of more safety infrastructure, such as barriers and warning lights, as well as public awareness campaigns to educate drivers and pedestrians about the risks of railway crossings. However, more research is needed to identify the underlying causes of railway crossing accidents in Sri Lanka and to develop more effective solutions to prevent them.

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LIST OF ABBREVIATIONS

Abbreviation	Description
IT	Information Technology
IOT	Internet Of Things
GPS	Global Positioning System
SMS	Short Message Service
UI	User Interface

1. INTRODUCTION

The proposal for a Train Detection & Alert System aims to address the challenges and safety concerns faced by citizens who cross railway crossings in Sri Lanka. With no proper solution in place to address railway crossing collisions, this project seeks to utilize advanced technologies to prevent accidents and ensure passenger safety. The proposed system consists of multiple components that work together to detect potential safety hazards and prevent accidents from occurring. These components include real-time tracking of trains and vehicles near the railway crossing, an alert system to notify vehicles approaching the railway crossing, and an alert system to notify all users who are near the railway crossing. In addition, the system incorporates IoT devices, GPS tracking, machine learning algorithms, security technologies, and real-time databases to provide real-time train location details and maintain system performance. The use of these advanced technologies helps to improve the overall efficiency and safety of railway crossings in Sri Lanka. The proposed Train Detection & Alert System also benefits train authorities who can monitor railway crossing collisions and take relevant actions to reduce them. By providing a user-friendly interface, the system can be easily accessed by a wide range of users, enhancing the overall passenger experience.

Railway crossings in Sri Lanka pose a significant safety risk to citizens. With over 500 reported railway crossing collisions and nearly 100 fatalities annually, a solution is needed to address this problem. The proposed Train Detection & Alert System seeks to reduce these numbers by utilizing advanced technologies that can detect potential safety hazards and prevent accidents from occurring. One of the key components of the proposed system is real-time tracking of trains and vehicles near railway crossings. This technology can provide real-time information to drivers approaching the railway crossing, notifying them of the presence of a train and reducing the likelihood of an accident occurring. This component is crucial in improving the safety of railway crossings in Sri Lanka. The alert system is another key component of the proposed system. It can alert all users who are near the railway crossing, notifying them of the potential danger and encouraging them to take necessary precautions. Additionally, the system can send alerts to vehicles approaching the railway crossing, notifying them to stop and wait for the train to pass. The proposed system also incorporates IoT devices, GPS tracking, machine learning algorithms, security technologies, and real-time databases. These technologies can provide real-time train location details and maintain system performance, ensuring that the system is accurate and reliable. Train authorities can also benefit from the proposed system. By monitoring railway crossing collisions, they can take relevant actions to reduce them, such as improving infrastructure and conducting awareness campaigns. The system can provide valuable data and insights that can inform these decisions and help to improve the overall safety and efficiency of railway crossings in Sri Lanka.

In addition to that my component is to be sending flooded messages from an IoT device to SIM users who are within a 1.5km radius. This means that when there is an emergency or critical situation, the IoT device will send a high volume of messages to nearby SIM users, alerting them of the situation and providing relevant information. An IoT device is a device that is connected to the internet and can collect and transmit data. In this scenario, the IoT device is being used to send messages to nearby SIM users. SIM, or subscriber identity module, is a smart card that is used to store the subscriber's information, including their phone number and network authentication data. When there is an emergency or critical situation, the IoT device will detect the situation and start sending messages to nearby SIM users. The messages will be sent in a flooded manner, which means that a high volume of messages will be sent to ensure that all nearby SIM users receive the message. The flooded messages will contain relevant information about the situation, such as the location of the emergency, the severity of the situation, and any instructions or actions that need to be taken. The range of the messages is limited to a 1.5km radius, which means that only SIM users who are within this range will receive the messages. This is an important aspect of the scenario as it ensures that the messages are targeted to those who are closest to the emergency or critical situation. This reduces the risk of unnecessary panic or confusion among SIM users who are not in the immediate vicinity of the situation. Sending flooded messages from an IoT device to nearby SIM users can be a highly effective way to alert people to emergencies and critical situations. It allows for rapid communication and dissemination of information, ensuring that people are informed and can take appropriate actions. The use of flooded messages also ensures that the messages are delivered even in areas with poor network coverage or high network traffic. Overall, the scenario of sending flooded messages from an IoT device to SIM users who are within a 1.5km radius is an innovative and effective way to improve emergency communication and response. It is an example of how technology can be used to address real-world problems and improve the safety and well-being of people.

The proposed Train Detection & Alert System has the potential to significantly improve the safety and efficiency of railway crossings in Sri Lanka. By utilizing advanced technologies, such as real-time tracking, alert systems, and IoT devices, this system can detect potential safety hazards and prevent accidents from occurring. Additionally, the system can provide valuable data and insights to train authorities, informing their decisions and helping to reduce railway crossing collisions. With nearly 100 fatalities annually, a solution is needed to address this problem, and the proposed Train Detection & Alert System offers a promising solution.

2. LITERATURE REVIEW

2.1 BACKGROUND

The safety of people who are crossing railway crossings has been a significant concern for a long time. Over the years, numerous accidents have occurred due to the lack of proper signaling systems. To address this issue, researchers have been exploring various solutions for improving safety measures. With the advancements in technology, new and innovative solutions are still being researched and developed to improve safety for pedestrians and drivers alike. This literature review aims to provide a background on the existing research and literature related to solutions for the safety of people crossing railway crossings. The first documented effort to address the issue of railway crossing safety dates to the 1870s when the first automatic signal system was installed in England. Since then, many countries have made significant progress in developing and implementing safety measures for railway crossings. For example, the United States introduced a system of highway-rail grade crossing warning systems in the early 1900s. This system included various types of signals, including flashing lights, bells, and gates, to warn drivers and pedestrians of the approaching train.

In the 21st century, technology has played a significant role in improving the safety of railway crossings. One such example is the use of sensors and cameras to detect the presence of trains and vehicles near the railway crossings. These sensors and cameras are often connected to a central monitoring system that alerts drivers and pedestrians of the approaching train. Another example is the use of mobile applications to provide real-time information on train schedules and the location of trains. Despite the progress made in improving railway crossing safety, there are still many challenges that need to be addressed. For example, in Sri Lanka, there is a lack of proper solutions to address railway crossing collisions. As a result, undergraduate students specializing in the IT field are proposing an IT-based solution to address these collisions. Their research project proposes a system that utilizes various technologies, including IoT devices, GPS tracking, machine learning algorithms, security technologies, and real-time databases. Other current research projects are also exploring the use of technology to improve railway crossing safety. For example, researchers in India are working on developing a system that uses artificial intelligence to analyze real-time data on train movements and predict potential accidents. The system uses machine learning algorithms to identify patterns in the data and make predictions about the likelihood of accidents.

In conclusion, the safety of people who are crossing railway crossings has been a significant concern for a long time. Over the years, researchers have explored various solutions to improve safety measures. With the advancements in technology, new and innovative solutions are still being researched and developed to improve safety for pedestrians and drivers alike. From historical backgrounds to current research and development, this literature review provides a background on the existing research and literature related to solutions for the safety of people crossing railway crossings.

2.2 LITERATURE SURVEY

"A Review of Train Detection Technologies for Grade Crossing Applications" by B. Padhi and M. D. Fontaine (2014): This paper provides an overview of the various technologies used for train detection, such as track circuits, axle counters, and infrared detectors. The authors also discuss the advantages and limitations of each technology.

"Design and Implementation of Train Tracking and Detection System Using RFID and GPS" by P. Kumar and S. Prasad (2018): This paper presents a system that uses RFID tags and GPS to track trains and detect their presence at specific locations. The authors describe the hardware and software components of the system and discuss its potential applications.

"Real-Time Train Tracking and Detection Using Machine Vision and Deep Learning" by A. R. Zamani et al. (2019): This paper proposes a system that uses machine vision and deep learning techniques to track and detect trains in real-time. The authors describe the image processing algorithms used and present results from a prototype system.

"Integration of Train Detection Systems for Railway Safety" by A. Razaque et al. (2016): This paper discusses the integration of various train detection technologies to improve railway safety. The authors present a system that combines track circuits, axle counters, and other sensors to provide redundant detection of trains.

"Train Tracking and Monitoring Using Wireless Sensor Networks" by A. Jain et al. (2017): This paper presents a system that uses wireless sensor networks to track and monitor trains. The authors describe the hardware and software components of the system and discuss its potential applications for train scheduling and optimization.

Overall, these papers demonstrate the wide range of technologies and approaches that can be used for train tracking and detection systems and highlight the importance of such systems for improving railway safety and efficiency.

3. RESEARCH GAP

Research \ Features	SIM Alerts	Alerts sending To Users	Real-Time Alert System Connected with IOT Device	Send Alerts to Relevant Authorities	Fast Moving Flooded Message System
Proposed Component	✓	✓	✓	✓	✓
Automatic Railway Crossing System with Crack Detection	✗	✓	✗	✗	✗
RDMNS.LK: LIVE Train Alerts	✗	✗	✗	✗	✗
Smart Railway Crossing Surveillance System	✗	✗	✗	✗	✗

Table 1: Research Gap Table

The research gap for the mentioned scenario could be the lack of existing solutions that use flooded messaging through IoT devices to alert SIM users within a specific radius about the approaching trains in railway crossings. While there are some existing studies on railway crossing safety, most of them have focused on physical infrastructure improvements and have not fully explored the potential of technology-based solutions to address this issue. Additionally, there is a lack of research on using IoT devices and flooded message systems to provide real-time alerts and warnings to users who are approaching railway crossings. Another research gap is the lack of focus on the specific problem of accidents caused by trains hitting pedestrians or vehicles at railway crossings in Sri Lanka. While there have been studies on railway safety in general, there is a need for more research on the specific context of Sri Lanka, where railway crossing collisions are a significant problem.

Furthermore, the current solutions may not use the latest technologies, such as IoT devices, which can be used to send flooded messages to users' SIM cards within a specific radius, ensuring that all nearby users are alerted about the approaching trains. There is a need to develop a more user-friendly and widely accessible solution that can provide real-time information and alerts to all users who are near railway crossings. Additionally, the research gap could also involve the lack of studies and research on the effectiveness of using IoT devices for flooded messaging and its impact on reducing the number of accidents in railway crossings.

Therefore, the proposed research aims to address this gap by developing a Train Detection System that utilizes IoT devices to send flooded messages to SIM users within a 1.5km radius of railway crossings, providing them with real-time train location details and alerts to help them avoid accidents. This research will contribute to filling the gap in the existing literature on the effectiveness of using IoT devices for flooded messaging and its impact on reducing railway crossing accidents. Therefore, the proposed research project aims to fill these research gaps by exploring the use of IoT devices and flooded message systems to provide real-time alerts and warnings to users who are approaching railway crossings, and by developing a user-friendly and widely accessible solution that can address the specific context of railway crossing collisions in Sri Lanka. By doing so, the project can contribute to the development of effective and sustainable solutions for improving railway crossing safety and reducing accidents in Sri Lanka.

4. RESEARCH PROBLEM

The statistics mentioned in the Sri Lanka Tweet (2019) highlight the alarming number of road accidents in Sri Lanka, with a person dying every three hours and a child dying every three days. This is a major concern that needs to be addressed by the authorities and the public. Additionally, the study conducted by Kulasingham Ragulan and Niranga Amarasingha on railway-roadway level crossing safety in Sri Lanka reveals the high number of railways crossing collisions that occur in the country annually. The WorldData.info website provides further insight into the mobile phone usage in Sri Lanka, with a ratio of 1.4 mobile phones per person. Related to train crossing crashes is to develop a system that can accurately detect and prevent collisions between trains and vehicles at railway crossings. Railway crossings are a critical point in train operations where vehicles and trains often intersect, and collisions at these intersections can have catastrophic consequences. In addition to detection technologies, research is also needed to develop effective collision prevention systems that can prevent collisions between trains and vehicles at railway crossings. These systems could include automated warning systems, such as s and audible alarms, that alert drivers and pedestrians to the presence of an approaching train. Addressing this research problem would significantly improve the safety of train operations and reduce the risk of collisions between trains and vehicles at railway crossings. This would help to protect the lives and property of people who live and work near railway crossings and enhance the overall safety and efficiency of train operations.

This indicates that there are more phones in Sri Lanka than the population itself. However, despite this high number of phones, there is a lack of proper utilization of this technology to address the safety of people in Sri Lanka. This presents a clear research problem that needs to be addressed. The problem is the lack of effective use of mobile phone technology to improve road safety and railway crossing safety in Sri Lanka. There is a need for a technological solution that can effectively utilize the high number of mobile phones in the country to provide safety alerts and information to the public.

The proposed solution is the development of a Train Detection System for Citizens via the Sim or a Tracker, which utilizes GPS and other real-time data sources to provide up-to-date information on trains and their movements. This system can be accessed through a separate tracker device or a mobile phone with a sim card. The system can provide alerts and information to both passengers and train operators, allowing for better travel planning and increased safety measures. The research problem can be further elaborated by analyzing the current state of road and railway crossing safety in Sri Lanka, examining the existing technologies and systems used for safety, and identifying the limitations and gaps in the current systems. The research can also explore the effectiveness and feasibility of the proposed Train Detection System, including the potential challenges and obstacles in its implementation.

In order to address the research problem, a comprehensive study needs to be conducted, including a literature review of existing research on road and railway crossing safety, as well as mobile phone technology for safety purposes. The study should also include surveys and interviews with the public, train operators, and relevant authorities to gather data on the current state of safety and the potential for implementing the Train Detection System. This considers the ethical and privacy concerns related to the implementation of the Train Detection System, such as the collection and use of personal data. Additionally, the study should examine the financial and logistical implications of implementing such a system on a national level.

In conclusion, the research problem of the lack of effective use of mobile phone technology for road and railway crossing safety in Sri Lanka presents a pressing need for a technological solution. The proposed Train Detection System for Citizens via the Sim or a Tracker can be an effective solution to address this problem, but a comprehensive study is needed to evaluate its feasibility, effectiveness, and potential obstacles. Such a study can help improve the safety and security of the people in Sri Lanka and reduce the number of road and railway crossing accidents.

5. OBJECTIVES

5.1 MAIN OBJECTIVE

- Sending the flooded messages from the IOT device for the SIM users who are within a 1.5km radius.

The statement "Sending the flooded messages from the IOT device for the SIM users who are within a 1.5km radius" refers to a system that utilizes Internet of Things (IoT) devices to send messages to users with SIM cards within a 1.5km radius of the device. The system is designed to enhance safety at railway crossings by providing users with real-time information about approaching trains.

The Internet of Things refers to the network of interconnected devices, sensors, and software that allow objects to collect and exchange data. The IoT devices used in this system may include sensors, cameras, and other devices that are able to detect the presence of trains and send information about their location and speed to a central hub.

The SIM users who are within a 1.5km radius refer to individuals who have a SIM card in their mobile phone and are located within 1.5 kilometers of the IoT device. This distance may be adjusted based on the specific requirements of the system, but the idea is to target users who are in the immediate vicinity of the railway crossing and may be at risk of accidents.

The term "flooded messages" refers to the use of multiple messages to ensure that users receive the information they need. This may involve sending multiple notifications to a user's phone, or broadcasting alerts over multiple channels to ensure that they are received by as many people as possible.

The main goal of this system is to improve safety at railway crossings by providing users with real-time information about approaching trains. By using IoT devices to detect the presence of trains and send alerts to nearby SIM users, the system can help prevent accidents and save lives.

One of the key advantages of this system is its ability to provide real-time information about approaching trains. This information can be critical for individuals who are crossing railway tracks, especially in areas where visibility may be limited. By receiving alerts about approaching trains, users can take appropriate action to avoid accidents and ensure their safety.

Another advantage of this system is its ability to target specific users who are in the immediate vicinity of the railway crossing. By using IoT devices to detect the presence of trains and sending alerts to nearby SIM users, the system can ensure that the right people receive the information they need at the right time. In addition to improving safety at railway crossings, this system may also have other potential applications. For example, it could be used to provide real-time information about traffic conditions or weather events, or to alert users to other potential hazards in their vicinity.

Overall, the concept of sending flooded messages from IoT devices to SIM users within a 1.5km radius has the potential to be a powerful tool for improving safety at railway crossings and other locations where real-time information is critical. However, it will be important to carefully consider the potential benefits and challenges of the system and to work closely with stakeholders to ensure its successful implementation.

5.2 SUB OBJECTIVES

- **Gathering the data from the IOT Device**

The process of gathering data from the IoT device for sending flooded messages to SIM users within a 1.5km radius involves multiple steps. Firstly, the IoT device must be equipped with sensors capable of detecting the presence of trains on railway tracks. These sensors may be installed on or near the tracks, and could utilize technologies such as ultrasonic, infrared, or magnetic sensing to detect the presence of a train.

Once the sensor has detected a train, it must send a signal to the IoT device, which then collects and processes the data. The IoT device may be equipped with a microcontroller or other processing unit, which can analyze the data from the sensor and determine if a train is approaching a railway crossing.

Next, the IoT device must determine the appropriate message to send to nearby SIM users. This may involve analyzing the data from multiple sensors to determine the speed and direction of the train, as well as the location of nearby railway crossings. Based on this data, the IoT device can send a message to nearby SIM users, warning them of the approaching train and advising them to exercise caution when crossing the tracks. To ensure that the message is sent to as many users as possible, the IoT device may employ a flooded messaging system. This system involves sending the message to all nearby SIM users within a 1.5km radius of the railway crossing, ensuring that even users who are not in the immediate vicinity of the crossing are aware of the approaching train. Finally, the IoT device must ensure that the message is sent in a timely and reliable manner. This may involve utilizing a cellular network or other wireless communication technology to transmit the message to nearby SIM users. The IoT device may also need to coordinate with local authorities or train operators to ensure that the message is accurate and up-to-date, and to ensure that the train is operated safely and within established guidelines.

Overall, the process of gathering data from the IoT device for sending flooded messages to nearby SIM users is complex and multi-faceted. It involves the use of sophisticated sensors, processing units, and communication technologies to detect the presence of trains and warn nearby users of potential hazards. By providing real-time information to users in the vicinity of railway crossings, this technology has the potential to improve safety and prevent accidents on Sri Lanka's roads and railways.

- **Provide the accurate real-time alert for the user within the specific radius.**

The accurate real-time alert system is crucial for sending the flooded messages from the IoT device to the SIM users who are within a specific radius. The system must provide timely notifications to the users about the presence of a train approaching a railway crossing. The alert system must be capable of determining the distance between the train and the crossing, as well as the speed of the train. It should also take into account any delays or changes to the train schedule. The system must use reliable and accurate data sources, such as GPS and real-time train data, to generate alerts. Additionally, the alert system must be able to send messages to the users in a timely and efficient manner. The system should use a flood messaging technique to ensure that the message reaches all the SIM users within the specific radius.

The alert message should be clear and concise, providing all the necessary information about the approaching train. It should also include safety instructions, such as asking the users to wait until the train has passed before attempting to cross the railway crossing. The system should have a backup mechanism in case of any technical failures or network outages, to ensure that the alert system is always operational and the users receive timely notifications. Overall, the accuracy and reliability of the real-time alert system are crucial for the safety of the users near railway crossings, and it is essential that the system is designed and implemented with careful consideration of these factors.

- **Flooding the alert among the users through the SIM.**

Flooding the alert among the users through the SIM is a process of disseminating real-time alerts to a large number of users through their SIM cards. This process is based on the concept of broadcasting messages to multiple recipients within a specific range. In this case, the range is within a 1.5km radius of the IOT device. The alerts can be triggered by various sensors on the IOT device, such as GPS, accelerometer, and gyroscope, which can detect the movement and location of the train in real-time. Once an alert is triggered, the IOT device floods the message to all SIM cards within the range, informing them of the train's location and other relevant information, such as its speed and direction. The users can then take appropriate action, such as avoiding the railway crossing or slowing down their vehicle to ensure safety. The flooded messages are sent repeatedly until the train passes the railway crossing, ensuring that all users within the range receive the alerts and stay informed. This technology has the potential to significantly improve safety at railway crossings by providing real-time alerts to a large number of users, enabling them to make informed decisions and avoid accidents.

Flooding the alert among the users through the SIM is a crucial step in the process of sending flooded messages from the IOT device for the SIM users who are within a 1.5km radius. When a potential danger is detected by the IOT device, the device must then transmit this information to the user's SIM card in real-time. This transmission process, known as "flooding," involves sending the alert to all SIM users within a specific radius, typically 1.5km. This is done to ensure that all potential users are alerted and can take necessary precautions. The alert can be in the form of a sound, vibration, or visual notification, depending on the user's preference.

It is crucial that the alert is accurate and timely to ensure that users can respond appropriately and avoid any potential danger. The flooded message can also include relevant information such as the location of the danger and the type of danger, enabling users to take informed decisions. The accuracy of the alert and the information provided can have a significant impact on the effectiveness of the system and the safety of the users. Therefore, it is crucial to ensure that the alert system is designed to provide accurate and relevant information to the users in real-time, enabling them to take necessary precautions and avoid any potential danger.

- **Make the flooding alert fast as possible among all the users within the radius.**

When it comes to sending the flooded alert messages from the IoT device to the SIM users who are within a 1.5km radius, it is crucial to ensure that the alerts are received by all the users in the area as fast as possible. One way to achieve this is by making use of efficient data transmission techniques such as multicast or broadcast. Multicast allows for the transmission of data to multiple recipients simultaneously, while broadcast allows for the transmission of data to all devices within a given range. These techniques can significantly reduce the time it takes for the alerts to reach the users and improve the overall effectiveness of the system.

Another important factor to consider is the reliability of the network used to transmit the alerts. The system should be designed to work on a reliable and stable network to ensure that the alerts are received by all the users within the specific radius. The use of redundant networks and backup systems can help to ensure that the alerts are still transmitted even in the event of a network failure. To make the flooding alert as fast as possible among all the users, it is also important to optimize the data transmission process. This can be achieved by minimizing the size of the alerts and ensuring that they are only sent when necessary. The system should also be designed to prioritize critical alerts over less important ones to ensure that users receive the most relevant information first.

Additionally, the system can be designed to leverage machine learning algorithms and predictive analytics to anticipate potential train movements and alert users in advance. This approach can help to further reduce the response time and provide users with more time to react and make informed decisions.

To making the flooding alert as fast as possible among all the users within the specific radius is essential for the success of the Train Detection System. By leveraging efficient data transmission techniques, reliable networks, and optimization strategies, the system can provide accurate and timely information to users and help to reduce the number of accidents and fatalities caused by trains in Sri Lanka.

6. METHODOLOGY

The aim of this research is to develop a system for sending flooded messages to SIM users who are within a 1.5km radius of an IoT device. The goal is to provide real-time alerts to users about approaching trains and improve safety at railway crossings. This methodology outlines the steps involved in developing and testing the proposed system. The research design for this study is a mixed-methods approach, involving both qualitative and quantitative methods. The research will begin with a thorough review of the literature on similar systems for alerting users of approaching trains and accidents at railway crossings. This review will provide insight into best practices and potential areas for improvement.

The methodology for creating the proposed train detection and alert system includes the following steps:

01) Literature Survey

- The use of IoT devices for sending real-time alerts and notifications has become increasingly popular in recent years. In the context of railway safety, several studies have focused on developing train detection systems to improve safety at railway crossings. However, there is a lack of research on utilizing IoT devices to provide real-time alerts to SIM users within a specific radius.

01) Data Collecting

- The first step in data collection is to collect data on train schedules and routes. This data will be gathered from existing sources, such as railway companies, to ensure accuracy and up-to-date information. The next step is to collect data on the location and movement of trains. This will be achieved through the use of GPS trackers and other real-time data sources. Data on the location and movement of trains will be fed into the IoT device, which will be used to send alerts to SIM users in the area.

01) Model Building

- To develop a model that can process the data and send flooded messages to the SIM users within 1.5km radius. The model can be developed using various machine learning algorithms such as decision trees, neural networks, or support vector machines. Once the model is developed, it needs to be trained on the collected data. The model training process involves dividing the data into training and validation sets, and using the training data to train the model.

01) Model Testing

- The model is training on a separate set of data to evaluate its performance. The testing process involves using the validation data to test the model and make sure it is accurate and effective. The final step is to deploy the model in a real-time environment, where it can process the data and send flooded messages to the SIM users within 1.5km radius. The model can be deployed on IoT devices, such as sensors or GPS devices, to ensure real-time updates and accurate flooded messages

01) UI Designing

- Designing a user interface for Sending Flooded Messages from IoT Devices for SIM Users within a 1.5km radius involves several key considerations. The UI should be intuitive and easy to navigate, with clear instructions and feedback for users. It should also be visually appealing and incorporate branding elements where appropriate. The app should use sound and vibration to alert users to potential dangers. These alerts should be customizable to suit the user's preferences and accessibility needs.

01) Security Designing

- Firstly, user authentication and authorization must be implemented to prevent unauthorized access to the system. This can be done through a login process and assigning user roles and permissions. Secondly, data encryption must be employed to secure the messages being sent between the IoT devices and the SIM users. This can be achieved through the use of secure protocols like HTTPS or SSL/TLS. Thirdly, measures must be taken to prevent malicious attacks such as denial-of-service attacks or man-in-the-middle attacks. This can be done by implementing firewalls, intrusion detection and prevention systems, and regularly updating system software to fix known vulnerabilities. Lastly, data privacy must be ensured by implementing data protection measures like anonymization and consent-based data sharing. Regular security audits and penetration testing should also be carried out to ensure the system's continued security.

01) Security Testing

- Security testing is a critical step in ensuring that the system is secure and protected against unauthorized access, data breaches, and other security threats. This can be measure by these types of testing methodologies: Penetration Testing, Vulnerability Scanning, Threat Modelling, Risk Assessment, Authentication and Authorization Testing, Data Protection and Encryption Testing, Physical Security Testing.

01) Integrating

- Integrating the system for Sending Flooded Messages from IoT Devices for SIM Users within a 1.5km radius involves bringing together various components to form a functional system. The first step is to integrate the IoT device with the messaging system, which requires configuring the device to communicate with the messaging platform. Next, the messaging system needs to be integrated with the SIM card network, which involves configuring the messaging gateway to work with the SIM card network's application programming interface (API). This allows the messaging system to send messages directly to SIM cards within the 1.5km radius. The user interface needs to be integrated with the messaging system to enable users to configure the system and receive alerts. Finally, security measures need to be integrated throughout the system to ensure the safety and privacy of user data. This includes encryption of messages and secure transmission protocols between devices and the messaging platform. Testing the integrated system is critical to ensure that it is functioning as expected. This includes testing the messaging gateway, the IoT device, and the user interface to ensure that they are all working together properly

01) Testing

- Testing is a crucial step in ensuring the effectiveness and reliability of the Sending Flooded Messages from IoT Devices for SIM Users within 1.5km Radius system. The testing process should include various types of tests, such as functional testing, performance testing, security testing, and user acceptance testing. Functional testing involves testing the system's functionality to ensure that it works as intended. This includes testing the message sending and receiving functionalities, as well as the accuracy of the data collected from the IoT device. Performance testing should be conducted to ensure that the system can handle high loads of messages without any delays or errors. This testing should be done by simulating high traffic conditions and monitoring the system's response time and overall performance. Security testing should be performed to ensure that the system is secure and protected from any potential security threats. This includes testing for vulnerabilities in the system's architecture, data encryption, and user authentication. Lastly, user acceptance testing should be performed to ensure that the system meets the needs of the users and is easy to use. This testing should involve a sample group of users who will test the system and provide feedback on their experience.

01) Deployment of the Prototype

- The deployment of the prototype for sending flooded messages from IoT devices for SIM users within a 1.5km radius involves several steps. First, the prototype must be tested in a controlled environment to ensure that it is functioning properly and that the flooded messages are being sent to the correct users within the specified radius. This testing may involve simulating various scenarios, such as different numbers of users and varying distances from the IoT device. Once the prototype has been tested and any issues have been resolved, it can be deployed in a real-world environment.

6.1 SYSTEM ARCHITECTURE DIAGRAM

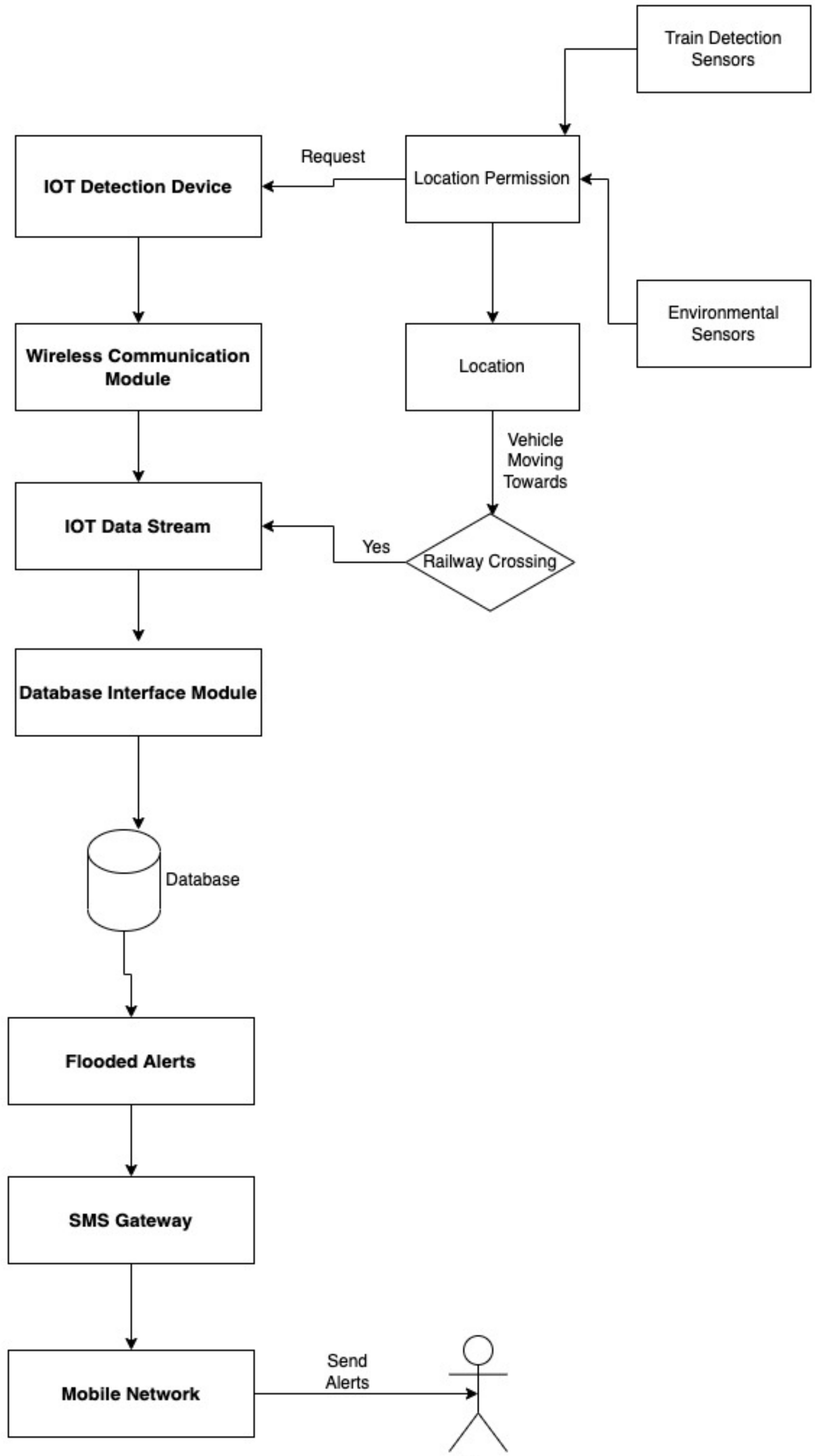

Figure 3: System Overview

In above diagram, there are two actors: the user and the IoT device. The user is the person who receives the alert message when flooding occurs. The IoT device is responsible for detecting flooding and sending the alert message to the cloud. The cloud is the intermediary between the IoT device and the SIM card. It receives the alert message from the IoT device and forwards it to the SIM card for delivery to the user. The SIM card is the final point of contact in the system, as it delivers the alert message to the user's mobile phone.

6.2 TOOLS AND TECHNOLOGIES

- IOT Devices
- Microcontrollers
- Arduino
- Zigbee
- Mobile Application Development - Flutter
- Data Storage – Firebase Realtime Database
- Machine Learning Algorithms
- Programming Languages
- Gateways

6.3 SYSTEM REQUIREMENTS

The system requirements for Sending Flooded Messages from IoT Devices for SIM Users within 1.5km radius would depend on various factors such as the complexity of the system, the scale of the deployment, and the type of hardware and software used. However, some of the basic system requirements that could be considered are:

1) **Hardware:**

- A microcontroller or microprocessor that can handle the IoT device's sensors, connectivity modules, and memory requirements. The device should have enough processing power to handle the real-time data processing and transmission requirements.

2) **Network Connectivity:**

- The IoT device should be able to connect to the internet or cellular network to transmit the data to the server. The connectivity should be reliable and secure.

3) **Cloud Server:**

- The cloud server should be able to handle the incoming data from the IoT devices and process it to send the flooded messages to the SIM users. The server should have enough processing power, storage, and memory to handle the data and real-time processing requirements.

4) **Database:**

- A database to store the incoming data from the IoT devices and the SIM users' information. The database should be scalable and secure.

5) **Software:**

- The software used for data processing, message generation, and transmission should be efficient, secure, and scalable. It should be compatible with the hardware and network infrastructure.

6) User Interface:

- A user interface to monitor the system's performance, configure the IoT devices, and manage the messages sent to the SIM users.

6.3 FUNCTIONAL REQUIREMENTS

- The system should be able to gather data from the IoT devices located within a 1.5km radius.
- The system should be able to send real-time alerts to SIM users within the specific radius.
- The system should have a flooding mechanism to send alerts to all SIM users within the radius.
- The system should have a user interface for users to manage their alert preferences.
- The system should be able to provide accurate location information of the IoT devices.

6.4 NON-FUNCTIONAL REQUIREMENTS

The functional requirements for Sending Flooded Messages from IoT Devices for SIM Users within a 1.5km radius can include:

01) Data gathering and processing:

- The system should be able to collect data from the IoT devices and process it to identify the users within a 1.5km radius.

02) Alert mechanism:

- The system should have an alert mechanism that sends a real-time alert to the identified users via their SIM card.

03) Flooded message delivery:

- The system should be able to deliver the flooded message to the identified users quickly and efficiently.

04) User management:

- The system should be able to manage the users within the 1.5km radius and ensure that only the relevant users receive the alert.

05) Security:

- The system should be designed with security in mind to protect the users' privacy and prevent unauthorized access.

06) Scalability:

- The system should be scalable to handle a large number of users and IoT devices.

07) Reliability:

- The system should be reliable and available at all times to ensure that users receive the alert in case of an emergency.

08) Compatibility:

- The system should be compatible with various IoT devices and SIM cards to ensure widespread adoption.

09) Real-time monitoring:

- The system should have a monitoring mechanism to detect any issues and resolve them in real-time.

10) User feedback:

- The system should allow users to provide feedback on the effectiveness of the alert mechanism and make improvements accordingly.

7. DESCRIPTIONS OF PERSONAL AND FACILITIES

7.1 COMMERCIALIZATION

Commercializing the Sending Flooded Messages from IoT Devices for SIM Users within a 1.5km radius system requires careful consideration of several factors. The first step is to create a business plan that includes a thorough analysis of the target market and the competitive landscape. This should involve identifying the potential customer segments and their specific needs and preferences, as well as conducting a detailed analysis of the existing solutions available in the market.

Once a solid business plan is in place, the next step is to develop a marketing strategy to reach the target customers. This can involve a range of activities, such as creating a strong brand identity, developing a digital marketing campaign, attending trade shows and events, and leveraging social media and other online platforms.

Another important aspect of commercializing the system is to establish partnerships with relevant stakeholders, such as telecommunications providers, IoT device manufacturers, and local government authorities. This can help to build credibility and trust in the solution and provide access to key resources and expertise.

In terms of pricing, it is important to conduct a thorough analysis of the costs associated with the development and deployment of the system, as well as the potential revenue streams. This can involve using different pricing models, such as subscription-based or pay-per-use, and setting prices that are competitive and attractive to potential customers.

As the system is built around IoT devices, it is important to ensure that it is secure and meets all the relevant regulatory requirements. This can involve conducting rigorous security testing and implementing strong data protection and privacy measures, as well as complying with relevant industry standards and regulations.

Finally, it is important to provide high-quality customer support and establish effective communication channels with customers to ensure their satisfaction and loyalty. This can involve providing user manuals, FAQs, and online resources, as well as offering responsive and personalized customer support through email, phone, or live chat.

Commercializing the Sending Flooded Messages from IoT Devices for SIM Users within a 1.5km radius system requires a careful and strategic approach that takes into account the specific needs and preferences of the target market, as well as the competitive landscape and regulatory requirements. By creating a strong brand identity, developing a comprehensive marketing strategy, establishing key partnerships, ensuring security and compliance, and providing high-quality customer support, the system can be successfully launched and adopted by a wide range of customers.

8. REFERENCES

[1] N. News, "NBC News," 27 April 2005. [Online]. Available: https://www.nbcnews.com/id/wbna7647780.

[2] Wikipedia, "Wikipedia," [Online]. Available: https://en.wikipedia.org/wiki/Polgahawela_level_crossing_accident#:~:text=Polgahawela%20level%20crossing%20accident%20was,the%20death%20of%2041%20people..

[3] N. A. Kulasingham Ragulan, "SLSTL," 2021. [Online]. Available: https://slstl.lk/wp-content/uploads/2021/10/A1.3.docx.

[4] IEEE, "IEEE Explore," 2017. [Online]. Available: https://ieeexplore.ieee.org/document/8361529.

[5] S. L. Tweet, "Twitter," 25 May 2019. [Online]. Available: https://twitter.com/SriLankaTweet/status/1132093011997863936.

[6] MDPI, "MDPI," January 2021. [Online]. Available: https://www.mdpi.com/2071-1050/13/2/832.

[7] T. R. Board, "TRB org," 1999. [Online]. Available: https://trb.org/publications/nchrp/nchrp_syn_271.pdf.

[8] IEEE, "IEEE Xplore," 01-03 November 2022. [Online]. Available: https://ieeexplore.ieee.org/document/10051357.

[9] RDMNS, "RDMNS," 2023. [Online]. Available: https://rdmns.lk/.

[10] IEEE, "IEEE Xplore," 23-25 June 2022. [Online]. Available: https://ieeexplore.ieee.org/document/9885699.

[11] W. D. Info, "WorldDataInfo," 2020. [Online]. Available: https://www.worlddata.info/asia/sri-lanka/telecommunication.php#:~:text=Under%20the%20country%20code%20%2B94,the%20world's%20average%20by%20population..

APPENDICES

APPENDIX A:

No	Task List	December	January	February	March	April	May	June	July	August	September	October	November
1	Initial Stage												
	Research Topic Selection												
	Requirement Gathering												
	Study on Research Area												
	Topic Evaluation form submission												
	Topic Evaluation (Project pre-assessments) resubmission												
	Topic Approved												
	Project Charter												
2	Proposal Stage												
	Proposal Draft Submission												
	proposal Presentation												
3	Implementation Stage 1												
	System Design and Planning												
	Implementation of functions												
	Integration and testing Level 1												
	Progress presentation -50%												
	Prepare Research Paper												
4	Implementation Stage 2												
	Implementation of functions												
	Integration and testing Level 2												
	Progress presenation -100%												
5	Final Stage												
	Final Thesis												
	Final Presentation												

Figure 4: Gantt Chart