



Wireless Red Signal Alerting for Rail Track Crossings By Using NRF24L01 WiFi Module

An undergraduate project report submitted to the

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in partial fulfillment of the requirements for the module

EE5305 Sensors and Transducers

by

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Abstract

Human error has been the main reason for the train accidents that have occurred in Sri Lanka. Mainly, most of the accidents happen at the railroad crossings, and most of the control problems also happen at the railroad crossings because all of the railroad crossings are operated using manpower. In this project mainly forces about to reduce no of accident that can be happen in the Sri Lanka railway crossings. In their mainly used wireless communication system, Arduinos and sensors to build this project. This train crossing system giving so much of benefits to government as well as general public. Because of this equipment, there are no want man to operate the gate and it is reducing the government expanses. Some train crossings are don't have the man to operate and because of that there can be so much of accident can happen. So, this equipment can place every crossing because this can be implemented very low coat. Otherwise, this system is safe for the general public. Because of that system, train transportation become very simple and safe transportation method and it will be given so much of benefit to people.

Preface

This is the proposal for the project that should be done under the module EE5305 Sensors and Transducers. This proposal is about the way that the project is to be implemented. In this project we are going to implement wireless red signal alerting for rail track crossings by using NRF24L01 Wifi Module.

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Acronyms

IR - infrared sensor
WI-FI - wireless fidelity-high fidelity

Chapter 1

Introduction

The rail transportation system is a vital part of any country's infrastructure and the safety of rail track crossings is of paramount importance. Despite the advancements in technology, accidents at rail track crossings continue to occur, causing significant loss of life and property. To address this issue, this project proposes the development of a wireless red signal alerting system using the NRF24L01 Wi-Fi module. The proposed system will be designed to detect the approach of a train and alert pedestrians and motorists of the presence of an approaching train through the use of wireless communication system and close the railway gates. This will reduce the risk of accidents at rail track crossings. The system will be designed to be easy to install, cost-effective and reliable, making it ideal for deployment at rail track crossings across the country. The aim of this project is to make the rail track crossing safer and reduce the number of accidents that occur at these locations.

1.1 Background

Rail track crossings have long been a source of concern for public safety, with accidents at crossings resulting in both injury and loss of life. The main causes of these incidents are driver inattention, malfunctioning equipment, and human error.

Traditional warning systems such as flashing lights, bells, and gates have been implemented at rail track crossings to alert users of the approaching trains. However, these systems have limitations and are not always able to prevent accidents. For example, in some incidents, the gates are not functioning properly, or the driver did not pay attention to the warning signs.

Wireless communication technology has the potential to improve the efficiency and reliability of warning systems at rail track crossings. The use of wireless technology can provide real-time information to crossing users, allowing for faster reaction times and reducing the likelihood of accidents. Moreover, it can be used as a backup system in case of failure of traditional warning system. The NRF24L01 wi-fi module is a low-cost, low-power wireless module that can be easily integrated into a variety of systems, making it an ideal choice for this application.

The proposed system will use the NRF24L01 wi-fi module to identify whether it is a train or not and transmit warning signals to the gate through wireless communication system in the event of an approaching train. The signals will be received by the antennas at the gate and the gates will be close automatically in presence of an approaching train. In addition to improving safety, the proposed system will also

demonstrate the potential of low-cost, low-power wireless modules in safety-critical applications and contribute to the field of wireless communications.

1.2 Problem Statement

Improper operation of red signal alerting in train path crossing tracks have left the crossings very dangerous. Many improper operating rail crossings have to be manually operated or directed by a person appointed for it. But despite of it, many accidents happened and happening within many places in srilanka. The wired mechanism used is sometimes ineffective due to low maintenance, blockages and human inaccuracy.

1.2.1 Objectives and Scope

Objectives

- Convert the red signal operating method manual to auto
- Convert the red signal operating mechanism from wired to wireless
- Creating auto gate close and open system
- Red signal alerting and gate closing must be at least 1 min before the train arrival
- The system should trigger only for a train or another rail vehicle.
- System must capable of operating simultaneously and without errors when two trains are arriving at two sides.

Scope

- Train Tracking through IR Sesnsors
- Gate operation through motors
- IR Sesnsors transmitting messages to NRF24L01 Module
- Module interacts with the algorithm
- Operation of motors and lights through instructions

1.3 Literature Review

Railways are the convenient, reasonable and popular mode of transport in almost all major cities all over the World. Nowadays most train accidents are occurring due to human errors or technical errors which were due to less maintenance. It is very difficult to avoid such train accidents because the speed of the train is very high and it requires some time to control it. Therefore, it has been a clear interest in train collision avoidance systems according to many research papers and journals.

A lot of projects have been conducted in order to identify and reduce train collisions. Some of them are based on RFID to eliminate train accidents by exploiting automated surveillance system using ARM Controller and GSM. In this system each train track is identified by track id, every train reads and sends its track id to nearby trains. If two trains are on same track id, then alert is send to main control room or to the train drivers. The train tracks are divided into segments with individual track segment number. Whenever a train enters a segment of the track, the track number of that segment of track is read from the Radio Frequency Identification (RFID) tags present at the beginning of each segment of track.

Some researchers are implemented a low-cost transportation management system using GPS and GSM data. GPS is used to collect train data and indicate location. GSM location notifications improve service. The system has three wirelessly linked GSM modules: Vehicle Module, BASE Station Module, and User Mobile Module. Every station's GPS Module receives train location information from the BASE Station module. Moreover, researchers presented a train crash pre-warning system using RFID and FLIR cameras. Camera and RFID power supply limit proposed system.

According to the above mentioned examples, it is clear that many researchers and projects are conducted to implement designs to eliminate train accidents by exploiting surveillance.

1.4 Methodology

This project is about wireless red signal alerting for rail track crossings by using the NRF24L01 WIFI Module, and mainly this project is done to reduce the number of accidents that happen at railway crossings. Because in the railway crossings' gates are operated by human and it has a very risk when there is no man to operate this system. Using this system, there can be reduced no of accidents that can be happen in the railway crossing. Some railroad crossings don't have a gate, and children as well as animals are going through this crossing. So, this kind of accurate security system is very useful for saving their lives.

According to this project, railway crossing gate is closed as the output when the train is come near to the cross. Here, wire-less connection method is used to communicate with red light alert system from user. Mainly there are two side in this project and those are sending side and receiving side. To make a transmitter and receiver, two NRF24L01 WIFI modules are used with two Arduinos. The transmitter and receiver sides are coding to their tasks, and the transmitter should transmit the signals to the receiver, and the receiver should get the signal that was transmitted by the transmitter. This transmitter side is places in the far away 800m from the cross gate. Here we place the two IR sensors to identify whether an object is passing the IR sensor, and two sensors are used to measure whether the object length is more than 10 m. We measure this length because this object is identified as a train. Because there can be other objects go through this object. After finding the train passing the sensor, transmit the signal to the receiver side, and the receiver should get the signal. After that signal comes to the receiver side, a motor is used to operate the gate and close the gate. After give some time to train to pass the crossing and after that system automatically open the gate. Figure 1.1 is shows the basic structure of the project.

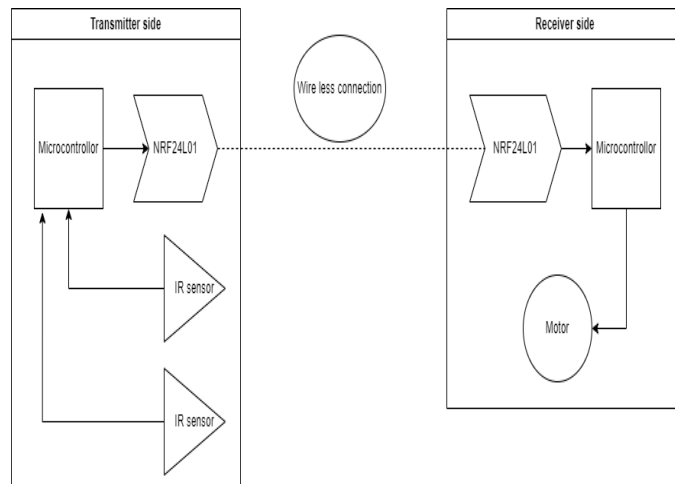


Figure 1.1: Basic structure of wireless red signal alerting for racetrack crossing

1.5 Significance and Implication of the Project

In Sri Lanka, there are a number of accidents have been reported due to errors of the Wireless Red Signal Alerting System for Trains using the NRF module. So, we understand the usual system is very expensive. Therefore, we decided on a simple system created using the NRF model and simple electrical components that won't be expensive and will be more accurate as well.

And using the usual railway red light system can only be used to notify whether the train comes or not. Because it's hardware implementation. But using software implementation lot of things we can track. Those are the speed, and the traffic whether there are vehicles close to the rail gate or not. Likewise, so it's open to a lot of updates rather than using the usual red-light system. And if we want, we can implement this system to give notifications to train drivers as well. In the usual system, they should hold a nonstop watch for any red signal that whether there is a red-light signal or not. But using this NRF system we can update this system to a more user-friendly way.

The basic idea of using this kind of NRF system, it's more accurate and inaccurate expensive compared to the usual red light signal alert system.

1.6 Time Plan

First, we got a few meetings with our group members and project coordinator to finalize the project. Then, we finalized the project as Wireless Red Signal Alerting System for Trains using the NRF module. Then, started to create a project proposal and submit to evaluation purposes.

Some research ~~ed~~ papers are red and hope to study more regarding this project for implementation. Our plan to find the hardware specifications to implement the model design. Although here ~~o~~ attached the basic budget for the project, we hope to find sensors and other hardware requirements free or low budget from the faculty, friends, and ourselves. The timeline also can vary according to the requirements of the project coordinator and the module coordinator.

Appendix A

Time Plan

A.0.1 Estimated Time Plan

Table A.1: Estimated time plan

	Week of the semester											
Task	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th
Select Project Topic												
Get Approval												
Project Proposal												
Designing part												
Real Implementation												
Troubleshooting												
Testing												
End of the project												

Appendix B

Budget Analysis

Table B.1: Estimated budget plan

Component	Quantity	Price (Rs.)
NRF24L01+PA+LNA 2.4G Wireless Transceiver Module with SMA Antenna	2	1800
Arduino UNO Normal Development Board	1	1950
Arduino Nano V3.0 Normal CH340G Mini USB	1	1600
Obstacle Avoidance Sensor IR Infrared Module	2	360
Servo Motor	1	680
Cables and Connectors	-	100
LED	1	20
Switch	1	120
Buzzer Module (Small) for Arduino	1	120
Total	-	6750

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