SMART RAIL-GATE SAFETY ALERT SYSTEM

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Abstract.
According to NCRB statistics on railroad accidents, 32 persons perished every day on average. Unmanned railroad level crossings are to blame for 66% of these incidents. Trespassing and gate guards' tardiness in closing crossing gates are two of the leading causes of the rail-related deaths and injuries. The majority of the crossings surveyed in a rural field research did not have any advance warning signs on one or more approach roads, which is considered noteworthy. This study provides an overview of the ways in which such fatalities are prevented by our operational paradigm. Two gadgets make up our operating model, one of which is located at the station master and the other at the gatekeeper. When the station master gives a signal, this mechanism assists in informing the gatekeeper that the train is approaching. The gateman receives an alarm and the time is recorded and entered in the database when the master enters the train number and presses a buzzer. When the level crossing gates are closed, the gateman will transmit the master an acknowledgement by pressing the buzzer. The Internet of Things (IoT) can be used to accomplish this by creating connectivity between two devices, and ongoing monitoring of the date and time will help to determine when and who is accountable when the error has occurred. The parts that we used for our model include an Arduino, LCD, Keypad, WiFi Module and Button among others. This prototype offers optimal security and level crossing accident prevention.

Keywords ThingSpeak, Arduino, ESP8266, Level Crossing, IOT

1 Introduction

Whenever a train is coming, there are barriers that lower to totally or partially obstruct the route. Freight trains have variable schedules; they don't run on a regular basis. For the purpose of allowing road traffic to cross railroad tracks, level crossings are provided. The crossing is referred to as a level crossing since the railroad track and the road traffic both travel at the same level. . The schedule of passenger trains is more predictable schedule. Even when the driver slams on the brakes, a loaded train can take more than a kilometre and a half to come to a stop. Trains also take a long time to stop. [1.5km]. The likelihood of you surviving a crash is low because trains can't swerve to avoid you, and airbags won't be able to save you if you collide with one. To prevent these types of damages, many researchers came up with their ideas, like automatic movable level crossing gates, which use various types of sensors, motors, and other components. However, these gates have several drawbacks, including components that don't work at all. Since they entirely lack human labour and there is a large potential for risk, Some models consume more power, while others require expensive maintenance, etc.

Fig 1 Level Crossing

We developed a novel technique to get around these disadvantages. This study provides a broad overview of how our operational paradigm prevents such fatalities. The two gadgets that make up our operating system—one at the station master and the other at the gatekeeper—are what allow communication between them. The gatekeeper receives a signal from the master whenever a train leaves the station. This technique serves to notify the gatekeeper that there is a signal from the station master by getting an alert message and buzzer, which will be useful if the gatekeeper is unconscious. Since lives are at stake, we must ensure maximum safety, which is only feasible through the use of labour. We all know that putting mor people on a software project makes it take longer.

1.1 Main Contributions of this work

1. The objective of our project is to improve the safety of railway management and reduce the chances of the accidents near level crossing gates.
2. It is an innovative model for the proactive management and new design of level crossing infrastructure.

2 Literature Survey

Chandolu Yeshwanth Sai Vivek, Dharaa C, Prakash P, Proposed a system as a "Railway Gate System: Railway Gate Status Detection "[1]. This constitutes a significant safety and environment concern.The Railway Crossing Gate Status Detection System is a simple but very useful project which detects whether the railway gate is open or closed at all times.Instead of being caught unaware whenever a railway gate is closed, this paper proposes a method of displaying the status of the gate, as it is at that time, on the cloud, thereby reducing the amount of traffic near the gates and the number of potential accidents that can occur.The advantages of this Railway Gate System, Railway Gate Status Detection is It is used detect whether the railway gate is open or closed at all times.The Main drawbacks are, This prototype consumes more data storage while displaying the status of the gate.

Adluru Murali Krishna,Davuluri Sanjay,Annam Ruthwik,Mrs. Vishnupriya.T, Proposed a system as a "Automatic Gate Crossing And IOT Based Train Track Crack Detection System Using IR Sensors"[2].Proposes a more and economical method for improving the safety of our level crossings. Road accidents at railway gate are a leading cause of death and injury worldwide.
Surveys conducted by Indian Railway found that about 21% of total railway accidents in India is crossing accidents of which majority happens at passive railway crossings. Whenever train embrace base at the sensor, caution is operated at the railway crossing so that the general population get instruction that entryway will be shut. At that point the control module begins and shuts the gates on both side of the track. Once the train crosses, this module naturally lifts the gate. To control a gate Servo Motor is used. We are utilizing an installed controller worked around the Arduino UNO for the control. As per the instructions produced at the microcontroller, the proper action will be made.

This logic was implemented in Embedded C and implemented to the Arduino Board.The advantage of this system uses Servo Motor to control a gate. The drawbacks are Maintenance cost of Servo Motor is high.

J.BANUCHANDAR,V.KALIRAJ,P.BALASUBRAMANIAN,S.DEEPA,N.THAMILA RASI,proposed a system as "Automated Unmanned Railway Level Crossing System"[3].It deals with the reduction of time for which the gate is being kept closed and secondly, to provide safety to the road users by reducing the accidents. By employing the automatic railway gate control at the level crossing the arrival of the train is detected by the sensors placed near to the gate.
Hence, the time for which it is closed is less compared to the manually operated gates. The operation is automatic; error due to manual operation is prevented.
Automatic railway gate control is highly microcontroller based arrangements, designed for use in almost all the unmanned level crossing in the train.
The advantages of this system ::It is used where there is no person managing the railway crossing gates.The main drawback is this prototype consumes more power and also put the people lives in risk in case of any component failed to work properly.

Prof. Sushant M. Gajbhiye,Apoorva Dugane,Parija Mahorkar,Snehalata Paikrao,Tejram Sahu,proposed a system as "FABRICATION OF SMART RAILWAY CROSSING"[4].This model includes infrared(IR)sensors,radiofrequency indication device(RFID),Liquid Crystal Display (LCD),Light emitting diode(LED),Lights,buzzer,motor driver and microcontroller. In the self-regulating railway gate control system, at the level crossing the meeting of the train is identify by the IR sensor and RFID placed close to the gate.In case of RFID it identifies only meeting of train. Hence, the time for which it is closed is less compared to the manually operated gates and reduces the human labor.As the whole system is automated fault occurring due to manual operation are restricted because the corrected of automated operation is more than the manned operation.The advantages are Prevention of accidents inside the gate and gate closing time is relatively less when compared to manual closing time.
The main drawback is to establish the entire network it is quite a costly task as many components are involved in it.

Dr.Praveena,P.Keerthipriya,S.Vaijynthi,D.Arvind,proposed a system as a"SMART RAILWAY GATE OBSTACLE DETECTION AND WARNING SYSTEM"[5].

This system uses sensors to detect the train and it makes the railway gate to open and close automatically and it captures the image of the obstacle detected and it sends to the train driver. So that train driver can operate the train accordingly.It reduces the manual error and unwanted deaths happening due to carelessness.The advantage is this system is helpful to detect obstacles in the path.The drawback is it cannot capture the things from the side view.

Atul Kumar Dewangan,Meenu Gupta,Pratibha Patel,proposed a system as a “Automatic Railway Gate Control Using Microcontroller”[6].The proposed model has been designed using 8052 microcontroller to avoid railway accidents occurring at unattended railway gates, if implemented detection of train approaching the gate can be sensed by means of two sensors placed on either side of the gate. This work utilizes two powerful magnetic sensors; one of these magnetic sensors is fixed at upside (from where the train comes) and similarly the other magnetic sensor is fixed at down side of the train direction. Sensors are fixed on both sides of the gate. We call the sensor along the train direction as ‘foreside sensor’ and the other as ‘after side sensor’. When foreside sensor gets activated, the sensed signal is sent to the microcontroller and the gate motor is turned on in one direction by relay driver and the gate is closed and stays closed until the train crosses the gate and reaches after side sensors. When after side sensor gets activated and the signal about the departure is sent to the microcontroller, motor turns in opposite direction and gate opens and motor stops. The advantage is this technology used in model Gate control, Track switching. The drawback is the use of sensors Very Sensitive to Extreme Environmental Changes and Sensitive to Temperature Changes.

Dr.S.Anila, B.Saranya, G.Kiruthikamani, P.Devi [7].An improvising system for Indian Railways that can be utilized to account for the problems with the level crossing gates operated manually by a gate keeper. Over 43.6% of railway accidents were held at level crossings in our country. No fruitful steps have been taken so far. In the proposed system the arrival or departure of the train near level crossing determines the opening or closing of the level crossing gate automatically with the help of IR sensor and warning signal (i.e Buzzer sound) at level crossings. But there may be a chance that during this automation process, a vehicle may be locked between the crossing gates. At this situation, the obstacle between the crossing gates could be detected with the help of ultrasonic sensor and it will be intimated to the train through GSM module.

Thus, the man power could be reduced and at the same time accidents at level crossings can be avoided into maximum extent.

3 Proposed Methodology

The suggested system makes use of cloud technology, which enables users to access and save data using devices that are linked to the internet. Here, the ThinkSpeak platform was utilized. You may collect, display, and analyse real-time data streams on the cloud with this free software. The train number, date, and time will immediately update in the cloud after the station master enters the train number and presses the submit button.

There are two devices in the suggested system. A power supply must be supplied to this system. The gatekeeper uses one device, while the station master uses the other. Using the keypad that is present in the first device, the station master enters the train number. The gate guard is then informed of the train's arrival by a message he sends. In the second gadget, a buzzer is used to notify the gate attendant. The level crossing gate is shut by the gateman, who also sends the station master an acknowledgement. The first device has a second buzzer so that the station master can hear the gatekeeper acknowledge his buzz. For later use, the cloud has all of this data recorded. When compared to other systems on the market, our suggested solution is incredibly straight forward and affordable.

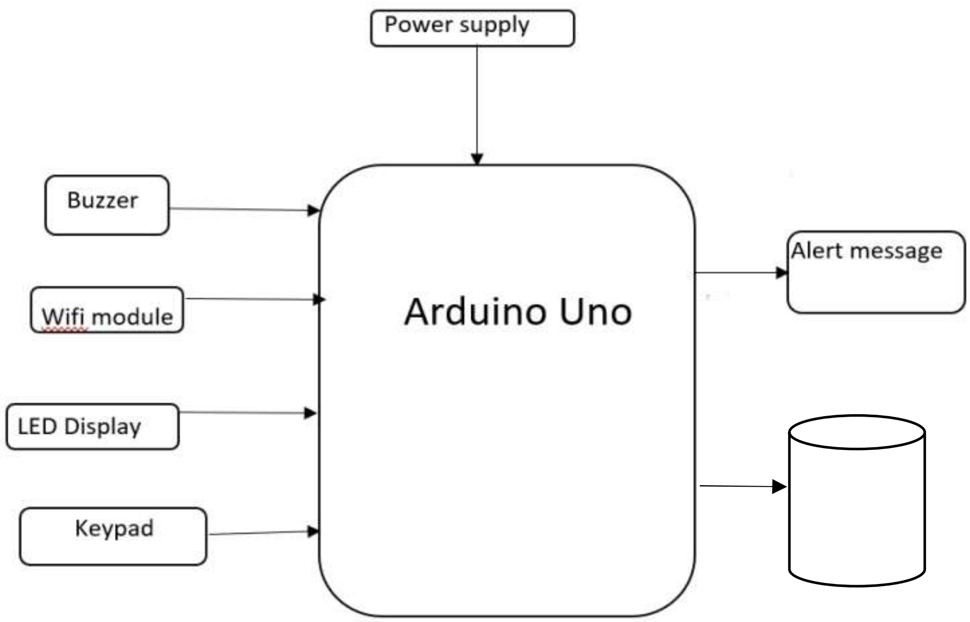

Fig 2.Proposed System Circuit Architecture

A. Hardware Implementation

Arduino uno:

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet).

It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

Esp8266 wifi module:

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

LCD 16*2:

An LCD (Liquid Crystal Display) screen is an electronic display module and has a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols.

Interface 4*3 Keypad:

4X3 Matrix Keypad - Membrane type is a 12-button keypad provides a useful human interface component for micro-controller projects. Convenient adhesive backing provides a simple way to mount the keypad in a variety of applications. The Keypad 4x3 features a total of 12 buttons in Matrix form.

B.Software Implementation

Thingspeak:

ThingSpeak™ is an IoT analytics platform service that allows you to aggregate, visualize and analyze live data streams in the cloud. ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeak. With the ability to execute MATLAB® code in ThingSpeak you can perform online analysis and processing of the data as it comes in. ThingSpeak is often used for prototyping and proof of concept IoT systems that require analytics.

Arduino.cc:

The Arduino Web Editor allows you to write code and upload sketches to any Arduino or Genuino board after installing a simple plug-in — your Sketchbook will be stored in the cloud and accessible from any device. You can even import your Sketchbook via a . zip file!

4 Algorithm

For device 1:
Step 1: Provide power supply to the device
Step 2: Enter the train number using the keypad
Step 3: Because of the wifi module's assistance in establishing communication with it, the buzzer will be audible in the second device.
Step 4: The data will be automatically updated in the cloud.

Device 2:
Step 1: Receives the buzzer.
Step 2: closes the level crossing gate.
Step 3: Sends an acknowledgment back to the station master after closing the gate.
Step 4: Additionally, the acknowledgment information will be kept in the cloud for later use.

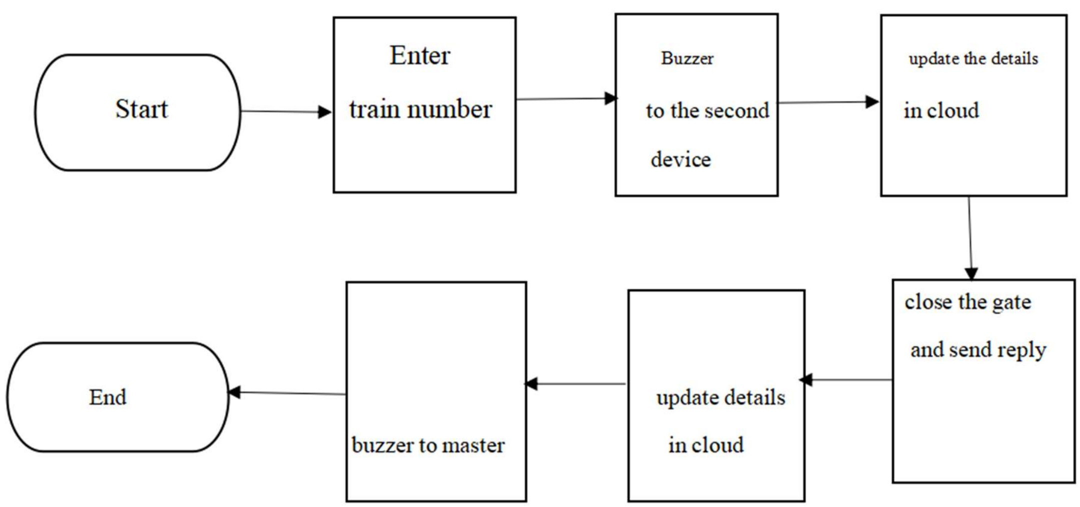

Fig 3.Block Diagram

5 Result Analysis

The gate guard is informed of the train's arrival using the proposed system. The train number that will be passing through that gate is sent by the station master. A keypad is positioned on the sender side of the proposed system. Using this, the master pushes a button after providing the train number. A wifi module is used at each end. The transmitter and receiver of our system communicate using the internet. A global platform for communication is the internet. Its use is growing every day. When the master presses the push button, an alarm will sound in the receiver's side kit. The distance and internet speed affect how long it takes to sound an alert.

The distance between a station and a gate often ranges between 2 and 3 kilometers. The buzzer announces the arrival of the train. So the level-crossing gate is shut by the gatekeeper. After that, he replies with an acknowledgement to the station manager. Additionally, the receiver kit has a buzzer. This serves as the gatekeeper's message. The cloud stores all of the information related to the train number, time, and date that messages are sent. The primary benefit of our suggested system is this. This was created in accordance with the client's specifications. There is no way to store data for cross-verification in any of the current implementations.

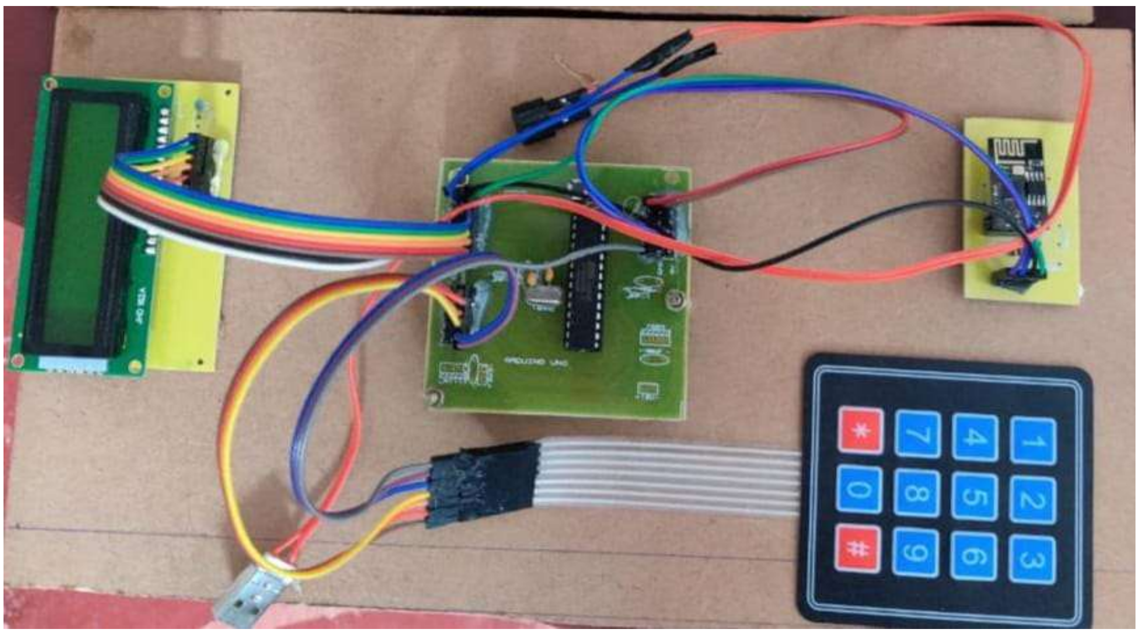

Fig 4 Transmitter end device

Fig 4 shows the prototype, which is a connection protocol, is for a smart railway gate safety alert system.

The LCD display, keypad, WiFi module (ESP8266), AT Mega 328U Micro Controller, jumper wires, and buzzer make up the prototype.

LCD Display: To show a train's status

Keypad: The train number is entered using the keypad.

The ESP8266 WiFi Module is a self-contained SOC with an inbuilt TCP/IP protocol stack that can grant access to your WiFi network to any microcontroller.

The ESP8266 is capable of offloading all Wi-Fi networking tasks from another application processor or hosting an application.

Microcontroller AT Mega 328U:

In several projects and autonomous systems that call for a straightforward, inexpensive micro-controller, ATmega328 is frequently employed.

Perhaps the most widespread use of this chip is on the well-liked Arduino development platform, specifically

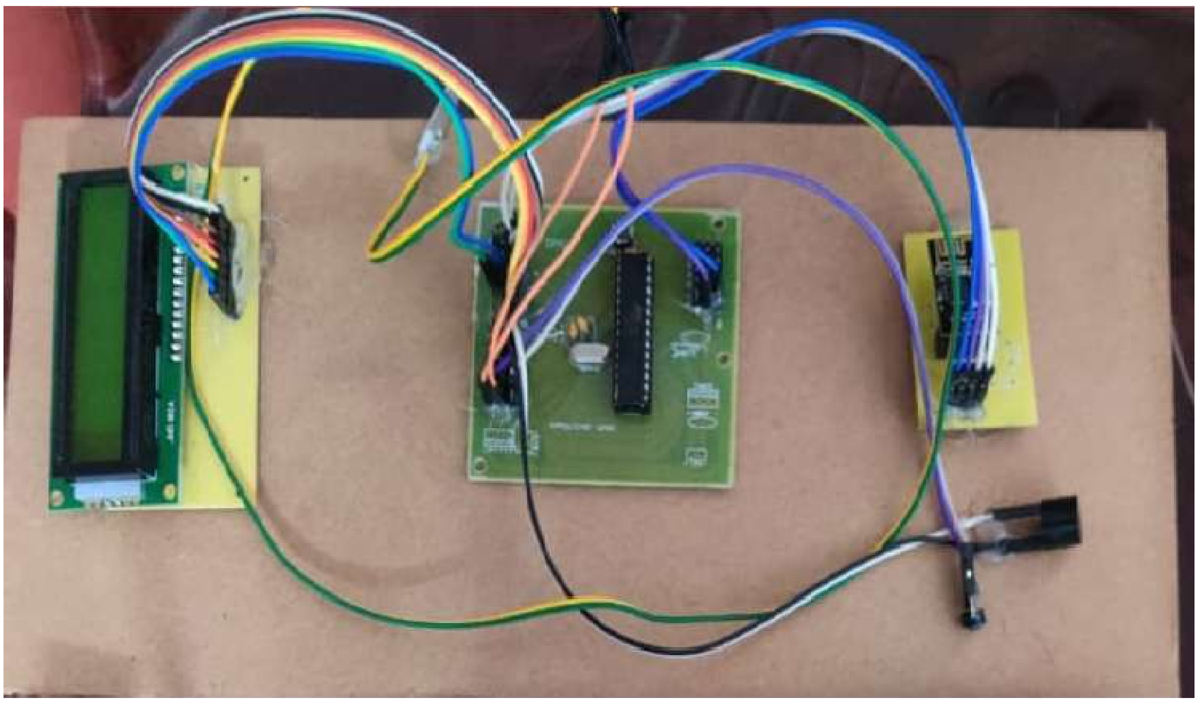

Fig 5 Receiver end Device

Fig 5 shows the prototype, which is a connection protocol, is for a smart railway gate safety alert system.The prototype is made out of an LCD display, an ESP8266 WiFi module, an AT Mega 328U microcontroller, jumper wires, and a buzzer.A buzzer, often known as a beeper, is a mechanical, electromechanical, or piezoelectric audio signalling device (piezo for short).

Buzzers and beepers are frequently used as alarm clocks, timers, train horns, and to validate human input such a mouse click or keyboard.

LCD Screen: To display a train's status

WifiModule(ESP8266): A self-contained SOC with an integrated TCP/IP protocol stack, the ESP8266 WiFi Module allows any microcontroller to access your WiFi network.

The ESP8266 is capable of offloading all Wi-Fi networking tasks from another application processor or hosting an application.

Microcontroller AT Mega 328U: ATmega328

Fig 6 Graph shows data regarding device 1 in ThingSpeak

Fig 6 shows the graph shows the state of Train1, a transmitter of a connection protocol that is used to broadcast the train number to the receiver and receive the status—a return acknowledgement—from the receiver.

The information about the train number, date, day we sent the information, and time we sent is stored in a graph.

The data is kept in the ThingSpeak Cloud.

In a ThingSpeak Cloud, the information can be utilised to refer to anything at any moment.

The amount of entries can be determined using the ThingSpeak cloud.

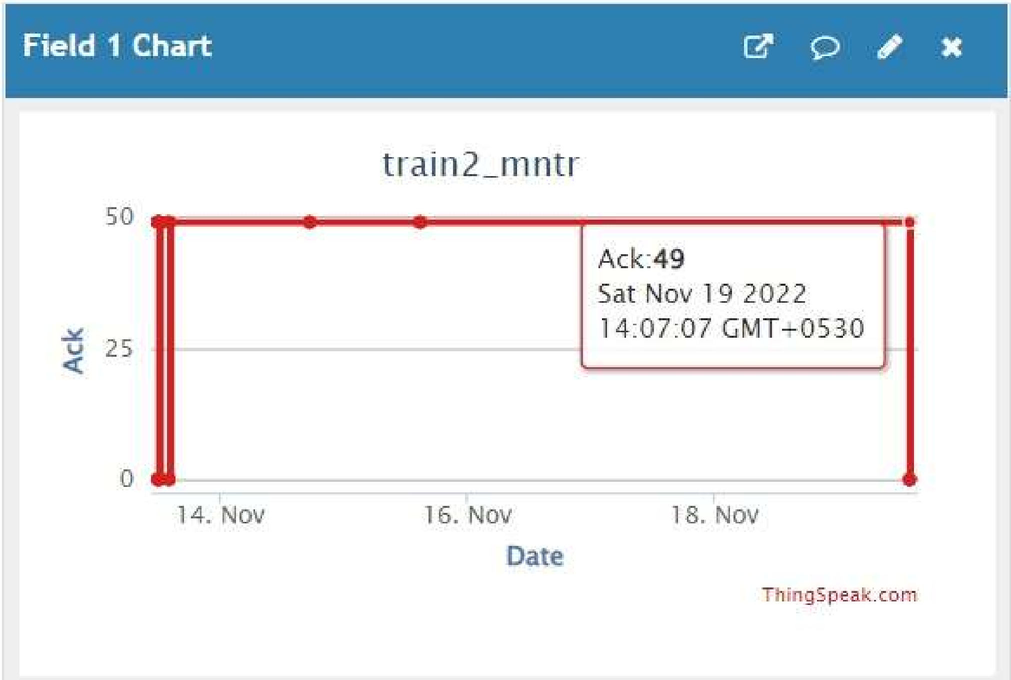

Fig 7 Graph shows data regarding device 2 in ThingSpeak

Fig 7 shows the graph shows the current condition of a Train2 receiver, a device used to receive information from a transmitter and broadcast a return acknowledgement to the transmitter.The train number, date, day we sent the acknowledgement information, and time we sent are all stored in the graph.

The data is kept in the ThingSpeak Cloud.In a ThingSpeak Cloud, the information can be utilised to refer to anything at any moment.The amount of entries can be determined using the ThingSpeak cloud.

6 Conclusion and Future Work

Our model improves communication between the lineman and gateman , resulting in fewer accidents and increased safety for those using level crossings. The data is also updated in cloud for proof checking. The scope is limited between two consecutive stations.(Later Extended)

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