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Extrication System of Wildlife on Railway Tracks

Arpitha J[1], Prasannakumar M[2], Rakesh H N[3], Shambhavi H L[4], Mrs. Asha R[5]
Students, Department of Electronics and Communication Engineering[1,2,3,4]
Faculty, Department of Electronics and Communication Engineering[5]
Vidya Vikas Institute of Engineering & Technology, Mysuru, Karnataka, India

Abstract: *This project is used to track the location of crossing zone of Animal in the wildlife reserves or national parks. This project utilizes a RFID (Radio Frequency Identification Device), DF Player Mini, RF Module and Arduino Nano for this purpose. Train Animal Conflict (TAC) is one of the major issues across the world which affects both human and animals. A recent research indicates many animals died due to train accidents mostly at night time. Despite railway authorities instructing the drivers to reduce the train speed in forest areas, there has not been much reduction in animals death from trains. The surveillance and tracking of animals are difficult due to their size. The negative effects of animal-vehicle collisions and the increase in collisions prompted the initiation of this project. Here the RFID card is placed 1km away from the animals crossing zones and speakers are placed near the crossing zone. When the train is 1km away, the RFID reader (Which is placed inside the train) detects the card placed in forest, and RFID Reader indicates the crossing zone is coming and DF player mini plays a loud sound near the animals crossing zone using speaker. We have found out that the animals are irritated by the sound, thus they move away from the track. And as soon as the RFID Reader reads the card the Loco pilot gets display the message inside the train that the crossing zone as occurred by these information the engine driver slow the train until train crosses the zone.*

Keywords: Extrication system, RFID card and reader, Arduino nano, DF Player Mini, Railway Track

I. INTRODUCTION

The Indian railways has the world's fourth longest railway network on the planet. At present railways is one of the widely used transportation system in the world. The extensive network of Indian Railways cuts across dense forests, habitat of various wild species. In many states, railway lines passing through animal habitats have led to numerous accidents and the death of 195 wild animals during 2019-2021. Many animals range widely across landscapes in the quest to meet their daily, seasonal and annual biological needs of food, water, shelter and mates. Train collisions were estimated in the province of British Columbia, Canada, during 1988–1990, with 266 collisions in a 92 km section of railways in Norway during 1980–1988, and between 9 and 725 collisions annually in Alaska. Similarly, 69 roe deer train collisions in the Czech Republic were reported during 2009. Therefore, there is an urgent need for more information on train–wildlife collisions and how these may be mitigated. India is one of the countries with serious problems of train–wildlife collisions. This is because the Indian Railways is one of the world's largest railway networks, comprising 115,000 km of tracks over a route of about 65,000 km and 7500 stations. In 2015–2016 Indian Railways transported more than 22,000,000 passengers and 3,000,000 tons of freight daily. Further more, the Indian Railway network cuts across various forested landscapes, and its impact on wildlife and their habitats has been a matter of increasing concern, although there are few studies on the subject. Direct as well as indirect impacts of the railways have exacerbated over the years with the expansion of the rail network, gauge conversion, and increases in frequency and speed of trains to meet the needs of a modernizing society and an increasing population. Elephants are architects of the forest and woodland ecosystem. Elephant intrusion across the railway track leads to Human-Elephant conflict, elephant death and injuries. Railway tracks pass through wild life habitats in several Indian states. In India, due to railway cross lines, the accidents that resulted in the death of 249 elephants during 1987-2018.

Elephants are the largest existing land animals. Elephants maintain "ecosystem" of the environment. So, it is necessary for us to save elephants. The issue of elephant mortality is definitely one of very serious concern and already several steps have been initiated by the Ministry of Railways along with Ministry of Environment and Forest for the mitigation

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of the problem. The “steps”—fencing, ramps and underpasses—however, have failed to prevent elephant deaths so far. We have heard tigers dying in road accidents which pass through the forests. But have we heard of Elephants dying on railway tracks? Yes, they do! There are 249 elephants dead in past 10 years! We talk about saving tigers, but why not elephants? Here, we have made a project finding a solution for the same. To give an idea of the numbers of accidents involving elephants along these tracks, 18 elephant deaths were recorded at Rajaji National Park, Uttarkhand, between 1987 and 2001, 35 deaths in Assam from 1987 to 2006, 16 in Odisha and 13 elephant deaths in Tamil Nadu between 2002 and 2013. However, the Siliguri Alipurduar track in northern West Bengal has witnessed the highest numbers of elephant deaths in train collisions; while 27 deaths were recorded between 1974 and 2002, the figure rose to 65 between 2004 and 2015 ; Dasgupta and Ghosh 2015; Roy and Sukumar 2016. As northern West Bengal is a “hotspot” of train–elephant collisions. The Union Ministry of Environment, Forest and Climate Change acted as early as 2016 to mitigate human-elephant conflict, but elephants have continued to die due to speeding trains. According to the Indian Railways, the Vande Bharat train was heading from Mumbai Central to Gandhinagar in Gujarat when the incident occured. "A cattle runover incident occurred with passing Vande Bharat train today near Atul in Mumbai Central division. The train was on its journey from Mumbai Central to Gandhinagar. Following the incident, the train was detained for about 15 minutes," the Indian Railways informed. It further added that the train has suffered no damage except the one at the nose cone cover of its front coach. On October 7, a similar incident was reported when a train running between Mumbai Central to Gurajat's Gandhinagar met with an accident between Vatva station to Maninagar. However, no functional part of the Gandhinagar-Mumbai Vande Bharat Express train was damaged as a result of it colliding with a herd of buffaloes came on that railway line. It is an modern technology which can be detect collision obstacle from particular distance of train and prevent collision energetically and efficiently by using arduino microcontroller, the object detection sensors are placed above the train tracks, these sensors will be monitoring the obstacles on the track and if it finds any object it will report the information to the train section.

II. LITERATURE SURVEY

[1] “Eradication of animals mortality and injury due to railway accident through automatic tracking and alert system” report explains the methodology to overcome the problem of animals mortality and injuries due to railway accidents by the use of automatic tracking and alert system. Automatic calling and tracking system has been implemented by incorporating GSM and GPS technology that would be attached to the body of an animals and would be continuously monitoring the position of the animal with respect to the GPS defined boundaries set up around the railway track. This system is flexible, cost effective and easy to implement and can be beneficial for monitoring animals related complexities like railway accidents, train delays, destruction of vegetation and threat to human life in the occasion of straying of elephants out of their habitation zone. The automatic tracking and alarm system can eliminate elephant death and injuries due to railway accidents and can also help the forest departments or any other responsible authorities monitor their movement so that they do not stray out of their habitation zone. Not many elephants are left in India. The time is fast approaching when this species will also become endangered. This tracking and alarm system will not be a huge monetary issue for Governments in terms of implementation and could see a decrement in elephant deaths due to railways accident.

[2] “Elephant meet with a gory end on rail tracks in india” The recent deaths of two elephants near Walayar of train-hit, the first within a forest range in Kerala in three years, have brought the focus right back to how little has been done to keep the wild animals safe in their own terrain. Railways plan a solution with Artificial Intelligence, while the Forest dept. promises increased vigil Last Friday, Vivek Express, the country’s longest running train from Kanyakumari to Dibrugarh in Assam, hit a herd of elephants at Kottamutti between the Walayar and Kanjikode stations on Railways’ B-line.

[3] "Preventing forest Animals from train accidents using outlier - Analysis algorithm in WSN“ According to recent survey by wildlife trust of india ,72 animals are dying each year due to collision with speeding trains , its high time we protect the lives of endangered species of animals. We need a mechanism to alert the animals from crossing railway

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tracks when the train is approaching near. This paper proposes a simple and efficient technique which alerts animals about speeding trains .so this proposed mechanism does not need human intervention for operation.

[4] In 2017, the Indian railway system launched a unique method called “Plan Bee in Deccan herald”. It is a amplifying system imitating the buzz of a swarm of honey bees. Thought this device, the buzzing sound of bees will be audible from a distance of 600 meters. The railways has been looking into the issue after animal deaths on the tracks increased sharply between 1987 and 2010. In the 23-year period, 150 elephants died while crossing railway tracks. Between 2009 and 2017, in just eight years, 120 elephants were killed on railway tracks. Limitation is the loco pilot couldn’t stop the train if the elephant is detected less than 600meters .due to this technology was not useful to save the elephants.

[5] “stray cattle continues to cause accident on tracks” discuss on the On reliable identification of factors influencing wildlife- vehicle collisions along roads by author. Wildlife-vehicle collisions (WVCs) are a global issue as many animals are killed on a daily basis on both roads and railways. Identification of the factors which influence the emergence of WVCs is important for application of suitable preventive measures. WVC numbers are rising in a number of countries. The aim of this study is to demonstrate, using genuine WVC data, that statistically significant local factors, which caused clustering of WVCs, should be reliably identified when WVC data are, prior to any statistical analysis, split into two groups: WVCs within clusters (representing spatially non-random events) and single WVCs which occurred outside the clusters (representing thus spatially random events better than places with zero WVC records).

[6] the Author designed “Automated detection and tracking of elephants in wildlife video”. The method does not make any assumptions about the environment and the recording setting. In a first step we learn a color model of the elephants from a small set of annotated training images. Learning the model does not include domain knowledge and explicitly specified constraints about elephants and their environment. The trained model is applied to individual frames of wildlife video sequences to identify candidate detections Next, we track the candidate detections over time and join temporally coherent detections in consecutive frames. As a result we obtain spatio temporally consistent detections which provide additional (stronger) clues for the detection of elephants. At the same time we obtain all information necessary to track the elephants in space and time.

III. OUTCOME OF LITERATURE SURVEY

By referring nearly10 papers and journals related to the project, the outcome for the literature survey is as follows it can conclude that many surveys had been done on extrication system of wildlife on railway tracks

- GPS is attached to the body of an animals so, when it is missed by default we cannot monitor
- The plan bee which was useful but the loco pilot couldn’t stop the train if has come near to the elephant
- Simulation part was not accomplished completely
- Not able make the animals movement fast while crossing track

IV. PROBLEM STATEMENT

Designing a technology oriented Rescue System of wildlife on Railway Tracks so that no wildlife is lost due to train accidents

V. METHODOLOGY

Proposed Model:

The proposed system totally consist of two different section as Transmitter section, Receiver section. The above figure shows the block diagram of proposed model, here the transmitter section consist of RFID module, LCD display, RF transmitter connected to the Arduino Nano. As soon as the RFID Reader reads the RFID tag which is placed 1km away from the crossing zone, the crossing zones are identified. Based on the observation of the animals routine by noticing this is the animals crossing zone. After specifying the zone RFID tag is placed 1Km away and that Tag gets scanned by the RFID reader which is placed inside the train this reader sends the information after reading the tag to the Arduino, by this information sent to the display that the crossing zone has been occurred near to display this information the LCD

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display is used this helps the loco pilot to maintain the minimum speed till the train crosses the zone. Then the RF Transmitter sends the message to the RF Receiver.

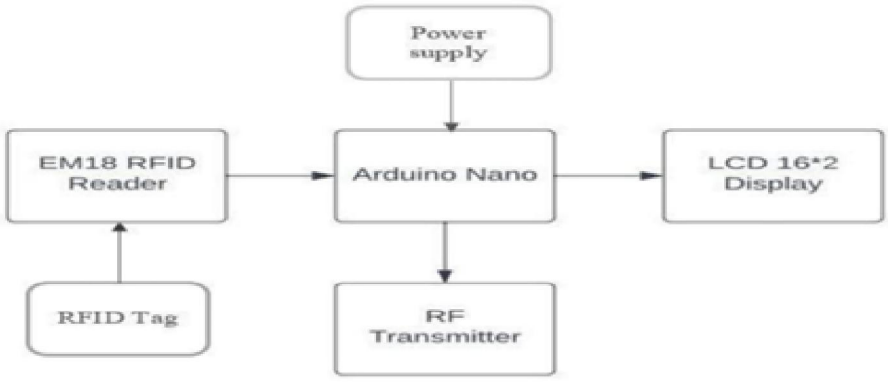

Fig 1: Block Diagram of Tranmitter section

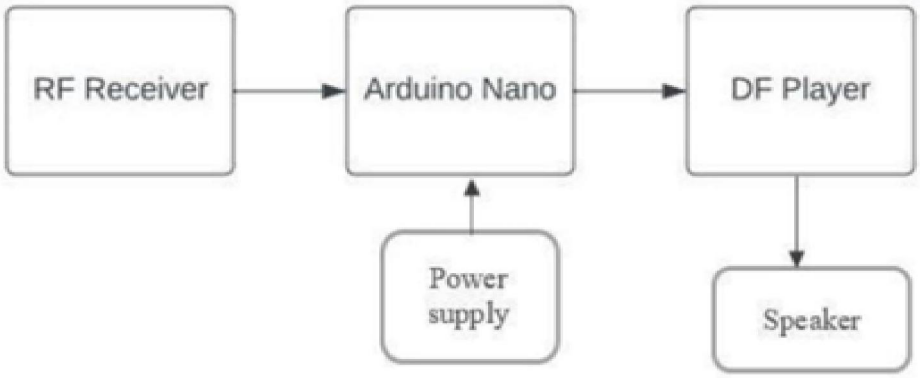

Fig 2: Block Diagram of Receiver section

The other section is the receiver section consists of RF receiver, DF player connected to the Arduino as soon as receiver receives the message from the transmitter and sends to Arduino Nano then it sends the information to DF player to play the particular song for the crossing zone. After receiving the message the DF player search for the song to be played for that crossing zone and it will be played using the Speaker. The song play here is to distract the animal near by the crossing zone, the animal get nervous to some sound or they get fear so they run away from that place for example the elephant is afraid of honey bee buzzing sound. By hearing this sound elephant get distracted or irritated by this buzzing sound and move on from track. So by using this technique the various sound will be played for different animal for which they are afraid of and the song gets off as soon as the train crosses the crossing zone. By this the animals life can be saved easily. If the animal get stucked in or isn't moving away from the track the loco pilot will stop the train and then move on after the track is clear.

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Flow Chart

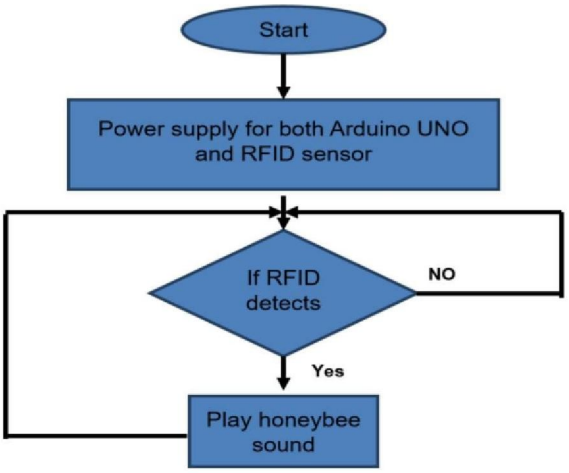

Fig 3: Flowchart of proposed model

VI. HARDWARE AND SOFTWARE REQUIREMENTS

- **Arduino Nano**

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P released in 2008. It offers the same connectivity and specs of the Arduino Uno board in a smaller form factor. The Arduino Nano is equipped with 30 male I/O headers, in a DIP-30-like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-B mini-USB cable or from a 9V battery. The Arduino Nano has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An FTDI FT232RL on the board channels this serial communication over USB and the FTDI drivers (included with the Arduino firmware) provide a virtual com port to software on the computer. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board flash when data is being transmitted via the FTDI chip and the USB connection to the computer (but not for serial communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Nano's digital pins. The ATmega328 also supports I2C and SPI communication. The Arduino software includes the Wire library to simplify use of the I2C bus.

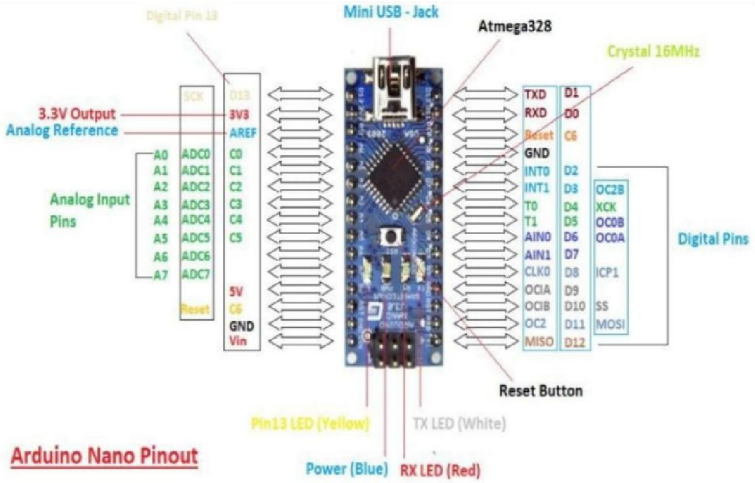

Fig 4: Arduino Nano

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- **RFID Reader Module**

Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. An RFID system consists of a tiny radio transponder, a radio receiver and transmitter. When triggered by an electromagnetic interrogation pulse from a nearby RFID reader device, the tag transmits digital data, usually an identifying inventory number, back to the reader. This number can be used to track inventory goods. Passive tags are powered by energy from the RFID reader's interrogating radio waves. Active tags are powered by a battery and thus can be read at a greater range from the RFID reader, up to hundreds of meters. Unlike a barcode, the tag does not need to be within the line of sight of the reader, so it may be embedded in the tracked object. RFID is one method of automatic identification and data capture (AIDC). RFID tags are used in many industries. For example, an RFID tag attached to an automobile during production can be used to track its progress through the assembly line, RFID-tagged pharmaceuticals can be tracked through warehouses, and implanting RFID microchips in livestock and pets enables positive identification of animals. Tags can also be used in shops to expedite checkout, and to prevent theft by customers and employees. Since RFID tags can be attached to physical money, clothing, and possessions, or implanted in animals and people, the possibility of reading personally-linked information without consent has raised serious privacy concerns. These concerns resulted in standard specifications development addressing privacy and security issues. In 2014, the world RFID market was worth US$8.89 billion, up from US$7.77 billion in 2013 and US$6.96 billion in 2012. This figure includes tags, readers, and software/services for RFID cards, labels, fobs, and all other form factors. The market value is expected to rise from US$12.08 billion in 2020 to US$16.23 billion by 2029.

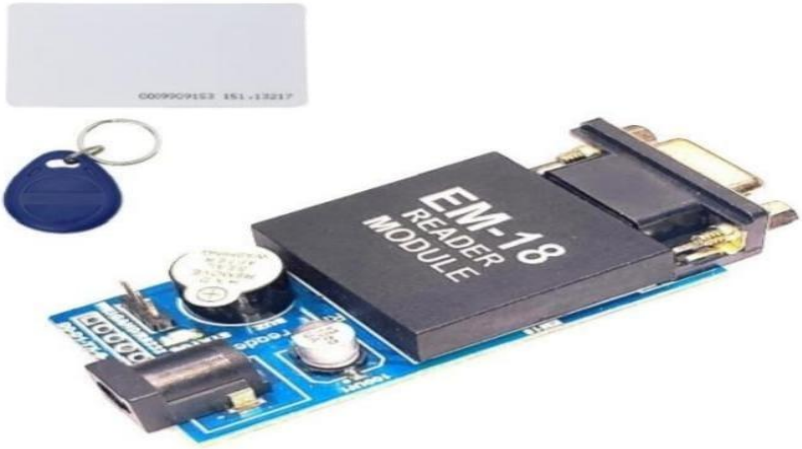

Fig 5: EM-18 RFID Reader Module

- **RF Transceiver Module**

A transceiver is a blend of a transmitter and a receiver in a single package. The name applies to wireless communication devices like cellular telephones, handheld two-way radios, cordless telephone sets, and mobile two-way radios. Sometimes the term is used in reference to the transmitter or receiver devices in optical fiber systems or cables. In a radio transceiver, the receiver is silenced while transmitting. An electronic switch permits the transmitter and receiver to be allied to the same antenna and stops the o/p of the transmitter from injuring the receiver. With this kind of transceiver, it is difficult to get signals while transmitting and this mode is named half-duplex. Some kind of transceiver is designed to let reception of signals through transmission periods. This mode is called full-duplex and needs that the transmitter (TX) and receiver (RX) work on considerably different frequencies so the signal which is transmitted doesn't interfere with reception. Communication device sets use this mode. Satellite communication networks frequently employ full-duplex transceivers at the surface-based subscriber points. The transceiver-to-satellite (transmitted) signal is called the uplink, and the satellite-to-transceiver (received) signal is called the downlink.

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Fig 6 :433MHz RSI RF Transceiver Module

- **DF Player Mini**

The DF Player Mini MP3 Player for Arduino is a small and low price MP3 module with an simplified output directly to the speaker. The module can be used as a stand alone module with attached battery, speaker and push buttons or used in combination with an Arduino UNO or any other with RX/TX capabilities.

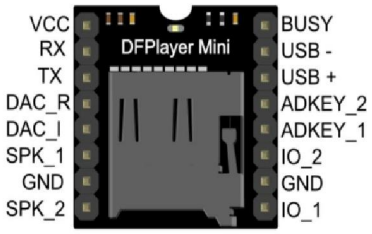

Fig 7 : DF Player mini

- **Memory Card**

Secure Digital, officially abbreviated as SD, is a proprietary non-volatile flash memory card format developed by the SD Association (SDA) for use in portable devices. The standard was introduced in August 1999 by joint efforts between SanDisk, Panasonic (Matsushita) and Toshiba as an improvement over Multimedia Cards (MMCs), and has become the industry standard. The three companies formed SD-3C, LLC, a company that licenses and enforces intellectual property rights associated with SD memory cards and SD host and ancillary products. The companies also formed the SD Association (SDA), a non-profit organization, in January 2000 to promote and create SD Card standards. SDA today has about 1,000 member companies. The SDA uses several trademarked logos owned and licensed by SD-3C to enforce compliance with its specifications and assure users of compatibility.

Fig 8: Memory card

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- **LCD Display Module**

Liquid Crystal Display (LCD) is widely used in various electronics' applications. It is commonly used in various systems to show different status and parameters. LCD16x2 has 2 lines with 16 characters in each line. Each character is made up of 5x8 (column x row) pixel matrix.

Fig 9: LCD Display Module

- **Speaker**

Multimedia speakers, are speakers sold for use with computers, although usually capable of other audio uses, e.g. for an MP3 player. Most such speakers have an internal amplifier and consequently require a power source, which may be by a mains power supply often via an AC adapter, batteries, or a USB port. The signal input connector is often a 3.5 mm jack plug (usually color-coded lime green per the PC 99 standard); RCA connectors are sometimes used, and a USB port may supply both signal and power (requiring additional circuitry, and only suitable for use with a computer). Battery-powered wireless Bluetooth speakers require no connections at all. Most computers have speakers of low power and quality built in; when external speakers are connected they disable the built-in speakers. Computer speakers sometimes packaged with computer systems are small, plastic, and have mediocre sound quality. Some computer speakers have equalization features such as bass and treble controls. Bluetooth speakers can be connected with a computer by using an Aux jack and compatible adaptor.

Fig 10: Speaker

- **Lithium-Ion (Li-ion) Battery**

A lithium-ion or Li-ion battery is a type of rechargeable battery which uses the reversible reduction of lithium ions to store energy. It is the predominant battery type used in portable consumer electronics and electric vehicles. It also sees significant use for grid-scale energy storage and military and aerospace applications. Compared to other rechargeable battery technologies, Li-ion batteries have high energy densities, low self-discharge, and no memory effect (although a small memory effect reported in LFP cells has been traced to poorly made cells).

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Fig 11 : Lithium ion battery

Software requirements

- **Arduino IDE**

The Arduino integrated development environment (IDE) is a cross-platform application (for Microsoft Windows, mac OS, and Linux) that is written in the Java programming language. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching, and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one clicks mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. The source code for the IDE is released under the GNU General Public License, version 2.The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main () into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. From version 1.8.12, Arduino IDE windows compiler supports only Windows 7 or newer OS. On Windows Vista or older one gets "Unrecognized Win32 application" error when trying to verify/upload program. To run IDE on older machines, users can either use version 1.8.11, or copy "Arduino-builder" executable from version 11 to their current install folder as it's independent from IDE.

Fig 12: Arduino IDE

VII. EXPECTED OUTCOME

This paper is proposed to frighten the animals in the forest range where the train will passes, RFID reader module. If such system is adapted in railways, when the RFID senses the Crossing zone through the RFID Tag it will sends the signal to the Arduino then it will play frightening sound through speaker for different animals and this total module consists of two modules each module have their own importance, the RFID reader module will convey such crossing

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zones message to train pilot monitoring unit which helps the pilot slow down the train. The train collision will prevent and animal life is saved. This system is the cheapest and efficient of rest all.

VIII. CONCLUSION

Every other day, some or the other species are getting extinct. Some species have become rare. Thousand are endangered. And some are on the verge of extinction. Time have come when strict counter measures needs to be taken up by the Government and made sure that it gets implemented regularly. The automatic tracking and alarm system can eliminate elephant death and injuries due to railway accidents and can also help the forest departments or any other responsible authorities monitor their movement so that they do not stray out of their habitation zone. Not many elephants are left in India. The time is fast approaching when this species will also become endangered. This tracking and alarm system will not be a huge monetary issue for Governments in terms of implementation and could see a decrement in elephant deaths due to railways accident. As human activities had led to intervention in wildlife, its consequences are visible in terms of animal extinction. Nowadays a lot of efforts are being made for animal conservation and advanced technology can certainly help in this regard. The Internet of things can do a lot in this direction. This project will reduce the man –power and prevents animals' death on the railway tracks by which animals (ecosystem engineers) will be able to maintain our ecosystem. This system can be further System can be powered using solar energy System and can be upgraded by connecting speaker through Bluetooth

REFERENCES

[1] Elephants meet with a gory end on rail tracks in Kerala " by published in Deccan herald in Oct 20, 2022
[2] Railway track tracer system for creature detection by M deepa in Feb 2021.
[3] Cattle — The Real Menace on Indian Highways, Feb. 2020,
[4] Stray Cattle Continues to Cause Accidents on Roads,Feb.2020, [online]Available:http://timesofindia.indiatimes.
[5] S. Shaikh, M. Jadhav, N. Nehe and U. Verma, "Automatic animal detection and warning system", Int. J.Adv. Found. Res. Comput., vol. 2, pp. 405-410, Jan. 2020.
[6] "Preventing forest Animals from train accidents using outlier - Analysis algorithm in WSN" By - V P Jayachitra & sumalatha Ramachandran April 2019.
[7] Information on Safe Following Distances Between Vehicles, May 2018, [online]Available: https://www.qld.gov.au/transport/safety/rules/road/distances.
[8] In 2017, the Indian railway system launched a unique method called "Plan Bee" by Swaraj Singh published in Deccan Herald.
[9] "Eradication of animals mortality and injury due to railway accidents through automatic tracking and alert system"By - Nirit datta, Saurabhkumar, Ashutosh mallick in April 2016.
[10] Ando, Chieko. "The relationship between deer-train collisions and daily activity of the sika deer, Cervus nippon." Mammal Study 28, no. 2 (2003): 135-143.