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FULLY AUTOMATED METRO TRAIN WITH ENHANCED SAFETY

Mandara. C.Y[1], Chandana. S [2],Charan. A[3],Ankitha. V[4], Dr. M. Levy[5]

[1 2 3 4] *Dept of Electronics and Communication, Sambhram Institute of Technology, India.*

[5]*Professor,Dept of Electronics and Communication, Sambhram Institute of Technology, India.*

ABSTRACT

In order to achieve high safety, we need advanced metro train system. The further features have been added in this metro train system electronically and mechanically, which help to achieve quick delivery without any traffic congestions. In order to overcome the drawbacks of existing system we are presenting Fully Automated Metro Train with enhanced safety features. The proposed system can provide comfortable travel to the passengers. Here Train runs between two predefined stations without having any driver inside in it. Since this prototype is fully, when implemented in real time system, it provides more safety against antisocial-activities such terrorist attacks. It helps to rescue the people from unexpected situations such as fire accidents and also provides medical alert, Theft alert and emergency alert to next station as well as control unit which is not present in current metro train system. It ensures the journey of the train on the tracks is safe by monitoring the tracks through monitoring unit. This fully automated metro system also makes efficient use of solar energy and piezoelectric energy. TheLI-FI communication is used for announcements. Additional enhanced features are explained in further sections.

Keywords: Crack detection,Fully Automated, Issue Selector, LI-FI, Solar, Piezoelectric.

I.INTRODUCTION

In various countries Rapid Transit or Mass Rapid Transit (MRT), is known in different names such as heavy rail, metro, subway, tube, U-Bahn or underground. It is a type of high-capacitypublic transportgenerally found inurban areas. Rapid transit systems areelectric railwayswhich cannot be accessed by amblers or other vehicles of any sort and which is oftengrade separatedintunnelsor on elevated railways.

It is inexpensive mode of travel, which helps in dropping energy consumption, is eco-friendly and the reason behind the prevention of accidents. The modern design of metro coaches, the fashionable appearance of metro stations and higher comfort facilities are some of the reasons why metro is becoming popular in India.

Namma Metro, also known as Bengaluru Metro is arapid transitsystem serving the city ofBengaluru,India.It is the fourth longest operational metro network in India after theDelhi Metro,Hyderabad MetroandChennai Metro.It also contains the first underground metro line inSouth India.The trains are composed of three to six coaches. Because of zero traffic facility, everyone is preferring metro transportation.

The current metro train system still has a lot of room for improvements which can be implemented using automation. The existing metro train system is semi-automated i.e, everything is controlled by man power which sometimes cause huge loss because of human errors. So fully automated metro train can overcome the drawbacks of current system. It makes thousands of passengers to travel in the train with more comfort by providing enhanced safety. The automated system for a metro train is an integrated application which makes announcements and displays the relevant station information when the train reaches a particular station.

The implementation multi-ticketing system can be done based on Radio Frequency Tags and corresponding readers. LI-FI communication is used for announcements and track detection can be achieved which is not present in existing system. Serial communication, non-volatile memory storage, voice chip implementation and others aid in bringing out the desired functionality.

This embedded application mainly focuses on overcoming loop holes in the existing system. It is optimized to meet the cost and power consumption requirements.

Fig 1: People rushing towards train

Fig 2: Inside of the current metro train system

Fig 3: Existing system (Metro train with driver)

II.LITERATURE SURVEY

[1] In paper entitled with **"Advanced Mechanized Metro Train",** Bomdar Bagra1, Vinay Kesharwani focused on passenger's safety so this prototype included the features such as collusion avoidance with the help of ultrasonic sensor and AT-MEGA 328p as it's core unit. It also monitors the temperature of wheels using IR sensors. Based on the information delivered by these sensor systems the train will stop and avoid any accidents..It's purpose is to provide high safety to passengers in order to save number of lives from human errors. The station announcements are completely automated.

[2] In paper entitled with **"Automated Metro Train to shuttle between two stations" ,**Premchand bharti1, Ratneshpandey designed metro train concept in which arrived stations can be detected using IR sensors and automatic door closing and opening is achieved. The numeral of travellers boarding and de-boarding is supervised by 2 pairs of IR sensors.

[3] In paper entitled with **"Driverless ,Metro Train "** ,Hemang Jani and Abhishek proposed a Driverless metro system in which PIC microcontroller is used to perform entire task of a train without assistance of any driver inside it. This also includes the implementation of LCD screen which helps to display the passenger count. It also focused on reducing human errors , less power consumption and to provide comfortable safe journey to the passengers during travelling.

[4] In paper entitled with **"Smart Metro train",**A.P More, MonaliSarade [4] proposed a smart metro train concept which is programmed using ARM7 microcontroller. It avoid the assistance of any driver to run the train. This prototype involves RFID module for ticketing system which allows the passengers to platform if their card is valid and relevant data is displayed on the LCD.

[5] In the paper entitled with **"Estimation of Passenger Route Choice pattern using Smart card data for complex metro systems"** ,Juanjuan Zhao, Fan Zhang [5] established a proposal using Automated fare collection (AFC) which helps to estimate how the passengers movements are forwarded to various routes and trains. Since existing system works in particular situations this paper going to make the system to work for complicated situations. This model can estimate from empirical analysis how the passenger flows are dispatched to different routs and trains.

[6] In the paper entitled with**"Field tests of an LTE-based wireless Train Backbone in metro environments" ,**Igor Lopez , Javier Goikoetxea developed a wireless system in metro using LTE and antennas operating in 5.8G Hz and required tests are performed using BOXPCS. It involves virtual coupling and train integrity as well.They have also indicated the dependency of the backbone performance with the reflections in the surrounding environment, due to the non-line-of-sight(NLOS) link between the antennas, as well as the limitations of operating in the 5.8 GHz ISM band. As a result of these tests, future steps have been identified for achieving an operational railway LTE backbone.

[7] In the paper entitled with **"Driverless Metro Train using ARM7",** Parkash Ratan Tambare proposed an idea to make train system to driverless using LPC2148 from ARM7 family. This includes station's announcements and automatic door terminating and opening. It has future developments for better metro train transportation.

III. PROPOSED SYSTEM

The proposed system makes use of microcontroller as central processing unit which controls every functions of the train. This Advance Mechanized Metro Train performs automatic open and closing of door in each station.

The train is highly sensitive to any obstacle that comes into the track. When it detects any obstacle, the train will automatically stop and the information is sent to the control unit so that required action will be taken by the central unit. The stations announcements can be done automatically with respect to the station arrived and train

gives an alarm while it is about to depart the station. LI-FI communication is used for announcements which is faster form of communication and very much helpful in underground tunnel communication.

RFID card is used for multi-ticketing (single card for multiple people) as prepaid metro card at entry and exit of metro station. The proposed system also introduces new feature called ' Issue selector' which involves multiple options such as Medical alert, Theft alert and Emergency alert. If any medical emergencies come such as heart attack or any other situations like 'Theft', this issue selector will be helpful to the passengers so that next station will be ready with required facilities to give quick response to the event occurred.

This prototype will measure the weight contained inside of the train more accurately than the traditional passenger counting method to avoid the weight inside the coach or compartment from exceeding its limit so that train can transport more efficiently. If the weight inside the coach exceeded then train will stop and message will be sent to the control unit saying that capacity of the train is crossed.

In our proposal we have introduced smoke detector which detects smoke caused by fire inside the coach and gives an alarm before any disaster can takes place so that we can save thousands of lives as well as precious metro train which is one of the public properties. Currently, metro trains are running by electric energy which is expensive to provide high voltage to run the trains so our prototype is going to utilize Solar energy and piezoelectric energy to run the train. This piezo electric can be plates or carpets which can be placed on platforms and entry and exit gates where more people are walking. It is one time investment we no need to invest repeatedly and it makes efficient usage of renewable energy sources.

Fig 4: Floor with Piezoelectric

Fig 5: Piezoelectric placed at entry and exit gates.

Fig 6: Solar panels placed on station's roof.

Fig 7: Driverless metro train

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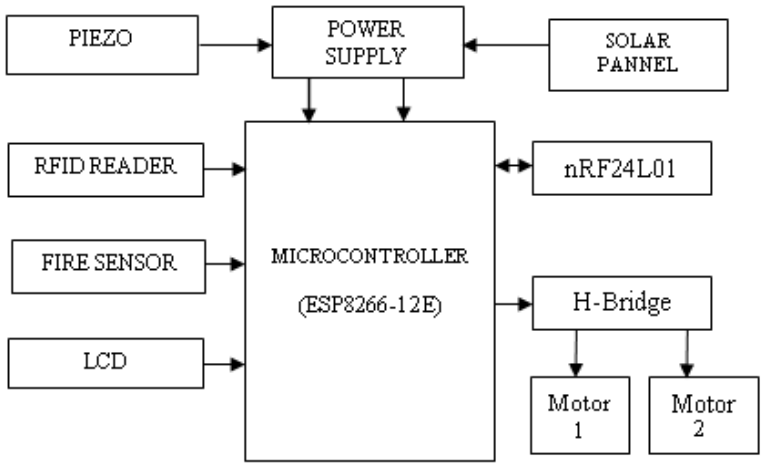
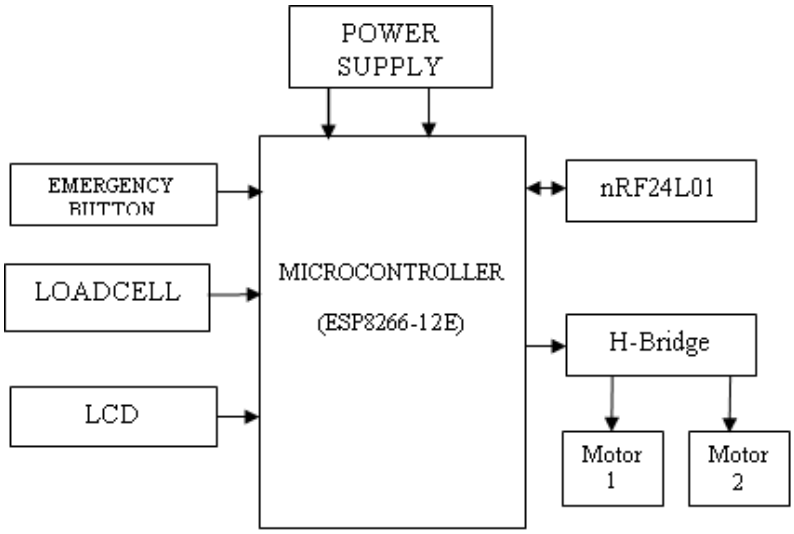
IV. METHODOLOGY

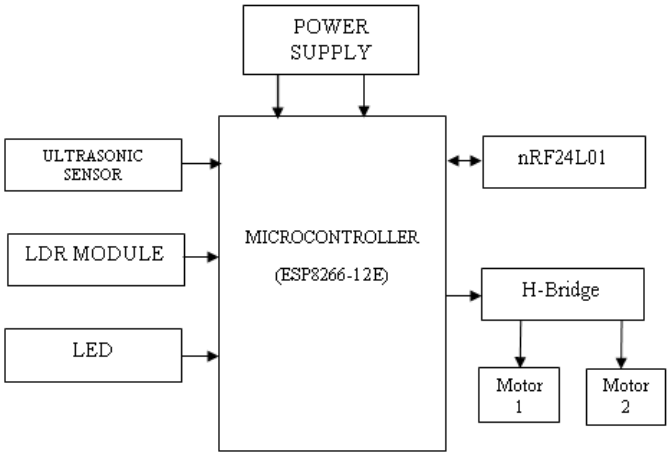
4.1 Engine



4.2 coach



4.3 Monitoring unit



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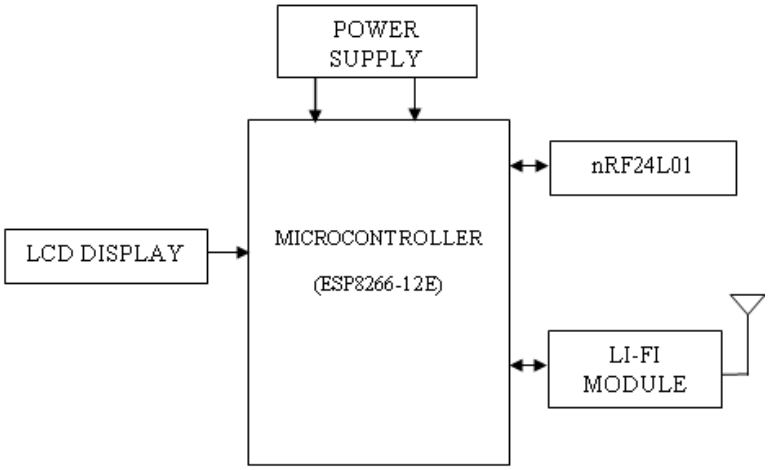
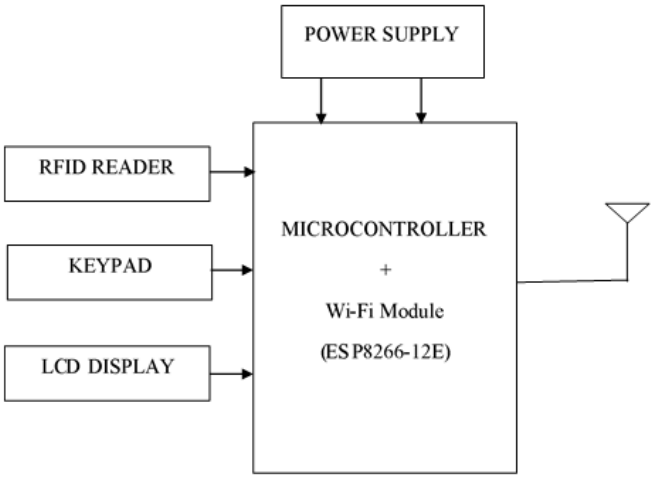
4.4 Control Room Unit



4.5 Station



The proposed system is mainly streamed towards end to end automation in metro train technology which includesmajorly 5 different modules.

- Monitoring Unit.
- Coach Unit.
- RFID Based ticket.
- Driverless Metro.
- Renewable Energy.

4.6 Monitoring Unit:

The system includes monitoring unit which runs ahead of metro train to ensure the safe journey of train by conducting the safety check before train approaches that spot, the system always leads the train which checks for the crack defects in track using LDR module and LED combination mechanism where light is passed using LED and LDR module is used to monitor the light which penetrates through the crack defects.

The unit also detects for obstacle on track using ultrasonic sensor to avoid collision. Any of the above abnormalities if detected by monitoring unit will be sent immediately to the engine unit of metro train using wireless technology Nrf24L01 and the train automatically stops. The alert is provided to control room unit also using wireless module so that authority can conduct necessary actions.

4.7 Coach Unit:

Every coach unit is installed with load cell which monitors the weight of passengers boarding on the coach, when the load exceeds the limit it is considered as overload condition and alert is provided to the control room and also the metro train will stop automatically.

The unit is also installed with emergency alert system where passenger can select the type of emergency condition using keys and screen to select, the selected emergency alert is sent to control room over the wireless module.

4.8 RFID based ticket system

Ticket system is implemented using RFID technology, where passengers carry RFID cards and RFID reader is placed at entry and exit points of metro stations.

When RFID card is tapped at the entry station, passenger can select single ticket or group ticket, when group ticket is selected, number of passengers can be selected and accordingly the charges will be deducted at the exit stations.

RFID cards can be recharged via android app provided to the passenger. When passenger updates the ticket, selection based on single or group ticket, the made selection is updated on to the online central server using Wi-Fi module ESP8266-12E. All the charges deduction at the exit points and on-going trips is updated to the online central server.

4.9 Driverless Metro

Nearest control room is used to trigger the metro train journey by using control switch and thereafter the metro train will stop automatically at every station without any human required to drive it manually. Using the LDR module and LED combination the train is stopped at every station for some regular interval of time and it moves automatically to next station. Li-Fi technology is used to audio announce the control room and platform about the approached train on the station.

4.10 Renewable Energy

Metro station and trains runs on electrical energy hence lots of power is required to manage the stations, so a renewable energy resource is used to energize and support the stations and train. Solar panels and piezo electric plates are installed at required places to generate the power efficiently and is stored in the battery.

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V. RESULTS AND ANALYSIS

PROPOSED METRO TRAIN SYSTEM	EXISTING METRO TRAIN SYSTEM
Fully Automated.	Semi-Automated.
Single card can be used for multi-ticketing purpose.	Single card cannot be used for multi-ticketing purpose.
Issue Selector is implemented (Medical alert, Theft alert and Emergency alert).	Issue selector is not present.
A system for checking capacity of a coach is developed.	There is no system to check coach capacity.
Automated station's announcements can be done by using LI-FI.	Station's announcements, door closing and opening system are controlled by the driver.
Solar energy and piezoelectric energy sources are used to run the train.	Electricity is used to run the train which is expensive.
Crack detection can be done and information is sent to control unit.	No crack detection facility is available.
LI-FI communication is implemented.	LI-FI communication is not implemented.

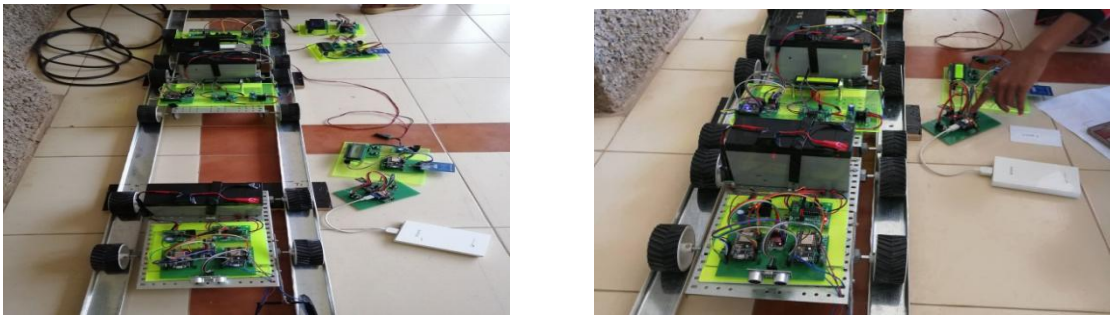

Fig 8: Working Model

VI. ADVANTAGES

- Manpower required for operation of train can be reduced.
- Reduced installation and integration time in the system.
- Monitoring the load contained inside the coach through load cell is better approach to prevent overloading and derailment.
- Service monitoring technology helps to identify the system operations and tracking vehicle location and quality and adequacy of service, automatic train supervision (ATS), and automatic vehicle location (AVL).
- Prevention of loss of life and property that can occur because of human errors.

- Harnessing solar energy and piezo electric energy helps in energy conservation that leads to low utility bills and increases the efficiency.
- The facility where a metro cardholder can buy multiple tickets for his/her fellow passengers can reduce the time that is required to stand in a queue to collect the tickets.
- Fully automated, driverless operations increase system availability, network capacity and operational efficiency to meet these challenges
- Creates demand for new jobs such as hi-tech machine experts, software developers and wireless network engineers.

VII. DISADVANTAGES

- Due to complex operations switching from a state to the end state might be difficult.
- Hackers getting into the vehicle's software and controlling or affecting its operation would be a major security worry.
- The efficiency of the solar panel drops in case of cloudy or rainy days.
- A single glitch in the computer may cause a major accident.

VIII. ACKNOWLEDGEMENT

The satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mention of the people who made it possible, whose constant guidance and encouragement crowned the efforts with success. We would like to profoundly thank Management of Sambhram Institute of Technologyfor providing such a healthy environment for the successful completion of project work. We would like to express our thanks to the Principal Dr.Chandrakanth for his encouragement that motivated us for the successful completion of project work. It gives us immense pleasure to thank Dr. C V Ravishankar,Professor and Head of Department of ECE for his constant support and encouragement. Also, we would like to express our deepest sense of gratitude to ourproject guide Dr.M.Levy,Professor, Department of Electronics and Communication Engineering for his constant support and guidance throughout the project work. We would also like to thank the project Coordinators and all other teaching and non-teaching staffs Department of ECE who has directly or indirectly helped me in the completion of the project work.

IX. CONCLUSION

Mass rapid transit or rapid mass transit (RMT) was introduced to provide a transport system with very less or no traffic transportation more efficiently than the traditional railway systems. This project is implemented with automations that help us to overcome the drawbacks in the current metro train system. The automations implemented in this project is not limited to metro trains alone, it can be implemented in other domains according to the requirements of the user. This project can be developed further by installing cameras in the coach with image processing in order to report any unseemly activity to the concerned authorities.

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ABOUT THE AUTHORS

DR. M. LEVY is currently working as Professor in the Department of Electronics and Communication Engineering at Sambhram Institute of Technology, Bengaluru. He is also the P.G Coordinator and Research Coordinator in ECE Department. He has obtained his Ph. D Degree in the thesis entitled "Investigations on fractal concepts in smart antennas, ultra-wide band antennas and optical antennas" jointly from University of Saskatchewan, Saskatoon Canada and National Institute of Technology, Tiruchirappalli, Tamil Nadu, India. Entering as Topper in Government Engineering College, Pondicherry affiliated to Pondicherry University, he has done Bachelor of Technology in Electronics and Communication Engineering. He studied Masters of Technology in Electronics and Communication Engineering as a top GATE candidate in the Pondicherry Engineering College, Government Undertaken, Pondicherry affiliated to Pondicherry University and completed as University Top Ranker and Gold Medallist. He has also won the Best Student Award and Chief Ministers Gold Medal Prize. He is also the Recipient of Best Project Award for his M.Tech

Project. He has attended several Workshops, Seminars, Faculty Development Programs, National and International Conferences, Specialized training Programs and presented several technical papers and also delivered special talks at various colleges, special gatherings and Institution of Engineers, India (IEI). He was a participant in the President meeting held at Anna university, Chennai and attended the special lecture delivered by Dr.A.P.J.AbdhulKalam, the then President of India in the year July 2003. He has Keen interest for Research in the Field of Smart Antennas for Wireless Communications, optical antennas and Ultra-Wide Band Antennas applying fractal concepts and working in the Areas of Applications and developing new algorithms in Smart Antennas Technology for Mobile Communications, designed and developed novel UWB antennas and done numerical analysis for the designed antennas. He has around 25 national and international conference papers published 15 international journal research papers in reputed journals and four journal papers are under preparation. He has won the MHRD scholarship and Canadian common wealth scholarship and is having International research experience at Canada from January 2012 to July 2012 at the University of Saskatchewan, Saskatoon, Canada under the leadership of Dr. Anh Dinh, Professor, Dept. of Computer and Electrical Engineering. He is having total 20 years of teaching experience and taught many subjects and guided around 20 B.Tech and M. Tech projects. He has applied to various organisations for funded projects which is under review. **Mandara. C.Y, Chandana. S ,Charan. A and ,Ankitha. V** are Final Year students of Electronics and Communication Engineering from Sambhram Institute of Technology, Bengaluru.