Fully Automated Metro Train with Enhanced Safety

Shripad G Desai[1], Akash Sudhakar Bhavsar[2]

[1]*Assistant Professor, Department of Electrical Engineering, Bharati Vidhyapeeth Deemed to Be University, College of Engineering, Pune, India*

[2]*Student, Department of Electrical Engineering, Bharati Vidhyapeeth Deemed to Be University, College of Engineering, Pune, 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. The LI-FI communication is used for announcements.**

Index Terms - **Crack detection, Fully Automated, Issue Selector, LI-FI, Solar, and 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-capacity public transport generally found in urban areas. Rapid transit systems are electric railways which cannot be accessed by amblers or other vehicles of any sort and which is often grade separated in tunnels or 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 a rapid transit system serving the city of Bengaluru, India. It is the fourth longest operational metro network in India after the Delhi Metro, Hyderabad Metro and Chennai Metro. It also contains the first underground metro line in South India. The trains are composed of three to six coaches. Because of zero traffic facility, everyone prefers 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 manpower 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 loopholes in the existing system. It is optimized to meet the cost and power consumption requirements.

II. IMPLIMANTATION ON AUTOMATED METRO

[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 collision avoidance with the help of ultrasonic sensor and AT-MEGA 328p as it "score 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. Its 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 travelers boarding, and de-boarding is supervised by 2 pairs of IR sensors.

[3] In paper entitled with "Driverless, Metro Train", Heming Jain 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 avoids 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", Jajuan 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", Prakash Rattan Tambar 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
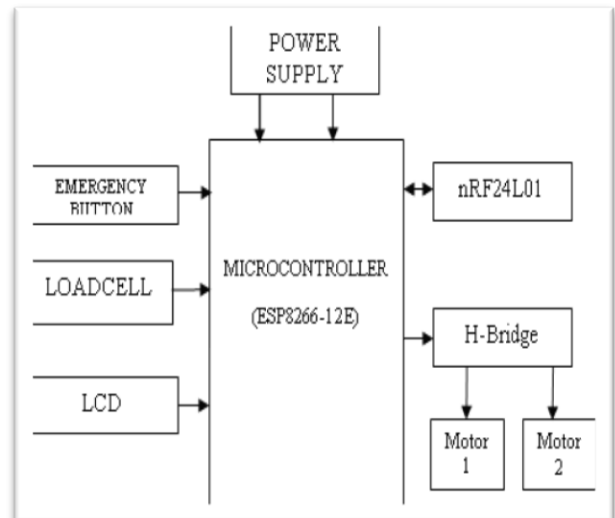
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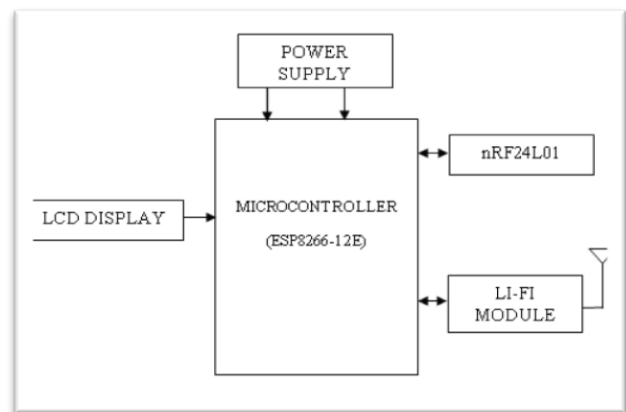
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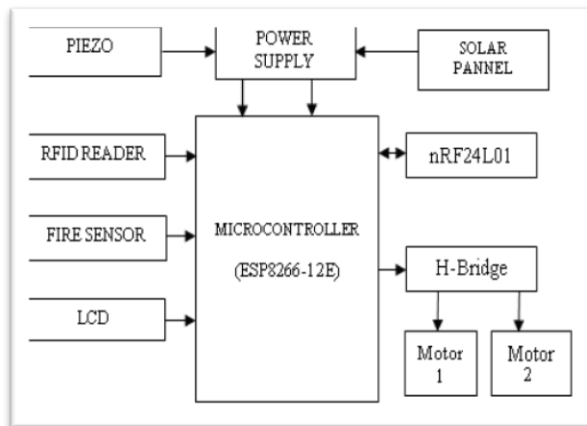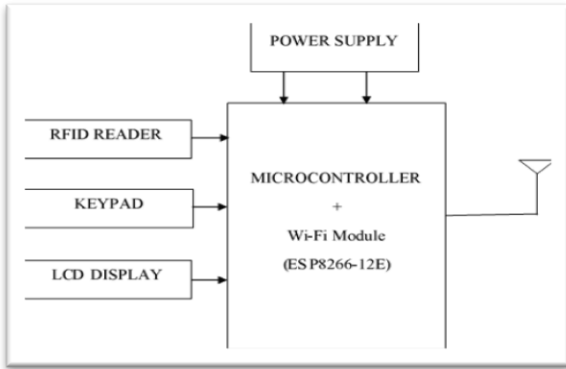
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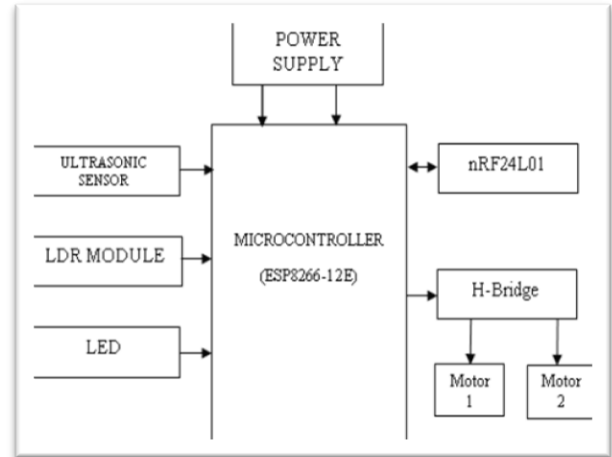
4.3: MONITORING UNIT SUPPLY:

4.4: CONTROL ROOM UNIT SUPPLY:

4.5 STATION SUPPLY:

The proposed system is mainly streamed towards end to end automation in metro train technology which includes majorly 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.

V. 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.

- Prevention of loss of life and property that can occur because of human errors
- 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).
- Creates demand for new jobs such as hi-tech machine experts, software developers and wireless network engineers.
- Fully automated, driverless operations increase system availability, network capacity and operational efficiency to meet these challenges
- 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.
- Harnessing solar energy and piezo electric energy helps in energy conservation that leads to low utility bills and increases the efficiency.

VI. DISADVANTAGES

- A single glitch in the computer may cause a major accident.
- The efficiency of the solar panel drops in case of cloudy or rainy days.
- 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.

VII. ACKNOWLEDGMENT

VIII. 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.

REFERENCES

[1] Parkash Ratan Tambare,Chandra Jogi, "Driverless Metro Train using ARM7".

[2] http://ebookbrowse.com/73-rfid-based-bus-ticketing-system-doc258240289.

[3] Hasan, M.F.M.; Tangim, G.; Islam, M.K.; Khandokar, M.R.H.; Alam, A.U., "RFID- Based ticketing for public transport system: Perspective Megacity Dhaka", Computer Science and Information Technology (ICCSIT), 2010 3rd IEEE International Conference Volume:6)

[4] Bomdar Bagra1, Vinay Kesharwani, Neerajsingh, "Advanced Mechanized Metro Train","IOSR Journal of Engineering(IOSRJEN)", ISSN (e): 2250-3021, ISSN(p): 2278-8719,volume 5,PP 21-24.

[5] Divyang Kaka, Harshad Sonawane, Hemang Jani, Abhishek Patel, "Driverless Metro Train "," International Research Journal of Engineering and Technology (IRJET)", e-ISSN: 2395-0056Volume: 05 Issue: 03 | Mar-2018.

[6] Prem chand bharti1, Ratneshpandey "Automated Metro Train to shuttle between two stations", "International Research Journal of Engineering and Technology (IRJET) ", e-ISSN: 2395-0056 Volume: 05 Issue: 03 | Mar-2018, p-ISSN: 2395-0072, IRJET | Impact Factor value: 6.171 | ISO 9001:2008 Certified Journal | Page 647.

[7] P. More, MonaliSarade, Madhura Punde, Shatataraka Ulhalkar," Smart Metro Train", International Journal of Research in Engineering, Science and Management (IJRESM), Volume-1, Issue-4, April 2018

[8] Igor Lopez, Javier Goikoetxea," Field tests of an LTE-based wireless Train Backbone in metro environments".

[9] Juanjuan Zhao, Fan Zhang, Member, IEEE, Lai Tu, Chengzhong Xu, Fellow, IEEE, Dayong

Shen, Chen Tian," Estimation of Passenger Route Choice Pattern Using Smart Card Data for Complex Metro Systems", IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS 1.