

Smart Train Station System: An IoT-Powered Platform with Arrival Detection

N. Dinesh Kumar^{1,*}, F.B. Shiddanagouda², B. Raviteja³, P. Aravind Kumar⁴, S. Abhinay⁵

Abstract

The primary objective of this paper is to provide railway platform users with timely arrival status information and automate pedestrian crossing of the railroad tracks without the need for a staircase. This approach aims to mitigate potential accidents, particularly significant in regions like India where train accidents are more prevalent. Using infrared transceivers, it determines each train's state and notifies the microcontroller about it. By using this research to prevent railroad crashes, we can prevent human casualties. Hence, railway departments can benefit from this project. Recent polls showed that platforms, flyovers, and metros are used. The overhead bridges for people with physical disabilities and our suggested solution deal with the elimination of these drawbacks. Here, we present the novel idea of an artificial railroad platform. Therefore, our suggested framework provides a better solution for moving physically challenged people from one station to another without the use of flyovers and metros.

Keywords: Infrared sensors, Arduino Uno, LED display, DC motor, Wi-Fi module, LED indicators

INTRODUCTION

The modern railroad infrastructure in India relies mostly on manually operated systems rather than the device management. Often, bridges are employed at train track stations to facilitate pedestrian crossing. Senior citizens and people with disabilities must travel a very long distance to cross the bridge. A sensor used to mechanically close or open cellular bridges is specifically used to sense a train's route. To detect train movement, sensors are placed on both sides of the track. The infrared sensors will be utilized to enable the micro controller to detect the trains. Consequently, upon detecting a train on one track, the controller will activate the stepper motor to automatically close the movable platform.

Staircases and bridges were built with the intention of facilitating passengers in rail stations without interfering with train operations. However, at peak hours, the increased rush and congestion pose significant challenges for elderly or disabled individuals attempting to utilize the bridge. To address

*Author for Correspondence

N. Dinesh Kumar
E-mail: nalidinesh@gmail.com

¹Professor, Department of Electronics and Communication Engineering, Vignan Institute of Technology and Science, Yadadri, Telangana, India

²⁻³Students, Department of Electronics and Communication Engineering, Vignan Institute of Technology and Science, Yadadri, Telangana, India

Received Date: May 05, 2024

Accepted Date: May 15, 2024

Published Date: May 27, 2024

Citation: N. Dinesh Kumar, F.B. Shiddanagouda, B. Raviteja, P. Aravind Kumar, S. Abhinay. Smart Train Station System: An IoT-Powered Platform with Arrival Detection. Journal of Microelectronics and Solid State Devices. 2024; 11(1): 32–38p.

this issue, we suggest the implementation of an automated system for closing and opening the mobile platform across railway lines. The mobile platform serves as a vital link between two platforms, enabling efficient navigation and ensuring all users can safely arrive at their destination.

LITERATURE SURVEY

Zhu et al. [1] introduced the numerous trains that run on rails and have a high rate of speed in large cities. Hence, it is important to prevent these kinds of incidents. This paper uses infrared (IR) transceivers to identify the status of each train and the information is sent to the microcontroller, which

then automatically trips the train's supply and stops the train. Also, they claimed that the bridge over the railroad would be convenient for individuals with disabilities. It also prevents accidents from occurring and helps the people without taking others help.

The moveable platform of the Indian railway station is primarily intended for those with physical disabilities [2]. The mobile device was replaced in this paper. The microcontroller ATmega8, DC motor, IR and LEDs (light-emitting diodes) will all be used to operate this system as a whole. This technique is practical for humans since it avoids problematic flyover populations. When a train approaches the track, a buzzer alerts and warns the individuals on the platform to vacate and avoid the portable platform usage. Additionally, an LED display indicates the arrival and departure of trains at the railway station.

The “automatic mobile platform” [3] is a system type that may be applied to production as well as other industries, with a focus on railway stations and other public spaces. The primary objective of this paper is to automate railway track crossing without the need for stairways and to provide platform users with real-time arrival status information. They contrasted the current railway system with the developed system. Under this method, difficulties with train collisions are also avoided; typically, manual braking systems are used to do so. Also, we have the option of using time-consuming track switching and train timetable modifications. Manual braking also functions only if the train driver notices it and occasionally may result in accidents. There is no human-made platform to shorten the distance between platforms. The entire process will be managed through programming for the embedded system in use. As trains arrive, the track poles are automatically switched, allowing the stoppage of the train. Artificial platforms are allowed over the tracks while they are not in use.

The movable platforms in between the railway trains now automatically close or open, according to Kottalil et al. [4]. The primary aim of this paper is to prevent accidents, largely caused by individuals crossing the tracks to access another platform, by introducing a movable platform that facilitates safe passage between platforms for passengers. It also makes it easier for people who are physically impaired to reach the platform. It is possible to modify this technique so that it is completely automated. This efficient approach enables precise arrival at the specific locations and facilitates platform crossings seamlessly. Utilizing a microcontroller, a servo motor governs the control operation of the mobile bridge, ensuring the smooth opening and closing [5]. Train detection is achieved through sensors integrated with the microcontroller, automatically triggering the mobile platform’s movement in response to approaching or departing trains.

Despite being the most cost-efficient transport mode, the increase of railroad accidents is attributed to irresponsible railroad crossings. Addressing this concern, workers’ negligence and careless behavior during operations remains primary contributors. The new smart train system presented in this study is primarily intended to assist elderly and physically challenged people. This railroad track operates on the railroad platform automatically. Typically, a traveler can stroll between two platforms that are connected by mobile platforms. To achieve this, two sensors on either side of the track, aim to automate railroad gate control with sensor assistance. When a train arrives at the first sensor, the mobile platform automatically closes, and the train moves through the track. When a train departs from the second sensor, the mobile platform automatically opens [6].

BLOCK DIAGRAM

Two sensors are used in this module, one on either side of the track. The first sensor is responsible for automatically closing the mobile stage upon the arrival of a train at the platform station. Subsequently, once the train departs, the second sensor assists in mechanically bridging the of two platforms [7]. In our system, infrared sensors, coupled with a micro controller, detect the presence of trains and transmit signals to a stepper motor device, which assist in the closure of the mobile stage. Use of green and red signaling to prevent pedestrians from being misinformed about how to use the

bridge. Pedestrians are permitted to utilize the bridge while the light is green. If it turns red, a train is on its way, and the bridge is now closed and cannot be used until it opens. A block diagram of the proposed system is shown in Figure 1.

An IC coupled to a DC motor is used for execution, and an AT89S52 microcontroller is used for the subsequent controlling operation. The proximity sensor detects the approaching train and sends its output to the micro controller when the train is close to the artificial platform. The platform may move forward and backward thanks to the IC, which also controls the DC motor. A signal is given to the microcontroller when the train is distant from the artificial platform, and the controller's output signal is sent to the IC, which rotates the DC motor both forward and backward. Moving platforms will be open when the train arrives, and an LED signal will then announce the train entry sign. Therefore, our suggested framework provides a better solution for moving physically challenged people from one station to another without the use of flyovers and metros.

The Arduino integrated development environment (IDE), or Arduino software, encompasses several essential elements. These include a text editor for coding, a message area, a text console, a toolbar featuring common functions, and a series of menus. This IDE facilitates the uploading of programs to the Arduino hardware and enables communication with them. Flowchart of the processing is shown in Figure 2.

When power is first applied to the circuit, sensor 1 detects the arrival of the train; an LED turns "red," and a buzzer sound is also provided so that visually impaired people can stop by listening to the sound [8, 9]. If any obstructions are present, a stop warning is given to make people move away from the platform. so that platform users cannot change between the platforms, and we can also prevent accidents. When sensor 2 detects the train's departure, the LED turns "green," allowing people to easily change platforms and travel between them.

RESULTS

Initial connections are made according to the block diagram, and the source code is dumped into the Arduino Uno. When all the connections are made correctly as shown in Figure 3, the prototype will look as follows.

When the power supply is given to the circuit, it is shown as given in Figure 4. When the power is given, it displays "Welcome" message and should be connected to the Wi-Fi when it displays "Waiting for the connection".

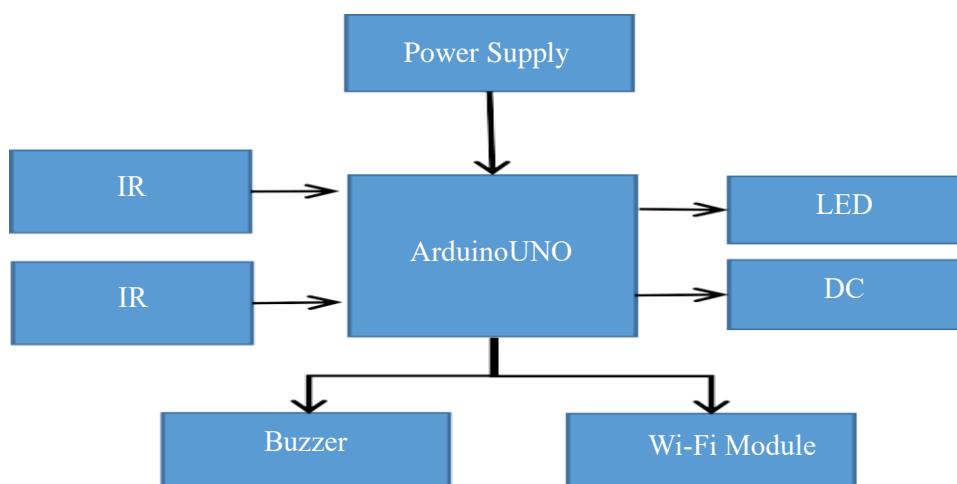


Figure 1. Block diagram of the proposed system.

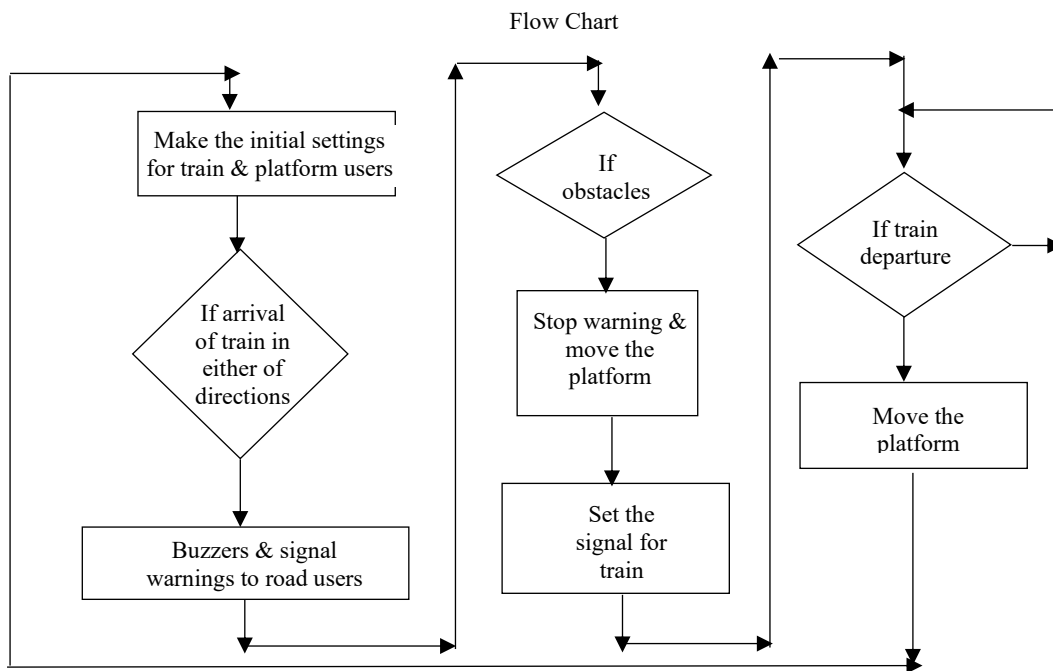


Figure 2. Flowchart of the processing.

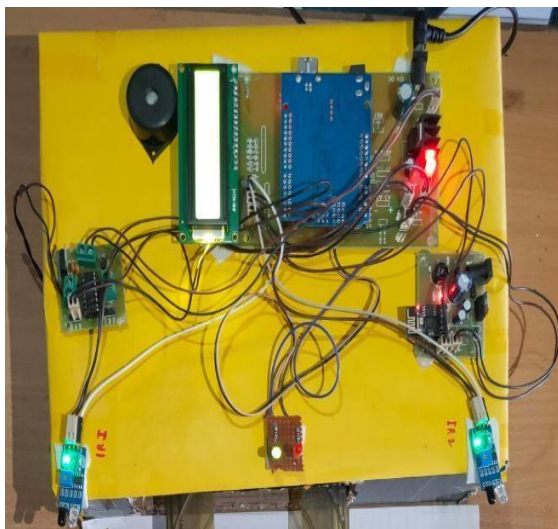


Figure 3. Connections given as per block diagram.

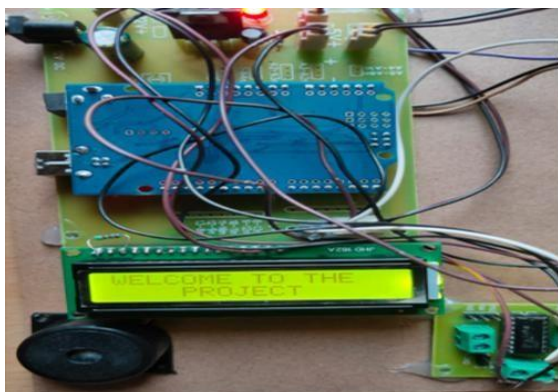


Figure 4. Power supply given to the circuit.

The telnet application can be used to connect to the Wi-Fi module. To access the Wi-Fi module, connect to the Wi-Fi network named "AI Thinker" on our mobile device. Later, type the IP address as "192.168.4.1" in the telnet application, and then it displays "connected" as shown in Figure 5.

When the train arrival is detected by IR sensor 1, the buzzer will be on, the LED will turn red, and the buzzer will also be used to alert the platform users, and then the bridge will be opened. so that people cannot cross between the platforms until the train departs. As a result, platform users must wait. This scenario is shown in Figure 6. When the train arrival is detected at IR 1, it is displayed as "IR 1: ON" and "IR 2: OFF" [10]. And, when the IR detects the arrival of the train, it indicates the LED as "red," as shown in Figure 7. Further, it also shows "platform open" both in mobile, that is, telnet application, and in display, as shown in Figure 8.

When the train departure is detected by IR sensor 1, the buzzer will be OFF, the LED will turn green, then the bridge will be closed, so that people can cross between the platforms after the train has departed. As a result, platform users can pass through the platforms. This scenario is shown in Figure 9. When the train departure is detected at IR 1, then it is displayed as "IR 1: OFF" and "IR 2: ON." When the IR detects the departure of the train, it indicates the LED as "green," as shown in Figure 10.

Further, it also shows "platform close" both in mobile, that is, telnet application, and in display as shown in Figure 11 to the passengers awaiting in the railway stations. The final model is shown in Figure 12. As shown in the figure, we have connected a CD driver to display the DC motor that opens and closes the platform. By giving extra power, we can connect another CD driver based on the DC motor voltage. And thereby, the platform becomes easily accessible to everyone.

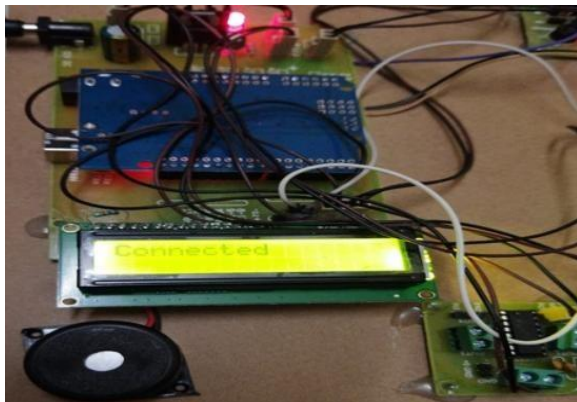


Figure 5. Connection to Wi-Fi module.



Figure 6. Train arrival detection.

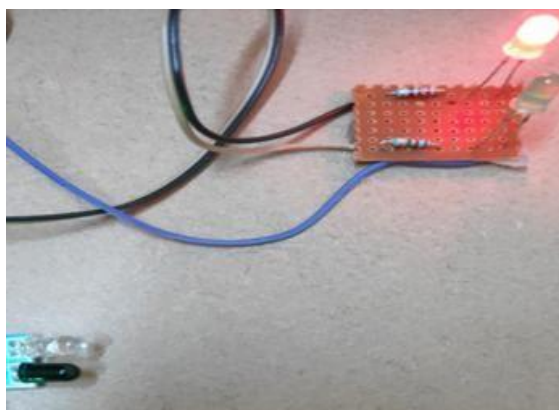


Figure 7. LED indicator as red.

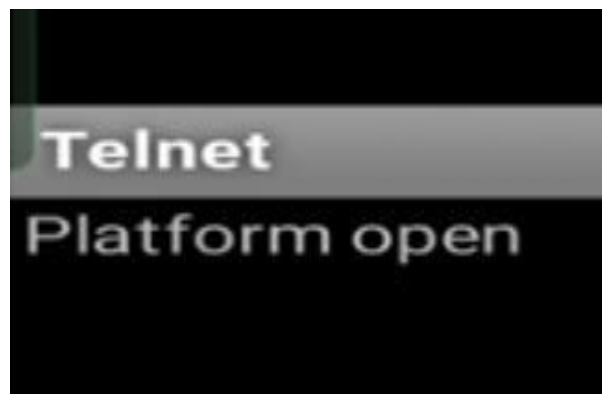


Figure 8. Display of the information.



Figure 9. Train departure detection.

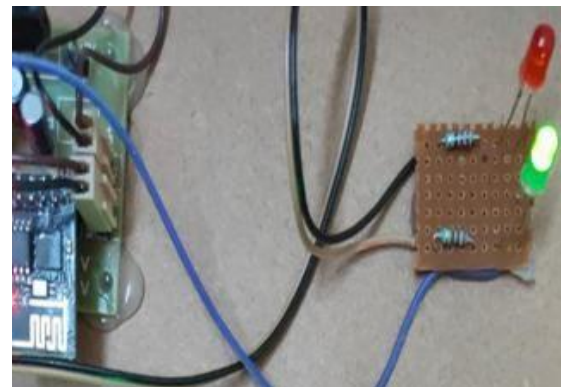


Figure 10. LED indicator as green.

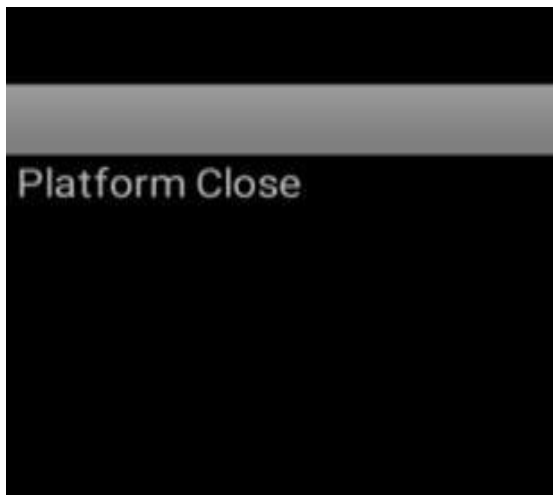


Figure 11. Display of the information.



Figure 12. The final model.

ADVANTAGES

- Efficient tracking of train with respect to platform.
- Automatic platform leads to less time consumption.
- Reduces train accidents.
- People can easily change in between platforms without using staircases. And helpful to handicapped persons.

CONCLUSION

This paper presents a model where the train's movements are continuously tracked, enabling the robotic automation of the opening and closing of the movable platform. This process is executed seamlessly and autonomously, ensuring efficient operation. For travelers using the railroad tracks, ascent of the staircase is no longer required because our suggested system takes care of everything. Another interesting feature is that it is also a suitable and efficient way to plan the timetables of trains heading in the same direction.

Acknowledgements

We would like to thank "IoT Research Center" Vignan Institute of Technology and Science for providing the required facility to complete the work successfully.

REFERENCES

1. Zhu L, Yu FR, Ning B, Tang T. Handoff performance improvements in MIMO enabled communication-based train control systems. *IEEE Trans Intell Transport Syst.* 2012; 13 (2): 582–593.
2. Adarsh KS, Riya R, Kavia E. Railway track pedestrian crossing between two platforms. *Int J Emerging Technol Adv Eng.* 2015; 5 (12): 259–261.
3. Arun Kumar N, Srinivasan V, Krishna Kumar P. Analysing the strength of unidirectional fibre orientations under transverse static load. *Int J Appl Eng Res.* 2014; 9 (22): 7749–7754.
4. Kottalil AM, Abhijith S, Ajmal MM, Abhilash LJ, Babu A. Automatic railway gate control system. *Int J Adv Res Electric Electron Instrum Eng.* 2014; 3 (2): 7619–7622.
5. Dinesh Kumar N, Priyanka M. Library and auditorium electrical appliances automation. *J Electron Design Technol.* 2016; 7 (1): 1–8.
6. Parthipan S, Vijay P, Priyanka G, Ramalakshmi K, Poornima R. Automatic mobile platform for physically challenged people in railway station. *South Asian J Eng Technol.* 2019;8(1):214–217.
7. Dinesh Kumar N, Srihitham, Pranitha E, Shireesha T. Smart garbage management system for hygienic and healthy environment. *Recent Trends Sensor Res Technol.* 2019; 6 (2): 21–27.
8. Eiza MH, Randles M, Johnson P, Shone N, Pang J, Bhih A. Rail internet of things: an architectural platform and assured requirements model. In: 2015 IEEE International Conference on Computer and Information Technology; Ubiquitous Computing and Communications; Dependable, Autonomic and Secure Computing; Pervasive Intelligence and Computing, Liverpool, UK, October 26–28, 2015. pp. 364–370.
9. Sparthan Azoh T, Nzie W, Sohfoosing B, Beda T. Development of an intelligent safety monitoring device for train-track system in Cameroon. In: Tchakounte F, Atemkeng M, Rajagopalan RP, editors. *Safe, Secure, Ethical, Responsible Technologies and Emerging Applications. SAFER-TEA 2023.* Cham, Switzerland: Springer; 2024. pp. 234–257.
10. Chang CS, Tsang KF. A cost effective approach on railway vehicle identification and positioning using RFID technology. In: *IET 2nd International Conference on Wireless, Mobile and Multimedia Networks (ICWMMN 2008)*, Beijing, China, October 12–15, 2008. pp. 490–493.