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Design of Cross Level Automatic Railway Gate Control System Using Arduino UNO 328

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Abstract- This paper presents the design and construction of an obstacle detection system for railway level crossings. The focus of this research is on reducing accident rates attributed to obstructions between the gates of the level crossing. Research indicates that approximately 30% of railway accidents at level crossings are resulting from obstacles blocking the tracks. To address this issue, we developed a system utilizing an Arduino Uno microcontroller, along with ultrasonic and reed switch sensors, and a GSM module for real-time alerts. While the ultrasonic sensors are deployed to monitor the gate crossing arena, the reed switches are positioned 3km away from each gate to detect the arrival/departure of the train. Such that when there is any obstacle detected the GSM triggers sms alert to the train operators for a possible halt to create room for evacuation of the obstacle. By facilitating timely responses, this system aims to decrease the likelihood of accidents, thereby enhancing safety for both rail and road users. This innovative solution highlights the potential for improved safety measures within railway infrastructure.

Index Terms- Obstacle detection system, Ultrasonic sensors, Reed switch, Arduino Uno microcontroller, GSM module

I. INTRODUCTION

Railway safety is crucial, especially at level crossings. Research shows that 29% of accidents in railway infrastructure occur at level crossings, these are often due to the unmanned gates or manual errors. Improving the situation at level crossing is the focus of this research work. This research work has incorporated a model of an automated system that could be placed at the gate to not only control the gating barricade but to create an awareness for passer byes both drivers and commuters of an approaching train. It utilizes some key components such as Arduino Uno, GSM module, sensors (reed switch and ultrasonic).

These together with others form a system that sensitizes the train and the passers bye. Hence, reducing the causes of accidents at level crossing.

The aim of this paper is to explore the improved version of automated level crossing obstacle detection system that will help to not only automate the operations of the gate at railway level crossings but will bring about a reduction of accidents rates at the spot. The step-by-step introduction of this paper will begin with review of relevant literatures, followed by its methodology, and eventually rap up with the hardware components used.

II. LITERATURE REVIEW

The paper, Intelligent Railway Cross Level Gates and Signaling System using Fuzzy Logic Control Technique by O. M. Olaniyi, I. M. Abdullahi, D. Maliki, & T.M Lasore. Focuses on developing an intelligent system capable of detecting the arrival/departure of a train on the rail track to control the operation of the cross-level gates using fuzzy logic control technique and IR sensors.

In the paper Automatic Railway Gate Control System Using 8051 Micro Controller by C.R. Balamurugan, P. Vijayshankarganth, R. Alagarraja, V.E. Subramanian, R. Ragupathy. The author focuses on the improving on the time at which gate is been closed and also contributes towards the safety of the railway transport system.

III. METHODOLOGY

1. Algorithm for the Design

The following algorithm outlines the process for designing an automated railway gate control system. It provides a systematic approach to managing the arrival and departure of trains while ensuring the safety of pedestrians and vehicles

- Start
- Initialization

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- Sensor R1 checks if train has arrived and then close the gates.
- Sensor U checks if obstacle is found in between the gates and message the train driver if any is found.
- If steps c & d are yes
- Gate is opened and obstacle is cleared
- If no, gates are closed
- Sensor R2 check the departure of the train and opens the gates Go back to first step.

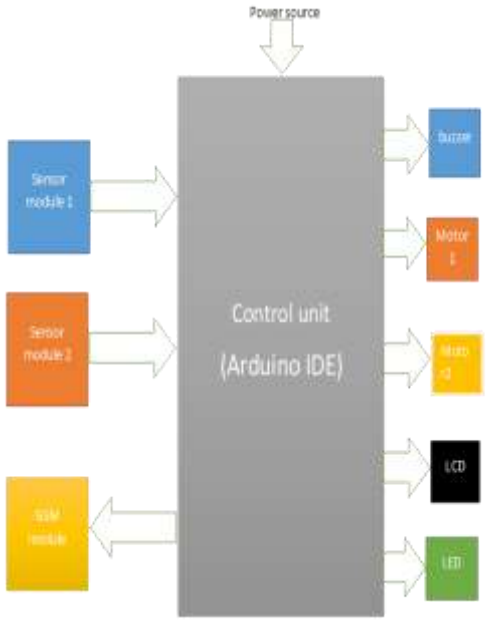

Figure 1: Block Diagram of the design

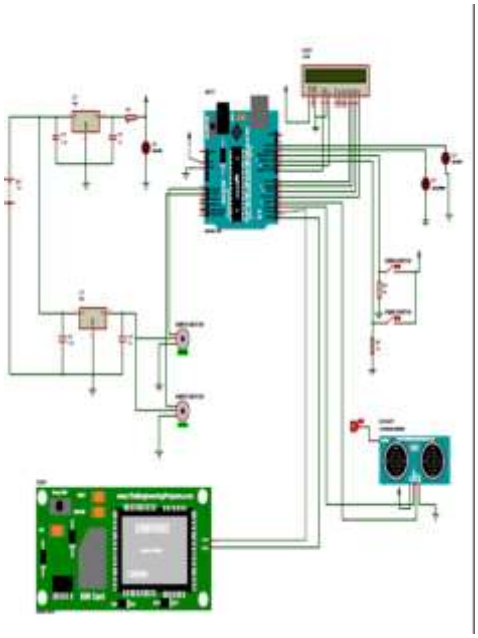

Figure 2: Circuitry of the design

Equipment and Specification

Key components include:

- **Reed Switches:** Detect train arrival and departure.
- **Ultrasonic Sensor:** Detects obstacles on the track.
- **Arduino Uno:** Serves as the central processor, controlling all components.
- **GSM Module:** Alerts the driver when obstacles are present.
- **Servo Motor:** Controls gate opening and closing.
- **Buzzers:** Provide signals.
- **LED:** Used for traffic indication.
- **LCD:** Acts as the display interface.

Table 1: Equipment and specification

Snr No	Equipment used	Specification
1	Main controller	ATmega328
2	Ultrasonic sensor	5V,15mA,40HZ
3	Reed switch	5V
4	Buzzer	5V
5	Resistor	10k
6	LCD	16*2
7	LED	5V
8	Jumper cables	-
9	GSM module	SIM800
10	Servo motor	5V
11	Voltage regulator	LM7805

The entirety of this design is divided into distinct stages:

(a)The arrival stage: at this stage, the system carries out the detection of the arrival of the train through the first reed switch. Once this sensor senses the train, the LCD display train is 3km away and immediately there is sound from the buzzer, the gate closed and the LED turns red implying no access for road users.

The Arrival Stage Showing The Red LED Signals

(b)The obstacle detection stage: this stage deals with detection of any obstruction on the route of the train, these obstacles are detected with the help of an ultrasonic sensor sited at a point between the cross level spot in a level higher than the reach of human such that the surface of the train is 22cm from the ground and the train height is 5cm, invariably from the surface of the train to the sensor is 17cm hence obstacles detected are programmed to be at least 19cm away from it surface to the sensor. Once these obstacles are detected, an SMS is

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generated and sent through the GSM module to the train assistant so he can halt the speed.

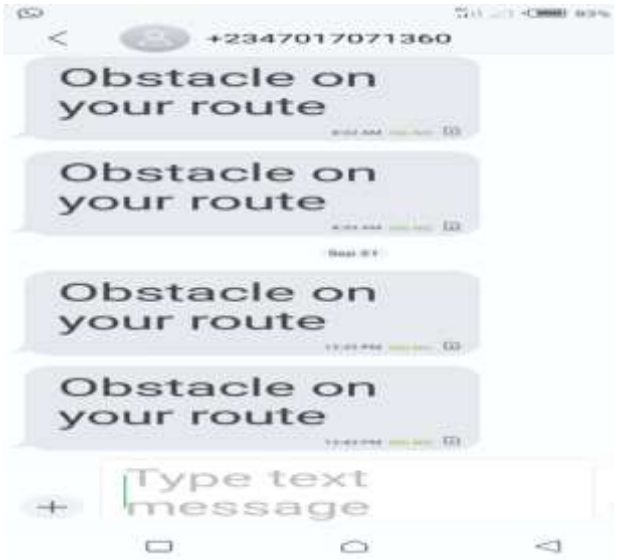

Figure 3: A display of GSM module messages sent when obstacles are detected

(c)The departure stage: in this stage, the departure of the train is sensed through the second reed switch after the train had passed through the first and second stage upon getting to this second reed switch the gate is opened and the LED turns green allowing other users to pass.

Figure 4: implementation of the design; Green Light Indicating Free Road for Motorists and Users

IV. CONCLUSION

The project to design and build an automatic railway gate control system has achieved its goal of automating gate operations at railway crossings to prevent accidents. The system efficiently handled the issue of track blockage, such as obstructions caught between gates, by integrating a GSM module with an ultrasonic sensor. These enhancements increased the system's reliability when compared to prior models.

Recommendation

The automatic railway gate control system, as designed, is not flawless and can be improved further. The following recommendations are suggested to enhance the system's efficiency.

- Application of more sophisticated obstacle detection sensor.
- Adopting a wireless connection method for the system.
- Application of cameras at cross levels for monitoring purposes at the cross level.

REFERENCES

1. M. Balog, J. Husár, L. Knapčíková, & Z. Šoltysová, (2015). Automation monitoring of railway transit by using RFID technology. Acta Tecnología, 9-12
2. N. Mapari, S.M Imran, S. Chaudhari, & N. Ashraf, (2016). Railway Level Gate Crossing Controller Using Android & GSM. Proceedings of 39th IRF International Conference, ISBN: 97893-85973-81-9.
3. R. J. C. Prasad, P. A. Reddy, & Y. S. Praneetha, (2016). GSM based Automatic Railway Gate control system with Real time Monitoring. International Journal of Science, Engineering and Technology Research (IJSETR), 5(3).
4. J. Ishan, M. Shubham, & A. Soumya, (2017). Automatic Railway Barrier System, Railway Tracking and Collision Avoidance using IOT. International Journal of Computer Application, 0975-8887
5. S. Sankaraiah, S. A. B. Mirza & R. Narsappa (2015). Automatic Railway Gate Control System using IR and Pressure Sensors with Voice Announcement. International Journal of Innovative Technology (IJIT), 3(3), 0355-0357.

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