AUTOMATIC RAILWAY GATE CONTROL AND TRACK SWITCHING WITH AUTOMATED TRAIN

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***Abstract*-Our project is designed to automatically control the railway gate at the level crossing, to automatically control the railway track switching mechanism and to automatically control the movement of the train (i.e.,)to start and stop the train automatically. As the number of accidents related to railway is increasing day by day, the above automations will reduce these accidents to a much greater extent. Project employs two pair of Infrared (IR) sensors, one pair of IR sensor is used to control the railway gate and the other pair of IR sensor is used to automatically switch the railway track. These IR sensors are used to sense the arrival and departure of the train. A reed switch is used to control the motion of the train. Reed consists a on-off switch which switches when it comes in contact with a magnet. As the entire system is automated errors occurring due to manual operation are prevented because the accuracy of automated operation is more than the manned operation. Our project is developed on an embedded platform using a microcontroller as a controlling unit.**

***Index Terms*— Infrared (IR) sensor, Microcontroller, Railway gate and track switching, Train controlling unit.**

I. INTRODUCTION

Project utilizes two pair of IR sensors, a pair of IR sensor is placed near the level crossing to control the railway gate, the sensors are placed at a certain distance from each other, considering the direction of movement of train the sensor which detects the arrival of train can be called as the upside sensor and sensor which detects the departure of the train can be called as the downside sensor. Each pair of sensor consist of a transmitter and receiver, in our case light emitting diode (led) is used as a transmitter and a p-n junction photodiode is used as receiver. Whenever the upside receiver is triggered the gate motor rotates in a particular direction and closes the railway gate and remains close until the downside receiver is triggered, once the downside receiver is activated the motor again rotates and the gate is opened. Now applying the same principle of operation of IR sensors used in gate controlling for track switching we can easily monitor the track and create switching of the track if necessary. In track switching mechanism a pair of sensor is placed near the track switching junction. Considering a situation wherein there is a goods carrying train on the main line track and suppose a local or an express train is taking the same route taken by goods carrying train, then in order to avoid any delay to the local train the track is switched to the bypass line track for the train to pass. The reed switch is used to control the trains movement, as the reed switch is a magnet sensor which consist of an on and off switch, the switch remains on until it senses any magnet once it senses a magnet the switch goes into off state. By placing a magnet in the train and a reed switch at the station the train can be stopped at the station and after a few second of delay the train can be allowed to go.

II. LITERATURE SURVEY

The proposed system can be referred as an enhancement of the current railway system converting the manned as well as unmanned railway gate into an automated railway gate controlling unit. Automatically switching between railway tracks and running the train automatically.

In 1988 Waheed, M.A.; Sethuraman, S.K.; Deans, N.D. developed the concept of controlling devices in real time using a microcontroller chip. This concept is the backbone of our project. The proposed project contains of IR sensors (i.e.,) an IR light emitting diode (led) and a p-n junction photodiode which generates signals for microcontroller to control the loads connected to the controller.

During the period of 1969-1973 Dennis MacAlistair Ritchie and Ken Thompson developed the C programming language, using the basis of c programming language a software program in embedded c is developed for our project. Embedded C programming is very advantageous in many ways as it is a combination of assembly language programming and c language programming. In C language programming stack memory cannot be directly whereas in assembly language programming stack can be easily called, combining assembly and c language an embedded c language was developed for real time application programming.

Infrared sensors being the most efficient sensor to detect any real time object is used in the proposed project to detect arrival and departure of train. In 1936 W.B. Ellwood invented a reed switch at the bell telephone laboratories which is an electrical switch. It is a magnet sensor which senses a magnet and can be used as a proximity sensor.

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Relay is used to drive the dc motor, relay operates on the principle of applied magnetic field, when a magnetic field is generated across the armature then the pole will switch to either normally closed or normally open [5].

III. METHODOLOGY

A. Block Diagram

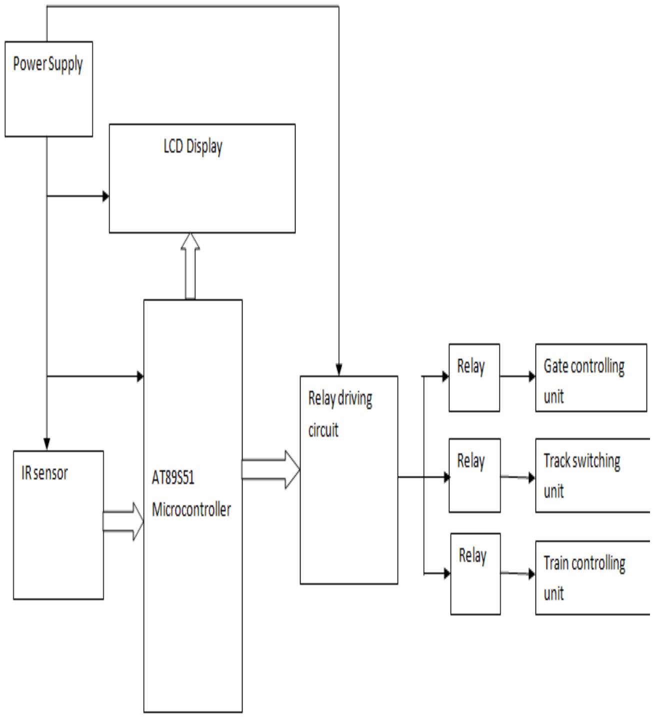

Fig 1. Microcontroller based railway system

The microcontroller is the controlling unit which controls the railway gate section, track switching section and the train controlling unit by means of a relay section. The actions performed by the microcontroller depend on the transition of energy from the IR sensor.

IR sensors: The IR sensor section consists of an IR transmitter and receiving section, transmitter section consists of an IR led with a current limiting resistor of 1Kilo ohms which continuously emits photons on the receiving unit [3].

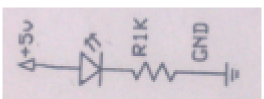

Fig 2. IR transmitter

IR receiver consists of a p-n junction photodiode driven through a transistor BC549 with a current limiting resistor of 1 Kilo ohms it receives the photons from the IR led and generates the signal required by the microcontroller to perform the needed operation.

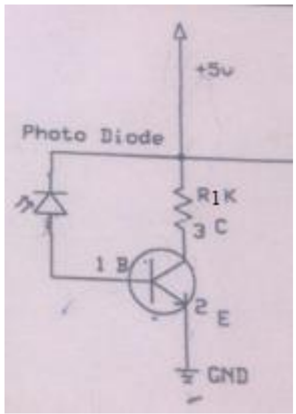

Fig 3. IR receiver

Microcontroller AT89S51: The microcontroller is the heart of our project which receives the signal from one end and controls the operation at the other end [1], it consists many advanced features such as 4Kilo bytes of in-system programmable (ISP) flash memory, 128x8 bit internal random access memory (RAM), 32 input/output lines and many more.

Relay section: Relay driving unit is a basic BC 549 transistor which amplifies the output current of the microcontroller to energize the coils of the 12 volts single pole double throw (SPDT) electromagnetic relay which in turn drives the 12 volts dc motor to control the loads connected to it. Project consist of total 5 relays and 2 dc motor, pair of relay is used to control the 12 volts dc motor (i.e.,) to rotate it in forward and reverse direction hence 4 relays control 2 dc motor one for the gate section and the other for track switching. The train is controlled by a single relay [5]

Gate controlling unit: The railway gate is opened and closed by a dc motor having which is rotated in forward and reverse direction by using 2 relays. DC motor used is a low torque motor having 30 rotations per minute [7], [8].

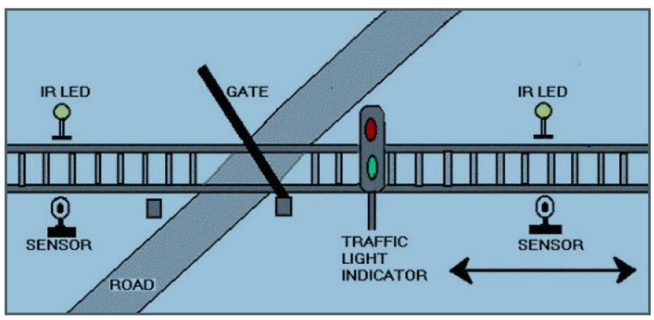

Fig 4. Gate controlling section

Track switching: Similarly by using the above principle of gate control the track switching can be achieved. DC motor used is a high torque motor having 10 rotations per minute [6].

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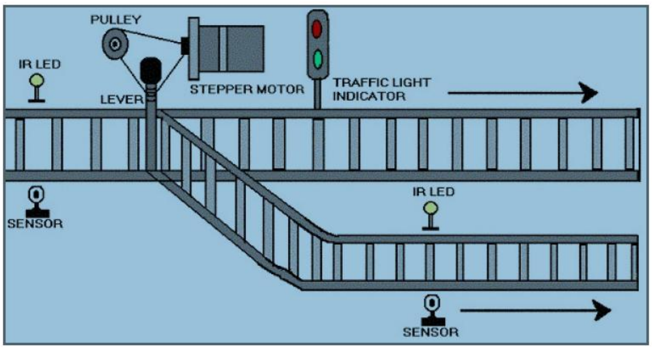

Fig 5. Track switching unit

Train controlling unit: In our project a toy train with a 3v dc motor is used, a relay is used to start and stop the train, the relay is configured in normally closed mode because of which the supply is continuous and the train is moving continuously. A magnet is placed inside the train such that when it comes into contact with a reed switch which is a magnet sensor the train will stop and the controller will be interrupted to run the delay program for 3 seconds this is done to stop the train at the station (using reed switch as a reference station).
LCD: A 16x2 liquid crystal display is used to display the on and off condition of the sensors [4].
Power supply: We are using 240 volts 50 Hertz ac supply which is stepped down to 12 using a step down transformer, and is rectified to produce a dc voltage to run the system. Using a 7805 voltage regulator 5volts dc signal is generated to drive the controller and the sensors and 12volts dc is used to drive relay and motor.

B. Implementation of Proposed System

This section includes the detail circuitry operation of the project, the significance of the components used in the project and the relationship between the different interfaces in our project. Fig 6 depicts the implemented project. The sensors are connected to port 1 of the microcontroller, the two gate controlling sensors are connected to pin no. P1.0 and P1.1. The two track switching control sensors are connected to pin no. P1.2 and P1.3. The reed switch is connected on pin no. P1.4. To port 0 a 16x2 liquid crystal display (lcd) is connected, the lcd in our case displays the on and off status of the sensors, the lcd can be used near the level crossing to indicate the user the time elapsed for the gate to close. Generally interfacing of lcd with the microcontroller requires two ports, on one port the data lines of lcd are connected and on the other port the control signals are connected but in our case we are operating the lcd in a 4 bit mode (i.e.,) 4bit data is send twice and on lcd 8bit data is displayed, advantage of this mode is that lcd is connected on a single port. To port 2 the controlled elements are connected, to pin no. P2.0 train mechanism is connected, to pin no. P2.1 and P2.2 track switching motor is connected, to pin no. P2.3 and P2.4 gate controlling motor is connected.

The transmitter unit is an IR led which emits photons onto the photodiode, the transmitter requires a +5volts supply to generate adequate light energy required for transmission.
Anode of the diode is connected to +5v and cathode is connected to ground through a current limiting resistor of 1 kilo ohms.
The receiver unit consists of a p-n junction photodiode which receives photons emitted by the transmitting led, as photodiode is connected in reversed biased mode a small leakage current will be generated when light energy is incident on it, this current is of small value and it needs to be amplified before feeding it to the microcontroller hence a transistor BC549 configured in common emitter configuration, operated in the active region is used to raise the signal level so that it can be fed to the microcontroller [2].
A power indicating led is used in our project to indicate the activation of 240volt 50 Hz ac supply, a step-down transformer is used to strep the voltage to 12 volt, full wave bridge rectifier is used to convert the ac voltage to dc voltage, full wave is used over half wave as full wave rectifier has better efficiency than half wave rectifier.
A voltage regulator 7805 is used to step-down the 12volt dc to 5v dc which is required by the microcontroller and the sensors for their operation and the 12volt dc signal is used by the dc motor and relays. When the project is turned on light beam from the IR transmitter is constantly incident on the IR receiver and the light beam breaks only when the train passes through the sensors.

Logical Operation: When light is incident on the photo diode the transistor connected to the photodiode is on hence the supply of the IR receiver flows to ground and microcontroller receives logic 0 as an input. When the controller receives logic 0 as an input it generates logic 0 output hence the transistor connected to the controller to drive the relay is off and since the pole is connected to normally close pin the motor is steady.
When the light beam is cut by the train at that time there is no light incident on the on the photodiode hence the transistor connected to the photodiode is off hence the 5 volt supply of the IR receiver is connected to microcontroller and it receives logic 1 as an input. When the controller receives logic 1 as an input it generates logic 1 as output hence the transistor connected to the controller to drive the relay is on which energizes the relay coil which in turn moves the pole of the relay from normally closed contact to normally open contact which will cause the dc motor to rotate.
Logic levels for motor rotation:
For railway gate when P2.4 is logic 1 and P2.3 is logic 0 the motor rotates in forward direction closing the railway gate. When P2.4 is logic 0 and P2.3 is logic 1 the motor rotates in reverse direction opening the gate for th motorist to pass.

For tracking switching when P2.2 is logic 1 and P2.1 is logic 0 the motor rotates in forward direction. When P2.2 is logic 0 and P2.1 is logic 1 the motor rotates in reverse direction.
A both forward and reverse rotation of the motor is used to switch the track.

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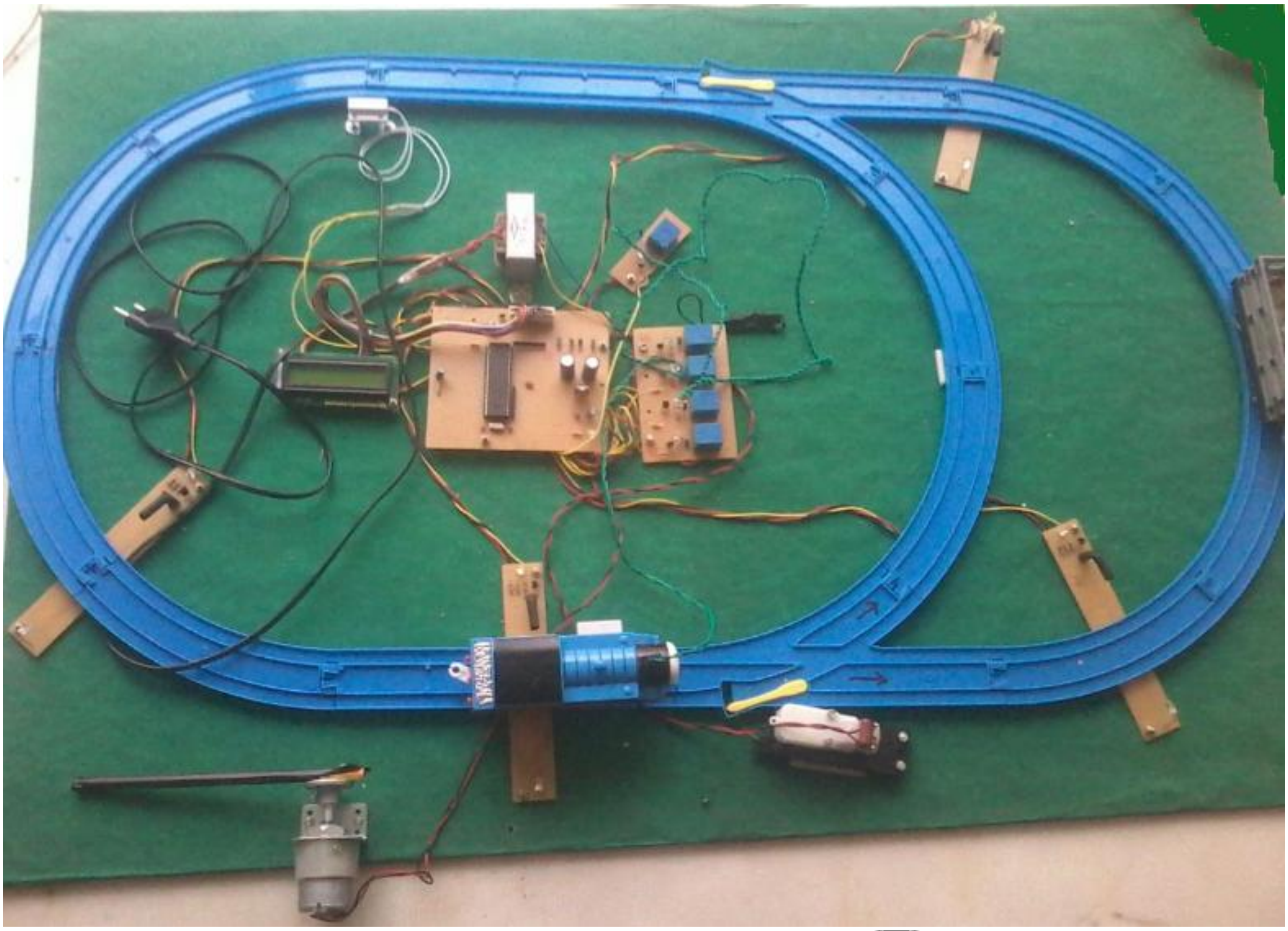

Fig 6. Proposed project

IV. SOFTWARE DESCRIPTION

In this project we have used Keil C Compiler for developing microcontroller program in C language. From the flowchart if P1.0 or P1.1 is set to logic low then the gate motor will rotate for P1.0 motor will rotate in forward direction closing the gate and for P1.1 the motor will rotate in reverse direction opening the gate. If P1.2 or P1.3 is set to logic low then the track will switch depending on the status of the other sensor. If P1.4 is set to logic low then the train will stop at the railway station.

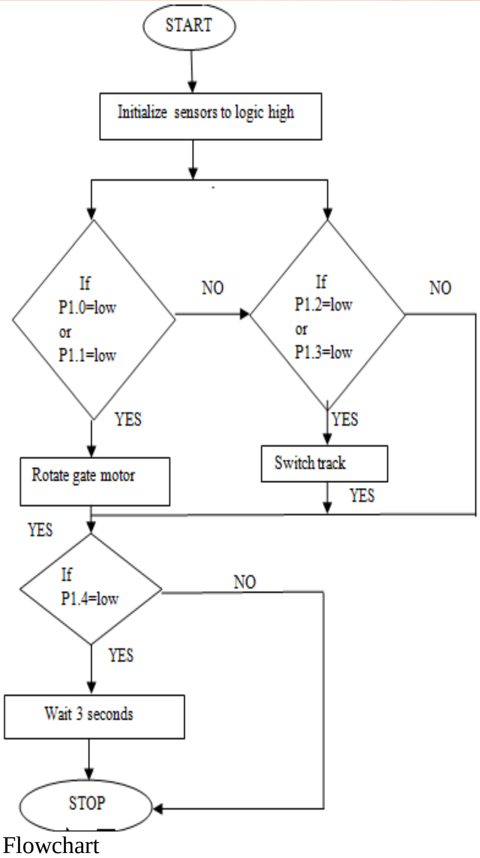

Fig 7. Flowchart

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V. CONCLUSION

The proposed project has many major advantages it will reduce the accidents occurring at the railway level crossing, it will increase the accuracy and reduce errors occurring due to manual operations. It will reduce the collision of train and will also manage the route of a particular train to avoid any delay in reaching its destination. Train will always be on time at the station no delay will be caused which occurs in manual operation. Security can be implemented by placing tracker in the train in order to monitor the location of the train in case of any issue. Solar panels can be used to generate power for the system there by increasing the efficiency of the system.

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