Automatic Railway Crossing Gate Control

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Abstract- **In this paper, the proposed work provides the design method of controlling a railway level crossing gate automatically. In general, Railway gates are opened or closed manually by a gatekeeper which involves work force and that could often lead to accidents. The information about arrival of train for opening or closing of door is received from nearby station.**

To avoid the human intervention at level crossings completely, we need to automate the process of railway gate control. This project deals with an interesting manner of automating the railway gate control where the gate is automatically opened or closed by detecting the arrival or leaving of the train and thus the proposed system rules out the need of any human involvement at the railway level crossing. This system involves opening and closing of the level crossing gate with help of high torque motors

Index Terms- **Arduino UNO, Photo resistors, Servo motor, Potentiometer, Light Emitting Diodes, Transmitter, Receiver, Liquid Crystal Display, Light Emitting Diode, Switches, Battery**

I. INTRODUCTION

A level crossing is an intersection where a railway line crosses a road or path at the same level, as opposed to the railway line crossing over or under using a bridge or tunnel. Other names include grade crossing, railway crossing, road through railroad, railroad crossing and train crossing. Early level crossings had a flagman in a nearby booth who would, on the approach of a train, wave a red flag or lantern to stop all traffic and clear the tracks. In the early days of the railways much road traffic was horse drawn or included livestock. It was thus necessary to provide a real barrier. Many countries therefore substituted the gated crossings with weaker but more highly visible barriers and relied upon road users to follow the associated warning signals to stop. In many countries, level crossings on less important roads and railway lines are often "open" or "uncontrolled", sometimes with warning lights or bells to warn of approaching trains. Many accidents have occurred due to failure to notice or obey the warning. Level crossings present a significant risk of collisions between trains and road vehicles. In general, Railway gates are opened or closed manually by a gate keeper. The information about arrival of train for opening or closing of door is received from nearby station. Opening and closing of railway level crossing involves manpower, which could be often erroneous leading to accidents. To avoid the human intervention at level crossings completely, we need to automate the process of railway gate control. This project deals with an interesting manner of automating the railway gate control where the gate is automatically opened or closed by detecting the arrival or leaving of the train and thus the proposed system rules out the need of any human involvement at the railway level crossing. This system involves opening and closing of the level crossing gate with help of high torque motors.

II. BACKGROUND

a) Automatic Railway Crossing Gate Control

Working Principle:
The main aim of this circuit is to control the railway gate automatically with the help of high torque motors. In this paper, we will be using two different methods in order to control the level crossing gate.

1. With the help of IR Sensors

Practically, the two IR sensors are placed at the left and right side of the railway gate. The distance between the two IR sensors is dependent on the length of the train. In general we have to consider the longest train in that route.

- If the sensor 1 detects the arrival of the train, the microcontroller starts the motor with the help of motor driver in order to close the gate.
- The gate remains closed as the train passes the crossing.
- When the train crosses the gate and reaches second sensor, it detects the train and the microcontroller will open the gate.

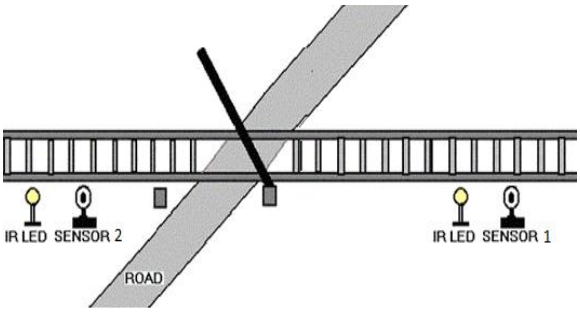

Figure 1: IR Censor operated diagram

2. With The Help Of Photo resistors

- A Servo motor is interfaced with the system. When the light is red, then the arduino interfaced sends an output signal which activates a mechanism to send a '0' degree rotation to the Servor to close the gate.
- When the light is turned Green, then the Servo motor switch the mechanism to send a '90' degree rotation to Servo and the gate is open again.
- Two Potentiometers P1 and P2 are used to set the delay of the red and green led respectively.

III. COMPONENTS REQUIRED

A) Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega32. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The ATmega328 has 32 KB. It also has 2 KB of SRAM and 1 KB of EEPROM

Figure 2: Arduino Uno

B) Infra-Red (IR) Sensors

The infrared sensors are the sensors that detect/measure infrared radiation or change in the radiation from outer source or inbuilt source. Infrared radiation is an electromagnetic wave with wavelength of 700nm to 1 mm. It is emitted by objects with temperature above 0 kelvin. Furthermore intensity and wavelength of infrared radiation depends on the temperature of the object. The circuit required to make an IR sensor consists of two parts; the emitter circuit and the receiver circuit. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR **photodiode** which is sensitive to IR light of the same wavelength as that emitted by the IR LED. IR Sensors work by using a specific light sensor to detect a select light wavelength in the Infra-Red (IR) spectrum. By using an LED, which produces light at the same wavelength as what the sensor is looking for, you can look at the intensity of the received light. When an object is close to the sensor, the light from the LED bounces off the object and into the light sensor. This results in a large jump in the intensity, which we already know can be detected using a threshold.

Figure 3: Infra-Red(IR) Sensors

C) Photo Resistors

A photoresistor (or light-dependent resistor, LDR, or photocell) is a light-controlled variable resistor. The resistance of a photoresistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photoresistor can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits. A photoresistor is made of a high resistance semiconductor. In the dark, a photoresistor can have a resistance as high as several megohms (MΩ), while in the light, a photoresistor can have a resistance as low as a few hundred ohms. If incident light on a photoresistor exceeds a certain frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electrons (and their hole partners) conduct electricity, thereby lowering resistance. The resistance range and sensitivity of a photo resistor can substantially differ among dissimilar devices. Moreover, unique photo resistors may react substantially differently to photons within certain wavelength bands.

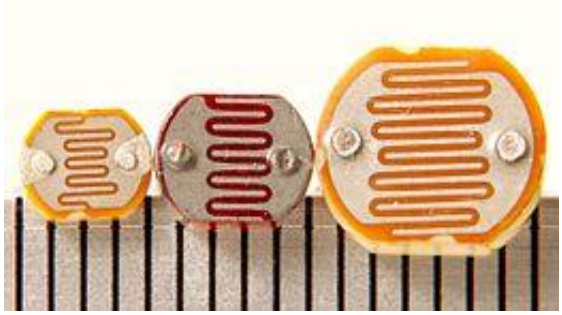

Figure: Photo Resistors

D) Servo Motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration.[1] It consists of a suitable motor coupled to a sensor for position feedback. A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analogue or digital) representing the position commanded for the output shaft.

The motor is paired with some type of encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops.

The very simplest servomotors use position-only sensing via a potentiometer and bang-bang control of their motor. Most modern servomotors are designed and supplied around a dedicated controller module from the same manufacturer. Controllers may also be developed around microcontrollers in order to reduce cost for large-volume applications.

Figure: Servo Motor

E) Light Emitting Diodes (LED)

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode, which emits light when activated.[5] When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. LEDs are typically small (less than 1 mm^2) and integrated optical components may be used to shape the radiation pattern. LEDs have many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. Light-emitting diodes are now used in applications as diverse as aviation lighting, automotive headlamp, advertising, general lighting, traffic signals, camera flashes, and lighted wallpaper. They are also significantly more energy efficient and, arguably, have fewer environmental concerns linked to their disposal.

Figure: Light Emitting Diode (Led)

F) Potentiometer

A Potentiometer is a three terminal device with a sliding or a rotating contact that forms an adjustable voltage divider. It is used to measure electric potential (voltage) and to control electrical devices such as volume controls on audio equipment. Potentiometers operated by a mechanism can be used as position transducers, for example, in a joystick. Potentiometers are rarely used to directly control significant power (more than a watt), since the power dissipated in the potentiometer would be comparable to the power in the controlled load. In this project, two potentiometers are used which are directly connected to the microcontroller.

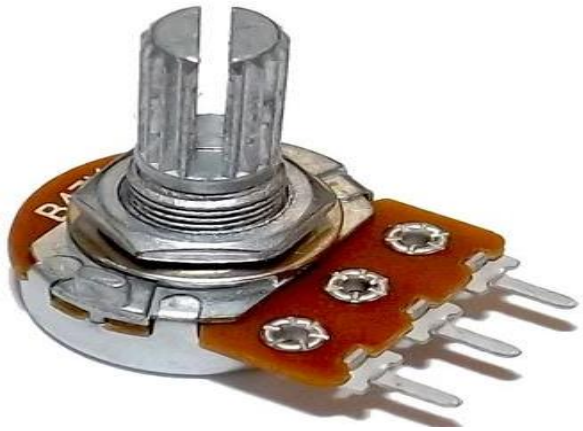

Figure: Schematic of Potentiometer

G) Liquid Crystal Display (LCD)

LCD (liquid crystal display) is the technology used for displays in notebook and other smaller computers. Like light-emitting diode (LED) and gas-plasma technologies, LCDs allow displays to be much thinner than cathode ray tube (CRT) technology. LCDs consume much less power than LED and gas display because they work on the principle of blocking light rather than emitting it. An LCD is made with either a passive matrix or an active matrix display grid. The active matrix LCD is also known as a thin film transistor (TFT) display. The passive matrix LCD has a grid of conductors with pixels located at each intersection in the grid. A current is sent across two conductors on the grid to control the light for any pixel. An active matrix has a transistor located at each pixel intersection, requiring less current to control the luminance of a pixel. For this reason, the current in an active matrix display can be switched on and off more frequently; improving the screen refresh time. Some passive matrix LCD's have dual scanning, meaning that they scan the grid twice with current in the same time that it took for one scan in the original technology. However, active matrix is still a superior technology. This project makes the use of a 16*2 LCD display that allows the representation of the status of the signal whether it is green or red.

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	VEE
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight VCC (5V)	Led+
16	Backlight Ground (0V)	Led-

Figure: Pin Description of an LCD

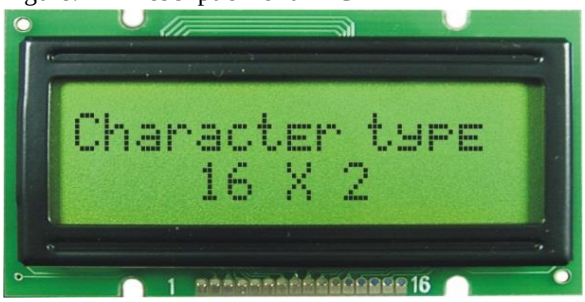

Figure: 16*2 LCD

H) Switches

In electronics, an electronic component or device that can switch an electrical circuit, interrupting the current or diverting it from one conductor to another is known as a Switch. Typically, electronic switches use solid state devices such as transistors, though vacuum tubes can be used as well in high voltage applications.

Figure: Switch

I) Battery

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smart phones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work. Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved additionally to include devices composed of a single cell.

Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and wristwatches to small, thin cells used in smart phones, to large lead acid batteries used in cars and trucks, and at the largest extreme, huge battery banks the size of rooms that provide standby or emergency power for telephone exchanges and computer data centres.

IV .AUTOMATIC RAILWAY CROSSING GATE CONTROL APPLICATION

- It can be used for Railway Gate Controlling
- Automatic crossing gate controllers can be used for Parking Gate Controlling

V. ADVANTAGES

- It acts as a safety measure that allows the citizens to cross the railway path safely.
- It helps in determining the distant signal during the fog .
- Less Time consuming as it controls the gate automatically.
- No human resource is required.

VI. CONCLUSION

The main purpose of this project is to provide a more safety way of controlling the railway crossing gate that would avoid railway accidents happening due to unattended railway gates.

During the foggy weather, this project will help the train driver to detect the signal with the help of the receiver situated in the train itself. Since the design is completely automated it can be used in remote villages where no station master or line man is present. Railway sensors are placed at two sides of gate. It is used to sense the arrival and departure of the train. This system uses the DC motor to open and close the gates automatically when it is rotated clockwise or anticlockwise direction. The LCD display shows the status of the railway gate control system. The system can also generate buzzer and light indicators while the train passing through the level crossing. Now a day's automatic system occupies each and every sector of applications as it is reliable and accurate.

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