1. INTRODUCTION

It is designed using AT89C51 microcontroller to avoid railway accidents happening at unattended railway gates, if implemented in spirit. This utilizes two powerful IR transmitters and two receivers; one pair of transmitter and receiver is fixed at up side (from where the train comes) at a level higher than a human being in exact alignment and similarly the other pair is fixed at down side of the train direction. Sensor activation time is so adjusted by calculating the time taken at a certain speed to cross at least one compartment of standard minimum size of the Indian railway. We have considered 5 seconds for this. Sensors are fixed at 1km on both sides of the gate. We call the sensor along the train direction as ‘foreside sensor’ and the other as ‘aft side sensor’. When foreside receiver gets activated, the gate motor is turned on in one direction and the gate is closed and stays closed until the train crosses the gate and reaches aft side sensors. When aft side receiver gets activated motor turns in opposite direction and gate opens and motor stops. Buzzer will immediately sound at the foreside receiver activation and gate will close after 5 seconds, so giving time to drivers to clear gate area in
order to avoid trapping between the gates and stop sound after the train has crossed.

The same principle is applied for track switching. Considering a situation wherein an express train and a local train are traveling in opposite directions on the same track; the express train is allowed to travel on the same track and the local train has to switch on to the other track. Two sensors are placed at the either sides of the junction where the track switches. If there’s a train approaching from the other side, then another sensor placed along that direction gets activated and will send an interrupt to the controller. The interrupt service routine switches the track. Indicator lights have been provided to avoid collisions. Here the switching operation is performed using a stepper motor. Assuming that within a certain delay, the train has passed the track is switched back to its original position, allowing the first train to pass without any interruption. This concept of track switching can be applied at 1km distance from the stations.
2. WHAT IS A GATE CONTROL

Railways being the cheapest mode of transportation are preferred over all the other means. When we go through the daily newspapers we come across many railway accidents occurring at unmanned railway crossings. This is mainly due to the carelessness in manual operations or lack of workers. We, in this has come up with a solution for the same. Using simple electronic components we have tried to automate the control of railway gates. As a train approaches the railway crossing from either side, the sensors placed at a certain distance from the gate detects the approaching train and accordingly controls the operation of the gate. Also an indicator light has been provided to alert the motorists about the approaching train.
3. BLOCK DIAGRAM AND GENERAL DESCRIPTION

3.1 Block diagram introduction:

The general block diagram of unmanned railway gate control, the various blocks of this are:

1. Power supply unit
2. Gate control unit
3. Track changing unit
4. LCD Message display unit
This uses AT89C51 microcontroller for programming and operation. And ULN2003 driver.

The Block diagram consists of the power supply, which is of single-phase 230V ac. This should be given to step down transformer to reduce the 230V ac voltage to lower value. i.e., to 9V or 18V ac this value depends on the transformer inner winding. The output of the transformer is given to the rectifier circuit. This rectifier converts ac voltage to dc voltage. But the voltage may consist of ripples or harmonics.

To avoid these ripples, the output of the rectifier is connected to filter. The filter thus removes the harmonics. This is the exact dc voltage of the given specification. But the controller operates at 5V dc and the relays and driver operates at 12V dc voltage. So the regulator is required to reduce the voltage. Regulator 7805 produces 5V dc and regulator 7812 produces 12V dc. Both are positive voltages.

The supply from 7805 regulator is used for the purpose of track changing which consists of a stepper motor driven with ULN2003 the current driver chip. The supply of 12v is given to drive the stepper motor for the purpose of gate control. Through uln2003
4. OPERATION:

The view of model.

This utilizes two powerful IR transmitters and two receivers; one pair of transmitter and receiver is fixed at up side (from where the train comes) at a level higher than a human being in exact alignment and similarly the other pair is fixed at down side of the train direction. Sensor activation time is so adjusted by calculating the time taken at a certain speed to cross at least one compartment of standard minimum size of the Indian railway. We have considered 5 seconds for this. Sensors are fixed at 1km on both sides of the gate. We call the sensor along the train direction as ‘foreside
sensor’ and the other as ‘aft side sensor’. When foreside receiver gets activated, the gate motor is turned on in one direction and the gate is closed and stays closed until the train crosses the gate and reaches aft side sensors. When aft side receiver gets activated motor turns in opposite direction and gate opens and motor stops. Buzzer will immediately sound at the fore side receiver activation and gate will close after 5 seconds, so giving time to drivers to clear gate area in order to avoid trapping between the gates and stop sound after the train has crossed.

The same principle is applied for track switching. Considering a situation wherein an express train and a local train are traveling in opposite directions on the same track; the express train is allowed to travel on the same track and the local train has to switch on to the other track. Two sensors are placed at the either sides of the junction where the track switches. If there’s a train approaching from the other side, then another sensor placed along that direction gets activated and will send an interrupt to the controller. The interrupt service routine switches the track. Indicator lights have been provided to avoid collisions. Here the switching operation
is performed using a stepper motor. Assuming that within a certain delay, the train has passed the track is switched back to its original position, allowing the first train to pass without any interruption. This concept of track switching can be applied at 1km distance from the stations.

In this Atmel 89c51 Micro controller Integrated Chip plays the main role. The program for this is embedded in this Micro controller Integrated Chip and interfaced to all the peripherals. The timer program is inside the Micro controller IC to maintain all the functions as per the scheduled time. The Liquid crystal Display (LCD) is interfaced to Atmel 89c51 Micro controller to display the message, stepper motors are used for the purpose of gate control and track changing interfaced with current drivers chip ULN2003 it’s a 16 pin ic.

Infrared sensors are used in this for the detection of the train when ever it sends a signal to microcontroller the stepper motor should operate or message will be displayed on LCD. It consists of units called transmitter and receiver circuit.

Infrared sensor circuit consists of IC555 timer C 555 is used to construct an astable multivibrator
which has two quasi-stable states. It generates a square wave of frequency 38 kHz and amplitude 5 Volts. It is required to switch ‘ON’ the IR LED.

A stepper motor is a widely used device that translates electrical pulses into mechanical movement. They function as their name suggests - they “step” a little bit at a time.

Operation of this can be explained through three units:

1. Gate control unit
2. Track changing unit
3. Announcement unit
4. Two trains opposite on same track case
Railways being the cheapest mode of transportation are preferred over all the other means. When we go through the daily newspapers we come across many railway accidents occurring at unmanned railway crossings. This is mainly due to the carelessness in manual operations or lack of workers. We, in this have come up with a solution for the same. Using simple electronic components we have tried to automate the control of railway gates. As a train approaches the railway crossing from either side, the sensors placed at a certain distance from the gate detects the approaching train and accordingly controls the operation of the gate.
Also an indicator light has been provided to alert the motorists about the approaching train.

The above figure shows the gate controlling unit block diagram. Its operation can be explained through that.

As the figure shows it consists of two pairs of infrared sensors placed at two sides of gate. They should keep at a distance of 9 cm (2km in usual case) from the gate. and a stepper motor is used for the purpose of the gate closing and opening. Interfaced to the ULN2003.

When train reaches the sensor, it is detected by IR sensors placed 9 cm before the station and led in the sensor will glow because the 555 timer works into quasi state of operation. such that the IR LED should glow till the timer works in quasi state i.e., when train passes away the sensors it again into normal state then it receives 5v at terminals that pin at the 89c51 terminal goes high which enables the power to the stepper motor to rotate in steps which drives gate to close similarly when it reaches the second pair of sensors it senses and send the signal to the microcontroller to enable the current driver to open the gate by rotating the stepper motor in steps to get back in to original position.
Using the same principle as that for gate control, we have developed a concept of automatic track switching. Considering a situation wherein an express train and a local train are traveling in opposite directions on the same track; the express train is allowed to travel on the same track and the local train has to switch on to the other track. Indicator lights have been provided to avoid collisions. Here the switching operation is
performed using a stepper motor. In practical purposes this can be achieved using electromagnets.

For the ease of description we are considering only two platforms thus this can be implemented to any number of platforms. When train reaches the platform before a 10cm distance apart a set of sensors are placed to detect the train and two pair of sensors are placed on each of track at platforms. When the train is at the first pair of sensors it sends a signal to microcontroller to know the availability of platform. Here after checking availability microcontroller operates stepper motor to change the track. The mechanism is arranged as shown in fig. but in this case the track changing is done due to second sensor that used to open the gate.

It consists of 5v driven stepper motor, ULN 2003 current driver chip and pulley for track changing mechanism.

6.1 Announcement unit:

Usually, announcement made at the station for the information of train arrival and departure. In this model
we are using a buzzer for the announcement and LCD for the purpose of display message. LCD is interfaced to 89C51 microcontroller.

The announcement and display message is according to the second sensor which should be used for the purpose of gate opening.

6.2 Train arrival detection:

Detection of train approaching the gate can be sensed by means of sensors R1, R2, R3 & R4 placed on either side of the gate. In particular direction of approach, R1 is used to sense the arrival; R3 is used to sense the departure of the train. In the same way R4 & R2 senses arrival and departure in the other direction. Train arrival and departure sensing can be achieved by means of relay technique. A confined part of parallel track is supplied with positive voltage and ground. As wheels of the train, is made up of aluminum which is a conducting material, it shorts two parallel tracks. When the wheels of the train moves over it, both tracks are shorted to ground and this acts as a signal to microcontroller (89C51) indicating train arrival. The train detection in the
other direction is done in the same way by the sensors R1 & R4. These sensors are placed five kilometers before the gate.

6.3 warning for road users:

At that moment the train arrival is sensed on either of the gate, road users are warned about the train approach by RED signal placed to caution the road users passing through the gate. RED signal appears for the road user, once the train cuts the relay sensor placed before the 5Kms before the gate. A buzzer is for train, when there is any obstacle; signal is made RED for train in order to slow done its speed before 5km from gate.

6.4 Train departure detection:

Detection of train is also done using relay techniques as explained the head of train arrival detection. Sensor R3&R2 respectively considering direction of train approach do train departure.

A message is displayed on LCD when train reaches the platform. Sensed by IR sensors.

6.5 Future enhancement:

In our technique though it has many merits, but still the power supply of 223V AC POWER is required for functioning of the motor. It can be avoided with the help
of a battery charged by a Solar Cell. Since solar energy is an inexhaustible natural source of energy.

6.6 **Two trains opposite on same track:**

We know that the rate of accidents increasing day by day, in this because failure of mechanism at track changing two trains coming on same track. This can also happens some times due to human negligence. This can avoided by using the following unmanned detection for two trains coming on same track case.

In our model of, we are using the gate controlling pair of sensors to execute this method. i.e., when two trains are coming same track at that location the two sensors will operate at a time i.e., two 555 timers of circuit are driven in to quasi stable state and thus corresponding two buzzer will operate at a time and two IR LED will operate and hence signal sends to micro processor to operate the stepper motor at tack changing. The components that we use in order to execute are stepper motor 5v, ULN2003, AT89C51 AND IR sensors.

6.7 **Initial signal display:**

Signals are placed near gate each at a specified distance. Train may be approaching gate at either direction so all four signals are made RED initially to
indicate gate is OPENED and vehicles are going through gate. The road user signals are made GREEN so that they freely move through gate. Buzzer is OFF since there is no approach of train and users need not be warned.

7. POWER SUPPLY

Circuit Diagram and introduction:
Power supply unit consists of following units

7.1 Step down transformer
7.2 Rectifier unit
7.3 Input filter
7.4 Regulator unit
7.5 Output filter

7.1 STEPDOWN TRANSFORMER

The Step down Transformer is used to step down the main supply voltage from 230V AC to lower value. This 230 AC voltage cannot be used directly, thus it is
stepped down. The Transformer consists of primary and secondary coils. To reduce or step down the voltage, the transformer is designed to contain less number of turns in its secondary core. The output from the secondary coil is also AC waveform. Thus the conversion from AC to DC is essential. This conversion is achieved by using the Rectifier Circuit/Unit.

**7.2 RECTIFIER UNIT:**

The Rectifier circuit is used to convert the AC voltage into its corresponding DC voltage. There are Half-Wave, Full-Wave and bridge Rectifiers available for this specific function. The most important and simple device used in Rectifier circuit is the diode. The simple function of the diode is to conduct when forward biased and not to conduct in reverse bias.

The Forward Bias is achieved by connecting the diode’s positive with positive of the battery and negative with battery’s negative. The efficient circuit used is the Full wave Bridge rectifier circuit. The output voltage of the rectifier is in rippled form, the ripples from the obtained DC voltage are removed using other circuits available. The circuit used for removing the ripples is called Filter circuit.
7.3 INPUT FILTER:

Capacitors are used as filter. The ripples from the DC voltage are removed and pure DC voltage is obtained. And also these capacitors are used to reduce the harmonics of the input voltage. The primary action performed by capacitor is charging and discharging. It charges in positive half cycle of the AC voltage and it will discharge in negative half cycle. So it allows only AC voltage and does not allow the DC voltage. This filter is fixed before the regulator. Thus the output is free from ripples.

7.4 REGULATOR UNIT:

7805 Regulator

Regulator regulates the output voltage to be always constant. The output voltage is maintained irrespective of the fluctuations in the input AC voltage. As and then the AC voltage changes, the DC voltage also changes. Thus to avoid this Regulators are used. Also when the internal resistance of the power supply is greater than 30 ohms, the output gets affected. Thus this can be successfully reduced here. The regulators are mainly
they can also be classified as:

i) Positive regulator
   1--> input pin
   2--> ground pin
   3--> output pin
   It regulates the positive voltage.

ii) Negative regulator
    1--> ground pin
    2--> input pin
    3--> output pin
    It regulates the negative voltage.

7.5 OUTPUT FILTER:

The Filter circuit is often fixed after the Regulator circuit. Capacitor is most often used as filter. The principle of the capacitor is to charge and discharge. It charges during the positive half cycle of the AC voltage and discharges during the negative half cycle. So it allows only AC voltage and does not allow the DC voltage. This filter is fixed after the Regulator circuit to filter any of the possibly found ripples in the output received finally. Here we used 0.1µF capacitor. The
output at this stage is 5V and is given to the Microcontroller.
8. MICROCONTROLLER

8.1 Introduction:

A computer-on-a-chip is a variation of a microprocessor, which combines the processor core (CPU), some memory, and I/O (input/output) lines, all on one chip. The computer-on-a-chip is called the microcomputer whose proper meaning is a computer using a (number of) microprocessor(s) as its CPUs, while the concept of the microcomputer is known to be a microcontroller. A microcontroller can be viewed as a set of digital logic circuits integrated on a single silicon chip. This chip is used for only specific applications.
8.2 ADVANTAGES OF USING A MICROCONTROLLER OVER MICROPROCESSOR:

A designer will use a Microcontroller to

1. Gather input from various sensors
2. Process this input into a set of actions
3. Use the output mechanisms on the Microcontroller to do something useful
4. RAM and ROM are inbuilt in the MC.
5. Cheap compared to MP.
6. Multi machine control is possible simultaneously.

Examples:

8051, 89C51 (ATMAL), PIC (Microchip), Motorola (Motorola), ARM Processor, Applications:

Cell phones, Computers, Robots, Interfacing to two pc’s.

8.3 89c51 Microcontroller IC

The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4Kbytes of Flash programmable and erasable read only memory (PEROM).
The device is manufactured using Atmel’s high-density nonvolatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer, which provides a highly-flexible and cost-effective solution to many embedded control applications. The AT89C51 provides the following standard features: 4Kbytes of Flash, 128 bytes of RAM, 32 I/O lines, two 16-bit timer/counters, a five vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator and clock circuitry. In addition, the AT89C51 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port and interrupt system to continue functioning. The Power-down Mode saves the RAM contents but freezes the oscillator disabling all other chip functions until the next hardware reset.
9. PIN DESCRIPTION OF ATMEL AT89C51:

The AT 89c51 micro controller is a 40-pin IC. The 40th pin of the controller is Vcc pin and the 5V dc supply is given to this pin. This 20\textsuperscript{th} pin is ground pin. A 12 MHZ crystal oscillator is connected to 18\textsuperscript{th} and 19\textsuperscript{th} pins of the AT 89c51 micro controller and two 22pf capacitors are

![DIP Diagram]

<table>
<thead>
<tr>
<th>Pin</th>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1.0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>P1.1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>P1.2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>P1.3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>P1.4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>P1.5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>P1.6</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>P1.7</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>RST</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>(RXD)</td>
<td>10</td>
<td>P0.0 (AD0)</td>
</tr>
<tr>
<td>(TXD)</td>
<td>11</td>
<td>P0.1 (AD1)</td>
</tr>
<tr>
<td>(INT0)</td>
<td>12</td>
<td>P0.2 (AD2)</td>
</tr>
<tr>
<td>(INT1)</td>
<td>13</td>
<td>P0.3 (AD3)</td>
</tr>
<tr>
<td>(T0)</td>
<td>14</td>
<td>P0.4 (AD4)</td>
</tr>
<tr>
<td>(T1)</td>
<td>15</td>
<td>P0.5 (AD5)</td>
</tr>
<tr>
<td>(WR)</td>
<td>16</td>
<td>P0.6 (AD6)</td>
</tr>
<tr>
<td>(RD)</td>
<td>17</td>
<td>P0.7 (AD7)</td>
</tr>
<tr>
<td>XTL1</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>XTL2</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>GND</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>P0.7 (VCC)</td>
</tr>
</tbody>
</table>
connected to ground from 18th and 19th pins. The 9th pin is Reset pin.

9.1 Port 0

Port 0 is an 8-bit open-drain bi-directional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high impedance inputs. Port 0 may also be configured to be the multiplexed low order address/data bus during accesses to external program and data memory. In this mode P0 has internal pull-ups. Port 0 also receives the code bytes during Flash programming, and outputs the code bytes during program verification. External pull-ups are required during program verification.

9.2 Port 1

Port 1 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups. Port 1 also receives the low-order address bytes during Flash programming and verification.
9.3 Port 2

Port 2 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs_Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups. Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that uses 16-bit addresses (MOVX @ DPTR). In this application, it uses strong internal pull-ups when emitting 1s. During accesses to external data memory that uses 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register. Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

9.4 Port 3

Port 3 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins they are pulled high by the internal pull-ups and can be used as
inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL) because of the pull-ups. Port 3 also serves the functions of various special features of the AT89C51 as listed below:

<table>
<thead>
<tr>
<th>Port Pin</th>
<th>Alternate Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>P3.0</td>
<td>RXD (serial input port)</td>
</tr>
<tr>
<td>P3.1</td>
<td>TXD (serial output port)</td>
</tr>
<tr>
<td>P3.2</td>
<td>INTO (external interrupt 0)</td>
</tr>
<tr>
<td>P3.3</td>
<td>INTO (external interrupt 1)</td>
</tr>
<tr>
<td>P3.4</td>
<td>T0 (timer 0 external input)</td>
</tr>
<tr>
<td>P3.5</td>
<td>T1 (timer 1 external input)</td>
</tr>
<tr>
<td>P3.6</td>
<td>WR (external data memory write strobe)</td>
</tr>
<tr>
<td>P3.7</td>
<td>RD (external data memory read strobe)</td>
</tr>
</tbody>
</table>

Port 3 also receives some control signals for Flash programming and verification.

**9.5 RST**

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device.

**9.6 ALE/PROG**

Address Latch Enable output pulse for latching the low byte of the address during accesses to external
memory. This pin is also the program pulse input (PROG) during Flash programming. In normal operation ALE is emitted at a constant rate of 1/6 the oscillator frequency, and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external Data Memory. If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the micro controller is in external execution mode.

9.7 PSEN

Program Store Enable is the read strobe to external program memory. When the AT89C51 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

9.8 EA/VPP

External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up
to FFFFH. Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset. EA should be strapped to VCC for internal program executions. This pin also receives the 12-volt programming enable voltage (VPP) during Flash programming, for parts that require 12-volt VPP.

9.9 XTAL1

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

9.10 XTAL2

It is the output from the inverting oscillator amplifier.

10. CONCLUSION

A new approach for improving safety at LCs on IR has been suggested. Formats have been given to maintain records of LC inventories, accident/incident reports. Each LC should be assigned a hazard rating and the priority of safety enhancement works be decided
accordingly. A regular assessment of safety performance should be done. This approach should be able to bring down the rising trend in accidents at LCs.

11. REFERENCES

3. “Principles of Electronics” by V.K. MEHTA.