

# Automatic railroad level crossing systems using AGM technologies

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**Abstract** Indian Railway system is a long network. It covers many rural and forest areas. There may be lack of power supply and manpower. Hence many accidents occur in level crossing, not only for the human beings as well as for animals. To improve the safety, we are designing a system that automatically open and close the gate in the level crossing. In this we proposed a solar system with AGM technology Batteries for power generation for operating the whole system, using the power of embedded system that will be achieved. Using this microcontroller system we can save the time of road users instead of waiting longtime beside the railway gate. This system simply uses sensors, 8051microcontroller, stepper motor and solar panels with AGM technology batteries for storing the solar energy. This system is not only for rural areas and is well suited for countryside also.

**Keywords:** Solar System; AGM; Microcontroller System.

## 1. Introduction

Railway System is the most important mode of public transport in India. This is the most commonly used and cost effective for long distance transportation. It covers 29 states and 7 Union Territories. It is the fourth largest network in the world; it comprises 119,630 kilometers of total track.

A level crossing is an intersection where a railway line crosses a road or path. The total of 42,000 level crossings of which 20,000 are unmanned. Level crossings are the biggest killers, more than 40% of train accidents happens due to unmanned or gate keepers' errors of these level crossing.

In this paper, we proposed a system that will recognize the train coming on this level crossing before 3 kilometers and the alarm will be ringed to alert the road users and show the red signal in the traffic light and the railway gate closed automatically. When the train crosses the station, again the traffic light changed to green and the gate opens automatically. This will be achieved by using embedded system. An embedded System is a computer system with a dedicated function; it is the combination of h/w and s/w. It often deals with the real time systems. It controls many electrical and mechanical systems. Here, we are using solar energy with AGM batteries for power generation so that this system can work for rural areas where there is no power and it is well suited for country side also.

### 1.1. Statistics For Railway Accidents And Their Reasons

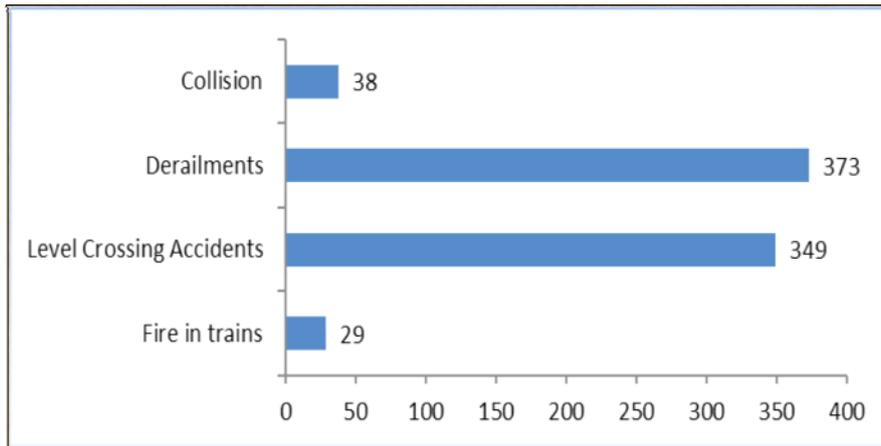


Fig 1: Number of Accidents Occurs in Indian-Railways (2010-15)

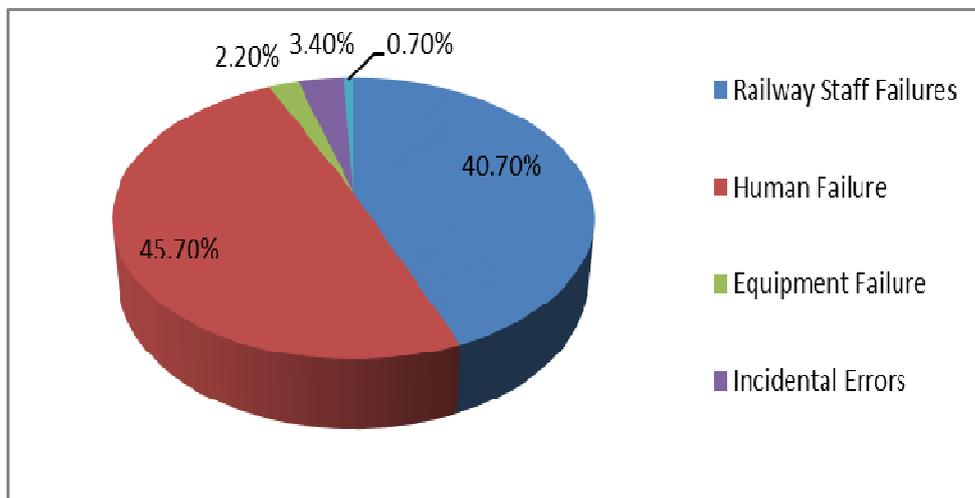


Fig2: Reasons for Accidents

Based on the statistics we come to know that most of the accidents occur in level crossing that is due to human failures for railway staffs or others may be the road users. For this reason we are proposing a microcontroller system to avoid such incidents. Here we are using Solar energy with AGM batteries because in some of the places, the power supply does not reach and we want to use the renewable energy, we get that at zero cost only the initialization cost is needed.

## 2. Solar System

Solar power is the energy from sun. “Solar” is the word comes from Latin. In Latin “solar” means sun. It is a renewable energy. Renewable energy is the one that is collected from renewable sources such as sunlight, wind, rain, etc.

The benefit of using solar are:

- solar energy is unlimited
- Once the solar panel installed it provide power at no cost
- Less maintenance
- Converting sun power to electricity doesn’t produce smoke (No air pollution)
- No noise made from the solar panels

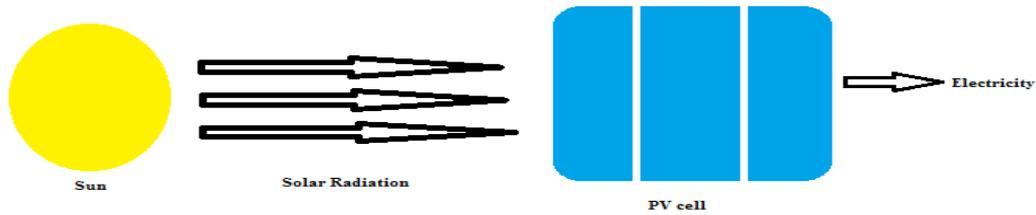


Fig 3: Solar energy

The photovoltaic cell (PV) is used for converting solar to electricity. The P-type and N-type semiconductor materials are used for creation of PV cells. In PV cell flat pieces of these material are placed together and the boundary between them is called PN junction. The electrodes connected to the PN layers produce the DC. Large set of PV cells or solar cells can be connected together to form solar panel.

Now days, solar system prices dropped dramatically while the electricity prices are continuously rising. Worldwide solar power is the most preferable option for home as well as business.

The energy producing rate will depends on three factors in solar system:

- Solar cell efficiency
- Solar panel size
- Amount of sunlight hitting the panel

In our system Proposal 1kw solar panel is more than enough but the energy production rate differs in various factors like weather, environmental criteria, etc. and as well as the solar system get larger , the price per watt is lower. So we selected 2kw solar panel system. The number of panels required for 2kw is 8 and the space required is 100 square feet. The unused powers may be used for powering the road lights, etc. The figure shows the 2kw solar panel:

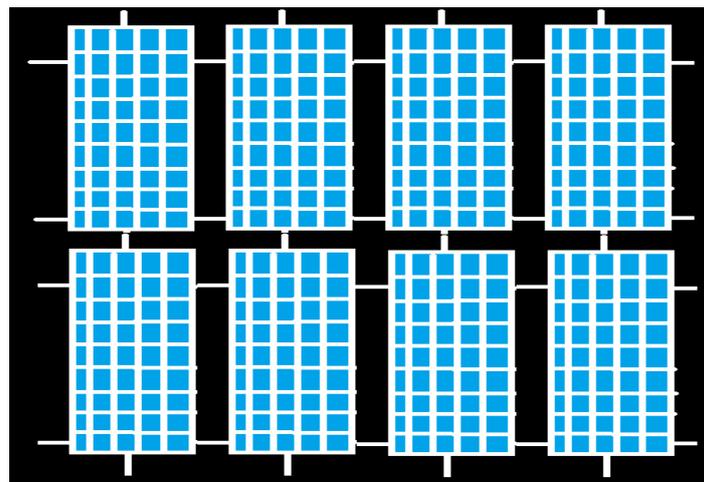


Fig4: 2kw solar panel system

### 3. AGM Technology

AGM -absorbent Glass Mat. This is a technology was originally invented in 1980 and developed and introduced in 1985 for military aircraft. It has a special mat of very thin glass fibers lie tightly between the lead plates of the battery and hold the entire electrolyte. The thin ultra-fine fiberglass mat sandwich between the plates that are saturated with battery acid to about 95% of what they can hold. This mat is then packed in between the plates and slightly compressed and welded in place. The sulfuric acid is absorbed by a very fine fiberglass mat, making the battery spill proof. AGM is one of the latest top range battery technologies. It is also called starved electrolyte. AGM batteries have extremely low internal resistance; there is almost no heating of the battery even under heavy charge and discharge currents. Service life of these batteries is long. When the current requirement is high it capable of deliver high current.

It is maintenance free. There is no free acid inside these type of batteries can be installed in any position other than upside down. Because our paper is mainly concentrating the unmanned level crossing that are in rural areas. So to install these batteries and let them operate over periods without maintenance is a benefit. For their increased performance and total energy output, it is a good choice for renewable energy applications at a lower price point than gel batteries.

#### 4. Microprocessor System

Level crossings can be divided into 4 types. They are special class, A class, B class, C class and D class depending upon the volume of the road traffic and the number of trains passing over the level crossing. Special class, A class and B class are found to be manned level crossings. The C and D class are unmanned level crossings. Unfortunately the number of level crossing in C and D class are almost equal to the manned level crossing. Unmanned level crossings are a major reason for train accidents and in sometimes accidents occur in manned level crossing also. So, we are proposing a system that avoids the human intervention at level crossings completely.

A system is an arrangement in which all its unit assembles together and works according to a set of rules. In system, all its subcomponents depend on each other. An embedded system is a microcontroller based system which is designed to perform a specific task. In our proposed system we are using microcontroller based real time embedded system.

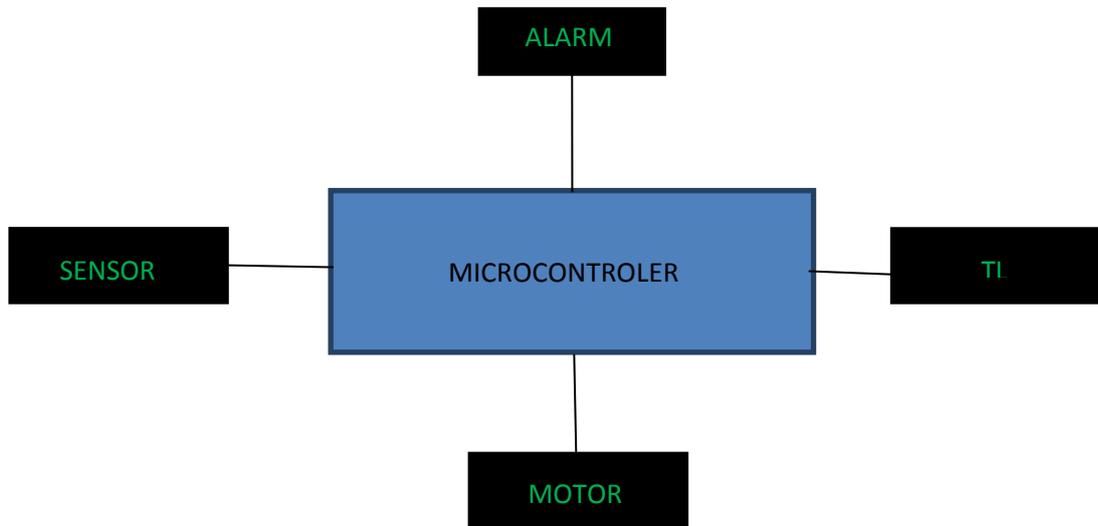


Fig5: Block diagram Of Microprocessor System

The Figure shows the Functional diagram of Microcontroller. The Microcontroller gets the arrival and departure signals from the sensors. It should alert the road users by signaling Red signal in the Traffic light and buzzer the alarm. After that the microcontroller closes the railway gates using stepper motor. When the microcontroller gets the departure signal from the sensor, it signals Green light in the traffic light and open the railway gate using stepper motor.

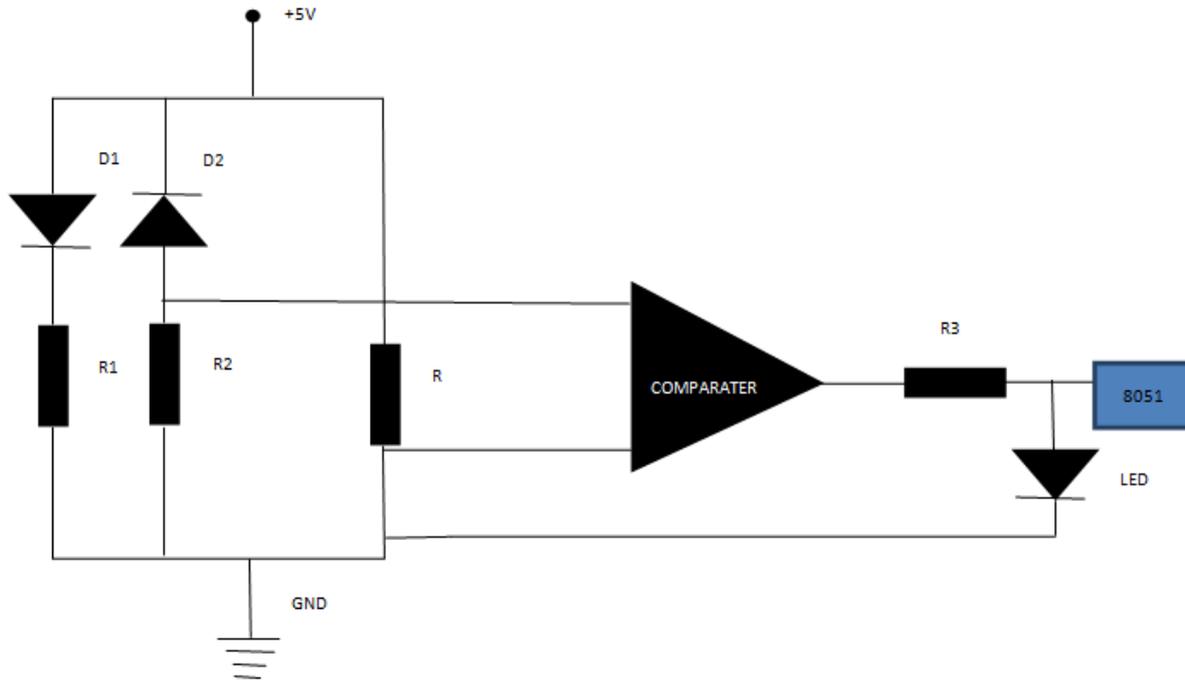


Fig6: Circuit Diagram of IR Sensor

The IR sensor consists of IR transmitter and IR receiver circuits. The IR transmitter consists of infrared LED and the receiver section which detects IR pulses transmitted by the IR-LED. In our proposed system two IR sensors are used. IR sensors are kept 3kms away from either direction of the railway track. when the train passes the first IR sensor, the microcontroller receives the signal from the IR sensor and it instruct the motor in clockwise direction to close the railway gate and it waits up to the train passes the second IR sensor after crossing second IR sensor, the microcontroller send the signal to the motor to rotate anti clockwise direction to open the railway gate.

The alarm is connected on the P1.0 pin of the 8051. The traffic light LEDs are connected with P1.5 and P1.4. When the microcontroller get the train arrival signal from the first IR sensor immediately this pin will be high and the alarm start to buzzer for 2min at the same time RED LED will be switched on in traffic light and it will be stayed on up to the train crosses the level crossing. As soon as the microcontroller gets the signal from the second IR sensor (that means the train crossed the level crossing) the GREEN LED will be switched on in the traffic light.

A stepper motor is an electro mechanical device; it converts electrical power into mechanical power. It is a brushless, synchronous electric motor that can divide a full rotation into an expansive number of steps. The motors position can be controlled accurately without any feedback mechanism.

It is a low cost, high reliability, high torque at low speeds and a simple, rugged construction that operates in almost any environment low maintenances required. Excellent response to start, stop and reversing operation

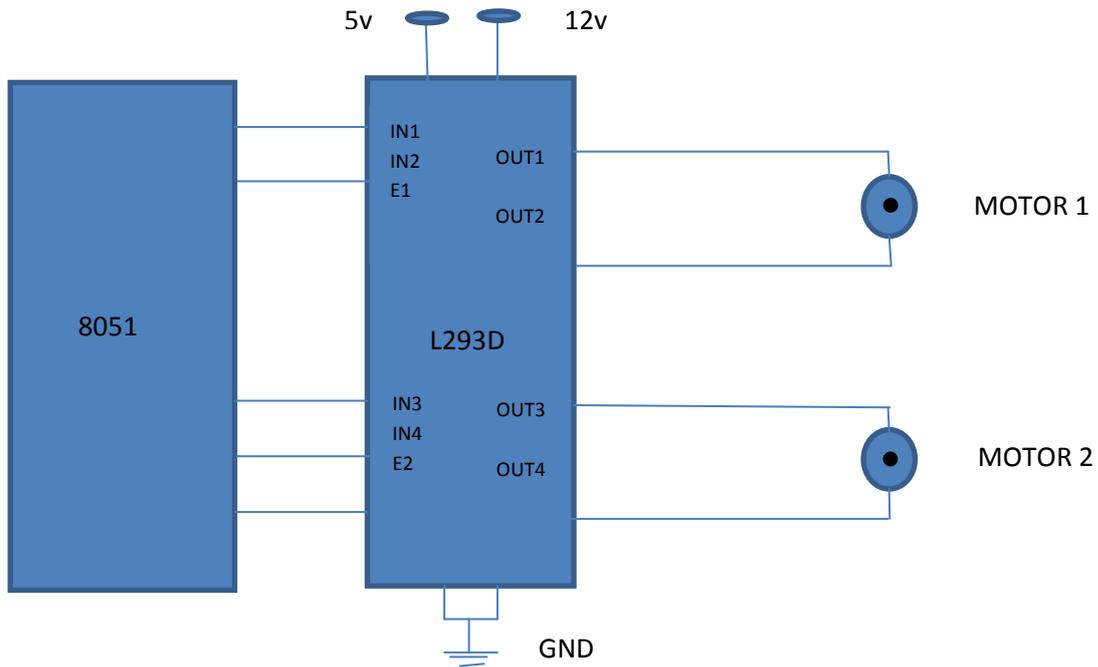


Fig7: L923D connected with Stepper motors

L293D driver is an H bridge motor driver contains 16 pin. In one IC we can connect two DC motors as well as we control the rotation of motors in clockwise and anticlockwise direction. If the 8051 send high signal to E1,E2 and IN1 and IN2, the MOTOR1 and MOTOR2 rotate in forward direction that means the railway is closed and E1 and E2 and IN3 and IN4 are high then the motors rotate in anticlockwise direction this one is for opening the railway gate.

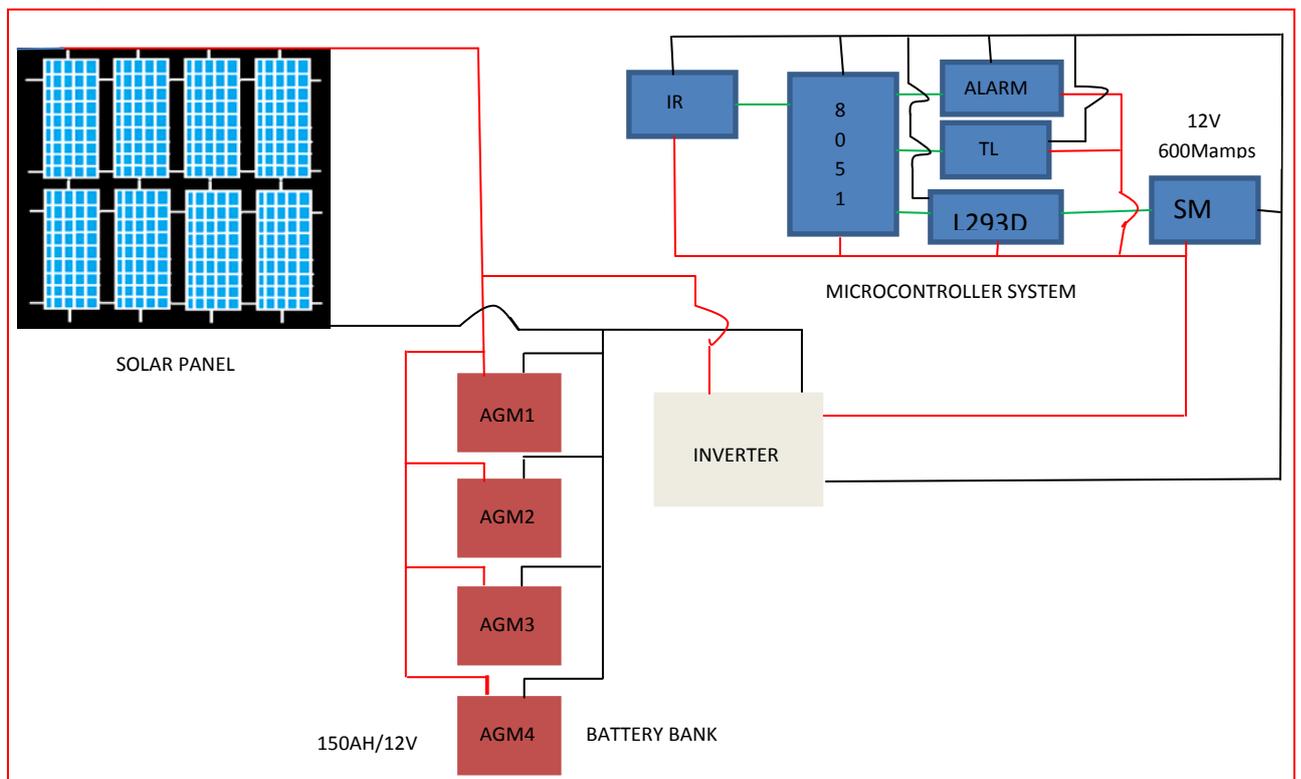


Fig 8: Circuit diagram of solar panel with AGM batteries connection to the

### Microcontroller system

A battery bank is a one where two or more batteries connected serial or parallel that work as a one large battery. This battery bank system stores electricity generated by solar PV systems to use at any time. In our proposed system 4 AGM batteries are connected in parallel manner to get increased ampere value while keeping the total voltage same as 12V. The inverter is used to convert the DC power into AC power and that will be supplied for the whole microcontroller system.

### 5. Conclusion

An automatic Railway system is well suited for rural and forest areas where there is no electricity and lack of manpower and it is well suited for township also. Implementing this system in unmanned railway level crossing definitely reduce the railway accidents. Here we are using the renewable energy as the source of energy so it will be environmental friendly no air pollution and noise pollution and we are getting at free of cost with less maintenance. But the initialization cost of solar panel and the batteries are costly so work to be carried out for finding the new technique that will reduce the initialization cost of solar panel and as well as fuzzy logic to be used in microcontroller system to finding the obstacles present in the railway tracks while train arriving on the railroad and indication should given to the train driver to stop the train.

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