

# 5

## **AUTOMATIC GATE SENSORS**

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### **5.1 INTRODUCTION**

Advancement in technology is a live of example of this concept. As it is too difficult for a common man to think earlier that can a gate could be opened automatically without any manual work. Also the types included in this system are vast in market. So the technological advancement is required to combine all such features in a single system. Also the system should be easily operatable by any beginner or any incoherent person. It also provides security as it's the major requirement from any gate by any user, without security the system is of no use. So, security is also a non-comprisable feature of this system. One more problem related to gate is that the user should be reliable on others also the security feature can be compromised due to innumerable reasons that occur related to humans.

First gate introduced was completely manual and humans were completely required to open such gates. Then came the next system used on toll booths that opened the gate after the click of the operator over switch. Later came the system that only recognized any type of moving vehicle and then opened the gate using the system, IR detector was used in this type of system. The next system used in the type was the system that only allowed the authorized user the access and opened the gate required to be opened for the unauthorized user. The main task of this system is to reduce manual work and bring technological advancement in the society. At last the system with some modifications from the above system was introduced like opening of gate by mobile application rather than opening it manually. This helps in reducing maximum of the physical work. The cost expenditure on machine is one time which is bearable whereas the cost expenditure on human is recurring and increases with

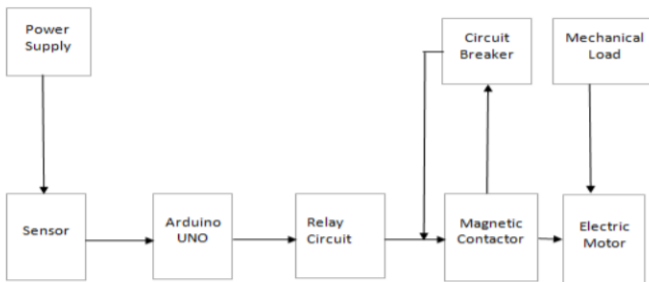
time.

Machines require regular servicing for smooth working and proper functioning. The sensors play an important role in the system as they are the whole and sole mechanism required for proper functioning. As the sensors are already available in market it makes the system easily developable with minimal cost. Also the recurring cost is very low than the manual cost required for guards. So this makes the system a completely reliable, functional and secure.

## 5.2 THEORY

### 5.2.1 General Design Theory and Concept

This section discusses in details the method and processes taken in the design, construction, and implementation of an automatic gate. The components used in the development of the automatic gate can be divided into mechanical and electrical components. The electronic components used in the development of the control circuit of the automatic gate are Electric motor single phase, Arduino UNO, IR sensor, Buzzer, Relay circuit, Magnetic Contactor, Control Switches, Thermal Overload Relay, Circuit Breaker, Indication Lights, Circuit Breakout Switches, Alarm Circuit, Cables. The mechanical components that were being used to carry out the design and construction of an automatic gate includes Metal Framing, Gate Rack, Metal Gear, Rollers, Cantilever Rollers, Counterbalance Post, Last Post, Counter Balance. The automatic gate can further be said to consist of three major sections which are the design of the power supply system, design of the gate, and design of the control system. Figure 5.1 shows general design concept of automatic gate.



**Figure 5.1:** General Design Concept of Automatic Gate

### 1.2.2 Design of the Power Supply Unit

The power supply system supplies current to the whole system, as shown in Figure 5.2. It sends current across the IR sensor, motor, switch, and circuit breaker. The transformer produces 110V – 240V. The power supply design consists of a transformer, rectifier, voltage regulator (7812 and 7805 IC), capacitor, resistor. The transformer uses a 230/12/5V which operates like every other transformer. The rectifier is a bridge rectifier which consists of four diodes connected in a square shape. From the circuit above, when the switch S1 is turned on, it takes 230/12/5V AC which is stepped down to 12v and 5v by the transformer.

The full wave rectifier converts the 12v and 5v Ac into a pulsating DC and the capacitors C1 acts as a filter, it removes repulse and eliminate the AC component of the waveform and produces nearly constant DC voltage output. The IC LM7812 and LM7805 are used to regulate the voltage to produce 12v and 5v respectively. LM7805 can deliver up to 1.5A of current (with heat sink).

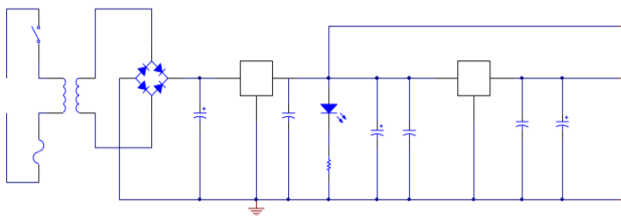


Figure 5.2: Power Supply Unit

### 5.2.3 Design of the Gate

The design of the gate included the use of metal, welding machine, rollers, gear, rack. The metal was being used to design the gate into the preferred shape. The metal was of length 5.358m each. The gate being created was of length 7.8m. With the length of each metal being 5.358m, an additional length of 2.442m was added to 5.358m to give us the desired length of 7.8m. The height of the gate was 1m. The various length was welded together to give a rectangular gate of 7.8m in length and 1m in height and 645kg in weight. The rectangular gate was further segmented with a measurement of 95.25m in order to make it more firm. The gate rack has a total length of 100.5cm, the screwing point of the rack has a distance of 45cm. The rack was placed at a distance of 10cm from the button of the gate. It has a forward space of 130cm from the starting point

of the gate and a backward space of 68.1cm from the back of the gate. The forward and backward space is an indication of where the gate rack starts and where it stops.

#### 5.2.4 Construction of the Gate

Measurement of the gate was taken and the metal was cut accordingly using a cutting machine and then welded together with the aid of a welding machine. Two poles were mounted with a depth of 55cm on which the rollers were mounted.

#### 5.2.5 Construction and mounting of gate rollers

After the poles have been mounted, rollers were created with the use of plates, metal rollers, washers and metals. The metal on which the rollers were inputted was created with the use of metals which are L-shaped. Two L-shapes are joined together with a metal. The L-shape is called the angle bolt, which consists of a washer, rollers and two plates. The arrangement of components on the angle bolt is in the form of a metal plate followed by a washer, the rollers which were greased to enable ease movement, then a washer and a metal plate. All these were locked to the angle bolt with the aid of bolt and nut. Four of these were made as shown in Figure 5.3.

These rollers were then placed on the poles that were being mounted. After successful mounting of the rollers, the gate was tested and it was able to move freely through the rollers.

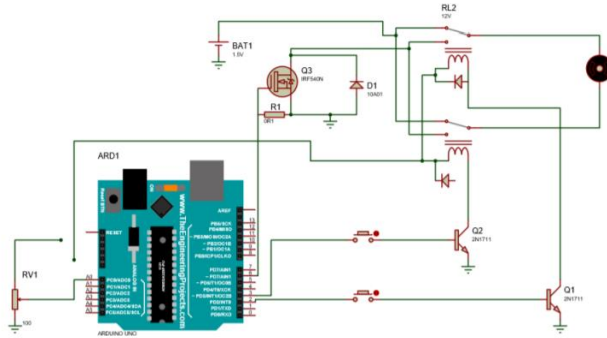


**Figure 5.3:** Four Rollers

#### 5.2.6 Programming the Arduino and connecting the relay circuit

Upon successful installation of the limit levers the Arduino UNO

was connected and programmed with the relay circuit as shown in Figure 5.4 Arduino UNO is a micro controller which consists of digital and analog pins, he codes for the Arduino is written in the Arduino IDE.

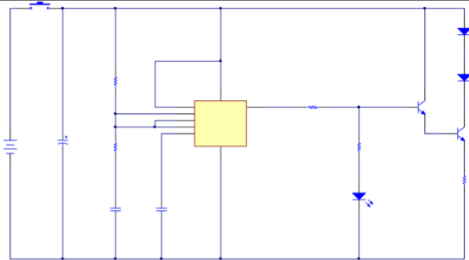


**Figure 5.4: Arduino UNO and relay circuit**

In the above circuit, the transistors are being used because the digital pins of the Arduino cannot supply the amount of current needed to turn on a normal 5V relay as a 12V relay is being used. The Vin pin of Arduino cannot supply enough current for both relays, hence, a transistor is being used to conduct the current from the Vin pin to the relay. MOSFET (Metal Oxide Semi-Conductor Field Effect Transistor) is used to control the speed of the motor. The MOSFET is switched on and off at high frequency voltage and since the motor is connected in series with the drain of the MOSFET, the PWM (Pulse Width Modulation) value of voltage determines the speed of the motor.

### 5.2.7 Configuration of Infrared Transmitter Module

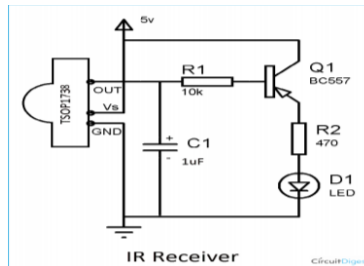
The infrared transmitter has the ability to transmit infrared beam but can only travel in a rectilinear manner or line of sight, which is received by the infrared receiver at another end. Infrared transmitter and receiver are used in many situations to control things remotely. It can be seen in some home appliances such as TV and remote control. The circuit in Figure 5.5 shows the transmitter module of the infrared.



**Figure 5.5:** Circuit diagram of infrared transmitter

### 5.2.8 Configuration of receiver circuit

The receiver circuit receives the signal coming from the transmitter circuit. This reception or non-reception of this signal is what determines the opening or closing of the gate. The receiver circuit is being shown in Figure 5.6.



**Figure 5.6:** Receiver circuit of the IR sensor

## 5.3 LITERATURE REVIEW

A number of security systems are being used for protection. One of the important parts is gate which secures the entry of any kind of burglar. In the existing gate security systems, ID card or biometrics is frequently exploited for identification and authorization. ID card based gate security system is widely adopted, but it is vulnerable to replication and modification of the ID card. Biometrics based gate security system has no weakness of replication and modification, but it requires high complexity and shows the high false identification ratio rather than ID card based system. [1] The other type of system that can be described as attempt to construct a small and simple model of an Automatic Gate is System, which uses a power window motor which uses for car power window and circuitry to move the gate. Other one is automatic gate system, in this

system the sensor senses the vehicle automatically and opens the gate for any vehicle. In this system we don't need security guard. In this system security level is the lowest of all the system, as the gate is opened for every vehicle. It is mainly used in malls or hotels where the number of guest incoming/outgoing is high. Other system similar is the gate system with a remote given to the security guard. He will then check the vehicle number and press the button on the remote and then the gate is opened. In this system the gate will not be opened for every vehicle entering as the remote is in the hands of guard, only the vehicles which are allowed by guard will be able to enter. In this system the security level is moderate. These types of systems are mainly used in toll booth systems or parking lot. [7] And the next one is the gate systems open for authorized users only. The sensors sense the presence of authorized user and command the system to open the gate whereas the difficulty that falls in this system is that no provision is being made for unauthorized user. So here comes the manual job for the guards to open the gate. And if, manual work is brought then the main feature that is security can be compromised with the human made mistakes/errors. So this system also doesn't include full basic features required. Next in the spectrum is in this paper, application software is designed for automatic Gate control system Based on license plate recognition, the system is successfully implemented. The performance of the developed of algorithms for License Plate Localization and License Plate Recognition is acceptable range. Also this project will be able to use in all the places, and able to works automatically without need human beings and also the system will be able to recognizes license plates. [3] The device connected to this gate is working through the process from microcontroller that has been programmed with assembled language and logic circuit. This process is controlled by 8-bit microcontroller AT89C2051, the microcontroller receives the infrared signal from the transmitter which remote control through IR sensor, decode it and switch ON the relay that control the DC motor which incorporate with gear that control the movement of the gate forward and backward, when the wrong password enters through IR remote control designed for the circuit and open button is press the gate will not open, the security alarm will sound for security purpose. This alarm system is incorporated with design in order to impede intruders from gaining entrance to the opening of 74 gate. [4] To increase safety in access automation systems, these systems include automatic swing and sliding gates, bollards and barriers to prevent unwanted access. In current installations the anti-crushing

protection is ensured by an electronic device installed on the control boards, which directly controls drive torque, and a couple of infrared photo detectors: when an obstacle is touched by the gate leafs or barriers, or cuts the infrared beam, the control board stops the gate movement. The new device returns a stop signal when an obstacle is present in a predefined area. The algorithm has been integrated in a real access system to test its performance. [5] A 2.45-GHz wireless IC card system has been developed for a noncontact-type train station automatic gate system. This system consists of compact transmitter-receiver equipment and noncontact wireless IC cards. [8]

## **5.4 CONTRIBUTIONS**

### **5.4.1 Sliding gate are convenient**

Automated gates allow people to enter properties without having to get out of their cars to open manual gates – a clear advantage when it’s raining or late at night. It also closes automatically so that you don’t have to be mindful of closing and locking the gate after entering.

### **5.4.2 Sliding Gate are More Secure**

Automated gates, as their name implies, come with automatic locks, integrated safety beams, and other features that boost security. Also, doing away with the need to get out of the car to open and close the gates significantly lowers the risk of something happening while you are outside the car such as getting mugged or having your car stolen.

### **5.4.3 Sliding gate take up less space**

Landscaping and parking area capacity are no longer problems when you decide on having automated sliding gates for your property. Since they slide instead of swing inside or outside, landscaping areas are not affected and so are parking areas. You can use even the space right by the sliding gate because it will not take up a large area when opening or closing. Smaller properties greatly benefit by opting to go with installing sliding gates.

### **5.4.4 Sliding gate are durable**

Design and manufacturing of these types of gates are done with the aid of precision technology. As such, they are built with durability and functionality in mind. Sliding gates are built to withstand any type of



weather-related conditions.

#### **5.4.5 Sliding gate enhance visual appeal and add value to your property.**

These gates are highly customisable and could easily accommodate most personal preferences. You get to decide the sliding gate's size, material, and finish down towards its features, drive system, and safety devices.

Since they are highly customisable, it can enhance your property's exterior. Also, having this particular feature can easily boost your property's market value and increases its appeal should you wish to sell in the future.

Automation Zone do not just sell gate systems. Our friendly staff members are equipped with knowledge to help you come up with the optimal gate solution for your property. They can answer any question you may have that will aid you in deciding on the best option for your properties. All our gate systems also come with professional installation to ensure you get both quality product and service.

### **5.5 CONCLUSION**

The main aim of the system is to make the society free from dependency without any human assistance or works. The system task is to make it reliable to all kind of users without any technical knowledge and still make it technologically advance. The system also takes care that even with least or no human the system and the place where the system is located to be secure. It also allows the operator to use the system with touch of button through mobile application.

The mobile application not only makes the operation easier but also suitable for the market as it demands only minimum manual work and maximum of smart work. The system only demands one time investment and only the recurring cost of the motor to be used, but the cost required for doing manual work that is the cost required for guards to manage security and other operations are too high and never stop rather increase day by day. Also the system avoids the errors that are done by human.

This brings to the conclusion that the system is secure to be used in place which require low and moderate security, also places where no human is present to the manual work and places where the users can't depend completely on human.

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## REFERENCES

- [1] A. S. Oluwole, "Design of automatic gate using infrared remote with password protection feature.," *IEEE*, vol. 34, p. 334, 1988.
- [2] K. O. and D. K. Eunggi Lee, Issac Lim, Hyeonwoo Kim, "The template will number citations consecutively within M. Young The Technical Writer's Handbook," 1989.
- [3] Z. X. Ismael Saad Eltoum, "Automatic Gate Control System Based On Vehicle License Plate Recognition," vol. 10, p. 122, 1990.
- [4] A.S.Oluwole,"Design of automatic gate using infrared remote with password protection feature.," *IEEE*, vol. 34, p. 334, 2015.
- [5] Luca Bombini and Alberto Broggi, "Advanced safety sensor for gate automation", *IEEE*, vol. 30, p. 335, 2012.
- [6] Cheng-Kang Chu, Sherman S. M. Chow, Wen-guey Tzeng, Jianying Zhou and Robert H. Deng, "Key Cryptography and data sharing in cloud storage", *IEEE*.
- [7] Pooja Kanase and Sneha Gaikwad, "Smart Hospitals using IoT (Internet of Things)", *IEEE*, vol. 25, p. 300, 2015.
- [8] K.-I. Konno, H Wada and K. Matsukawa, "A 2.5 GHZ Wireless IC card system for automatic gates", *IEEE*, vol. 34, p. 334, 2016.