

Design Analysis Automatic Garage Door Opener

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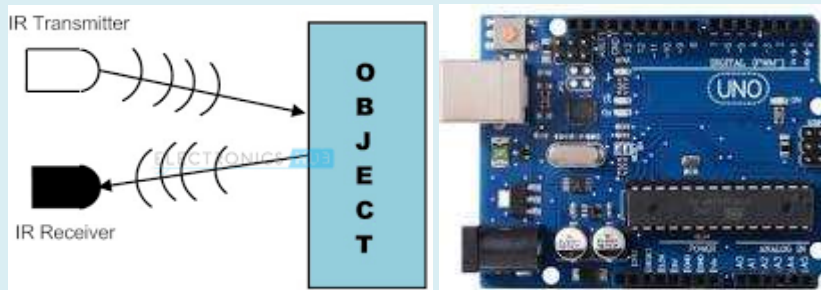
ABSTRACT

The project that we are designing will help us to provide an easy but secure access to garage door. The installation cost of the door is low and the changes that are required to be done are also very less.

To build such a door opener we need

- 1-Electric motor
- 2-Sliding door with rack and pinion arrangement
- 3-Wiring system,
- 4- Power source
- 5-Supporting clamps
- 6-Arduino Uno ,IR sensors
- 7-A remote to open and close the gate

We are designing this automatic door in order to understand the basic functions of the automatic door and also detailed working of the concepts behind this. This project will also help us to acquire some basic knowledge about electrical circuits, sensors and welding processes.



a)-IR Transmitter b)Arduino Uno

INTRODUCTION

The door that we are designing can be opened by a unique id which consist of some binary Codes.

There are basically two ways to open the door, first one is by remote in which by pressing a series of specific button ,we can open the door .It ensures the security of garage door. In second method when car comes near the garage door, IR sensor will send signal to IR receiver with a unique ID and door will be opened automatically.

In both Cases the IR receiver sends signal, to microcontroller which then decides the signal & Carries out the instruction. The binary code will decide the mode instruction means to open the gate or to close it.

All these processes are controlled by microcontroller which works as per a set of instruction. These instructions are basically set of programming done on open source Arduino software (IDE)

In mechanical arrangement we have a motor to drive our sliding door with rack and pinion arrangement, motor can run in clockwise as well as in anti-clockwise direction. One of the direction of motor will open the gate and the other will close it.

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This automatic garage door is mainly designed to reduce the human efforts and also ensures the security of the garage .These doors can also be opened in domestic as well as in industrial area because the features that are provided will reduces efforts and provide a secure system.

LITERATURE REVIEW

- According to Saswat Kumar Das et.al. , the goal of their project was to make a modification to the garage door in order to reduce human effort while the opening and closing were also increase the safety of garage.

They were designing a door modification which could also applied to several door that were sliding and rolling in nature.

For security purpose, they were considering swiping of a card or fingerprint scanning which makes their project secure but a bit costly because these security systems are pre made and thus they are not cheap

- According to Christopher K. Prinus et.al. In their project they designed a low cost automatic gate with a proper secure system. The aim of their project was to show simply how an automatic door works.

They used remote to open and close the garage door with IR sensors, they did not provide the system which opens automatically when car is near the garage door. This could have made the system advanced

- According to Sanner Mahmood et.al. they designed the project which was capable to reduce human efforts and provided 3 ways to open the garage
 1. Using IR sensors
 2. Using Bluetooth
 3. By a switch

They designed a system which could turn off the light or garage automatically after 60 seconds from any last order. The security that they were providing is not sufficient because they were not providing a series of pre defined buttons to open the gate ,they were only providing a single button to open it. Thus, a unknown person can easily open the garage door if he got the remote.

METHODOLOGY

In our project we are designing automatic garage door by using sensors and to ensure proper working we are providing an authenticate electrical system.

We are also providing a special feature in our system in which the garage door automatically opens when the car will come near to it.

In this feature, the door will open only for a particular car.

We are using an IR transmitter to transmit the signal and an IR receiver to receive the signal. The signal carries out a binary code which is unique. We will attach this transmitter to the car. After receiving signal, authenticity of the code will be processed to check.

To open and close the gate, there is also a remote which works on the same principle of IR sensors ,we have to press a series of fix buttons in order to open the gate and a signal button to close it.

Each button of remote have its own binary codes, when we press a series of buttons the microcontroller will check whether the series of codes are defined in our Arduino program or not and will open and close the gate accordingly. We use Arduino Uno as a microcontroller board based on AT mega 328P(datasheet).It has 14 digital pins ,of which 6 can be used as PWM outputs ,6 as analog input ,we can feed the command in Arduino uno with the help of IDE.

In IDE programming we will allow only those certain binary codes to open the gate which are generated by IR sensors that we are using in our designing .In this way we can provide a secure automatic mechanical door opener.

We will also mount IR obstacle avoidance sensor to the garage door to prevent closing of it while car is in the middle of the door.

Now to open the gate we have a 12V DC motor which provides a normal torque of 2.5N-m, when microcontroller transmits the signal to open the door, current will flow in motor and when signal is to close the door, the current will be flowing in opposite direction.

A 12V DC supply is given to the motor and Arduino Uno. Arduino Uno converts this voltage to its operating voltage i.e 5V and thus IR sensors have a supply of 5V.The potential is used to provide a rotational motion to the pinion via motor which is then converted into translational motion with the help of rack.

Our door is clamped with this arrangement ,thus it will also slide as rotation of motor takes place. Once the door is fully open the motor will stop and the door will remain at open position until another signal will be send.

In the final (opening and closing) positions we have placed a sensor which will break the circuit as the door will reach to the end .(in opening) and start (in closing) .Thus motor stops running and our door will remain stop at the end position.

CALCULATION

In calculation part we will calculate two major forces

1. Force delivered by motor
2. Calculation of force required to move the gate.

Motor Specification-

Nominal voltage	DC 12V
No load current	<2.5A
Load current	<=7A
Unload Speed	90rpm
Load speed	60rpm
Nominal Torque	2.5N-m
Locked torque	8N-m

Diameter of the gear connected to the motor shaft =0.08m
 Calculation for motor force:

$$T = F * r \text{ (where } T = \text{torque, } r = \text{radius of gear and } F = \text{motor force)}$$

$$F = T / r$$

$$F = 2.5 / 0.04$$

$$F = 62.5N$$

Thus, force required by motor=62.5N

Material that we are using to design our gate is steel

For steel:

Coefficient of static friction = (0.15-0.6)
 Coefficient of kinetic friction = (0.09-0.6)

Let, Mass of our door = 5Kg

Friction force between two steel surfaces:

$F_r = \mu mg$ (where μ is the coefficient of friction, m is mass of gate, g is acceleration due to gravity)

$$F_r = 0.6 * 5 * 9.81$$

$$F_r = 29.43N$$

Maximum frictional force = 29.43N

Clearly, force delivered by motor > Resisting friction force
 Thus our garage door will slide easily

RESULT

As per our calculation the door slides smoothly and the speed of rotation of motor is controlled by microcontroller, IR sensors are working properly and we have fixed the distance within which they will work properly.

We have also checked the working of IR obstacle avoidance sensor. It stops the door closing when someone /car is in between the garage door.

The electrical circuit is working properly and the set of program is also correct, overall our gate is opening and closing smoothly.

We have checked working of project and our objectives are fulfilled.

CONCLUSION

A project with secured system easily accessible at low cost has designed. We come to know about Arduino programming, electrical circuit, sensor working and some essential mechanical processor and concepts.

We also come to know how sensors can be used to make a system more advanced technically.

We need to do some reliability test so that the project can be used in future.

We can also use the concept behind this project in toll collection and to identify a particular vehicle after some modification.

After adding some features to the project, it is very much reliable to use this design in industrial and domestic levels.

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