Project No&Topic: Lab Assignment #2 Design an automatic door opening system

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Group No:

1.Introduction:

At this Project we designed a slide door.The purpose of this Project is control the motor with using a sensor which has analog output and thanks to logic circuit.At this system when you Show your hand to the sensor the door will be open and after showing When you pull your hand from the sensor, the door will close.For stopping the motor we used limit switches

2.Equipment:

1-)LDR : LDR is Light Dependent Resistor.Another name is photo resistance.Although LDR is a type of resistance,it is also a passive sensor.LDRs provide an output with varying resistance values in their circuits,but they act as a sensor since they perform this process with a physical change from the external environment.It has a working principle inversely proportional to the light intensity falling on it.In other words,as the light intensity increases,the resistance value decreases,and as the light intensity decreases,the resistance value increases.LDRs act as switching by changing their resistance values.

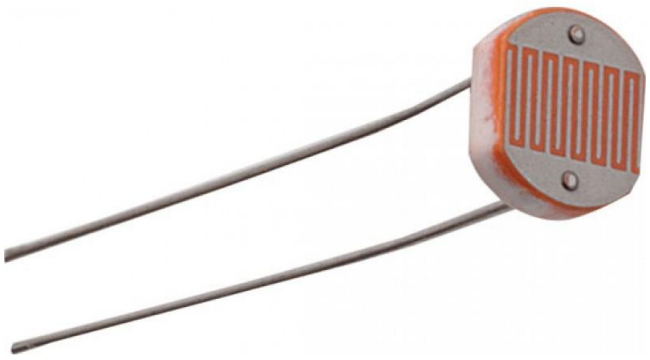

Figure 1 – Light Dependent Resistor

2-)BJT(BC548): The transistor is a semiconductor circuit element used to amplify or switch small electrical signals.The electric signal applied to one of the legs of the transistor having 3 or more legs can be controlled by the electric current between the other legs.

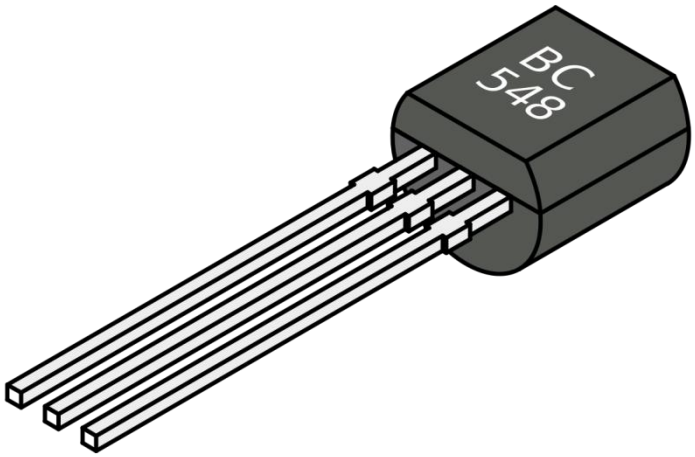

Figure 2 – BJT

3-)POTENTIOMETER: Potentiometers are resistors whose value can be changed by external physical interventions.

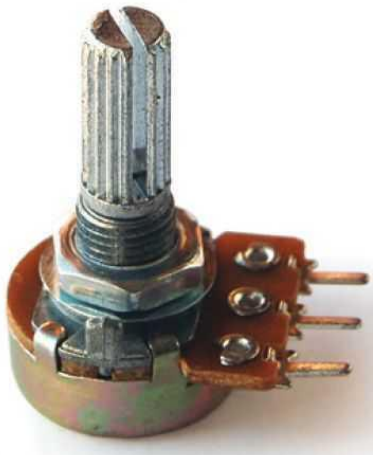

Figure 3 – Potentiometer

4-)OPAMP(LM741): Opamp circuits are integrated circuits with high signal amplification power which are used to increase the functionality of electronic circuits.They are supplied with DC and provide current and voltage gain.Consequently,they also perform power upgrade and impedance conversion tasks.

Figure 4 – Opamp(LM741)

5-)NOT GATE(74HC04)

Figure 5 – NOT Gate(74HC04)

6-)MOTOR DRIVER MODULE(L298N):L298N DC Motor Drive is a motor driver board prepared to drive two motors between 4.8V-46V.This two-channel motor drive delivers 2A current per channel.

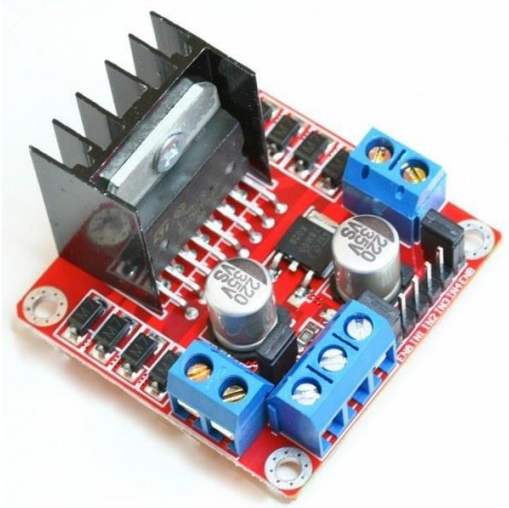

Figure 6 – Motor Driver Module(L298N)

7-)LIMIT SWITCH: The limit switch is an electrical switch that mechanically drives the position of the electrical contacts as a result of contact with a moving mechanism.Any electrical circuit is opened or closed as a result of the position change of the contacts of the limit switch,ie from the open position to the closed position or from the closed position to the open position.

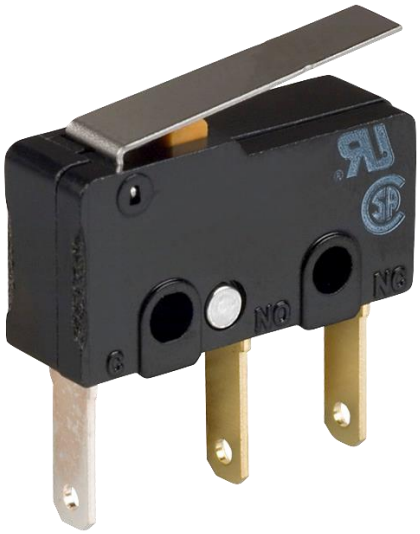

Figure 7 – Limit Switch

8-)DC MOTOR:DC motor is a machine that converts straight current electrical energy into mechanical energy.When the electric current is applied to the windings inside the motor,it is based on the principle of moving by the effect of the magnetic force formed in the opposite direction to the permanen magnets inside the motor.

Figure 8 – DC Motor

9-Resistance: Resistance in electrical circuits is the force that the electric current passes through a conductor.It shows similar properties to friction in mechanical systems.

Figure 9 – Resistance

3.Software:

For this Project we didn't use any software.Instead of software we used logic circuit.

4.Design and Assembly

Mechanical Design: In mechanical design, we make rack and pinion system.We designed rack,pinion and door in Solidworks and then printed them with a 3D printer.The diameter of the rack is 20mm and it has 25 teeth.Also,we drilled the rack with a diameter 2mm in order to connect the motor shaft.The lenght of pinion is 100mm.Also,the length of the door is 100mmx100mm.

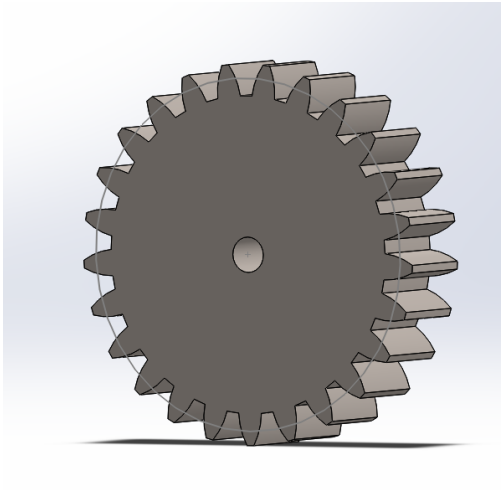

Figure 10 – Rack

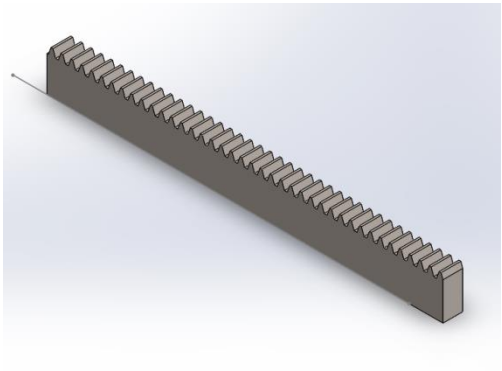

Figure 11 – Pinion

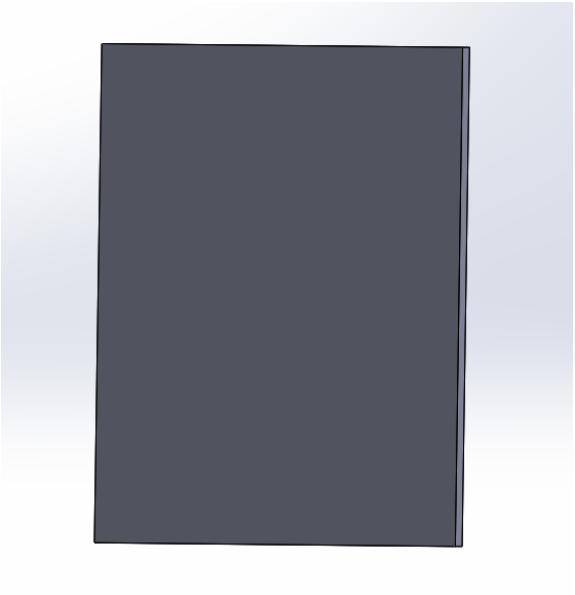

Figure 12 – Door

In the next step,we bonded the door and the pinion with silicone.Then,using a rod and pipette,we designed the door to move on a straight axis.We have placed limit switches on the part of the door where the movement starts and ends.We created a step fort he rack to coincide with the pinion and mounted the motor on this step.

Electrical Design: Firstly,we designed a Dark Actived Circuit for LDR.And then,we tested to see if the circuit works.In tihs circuit,one leg of the LDR is connected to the voltage source and the other leg is connected to the base leg of the BJT.A potentiometer was also connected to the base of the BJT to control the sensitivity.A 1k ohm resistor was connected to the collecter leg of the BJT and the emitter leg was connected to the ground.

Then,we designed a non-inverting comparator circuit to create a square wave.We took the output from the collector leg of the BJT in the LDR circuit and connected it to the third leg of the opamp.We determined the resistances of the voltage divider circuit in order to fix our 11V welding voltage between 0-5V.These resistros are 6kΩ and 5kΩ respectively.These resistors are connected to the second leg of the opamp.We set the opamp supply and voltage divider circuit voltage to 11V.

Next step,we used not gate which is 74HC04 and motor driver module which is L298N.The purpose of our use is to operate the motor bidirectionally according to the voltage from the sensor.We took the output from the sixth leg of the opamp and connected it to the input 2 port of the motor drive module and the first leg of the not gate.Then,we took the output from the second leg of the not gate and connected this output to the input 1 port of the motor drive module.The motor drive module was also supplied with 11V.We supplied the NOT Gate with 5V output of motor drive module.

Finally,The + leg of DC Motor is connected to closed leg of one of the limit switches and the – leg of DC Motor is connected to closed leg of another limit switch.The normally closed legs of the limit switches are connected to the out 1 and out 2 ports on the motor drive module.Finally,the circuit is completed by connecting the normally open legs of the limit switches to the ground.

5.Results And Discussion:,

Firstly we design our circuits separately.Firstly we set the sensor circuit.Then H bridge circuit and also we set the comparator circuit. After that we connected the circuits each other.But there were some big problems.Firsty we used a 7404 not gate so that the motor can run in reverse.But when we looked the datasheet of 7404,we can supply max 7V which can be dangerous also to the integrated.However when we checked the output of our comparator circuit,our output is bigger than 7V so changing for changing output we use potentiometer which effect to sensivity. this solution also helped the problem of changing the output voltage of the sensor circuit when the environment changes.Other big problem is lots of voltage sources.For motor and sensor 11 V is enough but for integrated input voltage must be 5V.For avoid the lots of voltage source we use H bridge driver. Thanks to L298n we use both as a motor driver and as a 5V voltage source.

As Result,After completing the circuit we measured the some outputs.For example As we metioned the above, firstly our comperator output was 7,84 volt but using potentiometer changed it.Its new value is 6.43.there are 2 output from our comparator output.One of them goes to H bridge and one of them goes to NOT gate.So when forward bias was 0 ,reverse bias will be 6,43 V.So motor can turn reverse.In other case, our sensor output which measured from BJT's collector is 0,89 volt.So this voltage increased and the output of this voltage from comparator circuit's output voltage is 1.91 volts.So again one of them goes H bridge an one of them goes NOT gate.So forward is 5,15 Volt which is measured by us from not gate and this time reverse will be 1,91 volt.Hence motor can turn forward bias.Also Other important thing is sensivity.Because sensivity of ldr can change the when the light intensity.For this we avoid this we used potentiometer so we can change the resistor at LDR circuit.Also If the light intensity is kept constant, the resistance may still vary significantly due to temperature changes, so they are sensitive to temperature changes as well.

Calculations:

Sensing range of the sensor: 32mm

Sensing resistance of the sensor: 3.49kΩ

$$\text{Sensitivity} = \frac{\text{Resistance}}{\text{Distance}}$$

$$\text{Sensitivity} = \frac{3.49\text{k}\Omega}{32\text{mm}} = 0.109\text{k}\Omega/\text{mm}$$

6.Conclusion:

In this Project , we use sensor circuit,comparator circuit and H bridge circuits.The aim of this task is controlling the motor with sensor.So firstly we built a sensor circuit.So firstly we learned that how LDR sensor Works and for LDR circuit which ones are important.Voltage output of LDR circuit is low so for increasing output and current we used BJT.The resistors are very important at this circuit because the total resistance effects to working principle of LDR.LDR has 2 type for working.These are dark activating an light activating.At this circuit our LDR is dark activating.Henceforwards, we connected the comparator circuit and sensor circuit.The second earning from this task is what is comparator circuit and what good is it?.Comparator circuit is changing our input.We mean that we took analog output from LDR circuit and thanks to comparator we converted it digital signal.Thus we can connect the comparator circuit and logic circuit. Because the input of the logic circuit must be 0 or 1, ie digital.Finally we connected the H bridge circuit and the other circuits Which have connected before.For setting the direction of motor we use logic circuit.As we metion above we took 2 output for motor from all circuits.One of them from logic circuit and other one is from our comparator circuit.One of them for forward bias and the other of them for reverse bias.When we gave the voltage to the forward bias the other part which is reverse bias must be low.So we use logic circuit and just 1 NOT gate.

CIRCUIT AT PROTEUS