TO DETECT THE STATUS OF THE DOOR USING FLEX SENSOR FOR HOME APPLICATION

B.Tech thesis submitted by

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Date – May 2015

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DECLARATION

I hereby declare that the project work entitled "**TO DETECT THE STATUS OF THE DOOR USING FLEX SENSOR FOR HOME APPLICATION**" is a record of my original work done under Professor Santosh kumar das, National Institute of Technology, Rourkela. Throughout this documentation wherever contributions of others are involved, every endeavor was made to acknowledge this clearly with due reference to literature. This work is being submitted in the partial fulfillment of the requirements for the degree of Bachelor of Technology in Electronics and Instrumentation Engineering at National Institute of Technology, Rourkela for the academic session 2011-2015

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CERTIFICATE

This is to certify that the thesis entitled, "**TO DETECT THE STATUS OF THE DOOR USING FLEX SENSOR FOR HOME APPLICATION**" submitted by **CHHABILA PRASAD SUNA** (111EI0263) in Partial fulfillment of the requirements for the award of Bachelor of Technology degree in **Electronics and Instrumentation Engineering** during the session 2011-2015 at National Institute of Technology, Rourkela and is an authentic work done by them under my supervision and guidance.

To the best of my knowledge, the matter embodied in the thesis has not been submitted to any other university/institute for the award of any Degree/Diploma.

Date-

Dr. Santos Kumar Das

Dept. of Electronics and Communication Engineering

Acknowledgement

I am grateful to my respected supervisor Prof. Santosh kumar das for his ubiquitous support and meticulous guidance throughout the duration of the project. I would also like to express our heartfelt appreciation and unfathomable note of thankfulness to Mr. kishan kumar patel for his altruism and guidance that helped me realize my goals. Lastly i would convey my gratitude to all the faculty members and staff of the Department of Electronics and Communication, National Institute of Technology, Rourkela.

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ABSTRACT

In this high-tech world everybody need privacy and security to maintain it. Many type of sensor and controller are used to designing security system . This paper presents that to detect the status of the door by using a flex sensor, which is used for home application purpose. Flex sensor response when it gets bend , its resistance change according to the amount of bending on it. At straight position it's give nominal resistance value and at 90 degree position it's give highest resistance value. Apart from this flex sensor can be used for making of gaming gloves , robotics etc. here it connected with a voltage divide circuit which output voltage is vary according to the bending of the sensor. The output of the voltage connected with Arduino kit. Arduino is hardware and software based platform for seeming well and good and control a greater amount of the physical world than your desktop PC. It's an open-source physical processing stage in view of a basic microcontroller board, and an advancement domain for composing programming for the board . The analog output voltage of the circuit get converted into digital form . Corresponding to the digital value a code is to be written in the Arduino software . we can check the status of the door in the software and also in the Arduino board by the indication of LED .

CONTENTS….

1. INTRODUCTION

The project is designed for automatic detection of door status using flex sensor .

This project propose a system of automatic detection of door status by sensing any movement at the door. This is achieved with the help of flex sensor . Flex sensor generally sense when its get bend . The sensor is attached with door when position of the door get changed the flex sensor gets bend , when it bends its output resistance also changes. The output resistance is connected with voltage divider circuit . Output voltage of the circuit changes according to the change in resistance of the sensor . After that it is connected with a Arduino controller where code is written to display the output whether the door is open or not , if it is opened how much portion it is opened.

2.1 Sensor

A sensor is a transducer whose reason for existing is to sense (that is, to recognize) some normal for its environs. It identifies occasions or changes in amounts and gives a relating yield, for the most part as an electrical or optical sign; for instance, a thermocouple changes over temperature to a yield voltage. Be that as it may, a mercury-in-glass thermometer is likewise a sensor; it changes over the deliberate temperature into extension and constriction of a fluid which can be perused on a balanced glass tube.

For ex. Thermocouple which is a temperature sensor , it detects temperature and gives output in voltage. Similarly different type of sensor are available which that detects events or changes in quantities and provides a corresponding output, generally as an electrical or optical signal.

2.2 Flex sensor

Flex sensor are the sensor that changes in resistance depending on the amount of bend on the sensor .They convert the change in bend to electrical resistance .The more the bend the more the resistance value .They are usually in the form of a thin strip from 1'' to 5'' long that very in resistance . A basic Flex Sensor is 2.2" long. As the sensor is flexed, the resistance over the sensor increments. The resistance of the flex sensor changes when the metal cushions are on the outside of the twist (message on within curve). Connector is 0.1" dispersed and bread board neighborly. The estimation of the yield relies on upon the twisting of the sensor subsequently, the yield we get is a simple quality also, this yield can be send to ADC IC or of Controller.

2.2.1 Working and Modifications :

- The Bending and resistance value are directly related to each other as :
    - Flat (minimum resistance)
    - 45 degree Bend (increased resistance)

- 90 degree Bend (resistance increased further)

- An Op - Amp is utilized and outputs either high or low relying upon the voltage of the inverting input. Thusly you can utilize the flex sensor as a switch without experiencing a microcontroller.
- To adjust the sensitivity range potentiometer can be added to the circuit.
- Utilize the sensor as the input of an resistance to voltage converter utilizing A double sided supply op-amp . A negative reference voltage will give a positive output. Should be used in situation when you want output at a low degree of bending.

2.2.2 Applications :

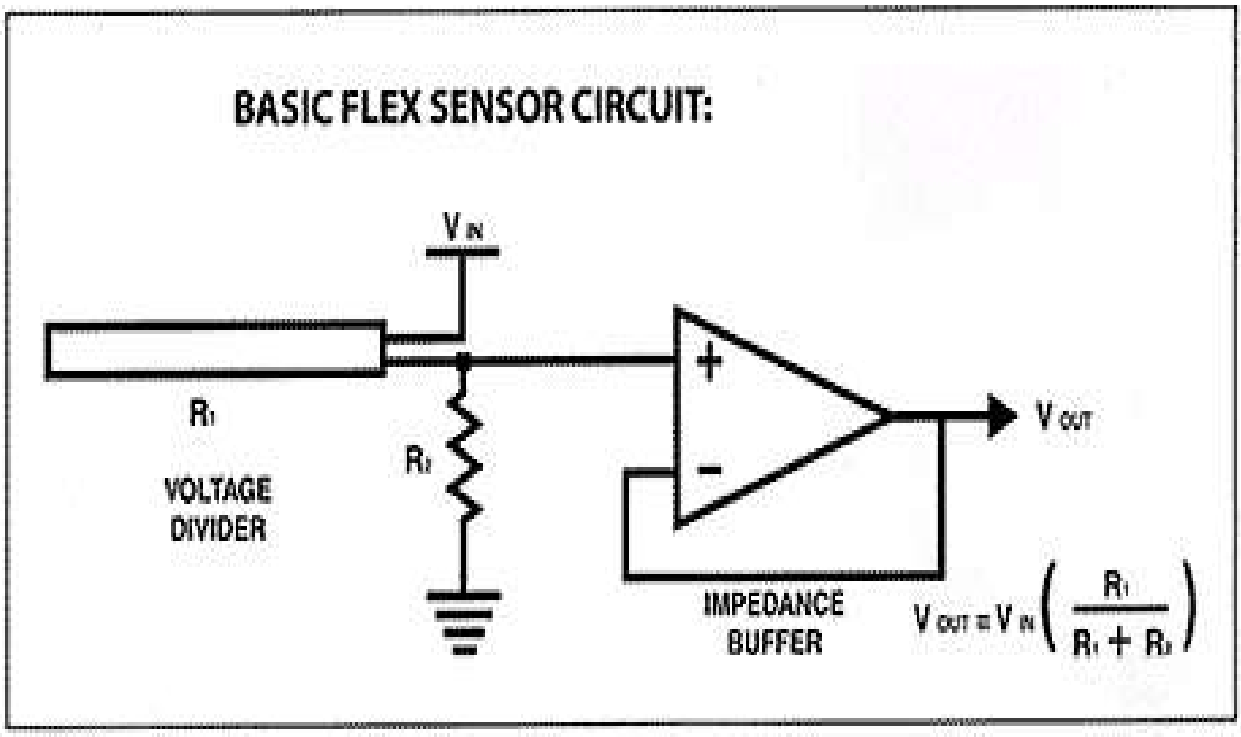
- Bends and Flexes physically with motion device
- Other Possible Uses
- Robotics
- Gaming (Virtual Motion)
- Medical Devices
- Computer Peripherals

- Musical Instruments
- Physical Therapy
- Simple Construction

2.2.3 Limitations

- Please refrain from flexing or straining this sensor at the base.
- The usable range of the sensor can be flexed without a problem, but care should be taken to minimize flexing outside of the usable range.
- For best results, securely mount the base and bottom portion and only allow the actual flex sensor to flex.

2.2.4 Basic flex sensor circuit



"The impedance buffer in the [Basic Flex Sensor Circuit] (above) is a single sided operational amplifier, used with these sensors because the low bias current of the op amp reduces errer due to source impedance of the flex sensor as voltage divider. Suggested op amps are the LM358 or LM324."

2.3 ARDUINO

Arduino is an instrument for appearing well and good and control a greater amount of the physical world than your desktop PC. It's an open-source physical preparing platform in perspective of an essential microcontroller board, and a change circumstance for creating programming for the board. Arduino can be used to make savvy articles, taking inputs from a blended sack of switches or sensors, and controlling a mixture of lights, motors, and other physical yields. Arduino endeavors can be stay single, or they can relate with programming running on your PC. The Arduino Uno is a microcontroller board in light of the ATmega328 (datasheet). It has 14 advanced information/yield pins (of which 6 can be utilized as PWM yields), 6 simple inputs, a 16 MHz gem oscillator, a USB association, a force jack, an ICSP header, and reset catch. It contains everything expected to backing the microcontroller; essentially interface it to PC with a USB link or force it with an AC-to-DC connector or battery to begin. The Uno varies from all going before sheets in that it doesn't utilize the FTDI USB-to-serial driver chip. Rather, it includes the Atmega8U2 customized as a USB-to-serial converter. "Uno" signifies "One" in Italian and is named to check the forthcoming arrival of Arduino 1.0. The Uno and variant 1.0 will be the reference variants of Arduino, getting up and go. The Uno is the most recent in a progression of USB Arduino sheets, and the reference model for the Arduino platform; for an examination with past variants, see the record of Arduino sheets.

2.3.1 Technical Specifications

Microcontroller	ATmega328
Operating Voltage	5V
Supply Voltage (recommended)	7-12V
Maximum supply voltage (not recommended)	20V
Digital I/O Pins	14 (6 are PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

2.3.2 Arduino is more preferable than other controller

Since the inception of the Arduino it is not an micro-controller anymore but an ecosystem and environment which is ported to different architectures.The key advantages to my knowledge are:---

- Debugging:- The Arduino Environment provide easiest debugging environment which is cross-platform and is accepted by every member of the family.
- No programmer or dumping flash by dirty ways, With most of the companies already providing on-board debugger still compared to a lot of microcontroller(8051) upload is a click away.
- Every time you don't need to take datasheet out and figure what the architecture is what are the addresses of the microcontroller to write simple functions like delay or interrupt.
- Design of the board is very carefully crafted for beginners be it Moron Switch or ISP header to the polarity of power, the chances are steep that you would be blow it.
- Peripherals and Modular Design :Arduino Ecosystem has fantastic modular design, you can simply add the already designed shields to the board with out any wire, just plug and play with peripherals like motor shield, Bluetooth shield, Wifi and what not already made.

- Libraries: A lot of libraries and IC's have already been build for the same which is crucial a lot of times.

- Using an Arduino simplifies the amount of hardware and software development you need to do in order to get a system running.

- The Arduino hardware platform already has the power and reset circuitry setup as well as circuitry to program and communicate with the microcontroller over USB. In addition, the I/O pins of the microcontroller are typically already fed out to sockets/headers for easy access (This may vary a bit with the specific model).

- As it is open source in nature so if you are not willing to pay huge amount for original one, then you can also buy the clones which are manufactured by vendors in your own country. These boards costs only about 40% of original one, yet fully compatible.

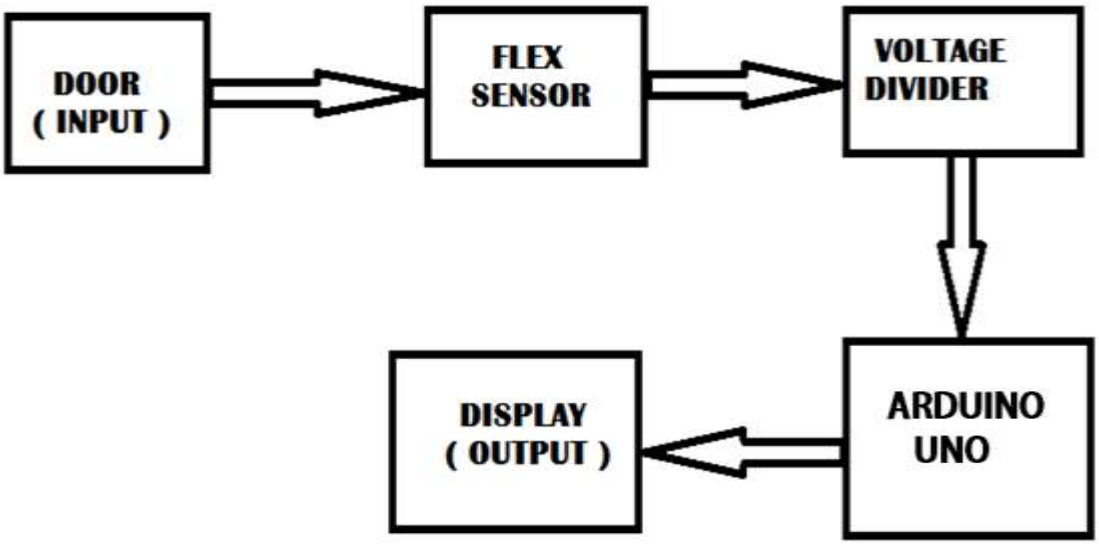
2.4 ATMEGA328

The superior Atmel 8-bit AVR RISC-based microcontroller consolidates 32KB ISP flash memory with read-while-compose capacities, 1KB EEPROM, 2KB SRAM, 23 universally useful I/O lines, 32 broadly useful working registers, three adaptable timer with analyze modes, inner and outer interrupts, serial programmable USART, a byte-arranged 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-diverts in TQFP and QFN/MLF bundles), programmable guard dog timer with interior oscillator, and five product selectable power sparing modes. The gadget works between 1.8-5.5 volts.

KEY PARAMETER

Parameter	Value
Flash (Kbytes):	32 Kbytes
Pin Count:	32
Max. Operating Freq. (MHz):	20 MHz
CPU:	8-bit AVR
# of Touch Channels:	16
Hardware QTouch Acquisition:	No
Max I/O Pins:	23
Ext Interrupts:	24
USB Speed:	No
USB Interface:	No

3.BLOCK DIAGRAM

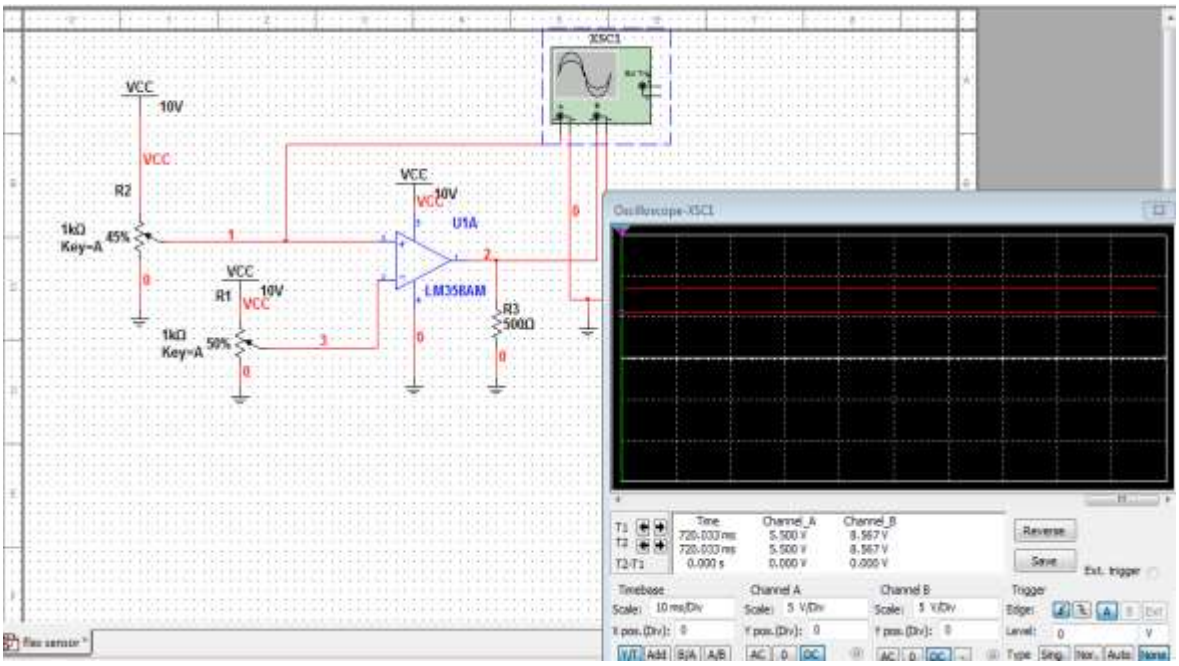


From the above block diagram the flex sensor is attached with a door, when the position of the door get changed the flex sensor also bend accordingly .flex sensor is connected with a voltage divider circuit ,when the flex sensor resistance changes the output voltage also change accordingly. The output voltage of the divider circuit is given to a Arduino uno kit . where the analog voltage is get converted into digital form ,according to the variation of the digital value I have written a program such that when the door is open the display will show the door is open and a led will glow otherwise the led will be remain off for the rest of the time.

4. CIRCUIT DESIGN AND SIMULATION

Due to the unavailability of flex sensor in simulation software I have used potentiometer in place of flex sensor. Potentiometer also provide a variable resistance .Here I have taken four different circuit to show variation in output due to the change in potentiometer resistance .LM358 op-amp and oscilloscope is used to see the output.

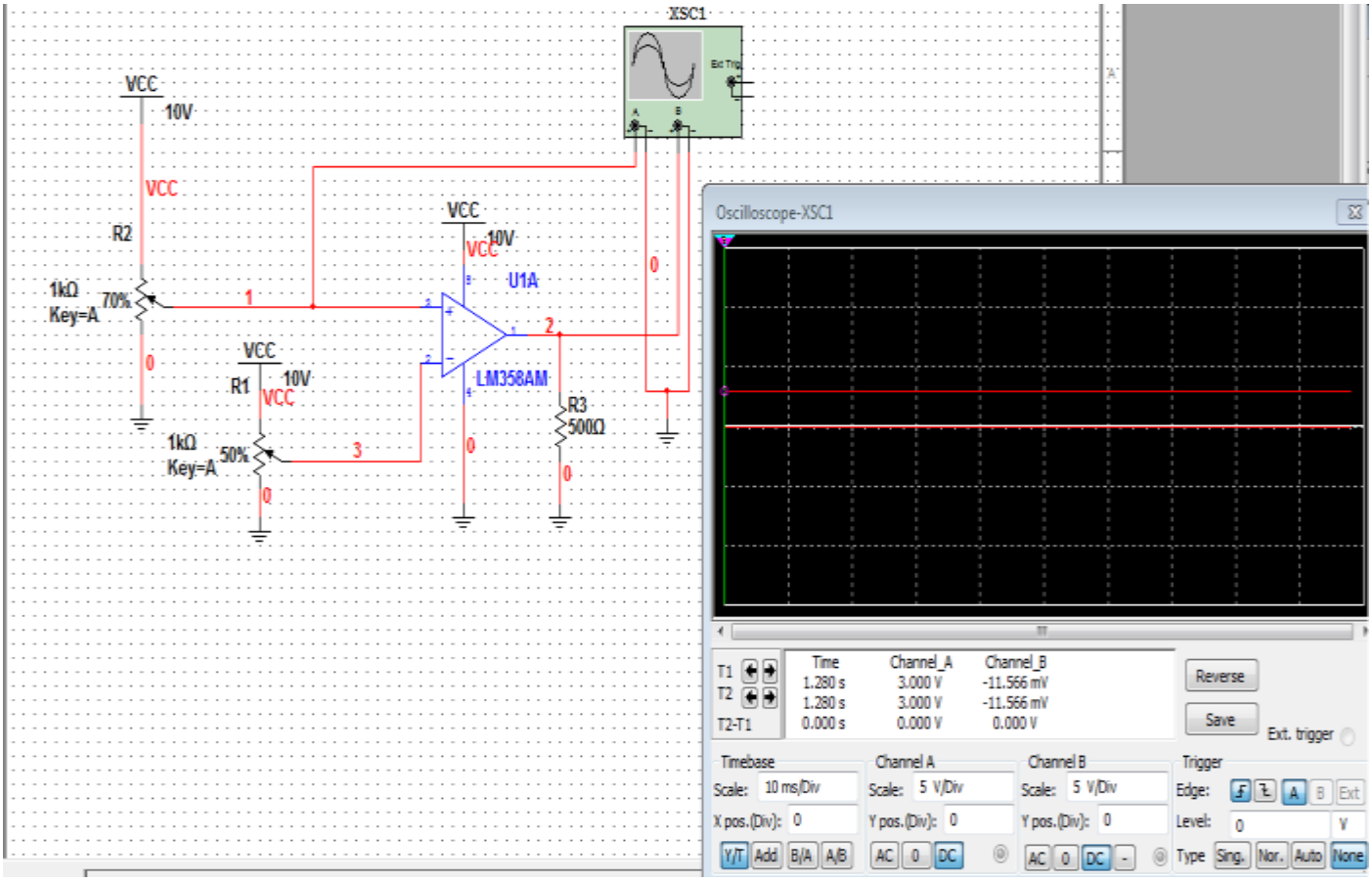
4.1 Potentiometer used as a switch :-



When the potentiometer at 45% of resistance or below it the output voltage is always high .

Circuit design and simulation

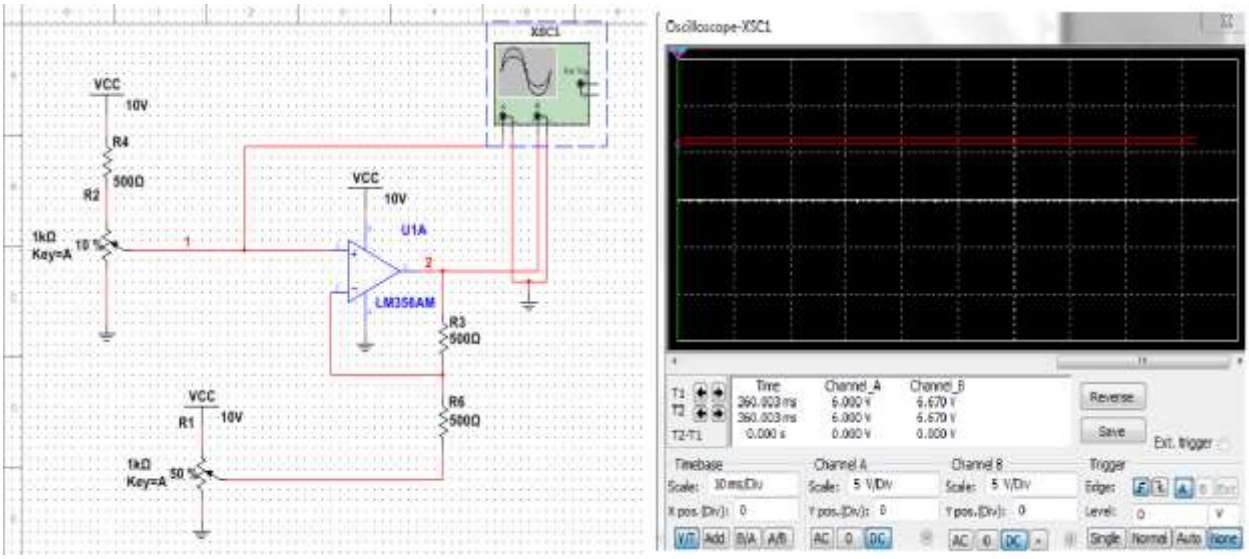
Potentiometer used as a switch:-



Here the potentiometer resistance is increased. Previously it was 40% of the total resistance now it is increased up to 70%. In the condition the output voltage is always low . This circuit is made for to check that the door status whether it is opened(high) or closed (low).

Circuit design and simulation

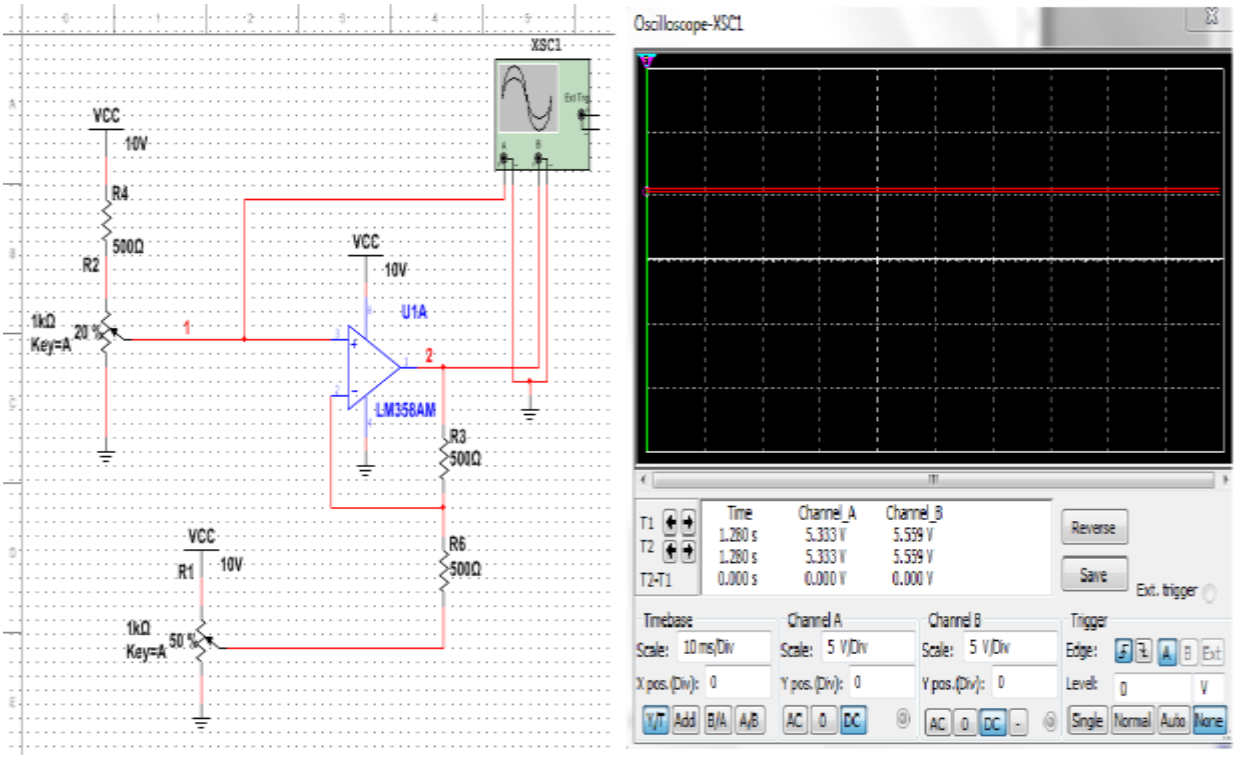
4.2 Buffer circuit for variable output:-



Buffer circuit is design to check how much portion the door is opened .

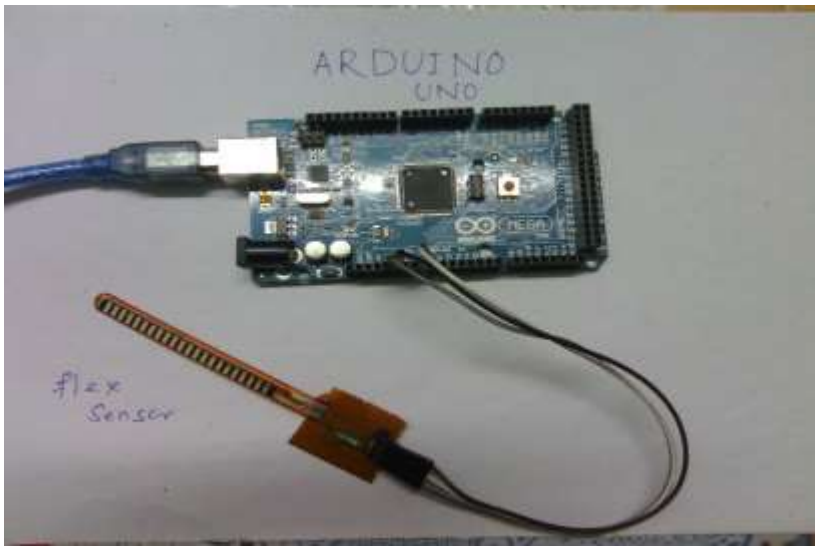
As in buffer circuit the output is vary linearly with the input here the potentiometer resistance is 10% and the output voltage is 6.67V. On gradually increasing the resistance of the potentiometer the output voltage gets decreased.

Buffer circuit for variable output



On increasing the potentiometer resistance to 20% the output voltage decreased to 5.559V

5. HARDWARE DESIGN



As it is shown on the above hardware figure that a flex sensor is connected with Voltage divider circuit. The circuit consisting of a r esistance of 1.6 kohm , and supply voltage is 5V .

the analog voltage output of the voltage divider circuit is connected to the Arduino uno kit at pin A0 . And other two pin are connected supply voltage point and ground point .

THE Arduino uno is connected to the laptop through a USB cable , its purpose is To take programming part from the software and also to take power from the system.

6. Programming

```
int a;
void setup()
{
  // put your setup code here, to run once:
  Serial.begin(9600);
  pinMode(13,OUTPUT);
}
void loop() {
  // put your main code here, to run repeatedly:
  a = analogRead(A0);
  a = a - 700;
  Serial.print(a);
 if(a>200)
 {
          Serial.println("\tON");
          digitalWrite(13,HIGH);
```

```
  }

  else
{
       Serial.println("\tOFF");
          digitalWrite(13,LOW);
      }

      delay(100);

}
```

Programming

```
int a;

void setup()
{

  // put your setup code here, to run once:

  Serial.begin(9600);

  pinMode(13,OUTPUT);

}

void loop() {

  // put your main code here, to run repeatedly:

  a = analogRead(A0);

  a = a - 700;

  Serial.print(a);

  if(a>230)

     {

          Serial.println("\t100% ON");

         digitalWrite(13,HIGH);
```

```
    }


else if(a>210)
    {
        Serial.println("\t50% ON");

        digitalWrite(13,LOW);

    }


   else

  {

        Serial.println("\tOFF");

        digitalWrite(13,LOW);

}

    delay(100);

}
```

7. Result and discussion

The output voltage of the flex sensor was varying from 600mv to 900mv. This analog voltage was converted to digital form by ADC. When the digital value exceed more than 200 the LED stated glowing means the sensor is in bend position and the door is opened .When the digital value is less than 200 the LED remains in off mode means the sensor is in straight position, and the door is closed. When the digital value is more than 210 it will show the door is 50% open and the led will glow. When the digital value more than 230 it will show the door is 100% open And the led will glow

8. CONCLUSION

As per the requirement of this project I have completed all the necessary and relevant work in positive manner . Due to the unavailability of flex sensor in simulation software I have taken potentiometer as a flex sensor and shown the four different circuit simulation. On the hardware part I have used Arduino uno board and avoltage divider circuit using the flex sensor .The required program is written on the Arduino software, and the output is checked both on the software and on the Arduino hardware board.

9. References

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