



DIGITAL PROJECT REPORT

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SUBJECT: DIGITAL DESIGN-1 (EC203)

SUBMITTED TO: Ms. Lavi Tanwar

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November, 2020



Electronics & Communication Engg. Deptt.
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Certificate

I hereby certify that the Project titled "**STEP COUNTER CIRCUIT USING A PIEZOELECTRIC SENSOR**" which is submitted by, Department of Electronics & Communication Engineering, Delhi Technological University, Delhi is a record of the project work carried out by the students under my supervision.

Ms. Lavi tanwer
SUPERVISOR



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Candidate's Declaration

We, hereby, declare that the work embodied in this project entitled " **STEP COUNTER CIRCUIT USING A PIEZOELECTRIC SENSOR** " submitted to the Department of Electronics & Communication Engineering, Delhi Technological University, Delhi is an authentic record of our own bonafide work and is correct to the best of our knowledge and belief. This work has been undertaken taking care of engineering ethics.

Names of the Students:

ARYAN 2K19/EC/032

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AIM:

To implement a FOOTSTEP COUNTER device using a piezo-electric sensor.

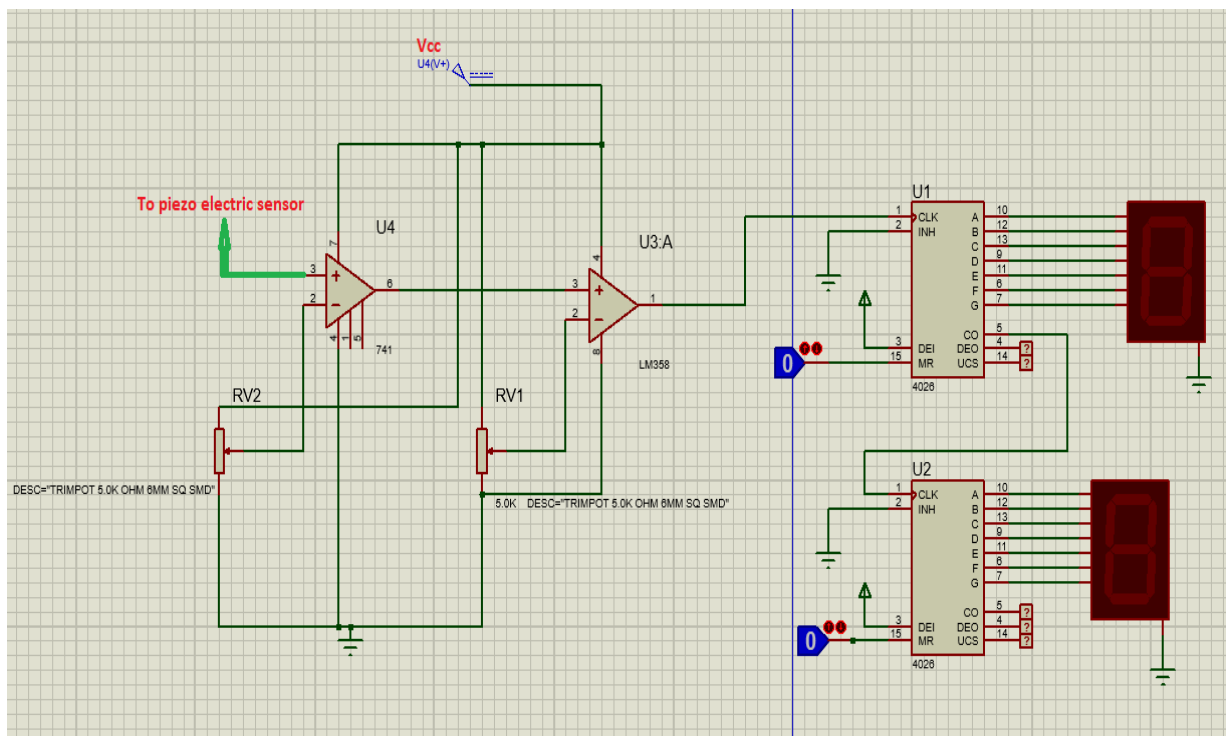
ABSTRACT:

- A piezo electric sensor is used to sense the pressure generated on keeping steps.
- The output voltage generated by piezo electric sensor is passed through a cascade combination of two voltage comparators, (LM 358 AND 741)
- Output of voltage comparators is HIGH(5V) when piezoelectric sensor is pressed and voltage across the sensor goes above the threshold
- The output of the comparators is fed to the counter circuit (implemented using 4026 IC), which counts the number of times the output is high/ steps moved.
- The output of the counter circuit is displayed on 7 segment display common cathode display

COMPONENTS USED:

- IC 4026
- IC 741
- IC LM 358N
- RESISTORS (10K AN 1K)
- POTENTIOMETER (10K)
- CONNECTING WIRES
- 7 SEGMENT DISPLAY
- CONNECTING WIRES
- PIEZOELECRIC SENSOR
- Breadboard
- PUSH BUTTON

CIRCUIT DIAGRAM:



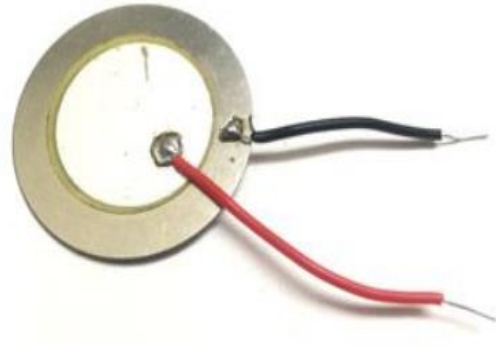
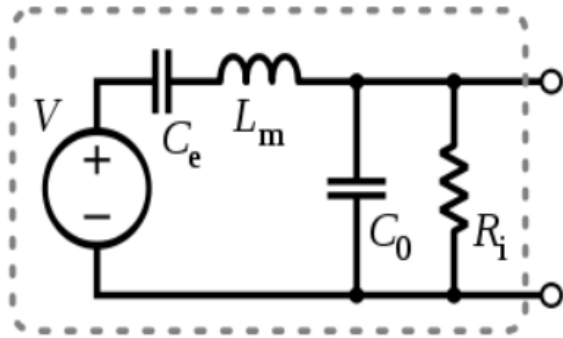
WORKING:

Piezoelectric Sensor:

A piezoelectric sensor works on the principle of conversion of energy in mechanical and electrical energy forms

The pressure sensor, a thin membrane is placed on a massive base to transfer the applied force to the piezoelectric element. Upon application of pressure on this thin membrane, the piezoelectric material gets loaded and starts generating electrical voltages. The produced voltage is proportional to the amount of pressure applied.

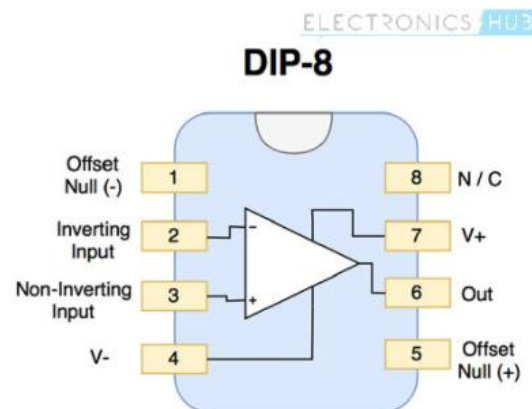
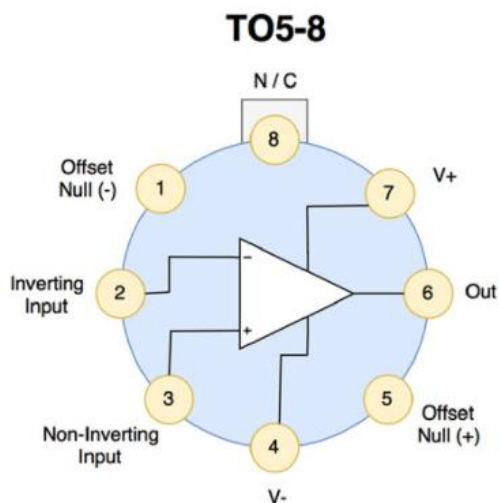
A piezoelectric sensor internal circuit is given below. The resistance R_i is the internal resistance or insulator resistance. The inductance is due to the inertia of the sensor. The capacitance C_e is inversely proportional to the elasticity of the sensor material. For the proper response of the sensor, the load and leakage resistance must be large enough so that low frequencies are preserved. A sensor can be called a pressure **transducer** in an electrical signal. Sensors are also known as primary transducers.



The output voltage of piezoelectric sensor for normal applied pressures is of order 0.5 volts.

IC 741 Op Amp (Operational Amplifier)

The 741 Op Amp IC is a monolithic integrated circuit, comprising of a general purpose Operational Amplifier.

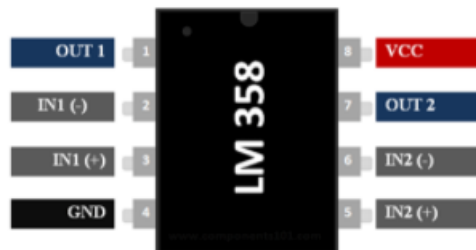


1. Pin 1 is balance pin (offset null)
2. Pin 2 is inverting input
3. Pin 3 is non inverting input
4. Pin 4 is negative power supply pin
5. Pin 5 is balance pin (offset null)

6. Pin 6 is output pin
7. Pin 7 is positive power supply pin
8. Pin 8 does not have any connection

LM358 Dual Op-Amp IC:

LM358 is a dual op-amp IC integrated with two op-amps powered by a common power supply. It can be considered as one half of LM324 Quad op-amp which contains four op-amps with common power supply. The differential input voltage range can be equal to that of power supply voltage. The default input offset voltage is very low which is of magnitude 2mV.

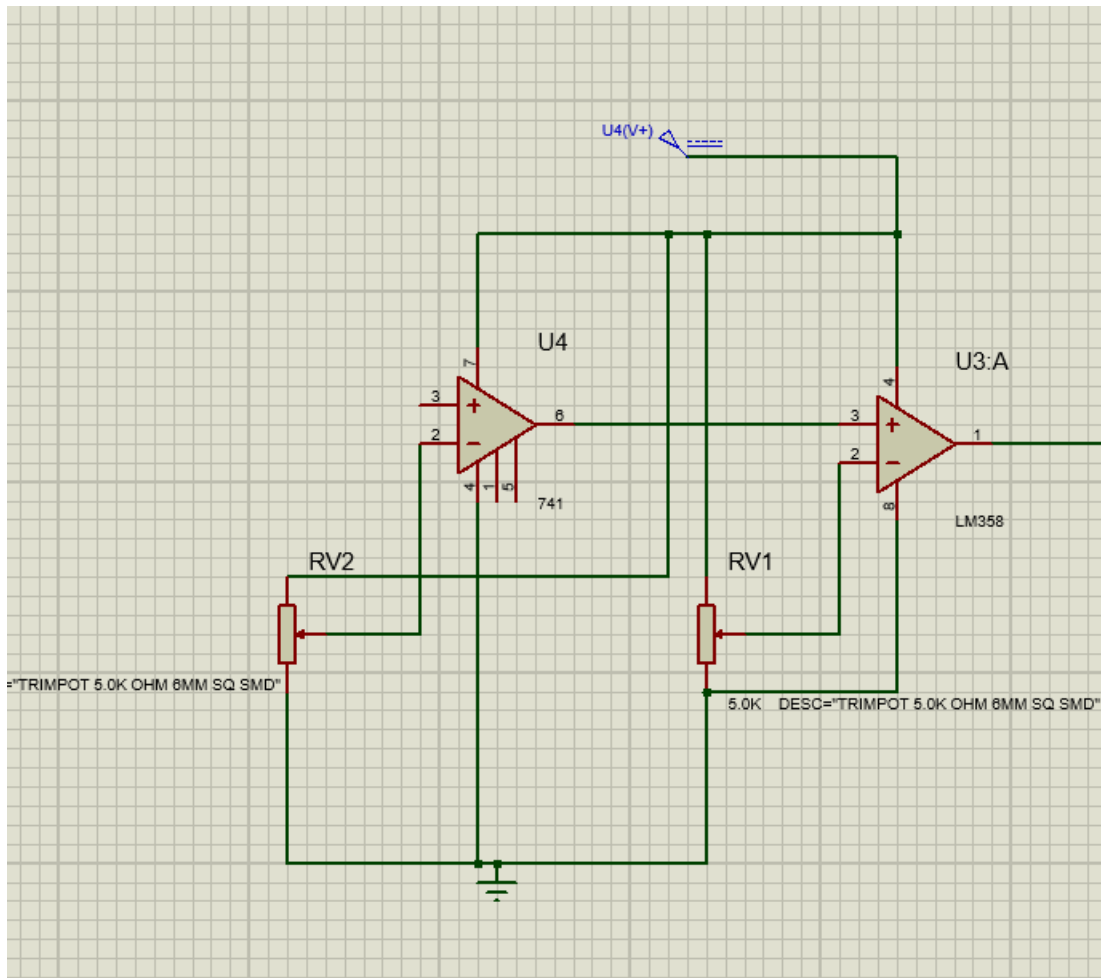


LM358 Pin Configuration

Pin Number	Pin Name	Description
1	OUTPUT1	Output of Op-Amp 1
2	INPUT1-	Inverting Input of Op-Amp 1
3	INPUT1+	Non-Inverting Input of Op-Amp 1
4	V _{EE} , GND	Ground or Negative Supply Voltage
5	INPUT2+	Non-Inverting Input of Op-Amp 2
6	INPUT2-	Inverting Input of Op-Amp 2
7	OUTPUT2	Output of Op-Amp 2
8	V _{CC}	Positive Supply Voltage

Cascading of IC 741 and IC LM 358:

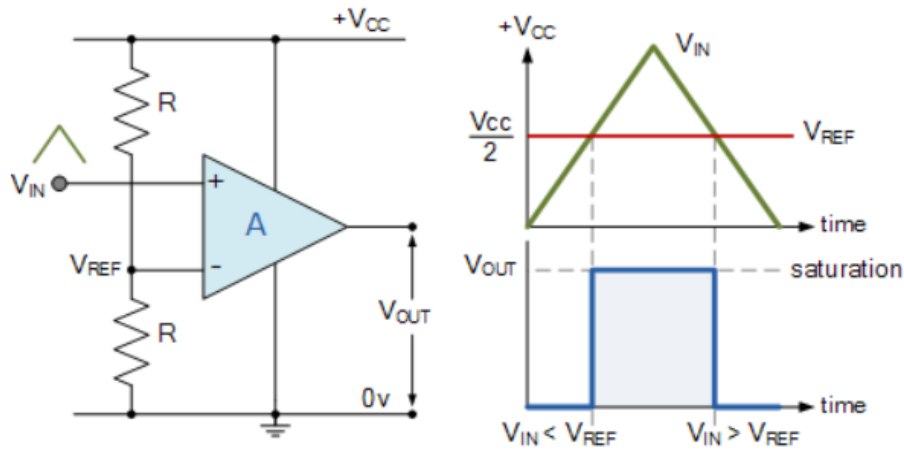
AS the voltage output of a piezoelectric sensor is very low, a single voltage comparator cannot amplify the voltage to 5 Volts which is required for proper operation of counter ICs . Hence two operational amplifiers are cascaded in order to get a proper 5 Volta signals when the piezo electric sensor is pressed.



Cascading of two ICs(LM 358 and 741)

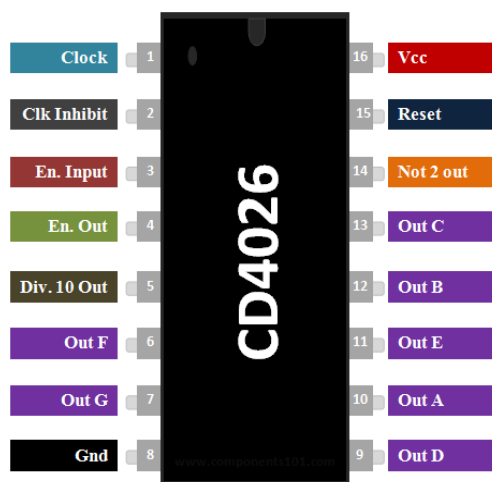
FUNCTION OF OPAMP AS A POSITIVE VOLTAGE COMPARATOR:

The basic configuration for the positive voltage comparator, also known as a non-inverting comparator circuit detects when the input signal, V_{IN} is ABOVE or more positive than the reference voltage, V_{REF} producing an output at V_{OUT} which is HIGH as shown



CD 4026 IC

The IC **CD4026** is an IC which can perform the function of both a counter as well a **7-segment Driver**. One single IC can be used to count from zero (0) to nine (9) directly on a Common Cathode type 7-segment display. The count can be increased by simply giving a high clock pulse; also more than one digit (0-9) can be created by cascading more than one **CD4026 IC**. So if you have a 7-segment (CC) display on which you have to display numbers that are being counted based on some condition then this IC will be a perfect choice.

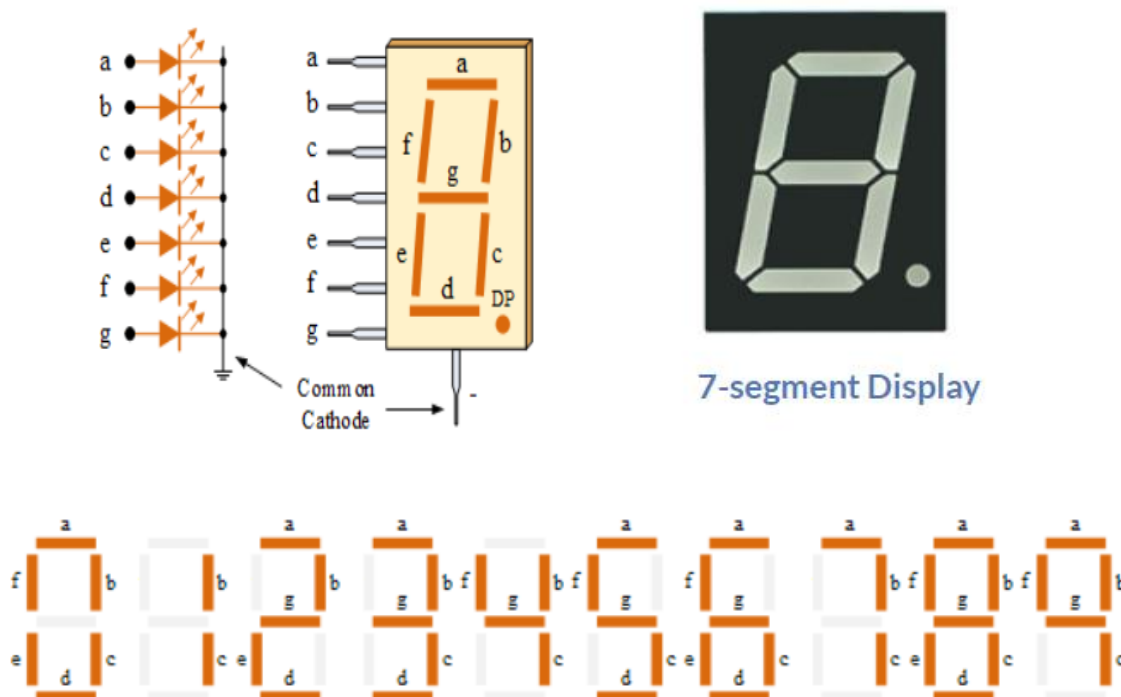


CD4026 Pin Configuration

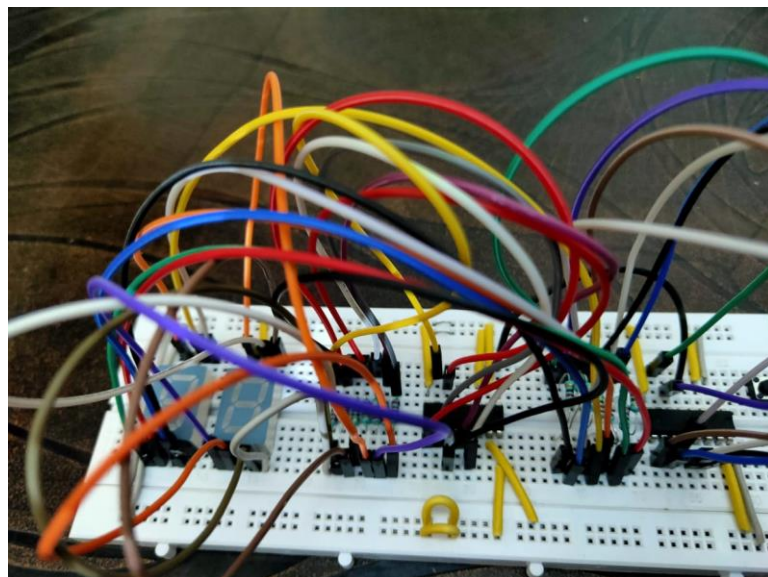
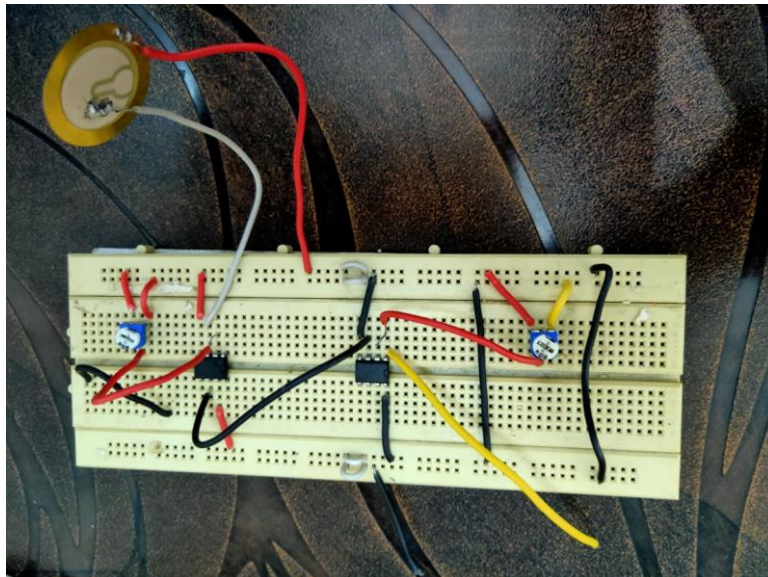
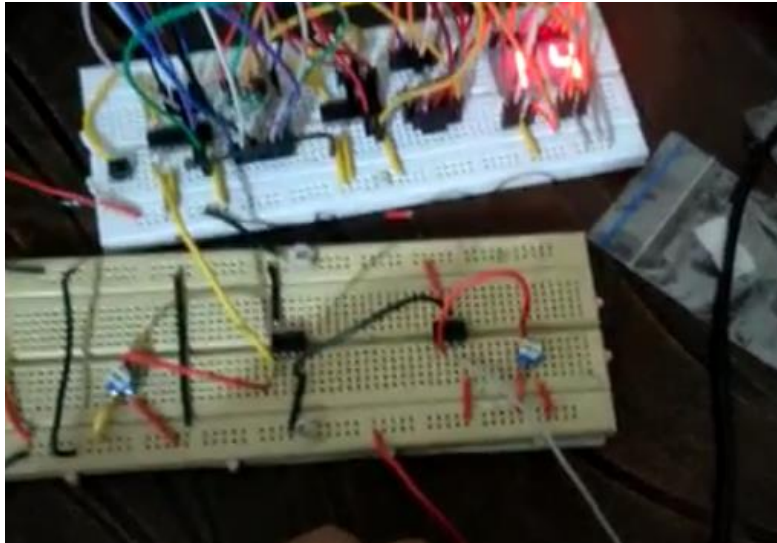
Pin Number	Pin Name	Description
1	Clock (CLK)	The counting happens when this clock pulse goes high, this pin is normally connected to 555 timer or other uC to produce a pulse
2	Clock Inhibit (INH)	Connected to the Ground (low) of the circuit, to enable clock pin
3	Enable Input (DEI)	This pin is connect to +5V (high) to enable the output pins (Out A to Out G)
4	Enable Output (DEO)	This is an output which always stays high, this pin will be only if more than one CD4026 IC is used (cascaded)
5	Divide by 10 (CO)	This is the carry over output pin; it produces a pulse after counting till 9. This pin will be only if more than one CD4026 IC is used (cascaded)
6,7,9,10,11,12,13	Out A,B,C,D,E, F,G	These are the decoded output pins which should connected to 7-Segment display.
8	Ground	The ground pin should be connected to ground of circuit
14	Not 2 out (UCS)	This is Ungated C segment pin. This is an output pin which will be rarely used when division is required.
15	Reset	This input pin when made high (+5V) will reset the count to 0.
16	Vcc	This pin powers the IC, typically +5V is used.

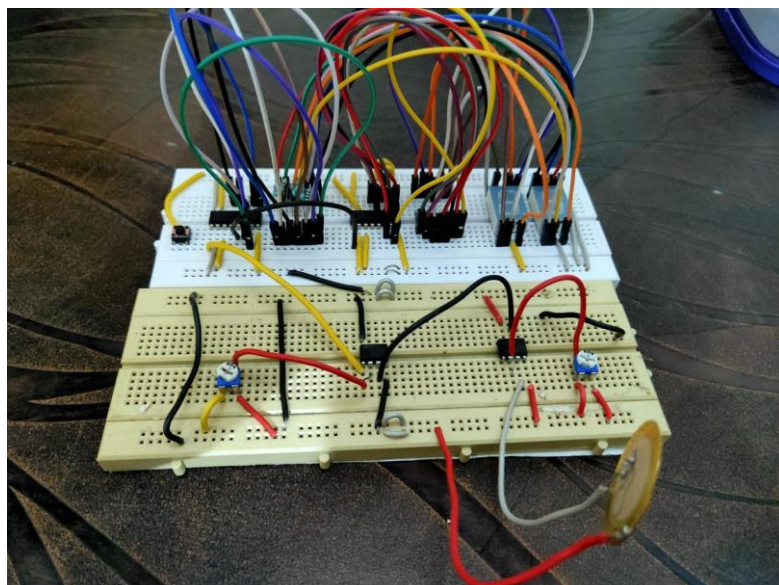
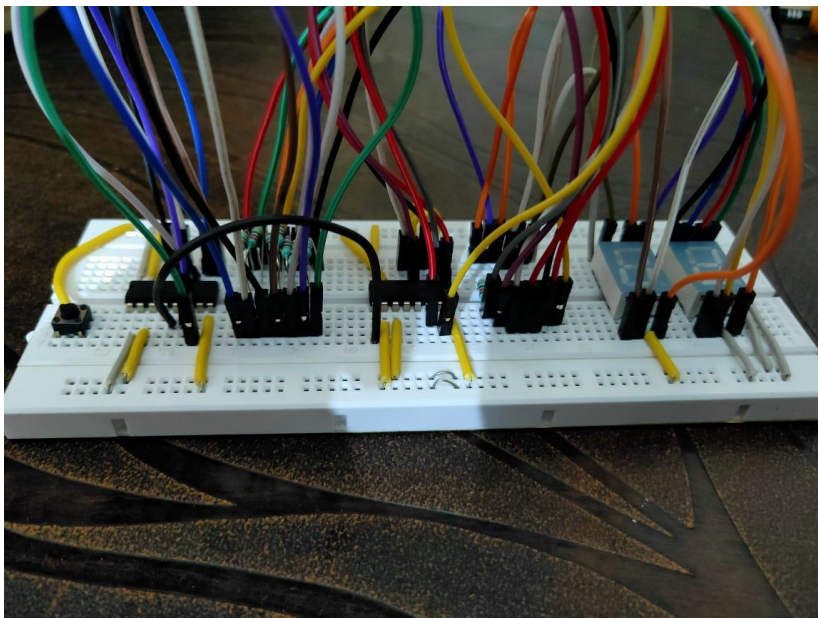
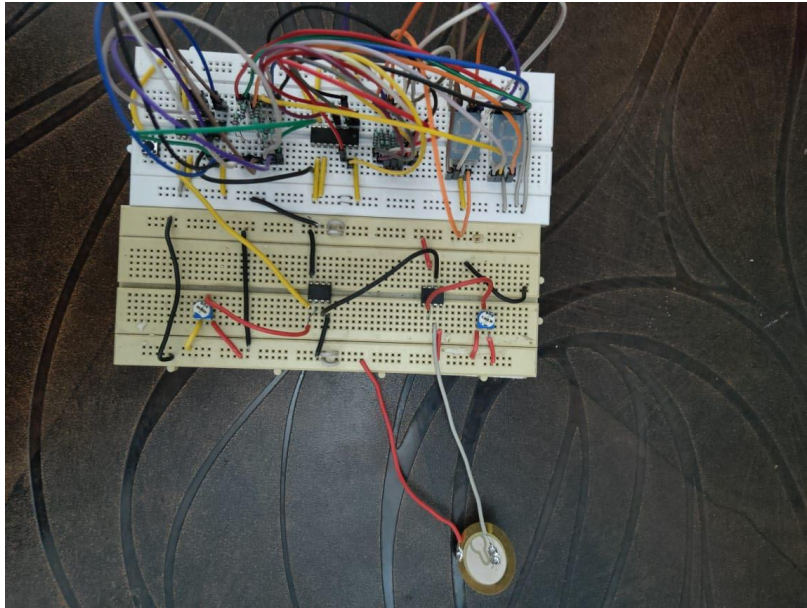
The Common Cathode Display (CC)

In the common cathode display, all the cathode connections of the LED segments are joined together to logic “0” or ground. The individual segments are illuminated by application of a “HIGH”, or logic “1” signal via a current limiting resistor to forward bias the individual Anode terminals.



HARDWARE PHOTOS:





VIDEO LINK:

<https://drive.google.com/folderview?id=14GbjCqUHnvnAVQ0nSvNVRKLG5tr84ZO7>

Conclusion:

- It can be used to count the no of steps moved by a person with very high accuracy.
- To count no. or jumps, no of ropes skipped and other various kinds of similar applications.
- There are very less chances of error in this device because piezo sensor cannot be triggered without a threshold amount of pressure

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