# DIGITAL LOGIC AND DESIGN

# (CSE1003)


## PROJECT REPORT

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# ACKNOWLEDGEMENT

The fulfilment of the undertaking gives me immense happiness and fulfilment by furnishing me with a chance to express my appreciation to everybody who has played animportant part in supporting me in my endeavour, and I would likewise step ahead to thanks everybody else who motivated me.

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Lastly, I would like to express my gratefulness to my parents and friends for having shown their trust and faith in me and boosting my morals constantly.

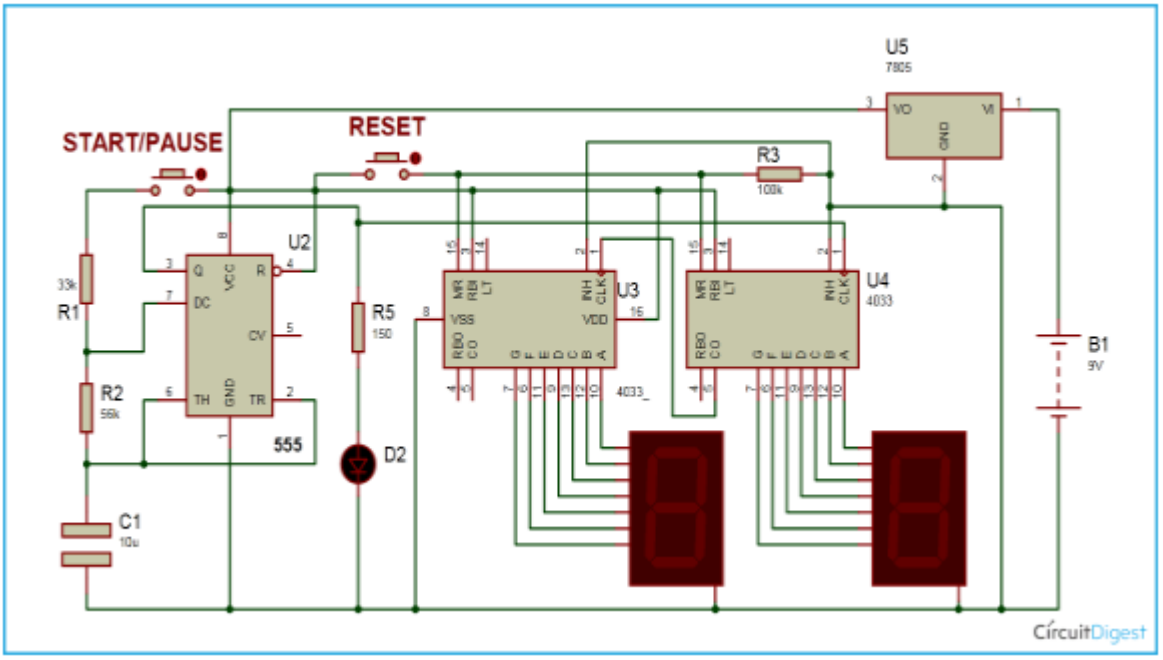
# ABSTRACT

Stopwatches find use as time keeping device in many fields, namely sports. Stopwatches may be analog or digital. Its function is to find out how long it takes in an activity .

Digital stopwatches are much more common the analog version owing to their higher accuracy and ease of use. Here we have tried to realize a digital stopwatch of reasonable accuracy and reliability.

This particular stopwatch can count up to 99 seconds .It is accurate. The circuit is relatively simple and easy to realize . The circuit us explained extensively in the following pages. The circuit operates on 9-v dc supply. It uses a seven segment LED display of common anode type to show time.

## CIRCUIT DIAGRAM:



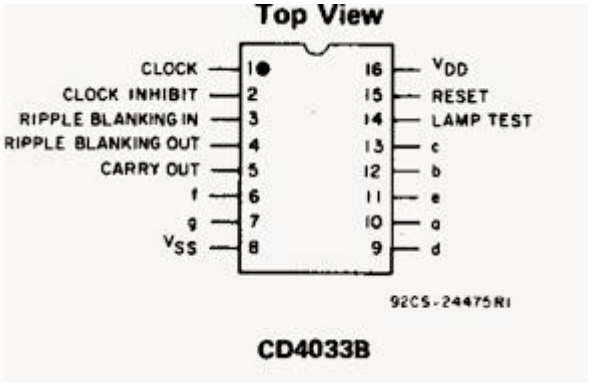

## METERIALS REQIRED:

- IC 4033 - 2
- 555 timer IC -1
- Common Cathode 7 Segment Display -2
- 150 Ohm -1
- 100K resistor -1
- 33K resistor -1
- 56K resistor -1
- 10uF capacitor -1
- On/off switch -1
- Push button -1
- Bread board -1

- 9 Volt Battery -1
- Battery Connector -1
- LED -1
- Voltage Regulator 7805 -1
- Connecting wires

**COMPONENTS:**

1. **<u>IC4033</u>**




The IC 4033 is another Johnson decade counter/decoder IC specifically designed for working with 7 segment displays. Basically it's a clock or pulse counter IC which responds to positive pulses at its clock input and decodes it serially to produce a directly readable display of the count number through the connected 7 segment display module.

**Pin#1**: It's the clock input pinout of the IC, which is assigned for accepting positive clock signals or the pulses which needs to be checked or counted.

**Pin#2**: It's the clock inhibit pinout of the IC, As the name refers to, this pinout could be used for inhibiting the IC from responding to the input pulses by configuring this pinout to the positive supply or the Vdd. Conversely in order to allow normal functioning of the IC this pinout should be grounded.

**Pin#3/#4:** These are the Ripple blanking IN and Ripple blanking OUT pinouts

of the IC, which provides the user with the option of either allowing the non-significant zeros to be displayed or to be left out from the connected digital displays.

For example suppose you have cascaded 8 nos 4033 ICs for reading 8 digit displays and have reached a reading of say 0050.0700. Expressing this number as 50.07 makes more sense than 0050.0700, for implementing this we need to assign pin3/4 which are blanking IN and blanking out respectively in a certain unique manner across the 8 ICs.

To understand the procedure we'll need to take account of the digits which is most significant in the order, and which is least significant. In the number 0050.0700, the most significant digit on the integer side is "0" in between 5 and the decimal, conversely in the fractional side the least significant digit is "0" at the extreme right.

For enabling the RBI and the RBO (pin#3/#4) correctly on the integer side, we need to connect RBI of the IC associated with the most significant digit to a low logic or ground and the RBO of that IC to the preceding lower significant IC's RBI. This should continued until we reach the first IC associated with the extreme left digit of the integer side.

Now for suppressing the non-significant zeros at the fractional side, we need to connect the RBI of the IC 4033 associated with the least significant display to ground and connect its RBO with the previous IC's RBI, and continue this until we reach the extreme digit of the display situated just before or just at the right side of the decimal point.

The above feature of the IC is called automatic non-significant zero suppressing.

However if the display is intended to display a purely fractional number, then the RBI pinout of the IC associated with the display that's touching the decimal point on the integer side must be terminated to the positive supply. For example, for a number 0.7643, the IC associated with "0" must be tackled as explained above, same for the IC associated with the digit "0" for the number 764.0

The above feature of suppressing non-significant zeros might look "insignificant" however the feature heps to save "significant" amount of power and becomes incredibly useful for applications that employ battery as the power source.

**Pin#14**: It's the "lamp test" pinout of the IC. As the name signifies it is used for testing the connected digital displays in terms of illumination level. When this pinout is connected to a high level or the positive supply, the normal function of the IC is disabled and all the digits of the 7 segment display are applied with a high state so that the digits are allowed to get illuminated together. This allows us to test the intensity levels of the digits and if any of the display digits are not functioning optimally or are dim due to some malfunction.

**Pin#6,7,9,10,11,12,13**: All these pinouts are the outputs of the IC which are configured with the discussed 7 segment digital display module.

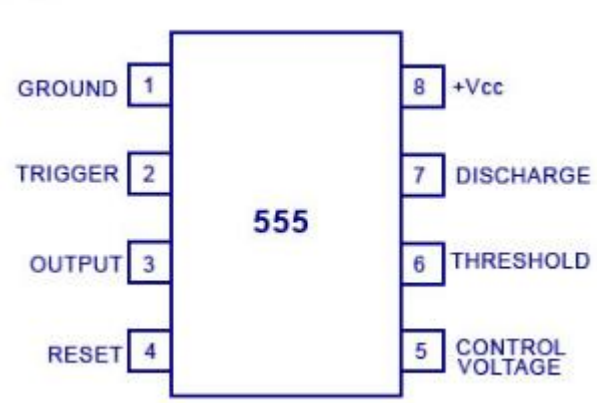
**Pin#15**: It's the reset input of the IC, a high logic or applying the supply voltage to this pin resets the IC completely, resulting in clearing all the data from the display and restoring it to zero.

**Pin#5**: It's the carryout pinout of the IC, it sends a high logic output after every 10 legit clocks at the clock pin#1 of the IC. Thus pin#5 is used as a clock output or a carry forward extension for the next corresponding IC 4033 when many of these are cascaded together in a multi-digit display counter systems.

**Pin#16** is the Vdd or the supply input of the IC.

**Pin#8** is the Vss, or the ground or the negative supply input pinout of the IC 4033.The IC works best with supply voltages between 5V and 20V.

## 2. 555 TIMER IC




The **555 timer IC** is an **integrated circuit**(chip) used in a variety of **timer**, pulse generation, and**oscillator** applications. The 555 can be used to provide time delays, as **oscillator**, and as a**flip-flop element**. Derivatives provide up to four timing circuits in one package.

**Pin 1**: **Grounded Terminal:** All the voltages are measured with respect to the Ground terminal.

**Pin 2: Trigger Terminal:** The trigger pin is used to feed the trigger input hen the 555 IC is set up as a monostablemultivibrator. This pin is an inverting input of a **comparator** and is responsible for the transition of **flip-flop** from set to reset. The output of the timer depends on the amplitude of the external trigger pulse applied to this pin. A negative pulse with a dc level greater than Vcc/3 is applied to this terminal. In the negative edge, as the trigger passes through Vcc/3, the output of the lower comparator becomes high and the complimentary of Q becomes zero. Thus the 555 IC output gets a high voltage, and thus a quasi stable state.

**Pin 3: Output Terminal:** Output of the timer is available at this pin. There are two ways in which a load can be connected to the output terminal. One way is to connect between output pin (pin 3) and ground pin (pin 1) or between pin 3 and supply pin (pin 8). The load connected between output and ground supply pin is called the **normally on load** and that connected between output and ground pin is called the ***normally off load***.

**Pin 4: Reset Terminal:** Whenever the timer IC is to be reset or disabled, a negative pulse is applied to pin 4, and thus is named as reset terminal. The output is reset irrespective of the input condition. When this pin is not to be used for reset purpose, it should be connected to + $V_{CC}$ to avoid any possibility of false triggering.

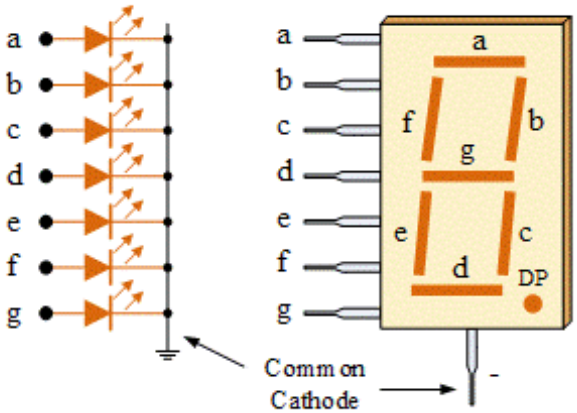
**Pin 5: Control Voltage Terminal:** The threshold and trigger levels are controlled using this pin. The pulse width of the output waveform is determined by connecting a POT or bringing in an external voltage to this pin. The external voltage applied to this pin can also be used to modulate the output waveform. Thus, the amount of voltage applied in this terminal will decide when the comparator is to be switched, and thus changes the pulse width of the output. When this pin is not used, it should be bypassed to ground through a 0.01 micro Farad to avoid any noise problem.

**Pin 6**: **Threshold Terminal:** This is the non-inverting input terminal of comparator 1, which compares the voltage applied to the terminal with a reference voltage of 2/3 $V_{CC}$. The amplitude of voltage applied to this terminal is responsible for the set state of flip-flop. When the voltage applied in this terminal is greater than 2/3Vcc, the upper comparator switches to +Vsat and the output gets reset.

**Pin 7** : **Discharge Terminal:** This pin is connected internally to the collector of transistor and mostly a capacitor is connected between this terminal and ground. It is called discharge terminal because when transistor saturates, capacitor discharges through the transistor. When the transistor is cut-off, the capacitor charges at a rate determined by the external resistor and capacitor.

**Pin 8: Supply Terminal:** A supply voltage of + 5 V to + 18 V is applied to this terminal with respect to ground (pin 1).

## 3. 7 SEGMENT DISPALY




Light emitting diodes have many advantages over traditional bulbs and lamps, with the main ones being their small size, long life, various colours, cheapness and are readily available, as well as being easy to interface with various other electronic components and digital circuits. But the main advantage of light emitting diodes is that because of their small die size, several of them can be connected together within one small and compact package producing what is generally called a 7-segment Display.

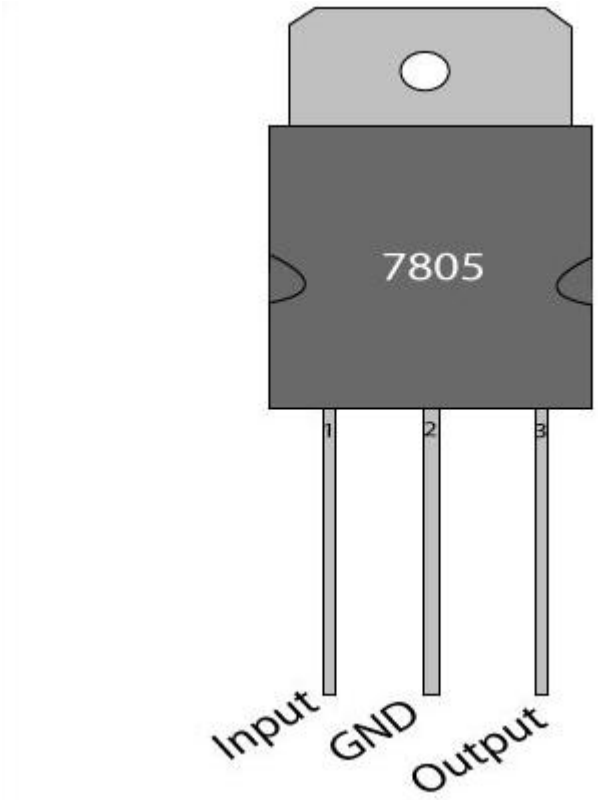
The 7-segment display, also written as “seven segment display”, consists of seven LEDs (hence its name) arranged in a rectangular fashion as shown. Each of the seven LEDs is called a segment because when illuminated the segment forms part of a numerical digit (both Decimal and Hex) to be displayed. An additional 8th LED is sometimes used within the same package thus allowing the indication of a decimal point, (DP) when two or more 7-segment displays are connected together to display numbers greater than ten.

Each one of the seven LEDs in the display is given a positional segment with one of its connection pins being brought straight out of the rectangular plastic package. These individually LED pins are labelled

from a through to g representing each individual LED. The other LED pins are connected together and wired to form a common pin.
So by forward biasing the appropriate pins of the LED segments in a particular order, some segments will be light and others will be dark allowing the desired character pattern of the number to be generated on the display. This then allows us to display each of the ten decimal digits 0 through to 9on the same 7-segment display.
The displays common pin is generally used to identify which type of 7-segment display it is. As each LED has two connecting pins, one called the “Anode” and the other called the “Cathode”, there are therefore two types of LED 7-segment display called: Common Cathode (CC) and Common Anode(CA).
The difference between the two displays, as their name suggests, is that the common cathode has all the cathodes of the 7-segments connected directly together and the common anode has all the anodes of the 7-segments connected together and is illuminated as follows.

1. The Common Cathode (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 (a-g).

## 4. Voltage Regulator 7805



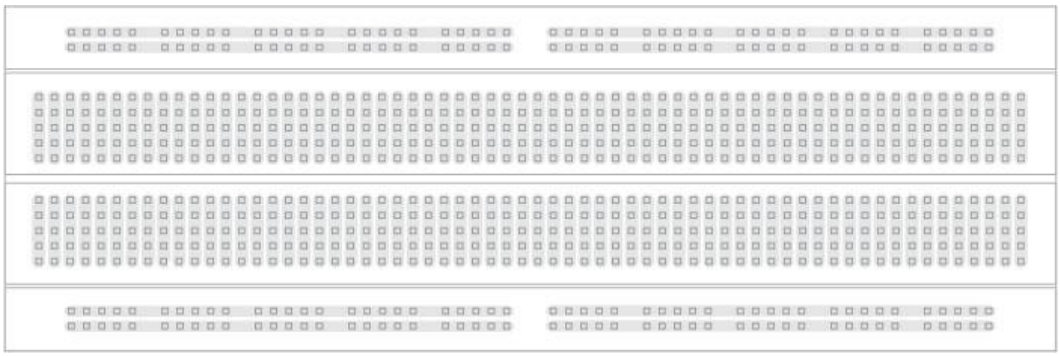

**7805** is a **voltage regulator** integrated circuit. It is a member of 78xx series of fixed linear voltage regulator ICs. The voltage source in a circuit may have fluctuations and would not give the fixed voltage output. The **voltage regulator IC** maintains the output voltage at a constant value. The xx in 78xx indicates the fixed output voltage it is designed to provide. 7805 provides +5V regulated power supply. Capacitors of suitable values can be connected at input and output pins depending upon the respective voltage levels.

ICs regulator is mainly used in the circuit to maintain the exact voltage which is followed by the power supply. A regulator is mainly employed with the capacitor connected in parallel to the input terminal and the output terminal of the IC regulator. For the checking of gigantic alterations in the input as well as in the output filter, capacitors are used. While the bypass capacitors are used to check the small period spikes on the input and output level. Bypass capacitors are mainly of small values that are used to bypass the small period pulses straightly into the Earth.

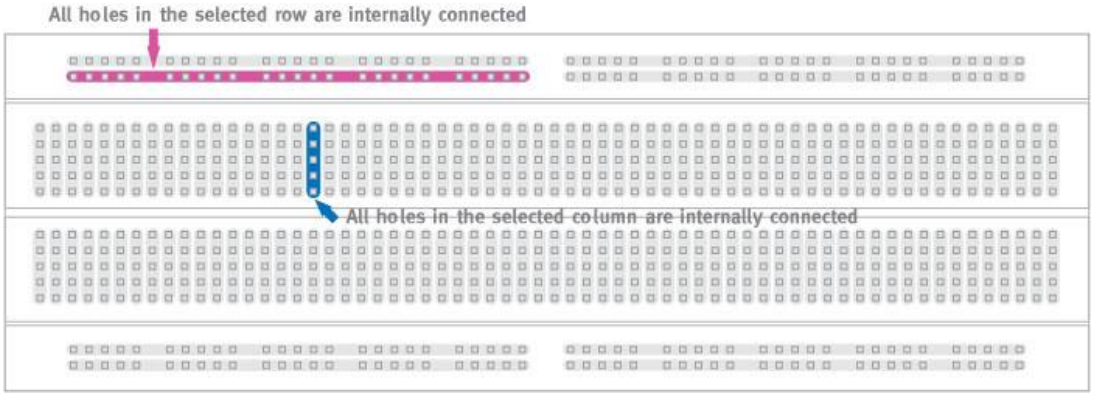
5. **Breadboard**

   A breadboard is a solderless device for temporary prototype with electronics and test circuit designs. Most electronic components in

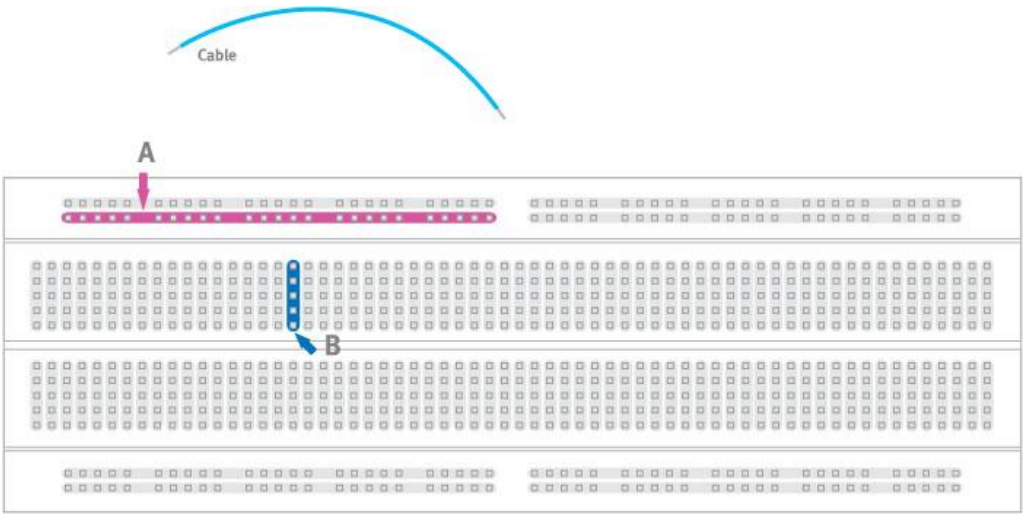
electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through wires where appropriate. The breadboard has strips of metal underneath the board and connect the holes on the top of the board. The metal strips are laid out as shown below. Note that the top and bottom rows of holes are connected horizontally and split in the middle while the remaining holes are connected vertically.



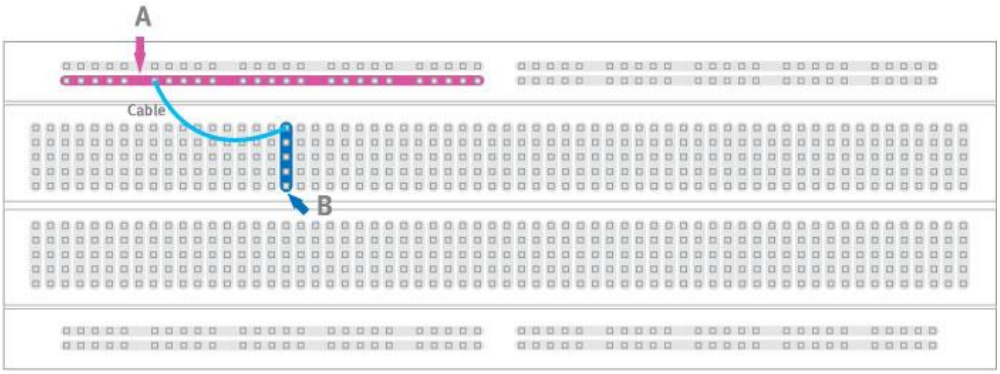
Note how all holes in the selected row are connected together, so the holes in the selected column. The set of connected holes can be called a node:




To interconnect the selected row (node A) and column (node B) a cable going from any hole in the row to any hole in the column is needed:




Now the selected column (node B) and row (node A) are interconnected:




**CIRCUIT EXPLANATION:**

In this circuit we have used a 555 timer IC based **astable multi-vibrator** which is for creating 1 second delay. And two common cathode seven segment decoder IC's namely CD4033. The output of astablemultivibrator is directly applied to seven segment decoder IC's (U4) Clock pin (1) and carry output pin(5) of U4 IC is directly connected to clock pin (1) of second seven segment decoder(U3). And two seven segment are connected with these decoder (U3 and U4). Its connections are shown in **stopwatch circuit diagram** given below. One push button is used to stop /start the stopwatch and one push button is used to reset the stopwatch. A 5 volt voltage regulator is used for providing 5 volt to whole circuit. And a 9 volt battery is used for powering the circuit. Rest of connections are shown in the circuit diagram.

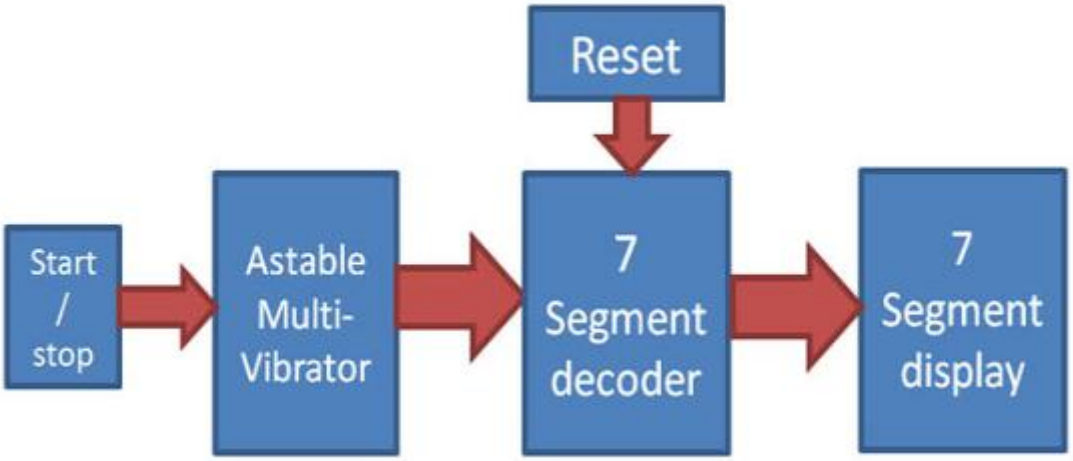
**WORKING:**

In this stop watch circuit we have generated one second delay by using **555 timer based astablemultivibrator**. By using some calculation we can easily generates one second delay. In astablemultivibrator there is two resisters and one capacitor is responsible for delay by charging or discharging capacitor through resistors.

F=1/T= 1.44/(R1 + 2R2) C1

In this project we have selects R1 is 33K, R2 is 56K and C1 is 10uF.

As Astable multi-vibrator generates one seconds delay, this delay is oscillations or pulse of 0 and 1. So we will use this pulse for triggering the seven segment decoder then seven segment decoder changes the digit number with the one second of time period.




When we ON the stopwatch (by start/stop button) it start counting from zero and if we turned OFF the same button then counting is stop or pause until again turned ON the same button or press reset button.

There are two seven segments, so this **stopwatch circuit** can count 00-99 seconds time.

## CONCLUSION:

After completion of this digital stop watch project i have learnt some knowledge in designing the circuit and understood theprocess. The circuit has been implemented on bread board. This circuit can operate in two modes with play and pause switches.

## REFERENCES:

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6.)