**B M S COLLEGE OF ENGINEERING**
**(AUTONOMOUS COLLEGE UNDER VTU, BELGAUM)**
**BANGALORE – 560019**

**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**
**2018-19**

# SELF STUDY REPORT

COURSE : DIGITAL ELECTRONICS
SEM : III SEMESTER

# DIGITAL SPEEDOMETER

Team members



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## INTRODUCTION:

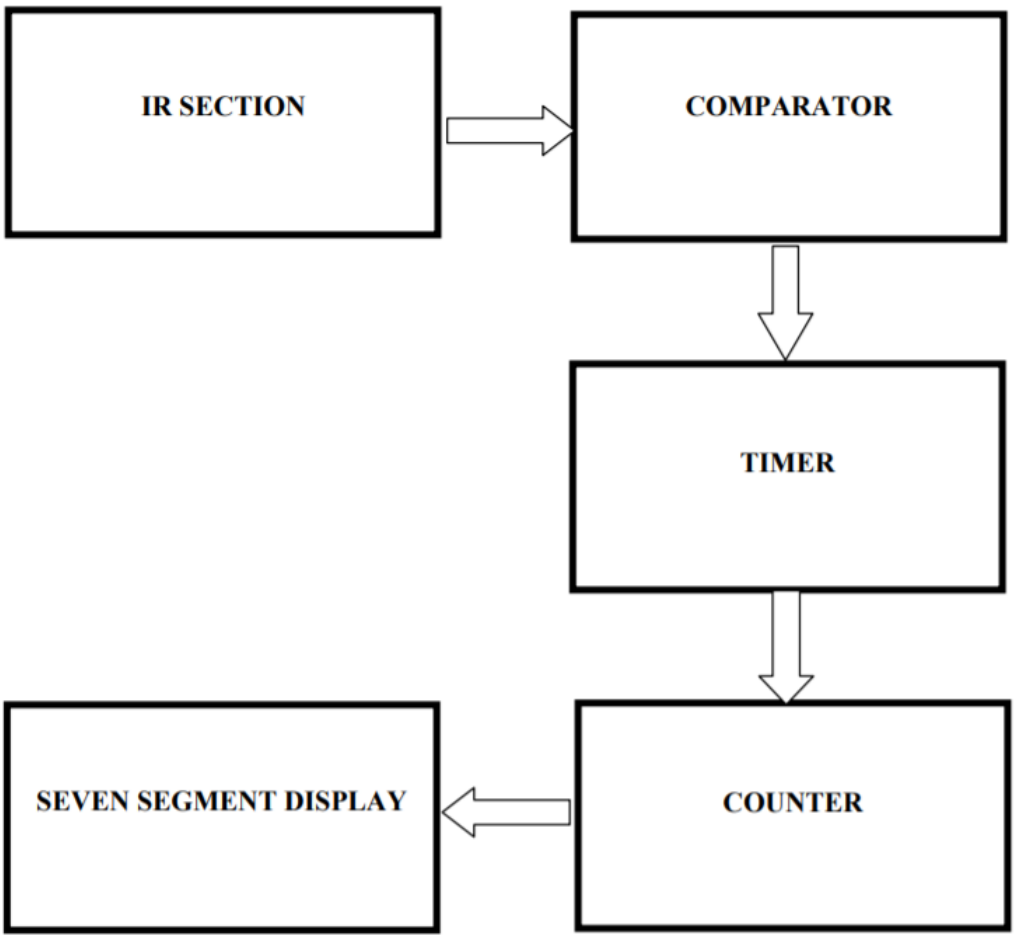
The aim of our project is to make a Digital Speedometer for use in vehicles having internal electrical power supply. In particular, the invention relates to a digital speedometer for automotive vehicles such as auto mobiles, trucks and motor cycles. The Digital Speedometer designed is highly efficient, low cost and can measure speed up to 99 kmph with a resolution of 1kmph.

## MOTIVATION:

Our Project is to create an efficient low-cost Digital Speedometer. It was inspired by the fact that most of the modern-day vehicles use Analog speedometers which have resolution of about 5kmph.

The Digital Speedometer we have designed can measure up to a speed of 99kmph with a resolution of 1kmph. It's rather inexpensive and can be used in almost all vehicles.

## BLOCK DIAGRAM:



## INPUT SECTION:

Input Section consists of IR LED, photo transistor, a comparator and a mechanical section. An opaque disc is mounted on the spindle attached to the front wheel of the vehicle. This disk has ten equidistant holes on its periphery. On one side of the disc an Infrared LED is fixed and on opposite side of the disc, in line with the IR LED, a phototransistor is mounted. IC LM324 is wired as a comparator.

## TIMER SECTION:

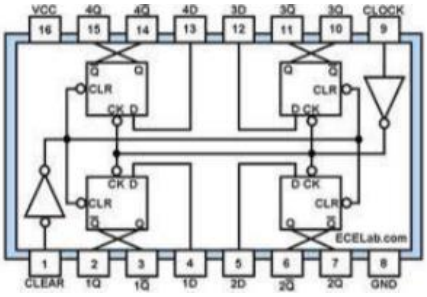
Timer section consists of astable and monostable multivibrator circuits. So, we use IC 556 for this purpose. Astable section is used to trigger the monostable multivibrator. IC 7400(AND gate) is used to set the gating period.

## OUTPUT SECTION:

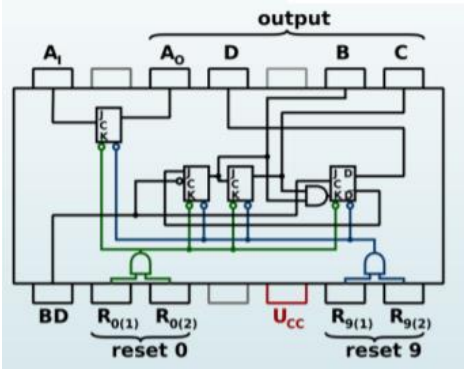
Output section consists of counter and latching sections along with LED display. IC 7490 is used to implement the counter section. The number of pulses counted during the gating period is the speed N in kmph. IC 74175(Quad D flip-flop) is used as the latching circuit. It helps in keeping the LED display constant for a particular period of time so that displayed value could be read. IC 7447 is used as BCD to seven segment decoders. Common anode LEDs are used in the output section to view the speed measured.

# COMPONENT DETAILS:

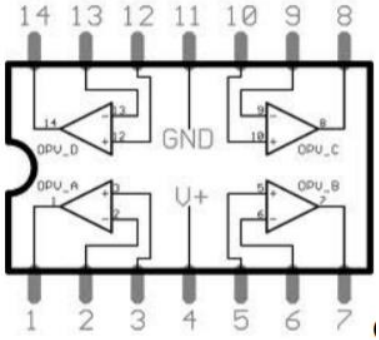
**IC 74175** is a quad, edge-triggered D-type flip-flop with individual D inputs and both Q and Q out puts. The common buffered clock (CP) and Master Reset (MR) inputs load and reset (clear) all flip flops simultaneously.



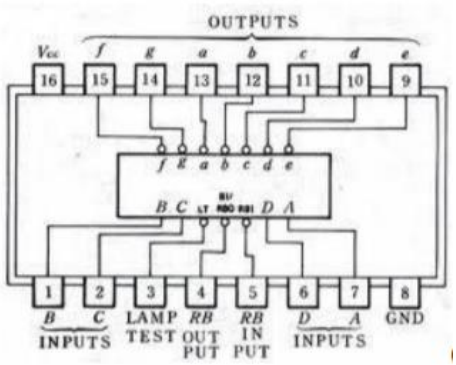

**IC 7490** is a monolithic counter contain four maser-slave flip flops and additional gating to provide a divide by two counter and a three-stage binary counter for which the count cycle length is divided by five. It has gated zero reset.



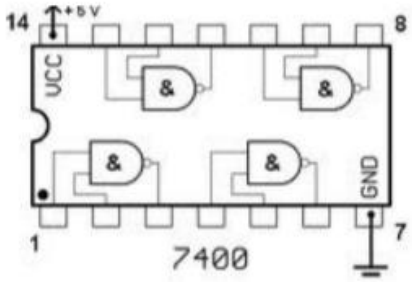

**IC LM 324** These devices consists of four independent high gain frequency compensated op-amps that are designed specifically to operate from a single supply over a wide range of voltages.



**IC 7447** It's a decoder driver IC used to drive a seven-segment indicator. There are two types of decoder drivers suitable to two types of seven segmented displays. Logic circuit inside the 7447 convert the 4-bit BCD input to seven-bit output which are active low.




**IC 7400** It's output will be low if all the inputs are in high state. IC 7400 is a Quad 2 input NAND gate.




**IC 556** This device provide two independent timing circuits of the NA555, NE555, SA555 or SE555 type each package. These circuits can be operated in the astable or monostable mode with the external resistor capacitor timing control.

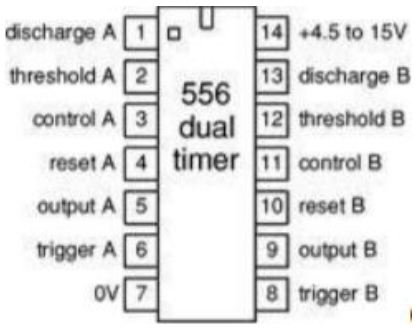


**PHOTO TRANSISTOR**

**IR LED**

# COST :

| SL.no | COMPONENTS | SPECIFICATIONS | QUANTITY | COST (Rs.) |
|---|---|---|---|---|
| **1.** | Decoder IC | IC 7447 | 2 | 30 |
| **2.** | D Flip Flop | IC 74175 | 2 | 30 |
| **3.** | BCD Counter | IC 7490 | 2 | 30 |
| **4.** | Comparator | IC LM324 | 1 | 15 |
| **5.** | 7 segment Display | LT 542 | 2 | 40 |
| **6.** | Timer | IC 556 | 1 | 20 |
| **7.** | NAND gates | IC 7400 | 2 | 30 |
| **8.** | Photo Transistor | - | 1 | 20 |
| **9.** | IR LED | - | 1 | 10 |
| **10.** | Miscellaneous | - | - | 200 |
| | | | Total | 325 |

## PRINCIPLE:

This instrument displays the speed of the vehicle in kmph. An opaque disc is mounted on the spindle attached to the front wheel of the vehicle. This disk has ten equidistant holes on its periphery. On one side of the disc an Infrared LED is fixed and on opposite side of the disc, in line with the IR LED, a phototransistor is mounted.

IC LM324 is wired as a comparator. When a hole appears between the IR LED and phototransistor, the phototransistor conducts. Hence the voltage at collector of phototransistor and inverting input of LM324 goes ‘low’, and thus output of LM324 becomes logic ‘high’. So, rotation of the speedometer cable results in a pulse at the output of LM324, the frequency of this waveform is proportional to the speed.

# DESIGN:

Gating Period: Let 'N' be the number of pulses in time 't' seconds and numerically equal to the number of kilometres per hour (kmph). For vehicle with a wheel circumference of 1.38 meters, and number of pulses equal to 10 per revolution, we get the relationship:

(N pulses)/t = N kmph

= (N×1000)/ (3600×1.38) m/s

= (N×1000×10)/ (3600×1.38) pulse per second.

Therefore, time 't'= 0.4968. Input Comparator Section: For the comparator, resistance values are determined by the voltage divide rule. Equal voltage (2.5V) are assumed across the + and – terminal. Thus, we use 56K at the positive terminal. In order to obtain perfect output, we used a 1M potentiometer at the collector of phototransistor.

Astable and Monostable Multivibrator Section: For astable multivibrator,

ton = 0.693. (R1+R2).C = 0.51 Sec.

Let R2= 1K and C= 10µF.

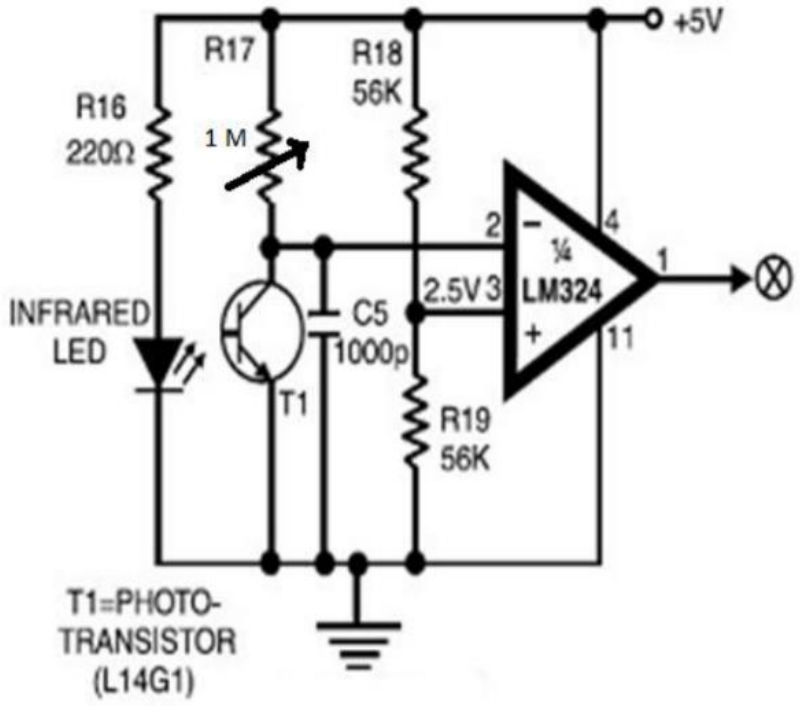
Thus, we get, R1= 72.9 K.

So, we use 100 K potentiometer. For monostable multivibrator,

T= 1.1RC = 0.4968 Let C= 0.47µF.

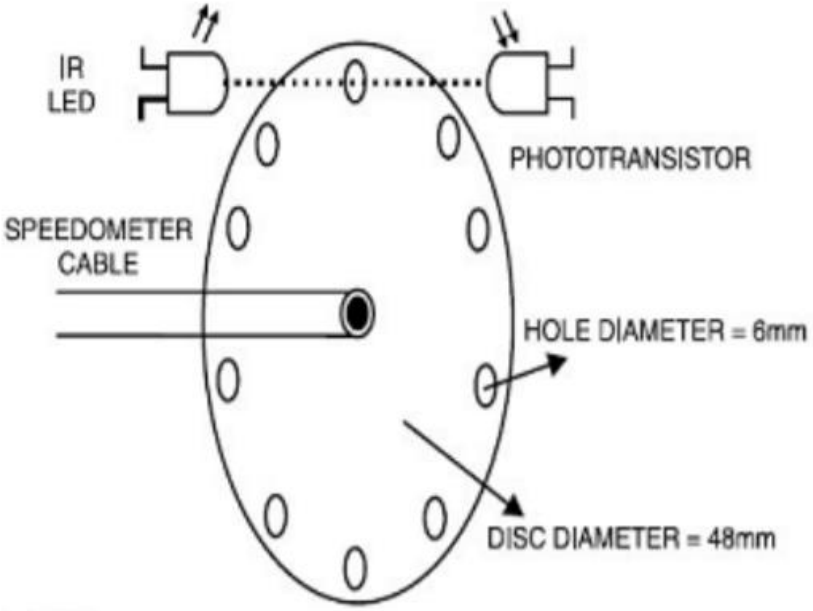
Thus, we get, R=960.9K. So, we use 1M potentiometer.

# TRANSDUCER SECTION:



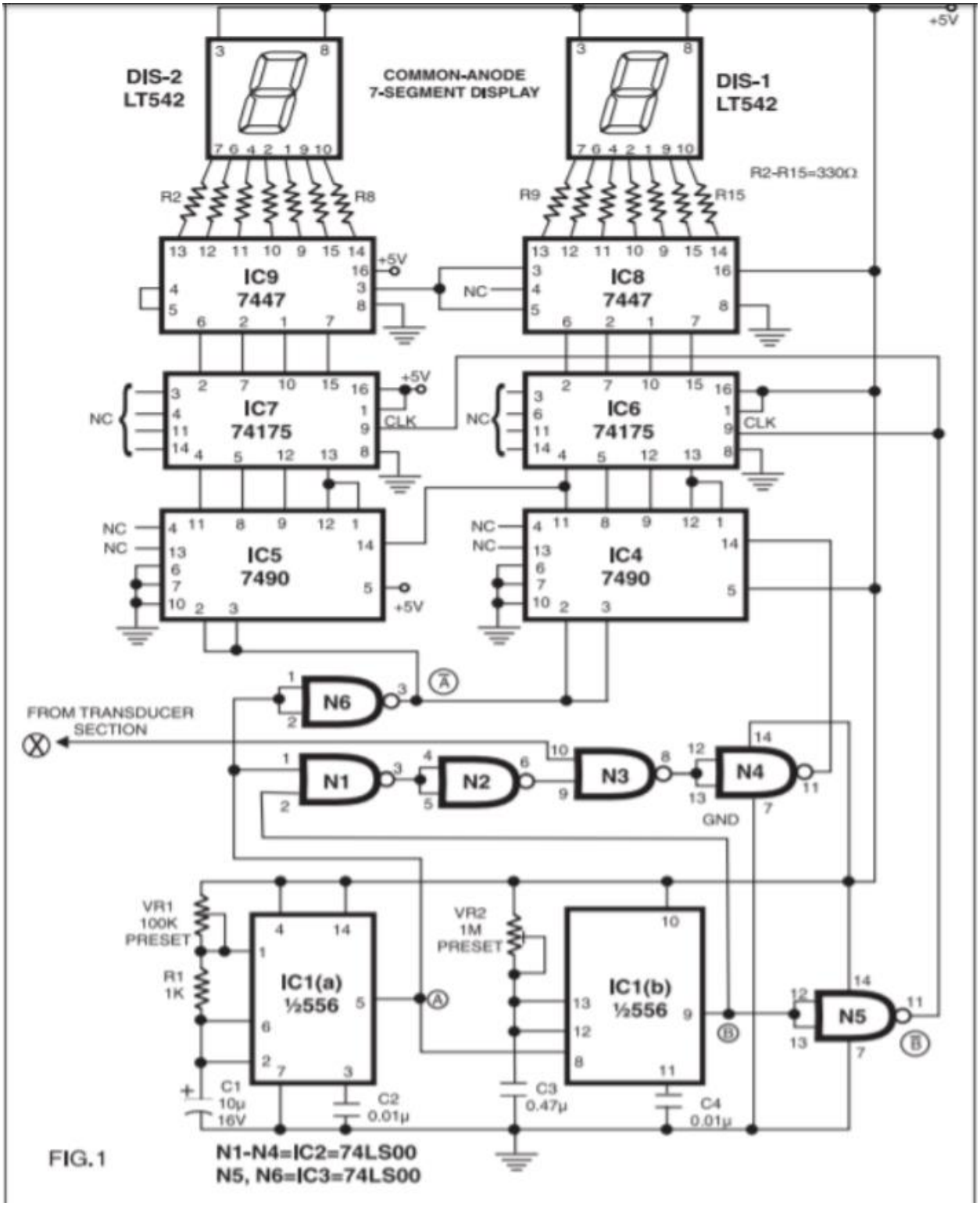

1. Transducer converts one form of energy to another. Here it converts light signal to electrical signal.
2. The disc will be set in alignment in between IR led and Photo Transistor.IR led will be sending signal continuously but it reaches photo transistor only when a hole appears in between.
3. Photo Transistor conducts only when IR signal is detected.
4. LM 324 is a comparator gives high output whenever the phototransistor conducts and that is when a hole appears in our setup and low output when photo transistor is not conducting.

## MECHANICAL ARRANGEMENT:




This Disc is attached to the shaft of the front wheel of the vehicle. So, that it rotates with the same rpm as that of the wheel.

# CIRCUIT DIAGRAM:



# TIMING DIAGRAM:

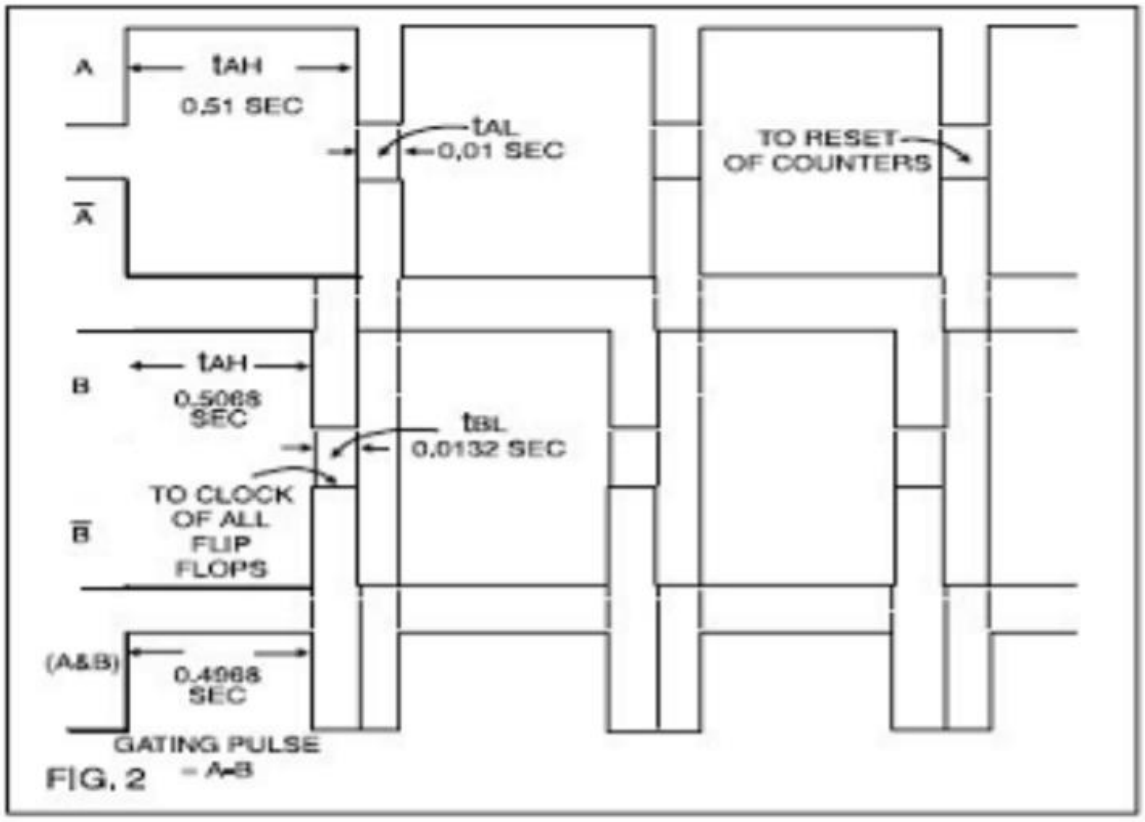


FIG. 2

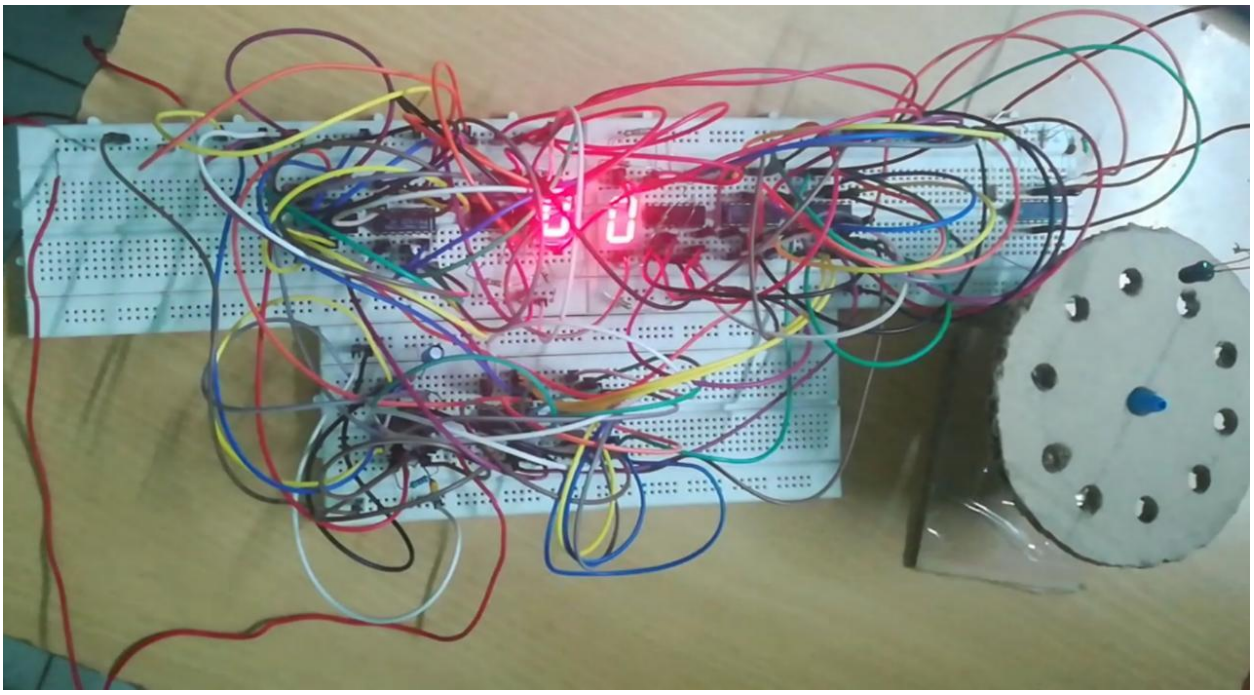
As shown in timing diagram, at t=0, output of astable flip-flop IC1(a) goes low and triggers monostable multivibrator IC1(b). Pulse width of monostable multivibrator IC1 (a), ton =0.513 and toff = 0.01 sec. The outputs of IC1 (a) and IC1(b) and the signal from the transducer section are ANDed.

The number of pulses counted during the gating period is the speed N is kmph. At the end of gating period, output 'B' of monostable IC1(b) goes low and B goes high. The rising edge of B is used to enable the quad 'D' flip-flops 74175. At this instant, i.e. at t=0.5068, the number (speed) 'N' will be latched corresponding to the 'D' flip-flops and displayed.

At t= 0.510, output of astable flip-flop IC1(a) goes low and remains low for 0.01 sec. This waveform is invented and applied to the reset terminals of the all counters (active-high).

Thus, the counters are rest and counting begins afresh at t=0.520. up to the time t=0.520 + 0.5068 sec. However, the 'D' flip-flops are not enabled and the previous speed is displayed. The new speed is displayed at t= 0.520+0.5068 sec. In this way speed will be updated every 0.520 sec. This speedometer can measure up to 99kmph with a resolution of 1kmph.

# OUTCOME:



- This Circuit is tested attaching a motor to the disc and the rated speed matched with the speed shown in the display.
- This circuit has been successful and it can be designed on a PCB.

## HURDLES FACED:

- Calculation of the Time period of the Gating pulse.
- Alignment of potentiometer is very difficult.
- Selecting a disc for proper functioning.
- Fluctuation in display while starting.

## APPLICATIONS:

- It can be used in almost all vehicles with certain modification in the timer section depending on the circumference of the wheel of the vehicle.
- It can be used for industrial machinery speed measurement.
- By modification in the circuit it can also be used as rpm counter and odometer.

## CONCLUSION:

- An efficient low-cost digital speedometer which can measure speed up to 99kmph with a resolution of 1kmph has been designed.
- Resolution can be improved by using additional displays.
- Circuit can be modified using microcontroller and LCD display