Implementation Of A Counter Using A Monostable Multivibrator State Of 555 Timer IC

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Abstract- *The project aims to use a monostable multivibrator in a counter which is useful for counting various entities such as objects. In this project, 555 Timer I.C. is used as a monostable multivibrator to use as an object counter which counts from 0 to 99. A multivibrator produces an output waveform by oscillating between two states; a "LOW" state and a "HIGH" state.*

Keywords- 555 Timer I.C., monostable, multivibrator, LOW, HIGH.

I. INTRODUCTION

An object counter is a device designed to count objects that are passing from above it or by touching it. But the main work of the object counter is the counting of objects or things. This output can be obtained by using LDR, THERMISTORS, VDR.

Many flip-flops are commonly connected in a cascade to make a counter circuit. Counters are a common component in digital circuits and are available as standalone integrated circuits or as components of larger integrated circuits.

Counters with bidirectional detection are useful for counting objects moving along a previously defined path. It may find applications as visitor counters and the counting of objects. Here in this project, we present a simple circuit that counts the number of objects entering the premises.

This circuit diagram can also be referred to as a People or Object counter Circuit Diagram utilising IC 555 and IC 4026 or a Digital I.R. Counter for Counting Door Entries.

II. THEORY

The 555 Timer IC was employed as a multivibrator that is monostable in this project. A multivibrator circuit, a single sequential logic circuit that produces a continuous output by oscillating between "HIGH" and "LOW" states, is used in this project. Astable, Monostable, and Bistable multivibrators are the three types of multivibrators. When triggered externally, monostable multivibrators have only "ONE" stable state (thus the name: Mono) and emit a single output pulse. It only returns to its original, stable state when a specific amount of time has passed. The connected circuit's RC constant determines this time. [8]

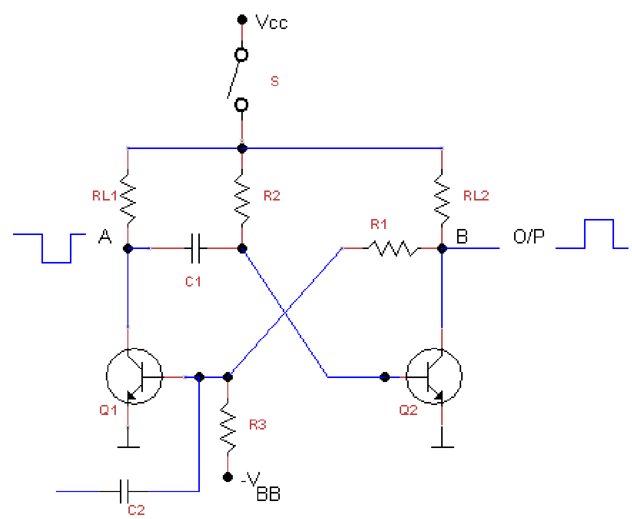

Fig 1: Monostable Multivibrator

A) The 555 Timer as a Monostable Multivibrator in Action:

1. The flip-flop is originally put at the high position, i.e. Q. This causes the transistor Qd to become saturated.
2. The capacitor is entirely discharged, and the voltage across it is near zero. Pin 3 has a low output.
3. Until the trigger voltage is larger than 1/3 VCC, the circuit state remains unaltered. When it falls below Comparator 2 output gets high at 1/3 VCC. When the flip-flop is reset, Q becomes low and Q' becomes high.
4. A low Q turns off the transistor Qd. As a result, the capacitor begins to charge through resistance R.
5. Vout at pin 3 is low at first, then rises high when the trigger is less than 1/3 VCC, then low again when the threshold is larger than 2/3 VCC until the next trigger pulse occurs.
6. As a result, the output is a rectangular wave. The charging duration of the capacitor determines the pulse width of this rectangular pulse.

7. As a result, the output is a rectangular wave. The charging duration of the capacitor determines the pulse width of this rectangular pulse. Thus R.C. controls the pulse width.
8. Pulse width is given by 1.1RC.
9. We have used a Resistor of 100 ohms and a capacitor of 100 uF. This gives a pulse width of 0.011 sec.

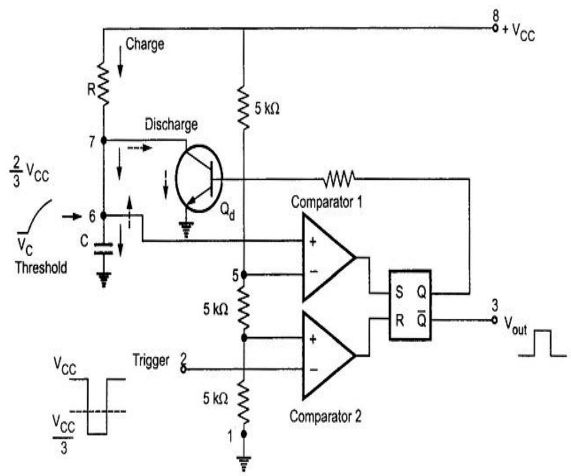

Fig 2: 555 Timer IC as a monostable multivibrator

B) Components

1. 555 Timer I.C. x1
2. 7 segment display x2
3. IC 4026 x2
4. Push button x2
5. Capacitor
· 1 uF x1
· 22 uF x1
6. Resistor
· 100ohm x1
· 56 K-ohm x1
· 33 K-ohm x1
· 1 K-ohm x1
7. Battery (9V) x1

1)555 Timer I.C.:

The 555 Timer I.C. is an integrated circuit (chip) used in delay, pulse generation, and oscillator applications. Derivatives provide two (556) or four (558) timing circuits in one package.

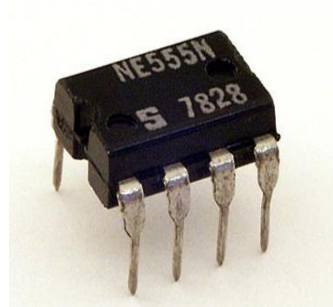

Fig 3: 555 Timer I.C.

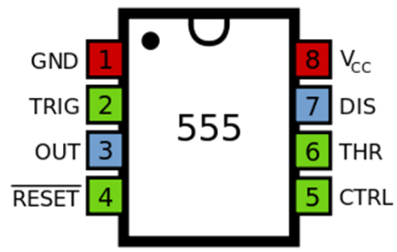

Fig 4: 555 Timer I.C. pin diagram

2)7 segment display:

A seven-segment display is an electronic device used for displaying decimal numbers and hexadecimal numbers. Sometimes there is an additional decimal point in the display for displaying numbers such as 11.2.

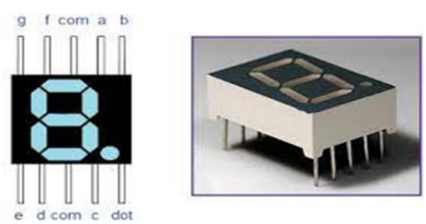

Fig 5: 7 segment display

3)*IC 4026:*

The 4026 is a decade counter I.C. with decoded outputs that help drive a common-cathode seven-segment LED display. The advantage of this I.C. is that it has decade counter functionality and a 7-segment decoder driver.

Fig 6: IC 4026

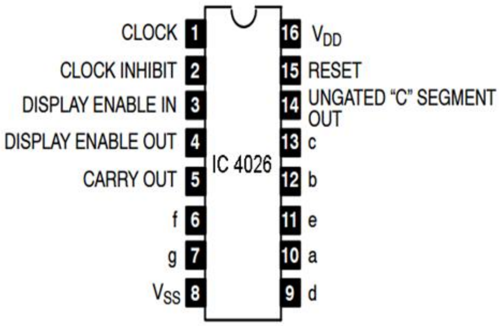

Fig 7: IC 4026 pin diagram

4)Pushbutton:

A push-button (sometimes spelled push button) or simply button is a simple switch mechanism used to control a machine or process.

Fig 8: Push-button

5)Capacitor:

A capacitor is an electronic device used to store electrical energy present in an electric field. It's a two-terminated passive electrical component.

Fig 9: 1uF capacitor

Fig 10: 22uF capacitor

6)Resistor:

A resistor is a two-terminal passive electrical component that is used in circuits to implement electrical resistance.

Fig 11: 100 Ω resistor

Fig 11: 56 kΩ resistor

Fig 12: 33 kΩ resistor

Fig 13: 1 kΩ resistor

7)Battery (9V):

The nine-volt battery, sometimes known as a 9-volt battery, is a popular size of battery used in early transistor radios. It has a polarised snap connector at the top and a rectangular prism-shaped battery with rounded sides.

Fig 14: A 9V battery

III. EXECUTION

3.1 Working of individual pins:

The working of the Digital counter can be divided into two parts i.e

1) Interfacing CD4026 with a seven-segment display.
2) Increment the numbers using a 555 timer.
To understand the actual working of the circuit, the working of individual pins of both I.C.'s is discussed below.

3.2 Display two-digit numbers:

1) CD4026, a seven-segment display decade counter, is used to drive a seven-segment display with the input clock pulse.

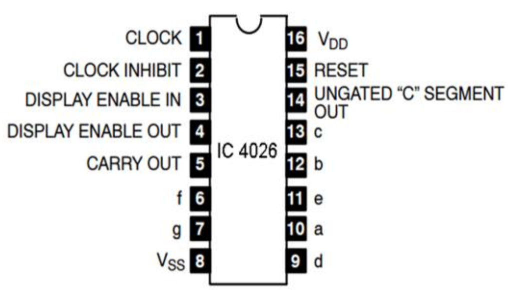

Fig 15: 4026 Timer I.C. pin diagram

Table 1. 4026 Timer I.C. pins and their functions

PIN	Function
Pin 6, pin seven and pin 9 to 13	7 decodes input from 'a' to 'g' are used to illuminate corresponding segments of the seven-segment display to display digits from 0 to 9.
Pin 5	We used to cascade one I.C. to the other. Pin 5 is connected to pin 1 of the other I.C. for displaying two-digit numbers.
Pin 3	For enabling the display, it is given a high signal in both the 4026 ICs.
Pin 1	With each positive clock pulse, it increments the counter.
Pin 15	Reset the counter to 0 when HIGH. Hence it is Active High. And it is connected to a push-button.

3.3 Incrementing using the 555 Timer I.C.:

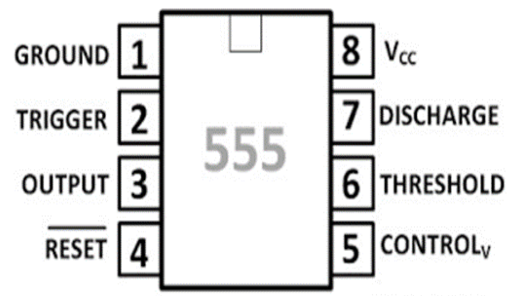

Fig 16: Incrementing values using 555 Timer IC

Table 2. 555 Timer I.C. pins and their functions

PIN Number	Function
Pin 2	It is connected to a push-button causing the output switch from a "LOW" to a "HIGH" state.
Pin 3	The output is given to pin1 of the I.C., which displays the unit's place of the two-digit number.
Pin 4	It is connected to logic 1 (positive) to avoid unnecessary resetting.
Pin 5	Not used. Hence connected to one □F capacitor to avoid noise.
Pin 6	Shorted to pin 7.
Pin 7	Connected to discharge the capacitor.
Pin 8	Connected to supply voltage.

4026 IC is used as a driver for two 7 segment displays. When you press the increment push button counter starts from zero and increments each time whenever pin 1 receives a positive pulse. When the switch is pressed for the first time,"1" is displayed, then "2" and increments up to “9” and starts counting from “0” again.[7]. Here, the 555 Timer I.C. works as a 'Monostable Multivibrator' and acts as a pulse generator. The duration of the pulse is determined by the value of the resistor and the capacitor connected externally to the 555 Timer I.C. In this, one state of the output is stable while the other is quasi-stable. Energy is stored by an externally connected capacitor (C) to a reference level which helps in auto-triggereing of the output from the quasi-stable state to the stable state. The transition of output from the stable state to the quasi-stable state is accomplished by external triggering. The schematic diagram of the Timer I.C. in monostable multivibrator mode of operation is shown[9].

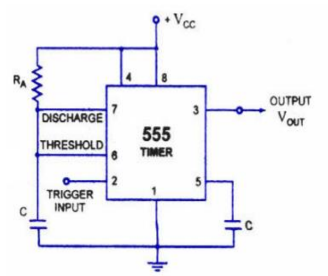

Fig 17: 555 Timer IC as a monostate multivibrator

3.4 Working of Monostable Multivibrator:

1. A negative-going pulse is applied to pin 2 by the monostable 555 Timer circuit connected to the push button.
2. When the push button is pressed, output goes into an unstable state and facilitates incrementing the numbers.
3. A negative-going pulse is applied to pin 23 by the monostable 555 Timer circuit. The 555 monostable will remain in this "HIGH" unstable output state once triggered until the network's timer has expired. In this case, the time elapsed will be 0.011 sec.

The time elapsed is calculated by

$$\text{Time}= 1.1*R*c$$
$$=1.1*100*100*10^{-6}$$
$$R= 100 \text{ ohm },C=100uF$$
$$=0.011 \text{ sec.}$$

4. Clock pulse obtained from the monostable multivibrator is fed into pin 1 of the I.C. 2 4026 since the count value should start from the 7 segment display which is placed on the right-hand side.

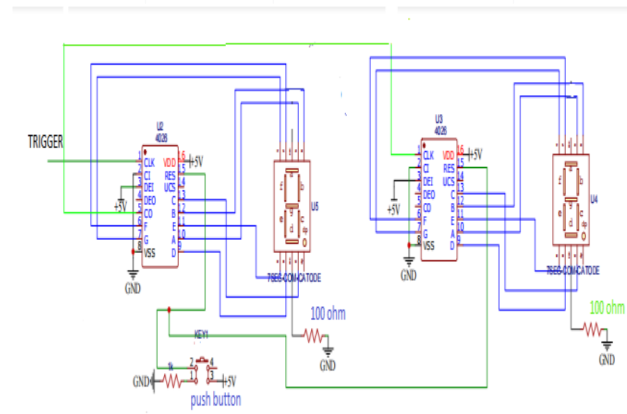

Fig 18: Working of the monostable multivibrator

3.5 Working of I.C. 4026 with seven-segment display:

1. Initially, when the circuit is switched "ON" the seven-segment display will indicate "00" count.
2. When the negative trigger is given to 555 high pulses will be obtained from pin 3. The high pulse is given to I.C. 2 pin 1.
3. Therefore, when we push the button the numbers will be incremented from 0 to 9.
4. When counter counts above 9 a high to low signal is obtained from the right-hand side I.C. pin 5, indicating the completion of ten increments.
5. Pin 5 of I.C. 2 is connected to pin 1 i.e. clock pin of I.C. 1.
6. Therefore, whenever 10 counts were completed by the 7 segment display on the right-hand side, the high to low signal at pin 5 is given to clock pulse input to the I.C. 1.
7. In this way, the corresponding 7 segment display will be incremented by one value.
8. I.C. 2 will count from 0 to 9 and then I.C. 1 will be incremented by one.
9. Thus, the counter counts to 99 and then returns to 0.

3.6 Reset Button:

10. The reset button is connected to pin 15 i.e. reset pin of both IC 4026.
11. Clicking the push-button triggers both the reset pins of the I.C. and the 7 segment display displays "00".

IV. RESULTS

This project i.e. Implementation of a Digital Counter is done considering the applications in industries of counters in various fields such as economy, research, agriculture, etc. Also, the usage, durability, and applications lead us towards the concept.

The output from the model confirms that the count is incremented when required. The model was able to increment and display the count when operated. This research aimed to design and implement a low-cost implementation of a Digital Counter. The results obtained after the execution are presented and fully discussed. After carrying out the necessary test, it was observed that the aim of the work was achieved. Some additional features can be included to give a better and more precise count. In the end, the use of this device is recommended only when workers are properly remunerated at when due.

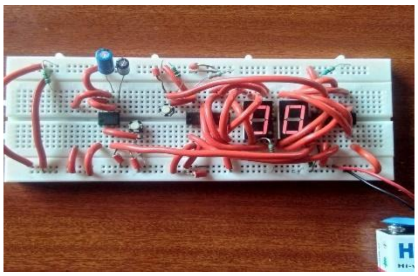

Fig 19: Getting "00" as output

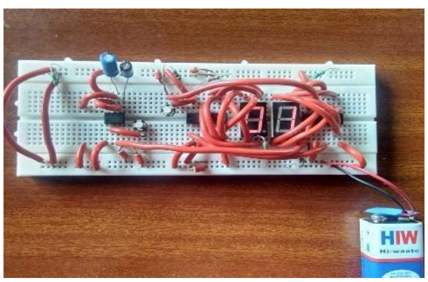

Fig 20: Getting "01" as output

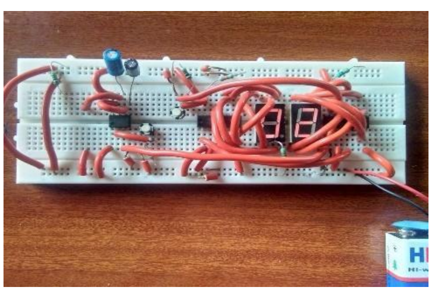

Fig 21: Getting "03" as output

V. CONCLUSION

The model delivered met the correct results and expectations. The output was taken without stress and easily. The model worked efficiently and without any problem.

VI. ACKNOWLEDGMENTS

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