Two Digit 7-Segment Display Counter using 555 Timer.

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***Abstract*— This report presents the design and implementation of a 2-digit 7-segment Display Counter using a 555 Timer. The objective of the project was to create a digital counter that can count from 0 to 99 and display the count on a 7-segment display. The counter was designed to increment the count using a push button and reset the count to zero using another push button. The project was first simulated using Proteus 8.16 software before implementing it on a breadboard. The simulation and experimental results matched closely, indicating that the counter was functioning as expected. A cost analysis of the project was also performed, with the total cost amounting to Tk. 625.2. The report discusses the limitations of the project and suggests potential improvements for future iterations. The project demonstrates that designing a simple, cost-effective 2-digit 7-segment Display Counter using a 555 Timer is feasible.**

***Keywords*— 2-Digit 7-Segment Display Counter, 555 Timer, digital counter, Proteus 8.16 software, cost analysis.**

I. INTRODUCTION

A. *Background of Study and Motivation*

Digital counters have become an integral component of a wide range of current applications, including digital clocks, calculators, and different electronic gadgets. These counters can be seen used in restaurants to keep track of orders, hospitals for patient waiting lists, fitness trackers and many more. The 7-segment display is a basic, low-cost approach for digitally presenting numbers. However, utilizing a 7-segment display to construct a digital counter that can count up to two numbers (from 00 to 99) presents several complications. This project was inspired by the desire to overcome these obstacles and create a 2-digit 7-segment display counter using a 555 Timer, a commonly accessible and affordable integrated circuit. [1].

B. *Project Objectives*

The primary objective of this project was to design and implement a 2-digit 7-segment Display Counter using a 555 Timer. The counter was designed to count from 0 to 99 and display the count on a 7-segment display. The counter also had to be able to increment the count using a push button and reset the count to zero using another push button. The project aimed to achieve these objectives while keeping the design as simple and cost-effective as possible [1].

C. *Outline of Report*

This report is organized into several sections to provide a comprehensive understanding of the project. The "Literature Review" section reviews relevant studies and projects related to digital counters and 7-segment displays. The "Methodology and Modeling" section details the apparatus used, the working principle of the project, the description of the components, and the experimental setup. The "Results and Discussions" section presents the simulation results, the experimental results, a comparison between the numerical and experimental results, a cost analysis, and the limitations in the project. The "Conclusion and Future Endeavors" section summarizes the findings of the project and suggests potential future improvements. Each section is intended to provide a comprehensive understanding of the project, from the initial motivations and objectives to the final results and future directions.

II. LITERATURE REVIEW

Several studies and projects related to digital counters and 7-segment displays have been conducted in recent years, demonstrating the practical applications and the various implementations of these devices.

In a study titled "An Efficient Implementation of BCD to Seven Segment Decoder using MGDI" by N. Radha and M. Maheswari, presented at the 2018 2nd International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud), the authors proposed a novel method for efficiently implementing a Binary Coded Decimal (BCD) to seven-segment decoder using Majority Gate and Differential Input (MGDI) [2]. The findings from this study could potentially be applied to improve the efficiency of the 7-segment display in our project.

Another study titled "A New Approach for Seven-Segment Display Control Based on One Control pin" by R. Alkhatib, A. Fares, H. Harb, A. R. El Mohamad and N. Miri, presented at the 2021 IEEE 3rd International Multidisciplinary Conference on Engineering Technology, proposed a new method for controlling a seven-segment display using just one control pin

[3]. This approach could potentially simplify the control circuitry in our project.

In a 2020 study titled "2 Digit Counter Using 7-segment Display and PIC16f1825" [4], the author used a PIC16F1825 Microcontroller from Microchip and CAT4016 serial to display driver IC from ON-Semiconductor to build a two-digit up counter. The counter incremented from 00 to 99, and a reset button was provided to reset the count to 00. This project is similar to our proposed project and shows the feasibility of creating a 2-digit counter using a microcontroller and a 7-segment display.

In a project posted on Gadgetronicx.com [5], the author built a two-digit counter using a 7-segment display and a 4026 IC. The authors highlight the importance of debouncing the input signals to the counter to prevent erroneous counts, which is a critical consideration for our project.

Finally, a study titled "A digital indicator system with 7-segment Display" [6] discusses a digital indicator system that uses a 7-segment display to display numerical information. Although the application differs from our project, the study provides useful insights into the use and operation of 7-segment displays.

These studies and projects demonstrate the feasibility of designing and implementing a 2-digit 7-segment Display Counter using a 555 Timer. They also provide valuable insights into the challenges and potential solutions involved in such a project.

III. Methodology and Modelling

A. Introduction

The aim of the project was to design and implement a 2-digit 7-segment Display Counter using a 555 Timer. The counter was designed to count from 0 to 99 using a 7-segment display, which is a common digital display device used to display numbers from 0 to 9 [1].

B. Working Principle of the Proposed Project

This project operated on the principle of counting clock pulses using a 7-segment display. The 555 Timer was used to generate clock pulses for incrementing the count when the increment button was pressed. The 4026 Integrated Circuit (IC) is a CMOS BCD counter IC which operates at very low power. It also has a BCD to 7-segment Display decoder. It displayed numbers on the 7-segment display and incremented the number by one when a clock pulse was applied to its PIN 1 [1] when the increment button was pressed. The counter could be reset to zero at any time with the reset button.

C. Description of the Components

The following components were used to practically implement the project:

1) Breadboard: The breadboard served as the base for connecting the components of the counter. It provided a way to implement the circuit without soldering, making it easy to modify.

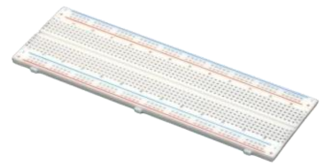


Fig. 1. Breadboard.

2) Two Single-digit 7-segment Display (Common Cathode): The 7-segment display was used to display the count from 0 to 99. It has 8 LEDs (7 segments + decimal point) for each digit and can display each digit from 0 to 9 by lighting up specific segments. The "Common Cathode" refers to the negative ends of the LEDS (cathode) which were connected together and placed at the ground.

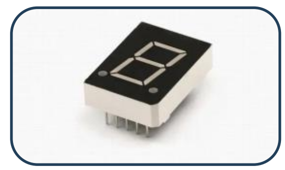


Fig. 2. 7-segment Display CC

3) Two Push Buttons: Two push buttons were used in this project. One push button was used to increment the count, while the other was used to reset the count to zero.

Fig. 3. Push Button

4) Resistors: Three 10 kΩ resistors and one 100 kΩ resistor were used for limiting the current in the circuit.

Fig. 4. 10 kΩ resistor and 100 kΩ resistor.

5) Capacitors: 1µF and 22 µF capacitors were used with the 555 Timer to control the timing of the clock pulses.

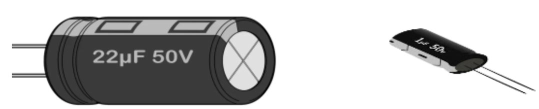


Fig. 5. 22µF and 1 µF capacitors.

6) Two CD4026 ICs: The CD4026 is a unique IC which has both a BCD counter and a BCD to 7-segment display driver/decoder. They are used to increment the count and drive the 7-segment display.

Fig. 6. CD4026 IC.

7) 555 Timer: It was used to generate clock pulses. It was configured in astable mode to generate a continuous stream of pulses.

Fig. 7. 555 Timer.

8) Connecting Wires: Wires were used to connect the components on the breadboard.

Fig. 8. Connecting wires.

9) 9V Battery: A 9V battery was used as the power source for the circuit.

Fig. 9. 9V Battery.

D. Experimental Setup

The experimental setup of the project was carried out as follows:

1) Breadboard setup: At first, the breadboard was prepared to implement the circuit. The inner layer of the breadboard was connected to the Ground and the outer layer to the V_{cc} (supply). The center of the breadboard was also connected using jumper wires providing a common supply and ground for the components.

2) 555 Timer setup: The 555 Timer was then set up. Pin 1 was connected to Ground and Pins 4 and 8 were connected to V_{cc}. A 10 kΩ resistor was connected to V_{cc} and Pin 2. Pin 2 was also connected to the positive terminal of the increment button, with the negative terminal of the button connected to the Ground. Pins 6 and 7 of the 555 Timer were connected together, and a second 10 kΩ resistor was connected to V_{cc} and this joint connection of pins 6 and 7. The joint connection of pins 6 and 7 was then connected to a 1μF capacitor, which was also connected to the Ground. This setup configured the 555 Timer in astable mode, generating a continuous stream of clock pulses.

3) 4026 ICs and 7-segment Displays setup: The 4026 ICs and the 7-segment displays were then set up. The common terminals of the two Single-digit 7-segment displays were connected to the Ground. Pins 3 and 16 of both 4026 ICs were connected to V_{cc}, while Pins 2 and 8 were connected to Ground. The 4026 ICs were then connected to the 7-segment displays according to the pin configuration of the ICs for driving the 7-segment displays.

4) Connection of ICs to 555 Timer: The ICs were then connected to the 555 Timer. A 100kΩ resistor was connected to Ground and a 22μF capacitor was connected to this resistor and Ground. The connection between the 22μF capacitor and the 100kΩ resistor was connected to Pin 3 of the 555 Timer and Pin 1 of the second 4026 IC. Pin 1 of the first 4026 IC was connected to Pin 5 of the second 4026 IC.

5) Connection to Reset Button: Finally, the reset button was connected. The positive terminal of the reset button was connected to V_{cc}. Pin 15 of both 4026 ICs were connected to the negative terminal of the reset button and to a 10 kΩ resistor, which was also connected to Ground.

After completing the circuit assembly, the output of the circuit was tested by observing the operation of the 2-digit 7-Segment Display Counter [7].

IV. Results and Discussions

A. Simulation

The circuit was first simulated using Proteus 8.16 software. In the simulation, the 555 Timer IC was configured in an astable mode to generate clock pulses. These pulses were then fed to the 4026 BCD counter/decoder ICs. The 7-segment displays, which were connected to the 4026 ICs, were observed to display the count accurately, incrementing from 00 to 99 in response to the clock pulses from the 555 Timer when the increment button was pressed, and resetting to 00 when the reset button was pressed [8].

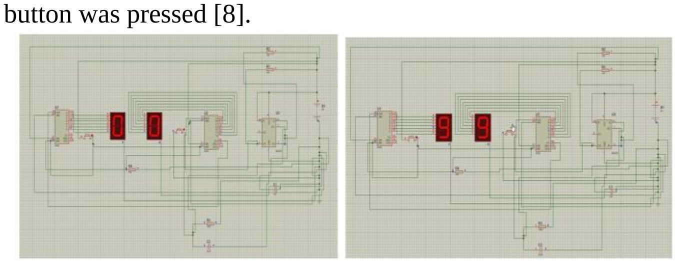


Fig. 10. Increment from 00 to 99 in simulation.

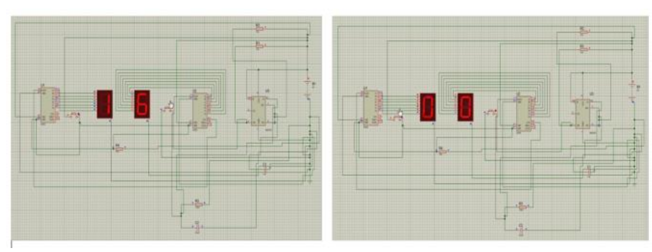


Fig. 11. Reset operation in simulation.

B. *Experimental Results*

According to the Experimental Setup, the circuit was physically implemented on a breadboard. The components were connected as per the setup, and the circuit was powered using a 9V battery. The operation of the 2-digit 7-Segment Display Counter was observed over multiple test runs. The counter was found to be incrementing correctly in response to the clock pulses when the increment button was pressed and resetting to 00 when the reset button was pressed. The functionality matched the expected behavior, validating the design and implementation of the counter.

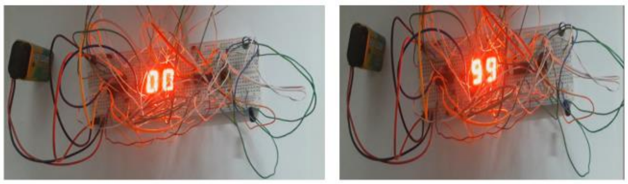
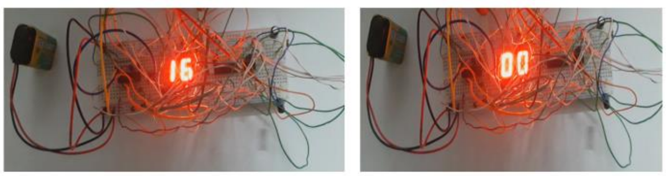


Fig. 12. Increment from 00 to 99 in practical demonstration.



. Fig. 11. Reset operation in practical demonstration.

C. *Comparison between Simulated and Experimental Results*

The results obtained from the Proteus 8.16 simulation and the practical implementation of the circuit were compared. The counter behavior, in both cases, was found to be consistent. This validated the accuracy of the simulation made in Proteus 8.16. The successful operation of the counter in the practical demonstration confirmed that the circuit was implemented correctly, and the components were functioning as expected.

D. *Cost Analysis*

A detailed cost analysis of the project considering each component is given in the following table:

TABLE 1
COST ANALYSIS

Items	**Cost**
Two Single Digit 7-Segment Displays (CC)	Tk. 29.7
Jumper Wires [M-to-M] (20 pieces)	Tk. 56.9
Connecting wires (30 pieces)	Tk. 150
Two 4-pin Push switches (small)	Tk. 15.6
9V Battery	Tk. 84
9V Battery Connector	Tk. 11.9
22 µF Capacitor	Tk. 3.1
1 µF Capacitor	Tk. 20
100 kΩ Resistor	Tk. 1.95
Three 10 kΩ Resistors	Tk. 5.97
Breadboard (Big)	Tk. 155
NE555 Timer	Tk. 17.7
Two CD4026BE ICs	Tk. 73.2
Total	**Tk. 625.2**

It can be seen that the total cost of the project was Tk. 625.2. This cost is feasible considering the functionality provided by the project.

E. *Limitations in the Project*

Despite the successful implementation of the 2-digit 7-segment Display counter, there were a few limitations. The counter was only able to count up to 99 due to the use of two 7-segment displays. For applications requiring a larger count range, more 7-segment displays, and 4026 ICs would be necessary. In applications requiring larger increments, the one-increment limit of the counter may be a constraint since the circuit must be changed accordingly. The counter also lacked non-volatile memory; therefore, it did not preserve the latest count value after power down and instead began from zero upon power-up. Additionally, the counter could only increment the count and did not have functionality for decrementing. A push button was used to increase the count in this project; however, physical buttons might cause "bouncing" as a result of mechanical and electrical noise, thereby producing more increments than intended. Sometimes, the count starts from 01 rather than 00 when the power is turned on [9]. This may happen as the count is not automatically reset when we turn off the power from the previous count. The counter needed to be manually reset. An automatic reset feature could be a useful addition in future iterations of the project [8].

V. CONCLUSION AND FUTURE ENDEAVORS

A. *Conclusion*

In conclusion, it can be said that this project successfully achieved its aim of designing and implementing a 2-digit 7-segment Display counter using a 555 Timer. The counter was able to count from 0 to 99 (when the increment button was pressed) and reset to 0 (when the reset button was pressed) using a 555 Timer and 4026 ICs. The simulation of the project using Proteus 8.16 software and the physical implementation on the breadboard both yielded consistent results, validating the design, setup and functionality of the counter.

The total cost of the project was Tk. 625.2, making it a cost-effective project for a digital counter. However, there were some limitations in the project, such as the inability to count down, restricted to two digits, the need for manual reset and many more. These limitations provide areas for improvement in future iterations of the project [8].

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B. *Future Endeavors*

For future endeavors, the project could be enhanced by adding features like countdown capability and automatic reset. These features would make the 2-digit 7-segment Display counter more versatile in a wider range of applications.

Moreover, the project could be expanded to include more digits in the counter by adding more 7-segment displays and corresponding 4026 ICs. This would allow the counter to count up to larger numbers, making it useful in more complex counting applications.

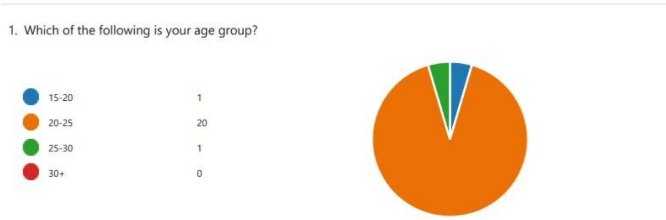
Lastly, the project could be integrated with other systems or devices to perform more complex tasks. For example, it could be used together with sensors or microcontrollers to count or measure quantities in real-time applications [8].

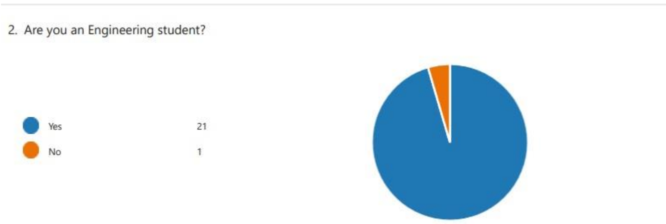
To sum it up, while the current version of the 2-digit 7-segment Display counter has successfully achieved its objectives, there are numerous possibilities for improvement and expansion in future iterations of the project.

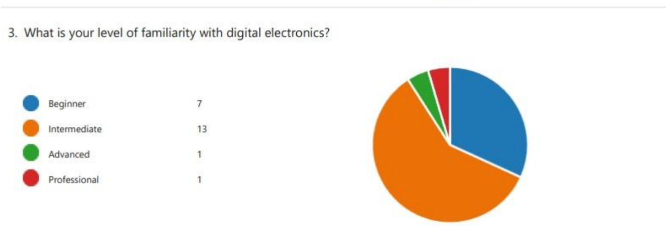
APPENDIX

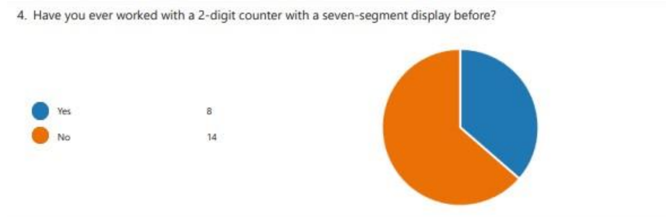

Survey on the Use and Development of a 2-Digit Counter with 7-Segment Display

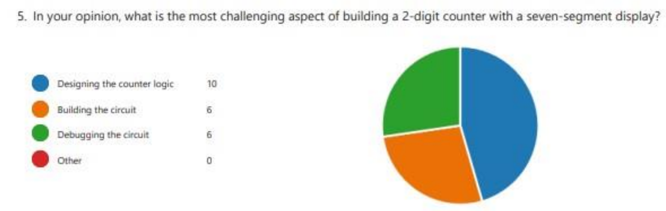
The aim of this survey is to collect insights regarding the use, development, and potential improvements of a 2-Digit Counter with a 7-Segment Display. Your feedback will assist us in understanding the obstacles encountered throughout the construction process, the real-world applications of this device, and prospective upgrades that can make it more helpful and user-friendly. The survey should take about 5 minutes to complete. We appreciate your time and feedback.

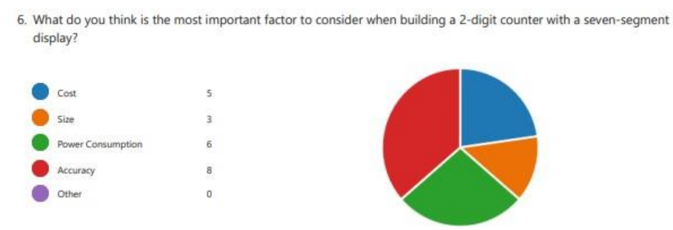


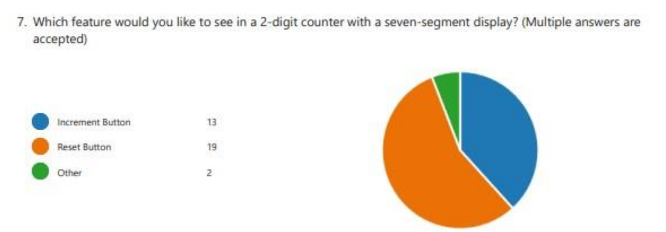


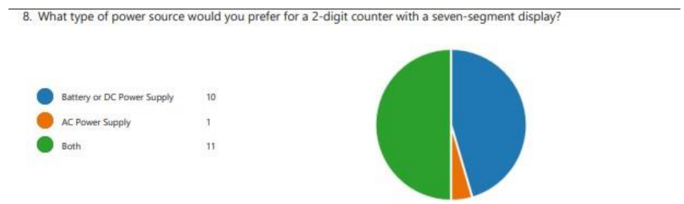


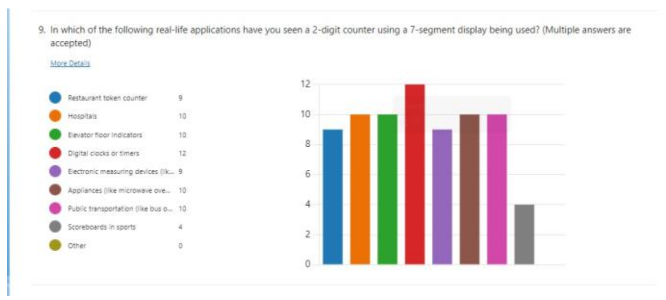


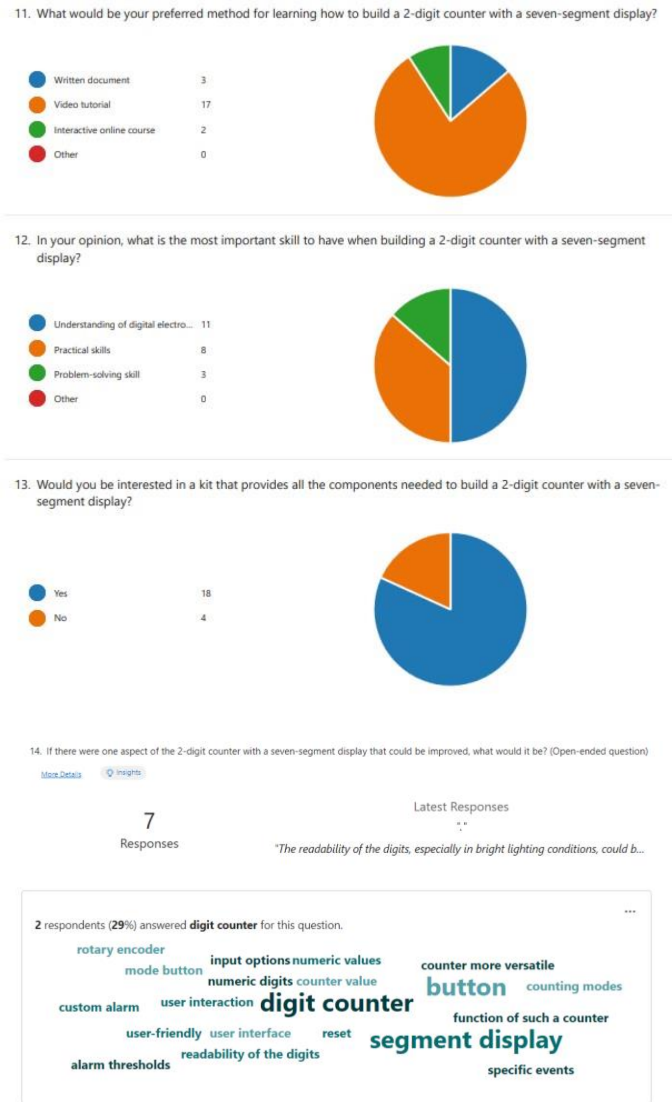












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