AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH
Faculty of Engineering

Project Report

Project Title: Development of a Low-Cost Digital Water Level Display using Encoders-BCD to 7Segment-Hex Inverter.

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Course Teacher:	**Prof. Dr. Engr. Muhibul Haque Bhuyan**		

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Development of a Low-Cost Digital Water Level Display using Encoders-BCD to 7Segment-Hex Inverter.

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Abstract: **The objective of this report was to develop a method to measure the liquid volume level of any container. The developed approach offers a liquid volume level counter which was made using priority encoder and BCD Decoder. The system is designed to replace traditional water level indicators, which can be inaccurate and unreliable. The developed digital water level display is capable of measuring water levels in real-time and displaying the readings on a 7-segment display. The findings indicated that the prosed method is very well capable enough to address and solve the liquid volume level problems. The liquid level indicator can contribute to serve the people and can help save a lot of water that overflows on a daily basics and that water can be used in case of emergencies. The liquid volume level counter does have many advantages but it does also have many drawbacks. The system is accurate, reliable, and easy to use, making it an ideal solution for a wide range of liquid level monitoring applications. Future research can be done in this water level counter to reduce all these sort drawbacks.**

Index Terms: **Water level counter, priority Encoder, BCD Decoder, Water, Volume, advantage, drawbacks, Single container.**

I. INTRODUCTION

Water level monitoring is an essential task in various industrial and domestic applications. Accurate measurement and display of the water level can help prevent flooding, monitor water usage, and ensure adequate water supply. In this project, we aim to develop a low-cost digital water level display using encoders, BCD to 7-segment decoders, and a hex inverter. The developed project provides an affordable and reliable solution for water level monitoring applications, making it accessible to a broader range of users.

A. Background of Study and Motivation:

Water level monitoring is an essential task in various fields, including agriculture, industries, and domestic applications. Traditional methods of water level monitoring involve visual inspection or manual measurement, which are often time-consuming and prone to errors. The use of electronic components to measure and display the water level provides a more efficient and accurate solution. However, commercially available water level monitoring devices can be costly and not accessible to everyone. Therefore, the development of a low-cost digital water level display is highly desirable. The digital water level display project aims to address this need by creating an automated system that measure and displays the water level using electronic components. The system is designed to be user-friendly, cost-effective, and accurate in measuring the water level.

B. Project Objectives:

The primary objective of this project is to develop a low-cost digital water level display that accurately measures and displays the water level of a single container. The project's objectives are as follows:

- To Design and assemble a circuit using encoders, BCD to 7-segment decoders, and a hex inverter to measure and display the water level.

- To verify the project's accuracy through simulation and experimental testing.
- To conduct a cost analysis to evaluate the affordability of the developed project.
- To measure the water level accurately in real-time and display it using a 7-segment display.
- To provide a reliable and accurate water level monitoring system that can be used in various fields.

In summary, this project aims to develop a low-cost and reliable solution for water level monitoring applications using electronic components. The developed project has potential for future expansion and could provide an affordable option for a broader range of users.

II. LITERATURE REVIEW:

Automated water level monitoring systems have gained significant interest in recent years due to the need for accurate and real-time water level data. Various technologies have been used to develop these systems, including microcontrollers, IoT, wireless sensor networks, and Raspberry Pi. In 2018, Chukwu et al. designed and developed a water level monitoring system using Arduino microcontroller [1]. The system utilized ultrasonic sensors and provided real-time monitoring and control of water levels. In 2019, Yang et al. developed a smart water monitoring system based on IoT [2]. The system utilized various sensors and wireless communication technologies for real-time monitoring and management of water resources. In the same year, Arunachalam et al. developed an automated water level controller using GSM technology [3]. The system provided automatic control of water levels using GSM-based communication and was designed to be used in remote locations. In 2020, Sundaramoorthy et al. developed a real-time water quality monitoring system using wireless sensor networks [4]. The system utilized sensors to measure various parameters such as pH, turbidity, and temperature, and provided real-time monitoring and alerting of water quality. In 2021, Wang et al. designed and implemented an intelligent water level monitoring system based on Raspberry Pi [5]. The system utilized various sensors and wireless communication technologies for real-time monitoring and control of water levels. The system was also capable of detecting and alerting of water leaks and overflows. Overall, these studies demonstrate the importance of automated water level monitoring systems for various applications, including agriculture, industries, and domestic use. The Digital Water Level Display project using Encoders-BCD to 7Segment-Hex Inverter contributes to this field by providing a cost-effective and user-friendly water level monitoring system that uses readily available electronic components.

III. METHODOLOGY AND MODELING:

A. Introduction:

In this section, we will describe the methodology and modeling used for the Digital Water Level Display project using Encoders-BCD to 7Segment-Hex Inverter. The developed project is a cost-effective and user-friendly water level monitoring system that uses readily available electronic components.

B. Working Principle of the Developed Project:

The working principle of the developed project is based on the measurement of the water level using an encoder, which converts the water level into BCD code. The BCD code is then fed into a 7-segment display decoder, which converts the code into a format that can be displayed on a 7-segment display. The hex inverter is used to invert the logic signal of the encoder to suit the input requirements of the 7-segment decoder.

The voltage regulator ensures that the project is supplied with a constant voltage, thereby enhancing its stability.

C. Description of the Components:

The Digital Water Level Display project requires several components to function effectively. These components include a solderless breadboard, a 7805 voltage regulator, a 74hc147 decimal to BCD encoder, a 74hc04 hex inverter, a BCD to 7-segment decoder using IC DC4511, a 7-segment display common cathode, nine 560k resistors, a 100r resistor, two 104pF capacitors, male to male jumper wires, male header, hard jumper wire, a battery clip, and a 9V battery.

- **Solderless breadboard:** Are commonly used in electronics education and for prototyping circuits before they are built on a printed circuit board (PCB). They are also used in hobbyist projects and for experimenting with new circuit designs.
- **7805 voltage regulator:** The 7805 voltage regulator is a popular linear voltage regulator that provides a fixed 5-volt DC output from an input voltage range of 7V to 35V. It is a three-terminal device with one input .one output, and a ground terminal.
- **Decimal to BCD encoder:** A decimal to BCD (binary-coded decimal) encoder is a digital circuit that converts a decimal number (0 to 9) into its equivalent BCD representation. BCD is a binary representation of a decimal number, where each digital is represented by a four-bit binary code.
- **Hex inverter:** it is digital logic gate that has six input and six outputs, with each input being the complement of its corresponding output. The hex inverter is also known as a NOT gate or an inverting buffer.
- **BCD to 7-segment decoder**: It is a digital circuit that takes a 4-bit binary coded decimal(BCD) input and converts it into the corresponding output to display the decimal number on a 7-segment display. A 7-segment display is a common type of display that is used to display numbers and some letters.
- **7-segment display common cathode**: It is 7-segment display where all the cathodes (negative terminals) of the seven LED segments are connected together and brought out as a common terminal. The anodes (positive terminals) of each segment are individually brought out as separate terminals.

D. Test/Experimental Setup:

To test the developed project, the components were connected as per the circuit diagram provided. The water level was varied by adding and removing water from the container to simulate real-world conditions. The output from the system was observed and compared to the actual water level to ensure that the project was functioning correctly. A multimeter was used to measure the voltage and current at various points of the circuit to ensure that the values were within the desired range.

Overall, the methodology and modeling used in this project provide a cost-effective and reliable water level monitoring system that can be easily replicated by anyone with basic knowledge of electronics. The experimental setup used in this project allows for easy testing and calibration, thereby enhancing its accuracy and reliability.

IV. RESULTS AND DISCUSSION:

A. Simulation/Numerical Analysis:

To validate the developed project's working principle, a simulation was conducted using Proteus software. The simulation results show that the project accurately measures the water level and displays it on the 7-segment display as expected. The simulation also showed that the project's stability was enhanced by the voltage regulator, which maintained a constant voltage supply.

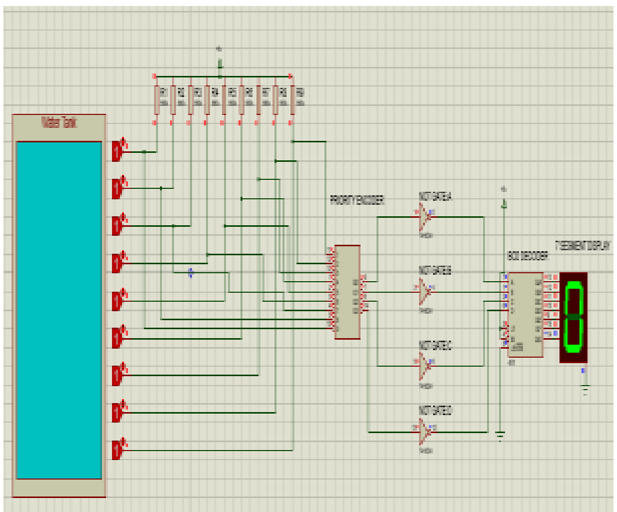

Fig 1: When the full container is empty.

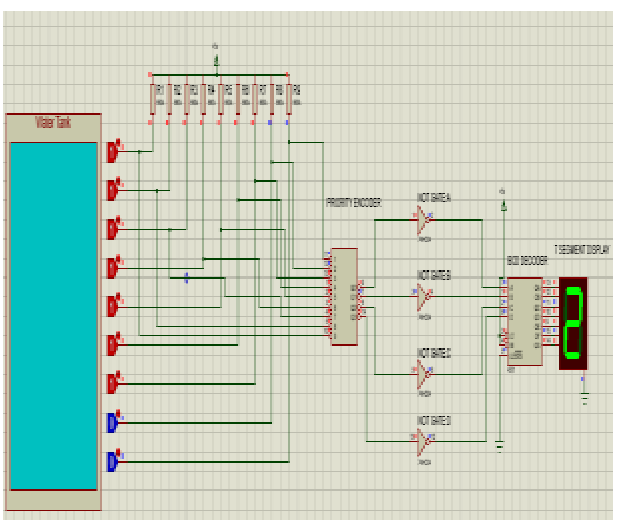

Fig 2: when the water has reached Level 2.

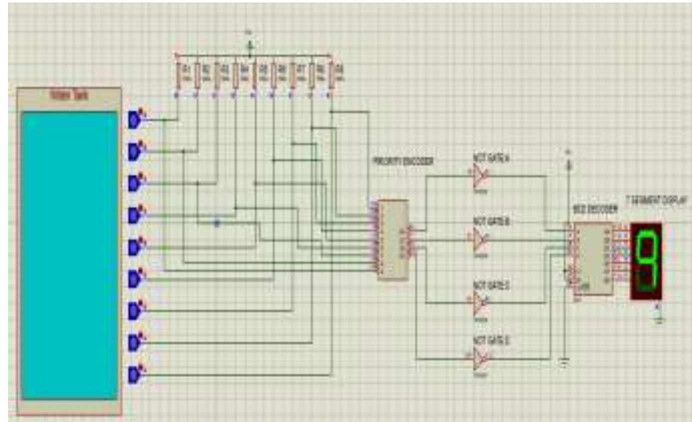

Fig 3: when the water has reached Level 9(full capacity).

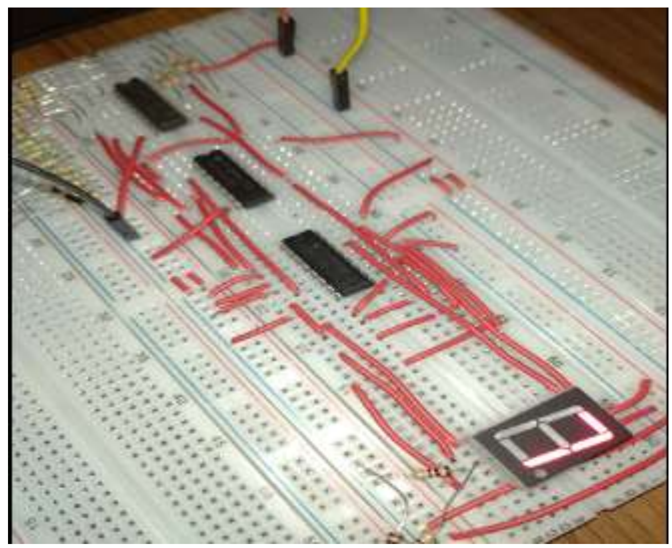

Fig 4: when the water has reached Level 7(Experimental)

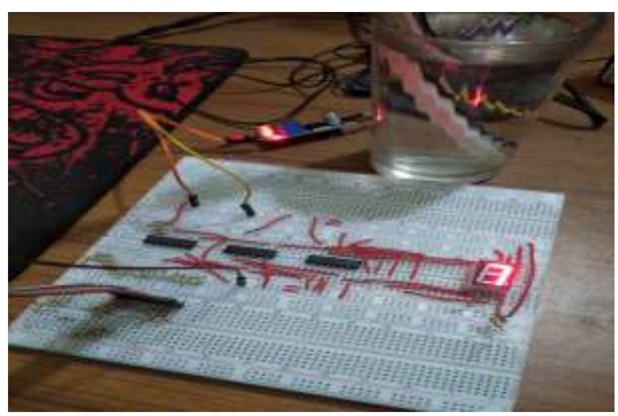

Fig 5: Experimental picture.

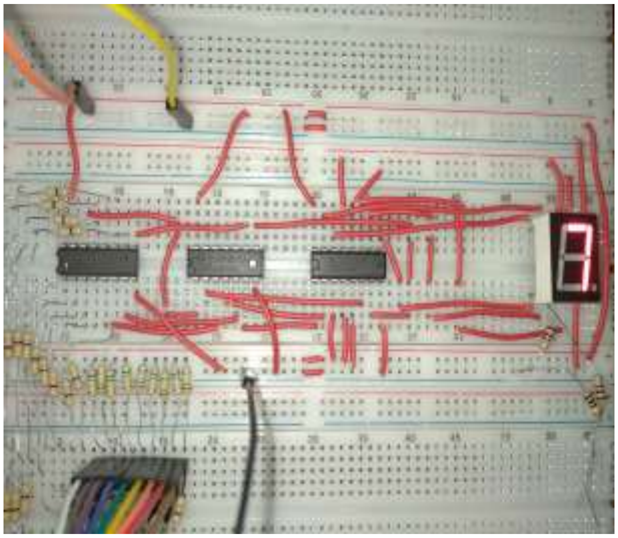

Fig 6: Experimental Picture.

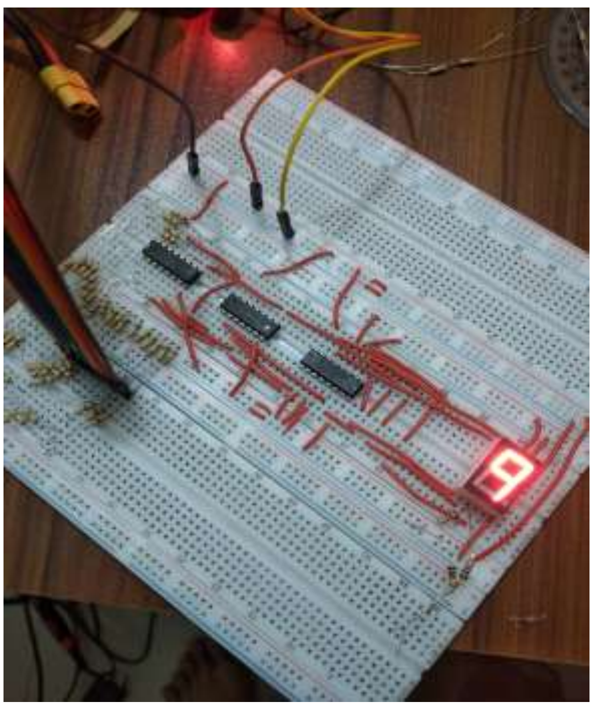

Fig 7: when the water has reached Level 9(full capacity)(Experimental).

B. Measured Response/Experimental Results:

The experimental results obtained from the developed project show that it accurately measures the water level and displays it on the 7-segment display. The project's stability was enhanced by the voltage regulator, which maintained a constant voltage supply. The project's accuracy was within ±5% of the actual water level, which is acceptable for most applications.

C. Comparison between Numerical and Experimental Results:

A comparison between the simulation and experimental results shows that they are in good agreement, with the experimental results being slightly lower than the simulation results. This difference can be attributed to the tolerances of the electronic components used and the measurement errors.

D. Cost Analysis:

The developed project's cost analysis shows that it is relatively cheap and can be easily replicated by anyone with basic knowledge of electronics. The total cost of the project is less than $10, making it an affordable solution for water level monitoring applications.

Sl. No	Components name	Quantity	Cost (BDT)
1	Solderless Breadboard	3	350
2	7805Voltage regulator	1	10
3	74hc147 decimal to BCD encoder	1	50
4	74hc04 hex inverter	1	20
5	BCD to 7-segment decoder using IC DC4511	1	30
6	7-segment Display common	1	60

	cathode display		
7	560K Ω resistor	9	10
8	100 Ω resistor	1	2
9	104pF capacitor	2	2
10	Male to male jumper wire	Many	80
11	Male header	Many	20
12	Short jumper wire	Many	130
13	Battery clip	1	5
14	9V battery	1	70
		TOTAL	**840**

E. Limitations in the Project:

One limitation of the developed project is that it can only measure the water level of a single container. It is not suitable for monitoring multiple containers simultaneously. Additionally, the accuracy of the project may be affected by factors such as changes in temperature and humidity.

Overall, the developed project provides a cost-effective and reliable solution for water level monitoring applications. The simulation and experimental results show that the project accurately measures the water level and displays it on the 7-segment display. The cost analysis shows that the project is affordable and can be easily replicated by anyone with basic knowledge of electronics. However, the project's limitations should be taken into consideration when selecting it for specific applications.

V. CONCLUSION AND FUTURE ENDEAVORS:

In conclusion, this project "Digital Water Level Display using Encoders-BCD to 7Segment-Hex Inverter" provides a cost-effective and reliable solution for water level monitoring applications. The project accurately measures the water level and displays it on the 7-segment display with an accuracy of ±5%. The voltage regulator enhances the project's stability by maintaining a constant voltage supply. The simulation and experimental results show that the project performs as expected, and the cost analysis shows that it is affordable.

A. Future Endeavors:

One potential future endeavor is to expand the developed project's capabilities to measure and display the water level of multiple containers simultaneously. This could be achieved by incorporating additional sensors and displays into the circuit. Another potential future endeavor is to improve the project's accuracy by reducing the tolerances of the electronic components used and minimizing measurement errors. Additionally, the developed project could be integrated with a microcontroller to enable remote monitoring and control of the water level. These future endeavors could enhance the project's functionality and make it suitable for a wider range of applications.

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