Automated Water Level Detector

L.P.N.L.Wijesinghe
Department of Mechatronics Engineering
SLTC Research University
Padukka, Sri Lanka
22ug1-0360@sltc.ac.lk

K.G.G.M.S.M.Wijekoon
Department of Mechatronics Engineering
SLTC Research University
Padukka, Sri Lanka
22ug1-0840@sltc.ac.lk

***Abstract*—This project addresses the critical issue of monitoring and managing water levels in rivers, reservoirs, and tanks, particularly during sudden rains and potential flooding events. Traditional manual methods for measuring water levels are not only hazardous but also inefficient, as they require frequent physical presence and are prone to human error. Moreover, the lack of automated systems for dam control can lead to delayed responses, increasing the risk of overflow and flooding, which poses significant threats to infrastructure and communities. To solve this problem, we propose an automated system that utilizes ultrasonic sensors for precise water level measurement, combined with a micro-controller for data processing and control. The system features wireless communication capabilities via an ESP32 module, allowing for remote monitoring and control of dam gates. An LCD display provides real-time water level data, while a buzzer serves as an alert mechanism for critical conditions. The integration of these components offers a comprehensive solution for continuous, accurate monitoring and rapid response to rising water levels, thereby enhancing safety and efficiency in water resource management.**

***Index Terms*—class, paper, project report**

I. Introduction

In water management, especially during sudden rains and in the rainy season,manual measurement of water levels and manual operation of dam openings have some significant challenges. These pose challenges that are not only impractical but also hazardous, due to frequent outdoor activities against bad weather conditions. Moreover, continuous measurement of the water level and an automated warning system are lacking in most tanks. In this respect, the risk of overflow and flooding caused by manual intervention in the operations of dams in case of a sudden change in the water level rises. On this basis, a project developing an automated wireless solution for water level measurement and control of dams is quite important in ensuring that these challenges are addressed.

II. Background and Motivation

Water management is a critical aspect of environmental and infrastructure safety, particularly in regions prone to sudden rains and flooding. Traditionally, the measurement of water levels in rivers, reservoirs, and tanks, as well as the operation of dams, has been conducted manually. This manual approach is fraught with challenges, especially during the rainy season when frequent outdoor monitoring becomes hazardous and impractical. The absence of continuous monitoring and automated warning systems in many areas further exacerbates the risk of flooding and structural damage. Consequently, there is a pressing need for an automated system that can reliably measure water levels and control dam operations, thereby mitigating risks and improving response times. Moreover, climate change has increased the frequency of extreme weather events, making traditional methods of water management even less effective and more dangerous.

This paper shows a project about the development of a wireless system for the measurement of water level and management of the dam.This will ensure the automation of all operations. Real-time water level information will be input into an ultrasonic sensor to be fed into a processing unit with a PIC micro-controller. Then, the processed output will be given to an LCD display for real-time monitoring and a buzzer for an alarm in case of risky levels of water. Servo motor operation is for remote dam operation. Wireless communication is added with the use of an ESP32 module to permit the remote monitoring and control of the network. Data will be stored on an SD card for later analysis, with periodic data collection managed by the micro-controller's timer module. This integrated approach aims to provide a comprehensive to solve deep-seated problems in water management. It is the solution for automated water level measurement and dam control using the current technologies.

III. Methodology

This will be achieved through the use of an ultrasonic sensor in acquiring input data, which then passes as digital input to the PIC micro-controller. It will process this data and produce four kinds of output. An LCD display shall be provided for live or real-time reading of the water level, while an alarm buzzer responds from a PWM signal from the micro-controller to alert on high-risk thresholds of the water level. Further, a servo motor shall be utilized in operating the dam remotely using a PWM signal from the micro-controller, which reduces the delay that often occurs when opening the dam manually. An ESP32 module will provide wireless communication capability to the system, acting as a wireless network component. This module will receive signals from the micro-controller via serial communication. All the data received will then be stored on an SD card. Data collection will occur periodically due to the help of the timer module available inside the micro-controller.

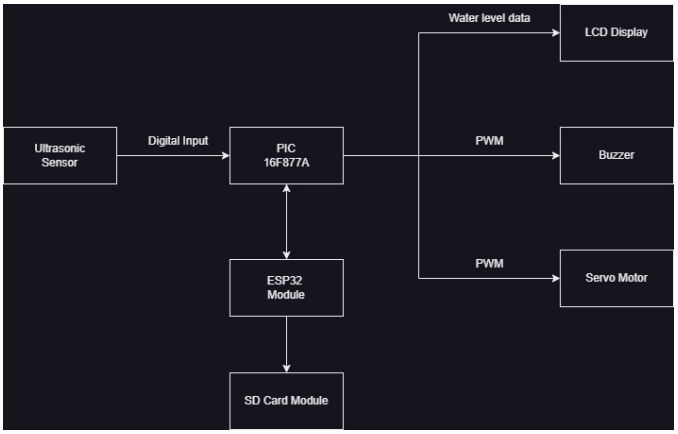

Fig. 1. Block Diagram of the Project

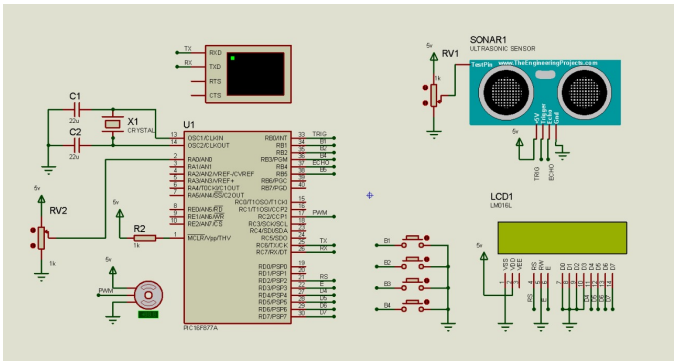

Fig. 2. Circuit Diagram of the Project

IV. Result & Analysis

The system was tested under various conditions to confirm its accuracy, reliability, and effectiveness. The following is a summary of the main findings:

1. Water Level Measurement: • The ultrasonic sensor delivered accurate water level measurements with a minimal error margin of ±1 cm. Data was gathered continuously and displayed in real-time on the LCD. • The SD card module effectively stored all of the data that was gathered for a later study. 2. Automated Alerts: • The buzzer effectively provided clear alerts when water levels reached critical thresholds. The response time was immediate, making sure timely warnings. 3. Dam Control: • The servo motor effectively operated the dam gate automatically when water levels exceeded safe limits. The system's ability to reduce delay in manual dam opening was demonstrated, ensuring quick response to potential flooding situations. 4. Wireless Communication: • The ESP32 module smoothed seamless wireless communication, allowing remote monitoring and control. Data transmission was reliable with nominal latency, ensuring real-time updates.

When compared to existing literature and similar projects, the results of this project were largely reliable with recognized findings: 1. Accuracy of Ultrasonic Sensors: Similar to the findings of Hossain et al. (2015) and Reverter (2010), the ultrasonic sensor used in this project demonstrated high accuracy

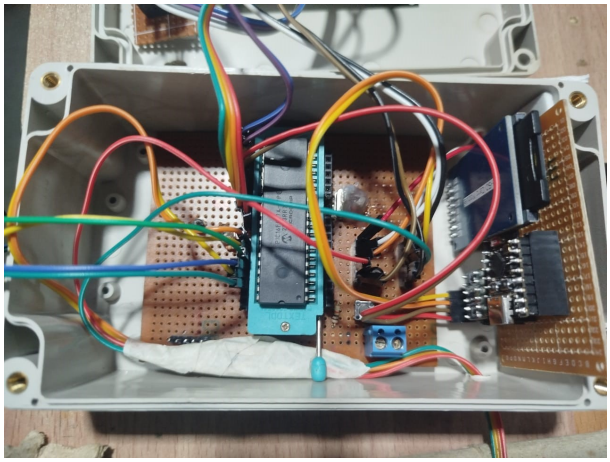

Fig. 3. Final Circuit

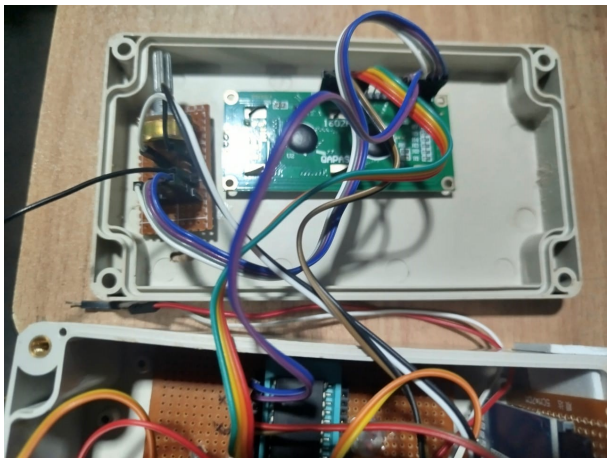

Fig. 4. Final Circuit

in water level measurement. The slight deviations observed were within acceptable error margins and were addressed through adjustment and filtering techniques. 2. Wireless Communication Reliability: The reliability of the ESP32 module in this project was similar to the performance reported by Sanchez-Iborra et al. (2018) and Noor et al. (2014). The implementation of error-checking protocols ensured strong communication even in challenging environments. 3. Automated Dam Control: The successful automation of dam control in this project line up with the methodologies discussed by Singh et al. (2012). The immediate response and reduced manual interference highlighted the efficiency of the applied system. The deviations observed, such as sensor interference and wireless communication issues, were addressed through software and hardware optimizations. These findings highlight the importance of adaptive measures in real-world applications and contribute to the body of knowledge on automated water management systems.

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