SMART WATER MANAGEMENT SYSTEM

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Abstract

The "Smart Water Management Project" aims to develop a comprehensive system for monitoring and managing water resources efficiently. Water scarcity and quality are critical issues globally, necessitating innovative solutions to conserve and optimize water usage. This project integrates various sensors and microcontrollers to create a smart water management system.

The system comprises three main components: flow sensors, and a microcontroller unit. Flow sensors are employed to measure water flow rates in different pipes or channels, providing real-time data on water consumption. A water level sensor is utilized to monitor water levels in reservoirs or tanks, enabling proactive management of water storage.

I. INTRODUCTION

Water is a fundamental resource for life, essential for human survival, agriculture, industry, and ecosystems. However, increasing population growth, urbanization, and climate change are exerting unprecedented pressure on water resources, leading to challenges such as water scarcity, pollution, and inefficient usage. Addressing these challenges requires innovative approaches to monitor, manage, and conserve water effectively. The "Water Management Project" endeavors to tackle these challenges by developing a smart and efficient system for monitoring and managing water resources. This project aims to harness the power of modern technologies, including Internet of Things (IoT), microcontrollers, and sensor networks, to create a comprehensive solution for water management.

The motivation behind this project stems from the urgent need to enhance water sustainability and resilience in the face of growing water-related challenges. By leveraging advanced sensors, data analytics, and automation, the Water Management Project seeks to empower individuals, communities, and organizations to optimize water usage, prevent wastage, and ensure the availability of clean water for current and future generations.

In this project, we will explore the design, development, and implementation of a smart water management system that integrates various sensors to monitor water flow rates, detect leaks, measure water levels, and analyze water quality parameters. The system will utilize microcontrollers, such as the Raspberry Pi Pico, to collect, process, and transmit data in real-time. Through this project, we aim to demonstrate the potential of technology-driven solutions in addressing water challenges and promoting sustainable water management practices. By providing actionable insights, remote monitoring capabilities, and automated control mechanisms, the Water Management Project seeks toempower stakeholders to make informed decisions and take proactive measures to conserve water resources. In the following sections, we will delve into the details of the project, including its objectives, methodology, system architecture, and potential applications. Additionally, we willdiscuss the significance of the project in the context of water sustainability and its implications for environmental conservation and socio-economic development.

II. LITERATURE SURVEY

[1] Michel R. Machado, Tiago Ribas Júnior, Michele R. Silva, João B. Martins; “Smart Water Management System using Microcontroller ZR16S08 as IoT Solution”, 2010 IEEE 10th Latin American Symposium on Circuits & Systems (LASCAS)

In this paper Smart Water Management system using Microcontroller ZR16S08 as IoT Solution presents that system operates through the smart monitoring of the water flow in pipes of the water distribution network, aiming to ensure the quality of the water supply, knowing that water losses characterize one of the great problems in the world, as pipe holes may be open doors to water contaminants.

[2] Kaushik Gupta, Mandar Kulkarni, Manas Magdum, Yash Baldawa, Prof. Shivprasad Patil; “Smart Water Management in Housing Societies using IoT”; 2nd International Conference on Inventive Communication and Computational Technologies, April 2011

In the Water Management system, IoT, automation is one of the essential attributes. This increases comfort and convenience in the lives of people. We would like to provide this in the domain of water management. Our motive is to help the readers understand the importance of using water judiciously and equipping them with the knowledge of the functioning of water management system which is done by using Internet of Things (IoT).

[3] Chanda Rajurkar ,S R S Prabaharan, S. Muthulakshmi, “IoT based water management”, IEEE 2017 International Conference on Nextgen Electronic Technologies: Silicon to Software (ICNETS2), 16 October2012

OPC UA (Object Linking and Embedding for Process Control Unified Architecture) is a platform independent service-oriented architecture for the control of processes in the logistics and manufacturing sectors. Based on this standard we propose a smart water management model combining Internet of Things technologies with business processes coordination and decision support systems. They provide an architecture for sub-system interaction and a detailed description of the physical scenario in which we will test our implementation, allowing specific vendor equipment to be manageable and interoperable in the specific context of water management processes.

[4] Thinagaran Perumal, Md Nasir Sulaiman, LeongC.Y; "Internet of Things (IoT) Enabled Water Monitoring System", 2015 IEEE 4th Global Conference on Consumer Electronics (GCCE), 04 February 2014

Water is always a crucial part of everyday life. Due to global environmental situation, water management and conservation is vital for human survival. In recent times, there were huge needs of consumer based humanitarian projects that could be rapidly developed using Internet of Things (IoT) technology. In this paper, we propose an IoT based water monitoring system that measures water level in real-time. Our prototype is based on the idea that the level of the water can be very important parameter when it comes to the flood occurrences especially in disaster prone areas. A water level sensor is used to detect the desired parameter, and if the water level reaches the parameter, the signal will be fed in Realtime to social networks like Twitter. A cloud server was configured as data repository. The measurement of the water levels is displayed in remote dashboard.

[5] Muhannad Al-Jabi Haya Sammaneh IoT-Enabled Adaptive Smart Water Distribution Management System 2014 International Conference on Promising Electronic Technologies (ICPET)

In this paper, aim of IoT-Enabled Adaptive Smart Water Distribution Management System is to facilitate water distribution management as well as analyze the demand and consumption behavior for the citizens. Advantages of this system, the nature of hierarchical design facilitates the detection of faulty components as it exploits the idea of decomposition of the system into subsystems. It based on a dynamic knowledge- based system that is used to analyze the demand and the consumption as well as to detect any leakage occurrence. But downside of this system, it will be costly a need a multidisciplinary team with different specialties. Therefore, this work will mainly focus on design as a first step to be presented to a support fund organization. Suggest that Using AI algorithms that can control the water distribution based on the parameters collected from our system. This increases the opportunity to make our system scalable and applicable to the enterprise level and increase the level of maintainability

III. PROPOSED WORK

A. *Block Diagram*

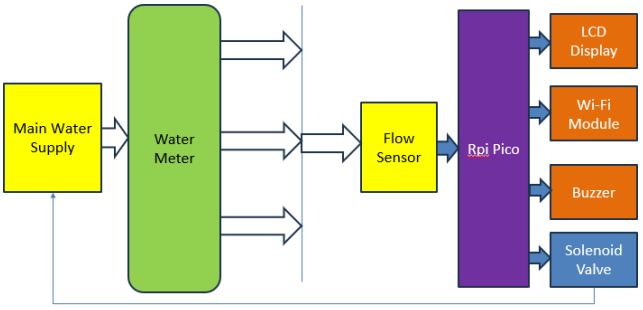

Fig 1. Block Diagram of Proposed System

- The suggested system is depicted in Figure. An Arduino UNO, an ultrasonic sensor, and a motor shield are used to build the human-following robot. This Arduino UNO interfaces with a motor shield and an ultrasonic Public water supply monitoring to avoid tampering and water man fraud is used in many ways.
- In this system, micro controller and LCD are arranged to display the quantity of water present in pipelines.
- As logic level converters and water pipelines are connected by RS 232 serial communication to detect the presence of water flow in one or more pipelines by usingLED's.
- Water should be released as per the instructions by officials' i.e. for example alternate days of supply are provided and only during specific period of time but notdaily.
- All the details will be shown in the web server using IOT module connected to controller. So that authorities can take necessary action in case of misuse.

B. *Hardware Specifications*

1) Raspberry pi pico: The Raspberry Pi Pico is a low-cost, high- performance microcontroller board with flexible digital interfaces. It feature the RP2040 which marks Raspberry Pi's first microcontroller designed in-house. Pico provides minimal external circuitry to support the RP2040 chip (Flash,crystal, power supplies and decoupling and USB(connector). The majority of the RP2040 microcontroller pins are broughtto the user IO pins on the left and right edge of the board. Four RP2040 IO are used for internal functions - driving an LED, on-board Switched Mode Power Supply (SMPS) power control and sensing the system voltages. Pico uses an on- board buck-boost SMPS which is able to generate the required 3.3 volts (to power RP2040 and external circuitry) from a wide range of input voltages (~1.8 to 5.5V). This allows significant flexibility in powering the unit from various sources such as a single Lithium-Ion cell, or 3 AA cells in series. Battery chargers can also be very easily integrated with the Pico power chain. Reprogramming the Pico's flash memory can be done using USB (simply drag and drop a file onto the Pico which appears as a mass storage device) or via the Serial Wire.

Debug (SWD) port. The SWD port can also be used to interactively debug code running on the RP2040.

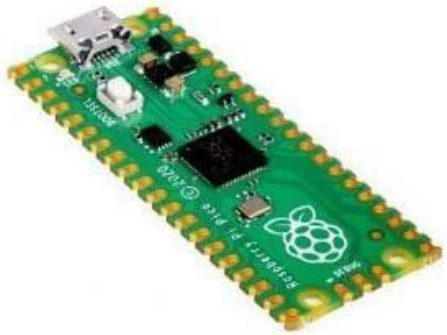

Fig 2 Raspberry pi pico

2)Node MCU: The NodeMCU with cp2102 WiFi Board

all-in-one microcontroller + WiFi platform that is very easy to use to create projects with WiFi and IoT (Internet of Things) applications. The board is based on the highly popular ESP8266 WiFi Module chip with the ESP-12 SMD footprint. This WiFi development board already embeds in its board all the necessary components for the ESP8266 (ESP-12E) to program and upload code. It has a built-in USB to serial chip upload codes, 3.3V regulator and logic level converter circuit so you can immediately upload codes and connect your circuits. This board contains the ESP-12E chip with a 4MB! flash memory so no worries for your long project codes. The ESP8266 NodeMCU with cp2102development board - a true plug-and- play solution for inexpensive projects using WiFi. The module arrives pre- flashed with NodeMCU firmware so just install your USB driver. The NodeMCU is an open-source project and you can find all the design files and so on from their GitHub page. This microcontroller board can easily be programmed using the Arduino IDE programming software.

Fig 3 Node MCU

3)Flow Sensor: This is YF-S201 Water Flow Measurement Sensor with 1-30Liter/min Flow Rate – Black. This sensor sits in line with your water line and contains a pinwheel sensor to measure how much liquid has moved through it. There's an integrated magnetic hall effect sensor that outputsan electrical pulse with every revolution. The hall effect sensor is sealed from the water pipe and allows the sensor to stay safe and dry.

Fig 4 Flow Sensor

4)Water Level Sensor: The Water Level Depth Detection Sensor for Arduino has Operating voltage DC3-5V and Operating current less than 20mA. The Sensor is the Analog type which produces analog output signals according to the water pressure with its Detection Area of 40x16mm.The Water Level Sensor is an easy-to-use and cost-effective with high level/drop recognition sensor by having a series of parallel wires exposed traces measure droplets/water volume in order to determine the water level.Easy to complete water to analog signal conversion and output analog values can be directly read Arduino development board to achieve the levelalarm effect.

Fig 5 Water Level Sensor

A. Circuit Diagram

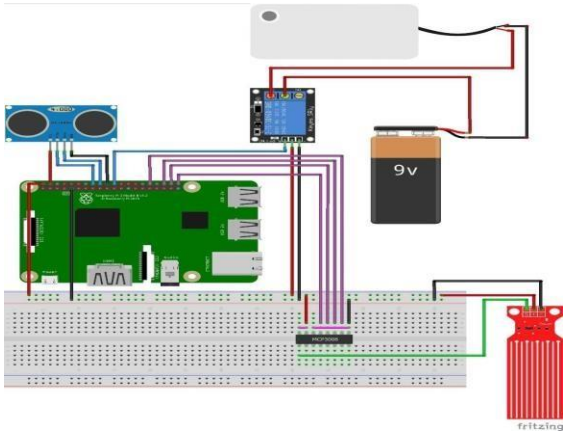

Fig 6 Circuit Diagram

IV. RESULT

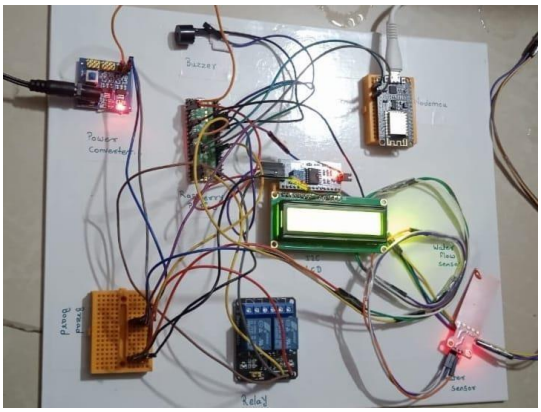

Fig 7 Output

The above fig. Shows the output on the LCD. The water level in the main tank is low then it shown on the LCD Display & also when the water level is high it is been shown on the LCD display this is done with the help of water level sensor. Bread Board is use for connection of all components. Power Converter is use for external voltage needed for all components. Relay is use for the time to time water supply form the all pipe lines. Nodemcu is use for upload the code form the thingspeack website.

Thingspeak Results:

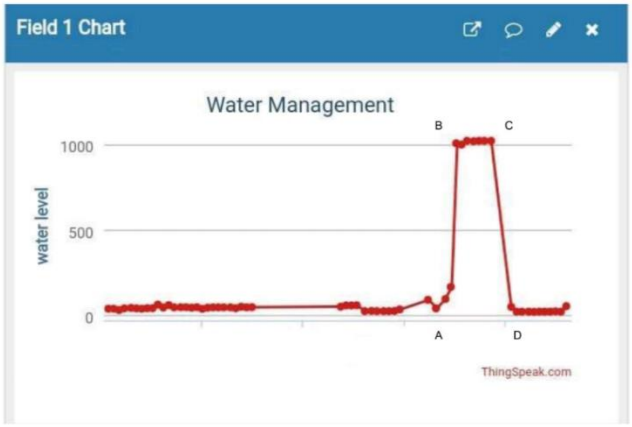

Fig 8 .Field chart 1

In field 1 chart it shows water level in tank. At point 'A' shows water is reserved condition in tank i.e. 0 liter. After that water level increases by 1000 liter in the tank till point 'B'. At point 'B' to 'C' it is stable. From point 'C' water level goes down for distribution i.e point 'D'.

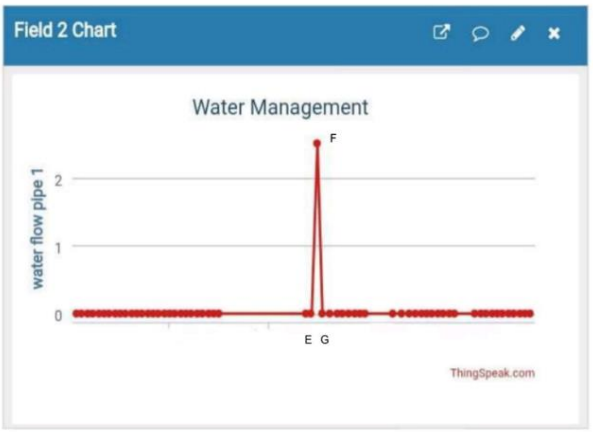

Fig 9 .Field chart 2

In field 2 chart it shows water flow in pipe 1. Till point 'E' it is stable. From point 'E' it is increased above 2 pa. From point 'F' pressure of water goes down to point 'G'.And from point 'G' it is stable condition.

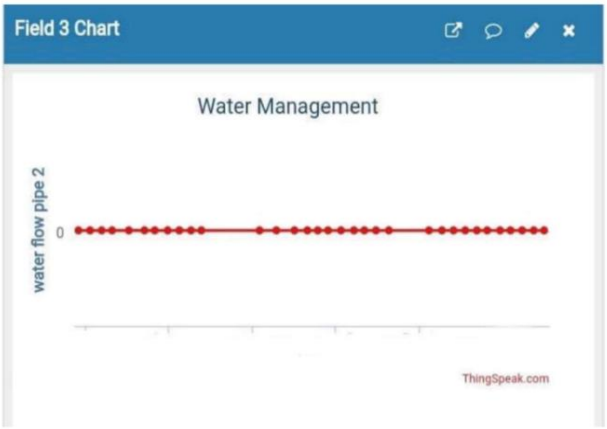

Fig 10 .Field chart 3

In field 3 chart it shows no water flow in pipeline 2. So,

it is straight line means no water flow in the pipeline 2.

Fig 11 .Field chart 4

In field 4 chart it shows difference between 2 pipelines of water flow. At point 'I' it is 2 pa shows difference of field chart 1 and field chart 2 shown in this field.

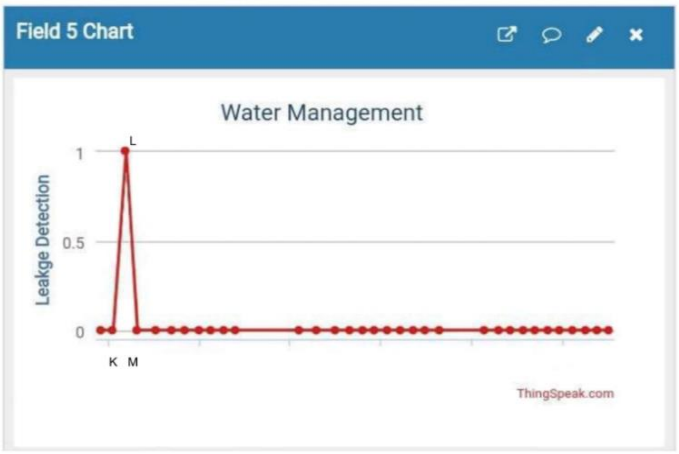

Fig 12 .Field chart 5

In field 5 chart it shows leakage is there in the pipelines. At point 'L' it is 1 pa it means leakage is present in the pipeline. Hence, pressure of water in pipelines is 1 pa or below 1 pa it means leakage is present in the water pipeline.

C. Advantages

1) Real Time Monitoring
2) Low-cost Solution
3) Wireless solution
4) No human efforts

D. Applications

a. The circuit can be implemented for effective usage of water.

b. It can be used in Municipal Corporation (or) water board to avoid water misuse.

V. CONCLUSION

In conclusion, the Smart Water Management Project represents a significant step towards addressing the complex challenges associated with water management and conservation. By leveraging advanced technologies such as sensors, microcontrollers, and data analysis algorithms, the project offers innovative solutions for monitoring, managing, and optimizing water resources in diverse settings. Through real-time monitoring of water flow rates, levels, and quality, the system enables early detection of anomalies such as leaks, low water levels, or contamination. This proactive approach not only minimizes water loss and infrastructure damage butalso promotes efficient usage and sustainability. The project's remote monitoring and control capabilities provide stakeholders with unprecedented access to water-related data and system status, empowering them to make informed decisions, implement timely interventions, and optimize water management strategies. Additionally, the user-friendlyinterface facilitates user interaction and engagement, enhancing the system's usability and accessibility.

REFERENCES

[1] Michel R. Machado, Tiago Ribas Júnior, Michele R. Silva, João B. Martins; "Smart Water Management System using Microcontroller ZR16S08 as IoT Solution", 2010 IEEE 10th Latin American Symposium on Circuits & Systems (LASCAS)

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