SMART WATER MANAGEMENT

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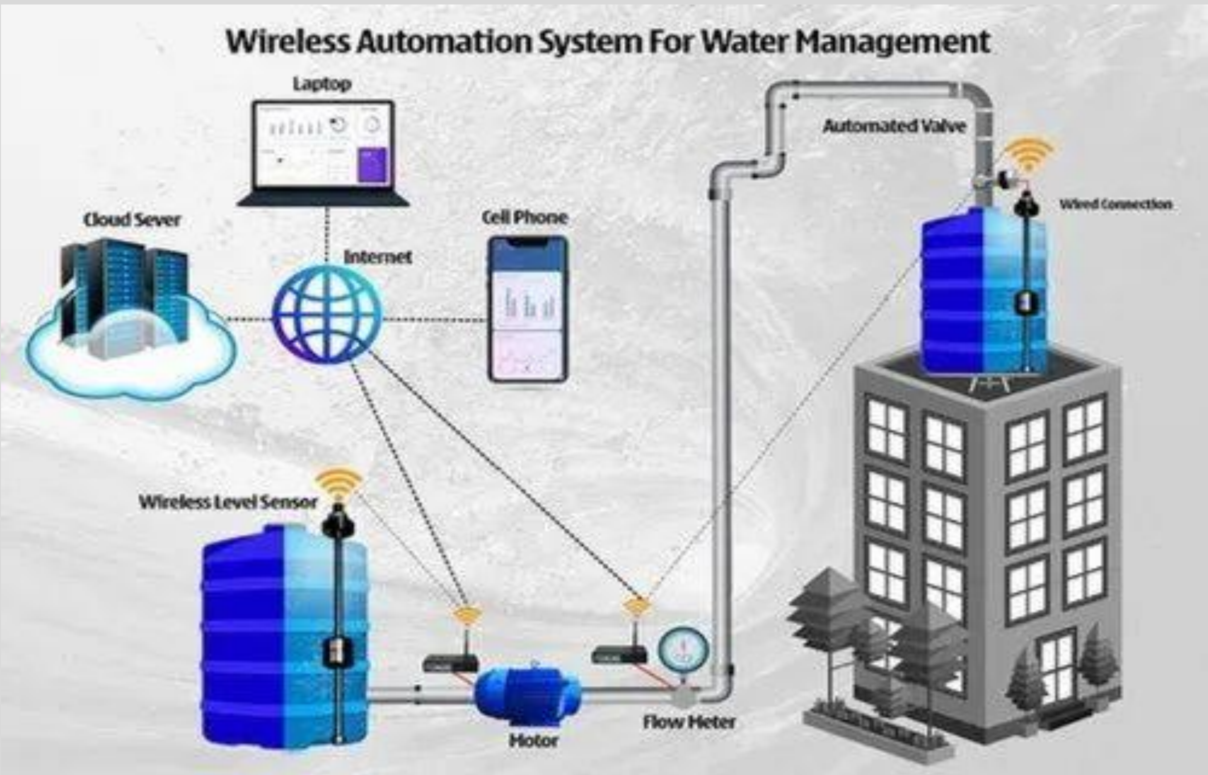

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1 | Introduction

1.1 | Overview

Smart water management is a revolutionary approach to efficiently and sustainably utilize our planet's most precious resource, water. In an era of growing water scarcity and environmental concerns, this innovative system harnesses the power of technology to optimize the distribution, consumption, and monitoring of water resources. By integrating sensors, data analytics, and automation, smart water management enables us to not only detect leaks and conserve water but also predict and respond to changes in demand and quality in real-time. This proactive approach empowers communities and industries to make informed decisions, reduce waste, and ensure that water remains accessible and clean for generations to come. As we face the challenges of an increasingly water-stressed world, smart water management emerges as a critical tool in preserving and safeguarding this invaluable resource.

1.2 | Purpose

The purpose of smart water management is to address the pressing challenges associated with water resource utilization in an era of growing population, climate change, and increasing water scarcity. This innovative approach aims to optimize the management of water resources through the integration of advanced technologies and data-driven solutions. By monitoring and analyzing data from various sources, including sensors, weather forecasts, and consumption patterns, smart water management systems can enhance efficiency, reduce waste, and improve the overall sustainability of water usage. This approach also empowers water utilities, municipalities, and industries to proactively detect and respond to issues such as leaks, water quality concerns, and changes in demand, thereby ensuring a consistent supply of clean water and minimizing environmental impact. Ultimately, the purpose of smart water management is to secure a more resilient and sustainable water future for our communities and the planet, preserving this critical resource for generations to come.

2 | Ideation and Proposed Solution

This Phase Contain

- Ideation and Brainstorming
- Problem Statement Definition
- Empathy Map
- Proposed solution

2.1 | Ideation & Brainstorming

Brainstorming combines an informal approach to problem-solving with lateral thinking, which is a method for developing new concepts to solve problems by looking at them in innovative ways. Some of these ideas can be built into original, creative solutions to a problem, while others can generate additional ideas. Prioritization was helpful to find immediate demands of customer.

This helps to figure out which demand must be solved immediately

2.2 | Problem Statement Definition

This statement defines who are the customer, what they trying to do, but what happens, Because of some reason, that situation how they feel.

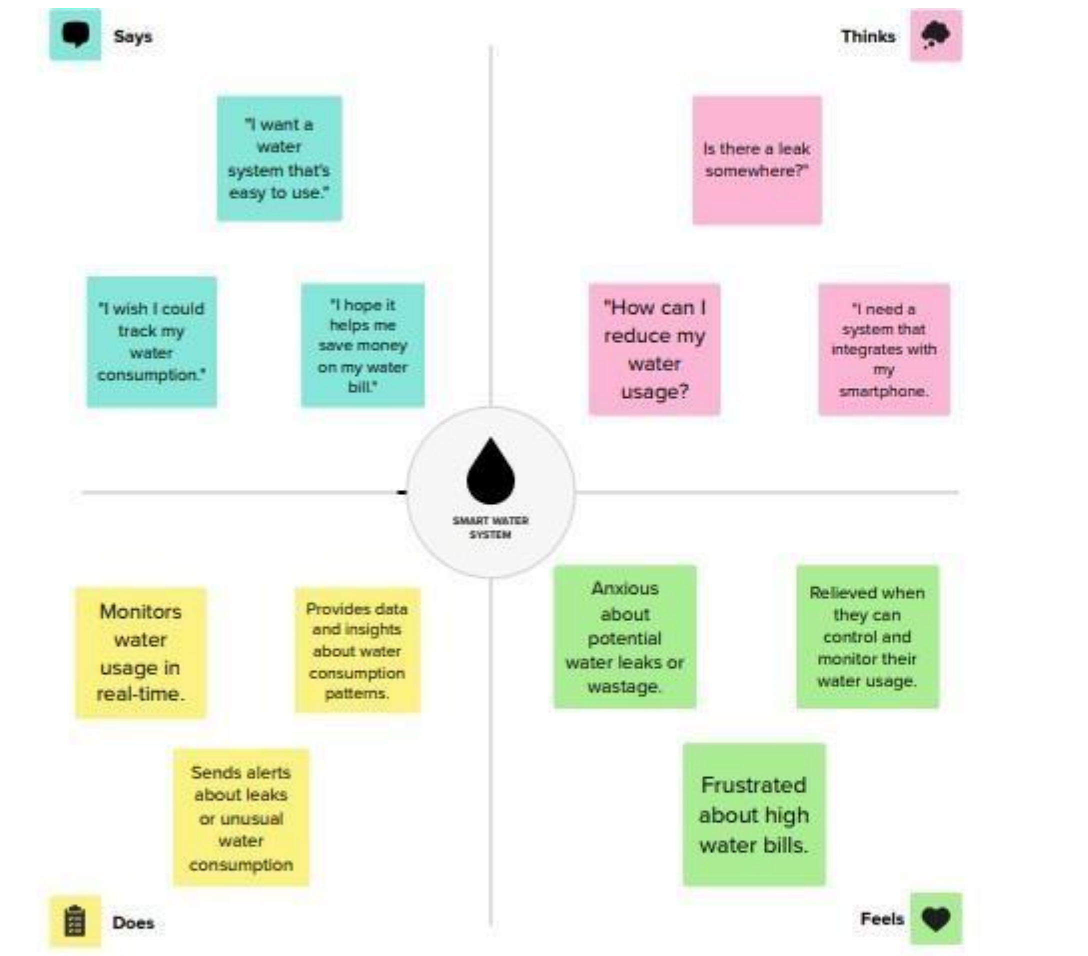
Problems statements

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	Consumer	Save water system	I need a system that integrates with my smartphon E	I wish I could track my water consumption	Relieved when they can control and monitor their water usage.
PS-2	Consumer	Control the unusual water consumption	The monitors water usage in real-time	To reduce water usage	Send alerts about leaks or unusual water consumption.
PS-3	Consumer	Control water leaks	There is a leak somewhere	The humans are anxious about potential water leaks	Frustrated about high water bills.

Figure 2.1: I am an Asthma Patient, Trying to Breath Fresh Air, but in air pollution days They struggle for breathing, which makes me feel Indoor precautions

2.3 | Empathy Map

Empathy map talks about customer feelings, thoughts, what they say, and action did by the customer.



2.4 | Proposed Solution

- Problem Statement (Problem to be solved) any communities struggle with limited access to clean and sustainable water sources. The challenge is to develop efficient and innovative solutions that can help monitor, conserve, and distribute water resources effectively while minimizing waste and ensuring a reliable supply for both urban and rural areas.
- Idea / Solution description Create a system that uses technology to track and control water usage in homes and businesses. This system can detect leaks, optimize water usage, and provide real-time information to help people use water more efficiently, thus conserving this precious resource

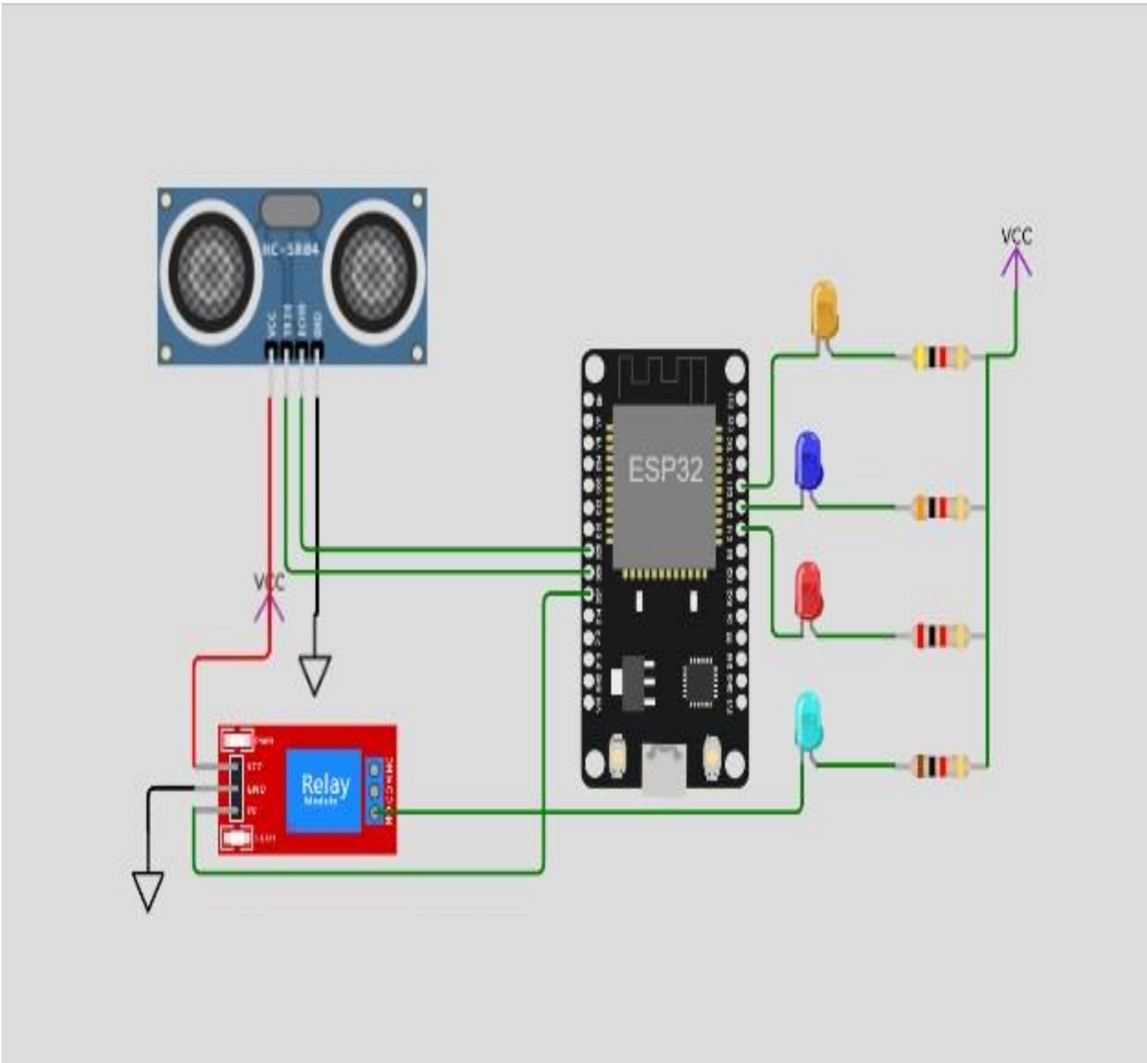
- Novelty / Uniqueness Invent smart device that automatically adjusts water usage based on real-time data and weather forecasts. This way, it optimizes water consumption by adjusting sprinkler systems and alerts users about potential leaks, saving water and promoting sustainable usage

Figure 2.2: Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	any communities struggle with limited access to clean and sustainable water sources. The challenge is to develop efficient and innovative solutions that can help monitor, conserve, and distribute water resources effectively while minimizing waste and ensuring a reliable supply for both urban and rural areas.
2.	**Idea /** Solution **description**	Create a system that uses technology to track and control water usage in homes and businesses. This system can detect leaks, optimize water usage, and provide real-time information to help people use water more efficiently, thus conserving this precious resource
3.	Novelty / Uniqueness	Invent a smart device that automatically adjusts water usage based on real-time data and weather forecasts. This way, it optimizes water consumption by adjusting sprinkler systems and alerts users about potential leaks, saving water and promoting sustainable usage
4.	Social Impact / Customer Satisfaction	Ensure that people using the smart water management system are happy with its performance. This means they should find it easy to use, reliable, and that it effectively helps them save water and money while ensuring they have a consistent and clean water supply
5.	Business Model (Revenue Model)	Create a plan to make money while providing smart water management solutions. This involves selling smart water devices, offering subscription services for data monitoring and analysis, and potentially partnering with water utilities to improve their efficiency and reduce water waste in exchange for revenue or cost-sharing arrangements

3 | Project Design

3.1 | Circuit Diagram



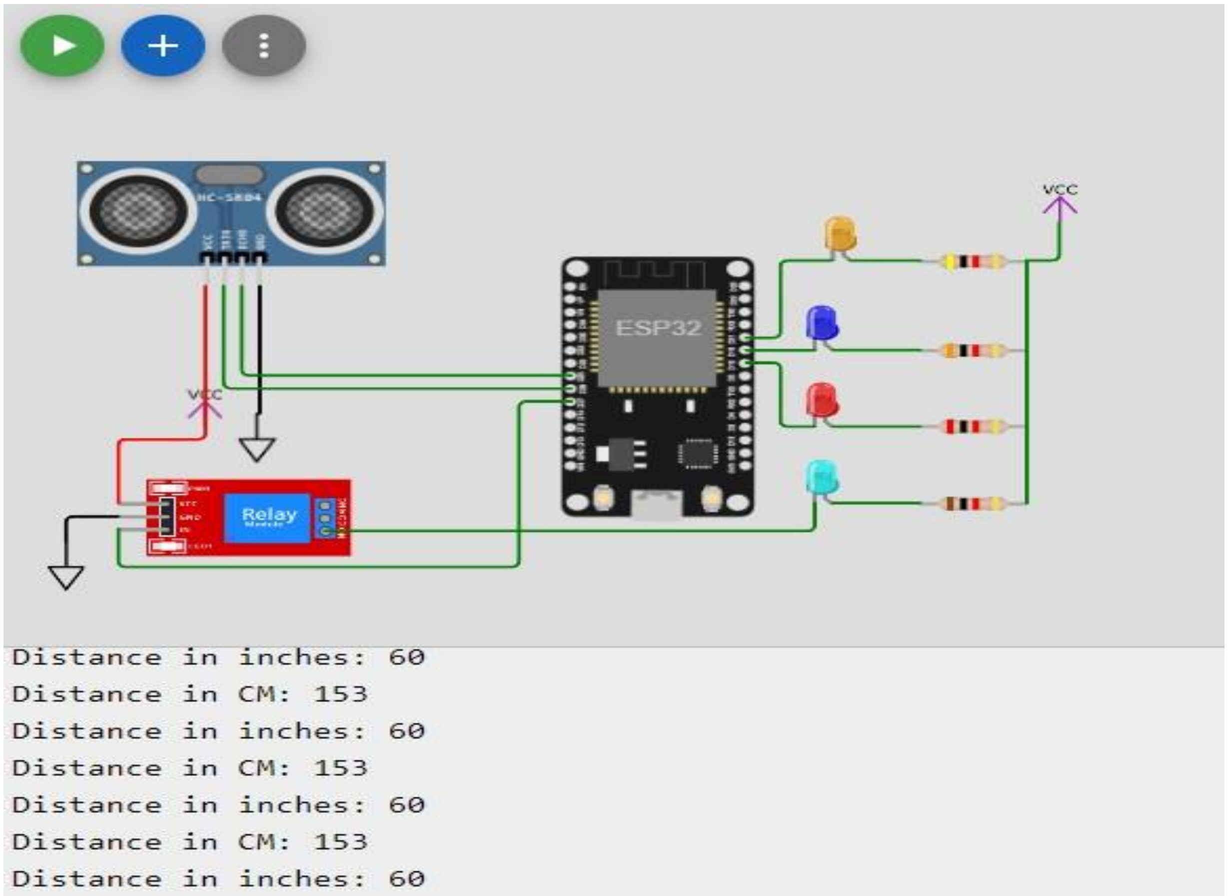
3.2 | Program code:

```
#define PIN_TRIG 26
#define PIN_ECHO 25
#define LOWLED 18
#define MIDLED 19
#define HIGHLED 21
#define MOTOR 27
unsigned int level = 0;

void setup() {
```

```
  pinMode(LOWLED, OUTPUT);
  pinMode(MIDLED, OUTPUT);
  pinMode(HIGHLED, OUTPUT);
  pinMode(MOTOR, OUTPUT);
  digitalWrite(LOWLED, HIGH);
  digitalWrite(MIDLED, HIGH);
  digitalWrite(HIGHLED, HIGH);
  digitalWrite(MOTOR, LOW);

  Serial.begin(115200);
  pinMode(PIN_TRIG, OUTPUT);
  pinMode(PIN_ECHO, INPUT);
}

void loop() {
  // Start a new measurement:


  digitalWrite(PIN_TRIG, HIGH);
  delayMicroseconds(10);
  digitalWrite(PIN_TRIG, LOW);

  // Read the result:
  int duration = pulseIn(PIN_ECHO, HIGH);
  Serial.print("Distance in CM: ");
  Serial.println(duration / 58);
  Serial.print("Distance in inches: ");
  Serial.println(duration / 148);

  level = (duration / 10);

  if(level < 100)
  {
    digitalWrite(LOWLED, LOW);
    digitalWrite(MOTOR, HIGH);
    digitalWrite(HIGHLED, HIGH);
    digitalWrite(MIDLED, HIGH);
  }

  else if ((level > 200 ) && (level < 400))
  {
    digitalWrite(LOWLED, HIGH);
    digitalWrite(HIGHLED, HIGH);
    digitalWrite(MIDLED, LOW);
  }

  else if (level >= 400 )
  {
    digitalWrite(HIGHLED, LOW);
    digitalWrite(MIDLED, HIGH);
```

```
    digitalWrite(LOWLED, HIGH);
    digitalWrite(MOTOR, LOW);
  }
  delay(1000);
}
```

3.3 | Output:



4 | Coding Solutioning

4.1 | Python Coding

Program Code:

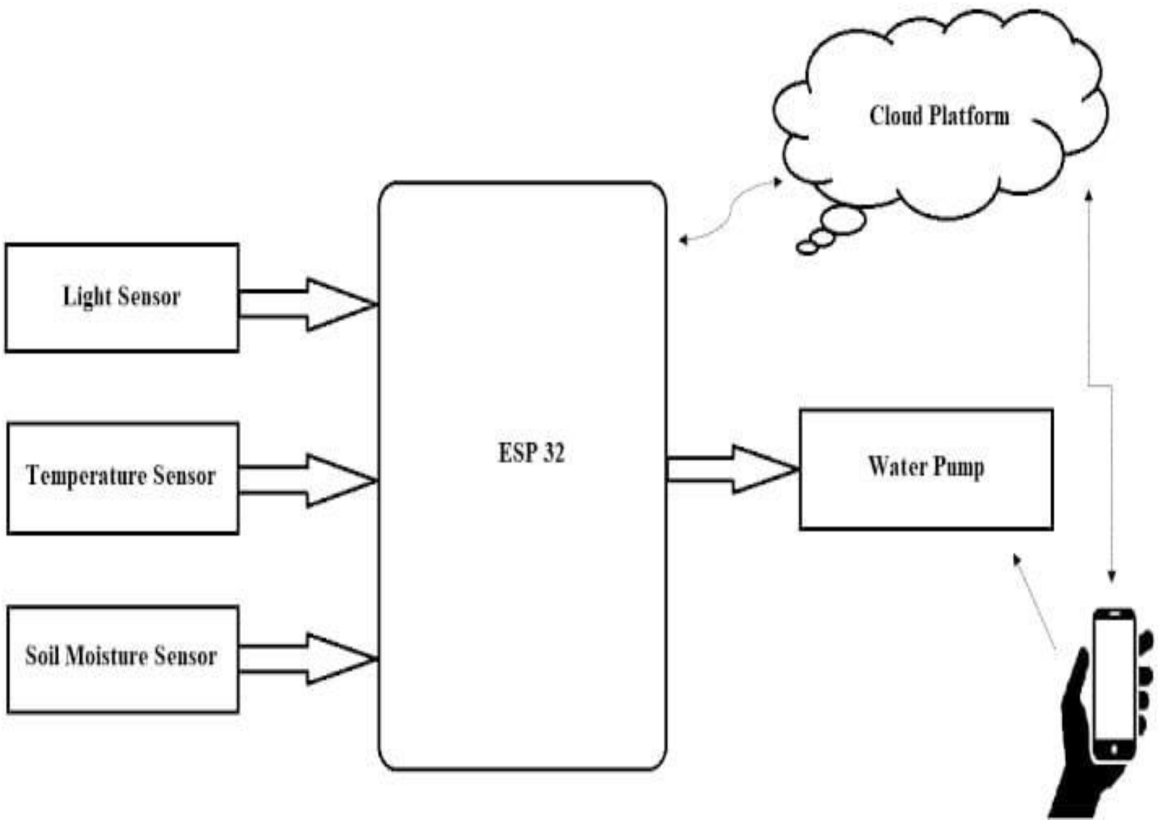
```
#define PIN_TRIG 26

#define PIN_ECHO 25

#define LOWLED 18

#define MIDLED 19
```

```
#define HIGHLED 21

#define MOTOR 27 unsigned int

level = 0;

void setup() {

  pinMode(LOWLED, OUTPUT); pinMode(MIDLED,
  OUTPUT);

  pinMode(HIGHLED,                OUTPUT);
  pinMode(MOTOR, OUTPUT);
  digitalWrite(LOWLED,             HIGH);
  digitalWrite(MIDLED,             HIGH);
  digitalWrite(HIGHLED,            HIGH);
  digitalWrite(MOTOR, LOW);

  Serial.begin(115200); pinMode(PIN_TRIG, OUTPUT);
  pinMode(PIN_ECHO, INPUT);
}

void loop() {
  // Start a new measurement:

  digitalWrite(PIN_TRIG, HIGH); delayMicroseconds(10);
  digitalWrite(PIN_TRIG, LOW);

  // Read the result:
```

```
int duration = pulseIn(PIN_ECHO, HIGH);

Serial.print("Distance in CM: "); Serial.println(duration /
58); Serial.print("Distance in inches: ");
Serial.println(duration / 148);

level = (duration / 10);

if(level < 100)
{
  digitalWrite(LOWLED, LOW); digitalWrite(MOTOR,
  HIGH); digitalWrite(HIGHLED, HIGH);
  digitalWrite(MIDLED, HIGH);
}

else if ((level > 200 ) && (level < 400))
{
  digitalWrite(LOWLED,                 HIGH);
  digitalWrite(HIGHLED,                HIGH);
  digitalWrite(MIDLED, LOW);
}

else if (level >= 400 )
{
  digitalWrite(HIGHLED,                LOW);
  digitalWrite(MIDLED,                 HIGH);
  digitalWrite(LOWLED,                 HIGH);
  digitalWrite(MOTOR, LOW);
```

```
  }
  delay(1000);
}
```

4.2 | Block Diagram



4.3 | Output

Output:

```
load:0x40080400,len:2972 entry 0x400805dc
Distance in CM: 192 Distance in
inches: 75 Distance in CM: 192
```

5 | Results

5.1 | Performance Metrices

Smart water management involves a comprehensive approach to conserving and efficiently utilizing our planet's most vital resource. Performance metrics play a pivotal role in this endeavor. These metrics encompass a wide array of criteria, ranging from water quality monitoring and energy consumption to leak detection and treatment efficiency. Amidst these considerations, the integration of hydrogen (H2) into smart water management emerges as a catalyst for sustainability.

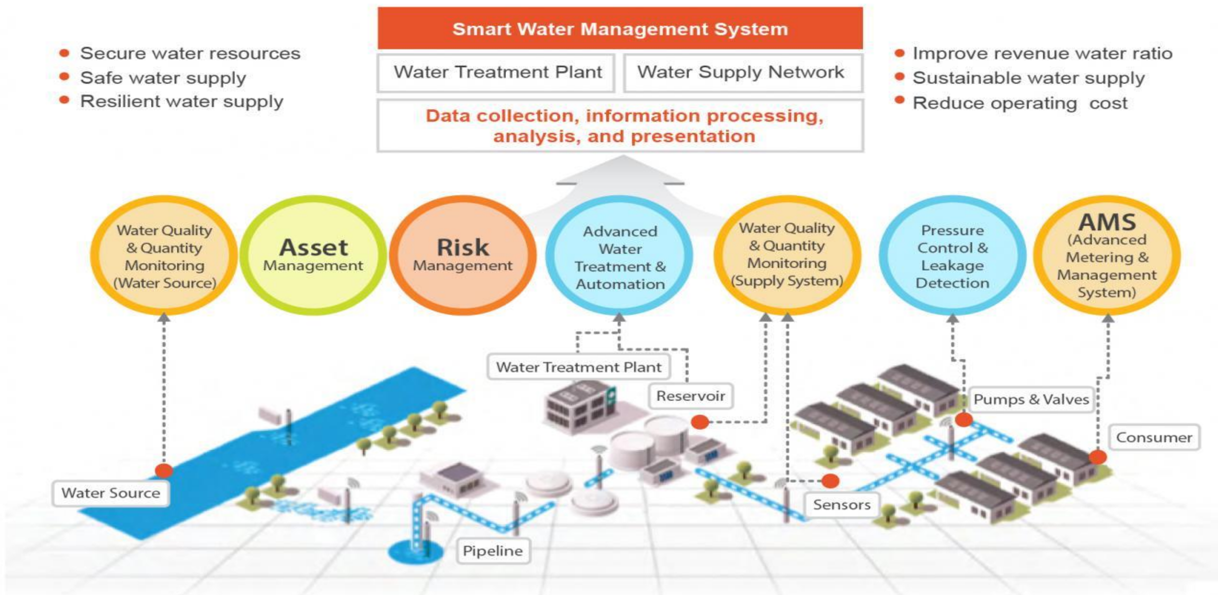
- **Hydrogen Production Efficiency**
- **Hydrogen Storage**
- **Hydrogen Transport**
- **H2O Monitoring**
- **Leak Detection**
- **Water Treatment Efficiency**
- **Hydrogen Fuel Cells**
- **Energy Consumption**
- **H2 Leak Detection**
- **Hydrogen Purity**
- **Safety Compliance**
- **Resource Conservation**
- **Data Analytics**

5.1.1 | Water Treatment Efficiency

Water treatment efficiency is a linchpin in the pursuit of responsible and sustainable water resource management. This critical metric addresses the effectiveness of processes designed to purify water, removing impurities and contaminants to meet stringent quality standards. By optimizing water treatment efficiency, we not only ensure that consumers receive a safe and clean water supply but also conserve water resources and reduce operational costs. This metric plays an essential role in safeguarding public health and the environment while promoting the judicious use of water, making it a vital aspect of any smart water management strategy.

5.1.2 | Safety Compliance

In the context of smart water management, safety compliance is an overarching priority that sets the foundation for a secure and dependable water supply. It encompasses a wide array of protocols and regulations that govern every aspect of water treatment, storage, and distribution, including the integration of hydrogen technology. Ensuring strict safety compliance is imperative in safeguarding not only the environment but also the well-being of the personnel involved in managing water resources. By adhering to these standards, we can mitigate potential risks associated with hydrogen, guaranteeing the smooth operation of our water systems and minimizing the potential for accidents or environmental harm.



5.1.3 | Hydrogen Production Efficiency

Efficiency in hydrogen production stands as a cornerstone within the realm of smart water management. The process of generating hydrogen, often through methods like electrolysis and renewable sources, is pivotal in ensuring a sustainable and cost-effective supply of this versatile gas. Enhanced hydrogen production efficiency not only reduces energy consumption but also contributes to the overall eco-friendliness of water treatment and distribution systems. This metric is instrumental in harnessing the potential of hydrogen to revolutionize the way we manage water resources, promoting both environmental responsibility and resource conservation.

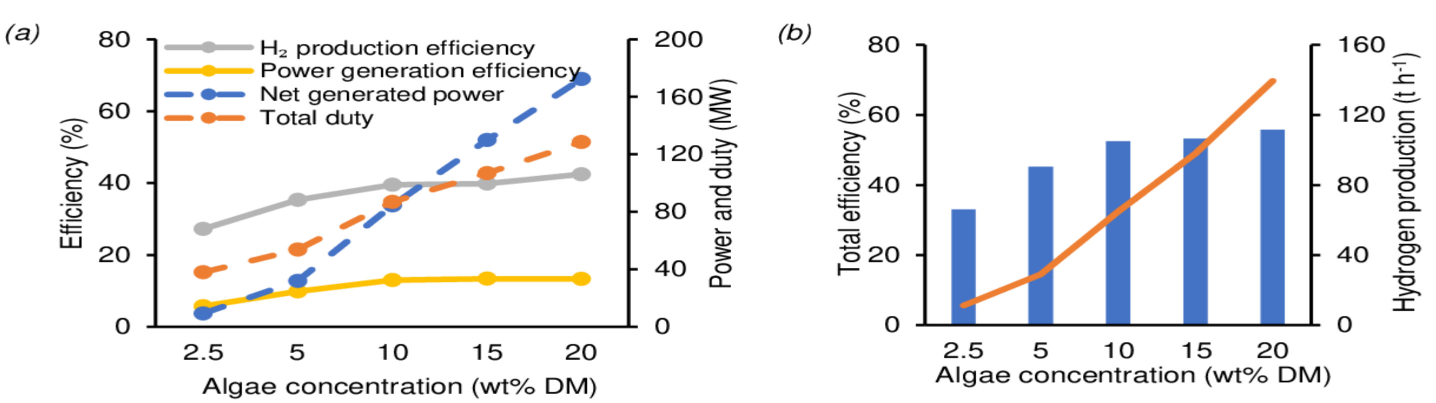


Figure 3: Effect of the algae concentration on a) power, duty, and efficiencies (T = 690 °C), and b) the total

6 | Advantages & Disadvantages

6.1 | Advantages

- **Resource Conservation**: Smart water management reduces water wastage through efficient distribution, reducing the strain on freshwater resources and promoting sustainability.

- **Cost Savings**: By optimizing water usage and reducing operational inefficiencies, businesses and municipalities can save money on water bills and operational costs.

- **Improved Water Quality:** Real-time monitoring and control of water quality ensures that consumers receive safe, clean water, reducing health risks

6.2 | Disadvantages

- **Initial Costs:** Implementing smart water management systems can be expensive, requiring investments in technology, infrastructure, and staff training.

- **Complexity:** Managing and maintaining smart systems may require specialized expertise, which can be challenging for smaller organizations.

- **Privacy and Security Concerns:** The collection of extensive data and its transmission over networks may raise privacy and security issues if not adequately protected

7 | Conclusion

In conclusion, smart water management offers a range of compelling advantages, including resource conservation, cost savings, improved water quality, and environmental benefits. The data-driven approach, efficient leak detection, and the promotion of sustainability make it an essential strategy for the future of water resource management. However, it comes with challenges, such as initial costs, complexity, privacy and security concerns, and dependency on technology. To harness the full potential of smart water management, a balanced approach that addresses these challenges while leveraging its benefits is essential. As technology advances and becomes more accessible, the long-term benefits of smart water management are likely to outweigh the initial drawbacks, ultimately enhancing the resilience and sustainability of our water systems.

8 | Future Scope

- **Integration of Advanced Technologies:** The future of smart water management will witness the integration of cutting-edge technologies such as artificial intelligence, machine learning, and the Internet of Things (IoT). These technologies will enable more precise data analysis, predictive maintenance, and automated decision-making, further optimizing water resource utilization.

- **Resilience to Climate Change:** As climate change intensifies, the scope of smart water management will extend to address the challenges posed by extreme weather events and shifting precipitation patterns. Resilience planning, including adaptive infrastructure and real-time monitoring, will become increasingly important to ensure a consistent and reliable water supply.

- **Global Expansion:** Smart water management will not be limited to urban areas but will expand to reach rural and underserved regions, driven by the need for equitable access to clean water and efficient agricultural practices. These technologies will play a crucial role in addressing water scarcity and water quality issues on a global scale.

9 | Appendix

9.1 | GITHUB Links

DANIEL CALEFF: https://github.com/Danielcaleff/IBM_IOT_SWM.git
MANOJ KUMAR: https://github.com/Leomanoj2001/IBM_IOT_SWM.git
MOHANA BALAJI: https://github.com/MohanaBal/IBM_IOT_SWM.git
SANJAI KUMAR:
Phase 1@4: phase-1&4: https://github.com/sabjai123/IBM_IOT_SWM.git
Phase 2: Phas-2: https://github.com/sabjai123/IOT_SWM.git
Phase 3: Phase-3: https://github.com/sabjai123/Phase-3.git