Phase 3 Submission Document

SMART WATER MANAGEMENT

TEAM MEMEBERS

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INTRODUCTION:

Smart Water Management :

Water is one of our planet's most precious resources, essential for life, agriculture, industry, and countless other aspects of human civilization. However, the growing global population, climate change, and unsustainable water usage practices are putting immense pressure on our water sources. This has led to an urgent need for more efficient and sustainable water management solutions.

Smart Water Management, often referred to as SWM, is a approach that leverages technology, data, and innovation to monitor, analyze, and optimize the use of water resources. It encompasses a wide range of strategies and tools designed to improve water quality, reduce wastage, enhance conservation, and ensure equitable distribution of water.

**Components of Smart Water Management System:**

1. Data Collection and Sensors:

Smart water systems use a network of sensors and data collection devices to monitor water quality, levels, and usage in real-time. These sensors provide valuable insights into the condition of water sources and infrastructure.

1. Data Analysis:

Collected data is processed and analyzed using advanced analytics and machine learning algorithms. This helps in identifying patterns, anomalies, and potential issues within the water supply and distribution systems.

1. Remote Monitoring:

Smart Water Management enables remote monitoring of water infrastructure, reducing the need for physical inspections and allowing for timely responses to problems like leaks, contamination, or unauthorized access.

1. Predictive Maintenance:

By analyzing data, SWM systems can predict when maintenance is required for water infrastructure, such as pipes, pumps, and treatment facilities. This proactive approach minimizes downtime and reduces maintenance costs.

1. Water Conservation:

Smart Water Management systems encourage water conservation through real-time feedback and consumer engagement. Consumers and businesses can monitor their water usage and receive alerts and tips for reducing consumption.

1. Leak Detection:

SWM systems are capable of quickly detecting leaks in the distribution network, preventing water loss and potential damage to infrastructure and the environment.

1. Demand Management:

By analyzing water consumption patterns, SWM can optimize water distribution and ensure a more equitable allocation of water resources.

1. Water Quality Management:

Continuous monitoring of water quality parameters ensures that drinking water remains safe and meets regulatory standards. Early detection of water contamination is crucial for public health.

1. Integration of IoT and Cloud Technology:

Internet of Things (IoT) devices and cloud computing are integral to Smart Water Management, allowing for real-time data transmission and storage, as well as remote access to information.

Problem Solving Techniques:

Steps in problem solving:

1. **Artificial Intelligence for Predictive Analysis**:

Utilize artificial intelligence and machine learning algorithms to predict water demand, identify leakage points, and optimize distribution, reducing water wastage.

1. **Real-time Water Quality Monitoring**:

Develop advanced sensors and IoT devices that can instantly detect contaminants and pollutants in water sources, providing early warnings and reducing the risk of waterborne diseases.

1. **Smart Irrigation Systems**:

Create intelligent irrigation systems for agriculture that use weather data, soil moisture levels, and crop requirements to optimize water use, minimizing over-irrigation.

1. **Mobile Apps for Consumer Engagement**:

Develop user-friendly mobile apps that allow consumers to monitor and control their water usage, receive personalized water-saving tips, and report water-related issues to authorities.

1. **Distributed Water Treatment**:

Implement decentralized water treatment systems that can be installed closer to the point of use, reducing the need for extensive distribution networks and making clean water more accessible, especially in remote areas.

1. **Solar Desalination**:

Combine solar power with desalination technologies to provide freshwater in regions with limited access to clean water, using renewable energy sources.

1. **Green Infrastructure**:

Design urban landscapes with permeable pavements, rain gardens, and green roofs to capture rainwater and reduce stormwater runoff, subsequently easing the burden on water treatment facilities.

1. **Water-Energy Nexus Solutions**:

Integrate water and energy management systems to optimize energy use in water treatment and distribution, reducing costs and environmental impact.

1. **Aquifer Recharge Techniques**:

Develop techniques for managed aquifer recharge, allowing excess water during wet periods to be stored underground for later use during droughts.

1. **Water Harvesting Technologies**:

Implement innovative rainwater harvesting systems for residential and industrial use, including large-scale collection systems in urban areas.

1. **Community-based Water Monitoring**:

Engage local communities in water management by providing them with low-cost, portable water testing kits and involving them in data collection efforts.

1. **Fog Harvesting**:

Explore fog harvesting technologies to collect water from the atmosphere in arid regions, providing a sustainable source of freshwater.

1. **AI-driven Leak Repair Drones**:

Use drones equipped with AI and infrared sensors to autonomously locate and repair water pipe leaks in hard-to-reach or densely populated areas.

1. **Desalination Efficiency Improvements**:

Invest in research and development to improve the energy efficiency and reduce the environmental impact of desalination processes.

1. **Eco-friendly Water Treatment**:

Develop environmentally friendly water treatment solutions, such as using natural processes and materials for purification.

1. **Water Recycling Innovations**:

Promote water recycling and reuse through advanced treatment processes and infrastructure that can purify wastewater for various non-potable uses.

CODE FOR SMART WATER MANAGEMENT:

#define \_DISABLE\_TLS\_

#include <ThingerESP8266.h>

#include <ESP8266WiFi.h>

#include <SPI.h>

#include <Wire.h>

#include <Adafruit\_GFX.h>

#include <Adafruit\_SSD1306.h>

#define OLED\_RESET LED\_BUILTIN

#define USERNAME "test123"

#define DEVICE\_ID "SWM"

#define DEVICE\_CREDENTIAL "ABCDEFGHIJ"

#define SSID "test123"

#define SSID\_PASSWORD "test123"

Adafruit\_SSD1306 display(OLED\_RESET);

byte indikator = 13;

byte sensorInt = 0;

byte flowsensor = D3;

float konstanta = 4.5; //konstanta flow meter

volatile byte pulseCount;

float debit;

float harga;

unsigned int flowmlt;

unsigned long totalmlt;

unsigned long oldTime;

ThingerESP8266 thing(USERNAME, DEVICE\_ID, DEVICE\_CREDENTIAL);

void setup()

{

display.begin(SSD1306\_SWITCHCAPVCC, 0x3C);

display.clearDisplay();

display.display();

display.setTextSize(1);

display.setTextColor(WHITE);

display.setCursor(0, 0);

// Inisialisasi port serial

Serial.begin(9600);

pinMode(flowsensor, INPUT);

pulseCount = 0;

debit = 0.0;

flowmlt = 0;

totalmlt = 0;

oldTime = 0;

harga = 0.0;

// digital pin control example (i.e. turning on/off a light, a relay, configuring aparameter, etc)

thing["sensor"] >> [](pson& out){

digitalWrite(flowsensor, HIGH);

attachInterrupt(digitalPinToInterrupt(D3), pulseCounter, FALLING);

out["debit"] = debit;

out["volume"] = totalmlt;

out["harga"] = harga;

};

}

void loop()

{

thing.handle();

display.clearDisplay();

if((millis() - oldTime) > 1000)

{

detachInterrupt(sensorInt);

debit = ((1000.0 / (millis() - oldTime)) \* pulseCount) / konstanta;

oldTime = millis();

flowmlt = (debit / 60) \* 1000;

totalmlt += flowmlt;

harga = totalmlt\*0.002;

unsigned int frac;

Serial.print("Debit air: ");

Serial.print(int(debit));

Serial.print("L/min");

Serial.print("\t");

display.setCursor(0, 0);

display.print("Debit air: ");

display.setCursor(60, 0);

display.print(int(debit));

display.setCursor(85, 0);

display.print("L/min");

Serial.print("Volume: ");

Serial.print(totalmlt);

Serial.print("mL");

Serial.print("\t");

display.setCursor(0, 12);

display.print("Volume: ");

display.setCursor(50, 12);

display.print(totalmlt);

display.setCursor(100, 12);

display.print("mL");

display.print("\t");

Serial.print("Harga: ");

Serial.print("Rp ");

Serial.println(harga);

display.setCursor(0, 24);

display.print("Harga: ");

display.setCursor(45, 24);

display.print("Rp ");

display.setCursor(70, 24);

display.println(harga);

display.display();

pulseCount = 0;

attachInterrupt(digitalPinToInterrupt(D3), pulseCounter, FALLING);

}

}

void pulseCounter()

{

// Increment the pulse counter

pulseCount++;

}

IOT EXPRESSION OF SWM-SYSTEMS:

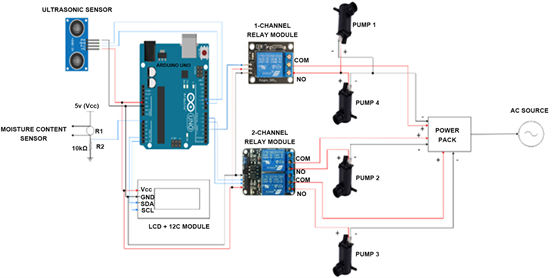


Diagram for SWM

Processing of IOT:

1. **Sensor Networks and IoT**:
   * Implement a dense network of IoT sensors to monitor water quality, consumption, and infrastructure health in real-time.
   * Develop predictive maintenance algorithms to identify and address potential issues before they lead to significant problems.
2. **Artificial Intelligence and Data Analytics**:
   * Use AI and machine learning to analyze historical and real-time data to predict water demand, detect anomalies, and optimize water distribution.
   * Develop AI-powered chatbots or virtual assistants to provide users with water-saving tips and recommendations.
3. **Blockchain Technology**:
   * Implement blockchain for transparent and secure water billing systems, ensuring tamper-proof records and fair billing.
   * Use blockchain to track water quality data from multiple sources, providing a trustable and immutable record.
4. **Remote Sensing and Satellite Technology**:
   * Utilize satellite imagery and remote sensing technology to monitor water bodies, detect pollution, and assess water levels in lakes, rivers, and reservoirs.
   * Combine remote sensing data with GIS (Geographic Information System) for efficient spatial planning and resource allocation.
5. **Smart Irrigation Systems**:
   * Integrate IoT technology into irrigation systems to optimize water usage in agriculture and landscaping.
   * Develop precision agriculture techniques that use sensors and data analytics to tailor irrigation to crop needs.
6. **Water Recycling and Desalination**:
   * Invest in advanced water recycling and desalination technologies to increase the availability of freshwater resources.
   * Create innovative financing models and public-private partnerships to support large-scale desalination projects.
7. **Citizen Engagement and Gamification**:
   * Develop mobile apps and online platforms that allow citizens to report water-related issues, such as leaks or water quality concerns.
   * Gamify water conservation efforts, offering rewards and incentives for reducing consumption.
8. **Water-Efficient Appliances and Fixtures**:
   * Promote the use of smart, water-efficient appliances and fixtures that automatically adjust water flow based on need.
   * Incentivize the adoption of these technologies through rebates and subsidies.
9. **Green Infrastructure**:
   * Implement green infrastructure solutions, such as permeable pavements and rain gardens, to manage stormwater and reduce the burden on traditional sewage systems.
   * Foster urban planning that incorporates green spaces and water-sensitive design.
10. **Education and Awareness**:
    * Develop multimedia campaigns and educational programs to raise awareness about the importance of water conservation.
    * Engage schools, communities, and businesses in water-saving initiatives and education.
11. **Collaboration and Public-Private Partnerships**:
    * Foster collaboration between governments, utility companies, businesses, and research institutions to share data, technologies, and resources.
    * Create public-private partnerships to fund and implement large-scale water management projects.
12. **Circular Economy Models**:
    * Explore circular economy models that promote resource recovery and reduce water wastage, such as capturing and reusing wastewater.
13. **Resilience Planning**:
    * Develop long-term resilience plans to address the challenges of climate change, such as adapting water infrastructure to handle extreme weather events and changing precipitation patterns.

Incorporating these innovative approaches into smart water management can help address existing water challenges while also preparing for the future. Collaborative efforts, cutting-edge technologies, and creative thinking are key to solving water-related problems and ensuring sustainable water management practices.