Phase 5: Smart Water Management System Based on IOT:

INTRODUCTION

Water represents an essential resource for survival. Today, the quality and quantity of water have decreased considerably. These are the effects of global industry development and the overexploitation of land and sea resources. Moreover, climate change has a strong impact on water resources, and drought is becoming more prevalent. All these factors can cause major damage to water resources, so intelligent water management systems are essential for maintaining efficient management in terms of the quality and quantity of drinking water.

One of the most important aspects of water sustainability is the continuous monitoring of water consumption in order to make the right decisions regarding the good management of this vital resource. Water scarcity, together with diseases caused by contaminated water, are major dangers that threaten humanity. Therefore, additional attention should be paid to this area, and the necessary resources should be allocated to monitoring water consumption. The collected data provide decision support for streamlining water resources.

Another important factor to note is population growth. The demand for water increases, and the need to develop an intelligent system becomes indispensable. An alternative that has become increasingly popular, with multiple benefits in many areas, is based on the concept of the Internet of Things (IOT). IOT has made significant contributions in various fields, including being integrated into intelligent water management systems. In households, the IOT concept can be implemented by installing sensors and collecting data in real time to provide continuous data monitoring. Solutions that include IOT in water management have multiple advantages including low costs and real-time remote data access. Furthermore, the integration of smart sensors in an existing system does not require many changes; IOT offers flexibility and only requires a few configurations to extend functionality

The Internet of Things

IOT, through some software, has access to the Cloud as a platform and generated data by a sensor network is transferred to the Cloud. The Cloud as a computing platform increases the computing efficiency and data storage, which is done with a high level of performance, almost a hundred percent reliability, and extensive scalability. There are several Cloud services. In our study, Sharpsburg Municipality has applied Microsoft Azure. Different types of the Cloud services. The sensor network is built by sensor devices to collect a massive volume of information from different resources. The connections between devices and IOT applications are carried out through Hub hosted in the Cloud, creating a bi-directional connection between devices and the Cloud. IOT Hub as a managed service is a center for sending messages and supports sending information from IOT devices to the Cloud and vice versa. The process and storage of data start as soon as the data arrives at the Cloud, which has the ability in real-time response, so the Cloud can decide to begin automatic adjustments or send alerts, and this process does not require any user.

Sensor Network:

The main reason for increasing sensors' use in various aspects is easy deployment and low cost. Various IOT sensors are applied based on our requirements for different goals in IOT, such as moisture IOT sensors, noise and acoustic IOT sensors,

temperature IOT sensors, water level IOT sensors, light IOT sensors, image IOT sensors, chemical IOT sensors, and gyroscope IOT sensors. The type of integrated sensors in our study for water consumption investigation was Lo Ra (Long Range) for Sharpsburg's IOT network and Lo Ra WAN protocol. The Lo Ra has structured as a physical layer based on Lo Ra WAN protocol and can transfer a huge volume of data or information over a high range of a geographic area. Indeed, low power can send data over long distances using radio frequencies, making it a remarkable and efficient technology. Lo Ra Technology includes outstanding characteristics such as low cost, long-range, low power, and open standard. It means it has the capability to decrease the cost of operating and infrastructure investments, it penetrates deeply in the dense urban structure and can cover sensors in long distances which are more than 30 miles far away in the rural areas, increase the lifetime of a battery up to 20 years through the use of Lo Ra WAN protocol which is perfect for low power, and with the help of Lo Ra WAN protocol provides some form of Prediction of Water Consumption Using Machine Learning 4 collaboration among telecom operators, applications, and IOT solution providers to expedite the adoption and deployment process.

IOT Devices:

HC-SR04 Ultrasonic Distance Sensor

VCC	**Voltage supply (5V)**
ECHO	**Measure the high pulse length to get the distance**
GND	**Ground.**

Operations:

To start a new distance measurement set the TRIG pin to high for 10us or more. Then wait until the ECHO pin goes high, and count the time it stays high. The length of the ECHO high pulse is proportional to the distance.

- Centimeters – Pulse Micros/58
- Inches –Pulse Micros/148

Relay Module:

Pin names:

VCC - Supply voltage

GND - Ground

IN - Control signal (e.g. from micro-controller)

NC - Normally closed

COM - Common pin

OPERATIONS:

The relay is an electronic switch.

When the IN pin is high / disconnected, COM is connected to NC (NC means normally closed).

When the IN pin is low, COM is connected to NO (NO means normally open).

Setting the "transistor" attribute to "pnp" inverts the logic: when IN is high, COM is connected to NO, and when IN is low / disconnected, COM is connected to NC.

Smart Water Management:

This IOT-based project involves building a smart water management system that can remotely monitor a particular liquid's level and prevent it from overflowing. This project holds immense value for the industrial sector that uses large volumes of fluids in its day-to-day operations. Apart from detecting a liquid's level, this monitoring system can also be used to track the usage of specific chemicals and to detect leaks in pipelines.

The system is fitted with ultrasonic, conductive, and float sensors. A Wi-Fi module helps connect the system to the Internet and facilitates data transmission. Four ultrasonic sensors help transmit the data on the liquid level and alert the user on the same.

Benefits of smart water management System-

- Allows to access fluid level
- Temperature monitoring

- Updates
- Alarms
- Automatic On/ OFF pumps
- Level Control

Features of smart water management System-

- Remotely monitor liquid levels
- Access fluid level information
- Buzzer/ Trigger Alarms
- Wi-Fi Modem
- Display levels of liquid.

Web Development Based on IOT:

1. **Improved Efficiency and Productivity**

One of the primary advantages of IOT projects is the ability to streamline processes and optimize resource usage. Businesses can monitor and manage operations in real time by deploying IOT-enabled sensors and devices. This leads to enhanced efficiency, reduced downtime, and improved overall productivity. For instance, in manufacturing, IOT sensors can track production lines, identifying bottlenecks and potential failures, allowing for timely maintenance and minimal disruptions.

2 Enhanced Data Collection and Analysis

IOT projects generate vast amounts of data from connected devices and sensors. This data offers valuable insights into operations, customer behavior, and equipment performance. Businesses can make informed decisions, identify trends, and predict outcomes through data analysis, leading to better planning and resource allocation.

3. **Cost Savings and Resource Management**

Optimizing resource usage not only improves efficiency but also leads to cost savings. IOT projects help organizations monitor energy consumption, water usage, and other resources, allowing for better control and conservation. Smart grids, for instance, can adjust energy distribution based on real-time demand, reducing waste and cutting costs for both providers and consumers.

4. **Remote Monitoring and Control**

IOT projects enable remote monitoring and control of devices and systems, offering convenience and safety. For example, IOT-enabled medical devices can transmit patient data to healthcare providers, enabling remote monitoring and timely intervention. Similarly, farmers can remotely monitor crops and irrigation systems in agriculture, optimizing agricultural practices and minimizing manual labor.

5. **Enhanced Customer Experience**

IOT applications can potentially revolutionize the customer experience by providing personalized and connected services. Smart homes with IOT devices offer seamless automation and control, enhancing comfort and convenience for residents. Retailers

can leverage IOT data to offer personalized recommendations and targeted marketing, increasing customer satisfaction and loyalty.

6. **Predictive Maintenance**

One of the most significant advantages of IOT projects is predictive maintenance. By continuously monitoring the condition of equipment and machinery, businesses can predict when maintenance is needed before a breakdown occurs. This approach reduces downtime, extends the lifespan of assets, and minimizes maintenance costs.

7. **Safety and Security**

IOT projects ideas can significantly improve safety in various environments. In industrial settings, IOT sensors can monitor workplace conditions, detect potential hazards, and ensure safety regulations compliance. Smart cities can use IOT to monitor traffic and public spaces, enhancing security and emergency response capabilities.

8. **Sustainable and Eco-Friendly Solutions**

IOT projects contribute to sustainability efforts by promoting smart and eco-friendly practices. Smart buildings can optimize energy consumption based on occupancy levels, reducing carbon footprints. IOT-enabled waste management systems can also improve recycling efforts and reduce waste generation.

9. **Innovation and Competitiveness**

Organizations that embrace IOT projects ideas gain a competitive edge by offering innovative solutions and services. IOT-driven insights and data analytics open new opportunities for businesses to differentiate themselves in the market and adapt to evolving customer needs.

10. **Transforming Industries and Creating Smart Cities**

They are instrumental in transforming industries and creating smart cities. IOT enables remote patient monitoring and telemedicine in healthcare, revolutionizing healthcare delivery. IOT-based precision farming techniques enhance crop yields while minimizing resource usage in agriculture. For transportation, IOT applications improve logistics and public transportation efficiency, reducing congestion and carbon emissions in smart cities.

Source code:

```
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);

void setup() {
  Serial.begin(9600);
  lcd.init();
  lcd.backlight();
  lcd.clear();
```

```
  pinMode(2 OUTPUT);
  digitalWrite(2 HIGH ;
  delay(1000);
  lcd setCursor(0   0);
  lcd print("IRRIGATION");
  lcd setCursor(0, 1);
  lcd print("SYSTEM IS ON ");
    lcd print("");
    delay(3000);
  lcd.clear();
}

void loop() {
  int value = analogRead A0);
  Serial.println(value);
  if (value > 950) {
    digitalWrite(2 LOW);
    lcd setCursor(0 0);
    lcd print("Water Pump is ON ");
  } else {
    digitalWrite(2 HIGH);
    lcd setCursor(0 0);
    lcd print("Water Pump is OFF");
  }

  if (value < 300) {
    lcd setCursor(0  1);
    lcd print("Moisture : HIGH");
  } else if (value > 300 && value < 950) {
    lcd setCursor(0  1);
    lcd print("Moisture : MID ");
  } else if (value > 950) {
    lcd setCursor(0 1);
```

```
    lcd print("Moisture : LOW ");
  }
}


//    ------------------------i2c_SCANNER_____________________
// i2c_scanner
//
// Version 1
//    This program (or code that looks like it)
//    can be found in many places.
//    For example on the Arduino.cc forum.
//    The original author is not know.
// Version 2  Juni 2012  Using Arduino 1.0.1
//     Adapted to be as simple as possible by Arduino.cc user Krodal
// Version 3  Feb 26  2013
//    V3 by louarnold
// Version 4  March 3  2013  Using Arduino 1.0.3
//    by Arduino.cc user Krodal.
//    Changes by louarnold removed
//    Scanning addresses changed from 0...127 to 1…119,
//    according to the i2c scanner by Nick Gammon
//    https://www.gammon.com.au/forum/?id=10896
// Version 5, March 28  2013
//    As version 4  but address scans now to 127.
//    A sensor seems to use address 120.
// Version 6, November 27, 2015.
//    Added waiting for the Leonardo serial communication.
//
//
```

```
// This sketch tests the standard 7-bit addresses
// Devices with higher bit address might not be seen properly.
//

#include <Wire.h>


void setup()
{
  Wire.begin();

  Serial.begin(9600);
  while (!Serial);             // Leonardo: wait for serial monitor
  Serial.println("\nI2C Scanner");
}


void loop()
{
  byte error, address;
  int nDevices;

  Serial.println("Scanning...");

  nDevices = 0;
  for(address = 1; address < 127; address++ )
  {
    // The i2c_scanner uses the return value of
    // the Write.endTransmisstion to see if
    // a device did acknowledge to the address.
```

```
    Wire.beginTransmission(address);
    error = Wire.endTransmission();

    if (error == 0)
    {
      Serial.print("I2C device found at address 0x");
      if (address<16)
        Serial.print("0");
      Serial.print(address,HEX);
      Serial.println("  !");

      nDevices++;
    }
    else if (error==4)
    {
      Serial.print("Unknown error at address 0x");
      if (address<16)
        Serial.print("0");
}


      Serial.println(address,HEX);
    }
  }
  if (nDevices == 0)
    Serial.println("No I2C devices found\n");
  else
    Serial.println("done\n");

  delay(5000);           // wait 5 seconds for next scan
```

}

Smart Water Management System using IOT Devices: