IOT EPBL - HCL

PROJECT REPORT

SMART CAMPUS WASTE MANAGEMENT SYSTEM

Project created by: Manoj S, Muhammad Afsan A,Manoj Kumar K

Project Reviewed By: Sasirekha .k

Project Created Date: 22/05/2024

Project Code: IoT 001

College code: 2113

\ **Team Name:** IOT 1457

DEPARTMENT OF INFORMATION TECHNOLOGY

CONTEXT

1. ABSTRACT
2. INTRODUCTION
3. COMPONENTS
4. SCOPE
5. METHODOLOGY
6. ARTIFACTS USED
7. WORKING
8. CIRCUIT DIAGRAM
9. CONCLUSION

1. Abstract

The increasing global waste generation has highlighted the necessity for efficient waste management systems. This thesis explores the development of a Smart Waste Management System (SWMS) utilizing Internet of Things (IoT) technologies to enhance waste collection efficiency and environmental monitoring. The system employs an ESP32 microcontroller, ultrasonic sensor, LCD display board, two LEDs, buzzer, switch, and a digital humidity and temperature sensor to monitor waste bin levels, environmental conditions, and notify relevant authorities for timely waste disposal. The proposed system aims to optimize waste collection routes, reduce operational costs, and minimize environmental impact.

2. introduction

The surge in waste generation due to rapid urbanization and industrialization has presented significant challenges for traditional waste management systems. Inefficient waste collection often leads to overflowing bins, unsanitary conditions, and environmental pollution. Implementing IoT-based solutions in waste management can address these issues by providing real-time monitoring and data-driven decision-making capabilities.

Objectives

To design and implement a Smart Waste Management System using ESP32 microcontroller and various sensors.

To monitor waste levels in bins and environmental conditions in real-time.

To provide timely notifications for waste collection to prevent overflow and unsanitary conditions.

To enhance the efficiency of waste collection routes based on real-time data.

Scope

This thesis focuses on the development of a prototype SWMS utilizing the ESP32 microcontroller, ultrasonic sensor for waste level detection, LCD display for system status, LEDs for visual alerts, buzzer for audio notifications, switch for manual controls, and digital humidity and temperature sensor for environmental monitoring

Literature Review

Traditional Waste Management Systems

Review of traditional waste collection methods, their inefficiencies, and environmental impact.

IoT in Waste Management

Exploration of IoT applications in waste management, highlighting various case studies and existing systems.

3. Components:

Components and Technologies

Detailed overview of the components used in this project: ESP32 microcontroller, ultrasonic sensors, LCD display boards, LEDs, buzzers, switches, and digital humidity and temperature sensors.

System Design and Architecture

System Overview

Description of the overall system architecture, including hardware and software components.

Hardware Components

ESP32 Microcontroller:

ESP32 is a chip that provides Wi-Fi and (in some models) Bluetooth connectivity for embedded devices – in other words, for IoT devices. While ESP32 is technically just the chip, the modules and development boards that contain this chip are often also referred to as "ESP32" by the manufacture

Ultrasonic Sensor:

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity.

LCD Display Board:

16x2 LCDs are compact displays that show 16 characters on 2 lines. Each character is formed by a 5x7 pixel matrix. They are widely used for text-based information in electronics, robotics, and embedded systems. Operated at 4.7-5.3V, they interface with microcontrollers.

1. Ultrasonic Ranging:

The esp32 communicates with the ultrasonic sensor, which emits a high-frequency

sound wave. When the sound wave strikes the garbage inside the bin and reflects back, the sensor measures the time it takes for the round trip

2. Blynk App Visualization:

A smartphone app created using Blynk can receive and display the bin fill level data in real-time. This allows users to monitor the bin status remotely.

3. . Garbage Segregation (Future work):

*** Additional sensors like infrared (IR) sensors or**

weight sensors can be integrated for potential waste

type identification.

*** IR sensors can detect material type based on**

reflectivity (e.g., plastic, metal).

*** Weight sensors can differentiate heavy and light**

waste, potentially indicating organics or dense

materials.

*** The Arduino Uno R3 would need to be programmed**

to interpret the additional sensor data and identify the

waste type.

*** The Blynk app could then be updated to display**

the identified waste type alongside the fill level for

enhanced waste management practices.

LEDs: Indicate different system states (e.g., bin full, system error).

Buzzer: Provides audio alerts for specific events.

Switch: Manual override for certain functions.

Digital Humidity and Temperature Sensor: Monitors environmental conditions inside the waste bin.

4. Scope:

This project covers the design, development, and implementation of a smart waste management system. It includes:

Monitoring waste bin levels using ultrasonic sensors.

Measuring environmental conditions (temperature and humidity) using the DHT22 sensor.

Displaying real-time data on an LCD screen.

Providing visual and audible alerts via LED lights and a buzzer.

Integration and programming of the ESP32 microcontroller to process and transmit data.

5. Methodology:

Requirement Analysis: Identify the requirements for the smart waste management system.

Component Selection: Choose appropriate sensors and components (ESP32, ultrasonic sensor, DHT22, LED lights, LCD display, buzzer).
System Design: Develop a schematic for integrating the components.

6. Artifacts used:

ESP32 Microcontroller: For processing data and controlling the system.

Ultrasonic Sensor: To measure the fill level of waste bins.

DHT22 Sensor: To monitor temperature and humidity.

LED Lights: To provide visual alerts for different statuses.

LCD Display: To show real-time data and system status.

Buzzer: To provide audible alerts for critical notifications.

Technical Coverage:

Microcontroller Programming: Using ESP32 for data processing and system control.

Sensor Integration: Interfacing ultrasonic sensors and DHT22 with ESP32.

Data Display: Real-time data display on an LCD screen.

Alert Mechanisms: Implementing LED and buzzer alerts.

Wireless Communication: Potential use of Wi-Fi for data transmission (optional).

7. working:

Initial setup and configuration of the SWMS.

Data collection from ultrasonic sensors measuring waste levels.

Environmental monitoring using digital humidity and temperature sensors.

User interaction through LCD display board, LEDs, buzzer, and switch.

Data processing and decision-making algorithms.

program:

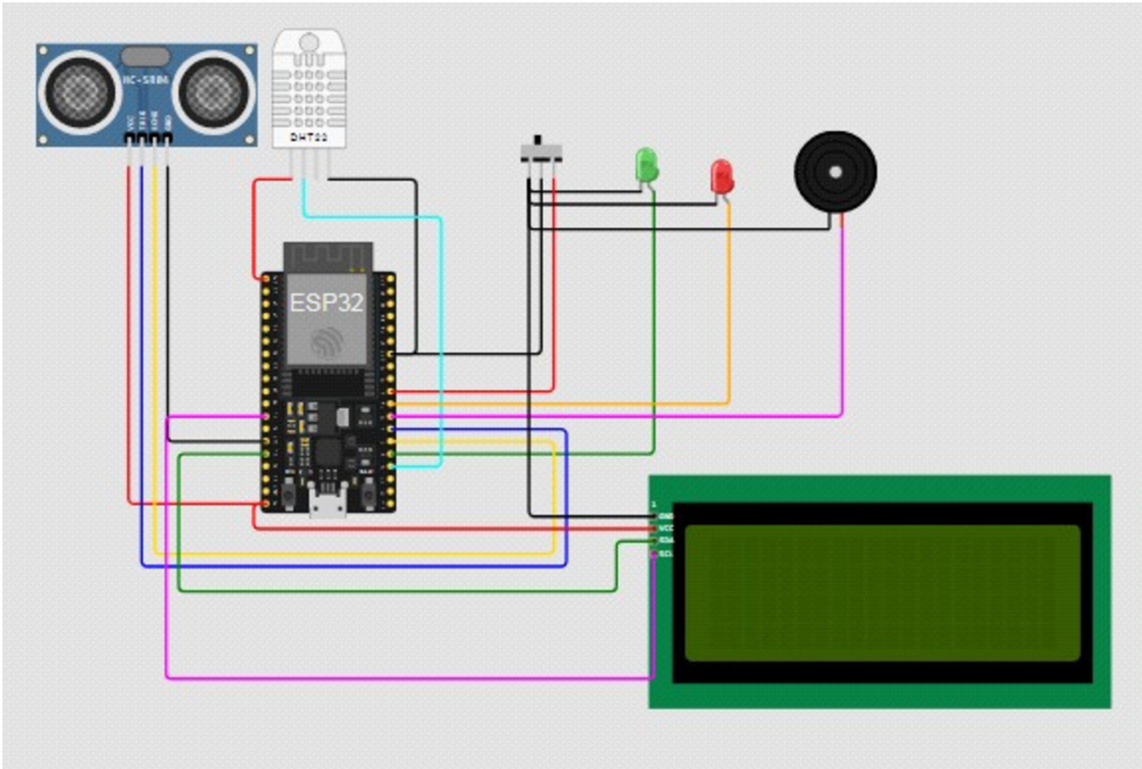
```
#define BLYNK_TEMPLATE_ID "TMPL3INvfh_bZ"
#define BLYNK_TEMPLATE_NAME "Smart
Campus Waste Management System
Project" #define BLYNK_AUTH_TOKEN
"4moD1lgcItZMfCOTfKLt4y2hA-zkAFIH"
```

```
#include <Wire.h>
#include "DHTesp.h"

#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>

// Your WiFi credentials.

char ssid[] = "Wokwi-GUEST";
char pass[] = "";

#include <DHT.h>

// Pins
#define TRIG_PIN 4
#define ECHO_PIN 0
#define DHT_PIN 15
#define DHT_TYPE DHT22

#define LED_PIN1 2
#define LED_PIN2 17
#define SPEAKER_PIN 16

#define SDA 13                    //Define SDA pins
#define SCL 14                    //Define SCL pins

LiquidCrystal_I2C lcd(0x27,16,2);
DHT dht(DHT_PIN, DHT_TYPE);

void sendSensorData() {
  // Ultrasonic sensor
  long duration, distance;
  digitalWrite(TRIG_PIN, LOW);
  delayMicroseconds(2);
  digitalWrite(TRIG_PIN, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIG_PIN, LOW);
  duration = pulseIn(ECHO_PIN, HIGH);
  distance = (duration / 2) / 29.1; // Convert to cm

  // DHT sensor
  float temperature = dht.readTemperature();
  float humidity = dht.readHumidity();

  // Send data to Blynk
  Blynk.virtualWrite(V2, distance);
  Blynk.virtualWrite(V0, temperature);
  Blynk.virtualWrite(V3, humidity);

  // Check if bin is full
  if (distance < 10) {
    Blynk.virtualWrite(V1,"Waste bin is full! ");
    //tone(16, 262, 250);
    tone(SPEAKER_PIN,262,250);
    digitalWrite(LED_PIN2, HIGH);
    digitalWrite(LED_PIN1, LOW);
    lcd.clear();
    lcd.print("Bin is Full!");
  }
  else{
    Blynk.virtualWrite(V1,"Bin has Space.");
    digitalWrite(LED_PIN1, HIGH);
    digitalWrite(LED_PIN2, LOW);
    lcd.clear();
    lcd.print("Bin has Space");
  }
  delay(5000);
}

BlynkTimer timer;

// This function is called every time the Virtual Pin 0 state changes
BLYNK_WRITE(V4)
```

```
{
  Serial.println("Inside Blynk Write");
  if(param.asInt() == 1)
  {
      Serial.println("Blynk Write: Value is 1");
     //digitalWrite(2,  HIGH);
     digitalWrite(LED_PIN1, HIGH);
     Blynk.virtualWrite(V1,"Started Successfully.");
     sendSensorData();
  }
  else
  {
    Serial.println("Blynk Write: Value is 0");
    //digitalWrite(2, LOW);
    digitalWrite(LED_PIN1, LOW);
    digitalWrite(LED_PIN2, HIGH);
  }
}

// This function is called every time the device is connected to the Blynk.Cloud
BLYNK_CONNECTED()
{
   Blynk.syncVirtual(V0);
   Blynk.syncVirtual(V1);
   Blynk.syncVirtual(V2);
   Blynk.syncVirtual(V3);
   Blynk.syncVirtual(V4);
   Serial.println("Inside Blynk: Blynk is Connected");
   lcd.clear();
   lcd.print("Blynk -Connected");
   delay(5000);
}

// This function sends Arduino's uptime every second to Virtual Pin 2.
void myTimerEvent()
{
  Blynk.virtualWrite(V0, millis() / 1000);
  Blynk.virtualWrite(V1, millis() / 1000);
  Blynk.virtualWrite(V2, millis() / 1000);
  Blynk.virtualWrite(V3, millis() / 1000);
  Blynk.virtualWrite(V4, millis() / 1000);
}

bool i2CAddrTest(uint8_t addr) {
  Wire.begin();
  Wire.beginTransmission(addr);
  if (Wire.endTransmission() == 0) {
    return true;
  }
  return false;
}

void setup()
{
  Wire.begin(SDA, SCL);
  if (!i2CAddrTest(0x27)) {
    lcd = LiquidCrystal_I2C(0x3F, 16, 2);
  }
  lcd.init();
  lcd.backlight();

  lcd.setCursor(0,0);
  lcd.print("Smart Campus");
  lcd.setCursor(0,1);
  lcd.print("Waste Management");
  //delay(2500);
  //lcd.clear();
  lcd.setCursor(0,2);
  lcd.print(" Version 0.0.1");
  //

  pinMode(5, INPUT_PULLUP);
  //pinMode(2, OUTPUT);
  //pinMode(17, OUTPUT);
```

```
pinMode(LED_PIN1, OUTPUT);
```

8. circuit diagram:



result:

https://wokwi.com/projects/399419344917160961

9. conclusion:

This project explored the design and development of a smart waste bin system with functionalities for real-time bin level monitoring and the potential for future integration of garbage segregation. Overall, this project demonstrates the feasibility and potential of leveraging IoT technologies to develop smarter waste management solutions.