

# Water System Monitoring

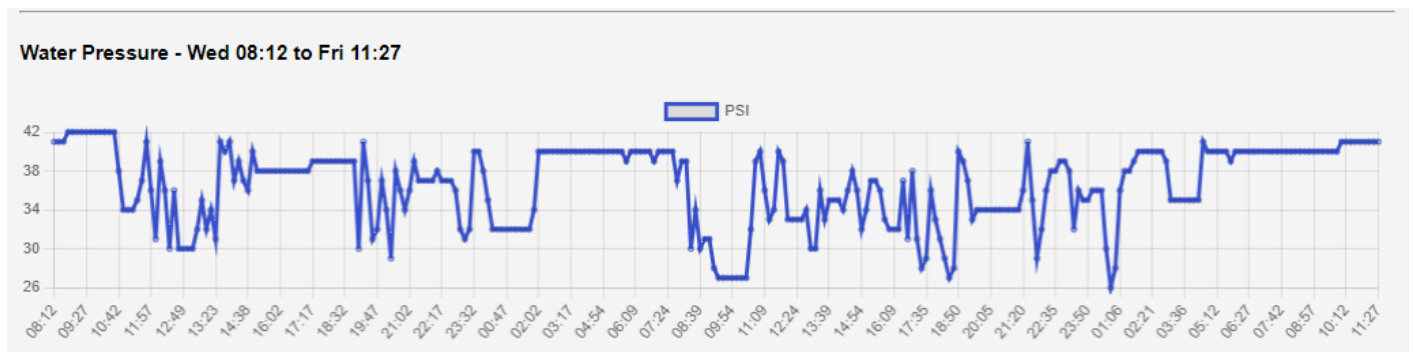


For this project I needed a way to confirm the water pump at a remote location was functioning properly over time. The goal was to ensure the pressure is kept at a consistent 40 psi.

The solution was relatively inexpensive (\$15 in parts) for an easily assembled unit using an automotive pressure sensor. The pressure sensor is wired to a ADS1115 module which then converts to voltage back to a pressure reading. The pressure reading is sent every 5 minutes to a remote server which logs the data and makes the readings available through a web page with line charts.

The server is an HP Elitedesk Pro mini pc with linux running through cloudflare (also free).

## Chart on server showing pressure readings over last 2 days

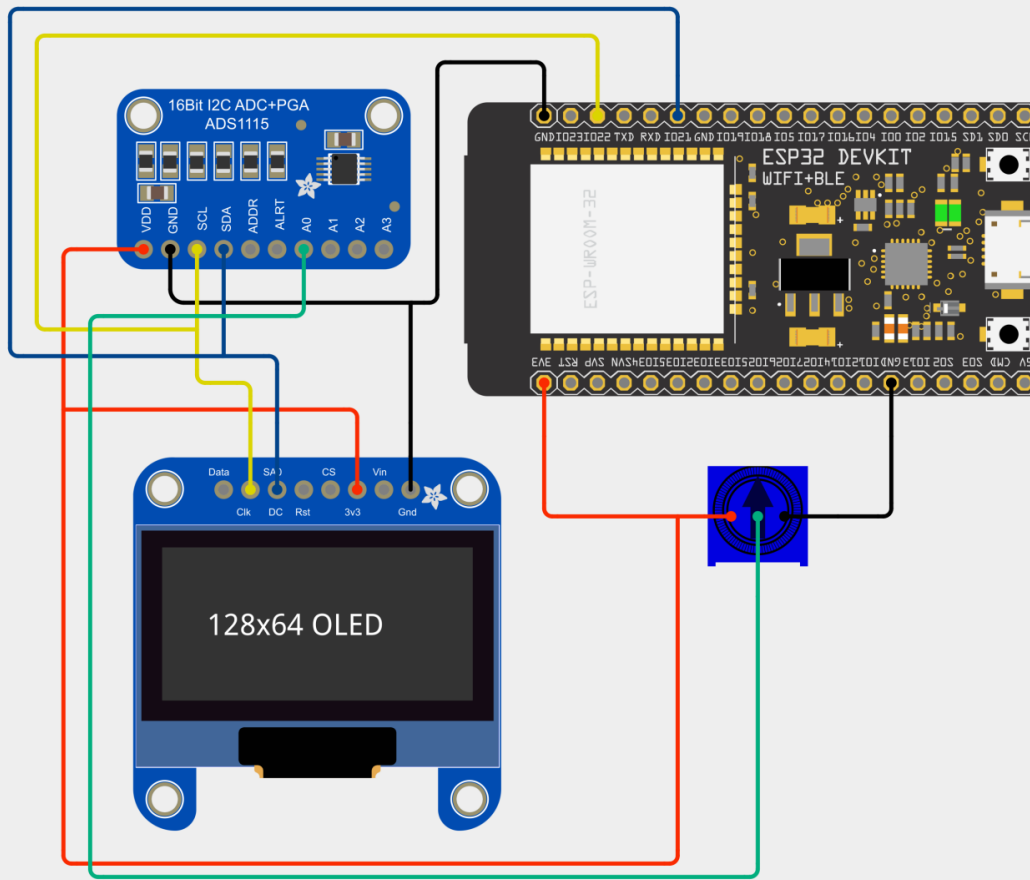


## Components:

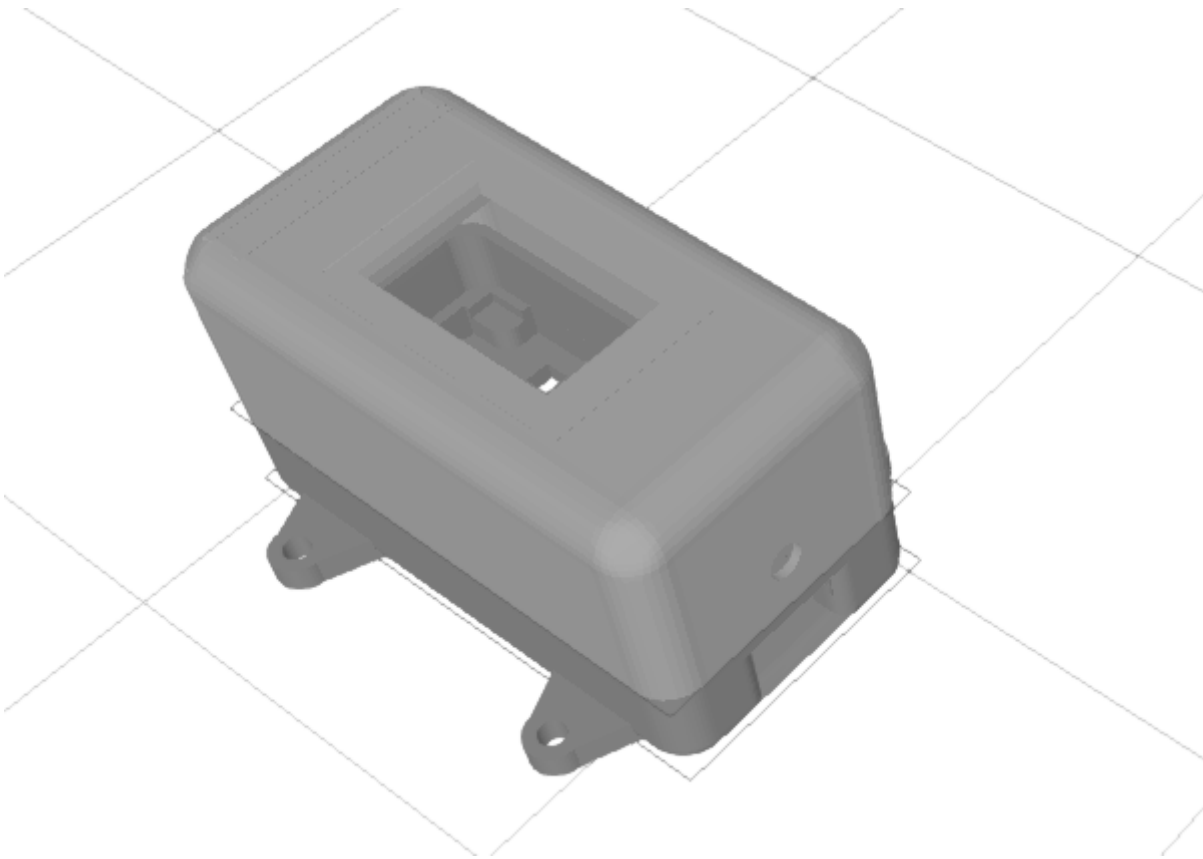
- ESP32 WROOM (\$4.76 CAD) - <https://www.aliexpress.com/item/4000471022528.html>
- 5V 1/8NPT Pressure Transducer (\$6.15 CAD) - <https://www.aliexpress.com/item/1005005255271180.html>
- 16 Bit I2C ADS1115 Module (\$2.79 CAD) - <https://www.aliexpress.com/item/32817162654.html>

- OLED SSD1306 (\$1.53 CAD) - <https://www.aliexpress.com/item/32643950109.html>

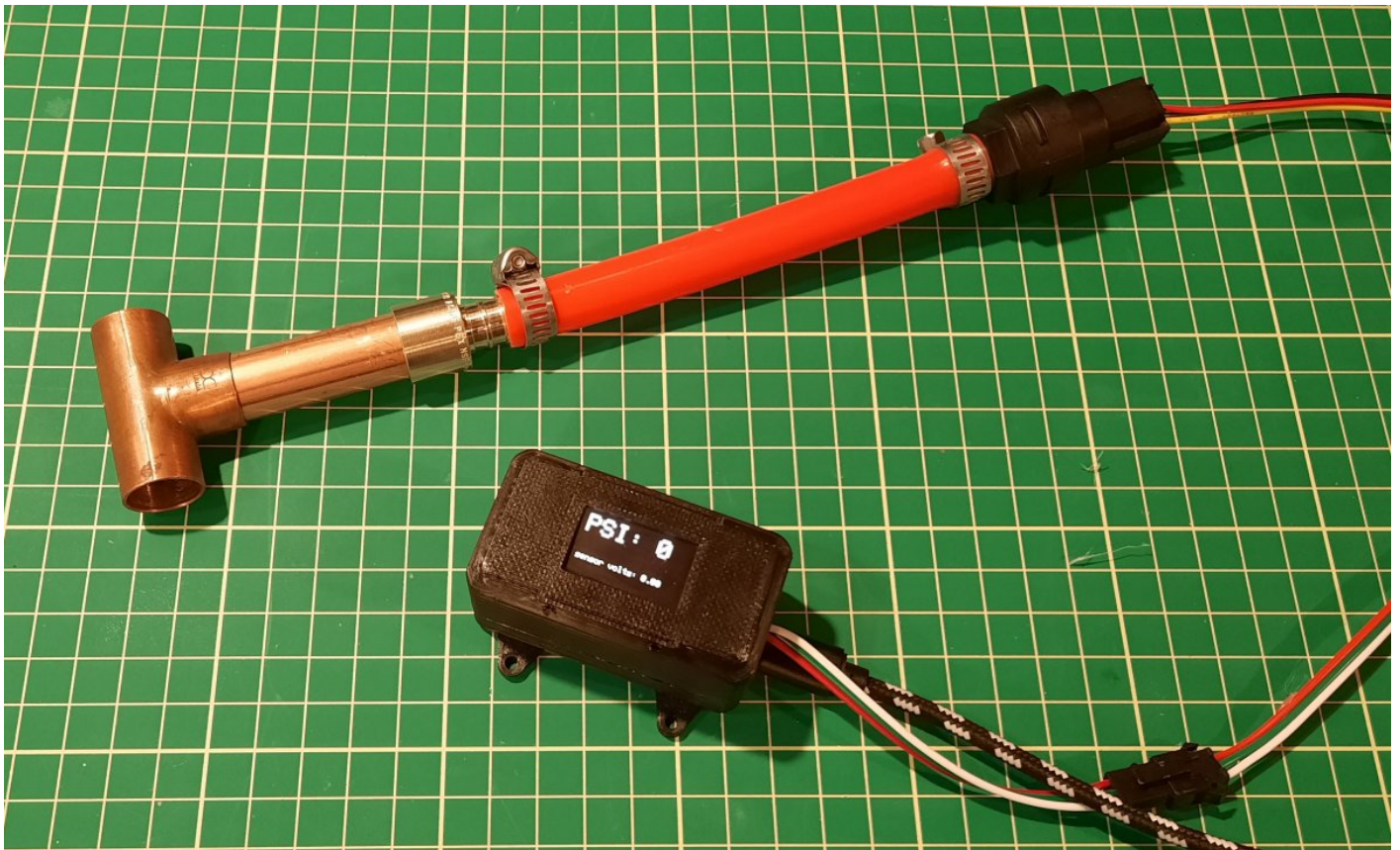
Circuit Designer



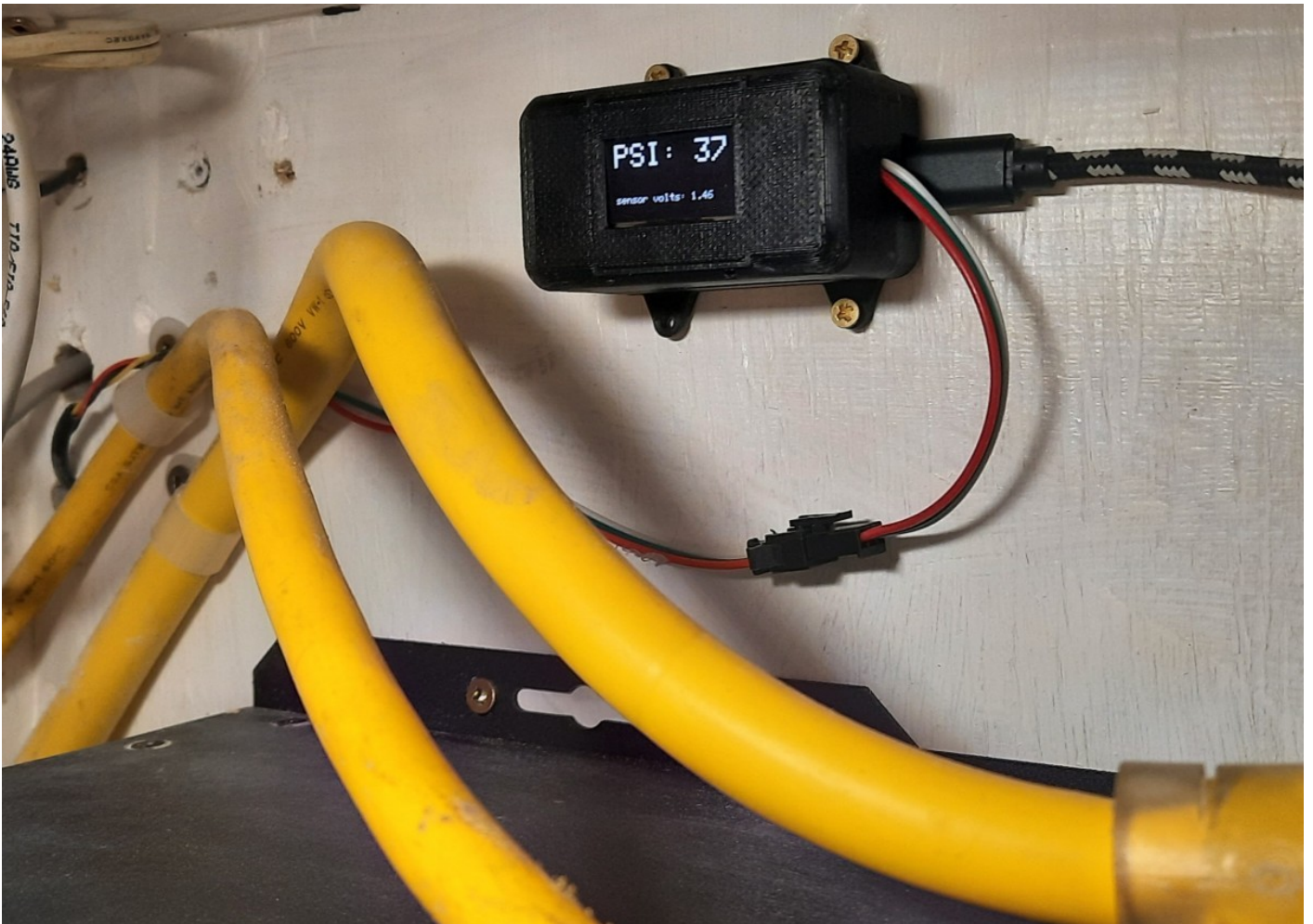
3d model for case designed for free with selfcad ([www.selfcad.com](http://www.selfcad.com))



<https://www.thingiverse.com/thing:6481134>







ESP32 code written in Arduino IDE (<https://www.arduino.cc/en/software>)

```

#include <SPI.h>
#include <WiFi.h>
#include <HTTPClient.h>
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
#include <Adafruit_ADS1X15.h>
#include <EEPROM.h>
#include "anniebitmap.h"

int activeConnection = 1;

// hansen
const String ssid1 = "xxx1";
const String password1 = "xxxxx";

// silo
const String ssid2 = "xxx2";
const String password2 = "xxxxx";

const String heartbeatUrl = "https://test.mysite.ca/silopower/heartbeat.php";
const String pressureUrl = "https://test.mysite.ca/silopower/set_water_pressure.php?data=";

#define EEPROM_SIZE 4
int eepromPingsAddress = 0;
float totalServerPings = 0;
int eepromFailedPingsAddress = 1;
float totalServerPingFails = 0;
int eepromActiveConnection = 1;

#define SCREEN_WIDTH 128 // OLED display width, in pixels
#define SCREEN_HEIGHT 64 // OLED display height, in pixels
#define LOGO_HEIGHT 128
#define LOGO_WIDTH 64

// Declaration for an SSD1306 display connected to I2C (SDA, SCL pins)
#define OLED_RESET - 1 // Reset pin # (or -1 if sharing Arduino reset pin)
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, & Wire, OLED_RESET);

Adafruit_ADS1115 ads;

```

```
long secondsOfHour = 0;

const int secondsPerHour = 3600; // set to 60 for debugging
const int pulseRate = 1000; // loop runs once per second

const int serverSendInterval = 10; // 10 minutes between sending a voltage update to the server
const int samplesPerReading = 60 * serverSendInterval; // every x minutes send a sample to the server

int loopCount = 0;

String payload = "";
int httpCode = 0;
bool wifiConnected = false;
bool wifiPaused = false;
int wifiPausedTick = 0;
bool wifiSleeping = false;
bool debug = false; // when true server does not update
bool serverFailed = false;
int wifiConnectionAttempts = 0;

float basePressureVoltage = 0.46;
float totalledAveragePressure = 0;
float averagePressure = 0;

HTTPClient http;

void setup() {

    Serial.begin(115200);

    // SSD1306_SWITCHCAPVCC = generate display voltage from 3.3V internally
    if (!display.begin(SSD1306_SWITCHCAPVCC, 0x3C)) {
        Serial.println(F("SSD1306 allocation failed"));
        for (;;); // Don't proceed, loop forever
    }

    if (!ads.begin()) {
        Serial.println("Failed to initialize ADS.");
        while (1);
    }
}
```

```
}

display.clearDisplay();
display.drawBitmap(0, 0, epd_bitmap_annie, 128, 64, 1);
display.display();
delay(3000);

//Init EEPROM
EEPROM.begin(EEPROM_SIZE);

activeConnection = EEPROM.read(eepromActiveConnection);

Serial.print("eepromActiveConnection :");
Serial.println(activeConnection);

if (isnan(activeConnection)) {
    activeConnection = 1;
}

if (activeConnection == 0) {
    activeConnection = 1;
}

Serial.print("activeConnection: ");
Serial.println(activeConnection);

float pingData = EEPROM.readFloat(eepromPingsAddress);
if (isnan(pingData)) {
    pingData = 0;
}
totalServerPings = pingData;
EEPROM.end();
EEPROM.begin(EEPROM_SIZE);
float pingFailData = EEPROM.readFloat(eepromFailedPingsAddress);
if (isnan(pingFailData)) {
    pingFailData = 0;
}
totalServerPingFails = pingFailData;
EEPROM.end();
```

```

if (!connectToWiFi()) {
    delay(2000);
    WiFi.disconnect();
    delay(1000);
    if (activeConnection == 1) {
        activeConnection = 2;
    } else {
        activeConnection = 1;
    }
    connectToWiFi();
}

delay(2000); // Pause for 2 seconds

}

void loop() {

    secondsOfHour++;

    // after 24 hours reset this integer
    if (secondsOfHour > 86400) {
        secondsOfHour = 1;
        // Serial.println("restarting :");
        ESP.restart();
    }

    int16_t adc0;

    adc0 = ads.readADC_SingleEnded(0);
    float voltage = (adc0 * 0.1875) / 1000; //- basePressureVoltage);

    float normalizedVolatage = voltage - basePressureVoltage;

    if (normalizedVolatage < 0) {
        normalizedVolatage = 0;
    }

    float pressure = normalizedVolatage * (30 - (normalizedVolatage * 3));

```



```
if (pressure < 0) {

    pressure = 0;
}

totalledAveragePressure += pressure;

averagePressure = totalledAveragePressure / loopCount;

Serial.println("averagePressure: ");
Serial.println(averagePressure);

display.clearDisplay();
display.setTextSize(3);
display.setTextColor(WHITE);
display.setCursor(0, 0);
display.print("PSI: ");
display.println(pressure, 0);
display.println("");
display.setTextSize(1);
display.print("sensor volts: ");
display.println(normalizedVolatage, 2);
display.display();

////////////////////
// SERVER RELAY

if (!debug && (loopCount >= samplesPerReading) || serverFailed) {

    loopCount = 0;
    totalledAveragePressure = 0;

    setWifiSleepMode(false);

    delay(2000);

    // do a heartbeat check to see if we are online...
    http.begin(heartbeatUrl);
```

```
httpCode = http.GET();
if (!httpCode > 0) {
    // wifi may not be alive yet so wait 3 seconds
    delay(3000);
}

String recordedPressure = String(averagePressure, 1);

recordedPressure.trim();

loopCount = 0;

http.begin(pressureUrl + recordedPressure);
httpCode = http.GET();
if (httpCode > 0) {
    payload = http.getString();
    Serial.println("HTTP Response: " + payload);
    recordPingSucces();
} else {
    recordPingFailure();
}
http.end();

setWifiSleepMode(true);
}

loopCount++;

delay(1000);

}

bool connectToWiFi() {

    String activeSsid = "";
    String activePassword = "";

    if (activeConnection == 1) {
        activeSsid = ssid1;
        activePassword = password1;
```

```
} else if (activeConnection == 2) {  
    activeSsid = ssid2;  
    activePassword = password2;  
}  
  
Serial.print("Connecting to WiFi: ");  
Serial.println(activeSsid);  
  
WiFi.begin(activeSsid, activePassword);  
  
while (WiFi.status() != WL_CONNECTED && wifiConnectionAttempts < 20) {  
    delay(500);  
    Serial.print(".");  
    wifiConnectionAttempts++;  
}  
  
wifiConnectionAttempts = 0;  
  
if (WiFi.status() == WL_CONNECTED) {  
    Serial.println("\nConnected to WiFi");  
    Serial.print("IP Address: ");  
    Serial.println(WiFi.localIP());  
    wifiConnected = true;  
  
    EEPROM.begin(EEPROM_SIZE);  
    EEPROM.write(eepromActiveConnection, activeConnection);  
    EEPROM.commit();  
    EEPROM.end();  
  
    Serial.print("set activeConnection to : ");  
    Serial.println(activeConnection);  
  
    return true;  
  
} else {  
    Serial.print("Connection to ");  
    Serial.print(activeSsid);  
    Serial.println(" failed. Trying alternative");  
    return false;  
}
```

```

}

/**
 * set wifi sleep mode between data relays to conserve energy
 * @param sleepMode - if true set wifi card to sleep to conserve energy
 */
void setWifiSleepMode(bool sleepMode) {

    wifiSleeping = sleepMode;

    if (sleepMode) {
        WiFi.disconnect();
        WiFi.setSleep(true);
        delay(1000);
        Serial.print("sleep wifi status: ");
        Serial.println(wl_status_to_string(WiFi.status()));
    } else {
        WiFi.setSleep(false);
        WiFi.reconnect();
        delay(1000);
        Serial.print("awaken wifi status: ");
        Serial.println(wl_status_to_string(WiFi.status()));
        // Check if the connection is still active. if not trigger wait for it to come back online
        if (WiFi.status() != WL_CONNECTED && !wifiPaused) {
            Serial.println("Connection lost. Attempting to reconnect in 1 minute ...");
            WiFi.disconnect();
            wifiPaused = true;
            wifiConnected = false;
            connectToWiFi();
        }
    }
}

/**
 * record server ping success in long term memory
 */
void recordPingSucces() {
    totalServerPings++;
    EEPROM.begin(EEPROM_SIZE);
    EEPROM.writeFloat(eepromPingsAddress, totalServerPings);
}

```

```

EEPROM.commit();
EEPROM.end();

wifiConnected = true;
serverFailed = false;
}

/**
 * record server ping fails in long term memory
 */
void recordPingFailure() {
    totalServerPingFails++;
    EEPROM.begin(EEPROM_SIZE);
    EEPROM.writeFloat(eepromFailedPingsAddress, totalServerPingFails);
    EEPROM.commit();
    EEPROM.end();
    wifiConnected = false;
    serverFailed = true;
}

/**
 * ESP32 wifi card statuses
 * @param status
 * @return string
 */
String wl_status_to_string(wl_status_t status) {

    String response = "";

    switch (status) {
    case WL_NO_SHIELD:
        response = "WL_NO_SHIELD";
        break;
    case WL_IDLE_STATUS:
        response = "WL_IDLE_STATUS";
        break;
    case WL_NO_SSID_AVAIL:
        response = "WL_NO_SSID_AVAIL";
        break;
    case WL_SCAN_COMPLETED:
        response = "WL_SCAN_COMPLETED";

```



```
    break;
case WL_CONNECTED:
    response = "WL_CONNECTED";
    break;
case WL_CONNECT_FAILED:
    response = "WL_CONNECT_FAILED";
    break;
case WL_CONNECTION_LOST:
    response = "WL_CONNECTION_LOST";
    break;
case WL_DISCONNECTED:
    response = "WL_DISCONNECTED";
    break;
}

return response;
}
```

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Revision #38

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