TECHNOLOGICAL UNIVERSITY OF THE PHILIPPINES
COLLEGE OF ENGINEERING
ELECTRONICS AND COMMUNICATION ENGINEERING DEPARTMENT

PECEC-1L
FINAL PROJECT

Weathering the Storm: ESP32 Based IoT System for High-Precision Remote Weather Tracking

SUBMITTED BY:

CASTAÑARES, TONI YENISEI CZAR S.
ETE, FRANCES DESIREE D.
ILIGAN, JOHN MICHAEL O.
ISLA, DANIEL ANGELO B.
REYES, REIGNE KENNETH A.

BSECE – 2C
Fri/1-4 pm

SUBMITTED TO:

ENGR. CHERRY G. PASCION
INSTRUCTOR

DATE PERFORMED:
JUNE 23, 2023

DATE SUBMITTED:
JULY 10, 2023

Weathering the Storm: ESP32 Based IoT System for High-Precision Remote Weather Tracking

I. INTRODUCTION

In the Philippines, which is made up of many islands in Southeast Asia, the weather can be quite unpredictable. They experience a wide range of weather patterns like typhoons, monsoons, and tropical cyclones. These weather events can have a huge impact on the lives and livelihoods of millions of people in the country. That's why it is an important thing to have access to accurate and up-to-date weather information. It helps with things like preparing for disasters, planning agriculture activities, and ensuring the safety of the general public.

Having a wireless weather station in the Philippines is significant. It allows farmers to make smart decisions about when to plant and harvest their crops, which helps them get the best yields and avoid losing crops. It also helps disaster management agencies keep an eye on severe weather conditions so they can evacuate people and take necessary precautions in a timely manner. For individuals and communities, a wireless weather station is a valuable tool for planning outdoor activities, scheduling travel, and protecting their homes and businesses from the unpredictable nature of the weather.

II. PROJECT DESCRIPTION

The Weathering the Storm project aims to create a wireless weather station using the ESP32, DHT11 for temperature and humidity sensor, BMP180 barometric pressure sensor, I2C LCD display module, and other components. The project's main

objectives are to measure and display live values of temperature, humidity, and barometric pressure, and to provide a user-friendly interface for data visualization through the Blynk IoT platform. The weather station collects data from the sensors, processes it using the ESP32 as microcontroller, and wirelessly transmits it to the Blynk, a low-code IoT software platform. Users can view the data in real-time through a web dashboard and a mobile app. Additionally, an I2C LCD display module is included to provide local display of the weather data. The project also focuses on component protection by utilizing an IP65-rated CCTV junction box as the enclosure. By integrating these key components and functionalities, the Weathering the Storm project offers an IoT-based solution for accurate weather monitoring and data analysis.

III. CIRCUIT DIAGRAM

a. Diagram

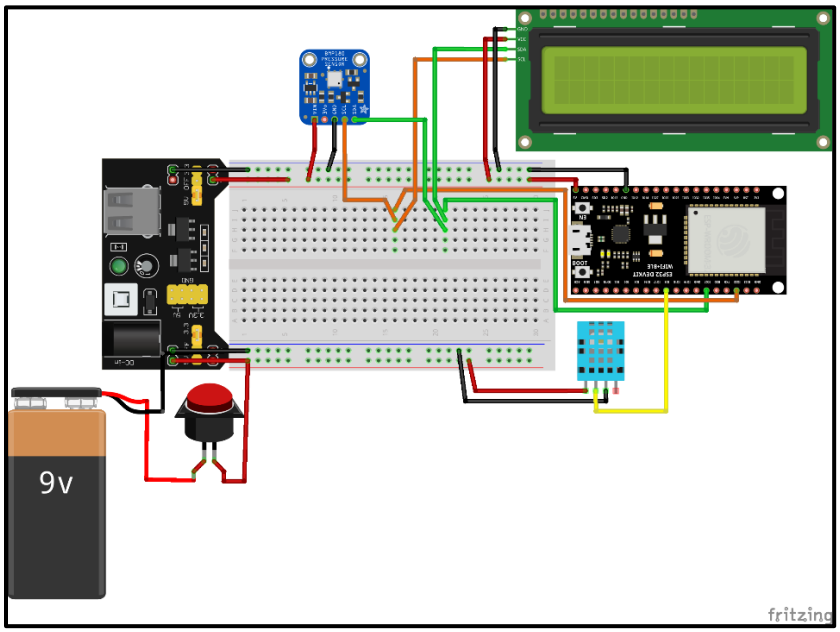

Figure 1: **Circuit Diagram**

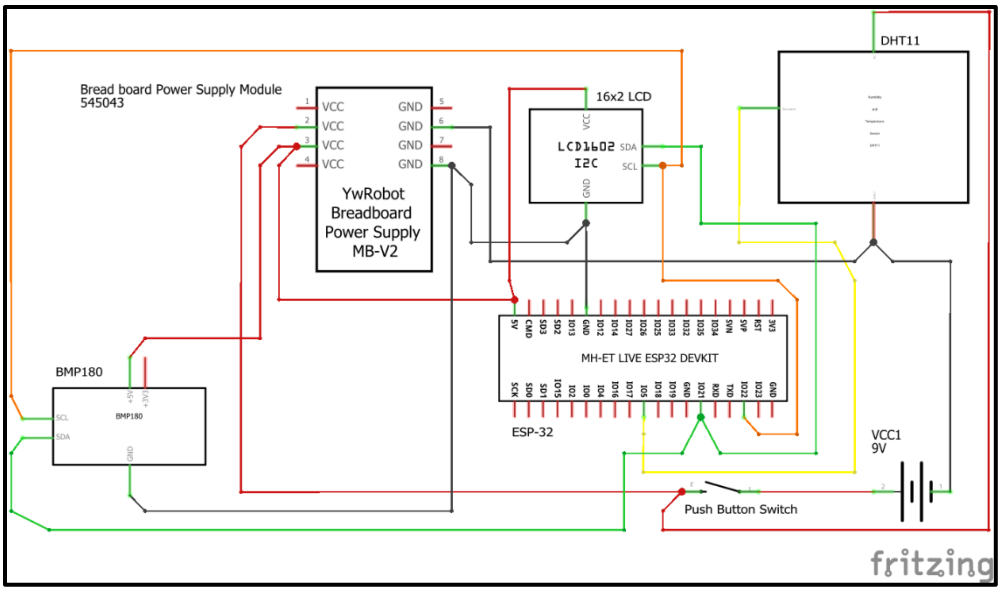

Figure 2: **Schematic Diagram**

b. Connections

i. DHT Temperature & Humidity Sensor

- VCC - VIN on ESP32
- GND – GND on ESP32
- NC – Not Connected
- SIG – D5 on ESP32

ii. BMP180 Barometric Pressure Sensor

- VCC – VIN on ESP32
- GND – GND on ESP32
- SDA – D21 on ESP32
- SCL– D22 on ESP32

iii. 16x2 I2C Liquid Crystal Display

- GND - GND on ESP32

- VCC – 5V on ESP32
- SDA – D21 on ESP32
- SCL – D22 om ESP32

IV. PARTS AND COMPONENTS

Parts	Specification	Quantity
ESP32 Development Board	• Single or Dual-Core 32-bit LX6 Microprocessor with clock frequency up to 240 MHz. • 520 KB of SRAM, 448 KB of ROM and 16 KB of RTC SRAM. • Supports 802.11 b/g/n Wi-Fi connectivity with speeds up to 150 Mbps. • Support for both Classic Bluetooth v4.2 and BLE specifications. • 34 Programmable GPIOs. • Up to 18 channels of 12-bit SAR ADC and 2 channels of 8-bit DAC • Serial Connectivity include 4 x SPI, 2 x I2C, 2 x I2S, 3 x UART. • Ethernet MAC for physical LAN Communication (requires external PHY).	1

	• 1 Host controller for SD/SDIO/MMC and 1 Slave controller for SDIO/SPI. • Motor PWM and up to 16-channels of LED PWM. • Secure Boot and Flash Encryption. • Cryptographic Hardware Acceleration for AES, Hash (SHA-2), RSA, ECC and RNG.	
DHT11 Temperature & Humidity Sensor	• Supply Voltage: 3.5 to 5.5V • Output Signal: digital signal via single-bus • Operating Range and Accuracy (Humidity): 20-80% RH; +/-5% RH • Operating Range and Accuracy (Temperature): 0 to 50°C; +/-2%°C • Average Sending Period: 2 seconds • Dimensions (excluding pins): 12.6mm (0.5”) length x 5.83mm (0.23”) width x 16mm (0.63”) height	1
BMP180 Barometric Pressure Sensor	• Operating Voltage: 1.3V – 3.6V • Input Voltage: 3.3 V – 5.5 V • Peak Current: 1000µA • Consumes 0.1µA standby • Maximum voltage at SDA, SCL: VCC + 0.3V	1

	• Operating Temperature: -40°C to 80°C	
I2C Liquid Crystal Display	• Display capacity: 16 characters x 2 rows • Display color: Blue backlit • Character size: 2.99mm wide x 4.35 mm high • Character pixels: 5W x 7H • Voltage requirements: 5 VDC +/-0.5V • Current requirements: 2mA at 5 VDC • Connection: 4-pin male header with 0.1": spacing • Overall dimensions: 3.15 x 1.42 x 0.51 in (80 x 36 x 13 mm) • Operating temperature range: 32 to 131°F (0 to 55°C)	1
Breadboard Power Supply Module	• Input Voltage: 6.5V to 9V DC • Maximum Output Current: 700mA	1
Breadboard	830 Tie Point	1
9V Battery		
Jumper Wires	Female to Male and Male to Male	
Micro USB Cable		1
IP65 CCTV Junction Box	• Material: ABS • Waterproof up to IP65 • Dimensions: 150x150x70 mm	1

V. ACTUAL PROJECT

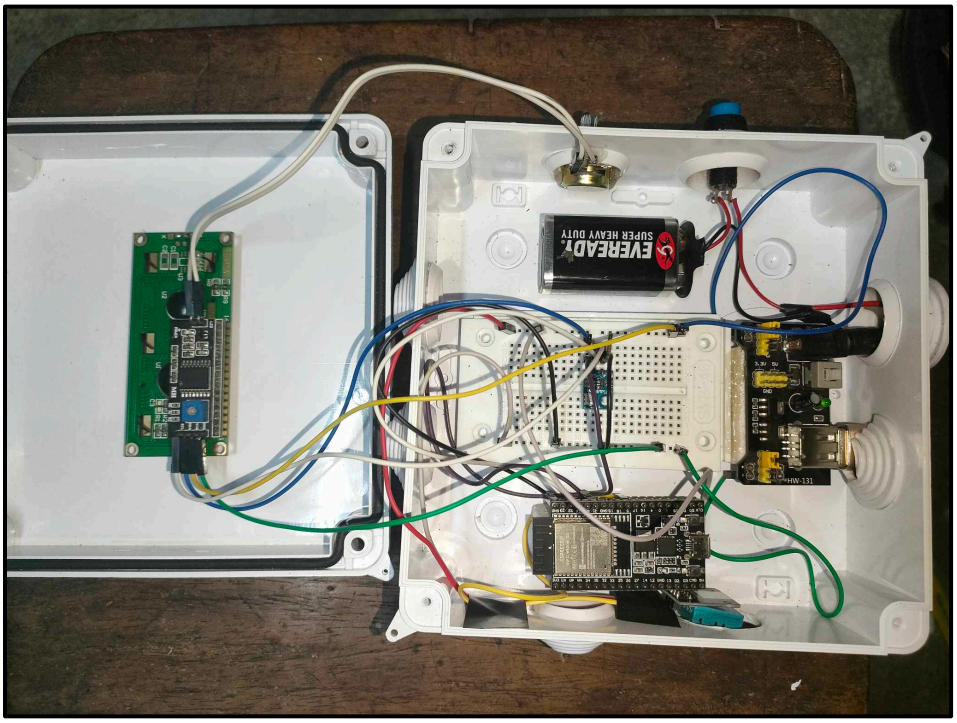

Figure 3: **Weather Station Interior**

Figure 4: **Physical and Web Dashboard of Weather Station**

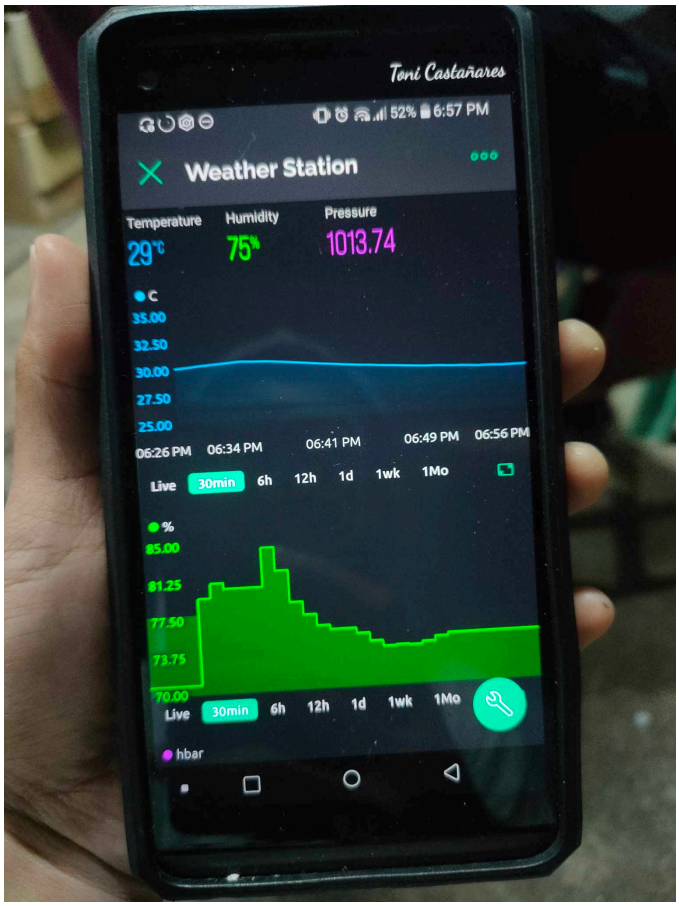

Figure 5: **Mobile Dashboard of Weather Station**

Figure 6: **Web Dashboard of Weather Station**

Figure 6: **System Data After Six Hours**

VI. CONCLUSION

The Wireless Weather Station presents an innovative solution for monitoring weather in the Philippines. It provides precise and up-to-the-minute weather information using wireless technology, allowing people, communities, and groups to make well-informed choices and take proactive steps when faced with changing weather conditions. This weather station is particularly significant in disaster preparedness, agricultural planning, and ensuring public safety. Its presence greatly contributes to creating a safer and more resilient Philippines. Based on the data, a clear indication of incoming rain is the gradual decrease in temperature followed by an increase in air pressure with some variations in humidity that increases before the rain and decreases immediately once it starts. Likewise, temperature continues to drop, humidity remains constant, but the pressure starts to increase once the rain stops.

VII. APPENDICES

a. Specification Sheets

i. ESP32 Development Board

Specification	Details
Microcontroller	ESP32
Operating Voltage	3.3V
CPU	Dual-core, up to 240 MHz
Wi-Fi	802.11 b/g/n
Bluetooth	Bluetooth v4.2 and BLE
GPIO Pins	38 (including UART, SPI, 12C, and PWM
Analog Input Pins	18
Flash Memory	4MB
RAM	520KB
Power Consumption	Varies depending on usage and configuration

ii. DHT11 Temperature & Humidity Sensor

Specification	Details
Sensing Method	Capacitive
Temperature Range	0°C to 50°C (±2°C accuracy)
Humidity Range	20% to 90% (±5% accuracy)
Operating Voltage	3.3V to 5V
Digital Output	1-Wire

Response Time	<5 seconds
Dimensions	15.5mm x 12 mm x 5.5mm

iii. BMP180 Barometric Pressure Sensor

Specification	**Details**
Pressure Range	300hPa to 1100hPa (±1hPa accuracy)
Temperature Range	-40°C to 86 °C (±1°C accuracy)
Operating Voltage	1.8V to 3.6V
Interface	I2C
Altitude Range	0 to 30,000 meters
Power Consumption	5µA (in standard mode)
Dimensions	3.6mm x 3.8mm x 0.93mm

iv. I2C Liquid Crystal Display

Specification	**Details**
Interface	I2C (Inter-Integrated Circuit)
Display Type	Liquid Crystal Display (LCD)
Number of Lines	Varies (e.g., 16x2, 20x4)
Character Size	Varies (e.g., 5x8, 5x10)
Backlight	LED backlight

Operating Voltage	5V
Dimensions	Varies depending on the model

v. Breadboard Power Supply Module

Specification	**Details**
Input Voltage	6.5V to 12V DC
Output Voltage	3.3 and 5V (selectable)
Maximum Current	700mA
Indicator LEDs	Power, 3.3V, 5V
Power Supply Rails	+ and – rails for easy connection
Dimensions	Varies depending on the model

b. References

[1] Adafruit Industries. (n.d.). DHT11 datasheet. Retrieved from https://cdn-learn.adafruit.com/downloads/pdf/dht.pdf

[2] Adafruit Industries. (n.d.). Using I2C LCDs. Retrieved from https://learn.adafruit.com/i2c-spi-lcd-backpack

[3] Bosch Sensortec. (2011). BMP180 datasheet. Retrieved from https://cdn-shop.adafruit.com/datasheets/BST-BMP180-DS000-09.pdf

[4] Department of Agriculture. (n.d.). Official Website. Retrieved from https://www.da.gov.ph/

[5] Espressif Systems. (n.d.). ESP32 Datasheet. Retrieved from https://www.espressif.com/sites/default/files/documentation/esp32_datasheet_en.pdf

[6] Hobby Components Ltd. (2019). MB102 Power Supply Module. Retrieved from https://hobbycomponents.com/quickstart-guide/66-breadboard-power-supply-module-quickstart-guide

[7] Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA). (n.d.). Official Website. Retrieved from https://www.pagasa.dost.gov.ph/

[8] Philippines' National Disaster Risk Reduction and Management Council. (n.d.). Official Website. Retrieved from http://www.ndrrmc.gov.ph/