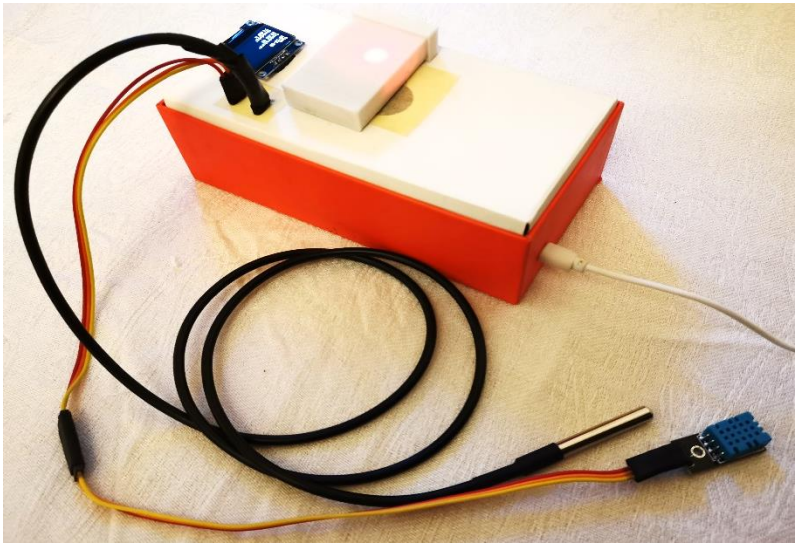
MEL 5405

Electronic Instrumentation Laboratory

ESP 32 Temperature and Humidity Data Acquisition Device

Technical Manual



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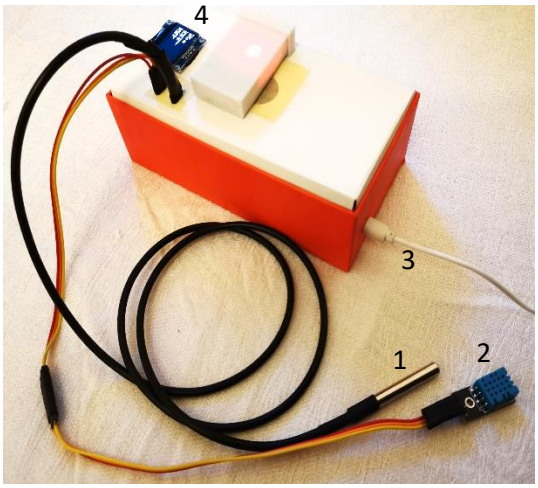
Introduction



1. Temperature Sensor
2. Humidity Sensor
3. Charging Port (micro-USB)
4. OLED Display

Figure 1: Temperature and humidity data acquisition device

This is an ESP32 data acquisition device and this device capable of collecting the temperature and humidity data. It has a display that shows the current temperature and humidity and the time. It uses the Internet via WiFi to get/update the current time of the ESP32 from an NTP server. Acquired data will be transmitted using MQTT, UDP, and HTTP protocols to external servers/clients via WiFi. If the Internet connection breaks up the data will be recorded when the Internet connects again the recorded data will be sent to the external servers/clients. pair of 18650 Li-ion batteries are used to power this device.

Features

- Collect Temperature and Humidity from the sensors
- Update the time from an NTP server
- Display the temperature, humidity, and time.
- Send the temperature, humidity, and time using the UDP protocol

Figure 2: OLED Display

Time	From IP	From Port	To Address	To Port	Method	Error	ASCII	Hex
00:18:45.734	192.168.8.101	54023	You	44444	UDP		Temperature: 29.81 Humidity: 72.00 Time : 1622832531	54 65 6D 70 65 72 61 74 75 72 65 3A 20 32 39 2E 38 31 20 48 75 6D 69 64 69
00:15:46.841	192.168.8.101	54023	You	44444	UDP		Temperature: 29.81 Humidity: 73.00 Time : 1622832350	54 65 6D 70 65 72 61 74 75 72 65 3A 20 32 39 2E 38 31 20 48 75 6D 69 64 69
00:12:47.330	192.168.8.101	54023	You	44444	UDP		Temperature: 29.75 Humidity: 73.00 Time : 1622832169	54 65 6D 70 65 72 61 74 75 72 65 3A 20 32 39 2E 37 35 20 48 75 6D 69 64 69
00:09:47.824	192.168.8.101	54023	You	44444	UDP		Temperature: 29.69 Humidity: 73.00 Time : 1622831988	54 65 6D 70 65 72 61 74 75 72 65 3A 20 32 39 2E 36 39 20 48 75 6D 69 64 69
00:06:48.213	192.168.8.101	54023	You	44444	UDP		Temperature: 29.69 Humidity: 73.00 Time : 1622831807	54 65 6D 70 65 72 61 74 75 72 65 3A 20 32 39 2E 36 39 20 48 75 6D 69 64 69

Figure 3: UDP Data

- Send the temperature, humidity, and time using the MQTT protocol

Figure 4: MQTT Data

- Send the temperature, humidity, and time using the HTTP protocol to the university server

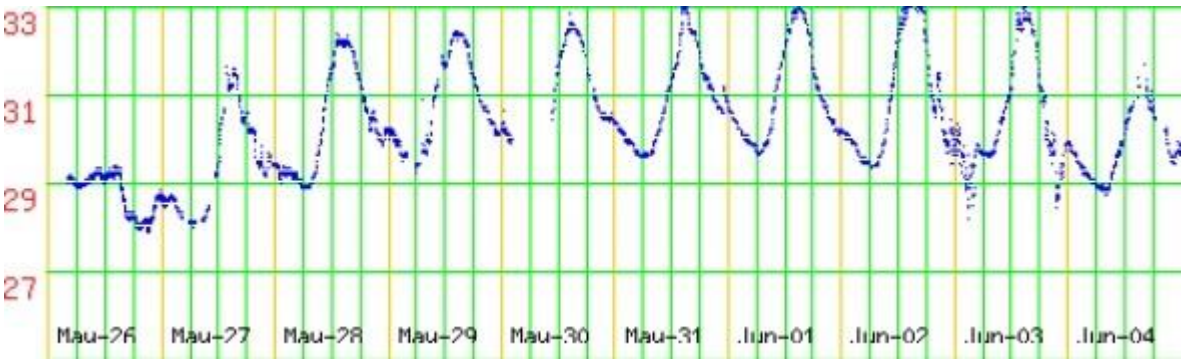


Figure 5: Temperature Graph

- Record data when no WiFi and send recorded data when WiFi available. (2000 records can be held in the device when exceeding the 2000 records earliest recorded data will be deleted)
- Work as a web server (if the IP address of the ESP32 called from a web browser temperature, humidity and time will be shown on a dynamic web page)

Figure 6: Web Portal

- More than 48hours can be powered the unit after a full charge of the battery unit
- The device is working while charging.
- The device can be power directly via the micro-USB port on the ESP 32 module
- ESP32 dev board, OLED display, DS18B20 Temperature sensor and DHT11 humidity sensor can be replaced easily without any soldering.
- Batteries can be replaced without turning off the unit (two batteries are connected parallelly if one battery removes no harm will occur but both batteries can't be removed at the same time)

Specifications

- Temperature Range -10°C to +85°C (Accuracy ± 0.5 °C)
- Humidity Range 20% to 90% (Accuracy ± 1%)
- Battery capacity 6400mAh (48 hours working time)
- 0.96-inch 128 x 64 OLED Display (text color - white)
- Micro USB charging port (Input voltage - 5V, current - 1A)
- Data sending frequency is 20 per hour.

Block Diagram

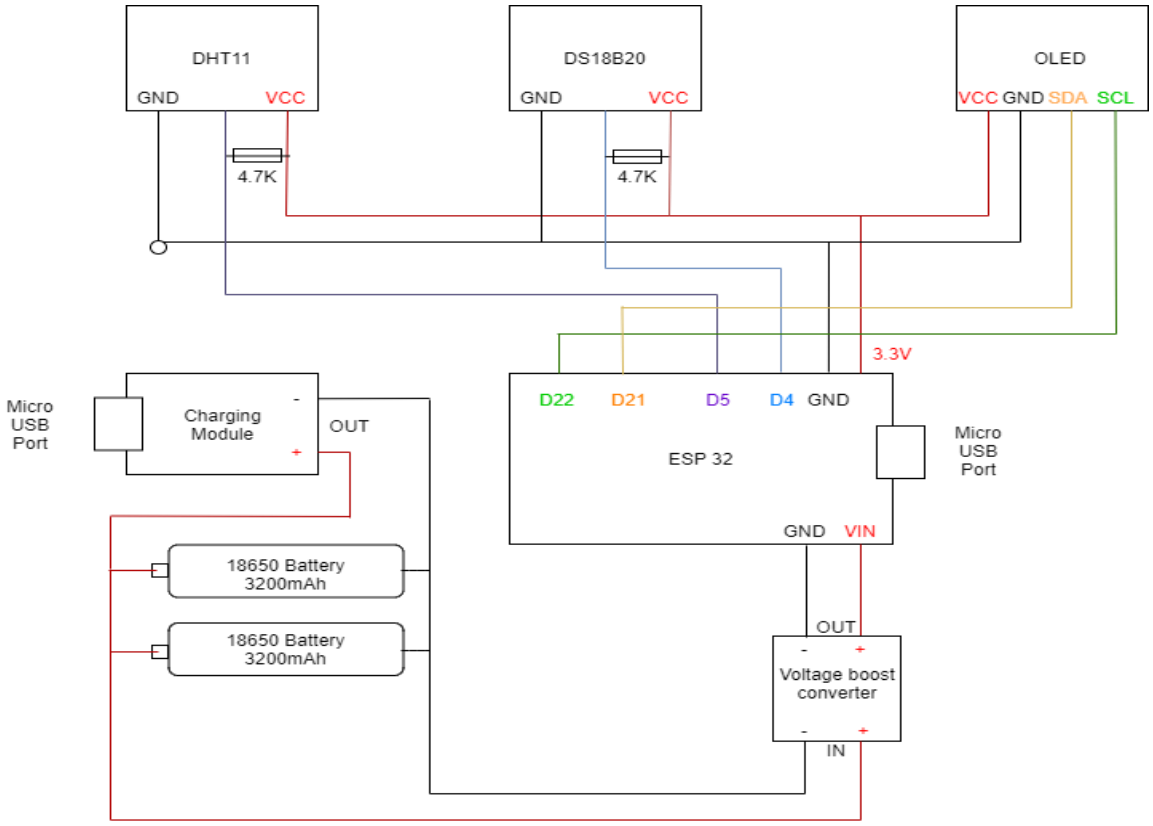


Figure 7: Block Diagram

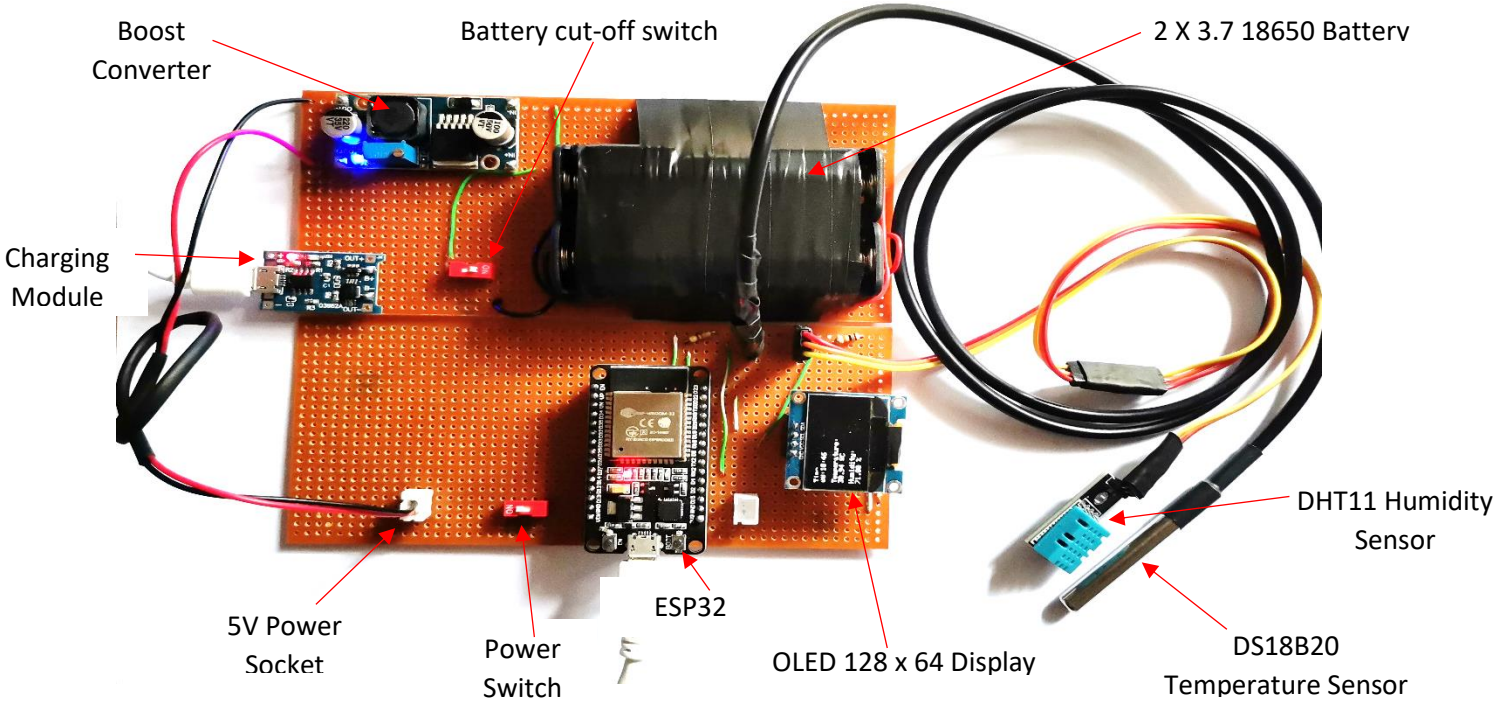


Figure 8:Temperature and humidity data acquisition device circuit

Description

First, the ESP32 will try to connect to the Internet via WiFi. If it connects then it will try to connect the NTP server and update the time of the ESP32. The temperature will read from the DS18B20 sensor and humidity will read from the DHT11 sensor. the current time of the esp32, temperature, and humidity data will be shown on the display at the same time those data will also be sent to the clients/servers using MQTT and UDP protocols. these time, temperature, and humidity values will be pushed to a queue, and esp32 will enable its wakeup timer and goes to a light sleep for three minutes. after three minutes it will wake up and repeats the above process and goes to the light sleep again. when the length of the queue reached 5 all the data will be sent in the queue to the university server using the HTTP protocol one by one (using POST method) and pops all the values of the queue. if the ESP32 could not be connected to the Internet then it will skip updating time from the NTP server and sending data but it will display the data on OLED and data will be pushed to the queue. the maximum length of the queue is 2000 if ESP32 could not be connected to the Internet it doesn't check the length of the queue it will keep pushing data into the queue. once the queue reached its maximum the oldest data will be popped and new data will be pushed. when it could connect to the Internet it will check the length of the queue and if the length of the queue is a multiplication of 5 then all the data of the queue will be sent to the university server. so that system can run without internet for days. this system also works as a server it can generate a dynamic web page to display current time, humidity, and temperature. Users can call this by entering the IP address of the ESP32 in the address bar of a web browser. In every iteration, ESP32 will sleep for three minutes. At that time ESP32 will not respond and generate the web page.

This is a battery-powered system and two parallel-connected 18650 li-ion batteries(3200mAh) are used. A charging module is used to charge these batteries. it has a micro-USB port to connect the power source. A red led will light up to indicate that batteries are still charging after the batteries are fully charged red led will turn off and a blue led will light up to indicate that batteries are fully charged on the charging module. These batteries are connected to a boost converter module to boost the battery voltage to 5V and this 5V line will power the system. Because the batteries are connected parallel single battery can be removed and it will not affect the system so batteries can be replaced without shutting down the system.