Implementation and Design of a Monitoring System for Tikrit Substation Using IoT

Omer Tareq Khattab [a], Dr. Mshari A Alshmmri [b] , Dr. Mehdi J. Marie [c]

[a] Master student, College of Computer Science and Mathmatics , Tikrit University , omeralsanawi@tu.edu.iq
[b] College of Computer Science and Mathmatics , Tikrit University, Dr.mshary.alshmmry@tu.edu.iq
[c] Ministry of Industry and Minerals, Baghdad, Iraq, mehdijelo@gmail.com

Abstract: Substation automation has become very necessary to improve the monitoring process and the workflow of the station, and it is necessary to detect the type of restriction that is taking place, therefore, it needs a monitoring system that is able to automatically detect, monitor and classify the existing restrictions. The purpose of this project is to remotely obtain electrical parameters such as voltage, current, temperature, humidity and flame and send the values in real time over the network. In addition, this system is designed to send alerts whenever the voltage or current exceeds pre-set limits. This project uses the IoT platform (Ubidots), in addition to the ESP32 microcontroller. The controller can communicate efficiently with the different sensors used.

Keywords: Voltage Sensor, Current Sensor, Humidity & Temperature Sensor, IoT, Flame Sensor, ESP32 , monitoring system ,Substation, Ubidots.

1. Introduction

Electric energy is used in various fields in our daily life in terms of household uses such as lighting, heating, operating household electrical appliances and in all other fields such as industry, agriculture, communications and scientific fields.

Transmission lines carry high voltage electricity over long distances, while distribution lines carry low voltage electricity to residential and commercial buildings over shorter distances. The transmission and distribution lines are connected by substations, which convert voltages up and down, as well as having additional and essential tasks of continuous measurement, monitoring, protection and control in their part of the network.

Systematic inspection of electrical substations is essential to detect malfunctions, which lead to a lot of wasted energy and major technical injuries, and fire. Therefore, reliable, accurate, and regular inspections are important to ensure long-term safe operation, safety, and protection (Usamentiaga, Fernandez, Villan, & Carus, 2018).

Therefore automation of substations has become necessary to increase their efficiency and improve the quality of the power supplied **(Gandhi, Kumar, Rodríguez-Gallegos, & Srinivasan, 2020)**. IoT technology provides an easy way to monitor problems in the power grid without spending manual efforts and extra time **(Raghavan et al., 2020)..**

The Internet of Things (IoT) is a network of physical devices integrated with electronics, software, sensors, actuators, and network connectivity that has the ability to identify, collect

and exchange data for communication purposes through wired or wireless connections. Monitor and manage power system applications so that machine operators can use the monitoring system in real time Actual to make informed decisions on electrical matters in substations **(Triantafyllou, Sarigiannidis, & Lagkas, 2018).**

2.Significance Of The Study

s The proposed system is manifested in that the system is controlled and controlled automatically to avoid errors and maintain a high level of accuracy and reliability, which helps reduce losses and electrical interruptions.

2- Monitoring the station from high temperature, humidity, or fires, and giving an alert when this occurs.

3- The proposed system will save time and effort in monitoring the station, reduce the number of employees and protect them from dangers.

3.Review Of Related Studies

In (Hossain, Rahman, Sarker, Haque, & Jahid, 2019)proposed a study on the development of a smart system based on the Internet of things for remote monitoring, which is an automated system that includes self-checking of the oil level and quality from the transformer / oil circuit breaker, and continuous sensing of two CT secondary currents, which sends data To the web server, and store and display the data in the web page, in view of this the proposed model has the ability to work with minimal manpower requirements and the lowest cost of operation and maintenance as a modern technology.

in (Balamurugan, Bhavya, Radhakrishnan, Kannan, & Lalitha, 2019)proposes a project to monitor substations using the microcontroller and the Internet of Things, by ensuring that the faults of the local substations are immediately realized and reported to the relevant departments via IOT, where the microcontroller collects data from sensors that measure current and voltage in substation and sends the measured parameters as SMS messages. It protects the distribution and power transformer from burnout due to overload, short circuit faults, overvoltage and sudden surges by shutting down the entire unit from the control area. Which reduces substation labor cost and spare parts time. Thus, the monitoring and working efficiency of the substation will be increased.

in (Hussain et al., 2020) a project to provide a simplified and efficient system to make the substation smart and secure any time , to ensure the quality of power provided to consumers by integrating a VCPID controller capable of mitigating abnormal conditions on the system. So the system is automated and also the real-time values of important line parameters are continuously monitored by IOT and cloud server. This provides complete data on the operating conditions of the systems for the entire period of their operation. The SMS alert via the GSM module informs the operator about the status of the system if the system is turned off or on. Load separation is preset using a timer that can control peak demand.

In (PRAKASH, 2020)proposes a model for monitoring and adjusting substations and transformer factors such as voltage, current, power and temperature. Using the Arduino and different types of sensors such as the current sensor (ACS 712), voltage sensor (25 V) and temperature sensor (LM 35). It monitors all parameters and sets the logic of comparative

coding so that it alerts when parameters exceed the limit or below the limit, and are displayed on the OLED screen. It will alert the people sitting in the substation by buzzer and LED indicator. And adding the IOT module so that it can be monitored and controlled from anywhere in the world.

4.Methods

In this part, the proposed work is discussed, whereby a visit to the Tikrit South Substation, which operates at a voltage of 11-132 kV, was visited to determine the points from which it is possible to obtain the important readings of the substation that are manually collected in paper records, inaccurately rather than in time. Therefore, it was proposed and designed a control and control system based on the Internet of things for the electrical distribution station .Where used in this system are hardware and software such as microcontrollers, sensors and the Internet of Things platform, all of which are dedicated to the implementation of a specific process. Where the process of turning on and off, sending and receiving data is monitored and displayed in real time on the Internet of Things platform, where the IOT system is monitored at any time and in anywhere online. Figure 1 shows the Block diagram parts of the system.

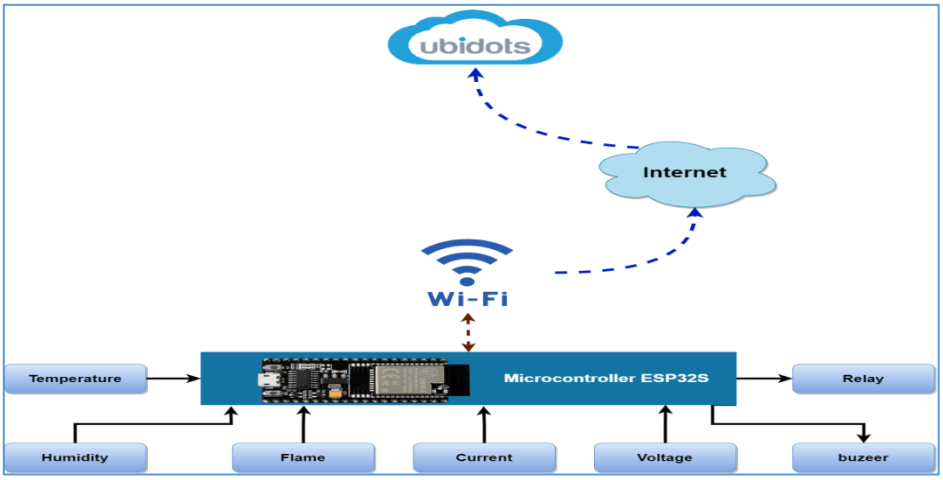

Figure 1.Block diagram parts of the system

The NodeMCU microcontroller (ESP-32S) is an open source platform that has the ability to exchange data with different devices and sensors. It is in the form of a small board that contains a dual-core Xtensa LX6 processor, equipped with RAM and flash memory, and contains 36 digital ports, PWM and ADC ports, and what distinguishes this board is the presence of a Bluetooth chip and a Wi-Fi chip that allows it to share data**(Foltýnek, Babiuch, & Šuránek, 2019).**

Various sensors have been used, including the current sensor (ACS712), which is used in industrial, commercial and communication systems, providing cost-effective and accurate solutions for sensing AC or DC current. It works with microcontrollers such as ESP and other similar technologies and has several measuring units, namely 5A, 20A, 30A**(Mnati et al., 2020)** .In addition, the(F031-06) voltage sensor measures DC voltage from 0 to 25 volts. This sensor works on the principle of a voltage divider and consists of two resistors 30 kilo

ohms and 7.5 kilo ohms. It has several units of measurement, which are 5v, 20v, 30v **(El Hammoumi, Motahhir, Chalh, El Ghzizal, & Derouich, 2018)** .

The Temperature and Humidity Sensor (DHT11) This sensor measures the temperature in Celsius / Fahrenheit. In addition, it can measure humidity. Its components include the wet-sensing resistor and NTC temperature-sensing components **(Bhadani & Vashisht, 2019).**The flame sensor is a fire detection device. The detection distance is up to 100 cm, and the wavelength range is (760 - 1100 nm). The sensor can output a digital or analog signal, and is used as a flame detector or as part of firefighter robots. The unit readings are stable thanks to the operating voltage (3.3-5 V) and comparison chip LM393 **(Aliff, Sani, Yusof, & Zainal, 2019).**

The relay is an electromechanical device that allows the microcontroller to manage loads with high voltage or intensity. It is a control device for direct or alternating current circuits and acts as a switch. The device responds to the signal that comes out of the microcontroller and through the LED indicator in it gives the signal of opening and closing ***(Hameed, 2020)*.**

The Buzzer is a sound-generating device that converts electrical energy into sound. This device is used to send sound signals or to trigger alerts. Or set the time, which is important in IoT systems because it is used for external alerts and warnings **(Leninpugalhanthi et al., 2019).**

The previously mentioned sensors and devices were used to implement a monitoring system to obtain important parameters of switchgear in substations in real time. It is connected as shown in Figure(2). These sensors are essential in electrical systems. This data is collected from the sensors by the ESP32s microcontroller and sent to the IoT platform(Ubidots).

Ubidots It is a cloud platform for Internet of Things applications. It provides a simple and secure way to send and receive various sensor data to and from IoT devices using the global cloud in real time. It is a stable platform for hobbyists, innovators and professionals that enables them to prototype and scale their production IoT projects. In addition, the data stored in it is secured and protected and only users with permission can access this data **(Mohammed, 2020)**. the Figure (3) shows the flowchart system .

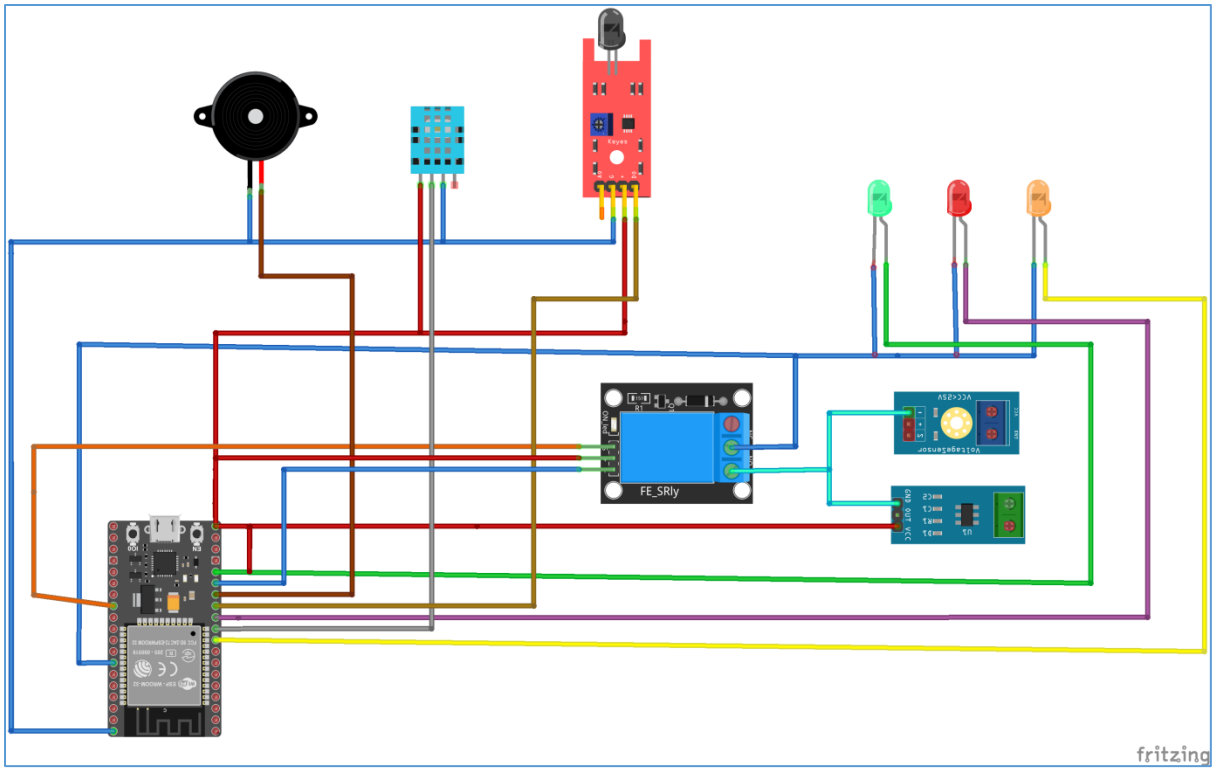

Figure 2 Connection of the sensors with the ESP-32S

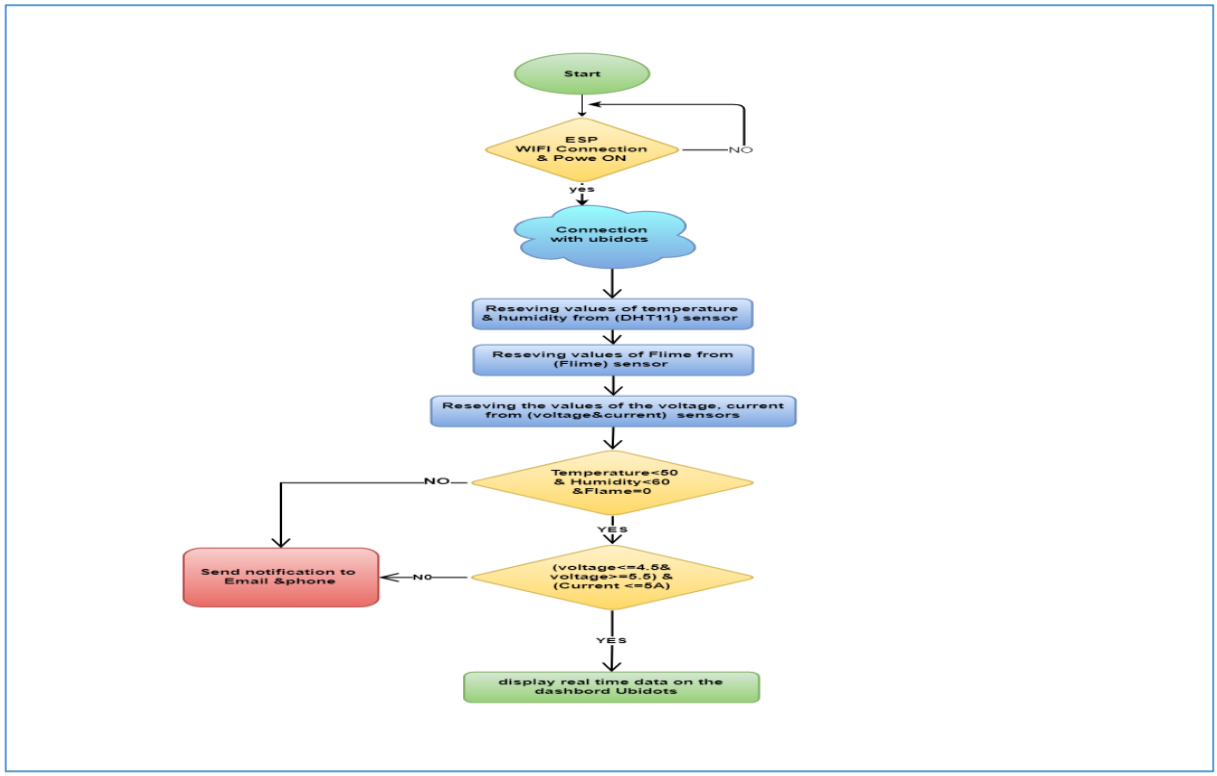

Figure 3.Flowchart for the proposed system

5.Results

In this section the results of the proposed system will be presented. Where the system was tested and checked by sending measurements of important electrical parameters (voltage ,

current, temperature, humidity and flame) measurements to the Internet of Things platform. The user received a real-time alert notification.

Where Figure 4 shows the over voltage, Figure 5 shows the under voltage, Figure 6 shows the over current, Figure 7 shows the High Temperature, Figure 8 shows the High Humidity and Figure 9 shows the Fire.

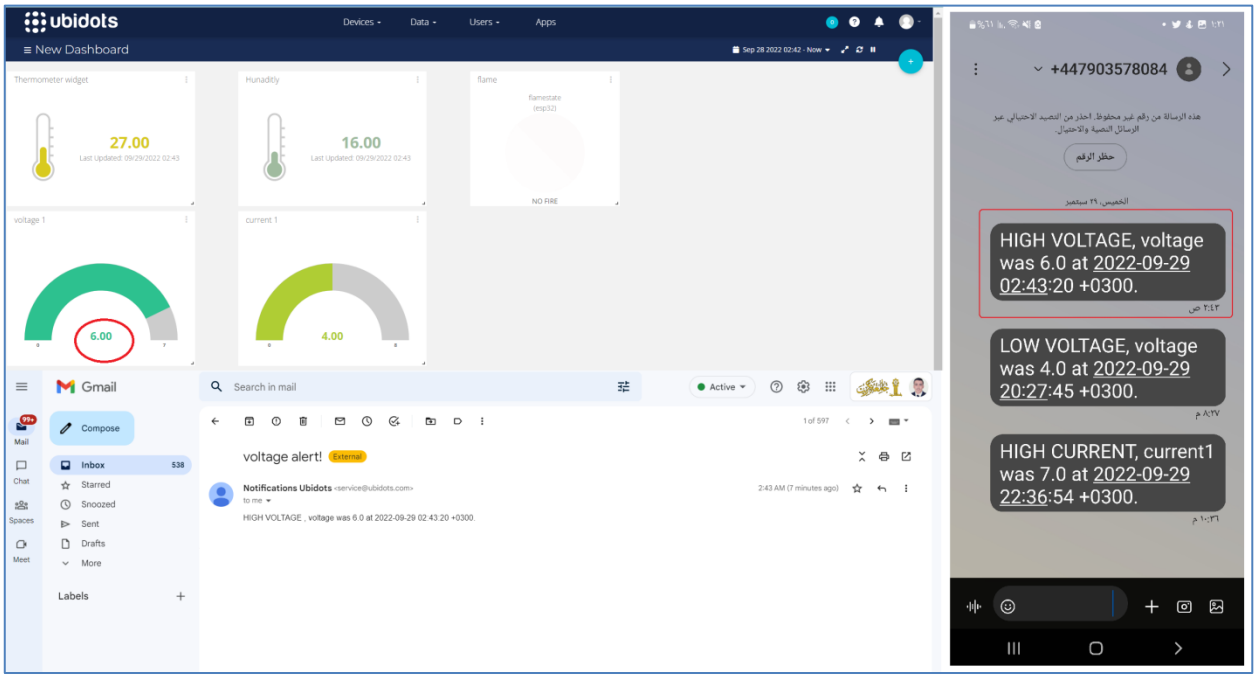

Figure 4 .the over voltage

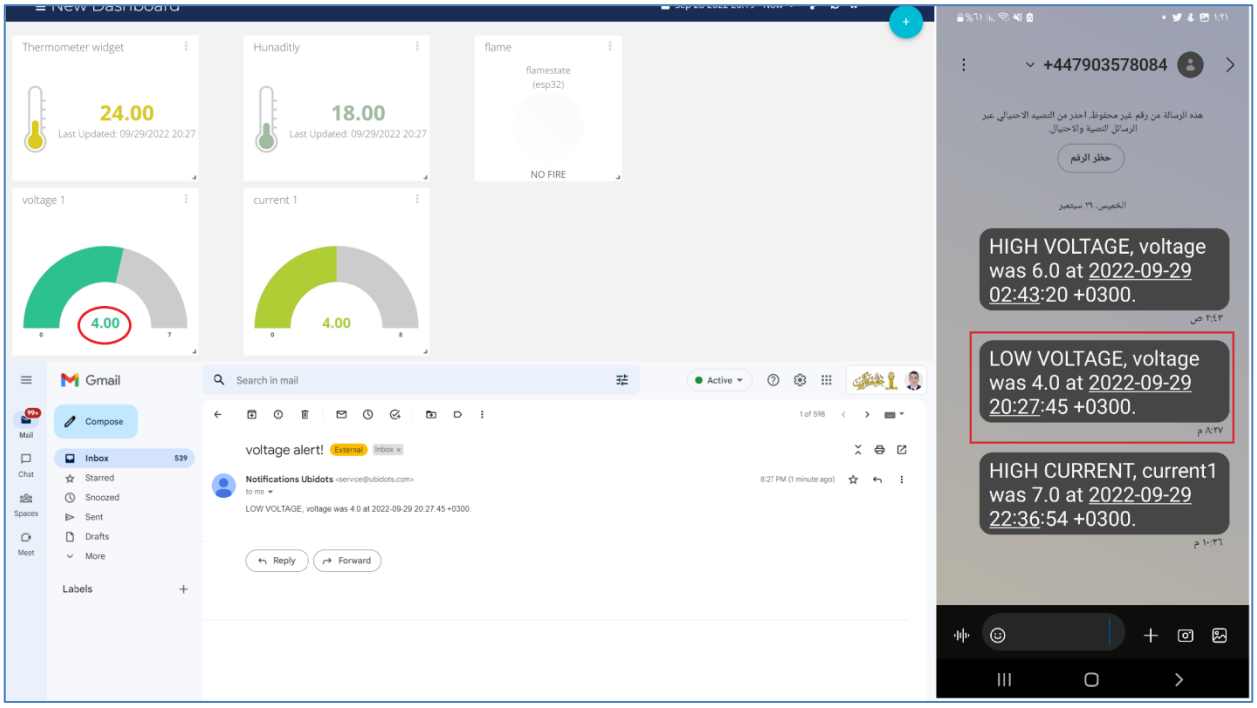

Figure1.The under voltage

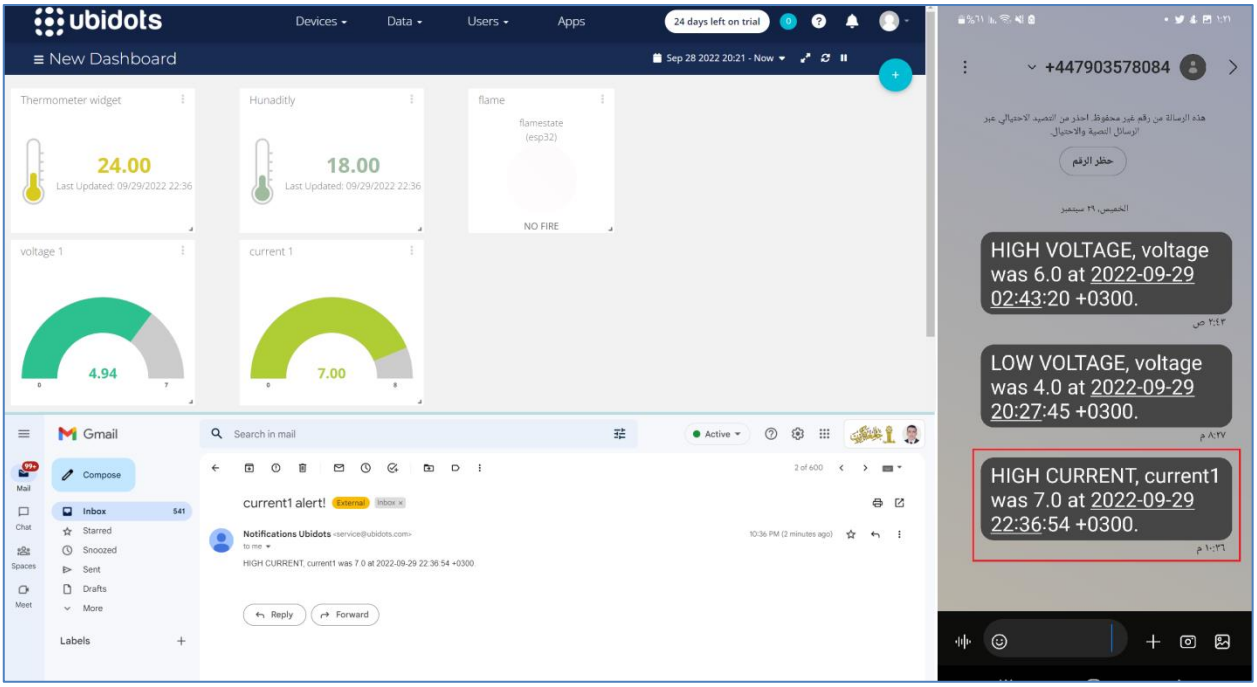

Figure6. The over current

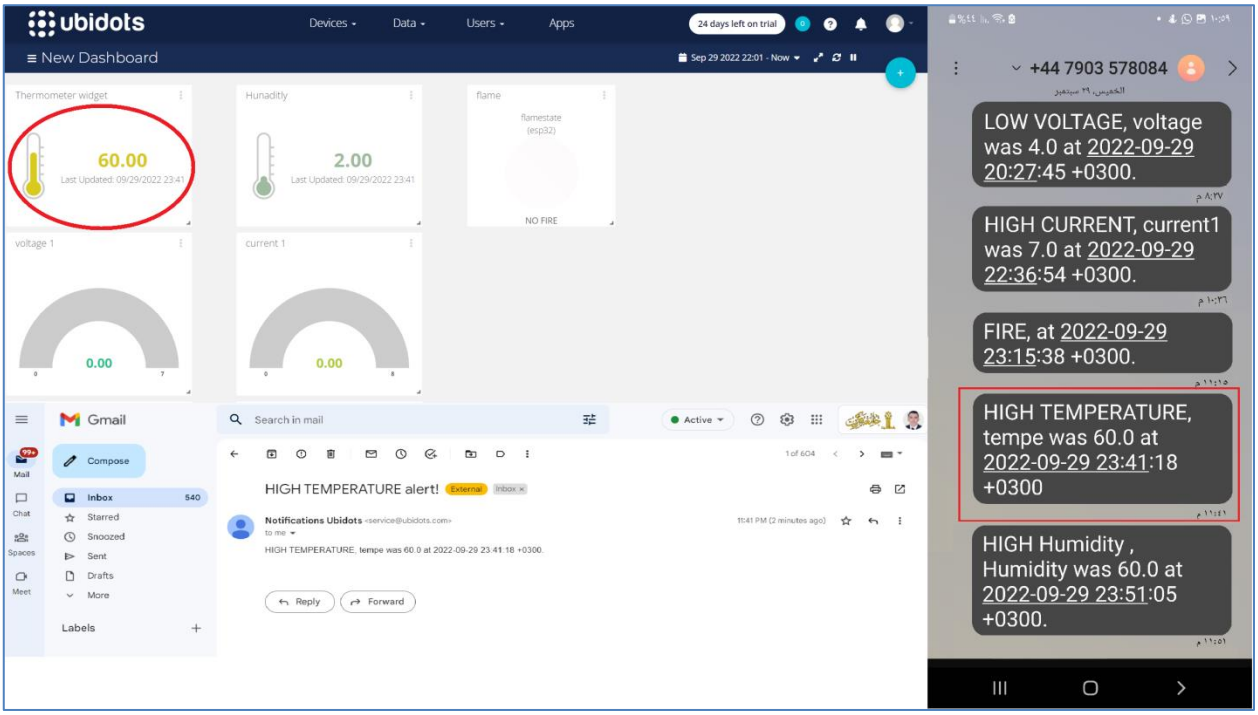

Figure7. the High Temperature

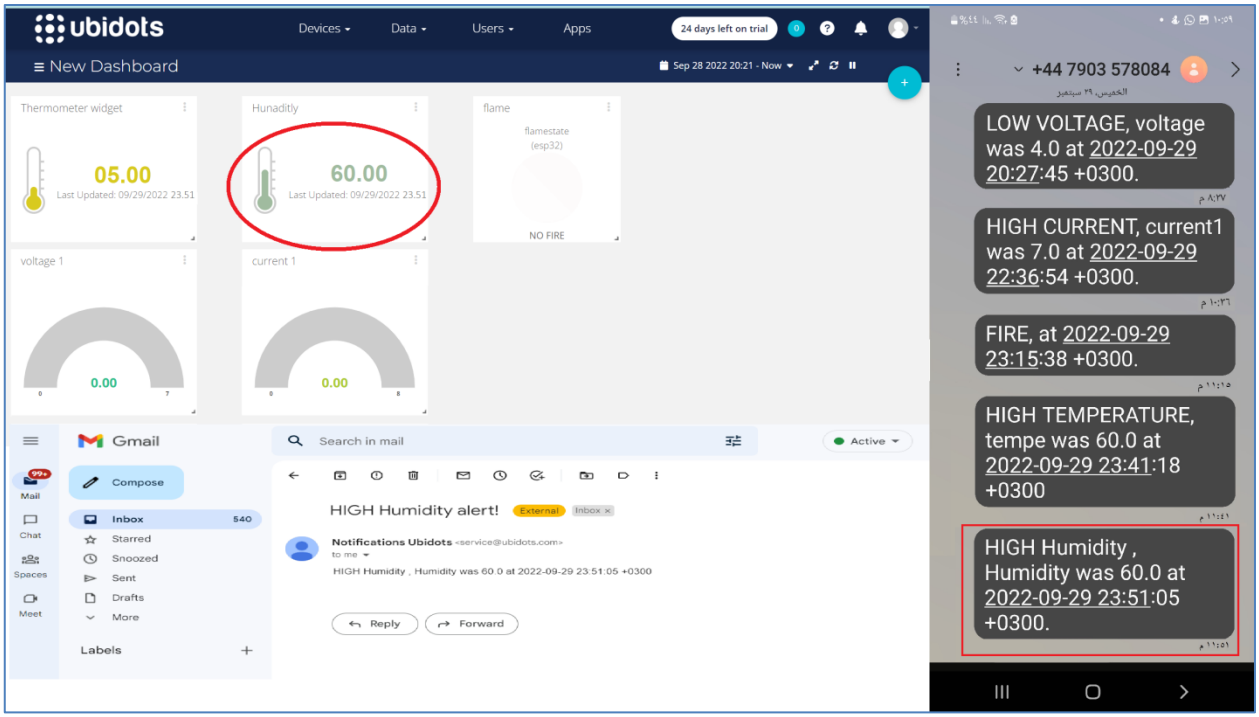

Figure8. The High Humidity

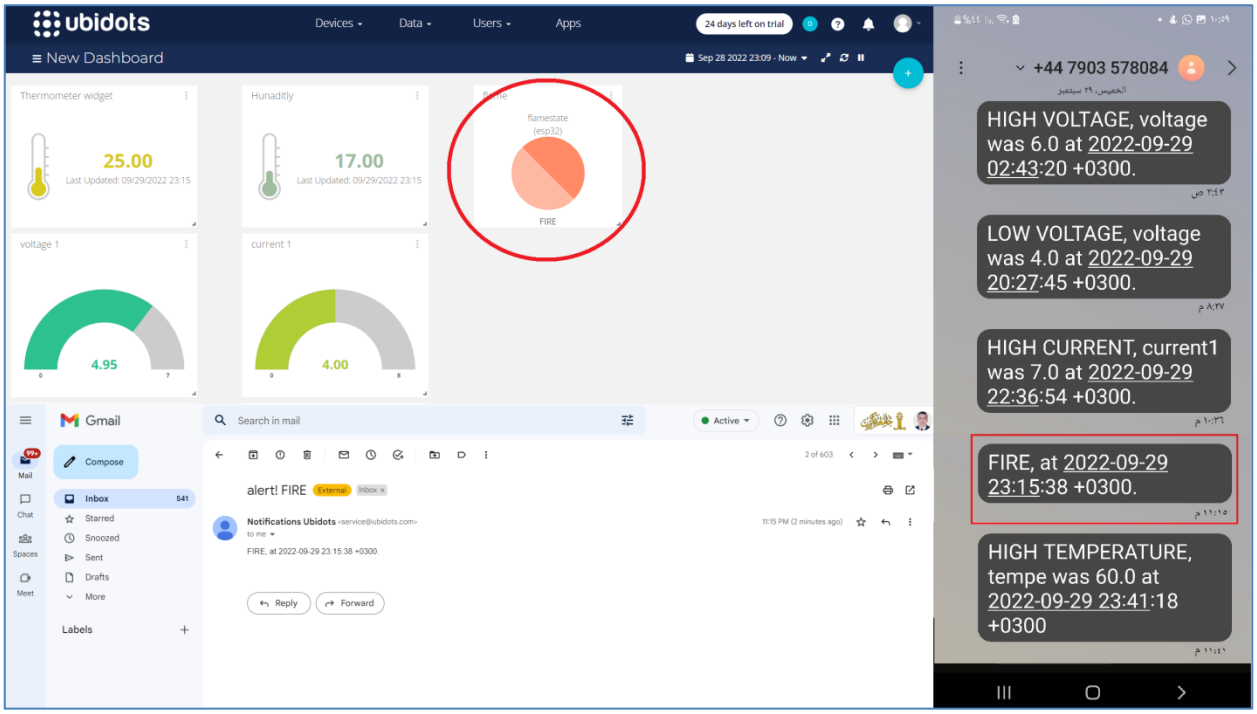

Figure9. The Fire

6.Recommendations

- The proposed system can be developed by linking more than one monitoring system together to monitor and control the systems remotely.
- Adding new sensors to the system to improve its functionality.
- The system can be developed by adding a camera to watch the station from a distance

7.Conclusion

The paper proposed an effective system to measure the most important electrical parameters and detect the error that will occur before the manual examination, which distinguishes it with its speed and accuracy. The system provides monitoring and data storage on the platform, which can be accessed remotely, and there is a visual and audible alert for an error in the substation. By sending alert messages on e-mail and phone in addition to a buzzer.

8.References

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