Implementation and Design of a Monitoring System for Tikrit Substation

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Abstract: Remote monitoring and control is an important issue for substation equipment, which is usually done manually, which leads to serious and costly problems, so it needs a control system to control and monitor the devices, which ensures the workflow of the station and know the type of restriction that has occurred. This paper proposed a system that monitors and controls Switchgear Located in the substation. Where the most important electrical parameters (voltage and current) in addition to (temperature, humidity and fire) are monitored and sent over the Wi-Fi network in real time via ESP32 to the program designed in the c# language, and these parameters are stored in the SQL server database . In addition to alerting about the type of event through the program and the buzzer.

Keywords: C#, Humidity & Temperature Sensor, buzzer, Voltage Sensor, Current Sensor, SQL, Flame Sensor, ESP32, monitoring system, Substation.

1. Introduction

Electric energy is used in many fields in our diurnal life in terms of ménage uses similar as lighting, heating, operating ménage electrical appliances.

Transmission lines carry high voltage electricity over long distances, while distribution lines carry low voltage electricity to domestic and marketable structures over shorter distances. The transmission and distribution lines are connected by substations, which convert voltages over and down, as well as having fresh and essential tasks of nonstop dimension, monitoring, protection and control in their part of the network.

Methodical examination of electrical substations is essential to descry malfunctions, which lead to a lot of wasted energy and major specialized injuries, and fire. thus, dependable, accurate and regular examinations are important to insure long- term safe operation, safety, and protection. (Usamentiaga, Fernandez, Villan, & Carus, 2018).

The smart grid is an electricity network grounded on digital technology used to give consumers with electricity via two- way digital communication. The smart grid was used to overcome the sins of traditional electrical networks. thus, transubstantiating substations into smart stations has come necessary to increase their effectiveness and ameliorate the quality of the energy handed. **(Gandhi, Kumar, Rodríguez-Gallegos, & Srinivasan, 2020)**.

2.Significance Of The Study

1- 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 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 **(Patil et al., 2021)** proposes a project to monitor substations by obtaining remote electrical parameters such as voltage, current, and temperature and sending these real-time values over the network. Also to protect electrical circuits when electrical parameters exceed preset values the system is shut down. Real-time electrical parameters are automatically updated periodically and alerts are sent whenever voltage or current exceeds preset limits. Uno Arduino is used with GSM, where GSM based monitoring of distribution switch is very useful compared to manual monitoring. After receiving any fault message, actions are taken immediately to prevent any failure of distribution switches, time of receiving messages may vary due to general GSM network traffic but it is more effective of manual monitoring.

In **(AlKasap & Hagem, 2021)** proposes design, implementation and testing of two systems in high voltage power stations. The first part is designed to obtain data on environmental conditions in substations, and important parameters from transmission lines in substations in real time. The system also provides the ability to automatically disconnect the loads under frequency if the frequency in the stations drops below the normal limit, which contributes to maintaining the efficiency and quality of electrical energy in the substations, and provides protection for the substations. The second part is designed to obtain parameter values that determine the conditions of the electrical transformers and monitor the status of the line in terms of shutdown and operation in real time at substations. Thus, these proposed systems transform traditional substations into smart substations.

In **(Ismail, Mubdir, Majeed, & Al-Hindawi, 2019)** suggest designing a system for monitoring and controlling the components of the power plant and substations with the help of GSM. It consists of two main parts, the first part is the unit that was designed and the PLC with GSM was used in it to be installed in the power station and collect sensor readings and process them in a package ready for transmission along with monitoring, and the second part was designed using an application based on the open source Visual Basic platform with a GSM modem In order to visualize the reading packets received from power plants. These

parameters are monitored by the PLC, where the PLC generates a text message and sends it to the control center and those responsible for monitoring. Another GSM modem that has the ability to connect to a PC using SMS receives and executes it. The performance of the system is acceptable in terms of errors in readings and time delays. The time required to deliver the message ranges from 19 to 24 seconds.

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, the control and control system for the electrical distribution station was proposed and designed.

Where used in this system are hardware and software such as microcontrollers, sensors and C# program, all of which are dedicated to the implementation of a specific process. Where monitoring and control of the process of turning on and off, sending and receiving data and displaying it in real time on the C# program . Figure 1 shows the Block diagram parts of the system.

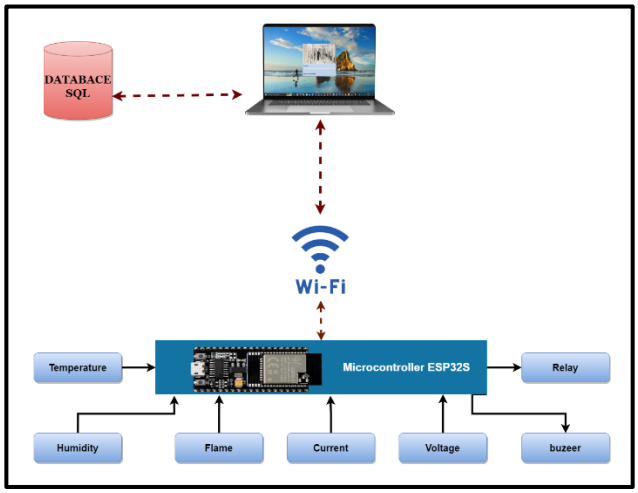

Figure 1.Block diagram parts of the system

The NodeMCU microcontroller (ESP-32S) was used. The microcontroller was produced in 2016 and is an integrated system on a single chip. It has many peripherals and great features, including Wi-Fi and Bluetooth connectivity. It is equipped with RAM and flash memory and contains 36 digital ports, PWM and ADC ports **(AlKasap & Hagem, 2021).**

Various sensors were used, including the current sensor (ACS712), which is an accurate sensor to measure AC / DC current up to 20 amperes. The sensor can measure high AC current and still be isolated from the measuring part due to the built-in Hall sensor. The board operates on 5V **(Khattab, Alshmmri, & Marie, 2022).** In addition to the voltage sensor F031-06, this is a sensor for measuring voltage, 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) is a combined temperature and humidity sensor that gives a digital output signal. Its components include the wet-sensing resistor and NTC temperature-sensing components**(Srivastava, Kesarwani, & Dubey, 2018).**

A Flame sensor is designed to detect and respond to a flame or fire. A flame detector can often respond faster and more accurately than a smoke or heat detector because of the technology it uses to detect flames (infrared) The detection distance is up to 100cm, the sensor can output a digital or analog signal. **(Zaw & Hla, 2018)**

And the relay, which is a key to open and close the electrical circuit, works with a voltage of 5v or 12v and allows the microcontroller to manage the loads with high effort or intensity. **(Hameed, 2020)**.and buzzer is an electronic component that can convert electrical signals into sound vibrations. The buzzer can be used with esp . **(Leninpugalhanthi et al., 2019)**

The previously mentioned sensors and devices were used to implement a monitoring and control system to obtain important parameters for switchgear in substations in real time and they are connected together as in **Figure (2)**, and these sensors are necessary in electrical systems. These data are collected from the sensors by the ESP32s microcontroller and sent to the c# program and stored in the database SQL Server.

The C# is a program that contains the c# language produced by Microsoft and present in Visual Studio for creating and developing many programs and applications**(Chioran & Valean, 2020)**.and the SQL is a one system of the best database management systems developed by Microsoft, in which data is stored in the form of tables, manages relational databases and contains a wide range of applications for processing transactions and analytics in corporate IT environments and business intelligence. Management Studio is the main tool used to manage servers and databases. SQL Server serves both academic and application needs. There are many different editions: Enterprise, Standard, Web, Developer and Express. **(Ilić, Kopanja, Zlatković, Trajković, & Ćurguz, 2021).** the **Figure (3)** shows the flowchart system .

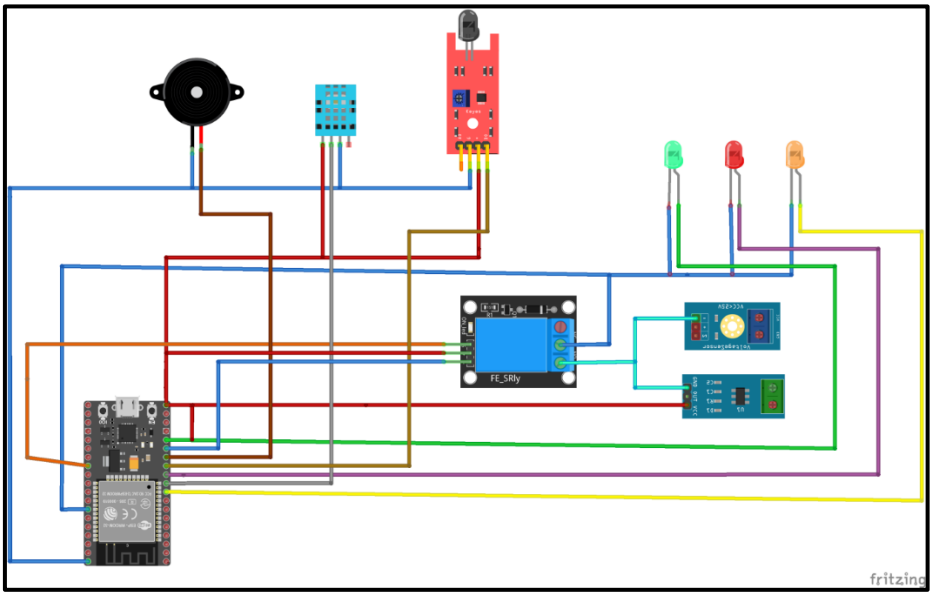

Figure 2 Connection of the sensors with the ESP-32S

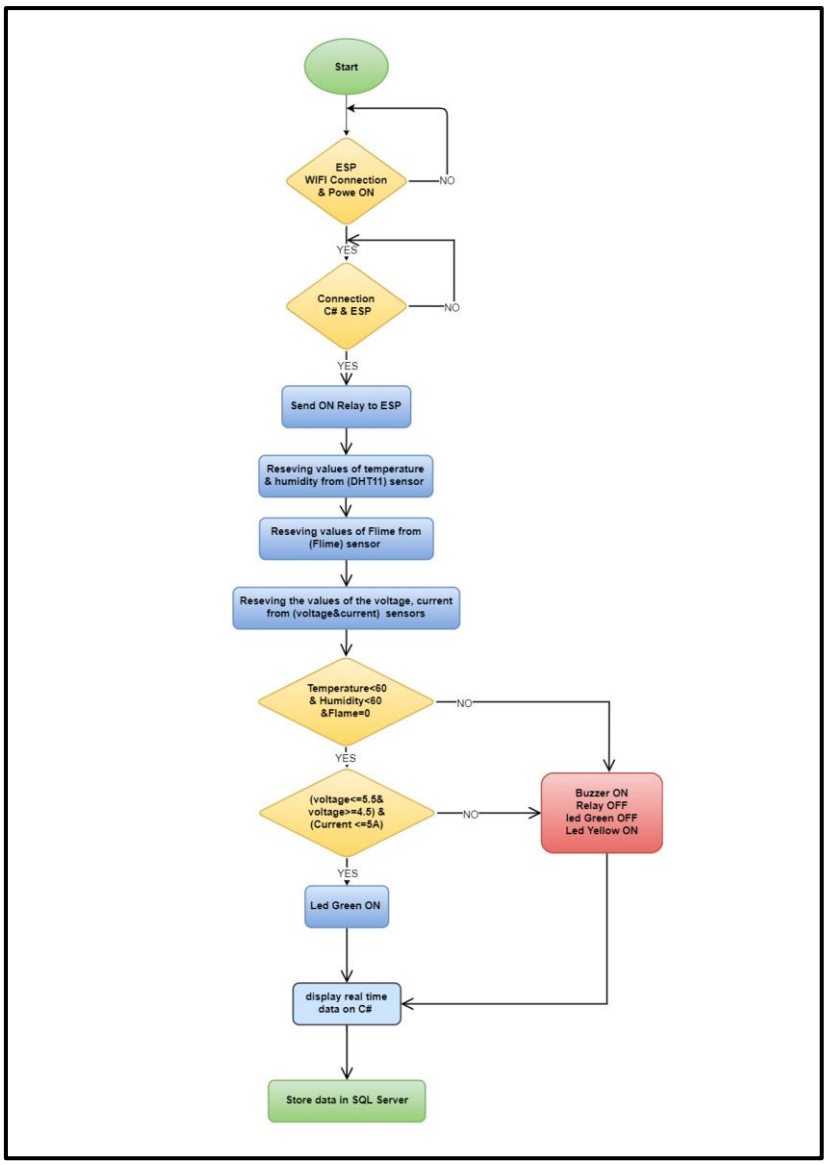

Figure 3. Flowchart for the proposed system

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 C#. 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.

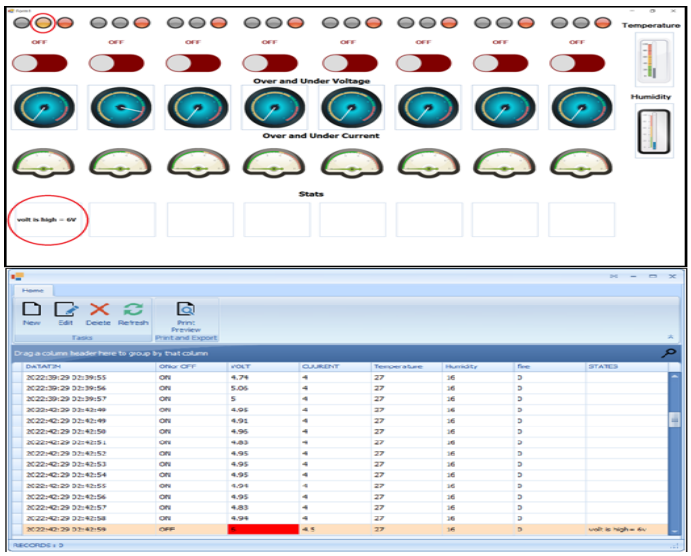

Figure 4 .the over voltage

Figure1.The under voltage

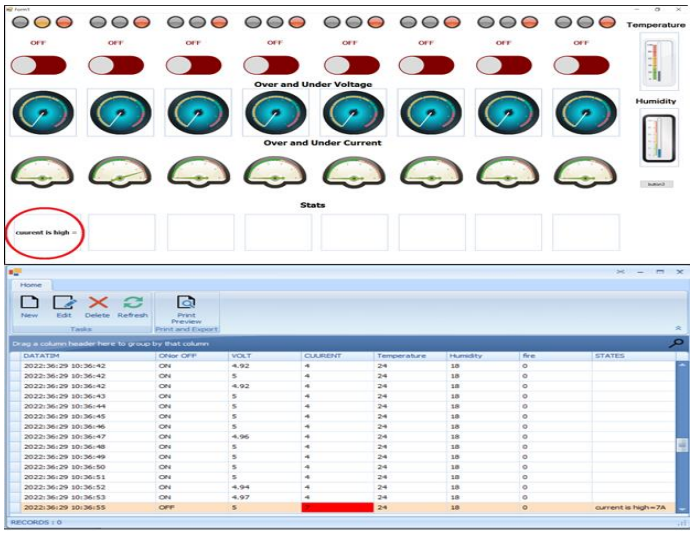

Figure6. The over current

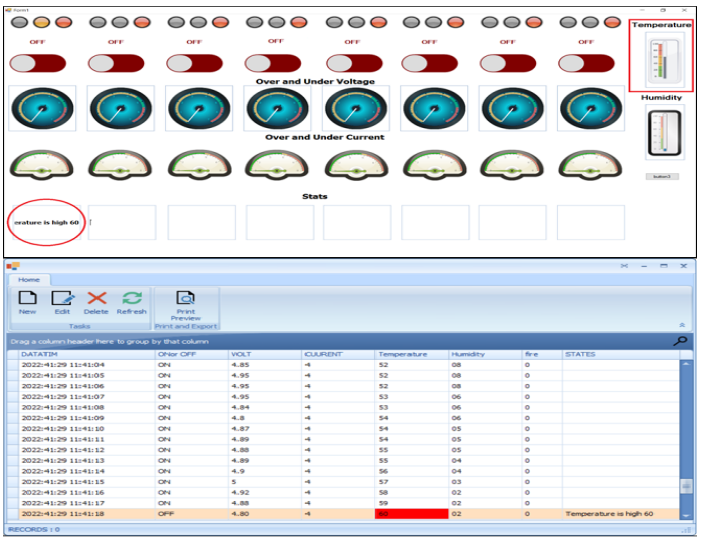

Figure7. the High Temperature

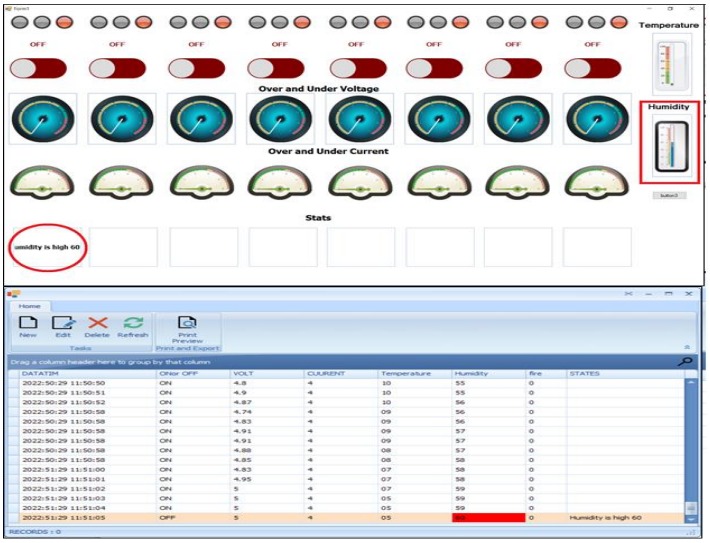

Figure8. The High Humidity

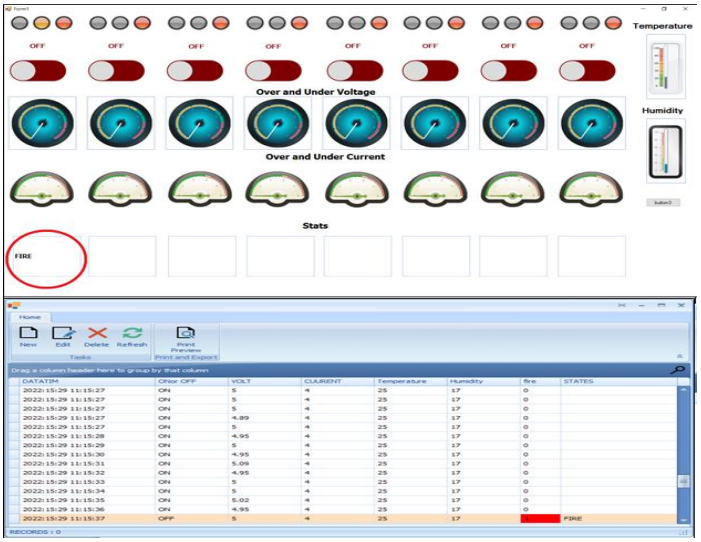

Figure9. The Fire

6.Recommendations

- The proffered system can be developed by relating further than one monitoring system together to cover and control the systems ever.
- Adding new detectors to the system to ameliorate its functionality.
- The system can be developed by adding a camera to watch the position from a distance

7.Conclusion

The paper suggested an effective system for measuring the most important electrical parameters and detecting the error that would occur before the manual examination, which distinguishes it with its speed and accuracy. The system provides control and monitoring using C#, data storage in SQL, which can be accessed remotely, and there is an audible alert of a substation error using the buzzer.

8.References

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