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Recent Developments in SCADA System for Remote Industry and It's Experimental Implementation

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***Abstract*—The world has latest development in remote access system. SCADA has given a prime importance in the field of remote industry .This paper discuss about few contemporary about SCADA system in recent years ,the new revolution in the field of remote industry. Different methods are discussed along with challenges and opportunities. This research includes discussion on SCADA system with their working and its applications along with prototype model which is implemented through software and hardware both .**

***Keywords*—Microcontroller AT89S51, C++, PCB layout, Remote monitoring system etc.**

I. INTRODUCTION

Supervisory Control and Data Acquisition (SCADA) is an integration of software and hardware components facilitating supervision and control of industrial or any processes remotely or locally. The system to be monitored and controlled involves the real time operation and data logging, process handling and supervisory control access. The SCADA unit facilitates the observation and control of all the pant process easily and more conveniently. In the current scenario, the SCADA system has been used more widely and its scope is increasing day by day, but due to the higher costs, the smaller and medium scale industries are in the shade of using SCADA system in monitoring of their plant processes. Furthermore, in this rapidly developing market, a successful digitization of production can play a vital role in stepping forward towards the modern age. For the European manufacturing industries, the digitization and the modern manufacturing have been supported by Industry 4.0, the factory of the future and Process IT. EU roadmap on process automation. By reducing the cost investment in the SCADA software and hardware system, it would be more accessible and its use and area of implementation would also get increased, and the cost can be reduced by using open-source software tools to develop own SCADA system and also the customization of the developed software is also possible depending on the requirements. In this article, we propose the cost-efficient SCADA system. The performance has been evaluated under testing environment in an industry. This approach of SCADA helps to eliminate the investment in purchasing the licensed SCADA software tools, and also gives the efficient performance which is comparable to the paid software. The first section of this paper introduced about the contribution of this paper in development of low-cost SCADA system along with its associated terms, its importance in power and process monitoring and control system, the second section describes related works in this field and the latest innovations in development of low cost SCADA system, third section explains the proposed system development methodology, fourth section explains the experimental setup and the hardware implementation and fifth section concludes the work with necessary discussions.

II. LITERATURE SURVEY

A few literature survey is carried out though latest and already published article based on same theme in order to get updated in same. Some of the articles are referred for proposed research work as follows.

The wireless communication between the mobile phone and the base station is performed by using GSM module. The supervisor of the plant can see the status of parameter without visiting the site. Therefore this system reduces

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the maintenance cost and necessity of continuous monitoring. Therefore this system increases the productivity and performance of the Plant. This System presents a low cost automation scheme which can be easily extended for more complicated control schemes including wireless control [1].

The SCADA system proposed in this work is based on the Internet of Things SCADA architecture which incorporates web services with the conventional (traditional) SCADA for a more robust supervisory control and monitoring. It comprises of analog Current and Voltage Sensors, the low-power ESP32 Thing micro-controller, a Raspberry Pi micro-controller, and a local Wi-Fi Router. In its implementation, the current and voltage sensors acquire the desired data from the process plant, the ESP32 micro-controller receives, processes and sends the acquired sensor data via a Wi-Fi network to the Thinger.IO local server IoT platform for data storage, real-time monitoring and remote control [2].

The cost investment for implementing the SCADA system is expensive and is not in approach of small and medium scale industries these days. Developing the customized SCADA system helps to reduce the cost in software components and becomes more close approach to the small and medium scale industries. In this research we presented a SCADA software developed in C# environment and successfully tested in industrial process monitoring and control. The developed SCADA software is capable of remotely supervise, control and data monitoring facility and is also capable of data logging in the IoT server. This approach has been found to be efficient in both aspects, technically and economically [3].

Supervisory Control and Data Acquisition systems are mostly used in industry for supervisory control and data acquisition of industrial process application as they are simple, robust, and reliable in use. This process can be industrial and infrastructural, with the further use of electronic and software technologies, the SCADA systems are used in industrial plant automation. It provides an efficient tool to monitor and control equipment in manufacturing processes. This paper explain the advanced use of SCADA system for laboratory based mini thermal power plant setup using Lab VIEW data logging and supervisory control (DSC) module. The design, control and security and user interface challenges are focused in this paper of SCADA [4].

III. RESEARCH METHODOLOGY

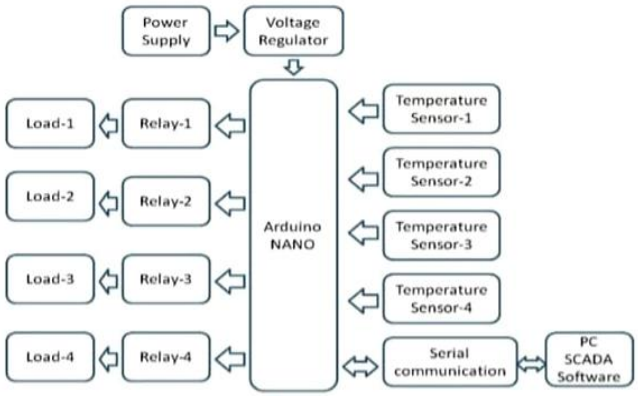

Fig. 1 Block diagram of proposed Model

IV. WHAT IS SCADA SYSTEM?

SCADA combines software and hardware to create a control system that is frequently referred to as automation technology. The system receives data about processes and related equipment, which supervisors then use to control and optimizes operations.

A SCADA system can be spread across different locations, sometimes over a wide geographical area, or contained within a single facility. SCADA is extensively used in the petrochemical industry, drinking water delivery systems, wastewater collection systems, pipelines and a range of other industrial processes.

But SCADA is not an end in itself. Maintaining efficiencies and identifying problems as soon as they occur are just some of the ways SCADA systems can support your operation. They can also improve productivity, quality and profitability while keeping costs at a minimum. SCADA is a significant long-term investment and choosing the right system is vital.

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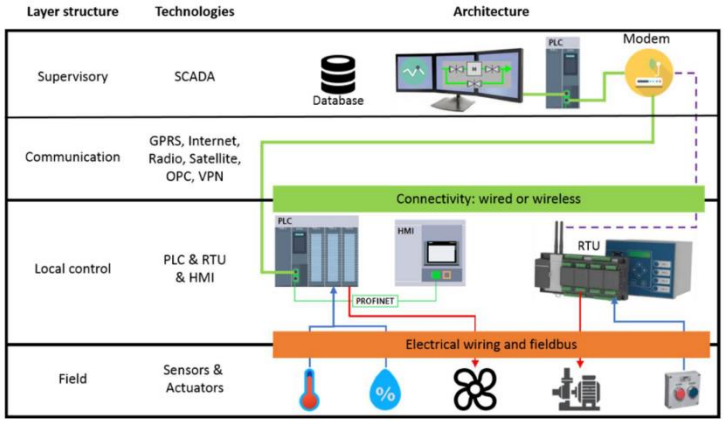

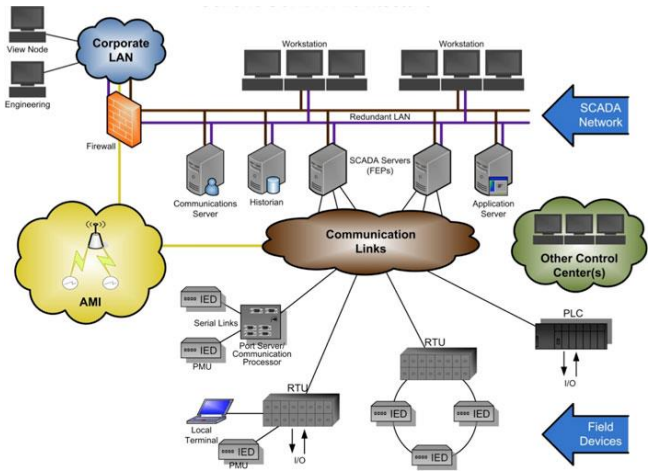

Fig. 2 and Fig.3 SCADA for remote access

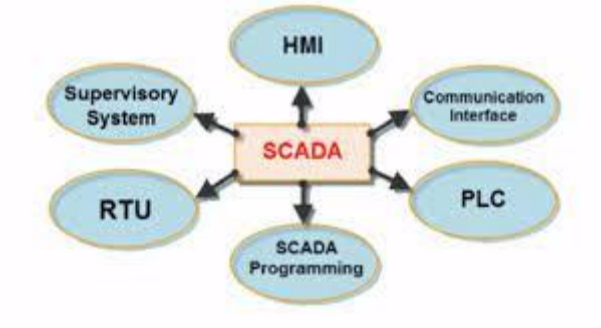

Fig. 4 Key features of SCADA

V. 10 KEY FEATURES SHAPING THE FUTURE OF NEXT GENERATION SCADA SYSTEMS

With the role of SCADA systems changing within the industry, it becomes essential that managers of different levels become familiar with the software's features that will become a necessity for their business. Innovation leaders agree that next gen SCADA will revamp several areas of the digital manufacturing data flow:

- Data management
- Energy management
- Information flow management
- Communications
- Diagnostics

For you, as a decision-maker, all the bullets from above mean the ability to make swift data-driven decisions on how to improve your production process. Without SCADA this would be nearly impossible. You can only imagine

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what it would mean for your business… Thus, we go back to the top 10 key features that shape the future of SCADA systems.

Portability

One of the best features of the SCADA systems is the seamless data flow. You have the ability to access data from the plant floor from any smart device so long as you have internet connection. This allows businesses, government officials, and even individuals to make informed, data-driven and prompt decisions about how to optimize their workflow.

Ultimately, the use-cases boil down to digitization, optimization and visibility of the enterprise that implements SCADA and its manufacturing environment.

Scalability

When you use a computer and you need your device to perform a new task, what is the first thing you do? You look for a software that can help your machine complete the assignment. Something that can expand the computer's capabilities. You don't immediately go and buy a new computer just because your machine can't accomplish the job right away. That would not be cost-effective.

With SCADA systems, you can apply the same principle… just on a much bigger scale. However, expanding your system for new functionalities might not always be as easy as installing a new program. Without proper pre-planning, organizations might face replacing entire systems for the lack of adaptability.

That's where scalability comes in play. Next Generation SCADA systems have the ability to expand in terms of scale and scope. You can add new connected devices, new data sources and even (if needed) reorganise the system's structure.

Simple Implementation

So, we can access our data from anywhere and we can reshape our system to fit the company's needs. What else do we need for a robust foundation?

Simplicity is something that often gets overlooked but with the rapid advance of technologies, it becomes vital. Training to both use and design a SCADA system should be straightforward and simple to understand. Otherwise the SCADA usability for a company would become very limited and costly.

Last but not least, we want to note that proper scalability should provide a foundation for simple implementations by nature. SCADA should be based on technologies that allow not only simplicity but also scalability. One perfect example for such technology is the machine-to-machine messaging protocol MQTT.

Versatility

Versatility of the SCADA systems is yet another feature that should be pre-planned and encoded in the core of the system. The ability to incorporate future updates smoothly and seamlessly without disturbing the workflow of the enterprise is crucial. The same goes for integrations.

A 21st-century Supervisory Control and Data Acquisition system needs to be able to evolve with new technologies. Therefore, versatility is at its core.

Modularity

Modularity is a prerequisite for versatility. But more than that, modularity for SCADA means also cost-effectivity. A system that can be decomposed to several self-serving modules stands for "future-proof" material.

Usability

Once upon a time systems were created for functionality only. No one paid much attention to the user side. With the evolution of technology and with so many competitive softwares on the market, you should have a product that is easy-to-navigate from any device (laptop, desktop and even phone).

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Backward Compatibility

Looking boldly into the future of IIoT, we have already discussed how the SCADA system will evolve – by seamlessly adapting new upgrades and integrations. However, in order to move forward, smart softwares also need to be able to communicate with less sophisticated devices.

The SCADA of the future needs to be able to work with all the assets and configuration you currently have. It should be able to communicate with them as seamlessly as with the assets being added.

Smart Diagnostics

One of the immense advantages of the future-proof SCADA system is the ability to feed you directly with smart data (the intelligent analysis of large amounts of data). In many use-cases around the globe this means lowered facility downtime and exclusion of costly, time-consuming inspections.

According to Siemens, thanks to smart data, precision diagnostics and advanced analytics, their engineers were able to solve 80% of the stopped turbines within ten minutes for devices set in hard-to-reach, offshore areas.

Logical, Commented Code Base

As SCADA is essentially a software that your in-house engineering team will need to use and maintain, it has to have logical, commented base code. Otherwise, you are set for failure before you even start operating.

Systems that don't offer an easy-to-follow code structure, that operate with obsolete or rarely used base code can't evolve fast enough to stay in stride with the evolution of IIoT. You have certainly witnessed a company stuck with an archaic piece of software simply somewhere along you career path. Ask yourself, would this have happened if the software had been planned with scalability in mind?

Rapid Development

The intelligent SCADA systems have a rapid application development (RAD) capabilities built directly in their core features. They allow users, even those without extensive programming knowledge, to design applications based on information gathered from the system. Flexible development and prototyping can reduce risk by testing difficult implementations and costs by finding problems earlier in the development cycle.

VI. The Future of SCADA/HMI: Features and Challenges

SCADA/HMI applications have been playing a key role in manufacturing. But what challenges will this technology face in the future of Industry 4.0? Let's take a look at the main features and requirements of future SCADA/HMI solutions.

Future generation SCADA/HMI: main features and requirements

Acronym for Supervisory, Control and Data Acquisition, SCADAs are supervision systems that allow you to monitor how the states of controlled processes evolve. In fact, they provide every functionality necessary to view and supervise in real time information on the actual status of processes. Furthermore, they allow you to access and manage historical records and exceptional states.

By nature, SCADA/HMI is the first device in an industrial machine to ever been involved both in the process of **integration between IT and OT networks**, and in today's "mobile devices oriented" way of working.

The Industry 4.0 paradigm poses several challenges for this technology. From the user interface to web technology integration, here are some of the main requirements of SCADA/HMI solutions of the future.

IT/OT integration

The integration between IT and OT is key in the smart factory. With Industry 4.0, there has been a growing flow of information between more and more connected and heterogeneous subjects, inside and outside the production plant. Industrial PCs or HMIs with two Ethernet ports are the interconnection point between the corporate IT network (internet access, interfacing with the MES and ERP applications) and the OT automation network of the machine.

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User interface

The SCADA/HMI solutions of the future must offer efficiency in terms of user-friendliness. In particular, we need a new user interface that uses the typical gestures of portable devices.

Web technology

The new generations of SCADA must be developed with the latest digital technologies in mind. Which means that SCADA/HMI solutions should be based on the very same web technologies that we use every day, so as to ensure greater compatibility with all devices. The only prerequisite is a compatible HTML5 browser.

Data management

In the new SCADA/HMI technology, the hardware mounted on the machine is replaced with a component that has no user interface and is installed inside the panel. Once the production data is collected, this component will:

- Make them usable thanks to the use of Wi-Fi devices in the system. In this way, operators can approach the machine and see on their tablet or smartphone the pages to manage the machine.
- Or, send them to the Cloud to be shared with high-level applications. Discover the ESA SCADA solutions and their applications in industrial processes

VII. HARDWARE IMPLEMENATATION

Sr. No.	Item Description	Specification	Quantity
1.	Power Supply	12v/1Amp	1
2.	Voltage Regulator	IC 7805	1
3.	Relay Module	5v/SPDT	4
4.	Temperature Sensor	DS1820	4
5.	Microcontroller	ATmega328P (Arduino NANO)	1
6.	Display	16x2	1
7.	Pot	10k	1
8.	Wire, etc.		

Working: In the above block diagram the arduino Nano is man brain of system which is used a Atmega 328p microcontroller. The user set required value in SCADA software; the SCADA software attached with hardware system via serial communication. the Arduino read temperature sensor data from temperature sensor, if any sensor goes to the reference value from set by user in SCADA. The Arduino read reference value from SCADA via Serial pins, then ON or OFF load according to the set point via relays.

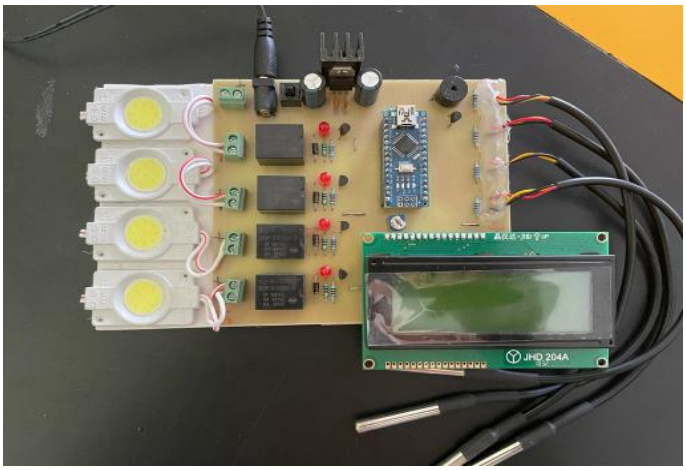

Fig. 5 Hardware model

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VIII. CONCLUSION

At the end conclusion is that by looking in to the latest challenges and opportunities in upcoming times the IOT system will perform better for remote sharing of data. As the fastest growing stage of technology IoT will be efficient and cost effective system for wireless communication. SCADA is also there but it needs to be updated by further implementation. Hence it is proved that our future will be completely rely on fastest growing technological change with time. Here we have implemented a small prototype by means of both hardware and software which operates with GSM.

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