GOCE DELCEV UNIVERSITY, STIP, NORTH MACEDONIA

FACULTY OF ELECTRICAL ENGINEERING

ETIMA 2023

SECOND INTERNATIONAL CONFERENCE

27-29 SEPTEMBER, 2023

TECHNICAL SCIENCES APPLIED IN ECONOMY, EDUCATION AND INDUSTRY

УНИВЕРЗИТЕТ
ГОЦЕ ДЕЛЧЕВ
ЕЛЕКТРОТЕХНИЧКИ
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GOCE DELCEV UNIVERSITY, STIP, NORTH MACEDONIA

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PREFACE

The Faculty of Electrical Engineering at University Goce Delcev (UGD), has organized the Second International Conference ***Electrical Engineering, Informatics, Machinery and Automation - Technical Sciences applied in Economy, Education and Industry-ETIMA.***
ETIMA has a goal to gather the scientists, professors, experts, and professionals from the field of technical sciences in one place as a forum for exchanging the ideas, strengthening the multidisciplinary research and cooperation, and promoting the achievements of technology and its impact on every aspect of living. We hope that this conference will continue to be a venue for presenting the latest research results and developments on the field of technology.
Conference ETIMA was held as online conference. More than sixty colleagues contributed to this event, from five different countries with more than thirty papers.
We would like to express our gratitude to all the colleagues, who contributed to the success of ETIMA'23 by presenting the results of their current research and by launching the new ideas through many fruitful discussions.
We invite you and your colleague to attend ETIMA Conference in the future as well. One should believe that next time we will have opportunity to meet each other and exchange ideas, scientific knowledge and useful information as well as to involve as much as possible the young researchers into this scientific event.

The Organizing Committee of the Conference

ПРЕДГОВОР

Меѓународната конференција ***Електротехника, Технологија, Информатика, Машинство и Автоматика-технички науки во служба на економија, образование и индустрија-ЕТИМА*** е организирана од страна на Електротехничкиот факултет при Универзитетот „Гоце Делчев".
ЕТИМА има за цел да ги собере на едно место научниците, професорите, експертите и професионалците од полето на техничките науки и да претставува форум за размена на идеи, да го зајканува мултидисциплинарното истражување и соработка и да ги промовира технолошките достигнувања и нивното влијание врз секој аспект од живеењето. Се надеваме дека оваа конференција ќе продолжи да биде настан на кој ќе се презентираат најновите резултати од истражувањата и развојот на полето на технологијата.
Конференцијата ЕТИМА се одржа online и на неа дадоа свој придонес повеќе од шеесет автори од пет различни земји со повеќе од триесет труда.
Сакаме да ја искажеме нашата благодарност до сите колеги кои придонесоа за успехот на ЕТИМА'23 со презентирање на резултати од нивните тековни истражувања и со лансирање на нови идеи преку многу плодни дискусии.

Организационен одбор на конференцијата

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DESIGN AND IMPLEMENTATION OF SCADA SYSTEMS

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Abstract

This paper discusses SCADA systems, their planning and projecting, and their increasing implementation in industry. SCADA are used for 24-hour supervision and management in systems and processes.
Industry requires daily supervision and management of processes, and technology advancements enable more efficient and creative management. SCADA systems enable control and supervision of complex systems, and also enabling employees to be more creative and productive. SCADA systems enable the management of subsystems in different locations, enhancing overall efficiency and productivity.

Key words

SCADA systems, contoling, proceses, sensors, PLC controller

1. Introduction

In the industry, there is a daily need for supervision and management of various processes. As technology develops, so do the possibilities for supervision and management of various processes. Everything that used to be done manually in industry now can be done automatically. For example, in the past, if a certain room had to have a set temperature, the employees had to go to the thermometer itself and look at the temperature in the building. With the development of technology, this process is not only facilitated, but it is also possible to monitor the data from a distance, so the employee does not need to go to the room to find out what the temperature is. This alone saves time that the employee would have spent, and the company itself becomes more productive.

The implementation of modern technologies in the industry will not only make employees more productive, but the same results can be achieved with a smaller number of employees. The implementation of new technologies and the automation of processes are the future for all companies. More and more companies have a lack of manpower, so where the process can be automated, it will be done, and the human factor, which is less and less available, will be used only in places where it is necessary, in places where the automated processes will be managed.

For the simplest case of process management, the process itself should be equipped with measuring instruments that correspond to the purpose for which the management is carried out and a certain type of control device. If a certain process meets these conditions, then it can be controlled through a system that will meet the needs of the user. Usually, the needs of the industry are to control different subsystems that are in different locations. To enable such control and supervision, computer-supported systems known as SCADA (Supervisory Control and Data Acquisition) systems are used. These systems are particularly suitable where 24-hour supervision and control of the processes being carried out are required.

2. SCADA systems

SCADA (Supervisory Control And Data Acquisition) is a system that is used to automate general processes. It is used to collect data from sensors and instruments located at remote stations and transmit and display that data at the central station for monitoring or management.

SCADA involves collecting, transferring, analyzing, and controlling information at a central site and displaying it on operator screens or displays. Control actions are then conveyed back to the process [1].

SCADA systems are computerized systems that are widely distributed. These systems are primarily used for remote management and monitoring of processes or plants with central locations. Almost any industrial automation system includes sensors for the detection of the various "states" of the controlled manufacturing process and actuators as outputs for real-time acting and achieving the desired behavior of the production procedure.[3] This means that the data is collected and sent to the headquarters (dispatch center), the necessary analysis is performed, and, if necessary, management is generated. At the end, a graphic display of the processed data is made, and this display is displayed on an operator terminal, which, depending on the complexity of the process, is displayed in the form of one or more monitor screens. Figure 1 shows a simple SCADA system for drinking water distribution.

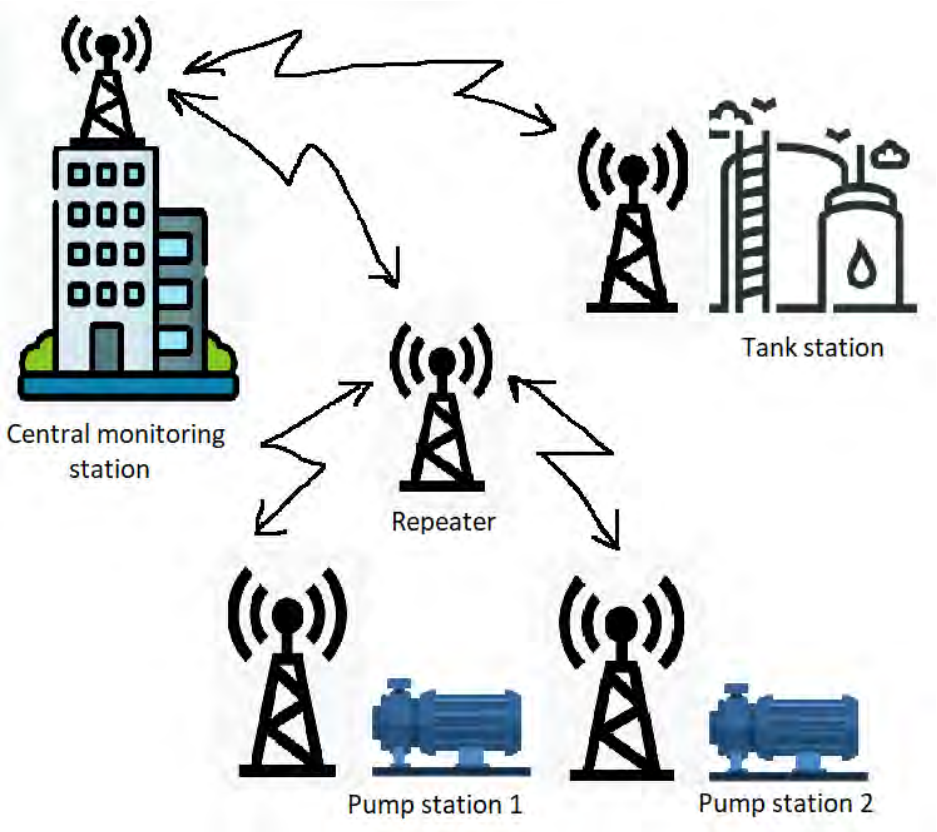

Fig. 1 SCADA system for drinking water distribution.

The main goals of SCADA systems are:

1. Carrying out supervision;
2. Establishing the management of the system in order to ensure the functioning of the system as expected from it;
3. Reduction of the need for human labor by applying process automation;
4. Storage of system behavior data;
5. Provision of information about the functioning of the system;

6. Establishing efficient functioning of the system without the need to go physically to the place where the process takes place;
7. Provision of a management system that will enable certain activities to be carried out remotely;
8. Provision of an alarm system that will enable the improper operation of the system to be monitored early and saved from the central location, from where it would be possible to stop the process, which would avoid major damages and accidents.

SCADA systems, in addition to being suitable for monitoring and managing processes that are carried out in remote locations, also are suitable for applications in processes that are dangerous to the lives of workers. The SCADA system does not always have to be implemented in the monitoring of processes that take place in geographically distant locations from each other; it can also be implemented in the monitoring of processes that are located in the same place, for example, in a factory plant. With the help of SCADA systems, the same functions can be realized across processes, regardless of whether they take place in the same location or are geographically distant.

In general, SCADA systems consist of several functionally connected units. The basic elements of SCADA systems are:

1. Measuring and regulation equipment;
2. Remote stations;
3. Communication system;
4. Supervisory -control center.

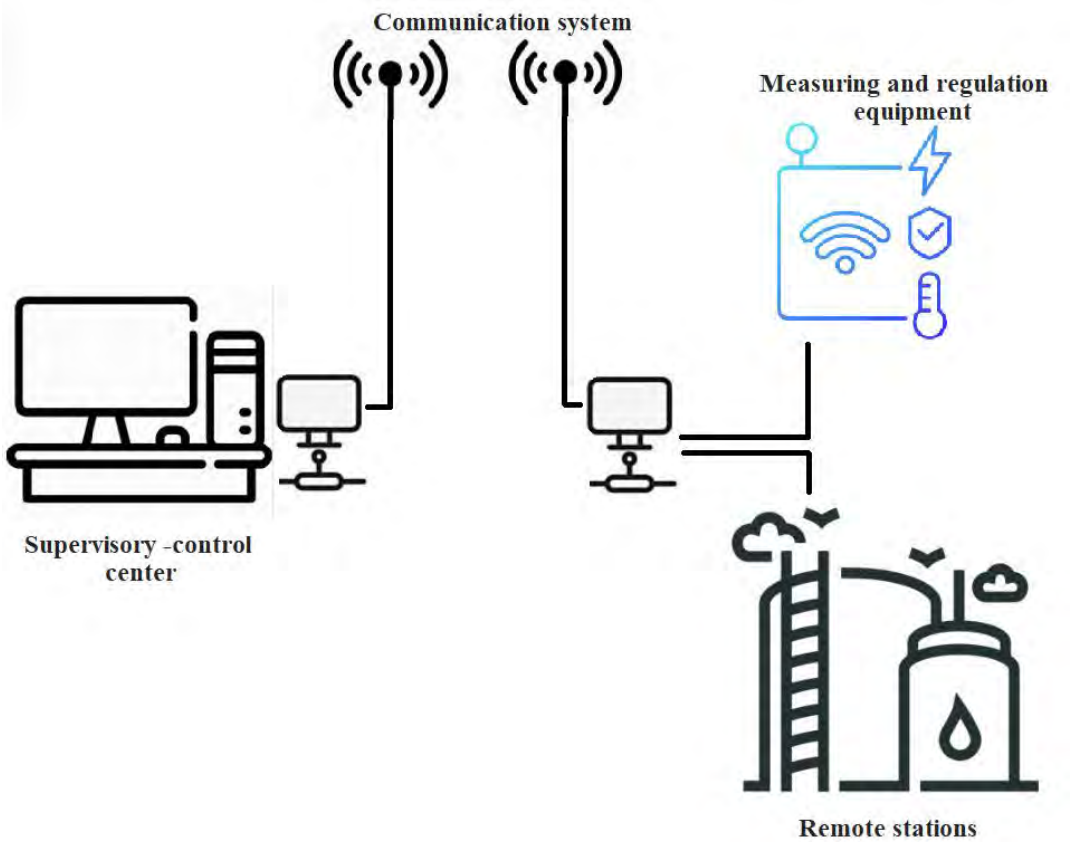

Fig. 2 Simple example of a SCADA system

Data collection is possible with the help of remote stations that scan the input devices, that is, the measuring equipment connected to the PLC devices. Then the central control unit scans the PLC devices in the SCADA system itself with the help of the communication system. The

received data is processed due to the detection of the set alarms; if inappropriate data is detected or a value does not correspond to the set limit, an alarm is activated that is visible to the operators themselves. Operators are notified of the alarm by graphic and sound signaling at the operator stations themselves. Operators can react and remove the reasons for which the alarm appears, which would prevent greater damage to the process. [2]

All processed data (process parameters, alarms, etc.) is stored in a database that is usually located on a computer that has the role of a server; access to data from the server is done using a specialized server.

Finally, with the help of specialized software, it is possible for the operator to give appropriate commands (through the communication system) as a suitable action for the events in the process, and it is possible for the software itself to generate suitable management actions. The control actions are defined by the central computer, and usually it is data that is sent to the PLC devices, which further perform the appropriate action.

The software used by operators and other responsible parties provides a wide range of possibilities, which can be split into two groups: [5]

- The possibility to monitor the data - Data that can be monitored in real time include the position of the alcove's components (busbar, line, earthing, circuit breaker), values for each phase's current and voltage, as well as information on active power, reactive power, apparent power, energy, power factor, frequency, relay parameters, and more.

- Ability to command (control) - Circuit breakers and protective relays are examples of equipment that can be remotely operated. Thus, it is possible to remotely turn on and off the circuit breakers. Operators stationed at the control center will be notified in real time the instant a feeder ceases to function as a result of any breakdown or problem.

When the SCADA system is implemented into the technological processes, it should be allowed for its upgrade to additional functions, either due to the development of the process itself or due to the improvement of management. SCADA systems should be built as an open system, and this is made possible by the fact that this system is based on information, so upgrades in its functionalities are possible. Therefore, open systems are a method of evolution for a control system based on nonproprietary and common software and hardware interfaces that enables future updates to be offered from various vendors at reduced cost and incorporated with comparatively little risk. [6]

3. Planning and designing of SCADA system

Automation is the process of replacing human decision-making and manual command-response tasks with logical programming commands and automated machinery. [4]

The future of every company is the implementation of SCADA systems and the automation of the processes that are carried out in the company itself. The automation itself would speed up the action of the process itself because all the things that the employees do manually, if it is possible to do them automatically, would save time and human resources for the execution of the process.

A growing number of companies in our country and around the world are facing a lack of labor force, so exactly the companies that will reduce the need for labor force will be more competitive in the market. It would be much easier to manage the processes themselves, and they would be executed in a shorter time interval if the human factor was reduced to a minimum.

Each company should first consider several factors that are key to deciding whether to introduce a SCADA system into its operations. It is necessary to pay attention to and analyze the following questions:

1. Can the processes that are performed in the company be automated?
2. What would be the advantage of automating the process?
3. Finding a company that will submit an offer for automation
4. Analysis of the offer in order to see the profitability of the investment.

In the following, we will use a Decision tree model, which should be used by every company that plans to introduce a SCADA system into its operations.
A decision tree is a decision-making model that is similar to a tree, hence its name. Decision tree models are used in the exploration of possibilities, especially in decision-making, to help achieve a specific goal.

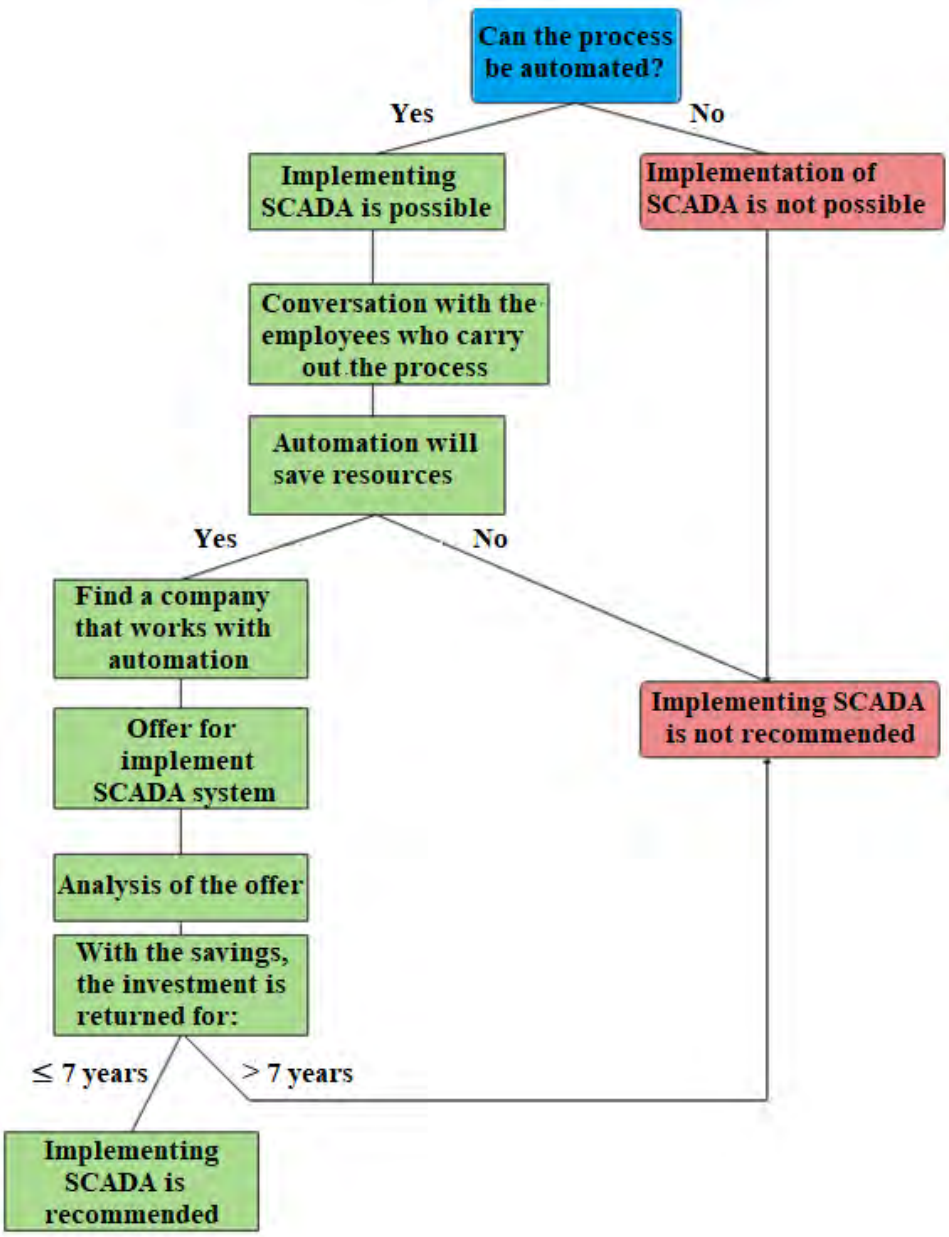

Fig. 3 Decision tree model for implementing a SCADA system

When designing a SCADA system, the processes that the system performs should be defined first. After defining the processes in the system, an analysis is made as to whether they can be

automated. There are cases in which some of the processes can be automated and some cannot. So an additional analysis is needed to determine whether, by automating part of the processes, some benefit would be obtained from the implementation of a SCADA system.

If the benefits obtained are minimal or the processes in the system cannot be automated, then the implementation of a SCADA system is not recommended.

If by automating part of the processes that are carried out in the system or by automating the entire system, there are possible benefits, such as faster execution of processes, reduced need for the human factor, increased reliability, and faster reaction for damage prevention, then it is necessary to continue with additional analysis that will lead us to the decision whether to implement a SCADA system or not.

First of all, an analysis is made of what would be gained by implementing the SCADA system: whether the number of employees hired to perform a certain process would be reduced, whether the duration of the process could be reduced, whether alarms could be introduced, and whether limit values of the process parameters could be introduced in order to prevent unwanted actions and damages that would occur if the process did not move according to the defined directions.

If we think that by implementing a SCADA system we can fulfill some of the above advantages, then it is necessary to contact a company that deals with automating processes.

The company itself, in a conversation with the employees who have activities on a given process, defines which part of the process could be automated and which hardware needs to be incorporated.

The automation company submits an offer that specifies the equipment and, of course, the investment that the company needs to make to automate the process.

With the savings that the company would have with the automation, reducing the number of employees who perform the process and reducing other resources needed to perform the process would cover part of the investment required for the automation of the process, so the company should make an appropriate analysis. The analysis consists of how long the company implementing a SCADA system would need to cover the funds invested in installing the system. If the investment can be recovered with the savings from the introduction of automation in 7 years or less, then this investment is worthwhile, and the company should implement a SCADA system. If the investment made by the company cannot be returned in more than 7 years, then it is an investment that is not profitable, so the recommendation is to not invest in the installation of a SCADA system.

4.Conclusions

Implementing a SCADA (Supervisory Control and Data Acquisition) system in an organization or industry can bring several advantages. SCADA systems enable centralized monitoring and control of various processes, allowing operators to streamline operations and improve efficiency. Real-time data acquisition and analysis help identify bottlenecks, optimize workflows, and reduce downtime, leading to increased productivity. SCADA systems provide operators with accurate and timely data on process performance, equipment status, and environmental conditions. This data empowers decision-makers to make informed choices, respond quickly to issues, and implement strategies for process optimization and resource allocation. SCADA systems allow operators to remotely monitor and control processes, even from off-site locations. This capability enables 24/7 monitoring, reduces the need for on-site personnel, and facilitates rapid response to emergencies or equipment failures. By optimizing processes, reducing downtime, and enabling predictive maintenance, SCADA systems can lead

to significant cost savings. They minimize manual intervention, prevent costly equipment failures, optimize energy consumption, and improve resource allocation, resulting in reduced operational expenses. Implementing a SCADA system can provide organizations with operational advantages, increased safety, improved decision-making, and cost savings, ultimately contributing to their overall success and competitiveness.

References

[1] Practical SCADA for industry, David Bailey, Edwin Wright, 2003
[2] Regulacija I avtomatizacija na HEP, Prof . d-r Atanasko Tuneski, Ass. M-r Darko Babunski, Pom. Ass. M-r Emil Zaev Skopje 2008
[3] Introduction to Industrial Automation, By Stamatios Manesis, George Nikolakopoulos Copyright 2018
[4] Industrial Automation Hands-On, Frank Lamb
[5] Ymeri, Armend & Krasniqi, Nexhmi & Gashi, Drenusha & Hysenaj, Fjolla & Zejnullahu, Shqiprim. (2022). SCADA system in control and automation of distribution system.
[6] *Power System SCADA* and *Smart Grids* [*Thomas*, Mini S., *McDonald*, John Douglas]