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Topical Applications of SCADA

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Abstract -The task of supervision of machinery and industrialprocesses on a routine basis can be an excruciatingly tiresome job.Always being by the side a machine or being on a 24x7 patrol duty around the assembly line equipment checking the temperature levels, water levels, oil level and performing other checks would be considered a wastage of the expertise of the technician on trivial tasks. In order to reduce the number of checks or not waste manpower on this trivial task engineers have come up with a newtechnique. As a result, SCADA systems were formed. SupervisoryControl and Data Acquisition (SCADA) offers the ease ofmonitoring of sensors placed at distances, from one central location. This paper also discusses the topical real time applications of SCADA which are based in industries worldwide.

This paper discusses four applications of SCADA namely: SCADA based green growth monitoring; Reverse Osmosis desalination plants; SCADA system in Oil Natural Gas Corporation LTD; Implementation of a Fully Automated Greenhouse Using SCADA Tool Like Labview.

I. INTRODUCTION

The task of supervision of machinery and industrial processes on a routine basis can be an excruciatingly tiresome job. Always being by the side a machine or being on a 24x7 patrol duty around the assembly line equipment checking the temperature levels, water levels, oil level and performing other checks would be considered a wastage of the expertise of the technician on trivial tasks. In order to reduce the number of checks or not waste man power on this trivial task engineers have come up with a new technique. As a result, SCADA systems were formed. Supervisory Control and Data Acquisition (SCADA) offers the ease of monitoring of sensors placed at distances, from one central location.

II. ELEMENTS OF SCADA

A. Computer Systems:

All the data and monitoring values whether its real time or near real time are collected from the units and stored in a master computer. It is generally standard computer hardware equipment and very few SCADA system suppliers have ventured out to make their own computer equipment. [1]

B. Human-Machine Interface:

The values that are stored in the host computer are further converted into language that can be read and monitored by any person in charge. Thus this provides the communication link between the machine and human. [1]

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C. Remote Terminal Units (RTUs):

The units where all the change in parameters are recorded and stored are known as RTUs. These units are present at a remote location, mostly where the entire project is set up.[1]

D. Programmable Logic Controllers:

The use of microprocessors on RTUs has helped RTUs become smarter with increased functionality. Re-programmability being the biggest asset, PLC based RTUs can be debugged and fixed on the field itself along with adding new features like support for multiple polling, exception reporting, time-tagging etc.[1]

E. SCADA Communication:

The conveying of data from an RTU to the master station and commands from the host to the RTU need to be done over a communication system. Since the system is not contained to jut one plant, its accuracy and speed for communication needs to be in real time. Thus communication is a very important aspect of SCADA. These systems have embraced LANs and WANs for seamless integration with everyday office computer networks. [1]

III. APPLICATIONS

There are extensive applications for SCADA. Few of the topical application will be explained in this paper.

A. SCADA based Green growth monitoring system.

Falling producer prices and rising costs of production are increasingly forcing agricultural businesses to optimize production costs. Therefore "precision farming", the selective use of inputs such as water, fertilizers or chemicals, is now indispensable in modern agriculture. The growing environmental awareness of consumers further accelerates this process. SCADA systems provide: site specific weather information, reliable wireless data transfer, almost real-time availability of important data, state-of-the-art consultancy software, proven disease models, optimal treatment recommendations. The growers benefits are getting important sprays when and where they are really necessary, increase yield and quality, saving energy, time and money, improving environmental stewardship, increased profitability.

This application focuses on providing an artificial and externally controlled environment for the growth of plants. The needs and requirements of a plant will be externally controlled via SCADA system and can be altered when needed. It aims to monitor and control the humidity, temperature, moisture, and light intensity that are needed for the plant to grow and survive. As and when any of these requirements change a message will be sent and these requirements can be automatically changed through the use of SCADA system.

Features:

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Light sensing: Providing the plant with light using an artificial source and controlling its intensity based on the specific requirement of the particular plant using Light dependent resistor(LDR).
Temperature sensing: To keep a check on the temperature of the artificially created environment for the plant and making sure it does not exceed the range needed by the plant.
This is achieved by using a temperature sensor(LM35) Humidity sensing: To sense the humidity content of the artificially created environment for the plant.
Moisture sensing: To sense the water content present in the soil and if the water content falls below the required level , the controller enables the motor to supply water to the soil.
Carbon Dioxide Sensing: To sense the amount of carbon dioxide content present in the vicinity of the plant. Fan to regulate the temperature of the plant environment. GSM : It acts as a medium for communication between the user and the greenhouse system . Hence real time monitoring and controlling few functions of the green house system.[2]

B. Reverse Osmosis Desalination Plant

Reverse osmosis Desalination plants is a water purification technique which is used in application of water treatment engineering all over the globe. This technology deals with water pressure pushing water through a semi permeable membrane, amputated many types of molecules and ions, this membrane technology is not a filtration method. Hence it is necessary that the control systems for these plants keep updating depending on the current usage of this technique hence removing the chances of using obsolete technology by time. On contrary using complicated and overestimated control systems are not convenient to use with these plants chiefly for remote area. Therefore, coming up with a monitoring system to monitor and control a Reverse Osmosis water treatment plant is a convenient solution with computer based software.[3]

C. SCADA system in Oil Natural Gas Corporation LTD

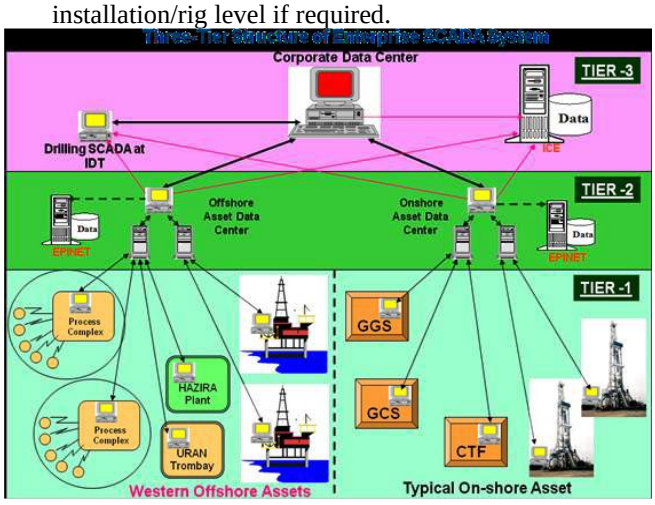
The ONGC uses this SCADA technology to monitor its real time Production and drilling data, which is used for efficient day to day operations and for supporting scientific and business decisions. Production and drilling information is required by different organizational scientific as well as business functional groups.
There are two different processes performed at ONGC drilling of well on sea bed for a offshore rig and land for onshore rig and production of oil. SCADA monitors weather the well drilled is at the correct geographical location and anticipates for any danger or problem faced during drilling into that well ,so through SCADA the data is stored and sent though satellite to the base station where the data is supervised. While Production, once the well is drilled the rigs are removed only the Platform remains (a surface where the drilled well is present) the platforms are unmanned it is this place where around nine different wells drilled are connected via tubes.
SCADA measures three most important parameters of the oil its pressure, temperature and its flow rate. This technology most importantly helps in decision making. Example if the pressure measured at the well mouth is 100kg and received at the platform at 70kg pressure for three consecutive days, but if suddenly there is any fall in the pressure at the well mouth or at the platform it will be because of any leakage or any choke or due to any other technical reason while transmitting. So at the supervisory level data is acquired and a decision is made regarding the well control measuring all its parameters and losses .Hence this technology in ONGC is very useful and important during its most important processes therefore making decision making effective, making the system cost effective and increasing the efficiency of its operations. Hence work at ONGC, the full usage of this technology SCADA i.e Supervisory control and data acquisition is done by supervisory control of the drilling and production at the base stations and storing the data received via satellite.

IV. OBJECTIVES

- The SCADA system in ONGC " s Production & Drilling Installation ensures:
- Efficient monitoring of required Production/Drilling parameters in real time domain.
- Remote control of Production Well in case of offshore from corresponding process complexes.
- Facilitate offline analysis of this valuable Well/Process data and Drilling data available in SCADA servers using different application programs/third party E&P application for value addition to activities of organisation.
- Provide useful summarized and aggregate information to management as well as Third party Enterprise application for supporting different decision and management processes of organization.

Architecture of SCADA system: SCADA system basically includes three-tier system architecture

- TIER-1: at different Production and Drilling installations. Functions: Data is acquired from field instruments, store Real-time as well as historical data and process the data for generating alarms, events and reports.
- TIER-2: at different Asset Head Quarters. Functions: there is a data center which acquires data from all the production and drilling installation of that asset have GUI, alarming and functionalities and interface with various applications. Key performance indicators sent to corporate level.
- TIER-3: at corporate level. Functions: Used by corporate level users with facility to drill down to the installation/rig level if required.



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D. Implementation of A Fully Automated Greenhouse Using SCADA Tool Like Labview

This application is basically based on the automation of the greenhouse monitoring system using Supervisory Control & Data Acquisition (SCADA) system. The resultant end product is expected to give the farmer or end user a kiosk type of approach. Entire greenhouse monitoring operation will be governed through this kiosk type of approach.

SCADA system is an interesting platform for developing system such as greenhouse automated system. It basically allows a „supervisory level " of control over the greenhouse, facilitates data acquisition and creates a developer-friendly environment for implementing algorithms. Greenhouse system designing is based on microcontroller.

Features:

- Heating System.: In greenhouses there are two types of heating systems- Central heating systems:

When a number of greenhouses are to be controlled we use a centralized heating system.

Localized heating systems: Small greenhouses utilize a localized heating system.

- Cooling System: Cooling system is consisting of a fan-and-pad system: Cellulose pads that are placed in one wall. A fan is placed on the opposite wall of the greenhouse. These are used in conjunction to reduce the temperature of the greenhouse.
- Humidity System: Humidity sensor is consisting of Foggers and dehumidifiers. This equipment is basically used to control the surrounding humidity level within the greenhouse automated system.

Both of them can be controlled electronically.

- Lighting Subsystem : A Lighting subsystem is basically including HID (high intensity discharge) lighting that has been used in the greenhouse automated system. Greenhouse lighting systems allow us to extend the growth of a plant by providing an indoor source of light which is equivalent to sunlight.
- Soil moisture control: Automatic Drip Irrigation is an essential tool which is required for accurate soil moisture control in highly specialized greenhouse automated system. It basically provides an accurate measurement of the soil moisture levels by mean of sensing and also applying the required amounts of water to the crop.
- Flow control: A flow control valve should be used in greenhouse automated system to regulate the quantity of water that can enter into the system. A flow control valve is independently controlling or operating a portion of the drip irrigation system.
- Fertilizer system: There are three types of fertilizers such as nitrates, sulphates and phosphates which are needs to be applied through the drip irrigation system for plants growth. This type of injection system is required to be properly planned in the greenhouse system so that distribution of fertilizer to every plant will be take place in accurate manner. [4]

V. CONCLUSION

The paper provides a basic understanding of the SCADA system and also tells us the main elements that build up the SCADA system. This paper also touches upon the versatile applications of SCADA which reduces the labor by making the system automated. The real time application of SCADA systems have been discussed in detail through this paper. It also shows the penetration of SCADA system into discrete application like Agriculture.

VI. ACKNOWLEDGMENT

It has been rightly said, "Whenever people are willing but unable to perform particular task, they need guidance of experienced people which is quite imperative in achieving the desired goals." We would like to express our gratitude to Prof. Vipul Gohil whose constant tutelage helped us complete this research paper.

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