A REVIEW ON APPLICATIONS OF SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEMS

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Abstract*—Supervisory Control and Data Acquisition commonly known as SCADA is now days used for variety of application in various sectors around the world. This paper deals with a state of art review on applications of SCADA systems in various areas. The SCADA system can be used for monitoring variety of processes including wind turbine, refinery, water flow, dams, industrial processes, air pollution, and water pollution from remote areas. With the development in technology now SCADA systems are available with many applications and they can be used with variety of intelligent systems. SCADA system is gaining more and more importance now, as world is moving towards sustainable development and becoming more environment conscious, in these scenarios SCADA can be used to monitor many issues related to environment. This paper presents a detailed review on applications of SCADA in variety of sectors like water monitoring, air pollution monitoring, in smart buildings etc.

***Keywords*— SCADA, Control Systems, Monitoring, Data Collection.**

I. INTRODUCTION

Control systems are often used by many industries to monitor and control variety of processes. The main operation which a control system performs is it collects variety of real time data from a process and that data is made available to user. From this user can decide the actual status of the process. Distributed control systems (DCS) and Supervisory control and data acquisition (SCADA) are the commonly used control systems. The former is used within a single process or generating plant or used over a smaller geographic area or even a single-site location and later is used for used for larger-scale environments that may be geographically dispersed in an enterprise-wide distribution operation. [1].

Supervisory control and data acquisition commonly known as SCADA was first introduced in the 1960s at Bonneville Power Administration [2].The main benefit of SCADA is one can monitor a process from anywhere. The SCADA system now a day's is used for monitoring and controlling of variety of processes including wind turbine, refinery, water flow, dams and industrial processes from remote areas.A right SCADA system can saves time and money by eliminating the need for service personnel to visit each site for inspection, data collection/logging or make adjustments to increase process reliability [3].

II. REVIEW ON APPLICATIONS OF SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEMS

Temido et al. [4] implemented SCADA and Smart Metering system for water companies. They found theses technologies can contribute for sustainable use of water and energy, and reduce the stress exerted on the environment which can help in promoting the reduction of CO_2 emissions and other greenhouse gases in water supply systems. According to them SCADA can monitor and control variety of equipments and processes, from the water source to the customer's tap, including transmission pipes, treatment plants, tanks and distribution networks. They also mentioned about use of SCADA systems in the urban water cycle to monitor and control wastewater and storm water systems. Tomic et al. [5] developed a smart SCADA system for monitoring and estimating the concentrations of major air pollutant gases, in an urban area. Their system measure air pollutants from various types of measuring stations and from a large number of measuring points. This system predicts pollutants in the air from this prediction people can be warned to avoid sites with potentially hazardous concentrations. Figueiredo and Costa[6]developed an operational control platform for intelligent buildings using a SCADA system which integrates different types of information like control of ventilation, temperature, illumination etc coming from the several technologies present in modern buildings. According to them SCADA system can be as an application development tool which creates sophisticated supervisory and control applications for many applications. They further mentioned about ability of SCADA to communicate with control equipment in the field, through the Implemented network.

Figueiredo et al. [7] built a SCADA-Matlab platform which connects usual SCADA supervisory system to MATLAB software to handle complex control algorithms. Their result demonstrated the reliability and effectiveness of SCADA-Matlab platform in real-life typical situations, including gate malfunctioning and extreme water off-take conditions. Morsi et al. [8] designed a SCADA system for oil refinery process and found that SCADA system is much faster than conventional Distributed Control System (DCS).They also mentioned the SCADA system can record and store a enormous amount of data. Further they found SCADA screens are more realistic than DCS screens and one can monitor the process from any place. Castellani et al. [9] analyzed the SCADA data for assessing the importance of how wind turbines align in patterns to the wind direction. With SCADA data they showed that non-trivial alignments with respect to the wind direction arise and significant performance deviations occur among the most frequent configurations. Nunoo and Mahama[3] employed Internet-based Supervisory Control and Data Acquisition (SCADA) system for monitoring power transformer parameters namely temperature, voltage, load and bushing condition. They reported that implementation of internet-based Supervisory Control and Data Acquisition can save running cost By optimizing maintenance schedule and reduce risk of failure to the power transformer.

Implementation of SCADA water and waste water systems, operators can be informed the about the design of new systems and also about the upgrade in existing systems. Further the number of customer complaints regarding low system pressure or poor water quality can be reduced[10].According to Ehrenreich [11] supervisory Control and Data Acquisition (SCADA) solutions can provide a base for enhanced monitoring of oil and gas installations such as pipelines, production sites, valve installations, compressor stations and other remote sites.

SCADA plays an vital part in providing means for upgrading their operating productivity, reducing maintenance costs, minimizing the number of outages, helping to avoid difficult problems and leading to safer operation of the entire infrastructure. Sanchez [12] reported improved performance, reliability and security because of implementation SCADA system in of water treatment facilities in the village.Dobriceanu et al. [13] employed SCADA system for the monitoring and control of the technical parameters in the water distribution stations. They reported optimum functioning of the pumping system, safety and endurance growth in the equipments, efficient energy usage and optimum administration of the drinkable water because of implementation of SCADA system. Aydogmus [14] presented use of SCADA control via PLC for a fluid level control system with fuzzy controller. They assembled a liquid level control set and PLC together. Membership functions are derived MATLAB/Simulink program. A SCADA system has been built up for monitoring of water level in tank and position of the actuator valve.

Zhang and Wang [15] proposed a fault detection method for main bearing wind turbine based on collected SCADA data using an artificial neural network (ANN).They found that because of above system main bearing fault can be identified at early stages which will to let the operator to make more informed decisions for maintenance. According to Wang et al. [16] there are few challenges that need to conquer in analysis of data collected by SCADA data. One of them is SCADA can differ from turbine to turbine and other is SCADA data change with the operational conditions. Therefore according to them pre-processing the raw data can equally contribute to the success of the CM algorithm itself. Sun et al.[17] developed a generalized model for wind turbine (WT) anomaly identification based on the data collected from wind farm supervisory control and data acquisition (SCADA).In their investigation they employed Neural Networks (NNs) to establish prediction models of the WT condition parameters which are dependent on environmental conditions such as ambient temperature and wind speed. Input parameters of the prediction models are selected based on the domain knowledge. Their method was been used for real 1.5MW WTs with doubly fed induction generators. They further reported effectiveness of this method in WT anomaly identification than traditional methods

Above review of literature can be summarized as, SCADA (supervisory control and data acquisition) is a system in which one can monitor and control the process remotely. SCADA basically operates on coded signals over communication channels. SCADA system offers variety of advantages over conventional monitoring and data collection systems. The most important aspect of SCADA is one can monitor the process from any remote place. Real time data is available for processing. Quick actions can be taken once the fault is detected. SCADA system can be successfully implemented in variety of application which includes Industrial applications, Infrastructure applications, Energy Applications, Defense, Space etc.

CONCLUSIONS:

A comprehensive review on applications of SCADA has been presented in this paper. Role of SCADA in variety of sectors like water monitoring, air pollution monitoring, in smart buildings, wind turbine, refinery, dams and industrial processes has been discussed in detail. SCADA systems can be constructively implemented in various sectors which will reduce human effort and improve accuracy of system monitoring. With implementation of SCADA one can monitor the process from any place and because of this benefit in many sectors where situation favors SCADA systems can be implemented.

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