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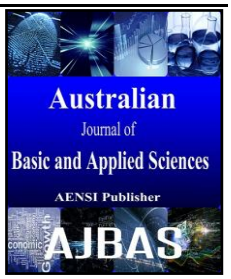

Design And Implementation Of Industrial Grade Ph Control System

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ABSTRACT

To designing and implementing an industrial grade ph control system to neutralize the water to normal, because industrial waste water may contain acidic or basic content, so it's industries commitment to treat the waste water that leaving out to river. Scaling of pH sensor reading from several milli-volts to a range of 1v to 5v to make the neutralization more accurate in a alternative low cost model.

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INTRODUCTION

pH plays an important role in determining product quality in various industries like chemical, petrochemical, petroleum refineries, fertilizer, pharmaceutical, food industries, effluent treatment and in many other organic and in organic plants. For instance, in any industrial wastewater treatment plant, the pH is monitored and controlled by manipulating acid or base stream which is strong acid or strong base. Modern treatment plant involves physical and chemical precipitation or flocculation along with biological treatment in aerators or trickle filters, membrane etc., where the control of pH is the key factor for efficient treatment.

Methodology:

first phase of this project deals with the designing of transmitter circuit for amplifying and calibrating the pH sensor value. Output of transmitter is given to ATmega328 (Arduino Nano 3.x), microcontroller. Second phase of the project deals with the programming of microcontroller, displaying of output in LCD display and the final stage deals with the designing of SCADA setup for waste water treatment control system.

Objective:

- To understand the basic design of industrial grade pH control system.
- To neutralize the pH value of the waste water from industries.
- Monitoring the pH of waste water, to scale the output of ph sensor from milli-volts to range of 1v - 5v in Order to open and close the valve of neutralizer more precisely.
- To study and design SCADA setup for waste water treatment process of industries.

Working Principle:

pH control:

By pH control we mean to maintain the pH value during continuous operation at specific desired value through manipulating the alkaline flow rate. Usually in most industrial application, the desired value is chosen to be around 7. This is the safest value for portable water, utility water used in industry, or waste disposed water. In typical control implementation, the control objective should be maintained during transient operation. Transient behavior is encountered when moving from one operating condition to another (start-up, grade changeover), or when the process is under the influence of upsets (disturbances). The control problem during startup is known as servo problem, while the control problem during disturbance is known as regulatory problem.

Many methods are used to control pH neutralization process, which may be classified into:

- Conventional method such as feedback control.

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- Modern method such as adaptive control, fuzzy control, multiregional fuzzy control and genetic adaptive control.

pH control is well known as a difficult problem. The difficulty arises from the high non-linearity of the process around the neutralization point. The non-linearity appears in the S-shape titration curve associated with pH processes. The process gain grows drastically at the intermediate region of the S-shape curve, i.e. around the neutralization point. This behavior is the main source of control difficulty. Moreover, the shape of the titration curve is distorted when the feed condition changes. This situation adds more complexity to the control system. For this reason, pH control was and still is the scope of work for many researchers.

A feedback configuration is used for the pH control problem as shown in Figure (1.1) that shows the experimental closed-loop setup. All required instrumentation shown in figure (1.1) is installed and ready to operate.

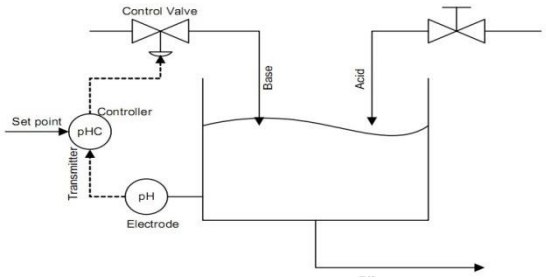

Fig. 1.1: Experimental closed-loop system.

It was shown that the wastewater neutralization processes performing in a continuous form present a very difficult and challenging control problem because of several factors:

- Neutralization process is highly nonlinear.
- Sensitivity of the pH to titrating reagent addition tends to be extreme near the equivalence point, and small portion of titrating reagent can result in a change of one pH unit.
- The process gain is a complicated function of components of the solution, so titration curve is unknown for multi-component and poorly defined streams.
- The titration curve of a real-world process changes in time due to variations in components. Indeed, the process is often subject to unpredictable, immeasurable disturbances.

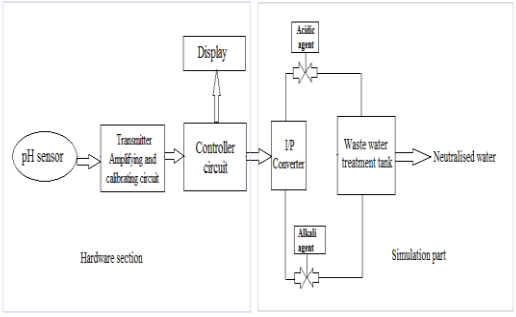

Fig. 1.2: Block diagram of neutralizing process.

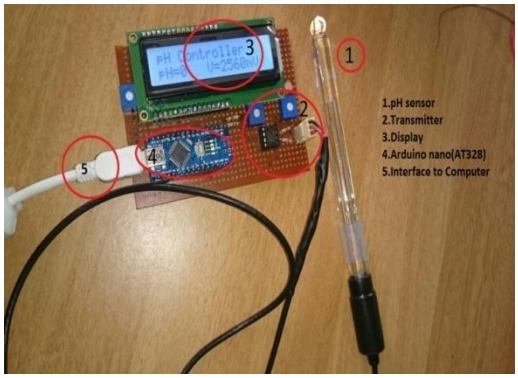

Fig. 1.3: pH measuring and calibrating circuit.

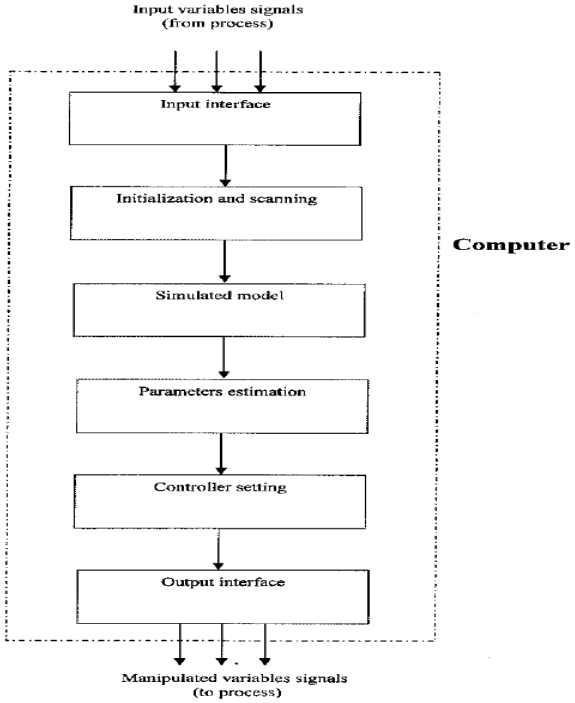

Fig. 1.4: Computer functional diagram.

Simulation:

SCADA: Acronym for supervisory control and data acquisition, a computer system for gathering and analyzing real time data. SCADA systems are used to monitor and control a plant or equipment in industries such as telecommunications, water and waste control, energy, oil and gas refining and transportation. A SCADA system gathers information, such as where a leak on a pipeline has occurred, transfers the information back to a central site, alerting the home station that the leak has occurred, carrying out necessary analysis and control, such as determining if the leak is critical, and displaying the information in a logical and organized fashion. SCADA systems can be relatively simple, such as one that monitors environmental conditions of a small office building, or incredibly complex, such as a system that monitors all the activity in a nuclear power plant or the activity of a municipal water system. SCADA systems were first used in the 1960s.

The term is used to describe a number of different computer features. For example, real-time operating systems are systems that respond to input immediately. They are used for such tasks as navigation, in which the computer must react to a steady flow of new information without interruption. Most general-purpose operating systems are not real-time because they can take a few seconds, or even minutes, to react.

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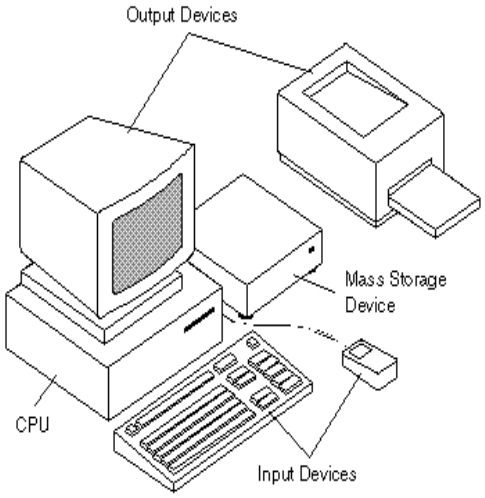

A programmable machine. The two principal characteristics of a computer are:

- It responds to a specific set of instructions in a well-defined manner.
- It can execute a prerecorded list of instructions (a program).

Modern computers are electronic and digital. The actual machinery -- wires, transistors, and circuits -- is called hardware; the instructions and data are called software.

All general-purpose computers require the following hardware components:

- memory : Enables a computer to store, at least temporarily, data and programs.
- mass storage device : Allows a computer to permanently retain large amounts of data. Common mass storage devices include disk drives and tape drives.
- input device : Usually a keyboard and mouse, the input device is the conduit through which data and instructions enter a computer.
- output device : A display screen, printer, or other device that lets you see what the computer has accomplished.
- central processing unit (CPU): The heart of the computer, this is the component that actually executes instructions.

In addition to these components, many others make it possible for the basic components to work together efficiently. For example, every computer requires a bus that transmits data from one part of the computer to another.

Computers can be generally classified by size and power as follows, though there is considerable overlap:

- personal computer : A small, single-user computer based on a microprocessor. In addition to the microprocessor, a personal computer has a keyboard for entering data, a monitor for displaying information, and a storage device for saving data.
- workstation : A powerful, single-user computer. A workstation is like a personal computer, but it has a more powerful microprocessor and a higher-quality monitor.
- minicomputer : A multi-user computer capable of supporting from 10 to hundreds of users simultaneously.
- mainframe : A powerful multi-user computer capable of supporting many hundreds or thousands of users simultaneously.
- supercomputer : An extremely fast computer that can perform hundreds of millions of instructions per second.
- operating system

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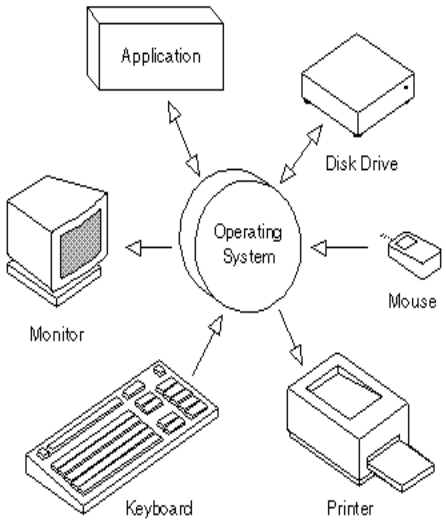

The most important program that runs on a computer. Every general-purpose computer must have an operating system to run other programs. Operating systems perform basic tasks, such as recognizing input from the keyboard, sending output to the display screen, keeping track of files and directories on the disk, and controlling peripheral devices such as disk drives and printers.

For large systems, the operating system has even greater responsibilities and powers. It is like a traffic cop -- it makes sure that different programs and users running at the same time do not interfere with each other. The operating system is also responsible for security, ensuring that unauthorized users do not access the system.

Operating systems can be classified as follows:

- multi-user : Allows two or more users to run programs at the same time. Some operating systems permit hundreds or even thousands of concurrent users.
- multiprocessing : Supports running a program on more than one CPU.
- multitasking : Allows more than one program to run concurrently.
- multithreading : Allows different parts of a single program to run concurrently.
- real time: Responds to input instantly. General-purpose operating systems, such as DOS and UNIX, are not real-time.

Operating systems provide a software platform on top of which other programs, called application programs, can run. The application programs must be written to run on top of a particular operating system. Your choice of operating system, therefore, determines to a great extent the applications you can run. For PCs, the most popular operating systems are DOS, OS/2, and Windows, but others are available, such as Linux.

As a user, you normally interact with the operating system through a set of commands. For example, the DOS operating system contains commands such as COPY and RENAME for copying files and changing the names of files, respectively. The commands are accepted and executed by a part of the operating system called the command processor or command line interpreter. Graphical user interfaces allow you to enter commands by pointing and clicking at objects that appear on the screen.

SCADA stands for Supervisory Control And Data Acquisition. As the name indicates, it is not a full control system, but rather focuses on the supervisory level. As such, it is a purely software package that is positioned on top of hardware to which it is interfaced, in general via Programmable Logic Controllers (PLCs), or other commercial hardware modules.

SCADA systems are used not only in industrial processes: e.g. steel making, power generation (conventional and nuclear) and distribution, chemistry, but also in some experimental facilities such as nuclear fusion. The size of such plants range from a few 1000 to several 10 thousands input /output (I/O) channels. However, SCADA systems evolve rapidly and are now penetrating the market of plants with a number of I/O channels of several 100 K: we know of two cases of near to 1 M I/O channels currently under development.

SCADA systems used to run on DOS, VMS and UNIX; in recent years all SCADA vendors have moved to NT and some also to Linux.

1) Architecture

This section describes the common features of the SCADA products that have been evaluated at CERN in view of their possible application to the control systems of the LHC detectors [1], [2].

1.1) Hardware Architecture

One distinguishes two basic layers in a SCADA system: the "client layer" which caters for the man machine interaction and the "data server layer" which handles most of the process data control activities. The data servers communicate with devices in the

field through process controllers. Process controllers, e.g. PLCs, are connected to the data servers either directly or via networks or fieldbuses that are proprietary (e.g. Siemens H1), or non-proprietary (e.g. Profibus). Data servers are connected to each other and to client stations via an Ethernet LAN. The data servers and client stations are NT platforms but for many products the client stations may also be W95 machines.

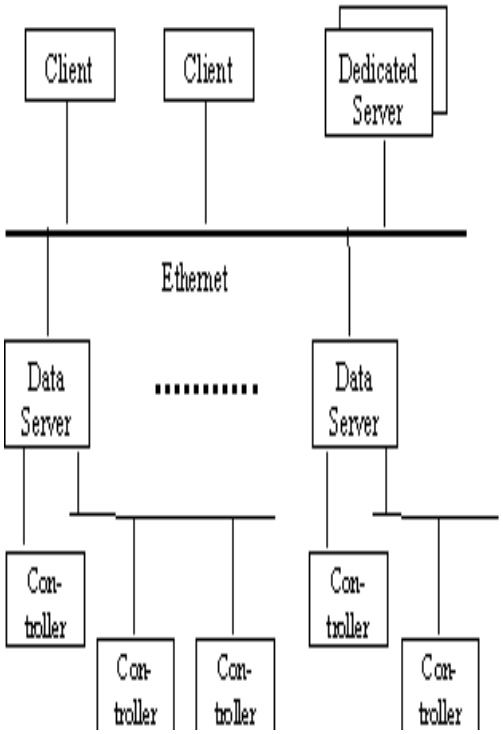

Fig. 2: Typical Hardware Architecture

1.2) Software Architecture

The products are multi-tasking and are based upon a real-time database (RTDB) located in one or more servers. Servers are responsible for data acquisition and handling (e.g. polling controllers, alarm checking, calculations, logging and archiving) on a set of parameters, typically those they are connected to.

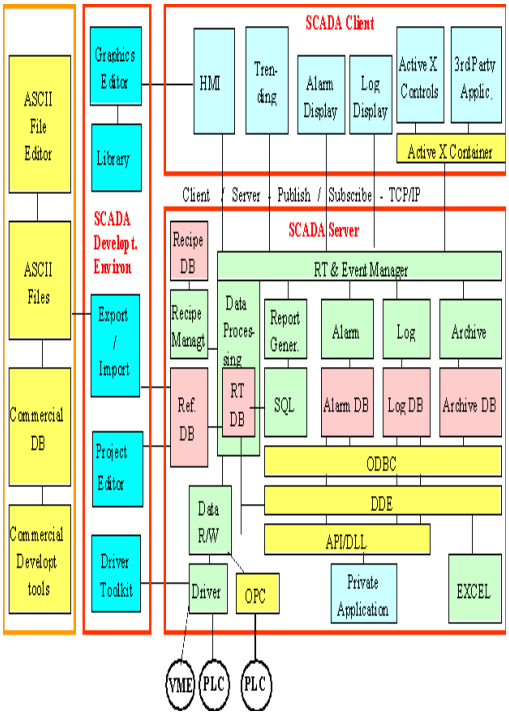

Fig. 2: Generic Software Architecture

System Analysis:

1) Existing System: Pneumatic control system is used, which Have less accuracy in opening and closing the control valve. It works with the chart pen recorder. It is not enough accurate. Since a small amount of acid or base can produce a large variation in the pH of a solution. Output of pH value is in the milli-volt reading.

2) Proposed System: Our proposed system in this project is control the pH value of the wastewater that is neutralization of pH value to 7. Monitoring the pH of waste water, to scale the output of ph sensor from milli-volts to range of 1v - 5v in Order to open and close the valve of neutralizer more precisely. To study and design labview setup for waste water treatment process of industries.

3) Process control: Control of the pH neutralization process plays an important role in different chemical plants, such as chemical and biological reaction, waste water treatment, electrochemistry & precipitation plants, Production of pharmaceuticals, fermentation, and food production. However, it is difficult to control a pH process with adequate performance point due to its nonlinearities, time-varying properties and sensitivity to small disturbances when working near the equivalence point.

Results and Conclusion:

- Hardware circuit for sensing, scaling and controller circuit is designed successfully and got the output.Industrial grade pH control system for neutralization of waste water treatment is done successfully using SCADA setup.
- The field of pollution monitoring and control is very wide and this project is an attempt to minimize the problem of cost and regular inspection by the utility of industrial grade pH control system. As a chemical component of the wastewater, pH has direct influence on wastewater treatability - regardless of whether treatment is physical/chemical or biological. Because it is such a critical component of the makeup of the wastewater, it is therefore critically important to treatment. SCADA was the powerful and versatile programming language for operating and controlling the wastewater treatment system.

Future Scope:

The field of pollution monitoring and control is very wide and this project is an attempt to minimize the problem of cost and regular inspection by the utility of industrial grade pH control system. As a chemical component of the wastewater, pH has direct influence on wastewater treatability - regardless of whether treatment is physical/chemical or biological. Because it is such a critical component of the makeup of the wastewater, it is therefore critically important to treatment. SCADA was the powerful and versatile programming language for operating and controlling the wastewater treatment system.

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