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# Implementation on Monitoring and Interfacing of SCADA Based Natural Fertilizer Packaging Process

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**Abstract**— In many industries, Supervisory Control and Data Acquisition (SCADA) system was being used to control easily and simply. This system is a computer control and software application. This paper describes implementation of real-time monitoring on SCADA based control system for natural fertilizer manufacturing process. This monitoring system is utilized the Visual C#.Net programming from Visual Studio 2008 software. Parallel port interfacing is applied in this system to input the computer and to output the process. PIC16f877 is used to control the whole process. This paper is supported manufacturing processes to be easy, simple and accurate.

**Keywords**—SCADA, manufacturing process, parallel port interfacing, Visual C#.Net programming, real-time monitoring system.

## I. INTRODUCTION

Factory automation has been introduced in today industrial world. Most of the modern industrial plants have a control centre where a SCADA system installed. It is a software application specially designed to work on computers in the production control, which provides communication with the devices (programmable robots, independent controllers, etc.) and controls the process from the screen of the computer [4]. In this system, It usually includes a computer, which carries out tasks of supervision and management of data, as well as data processing and process control. So, one or two operators can control the whole manufacturing process from a central point.

This paper describes the natural fertilizer manufacturing process and the facts that include how interface and monitor the process. And then this paper is intended to understand Visual C#.Net programming in Visual Studio 2008 software to control, communicate and monitor for natural fertilizer manufacturing process using SCADA based control system. It is mainly implemented the desired programs for monitoring, interfacing and acquisition for natural fertilizer manufacturing process. In typical SCADA software, it applies for controlling and monitoring between hardware devices and computer. So, hardware devices include dc motor drivers, sensing drivers, programmable interface controller (PIC16F877A) and parallel port communication. The parallel port communication interfaced between the remote terminal units (RTU) and master station [7]. Fig. 1 shows the whole process of natural

fertilizer manufacturing process using SCADA based control system.

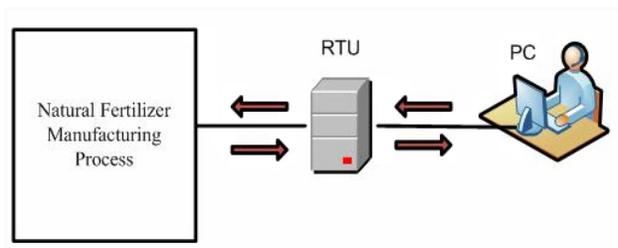


Fig. 1 The whole process of SCADA based control system

## II. OPERATION OF THE CONTROL SYSTEM

There are three processes to fully activate the natural fertilizer manufacturing plant. These processes are mixing process, filling process and packaging process. Mould, rice husk ash and microorganisms' culture broth are filled in the mixer until reaching the specified weight level. The filling process in the mixer is stopped when the (mixer) weight sensor senses the specified weight level. The filling process in the bag is operated simultaneously. The filling process in the bag is stopped when the (bag) weight sensor senses the specified weight level. And then the conveyor moves towards one direction by necessary speed. The position sensor senses the bag whether the specified position on the conveyor or not. If the bag reaches at this position, the sewing motor is operated. The robot picks up the bag on the conveyor and places it on the truck when another position sensor senses the bag. When the counter has five bags, the counter resets and the process start again.

### A. Circuit Diagram

This system consists of two portions; control unit for the operation of natural fertilizer manufacturing process and the other for displaying and interfacing the monitoring windows chosen by user. The pin connections of the PIC 16F877A are important to control the different parts of the natural fertilizer manufacturing process and to work correctly. These connections are shown Fig. 2. Pin RD0-RD3 from the port D is used as the counter output pins when the number of packages is counted. After the number of package had counted

to five, the counting reset. And pin RB0-RB5 from the port B are also used as motor indicators (mixing motor, a filling motor, a conveyor motor, a sewing motor and a robot arm motor) because the conditions of operating and stopping for the motors is wanted to monitor on the computer.

Pin RA0-RA3 from the port A are used as the input signal in this project. These pins are used as weight sensor (mixer), weight sensor (bag), position sensor (bag) and another position sensor. The variable resistors are used instead of sensors. Pin RA4 is used through the OR gate for a start/stop signal. So, starting and stopping state for this process can be made either manual or from computer.

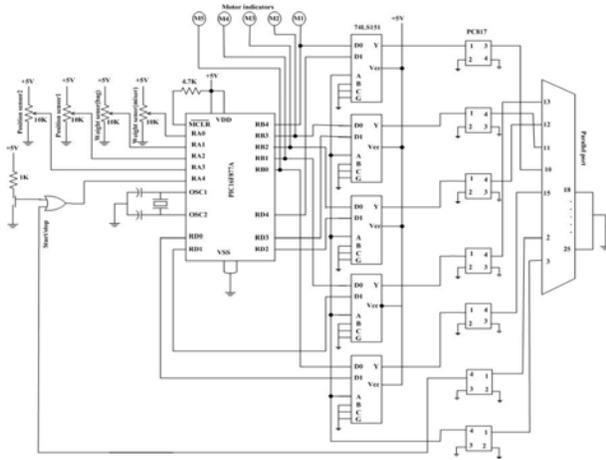


Fig. 2 Process control circuit diagram

### B. Program Flowchart

In Fig. 3, when the weight sensor (mixer) detects the specified weight level, the filling motor is opened. And when the weight sensor (bag) detects the specified weight level, the filling motor is closed and the conveyor motor is driven. If the position sensor (bag) senses the bag, the sewing motor is operated. When the time duration takes 10 sec, the sewing motor is stopped. The robot arm picks up the package and places it on the truck when another position sensor senses the package. Finally, the number of packages counts from the PIC. If the counter has complete five packages, the operation will start again.

### III. SOFTWARE DEVELOPMENT FOR PARALLEL PORT

Among the I/O ports of the computer system, parallel interfacing is applied in this system to input the computer and to output the process. The parallel port communication is used to communicate, control and collect data for RTU linking with operation. This system uses library files “.dll” to control visual C#.net for input/output signal from the real-time process. When window application runs, it links to the DLLs declared in its program code, and the corresponding DLLs load into memory. The program declares the Inp32 and Out32 contained in inpout32 and declares variables by using software for natural fertilizer manufacturing process [5].

```
public class PortAccess
```

```
{
    [DllImport("inpout32.dll")]
    public static extern short Inp32 (short PortAddress);
    [DllImport("inpout32.dll")]
    public static extern void Out32 (short PortAddress, short Value);
}
```

The Inp32 function used in the above class is used to read the parallel port .The Out32 function is send the data out to the required port [9].

### IV. MONITORING AND DISPLAYING

Visual C#.Net from IDE is used for the monitoring of the process. The monitoring software of main window runs and sends appropriate command to the RTU. After receiving and checking the command, the data acquisition and processing module (operation mode) are processed. If the command is selected to acquire data from sensors and requested to send acquire data, the operation mode acquires the signal input from sensors, process and send the result to output system.

### V. SIMULATION RESULTS OF MONITORING SYSTEM

In this system, monitoring programs are written by Visual C#.Net programming. The result contains the main page that links other window application and simulation page for the real-time operation. This system only intends to monitor and control for the natural fertilizer manufacturing process.

In main window, it contains the interfacing system for the I/O signal from parallel port. The start and stop buttons are used to operate and stop the whole system which is real-time monitoring process. The instruction window is used to express the user guide. The operation button is used to display the simulation result of the whole process. The hardware button is utilized to show the monitoring of hardware devices. The exit button is used to end the process and to exit the monitoring system by linking with the yes or no message box. It is shown in Fig. 3.

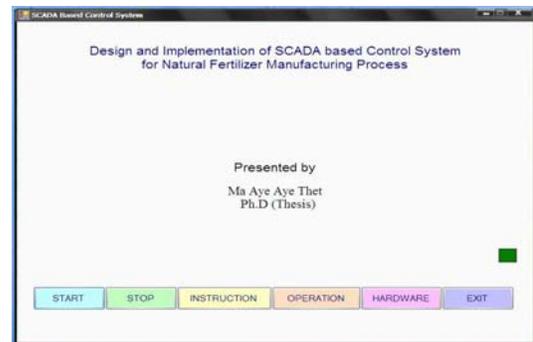


Fig. 3 Screenshot of the main window

In instruction window, it shows the user guide for the overall system how to use and what contains it. It links with the main window. If the user wants to go back the main window, the data window will be closed. It is shown in Fig. 4.

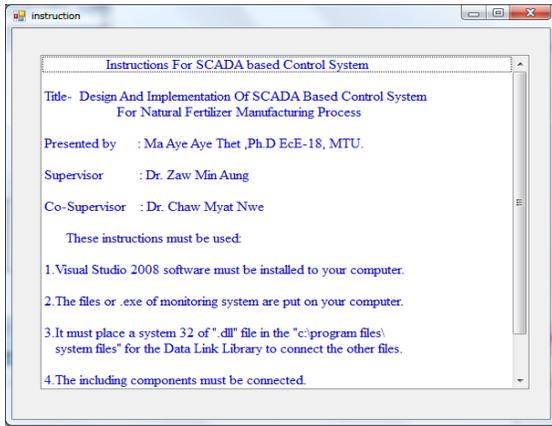


Fig. 4 Screenshot of the instruction window

In operation window, it shows a main process for all operation. It is designed with the sample components for the real devices of the whole process by using the sample figures of actual devices. It displays the monitoring or moving of each components. It uses I/O signal form the main window for operation of device by using each signal. The motor button is used to display the operating condition of motors due to each input signal by linking with it. The sensor button is utilized to express the condition of sensors by linking with it. The counter button is used to display the number of bag by linking with it. The back button is used to go back the main window like to close the operation window. It is shown in Fig. 5.

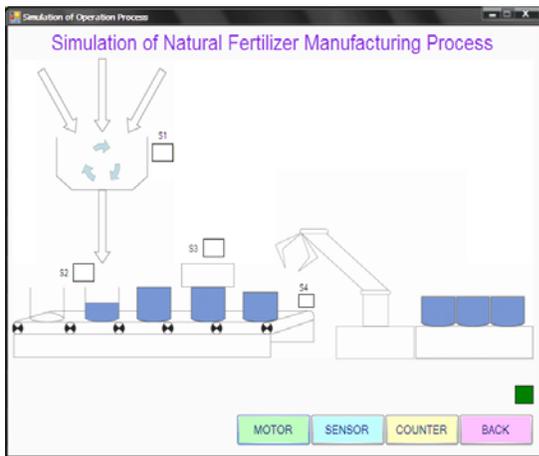


Fig. 5 Screenshot of the operation window

In motor window, it includes symbols of motor like the moving of motors for the manufacturing process. It contains mixer motor, conveyor motor, sewing motor and robot arm motors. If the input signal of pin assigned motors gets, the running condition of motor will display on the window. It links to the operation window. The back button is used to go back the operation window. It is shown in Fig. 6.

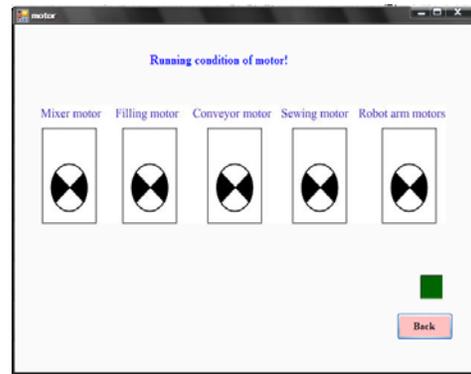


Fig. 6 Screenshot of the motor window

In sensor window, it includes the symbols of sensor like the changing of colours for the manufacturing process. It contains weight sensor (mixer), weight sensor (bag), position sensor1 (bag), position sensor2 (bag). If the input signal of pins assigned sensors gets, the changing of colour for running sensors will display as gray or light green on the window. It links to the operation window. The back button is used to go back the operation window. It is shown in Fig. 7.

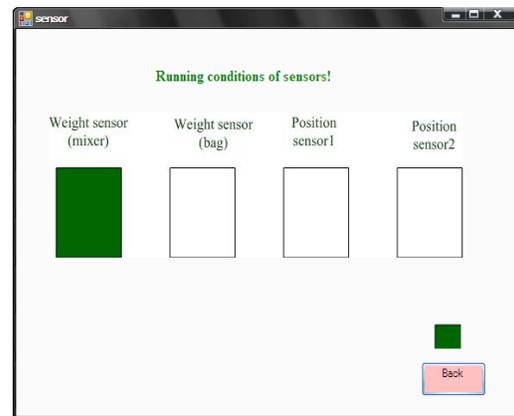


Fig. 7 Screenshot of the sensor window

In counter window, it contains the images of bag like the number of bags for the running process. It includes five bags for one cycle operation. It displays the number of bags which is full after it has filled at the real devices from hardware process. If the input signal of pins assigned counter gets, the number of bottles will show on the window. It links to the operation window. The back button is used to go back the operation window. It is shown in Fig. 8.

In hardware window, it includes the hardware images like the components for the SCADA based natural fertilizer manufacturing process. If the input signal of start button gets, the changing colours of arrows will show on the used window. It links with the main window. The back button is to go back the main window. It is shown in Fig. 9.

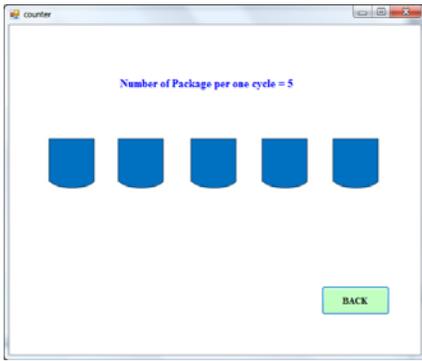


Fig. 8 Screenshot of the counter window

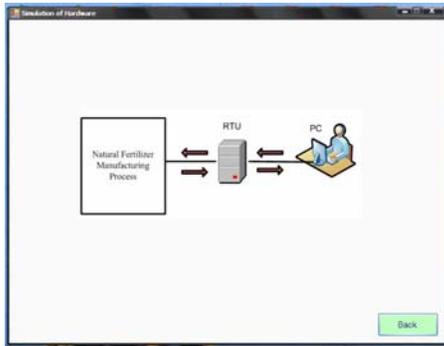


Fig. 9 Screenshot of the hardware window

In exit window, it contains the decision for running condition or stopping condition of the monitoring system. It uses the message box including yes or no decision that is if it is yes, it will exit from the monitoring system otherwise the process is gone on the operation. It is shown in Fig. 10.



Fig. 10 Screenshot of the exit window

## VI. SIMULATION RESULTS

The main important parts are monitoring and displaying system using Visual C#.Net. The simulation results have been mentioned to each condition such as main page, instruction, operation, hardware and exit window of the SCADA software components. In this test, Visual studio 2008 software must be installed to the computer that must use natural fertilizer manufacturing process. The files or .exe of monitoring system must place on the computer desktop. It must put input32.dll file in the "C:\WINDOWS\system" for the Data Link Library to connect the other files [9]. The parallel port communicates the computer and hardware devices. It tests LEDs instead of

motors and variable resistors instead of sensors. In this way, it is tested the interfacing system for the I/O signal from parallel port and links with other windows and sends to the other pages the condition of I/O signal. Five output pins of PIC are connected to the pin 10,11,12,13 and 15 of the parallel port cable from the computer. If one of them gets a input signal, the real time operation of these motors will show on the screen of the computer. Other windows are simulated by receiving another output pins of PIC using multiplexers. The operation works well in this simulation result as shown in Fig. 12.

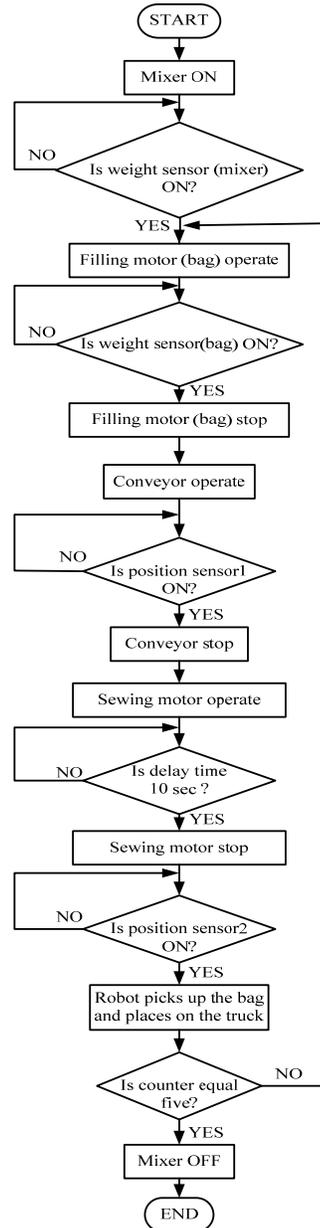


Fig. 11 Program flowchart of the natural fertilizer manufacturing process

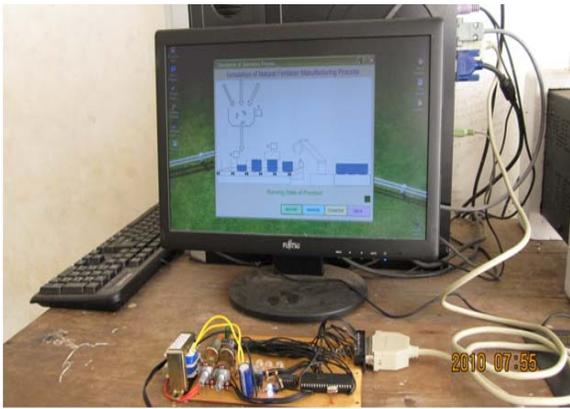


Fig. 12 Photo of communication of Hardware and Software

## VII. CONCLUSION

In this paper, this system aims to develop the controlling devices from anywhere by monitoring the overall system. Using this monitoring control system, it is intended to become security and reliability for the processes. A low cost data acquisition, processing and monitoring system based on the SCADA control system has successfully developed in this paper. It includes motors, sensors and other devices and applies to control the type of Visual C#.Net programming like SCADA software. Fig. 12 shows the performance test with hardware component and software system for natural fertilizer manufacturing process.

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