

ARTICLE

Implementation of Distributed Control System for Rice Mill Using C#

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ABSTRACT

The paper presents the distributed control system for rice mill using C# language. The real-time manufacturing system can be implemented by utilizing the signal from the real time control units that is more operative than other old-fashioned control systems in the extent of modern industrial days. The software-based Distributed Control System (DCS) is novel fashionable than any other conventional control systems in the state-of-the-art manufacturing developments. This research study emphasizes on the implementation of the DCS-based rice mill using visual C#.net. The Industrial Ethernet (IE) is realized between the top level controller for the operator and the controlled station for the remote devices. The model of client-server approach is more appropriate for the automation and manufacturing research purposes. In this study, the computer graphical simulation of the complete control development is depicted in real-time status quo by visual C# language under Visual Studio 2008 software. The parallel ports in the computers of remote terminal level and the master terminal level controllers have been interconnected with port interface coding by visual C# program.

1. Introduction

RICE is the staple food for 100% of the population in Myanmar. It is the major consumed calorie source surrounded by the food grains. With a per capita accessibility of 73.8 kg it convenes 31% of the whole calorie obligation of the population. Myanmar is the world largest producer of rice in the world. Aside from rice milling system, rice bran processing for oil extraction is also a significant agro dispensation action for value accumulation, income and service production^[1-7].

Numerous of the rice processing divisions are of the conventional huller type and are unproductive. Up to date rice mills are encompassing elevated capability and are principal concentrated, although incompetent. Miniature contemporary rice mills have been expanded and are obtainable in the market but the need of information is a blockage in its approval by the potential industrialist. The present replica will go a lengthy method in connecting the information break. The overall system block diagram for DCS based rice mill system is illustrated in Figure 1.

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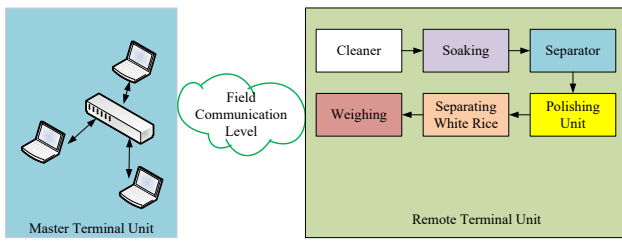


Figure 1. DCS-Based Rice Mill

2. Milling Process

Where the current machinery is touch expensive and manufacturing rate is somewhat towering still the rice generated farther the contemporary machinery has acquired additional order in open marketplace. Foreword of mechanical dryer is a significant adding together in excess of manual sun drying procedure. Here in mechanical drying scheme condensation is being utilized and it is an un-interrupted procedure takes 6 to 7 hours for drying paddy. Benefit is that the rice mills can be operated during rainy condition. Insertion of parboiling with mechanical dryer has been measured as contemporary rice mills in Myanmar. Rest other procedures are ordinary in this region.

When rice is harvested it has a non safe to eat shell or hull neighboring the essential part. At the rice mill, all trails and extra far-off substance are detached from the jagged rice by an assortment of dedicated machinery. Parboiled rice is fashioned using a condensation pressure procedure earlier than milling process. Rice is parboiled in the shell or hull which becomes softer the essence, permitting the exterior starch, fiber and additional parts to comingle.

The water is afterward shattered and the rice is suspiciously condensation dried. The dried parboiled rice is sent throughout machines which eradicate the shell or hull and shine the essence. Brown rice doling out engrosses fleeting the rough rice through defender machines which eradicate the shell or hull, manufacturing brown rice with the bran layers still unharmed around the essence.

Ordinary milled colorless rice is fashioned by eradicating the shell or hull and bran layers. The bran layers are detached by a polishing machine the chafes that grains collectively underneath pressure. The result is a refined white essence ^[8-12].

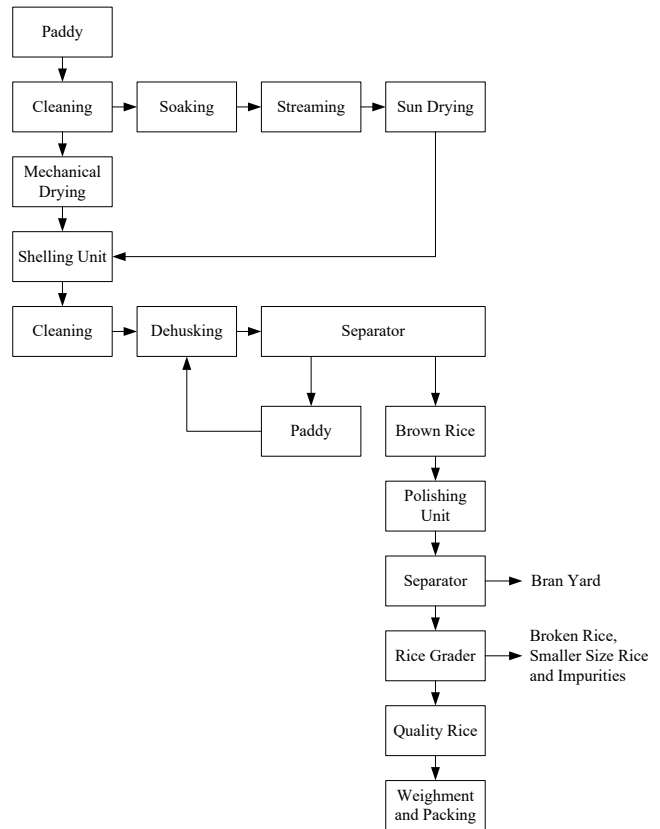


Figure 2. Block Diagram of Raw Rice/Parboiled Rice Processing

3. DCS System for Rice Processing

The DCS composes of a Supervisory Control and Data Acquisition (SCADA) scheme and of front-end schemes. The forename SCADA points out that the functionality is dual: It obtains the information from the front-end modules and it puts forward supervisory control purposes, for instance information dispensation, demonstrating, accumulating and collecting. This facilitates the managing of instructions, communications and agitations. The front-end schemes could be depicted in expressions of campaigns and of Input and Output ports. Front-end schemes can array from straightforward Input and Output devices to sophisticated schemes based on high performance computer which are linked to the SCADA schemes by using industrial communication network. A Real-Time SCADA database includes evidences where the data values are accumulated.

Distributed Control System can be separated into up-

right portions. Such a separation can be activated entirely autonomously from other portions of the DCS and advocates the complete SCADA function to its clients. Two or more separations can be composed of one control province by linking the real-time databases to each other. Apparently, a control province can be made up of a single division additionally. Separations contained by this control province exchange data with both by interpretation and lettering the evidences in the distributed real-time database. With the exception of this database access, there are no additional communication acquaintances recognized between specific divisions of the control scheme. Figure 3 displays a fragment of a control system that includes two divisions coupled to front-end schemes in addition of a SCADA system committed to the supervisory control errands deprived of a through link to the front-ends. These divisions can be energetically set up, e.g. on appeal of the DAQ structure in order to cup tie its segregating^[13].

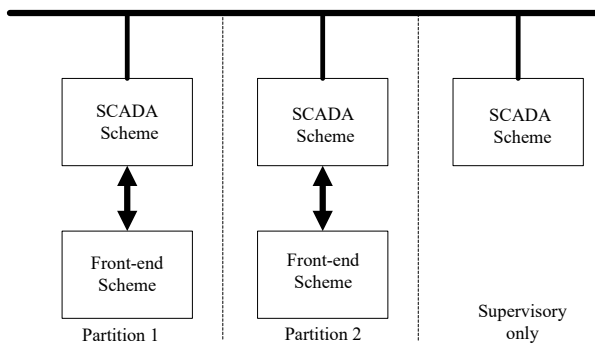


Figure 3. DCS Segregating

4. Software Apparatus of DCS

The similar categories of software apparatus must be utilized for all the dissimilar DCS divisions as revealed in conjunction with the data-flow acquaintances in Figure 4. They are the resulting:

- Systems of disseminated SCADA.
- Control functions using the implementation of SCADA.
- Interfacing to the front-end modules.
- Interfacing to the exterior structures.
- Front-end control purposes for non-SCADA.

A SCADA structure gives a broad variety of services to advance and route a committed purpose for control process. The interfacing to the front-end devices can be realized what's more as innate drivers in the SCADA structures to contact the devices unswervingly associated or utilizing the client-server model. Especially, the consequences of SCADA system have a set of completed device drivers, the OPC user software to link to whichever a manufacturing or a commissioned OPC server and the Ap-

plication Program Interface (API) library, countenancing an exterior solicitation to contact the run-time database for distributed structures.

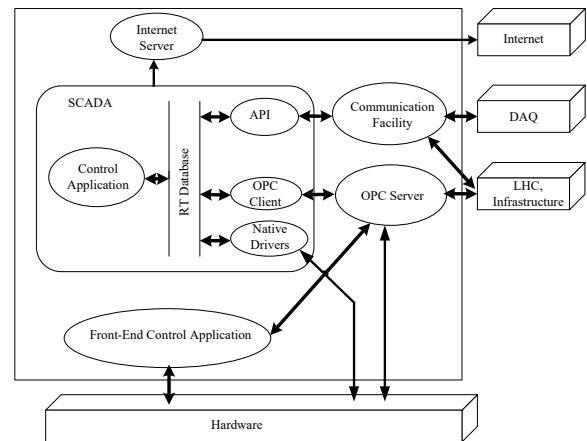


Figure 4. DCS IDE Apparatus

The control function based on SCADA drives most of the purposes essential for the operation of the detector. On the other hand, a convinced set of control functions might be offered wherever appropriate by a control purpose for front-end modules such as a system based on VME with an entrenched computer, or a IDE imitation of a Programmable Logic Controller. The fitting together of the front-end structure to the SCADA systems must be recognized if possible through a committed OPC server. The interfacing to the exterior structures shall be if at all possible established as OPC servers or as customized communication amenities after it is realistic to do so as a consequence of explicit characteristics of the data conversation, as in the occasion of connection with the DAQ structure. Secluded contact to the DCS would be approved through an Internet server in reference to the contact privileges of the diverse categories of handlers.

In the rice production factory, the overall method is accustomed to control SCADA and front-end modules such as DCS architecture. It is revealed in Figure 5. It could manage in a number of control scheme. Nevertheless, most of up-to-the-minute manufacturing system utilize DCS structure as a consequence of system's security and system's reliability. DCS structure includes master terminal unit (MTU) together with server and remote terminal unit (RTU) together with client computers. But it uses only one master station (personal computer). And another plants use PLC controller unit in RTU. The present system can be designed by using PIC microcontroller instead of PLC and other control circuits. The remote terminal unit (RTU) includes interfacing circuit, PIC microcontroller and devices driver control circuit. It uses parallel port communication to connect master station and RTU. The

data from sensors are controlled by the controller circuits and interfacing circuits match the data to understand the computer using parallel port including multiplexers. The motors are operated by PLC controller^[14].

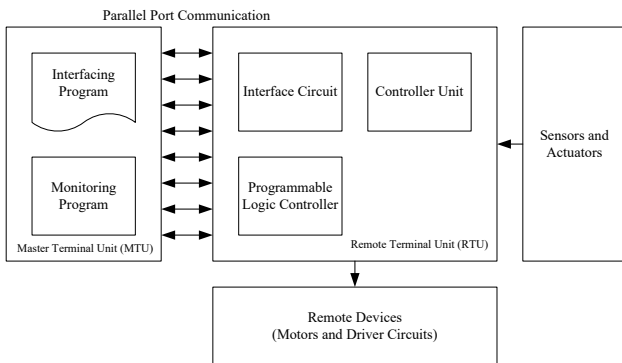


Figure 5. Block Diagram of DCS System for Rice Production Factory

For small factory, it is monitoring system using Visual C#.Net, Visual Basic. It can be designed with real-time monitoring system. So it consists of master station, data acquisition and visualization programs and RTU, signal sensing and supervisory control. DCS software has various types (DiscoNet, ATLAS DCS, Yokogawa DCS, etc.). But it is used own monitoring programs for present plant instead of the DCS software using Visual C#.Net.

This research initiates with an inspection of control systems, and DCS systems specifically. It depicts the diverse components in a DCS system and the diversity of open communications protocols that have been specified. The research then improves a three-tiered model and eventually gives a matrix approach to recitation and defining the features, functions and capabilities of a DCS system.

5. Monitoring and Displaying for DCS System

The basic operation principle of the system is described in following. The monitoring software of main window (personal computer) must run and send appropriate command to the Remote Terminal Unit (RTU)^[14,15]. After receiving and checking the command, the data acquisition and processing module (operation window) are processed by the received command. If the command is selected to acquire data from sensors and requested to send acquire data, the operation mode acquire the analog signal input from sensors, process and send the result to output system^[16,17].

5.1 Linking Windows System for DCS Process

The process of the DCS could be operated and stopped after central window by controlling of the operator. The main window obliges to accumulate the data from process

mode and demonstrate in real-time condition and keep the unruffled information. The graph link is strained in just about 1 second step up until the STOP command is recognized. When the central window program is power cut the data attainment and dispensation is correspondingly shut down all procedure excluding unloading command from the central window. Consequently, the solicitation software can be observed in that windows, the central window of PC and other windows can be linked with other windows in the DCS structure.

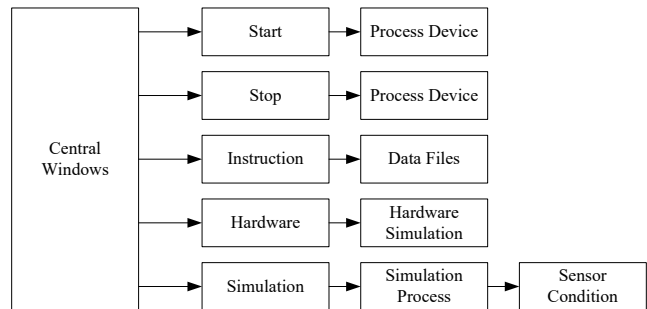


Figure 6. Block Diagram of Linking Window System

5.2 Designing the Program for Central Window

The central window utilizes the Visual C#. Net ration of window solicitation from the Visual Studio 2018 IDE package. It could be considered a window form by utilizing the programming for solicitation information and consumption data by conditional on the procedure from the properties of software items. The modules for controlling purposes are considered on the form by utilizing the toolbox in the package. In addition, the instruction sets of programming language for each of the items are created onto the code viewer by utilizing Visual C# language.

Timer tools are utilized for data timing for interfacing and input and output for the processing of data analysis stage. A timer is utilized to nurture an occurrence at user-defined interludes. Getting the time or setting the time, in millisecond period, is flanked by timer ticks. Window forms timer element has an interval property that stipulates the number of milliseconds that authorization between one timer occurrence and the succeeding. Without the element is incapacitated, an element is intended for a windows forms environs. The signal for read or write purposes of timer carry on to obtain the Tick occurrence at coarsely equivalent to the interval of time. This input and output system galvanizes every time. It utilizes timer tool of (timerIn_Tick) to wristwatch the port structure. The warning sign after timer state is streamed to designated pin of user computers.

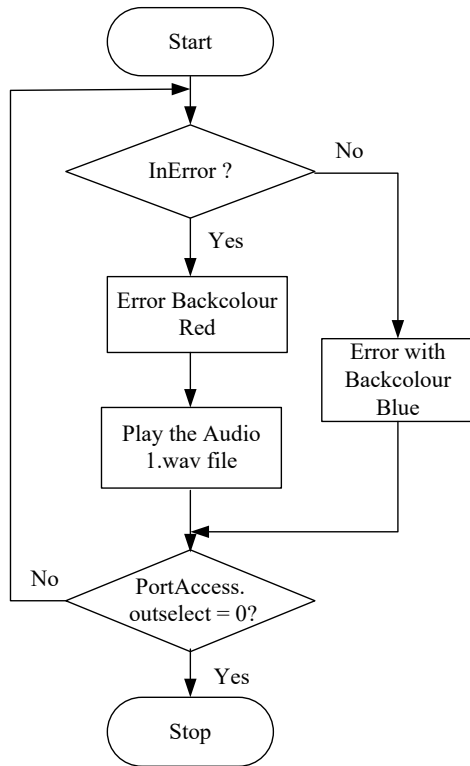


Figure 7. Flowchart of Error System

5.3 Designing the Program for Monitoring with Simulation Window

This window utilizes the monitoring of constituents on the form (SimulationForm). The signal from simulation button for each process is grown to demonstration on the window from timer (timer_In_Tick) of central window. So the location of each of image is put on the form using picture box tool (picName). Next, the text showing the running process and the stopping process displays on the form by using start button on state. This system needs to test how the state of input pin is. So it uses timer tool from window application to display the components. The simulation of running conveyor is used timer tool (timer_Conveyor_Tick) and it is shown in Figure 8. If the input of signal for conveyor (inConveyor) gets from input timer, the displaying of conveyor shows on the form.

The displaying of image for robot gripper is three images of intention for gripping. It utilizes timer tool (timer_Gripper_Tick) to grow indication from the input system. Firstly, the color of work piece sensor put lime. If the signal of input pin (inWorkpiece) is true, it displays the image of full robot gripper (RobotGripper) in the location of image (picGripper) and the red color of work piece sensor on the form. If it is not the above, it is tested true or false

for the signal of input pin (inRobotGripper) and if it is true, it displays the image of robot gripper (RobotGripper) in the location of the image (picGripper). If it is not true also the above, it displays the image of normal robot gripper (RobotGripperNormal). The flowchart of simulation for robot gripper control system is shown in Figure 9.

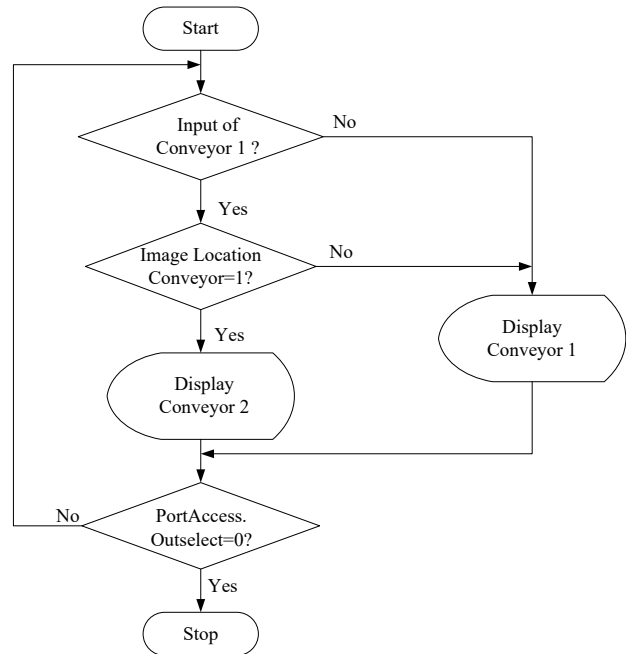


Figure 8. Flowchart of Monitoring for Conveyor

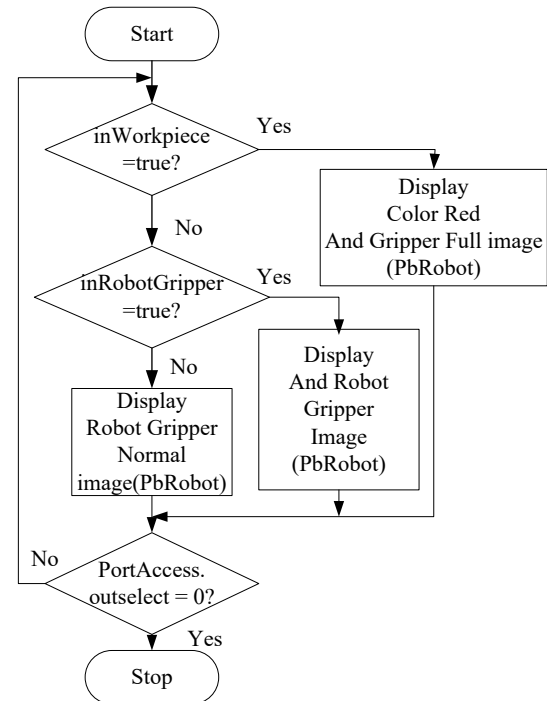


Figure 9. Flowchart of Simulation for Robot Gripper System

6. Simulation Results

6.1 Display Result of Central Window

In this window, it comprises five switches – start switch, stop switch, process switch, simulation switch, instruction switch, hardware switch and exit switch. And it uses two tags appellation together with title and designer appellation, and alarm color scheme utilizing the circumstance of error signal. This window is indispensable for the complete scheme. It comprises the interfacing scheme for the input and output signal from parallel port in addition links with other windows and conducts to the supplementary windows the condition of input and output signal.

The start switches and stop switches are utilized to track and rest the complete scheme which is real-time observing procedure. The simulation switch is used to exhibit the simulation consequence of the procedure. The instruction switch is utilized to prompt the user guide for the scheme. The hardware switch is exploited to confirm the observing of hardware modules by associating with it. The exit switch is utilized to finale the procedure and to walking out the observing scheme by associating with the yes or no message box. It is publicized in Figure 10.

6.2 Display Result of the Simulation Window

In this window, it includes two switches – back switch and sensor switch. This window is a central process to show for entirely procedure. On the form, it is designed with the sample components for the real devices of automation process by utilizing the illustration information of real devices.

It shows the monitoring or moving of each components. It uses input and output signal from central window for procedure of device by utilizing for each signal. It is revealed in Figure 12.



Figure 10. Display Result of the Central Window

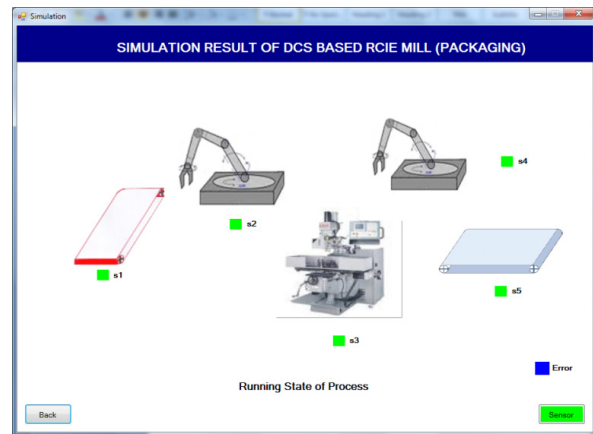


Figure 11. Display Result of Simulation Window

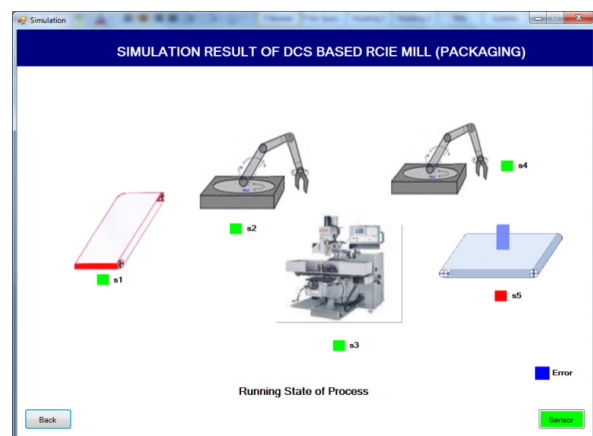


Figure 12. Display Result of Complete Simulation Windows

The back switch is applied to go back the central window like to close the operation window. The sensor switch is used to express the condition of sensors by linking with it. It includes data, hardware, sensor and exit windows. All windows are used by the input signal from each input pins.

6.3 Display Result of the Instruction Window

This window confirms the user guide for the complete scheme how to utilize and what contains it. It is to associate with the central window. It is publicized in Figure 13. If the user desires to go back the central window, the instruction window will be padlocked.

6.4 Display Result of the Visual Hardware Window

This window illustrates the hardware pictures corresponding to the modules of DCS-based structure. If the user impulses the start switch, the complete scheme would track and the arrow pictures would express onto the window form. It associates with central window. The

back switch is utilized to go back the central window that exposed in Figure 14.

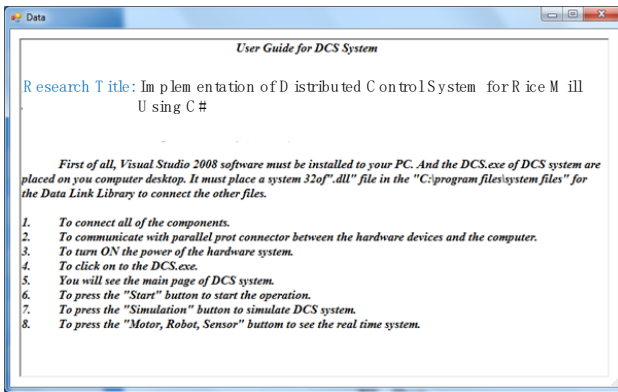


Figure 13. Display Result of Data Window

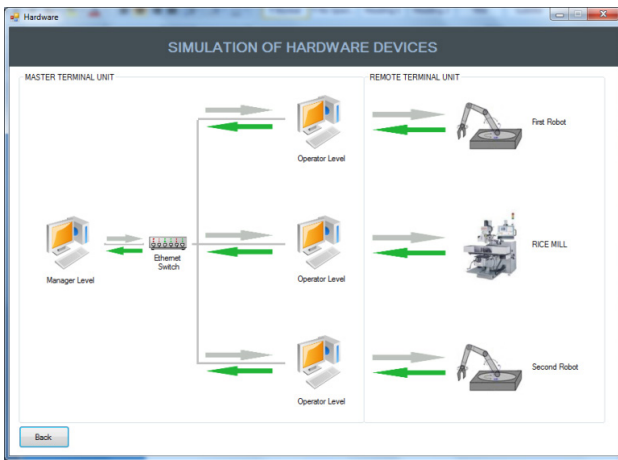


Figure 14. Display Result of Visual Hardware Window

6.5 Display Result of the Sensor Window

This window mentions the conditions of sensor by changing the colors of the running state of the process. It includes three sensors- position sensor for robot (1), position sensor for conveyor, position sensor for robot (2). If the sensors get the signal from input pins, the changing color of sensors will show as red or light green on the form. It links to the simulation window. The back switch is utilized to go back the simulation window. It is exposed in Figure 15.

6.6 Display Result of the Process Window

This window illustrates the procedure of rice production process from paddy. The detailed algorithm has been described in previous chapter. There are at least six processes to produce rice from paddy. They are cleaning, soaking, separating, polishing, separating white rice and weighting. The screenshot result is publicized in Figure 16.

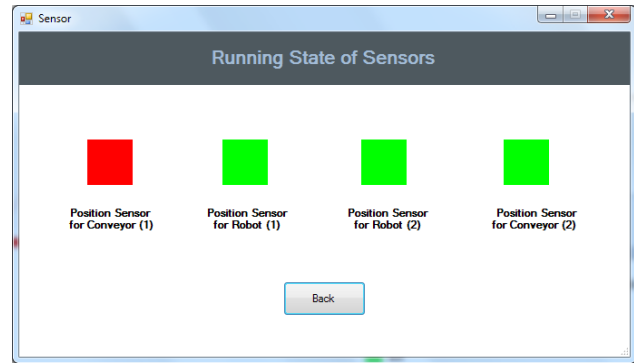


Figure 15. Display Result of the Sensor Window



Figure 16. Display Result of the Process Window

6.7 Display Result of the Exit Window

This window displays the decision making for the operator to track or break of the existing circumstance of the complete scheme. It utilizes the message box together with yes or no decision buttons that is if it is the condition of “yes”, it will exodus from the scheme or else the process would endure the procedure. It is revealed in Figure 17.

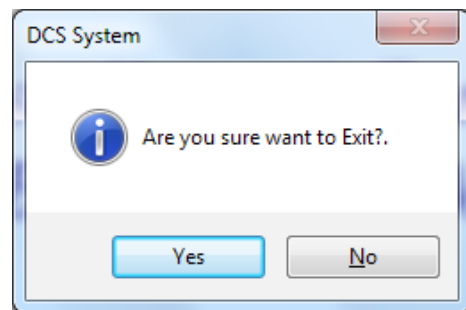


Figure 17. Display outcome of the Exit Window

7. Conclusions

This study certainly intention to advance the governing

hardware devices from all over the place by observing and scheming the complete scheme. This observing scheme can contact with the supplementary progression. This study is established to control the rice mill system by using visual C#. Utilizing this observing control scheme, it is envisioned to develop the process security and process reliability from the MTU. An inexpensive data achievement, dispensation and observing scheme based on the DCS has effectively developed in this research work. Since technologies change quickly, this system is only as good as the ease with which it can be adapted to more complicated system. This research expects technologies of Distributed Control System based rice mill system. It comprises motors, sensors and supplementary hardware devices and applies to control the type of visual basic. net programming like DCS software. And the simulating and monitoring for the industrial automation use own programs without popular DCS software. So it can be used that customers want to desire from their application. It is very suitable price for using this application and has publicized that high performance computers and automatic control can be utilized as a contrivance to upsurge the quality of product and fabrication suppleness. In this research work, rice mill process was used by Visual C#.Net programming for the monitoring of DCS system has been intended and implemented. The communication scheme uses parallel port and circuit that is utilized for interfacing purposes. Hardware devices for this scheme are planned with the trivial emblematic model and confirmed by linking the hardware and computer system, and it could be organized to start and stop with element utilizing observing scheme and can be realized all of state consecutively for this scheme.

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Conflict of Interest

There is no conflict of interest.

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