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Introduction of Programmable Logic Controller to Electric Overhead Travelling Crane

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Abstract: **In this paper, we are using PLC programmes to control the crane movement. The application of PLC could simplify circuits and make the design easier, safer and more reliable. Earlier in Industry, relays and contactors are adopted to control the crane motion in desired directions. Starting of the cranes and speed control of the crane is realized through convectional starters and resistance series. This kind of design has low reliability, complex operation, high electrical failure rate, power waste and low efficiency .These problems can be rectified by using programmable logic controller.**

Keywords: **PLC, ladder logic, automatic control, software wiring.**

1. INTRODUCTION

Till now cranes are one of the important systems for material handling for heavy goods. Although Automatic cranes are comparatively rare in the industrial practices. Because of the high potential of rationalization, in the past several attempts have been made but none of them had succeeded. In view of these an attempt has been made to make it automatic by replacing contactor logic with variable frequency drive and programming it with the help of PLC. Ladder logic programming has been developed to control the crane in desired direction.

Electrical technology for crane control has undergone a significant change during the last few decades. The shift from Ward Leonard system to DC drive technology and the advent of powerful Insulated Gate Bipolar Transistors (IGBTs) during the 1990s enabled the introduction of the AC drive . Conventional AC operated crane drives use slip ring induction motor whose rotor windings are connected to power resistance in 4 to 5 steps by power contactors. Reversing is done by changing the phase sequence of the stator supply through line contactors. Braking is achieved by plugging. The main disadvantage is that the actual speed depends on the load. An electronic control system has recently been added to continuously control rotor resistor value. Nowadays, these systems are replaced by frequency converters supplied squirrel-cage induction motors for all types of motion.. In view of these Electric Overhead crane has been modified in the existing system.

EXISTING SYSTEM:

In the recent times, the cranes are operated manually in the industry for the segregation and transportation of products. The process results in increased time delay for the products to reach the destination due to malfunctioning and frequent failure of conventional starters. low reliability, complex operation, high electrical failure , .power waste and low efficiency.

PROPOSAL SYSTEM:

The Proposed system for the above problems is the introduction of Programmable logic controllers. Originally they were designed as a replacement for hard-wired relay and timer logic control systems.

PLCs have the great advantage that it is possible to modify a control system without having to rewrite the connections to the input and output devices, the only requirement being that an operator has key in a different set of instruction. The result is a flexible system which can be used to control systems which vary quite widely in their nature and complexity.

PLCs are similar to computer but have certain features which are specific to their use as controllers. These are:

1. They are rugged and designed to withstand vibrations, temperature, humidity and noise.
2. The interfacing for inputs and outputs is the controller.
3. They are easily programmed and have easily understood programming language.
4. It contains programmable functions.
5. It scans memory, inputs and outputs in predetermined manner.
6. It provides error checking diagnostics.
7. A PLC can provide some form of monitoring capabilities
8. A PLC can be effectively designed for a wide variety of control tasks.

2. RELATED WORKS

A few selected research papers related to PLC and Automation has been done to study the various methodologies used by the researchers.

J Ahir et al in their research have worked on the design and development of PLC and SCADA based control panel of monitoring of three-phase induction motor. They have continuously monitored measurements of voltage, current temperature and speed for protection purposes. It was found that PLC was able to achieve optimum accuracy with a virtually power factor along with easy error detection and correction, along with being more reliable than traditional methods. The monitoring of three-phase induction motor driven by VFD, with PLC as a controller provided high accuracy in the regulation of its speed. Maria G. Ioannides et al. has developed a PLC based continuously monitoring and control of a three-phase induction motor. Various types of sensors were used for monitoring the parameters such as speed and current. With the help of PLC ladder lgic programming, it was proven that speed control of motor was achieved with high accuracy as well as efficiency. It was found that at high speeds and loads, the efficiency of the system was increased up to 10 to 12%. In brief this paper proved that PLC was a versatile and efficient control tool in industrial electric drives applications. N D Ramesh presented a study on PLC which uses a programmable memory for implementing specific functions such as logic sequencing, timing, counting, and arithmetic control through digital or analog input/output modules. The functions of PLC include on-off control, sequential control, feedback control and motion control, to name a few. Industrial PLCs normally operate at an input-output voltage supply of 24V DC. Physical connections from the real world to the PLC are designated inputs such as limit switches, push button switches, sensors or basically anything that works on the principle of “switching” a signal on or off. Outputs of a PLC are usually solenoids, lamps, contactors, relays, etc. The number of digital input/outputs can be increased by adding additional digital input/output modules. One of the most common methods of PLC programming is also known as Ladder Logic programming which is a language using relay symbols as a base in an image similar to a hard-wired relay sequence. It looks like a ladder, whose sides are the power rail on the left and ground rail on the right. The rungs of the ladder consist of virtual relay components which perform certain tasks based on the instructions given in the program. S. Da'na has discussed the design and implementation of a platform to remotely monitor and control PLC-based processes over TCP/IP or by using the GSM network. The platform is built using industry-standard off-the-shelf PLCs. Integrated with each PLC are communication processors that can be used for connectivity to the network and to a GSM modem. The communication processor module (Ethernet module) used in this work, provides an industrial compatible protocol over TCP/IP that achieves the same functionality as Profinet but at a much higher bandwidth (10/100 Mbps). Additionally, a mobile-based communication protocol that facilitates remote monitoring and control of PLCs using SMS messages has also been developed. The intent here is to provide system users with a back-up communication mechanism in case of a network failure. M Zajmovic et al. presented a paper on the management of induction motors using PLC which executes instructions according to the programmed logic and sends signals to the Variable Speed Drives, from which it receives feedback of the motor speed so as to control its speed by modulation of voltage and frequency. A Zelio PLC was used with the help of a frequency transformer which controlled a 5.5 kW asynchronous induction motor at a speed of 1500 rpm. A windows XP operating

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system with SCADA software from DAQ Factory was used for interfacing to the induction motor through an Ethernet connection. W J Weber et al. Discussed about the advent of the VFD system and its benefits, such as greater reliability, smaller size, lower production costs, better performance and increased automation potential as compared to conventional methods of control by which it allows continuous control of motor speed and torque, thereby increasing efficiency and flexibility. Various processes are sensed and fed back to the central plant controller, which after receiving inputs from an operator via the Human Machine Interface (HMI). The controller then instructs the VFD to maintain optimum performance according to the desired inputs. The basic function of VFD is to synthesize the voltages and frequency applied to a motor so as to control and achieve desired speed and/or torque.

Programmable Logic Controller:

A Programmable Logic Controller is a solid state control system that continuously monitors the status of devices connected as inputs. Based upon a user written program, stored in memory, it controls the status of devices connected as outputs.

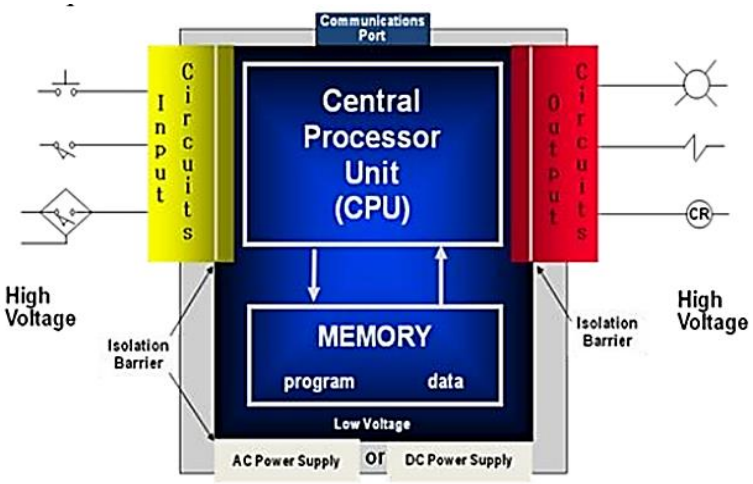

Figure.1: Inside a PLC

A. Operating cycle of PLC:

There are four steps in PLC operations. They are (1) Input scan, (2) Program scan, (3) Output scan, and (4) Housekeeping.

1. Input scan- scan the status of the inputs

2. Program scan- processes the program logic

3. Output scan- energize/de-energize the outputs

4. Housekeeping- this step includes communication, internal diagnostics, etc.

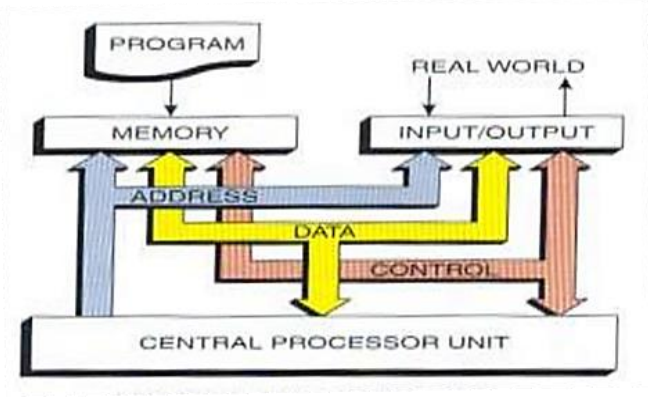

Figure.2: PLC Parts and architecture

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B. Programming of a PLC:

Control tasks are recorded by the user in a program. By the use of a set of language elements, the program for specific tasks is created. Since tasks for the processing of binary signals are handled, the language elements for these functions are interrupted. From such limited requirements five programming languages were developed for practical use:

• Ladder diagram (LD)

• Function block diagram (FBD)

• Instruction list (IL)

• Flow languages (AS)

• Structured Text (ST)

Among them, the programming language of PLC that is used in this paper is Ladder diagram (LD)

3. PROPOSED WORK

Now let's compare a simple ladder diagram with its real world external physically connected relay circuit and see the differences.

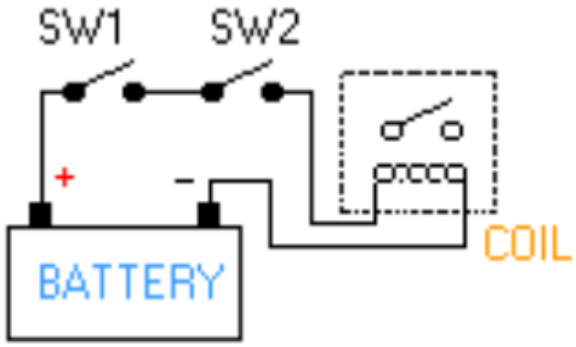

Figure.3: Relay Circuit

In the above circuit, the coil will be energized when there is a closed loop between the + and - terminals of the battery. We can simulate this same circuit with a ladder diagram. A ladder diagram consists of individual rungs just like on a real ladder. Each rung must contain one or more inputs and one or more outputs. The first instruction on a rung must always be an input instruction and the last instruction on a rung should always be an output (or its equivalent).

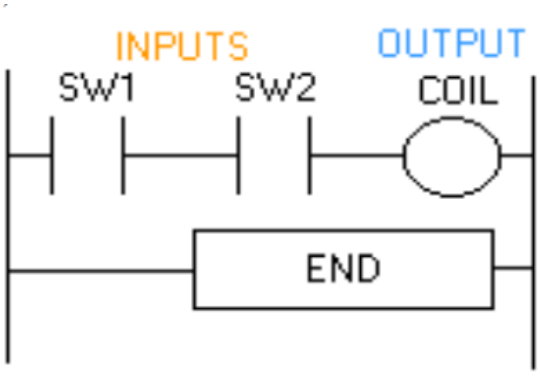

Figure.4: Ladder logic

Notice in this simple one rung ladder diagram we have recreated the external circuit above with a ladder diagram. Here we used the Load and Out instructions. Some manufacturers require that every ladder diagram include an end instruction on the last rung. Some PLCs also require an end instruction on the rung after the end rung .

4. IMPLEMENTATION STEPS

1. Compare relay based starter circuit with conventional logic circuit

2. Install Siemens make PLC software on the P.C for development of ladder logic

3. Develop ladder logic diagram for the Main hoist, Cross travel and long travel keeping its view on crane operation and protection

4. Install Siemens make Wincc software on the PC. Develop the crane model on the SCADA software

5. Simulation of PLC software with SCADA software with the aid of simulator

6. Testing of the above procedure.

5. FUTURE SCOPE

In these paper, the simple starter circuit is compared with Ladder Logic Programming of PLC,. further Ladder Logic Programming has been developed for motion control in three dimensional axis and crane model has been developed in the Siemens SCADA software.

6. CONCLUSION

The soft wiring advantage provided by programmable controllers is Tremendous. In fact, it is one of the most important features of PLCs. Soft wiring makes changes in the control system easy and cheap. In a traditional system, making this type of change would involve physically changing the wiring between the devices, a costly and time-consuming endeavor. In future definitely PLC is dominated on all other controlling methods.

REFERENCES

[1] Mohammed Bani Younis and Georg Frey.," A Formal Method Based Re-Implementation Concept for PLC Programs and Its Application". 1-4244-0681-1/06/2006 IEEE.

[2] LiLingWang1,HongYingwei2.,"DEVELOPMENT OF A DISTRIBUTED CONTROL SYSTEM FORPLC-BASED APPLICATIONS", Proceedings of the Ninth International Conference on Machine Learning and Cybernetics, Qingdao, 11-14 July 2010, 978-1-4244 6527-9/10/©2008 IEEE.

[3] Vijay Kumar Khatri, Ahsan Javed Ghangro, Jetandar Kumar and Syed Jaad UI Haque.,"Industrial Data Acquisition and Control System using two PLCs' Networked over MPI Network", 2009 IEEE symposium on Industrial Electronics and Application (ISIEA2009), October46,2009,KualaLumpur,Malaysia.,978-1-4244-4/09/@2009IEEE.

[4] Coia Ferrater-Simon, Lluis Molas- Balada, Oriol Gomis-Bellmunt,"A Remote Laboratory Platform For Electrical Drive Control Using ProgrammableLogicControllers".,IEEETransactiononEducation,Vol,52,No.3,August 2009.

[5] S. Da'na, A. Sagahyroon , A. Elrayes, A.R. Al-Ali, R. Al-Aydi, "Development of a monitoring and control platform for PLC-based applications", Computer Standards & Interfaces 30 (2009) 157–166.

[6] .J.Velagić, A. Galijašević, „Design of Fuzzy Logic Control of Permanent magnet DC motor under real constraints and disturbance", 3. IEEE Multi-conference on Systems and Control (MSC 2009), Saint Petesburg, Russia (in press), July 8-10, 2009.

[7] Yasar Birbir, "Design and implementation of PLC-basedbmonitoring control system for three-phase induction motors fed by PWM supply" International Journal of Systems Applications, Engineering & Development, Issue 3, Volume 2, pages 128-135, September 2008

[8] K Gowri Shankar, "Control of boiler operation using PLC-SCADA" International MultiConference of Engineers and Computer Scientists, Vol. 2, ISBN: 978- 988-17012-1-3, 19-21 March 2008.

[9] William J Weber, Robert M Cuzner, Eric Ruckstadter, Jim Smith, "Engineering fundamentals of multi-MW Variable Frequency Drives" Proceedings of the thirty-first Turbomachinery Symposium, pages 177-194, 2002

[10] Peng Sun, Bin Ge, Xuan Zou, "Constant Pressure Water Supply System Control Using PLC" International Journal of Automation And Power Engineering, pages 73-76, published online www.ijape.org May 2012

[11] Thomas F Kaiser, Richard H Osman, Ralph O Dickau, "Analysis Guide for Variable Frequency Drive Operated Centrifugal Pumps" Proceedings of The Twenty Fourth International Pump Users Symposium, pages 81-106,2008

[12] Brian Shuman, "Building A Reliable VFD System" Belden Technical Support 1.800. BELDEN.1www.belden.com 2009

[13] Tyson M Murphy, "A Method For Evaluating The Application Of Variable Frequency Drives With Coal Mine Ventillation Fans" Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University, for Master of Science In Mining and Minerals Engineering, 14 April 2006

[14] A. R. Al-Ali, M. M. Negm, and M. Kassas, "A PLC based power factor controller for a 3-phase induction motor" Proceedings of Conference Records IEEE Industry Applications, vol. 2, pages 1065–1072, 2000

[15] Jan-Erik Rä sä nen and Eric W Schreiber , "Using Variable Frequency Drives (VFD) to save energy and reduce emissions in newbuilds and existing ships" White Paper – ABB Marine and Cranes, 2012

[16] Cristina Anita Bejan, Mihai Iacob and Gheorghe-Daniel Andreescu, "SCADA Automation System Laboratory, Elements and Applications " IEEE, pages 181-186, 2009

[17] M. Iacob, G.-D. Andreescu, and N. Muntean, "SCADA system for a central heating and power plant" in Proceedings of 5th International Symposium on Applied Computational Intelligence and Informatics, pages 159– 164, May 2009

[18] Mini S. Thomas, Pramod Kumar, V.K. Chandna, "Design, development, and commissioning of a supervisory control and data acquisition (SCADA) laboratory for research and training" IEEE transactions on Power System, Vol.19, No. 3, pages 1582- 1588, August 2008.

[19] Gopal K. Dubey, Fundamentals of Electrical Drives, Second Edition, Narosa Publishing House, 2007

[20] Mohan Undeland Riobbins, Power Electronics Converter, Applications and Design, Wiley Student Edition, Wiley India Pvt Ltd, 2006