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Real time industrial monitoring with the help of embedded PLC

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Abstract
An Embedded PLC is a standard industrial control device that provides a simple, yet robust, method of controlling manufacturing and dynamic processes. As a result of their low cost, adaptability, and reliability, Embedded PLC can be used in manufacturing businesses of all sizes for environment control, food processing, motion control, and automated test equipment. Designing of such Embedded PLC has the objective to provide advance & compact solutions to industrial problems and make it keeping simple and most strong technology in the field of automation; accelerate innovation, and control & monitoring in industry. Such pervasively, is particularly an evident in immersive realities i.e. scenarios in which invisible Embedded PLC need to be continuously interact with human users; in order to provide continuous sensed information and to react to service requested from the users themselves. Examples of such scenarios are digital automation, automotive, next generation buildings and infrastructures, e-health & domestics. Purpose of development of Embedded PLC is to meet all the simplicity of embedded systems & robustness, functionality of PLC. Embedded PLC is a PIC microcontroller based system which incorporates the several modules such as wireless modules, sensors to accomplish specific task. To program Embedded PLC, special web based software is used. Which has been developed using JAVA, Platform, and JSF plugins. This makes Embedded PLC programming much easier and faster through remote location from anywhere.

1. Introduction

Automation control systems are used across many industries to manage complex systems of inputs and outputs, such as a machine used in manufacturing. Embedded PLC is developing to use in industrial environments for operating and monitoring technical machinery. They can be placed near the underlying machines sensors and actuators to perform local computation tasks on-site with quick reaction times. Much of the computation required for process control or condition monitoring on industrial facilities is performed on computational devices that are embedded in the surrounding field in a decentralized manner. This is in contrast to the central computation performed on PCs in areas such as business applications. When Embedded PLC run, knowledge-based systems that apply computational techniques of automated reasoning, we speak of Embedded PLC.

One particular use case for Embedded PLC is on-site diagnostics of industrial facilities based on diagnostic knowledge models for technical devices. Embedded PLC can perform reasoning on sensor data in the context of diagnostic background knowledge to detect a machines faulty behavior to trace the causes. Single diagnostic

Results reasoned over local device models can be combined to yield an overall diagnosis for the whole facility under investigation. An example scenario is reactive diagnostics for steam and gas turbines in electrical power plants, where early detection of anomalies in running a plant helps avoid costly downtimes and repair of turbine machinery.

The project is design to control & monitor various industrial parameters & processes which ordinary PLC can perform. The project is to having control operating system that can detect & sense various controlling parameter from surrounding & perform necessary action to accomplish task.

The project can be describing the interfacing of new technology with Embedded PLC. Embedded PLC performs the actions with multiple functional ability compared to conventional PLC which is discussed in literature review. Embedded PLC proves its wide application area which discuss in next section of this report.

For example sensing the temperature of any device which located remotely where human interface is not possible, so sensing such temperature above critical level, the device should automatically off. For this function Embedded PLC supports wireless technology such as Zigbee, GSM, and RF etc. A heat sensing circuit is placed to detect the heat from device. Then circuit continually transfers reading to control unit. After critical value of temperature, control unit send the switch off signal. All these operation perform using wireless technology. Like this Embedded PLC has numerous applications where ordinary PLC fail to perform such operation, also cost issue is most important. Especially we cannot employee ordinary PLC system for relatively small application. It increase the overall cost of project. In such case Embedded PLC provide reliable, low cost & advanced solution for small application to big application. Also there are no big hardware changes as per application, use with any kind of sensors, opt couplers, AC-DC relays, solenoids etc.

2. Existing System

It is estimated that companies lose millions of rupees each year due to process variability and poor control performance; they are often unaware that they even have a problem. Process control engineers are typically overworked and ill-equipped to monitor and maintain the hundreds of control loops and instruments that they are responsible for. There are number of systems are used for industrial automation. Programmable logic controller, hard wire relay, DCS, logic controller, specialized systems etc. is the common systems used for Industrial automation.

Early PLCs, up to the mid-1980s, were programmed using proprietary programming panels or special-purpose programming terminals, which often had dedicated function keys representing the various logical elements of PLC programs [2]. The most widely applied method to model a PLC is to use the Ladder Logic Diagram (LLD).As a system gets more complex, LLD implementation become more and more complex. In such situation performance of the PLC decreases because PLC processor is not capable to perform such complex computations [3]. Also for troubleshooting of complex ladder logic, skill engineers are necessary. Fresher or inexperience person increase downtime of PLC. Load, store instructions and function block instructions which occupy 70.4% frequency of PLC instructions. The general processor is used for compiling the PLC concurrent program, controlling the peripheral equipment's and executing arithmetic instructions. Execution of complex ladder diagram need dedicated processor which are capable of handling complex computations, it needs large memory to store this ladder logic diagram [4]. Different manufacture provide different software with PLC, same level programing standard is maintain but that software not supports the other PLC[5]. The dependability of PLC I/O modules has an important weight in the overall dependability of the PLC system. More exactly 90% of the PLC faults belong to its I/O modules. This requires a distinct treatment of the dependability of the PLCs I/O modules. The I/O modules represent the interface between the PLC and the process. Input modules transform electrical signals bringing information from the process sensors into input variables used by the PLC program. Output modules convert PLC program output variables into commands for the process actuators [6]. Generally PLC I/O are digital, for connecting analog device first it is necessary to convert that analog signal into digital & then applied to I/O of PLC. These extra modules make PLC complicated for design [7]. Input or Output devices are not always produce the some analog or digital signal, at this time design is complicated & make overhead on program designer. The particularization of the I/O module type becomes necessary only at the final stage of the analysis. There is realized qualitative & quantitative analysis of I/O modules dependability. Because reliability is not an eloquent parameter in any situation, there is defined probabilistically parameters for both I/O point and I/O points systems and are made comparisons between some I/O points configurations [8]. Suppose any high frequency application such as high resolution rotary encoder are interface to PLC, then it is necessary to match the PLC's frequency to the encoder speed, in such condition we have to use high bit ADC which PLC support & then match rotary encoder to this. This introduces limitation over rotary encoder operations. PLC has limited transmission speed, it is normally in Kilobytes. This speed is not sufficient when your PLC is connected over the network or connected to internet. The most serious problems are attenuation of signal, distortion of transmitted signal & noise. For this reason PLC are limited to several area [9].

3. Purposed System

To overcome all these limitation & make Industrial

Process automation smothers & flexible we propose new kind of system "Embedded PLC."

Embedded PLC is actually an advanced industrial microcontroller system where you have hardware and software specifically adapted to industrial environment. Special attention needs to be given to input and output, because in these blocks you find protection needed in isolating a CPU blocks from damaging influences that industrial environment can bring to a CPU via input lines. Program unit is usually a computer used for writing a program (often in ladder diagram).

Here we use high performance PIC 18F Family devices. This family offers the advantages of all microcontrollers' namely high computational performance at an economical price with the addition of high-endurance, flash program memory. On top of these features the PIC18 (L) F2X/4XK22 family introduces design enhancements that make these microcontrollers a logical choice for many high-performances, power sensitive applications.

All of the devices in the PIC18 (L) F2X/4XK22 family incorporate a range of features that can significantly reduce power consumption during operation. In Embedded PLC. Figure 1 shows block diagram of Embedded PLC

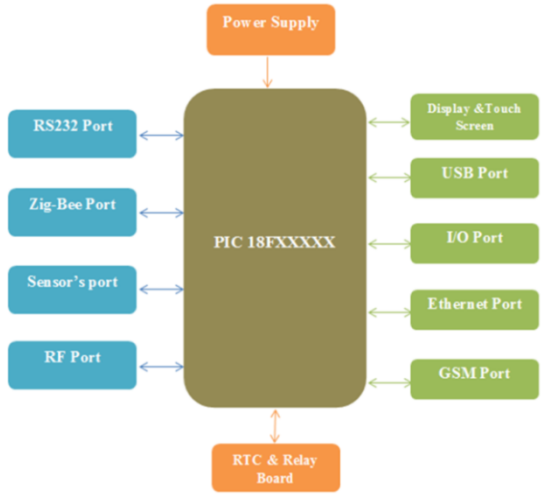

Figure 1.*Embedded PLC*

3.1. Software for Embedded PLC

Generally Structural languages, Functional Block diagram, Ladder logic are the basic languages are used to program PLC. All are these language need some Programming skills, logic proficiency , by studying all difficulties , we introduce some new software to program Embedded PLC , formally known as e-PLC Soft logic . This software includes all the advantages of basic programming of PLC.

e-PLC Soft-logic is web based solution to program the Embedded PLC as well as conventional PLC. This software is develop using JAVA &ICEfaces JSF Framework, ICE Components. This software has several functionality such as PLC type selection for programming, here we either select Embedded PLC or Regular PLC.

Figure 2 shows the development life cycle of e-PLC Soft-logic.

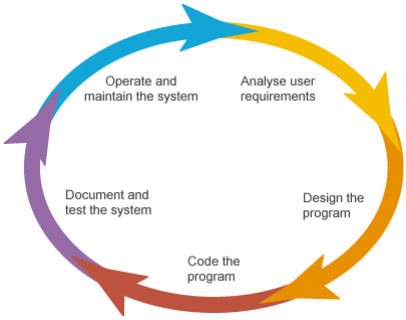

Figure 2.*Development lifecycle of e-PLC Soft-logic*

e-PLC Soft logic is web based solution for PLC programming. For designing e-PLC soft logic JSF Architecture with ICE Components is used.

3.2. Software Operation Flow

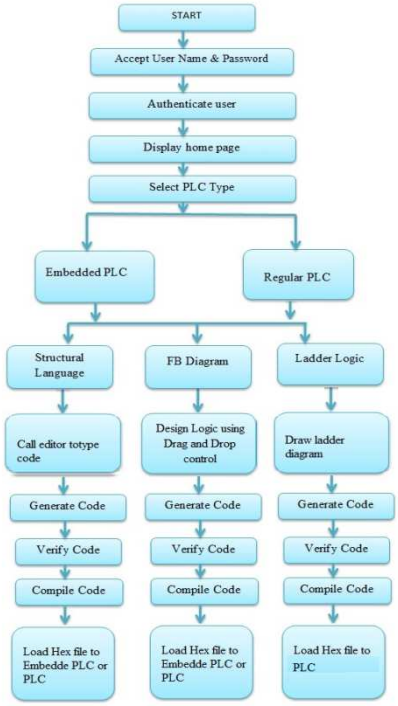

Figure 3. *Opeartion Flow of e-PLC Soft-logic*

Using e-PLC soft-logic we can program Embedded PLC as well as regular PLC.

4. Real Time Industrial Monitoring

We are attempting to interface the Temperature sensor with Embedded PLC and show the reading on LDC display. The programming of this sensor is done through e-PLC Soft logic.

Interfacing of LM35 Temperature sensor with Embedded PLC & programming of it through e-PLC soft Logic is discuss here.

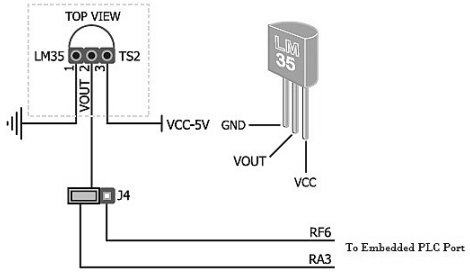

Figure 4.*LM35 Interfacing with Embedded PLC*

Here we use e-PLC soft logic software to program embedded PLC. Here simple philosophy is used to program embedded PLC i.e. just drag and drop to generate the code.

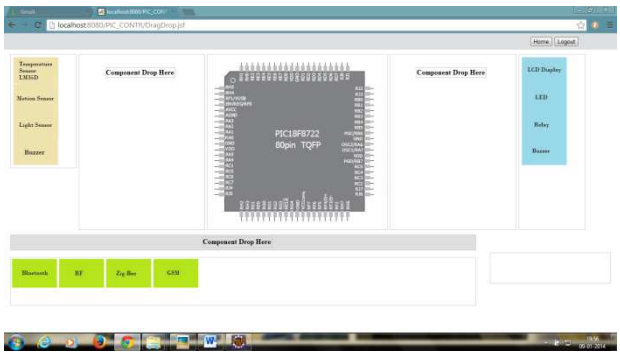

Figure 5.*Drag and drop System*

In the e-PLC soft-logic system, Input & Output component are place left & right side of controller respectively. We just drag the input to the box near to controller & output to box near to controller after Input& Outputs are drag to respective position, generate button code is active, by clicking this, code is automatically generated. Using compiler & programmer we program the embedded PLC.

5. Experimental Result

Figure 6.*Interfacing of temperature Sensor to Embedded PLC*

It is very easy to interface normal sensor like Temperature Sensor to embedded PLC. E-PLC soft logic provide graphical user Interface to program embedded PLC. Using this it is very easy. Even un-experienced person with some computer literate also program the embedded PLC.

6. Conclusion

We designed Embedded PLC for Industrial Monitoring & Controlling system. This Embedded PLC will be very flexible in industrial sector. Embedded PLC can also be used for commercial application. e-PLC Soft logic software provide online support for Embedded as well as Conventional PLC Programming.

In this paper we present the simple sensor interfacing with embedded PLC & Programming of embedded PLC using e-PLC soft logic. Hardware with software makes the industrial monitoring very easy.

References

[1] E. A. Parr, "*Industrial Control Handbook*", Industrial Press 1. Inc., 1999 ISBN 0-8311-3085-7.

[2] Bennett, S., "Real-time computer control," Prentice Hall: New York; London, 1988.

[3] Miller, R.C., "Process Control Computer Systems, in Handbook of industrial control computers", T.J. Harrison, Editor, Wiley-Interscience: New York; London, 972.

[4] E. A. Parr, Industrial Control Handbook, Industrial Press 1. Inc., 1999 ISBN 0-8311-3085-7

[5] Shuting-zeng , "A high performance architecture design of plc dedicated Processor" Industrial informatics laboratory Shenyang institute of automation, Graduate School of the *Chinese Academy of Sciences*. Shenyang, China, e-mail: zengshuting@sia.cn

[6] Xi Xueliang, Tao Cheng, Fang Xingyuan, "A Health Care System Based on PLC and Zigbee,"Modern Telecommunication Institute of Beijing Jiaotong University, Beijing, China , xueliangxi@126.com, chtao@bjtu.edu.cn, fxingyuan@sina.com

[7] XiaonengGao, Pengtong Fan., "Internet Access Technology Based on the Embedded Devices". IEEE(2011).

[8] Hongtao Ma, Xiaojun Wang, "Measuring and Controlling of Analog signal Based on High-speed I/O port of PLC," FenPing Zhou College of Information Science and Engineering Hebei University of Science and Technology Shijiazhuang, China, miracle@hebust.edu.cn, ma-hongtao@sohu.com

[9] Wei-Fu Chang Yu-Chi Wu Chui-Wen Chiu , "Design and Implementation of a Web-based Distance PLC Laboratory," Department of Electrical Engineering, National Lien-Ho Institute of Technology, Miao-Li, Taiwan 360, R.0.C

Biography

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