Design of Architecture for Uniform Reconfiguration and Processing over Industrial Control System

Puja D. Kumbhare

Abha Gaikwad Patil College of Engineering, Mohgaon, Nagpur.
Dept. of M.E. Wireless communication And Computing.

Abstract— **In industrial setups, there will wired sensors, wireless sensor and embedded devices which forms a heterogeneous programmable distributed system. To reconfigure devices each time user needs to develop the new code, For node reconfiguration. This require programming expertise.**

In this project, we aim to create such a system that can be used to wirelessly reconfigure industrial embedded devices and machines. The intent is to build a system, that will include the redesigning of industrial embedded devices such that they can be reconfigured in context of process and operation. Also, to enable collective reconfiguration of the entire set of industrial devices, a protocol will have to be designed where in various codes can be assigned to various machine parameters, and via these codes, the various new configurations can be applied. To implement this protocol scheme, an encoder module software that runs on the server will have to be designed. Also, at the industry side, a microcontroller based system that receives, decodes, and implements new configurations over the embedded devices will be designed.

Upon implementation, this project will enable factory engineers, supervisors and even users, who do not have that much knowledge of programming to remotely monitor / reconfigure the operation of various machines, and verify its accurate implementation, wirelessly via a remote server.

Keywords—Reconfiguration, code, embedded device, microcontroller.

I. INTRODUCTION

Many industrial control system, such as a refinery, thermal power plant,automation plant have hundreds or thousands of sensors and actuators along with embedded control system which automatic monitor and control functionalities with more advanced and complicated hardware. Due to some environment effects or any other technical effects, malfunction in devices or in sensors may occur. Traditionally, these devices must need to design again replaced. This in turn, increases the cost and time consuming. So the systems must support easy and convenient system reconfiguration with different combinations of hardware and software. Software for machine control systems is usually designed and implemented with a set of functions, such as device drivers, control functions, and algorithms, all running on a desiredplatform. Components threshold value may need to be added, removed, and modify in real timeto satisfy new product requirements in industry. The execution platform may also need to be upgraded, oftentimes with new computing and communication hardware and software. This trend calls for reconfigurable embedded system, software that reuses,modify existing hardware components to generate the control software for new applications very quickly. This will, in turn, enable low-cost product development and Maintenance.

The role of information technology in achieving these goals has become critical. Large and complex production systems cannot be efficiently and safely managed without

International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-2, Issue-2, February 2016
ISSN: 2395-3470
www.ijseas.com

advanced information management and process control. End users expect to get improved functionality at reasonable cost. Management of knowledge and real-time information, integration with condition monitoring and plant maintenance, high availability, flexible upgrades and life-cycle support are examples of key requirements. System integrators need efficient tools for building applications. With the emergence of microprocessors, pneumatic controllers were transferred to computer screens of Distributed Control Systems (DCS). Since then, PC technology has, found its way to industrial applications. Current control systems are typically a mixture of many techniques. Product and process changes requiring modifications to the control system are more frequent than earlier. In industrial applications, system updates must often be carried out on-line without interruptions in production. A further demand for flexibility comes from availability requirements. The control platform must support redundant hardware and software.

II. LITERATURE RIVIEW

There are various techniques exist, several works that address reconfiguration, are mostly targeted at hardware changes and to offer the application configuration flexibility. Some of them are designed to provide the Computational solutions flexibility to adapt for industrial process changes. The different techniques exists to adapt for reconfiguration of industrial process changes are follows as

2.1 MidSN architecture:

MidSN architecture aims at designing a well-defined MidSN, standard components and formats exist that are followed by any node and in order to deploy a system architecture for deploying and configuring the servers and embedded devices with operations at the beginning of deployment, providing configuration flexibility prior to operation through remote configuration. The proposed MidSN architecture builds an intermediate computing layer which will serve as an abstraction hiding the different hardware implementations from embedded devices networked applications.

2.2 CPLD programmable technology:

Complex Programmable Logic Device (CPLD) designs and realizes a reconfigurable smart sensor interface for industrial WSN in IoT environment. This design presents many advantages, First CPLD is used as the core controller to release the restriction on the universal data acquisition interface, and realize truly parallel acquisition of sensor data. It has improved the sensor data collection efficiency of industrial WSN, Secondly, a new design method is proposed multi-sensor data acquisition interface that can realize plug and play for various kinds of sensors in IoT environment. The design system applies the IEEE1451 interface protocol standard that is used for smart sensors of automatically discovering network.

2.3 Tight coupling of a small processor Design:

In this technique, HW reconfiguration is design by *ad hoc* reconfigurable devices. a new approach based on the tight coupling of processor with a dynamically reconfigurable function unit which is optimized for wireless sensor network Devices. Dynamic reconfiguration is part of the regular operation mode and the key concept to achieve a small approach that provides sufficient performance, high adaptivity and good energy-efficiency. But it is prepared to be adapted for only prerecorded applications.

2.4 Agilla:

This is first mobile agent middleware works for reconfiguration of a WSN implemented entirely in TinyOS. This paper presents an in-depth case study of Agilla using a fire tracking application. In this application, mobile agents are

International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-2, Issue-2, February 2016
ISSN: 2395-3470
www.ijseas.com

deployed to dynamically form and maintain a perimeter around a fire as it spreads through a network comprised of 26 MICA2 motes. This paper makes three primary contributions. First, it demonstrates how a mobile agent middleware can be used to facilitate the development and deployment of a nontrivial application. Agilla able to rapidly create and deploy the entire fire tracking application by injecting 47-byte fire agents and a 100 byte tracker agent. Second a set of application-level performance results that demonstrate the reliability and efficiency of mobile agents and tuple spaces in a highly dynamic application. Finally, it provide new insights into, and lessons about, mobile agent programming techniques or WSNs.

III. METHADOLOGY

3.1 Block Diagram:

The block diagram of developed system is shown fig. 3.1 which consist various hardware and software connectivity. The following process system model to be constructed aims to provide a flexible system with user friendly connectivity. The model is divided into two parts i.e. hardware part and software part, where hardware part is consist of test bed example of automation industrial process system and software part shows reconfiguring software developed in VB6 . Firstly, a circuit diagram is designed which consist of Microcontroller (AT89C51) based DC motor controlled conveyor belt mechanism, stepper motor controlled cutting process mechanism, Relay based drying process with Fan and six LEDs based light heating treatment process unit and Serial Communication (RS232).DC motor and stepper motor are interfaced using L293D driver IC to microcontroller. Port D is used in which pin no. 2 & 3 is used for connecting serial communication i.e. RS232 for transmission and reception of data. The second stage is of software part which is again divided into two parts namely designing the reconfiguring software in VB6 and assigning the MDL codes to command

buttons which allow the user to give command to reconfigure the process pattern in real time. The reconfiguring software implementation is shown in snapshot of software implementation.
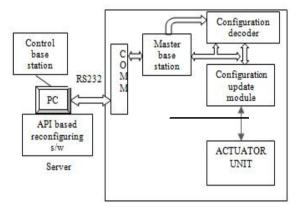

Fig. 3.1 Block Diagram

3.2 Flow Chart:

The flowchart given in the following Figure 3.2 describes the working principle of the how reconfiguration is done.
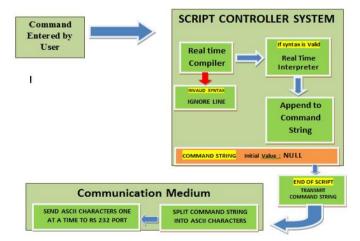

Fig. 3.2 Flow diagram for reconfiguration of process system

The user first has to give only simple reconfiguring command to which, process needs to be changed its process pattern. After giving the command by user it decoded into

International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-2, Issue-2, February 2016
ISSN: 2395-3470
www.ijseas.com

its corresponding MDL codes. Microcontroller based process system continuously check for these codes on Interrupt event triggered based programming. As event occurs the microcontrollers gets interrupted and work accordingly. In this way the process of reconfiguration is carried out, the result and snapshot of proposed system is shown in further section. The flow chart explains in briefly how the whole system works for changing the running process pattern.

IV. TOOLS AND PLATFORM

The hardware components that are required for implementing this project work are described in section 4.1. and section 4.2.describes about the software which is required for operation of the implemented hardware.

4.1. Hardware Components:

4.1.1. Microcontroller (Atmel AT89S52):

Atmel AT89S52 is used which is a 8-bit microcontroller with High-performance and Low-power AVR. In the proposed system port D is used for connection with RS232 serial communication. It has 16k Bytes of ISP Flash and 512K Bytes of EEPROM. Atmel AT89S52 achieves throughputs of 1 MIPS per MHz by executing instruction in single clock cycle. It consists of Two 8-bit Timer/Counters and one 16-bit Timer/Counter with separate pre scalar. In proposed system two fingerprint sensors are interfaced with microcontroller with two UART and the Serial Communication is done via a Relay as third UART port. It has 16K bytes of In-System Programmable Flash Program memory with Read-Write capabilities and 1KB SRAM. For detailed explanation of Atmel AT89S52 refer Annexure-III and its diagram is shown in Figure 4.1.

Fig. 4.1 Atmel AT89S52

4.1.2. Development Board:

8051 board, also called as 8051 evaluation board or 8051 development board is an interesting product for experiments and testing of 8051 based applications. With this board you can develop and prototype with any of 8051 40 pin microcontrollers. The RS232 driver on board allows easy connection with PC or other embedded hardware. The board has User buttons and status LEDs. The bridge rectifier allows this board to be powered with both AC and DCpower supply adapters.

Main Features:

- RS232 Tx, Rx interface with MAX232 IC on socket
- Quartz crystal 11.0592Mhz
- Rectifier
- Voltage Regulator
- LCD Contrast
- Microcontroller – 8051
- Serial Connector

4.2. Software Platform:

For programming of microcontroller software are used as follows.

4.2.1 Keil µVision:

µVision4 is an IDE (Integrated Development Environment) that helps to write, compile, and debug embedded programs. The µVision IDE from KEIL combines project management, make facilities source code editing, program debugging, and complete simulation in powerful environment. The µVision development platform is easy to

use and helping you quickly creates embedded programs that work. The Keil C development tools for the ATMEL processor family support every level of developer from the professional applications engineer to the student just learning about embedded software development. The industry-standard Keil C Compilers, Macro Assemblers, Debuggers, Real-time Kernels, and Single-board Computers support all ATMEL processor compatible derivatives and help you get your projects completed on schedule. With the Keil tools, we can generate embedded applications for virtually every ATMEL derivative. The Keil Software ATMEL development tools are designed for the professional software developer; any level of programmer can use them to get the most output of the ATMEL processor architecture. Keil C µ Vision 4 help provides the various simulation output.

4.2.2 Flash Magic:

Flash Magic is a PC tool for programming flash based microcontrollers from NXP using a serial or Ethernet protocol while in the target hardware.Flash Magic works on Windows 8, 7, XP, Vista and 7. 10Mb of disk space is required.

4.2.3 Visual Basic (VB)

Visual basic is a powerful language tool which replaces c language. Generally visual basic is used for creating user interface and drawing certain text box, buttons and user interface items. Instruction used in visual basic is simple

compared to c language.

V. CONCLUSION

A flexible system with MDLA architecture for uniform reconfiguration and processing of automation industrial processing system is proposed. The developed system is tested by giving number of commands to reconfigure the run time process pattern, for analysing the system to check for accuracy, system performance, different parameters are taken into consideration and calculate the detailed of test results are described. To reconfigure the run time process pattern of experimental set up implementation, The GUI based reconfigurable software is developed in Visual Basic studio 6.0 and also assign the MDL codes to process the commands, for easy and convenient handling of different class of users.

References

[1] 1]   E. Monmasson and M. N. Cirstea, "FPGA design methodology for industrial control systems—A review," *IEEE Trans. Ind. Electron.*, vol. 54, no. 4, pp. 1824–1842, Aug. 2014.

[2] [2]   A. Rowe, M. Berges, G. Bhatia, E. Goldman, R. Rajkumar, L. Soibelman, J. Garrett, and J. Moura, "Sensor Andrew: Large-scale campus-wide sensing and actuation," *IBM J. Res. Develop.*, vol. 1, pp. 1–6, 2013.

[3] [3]   H. Hinkelmann, P. Zipf, and M. Glesner, "Design concepts for a dynamically reconfigurable wireless sensor node," in *Proc. 1st NASA/ESA Conf. Adaptive Hardware Syst.*, Jun. 2012, pp. 436–441.

[4] [4]   C.-L. Fok, G.-C. Roman, and C. Lu, "Agilla: A mobile agent middleware for self- adaptive wireless sensor networks," *ACM Trans. Auton. Adaptive Syst.*, vol. 4, no. 3, pp. 1–26, 2008, Art. 16.

[5]   [5] P. Suriyachai, J. Brown, andU.Roedig, "Time-critical data delivery in wireless sensor networks," in *Proc. DCOSS*, 2010, pp. 216–229.

[6] [6]   E. Monmasson and M. N. Cirstea, "FPGA design methodology for industrial control systems—A review," *IEEE Trans. Ind. Electron.*, vol.54, no. 4, pp. 1824–1842, Aug. 2007.