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Lab VIEW Based Process Control and Monitoring For Industrial Process Parameters

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ABSTRACT-In a modern industry there are a variety of processes that are to be controlled from a central place. These processes may be located from a far of place within an industry. Each process will also have a separate data acquiring and controlling mechanism – an individual embedded system that controls the process. In many times these processes have to be coordinated within themselves and with the central controller for the proper operation and to have a fault tolerance system.

In this project a sugar industry is considered and the process of syrup processing mechanism is taken into consideration. It has many processes such as sugar cane crushing to extract syrup, transferring it to the heater where it is heated and passed on to a mixer where it's mixed with other solutions. In each of these processes there is a dedicated control system that performs data logging and control operations. There is also a PC as master system that acts as a virtual instrument. Further all the obtained data and the control data are displayed on the PC which runs Lab VIEW which is an advanced measurement and automation software. The project provides a good combination of various protocol implementations in creating a bidirectional noiseless network and usage of an advanced graphical user interface in process control. This project replaces large control panels that are placed in large rooms. Further there is no mechanical gauges or control knobs. Everything is brought under a single PC making it highly dynamic at the same time cost effective**.**

KEYWORDS: ARM (Advanced Risc Machine),RISC (Reduced Instruction Set), RFS(Rotor Flow Switches)**,**FCRIS (Flash Controller Raw Interrupt Status)

I. INTRODUCTION

India has become largest producer of sugar cane/sugar producing 280 MnT of cane and 16.5 MnT of sugar in 1995-96, making it the largest producer of sugar in the world, representing about 20% of cane sugar production. India also produces another 10 MnT of traditional sweeteners (gur 9 MnT, khandsari 1 MnT). India also has a large consumer base, thus makes it quite vulnerable to international sugar market, in the event of surplus or deficit situation. At the sametime it has good potential and prospects.

The Centralized controlling and monitoring is the key factor involved in this project. The sensors and transducers are distributed locally, keeping in mind with the view of making the best sugar production. To measure the hydrogen ion concentration, two separate electrodes (one reference electrode namely calomel electrode and one standard electrode namely Standard Hydrogen Electrode) are connected to pin 21 and pin 22 of the ARM. The concept of flow and level measurement includes separate standard sensors connected to the pin 1 and pin 4 of the ARM respectively. The standard temperature sensor LM35 is connected to the pin 3 of the ARM using analog to digital converter.

Using the concept of level measurement, the parameter density is displayed in the front panel. The power supply section includes diodes, suitable discharge capacitors to get the constant step up/down voltage as and when required. The motor unit is connected to the pin 29 of the arm for sugar input load measurement. The controllers are separately employed for individual parameters. The proportional integral controller is employed for level measurement. The task of interfacing is done using USB (Universal Serial Bus) trough pin no 27 and pin 28 of the ARM which is meant for transmission (TXD) and reception (RXD). The Professional Development Software LabVIEW interfacing to PC is also done using USB.

Winds of liberalisation have touched sugar also. Licensing is liberalised. The imports freely allowed. Exports deregulated. Many lessons learnt. Competition became intense. Customer more demanding on quality and service.

The document gives an overview of agricultural background development in cane. Sugar production, consumption, policy/regulations. The paper ends up dealing with important issues, aspects of deregulation, decanalisation of exports, the potential and the comparative advantage of Indian sugar.

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II. LITERATURE SURVEY

Researches had been carried out to replace the large control panels using different microcontrollers.The project is implemented using ARM microcontroller which is highly efficient. In the present days interfacing with the LabVIEW and monitoring the process is not available.In the proposed project the same is implemented using LabVIEW. Various authors have discussed about the sensors and the ARM Microcontroller. [1]A.K.Sawhney, 'A course in Electrical & Electronic Measurements and Instrumentation', Dhanpath Rai & Co(P) Ltd, 2004.Jacob Millman, Christos C.Halkias, 'Integrated Electronics – Analog and Digital circuits system ', Tata McGraw Hill ,2003.[2]Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'ARM Micro Controller and Embedded System', PHI Pearson Education, 5th Indian reprint, 2007.[3]Eckman.D.P. Automatic Process Control, Wiley Eastern Ltd., New Delhi, 1993. [4] IEEE Paper on "Virtual and Remote Robotic Laboratory Using EJS, MATLAB and LabVIEW" published by Dictino Chaos, Jose Antonio Lopez-Orozco and Sebastian Dormido . [5] IEEE Paper published on "A LabVIEW based template for user created experiment automation" by D. J. Kim and Z. Fisk.
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III. HARDWARE DESCRIPTION

A. BLOCK DIAGRAM

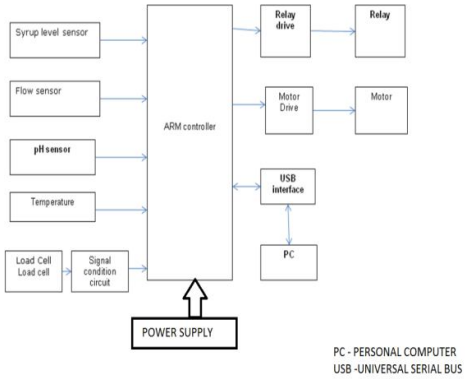

Fig 1. Block Diagram

B.BLOCK DIAGRAM DESCRIPTION:

In the automation of sugar industry proposed in this project concerned, the control and manipulated variables are distributed throughout the process of sugar manufacturing. The project involves the application of various sensors and transducers to measure and control the parameters involved in the sugar industry. Different types of control algorithms are employed in the process of automation in order to make the operation a defacto. The measuring parameter involves temperature, pressure, density, flow, level, speed and so on. The increasing development in the industrial sectors allows all the measuring variables to interact each other. In this model some of the parameters are inter-linked. The value of density depends on the value of flow.

Computational algorithms are fed with suitable formula with the intention of making the process a simple one to employ. The matter of interfacing has to be simple like USB. The controlling panel of the process involves a separate method for individual parameter. Various types of controllers are employed in the controlling panel. The issue of front panel control is overcome by means of Professional Development Software named LabVIEW 9.0. The issue of sophisticated front panel control simplifies the task of engineering interface. The high level operator interface and the high level engineering interface makes the process of sugar factory automation the simplest one to follow.

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C. ARCHITECTURAL DIAGRAM OF ARM:

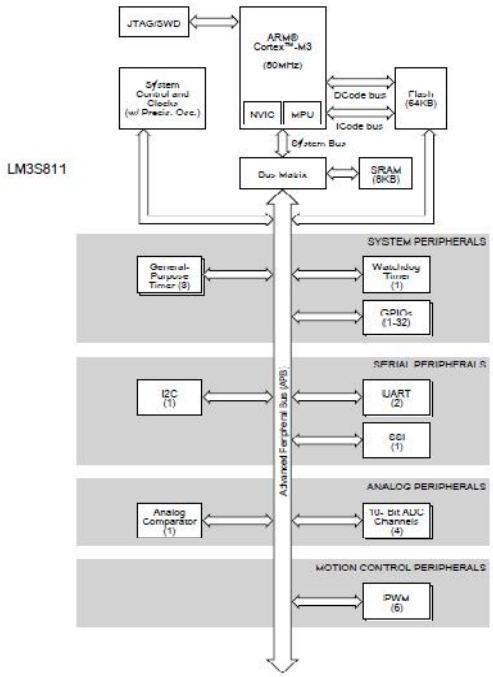

Fig 2. ARCHITECTURAL DIAGRAM OF ARM

IV. MEASUREMENT SETUP

The various parameters that needs to be continuously measured and monitored are temperature , flow,load and pressure. The sensors for specified operation are discussed.The reason for using ARM Microcontroller is that it produces efficient and accuarate output when compared to other Microcontrollers such as Pic Microcontroller.

A. ARM MICROCONTROLLER DEVELOPMENT VALUE

From a development standpoint, ARM cores offer the advantage of a fully 32-bit processor designed specifically for embedded applications. An important feature is the embedded core debug facilities, which reduce the debugging stage of development. In some cases, this can be two-thirds of the overall development cycle.

ARM and third parties offer the developer proven compiler technology and debug solutions. Multiple RTOSs and silicon sources mean that the developer will not need to change the preferred vendor in order to migrate to this architecture.

B.LM35 TEMPERATURE SENSOR

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling.

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C. RELAY:

A relay is an **electrically operated switch**. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are **double throw** (**changeover**) switches.

D. LOAD CELL

A load cell is a transducer that is used to convert a force into electrical signal.This conversion is indirect and happens in two stages. Through a mechanical arrangement, the force being sensed deforms a strain gauge. The strain gauge measures the deformation (strain) as an electrical signal, because the strain changes the effective electrical resistance of the wire. A load cell usually consists of four strain gauges in a Wheatstone bridge configuration.

E. POWER SUPPLY
MEDIUM POWER LINEAR SWITCHING APPLICATIONS
The power supply section is the important one. It should deliver constant output regulated power supply for successful working of the project. A 0-12V/1 mA transformer is used for this purpose. The primary of this transformer is connected in to main supply through on/off switch& fuse for protecting from overload and short circuit protection. The secondary is connected to the diodes to convert 12V AC to 12V DC voltage. And filtered by the capacitors, which is further regulated to +5v, by using IC 7805.

F. FLOW SENSOR-RFS 2500:

A flow sensor is a device for sensing the rate of fluid flow. Typically a flow sensor is the sensing element used in a flow meter, or flow logger, to record the flow of fluids. As is true for all sensors, absolute accuracy of a measurement

G. INTERFACING SENSORS AND THE ARM PROCESSOR

The sensors are interfaced with the ARM Processor in the respective and the input is given for a wide range and hence the response is controlled and monitored using LabVIEW in a personal computer

V.IMPLEMENTATION DISCUSSION

A. CROSS COMPILERS

First of all we begin this chapter by giving a brief introduction about cross compilers in embedded programming and their applications. We know that the execution of code in a microcontroller takes place as a hexadecimal code. So we can program any microcontroller using an assembly language. Also though the use of cross compilers we can program the microcontrollers in any language like ‘C’ or ‘C++.

In this our project the use of Keil cross compiler is to program the microcontroller. In this chapter we discuss the introduction to programming in Keil features of Keil and finally advantages of using Keil when compared to other cross compilers. When we are writing program for any microcontroller using cross compiler we cannot directly write the converted code on to the microcontroller. This means we need to use a special technique to load the program into the microcontroller. One of the methods is to use a microcontroller with a flash memory. Flash memory is similar to erasable programmable read only memory. So once program is written and debugged using cross compiler, we need to flash the program on to the flash memory of the memory. Once program is flashed the microcontroller is loaded with the hex code and it will be ready for execution.

B. DEVELOPMENT TOOLS IN KEIL

The tools listed in this diagram comprise the professional developer’s kit. In addition to the professional kit, Keil Software provides a number of other tool kits for the 8051 developer. The most capable kit is the professional developer’s kit is described as follows:

The professional developer’s kit includes everything the professional 8051 developer needs to create sophisticated embedded applications. This tool kit includes the following components:

- C51 Optimizing C compiler,

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- A51 Macro Assembler,
- BL51 Code Banking Linker/Locator,
- OC51 Banked Object file converter,
- OH51 Object-Hex converter,
- LIB51 Library Manager,
- dScope-1 Simulator/debugger,
- tScope-51 Target Debugger,
- Monitor-51 ROM Monitor and Terminal Program,
- Integrated Development Environment,
- RTX-51 Tiny Real-Time Operating System.

C. OPTIMIZING C CROSS COMPILER

The Keil software C51 optimizing cross compiler for the MS-DOS operating system is a complete implementation of the ANSI (American National Standards Institute) standard for the C language. The C51 compiler generates code for the 8051 microcontroller but is not a universal C compiler adapted for the 8051 target. It is a ground-up implementation dedicated to generating extremely fast and compact code for the 8051 microcontroller. For most 8051 applications, the C51 compiler gives software developers the flexibility of programming in /c while matching the code efficiency and speed of assembly language. Using a high-level language like C has many advantages over assembly language programming

D. REGISTER ORGANIZATION

There are 37 total registers divided among seven different processor modes.
Supervisor mode is the default mode of the processor on start up or reset. Undefined mode traps unknown or illegal instructions when they are passed through the pipeline. Abort mode traps illegal memory accesses as a result of fetching instructions or accessing data.
As a result, these instructions can only access the low registers in Thumb, R0 through R7. The high registers, R8 through R15, have more restricted use. Only a few instructions have access to these registers.

E. LabVIEW:

LabVIEW (short for Laboratory Virtual Instrumentation Engineering Workbench) is a system design platform and development environment for a visual programming language from National Instruments.

In this project the parameters of temperature, load and flow are measured and the corresponding response is monitored using LabVIEW. As a result it is possible to control and monitor the above parameters in a sugar industry by making our presence not near the control panels

Advantages of using ARM Microcontroller over PIC Microcontroller and 8051 Microcontroller:

Over the period of time research projects using PIC and 8051 Microcontroller had been carried out and there were found issues in the accuracy and processing speed of the various processes. As a result using ARM Microcontroller much accuracy and processing speed had been achieved.

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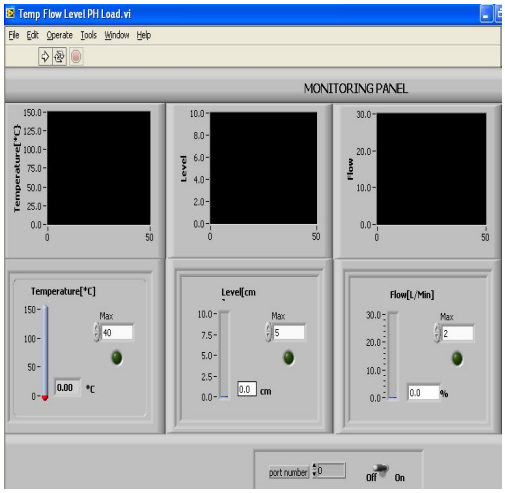
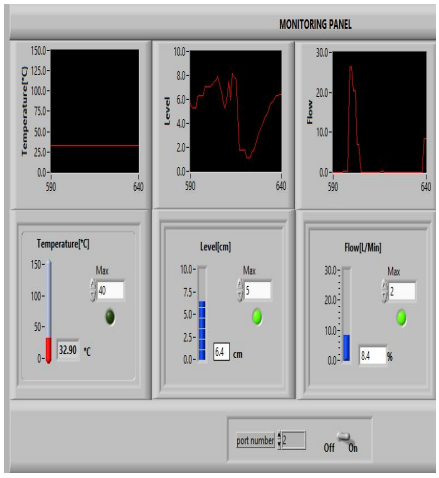
VI.RESULTS

BEFORE SENSING THE PARAMETERS:



AFTER SENSING AND CONTROLLING THE PARAMETERS:



VII. CONCLUSION

In this competitive world of industrial sectors, all factories and enterprises have been modernized and refined using automation. The industrial automation has played an important role in refineries such as cement factories, oil industries, lubricants, petroleum products and so on. In our project we have suggested an innovative proposal which will take automation in sugar industry to the next level using advanced technology. The processor ARM LM3S811 is the modernized integrated chip that has brought automation in to picture. The proposed model of LabVIEW cum ARM processor has several distinct advantages over the existing technology.

The sugar industrial automation is the use of machines, control system and information technologies to optimize productivity in the production of sugar and delivery of services. In the scope of industrialization, automation is a step beyond mechanization. The automation lessens the human work force to a great extent. The main advantages of this innovation in sugar industry are higher consistency and quality, reduced lead times simplified productions improved work flow, reduced handling of equipment and increased worker morale when a good implementation of the automation is made. The further extension to this project involves the application of human minds beyond the scope of existing automation technologies using artificial intelligence, neural networks and fuzzy logics. The advanced future scope involves the application of higher flexible robots in place of existing heavier and bulky machines.

We firmly conclude by saying that the implementation of this project will serve to provide development in terms of industrial improvement in sugar refineries concerned.

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