GUI Based Industrial Monitoring and Control System

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Abstract—Over the years the Graphical User Interface (GUI) based systems are becoming accepted by the users to interact with electronics environment through graphical icons and visual indicators. In the industries GUI based systems are really essential to monitor and control the surroundings with a central supervisor. In this paper a GUI based system is described which can sense and monitor multiple number of sensors and also can be used to run number of machines and also has the ability to control a motor belt. This implemented control system can be used in the medicine, beverage, chemical production and packing industries.

Index Terms—Serial Communication; Baud rate; Flowcode; 1-wire communication; PWM.

I. INTRODUCTION

The concept of Human Computer Interaction (HCI) [1] in the early 60's brought out the idea of Graphical User Interface (GUI) latter on. And now it is in such a stage that in our every spares of daily life we are expecting some graphical windows which will make our life easier. Now-a-days GUI's are used in the applications like home security [2], different industrial and power managements [3], [4], [5] and in laboratory instruments [6]. Some GUIs are also developed for the blind or visually impaired human class [7]. There have been several popular graphical software applications in the market like Visual Basic, C#, Java applets, Adobe Flash CS4 [8] etc; that integrate graphical user interface and programming scripting functions all-in-one for interface designer and software developer to work seamlessly for a software development work.

Universal Serial Bus (USB) is an input/output port standard for computers and digital equipments that allows easy transfer of data at high speeds via a direct connection or cable and can be interfaced with microcontrollers straightforwardly [9]. USB is intended as a high speed upward extensible fully standardized plug-and-play interface between one computing device using a single port and N number of peripherals using one port each with all control being accomplished by signals within the data stream [10].

In this paper a complete industrial GUI system is proposed where GUI is developed using Visual Basic and the control system is interfaced with the computer using USB serial communication protocol. PIC 18 series microcontroller is used here as the communication bridge between the computer and exterior devices.

II. METHODOLOGY

The developed system is divided in to two parts. One is the GUI system for monitoring and controlling and another part is microcontroller hardware interfacing and implementation. In figure 1 the overall system is presented where the central controller 18 series PIC microcontroller 18F2550 [11] is interfaced with a computer through USB. One temperature and humidity sensor is connected with the PIC along with a DC motor and industrial machines. The overall supervision is done by a Visual Basic based GUI which is capable of sensing temperature and humidity, controls three machines or devices and also can run a DC motor. For developing the code for PIC an advanced level simulator software Flowcode Ver.5 is used.

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III. USB INTERFACING

The Universal Serial Bus (USB) is a well admired method to communicate between a peripheral and a computer. USB is a
plug-and-play type interface which can also provide power to the USB devices by only this means that the computer does not plug in or unplug device from the computer. The goal of the USB is to broaden the range of external peripherals that can be used on a computer.

The USB Serial device is used to stream data between the microcontroller system and a PC. This method of USB is good for transferring both small and large amounts of data in an ad-hock or as required manner. The Flowcode Serial USB device requires a driver in order to create the virtual COM port connection. This driver file is included as part of the USB pack of Flowcode ver. 5 software with a default device name of "Flowcode USB Serial". The Flowcode USB serial component creates a virtual COM port on the PC which is shown in figure 2, it is connected to which enables easy software access to the device data streams.

Every USB device must have a unique set of PID (Product ID) and VID (Vendor ID) codes. For this device the VID is Ox12BF and PID is OxFO10. Here the USB communication is done with a Standard-B type plug in connector.

IV. GUI DEVELOPMENT

For this project Graphical User Interface (GUI) is developed by using Visual Basic 2010. Visual Basic has a default serial communication prototype. Designer only has to configure that according to required serial device. In figure 3 the designed GUI is shown. The whole GUI panel is divided in to four sections. The first section is designed to connect the GUI with the USB or disconnect. The Baud rate is fixed to 9600 bps in the code. Here user only has to select the COM port where device is connected. In Sensor Panel temperature and humidity is shown. Here sensor data is received as a string value. For categorizing and recognizing different sensor values an initial identifying character is received for corresponding sensors. Here any number of sensors can be imposed in the GUI. In Control Panel three on and off switches are given to control three machines or devices. Here also the string value is send to the microcontroller to control a particular pin for switching operation. Here Motor Panel is also implemented to control the forward and reverse rotation and also a stop button is there to stop the motor instantly and speed control slide bar is also included. Flow chart for the GUI is given in figure 4.

Fig. 2. Flowcode USB COM port

Fig. 3. Proposed GUI

Fig. 4. GUI Flow Chart
This kind of GUI can be used in chemical and medicine production industries where the environment monitoring is a major concern. Other than that, this GUI can be used for industries like textile, machineries etc.

V. Controller and Peripherals Design

As a central controller PIC 18F2550 is used in this project. It is a 8-bit 28-pin microcontroller with a 10-bit ADC and with USB interfacing module. Here USB interfacing is done by a type B connector. For temperature sensing DS18B20 is used in this project. DS18B20 is a single-bus intelligent temperature sensor which can generate serial output, the temperature range of -55 – 125°C (in the range of -10 – 85°C with the accuracy of ± 0.5°C) [12]. DS18B20 can be used in parasite power mode where the communication with master and power taking both are done via the 1-Wire bus [13]. One wire communication can be established with any I/O or analog pin of microcontroller. For humidity measurement HDK series humidity sensor is used. It is a linear humidity sensor. We can control different high power machines or devices through the microcontroller output by using relay and a opto-coupler in between the relay and microcontroller. Opto-coupler is used to isolate the microcontroller optically for its safety from any kind of disaster. For motor speed controlling Pulse Width Modulation (PWM) module of microcontroller is used. PIC 18F2550 has two built in PWM channels. So both the channels are used for speed controlling and direction controlling along with a motor driver IC L293D. High power motors also can be driven by using MOSFET driver circuits.

VI. Result and Discussion

Flowcode is a high level programming language dedicated to simplifying complex functionality with advanced level simulation environment. Figure 5 shows the simulation window for this project. Here USB serial communication module, 1-wire communication module, one knob for ADC, two PWM channels and for output representation five LEDs are added in the simulation panel.

In figure 6 overall circuit diagram is provided. PIC 18F2550 is the central controller along with the USB type B connector interfaced with it in RC4 and RC5 pin. The 1-wire temperature sensor is connected in to the RA1 although it is an analog pin, here it is used as digital I/O pin and the humidity sensor is connected in analog pin AN1 or RA1. Motor driver IC L293D is connected in the RC1 and RC2 which are the PWM pins of this uC. Again from RB0, RB1 and RB2 three relays are controlled through optocouplers. Optocouplers are used to keep the uC safe from the back EMF of the relay.

In figure 7 the practical testing diagram is provided. This project is tested on a board which was developed for advanced level project testing. This board includes many advanced features like FAT, external EEPROM, stepper motor, real time clock, ultrasound sensor etc. For testing this project the USB type B port, sensors (DS18B20 and HDK humidity) are used.
The L293D connected motor is also available in the board, so that section is also tested from that board. The relay section is tested through the LED section of the board.

VII. CONCLUSION

The system is designed for high precision industrial works. The controller uses USB communication for PC based control over the speed of the motor and also monitoring for different sensing parameters. The developed system can be used in different industrial machines and also any number of machines can be maintained. Visual Basic based GUI provides the opportunity to build the installation file and to use in any PC. The plug and play makes the USB to interface and use easy. The overall system is low cost and beneficial for any industry use.

REFERENCES


