Industrial Application Monitoring and Control using Raspberry pi and TCP/IP Protocol

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Abstract: The design and implementation of embedded web server that can be used for Electrical Equipment monitoring system using Raspberry pi . Sensors are interfaced with microcontroller to measure parameters like temperature, gas and transmitted through zigbee. The received values are uploaded in internet by Ethernet cable. So by typing IP address in web browser, client can monitor all devices in industry from any remote places via its own local browser.

Keywords: Optical Character Recognition, Digitization, Skeletonization, Field Programmable Gate Array, Simulink HDL coder.

I. INTRODUCTION

The arrival of internet reduced the whole world communication boundary to that of a single village. After the "everybody in internet wave" now obliviously follows the "everything in the internet wave". When the embedded devices are provided with internet access, it is of no doubt that demand will rise due to the remote accessing capability of the devices. The paper includes complete implementation of an HTTP Web Server in Raspberry Pi.

This development kit which contains Ethernet interface is connected to PC using RJ45 cable. Sensors are connected to 89C51 Microcontroller. Temperature, Gas, Humidity, pressure, motion, and speed are must often measure parameters. Some electronic circuits, chemical reactions, biological processes perform best with in limited temperature and also necessary to measure gas in environment. These parameters are mostly used in power plants, chemical industry, hospital, medicine Production Company. In this paper embedded systems and Internet technology are combined to form a new technology –the Embedded Internet Technology, which developed with the popularization of computer network technology in recent years.

The heart of communication is TCP/IP protocol. Network Communication is performed by the IEEE 802.3 Ethernet standard. It is the most modern technology of embedded systems. Since ARM embedded web server based on Raspberry Pi has fast execution capability and Ethernet standard can provide internet access with reasonable speed, this system is suitable for enhancing security in industrial conditions by remotely monitoring various industrial applications.
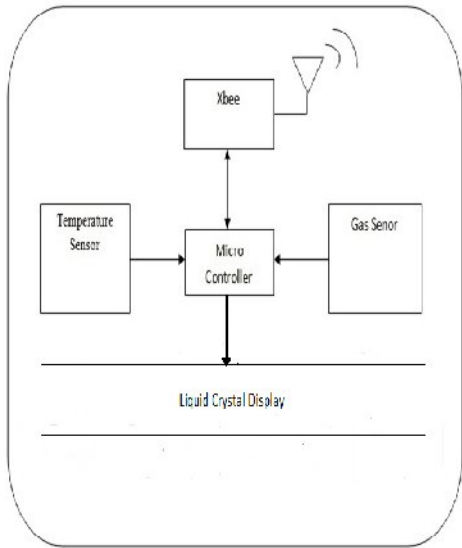
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The Broadcom used in the Raspberry Pi is equivalent to a chip used in an old smartphone (Android or iPhone). While operating at 700 MHz by default, the Raspberry Pi provides a real world performance roughly equivalent to the 0.041 GFLOPS. On the CPU level the performance is similar to a 300 MHz Pentium II.

Fig 1. Sensor module (transmitter section)
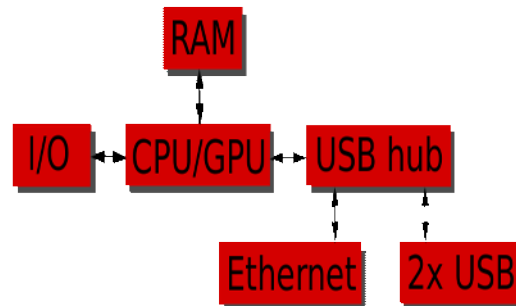
Fig :3 block diagram of raspberry pi

On the older beta model B boards, 128 MB was allocated by default to the GPU, leaving 128 MB for the CPU. On the first 256 MB release model B ,three different splits were possible.

Most standard USB keyboards and mice will work with the Raspberry Pi. Wireless keyboard/mice should also function, and only require a single USB port for an RF dongle. In order to use a Bluetooth keyboard or mouse you would need to use a Bluetooth dongle, which again uses a single port. Remember that the Model A has a single USB port and the Model B only has two (typically a keyboard and mouse will use a USB port each).
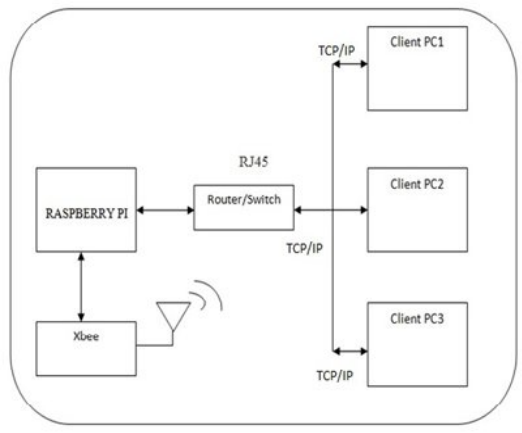
Fig 2. Server module (receiver section)

II. RASPBERRY PI

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. The Raspberry Pi is based on the Broadcom BCM2835 system on a chip which includes an ARM MHz processor.

A.Industrial Monitoring and Controlling

The architecture of Industrial monitoring system consists of three modules as follows. Sensor module consists of 89C51 microcontroller and XBee. Server node consists of Raspberry Pi with inbuilt Ethernet Controller and Xbee. Thirdly, GUI (graphical user interface) on PC where is parameter of industrial plant is monitored. In sensor module, node of two sensors are developed i.e .temperature, and gas respectively which will sense or a measure

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physical quantities of the industrial device. 89C51 microcontroller interfaces with these sensors using PCF8591 Analog to Digital converter (ADC) and gets the converted digital data through I2C bus. By using wireless technology, it will transmit data to the server node. In addition in built 10 bit ADC converts sensors Analog data into digital data and sends value to LCD. These measured values are transmitted to PC through serial protocol SPI and Ethernet. This transmitted data is then displayed on PC by typing IP address on the GUI design. For security proposes login's are provided for employer who will monitor the plant. When client types IP address on web browser and logged in he/she will get web page that contains all parameters like temperature and gas.

Wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, humidity, pressure, etc. and to cooperatively pass their data through the network to a main location or server. Now most modern networks are bi directional and also have enabling control of sensor activity. The WSN is built of "nodes" from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors . Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source usually a battery or an embedded form of energy harvesting.

B. Embedded Web Server

An embedded web server is a hardware component of a system that implements the HTTP protocol interfaced with an application .It can be used to provide a application or to design application for the distribution and acquisition of information to be displayed in the regular interface, it has an advantage of easily being interfaced with a Network through Ethernet. The aim of this model is to monitor/control the physical parameter values or devices from the remote areas. A wireless communication is required to fulfill the application. Out of different wirelesses communications existing XBee module is used here as RF communication system Objective of work here is to observe and control sensor network wirelessly using an embedded web server in an industrial setup. The embedded web server designed here performs two tasks continuously displays the output of WSN node to all the systems connected through LAN/Ethernet and control one AC & one DC device from the web through R.F Module.

It is also known as "Apache HTTP Server" which allows the online distribution of website service using Hyper Text Transfer Protocol (HTTP). It is widely popular web server for different operating systems such as Linux, Unix, Windows, Solaris, Mac OS X, Novell NetWare, OS/2 etc. Apache2 version was used in this project for creating web server.

The PHP hypertext preprocessor (PHP) is a server- side scripting language designed for web development. PHP code is integrated by a web server with a PHP processor module which generates the resulting web page. PHP is basically used for developing web based software applications and also to manage database, dynamic content, session tracking, even build entire e-commerce sites. PHP5 version was used in this project.

MySQL is database management system which runs on a server. It support standard SQL and compiles on a number of platform. MySQL is open source, free to download and use.

HTML elements form the building blocks of all websites. HTML allows images and objects to be embedded and can be used to create interactive

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forms. It provides a means to create structured documents by denoting structural semantics for text such as headings, paragraphs, lists, links, quotes and other items. It can embed scripts written in languages such as JavaScript which affect the behavior of HTML web pages.

C. TCP/IP Protocol

The software running on the embedded web server follows the same layered structure as used in the TCP/IP protocol suite. The TCP/IP protocol suite allows computers of all sizes, running different operating systems, to communicate with each other. The TCP/IP protocol suite is a combination of different protocols at various layers Every layer acts independently from each other. The Link Layer normally includes the device driver in the operating system and the corresponding network interface (card) in the computer.

An Ethernet controller driver controls the Ethernet interface. The network layer controls the communication between hosts on the Ethernet. The Address Resolution Protocol (ARP) at network layer translates IP addresses to Ethernet MAC addresses. Internet Protocol (IP) delivers packets to Transmission Control Protocol (TCP), UDP, and Internet Control Message Protocol (ICMP), the ICMP answers to PING requests. TCP/UDP delivers data to the applications. HTTP runs on the top of TCP/IP protocol. It is set of the rules for transferring files like text, image, sound and other multimedia file on the World Wide Web. When Web. The applications can communicate with the transport layer through buffers with data and variables with control information. As soon as a Web user opens their Web browser, the user is indirectly making use of HTTP. When you are set up with direct access to the Internet, your computer is provided with a copy of the TCP/IP program.

III. PROPOSED METHOD

The proposed method which uses raspberry pi The individual testing of different modules are developed and the final setup was made arranging all devices in proper manner. After this final arrangement the whole system was tested. The protocol used for the communication between webserver and web browser is Hyper Text Transfer Protocol or HTTP protocol. This protocol defines all the basic frame work of web communications by handling requests and also by providing control information to be transferred between browser and server. To obtain a web document, the browser and server should establish a connection at Port 80. The HTML web page displayed when the configured IP address entered on the web browser is shown. Here the first data gives information about the temperature sensed in the remote location. The second data displays the concentration of CO in the location of monitoring.

Thresholding is done by calculating the mean value for the pixels of the image and the values which are above threshold is set to white and for below to black. Thresholding is of two types: Global thresholding and locally adaptive thresholding. Locally adaptive thresholding produces a satisfactory output when compared to global thresholding. To find thresholding, 1) select an initial estimate for T (typically the average grey level in the image).2) Segment the image using T to produce two groups of pixels: G_1 consisting of pixels with grey levels $>T$ and G_2 consisting pixels with grey levels $\leq$ T. 3) Compute the average grey levels of pixels in G_1 to give μ_1 and G_2 to give μ_2. 4) Compute a new threshold value:

Skeletonization is the process of removing the noise that is present in the images. Gaussian Filters are used to remove the noise in skeletonization. The filtering function is given by H(u,v). $G(u,v)=H(u,v)*F(u,v)$ where $F(u,v)$ is the input

image. Thinning is the other name for skeletonization.

Text line Detection, Slant detection, Slant Correction and skew correction are the steps involved in Rectification of the images. Recognition of the character is done by horizontal and vertical text line extraction. First the horizontal line extraction is done and then segmentation is made vertically. Thus words are recognized and are displayed in notepad.

HDL Coder used to generate synthesizable HDL code for FPGA and ASIC implementations in a few steps: Model your design using a combination of MATLAB code, Simulink blocks, and Stateflow charts. Optimize models to meet area-speed design objectives. Generate HDL code using the integrated HDL Workflow Advisor for MATLAB and Simulink. Verify generated code using HDL Verifier.

LABVIEW

Lab VIEW (Laboratory Virtual Instrument Engineering Workbench) is a graphical programming language that uses icons instead of lines of text to create applications. In contrast to text-based programming languages, where instructions determine the order of program execution, LabVIEW uses dataflow programming, where the flow of data through the nodes on the block diagram determines the execution order of the VIs and functions. VIs, or virtual instruments, are LabVIEW programs that imitate physical instruments.

The HDL Workflow Advisor in HDL Coder automatically converts MATLAB code from floating-point to fixed-point and generates synthesizable VHDL and Verilog code. This capability is used to model the algorithm at a high level using abstract MATLAB constructs and System objects while providing options for generating HDL code that is optimized for hardware implementation. HDL Coder provides a library of ready-to-use logic elements,

such as counters and timers, which are written in MATLAB.

IV. CONCLUSION

Implementation of web server using Raspberry Pi for intelligent monitoring is a new method to monitor an environment which designed here for the real time implementation. The system can also communicate with PC through RS-232 Serial Port. It supports online supervision and control not only within Private Network (LAN) but also in Public Network (Internet).The whole system has low-cost, good openness and portability, and is easy to maintain and upgrade. It is possible to interface different kind of Sensors with these modules and make various applications. So it can monitor embedded system operation state through Internet, achieving network monitoring purposes. The HTML web page displayed when the configured IP address entered on the web browser is shown. Here the first data gives information about the temperature sensed in the remote location. The second data displays the concentration of CO in the location of monitoring. This work can further be extended with usage of high end embedded servers along with wireless sensor networks with increase in parameters and increase in sensor nodes. In conclusion , this paper advances the industrial monitoring and controlling with the embedded web server and raspberry pi

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