ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Monthly Peer Reviewed Open Access International e-Journal

Remote Monitoring & Control System Using Embedded Web Server on Arm 11

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ABSTRACT:

The web technology has begun to have a rapid development in the field of embedded systems in the post-PC era. The application of embedded web technology in the remote monitoring system has given rise to the technological change in the field of industrial control.

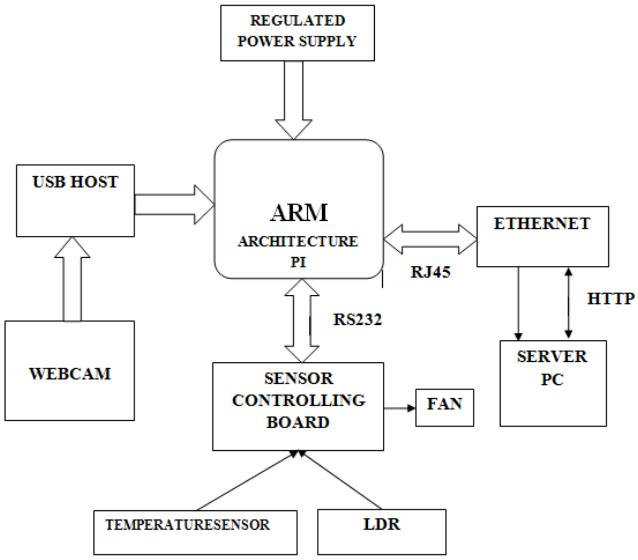
Nowadays the management of the domestic laboratories in the research institute and universities has issues of poor real time, high cost and low precision .It is difficult to determine the quality of the environment of the laboratory. So the Laboratory Intelligent Monitoring System should be developed to implement early warning, remote control, real-time monitoring and other functions.

This paper comes up with a design solution of an embedded web-based remote monitoring system for the environment in the laboratories, which realizes the local management and remote publishing applications for large-scale dynamic data of sensor networks and video images.

In this project we are using ARM Intelligent Monitoring Center which uses Samsung's processor as its main controller. The environmental conditions present inside the lab can be monitored using sensors like temperature, gas and LDR.

All the sensors are connected to sensor board. From the sensor board we are sending monitored values to control room (ARM board) through RS232 serial cable. The serial cable is connected to one of UART port of ARM board.

Block diagram:



INTRODUCTION:

In present days the management of the domestic laboratories in the research instiute anduniversites has isues of por real time, high cost and low precision .It is dificult to determine the quality of the environment of the laboratory [1]. By using this project should be developed to implement early warning, remote control, real-time monitoring and other functions.

Also we design solution of an embeded web-based remote monitoring system for the environment in the laboratories, which realizes the local management and remote publishing aplications for large-scale dynamic data of sensor networks.

Here, we propose the design and implementation of low cost web based remote monitoring system with built-in security features. Due to the usage of an embedded intelligent monitoring module which is the Raspberry Pi 32-bit ARM Raspberry Pi Processor as its main controller, the performance and frequency of which are suitable for real-time video image capture and processing applications.

This micro controller works for a voltage of +3.3V DC and at an operating frequency of 700 MHz, The maximum frequency up to which this micro controller can work is 533 MHz making it very much suitable for a portable system. Later programming is done on this Board to make it act as an embedded web server.

EXISTING METHOD:

In the existing system the Lab monitoring system is design and controlled by using RF technology which can monitor and control the system inside the lab only in places where network availability is more. They are bit more costly because cost of components is increased. Not so easy to implement as you have to take great care of noise, Because of antennas it is bulkier.

PROPOSED METHOD:

The proposed method is used to overcome the drawbacks present in existing method. Here we are using ARM Intelligent Monitoring Center which uses Samsung's processor as its main controller. The environmental conditions present inside the lab can be monitored using sensors like temperature, gas and LDR. All the sensors are connected to sensor board. From the sensor board we are sending monitored values to control room (ARM board) through RS232 serial cable.

The serial cable is connected to one of UART port of ARM board. Whenever a person is entered inside the lab, the person's image can be captured by camera and send it to controller.

The controller transmits the data to remote PC through Ethernet by using FTP. FTP is a protocol through which users can upload files from their systems to server. Once data is placed at server we can view the data at remote PC (with internet) on web page with unique IP address.

We can view continuous streaming of video as well as senor's data.If we want to control the devices based on sensor's information we can control through web page from remote location using HTTP protocol.

HTTP protocol continuously requests the server for control (turn on or turn off) the devices. In this way we can monitor and control the devices through remote PC.

ARM 11 MICROCONTROLLER:

ARM is a 32-bit RISC processor architecture developed by the ARM corporation. ARM processors possess a unique combination of features that makes ARM the most popular embedded architecture today.

First, ARM cores are very simple compared to most other general-purpose processors, which means that they can be manufactured using a comparatively small number of transistors, leaving plenty of space on the chip for application specific macro cells.

A typical ARM chip can contain several peripheral controllers, a digital signal processor, and some amount of on-chip memory, along with an ARM core.

Second, both ARM ISA and pipeline design are aimed at minimizing energy consumption — a critical requirement in mobile embedded systems.

Third, the ARM architecture is highly modular: the only mandatory component of an ARM processor is the integer pipeline; all other components, including caches, MMU, floating point and other co-processors are optional, which gives a lot of flexibility in building application-specific ARM-based processors.

Finally, while being small and low-power, ARM processors provide high performance for embedded applications.

For example, the PXA255 XScale processor running at 400MHz provides performance comparable to Pentium 2 at 300MHz, while using fifty times less energy.

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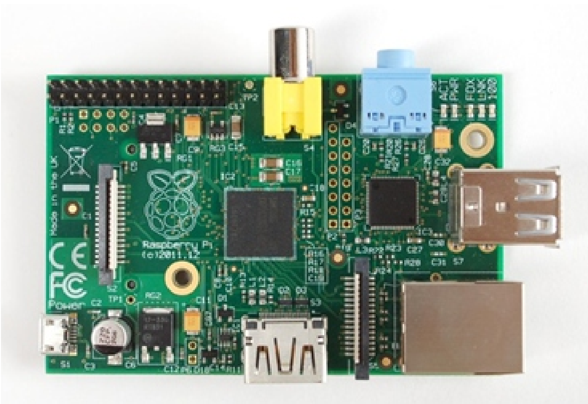

Fig: RASPBERRY PI BOARD

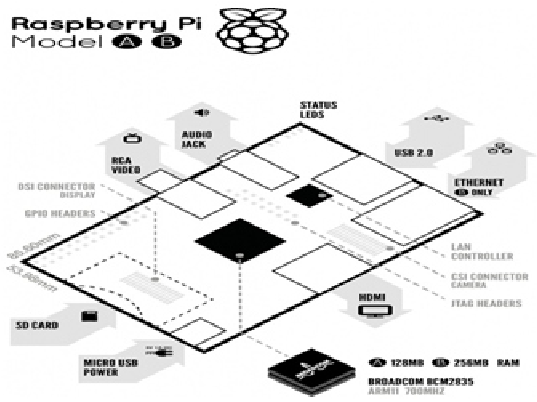

Fig-4 : BOARD FEATURES

The Raspberry Pi is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools.

The Raspberry Pi is manufactured in two board configurations through licensed manufacturing deals with Newark element14 (Premier Farnell), RS Components and Egoman.

These companies sell the Raspberry Pi online. Egoman produces a version for distribution solely in China and Taiwan, which can be distinguished from other Pis by their red coloring and lack of FCC/CE marks. The hardware is the same across all manufacturers.

The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor, Video Core IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded to 512 MB.

It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and persistent storage.

The Foundation provides Debian and Arch Linux ARM distributions for download. Tools are available for Python as the main programming language, with support for BBC BASIC (via the RISC OS image or the Brandy Basic clone for Linux),C, Java and Perl.

HARDWARE IMPLIMENTATION TEMPERATURE SENSOR:

LM35 is a precision IC temperature sensor with its output proportional to the temperature (in oC). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermostor.

It also possess low self heating and does not cause more than 0.1 oC temperature rise in still air. The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every oC rise/fall in ambient temperature, i.e., its scale factor is 0.01V/ oC.

LIGHT SENSOR (LDR):

A light-dependent resistor, alternatively called an LDR, photo resistor, photoconductor, or photocell, is a variable resistor whose value decreases with increasing incident light intensity.

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An LDR is made of a high-resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance.

GAS SENSOR:

A CO gas sensor according to the present invention includes a gas collecting container for collecting a measured gas therein; a detecting section provided within the gas collecting container and having at least a pair of electrodes positioned through electrolyte; and a voltage applying apparatus for applying voltage to the detecting section.

One of the electrodes of the detecting section is a detection electrode having the capability of adsorbing at least one of hydrogenous gas and CO gas when a voltage is applied and then oxidizing it. By introducing a measured gas into a gas collecting container of the CO gas sensor and carrying out electrolysis according to a potential sweep method or a pulse method with the measured gas being in contact with the detecting section, a CO gas concentration in the measured gas can be measured based on an electrical current value obtained at the detecting section and changes of the electrical current with elapse of time.

According to the CO gas sensor of the present invention, it is possible to accurately carry out detection and measurement of the concentration of CO gas when CO gas is to be detected or measured even in a gaseous atmosphere containing a relatively large amount of hydrogen gas and CO2 gas.

ETHERNET:

Ethernet is a family of computer networking technologies for local area networks (LANs) commercially introduced in 1980. Standardized in IEEE 802.3, Ethernet has largely replaced competing wired LAN technologies.

Systems communicating over Ethernet divide a stream of data into individual packets called frames. Each frame contains source and destination addresses and error-checking data so that damaged data can be detected and re-transmitted.

The standards define several wiring and signaling variants. The original 10BASE5 Ethernet used coaxial cable as a shared medium. Later the coaxial cables were replaced by twisted pair and fiber optic links in conjunction with hubs or switches. Data rates were periodically increased from the original 10 megabits per second, to 100 gigabits per second.

Ethernet LAN Features:

- s topology, Wired LAN in IEEE 802.3 physical layer standard.

- 10 Mbps, 100 Mbps (Unshielded and Shielded wires) and 4 Gbps (in twisted pair wiring mode).

- Broadcast medium Passive, Wired connections based.

- Frame format like the IEEE 802.2.

- SNMP (Simple Network Management Protocol) Open system (therefore allows equipment of different specifications)

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International Journal & Magazine of Engineering, Technology, Management and Research
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• Each one connected to a common communication channel in the network listens and if the channel is idle then transmits. If not idle, waits and tries again.

• Multi access is like in a Packet switched network.

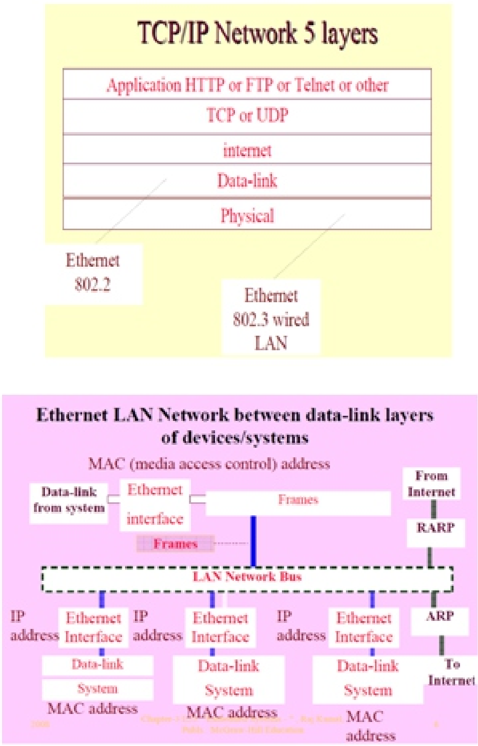

Fig-10 TCP/IP NETWORK LAYER

RESULT:
Description:

In this project, we are giving the complete description on the proposed system architecture. Here we are using Raspberry Pi board as our platform. It has an ARM-11 SOC with integrated peripherals like USB, Ethernet and serial etc. On this board we are installing Linux operating system with necessary drivers for all peripheral devices and user level software stack which includes a light weight GUI based on XServer, V4L2 API for interacting with video devices like cameras, TCP/IP stack to communicate with network devices and some standard system libraries for system level general IO operations. The Raspberry Pi board equipped with the above software stack is connected to the outside network and a camera is connected to the Raspberry Pi through USB bus.

The architecture of the web server has the following layers.

• In the lower level the web server has the physical hosting interfaces used for storing and maintaining the data related to the server.

• Above the Physical hosting interface the server has HTTP server software and other web server components for bypass the direct interaction with the physical interaction with the lower levels.

• The final layer has the tools and services for interacting with the video streams which includes the Image codec and storing interfaces, connection managers and session control interfaces etc.

After connecting all the devices power up the device. When the device starts booting from flash, it first load the Linux to the device and initialize all the drivers and the core kernel. After initialization of the kernel it first check weather all the devices are working properly or not. After that it loads the file system and start the startup scripts for running necessary processes and daemons. Finally it starts the main application.

When our application starts running it first check all the devices and resources which it needs are available or not. After that it check the connection with the devices and gives control to the user.

The Interface for the user has the following things.

• A label for displaying the image which is coming from the image.

• Text-boxes for showing the sensor values.

• Controlling the DC fan.

The board continuously reads data from the camera and at the same time it reads the data from the sensors. The scheduler is monitoring the process dedicated for camera reading and sensor reading. The camera read image and sensor values with scheduler information will send to the web server. There the user in front of the web server will monitoring the priorities and the sensor and camera data. Whenever the user wants to change the priorities of the processes then using the web interface he can change the priorities.

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When ever change is occurred then the web server send the modified signals to board. Whenever the board got the modification, it will send the scheduler to change the priorities.

SNAPSHOTS:

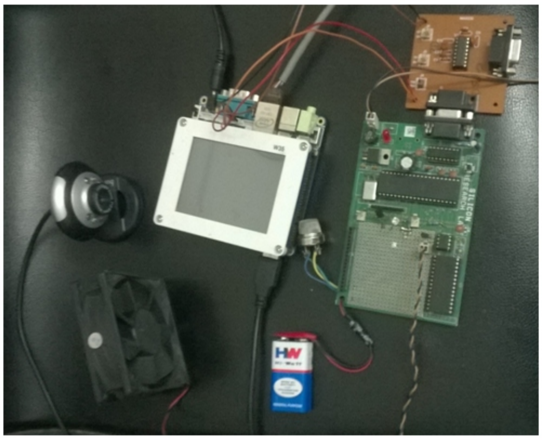

Fig-15 : COMPLETE HARDWARE DEVICES CONNNECED 01

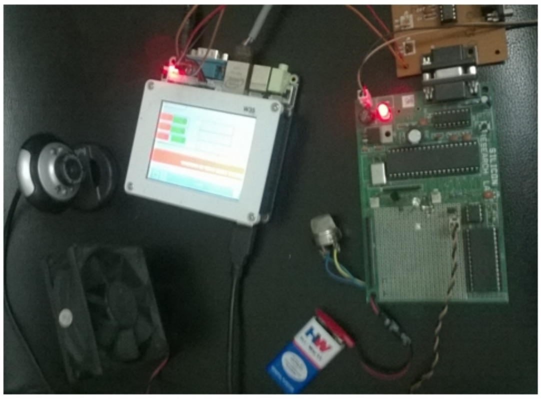

Fig-16 : COMPLETE HARDWARE DEVICES CONNNECED 02

Fig-17 : MONITORING THE VALUES

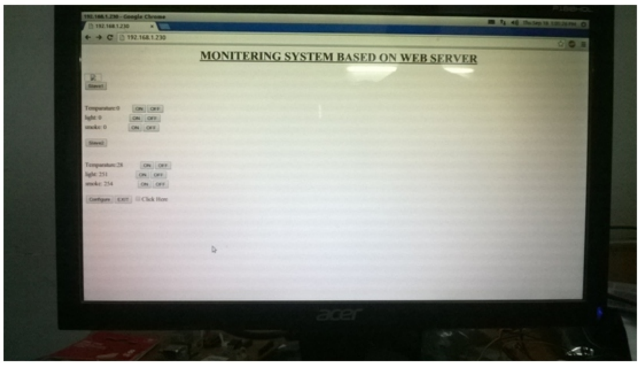

Fig-18 : VIDEO MONITORING AND CONTROLLING USING ETHERNET 01

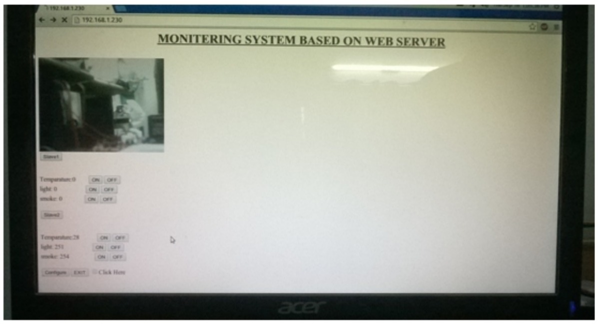

Fig-19 : VIDEO MONITORING AND CONTROLLING USING ETHERNET

CONCLUSION & FUTURE SCOPE:

FUTURE SCOPE:

» The cost of ARM11 is more that's why in future we can implement this system using ARM CORTEX A8, Beagle bone etc as well as updated processors with high frequencies will work fine.

» As the storage space is also less in future we can also record these live streaming data by connecting external memory storage.

» We can complete our project using wireless technology.

» In future we can provide more security to data by using encryption, decryption techniques.

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CONCLUSION:

The project “REMOTE MONITORING & CONTROL SYSTEM USING EMBEDDED WEB SERVER ON ARM 11” has been successfully designed and tested.

It has been developed by integrating features of all the hardware components and software used and tested.

Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit.

Secondly, using highly advanced ARM Cortex A8 Processor board and with the help of growing technology the project has been successfully implemented.

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