ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2016

Raspberry Pi Based Remote Lab Implementation

Darshana D. Magdum[1], R. D. Patane[2]

PG Student, Dept. of Electronics, Mumbai University, Navi Mumbai, India[1]

HOD, Dept. of General Science and Engineering, Mumbai University, Navi Mumbai, India[2]

ABSTRACT: This paper presents a new design of remote laboratory multiuser based embedded web server that is used for the lab microcontroller system. Architecture of Remote Lab System consists of a computer server, two experiment module microcontroller system and two embedded web server for controlling lab modules. The computer server is used as a web server remote lab that serves as a homepage and user management. Embedded web server serves as the user interface to control the lab module microcontroller via the internet. The propose of the system is the remote laboratory architecture is multi user, so that at the same time can be used by more than one user.
.

KEYWORDS: ARM, AVR, Embedded server, PHP, Raspberrypi

I. INTRODUCTION

Because of the rapid development and expansion in the field of internet and microprocessors the application performed by those to the end user also kept on increasing and demanding .This project designs on such issues of remotely programming microcontrollers, where a prototype of remote lab is setup with the help of Raspberrypi which can program any microcontrollers attached to it if it is specified and setup properly. This project also 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 The design proposed in this project is expected to answer the issues often raised in the implementation of the remote lab. The remote labs find much application in industrial and educational institutions Its advantages over conventional PC servers are explained below:
Implementation on Embedded Web Server for the remote lab will provide advantages like cost effectiveness because the required hardware is cheaper when compared to using a PC server and software is built on open source utilities and API's, the power required is very optimum since the system is running on minimum requirements and the dimension of equipment are also smaller providing easy installation and maintenance.
Remote labs can be multiuser, so that at an instant multiple users can log onto to the system and through proper context switching all can access the system resources depending on
processing speed of processor and the number of experimental module installed.

II. LITERATURE SURVY

The embedded web server which can control and monitor the remote devices without any restriction of distance .Also it gives the real time status of the device .The embedded web server has the advantages over the traditional remote monitoring system.

A. IOT [internet of Things][1]
1. The Internet of Things (IoT) is defined as an integrated part of the future Internet, which ensures that 'things' with identities can communicate with each other.
2. IOT will be applied in different areas eg. smart Cities ,agriculture .

B. GSM-Bluetooth based remote monitoring system[2]
1.InGSMBluetooth based remote monitoring system there is restriction of distance

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2016

2. But it is not efficient in situations which have strong real time requirements
3.Also in GSM-Bluetooth monitoring system there is no stability also its not a real time system .

C. *PC based monitoring system[3]*
Pc based remote monitoring system has drawback high cost ,unsatisfactory stability and reliability. Moreover in the Client/Server architecture, the maintenance burden on the server would be heavy because some particular monitor software should be installed on each remote monitor terminal. In various Internet applications based on client server architecture, it is better to use embedded WEB server other than PC server for decreasing volume, cost and power consumption.

III.THE PROPOSED MECHANISM

To overcome the disadvantages GSM and Bluetooth ,pc based remote lab implementation we are going to implement the remote lab implementation on embedded web server .

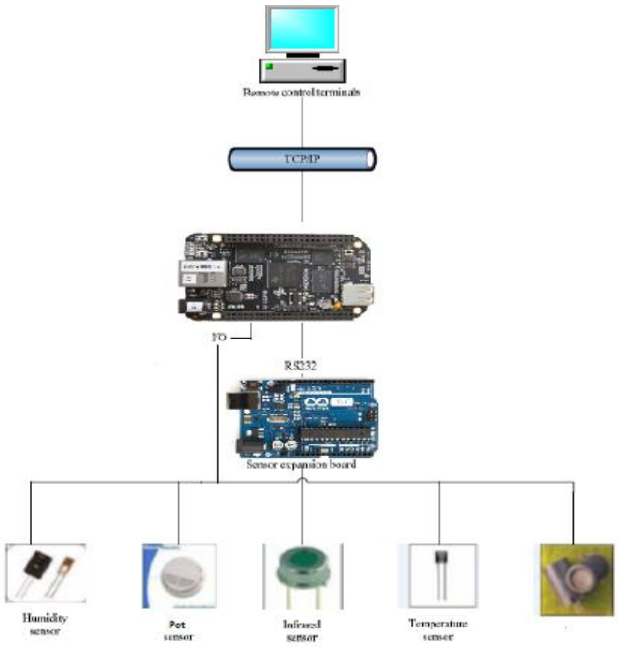

Fig 1. General Architecture of system

A new design of remote laboratory multiuser based embedded web server. Architecture of Remote Lab System consists of a computer server, two experiment module microcontroller system and two embedded web server for controlling lab modules.
The computer server is used as a web server remote lab that serves as a homepage and user management. Embedded web server serves as the user interface to control the lab module microcontroller via the internet. The novelty of the system proposed is the remote laboratory architecture is multi user.
The central processing unit is a raspberrypi board consisting of ARM cortex A-8 processor The general framework of remote lab can be classified into two. The remote monitoring system consisting of various sensors whose calibrated values can be published on the server and the expansion board which can be programmed remotely which is the Arduino uno in this design.The design proposed in this paper is expected to answer the issues often raised in the implementation of the remote lab. The remote labs find much application in industrial and educational institutions Its advantages over conventional PC servers are explained below:

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2016

1. Implementation on Embedded Web Server for the remote lab will provide advantages like cost effectiveness because the required hardware is cheaper when compared to using a PC server and software is built on open source utilities and API's, the power required is very optimum since the system is running on minimum requirements and the dimension of equipment are also smaller providing easy installation and maintenance.
2. Because the Embedded Web Server working with pure HTML and PHP instructions that opened the port is port 80 only, so that the firewall is safe.
3.Remote labs can be multiuser, so that at an instant multiple users can log onto to the system and through proper context switching all can access the system resources depending on processing speed of processor and the number of experimental module installed.
4.Other telemetric activities like remotely programming or re-programming based on the environment conditions pertaining to the remote location became challenging. This paper discusses and designs on such issues of remotely programming microcontrollers.

IV. SYSTEM HARDWARE

A. *Raspberry pi*

Raspberry Pi is a single-board computers developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science. The original Raspberry Pi is based on the Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-700 MHz processor, VideoCore IV GPU, 512Mb of RAM.

Fig 3 Raspberry pi b+ Board

- **More GPIO**. The GPIO header has grown to 40 pins, while retaining the same pin out for the first 26 pins as the Model A and B.
- **More USB**. We now have 4 USB 2.0 ports, compared to 2 on the Model B, and better hot plug and over current behavior.
- **Micro SD**. The old friction-fit SD card socket has been replaced with a much nicer push-push micro SD version.
- **Lower power consumption**. By replacing linear regulators with switching ones we've reduced power consumption by between 0.5W and 1W.
- **Better audio**. The audio circuit incorporates a dedicated low-noise power supply.
- **Neater form factor**. We've aligned the USB connectors with the board edge, moved composite video onto the 3.5mm jack, and added four squarely-placed mounting holes.

The Foundation provides Debian and Arch Linux ARM distributions for downloads. 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, C++, Java, Perl and Ruby.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2016

B. *ARDUINO UNO*

High Performance 8-Bit MCU
RISC Architecture
– 32 Registers
– 2-Address Instructions
– Single Cycle Execution
Low Power
Large linear address spaces
Efficient C Language Code Density
On-chip in-system programmable memories

C. *SENSORS*

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade .
Humidity is the presence of water in air. The amount of water vapour in air can affect human comfort as well as many manufacturing processes in industries. The presence of water vapour also influences various physical, chemical, and biological processes. Humidity measurement in industries is critical because it may affect the business cost of the product and the health and safety of the personnel. Hence, humidity sensing is very important, especially in the control systems for industrial processes and human comfort.

V. SYSTEM SOFTEWARE

Raspberry PI is configured as server which has the capability to program the Arduino using AVRDUDE installed on it. Raspberry PI is ported with raspbian jessie OS based on Linux Kernel, Firmware of Raspberry PI controller is written in python. On the Client side a software application created using Labview which connects to the server and capable of transferring hex file to the server and Communication commands for certain actions of the server through TCP/IP Protocol.

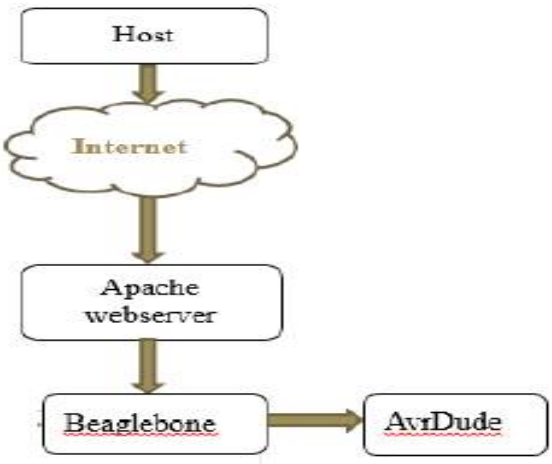

Fig 3. Remote programming system overview

A. Features / Capability of the Server controlled via the Client:

Entire project is based on command driven approach.
1. Client can send Transmit command and server accepts the connection and gets ready to receive hex file, client

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2016

transmits the hex file and once its successfully done socket connection is closed
2. Client can send program command to the server and server Initiates the programming of Arduino using AVRDUDE which in turn uses concept of Bit Banging, converting GPIO lines of the raspberry PI in to SPI lines and programs the arduino using ICSP lines
3. Client application is Event based which connects to the server only when transmit button click event happens or program button click event happen.
4. Number of Devices can be connected to the Raspberry PI but limited by the number of GPIO lines available on thePI

B. Features of the Project

1. Client is able to connect to the server on port 8888 with server IP details and instructs the server to program the Arduino devices connected to it.
2. Multiple clients can be connected to the server and Multiple devices can be programmed accordingly
3. The communication is over the TCP/IP Protocol hence distance is not the limitation but for this project the server as well as the client has to be in the same network

VI .ADVANTAGES[4]

1.Low cost
2.Minimum power required
3.Easy to installation
4.Easy to maintain
5.Safe
6.Remote lab can be multiuser

VII. APPLICATIONS

1.For industrial application
2.Educational institutions
3.Home automations

VIII. CONCLUSION

An embedded web server thereby reducing the implementation cost, power consumption, boot-up and runtime. Also show that the system designed realizes safe and convenient remote monitoring and local management of the environment in laboratories and has high availability, reliability and popularization

REFERENCES

[1] Ivan Ganchev, Zhanlin Ji, M´airt´ın O'Droma "A Generic IoT Architecture for Smart Cities" ISSC 2014 / CIICT 2014, Limerick, June 26–27
[2] Vini Madan , S.R.N Reddy "GSM-Bluetooth based Remote Monitoring and Control System with Automatic Light Controller" International Journal of Computer Applications (0975 – 8887) Volume 46– No.1, May 2012
[3] Arkhomenko Anzhelika, Gladkova Olga, Eugene Ivanov, Aleksandr Sokolyanskii, Sergey KursonP "Development and Application of Remote Laboratory for Embedded Systems Design" 978-1-4799-7839-7/15/$31.00 ©2015 IEEE
[4] Alexander P J, N. Radhakrishnan "Remote Lab Implementation on an Embedded Web Server" 2015 International Conference on Circuit, Power and Computing Technologies [ICCPCT]
[5] Martin Kalu´z, L'ubos˘ C˘ irka and Miroslav Fikar "Simplifying the Implementation of Remote Laboratories in Educational Environments Using Industrial Hardware" 2013 International Conference on Process Control (PC) June 18–21, 2013, Štrbské Pleso, Slovakia
[6] Anzhelika Parkhomenko, Aleksandr Sokolyanskii, Olga Gladkova, Sergey Kurson "Investigation of Remote Lab Design Technologies" MEMSTECH 2015, 2-6 September, 2015, Polyana-Svalyava (Zakarpattya), UKRAINE
[7]Shuang Wang; Huiyang Zhao, "Design and implementation of remote virtual network lab," Systems and Informatics (ICSAI), 2012 International Conference on , vol., no., pp.1005,1007, 19-20 May 2012
[8] Yeoh, K.J.M.; Hwee Ling Wong, "Web-based remote navigational robot for multiclass human-robot interaction," Sustainable Utilization and Development in Engineering and Technology (STUDENT), 2012
[9] Xu Wei, "The Research of Embedded Database of Mass Storage Technology", microcomputer Information, (in Chinese). (24):119-120 2008.
[10] Zhang Quan-gui, "Embedded Internet and the application in the monitoring and control system, Information Technology", vol.28no. 4, pp52-54,2004.