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RASPBERRY PI BASED EMBEDDED WEB SERVER TO MONITORING AND CONTROLLING OF INDUSTRIAL DEVICES USING SENSORS

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Abstract: Industrial automation is becoming more and more popular day by day due to its numerous advantages. Achieved by local networking and remote control Monitoring and Controlling industrial Devices on Raspberry Pi and embedded web server. Raspberry Pi board consisting ARM11 processor and Real Time Operating system. Embedded web server technology is the combination of embedded device and Internet technology. Using embedded web server flexible remote device monitoring and controlling and management function based on internet browser. Using both technology reduce complexibiliy of devices, reduce overall cost. Embedded web server user can access their equipment remotely.

Keywords: Raspberry Pi, Web Server, Rasbian OS

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INTRODUCTION

Modern era of automation and advanced computing the social and commercial needs of mankind are changing very frequently. To keep up with these changes, we need to develop systems which are capable of performing different functions within some specified limits of time, accuracy and cost. Automation can be very effective to reduce human effort and involvement in different areas. This can be a boon for those industries which need a lot of skilled employees and also in areas where it is dangerous for lives of people involved in that job. In most of the modern industries, there is a need of data monitoring and controlling.

Develop remote Monitoring and Controlling system based on web server using raspberry pi Board consisting Arm11 processor and real time operating system. Data collecting wirelessly (Wi-Fi, zig-Bee or RF Module 2.4 GHz module) from Industrial Unite Slave Node1 and Unite Slave Node2. Raspberry pi Collecting data form nodes and send to the centralized server .The server collects the data and store it in database. The web page creating scripting languages using HTML and PHP. When login the page all the data available in page so Controlling, Monitoring and analyse data easily using smart phone.

III. System Architecture

The proposed system is divide in two parts. Industrial Nodes and Embedded Web server. Linux ARM11 Based Raspberry Pi Embedded Web Server to Monitoring and Controlling of Industrial Devices using sensors from distance location. Raspberry pi is based on ARM11 processor which is having HDMI, Memory Card, Ram, Audio, Ethernet to build Small Low Cost Computer with Linux based Operating System freely available Open source Operating system. I have make two slave Module that is Industrial slave Node 1 and Energy and water supply unite slave 2. Both slave modules data Transmit and receive wirelessly using (RF module) also data monitoring and controlling manually both nodes. Both nodes have different sensors, Control Unit, Display Unit, Main controller, Power supply. Data Monitoring and Controlling Main module, Salve Node 1 and Node 2 using Embedded Web Server.

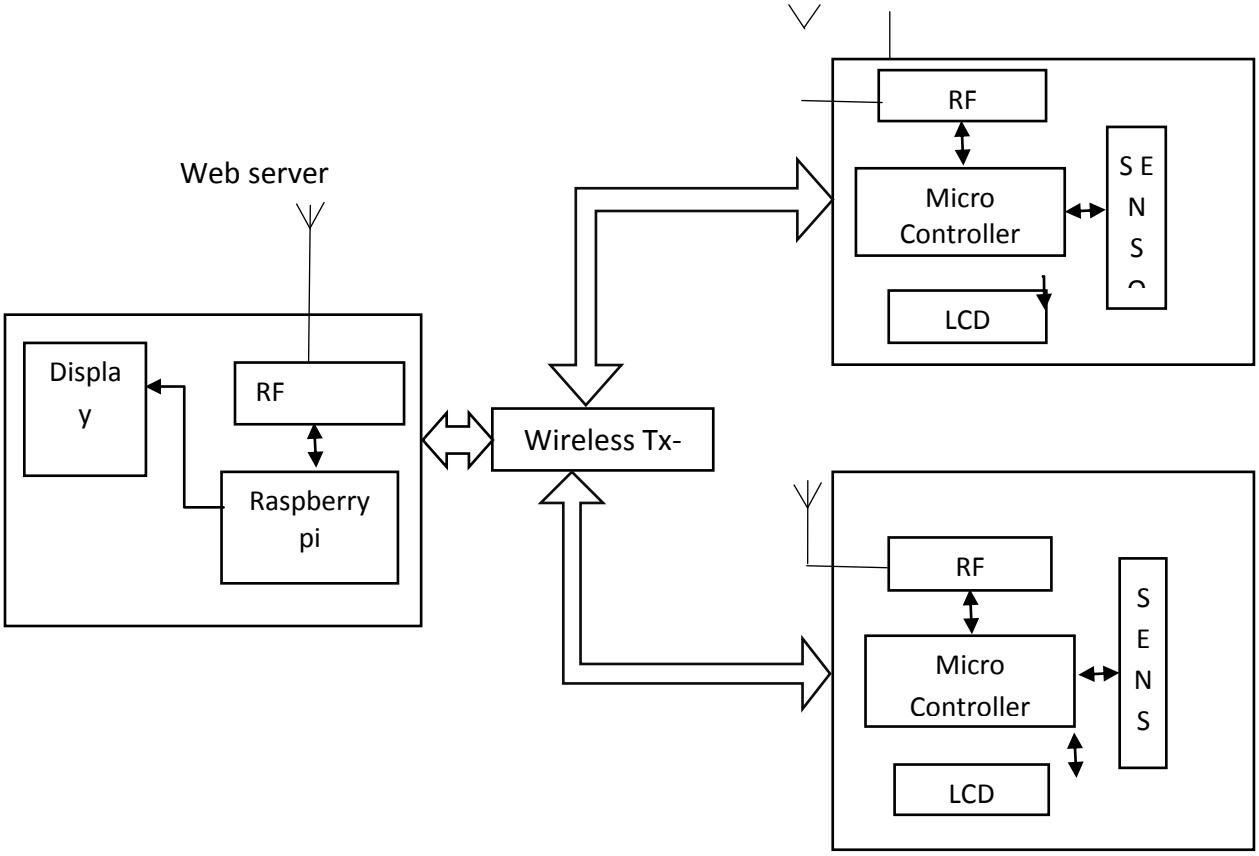

FIG 1.Genral Block Diagram

Embedded Web Server technology is the combination of embedded device and Internet technology, which provides a flexible remote device monitoring and controlling function based on internet browser. Raspberry pi Collecting data form nodes and send to the centralized server .The server collects the data and store it in database. The web page create using HTML.Using IP address open the web page simple log in page all the data available on page. IP address is two type static IP address and Dynamic IP address. Static IP address use for the controlling and monitoring anywhere of the world. From distance location controlling simply using smart phone internet connection is available in phone using IP address log in page controlling all device from that location all the data available on page monitoring devices easily

The architecture of Industrial Monitoring and controlling system consists of three modules as follows. Main module and two industrial slave module, slave module consist of ATmega32 microcontroller, sensors and RF module. Main module consists of Raspberry pi with inbuilt Ethernet,RF module and GUI (graphical user interface) on PC where is parameter of industrial

plant is monitored. Fig 2&3 below shows the overall Block Diagram of Industrial slave module & Main module

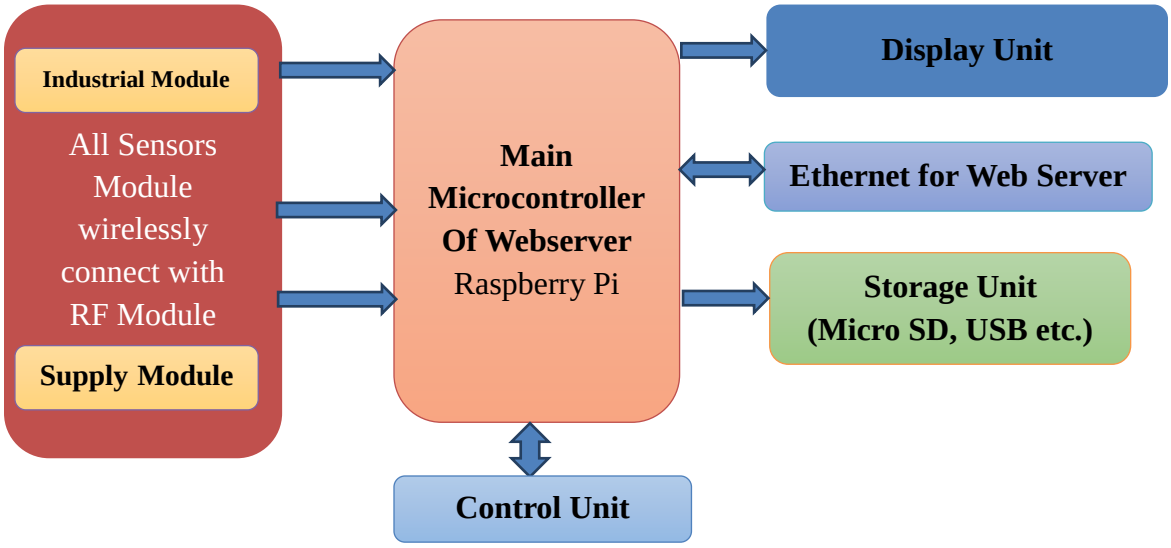

FIG 2. Main Module

In slave Nodes, slave Node 1 of one sensors are developed i.e. Temperature sensor, which will sense or measure physical quantities of Industrial devices.ATmega32 microcontroller inerfaces with sensor using amplifier circuit connect directly ADC and gets the converted digital data.By using of wireless technology,it will transmit data to the server.In addition in built 10 bit ADC converts sensors Analog data into digital data and send value to LCD.Slave module work as both way manually and automatically we want to device on or off possible Manually .slave 2 design same as slave one but sensor are different.

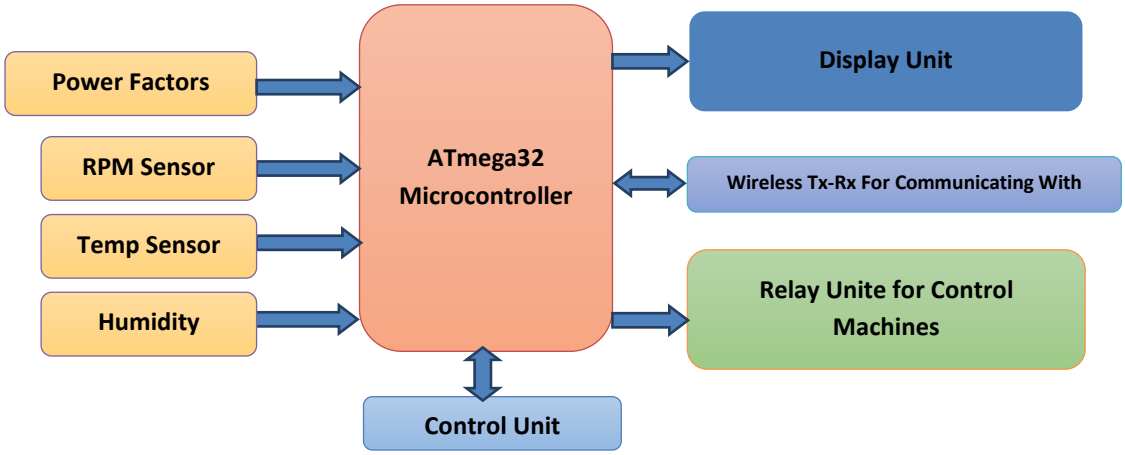

FIG 3. Slave Module

IV. Process Flow of Main Module & Slave Module

Start Main Module configure all devices. Initialize all device check Raspberry Pi Board if not Satisfied go to configure device otherwise do next process. Send command Raspberry Pi through The RF Module command given to microcontroller that chose the device. If error occur check command through Raspberry Pi. Satisfied condition update Database of Wed server. Slave Module initialize LCD .Microcontroller initialize by RF module. Controller select device mode on or off condition. Select the sensor by the microcontroller RPM and Counter sensor only give pulse controller if select Power Factor sensor and Temperature that start ADC conversion send data display on LCD. If Switch press manually controller find the switch press according to start device in ON or OFF mode. If receive command RF module from the Raspberry pi according data send o he raspberry pi. After go to controller acquire data.

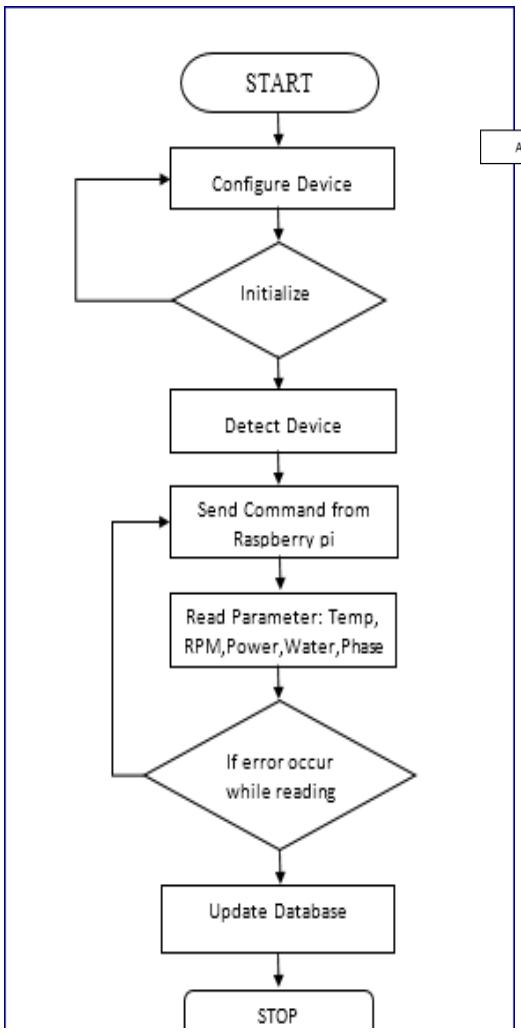

Fig 4. Flow Chart of Main Module

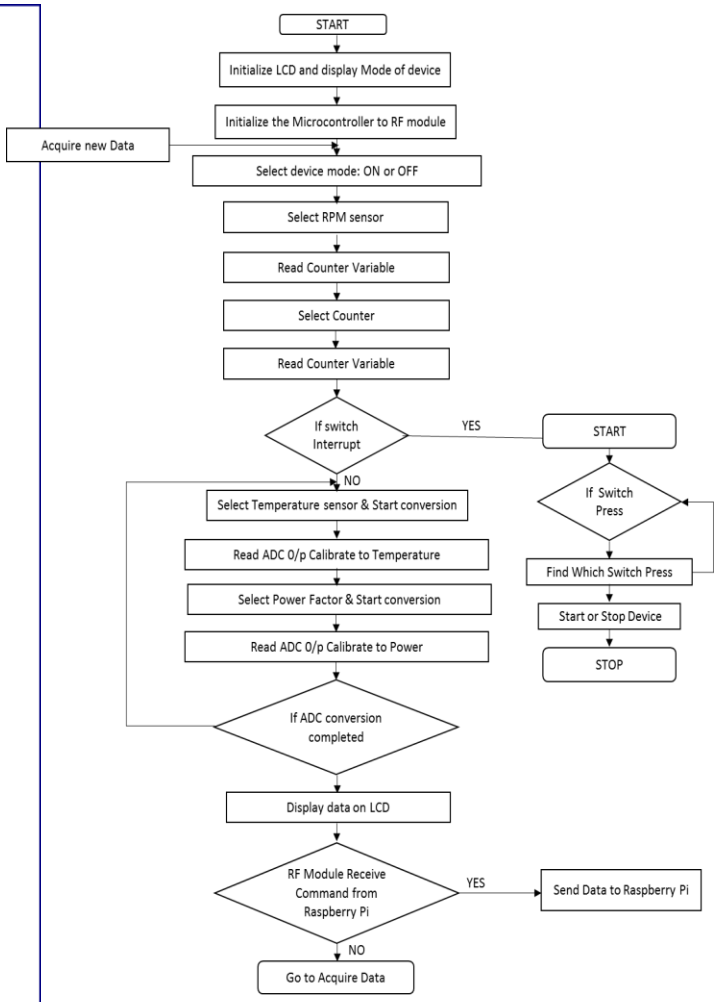

Fig 5. Flow Chart of Slave Module

V. SYSTEM DESIGN

The designing part includes basically two section as follow.

- Hardware design
- Software design

A. Hardware Design

It includes Raspberry Pi, Temperature sensor, microcontroller, Liquid Crystal Display , ULN2003, ST232CN ,Relay , Switch.

B. Raspberry Pi

The Raspberry Pi is a small computer about the size of a credit card. A complex IC that integrates the major functional elements in to a single chip in Raspberry Pi it is programmable processor, on-chip memory, accelerating function hardware (e.g. GPU) , both hardware and software, analog components so benefit of the use as Raspberry pi Reduce overall cost system, Increase performance, Lower power consumption ,Reduce size of hardware.

C. Microcontroller

The Atmel AVR ATmega32 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, theATmega32 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed. The ATmega32 provides the following features 32K bytes of In-System Programmable flash Program memory with Read-While-Write capabilities, 1024 bytes EEPROM, 1K byte SRAM, 40 general purpose I/O lines, 32 × 8 general purpose working registers.

D. Temperature Sensor PT100

The principle of operation is to measure the resistance of a platinum element. The most common type (PT100) has a resistance of 100 ohms at 0 °C and 138.4 ohms at 100 °C. The relationship between temperature and resistance is approximately linear over a small temperature range, if you assume that it is linear over the 0 to 100 °C range, the error at 50 °C is 0.4 °C.

E. CC2500

The **CC2500** is a low-cost 2.4 GHz transceiver designed for very low-power wireless applications. The circuit is intended for the 2400-2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band. High sensitivity (-104 dBm at 2.4 kBaud, 1% packet error rate),Low current consumption (13.3 mA in RX, 250 kBaud, input well above sensitivity limit) Programmable output power up to +1 dBm.

B. Software design

F. Raspbian OS

Raspbian is an unofficial port of Debian Wheezy armhf with compilation settings adjusted to produce optimized "hard float" code that will run on the Raspberry Pi. This provides significantly faster performance for applications that make heavy use of floating point arithmetic operations. All other applications will also gain some performance through the use of advanced instructions of the ARMv6 CPU in Raspberry Pi.

G. Apache HTTP Server

The Apache HTTP Server, colloquially called Apache, is the world's most widely used web server software. Originally based on the NCSA HTTPd server. Apache played a key role in the initial growth of the World Wide Web. Apache is developed and maintained by an open community of developers under the auspices of the Apache Software Foundation. Most commonly used on a Unix-like system (usually Linux), the software is available for a wide variety of operating systems, including Unix, FreeBSD, Linux, Solaris.

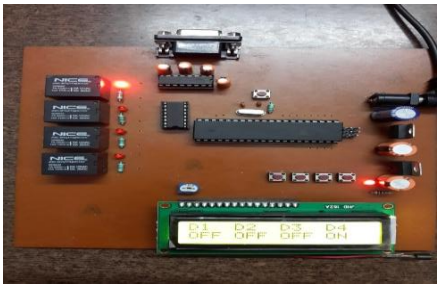

FIG 6. Industrial slave Module

VI. RESULT

This hardware setup is shown in fig 5.when press the switch according to switch number of device ON or OFF shown in LCD display. After few second show the result of temperature sensor.

The temperature sensor is the transducer that reads temperature of the industrial environment, which we want measure and converts the temperature into corresponding electrical signal.This analog signal is converted Amega32 microcontroller by means of analog to digital converter in order to read microcontroller. ATmega32 is programmed to read this digital value corresponding to temperature value. Data can be display in LCD by programming the microcontroller.

The HTML web page display when the configure IP address entered on the web browser. Here using RF module throw Raspberry pi device ON or OFF using web server throw remote place. Data monitoring on the web page, slave module data transmit and receive by the RF module that data shown on the web page.

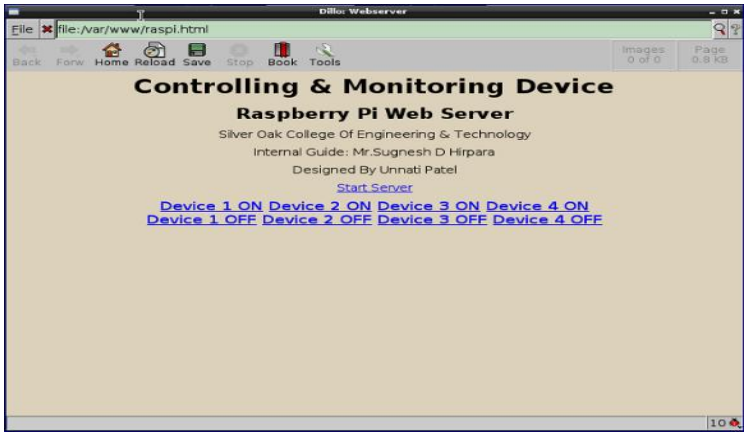

Fig 7. Embedded webserver controlling & monitoring page

VII. CONCLUSION

Raspberry pi smart, economic and efficient platform for implementation of industrial automation device. The system of industrial slave module monitoring and controlling different parameter like Temperature, RPM , Humidity From distance location using webserver. Implementation of web server using Raspberry Pi for intelligent monitoring is new method to monitor parameter. The whole system has low-cost and easy to maintain and upgrade. Using Raspberry pi we can reduce cost as well as reduce the complexibility of Industrial device, Also

we can do work as high efficiently. Real time data monitoring and controlling of device from distance location that is possible using Raspberry Pi and web server.

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