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Last-Meter Smart Grid Embedded In an Internet-Of-Things Platform

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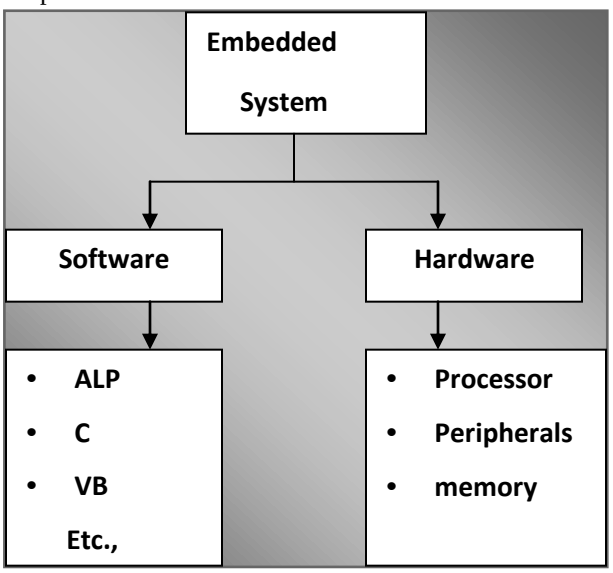
ABSTRACT:

This paper proposes an approach to build a cost effective standardized environmental monitoring device using the Raspberry-Pi (R-Pi) single-board computer. The system was designed using Python Programming language and can be controlled and accessed remotely through an Internet of Things platform. It takes information about the surrounding environment through sensors and uploads it directly to the internet, where it can be accessed anytime and anywhere through internet. Experimental results demonstrated that the system is able to accurately measure: temperature, humidity, light level and concentrations of the carbon monoxide harmful air pollutant. It's also designed to detect earthquakes through an assembled seismic sensor

Introduction

This project implements monitoring Environmental changes by sensing certain parameters and update data to the webserver using ARM11 and Internet of things. The project is implemented by using advanced processor ARM11 which is a 32 bit microprocessor. This project mainly deals with the Environmental monitoring by monitoring certain parameters and updates the localities with the changes. This project's major modules are Rasperry pi, sensors, ADC, LCD.

This chapter contains the overview of embedded systems block diagram, processors classification,memory architecture and contents overview of all chapters



Modern uses of the Harvard architecture

The principal advantage of the pure Harvard architecture - simultaneous access to more than one memory system - has been reduced by modified Harvard processors using modern CPU cache systems. Relatively pure Harvard architecture machines are used mostly in applications where tradeoffs, such as the cost and power savings from omitting caches, outweigh the programming penalties from having distinct code and data address spaces.

Digital signal processors (DSPs) generally execute small, highly-optimized audio or video processing algorithms. They avoid caches because their behavior must be extremely reproducible. The difficulties

of coping with multiple address spaces are of secondary concern to speed of execution. As a result, some DSPs have multiple data memories in distinct address spaces to facilitate SIMD and VLIW processing. Texas Instruments TMS320 C55x processors, as one example, have multiple parallel data busses (two write, three read) and one instruction bus.

Thesis Organization

Chapter1 This chapter gives the introduction of embedded systems.

Chapter2 This chapter gives the literature survey on the automated irrigation system.

Chapter3 This chapter contains the description of Internet of things based smart environmental monitoring using raspberry pi.

Chapter4 This chapter explains the implementation of complete project.

Chapter5 This chapter gives theresults and observations of the complete project.

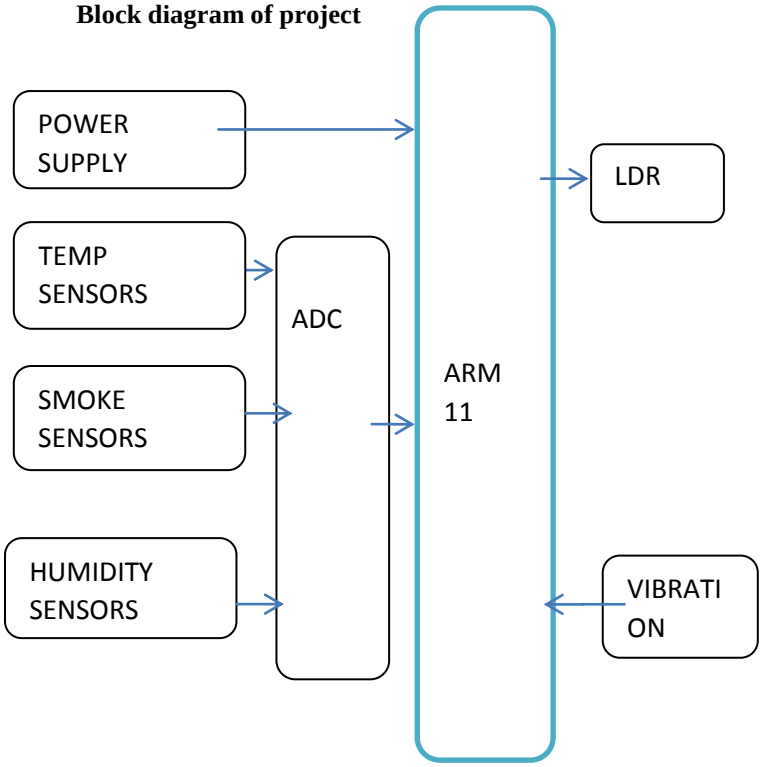
Chapter6 This chapter contains the conclusion, future scope and references for this project.

LITERATURE SURVEY

One of the buzzwords in the Information Technology is Internet of Things (IoT). The future is Internet of Things, which will transform the real world objects into intelligent virtual objects. The IoT aims to unify everything in our world under a common infrastructure, giving us not only control of things around us, but also keeping us informed of the state of the things.

The Internet of Things is a technological revolution that represents the future of computing and communications and its development depends on dynamic technical innovation in a number of important fields, from wireless sensors to nanotechnology The first Internet appliance was a Coke machine at Carnegie Melon University in the early 1980s. Programmers working several floors above the vending machine wrote a server program that chased how long it had been since a storage column in the machine had been unfilled. The programmers could connect to the machine over the Internet, check the status of the machine and determine whether or not there would be a cold drink awaiting them, should they decide to make the trip down to the machine. Though the buzzword “Internet of Things” evolution was set out a way back in 1980’s with coffee vending machine, the original term is coined by Kevin Auston, the Executive Director of Auto-ID Labs in MIT in 1999. The concept of IoT first became very popular through the Auto-ID centre in 2003 and in related market analysts publications. Right from the beginning the Internet of Things evolution started, there were many things or objects connected to the internet for the different applications through diverse technologies depending on the type of object for the comfort ability of Human.

Block diagram of project



Hardware Modules of the Project

1. Raspberry Pi
2. Liquid Crystal Display
3. Temperature Sensor
4. Light Sensor
5. Humidity Sensor
6. Gas Sensor

7. Vibration Sensor
8. ADC
9. LAN Cable

Raspberry pi board

TEMPERATURE SENSOR

A sensor can be defined as a device which can convert one form of energy into electrical energy. Here we are using a sensor to sense the temperature around us. For this purpose we will be taking help of LM 35 which is a temperature sensor.

Pros and Cons:

Capactive type sensors are very linear and hence can measure RH from 0% to 100%, but require complex circuit and also need regular calibration. Resistive type sensors find difficulty in measuring low values (below 5%RH) , the change is impedance is too high and hence it is difficult to control the dynamics, temperature effects the properties significantly. However, advances in electronics can mitigate the problems of temperature effects and high impedance change.

Capacitive RH sensors dominate both atmospheric and process measurements and are the only types of full-range RH measuring devices capable of operating accurately down to 0% RH. Because of their low temperature effect, they are often used over wide temperature ranges without active temperature compensation. Thermoset polymer-based capacitive sensors, as opposed to thermoplastic-based capacitive sensors, allow higher operating temperatures and provide better resistivity against chemical liquids and vapors such as isopropyl, benzene, toluene, formaldehydes, oils, common cleaning agents, etc.

Software Modules

1. Linux
2. Raspbian
3. Embedded Software

Embedded C Programming

- Embedded C is a generic term given to a programming language written in C, which is associated with particular hardware architecture.
- Embedded C is an extension to the C language with some additional header files. These header files may change from controller to controller.
- Differences are discussed in below table3.5

Difference between C and Embedded C

C programming	Embedded C programming
Possesses native development in nature.	Possesses cross development in nature.
Independent of hardware architecture.	Dependent on hardware architecture (microcontroller or other devices).
Used for Desktop applications, OS and PC memories.	Used for limited resources like RAM, ROM and I/O peripherals on embedded controller.

Booting an SD Card:

The Raspberry Pi doesn't have a BIOS or internal persistent storage. It has only an SD card slot. Use a separate computer to install the Pi's operating system on an SD card that is used to boot the Pi. A PC with a card reader to modify the SD card is needed. No matter what operating system will be used for the installation process, one have to download the Raspbian image from the official download site. Download it using HTTP or via Torrent. After the download has finished, one

should have a file named 2012-07-15-wheezy-raspbian.zip on your local hard driver.

Flash an SD Card Using Linux

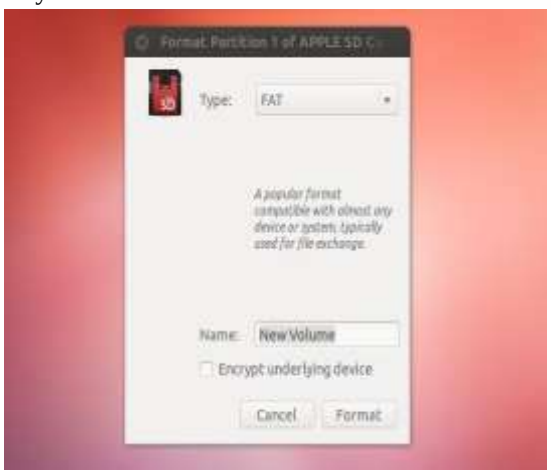
The Linux distributions provided, for Raspberry Pi, are done so as a compressed image file. You will need to download, uncompress and then install onto your SD card. For the purposes of this tutorial I am using Ubuntu, one of the most popular Linux distributions.

Format the SD Card

It may be necessary to format the SD card so that it can be read by your Raspberry Pi. If this is the case, you can use the **Disk Utility** application in Ubuntu.

Use Ubuntu Disk Utility to format the SD card

Select your SD card and format as **FAT**.



Formatting the SD card using Ubuntu Linux

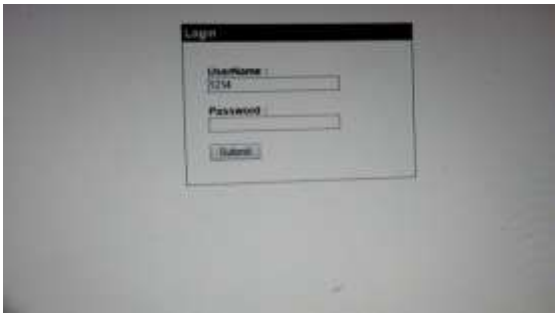
Working of the project

The connections are made as per the block diagram. The project consists of five sensors which are explained in the previous chapters Humidity sensor, Light sensor, Temperature sensor, Gas sensor and vibration sensor.Of these five sensors four are connected to raspberry pi through a analog to digital convertor as these sensors give analog output and raspberry pi is a digital processor and one remaining sensor is connected directly to the raspberry pi. Sensors like humidity sensor, temperature sensor, gas sensor and light sensor are connected to analog to digital converter and in turn connected to raspberry pi. Vibration sensor used provides only digital output and hence it is connected directly to the raspberry pi.

Implementation with Results and Observations

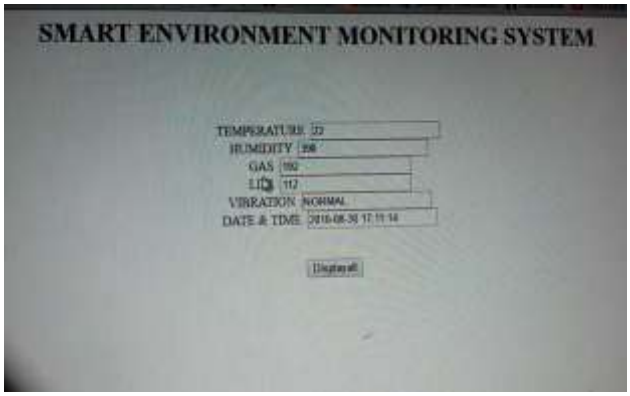
Here we are implemented the project. Every sensor is connected to raspberry-pi computer. We connected LM35 temperature sensor, Humidity sensor, Vibration sensor, MQ-7 gas sensor and LDR sensor.

These sensors are updating their values through internet via LAN cable. When we want see the updating values we have to first login the login page of smart weather monitoring website.



Web page login

After enter into login page we can see the display which contains project title, Sensor names and updated values.



Updated values

We can see these values in LCD display also same as WEB page.

LCD display

Here we read the values from controller every 2msecs and we update the values for every 5msecs.We are displaying updated packets also this page will open by pressing **display all** button.

Conclusion

The weather monitoring system might offer several potential benefits; It provides monitoring services for remote areas and for adhoc applications that are normally not available from larger monitoring systems owned by governments and big agencies. Its' earthquake detection capability can help saving millions of lives. The total life-cycle cost of the system is minimized and could theoretically run for months on end entirely without the need for human intervention. Due to its ability to automatically upload to the internet, one correctly placed system can provide easily-accessible weather data for the whole community. It can be used to predict the onset of bad weather using signs such as changing temperature and humidity. Raising the awareness of how society is affected the region's environmental policies and have the knowledge basis to push for the change.

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