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WSN AND RASPBERRY PI BASED ENVIRONMENTAL MONITORING APPLICATION

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ABSTRACT

Embedded controlled sensor network is the technology used to implement environmental solutions effectively. Many researchers have been making attempts to develop the embedded controlled sensor network. The existing systems are bulky, very costly and difficult to maintain. The proposed system is cost effective and controlled by user friendly embedded systems. In the proposed system Raspberry Pi 2 based microcontroller and wireless sensors are used to control the various devices and to monitor the information regarding the environment using Zigbee and GSM technologies. In this system, we can monitor the different physical parameters in the nature like Temperature, Humidity and Light. And also we can control the loads based on the parameters Condition. We can either control the loads using our PC Monitor Hyper Terminal Section (Zigbee Communication) and also by our Mobile Phone (GSM).

Key words: Embedded controlled sensor networks; Raspberry Pi; Environment monitoring system.

1. INTRODUCTION

An Embedded System is a combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a specific function. A good example is the microwave oven. Almost every household has one, and tens of millions of them are used every day, but very few people realize that a processor and software are involved in the preparation of their lunch or dinner.

This is in direct contrast to the personal computer in the family room. It too is comprised of computer hardware and software and mechanical components (disk drives, for example). However, a personal computer is not designed to perform a specific function rather; it is able to do many different things. Many people use the term general-purpose computer to make this distinction clear. As shipped, a general-purpose computer is a blank slate; the manufacturer does not know what the customer will do wish it. One customer may use it for a network file server another may use it exclusively for playing games, and a third may use it to write the next great American novel. Frequently, an embedded system is a component within some larger system. For example, modern cars and trucks contain many embedded systems. One embedded system controls the anti-lock brakes, other monitors and controls the vehicle's emissions, and a third

displays information on the dashboard. In some cases, these embedded systems are connected by some sort of a communication network, but that is certainly not a requirement. Given the definition of embedded systems earlier is this chapter; the first such systems could not possibly have appeared before 1971.

Overview of Embedded System Architecture:

Every embedded system consists of custom-built hardware built around a Central Processing Unit (CPU). This hardware also contains memory chips onto which the software is loaded. The software residing on the memory chip is also called the 'firmware'. The embedded system architecture can be represented as a layered architecture.

2. RASPBERRY PI

PROLOAD:

Proload is software which accepts only hex files. Once the machine code is converted into hex code, that hex code has to be dumped into the microcontroller placed in the programmer kit and this is done by the Proload. 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 through licensed manufacturing deals with Newark element14 (Premier Farnell), RS Components and Egoman.

All of 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 (The firmware includes a number of "Turbo" modes so that the user can attempt over clocking, up to 1 GHz, without affecting the warranty), 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 long-term storage.

HARDWARE DESCRIPTION OF RASPBERRY PI:

Initial sales of the Model B, with Model A following in early 2013. Model A has one USB port and no Ethernet controller, and will cost less than the Model B with two USB ports and a 10/100 Ethernet controller. Though the Model A doesn't have an 8P8C (RJ45) Ethernet port, it can connect to a network by using an external user-supplied USB Ethernet or Wi-Fi adapter. On the model B the Ethernet port is provided by a built-in USB Ethernet adapter.

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RASPBIAN:

After cycling through several recommendations since just before the hardware was first made available, the Raspberry Pi Foundation created the New out Of Box System (NOOBS) installer, and as of July 2013 suggests using it to install the Debian-derived Raspbian. A server computer systems oriented edition of Raspbian, the Raspbian Server Edition is a stripped version of Raspbian with other software packages bundled as compared to the usual desktop computer oriented Raspbian.

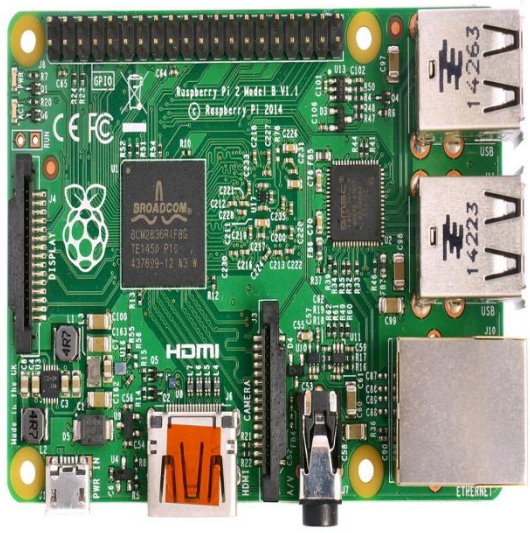

Fig.1: RASPBERRY PI

3. ARM CORTEX-A7:

The ARM Cortex-A7 MPCore CPU has 2 core(s), resulting in good multi-tasking when compared to a single core processor. It is broken up into 8 stages meaning that a single instruction would have to go through 8 stages to finish executing. This is beneficial over a single stage processor because an instruction goes through each stage quicker and once an instruction completes a stage, a new instruction can immediately enter that stage. As a result of following the Harvard architecture, the CPU has a separate Level 1 instruction and data cache leading to a slight improvement in performance over a unified Level 1 cache. The instruction cache is only used for storing instructions and executes in a sequential manner. The data cache stores data used by instructions; the point of access or storage is generally specified by an instruction. This processor is based on the Reduced Instruction Set Computing (RISC) design strategy enabling instructions to execute faster, as opposed to the Complex Instruction Set Computing (CISC) design strategy, which is generally slower at executing due to lengthy instructions.

Key features of the Cortex-A7 core are:

1. Partial dual-issue, in-order micro architecture with an 8-stage pipeline

2. NEON SIMD instruction set extension

3 .VFPv4 Floating Point Unit

4. Thumb-2 instruction set encoding

5 .Hardware virtualization

6. Large Page Address Extensions (LPAE)

7. Integrated level 2 Cache (0–1 MB)

8. 1.9 DMIPS / MHz [2]

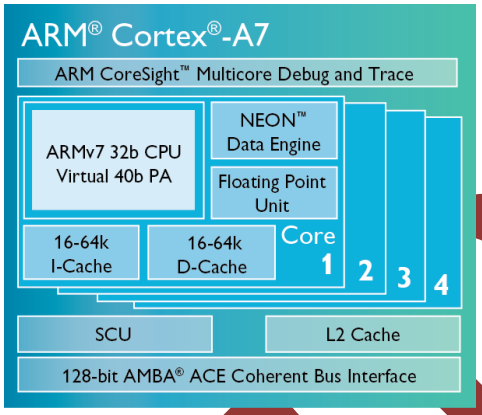

Fig.2: CORTEX A-7 Architecture

4. HUMIDITY SENSOR, TEMPERATURE AND LIGHT SENSOR:

Humidity is the presence of water in air. The amount of water vapor in air can affect human comfort as well as many manufacturing processes in industries. The presence of water vapor 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.

Humidity measurement can be done using dry and wet bulb hygrometers, dew point hygrometers, and electronic hygrometers. There has been a surge in the demand of electronic hygrometers, often called humidity sensors. Controlling or monitoring humidity is of paramount importance in many industrial & domestic applications. In semiconductor industry, humidity or moisture levels needs to be properly controlled & monitored during wafer processing. In medical

applications, humidity control is required for respiratory equipments, sterilizers, incubators, pharmaceutical processing, and biological products.

LIGHT SENSOR:

A Light Sensor generates an output signal indicating the intensity of light by measuring the radiant energy that exists in a very narrow range of frequencies basically called "light", and which ranges in frequency from "Infra-red" to "Visible" up to "Ultraviolet" light spectrum. The Light Sensor is a passive devices that convert this "light energy" whether visible or in the infra-red parts of the spectrum into an electrical signal output. Light sensors are more commonly known as "Photoelectric Devices" or "Photo Sensors" because the convert light energy (photons) into electricity (electrons).

THERMISTOR:

To read the temperature we will use a thermistor. This is a special type of resistance that changes values depending on the ambient temperature. Two types of Thermistors exist, NTC and PTC Thermistor PTC (Positive Temperature Coefficient): This type of thermistor has a positive temperature coefficient, in other words, its resistance increments as temperature increases. Thermistor NTC (Negative Temperature Coefficient): This is the inverse of the PTC; it has a negative temperature coefficient. Its resistance decrements as temperature increases. The nominal value of the thermistor is normally 25 degrees Celsius; in this case we will use a 10K thermistor. It can read temperatures between -40 and +125 degrees Celsius. Thermistors are temperature-sensing elements made of semiconductor material that has been sintered in order to display large changes in resistance in proportion to small changes in temperature. This resistance can be measured by using a small and measured direct current, or dc, passed through the thermistor in order to measure the voltage drop produced.

5. ZIGBEE:

ZigBee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal with small, low-power digital radios. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that require short-range low-rate wireless data transfer. Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics. Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and

secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys). ZigBee has a defined rate of 250kbit/s, best suited for intermittent data transmissions from a sensor or input device. ZigBee was conceived in 1998, standardized in 2003, and revised in 2006. The name refers to the waggle dance of honey bees after their return to the beehive. ZigBee is a low-cost, low-power; wireless mesh network standard targeted at wide development of long battery life devices in wireless control and monitoring applications.

ZigBee is Reliable:

ZigBee harnesses the power of the mesh to connect every product to every other product. So if one of your products fails, the others will continue to communicate without interruption.

6. GSM:

Global System for Mobile Communications, originally Grouped Special Mobile, is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe the protocols for second-generation (2G) digital cellular networks used by mobile phones, first deployed in Finland in July 1991.[2] As of 2014 it has become the default global standard for mobile communications - with over 90% market share, operating in over 219 countries and territories.[3] 2G networks developed as a replacement for first generation (1G) analog cellular networks, and the GSM standard originally described a digital, circuit-switched network optimized for full duplex voice telephony. This expanded over time to include data communications, first by circuit-switched transport, then by packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution or EGPRS). Subsequently, the 3GPP developed third-generation (3G) UMTS standards followed by fourth-generation (4G) LTE Advanced standards, which do not form part of the ETSI GSM standard. "GSM" is a trademark owned by the GSM Association. It may also refer to the (initially) most common voice codec used, Full Rate.

Fig.3. GSM Module

FETAURES OF SIM 900:

Frequency GPRS/GSM Module is an ultra compact and reliable wireless module. It is a breakout board and minimum system of SIM900 Quad-band GSM/GPRS module. It can communicate with controllers via AT commands (GSM 07.07, 07.05 and SIMCOM enhanced AT Commands). This module support software power on and reset. The GPRS is configured and controlled via its UART using simple AT commands. Just connect on the Arduino/AVR/PIC/ARM/FPGA board; you could easy to use AT command control it. This board can be connecting to PC via FT233RL.

7. RELAY DRIVER:

We know that most of the high end industrial application devices have relays for their effective working. Relays are simple switches which are operated both electrically and mechanically. Relays consist of an n electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet. There are also other operating principles for its working. But they differ according to their applications. Most of the devices have the application of relays. The main operation of a relay comes in places where only a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. The application of relays started during the invention of telephones. They played an important role in switching calls in telephone exchanges. They were also used in long distance telegraphy. They were used to switch the signal coming from one source to another destination. After the invention of computers they were also used to perform Boolean and other logical operations. The high end applications of relays require high power to be driven by electric.

8. ADVANTAGES:

Environment monitoring and device control allows new level of comfort in homes and it can also manage the energy consumption efficiently which in turns promotes the saving. Remote controlling of the devices offers many advantages to senior citizens and people with disabilities which helps them in being more autonomous and increasing quality of life. In addition to remote control, monitoring temperature, flood and carbon monoxide in homes is also a major concern. There is a severe need to monitor temperature or gases as they can be costly and deadly. A monitored low temperature sensor warns about freezing temperatures inside house. Also if the boiler, washer or pipes leaks in the home, it can cause considerable damage.

9. CONCLUSION:

The proposed project demonstrates designing of embedded controlled sensor networks used for controlling the home devices as well as monitoring the environmental parameters. The features of GSM and Zigbee are explored to design the system for long distance as well as short

distance... Embedded controlled sensor networks have proven themselves to be a reliable solution in providing remote control and sensing for indoor environmental monitoring systems. Three commercial sensors had been integrated with the system to monitor and compute the level of existence of CO gas, temperature and humidity in atmosphere using information and communication technologies.

REFERENCES:

[1] F.L. Lewis, ³Wireless Sensor Networks paper´.

[2] S. Bandyopadhyay, E. J. Coyle, ³An energy efficient hierarchical clustering algorithm for Wireless sensor networks, IEEE Conference on Computer Communication (INFOCOM) ´.

[3] www.xbow.com

[4] Mike Horton, John Suh, ³A Vision for Wireless Sensor Networks´, IEEE 2005.

[5] D. Braginsky, D. Estrin, ³ Rumor routing algorithm for sensor networks´, In Proceedings Of the 1st ACM International Workshop on Wireless Sensor Networks and Applications, New York, USA, 2002.