

Low Cost Web Based Remote Monitoring and Controlling Systems

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Abstract: An Embedded System is a special-purpose computer system designed to perform one or a few dedicated functions, often with real-time computing constraints. It is usually embedded as part of a complete device including hardware and mechanical parts. In contrast, a general-purpose computer, such as a personal computer, can do many different tasks depending on programming. Embedded systems have become very important today as they control many of the common devices we use. Since the Embedded System is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product, or increasing the reliability and performance. Some Embedded Systems are mass-produced, benefiting from economies of scale. Physically, Embedded Systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

In general, Embedded System is not an exactly defined term, as many systems have some element of programmability. For example, Handheld computers share some elements with embedded systems such as the operating systems and microprocessors which power them but are not truly embedded systems, because they allow different applications to be loaded and peripherals to be connected.

1. INTRODUCTION

1.1. Architecture of an Embedded System

An Embedded System usually contains an embedded processor. Many appliances that have a digital interface -- microwaves, VCRs, cars -- utilize embedded systems. Some Embedded Systems include an operating system. Others are very specialized resulting in the entire logic being implemented as a single program. These systems are embedded into some device for some specific purpose other than to provide general purpose computing.

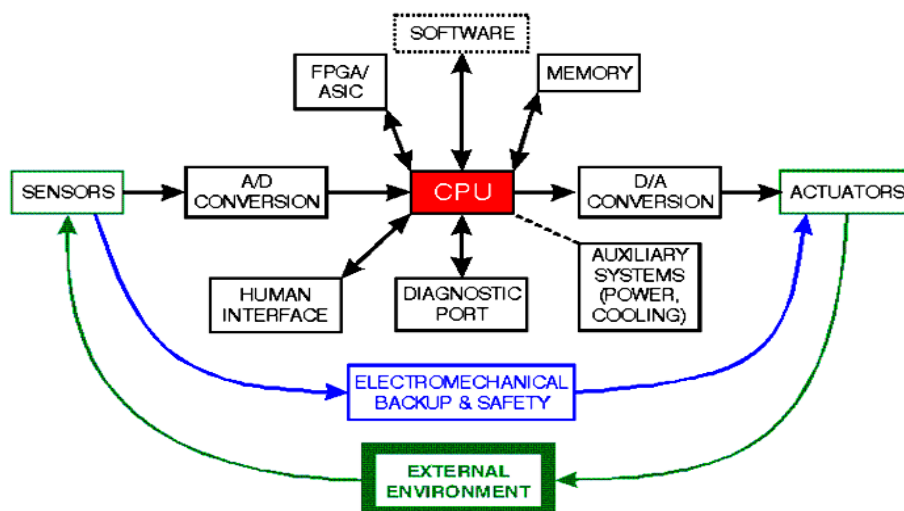


Fig1.1. Architecture of a Typical Embedded System

2. CHARACTERISTICS OF EMBEDDED SYSTEMS

Embedded systems are characterized by a unique set of characteristics. Each of these characteristics imposed a specific set of design constraints on embedded systems designers. The challenge to designing embedded systems is to conform to the specific set of constraints for the application.

2.1. Application Specific Systems

Embedded systems are not general-purpose computers. Embedded system designs are optimized for a specific application. Many of the job characteristics are known before the hardware is designed. This allows the designer to focus on the specific design constraints of a well-defined application. As such, there is limited user reprogram ability. Some embedded systems, however, require the flexibility of reprogram ability. Programmable DSPs are common for such applications

2.2. Reactive Systems

As mentioned earlier, a typical Embedded Systems model responds to the environment via sensors and control the environment using actuators. This requires Embedded Systems to run at the speed of the environment. This characteristic of Embedded System is called "Reactive". Reactive computation means that the system (primarily the software component) executes in response to external events. External events can be either periodic or a periodic. Periodic events make it easier to schedule processing to guarantee performance. A periodic events are harder to schedule. The maximum event arrival rate must be estimated in order to accommodate worst case situations. Most Embedded Systems have a significant reactive component. One of the biggest challenges for Embedded System designers is performing an accurate worst case design analysis on systems with statistical performance characteristics (e.g., cache memory on a DSP or other embedded processor). Real time system operation means that the correctness of a computation depends, in part, on the time at which it is delivered. Systems with this requirement must often design to worst case performance. But accurately predicting the worst case may be difficult on complicated architectures. This often leads to overly pessimistic estimates erring on the side of caution. Many Embedded Systems have a significant requirement for real time operation in order to meet external I/O and control stability requirements. Many real-time systems are also reactive systems.

3. HETEROGENEOUS ARCHITECTURES

Embedded systems often are composed of heterogeneous architectures. They may contain different processors in the same system solution. They may also be mixed signal systems. The combination of I/O interfaces, local and remote memories, and sensors and actuators makes embedded system design truly unique. Embedded systems also have tight design constraints, and heterogeneity provides better design flexibility.

3.1. Harsh Environment

Many Embedded Systems do not operate in a controlled environment. Excessive heat is often a problem, especially in applications involving combustion (e.g., many transportation applications). Additional problems can be caused for embedded computing by a need for protection from vibration, shock, lightning, power supply fluctuations, water, corrosion, fire, and general physical abuse.

3.2. System Safety and Reliability

As Embedded System complexity and computing power continue to grow, they are starting to control more and more of the safety aspects of the overall system. These safety measures may be in the form of software as well as hardware control. Mechanical safety backups are normally activated when the computer system loses control in order to safely shut down system operation. Software safety and

reliability is a bigger issue. Software doesn't normally "break" in the sense of hardware. However software may be so complex that a set of unexpected circumstances can cause software failures leading to unsafe situations. Discussion of this topic is outside the scope of this book, but the challenges for embedded designers include designing reliable software and building cheap, available systems using unreliable components.

4. LITERATURE REVIEW

Introduction: The objective of this is to design and implement a web monitoring and controlling system which is capable of monitoring visually and controlling the devices at remote areas autonomously through the web page.

Aside from the sheer thrill of designing and developing a system which is capable of monitoring and controlling a remote location. The system should also be scaled from home (single unit) to Large Industry. The main feature of this project is to control the system by alerting the neighborhood with an alarm and can be monitored from anywhere in the world.

Monitoring and security are the two major areas of concern in industrial establishments. Monitored parameters include various environmental phenomena like temperature, light intensity, moisture, pressure etc. Of all the functionalities present in the system, remote measurement and control of critical parameter plays a very important role. In order to make a remote connectivity feasible following requirements need to be met, like server connectivity with back end database like

MYSQL or ORACLE and a web server like application (eg: apache, NGiNX) running on it. Another possible method is by using a web server board. Security is also a prime area of concern in industrial setup, be it a door type security or security to machinery setup. 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 Beagle Board from Texas

Instruments, portability, low power consumption and low cost have been achieved in the system. The intelligent embedded module is made up of a TI DM3730 -1GHz Cortex A8 core processor. The maximum power consumption of the board is 2 watts. The Beagle Board is a low-power open source hardware single-board computer which measures (82.55 X82.55) mm, 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.

4.1. Intelligent Monitoring System

The data from all the arbiter intelligent monitoring system is made up of an open Board which is a single board processor, which is a comb processor, TMS320C64x+ cor Graphics Processor. It has 512Mb RAM and has the cap loaded with operating systems Fedora and Ubuntu. The dime (82.55) mm the intelligent monitoring s packages so that it is made to a web server. The intelligent monitors external accessories like GPR network accessories for all respectively.

4.2. External Peripheral Setup

As already mentioned, the and network accessories are co GPRS /GSM modem alerts the request by the intelligent mo connected to central monitor surveillance of the locality security feature to the system webcam is then hoisted on the that it can be viewed from remote. The intelligent monitoring source hardware called Beagle board computer with TI DM3730 inaction of ARM Cortex A8 Power VR SGX 2D/3D 1GHz processing speed with capability to boot from SD card like Android, Angstrom Linux, tension of the board is (82.55 X) system is preloaded with certain act as a flash media as well as a monitoring system is connected to RS/GSM modem, webcam and alert, security and connectivity

GPRS/GSM modem, web cam Connected to central system. The personnel by sending SMS on monitoring system. The Web camping system does the overall and thereby provides added advantage. The video captured by the portal on a real time basis so the locations.

5. ARCHITECTURE OF WEB BASED MORINITORING SYSTEM

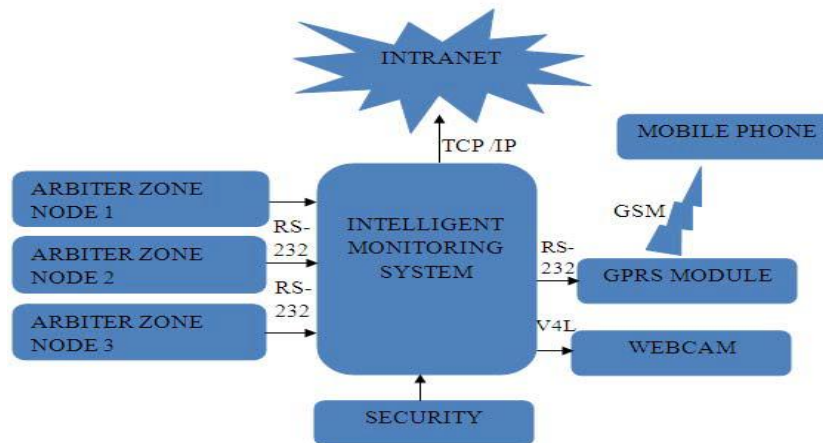


Fig2.2. System Architecture

6. EMBEDDED WEB SERVER

A web server can be embedded into a device which can be accessed remotely from a web browser. This embedded system can serve the web documents on request by a client from other system. Such type of a web server is called as Embedded Web Server (EWS). It consist of ARM processor that contains internet software which suite for monitoring, controlling and remotely access the system.

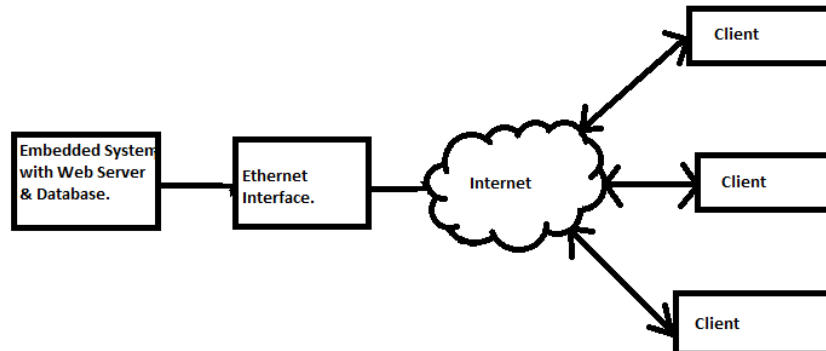


Fig2.3. Architecture of Embedded Web Server

Embedded web server refers to import Web Server at the scene the monitor and control equipment, in the support of appropriate hardware platforms and software systems, transfer traditional monitor and control equipment into an internet based, possessed with TCP/IP protocol as the underlying communication protocol and Web server technology as its core. General web servers, which were developed for general purpose computers such as NT servers or Unix and Linux workstations, typically require megabytes of memory, a fast processor, a pre-emptive multitasking operating system, and other resources. A Web server can be embedded in a device to provide remote access to the device from a Web browser if the resource requirements of the Web server are reduced.

7. DESIGN AND IMPLIMENTATION

Introduction: The “Design and implementation of mobile monitoring and controlling of remote areas using Raspberry pi” is to continuously monitor a system using web camera and provide security for the system (Industry), using Raspberry Pi Which is an ARM 11 based System on Chip.

This is possible by Raspberry Pi which itself acts as a server. This system uses Broadcom2835 which is a multimedia application processor. This processor internally consists of ARM11 Gazelle cores which are used to communicate between user and hardware by using Python programming language

Security has become a major concern in many fields which involves high maintenance cost and life security threat, unauthorized access to data or devices creates a lot of problems.

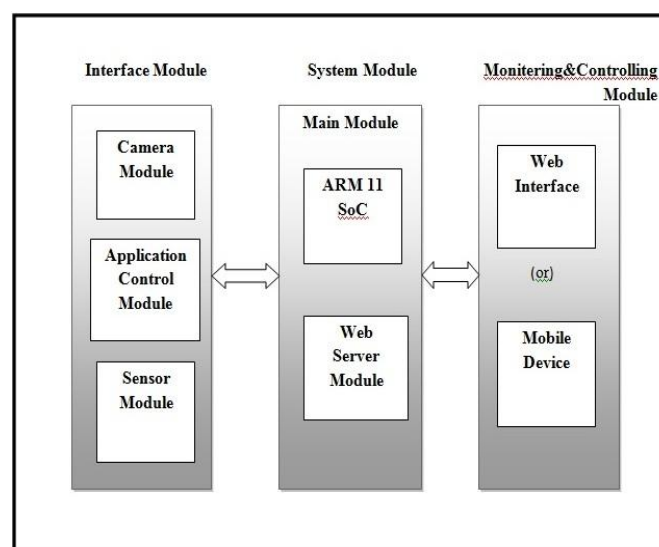
Here in our project we used to monitor the system using a web cam which is connected to Raspberry Pi board. The Raspberry Pi board acts as a platform which acts as a server which provides services like web & device control. Two Interrupt driven sensors are used on the either side of the gate whenever an interrupt occurs the proximity sensor detects and triggers the stepper motor. Stepper motor rotates to direction where the interrupt occurred focusing the web cam to monitor the scenario & sends intimation by giving a buzzer to alert neighborhood and the video can be observed from Laptop or Smart phone which is connected with internet. By this way surveillance and a security system can be made.

This is possible by Raspberry Pi which itself acts as a server. This system uses Broadcom2835 which is a multimedia application processor. This processor internally consists of ARM11 Gazelle cores which are used to communicate between user and hardware by using Python programming language.

The first thing that shocks you about the Raspberry Pi is how tiny it is. The board is roughly the same size as a credit card, with ports and sockets jutting out from every side. The device is so light that it becomes a hostage to the tension of the cables plugging into it; our chunky HDMI cable lifted the body clean off the desk, like a child holding a bunch of helium balloons.

The Raspberry Pi comes in two flavours: the Model B, which we have here, and the lesser-specified Model A. At its heart is a Broadcom BCM2835 System on Chip (SoC) running at 700MHz. This is based on an ARM11 processor.

Block Diagram Web Based Remote System



8. POWER SUPPLY UNIT

The raspberry pi board uses a micro usb power supply and gets power supply from AC to Dc adapter through 7805, 5 volts regulator. The adapter output voltage will be 12V DC non-regulated. The 7805/7812 voltage regulators are used to convert 12 V to 5V/12V DC.

The power supply unit is used to provide constant 5 V dc supply to the peripherals. The 230 V ac is

converted into 9 V ac by using a transformer and then a bridge rectifier rectifies it to a 9 V dc with ac ripples. This is then filtered by electrolytic capacitors used across the rectifier output. LM7805 regulator is employed to obtain a constant 5 V dc at the output.

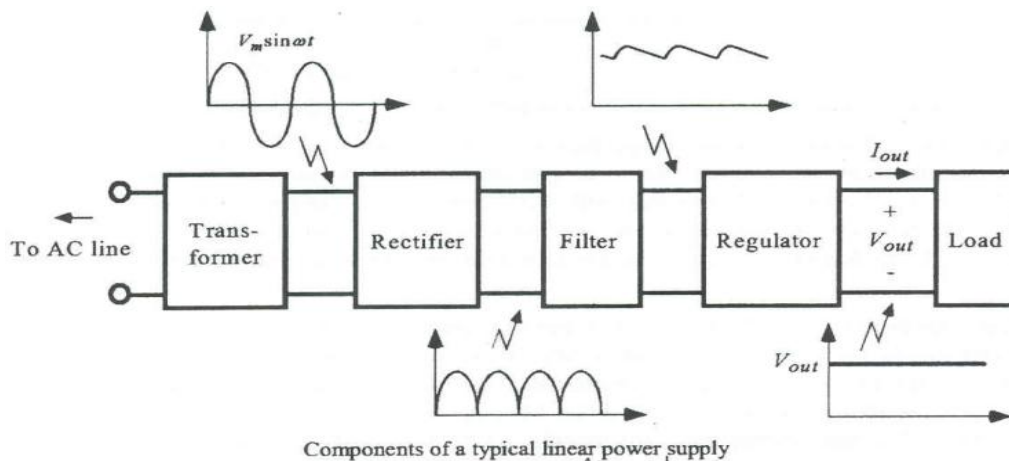


Fig. Power Supply

The LM7805 is simple to use. You simply connect the positive lead of your unregulated DC power supply (anything from 9VDC to 24VDC) to the Input pin, connect the negative lead to the Common pin and then when you turn on the power, you get a 5 volt supply from the Output pin.

9. SENSORS

9.1. Proximity Sensor (IR)

Obstacle Detecting Sensor is used to detect objects and obstacles in front of sensor in a narrow angle useful in robotics applications. Sensor keeps transmitting modulated infrared light and when any object comes near, it is detected by the sensor by monitoring the reflected light from the object. It can be used in robots for obstacle avoidance, for automatic doors, for parking aid devices or for security alarm systems, or contact less tachometer by measuring RPM of rotation objects like fan blades.

Operation:

Basic Idea is to send infrared light through IR LEDs which is then reflected by any object in front of sensor. One of the biggest problems that can cause the malfunctioning of an IR proximity sensor, is the ambient light and surrounding

Sources of IR like the sun and halogen lamps that can cause false triggering of the sensor due to emission of infrared light. To avoid getting false detection the solution is to send pulses of IR light at a certain frequency instead of a constant beam, and build a receiver that would only detect IR pulses of the same exact frequency, cutting off all pulses of higher or lower frequency. The kind of device capable of filtering signals this way is called a band pass filter. There are a lot of types of band pass filters; a whole branch of electricity is dedicated to this subject. The Central frequency is fixed by the constructor usually at 1 kHz. IR receiver filters all the source of light except the 1Khz IR signal. It all starts by generating the 1 KHz pulses of electricity that are fed to an IR LED, emitting 1 KHz pulses of Infra Red light. A weaker signal but with the same frequency is reflected from an eventual obstacle to the IR receiver, it passes through the IR-PASS filter, which will eliminate other sources of light which are not IR (visible light). The IR-PASS filter still detects a lot of noise due to other sources of IR light like the sun for example, so the signals received by the diode are fed to another stage composed of an active filter to select the 1Khz IR signals among all others, amplify it and demodulate it, providing a clean logic output (5 or 0 volts).

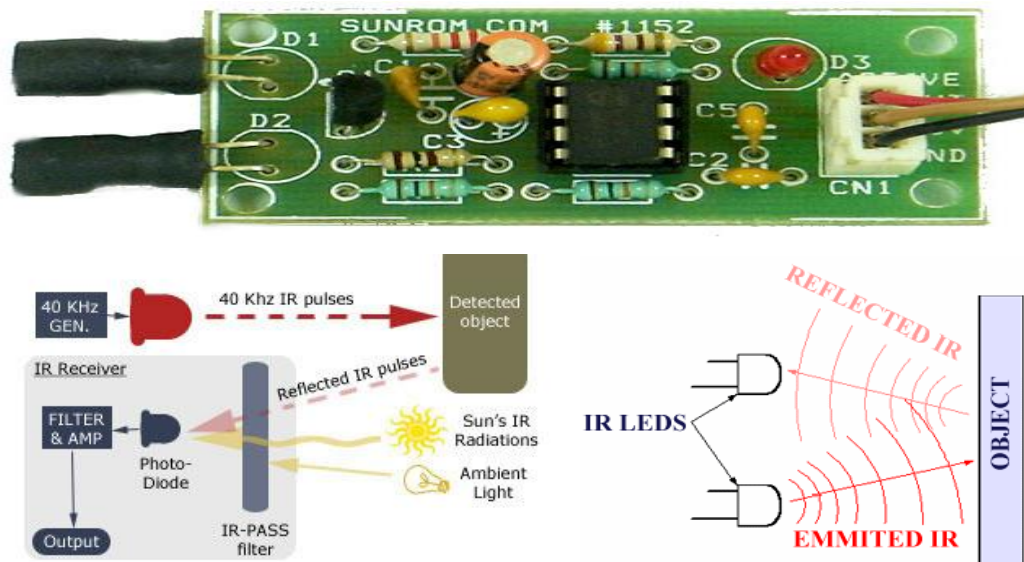


Fig3.5.1. Proximity Sensor

- Connect regulated DC power supply of 5 Volts. These wires are also marked on PCB as +5V and GND.

10. INTERFACING OF STEPPER MOTOR WITH MOTOR DRIVER

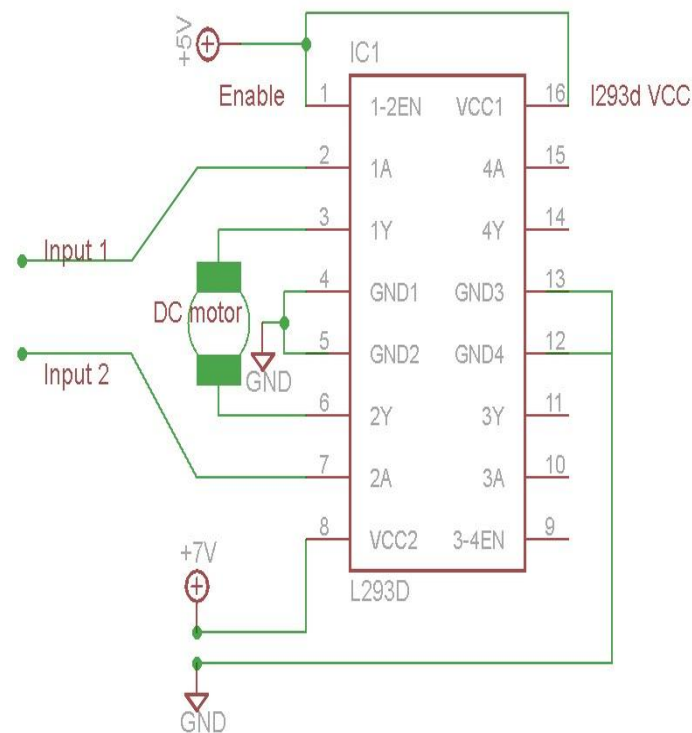


Fig3.6.3. Interface of Steppper Motor with L293D.

11. WEB CAMERA

In this we describe how to build a surveillance cam based on a Raspberry Pi micro-computer which records HD video when something moves in the monitored area. Live picture can be viewed from any web browser, even from your mobile.

This module was specially built for the Raspberry micro-computer. It has a connector to be plugged directly into the Raspberry board and supports HD video up to 1080p.



Fig. *Web Camera*

We can use any camera for housing, but only we should think about the size of the housing so that the Raspberry board will fit in there.

To connect this camera to our network, we also need some kind of network connection. One possibility is to use a LAN connection, but we need to put LAN cable to the point where we want to mount the camera. A better alternative is such a Wi-Fi USB adapter.

Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.

Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz.

12. SUBMERSIBLE PUMP

Description

This submersible pump is designed for reliability and ultra-quiet operation to provide years of service. The small profile size makes the pump easy to hide or disguise. Has adjustable flow and is easy to clean.

This submersible water pump is great for aquarium, fountains, spout and hydroponic systems.



Fig. *Submersible Pump*

13. FLOW CHART FOR REMOTE MONITORING SYSTEM

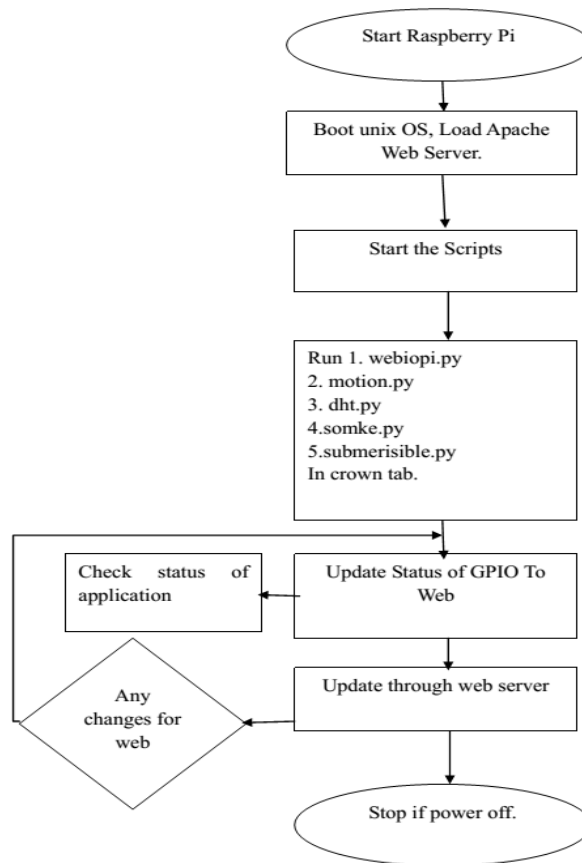


Fig. Flow Chart for Web Based Remote Monitoring System

14. ALGORITHM

In this project the work flow of web based remote monitoring system can be given as

Step1: Let initialize the complete system setup.

Step2: Boot the linux os in the board and load the apache web server.

Step3: Start the scripts in python.

Step4: Automatically run the scripts webiopi.py, motion.py, dht.py, somke.py, submerisible.py by using crown tab.

Step5: Update the status of the GPIO pins to web page through web server.

Step6: Check for the application status in web page.

Step7: If any changes found on web server update the status of the GPIO pins to web page.

Step8: If power off then system will shutdown.

15. RESULTS

Web based remote monitoring and controlling using raspberry has five modules mainly. IR sensor pair, Stepper Motor, Motor driver, Raspberry pi and Web camera. Raspberry pi plays an important role in the project as it is a platform which acts as a server which provides services like web & device control.

IR sensors detect the interrupt by which stepper motor gets rotated and web camera starts monitoring the scenario to the direction where the interrupt has occurred.



Fig. Embedded Trainee Kit

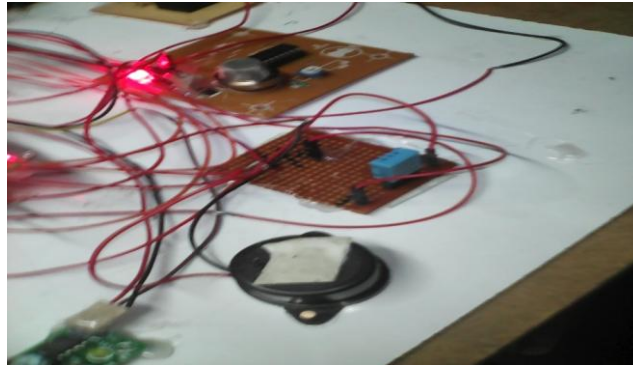


Fig. Setup of Dht11 and Smoke Sensor

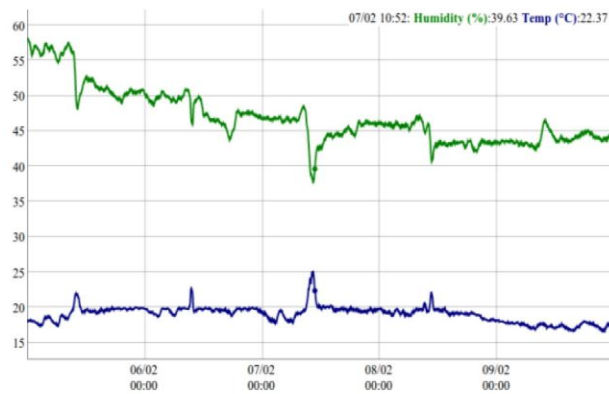


Fig. Output of DHT11 Shown On Web Page

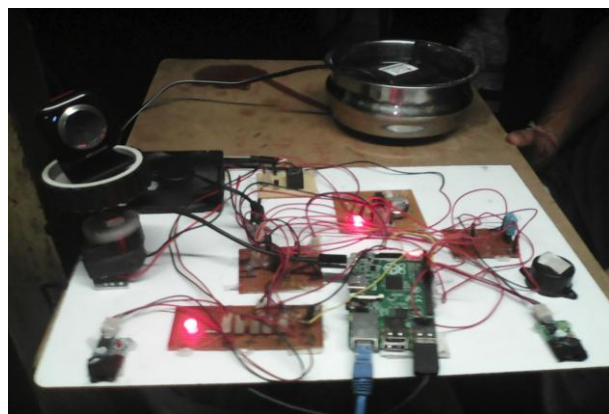


Fig. Pair of IR Sensors and Web Camera

From the snapshot of the kit of Mobile monitoring and Controlling system using raspberry pi we come to know that how can we monitor and control the system from anywhere in the world through the IP address generated in the web.

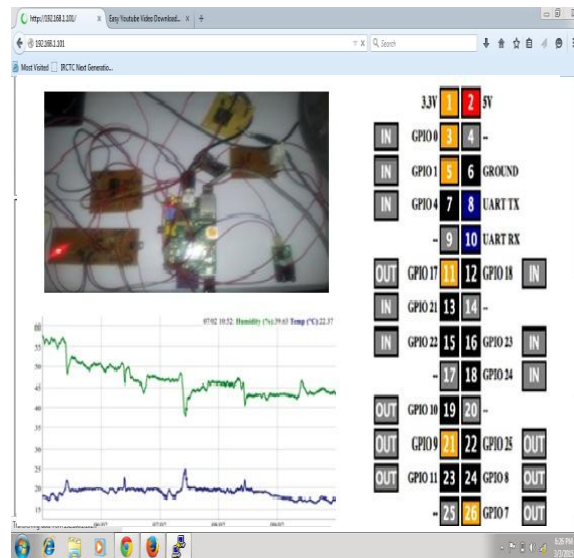


Fig6.5. Output from Web Page and Controlling Using GPIO Pins

Applications

- A Portable & low cost mobile monitoring and controlling system which can be used and scaled from small Home units to Large systems like industries.
- Can be deployed easily to any scale of system.

16. CONCLUSION

- Thus mobile monitoring and controlling using raspberry pi is used instead of security guard which can be scaled from home (single unit) to Large Industry.
- If this method is used it is easy to control the system by alerting with an alarm near system and can be monitored from anywhere in the world.
- So this is the best way which can be adopted for surveillance and security using raspberry pi.
- Surveillance and security using raspberry pi is actually much closer to reality than what you may think.

17. FUTURE SCOPE

- In mobile monitoring and controlling using raspberry pi the neighborhood is alerted with a buzzer and can be monitored from anywhere in the world.
- Here we don't get any message to mobile to alert the system from anywhere in the world, which can be further implemented by using GSM module.
- By using GSM module we will get an SMS to our mobile by which we can alert the system.

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