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Internet of Things (IOT) Using Raspberry Pi

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Internet of Things has been in development for decades and just in 1999 it is proposed in a conference. The first Internet appliance, for example, was a Coke machine at Carnegie Melon University in the early 1980s. The programmers might connect to the machine more to the internet, check the status of the machine and conclude whether or not there would be a cold drink pending on them, should they decide to make the trip down to the machine. This article gives an overview of IOT using Raspberry Pi.

IOT using Raspberry Pi

1- What is Internet of Things ?

The Internet of Things (IoT) is a scenario in which objects, animals or people are provided with single identifiers and the capability to automatically transfer and the capability to automatically transfer data more to a network without requiring human-to-human or human-to-computer communication. IOT has evolved from the meeting of wireless technologies, micro-electromechanical systems (MEMS) and the internet.

2- IOT Design Methodology

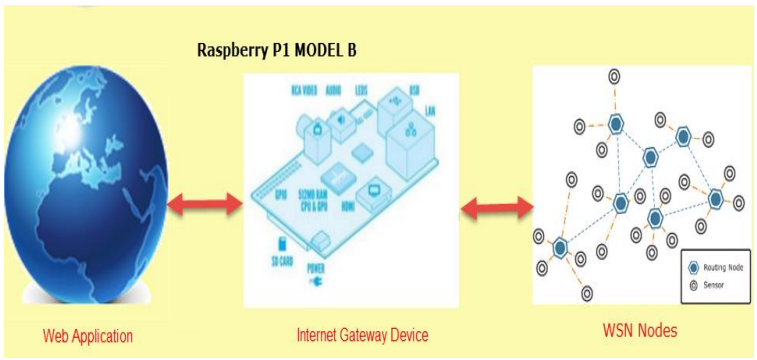
All web application is developed natively in Java Programming Language. It includes java technologies similar to JSP, servelts, hibernate, and web services etc., latest version of net beans IDE is basically used for web applications development. Additional technologies like bootstrap, java script, jQuery etc are used to handle UI and client side validations. Cisco provided APIs are used to develop application related to Cisco IP phones.

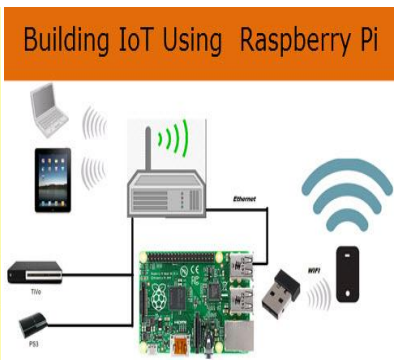
Five steps are used in web applications

- Installing Apache Web server
- Create My SQL database system
- Developed web application For the GUI (Graphical User Interface)
- Write lots of PHP, JAVA script, CSS and Python Programs for the Web Application
- Host Web application on our Web server

3- Raspberry Pi

The history of the Raspberry Pi was basically introduced in 2006. Its main concept is based on Atmel ATmega644 which is particularly designed for educational use and intended for Python. A Raspberry Pi is of small size i.e., of a credit card sized single board computer, which is developed in the United Kingdom(U.K) by a foundation called Raspberry Pi. The main motto of this foundation is to promote the teaching of basic computer science in the education institutes and also in developing countries. The first generation of Raspberry (Pi 1) was released in the year 2012, that has two types of models namely model A and model B.





4- **Why Raspberry Pi?**

The Raspberry Pi is a popular choice when developing IoT products. It offers a complete Linux server with a tiny platform at an incredibly low price. Actually, the Raspberry Pi is so well-known to IoT that the company has featured several Internet of Things projects on their site. Here you will find projects and community support for a range of IoT activities. Take for example, the World's First Cloud Texting Enabled Espresso Machine – powered by Raspberry Pi.

Partnered with the Zipwhip cloud texting application, the Raspberry Pi connects to an espresso machine and allows people to text a message to it that automatically turns it on and starts brewing beverages. See it in action and learn more about the project below!

In the subsequent year A+ and B+ models were released. Again in 2015, Raspberry Pi2 model B was released and a immediate year Raspberry Pi3 model B was released in the market.

Raspberry Pi can be plugged into a TV, computer monitor, and it uses a standard keyboard and mouse. It is user friendly as can be handled by all the age groups. It does everything you would expect a desktop computer to do like word-processing, browsing the internet spreadsheets, playing games to playing high definition videos. It is used in many applications like in a wide array of digital maker projects, music machines, parent detectors to the weather station and tweeting birdhouses with infrared cameras.

All models feature on a broadcom system on a chip (SOC), which includes chip graphics processing unit GPU(a Video Core IV), an ARM compatible and CPU. The CPU speed ranges from 700 MHz to 1.2 GHz for the Pi 3 and on board memory range from 256 MB to 1 GB RAM. An operating system is stored in the secured digital SD cards and program memory in either the MicroSDHC or SDHC sizes. Most boards have one to four USB slots, composite video output, HDMI and a 3.5 mm phone jack for audio. Some models have WiFi and Bluetooth.

The Raspberry Pi Foundation provides Arch Linux ARM and Debian distributions for download, and promotes Python as the main programming language, with support for BBC BASIC, Java, C, Perl,Ruby, PHP, Squeak Smalltalk, C++, etc.

The following are essential to get started

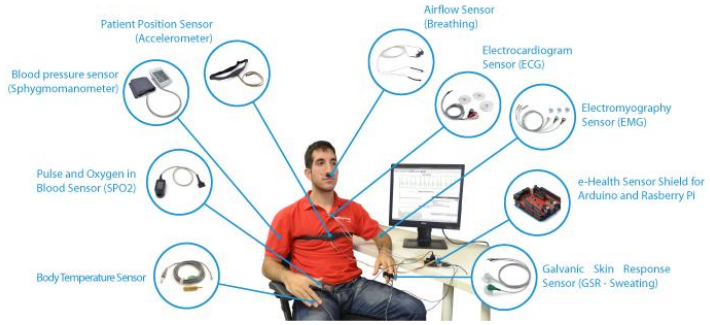
- Video cable to suit the TV or monitor used
- SD card containing Linux Operating system
- Power supply (see Section 1.6 below)
- USB keyboard
- TV or monitor (with DVI, HDMI, Composite or SCART input)

Recommended optional extras include

- Internet connection, Model B only: LAN (Ethernet) cable
- USB mouse
- Powered USB hub
- Internet connection, Model A or B: USB WiFi adaptor

5- IoT with Raspberry PI Applications

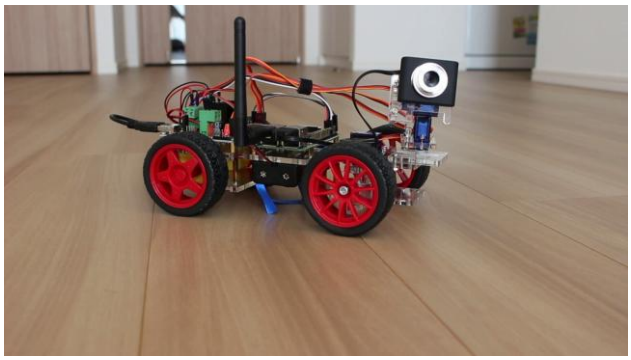
Smart_Health



Smart Home automation

IOT is transforming the way devices operate at home. Using IOT several home devices are automated and they can interact among themselves and with humans. Sensors are often used for automation in home appliances. Some home automation **IOT projects for engineering students** are automation using hand gestures, smart garage door, facial recognition door, smart alarm clock and automated blinds.

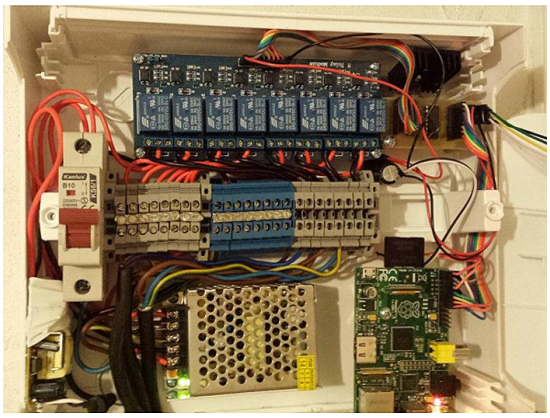
Smart car Navigation



Industrial IoT

Automation has been extensively used in all the industries to reduce the manual errors in the production process. Using IOT devices, industries will be able to control and monitor various equipment, machinery, processes and other applications with less or no human intervention. Automation helps in reducing the errors and improving the efficiency of production. Thus, many industries are trying to adapt IOT system into their operations. Some industries also offer IOT training to their employees to get knowledge on how to handle IOT systems and devices. Some of the industrial automation **IOT projects for final year students** are vehicle simulation, smart parking system, smart building project, biometrics and smart security model.

IOT can help to perform any desired action like controlling a device or monitoring from a remote location. This technology makes equipment and machinery more digitized and connected. This technology is preferred even by the government to achieve better energy efficiency, a cleaner city and higher productivity. A few IOT projects for smart cities are baggage tracker, smart trash collector, smart energy meter reading and smart liquid level monitoring.



6- Raspberry Pi performances

The Raspberry Pi performances will be compared with following IoT prototype platforms (Fig. 3): **Arduino –** an open-source physical computing platform• based on a simple microcontroller board, and a development environment for writing software for the board (Fig. 3 a). It can receive input from variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the hardware board can be programmed using the Arduino programming language and the Arduino Integrated Development Environment (IDE). Arduino supports two working modes, stand-alone or connected to a computer via USB cable [3].

BeagleBone Black – a single-board computer based on• low-power Texas Instruments processors, using the ARM Cortex-A8 core (Fig. 3 b). It is a small credit card-sized computer which can run an operating system such as Linux/Android 4.0. The main difference between it and Arduino is that it can run a small operating system, thereby practically converting it into a minicomputer that can run programs on these operating systems. BeagleBone is designed to function at a much higher level and it has far more processing capacity than Arduino [7].

Phidgets – a set of "plug and play" building blocks for• interfacing the physical and the virtual worlds via low cost USB sensing and control from PC. Phidgets includes USB-based hardware boards for input (e.g., temperature, movement, light intensity, RFID tags, switches, etc.) and output actuators (e.g., servo motors, LED indicators, LCD text displays) (Fig. 3 d). Its architecture and API let programmers to discover, observe and control all Phidgets connected to a single computer. On the software side, all the required components are packed as an ActiveX COM Component. Each Phidget component requires a corresponding visual component, providing a visual onscreen interface for interactive end-user control. The system has an extensive library of APIs and can be used with a large number of applications, even with other toolkits in some cases. Using Phidgets enables programmers to rapidly develop physical interfaces without the need for extent knowledge in electronics design issues [3, 8].

Udoo - a mini PC that can be used both with Android and• Linux OS, with an embedded Arduino-compatible board. It is a powerful prototyping board for software development and design. Udoo embeds a micro-computer with the most common communication ports

(Ethernet, WiFi, USB, HDMI, SATA, digital and analog input/output) and a microcontroller with a standard pinout for fast prototyping applications. Thus, Udoo is an open hardware, low-cost platform equipped with an ARM i.MX6 Freescale processor, and an Arduino Due compatible section based on ATMEL SAM3X ARM processor. It can be summarized that Udoo seeks to bring the best elements of Raspberry Pi and Arduino together into a single mini-PC. Udoo designers claim that the board will have the power of four Raspberry Pis. Udoo retail line up consists of three models, sharing most of the features and different only for connectivity and i.MX6 processor used [9]: Udoo Quad, Udoo Dual and Udoo Dual Basic.

A. Size and Cost Ease and cost of platform deployment is directly influenced by the physical size and cost of each platform. In other words, smaller components, used as sensor nodes, can be placed in more locations and used in more scenarios. On the other side, one of the main goals of every network is to collect data from as many locations as possible without exceeding fixed budget. A reduction in per-platform cost will result in the ability to purchase more of them, to deploy a collection network with higher density, and to collect more data [7]. Table I presents size, weight and cost of Raspberry Pi compared to above mentioned prototype platforms.
B. Power and Memory The main goal of proposed platforms is low power consumption in order to meet the multiyear application requirements. Ultra-low-power operation can only be achieved by combining both low-power hardware components and low duty-cycle operation techniques. In addition, algorithms and protocols must be developed to reduce radio activity whenever possible what can be achieved by using localized computation to reduce the streams of data being generated by sensors and through application specific protocols. One of the solutions is to combine together events from multiple sensor nodes by a local group of nodes and then transmit a single result across the sensor network [10].

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