

RASPBERRY PI

Ms. Shriya V. Thakre

Prof. Priyanka V. Shirbhate

Ms. Ashanka M. Nutpelliwar

Mr. Shankar V. Chavhan

***Abstract* — Raspberry Pi is a credit-card sized computer manufactured and designed in the United Kingdom by the Raspberry Pi foundation. Raspberry Pi is an innovative product. The sheer number of users and fan base support the fact that the device can see a great future ahead. The device can surely help anyone who really wants to lean electronics and computers. Increasing the processing power can surely help the product in the future. Also supplying a case and a proper instruction manual will improve the product. Supporting computer operating systems like Linux and providing simple input/output lines i.e. the GPIO makes it perfect for controlling almost anything. Programming the GPIO is much easy and intuitive then an traditional FPGA or microprocessor. Finally it can be said that Raspberry Pi can be effectively used if its processing power is kept in mind. It can work as a personal computer but cannot replace it.**

***Key Words* — Raspberry Pi , Credit-card sized , SoC.**

1. INTRODUCTION

Raspberry Pi a credit-card sized computer manufactured and designed in the United Kingdom by the Raspberry Pi foundation with the intention of teaching basic computer science to school students and every other person interested in computer hardware, programming and DIY-Do-it Yourself projects. The Raspberry Pi is manufactured in three board configurations through licensed manufacturing deals with Newark element14 (Premier Farnell), RS Components and Egoman. 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 Foundation provides Debian and Arch Linux ARM distributions for download. Tools are available for Python as the main programming language, with support for BBC BASIC (via the RISC OS image or the Brandy Basic clone for Linux), C, Java and Perl. As of February 2014, about 2.5 million boards had been sold. The board is available online in India at a price of Rs. 3000.

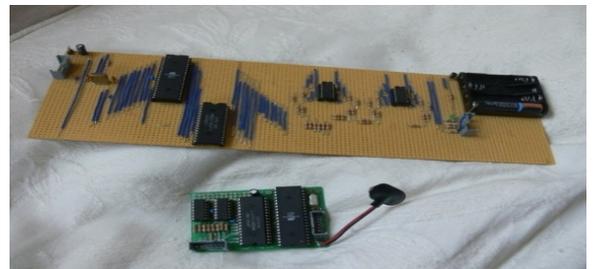


Figure: Raspberry Pi

1.1 Brief history of ultra-cheap and small computers:

Computers were very expensive during the 1950's. Computers of that time were used in weather forecasting, plotting values of logarithmic functions and other complex calculations. They were huge machines with little or no operating systems. They needed dedicated air-conditioned rooms and special trained operators. Examples of these include the ENIAC, the ZUSE Z3 etc. Then vacuum tubes were replaced by bipolar transistors, which made those huge machines a bit smaller. The invention of Integrated Circuit(IC) gave computers a huge leap in terms of computing power and a basis for personal computers.

INITIAL DESIGN CONSIDERATIONS

From 2006 to 2008 they created many designs and prototypes of what we now know as the Raspberry Pi. One of the earliest prototypes is shown below:

These boards use an Atmel ATmega644 microcontroller clocked at 22.1MHz, and a 512K SRAM for data and frame buffer storage. By 2008, processors designed for mobile devices were becoming more affordable, and powerful enough to provide excellent multimedia, a feature which would make the board desirable to kids who wouldn't initially be interested in a purely programming-oriented device. Eben (now a chip architect at Broadcom) MD of hardware design and manufacture company Norcott Technologies, and David Braben, co-author of the BBC Micro game Elite, to form the Raspberry Pi Foundation to make it a reality.

1.2 The Idea to create the Raspberry Pi:

The idea behind a tiny and affordable computer for students came in 2006, when Eben Upton, Rob Mullins, Jack Lang and Alan Mycroft, based at the University of Cambridge's Computer Laboratory, became concerned about the year-on-

year decline in the numbers and skills levels of the A Level students applying to read Computer Science. From a situation in the 1990s where most of the kids applying were coming to interview as experienced hobbyist programmers, the landscape in the 2000s was very different; a typical applicant might only have done a little web design. Something had changed the way kids were interacting with computers. A number of problems were identified: majority of curriculums with lessons on using Word and Excel, or writing webpages; the end of the dot-com boom; and the rise of the home PC and games console to replace the Amigas, BBC Micros, Spectrum ZX and Commodore 64 machines that people of an earlier generation learned to program on.

2. LITERATURE REVIEW

2.1 Hardware Layout

1)Processor / SoC (System on Chip):

The Raspberry Pi has a Broadcom BCM2835 System on Chip module. It has an ARM1176JZF-S processor. The Broadcom SoC used in the Raspberry Pi is equivalent to a chip used in an old smartphone (Android or iPhone). While operating at 700 MHz by default, the Raspberry Pi provides real world performance roughly equivalent to the 0.041 GFLOPS. On the CPU level the performance is similar to a 300 MHz Pentium II of 1997-1999, but the GPU, however, provides 1 Gpixel/s, 1.5 Gtexel/s or 24 GFLOPS of general purpose compute and the graphics capabilities of the Raspberry Pi are roughly equivalent to the level of performance of the Xbox of 2001. The Raspberry Pi chip operating at 700 MHz by default, will not become hot enough to need a heat sink or special cooling.

2)Power source

The Pi is a device which consumes 700mA or 3W power. It is powered by a Micro USB charger or the GPIO header.

Any good smartphone charger will do the work of powering the Pi.

3)SD Card

The Raspberry Pi does not have any on board storage available. The operating system is loaded on a SD card which is inserted on the SD card slot on the Raspberry Pi. The operating system can be loaded on the card using a card reader on any computer.

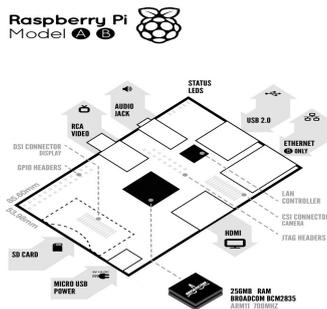


Figure: Block Diagram of Raspberry Pi

4)GPIO

GPIO – General Purpose Input Output

General-purpose input/output (GPIO) is a generic pin on an integrated circuit whose behaviour, including whether it is an input or output pin, can be controlled by the user at run time.

GPIO pins have no special purpose defined, and go unused by default. The idea is that sometimes the system designer building a full system that uses the chip might find it useful to have a handful of additional digital control lines, and having these available from the chip can save the hassle of having to arrange additional circuitry to provide them.

GPIO capabilities may include:

GPIO pins can be configured to be input or output
 GPIO pins can be enabled/disabled

5)DSI Connector

The Display Serial Interface (DSI) is a specification by the Mobile Industry Processor Interface (MIPI) Alliance aimed at reducing the cost of display controllers in a mobile device. It is commonly targeted at LCD and similar display

technologies. It defines a serial bus and a communication protocol between the host (source of the image data) and the device (destination of the image data). A DSI compatible LCD screen can be connected through the DSI connector, although it may require additional drivers to drive the display.

6)RCA Video

RCA Video outputs are available on all models of Raspberry Pi. Any television or screen with a RCA jack can be connected with the RPi.

7)Audio Jack

A standard 3.5 mm TRS connector is available on the RPi for stereo audio output. Any headphone or 3.5mm audio cable can be connected directly. Although this jack cannot be used for taking audio input, USB mics or USB sound cards can be used.

8)USB 2.0 Port

USB 2.0 ports are the means to connect accessories such as mouse or keyboard to the Raspberry Pi. There is 1 port on Model A, 2 on Model B and 4 on Model B+. The number of ports can be increased by using an external powered USB hub which is available as a standard Pi accessory.

9)Ethernet

Ethernet port is available on Model B and B+. It can be connected to a network or internet using a standard LAN cable on the Ethernet port.

10)CSI connector

CSI – Camera Serial Interface is a serial interface designed by MIPI (Mobile Industry Processor Interface) alliance aimed at interfacing digital cameras with a mobile processor. The RPi foundation provides a camera specially made for the Pi which can be connected with the Pi using the CSI connector.

11)TAG headers

JTAG is an acronym for 'Joint Test Action Group', an organisation that started back in the mid 1980's to address

test point access issues on PCB with surface mount devices. The organisation devised a method of access to device pins via a serial port that became known as the TAP (Test Access Port).

12)HDMI

HDMI – High Definition Multimedia Interface.

HDMI 1.3 a type a port is provided on the RPi to connect with HDMI screens.

2.2 Brief description of System on Chip (SoC)

Since smartphones and tablets are basically smaller computers, they require pretty much the same components we see in desktops and laptops in order to offer us all the amazing things they can do (apps, music and video playing, 3D gaming support, advanced wireless features, etc).

A system on a chip or system on chip (SoC or SOC) is an integrated circuit (IC) that integrates all components of a computer or other electronic system into a single chip. It may contain digital, analog, mixed-signal, and often radio-frequency functions—all on a single chip substrate. SoCs are very common in the mobile electronics market because of their low power consumption. A typical application is in the area of embedded systems.

A typical SoC consists of:

- A microcontroller, microprocessor or DSP core(s). Some SoCs—called *multiprocessor system on chip* (MPSoC)—include more than one processor core.
- memory blocks including a selection of ROM, RAM and flash memory
- timing sources including oscillators and phase-locked loops
- peripherals including counter-timers, real-time timers and power-on reset generators

2.3 Accessories

Camera – The Raspberry Pi camera board contains a 5 MPixel sensor, and connects via a ribbon cable to the CSI connector on the Raspberry Pi. In Raspbian support can be

enabled by the installing or upgrading to the latest version of the OS and then running Raspi-config and selecting the camera option.

Gertboard – A Raspberry Pi Foundation sanctioned device designed for educational purposes, and expands the Raspberry Pi's GPIO pins to allow interface with and control of LEDs, switches, analog signals, sensors and other devices. It also includes an optional Arduino compatible controller to interface with the Pi.

USB Hub – Although not an official accessory, it is a highly recommended accessory for the Pi. A powered USB Hub with 7 extra ports is available at almost all online stores. It is compulsory to use a USB Hub to connect external hard disks or other accessories that draw power from the USB ports, as the Pi cannot give power to them.

2.4 Operating System

The Raspberry Pi primarily uses Linux kernel-based operating systems. The install manager for Raspberry Pi is NOOBS.

2.5 Boot Process

The Raspberry Pi does not boot as a traditional computer. The VideoCore i.e. the Graphics processor actually boots before the ARM CPU.

The boot process of the Raspberry Pi can be explained as follows:

When the power is turned on, the first bits of code to run is stored in a ROM chip in the SoC and is built into the Pi during manufacture. This is called the **first-stage bootloader**.

The SoC is hardwired to run this code on startup on a small RISC Core (**Reduced Instruction Set Computer**). It is used to mount the FAT32 boot partition in the SDCard so that the **second-stage bootloader** can be accessed. So what is this

‘second-stage bootloader’ stored in the SD Card? It’s ‘**bootcode.bin**’. This file can be seen while mount process of an operating system on the SD Card in windows.

- This is the **third-stage bootloader** and is also the most important. It is the firmware for the GPU, meaning it contains the settings or in our case, has instructions to load the settings from **config.txt** which is also in the SD Card. We can think of the config.txt as the ‘BIOS settings’.

3.CONCLUSION

Raspberry Pi is an innovative product. The sheer number of users and fan base support the fact that the device can see a great future ahead. The device can surely help anyone who really wants to lean electronics and computers. Increasing the processing power can surely help the product in the future. Also supplying a case and a proper instruction manual will improve the product. Also currently Windows operating systems are not compatible because of the ARM processor. If the processor is improved or any workaround is found to run Windows directly on the Raspberry Pi, then it can be a great step for the Pi.

The Raspberry Pi is an amazing piece of hardware because of the combination of the features of a traditional computer and an embedded device. Supporting computer operating systems like Linux and providing simple input/output lines i.e. the GPIO makes it perfect for controlling almost anything. Programming the GPIO is much easy and intuitive then an traditional FPGA or microprocessor.

Current Engineering and Technology, Vol.4, No.6 (Dec 2014),PP 3818 – 3819.

[3] http://elinux.org/RPi_Hardware

AUTHOR’S PROFILE

	<p>Miss Shriya V. Thakre B.E. Final Year (I.T.), Jawaharlal Darda Institute Of Engineering & Technology,Yavatmal Email: thakreshriya5@gmail.com</p>
--	---

	<p>Prof. Priyanka V. Shirbhate Assistant Professor, Information Technology Jawaharlal Darda Institute Of Engineering & Technology,Yavatmal Email: priyavshirbhate@gmail.com</p>
---	---

	<p>Miss Ashanka M. Nutpelliwar B.E. Second Year (I.T.), Jawaharlal Darda Institute Of Engineering & Technology,Yavatmal Email: ashankanutpelliwar222@gmail.com</p>
--	--

	<p>Mr. Shankar V. Chavhan B.E. Third Year (I.T.), Jawaharlal Darda Institute Of Engineering & Technology,Yavatmal Email: shankarchavhan69@gmail.com</p>
--	---

4. REFERENCES

- [1] HarshadaChaudhari ,”*Raspberry Pi Technology: A Review*”, International Journal of Innovative and Emerging Research in Engineering,Volume 2, Issue 3, 2015,PP 83-87.
- [2] PritishSachdeva* and ShrutikKatchiiB,” *A Review Paper on Raspberry Pi*”, International Journal of