RASPBERRY Pi: A REVIEW

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Abstract— Raspberry Pi is a very powerful computer having the dimensions of a business card. In this paper we review Raspberry Pi whose popularity has taken the learning process and application of ideas to a whole new level. Raspberry Pi was initiated by a group of computer scientists lead by Eben Upton at the University of Cambridge's Computer Laboratory in 2006 struck upon the idea of producing a cheap educational micro-computer geared towards the amateur computer enthusiast, budding students, and children and the cost of building a miniature, portable microcomputer with many of the multimedia functions that the public were accustomed to was becoming sustainable.

Keywords - Raspberry Pi, Raspbian OS

1. INTRODUCTION

In today’s world, where computers are becoming more powerful and advanced, a Raspberry Pi looks like a tiny open circuit board. Since its introduction in the computer field, it is gradually becoming popular among the students. The Raspberry Pi was developed with an intention that every student can have their own affordable computer. It connects into a TV and a keyboard, and thus a cheap computer is ready. This cheap computer has the ability to perform many tasks such as word processing, playing games, programming and so on. There are many projects that can be performed using this single board computer.

The Raspberry Pi is a microcomputer, very like the computers with which you’re already familiar. It uses different kind of processor, so you can’t install Microsoft Windows versions on it. But you can install several versions of the Linux operating system that look and feel very much like Windows. If you want, you can use the Raspberry Pi to surf the internet, send an email or write letter using a word processor. But you can also do so much more easily and advance project. [1] Easy to use but powerful, affordable and (as long as you’re careful) difficult to break, Raspberry Pi is the perfect tool for aspiring computer scientist and electronic aspirants.

Raspberry Pi board costs only $35 and does the work of a computer costing hundreds of dollars [2]. Though its purpose is not to replace computers, laptops etc. but to work in supplement with them. This card is stunning in style and design and its looks aren’t far away from a James Bond style gadget. Boot it up, and you have a got a fully functional powerhouse. Grab a four-gigabyte SD card and flash it with the free Linux-based operating system on the Raspberry Pi Foundation’s website. Put the SD card into the slot, apply power, and you’ve got a 700 MHz workstation with hardware accelerated 3-D graphics—something that would have been state-of-the-art in 2001 and set you backs several thousand dollars.

The rest of this paper is organized as follows. The basic information about Raspberry Pi with its history and hardware specifications is presented in Section II. Raspberry Pi’s booting process is explained in Section III followed by its advantages and disadvantages in Section IV. The Section V stated its applications. Finally, Section VI provides conclusion remarks.

2. WHAT IS RASPBERRY Pi?

A Raspberry Pi is a small, credit-card sized microcomputer developed by Raspberry Pi Foundation, UK. This single board computer was developed with aim of teaching the basics of computer science and programming to school students all around the world. This credit card-sized computer with many performances and affordable for 25-35$ is perfect platform for interfacing with many devices. The Raspberry Pi board contains a processor and graphics chip, program memory (RAM) and various interfaces and connectors for external devices. Some of these devices are essential while others are optional but all Raspberry Pi models have the same CPU named BCM2835 which is cheap, powerful, and it does not consume a lot of power. Raspberry Pi operates in the same way as a standard PC, requiring keyboard for command entry, a display unit and a power supply. SD Flash memory card normally used in digital cameras is configured in such a way to ‘look like’ a hard drive to
Raspberry Pi’s processor. [3] The unit is powered via the micro USB connector. Internet connectivity may be via an Ethernet/LAN cable or via an USB dongle (Wi-Fi connectivity) Like any other computer, Raspberry Pi also uses an operating system and the “stock” OS is a flavor of Linux called Raspbian. Linux, as a free and open source program, is a great match for Raspberry Pi. There are also a few non-Linux OS options available. The additional hardware and software requirements can be achieved by already existing hardware modules and open source software. One of the great things about the Raspberry Pi is that it has a wide range of usage.

2.1 History of Raspberry Pi

The history of development of Raspberry Pi dates back to 2006. Realizing the decline of interests in computer sciences, some scientists (Eben Upton, Jack Lang and Alan Mycroft) from the Computer Laboratory in University of Cambridge decided to develop something cheap and small which would help students gain computer skills. Although many prototype of their concept of small and cheap computers were designed from 2006 to 2008, it was only in 2012 when they finally created a credit card-sized, low-priced, tiny computer called Raspberry Pi. [4]

2.2 Hardware and Specifications

The following are specifications of Model B+:

- Broadcom BCM2835 SoC processor with 700 MHz ARM1176JZF-S cores
- 512MB RAM
- Videocore 4 GPU supports upto 1920x1200 resolution
- MicroSD card slot
- 10/100Mbps Ethernet port
- 4 x USB 2.0 ports
- HDMI, audio/video jack
- GPIO header containing 40 pins
- MicroUSB port providing 2A current supply
- DSI and CSI ports
- Dimensions: 85.6x56mm

We will briefly go over some of the core components that make up the Raspberry Pi to give you a better feel for what it is capable of. The Raspberry Pi is built off the back of the Broadcom BCM2835 processor [5]. The BCM2835 is a multimedia application processor geared towards mobile and embedded devices.

- **Dimensions**
The Raspberry Pi is a small device coming in at 85.60mm x 53.98mm x 17mm and weighing only 45-50grams. This makes it perfect for home automation, where small device can be placed in a case and mounted inside an electrical box, or replace existing thermostat device on a wall.
• **3.5mm analog audio jack**  
The 3.5mm analog audio jack allows you to connect headphones and speakers to the Raspberry Pi. This is useful for audio and media player based projects.

• **Composite RCA port**  
We are probably familiar with the composite cables used to hook up our DVD player to the TV. They usually come in red, white, and yellow plug variety. The Raspberry Pi has a port for attaching the yellow video cable from your TV to it, allowing you to use your TV as monitor.

• **Two USB 2.0 ports plus one micro USB**  
USB is one of the most common methods for connecting peripherals and storage devices to computer. The Raspberry Pi comes equipped with two of them, allowing you to hook up keyboard and mouse when you get started and a micro USB port for powering your device.

• **HDMI port**  
The High Definition Multi-media Interface (HDMI) port allows the Raspberry Pi to be hooked up to high-definition televisions and monitors that support the technology. This provides additional option to the composite RCA port for video and additionally supports audio. You wish to stream video and audio from the web to your TV, this is the port you would want to use frequently.

• **SD card slot**  
The main storage mechanism of the Raspberry Pi is via the SD card will be where you will install your operating system and will act as your basic hard disk. This storage can be expanded upon using the USB ports.

• **256 MB/512 MB SDRAM shared with GPU**  
The Raspberry Pi comes equipped with 256 MB of SDRAM on older versions of the model B and 512 MB on the newer revisions. This isn't huge amount, and much less than you would expect on PC, where RAM is available in gigabytes. However, for type of applications we will be building, 256 MB or 512 MB of RAM will be powerful enough.

• **CPU**  
The Raspberry Pi comes equipped with 700MHz:ARM1176JZScore – part of the ARM 11 32-bit multi-processor core family [6]. The CPU is the main component of Raspberry Pi, responsible for carrying out the instruction of a computer program via mathematical and logical operations. Raspberry Pi is in good company using the ARM 11 series and has joined the ranks of iPhone, Amazon Kindle, and Samsung Galaxy.

• **GPU**  
The graphics-processing unit (GPU) is a specialized chip designed to speed up the manipulation of image calculations. In the case of our Raspberry Pi, it comes equipped with a Broadcom Video Core IV capable of hardware accelerated playback and support for OpenGL.

• **GPIO pins**  
The General Purpose Input/output (GPIO) pins on the Raspberry Pi are the main way of connecting with other electronic boards. As the name suggests, the GPIO pins can accept input and output commands and thus can be programmed on the Raspberry Pi. This is useful in home automation project, where we may wish to store sensor data or manipulate motors based upon a program running on the Raspberry Pi's operating system.

2.3 **Raspberry Pi’s specification**  
The softwares offered are RASPBIAN, PIDORA, OPENELEC, RASPBMC, RISC OS, ARCH LINUX. All these software can be downloaded easily and for free from the official forum under the NOOBS (new out of the box software) category. It provides support for functioning and coding in Python as the main programming language [7].
Table 1. Raspberry Pi’s specifications (Raspberry Pi Model A & Model B Comparison)

<table>
<thead>
<tr>
<th></th>
<th>Model A</th>
<th>Model B</th>
</tr>
</thead>
<tbody>
<tr>
<td>RRP</td>
<td>$25</td>
<td>$35</td>
</tr>
<tr>
<td>SoC</td>
<td>Broadcom BCM2835</td>
<td></td>
</tr>
<tr>
<td>CPU</td>
<td>700MHz ARM1176JZF-S Core</td>
<td></td>
</tr>
<tr>
<td>GPU</td>
<td>Broadcom VideoCore IV, OpenGL ES 2.0. Device capable of MPEG-2 and VC-1. 1080p30 h.264/MPEG-4 AVC decoding and encoding.</td>
<td></td>
</tr>
<tr>
<td>Memory (SDRAM)</td>
<td>256 MB</td>
<td>512 MB</td>
</tr>
<tr>
<td>USB 2.0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Video Out</td>
<td>Composite RCA, HDMI</td>
<td></td>
</tr>
<tr>
<td>Audio Out</td>
<td>3.5 mm jack, HDMI</td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>SD/MMC/SDIO card slot</td>
<td></td>
</tr>
<tr>
<td>Network</td>
<td>No connector</td>
<td>RJ45 Ethernet through</td>
</tr>
<tr>
<td>Peripheral connectors</td>
<td>8 x GPIO, UART, PC bus, SPI bus</td>
<td></td>
</tr>
<tr>
<td>Power rating</td>
<td>300mA (1.5W)</td>
<td>700mA (3.5W)</td>
</tr>
<tr>
<td>Power source</td>
<td>5 volt via MicroUSB or GPIO header</td>
<td></td>
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</tbody>
</table>

3. BOOTING PROCESS

Since the board has been designed with curious school children in mind, it’s easy to use. The booting method involves the following steps:

a) Downloading the NOOBS operating system install manager from the official forum of Raspberry Pi.
b) Formatting a microSD card.
c) Burning the NOOBS image onto a microSD card.
d) Inserting the card into the microSD card slot on the Raspberry Pi board.
e) Plugging in keyboard, mouse and monitor cable onto the board and to the monitor.
f) Plugging in the USB power cable.
g) The boot process has now begun and a configuration window appears to enable the camera module if present and setting the date and time.
h) The command line interface loads up asking for the username and password, upon submitting successful information the board is fully operational.
i) The graphical user interface can be chosen by typing startx.
j) Default username and passwords for first boot are: username: pi and password: raspberry [8].

After booting process the board can be utilized for any project.

4. ADVANTAGES AND DISADVANTAGES

4.1 Raspberry Pi advantages can be stated as:

- It is important to mention that Raspberry Pi is a small independent computer that runs on the Linux operating system and can be programmed as needed.
- It has a very large working memory (many other sensor nodes do not have).
- It has expandable memory to store data.
- It works on processor which supports a large set of instructions.
- It operates at speed from 700 MHz to 1000 MHz.
- It has support for USB 2.0 which allows its expansion with a large number of peripherals.
- Depending on the needs it is possible to expand the Raspberry Pi with Wi-Fi and Bluetooth adapters (power and range can be changed by changing the adapter).
- Expansion and communication with network device over a LAN adapter are possible.
- It is possible to form expandable system with various electronic components (sensors and electronic circuits) using digital inputs and outputs, I2C or SPI protocols (most of today’s devices use one of these methods of communication).
4.2 The disadvantages of Raspberry Pi are:

- It does not have a real-time clock (RTC) with a backup battery. The fact of missing clock can be Work arounded using a network time server, and most operating systems do this automatically.
- The Raspberry Pi always boots from an SD card. It means that even a perfectly valid installation of an operating system is available on a USB stick or an external hard drive, it can’t be booted. In other words, external storage devices can be used but can’t be used to boot the Raspberry Pi.
- It does not support Bluetooth or WiFi out of the box but these supports can be added by USB dongles. MIPRO 2014/CTS 1251
- Most Linux distributions are a bit picky about their hardware, so it should be first checked whether flavor of Linux supports particular device.
- It doesn’t have built-in an Analog to Digital converter. External component must be used for AD conversion.
- Its power consumption varies depending on how busy Raspberry Pi is and what peripherals are connected. Typically, the model B uses between 700-1000 mA depending on what peripherals are connected, and the model A can use as little as 500 mA with no peripherals attached. Thus, it is necessary to provide a power supply that can provide enough current to power the device plus any connected peripherals [10].

5. APPLICATIONS

Raspberry Pi is intended to get people interested in computing, coding or even to solve their general needs. School kids, college kids, youngsters, oldies of the technology sphere have all started working on this board and many interesting projects have surfaced [11]. People are inclined to use this board for tinkering, for enhancing everyday experiences like using the FAX machine, innovating Home-robots, media players, video camera streamers [12]. Some of them include:

- Pi in the sky: This board is a GPS receiver and radio transmitter designed for tracking high altitude balloon flights.
- R2D2 powered by RaspPi: R2D2 tracks face and motion, is motorized for movement, and has the ability to respond to voice commands.
- Otto: Otto is a camera product that captures pictures with a twist. It converts them into animated GIF’s, time lapses, and can added many effects to a picture or to a GIF.
- Livebots: Livebots is a project that allows users to control many robots based on Raspberry Pi over the internet.
- Lap pi: The project feature a laptop built from scratch based on the Raspberry pi board.

6. CONCLUSION

It is concluded that besides the power consumption issue, Raspberry Pi is ultra-cheap-yet-serviceable computer board. With support for a large number of input and output peripherals, and network communication it makes the perfect platform for interfacing with many different devices and using in wide range of applications. Further, The Linux operating system usage provides additional advantages of using Raspberry Pi. Programming in high-level languages such as C, C++, Python, or Java, solution implementation is quite simple and it is enabled to a large number of users, opposed to micro controller programming which usually depends of development kit. There are many projects that can be performed using this single board computer.

7. REFERENCES

