

# A Review On The Raspberry Pi Platform: Large Computation On A Small Space

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**Abstract - Raspberry Pi, a generation of small, handy and noteworthy computation boards, capable of performing almost all types of processing that a regular everyday computer can do. The Raspberry Pi was created with the idea of providing basic computer knowledge and coding skills to young students, but the Raspberry Pi is not just limited to the younger age group, people from all ages are using this card sized computer to engage themselves in coding and also versatilely using the Raspberry Pi in various projects, thus being very adept in creating solutions that were never visualized before. In this review paper we dive into the hardware and software details of the Raspberry Pi, discussing about the various models present in the Raspberry Pi series, as well as look into the highly popular HATs (Hardware On Top) used in conjunction with the Raspberry Pi to further increase its capabilities, and finally we see some of the application areas of the Raspberry Pi.**

**Keywords - Pi, HATs, SD, IoT, OS, GPIO, IDE.**

## I. INTRODUCTION

The Raspberry Pi Foundation is the vision and the backbone behind the development of the Raspberry Pi computer boards, the first board from the foundation was the Raspberry Pi 1 released in February 2012 in two models namely Model A and Model B, later they were followed by their successors Model A+ and Model B+ . The next Pi which followed these models was the Raspberry Pi 2 Model B in February 2015, another revolution in this category of boards with much more advanced power, finally the latest version and the best of all its predecessors the Raspberry Pi 3, which if encased in a normal computer casing, would definitely get a person wondering if they are using a small board computer or an actual regular computer. Though we have such amazing computer boards in the Raspberry Pi, the cost of \$35 could still be a constraint for some people, the solution: Raspberry Pi Zero, this is by far the most compact model from Raspberry Pi offered at a price of \$5, it does have support for an operating system and is in line with the other models.

Coming to the hardware and software areas, the hardware of the Raspberry Pi is elegant and placed all in one attractive square with a powerful processor, a set of USB hubs, an HDMI port, power points, an Ethernet point, and finally a set of GPIO pins for interfacing with the physical world. The operating systems for the Raspberry Pi are

numerous and all of which can be individually loaded into an SD card and docked into the Raspberry Pi SD slot, that's all and we have a live system running and ready to deliver a cool graphic interface with features to perform almost anything you name, whether its coding, playing a game, acting as a music hub, interfacing with the physical world and even connecting to the Internet to browse and surf through all resources on the web.

The most widely used operating system for the Pi is the RASPBIAN a Linux based OS, other operating systems used on the Pi are the UBUNTU MATE, SNAPPY UBUNTU CORE, WINDOWS IOT CORE, OSMC, RISC OS [3] , each specialized for certain areas, where an OS might be suitable for IoT, or for Developers, or as a media center.

## II. DETAILS ABOUT THE MODELS IN RASPBERRY PI

### 2.1 RASPBERRY PI MODEL A:

Model A is the low-end variant of the Raspberry Pi, mainly used in embedded projects due its less complicated design. [1]

It consists of 256MB of RAM without the facility for an Ethernet port and having one USB port. Due to its less power it's widely used in areas where heavy computation is not required.

The price is at \$25, it has a Broadcom BCM2835 processor and 1 USB port, 1 HDMI, Ethernet not available and a 3.5 mm audio jack. [1] It typically runs a Linux operating system and has 26 GPIO pins.

### 2.2 RASPBERRY PI MODEL B:

Model B is the upper model of the Raspberry Pi 1 series, the RAM is double that of Model A, thus offering better processing compared to Model A making it a better option to be used in applications much more advanced compared to the Model A.

The price is at \$35, it has a Broadcom BCM2835 processor and 2 USB port, 1 HDMI, Ethernet is available and a 3.5 mm audio jack. [1] It typically runs a Linux operating system and has 26 GPIO pins.

### 2.3 RASPBERRY PI MODEL A+:

Model A+ is the successor of the Raspberry Pi Model A, it was launched in November 2014, with its popular application areas in embedded projects and projects which require low power.

Compared to the Model A it has improved in following areas:

- Increase in GPIO Pins ( 26 to 40) [4]
- Replaced the old SD-card socket with Micro SD-card socket [4]
- Reduced power consumption [4]
- Low-noise power supply to the audio, hence better audio quality [4]
- Decreased board size and better form factor [4]

The price is at \$20, it has a Broadcom BCM2835 processor and 1 USB port, 1 HDMI, Ethernet not available and a 3.5 mm audio jack. [1] It typically runs a Linux operating system and has 40 GPIO pins.

### 2.4 RASPBERRY PI MODEL B+:

Just as how Model A+ is the successor of Model A, similarly Model B+ is the successor of Model B, and also the final revision in the Raspberry Pi first generation. [5] It replaced the Model B in July 2014 and took center stage until the second generation of the Raspberry Pi emerged.

Compared to the Model B, it has significant improvements:

- Increased GPIO pins(26 to 40) [5]
- More USB ports (from 2 in Model B to 4 ports) [5]
- Replaced the old SD-card socket with Micro SD-card socket [5]
- Reduced power consumption [5]
- Low-noise power supply to the audio, hence better audio quality [5]
- A better and neater form factor [5]

The price is at \$25, it has a Broadcom BCM2835 processor and 4 USB port, 1 HDMI, Ethernet is available and a 3.5 mm audio jack. [1] It typically runs a Linux operating system and has 40 GPIO pins.

### 2.5 RASPBERRY PI 2 MODEL B:

The Raspberry Pi 2, is the second generation board for Raspberry Pi, it was released in February 2015 featuring improvements over the first generation series. The most significant upgrades this board has are:

- A 900MHz quad-core ARM Cortex-A7 CPU [6]
- A 1GB RAM [6]

The Pi 2 has identical form factor to that of the Pi 1 Model B+ and thus gives compatibility with the Raspberry Pi 1. [6]

The price is at \$35, it has a Broadcom BCM2836 processor and 4 USB port, 1 HDMI, Ethernet is available and a 3.5 mm audio jack. [1] It typically runs a Linux operating system and has 40 GPIO pins.

### 2.6 RASPBERRY PI 3 MODEL B:

The latest board released for Raspberry Pi, is the Pi 3, coming under the third generation of the Pi boards, it was released in February 2016. In comparison to the Raspberry Pi 2 it has improvements such as:

- 1.2GHz 64-bit quad-core ARMv8 CPU [7]
- Supports Wireless LAN, thus enabling WiFi connectivity
- Bluetooth 4.1 and Bluetooth Low Energy [7]

The price is at \$35, it has a Broadcom BCM2837 processor and 4 USB port, 1 HDMI, Ethernet is available and a 3.5 mm audio jack. It typically runs a Linux operating system and has 40 GPIO pins. This model also has an 802.11n Wireless LAN and Bluetooth 4.1. [7]

### 2.7 RASPBERRY PI ZERO:

The Raspberry Pi Zero, the tiniest computer board released from Raspberry Pi, useful in almost any project requirements, its half the size of Model A+ but provides twice the power and performance of Model A+. [1]

Notable features of the Raspberry Pi Zero are:

- 1Ghz, Single Core CPU [1]
- 512 RAM
- HAT- Compatible 40-pin Header

The price is at \$5, it has a Broadcom BCM2835 processor and 1 mini-HDMI, Ethernet is not available and a 3.5 mm audio jack. [1] It typically runs a Linux operating system and has unpopulated 40-pin header.

## III. HARDWARE ON TOP (HATs) -ADD-ON BOARDS

The Raspberry Pi alone is a mini-scale power machine when it comes to computing, but that's not the limit for the Pi, we can further increase its capabilities and performance to do much more functions with the help of something called the HATs or simply saying Add-On boards which can act as input sensors or output generators, ranging from taking the temperature, pressure etc to outputting data on LED screens or even producing sound effects.

The various HATs commonly available for the Raspberry Pi are; Sense HAT, MoToZero, Unicorn HAT, Traffic

HAT, Adafruit Capacitive Touch HAT, Skywriter HAT, and more. Each of them are unique in the functioning and provide various additions to the projects made by the Raspberry Pi. One such HAT, which has gained a huge popularity and has an extensive list of functions is the Sense HAT, our prime focus for this section will be on the Sense HAT.

The Sense HAT was made specifically for the Astro Pi mission and was launched to the International Space Station in December 2015. [1]

The Sense HAT, as the name itself is indicating is provided with a variety of sensors for collecting data such as: Barometer, Gyroscope, Temperature sensor, Magnetometer, Humidity Sensor, Accelerometer, in addition to all these it also has an 8x8 LED matrix for displaying text, pictures and many other things, each of the LED can project a combination of Red, Green and Blue colors or individually. It even consists of a 5-button joystick for taking inputs.

Once the Sense HAT is properly attached on top of the 40-pin Header, on the Pi we need to install the Sense Hat API in Python, which provides us with all the Python library functions for performing all the input and output functions on the Sense HAT.

#### IV. AREAS OF APPLICATION

Raspberry Pi provides vital support for many applications and used well in areas such as:

**Robotics-** Code could be written using the programming languages supported by the Pi. (Python IDE as an example), and by means of the GPIO pins, motors and other physical components can be controlled as needed.

**Image processing** is another area where the Pi can be used, the Raspberry Pi Foundation has a hardware called the Camera Module, it can be used to take still photography and even HD videos, but these are just the basic functions and for a more advanced user it can be used for time-lapse, slow-motion etc.[1]

**Home-Automation,** is another areas of use, where we could network all the devices in our home to connect to the Internet and communicate with the Raspberry Pi as the central controller of these devices, thus allowing us to have control over them from anywhere.

**Internet of Things,** one of the latest and popular idea, where the Raspberry Pi can acquire data being captured by the sensors, and store this data locally or send it to the cloud to be processed and Insights to be obtained from it.

#### V. CONCLUSION

The ultimate conclusion is that, the Raspberry Pi has made a quantum leap in accessibility of computers for coding, making projects and most importantly has been able to create coding interest in everyone who comes across Raspberry Pi, enabling them to do something innovative and bringing out the computer genius in them. All at the same time in a low price and small space. The Raspberry Pi also stands as a parody in invention and innovation, creating inspiration in all ages to come up with ideas to change the world in a positive way, thus it creates better opportunities and platform for others to build wonders on it. In this paper a detailed review of all the Raspberry Pi boards has been done, the technical specifications have been discussed, further some of the add-on boards available for the Raspberry Pi have been stated and in depth review of the Sense HAT has been done. This paper will provide a reference on how the various boards can be used depending upon the project requirements and by using the HATs how we can further increment the functionality of the Raspberry Pi.

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