

SETTING UP AND INSTALLATION OF RASPBERRY PI FOR DESIGNING OF ELECTRONICS BASED PROJECTS

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Abstract - Microcontrollers being integral components in electronics designing of any system form the backbone of many automated systems and smart devices. Microcontrollers are designed in such a way that they are embedded into the systems for providing processing capabilities. They are cost effective and energy-efficient. They are highly integrated, combining a CPU, memory, input/output peripherals on a single chip unlike Microprocessors which needed to interfaced with external input/output devices. For microcontrollers, it started with 8051, 80251, MCS96, LPC2148, PIC microcontrollers and many more. The need for scaling up the devices and correspondingly lowering the size of microcontrollers was felt to accommodate more input/output devices. Thus, Raspberry Pi board which is a small computer with small computing device, almost size of the credit card is widely used. For using it in designing of various applications proper installing of the operating system and setting up of the board is quite important.

Index Terms - Microcontrollers, CPU, Microprocessors, 8051, 80251, MCS96, LPC2148, operating system

• Introduction

The Raspberry Pi is equipped with a 700 MHz core CPU with it. It has 513 MB of SRAM. The USB port 2.0 uses external data connectivity options for interfacing. The Raspberry Pi uses Ethernet main gate to communicate with other devices and the internet. Micro-USB adapter is used for drawing minimum current in the range of 500mA.

Raspberry Pi: The "Raspberry Pi" is the series of development boards manufactured by the "Raspberry Pi Foundation". A "United Kingdom" charity, focusing and aiming to educate people with embedded hardware and software programming for creating awareness and access to computer education. The Raspberry Pi has commonly employed in small-scale IoT industries, educational projects, and robotics. There are many types of models of Pi available in the market. They are as follows

1. Pi 1 Model B (2012)
2. Pi 1 Model A (2013)
3. Pi 1 Model B+ (2014)
4. Pi 1 Model A+ (2014)
5. Pi 2 Model B (2015)
6. Pi Zero (2015)
7. Pi 3 Model B (2016)
8. Pi Zero W (2017)
9. Pi 3 Model B+ (2018)
10. Pi 3 Model A+ (2019)
11. Pi 4 Model A (2019)
12. Pi 4 Model B (2020)
13. Pi 400 (2021)

- **Components Required**

For implementation of system design using Raspberry Pi following components are required:

1. Raspberry Pi board
2. Prepared operating system SD card
3. USB keyboard
4. Display with HDMI, DVI, or composite input
5. Power supply it can be simple mobile charger

Highly suggested extras:

1. USB mouse
2. Internet connectivity
3. Power USB hub as pi has only 4 USB port
4. Case

- **Requirements for connectivity**

1. A television or computer monitor with HDMI port
2. A USB keyboard and mouse
3. We need to install an operating system. The 8GB MicroSD card with NOOBS comes with the toolkit.
4. To begin with plug keyboard and mouse into the USB ports of the raspberry pi
5. Next, insert your micro SD card into the SD card slot on the Raspberry pi, it will fit only one way
6. Make sure that your monitor or TV is turned ON, and that you have selected the right input e.g. HDMI, DVI etc
7. Connect the HDMI cable from your raspberry pi to your monitor or TV
8. When you have plugged all the cables and the SD card in correctly, connect one end of the micro USB power supply to a 120/240 volt power source, and the other to the Raspberry PI.
9. This action will turn ON and boot your Raspberry Pi. You need to see 3 things.
10. A small red LED come in the lower left side of the Raspberry Pi board, right next to the power port, indicating it properly has power.
11. Then a small green LED should blink whenever there are data transfers happening between the MicroSD card and the circuitry on the Raspberry Pi board.
12. The last is to check whether your monitor should begin displaying visuals it is booting up, followed by a GUI display window.
13. Use the Raspberry symbol to open the applications menu and explore the range of applications installed by default on the full Raspberry Pi OS included in the Raspberry Pi started kit
14. Connect your Raspberry pi to your local wired or WiFi ethernet.

- **Initialization and Setting up steps**

For using the Raspberry Pi in various applications the setting up of Raspberry Pi is necessary. Following is the method of setup and starting of Raspberry Pi:

It comes with an SD card. This slot allows us to insert an SD card and use it as our device. That is a main storage mechanism like a hard disk on a PC. The bootable operating system is loaded onto the card. The raspberry pi is supported to LINUX, Qtopni, Mac operating systems. We can select one operating system, we will need to write it to an SD card using an application like Disk manager. We can also use other storage mechanism USB drive or USB external hard drive. Before we start we need to connect display and keyboard mouse like computer. The Pi supports three different outputs composite video, HDMI video and DSI video.

Raspbian OS is a LINUX based operating system built for Raspberry Pi. New out of the box software or NOOBS is an operating system installer for raspberry pi delivered primarily on SD card, which contains a variety of operating system. With NOOBS the user only needs to connect their Raspberry Pi to a display screen and a keyboard and then power it up, The NOOBS will boot. There we can select which operating system we want to install, and NOOBS will install

the respective OS on the same SD card within few minutes. Other OS are miniban and Raspbian lite, window IoT core, Ubuntu mate, gentoo Linux, SARPI, FreeBSD.

- **Four methods of installation**

There are four methods of installation of Raspberry Pi which are given in detail as follows:

First method:

1. Install Raspberry Pi OS using Raspberry Pi imager and click on download for windows
2. After download click on raspberry Pi imager and select the operating system according to the available board and select the version with desktop environment and select on storage.
3. Click on settings for various options such as SSH, for configuring wireless LAN, login id and password for raspberry pi.
4. After successful installation of OS on memory card. Check for IP scanner and start scanning and the raspberry pi who has taken the IP address of wifi network will be shown.
5. The SD card after inserting into the slot of raspberry pi and check on IP scanner whether it is powered on by checking the ip address on IP scanner.
6. Check whether SSH is enabled or not by opening the putty and enter the ip address of raspberry pi into the putty.
7. Then enter username and password in terminal and activate the VNC viewer.
8. This can be done by using command `sudo raspi-config`.

Second method:

1. We need Raspberry Pi OS image, Raspberry Pi imager, 16GB memory card, card reader.
2. After downloading zip file of raspberry pi OS unzip the file and open the file.
3. Instead of choosing raspberry pi operating system click on custom. Then select the image and select storage and click on write.

Third method:

1. Go to raspberrypi.org then go to downloads and click on NOOBS.
2. Extract the zip folder and copy contents of the NOOBS folder into memory card. Before that format the SD card.
3. Insert the memory card into raspberry pi and use monitor, keyboard, mouse for installing the OS into raspberry pi.
4. Use HDMI to VGA connector for connecting raspberry pi to monitor.
5. If all the connections are proper then click on operating system and chose keyboard layout and install the operating system.
6. After installation raspberry pi reboots on its own.
7. For starting certain interfaces click on terminal and type `sudo raspi-config`, then configuration window will be opened and click on interfacing option and click on SSH and enable SSH server then enable VNC server also.
8. The do `sudo reboot` on terminal.

Use VNC viewer for accessing Raspberry pi using laptop:

1. Download VNC viewer on laptop
2. Look for the IP address of raspberry pi by using `ifconfig` on terminal
3. From the VNC viewer on the laptop enter the IP address of raspberry pi. Then raspberry pi will be displayed on laptop screen.
4. For that VNC server should be activated during installation method. Note that both the raspberry pi and laptop should be connected to same wifi network.

Fourth method:

1. Use Raspbian and download the zip file from the menu download from Raspbian buster with desktop and recommended software.
2. Instead of copy and paste write the extracted file into memory card.
3. Remove the memory card and insert it into raspberry pi then the installation will start.

For implementation of the system with Raspberry Pi code has to be written in python and following points are to be considered while writing code.

1. For writing python code use thonny IDE, it can be done on terminal by typing thonny
2. You can access the raspberry pi pin use pin no by the name by using gpio
3. For raspberry pi logic 1 is 3.3 V and logic 0 is 0V. While giving input give 3.3 V maximum.
4. If we have to use pin number of raspberry in the code then use GPIO.BOARD and access pin name of raspberry then use GPIO.BCM.
5. Raspberry Pi is a small computer but not any microcontroller, software IC. It does not contain hard disk but only small memory card.
6. When you have to develop a product you have to use small microprocessors and for industrial purpose use industrial grade devices.

Before starting coding in python certain packages have to be installed. The packages can be installed by typing certain commands in the command prompt terminal.

1. `sudo apt-get update`
2. `sudo apt-get upgrade`
3. `sudo apt-get install python-dev`
4. `sudo apt-get install python-pip`
5. `sudo apt-get install python-rpi.gpio`

- **Commands which are highly used for setting up of the system**

Some important commands to be used in command prompt terminal are listed in the table given below.

Commands	Function
Ctrl + alt + T	Shortcut for terminal in Raspberry Pi
ls	Show all files
mkdir(name of folder)	Create a folder
cd(name of folder)	Entering into particular folder
cd	Exiting to home location
cd..	Going back one location
cd/in	Going to root location
sudo mkdir(name of folder)	Creating folder in root directory
touch(file name.txt)	Creating a file
nano (file name)	Opening editor
clear	Clear the terminal
rm name of file.txt	Deleting file
rm -r folder name	Deleting folder
time and date	Fetch time and date
sudo apt-get install software name	Installing a particular software
sudo apt-get update or sudo apt-get upgrade	Upgrading and updating software
Thonny	Starting python
cat file. type of file i.e. text or any other type	Showing file contents

locate file.type of file i.e. text or any other type	Searching for file type
lsusb	Listing USB devices
pwd	Print name of current working directory
mv source file type destination file type	Renaming or moving file type
sudo reboot	Rebooting device
sudo shutdown -h now	For shutting down
ifconfig	Configuring a network interface
wget (link of file)	For non-interactive network downloader

Conclusion:

Setting up of the Raspberry Pi is quite straightforward process where in one needs to follow the steps and with it doors are opened for wide range of applications. The applications range from simple projects to complex IoT applications. Before following procedures for installing, it is fairly important that proper model is selected with gathering of necessary components. Download the latest version of the Operating system and power up the Raspberry Pi. By following the steps in structured manner for installation the user will be in position for exploring the prospects of Raspberry Pi and become well versed in designing of the electronics based system.

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