Introduction to Internet of Things
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Lecture – 28
Introduction to Raspberry Pi– 1

In this lecture on the introduction to Raspberry Pi, you will learn about what Raspberry pi is what are the different functions of Raspberry pi and more importantly about why Raspberry pi is so important in the development of IOT.

So, Raspberry pi compared to Arduino is more powerful, it is more powerful in terms of the computation or processing power. Additionally it has better memory capacity and also it can integrate different types of sensors and actuators and this part is more attractive than compared to the similar kind of feature of Arduino. So, we can do different types of sensors integration in Raspberry pi and due to the feature that it can process more compared to Arduino it has better processing capabilities and more features and so on. This is particularly attractive for sensors which have which require more processing for example, imaging sensors multimedia different types of multimedia sensors which require more processing you know this sort of device becomes more useful.

So, in the same way as we can have an Arduino based IOT node here also we can have using Raspberry pi, we can have a Raspberry pi enabled IOT node and this IOT node would be more powerful compared to the Arduino based node. Additionally we have to keep in mind that although it has better capabilities, but it comes at more cost the cost of purchasing Raspberry pi is more than the cost of Arduino in general. So, there is a trade off of course; however, it all depends on the requirements if the requirement of the particular IOT application that is being developed is to have some nodes which you know which should act as a server then Raspberry pi would be a better option than Arduino.
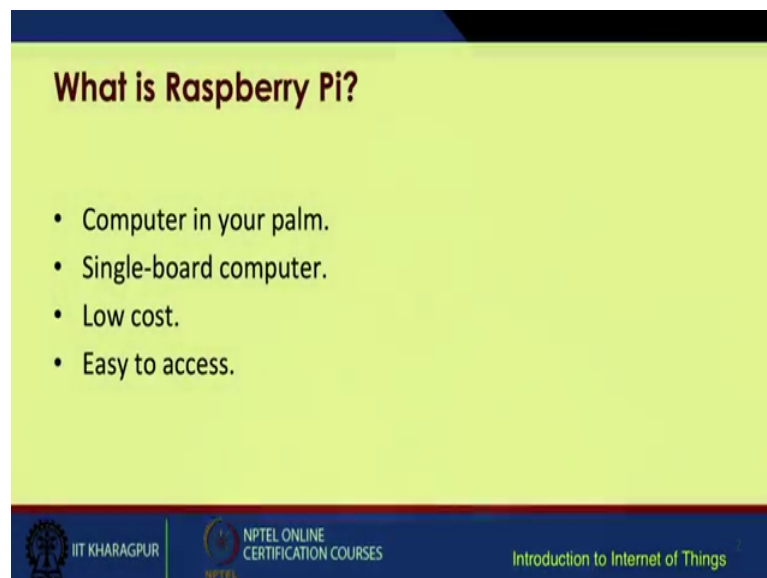
Second thing is that you know with Raspberry pi you can configure Raspberry pi as a web server you can even configure Raspberry pi as an edge device and so on. So, there are different capabilities that are there, but at the same time you know more computation means more power consumption. So, if you have the same kind of you know application

with a more power consumption requirements, etcetera, etcetera and if that is not a problem then you know one can go for raspberry pi; however, this particular issue is a little bit you know tricky because there are certain scenarios where Arduino can also come to be beneficial with respect to this.

So, we are going to go through the different aspects of Raspberry pi and try to understand how Raspberry pi can be used. So, I said before you know if you have a Raspberry pi module along with you can practice as we explain to you the different steps the different features and. So, on in this lecture and the subsequent one the next one in both of these we are going to teach you about raspberry pi. So, I have along with me; my TA for this course Mr. Anandroop Mukherjee; like the previous few lectures you know he is going to take you through the hands on aspects of Raspberry pi.

Hello, today this lecture will cover an introduction to Raspberry pi. So, this will be again a 2 part lecture and the part first part will cover the basic introduction to what is Raspberry pi the hardware system and how you go about installing basic operating system on the Raspberry pi and how to access that device. So, what exactly is Raspberry pi?

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It is basically micro sized computer or commonly in common terms it is said as a computer in your palm more specifically it is a single board computer which is very low cost device and which is very easy to access. So, these are one of the main reasons these

are some of the main reasons why Raspberry pi has become. So, popular with respect to IOT as well as hobby electronics people.

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Specifications

Key features	Raspberry pi 3 model B	Raspberry pi 2 model B	Raspberry Pi zero
RAM	1GB SDRAM	1GB SDRAM	512 MB SDRAM
CPU	Quad cortex A53@1.2GHz	Quad cortex A53@900MHz	ARM 11@ 1GHz
GPU	400 MHz video core IV	250 MHz video core IV	250 MHz video core IV
Ethernet	10/100	10/100	None
Wireless	802.11/Bluetooth 4.0	None	None
Video output	HDMI/Composite	HDMI/Composite	HDMI/Composite
GPIO	40	40	40

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So, there are various variants of raspberry pi. So, some common variants are you have the newest Raspberry pi 3 model b then pi 2 model b pi 0. So, these are the once most commonly being used. So, there are other variants also, but these 3 can be considered as the main market holders. So, as you can see the ram requirements for pi 3 pi 2 and pi 0 for pi 3 it is 1 GB pi 2 it is 1 GB whereas, for pi 0 it is bit lesser at 512 MB. The CPU is a quad core cortex a 53 processor processing speed is approximately 1.2 Gigahertz whereas, for pi 2 it is 900 megahertz. GPU requirements you have on pi 3 400 megahertz of video core 250 megahertz video core for pi 2 and 250 megahertz again for pi 0 you have provision for Ethernet on pi 3 and pi 2 whereas, there is no provision for either Ethernet or Wi-Fi on pi 0. Yes, there is a provision for Wi-Fi and Bluetooth only on mod pi 3. Generally video output is from HDMI port and there are 40 GPIO pins. So, these GPIO pins are mainly known as general purpose input output pins.

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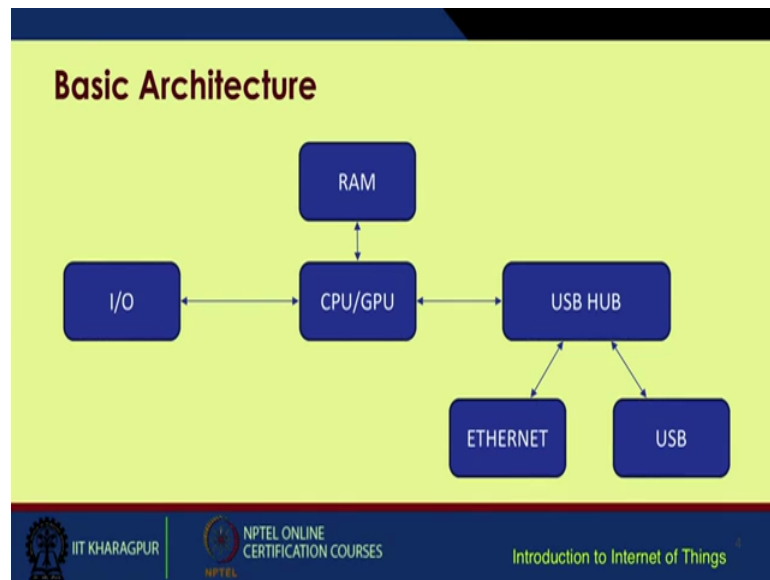
So, this is the basic functional architecture of a raspberry pi. So, at the center you have a CPU or GPU you have various input output ports connected to it you have a RAM you have a USB hub from which you can connect an Ethernet as well as you have various USB ports to which you can connect regular USB devices. So, in short this thing is as similar to your normal PC, right.

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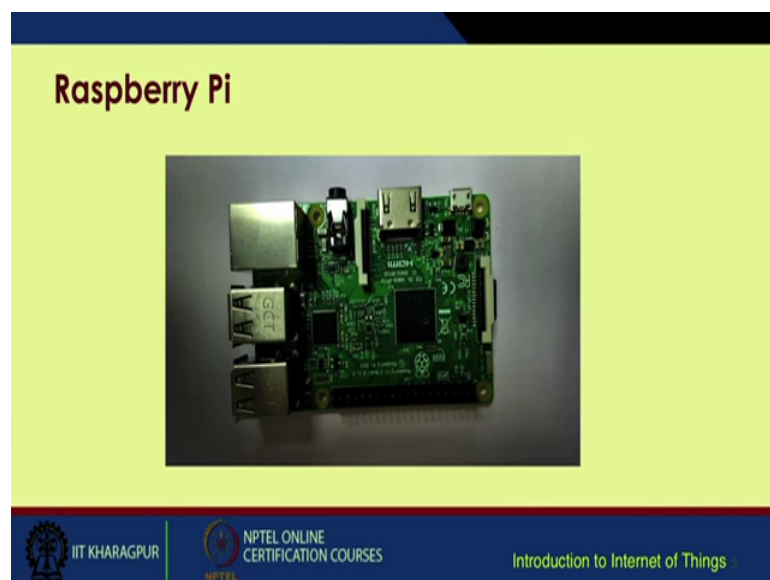
So, this is the picture of a raspberry pi. So, I have one Raspberry pi with me right now. So, if you can see this is a Raspberry pi 3 model b.
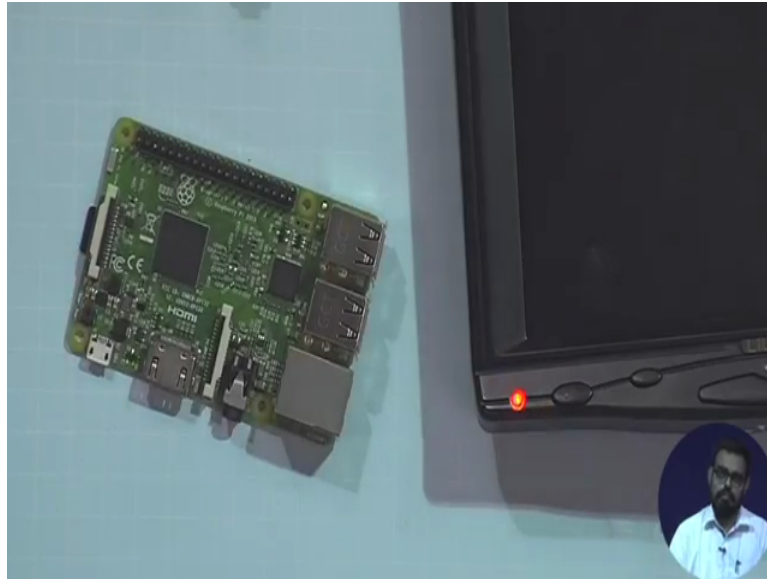
So, over here you have one HDMI port this small port is for the power adapter these are the GPIO pins interlaced with some power pins like 5 volt 3.3 volt in ground and you have this processors this is the arm base processor you have four USB ports you have one Ethernet port. So, and you have one sound card output also and turning it over to the other side you can see there is a small memory card attached. So, if you take it out. So, we are using a 32 GB memory card, but generally 8 to 16 GB memory cards are sufficient. So, the main function of this memory card is it actually holds the OS of the raspberry pi.

So, first step towards initializing Raspberry pi is you download the OS available on freely online you load the OS on the memory card and you just plug this thing into your memory card slot on the raspberry pi. So, in goes like this and your system is ready then we need some basic configurations to get this up and running and available on the network.

So, once your system is up and running you can see will you may access the Raspberry pi based OS which is primarily a GUI based system.

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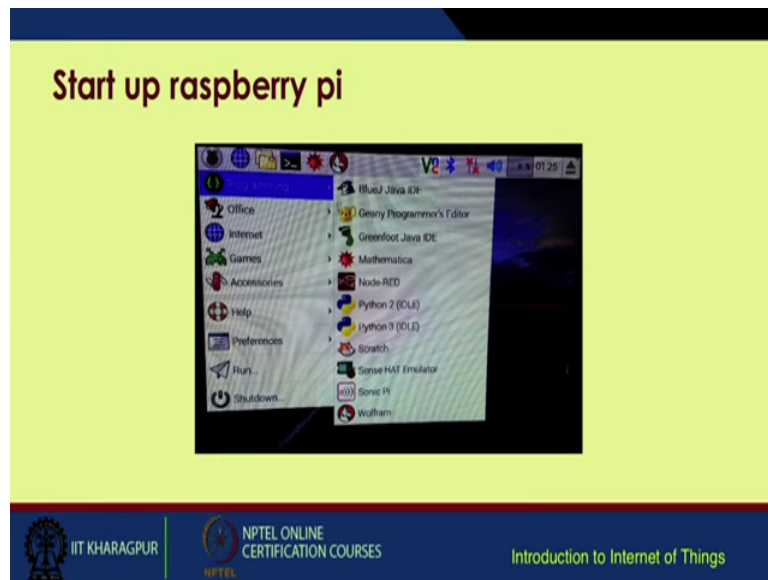
So, it is quite similar to your normal logo on base systems. So, you can see you have various programming languages which are already available within this you do not need to externally install it you see your python 2 python 3 scratch blue j which is a Distro for java and various other options you have some office options also so on. So, basically you get the idea there is one symbol for Bluetooth the symbol for increasing decreasing the sound this one shows the ram usage time and so on. So, it is quite similar to your normal oven to based systems.

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So, these Raspberry pi GPIOs or the general purpose input outputs they can act as both digital output as well as digital input it is quite similar to your input output digital input output pins on the Arduino boards we covered previously. So, if you pay attention to this thing.

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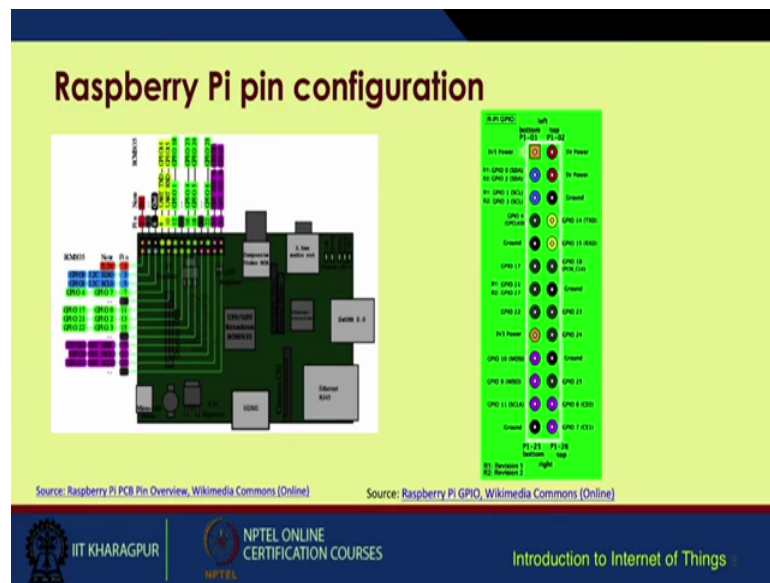
So, these GPIO pins these are a bit confusing. So, I have included one chart descript describing the pin configurations over here these 2 red pins are the five volt power pins the black ones over here are the ground pins and the remaining are GPIO pins. So, you have certain GPIO pins which act as you know your qart txt an rxt; that means, transmission and for reception there are normal GPIO pins and this chart or this configuration is very easily available online.
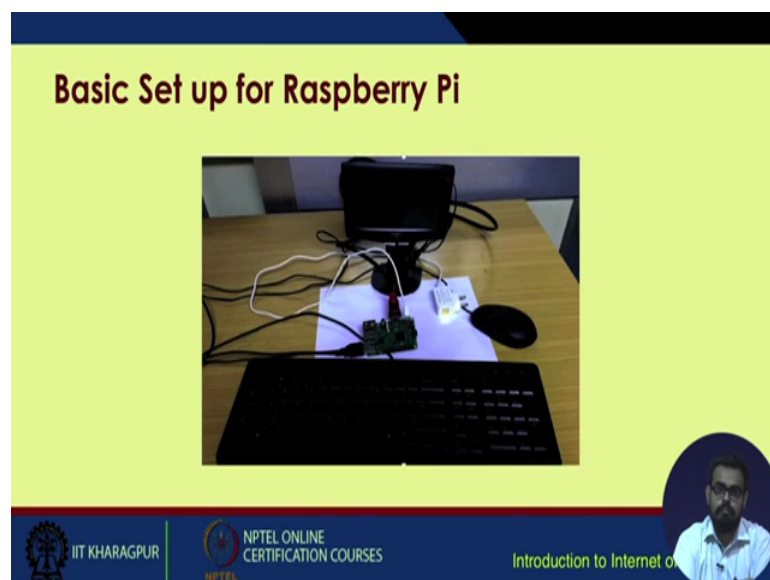
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So, the basic setup for this Raspberry pi will require a few components first and foremost when you are setting up the Raspberry pi for the very first time you will require a external monitor you will require an HDMI cable to connect the monitor and the Raspberry pi you will require a keyboard and mouse a basic 5 volt adapter to power up the pi LAN cable and your memory card which will include the operating system on it.

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So, we will come to the set up orbit later will I will give a demonstration of how to set up the whole system. So, regarding the operating system certain official bestows for Raspberry pi or Raspbian and Noobs and some third party OSs which can also be installed on the Raspberry pi are this UBANTU made Snappy Ubuntu core you even have nowadays windows ten core for Raspberry pi is finite and so on.

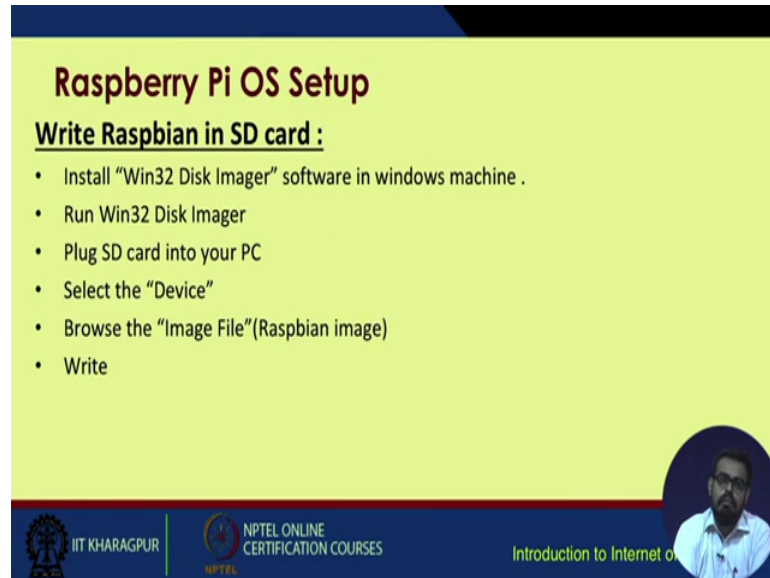(Refer Slide Time: 12:21)

So, you can download your Raspberry pi normal Raspbian image distribution from this link you otherwise you go on to this site you search for Raspbian distribution there are

various versions of various releases you select the most appropriate one and that is it. And once the download is finished you will end up with a zip file you unzip it you will get a image file and you just write that image onto the memory card.
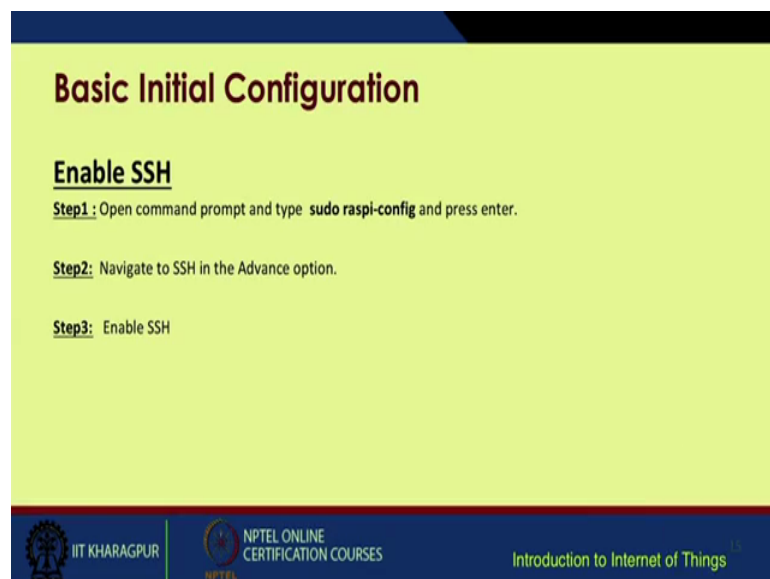
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So, for windows based systems since most of the people use a windows based system; the installation for this image is quite easy you require a software called win 32 disk imager. It is freely available online you run this disc imager software plug in the SD card into your PC you will need an USB adapter for the a SD card you select the device browse for the image file which contains that Raspbian image and you just select write. So, it will take around anything between 15 minutes to half an hour. So, once your writing is finished your memory card is ready to be integrated with the Raspberry pi.

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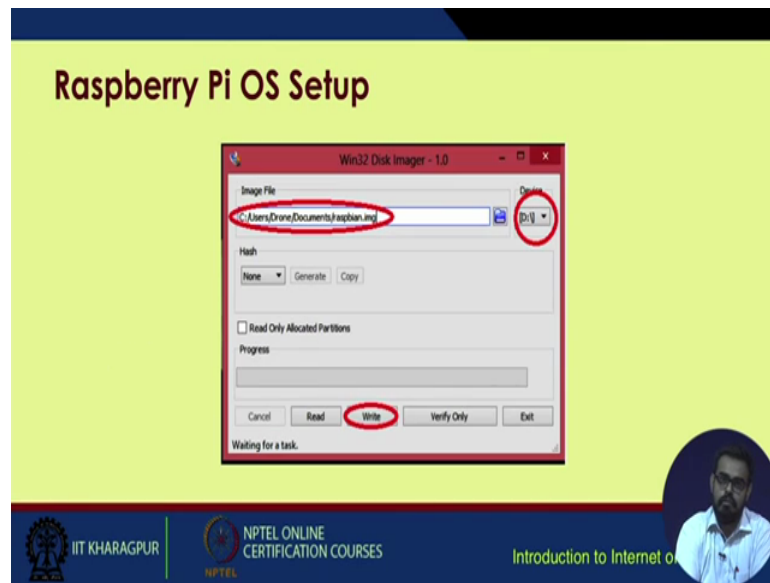
So, you can see you just select the distribution or the image the location of the image on your PC on the right hand side you can see you select the device onto which you want to write and after both of these have been done you just click on the right button that is it.

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So, now, before coming to this step let me give you a demo of how to start off with the basic Raspberry pi installation.

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So, over here first of all I have a keyboard and mouse I will just connect them to the USB ports choose any USB port I have a LAN cable ready I am connecting it to the Ethernet port this is an a small monitor portable monitor. So, it is being powered by a external power supply and it is connected it will be connected to the Raspberry pi via this HDMI cable on this HDMI port. So, once all of these have been done you just plug in your power supply for the Raspberry pi you already check whether you already have the memory card in place. So, it is there you just plug it in.

So, now if you pay attention on the screen you are booting starts. So, once the boot is finished you get a GUI based interface. So, just like the screen shot in the previous light. So, you have got one terminal you have got a start menu option you can access various programming languages. You can access internet options have got options for mail you have got options for other things you can also set up a VNC server or VNC viewer on raspberry pi so that you can remotely access the user interface on the network.

So, once the Ethernet cable has been plugged see this Ethernet has been plugged. So, it is showing one IP. So, this IP will be required to remotely access your PC Raspberry pi from your pc. So, best practice is you go to terminal right.
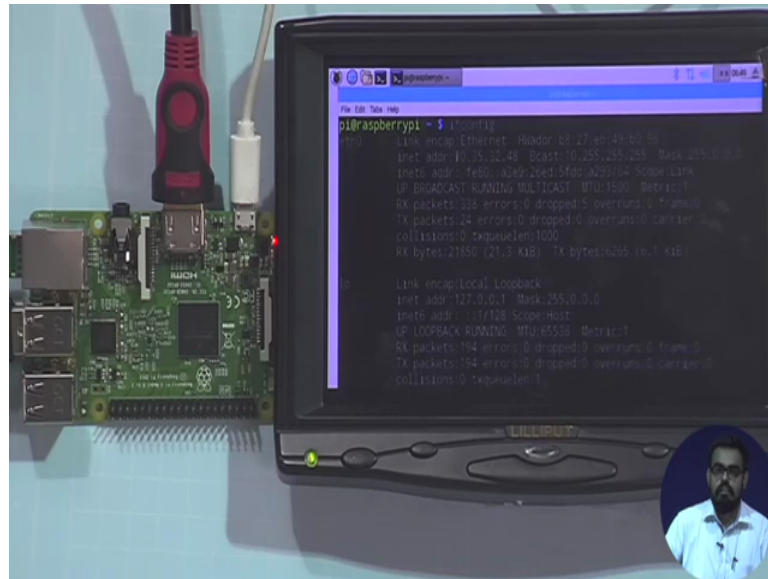
One more thing; the default name for the Raspberry pi distribution is pi p I and the password is Raspberry; ra sp be rry. So, whenever you are remotely logging into the system you give the; I username as pi and the password as raspberry. So, first of all I will check for the IP of the system. So, I give the command IP config. So, you see various interfaces have been located. So, I am more interested in the first part. So, this is going to be my required IP. So, now, I will store this IP and I can remotely login to the system using this IP. So, now, my Raspberry pi is ready to be accessed remotely. So, now, I do not need to use the monitor anymore. So, the main function of the monitor is to initially get the IP address for your system and for basic configurations.

So, coming back to the presentation; so, initial configuration we have done now enabling this SSH option SSH as you know is stands for secure shell login. So, just check on your Raspberry pi; go to the go again to the terminal you give the command Pseudo Raspberry pi config and press enter. So, you will get something like this, right.
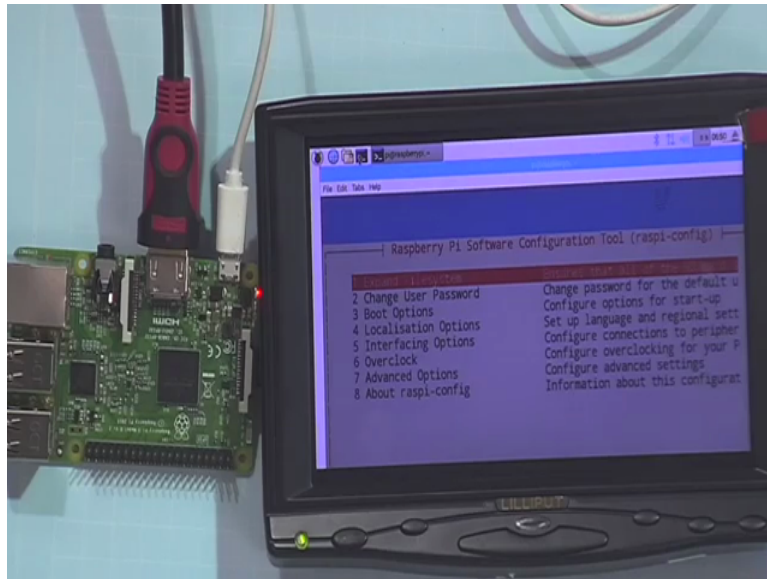
Since I am already using this Raspberry pi for quite some time this is not a fresh install. So, all the operations have already been performed, but post first time installation of your Raspberry pi you need to expand your file system because these images are more or less compressed and if you expand the file system it will cover your entire memory card. So, your entire memory card; suppose I am using a 32 GB memory card, but the image was 2 GB approximately. So, it will now expand to cover the maximum of the memory card.
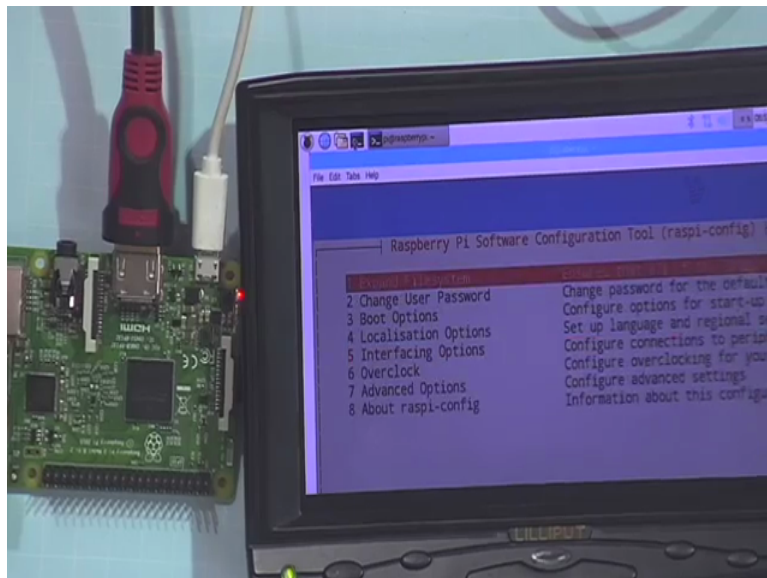
So, you will have lots of space for additional functions installing new softwares putting on files etcetera. So, once you expand the file system after this operation is done you reboot the system. So, I will go to advanced options.
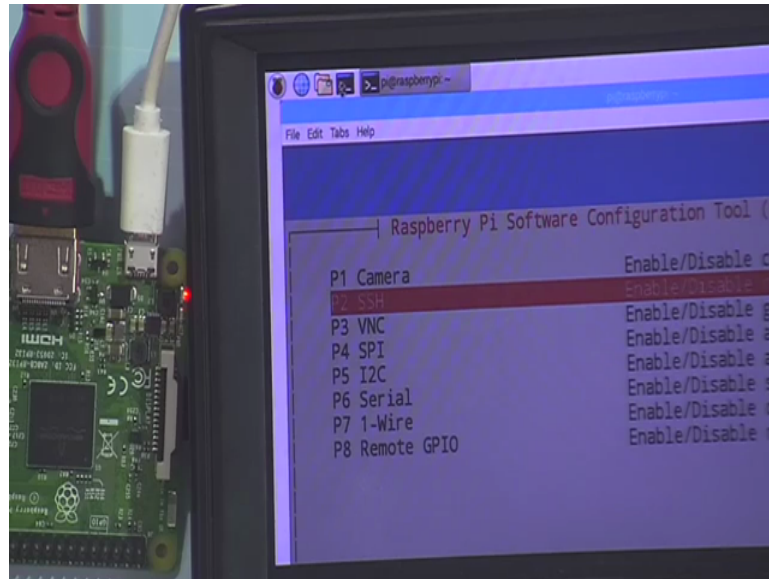
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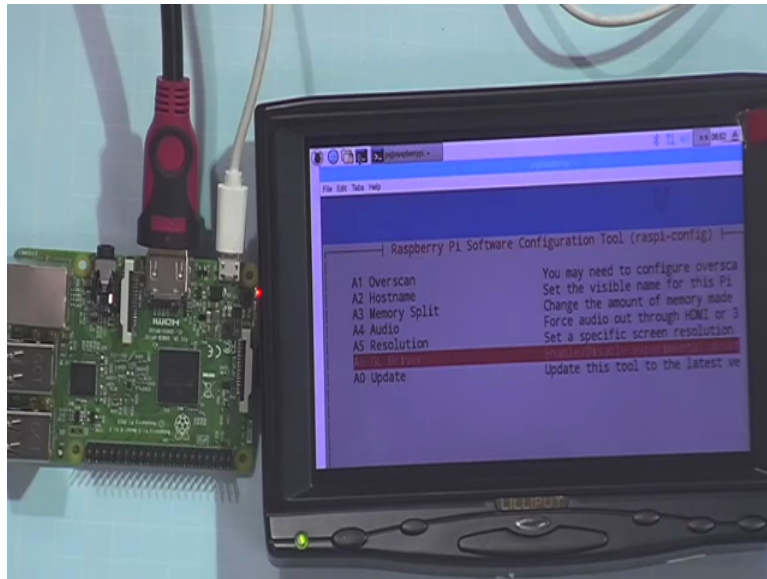
Sorry, I will go to advanced options as you can see there are variation of options for over scan resolution audio driver and so on and there should be one option for and go to interfacing options for this distribution you have your enable SSH in the interface options under Raspberry config.
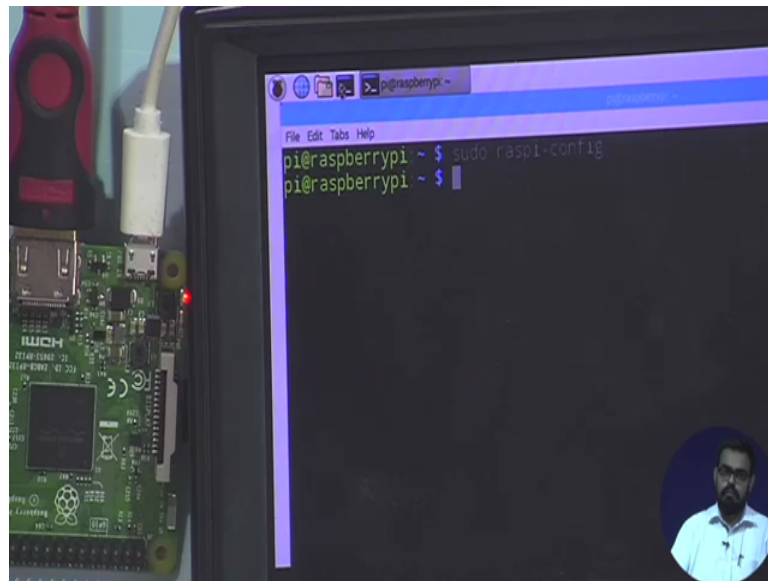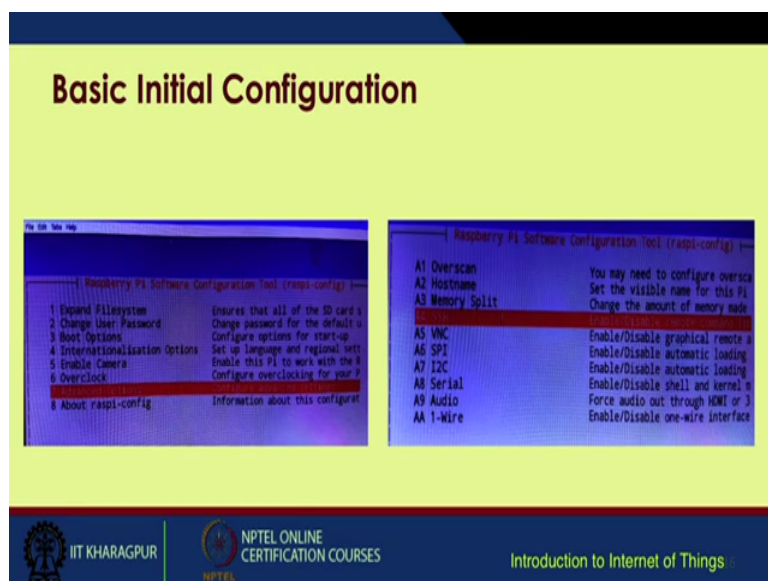
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So, you select SSH and press enter and once your SSH is enabled you reboot your system. So, this will allow you to access your Raspberry pi over the network from any remote PC from windows based systems you can use software such as putty or any SSH plant from Ubuntu based systems or MAC based systems you can only use the terminal to perform this SSH operation. So, my SSH is already enabled you can also enable your additional options like if you have a Raspberry pi camera there are these are special cameras which can be integrated to   as Raspberry pi. You can obviously, integrate USB cameras to wireless USB ports and there are as you can see there are various other options if you need to use the VNC server you enable this VNC option and so on.

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So, I hope you get the idea. So, I will escape this thing now coming back to the presentation once the SSH has been enabled. So, we have covered this thing.

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Then file system expansion we have explained. So, as you remember from the live demo this option was there the first option expand file system.

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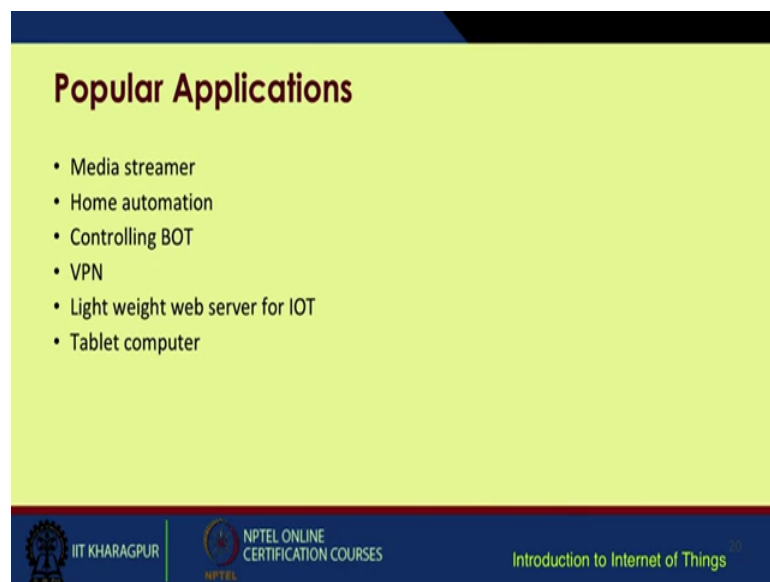
So, post this as I have already told you the basic default programming languages which are installed are Python, Java, C, C++, Scratch and Ruby. So, more or less any language that will compile for arm version six can be used easily with Raspberry pi.

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So, some basic and very popular applications you will come across on the internet for Raspberry pi based systems mostly they are media streamers home automation systems controlling abort virtual private networks a lightweight web server for IOT. So, like instead of having a dedicated big server for running IOT based applications suppose you

want to install a small IOT network in your home maybe for home automation or home monitoring you can; obviously, go for a Raspberry pi base system. So, this system will act as a server whereas, your devices will start uploading data to the server you can even run various analytics on the Raspberry pi based server and then you; obviously, have a tablet computer based system. So, this Raspberry pi is already a computer just interface a monitor and some external peripheral devices any other and you are ready to go.

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So, coming back once again to the system; so, I do not require this anymore I just close it now I will do one thing let me access this pi base system from my PC I already have the IP. So, I will write for my since my PC is running a MAC based system I will write the command SSH minus y then space pi at the rate the IP address for your raspberry pi. So, once I press enter it will start it will ask for the address as I have told you; the default sorry it will ask for the password the default password is raspberry once you enter the password you are ready to go first it will give some basic information about the system and then you will see a prompt which will say pi at the rate Raspberry pi.

So; that means, you are ready to go. So, you can just see your file system what exactly are there you can give a basic LS command or list file. So, these are some of the directories or files put in your Raspberry pi you can even remotely start restart your PC or raspberry pi. So, for the end of this lecture I will just reboot my raspberry pi. So, I

write pseudo reboot, press enter ok. So, as you can see over the monitor my Raspberry pi has gone into reboot again it is starting up. So, this was the end of our part one lecture.

Thank you.