
PRACTICAL

INTERNET OF THINGS (IoT)

SHEKHAR SUMAN

CERTIFICATE

Class: **T.Y.B.Sc.I.T.**

Year: **2025 - 2026**

This is to certify that work entered in this Journal is the work of

Shri / ~~Kumari~~: **SHEKHAR SUMAN**.

of **T.Y.B.Sc.I.T** division _____ Roll No. **47**.

Uni. Exam No. _____ has satisfactorily completed the

Required number of practical and worked for the **5TH** Semester

Of the year **2025 - 2026** in the college laboratory as laid down

By the university.

Head of the
Department

External
Examiner

Internal Examiner
Subject teacher

Date:

NAME: SHEKHAR SUMAN		INDEX
CLASS: T.Y.B.Sc.I.T.	ROLL No: 47	
SUBJECT: INTERNET OF THINGS (IoT)		
COLLEGE: ST. ROCK'S DEGREE COLLEGE		

PR No:	TITLE	DATE	SIGN
<u>1</u>	Understanding Raspberry Pi and its pins.		
<u>2</u>	Installing operating system NOOBS on SD card and burning it.		
<u>3A</u>	Installing Raspbian OS on raspberry Pi.		
<u>3B</u>	Installing Raspbian OS with the help of virtual machine software.		
<u>4</u>	Blinking LED using Raspberry Pi.		
<u>5</u>	Capturing Images by connecting camera using Raspberry Pi.		
<u>6</u>	Capturing video by connecting camera using Raspberry Pi.		
<u>7</u>	Interfacing seven segment display with Raspberry Pi.		

PRACTICAL – 1

AIM: Understanding Raspberry Pi and its pins.



	3V3	1	2	5V	
I2C SDA	GPIO2	3	4	5V	
I2C SCL	GPIO3	5	6	GND	
	GPIO4	7	8	GPIO14	UART TX
	GND	9	10	GPIO15	UART RX
	GPIO17	11	12	GPIO18	PCM CLK
	GPIO27	13	14	GND	PWM0
	GPIO22	15	16	GPIO23	
	3V3	17	18	GPIO24	
SPI MOSI	GPIO10	19	20	GND	
SPI MISO	GPIO9	21	22	GPIO25	
SPI SCLK	GPIO11	23	24	GPIO8	SPI CE0
	GND	25	26	GPIO7	SPI CE1
I2C ID EEPROM	GPIO0	27	28	GPIO1	I2C ID EEPROM
	GPIO5	29	30	GND	
	GPIO6	31	32	GPIO12	PWM0
PWM1	GPIO13	33	34	GND	
PWM1	GPIO19	35	36	GPIO16	
PCM FS	GPIO26	37	38	GPIO20	PCM DIN
	GND	39	40	GPIO21	PCM DOUT

Raspberry Pi GPIO Pins Overview

- **Physical Pins:** The header on the Raspberry Pi consists of 40 pins, numbered from 1 to 40 (top left to bottom right in the image).
- **Types of Pins:**
 - **Power Pins:**
 - 3.3V (Pins 1, 17): Orange blocks.
 - 5V (Pins 2, 4): Red blocks.
 - Ground/GND (Pins 6, 9, 14, 20, 25, 30, 34, 39): Black blocks.
 - **GPIO Pins:** Used for input/output operations. Named GPIO followed by a number (e.g., GPIO2, GPIO3).
 - **Special Function Pins:**
 - **I2C:** Pins for communication using Inter-Integrated Circuit protocol (Pins 3 (SDA), 5 (SCL), light blue).
 - **UART:** Pins for serial communication (Pins 8 (TX), 10 (RX), purple).
 - **SPI:** Pins for Serial Peripheral Interface (MOSI, MISO, SCLK, CE0, CE1; green blocks).
 - **PWM:** Pins for Pulse Width Modulation (PWM0, PWM1; light purple).

How to Use These Pins

- **Digital Input/Output:** Most pins labeled GPIO can be programmed to read digital sensors (input) or control devices like LEDs (output).

- **Communication Protocols:** Use the I2C, SPI, and UART specific pins to connect with modules that support these protocols.
- **Power Supply:** Use the 3.3V or 5V pins and GND pins to supply power to your connected components.

Example Practical: Blink an LED

1. Connect:

- LED's positive leg to GPIO17 (Pin 11).
- LED's negative leg to GND (Pin 6).

2. Write a Simple Python Code: Use GPIO17 in your code to turn the LED on/off.

Summary Table (Main Functions)

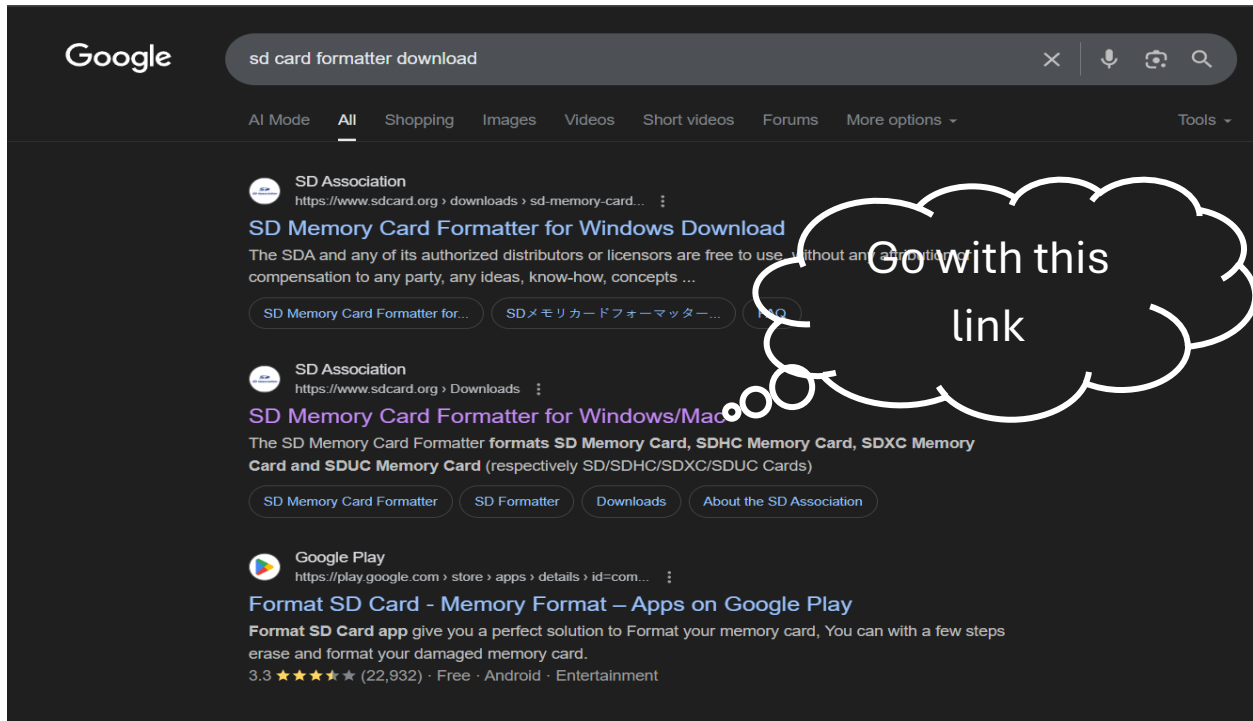
Pin No.	Function	Color Code
1, 17	3.3V Power	Orange
2, 4	5V Power	Red
6, 9...	Ground (GND)	Black
3, 5	I2C SDA/SCL	Light Blue
8, 10	UART TX/RX	Purple
19, 21, 23, 24	SPI (MOSI, MISO, SCLK...)	Green
11, 13, ...	GPIO Pins	Blue, Yellow

PRACTICAL – 2

AIM: Installing operating system NOOBS on SD card and burning it.

Downloading the SD CARD formatter.

Step 1: Browse the SD card formatter download in your browser and go with the original link.



Step 2: After that scroll down and find this option then choose your operating system, here my operating system is Window so I prefer myself to choose Window option.

SD Memory Card Formatter Download for Windows/Mac



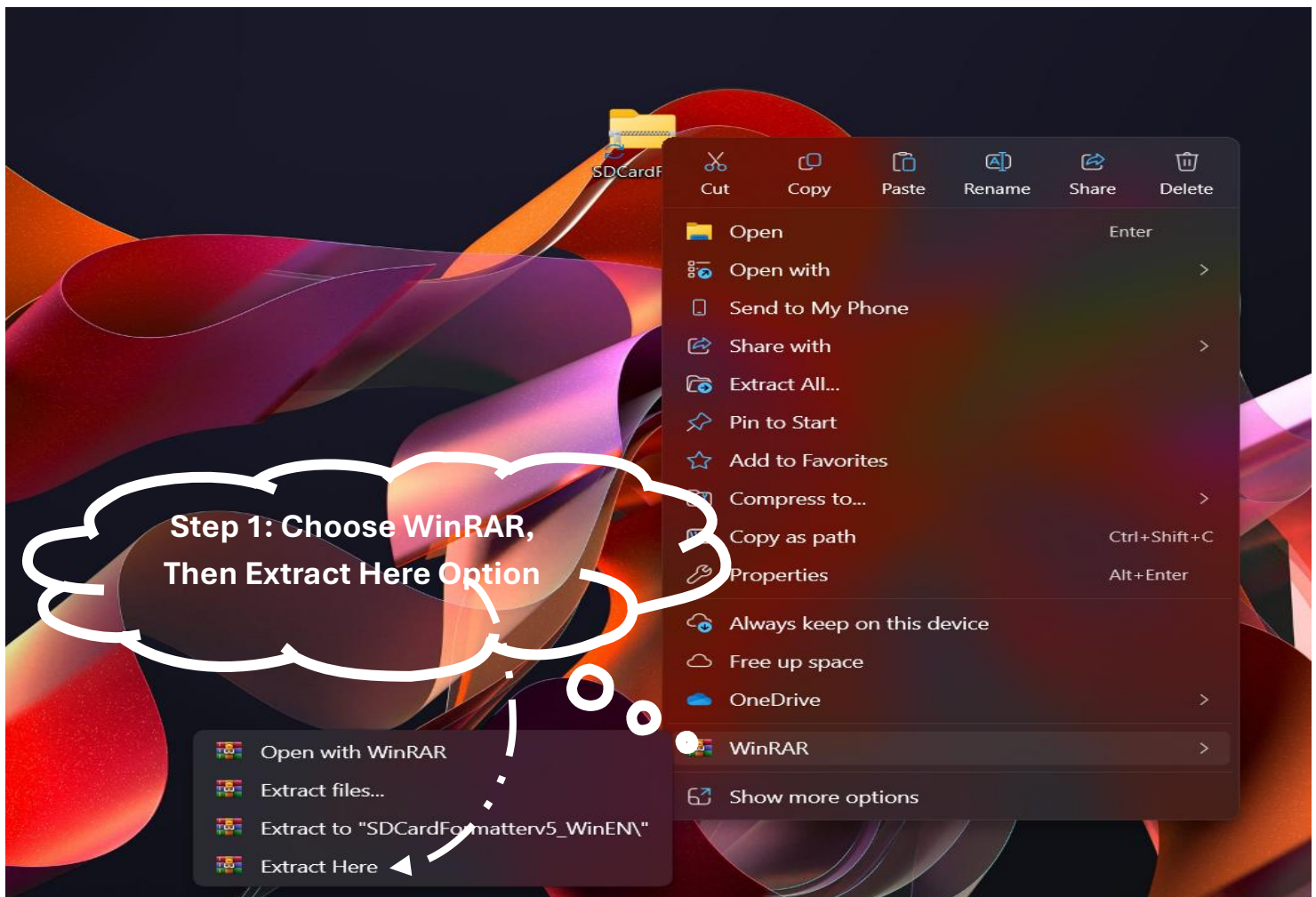
Developed by [Tuxera](#)

Step 3: On the clicking on Window option, you got the interface of SD card formatter user license and agreement with their notice. Read carefully and scroll down and find this option then click on Accept button. When you click on the Accept button then your file is automatically downloading in the ZIP format.

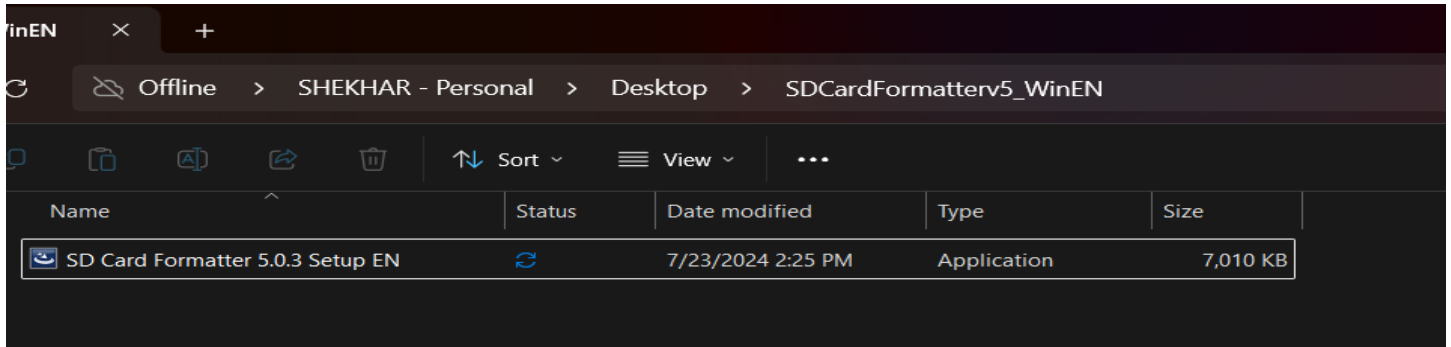
YOU ACKNOWLEDGE AND AGREE THAT YOU HAVE READ THIS AGREEMENT AND INTEND TO BE BOUND AS IF YOU HAD SIGNED THIS AGREEMENT IN WRITING. IF YOU ARE ACTING ON BEHALF OF AN ENTITY, YOU WARRANT THAT YOU HAVE THE AUTHORITY TO ENTER INTO THIS AGREEMENT ON BEHALF OF SUCH ENTITY AND BIND SUCH ENTITY TO THE TERMS OF THIS AGREEMENT.



Step 4: Once your download is complete then open your file explore and go to the download option find your downloaded file and extract that file.



Step 5: When your extraction is complete then you got the new folder with the same name where you extract your folder. Go inside that folder you find the application file.



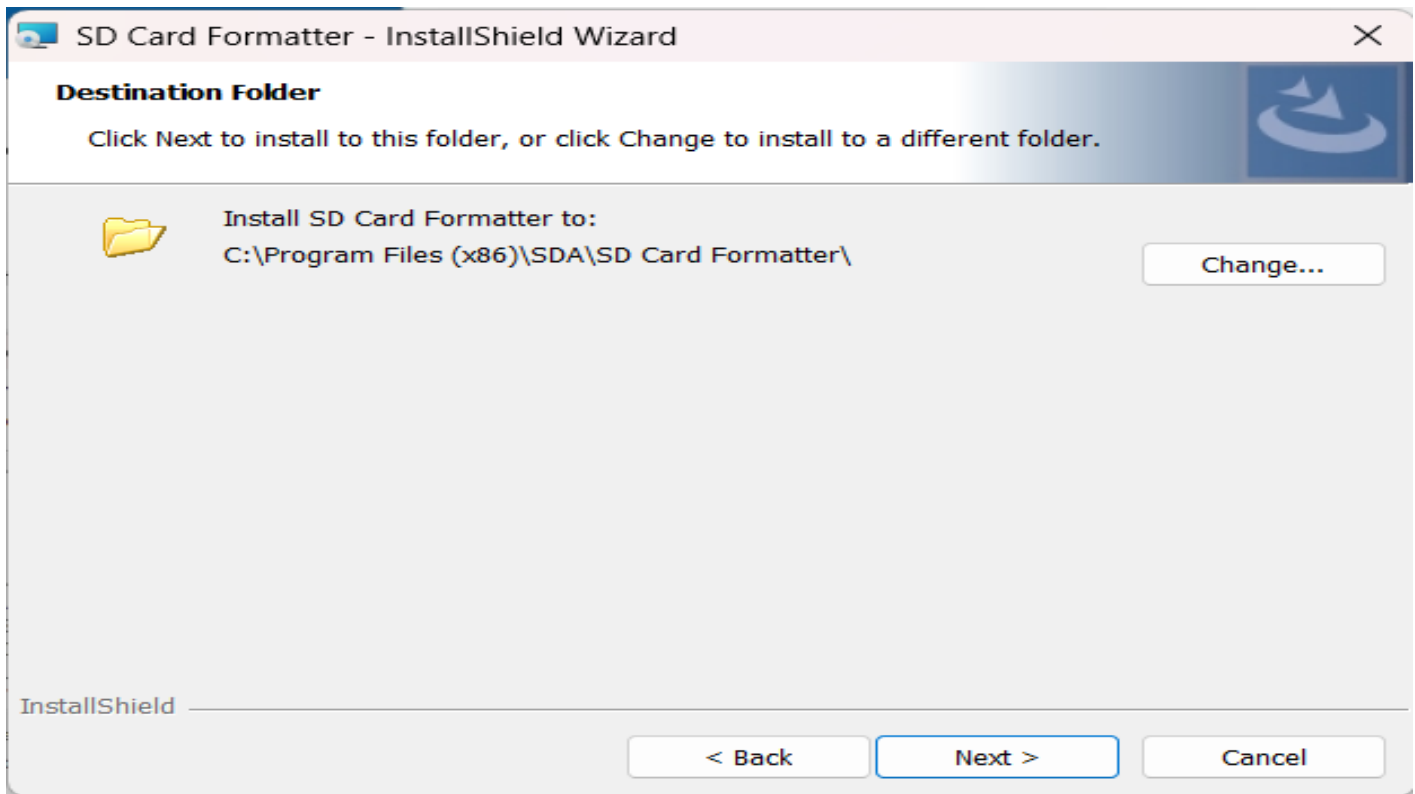
Step 6: Double click on it, it takes few seconds for the preparing your installation. Once your preparing is done then you got the interface of InstallShield Wizard, click on the next button for the next processing.



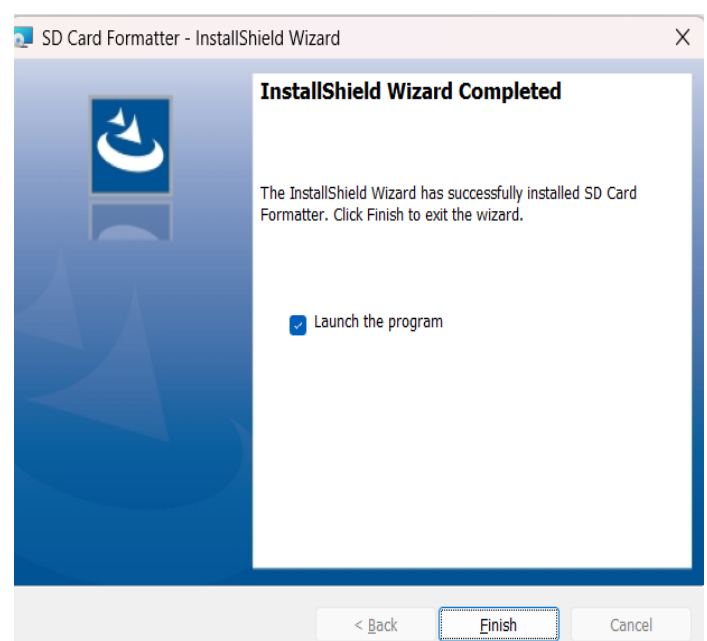
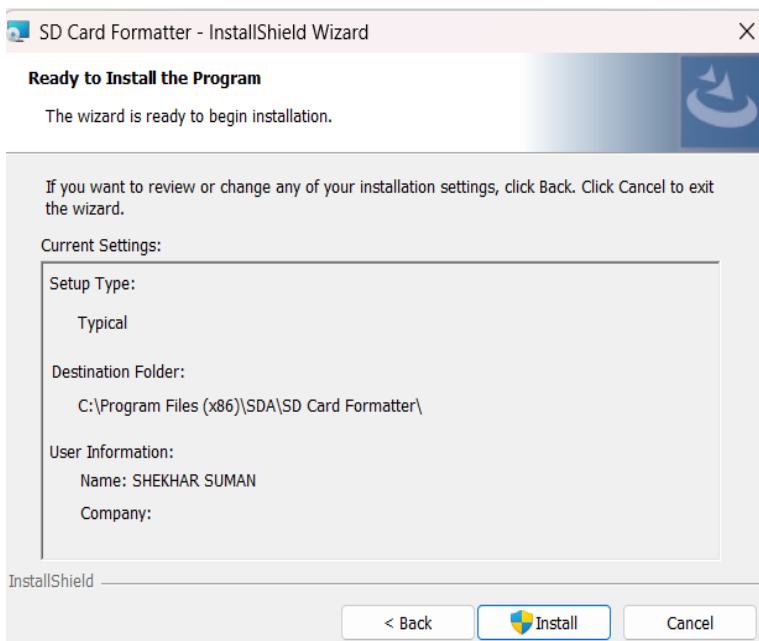
Step 7: Accept the terms and license agreement then click on the next button.



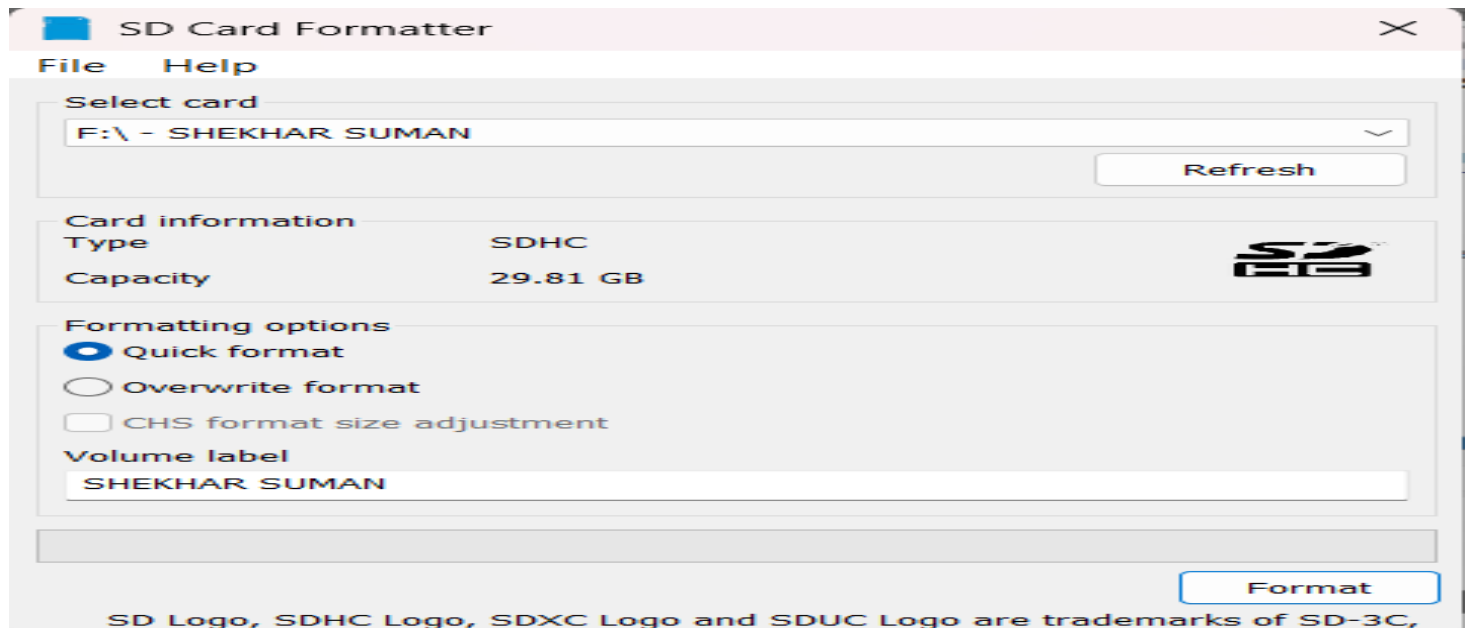
Step 8: Then it asks from you for the application destination, if you want to change your location / destination the browser your destination, here I don't need to change my destination so I go with the default location. Then I click on the next button.



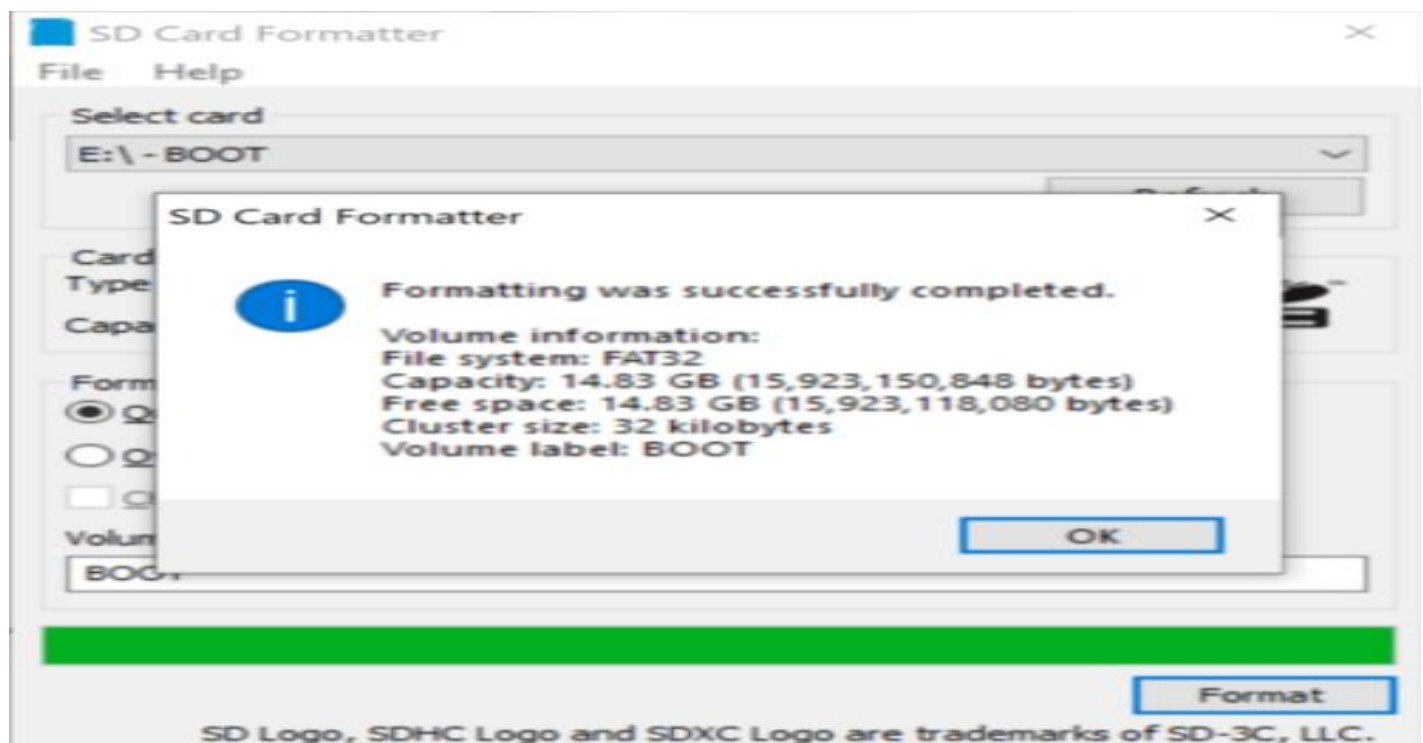
Step 9: Then your application is ready to install, you can see your information about this application click on the install button for the installing your application. When your click on the install button it takes some times for preparing your installation. Once your installation is done then click on the finish button here your SD card formatter in successfully download.



Step 10: Insert your SD card in your laptop / computer with the help of card reader then open the SD card formatter application it automatically detects your SD card. They're you can see your card information and formatting options. In formatting options, you have to choose Quick format, below the formatting options you can see the Volume label here you can give the name of your SD card whatever you want here I give my name "SHEKHAR SUMAN", at first time it detects automatically according to your SD card name. after this process click on the format button.

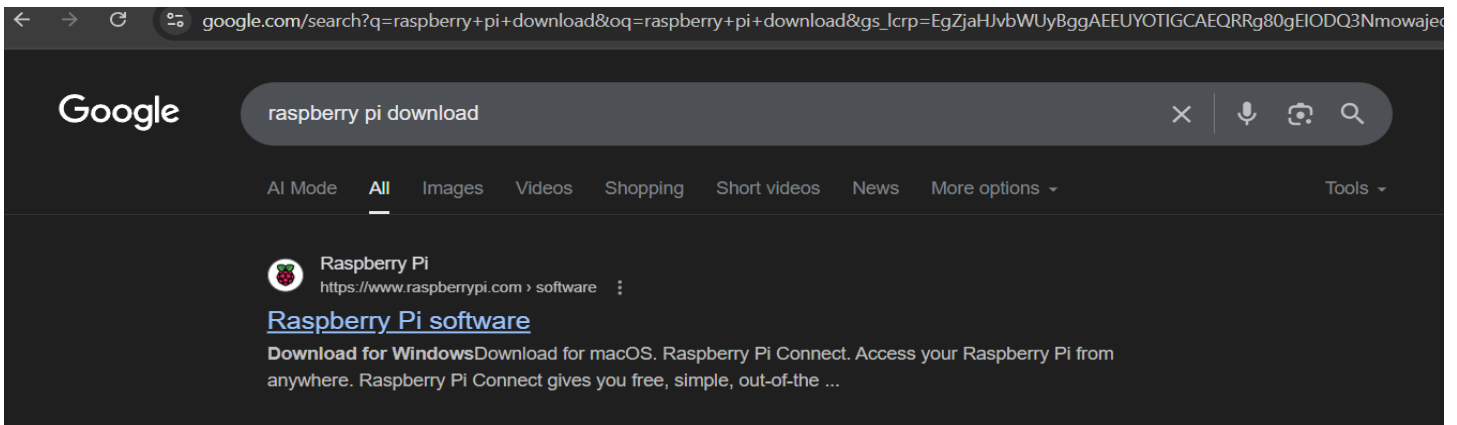


Step 11: Once your format is done then you see the interface of formatting was successfully completed.



O.S Manager NOOBS Installation

Step 1: Browse in the browser Raspberry pi download go with the first link



Step 2: Here we can see that raspberry pi software Raspberry pi Imager, then choose your Operating system. When you click on the Download for according to your operating system, then your exe file is start downloading.

Raspberry Pi Imager

Raspberry Pi Imager is the quick and easy way to install **Raspberry Pi OS** and other operating systems to a microSD card, ready to use with your Raspberry Pi.

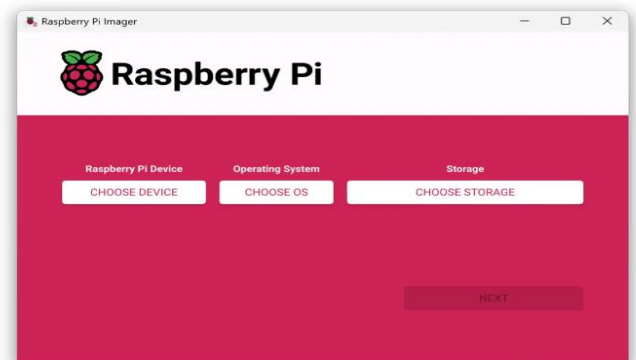
Download and install Raspberry Pi Imager on a computer with an SD card reader. Insert the microSD card you'll use with your Raspberry Pi into the reader and run Raspberry Pi Imager.

[Download for Windows](#)

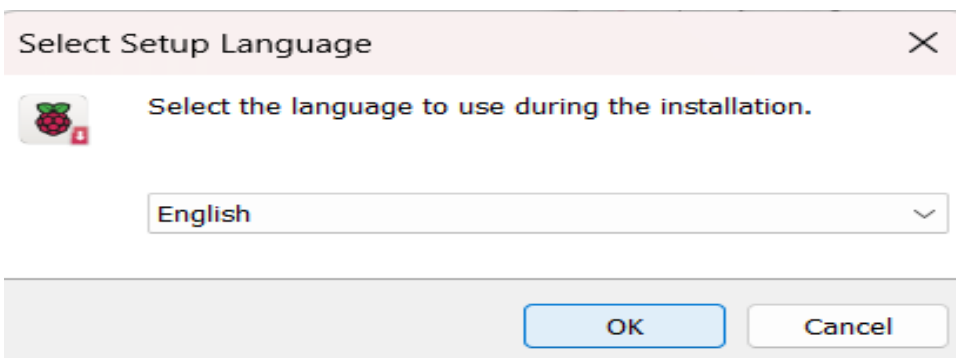
[Download for macOS](#)

[Download for Debian or Ubuntu \(x86_64\)](#)

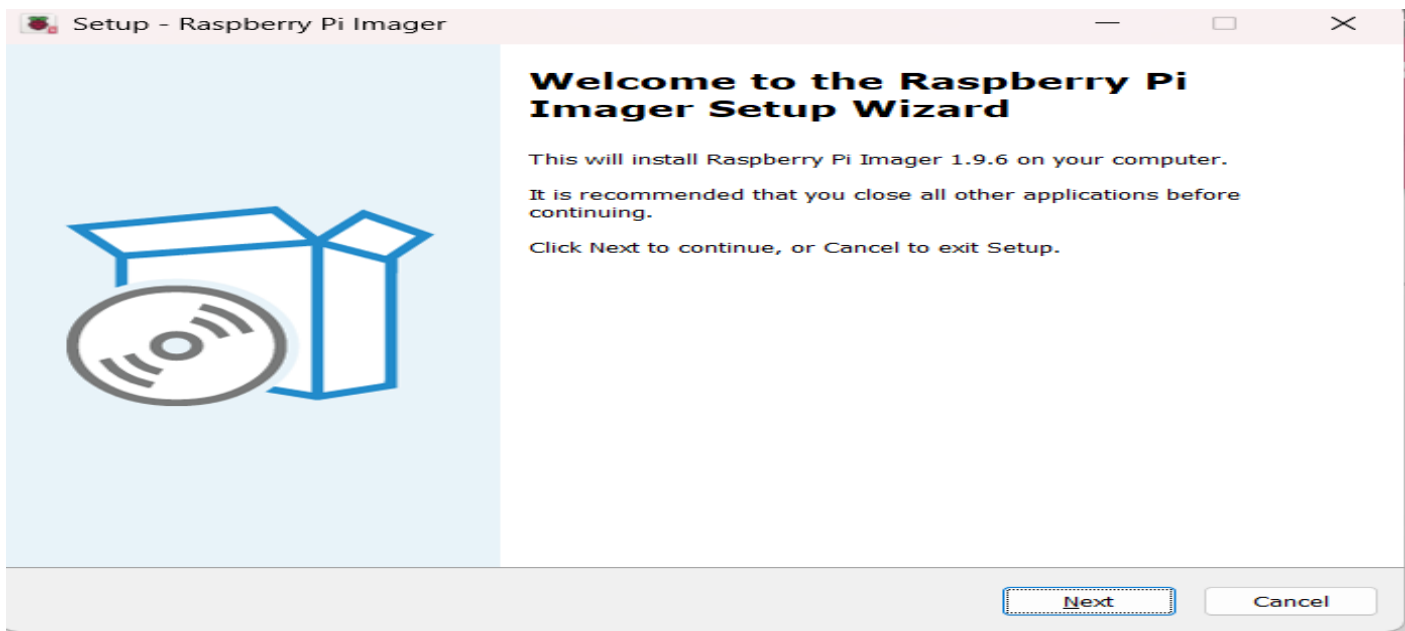
To install on **Raspberry Pi OS**, type
`sudo apt install rpi-imager`



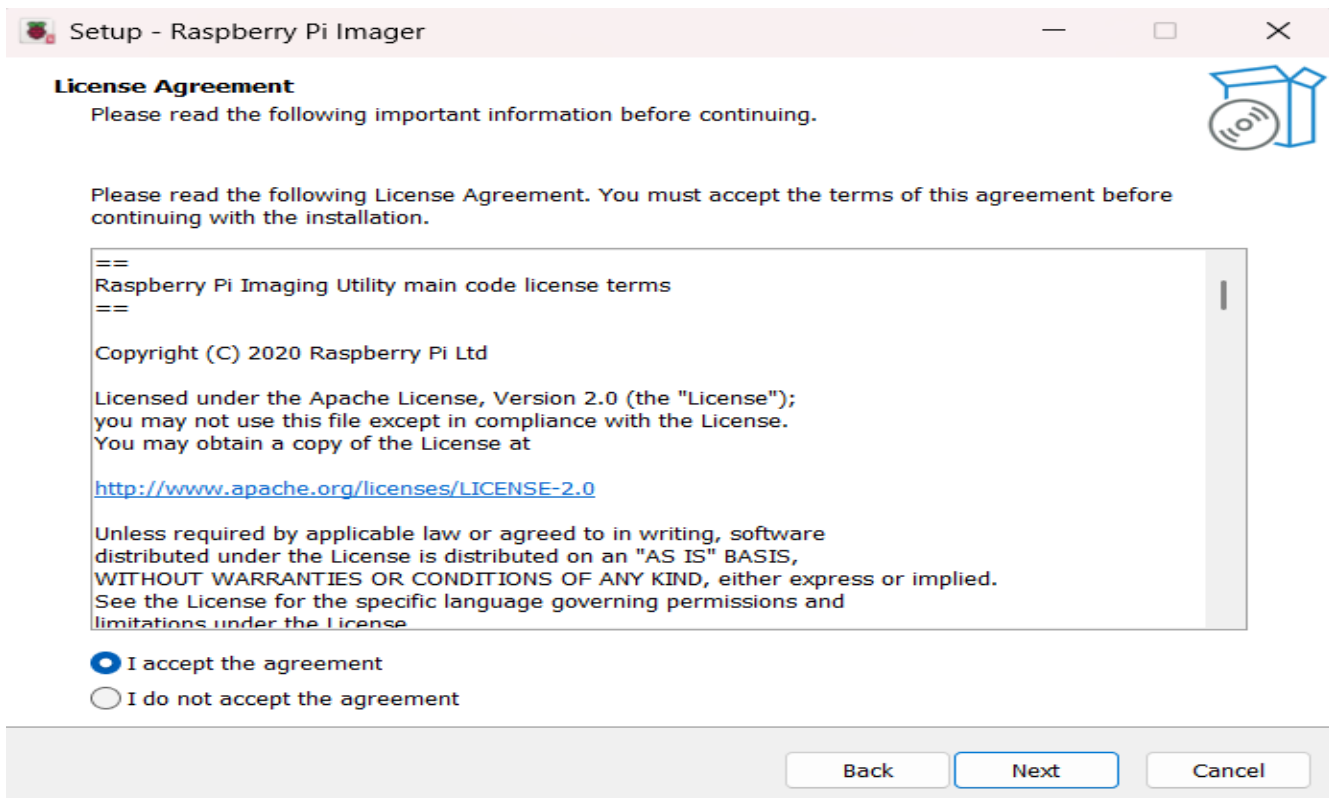
Step 3: After the downloaded of exe file then double click on that file and open it, then its ask from you choose your language then press on the ok button.



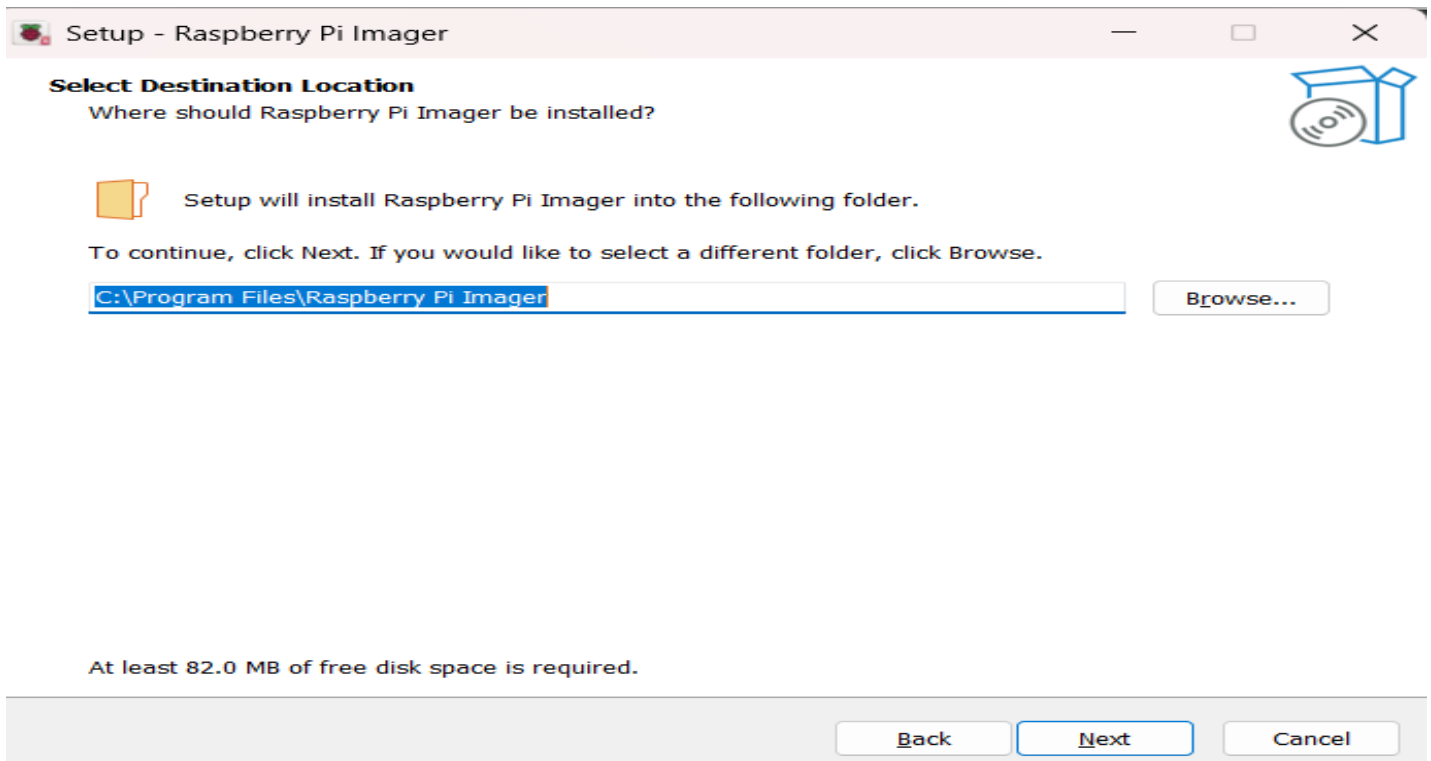
Step 4: Then you redirect on the set-up page on your raspberry imager click on the next button.



Step 5: Accept the agreement after that then click on the next button.



Step 6: Choose the destination location if you want otherwise make it default. Then click on the next button.



The screenshot shows the 'Setup - Raspberry Pi Imager' window. The title bar includes the Raspberry Pi logo and window controls. The main heading is 'Select Destination Location' with a sub-question 'Where should Raspberry Pi Imager be installed?'. A folder icon indicates the installation path: 'C:\Program Files\Raspberry Pi Imager'. A 'Browse...' button is to the right. Below the path, a note states 'At least 82.0 MB of free disk space is required.' The bottom of the window features 'Back', 'Next', and 'Cancel' buttons.

Setup - Raspberry Pi Imager

Select Destination Location

Where should Raspberry Pi Imager be installed?

Setup will install Raspberry Pi Imager into the following folder.

To continue, click Next. If you would like to select a different folder, click Browse.

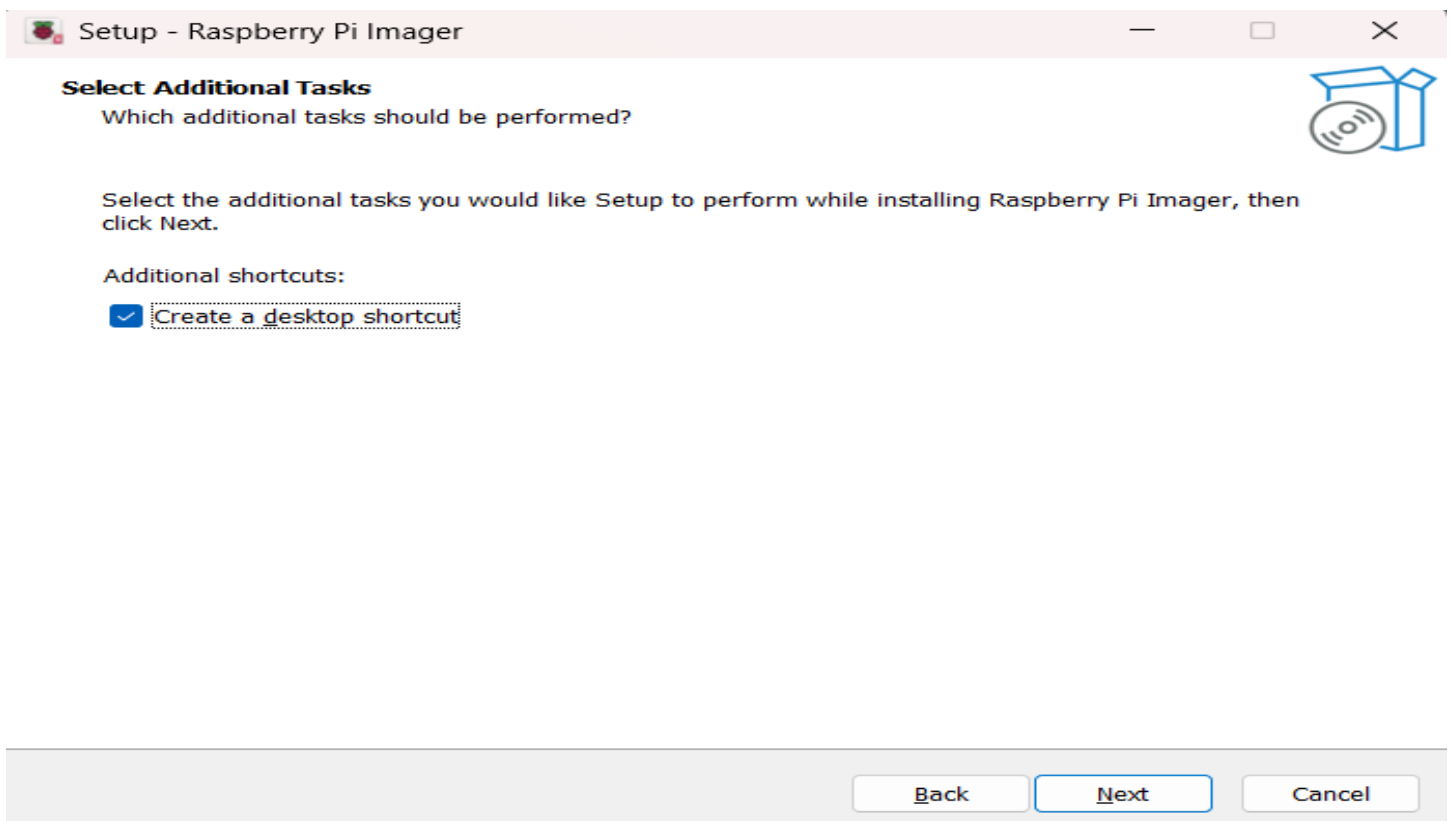
C:\Program Files\Raspberry Pi Imager

Browse...

At least 82.0 MB of free disk space is required.

Back Next Cancel

Step 7: Then you got the option for creating desktop shortcuts if you want then check on the checkbox otherwise make it unchecked and click on the next button.



The screenshot shows the 'Setup - Raspberry Pi Imager' window. The title bar includes the Raspberry Pi logo and window controls. The main heading is 'Select Additional Tasks' with a sub-question 'Which additional tasks should be performed?'. Below this, instructions state 'Select the additional tasks you would like Setup to perform while installing Raspberry Pi Imager, then click Next.' Under the heading 'Additional shortcuts:', there is a checked checkbox for 'Create a desktop shortcut'. The bottom of the window features 'Back', 'Next', and 'Cancel' buttons.

Setup - Raspberry Pi Imager

Select Additional Tasks

Which additional tasks should be performed?

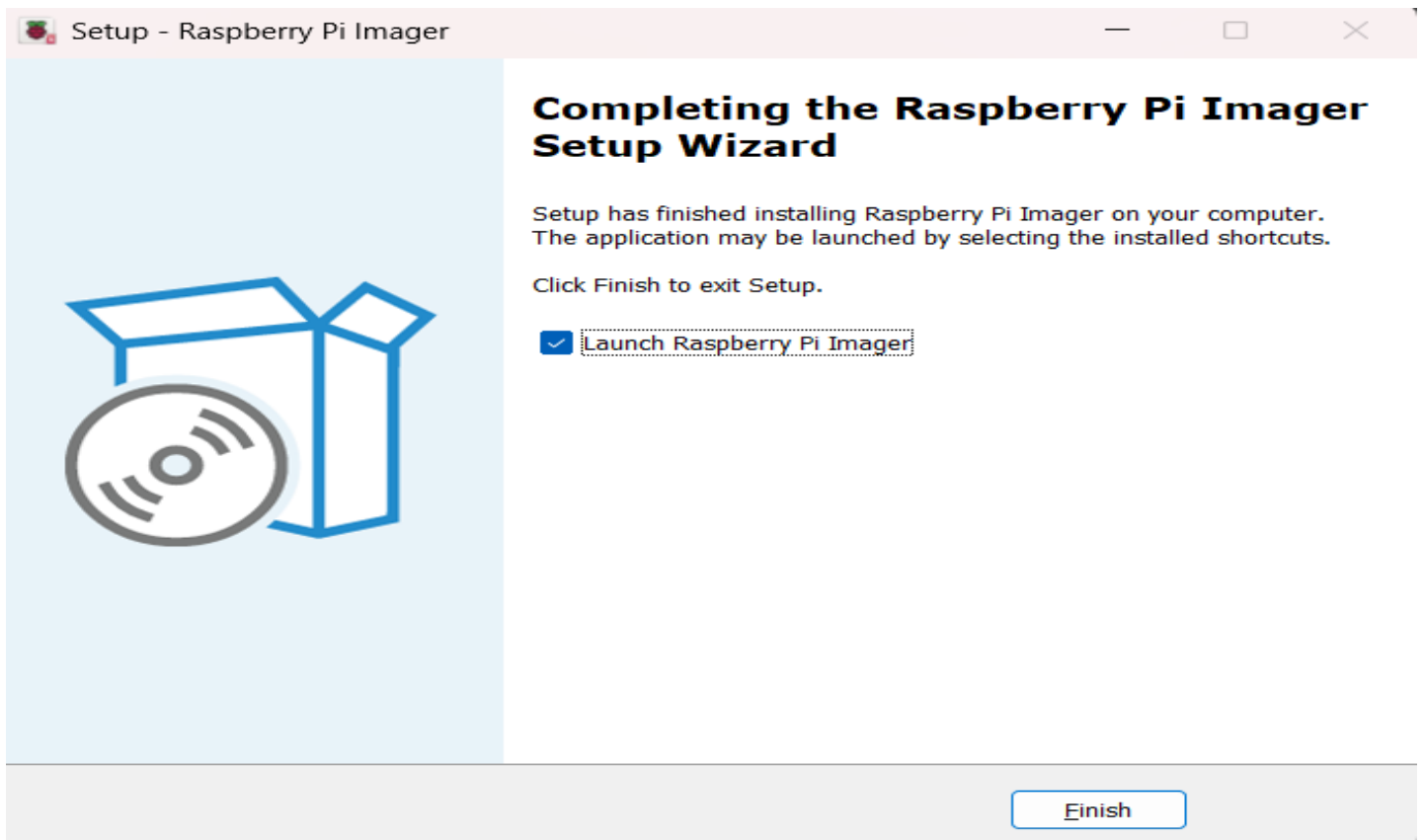
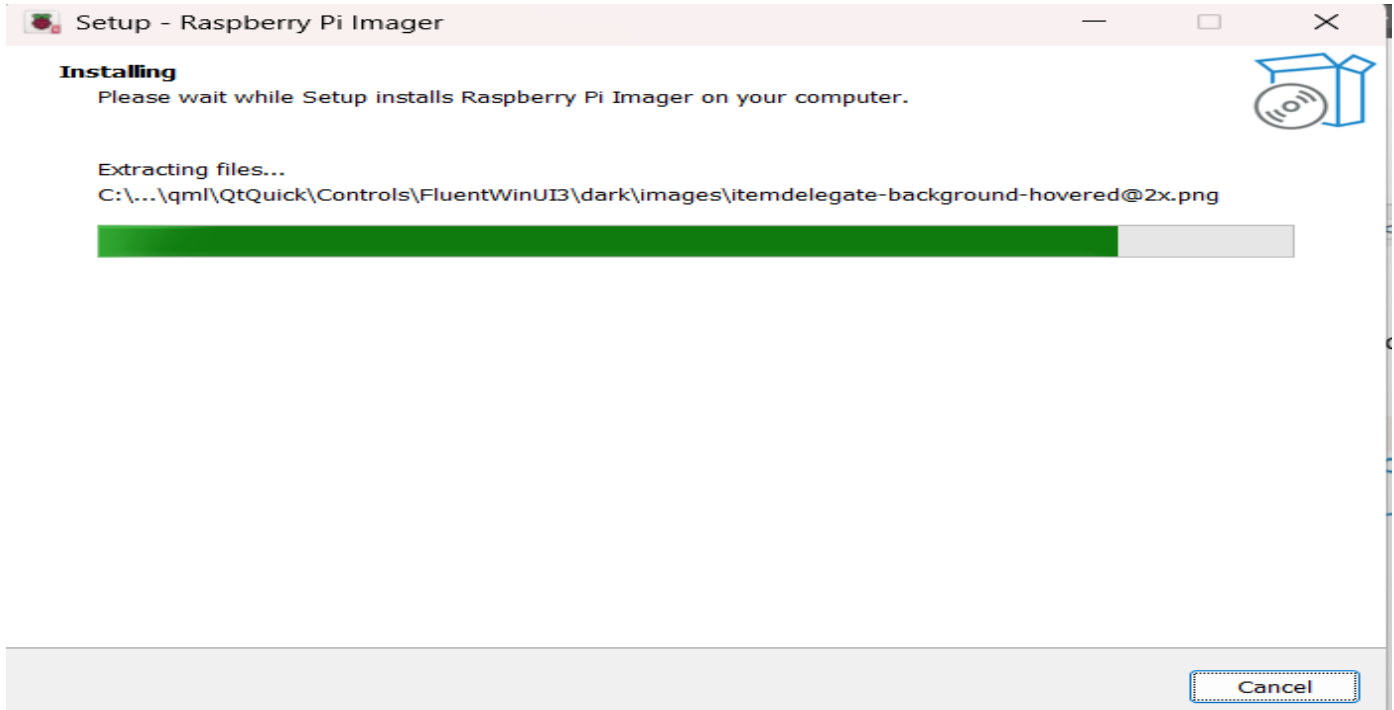
Select the additional tasks you would like Setup to perform while installing Raspberry Pi Imager, then click Next.

Additional shortcuts:

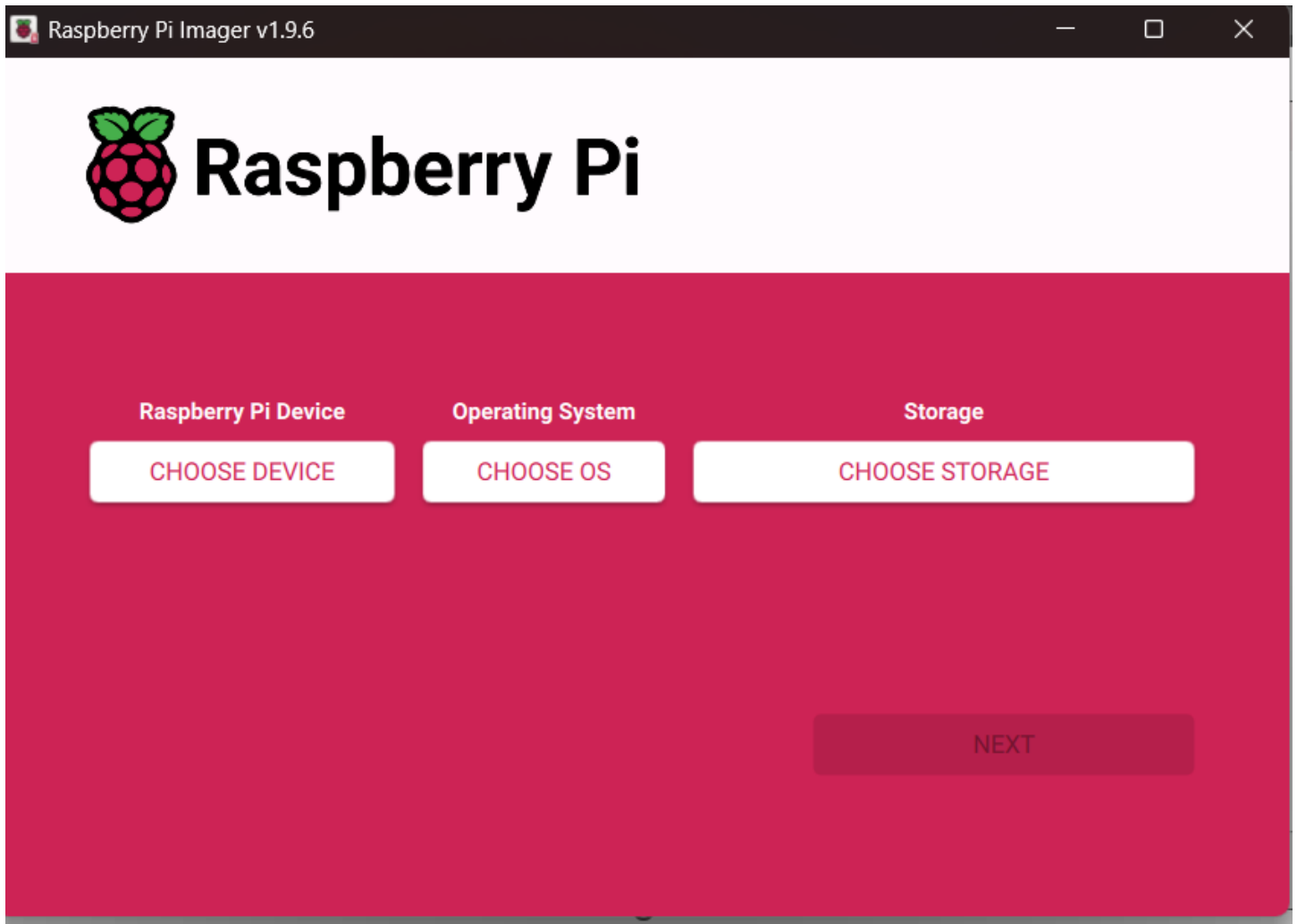
☒ Create a desktop shortcut

Back Next Cancel

Step 8: It is installing now when it successfully installed on your computer then you got, he completing the Raspberry pi imager set-up wizard. Then you have the click finish button to exit the setup.



The final output of installation is this, this is the interface of the Raspberry Pi imager Application.

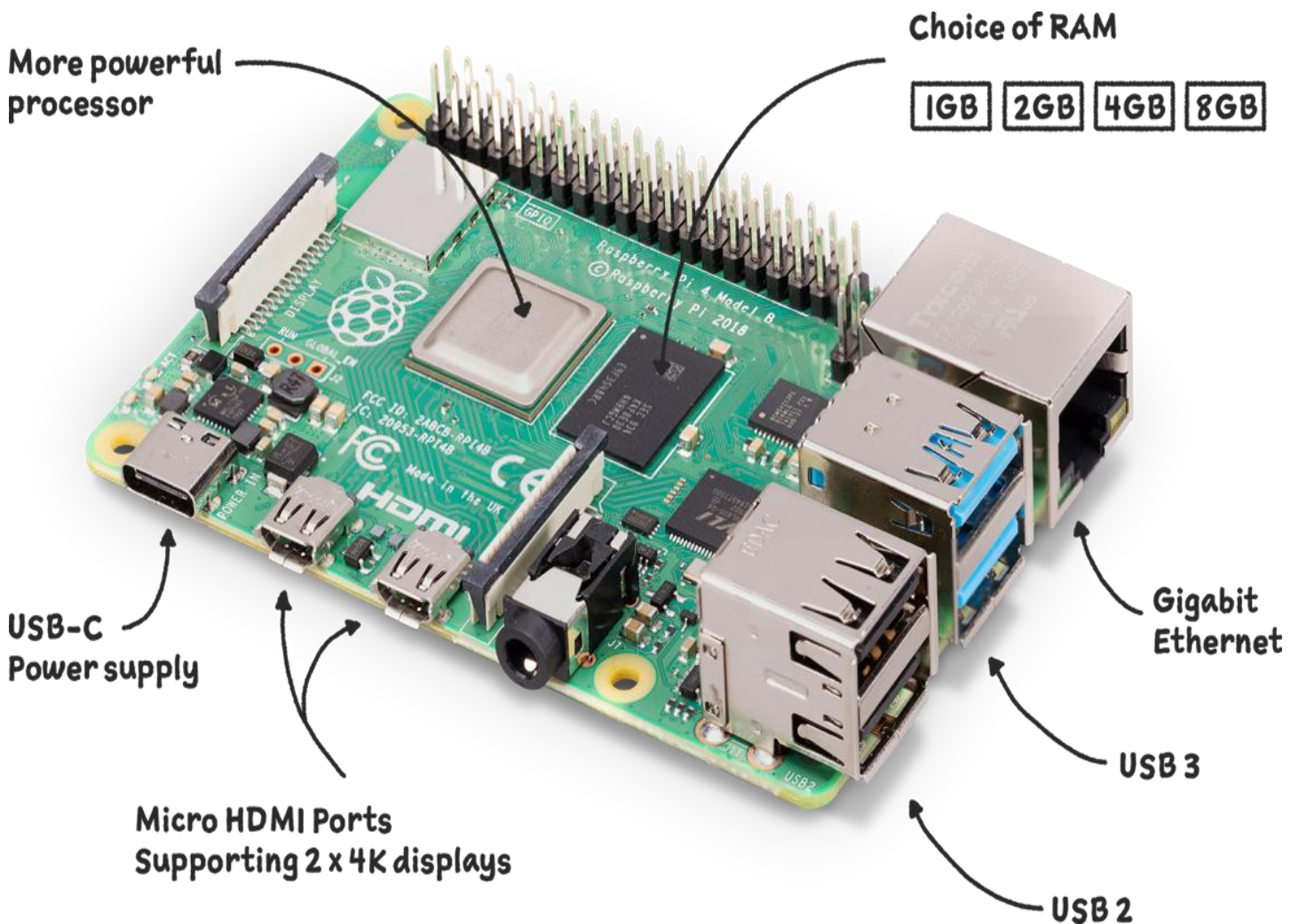


PRACTICAL 3A

AIM: Installing Raspbian OS on raspberry PI

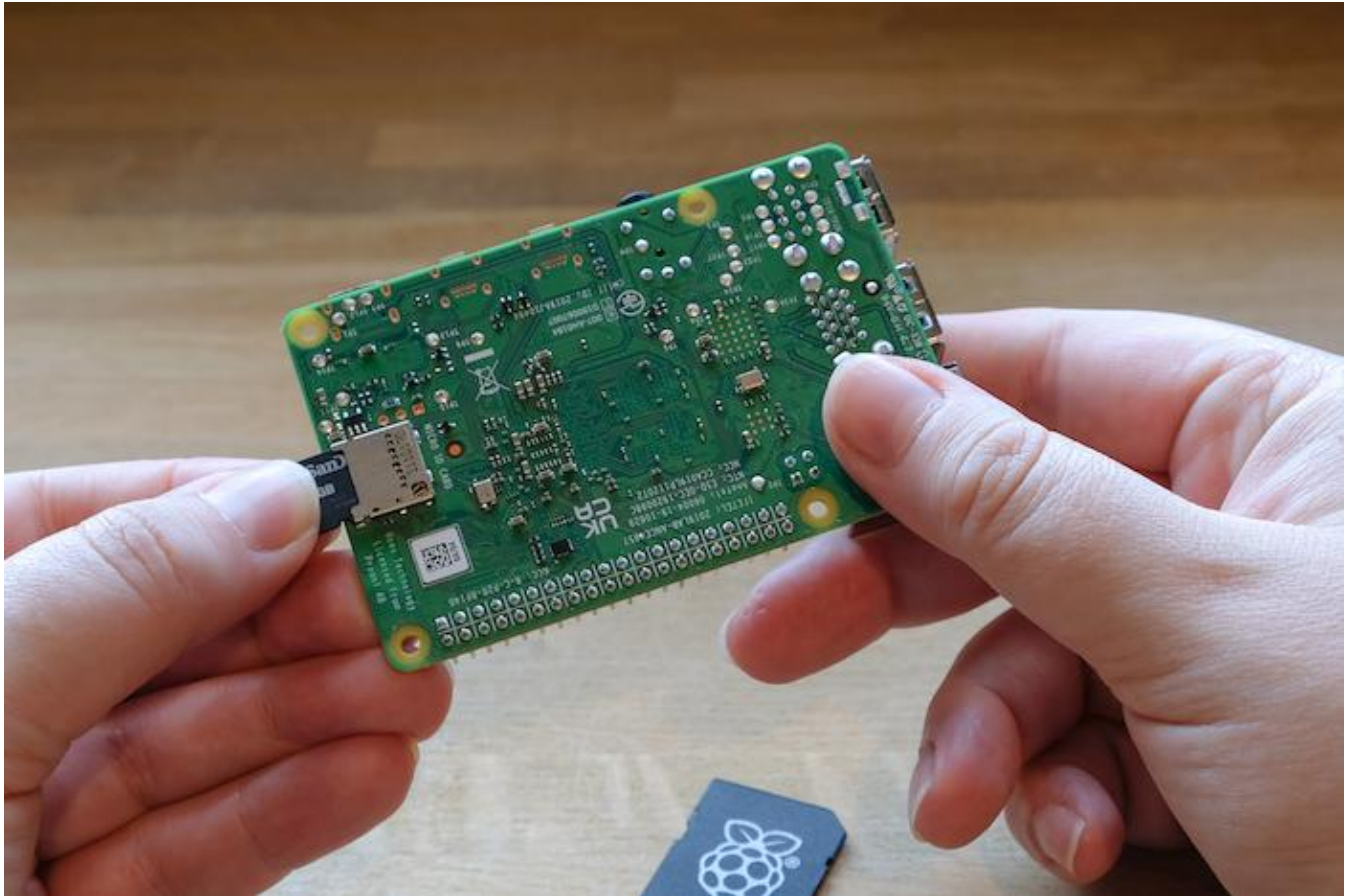
<u>SR.No.</u>	<u>REQUIREMENTS</u>	<u>WORKS</u>
1	Raspberry Pi	The main mini-computer where the OS runs.
2	SD card	Works as the storage drive to hold Raspberry Pi OS and files.
3	HDMI cable	Connects Raspberry Pi to a monitor/TV for display output.
4	Monitor	Displays the Raspberry Pi OS interface.
5	Adaptor	Supplies stable power to the Raspberry Pi.
6	USB Type C cable	Provides power supply to the Raspberry Pi.
7	Key Board & Mouse	Used for input and controlling the Raspberry Pi.

About the Raspberry Pi.



CONNECTION

Step 1: Insert the SD card into the Raspberry Pi, it acts as the main storage, containing the Raspberry Pi OS, and allows the system to boot and run applications properly.



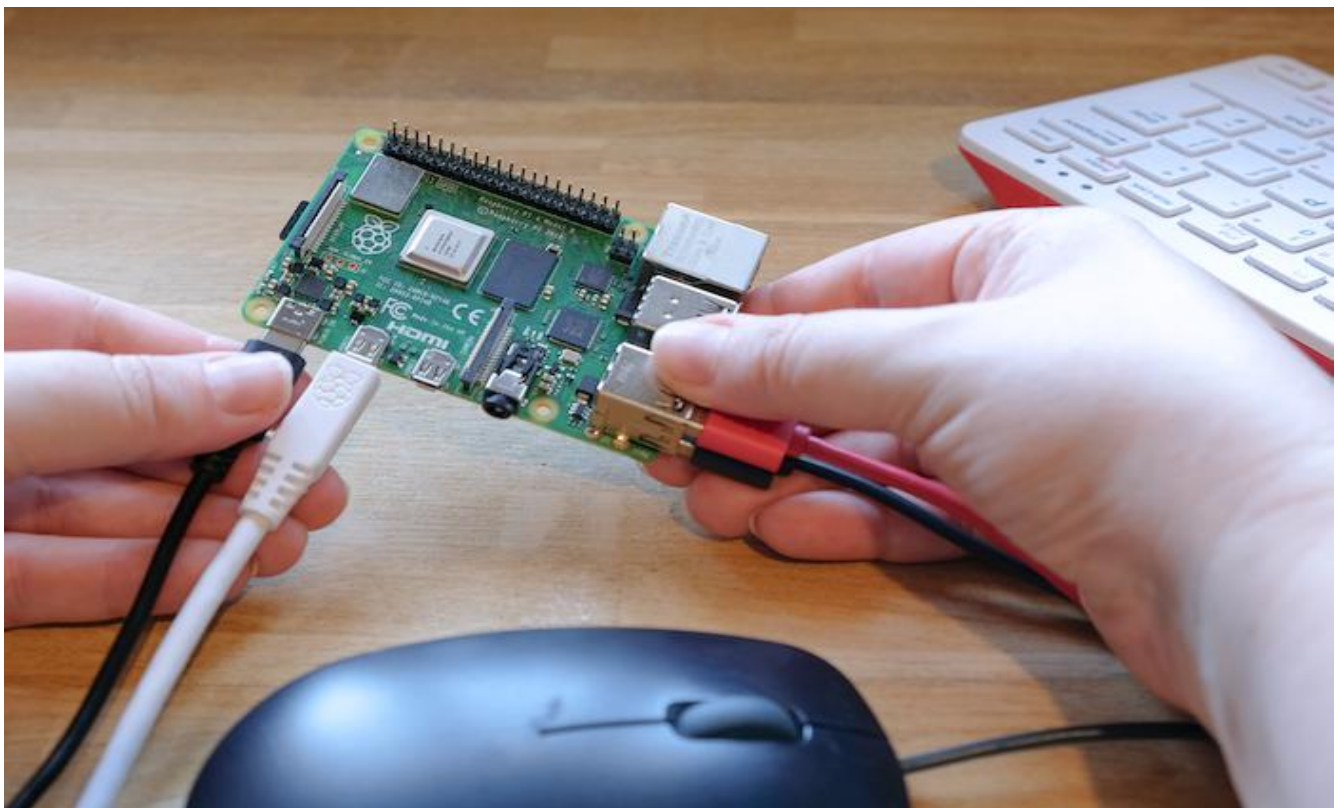
Step 2: Connect the keyboard and mouse to the Raspberry Pi, they provide input control, allowing us to type commands, navigate the desktop, configure settings, and interact with the operating system easily.



Step 3: Connect the HDMI cable to the Raspberry Pi, it transfers both video and audio signals, enabling the monitor or TV to display the operating system and user interface clearly.



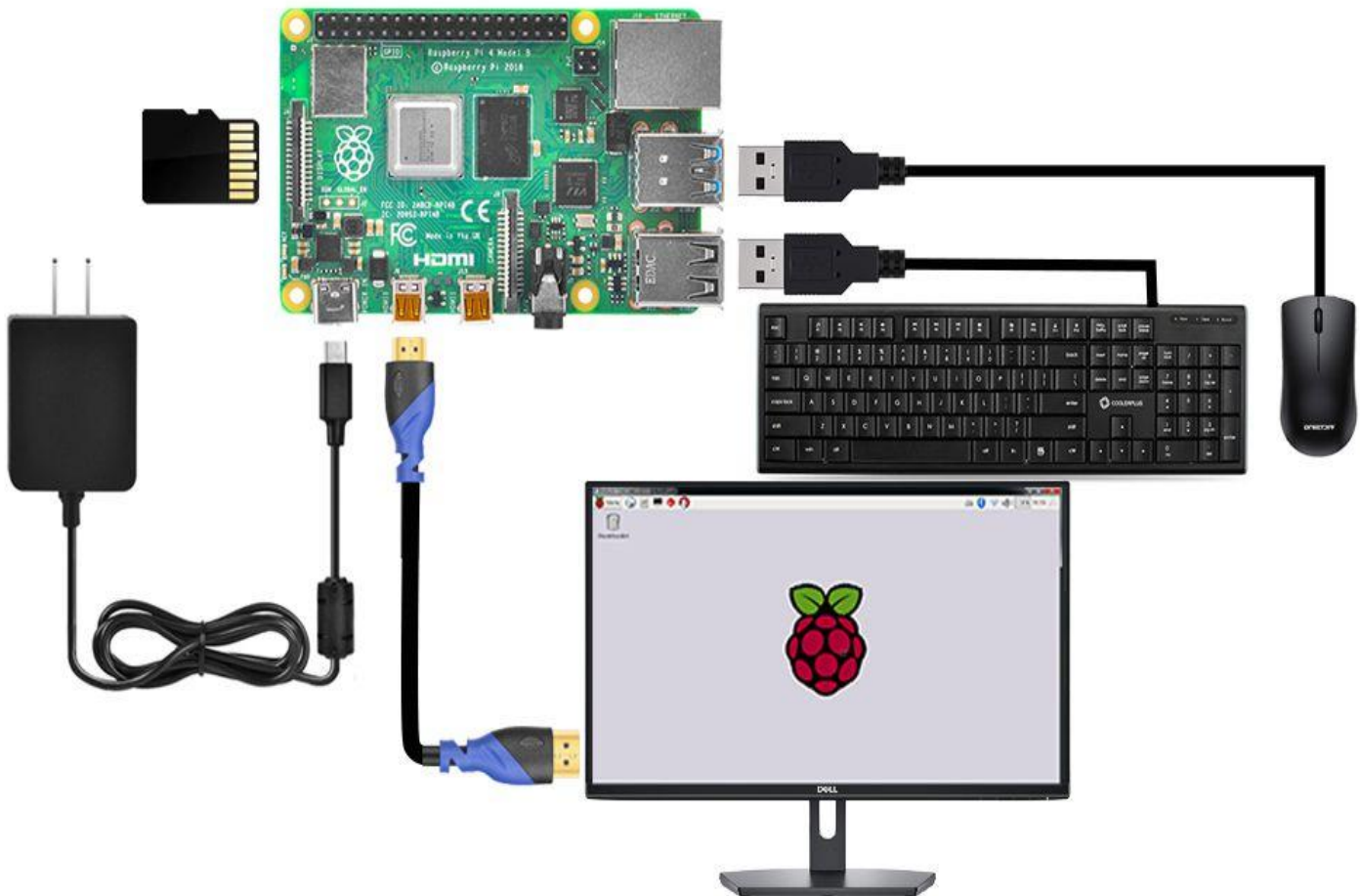
Step 4: Connect the Type-C cable to the Raspberry Pi, it provides the required power supply, ensuring the board starts, runs the operating system, and functions properly for all tasks.



When all connections are done and we power the Raspberry Pi:

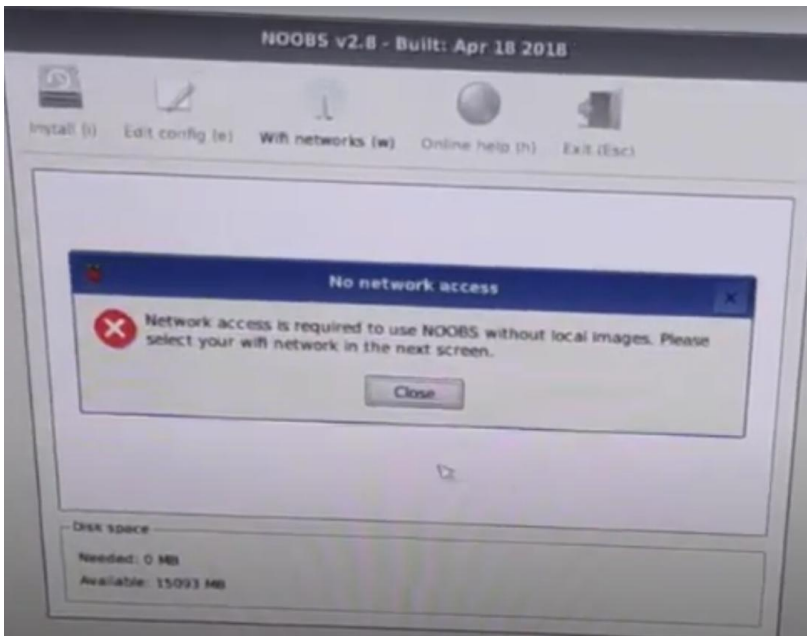
1. **Red LED lights up** → confirms power supply.
2. **Green LED blinks** → Raspberry Pi reads the SD card and boots the OS.
3. **Display appears on monitor via HDMI** → Raspberry Pi OS logo and boot process show up.
4. **Keyboard and mouse become active** → allow you to control and set up the system.
5. **Raspberry Pi is ready to use** → you can start programming, browsing, or running projects.

CONNECTION DIAGRAM

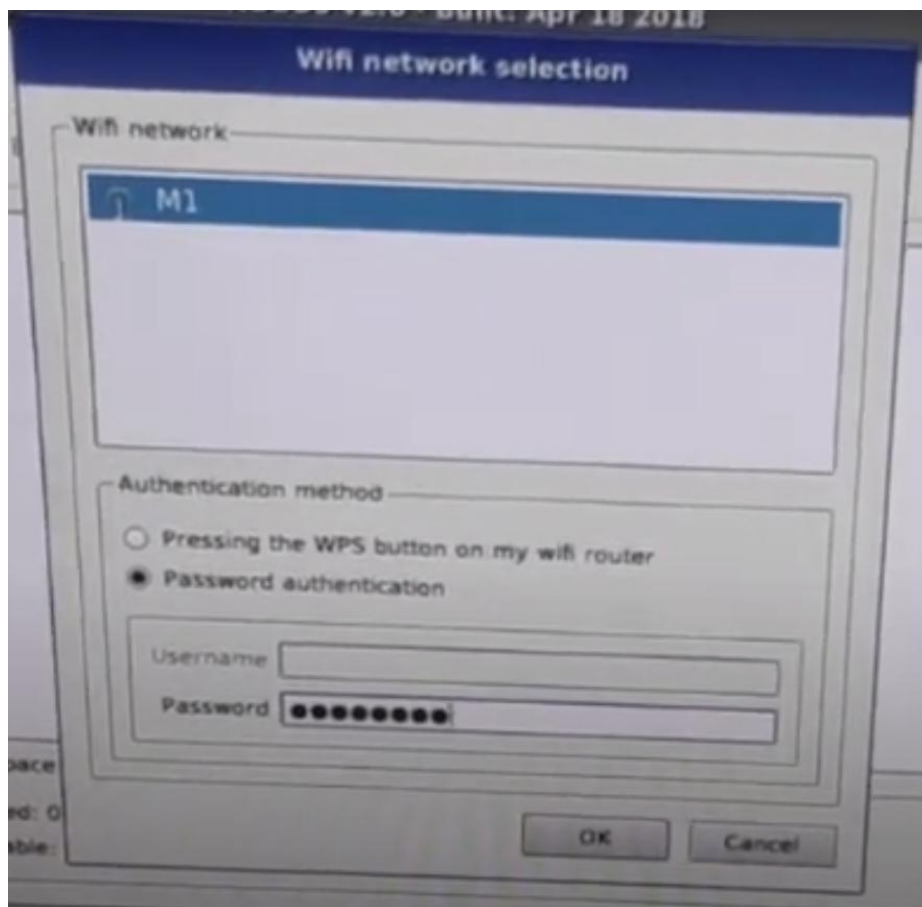


INSTALLATION

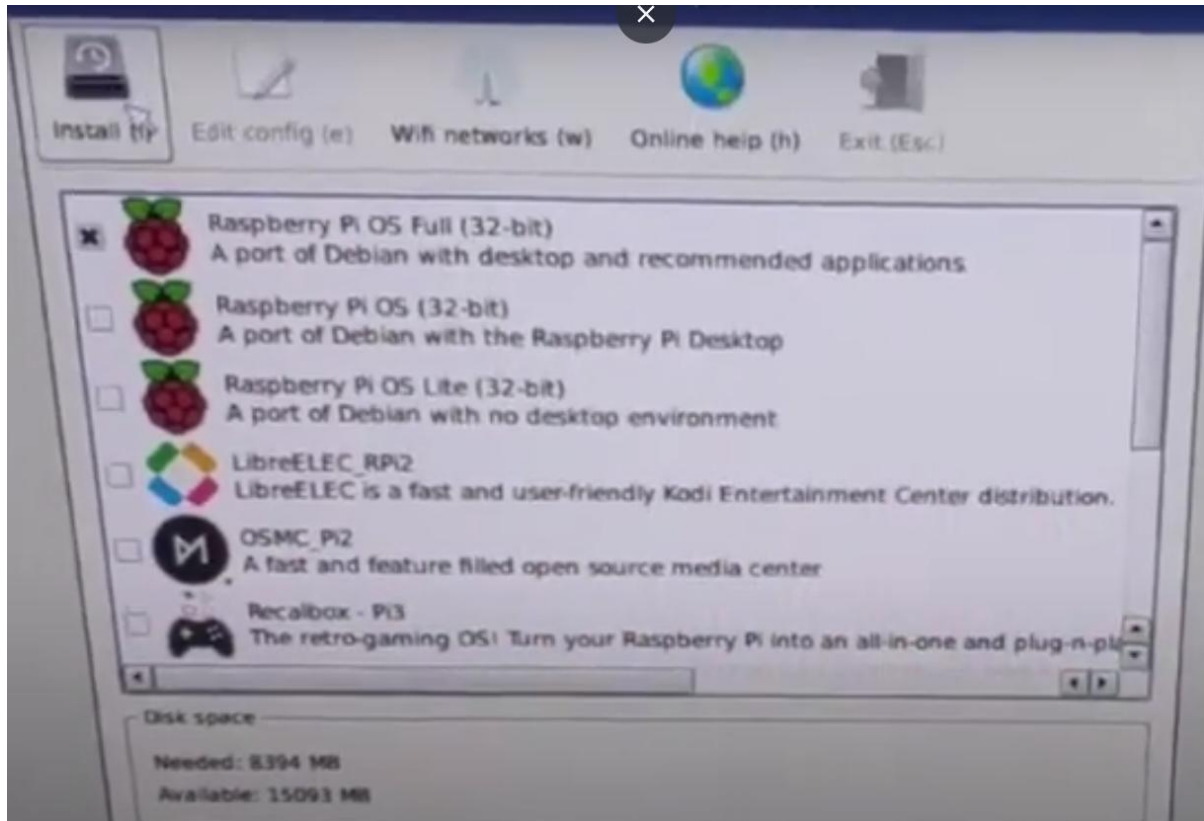
In the beginning it shows the error of the internet connection like this.



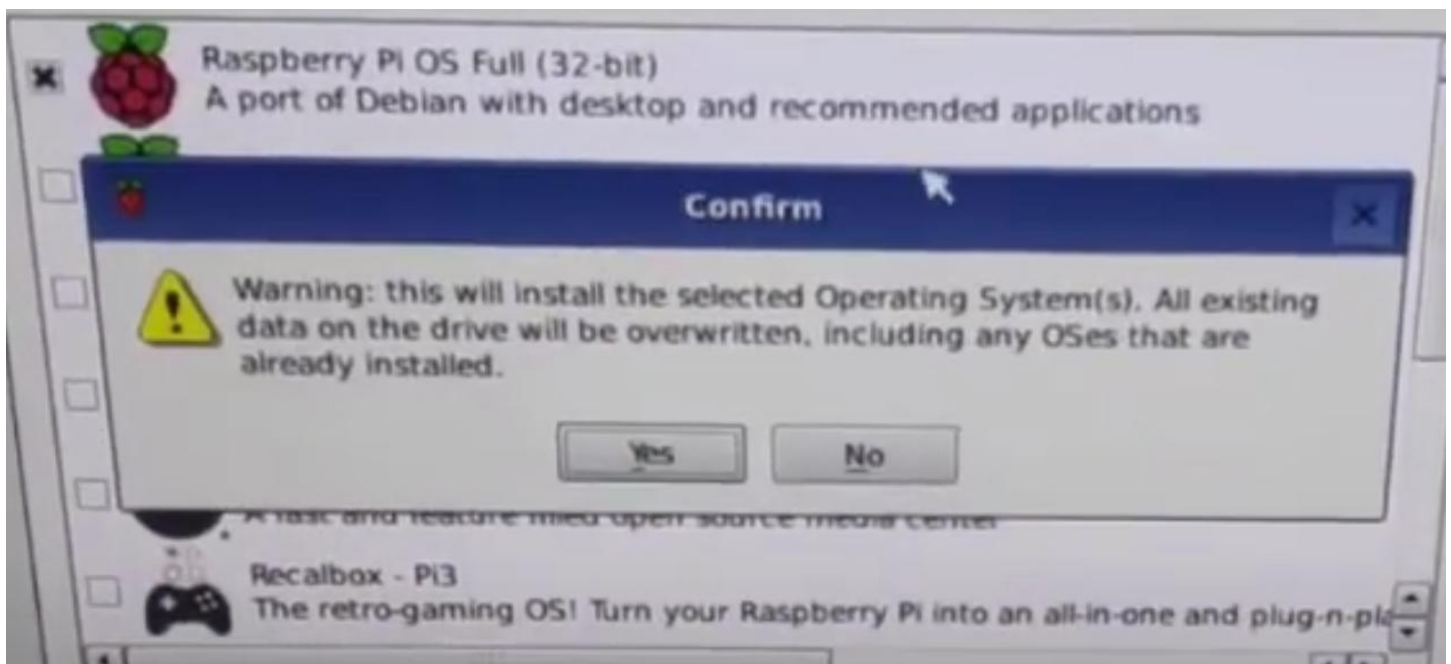
Step 1: Select your Wi-Fi name, after the selection of your Wi-Fi name then enter the password and hit the ok button.



Step 2: Select your preferred operating system from the NOOBS menu, then click “Install.” The Raspberry Pi will automatically install it.



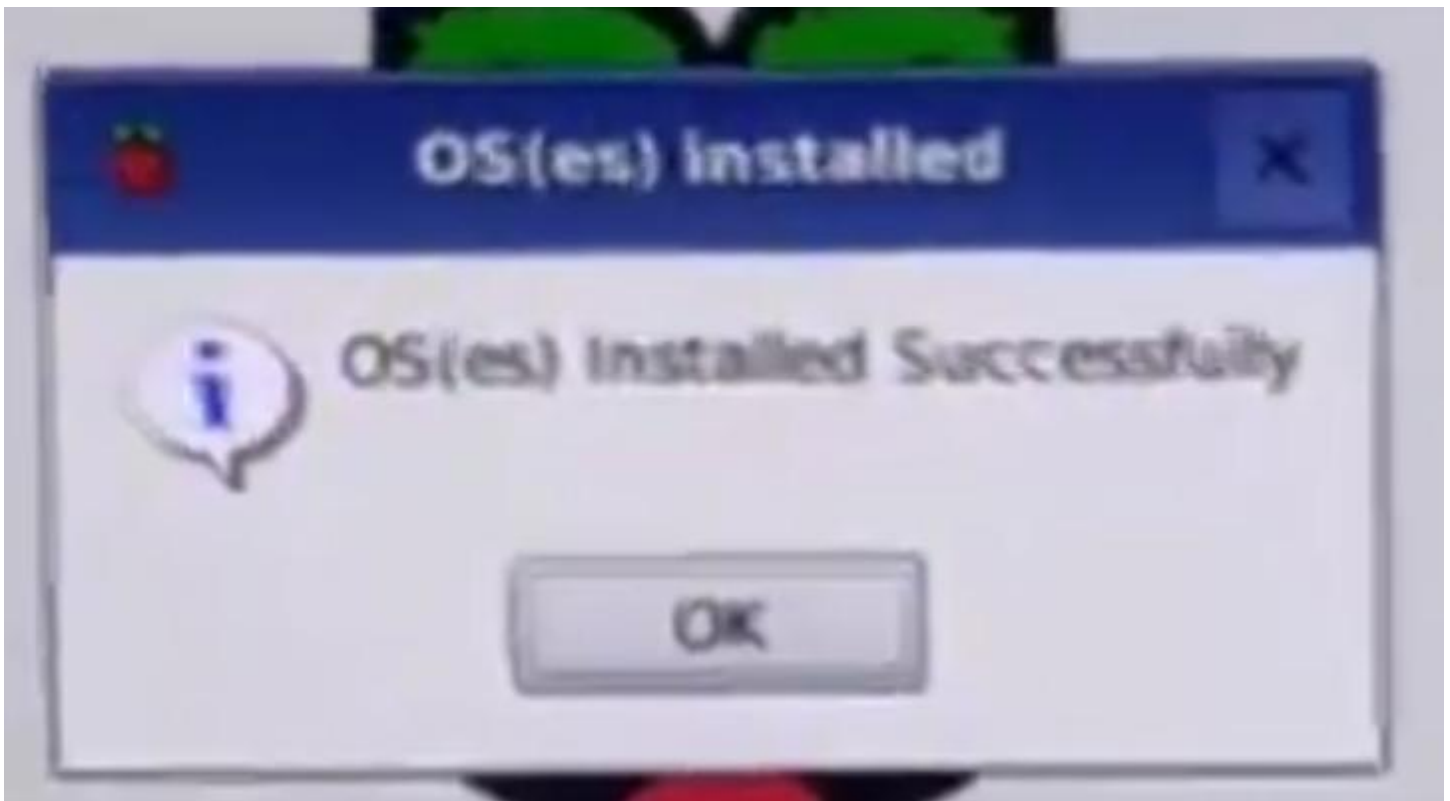
Step 3: After clicking on the install button, it shows a warning click on the Yes button.



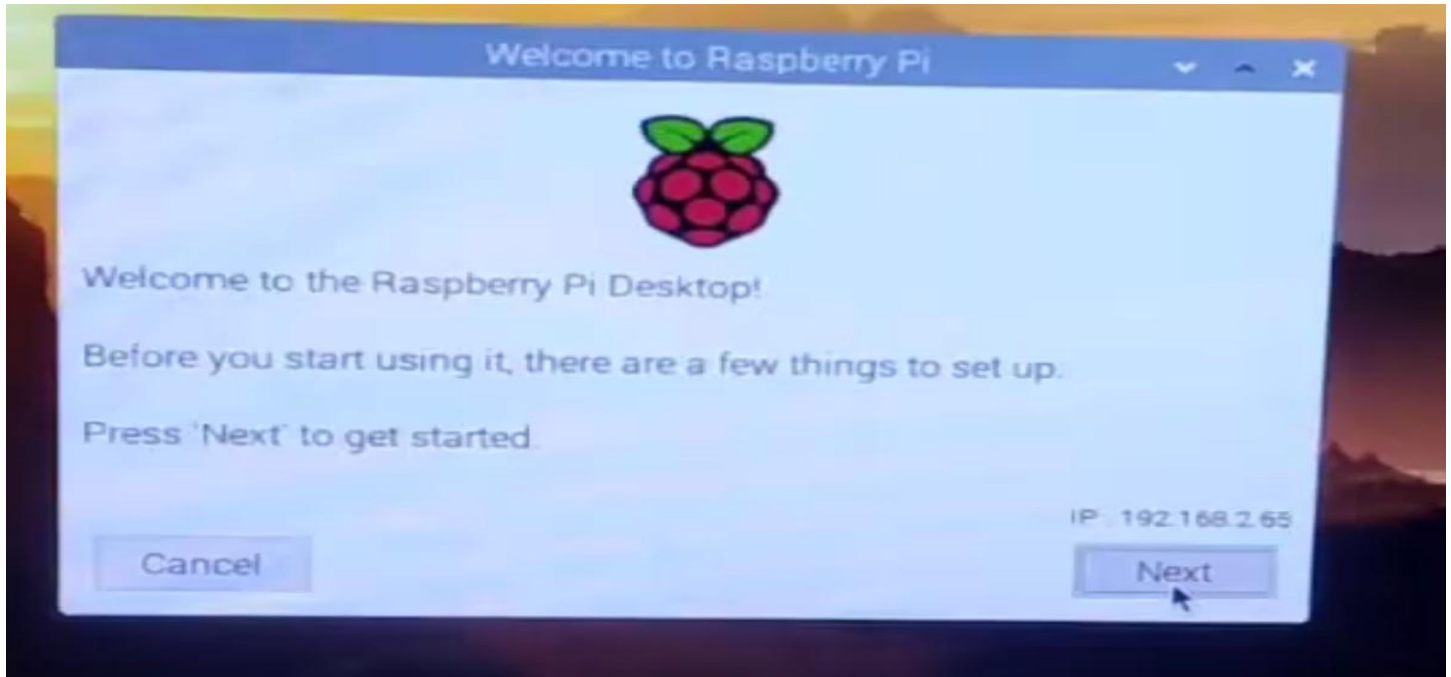
Step 4: Now it is Installing.



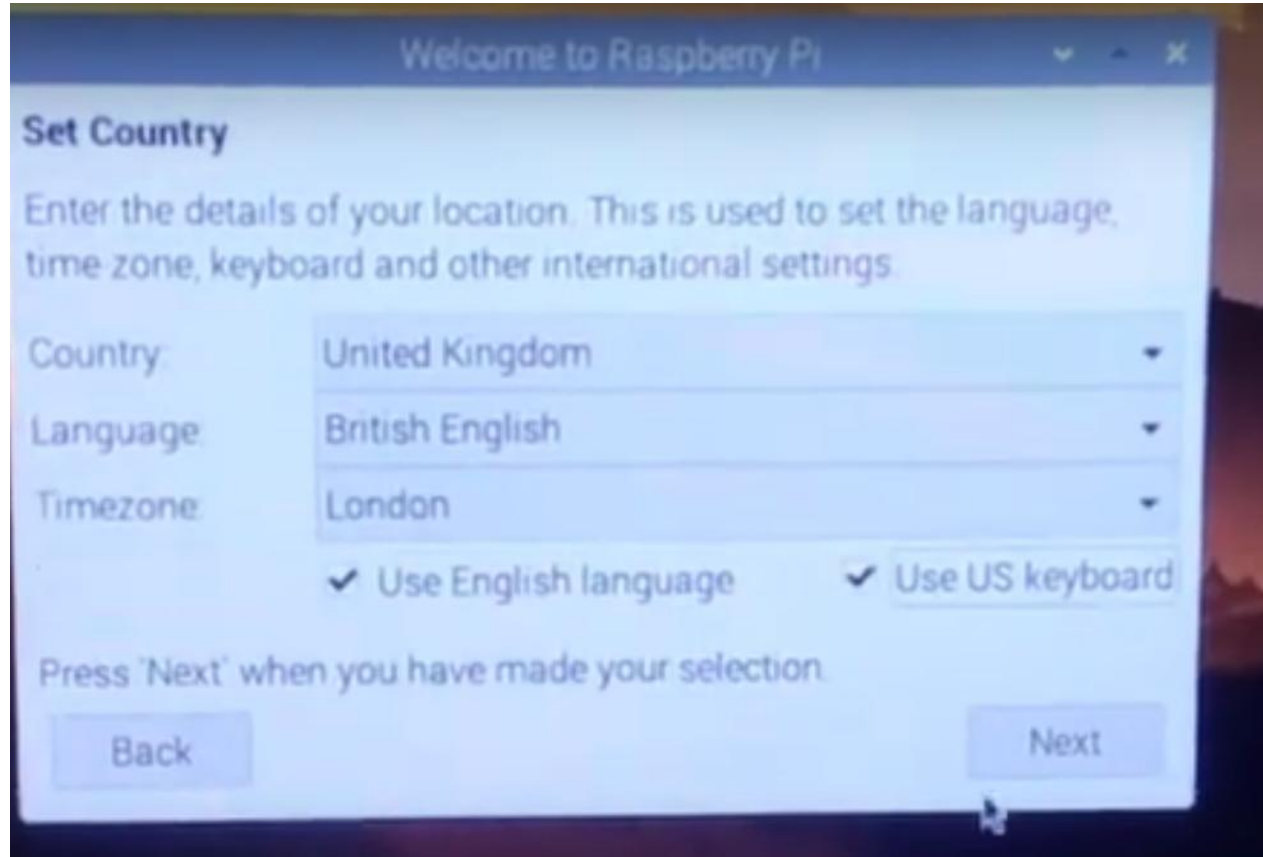
Step 5: When this is installed then you show the Installed successfully message, then click on OK button.



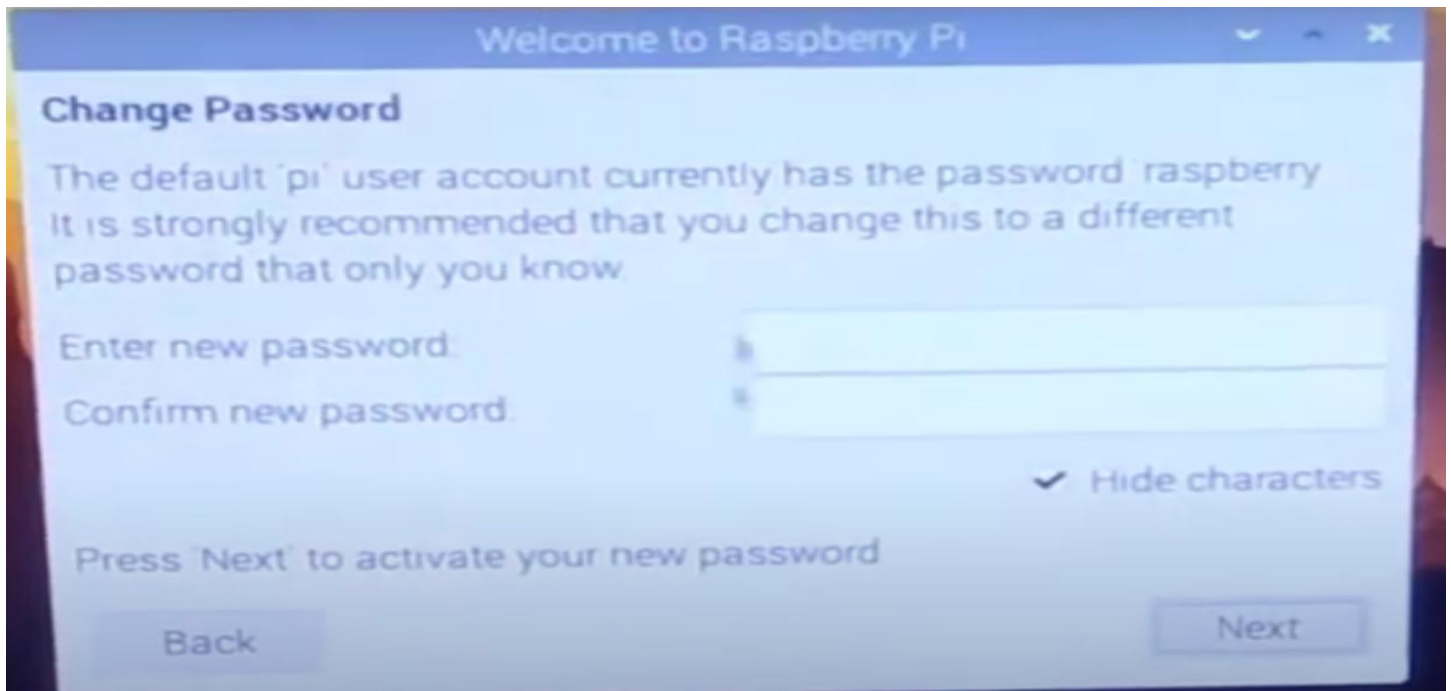
Step 6: After the successfully installation then we have to do some set-up, Now you see the set-up dialog click on the Next button.



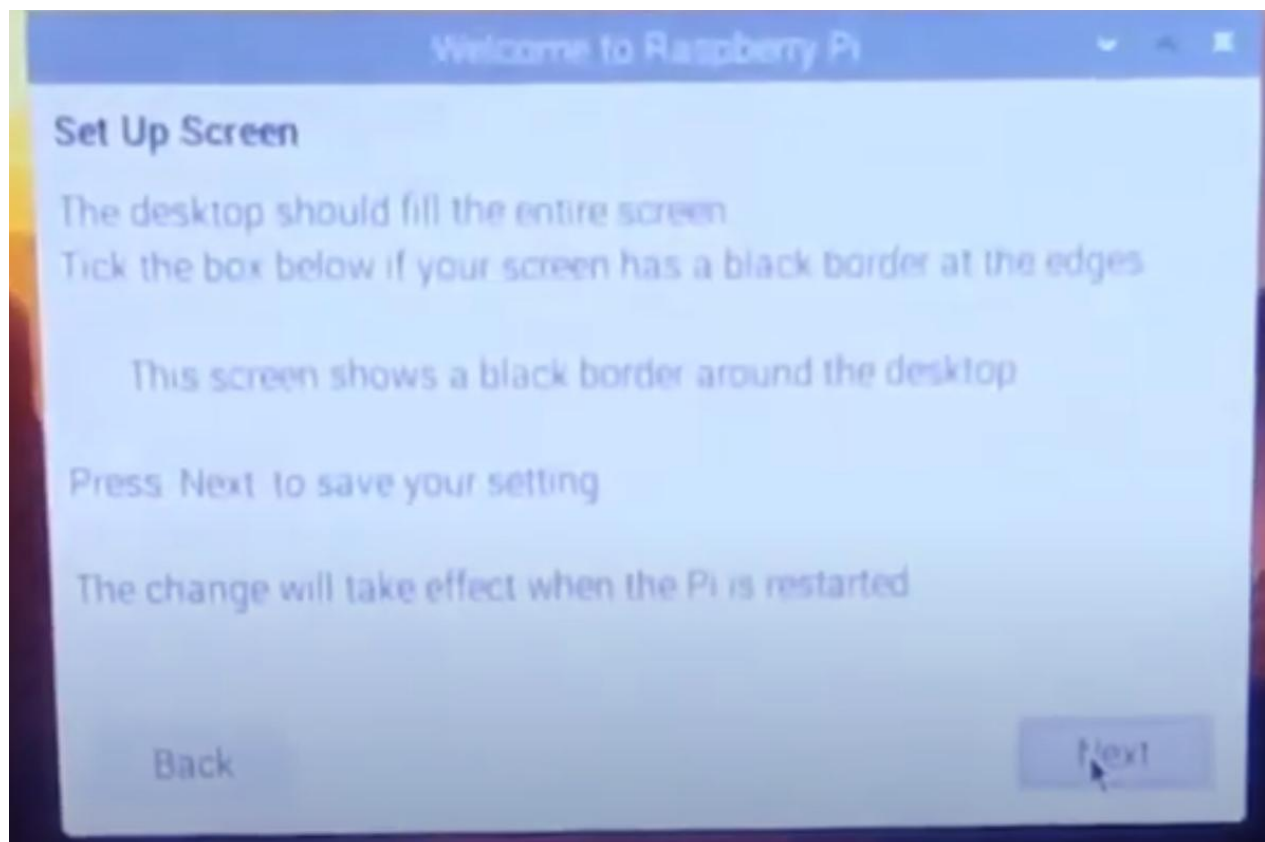
Step 7: Then click on the checkbox of Use English Language and Use US Keyboard



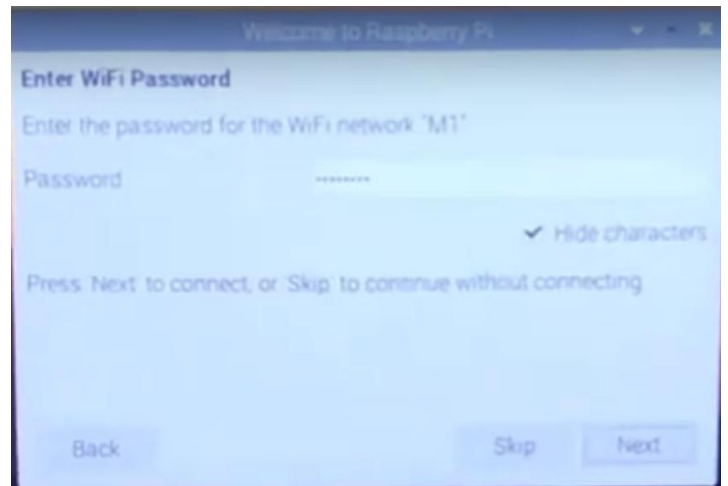
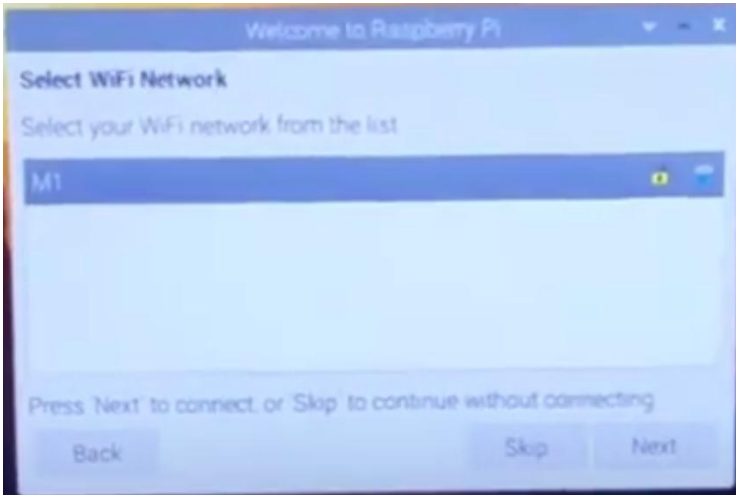
Step 8: After clicking the next button then we show the change password interface, here no need to keep password, if you want then you can choose randomly otherwise the default password is “raspberry”. Then click on the next button.



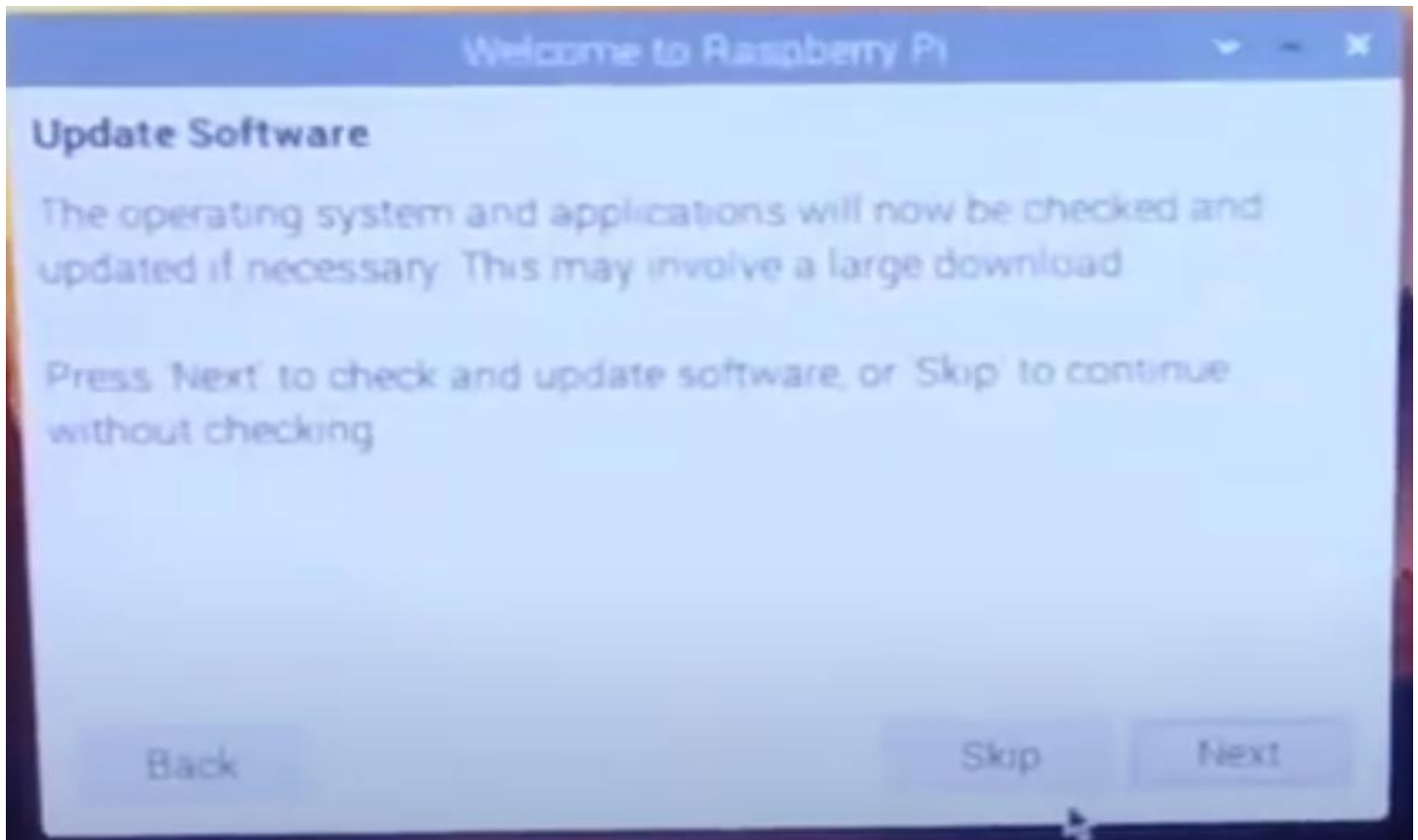
Step 9: Now we show the Setup screen interface, here nothing to do changes then click on the next button.



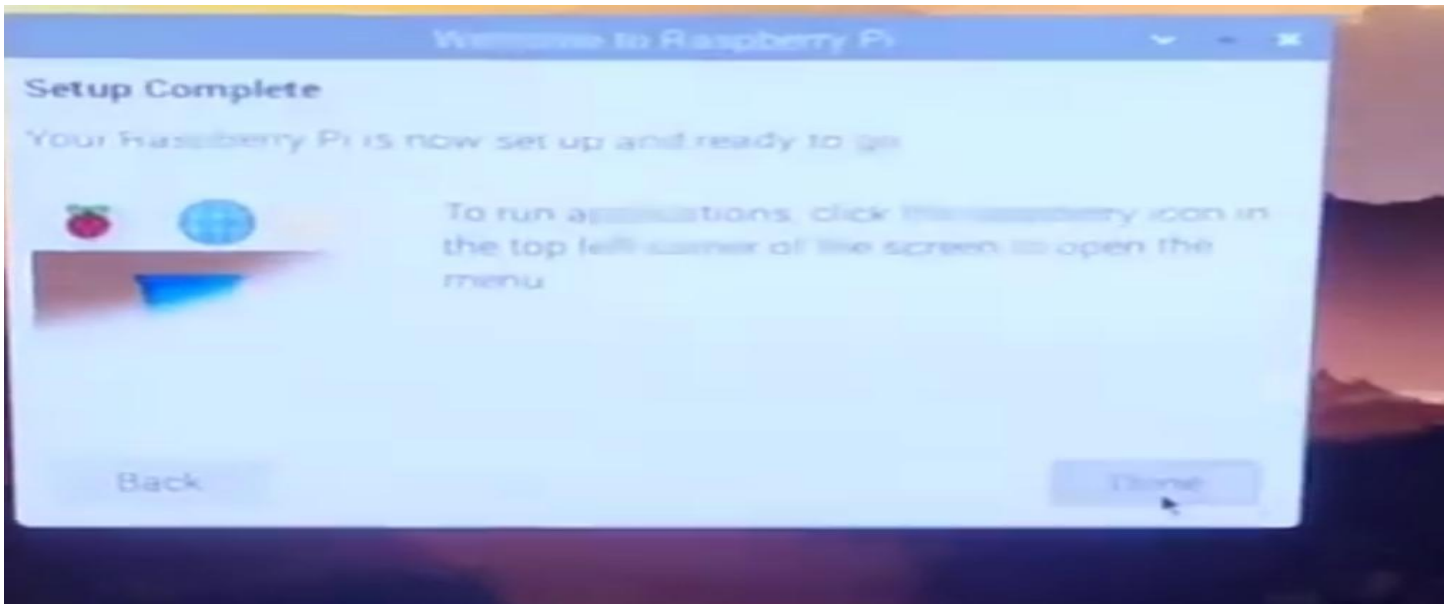
Step 10: Select your Wi-Fi and select Next button then Enter your Wi-Fi password again click on the Next button.



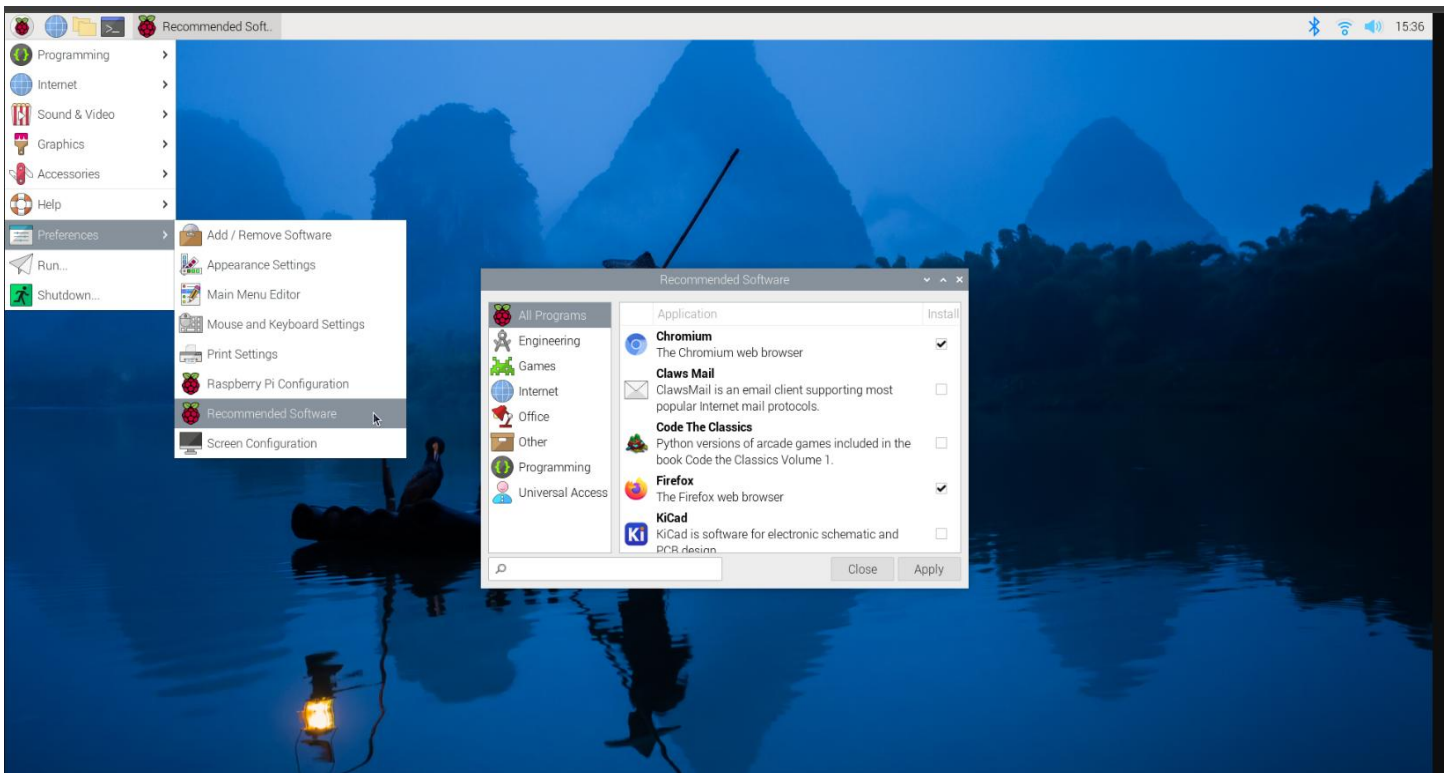
Step 11: Now you see the Update software at this time we don't need to update it takes so many times to update, so we click here **Skip**.



Step 12: Now we have the interface of Setup Complete and click on the Done button.



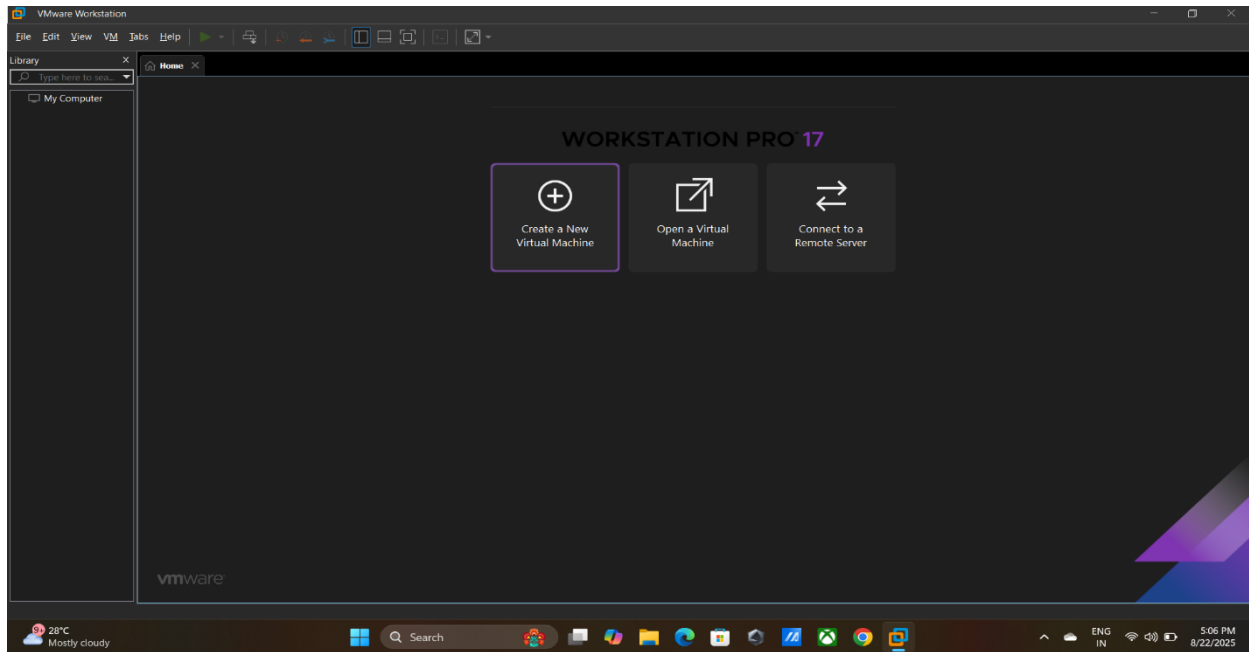
Step 13: Now we are good to go to run our raspberry pi. Here is the final Output of the raspberry pi display.



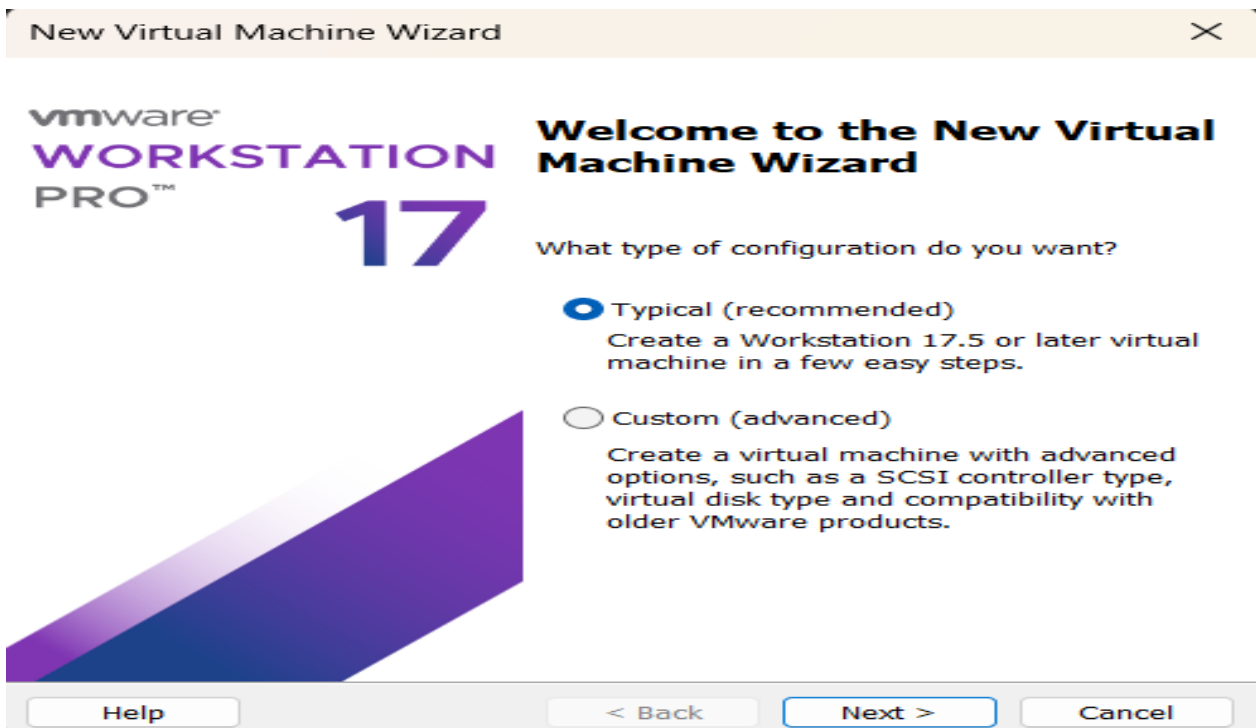
PRACTICAL – 3B

AIM: Installing Raspbian OS with the help of virtual Machine software.

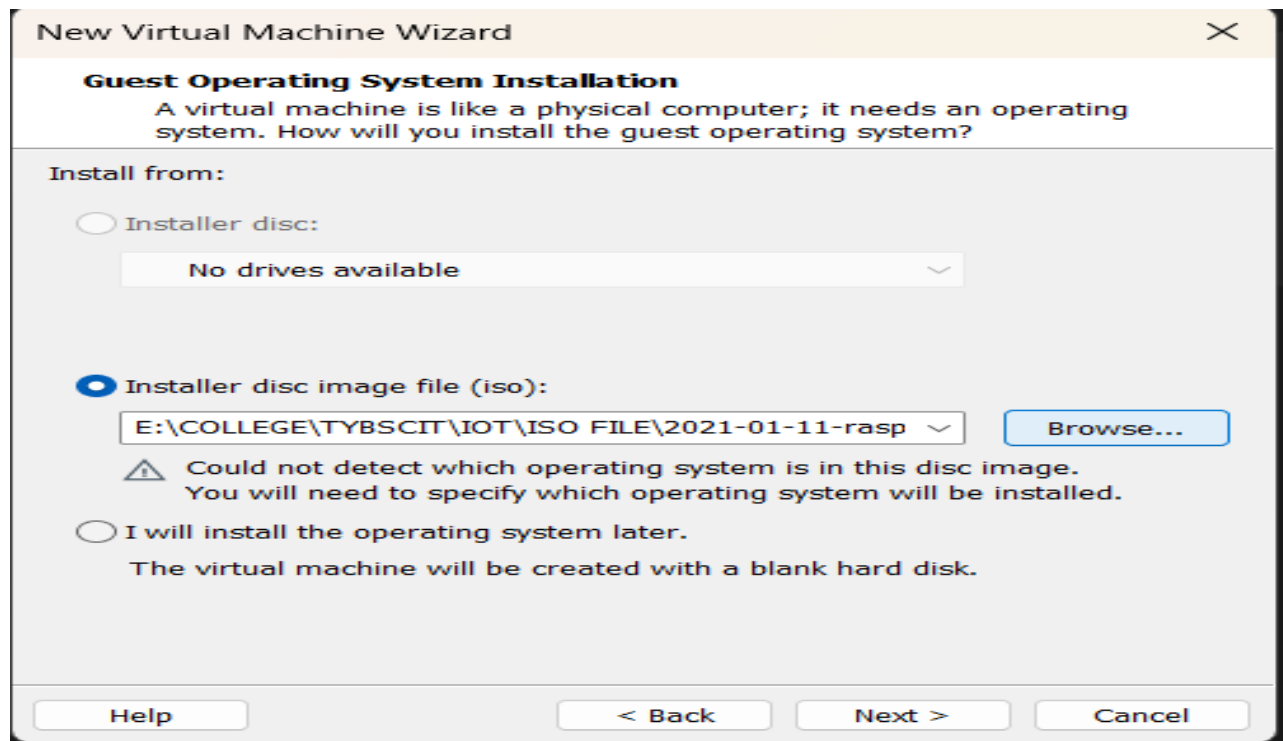
Step 1: Open VMware and click on create new virtual machine



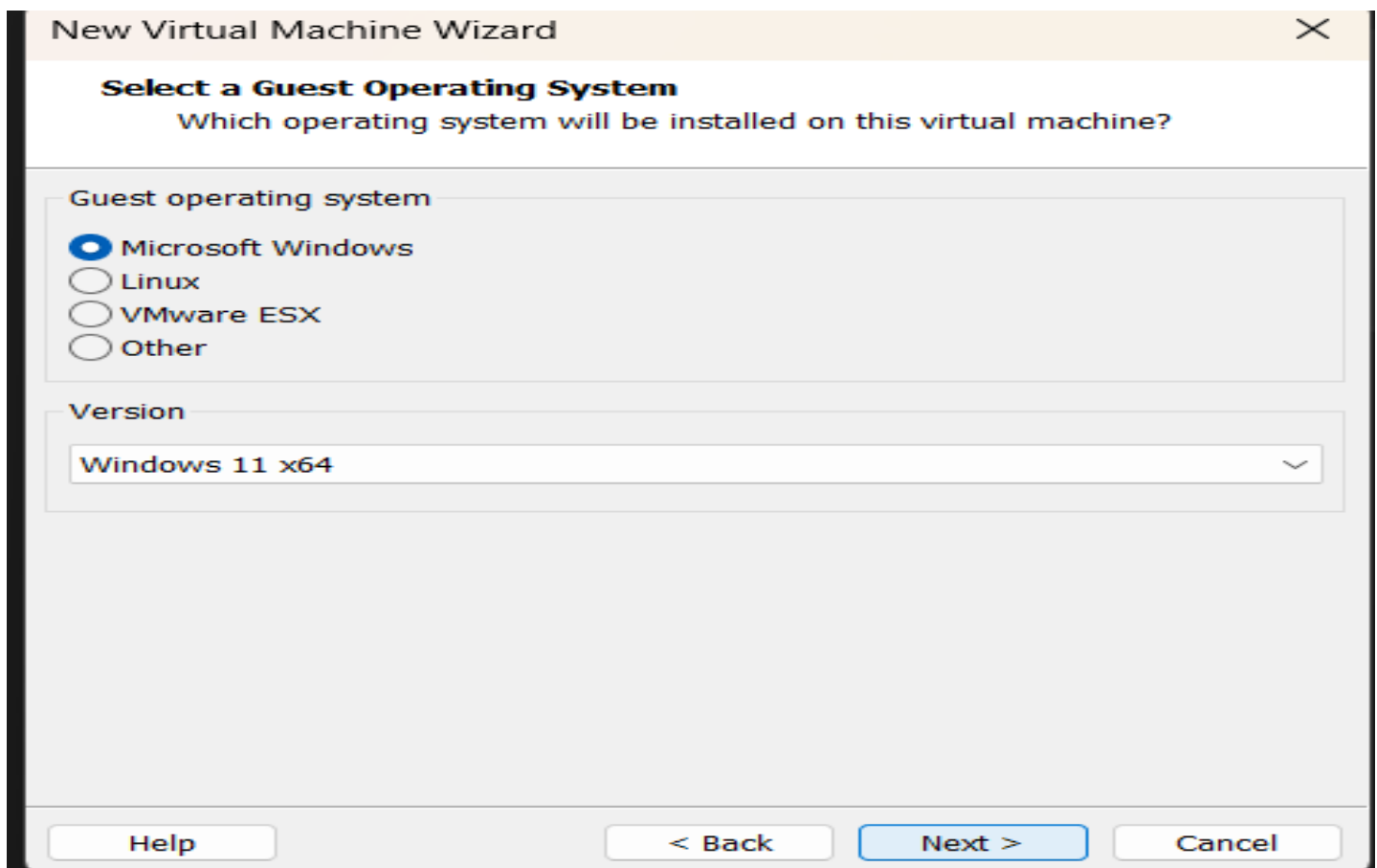
Step 2: Now click on Typical and click on the Next button.



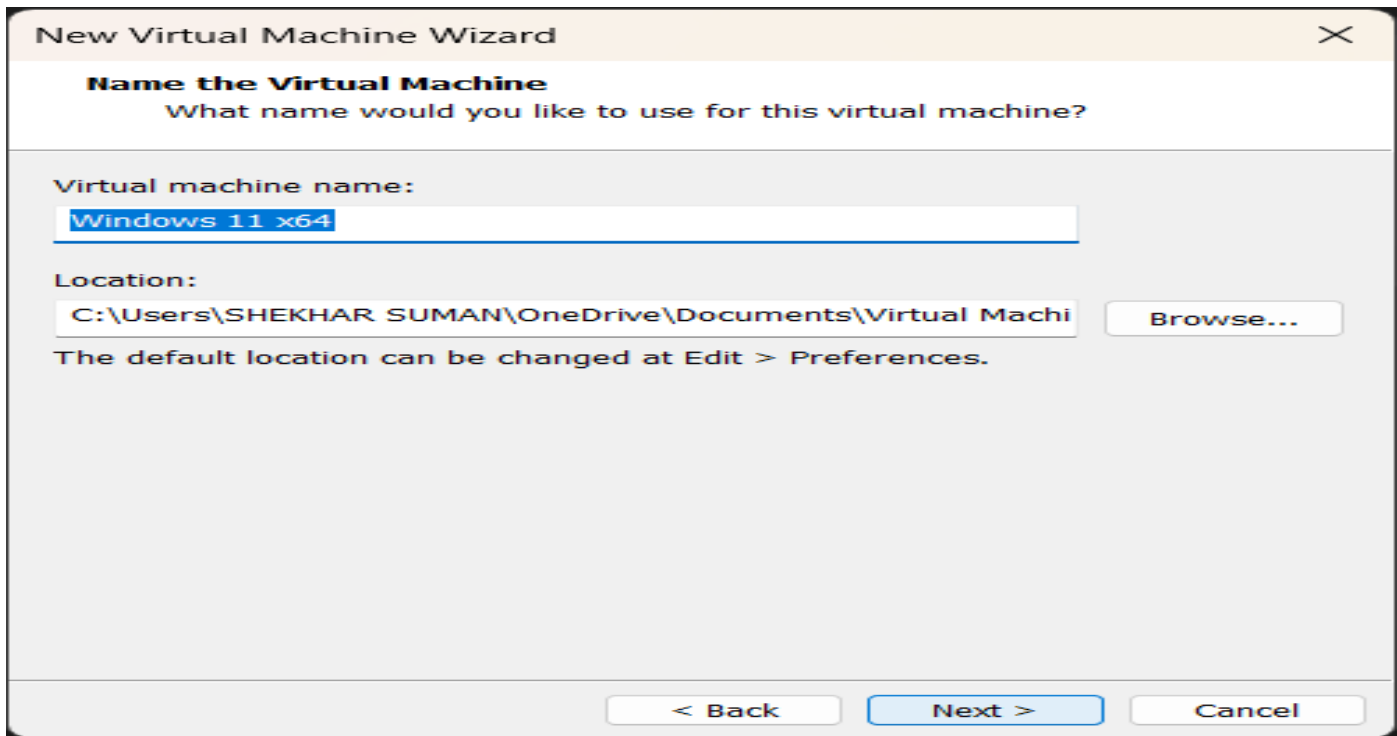
Step 3: Then browse the **ISO** file and again hit the next button.



Step 4: Click on the Microsoft window and click on the Next button.

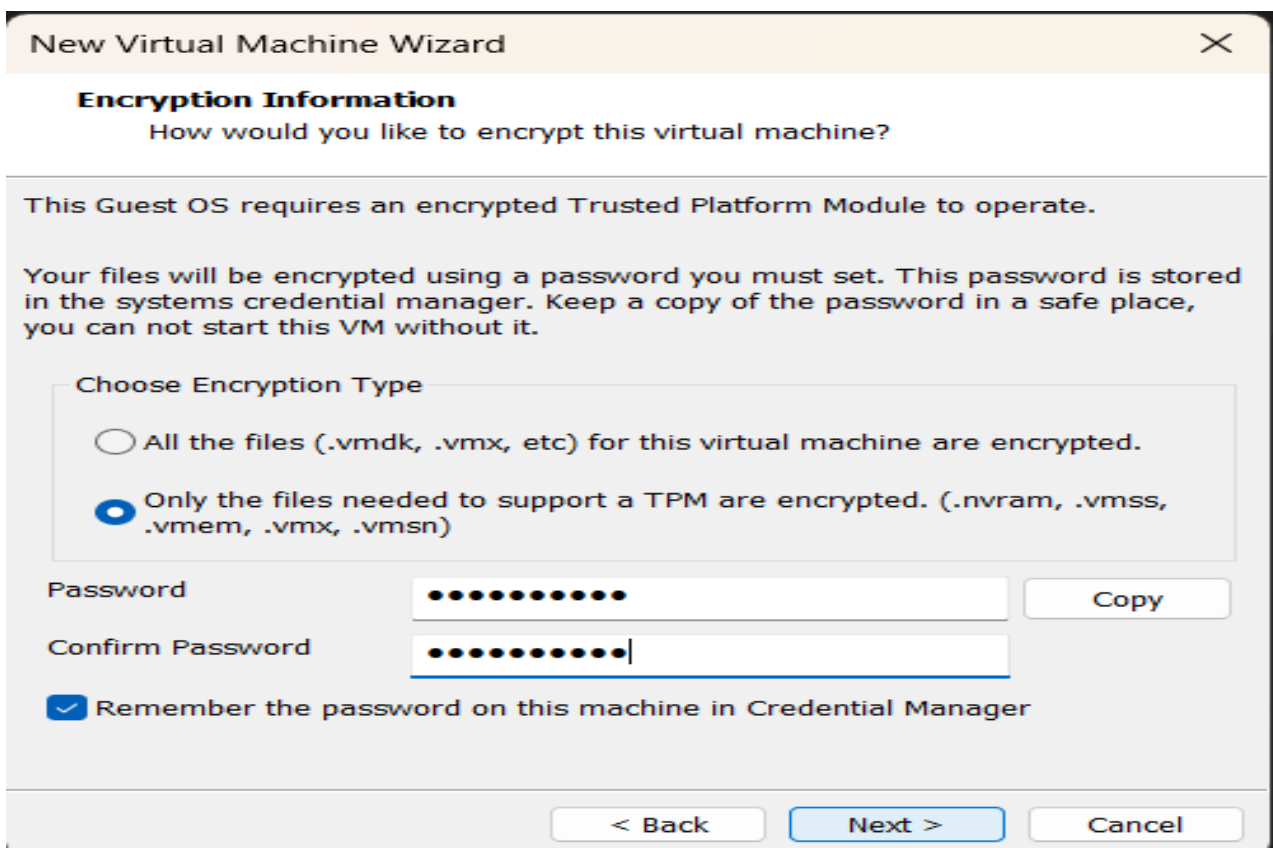


Step 5: Now the system asks the name of our virtual machine, here I don't want to change the name so I go with the default name then click on the next button.



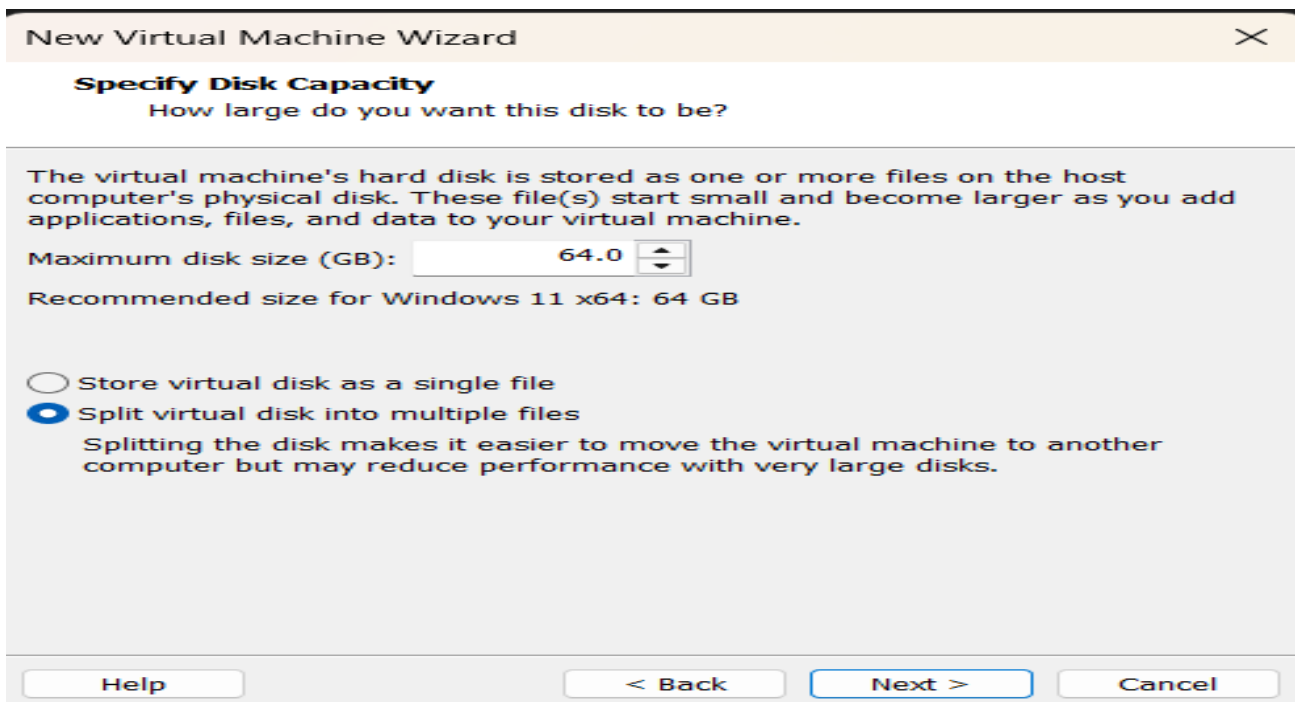
The screenshot shows the 'New Virtual Machine Wizard' dialog box. The title bar says 'New Virtual Machine Wizard' with a close button. The main heading is 'Name the Virtual Machine' with the subtitle 'What name would you like to use for this virtual machine?'. Below this, there is a text field for 'Virtual machine name:' containing 'Windows 11 x64'. Underneath is a 'Location:' section with a text field showing 'C:\Users\SHEKHAR SUMAN\OneDrive\Documents\Virtual Machi' and a 'Browse...' button. A note states 'The default location can be changed at Edit > Preferences.' At the bottom, there are three buttons: '< Back', 'Next >', and 'Cancel'.

Step 6: Then create your strong password then click on the next button.



The screenshot shows the 'New Virtual Machine Wizard' dialog box at the 'Encryption Information' step. The title bar says 'New Virtual Machine Wizard' with a close button. The main heading is 'Encryption Information' with the subtitle 'How would you like to encrypt this virtual machine?'. Below this, a message states 'This Guest OS requires an encrypted Trusted Platform Module to operate.' and another message explains that files will be encrypted using a password stored in the system's credential manager. There is a section 'Choose Encryption Type' with two radio button options: 'All the files (.vmdk, .vmx, etc) for this virtual machine are encrypted.' and 'Only the files needed to support a TPM are encrypted. (.nvram, .vmss, .vmem, .vmx, .vmsn)'. The second option is selected. Below this are two password fields: 'Password' and 'Confirm Password', both containing masked characters. A 'Copy' button is next to the first password field. At the bottom, there is a checked checkbox 'Remember the password on this machine in Credential Manager' and three buttons: '< Back', 'Next >', and 'Cancel'.

Step 7: Nothing to change here and click on the next button.



New Virtual Machine Wizard

Specify Disk Capacity
How large do you want this disk to be?

The virtual machine's hard disk is stored as one or more files on the host computer's physical disk. These file(s) start small and become larger as you add applications, files, and data to your virtual machine.

Maximum disk size (GB):

Recommended size for Windows 11 x64: 64 GB

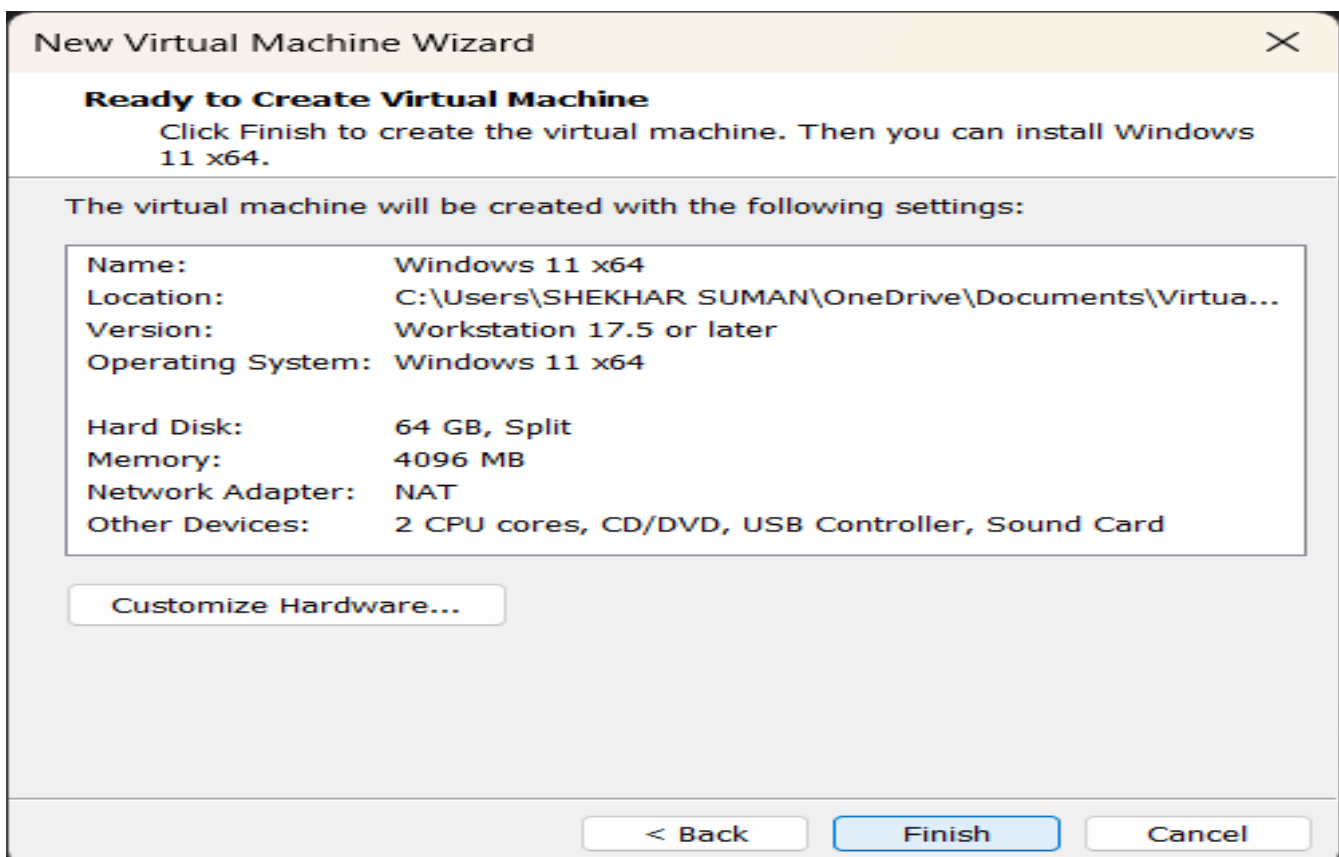
☐ Store virtual disk as a single file

☒ Split virtual disk into multiple files

Splitting the disk makes it easier to move the virtual machine to another computer but may reduce performance with very large disks.

Help < Back Next > Cancel

Step 8: Then click on the finish button to finish of the setup Raspbian ISO file.



New Virtual Machine Wizard

Ready to Create Virtual Machine
Click Finish to create the virtual machine. Then you can install Windows 11 x64.

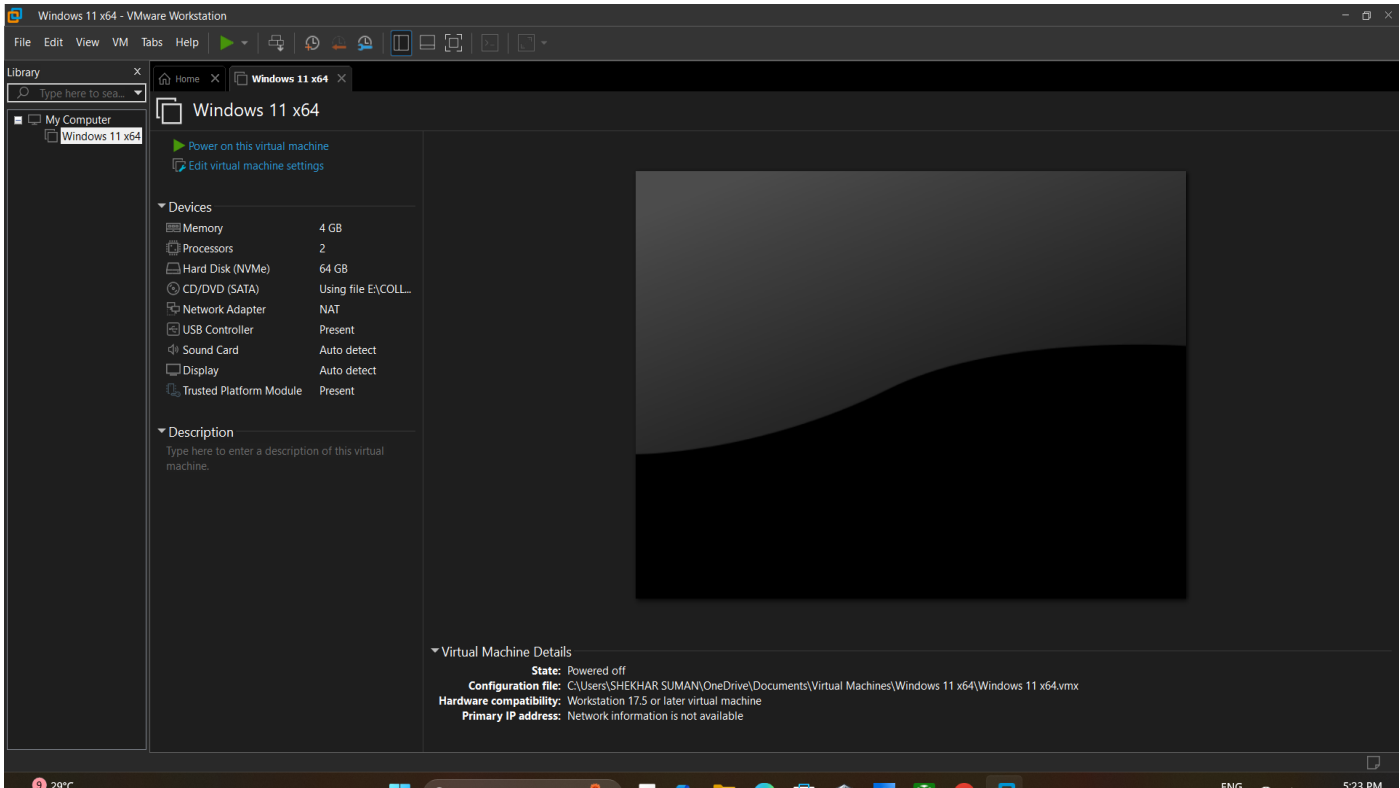
The virtual machine will be created with the following settings:

Name:	Windows 11 x64
Location:	C:\Users\SHEKHAR SUMAN\OneDrive\Documents\Virtua...
Version:	Workstation 17.5 or later
Operating System:	Windows 11 x64
Hard Disk:	64 GB, Split
Memory:	4096 MB
Network Adapter:	NAT
Other Devices:	2 CPU cores, CD/DVD, USB Controller, Sound Card

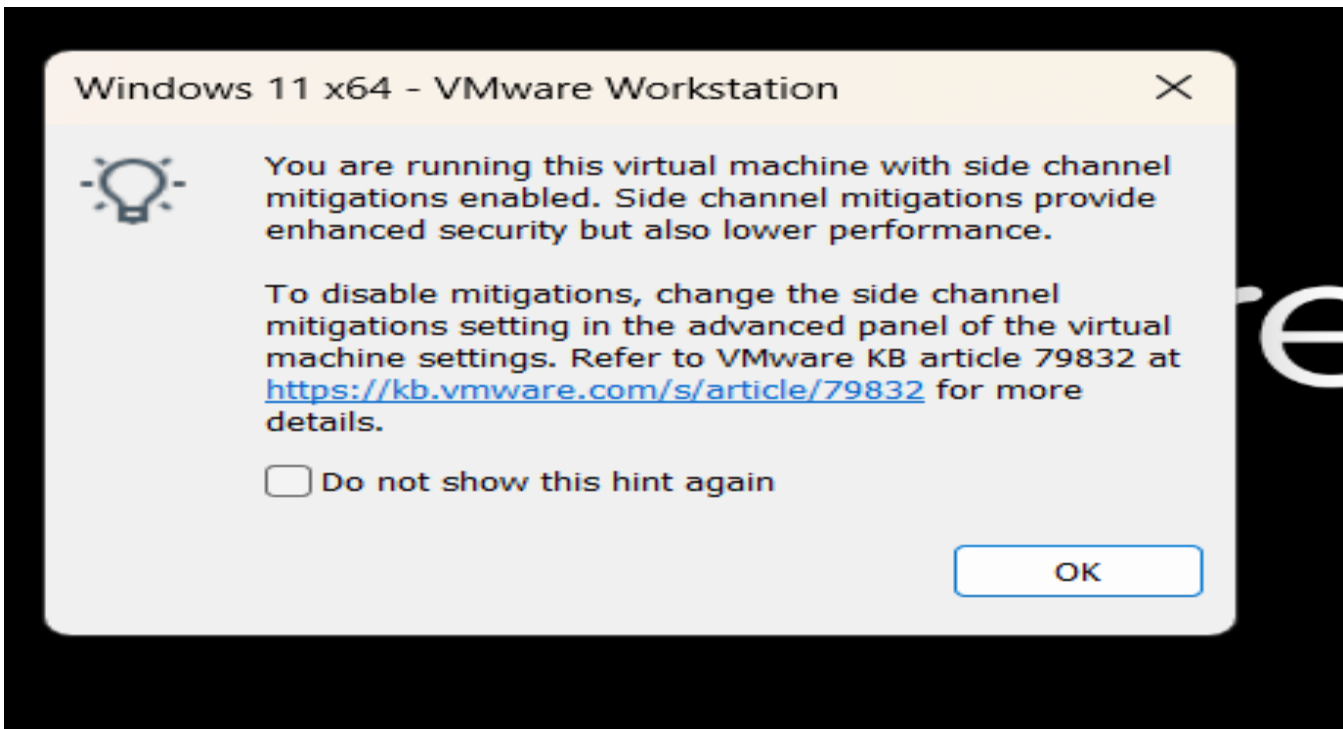
Customize Hardware...

< Back Finish Cancel

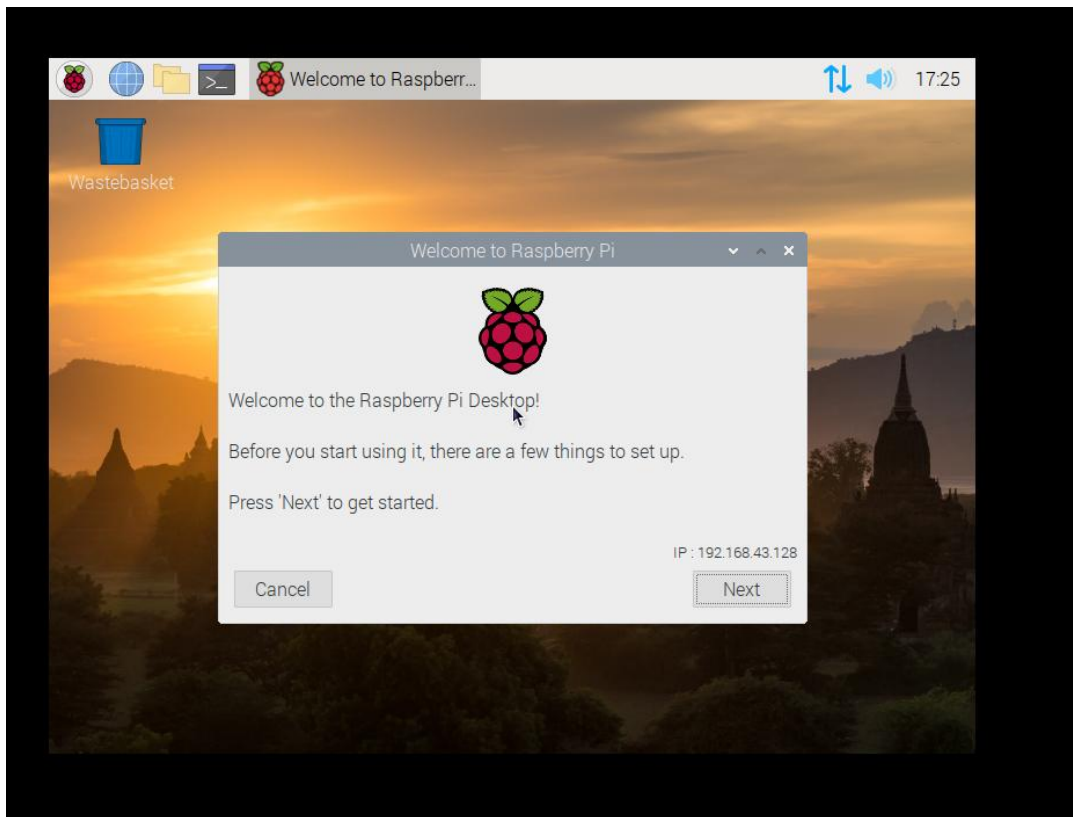
Step 9: Now we automatically redirect on the home interface of the VMware application. Select your machine name and click on the power on this virtual machine. This option is at top left hand side.



Step 10: Now here we show the unwanted option interface click on the OK button for the Next.



Step 11: Now we redirect to the Set-up the Raspbian O.S on the VMware software. Click on the next button.



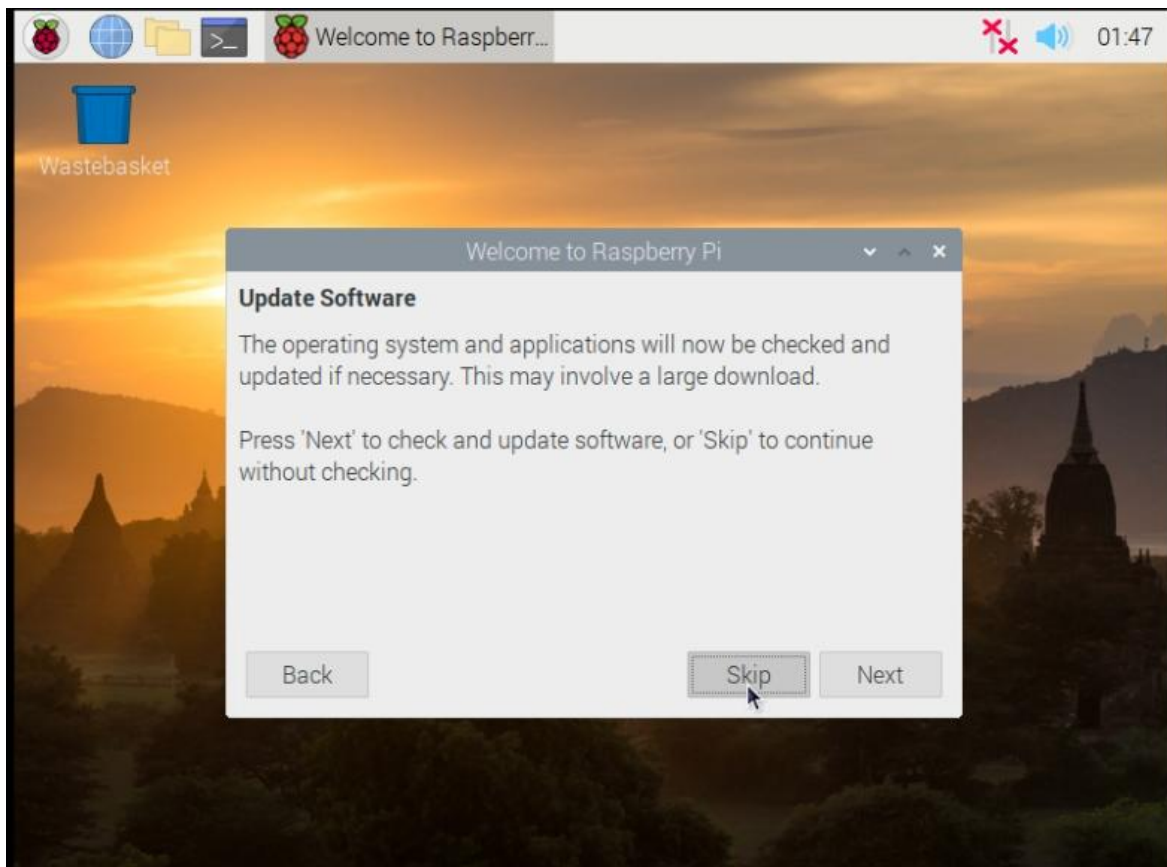
Step 12: After clicking on the Next button then click on the both option Use English language and Use U.S keyboard then click on the Next Button.



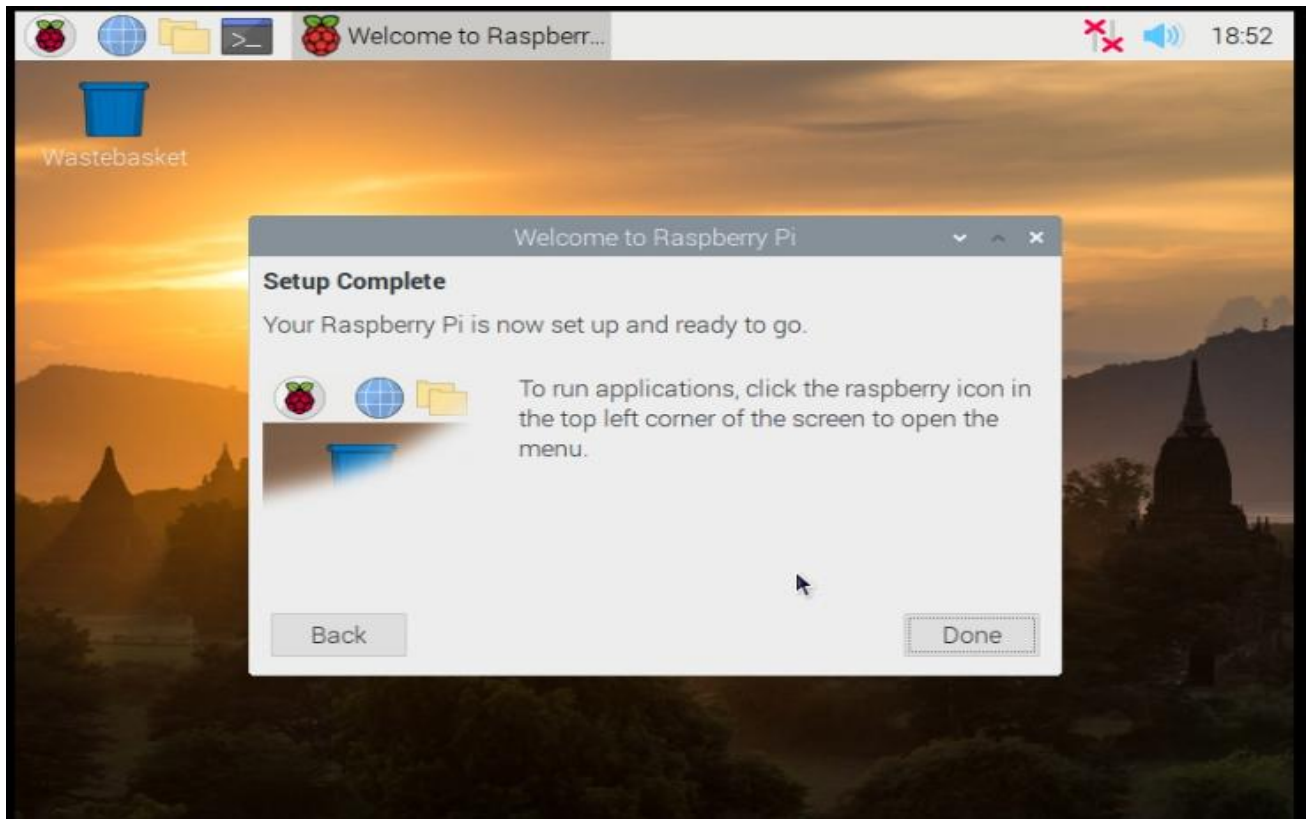
Step 13: I don't want password here so I kept it blanks, if you want your personal password then you can enter the password otherwise, they have their own default password "raspberrry". Then click on the Next button.



Step 14: I don't want any update right now then I want to choose skip button for the skip the Updates.



Step 15: This is the last and the final process of yours installing the Raspbian O.S on your VMware box. Now you get the interface of Setup complete. Click on done button and Enjoy your Raspbian O.S on your VMware box.



The final desktop of Raspbian O.S in the VMware workstation.

PRACTICAL – 4

AIM: Blinking LED using Raspberry Pi.

Step 1: Connect LED to breadboard.



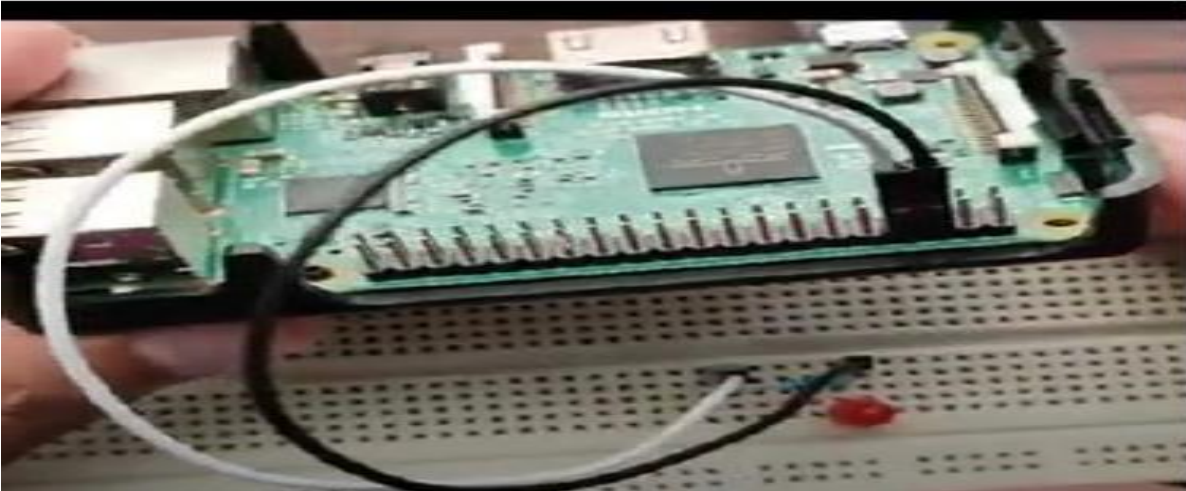
Step 2: Connect Resistor on breadboard.



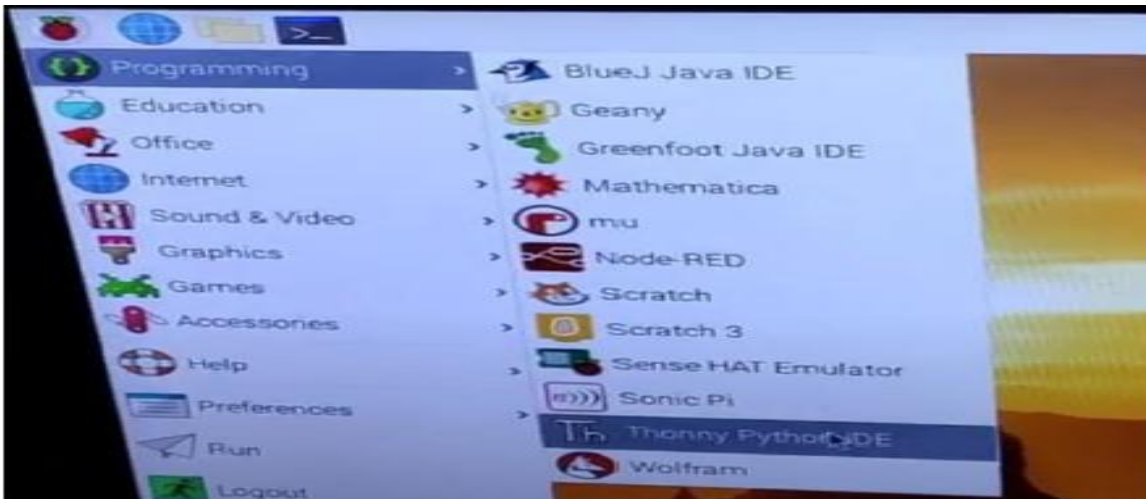
Step 3: Connect two jumper wire to breadboard of one leg is in register and another is in LED



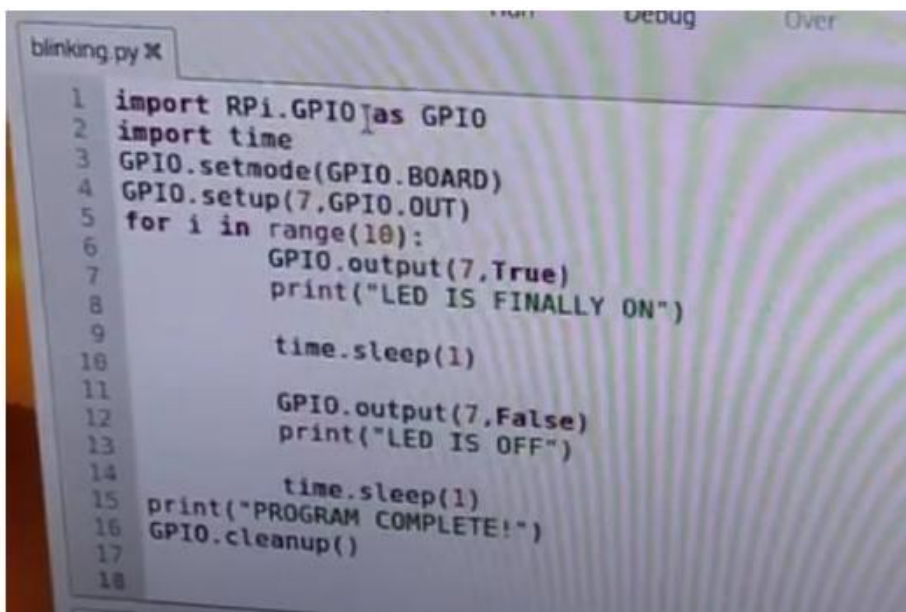
Step 4: Connect these jumper wire to Pin 7 and Pin 9 of Raspberry Pi respectively.



Step 5: Open Thonny Python IDE on Raspberry Pi OS.



Step 6: Write a code on IDE to blink the LED and Run the code.



PRACTICAL – 5

AIM: Capturing Images by connecting camera using Raspberry Pi.

Step 1: Insert Camera strip into CSI connector and power on the Raspberry Pi.



Step 2: Install Pip 3 on IDE.

Step 3: Install “Picamera” library on it

Syntax: - pip3 install picamera

Step 4: Write the Following code Thonny IDE and run the code.

```
File Edit Format Run Options Window Help
import time
from picamera import PiCamera
camera = PiCamera()
camera.resolution = (1280, 720)
camera.start_preview()
time.sleep(5)
camera.capture('/home/pi/Desktop/ty1.jpg')
camera.stop_preview()
```

PRACTICAL – 6

AIM: Capturing Images by connecting camera using Raspberry Pi.

Step 1: Insert Camera strip into CSI connector and power on the Raspberry Pi.



Step 2: Install Pip 3 on IDE

Syntax: - sudo apt-get install python3-pip

Step 3: Install “Picamera” library on it

Syntax: - pip3 install picamera

Step 4: Write the Following code Thonny IDE and run the code.

```
import time
from picamera import PiCamera
camera = PiCamera()
camera.start_preview()
camera.start_recording('/home/pi/Desktop/video1.h264')
camera.wait_recording(5)
camera.stop_recording()
print("Finished Recording")
```

PRACTICAL – 6

AIM: Interfacing seven segment display with Raspberry Pi.

Step1: Connect 4 jumper wires to 4 digit 7-segment display.



Pins of seven segment display:

- I. CLK – Clock Pin
- II. DIO – Data Input Output Pin

These two pins are used to transfer the data.

- I. VCC
- II. GND

These two pins are used to connect the power.

Step2: Connect these pins to GPIO pin of raspberry pi with the help of jumper wire.

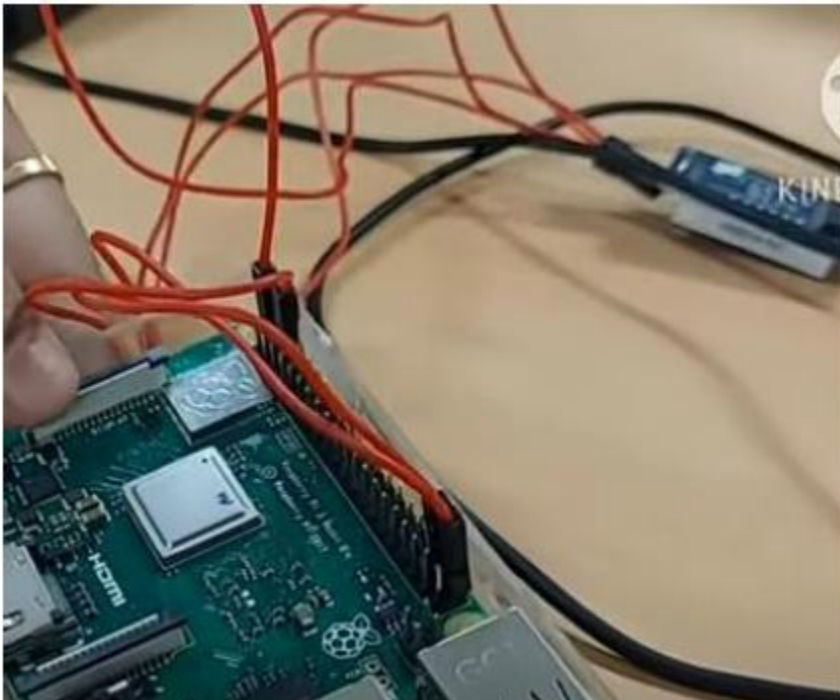
Connections are as follows:

CLK Pin to 40th GPIO pin

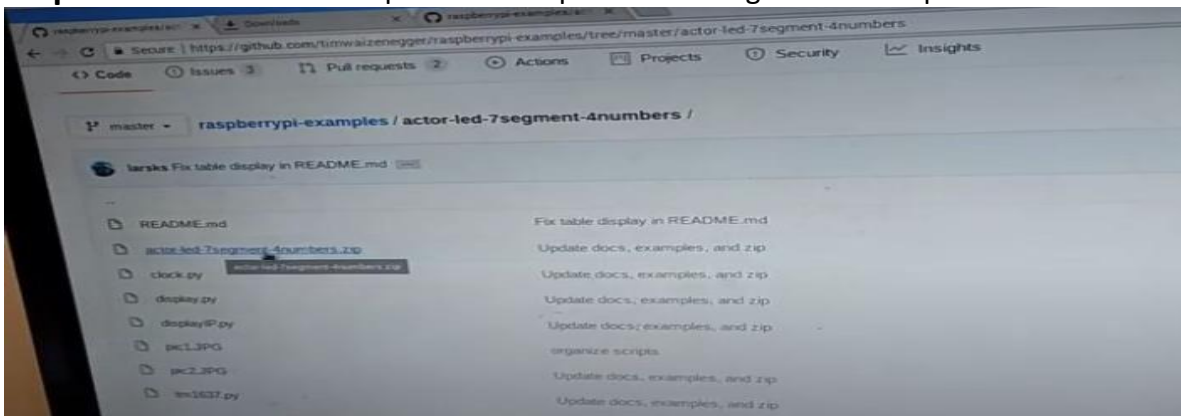
DIO Pin to 38th GPIO pin

VCC Pin to 2nd GPIO pin

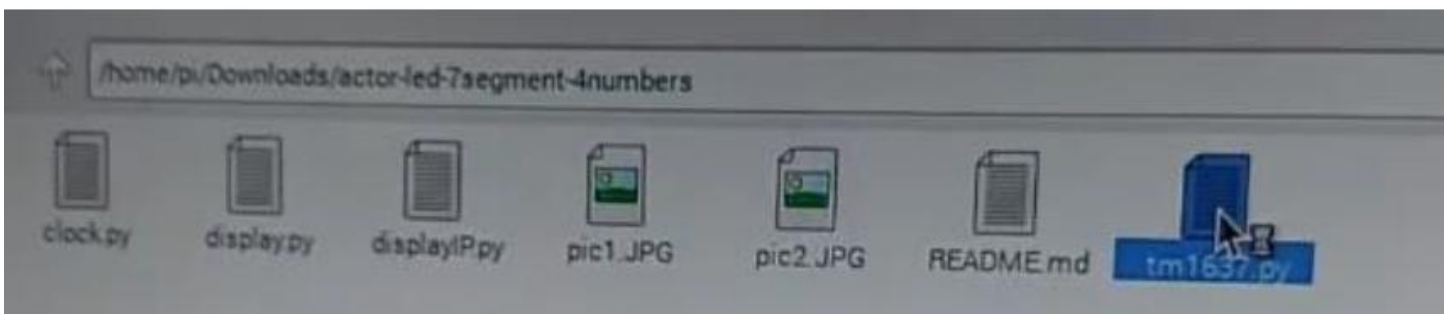
GND Pin to 6th GPIO Pin



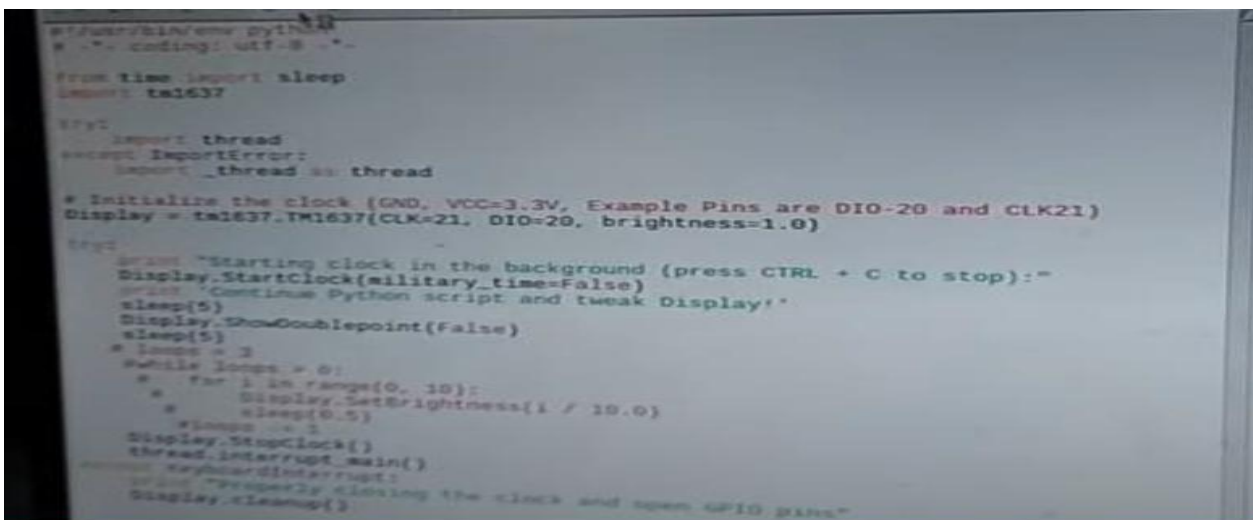
Step3: Download the file required to do operation from github desktop.



Step 4: In this folder use package “tm1637” to write the code.



Step 5: Write the following Code.



Step 6: Run the code the will display on seven segment display screen

