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*M.Sc. (I.T.) SEM III
Advance Internet of Things (AIOT)*

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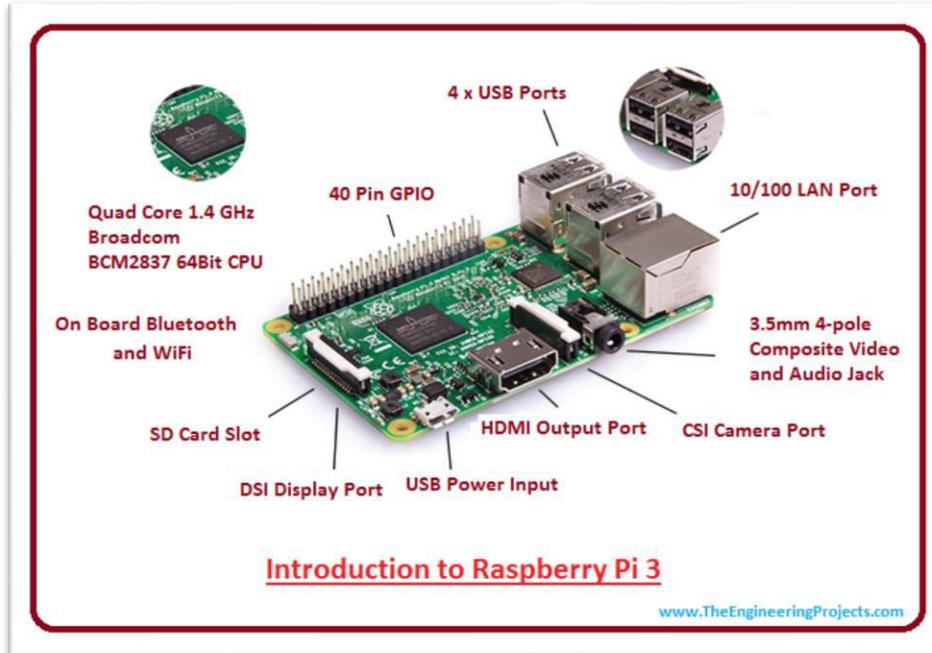
Practical – 1: Loading Rapian/BusterOS on Raspberry Pi (Installation)

What is Raspberry Pi OS (Raspbian)?

- Raspberry Pi OS is a free, open-source Debian Linux-based operating system engineered for use on Pi boards. Additionally, several ARM-based single-board computers also run Raspberry Pi OS.
- The first version, then known as Raspbian, debuted in 2013, and from 2015 onwards the Raspberry Pi Foundation offered it as an officially-sanctioned Pi distro.
- A Raspbian image is a file that you can download onto an SD card which in turn can be used to boot your Raspberry Pi and Via APC into the Raspbian operating system. Using a Raspbian image is the easiest way for a new user to get started with Raspbian.

Introduction of Raspberry Pi 3 Model B:

- This is an introduction of Raspberry Pi 3 Model B. We will explore what Raspberry Pi 3 has to offer in terms of its features and performance.
- I would like to introduce Raspberry Pi as a world's most inexpensive and powerful Single Board Computer. Ever since the launch of Raspberry Pi from 2012, we have seen several versions of it. This is world's cheapest microprocessor unit specially built for learner and makers.
- We can easily learn how software and hardware work together without been worrying about damage/cost.
- We can buy Raspberry Pi board with just somewhere around 35\$. The cost of Pi allows newbies to celebrate mistakes and learn most out of it.
- Also, Raspberry Pi has a huge community and plenty of online resources which make learning smooth.



Raspberry Pi 3 Model B Features:

- CPU:** Raspberry Pi 3 uses Broadcom BCM2837 SOC 64-bit quad-core ARM Cortex A53 (ARMv8 CPU) with 512KB shared L2 cache.
- Memory:** Provided with 1 GB of RAM
- Wi-Fi Support:** 802.11n Wireless LAN
- Bluetooth:** Supports Bluetooth 4.1 Bluetooth Low Energy (BLE)
- USB Ports:** 4-USB ports which allow attaching four different USB devices like keyboard, mouse, etc.
- Ethernet Port:** Standard Ethernet port to quickly setup and access internet. This can be very useful when we want to setup raspberry pi for the first time without a monitor.
- GPIO Pins:** Raspberry Pi 3 supports 40 GPIO Pins General Purpose Input Output. These digital input/output pins can be used to drive LED, Switches, and Sensors etc.
- Full HDMI Port:** Support HDMI port (High-Definition Multimedia Interface) which can be used to quickly connect raspberry pi to HDMI Monitor. With HDMI Cable and Monitor we can add Screen to Raspberry Pi.

9. **Micro SD card slot:** The Micro SD Card will hold the operating system which will boot while we power on Raspberry Pi 3. In next tutorial, we will learn how to setup and prepare SD card with Raspbian OS.
10. **Audio/Video:** Combined 3.5mm audio jack and composite video
11. **Display interface (DSI):** enable us to interface Display Module
12. **Camera interface (CSI):** enable us to interface Camera Module
13. **Graphics Support:** Video Core IV 3D graphics core for advance graphics capabilities.

Set up Your Raspberry Pi

To get the Raspberry Pi ready to boot we need to:

1. Insert the MicroSD memory card into the Raspberry Pi
2. Connect the USB keyboard
3. Connect the HDMI cable
4. Connect the USB Wi-Fi adapter (or Ethernet cable). Skip this step if you are using a Raspberry Pi 3
5. Connect the micro-USB power supply
6. The Raspberry Pi should now be booting up
7. When the Raspberry Pi is finished booting up, log in using username: pi and password: raspberry

How to Install Raspbian on Raspberry Pi

Here are the step-by-step instructions to install Raspbian on the Raspberry Pi. You can also read my article on [how to set up raspberry pi](#) where I explained (with screenshots) how to install Raspberry Pi OS (formerly Raspbian) with Raspberry Pi Imager software.

Step 1: Download Raspbian

Head over to the official Raspbian [download page](#) and select the one which is suitable for you. If you want your Raspberry to use as a desktop PC, then download any one of the desktop images. For any other uses that don't require a GUI, then download the Lite version.

Step 2: Prepare your SD Card

Since the Raspberry Pi bootloader only supports the FAT file system, you have to format it to the FAT32 file system before burning the OS. If you are using an SD card of 64 GB or more ensure that it is formatted to FAT32 and not to exFAT.

Formatting on Windows

1. On Windows, the formatting can be done using the standard disk management tool.
2. Connect your SD card to your PC.
3. Search for “Disk” in the search bar and select the “Create and format hard disk partitions” option from the results.
4. Right-click on the unallocated space and start it by clicking on New Simple Volume and then Next.
5. You will be asked for the volume size required. Choose the default option and click Next.
6. Now you will be prompted for specifying the mount path. Click Next.
7. Then select the FAT32 system > Next > Finish. This will not work for 64GB or higher cards. so, format it to exFAT first and then convert it to FAT32 using [this tool](#).

Rufus:

You can use Rufus to format an SD card. Clicking the “Boot selection” menu item allows you to choose whether you want to boot from the USB drive. Selecting “Non-bootable” formats the SD card without letting a computer boot from it. If you want to use your SD card to run your Raspberry Pi OS, then you don’t want this option.

Note: In Rufus, click on the dropdown menu for Device to select the USB stick. Next, click on the icon showing an image of a CD/DVD tray, which is about three quarters of the way down the box, next to ‘Create a bootable disk using’, and select the Raspbian ISO file you just downloaded. Then click Start.

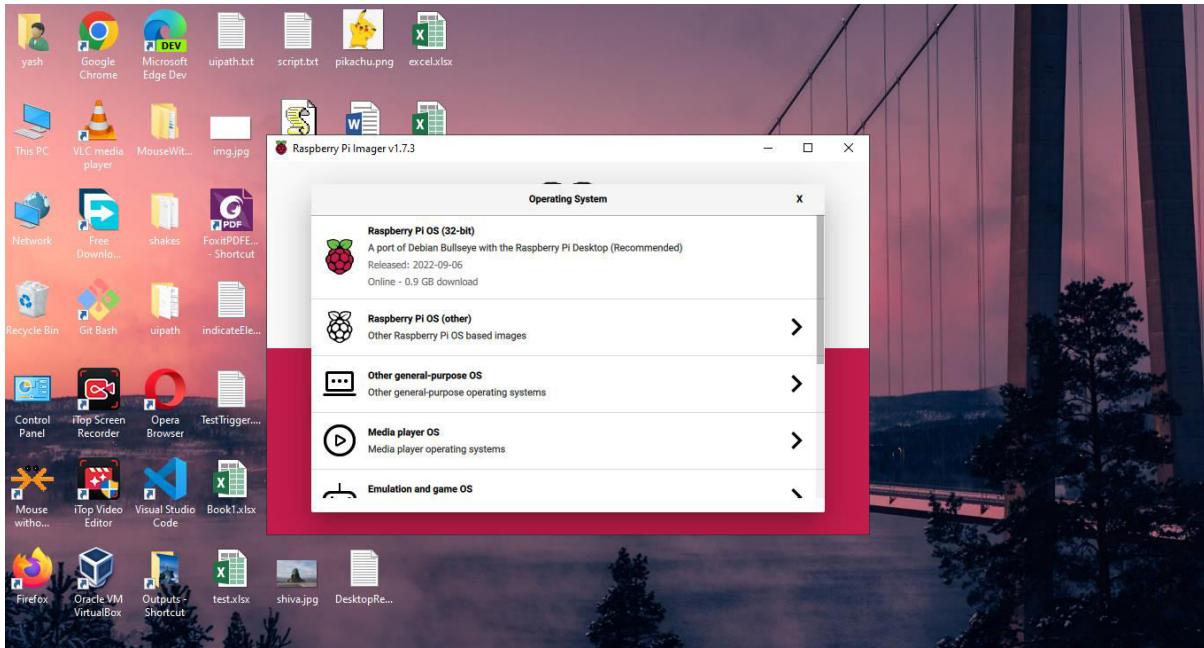
Step 3: Put the microSD card in your Pi and boot up

Once disc write completed insert the microSD Card in card slot available on raspberry Pi board. The current edition to Raspbian will boot directly to the desktop and it will be ready for use. Your default credentials are username pi and password raspberry.

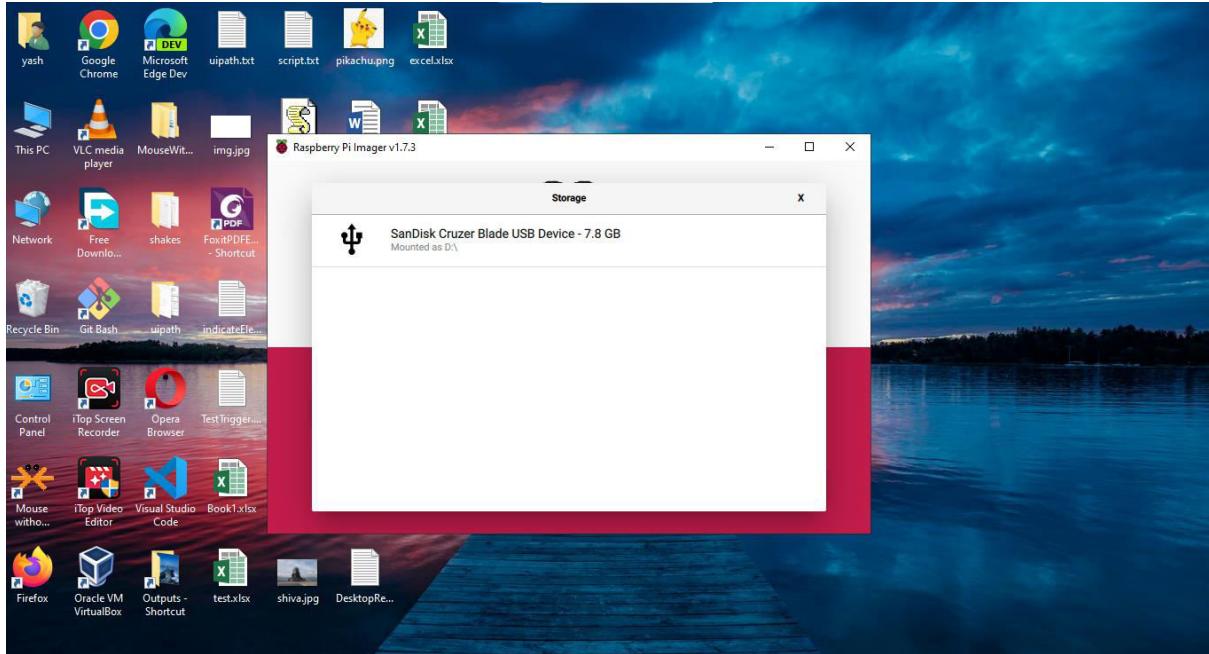
1. Go to raspberry pi official website and download raspberry pi imager and download it

The screenshot shows a web browser window with the URL <https://www.raspberrypi.com/software/>. The page title is "Install Raspberry Pi OS using Raspberry Pi Imager". It contains instructions for downloading and installing the software, followed by download links for Windows, macOS, and Ubuntu. To the right of the browser, a separate window titled "Raspberry Pi Imager v1.6" is open, displaying the software's interface with tabs for "Operating System" and "Storage".

2. Install imager and select raspberry pi OS in operating system.



3. Next select your SD card/USB



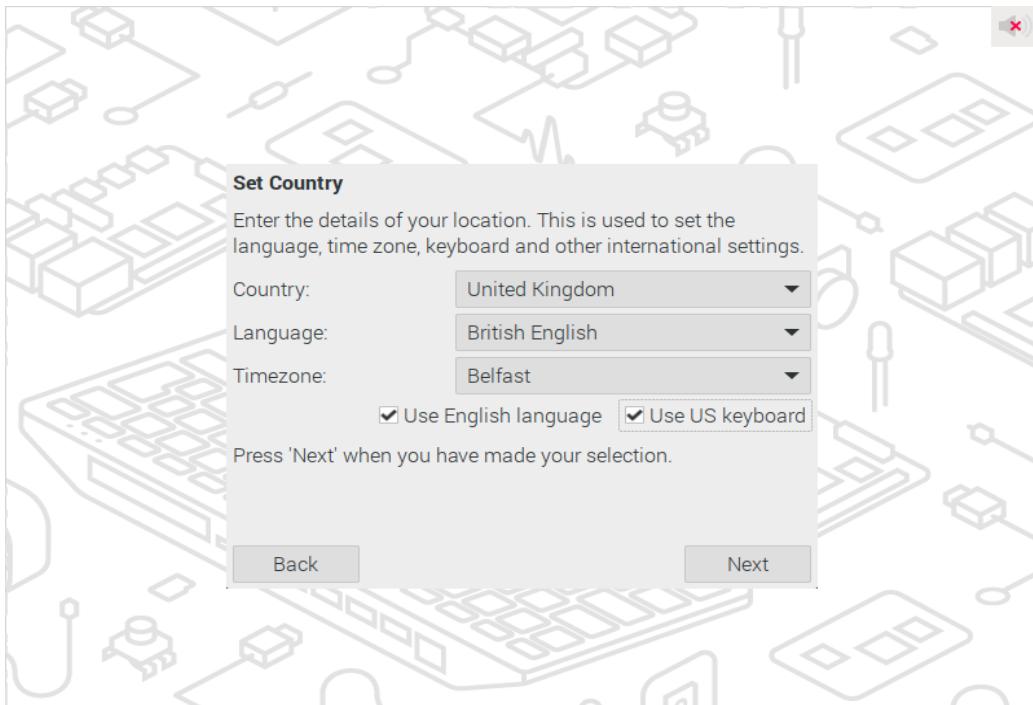
4. Click on WRITE this will write pi OS on SD card



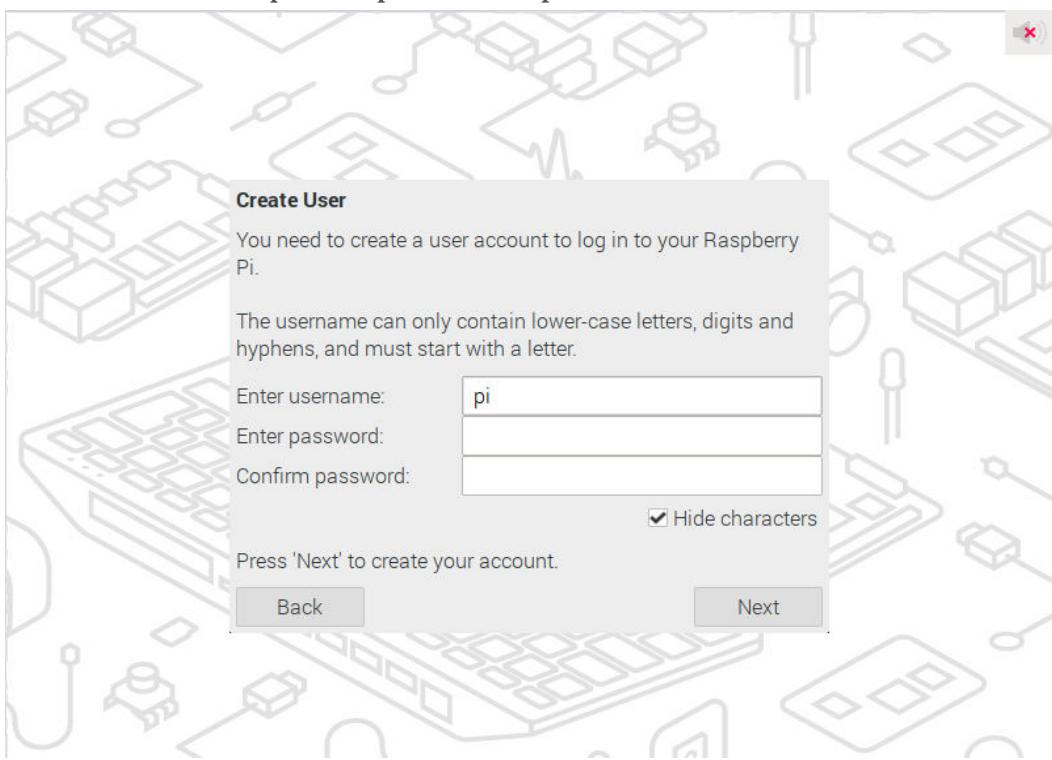
5. Insert SD card and press boot key if no OS is installed then pi will boot automatically click on next.



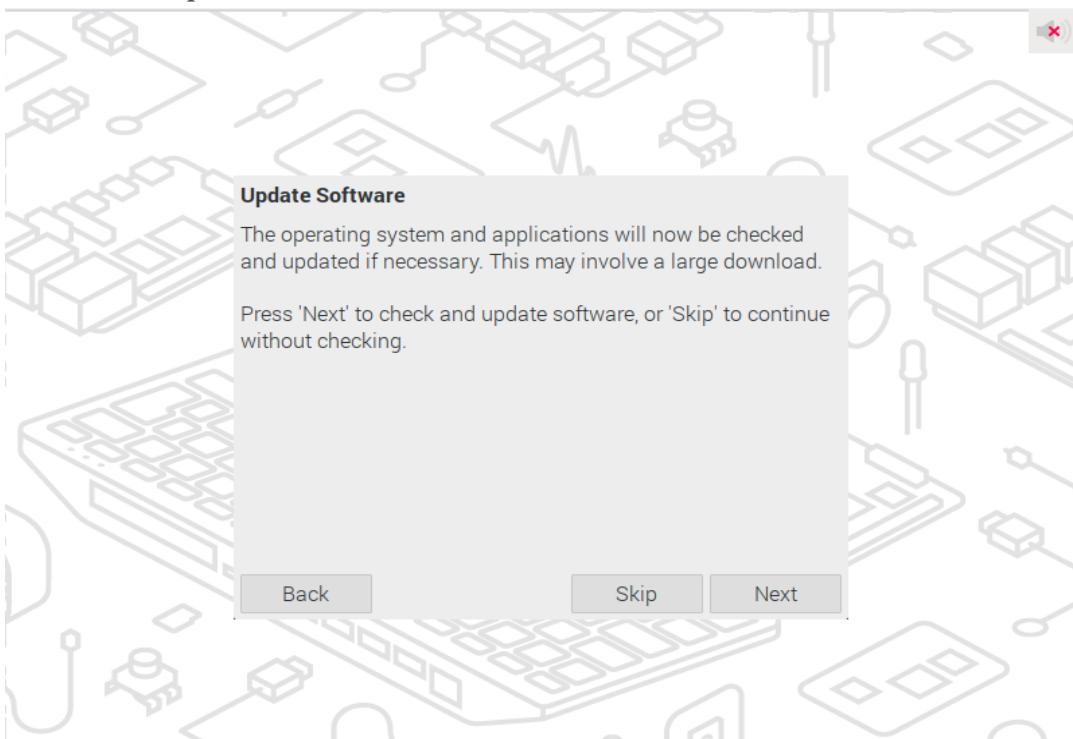
6. Select time zone and keyboard and click next.



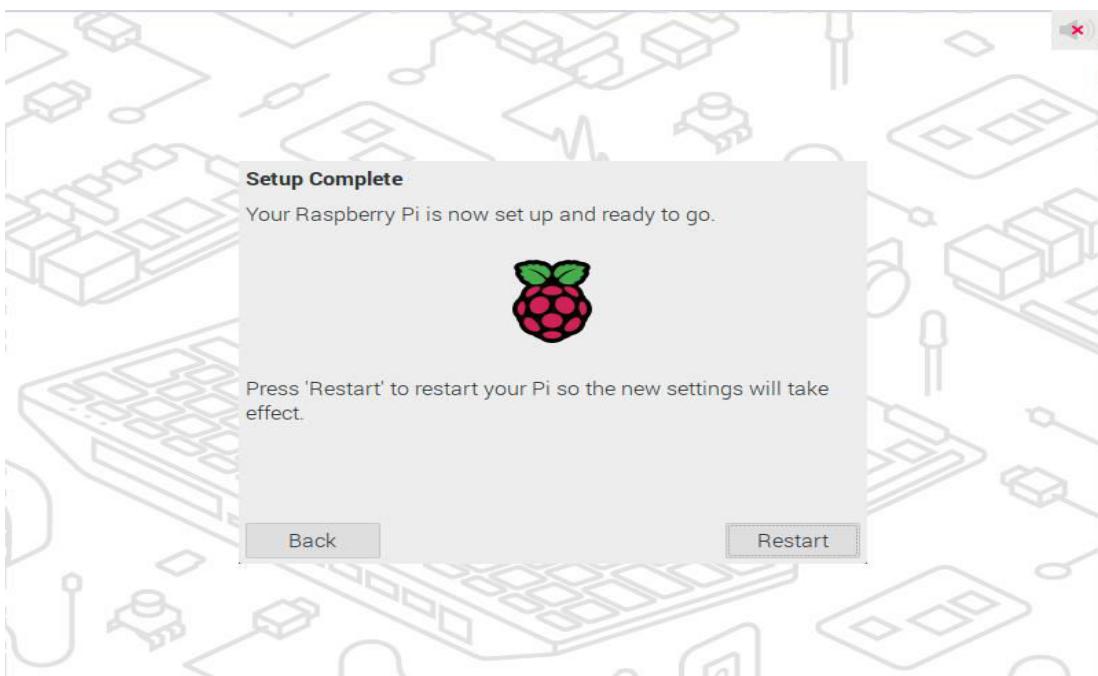
7. Enter username pi and password pi and click on next



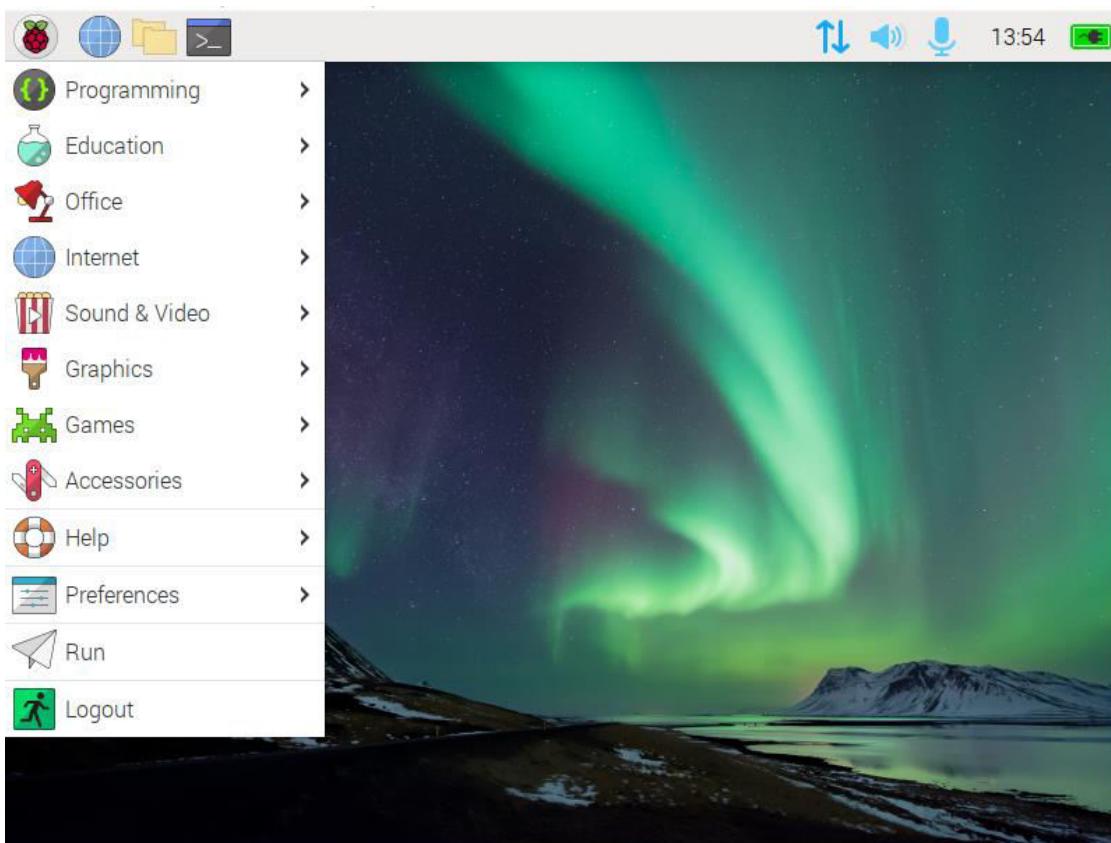
8. Click on skip.



9. Click on restart.



10. Pi will boot and start if installation starts again than remove boot SD card and restart pi.



Practical – 2: Installing Windows 10 IOT Core on Raspberry Pi

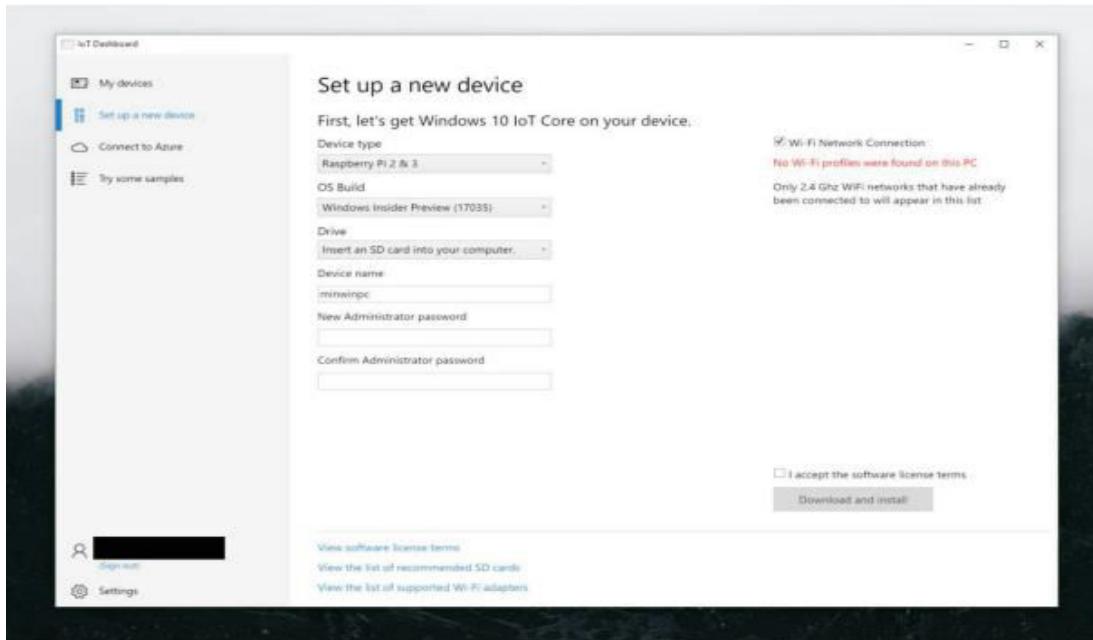
- Windows 10 IoT is a member of the Windows 10 family that brings enterprise-class power, security and manageability to the Internet of Things. It leverages Windows' embedded experience, ecosystem and cloud connectivity, allowing organizations to create their Internet of Things with secure devices that can be quickly provisioned, easily managed, and seamlessly connected to an overall cloud strategy.

- Hardware Guide:
For getting started with windows 10 IOT, you will require the following hardware
 - 1. Raspberry Pi 3
 - 2. 16 GB Micro SD Card – class 10
 - 3. Display
 - 4. Keyboard
 - 5. Mouse
 - 6. Windows 10 PC
 - 7. Card Reader

- Installation Guide:
Use this tutorial to get yourself comfortable with Windows 10 IoT quickly. You'll learn how to flash a Windows 10 IoT Core image onto a device and how to deploy an app from your device.

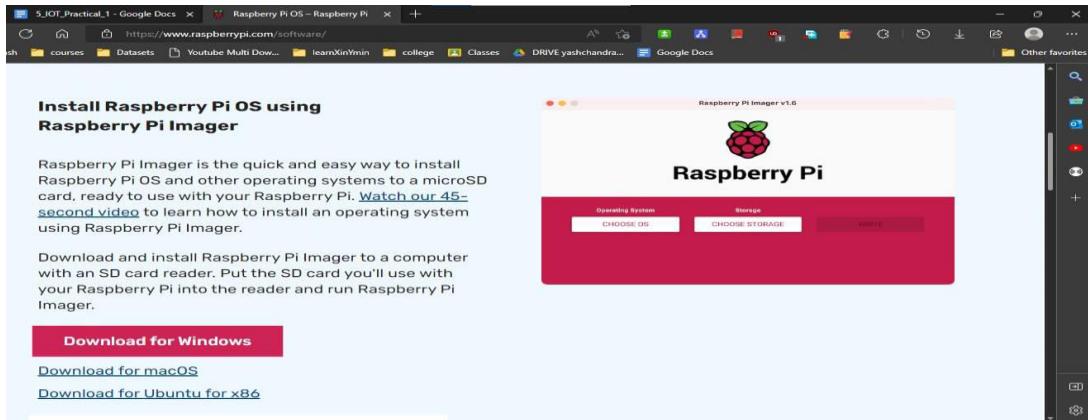
- 1. Download the Windows 10 IoT Core Dashboard from
<https://developer.microsoft.com/en-us/windows/iot/Downloads>

- Once downloaded, open the Dashboard and click on set up a new device and insert a SD card into your computer.

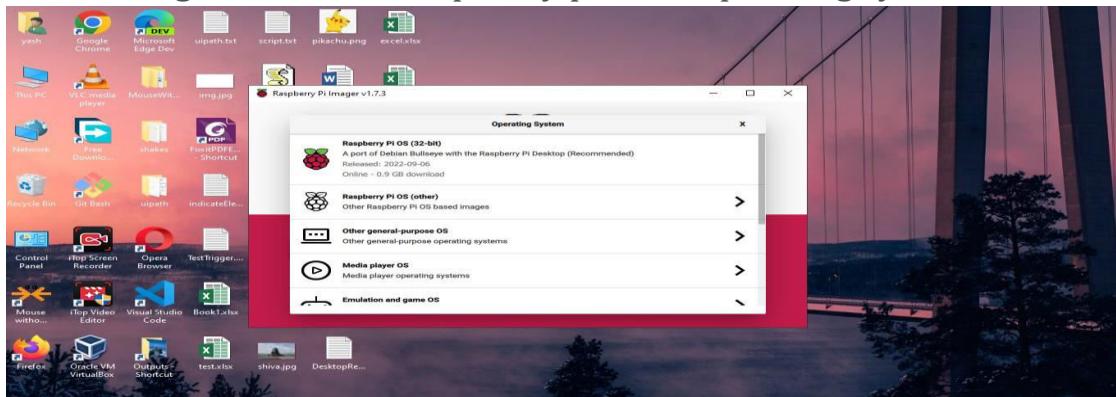


- Fill out all of the fields as indicated.
- Accept the software license terms and click Download and install. You'll see that Windows 10 IoT Core is now flashing onto your device.
- Connecting to a network (Wired connection) - If your device comes with an Ethernet port or USB Ethernet adapter support to enable a wired connection, attach an Ethernet cable to connect it to your network.
- Or alternatively connect via Wireless wifi card or dongle
- Connecting wireless Display - If you haven't connected and display and would like to connect via Wi-Fi, you'll need to:
 - Go to the IoT Dashboard and click on My Devices.
 - Find your unconfigured board from the list. Its name will begin with "AJ_..." (e.g., AJ_58EA6C68). If you don't see your board appear after a few minutes, try rebooting your board.

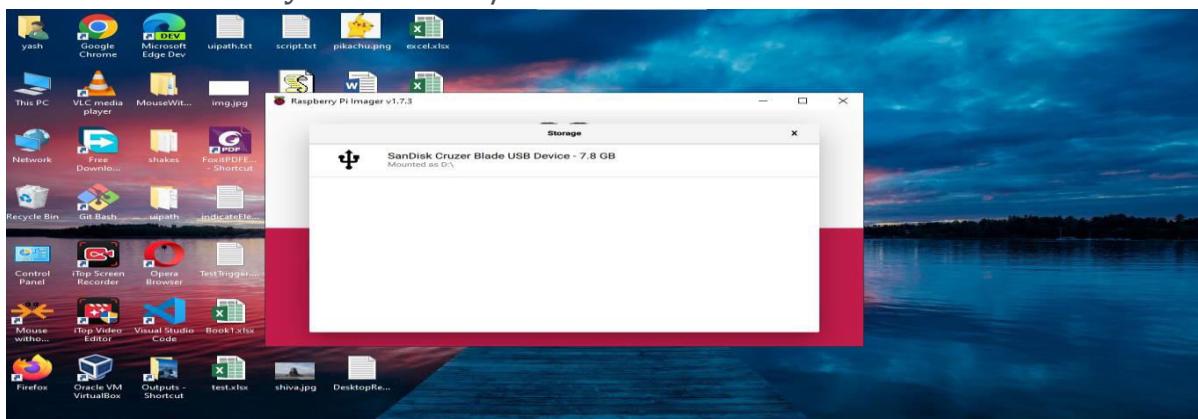
- c. Click on Configure Device and enter your network credentials.
This will connect your board to the network.
8. Go to raspberry pi official website and download raspberry pi imager and download it



9. Install imager and select raspberry pi OS in operating system.



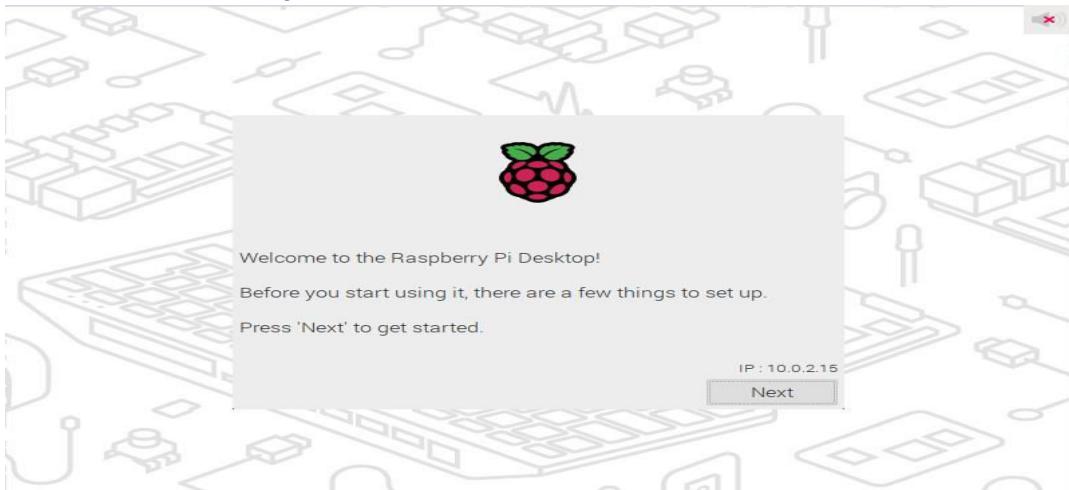
10. Next select your SD card/USB.



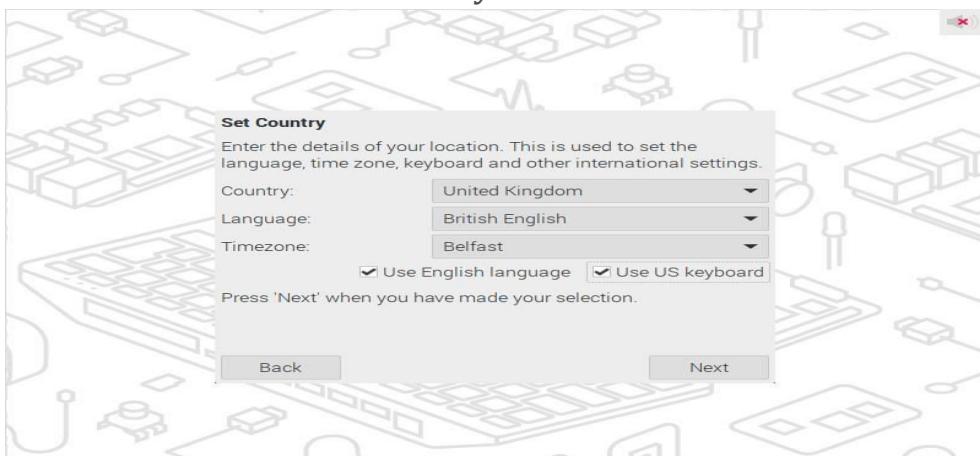
11. Click on WRITE this will write pi OS on SD card



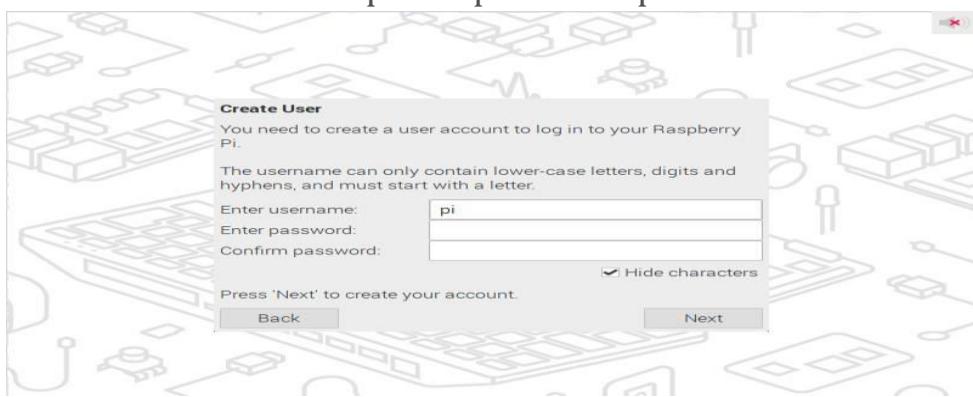
12. Insert SD card and press boot key if no OS is installed then pi will boot automatically click on next.



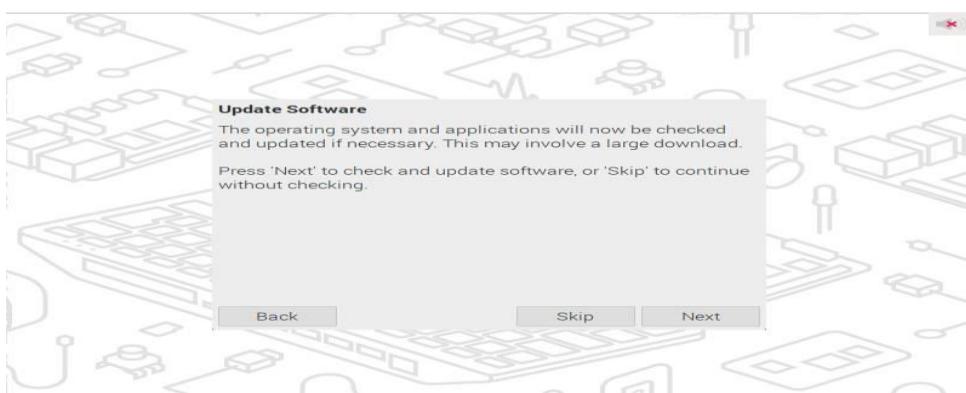
13. Select time zone and keyboard and click next



14. Enter username pi and password pi and click on next.



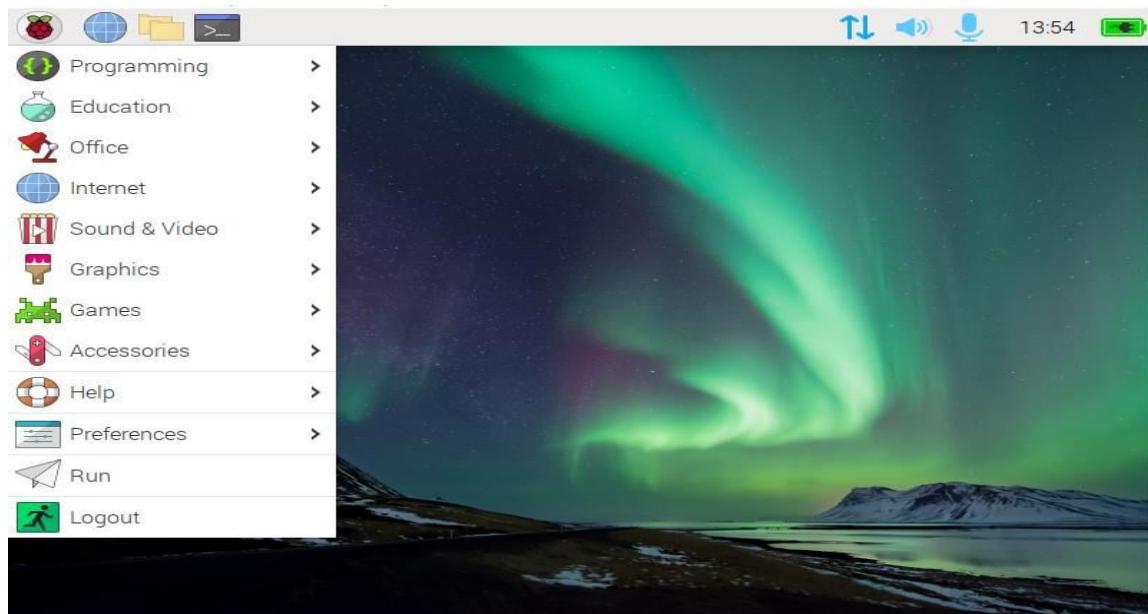
15. Click on skip.



16. Click on restart.



17. Pi will boot and start if installation starts again than remove boot SD card and restart pi.



Practical – 3: Install and execute application on Node.js and Python

Install Nodejs and NPM on Raspberry Pi

What is NodeJS

- Nodejs or Node is an open-source and cross-platform runtime environment for executing JavaScript code outside of a browser. We often use Node to build back-end services, also called APIs (Application Programming Interfaces). These services power our client application, like a web app running inside a web browser or a mobile app running on a mobile device.
- These client apps are simply what a user sees and interacts with. They are just the surface and need to talk to some services sitting on the server or in the cloud to store data, send emails or push notifications, kick-off workflows, and so on. Node is ideal for building highly scalable data-intensive and real-time back-end services that power our client applications.
 - **An online platform**
 - **A command-line tool**
- NPM, as an online platform, is a place where developers can publish and share tools written in JavaScript. Anyone can search and use tools available on this online platform. You can find tools for use in the browser, server, or even the command line.
- NPM, as a command-line tool, helps developers interact with the NPM online platform. You can use NPM to install and uninstall packages available on the NPM online platform. NPM is also used to manage package versions and dependencies.

Install NodeJS and NPM on Raspberry Pi

There are two main ways you can use to install NodeJS and NPM on your Raspberry Pi.

- Install NodeJS and NPM from the Node Source repository
- Install NodeJS and NPM from source code.

This post will look at all the methods above, and you can pick one that suits you.

Lab Requirements

- A Raspberry Pi running the Official Raspberry Pi OS: For better performance, we highly recommend using Raspberry Pi board 3 or 4.

- An active internet connection
- A reliable power supply

Creating Our First Program

Once the new window loads, we can finally enter our first Python program. To do this, enter the code as shown below into the window. Then, save the file.

```
# A Basic Python Program

# Declare some variables first
name = ""
age = 0
currentYear = 0
yearBorn = 0

# -----
# Start by getting the users details
name = input("Enter your name: ")
age = int(input("Enter your max age this year: "))
currentYear = int(input("What is the current year? :"))

# -----
# Perform a basic calculation
yearBorn = currentYear - age

# -----
# Print the result
print("You were born in the year " + str(yearBorn))
```

Running Our Program

With the code entered and the file saved, it's time to run the program. Running a Python program can be done in one of three ways: press F5 in the window with the program to run, go to the menu bar and click Run > Python Shell, or run the file via a terminal window as an argument for Python.

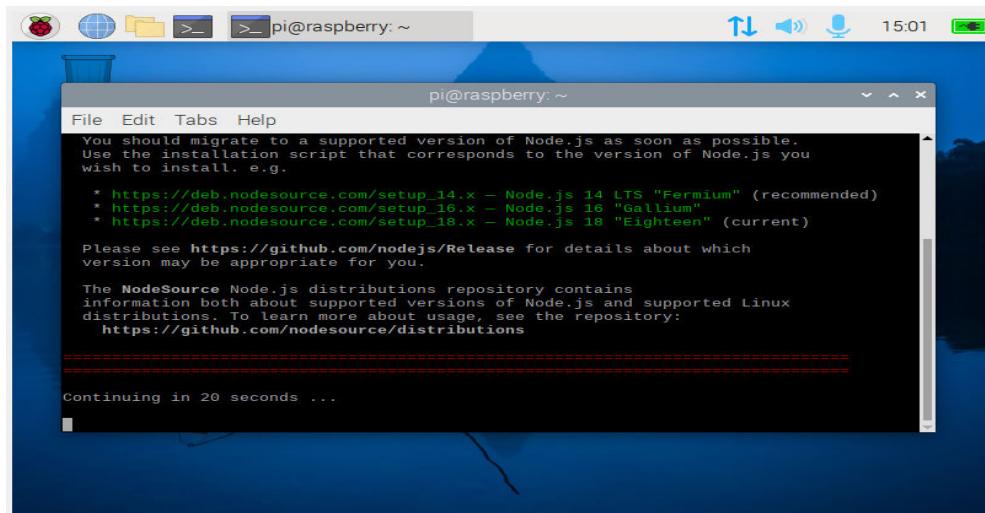
For now, the easiest way is to simply press F5 in the window with the code. Once pressed, the code should return no errors, and the shell window should prompt for data.

Install NodeJS and NPM From the NodeSource Repo

1. Enable the NodeSource Repository.

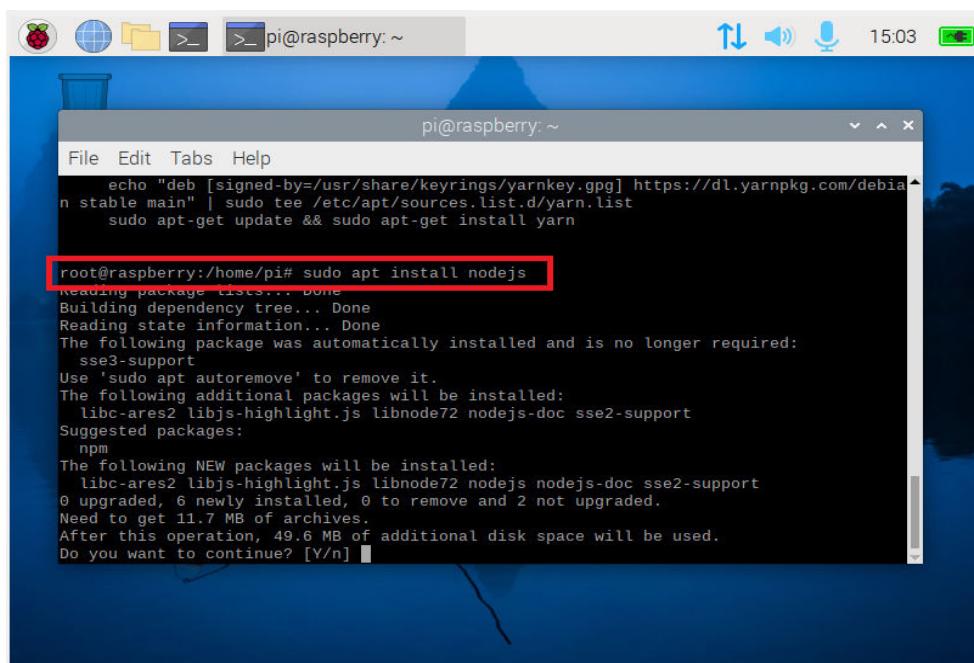
sudo su

curl -fsSL https://deb.nodesource.com/setup_17.x | bash -



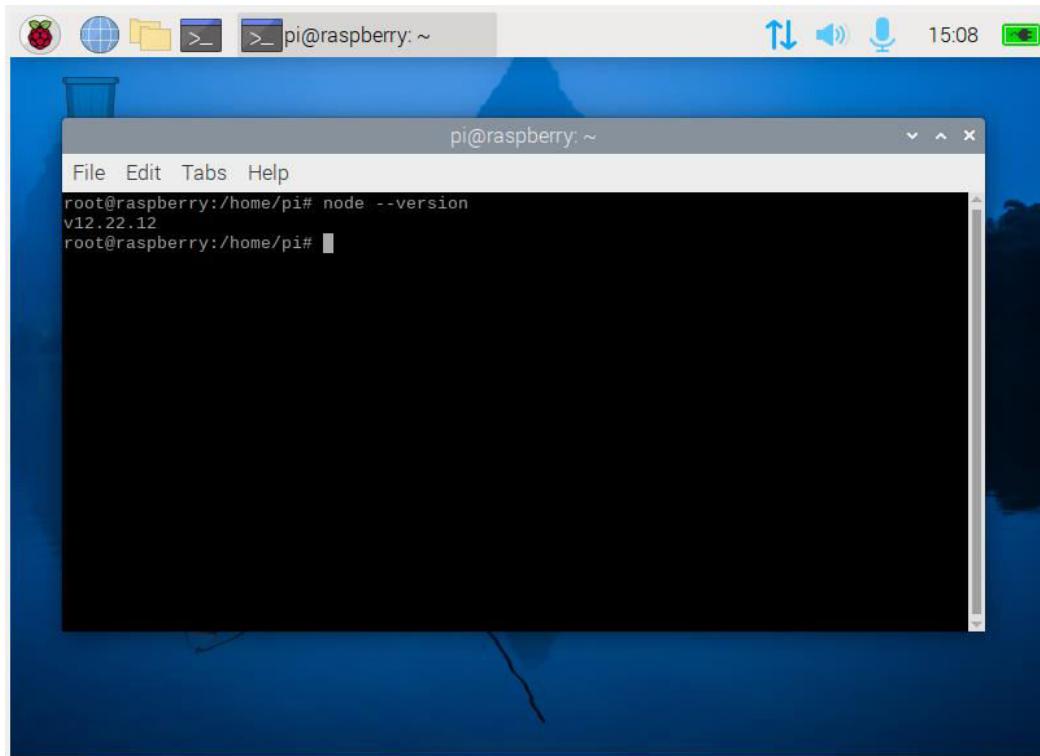
2. Install node.

sudo apt install nodejs

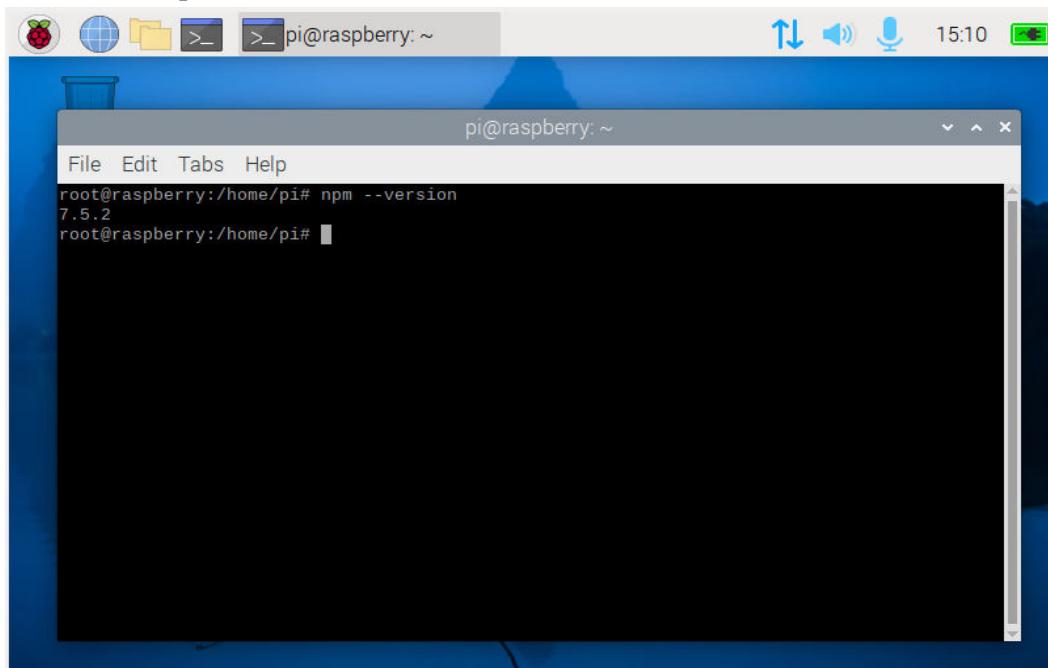


3. Check node.js version

node --version



4. Check npm -version

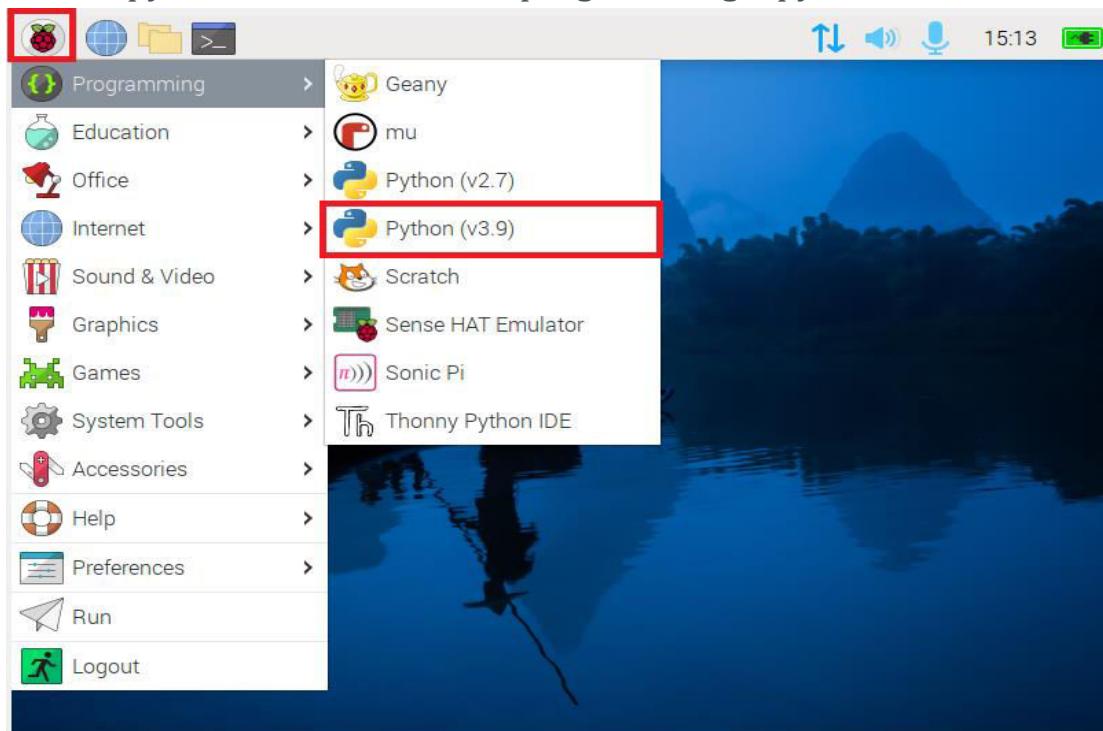


5. To remove node run following command

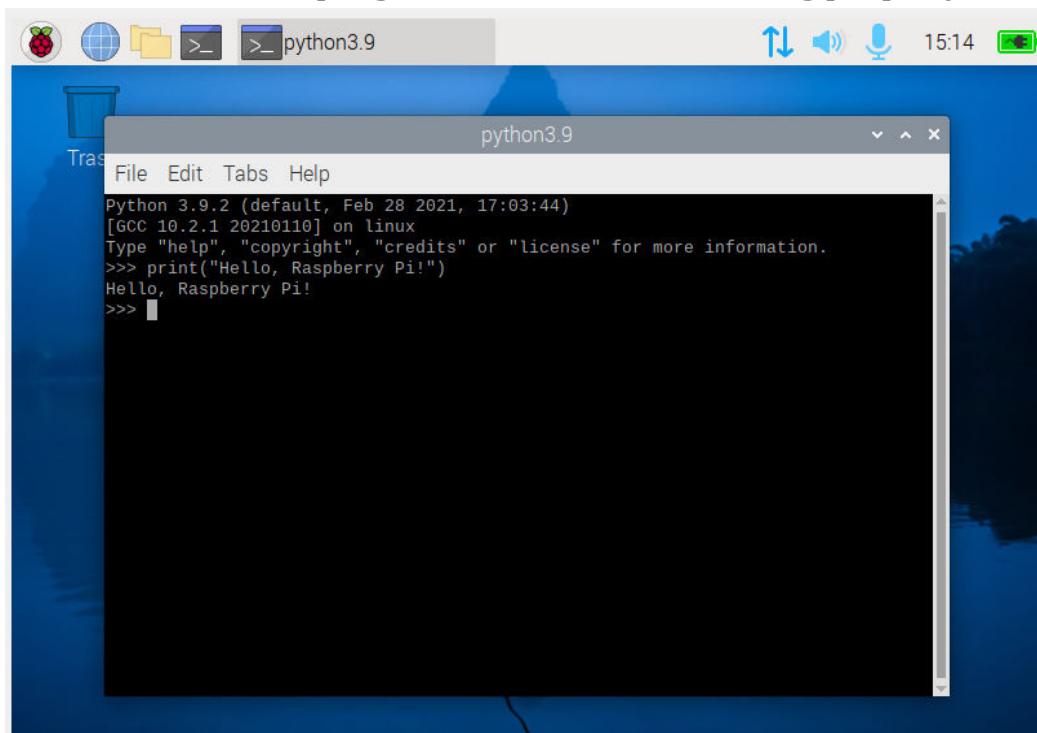
sudo apt remove nodejs

```
pi@raspberry:~$ sudo apt remove nodejs
Reading package lists... done
Building dependency tree... done
Reading state information... done
The following packages were automatically installed and are no longer required:
  gyp libc-ares2 libjs-highlight.js libjs-inherits libjs-is-typedarray libjs-psl
  libjs-typedarray-to-buffer libnode-dev libnode72 libssl-dev libuv1-dev node-chownr
  node-color-name node-err-code node-extsprintf node-fast-deep-equal node-indent-string
  node-ini node-is-typedarray node-json-parse-better-errors node-json-schema
  node-json-schema-traverse node-qs node-resolve-from node-through
  node-typedarray-to-buffer node-universalify node-uuid nodejs-doc sse2-support
  sse3-support
Use 'sudo apt autoremove' to remove them.
The following packages will be REMOVED:
  node-abbrev node-agent-base node-ajv node-ansi node-ansi-regex node-ansi-styles
  node-ansistyles node-aproba node-archy node-are-we-there-yet node-asap node-ansi
  node-assert-plus node-asynckit node-aws-sign2 node-aws4 node-balanced-match
  node-bcrypt-pbkdf node-brace-expansion node-builtins node-cacache node-caseless
  node-chalk node-clone node-color-convert node-colors node-columnify
  node-combined-stream node-concat-map node-console-control-strings
  node-copy-concurrently node-core-util-is node-dashdash node-debug node-defaults
```

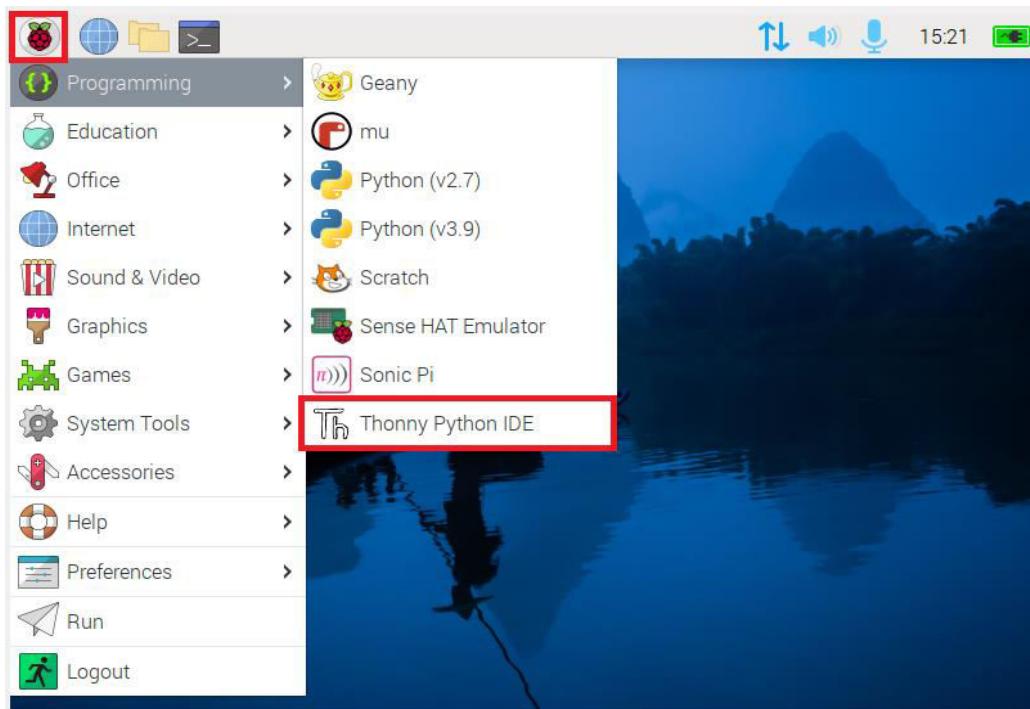
6. Run python > click on start > programming > python 3.9



7. Run hello world program to check if it's running properly.



8. Go to start > programming > Thonny Python IDE.



9. Write code and run in IDE.

The screenshot shows the Thonny IDE interface. The top bar displays the title "Thonny - /home/pi/..." and the status "15:20". The menu bar includes "File", "Edit", "Tabs", "Help", and icons for file operations like New, Load, Save, Run, Debug, Over, Into, Out, Stop, Zoom, and Quit. The main window has a code editor titled "616_AIoT_Practical_1.py" containing the following Python code:

```
8 name = input("What is your Name? ")
9 age = int(input("Enter your max age in years: "))
10 currentYear = int(input("What is the current year: "))
11
12 # calculate age
13 yearBorn = currentYear - age
14
15 # print result
16 print("You were born in year " + str(yearBorn) + ".")
```

Below the code editor is a "Shell" tab showing the terminal output of running the script:

```
>>> %cd '/home/pi/Desktop/pract 1 python'
>>> %Run 616_AIoT_Practical_1.py
What is your Name? yash
Enter your max age in years: 22
What is the current year: 2022
You were born in year 2000.

>>> |
```

The status bar at the bottom right indicates "Python 3.9.2".

10. Code can also be run in terminal

The screenshot shows a terminal window on a Raspberry Pi. The title bar says "pi@raspberry: ~/Desktop/pract 1 python". The window contains the following terminal session:

```
File Edit Tabs Help
pi@raspberry:~ $ cd Desktop/'pract 1 python'
pi@raspberry:~/Desktop/pract 1 python $ ls
616_AIoT_Practical_1.py
pi@raspberry:~/Desktop/pract 1 python $ python 616_AIoT_Practical_1.py
What is your Name? Yash
Enter your max age in years: 22
What is the current year: 2022
You were born in year 2000.

pi@raspberry:~/Desktop/pract 1 python $ |
```

Conclusion

Getting Python programs to run on the Raspberry Pi is incredibly easy with an OS like Raspbian, which is designed for programmers of all kinds.

Another major advantage of using Python on the Pi is that you can write the program on a different computer (such as Windows) and then transfer the program to the Pi when it's ready to run. Just remember, however, that some code in Python is unique to the Pi—only the Pi has GPIO!

Practical – 4: Create Home Automation system and control the devices remotely.

Cayenne APP

- Cayenne is the world's first drag-and-drop IoT project builder.
- It is used to remotely control setup your IoT projects with drag and drop widgets from an app.

Actuator

- An Actuator is a device that makes something move or operate.
- It converts the source of energy into physical-mechanical motion.

Relay:

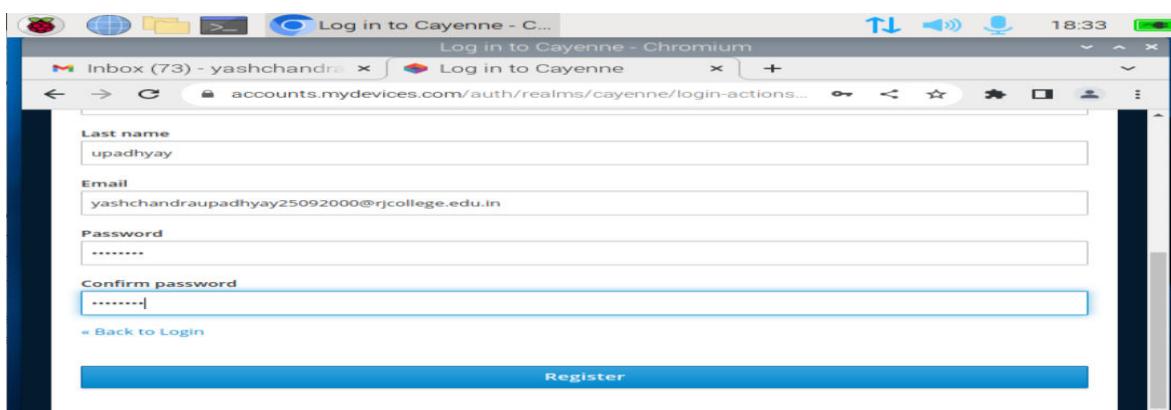
- Relay is a switch which controls (open and close) circuits electromechanically.
- The main operation of this device is to make or break contact with the help of a signal without any human involvement in order to switch it ON or OFF.

Connection:

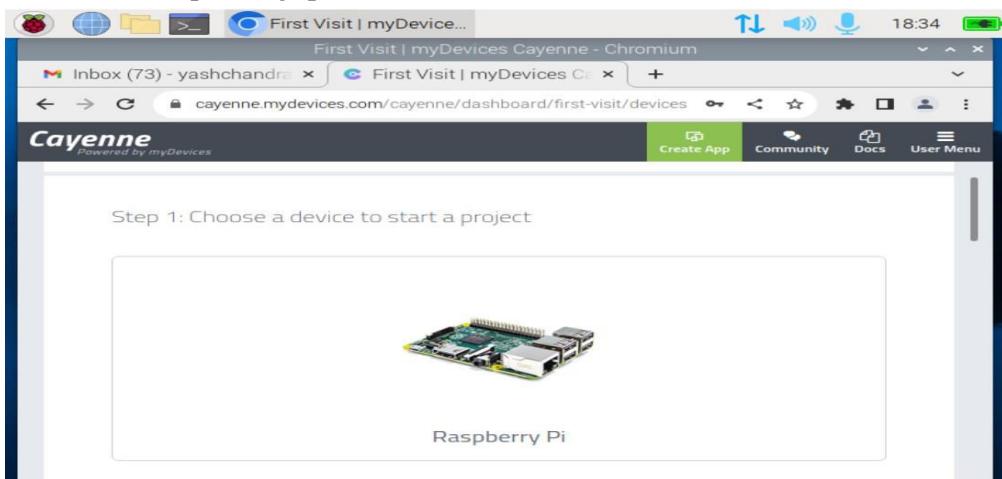
- (Red wire) power supply +Ve => Relay K2 front slot
- (Red wire) Fan +Ve=>Relay slot (Next to K2)
- (Black wire) Fan -Ve=> power supply -Ve (black wire)
- Relay Pin connection: -
 - i) VCC 5v =>Pin 2
 - ii) GND GND =>Pin 6
 - iii)IN GPIO17 =>Pin 11

After Fan connection gets finish. Go to Browser and use this link to navigate to Cayenne.

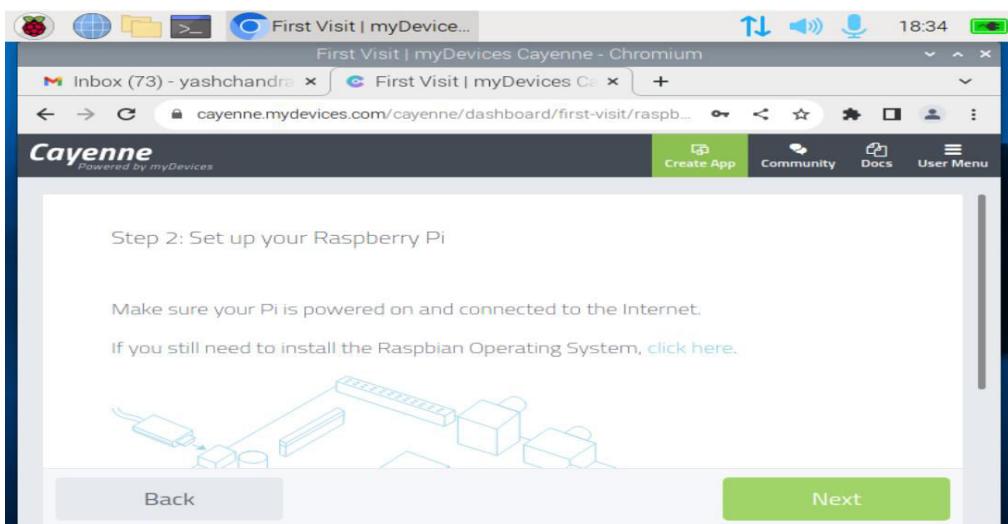
1. Register on cayenne my devices



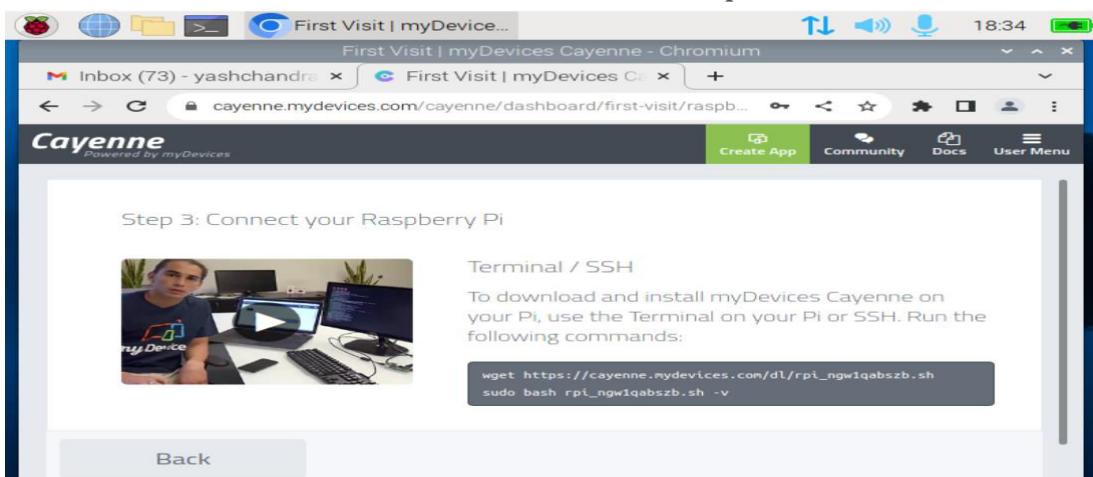
2. Click on raspberry pi



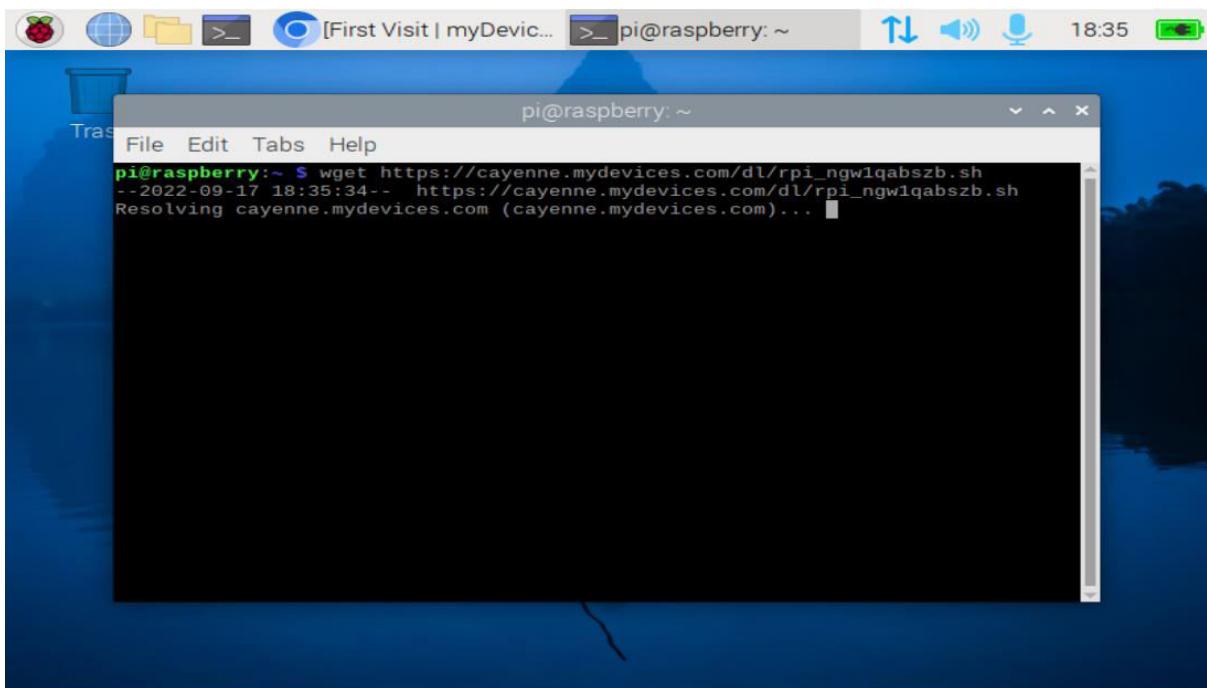
3. Click on next



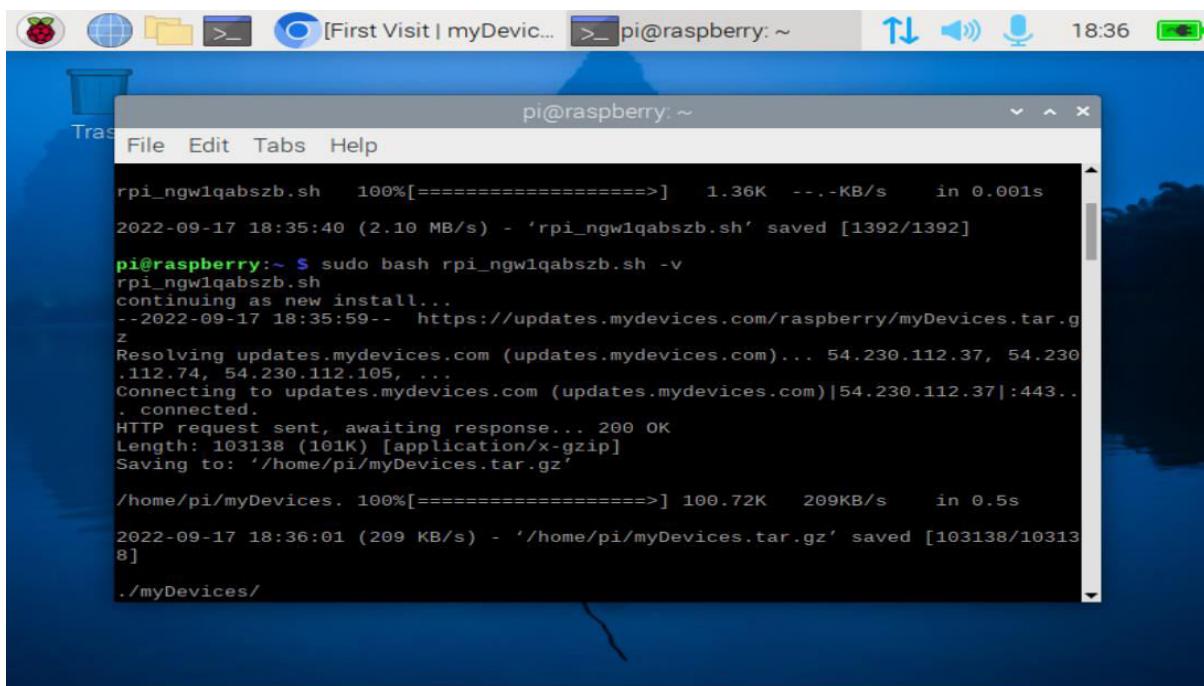
4. Run both commands in terminal and wait till pi restarts.



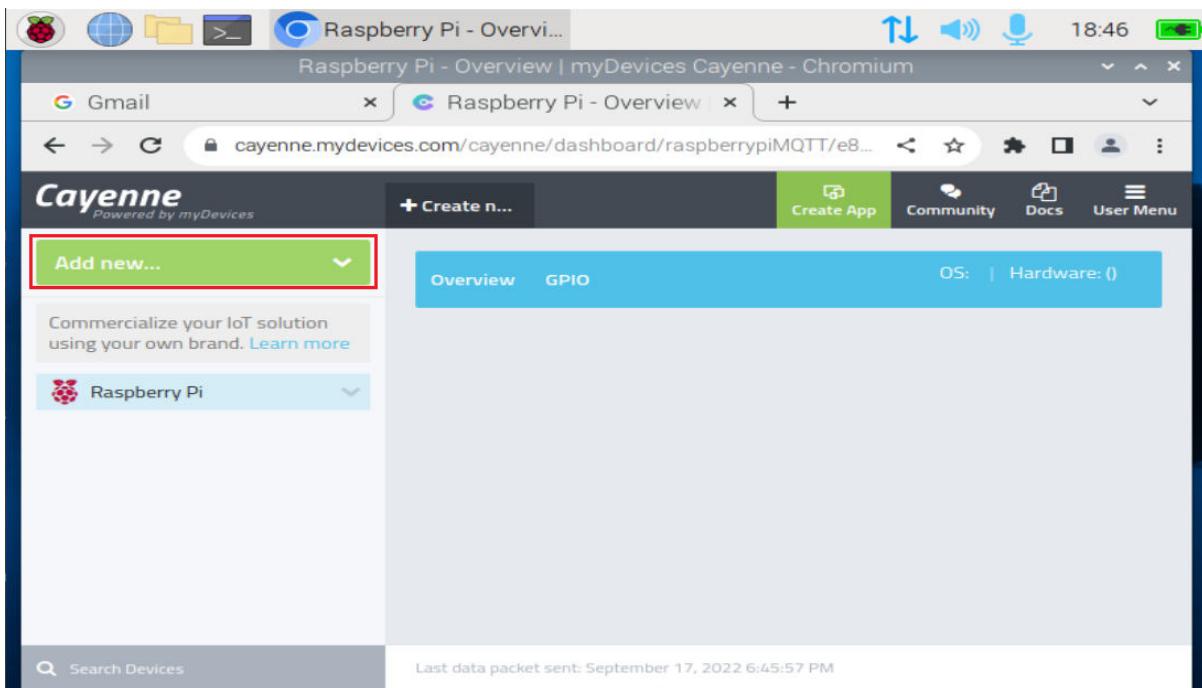
5. Command 1



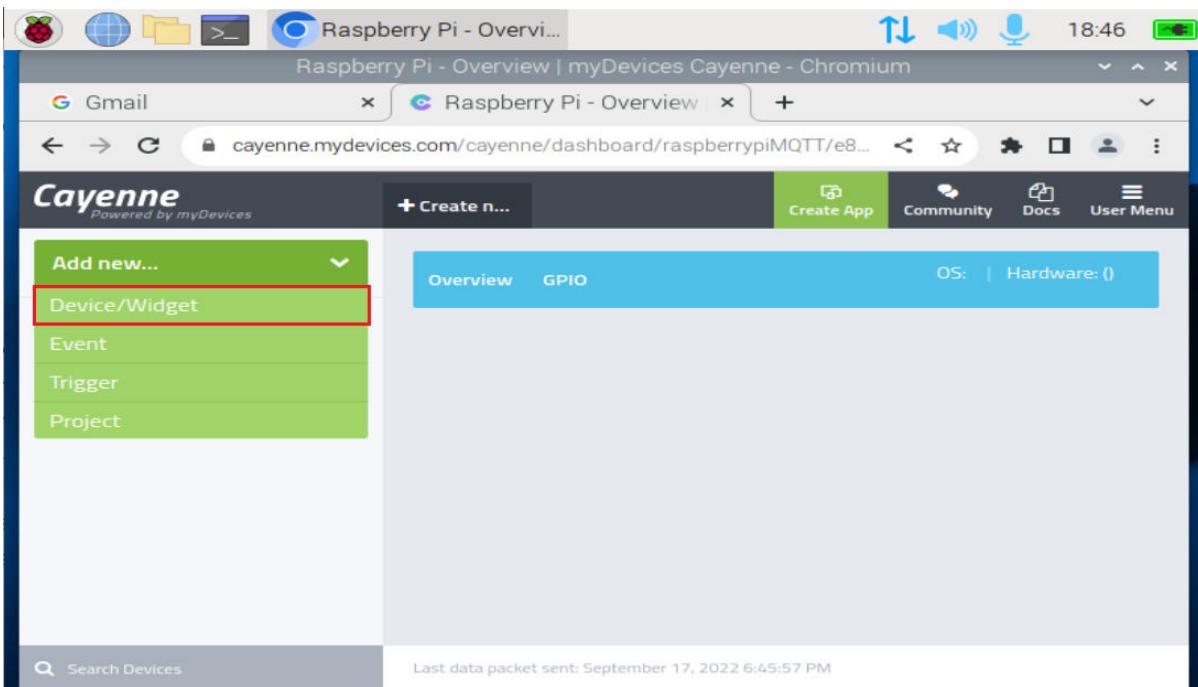
Command 2



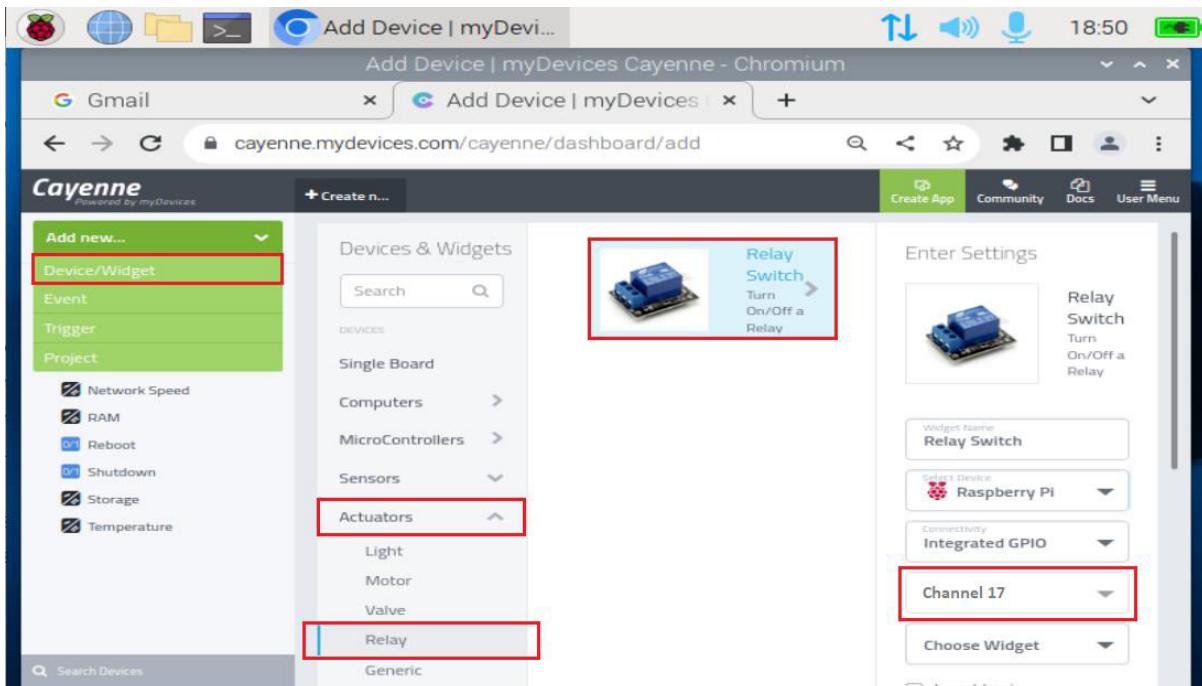
6. Click on add new



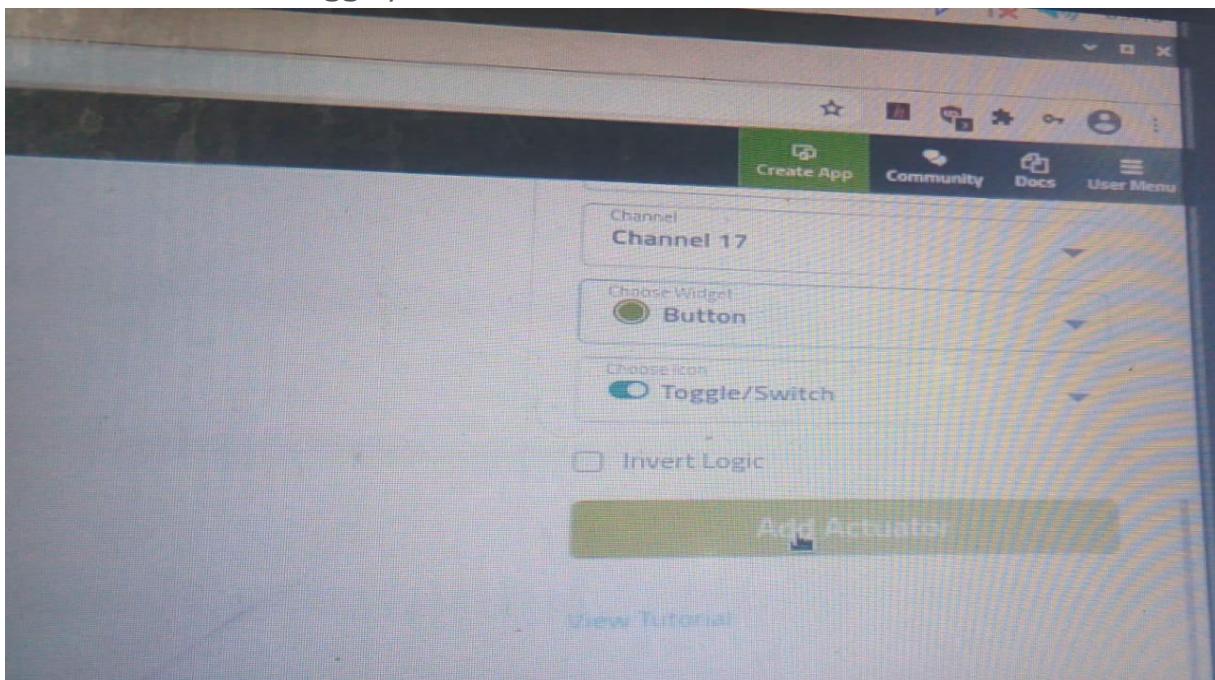
7. Click on devices/Widget



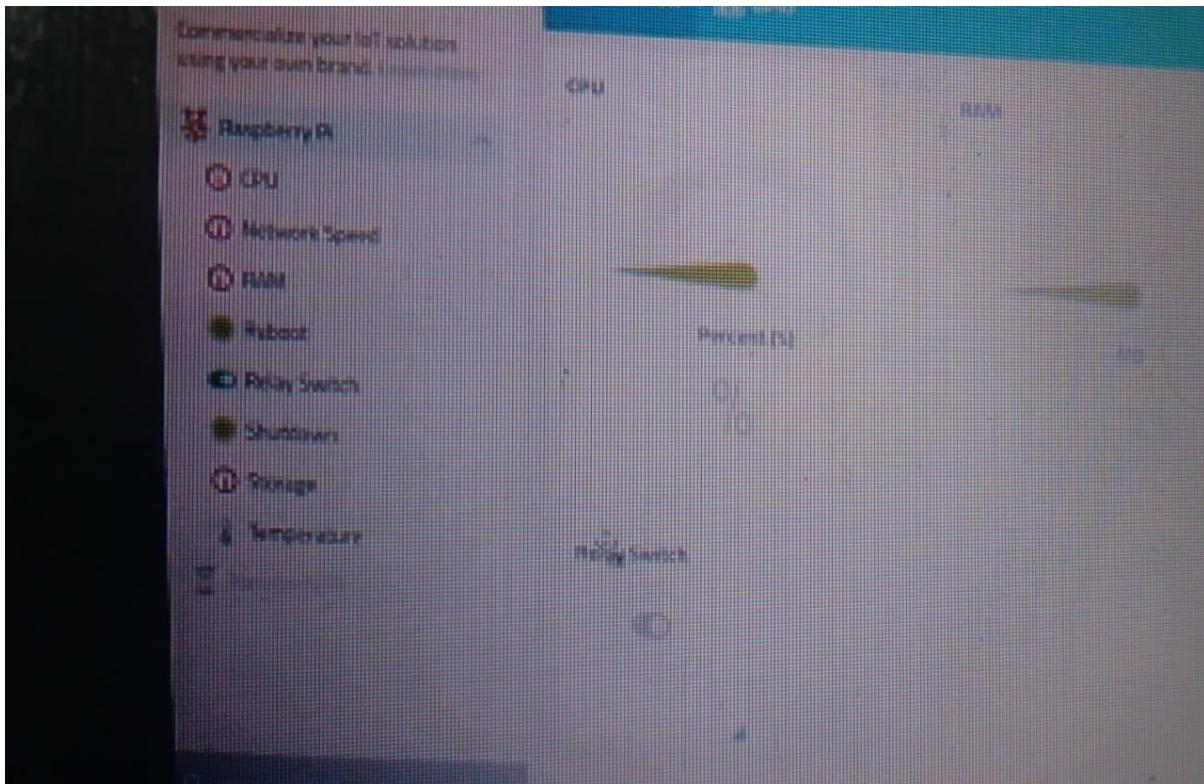
8. Click on actuators > relay > relay switch and select Integrated GPIO and channel 17



9. Select button and toggle/switch and click on add actuator



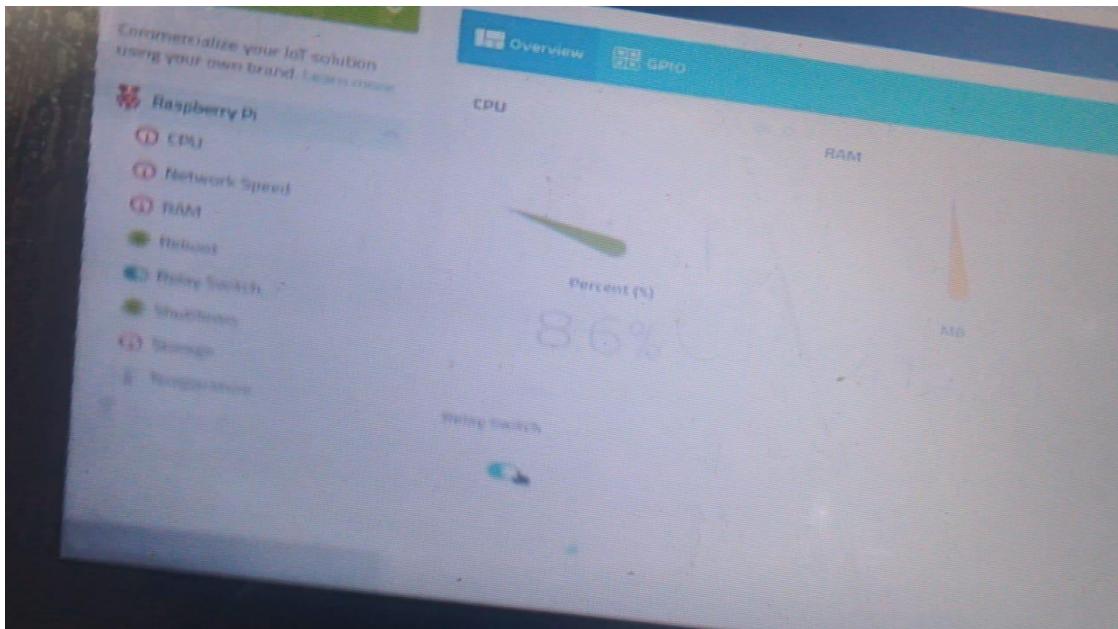
10. Toggle on switch from my devices online page



11. Fan will start to run.



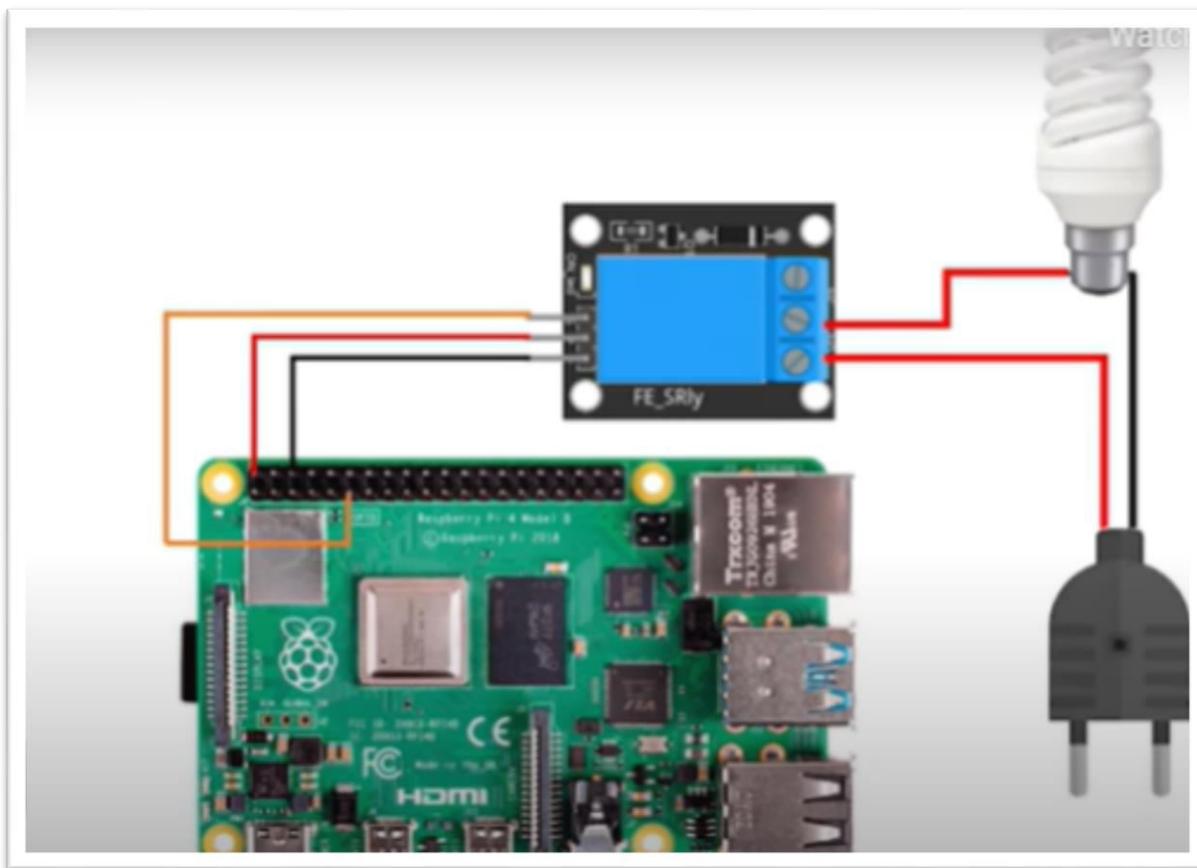
12. Toggle off



13. Fan stopped

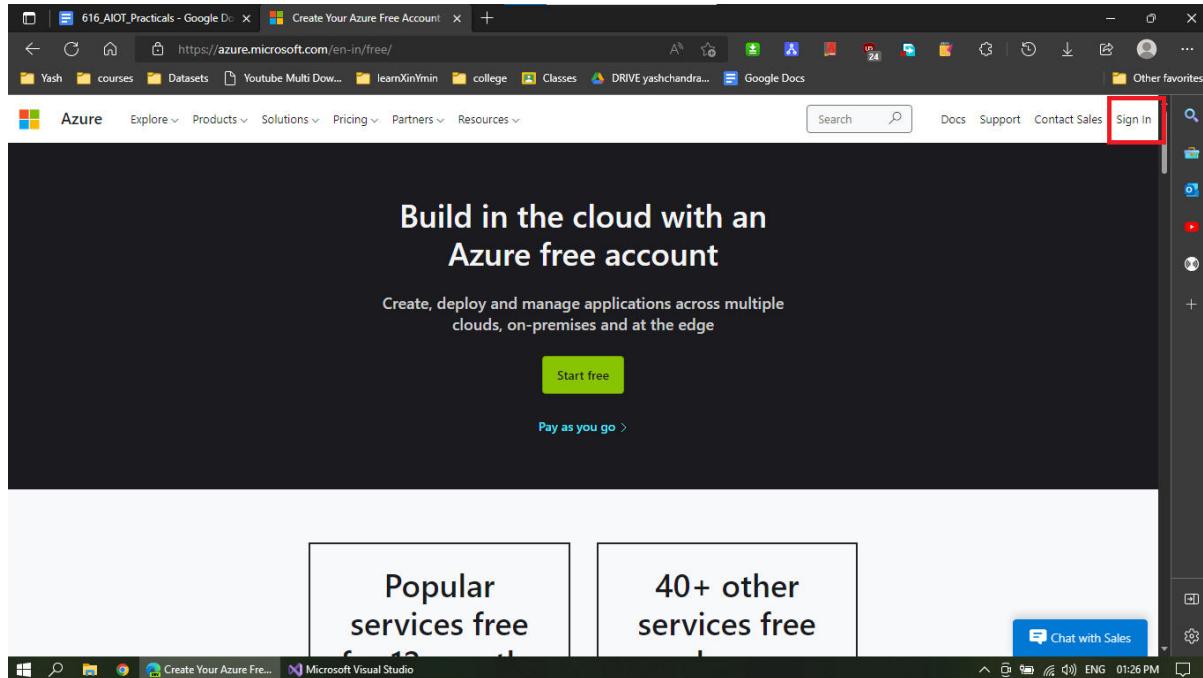


Architecture of home automation.

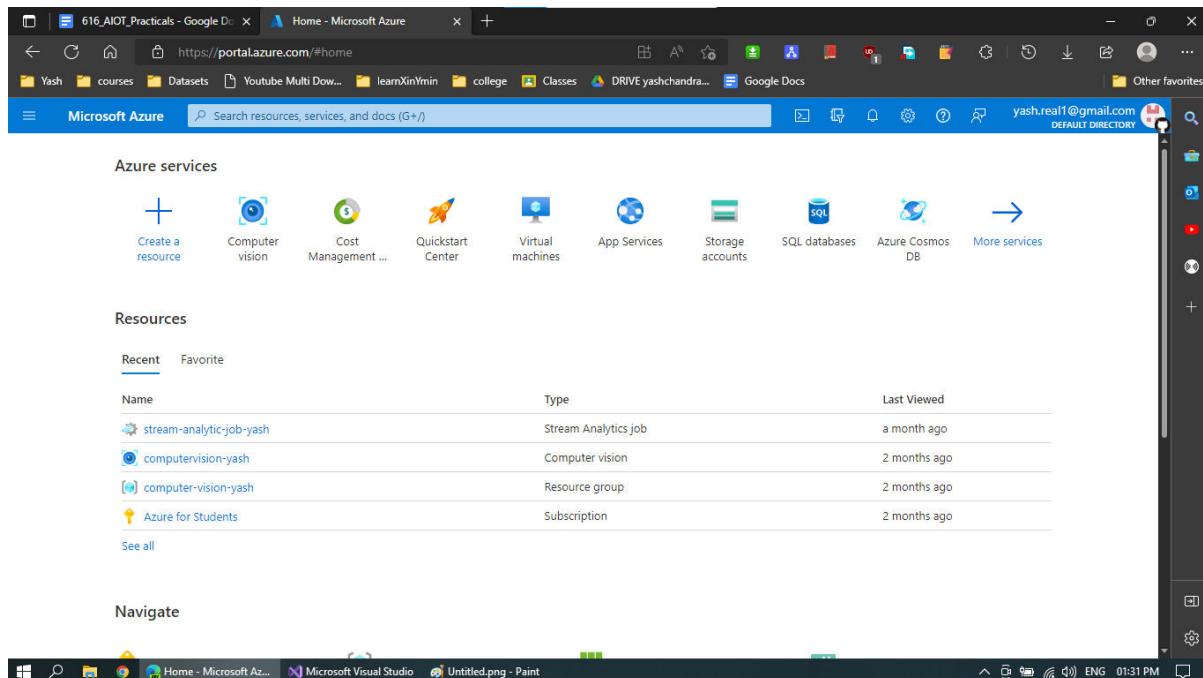


Practical – 5: Create the programs using the Microsoft Cognitive APIs for IoT (computer vision)

1. Go to azure portal



2. Sign in to account or create new



3. Click on create a resource

The screenshot shows the Microsoft Azure portal homepage. At the top, there's a navigation bar with links like 'Home - Microsoft Azure', 'Search resources, services, and docs (G+)', and user information. Below the bar, under 'Azure services', there's a large red box highlighting the 'Create a resource' button, which is a white square with a blue plus sign. To the right of this are icons for various services: Computer vision, Cost Management ..., Quickstart Center, Virtual machines, App Services, Storage accounts, SQL databases, Azure Cosmos DB, and More services. Below this section is a 'Resources' area with tabs for 'Recent' and 'Favorite'. It lists several items: 'stream-analytic-job-yash' (Stream Analytics job), 'computervision-yash' (Computer vision), 'computer-vision-yash' (Resource group), and 'Azure for Students' (Subscription). At the bottom, there's a 'Navigate' section with a browser-like interface showing the URL 'https://portal.azure.com/#create/hub' and a list of recent tabs.

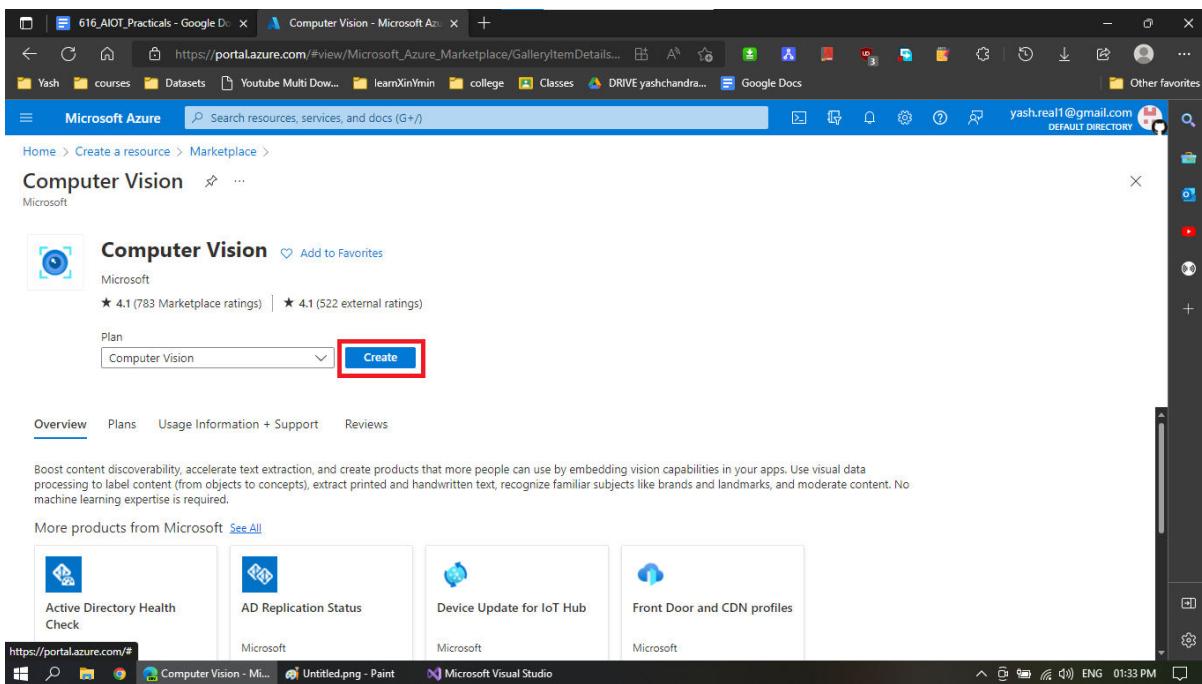
4. Search for computer vision

The screenshot shows the Microsoft Azure Marketplace search results for 'computer vision'. The search bar at the top has 'computer vision' entered. Below the search bar, there are filters for 'Pricing : All', 'Operating System : All', 'Publisher Type : All', and 'Product Type : All'. The main area displays four search results in a grid:

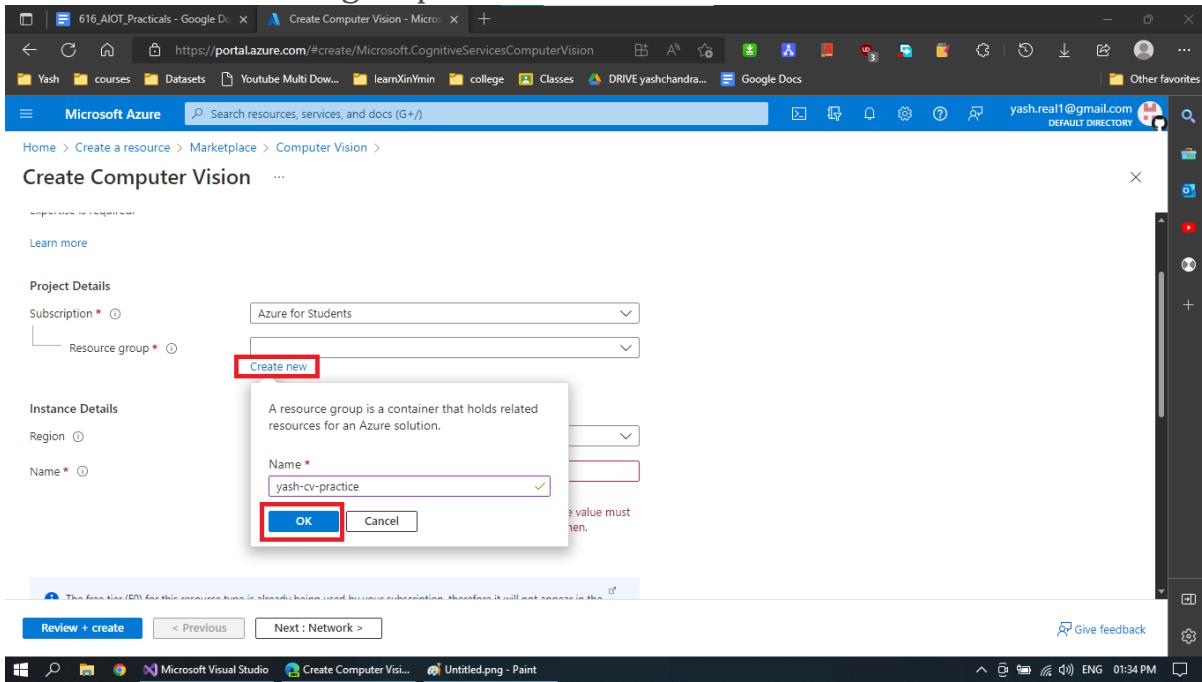
- Computer Vision** (Microsoft, Azure Service): An AI service that analyzes content in images. A red box highlights this item.
- Custom Vision** (Microsoft, Azure Service): An AI service and end-to-end platform for applying computer vision to your specific scenario.
- Roboflow: End-to-end Computer Vision Platform** (Roboflow, Inc., SaaS): Simplify data collection & annotation, model training & deployment with our dev tools & APIs.
- Jupyter Hub for Computer Vision using Python** (Data Science Dojo, Virtual Machine): Our Jupyter instance provides easy to use environment for Computer Vision applications.

On the left sidebar, there are sections for 'Get Started', 'Service Providers', 'Management', 'My Marketplace', 'Categories', 'AI + Machine Learning (34)', and 'Analytics (16)'. At the bottom, there's a footer with the text 'Is Marketplace helpful?' and a list of system status icons.

5. Click on create.



6. Create new resource group.



7. Set region and name.

Boost content discoverability, accelerate text extraction, and create products that more people can use by embedding vision capabilities in your apps. Use visual data processing to label content (from objects to concepts), extract printed and handwritten text, recognize familiar subjects like brands and landmarks, and moderate content. No machine learning expertise is required.

[Learn more](#)

Project Details

Subscription * Resource group * [Create new](#)

Instance Details

Region Name *

[Review + create](#) < Previous Next : Network > Give feedback

8. Set pricing tier

Pricing tier * View full pricing details

Responsible AI Notice

Microsoft provides technical documentation regarding the appropriate operation applicable to this Cognitive Service that is made available by Microsoft. Customer acknowledges and agrees that they have reviewed this documentation and will use this service in accordance with it. This Cognitive Services is intended to process Customer Data that includes Biometric Data (as may be further described in product documentation) that Customer may incorporate into its own systems used for personal identification or other purposes. Customer acknowledges and agrees that it is responsible for complying with the Biometric Data obligations contained in the Online Services DPA.

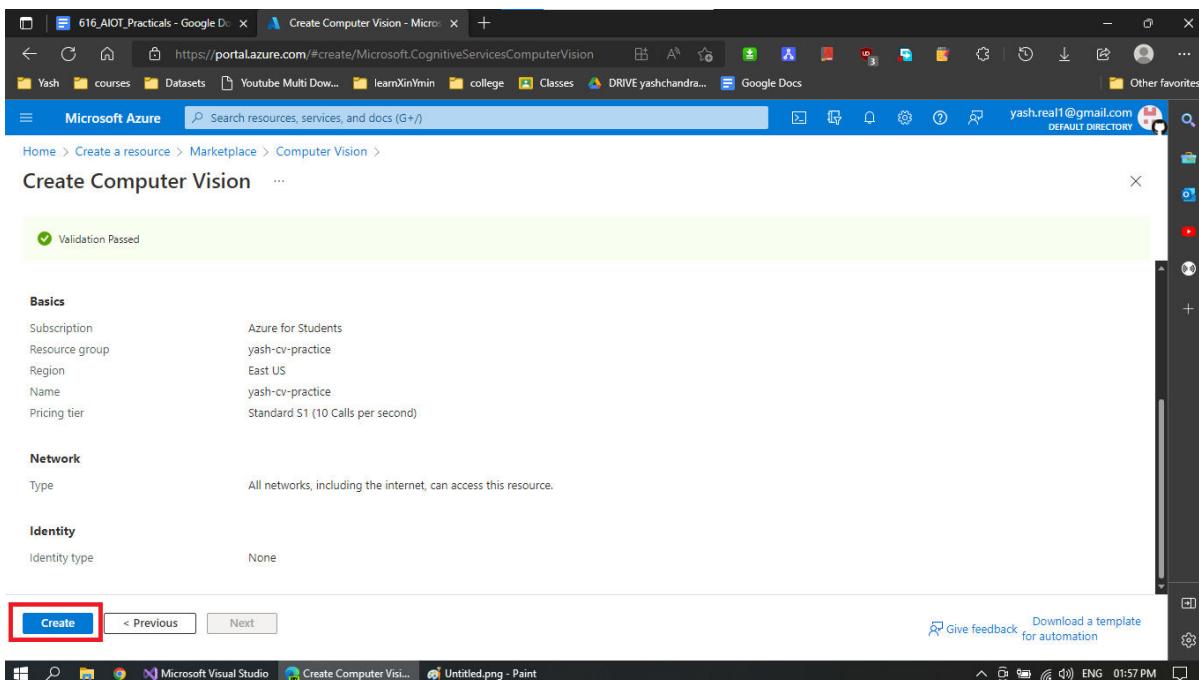
Online Services DPA

Responsible Use of AI documentation for Spatial Analysis

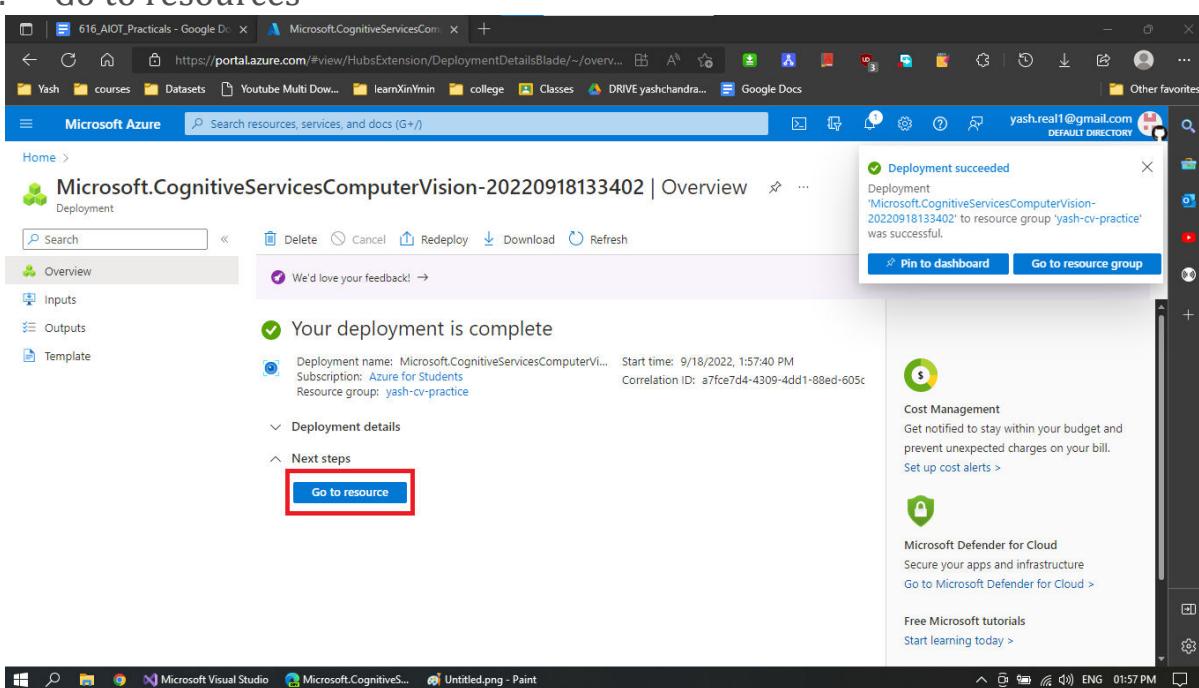
By checking this box I certify that I have reviewed and acknowledge the all the terms above.*

[Review + create](#) < Previous Next : Network > Give feedback

9. Click on create



10. Go to resources



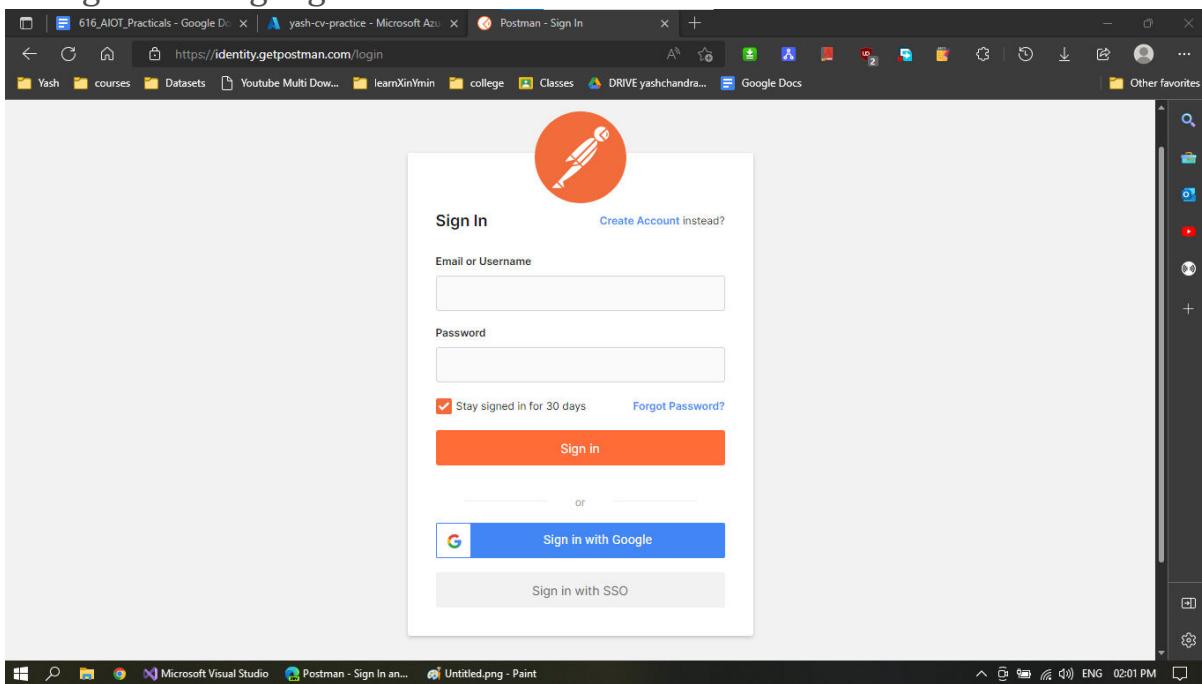
11. Note down keys

The screenshot shows the Microsoft Azure portal interface. In the top navigation bar, there are two tabs: '616_AIOT_Practicals - Google Docs' and 'yash-cv-practice - Microsoft Azure'. The main content area is titled 'yash-cv-practice | Keys and Endpoint'. On the left, a sidebar has a red box around the 'Keys and Endpoint' item under 'Resource Management'. Above the key fields, there is a button labeled 'Hide Keys' with a red box around it. The key fields are labeled 'KEY 1' and 'KEY 2', each containing a long string of characters. Below the keys is a 'Location/Region' dropdown set to 'eastus'. At the bottom is an 'Endpoint' field with the URL 'https://yash-cv-practice.cognitiveservices.azure.com/'. The status bar at the bottom right shows 'ENG 01:58 PM'.

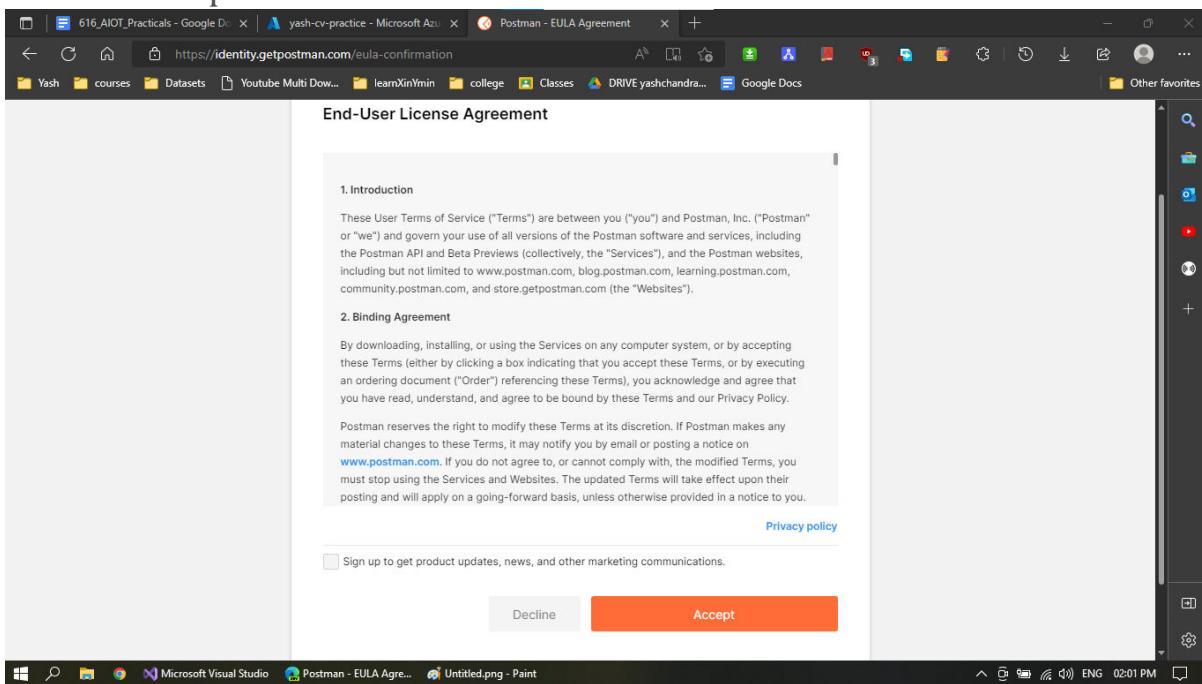
14. Sign in postman web

The screenshot shows the Postman API Platform interface. At the top, there are tabs for '616_AIOT_Practicals - Google Docs' and 'yash-cv-practice - Microsoft Azure'. The main area is titled 'Postman API Platform | Sign Up'. The 'Explore' tab is selected. A yellow callout points from the 'Explore' menu to the 'Single Tweet' collection under 'Twitter API v2 / Tweet Lookup'. The right side of the screen displays the 'Single Tweet' request details, including the URL 'https://api.twitter.com/2/tweets/:id', parameters like 'id' (with a value of '1403216129681628420'), and a preview of the JSON response. The response body shows a single tweet with an ID of '1403216129681628420', a timestamp, and a text field containing 'Donovan Mitchell went down after a collision with Paul George toward the end of Game 2. <https://t.co/V9iXhDlN>'. The status bar at the bottom right shows 'ENG 02:01 PM'.

15. Sign in with google



16. Click accept



17. Enter below details

https://yash-cv-practice.cognitiveservices.azure.com/vision/v3.2/describe/

POST https://yash-cv-practice.cognitiveservices.azure.com/vision/v3.2/describe/ Send

Params Authorization Headers (8) Body Pre-request Script Tests Settings Cookies

Headers 7 hidden

KEY	VALUE	DESCRIPTION	...	Bulk Edit	Presets
<input checked="" type="checkbox"/> Ocp-Apim-Subscription-Key	bec2109d600a40b0821288a1dcc02e59				
Key	Value	Description			

18. Attach image file and send change GET to POST

https://yash-cv-practice.cognitiveservices.azure.com/vision/v3.2/describe/

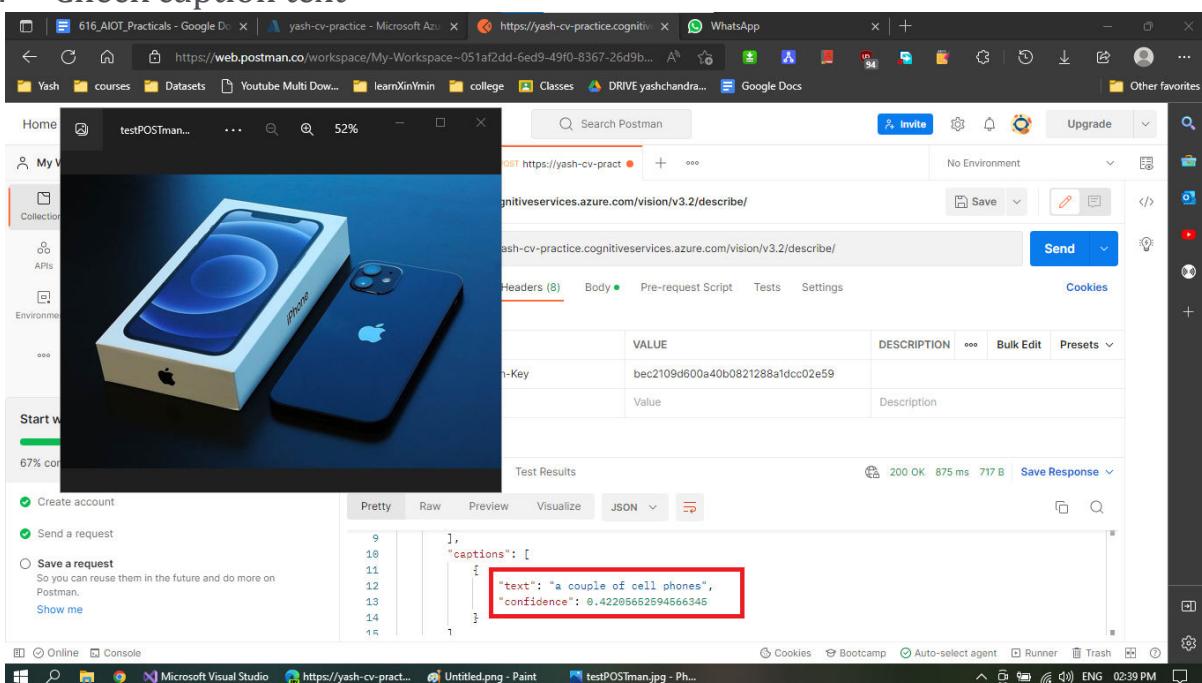
GET https://yash-cv-practice.cognitiveservices.azure.com/vision/v3.2/describe/ Send

Params Authorization Headers (8) Body Pre-request Script Tests Settings Cookies

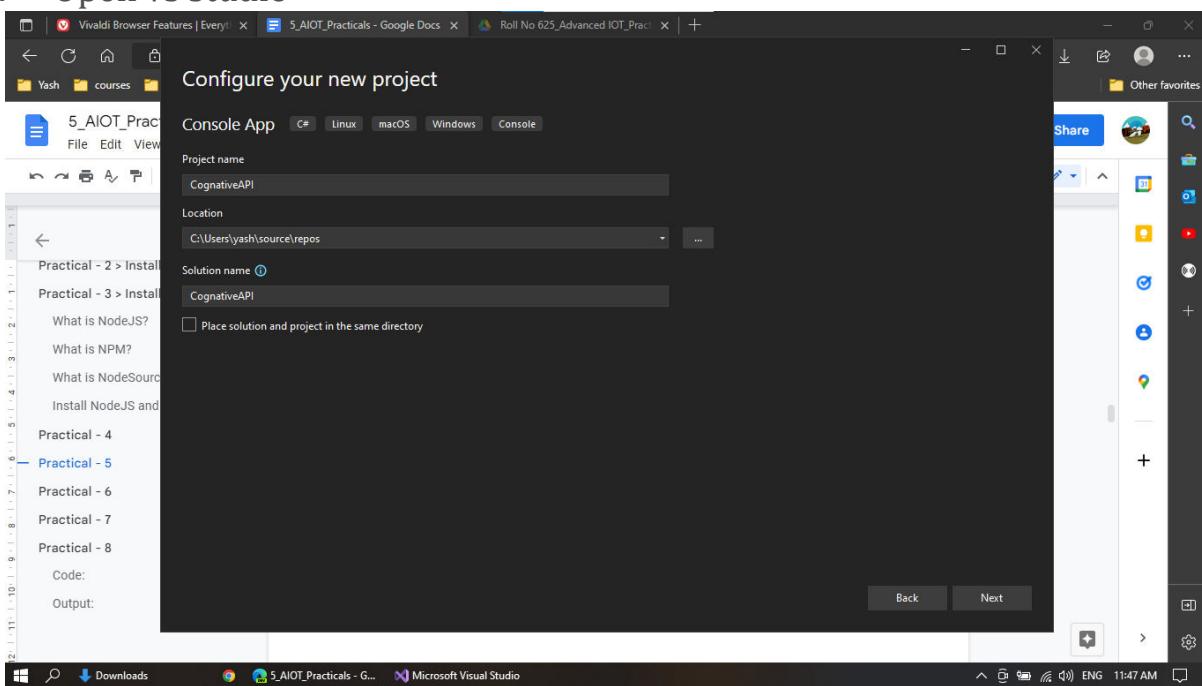
Body

KEY	VALUE	DESCRIPTION	...	Bulk Edit
<input checked="" type="checkbox"/> image	File: O_PnRIV/testPOSTman.jpg			

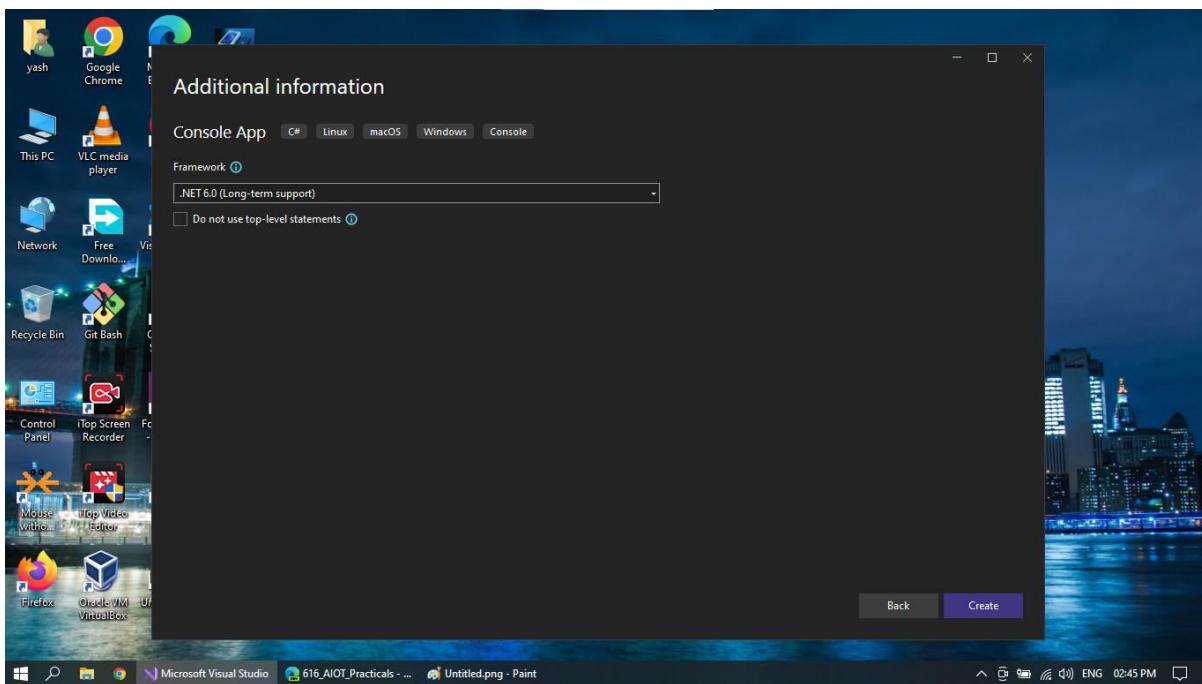
19. Check caption text



20. Open vs studio



21. Select .net version



Write below code -

```
using System;  
  
using System.Collections.Generic;  
  
using System.Configuration;  
  
using System.Linq;  
  
using System.Net.Http;  
  
using System.Text;  
  
using System.Threading.Tasks;  
  
using System.Web;
```

```
namespace MyFirstCognitiveApp

{
    internal class Program
    {
        private const string key = "bec2109d600a40b0821288a1dcc02e59";

        static void Main(string[] args)
        {
            Task<string> result =
DescribeImage(@"C:\Users\yash\Desktop\testPOSTman.jpg");

            Console.WriteLine(result.Result);

            Console.ReadLine();

        }

        public static async Task<string> DescribeImage(string imagePath)
        {
            using (HttpClient myHttpClient = new HttpClient())
            {

                //myHttpClient.DefaultRequestHeaders.Add("Ocp-Apim-
                Subscription-Key", ConfigurationManager.AppSettings
                //["AzureSubscriptionKeyVision"]);

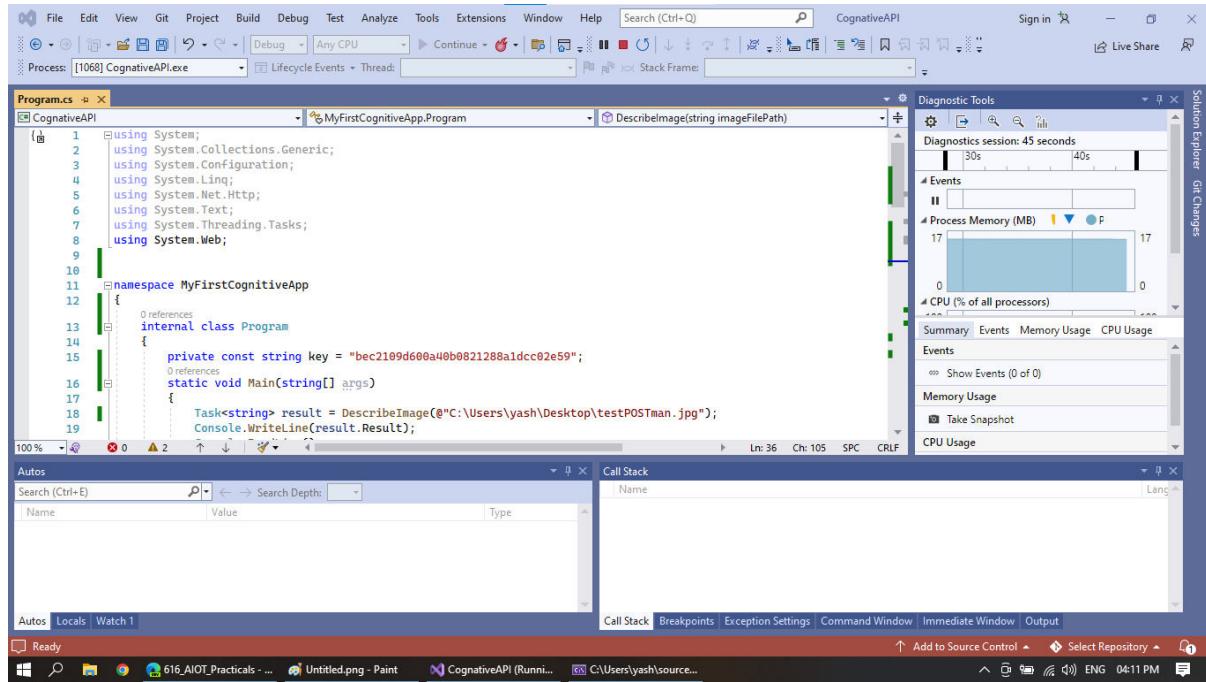
                myHttpClient.DefaultRequestHeaders.Add("Ocp-Apim-Subscription-
                Key", key);

                using (MultipartFormDataContent reqContent = new
                    MultipartFormDataContent())
                {
```

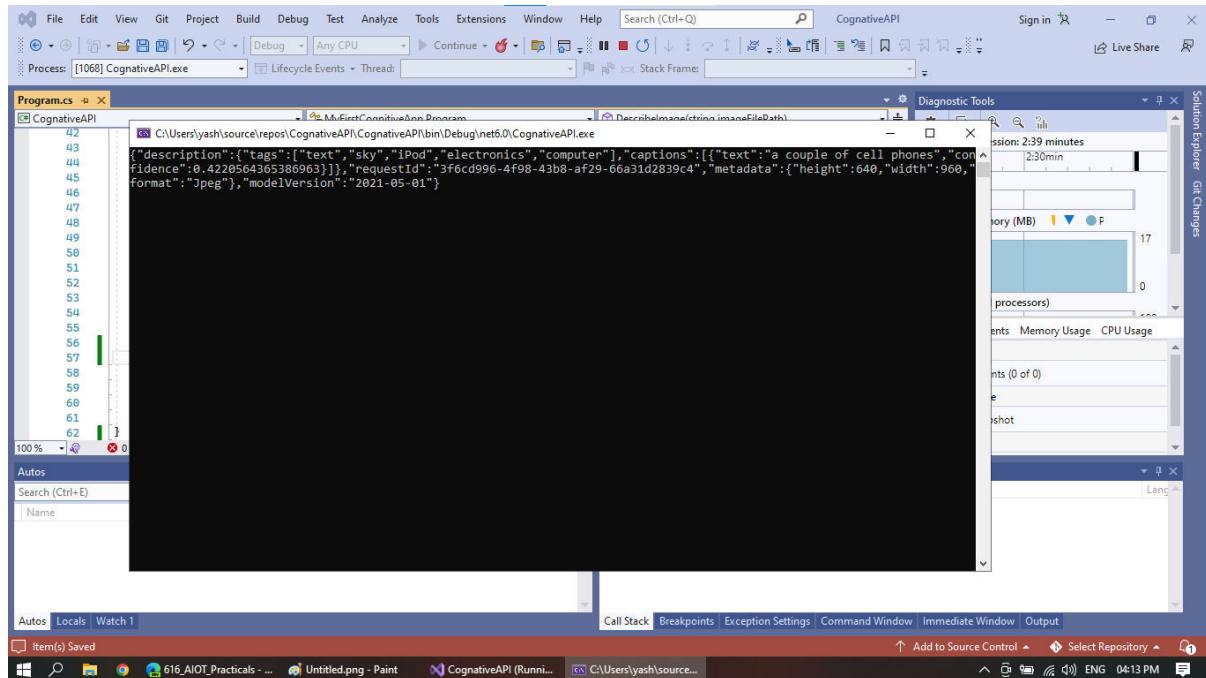
```
{  
    var queryString = HttpUtility.ParseQueryString  
    (string.Empty);  
  
    queryString["maxCandidates"] = "1";  
  
    //var uri = "https://eastus.api.cognitive.com / vision / v3.2 /  
    describe /? " + queryString;  
  
    var uri = "https://yash-cv-  
    practice.cognitiveservices.azure.com/vision/v3.2/describe/? " + queryString;  
  
    try  
    {  
        var imgContent = new ByteArrayContent(System.  
        IO.File.ReadAllBytes(imageFilePath));  
  
        reqContent.Add(imgContent);  
  
        HttpResponseMessage respMessage = await  
        myHttpClient.PostAsync(uri, reqContent);  
  
        string finalJson = await respMessage.Content.  
  
        ReadAsStringAsync();  
  
        return finalJson;  
    }  
    catch (System.IO.FileNotFoundException ex)
```

```
{  
    return "The specified image file path is invalid.";  
}  
  
catch (ArgumentException ex)  
{  
    return "The HTTP request object does not seem to be correctly  
formed.";  
}  
}  
}  
}  
1. }
```

Run code



Output



Practical – 6: Create blockchain on Raspberry Pi and implement and test it. Authenticate IoT with blockchain.

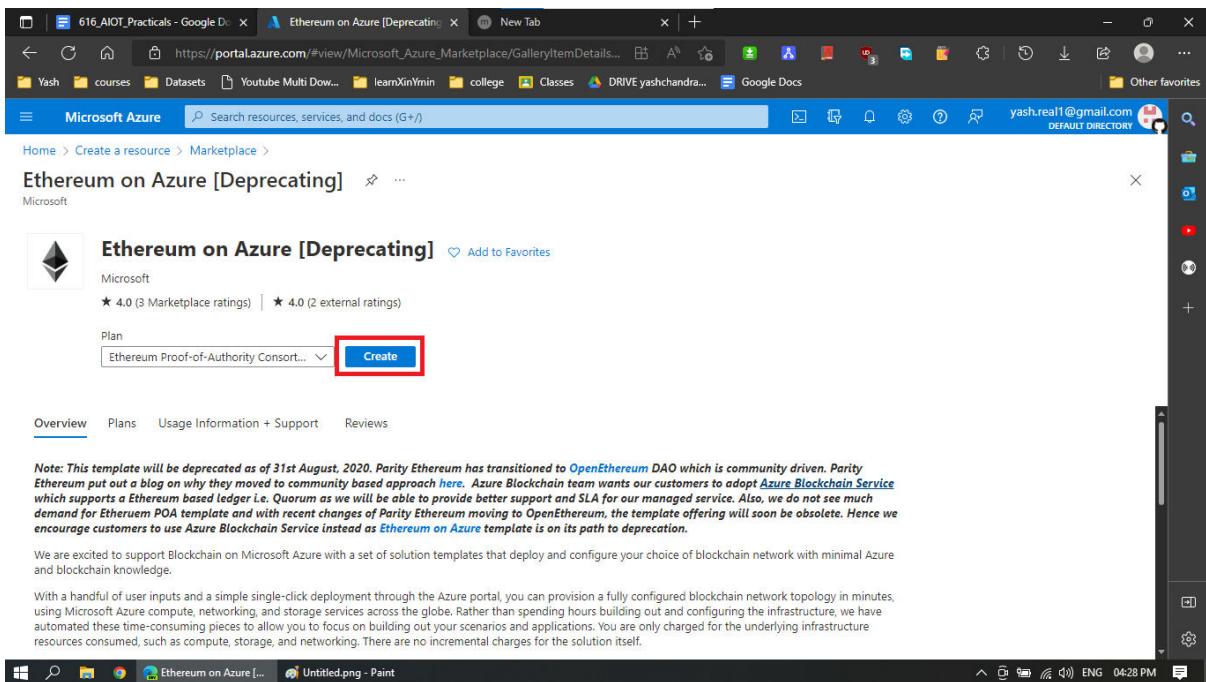
1. Click on create resources.

The screenshot shows the Microsoft Azure home page. At the top, there's a search bar and a navigation bar with various service icons like Computer vision, Cost Management, Quickstart Center, Virtual machines, App Services, Storage accounts, SQL databases, and Azure Cosmos DB. Below this is a section titled 'Azure services' with a prominent 'Create a resource' button, which is highlighted with a red box. To the right of this are icons for Computer vision, Cost Management, Quickstart Center, Virtual machines, App Services, Storage accounts, SQL databases, Azure Cosmos DB, and a 'More services' link. Below these sections is a 'Resources' area with tabs for 'Recent' and 'Favorite'. It lists several resources: 'yash-cv-practice' (Computer vision), 'yash-cv-practice' (Resource group), 'stream-analytic-job-yash' (Stream Analytics job), 'computervision-yash' (Computer vision), 'computer-vision-yash' (Resource group), and 'Azure for Students' (Subscription). A 'See all' link is at the bottom of the list. The browser taskbar at the bottom shows multiple tabs and icons.

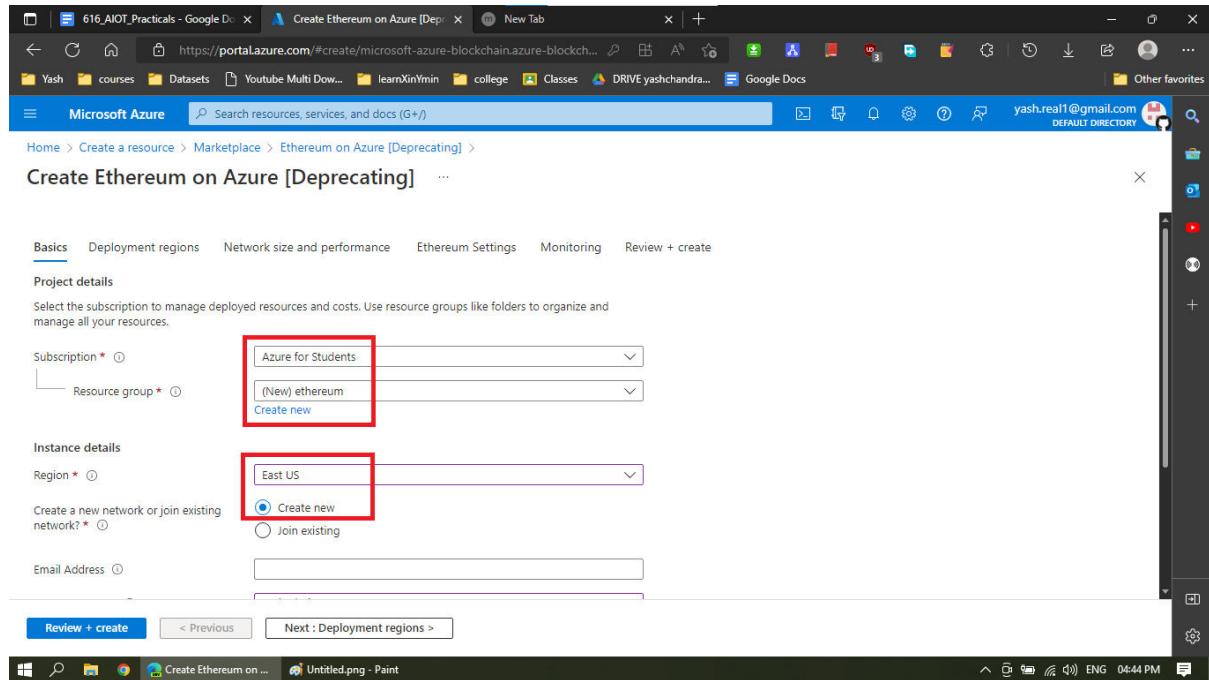
2. Select Ethereum on azure

The screenshot shows the Microsoft Azure Marketplace. On the left, there's a sidebar with 'Get Started', 'Service Providers', 'Management' (selected), 'Private Marketplace', 'Private Offer Management', 'My Marketplace' (selected), 'Favorites', 'Recently created', 'Private products', 'Categories' (selected), 'Blockchain (20)', and 'Developer Tools (6)'. The main area has a search bar with 'ethereum' typed in, and filters for 'Pricing : All', 'Operating System : All', 'Publisher Type : All', and 'Product Type : All'. Below the search bar, it says 'Showing 1 to 20 of 23 results for "ethereum"'. There are three items listed: 'Ethereum Full Node' (TechLatest, Virtual Machine, Out of box Ethereum Full Node, Create), 'Ethereum on Azure [Deprecated]' (Microsoft, Azure Application, Deploy and configure an Ethereum blockchain network in minutes, Create), and 'Ethereum developer kit (techlatest.net)' (TechLatest, Virtual Machine, Complete out of box development environment for Ethereum, Create). The 'Ethereum on Azure [Deprecated]' item is highlighted with a red box. The browser taskbar at the bottom shows multiple tabs and icons.

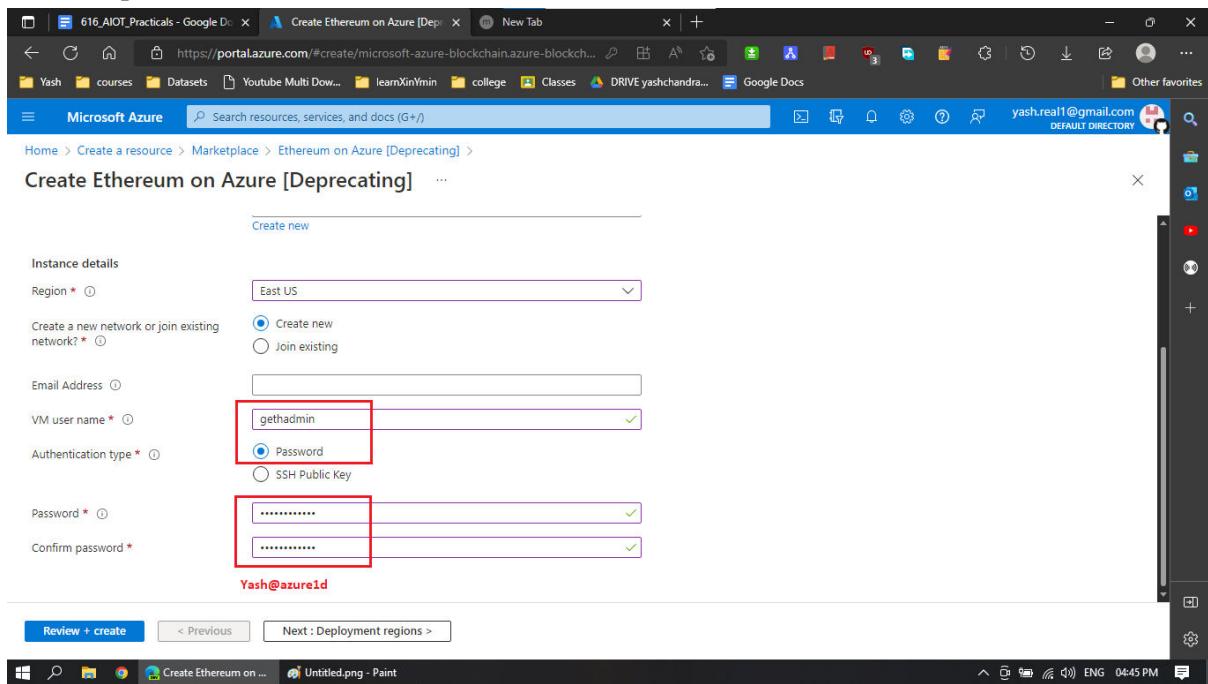
3. Click on create.



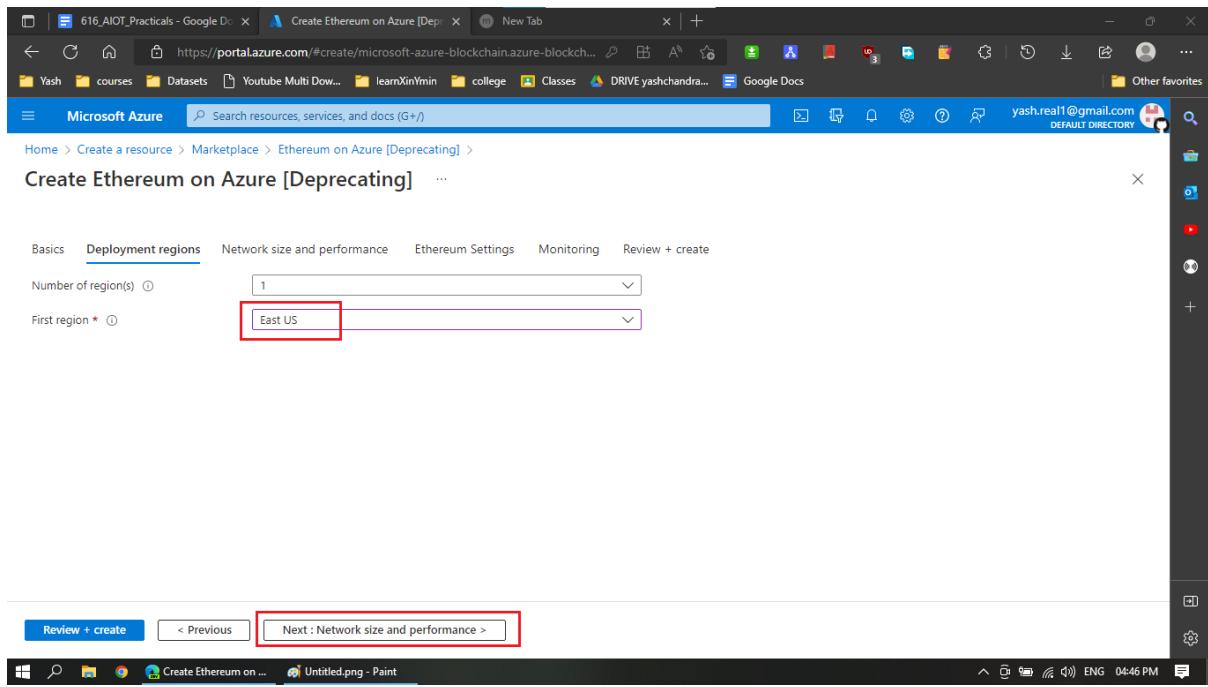
4. Fill according to below details



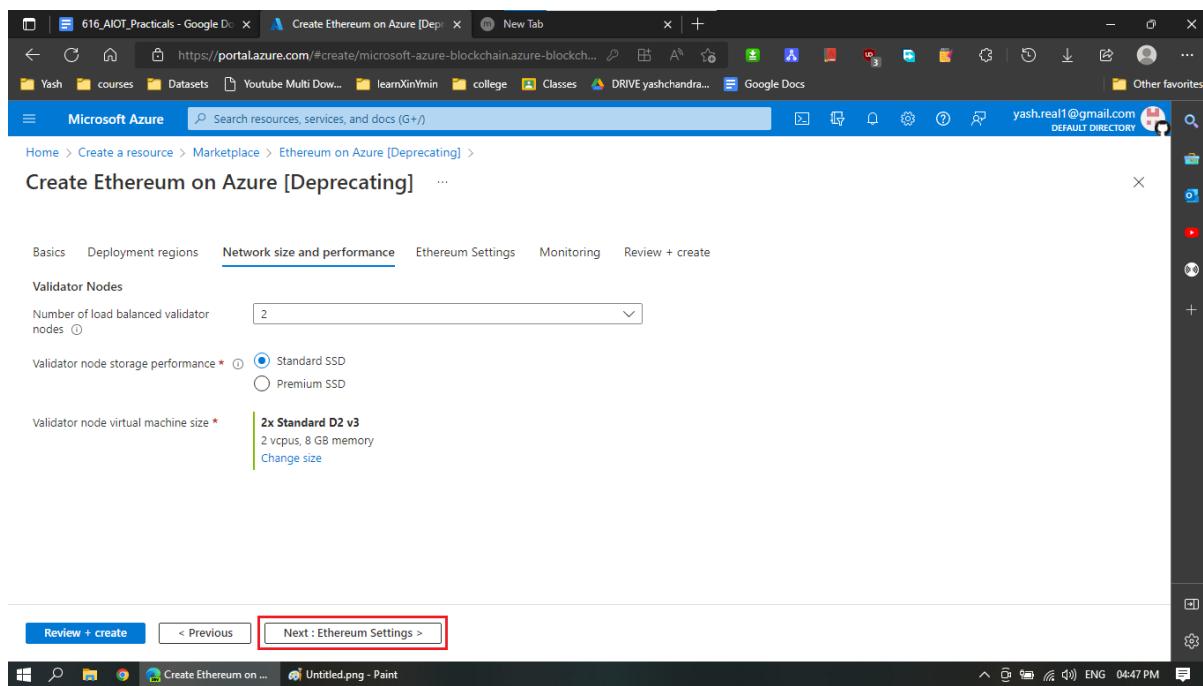
5. Set password and click on next



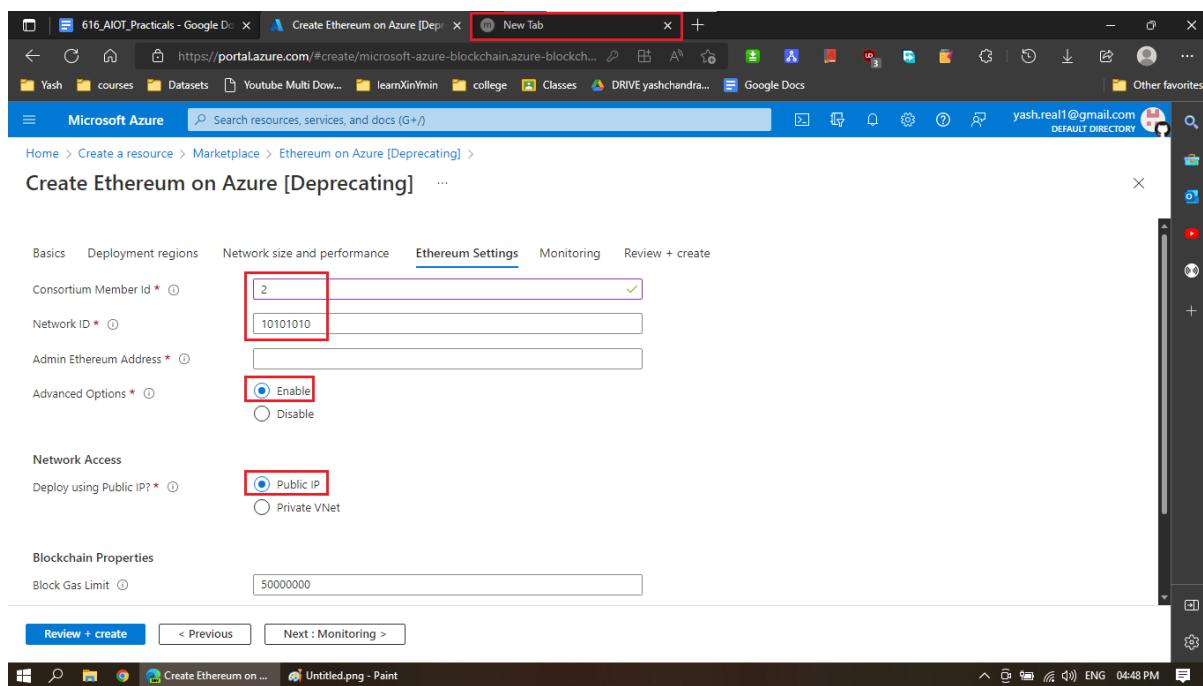
6. Set region same as before



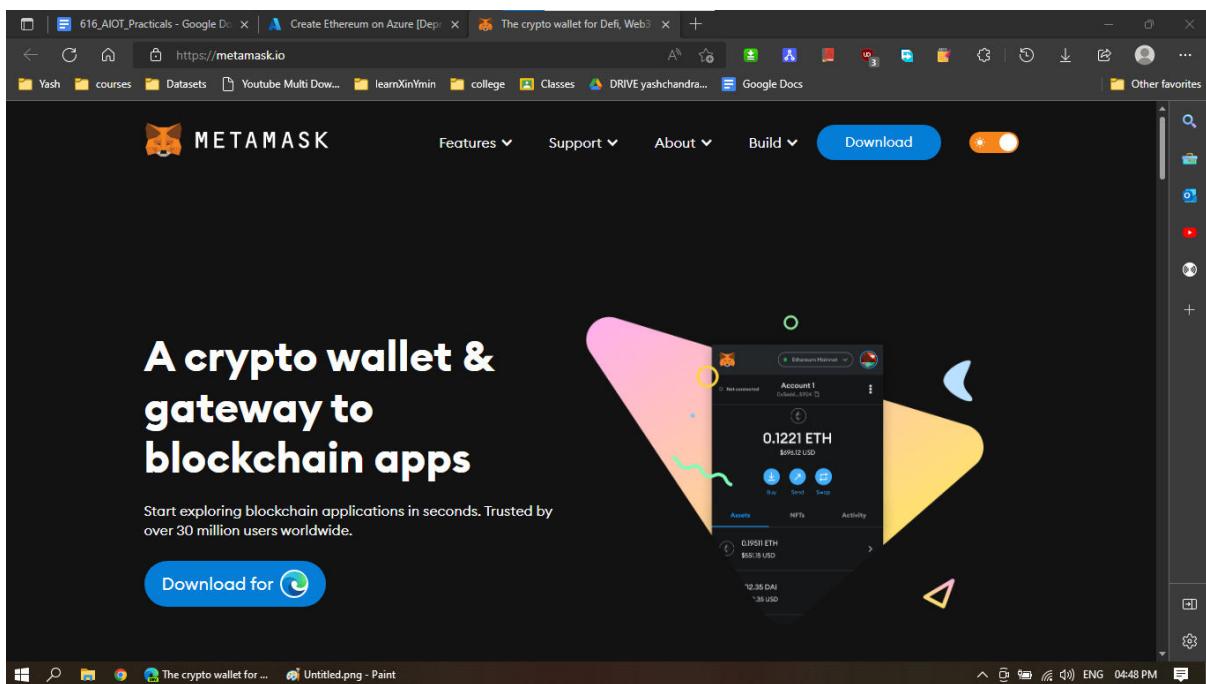
7. Click next



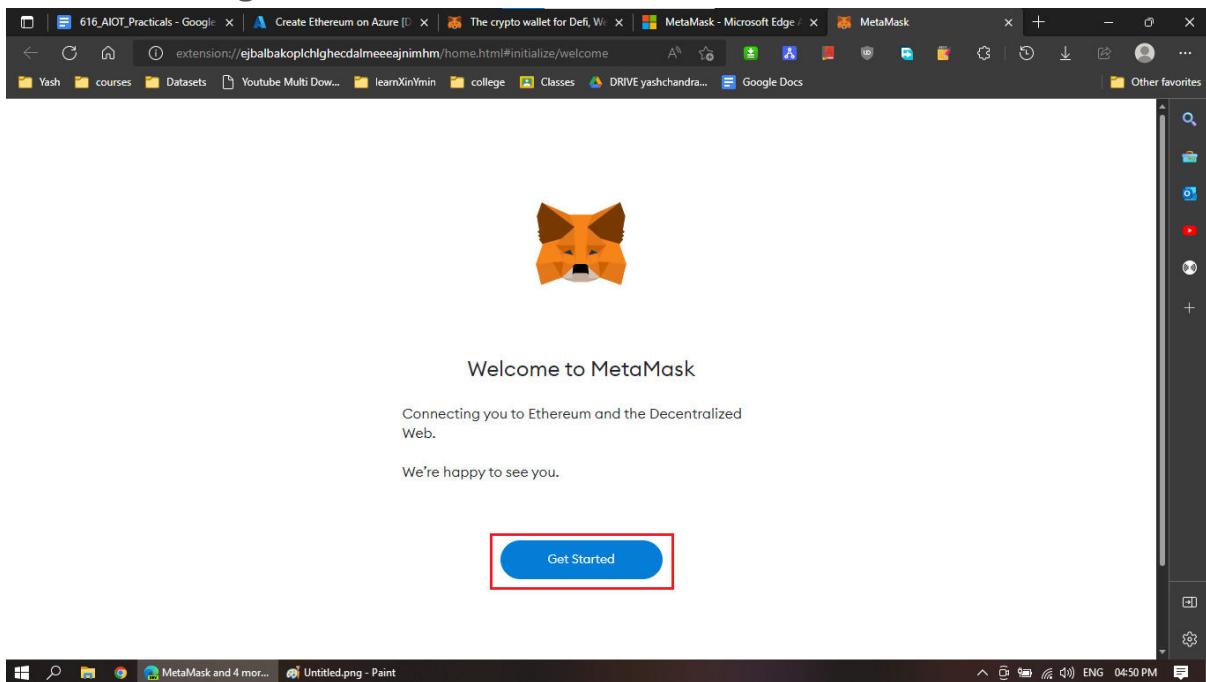
8. Fill as below detail and for Ethereum address keep azure open and go to new tab



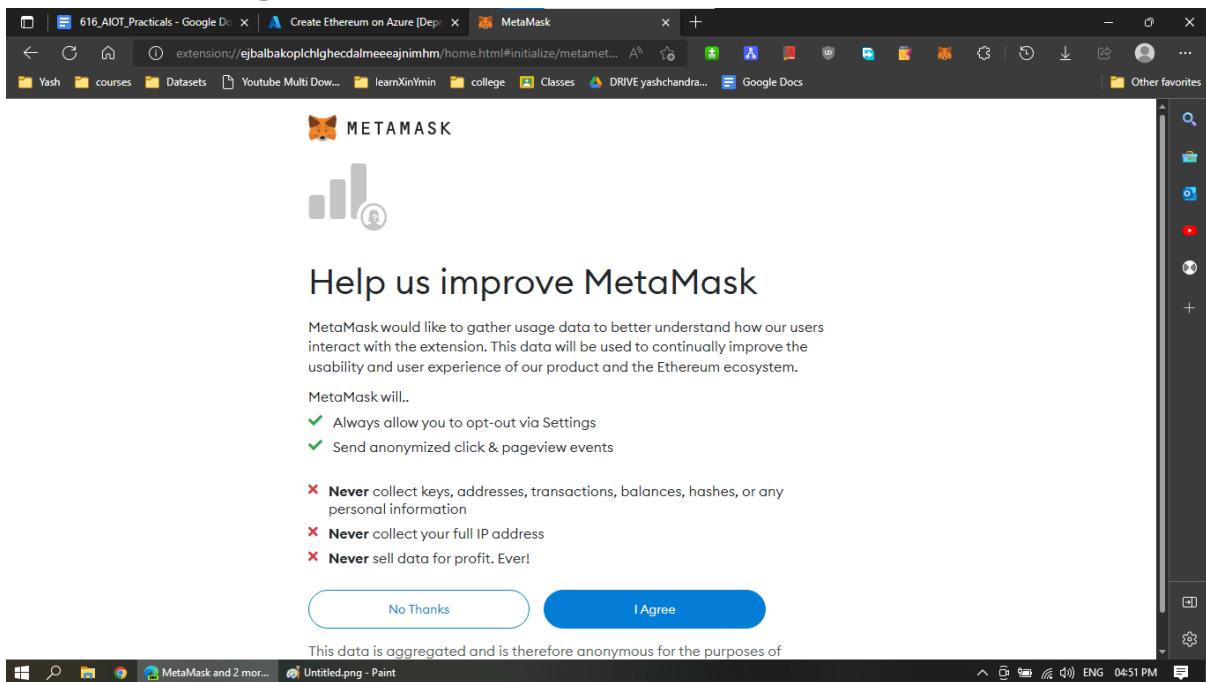
9. Download meta mask



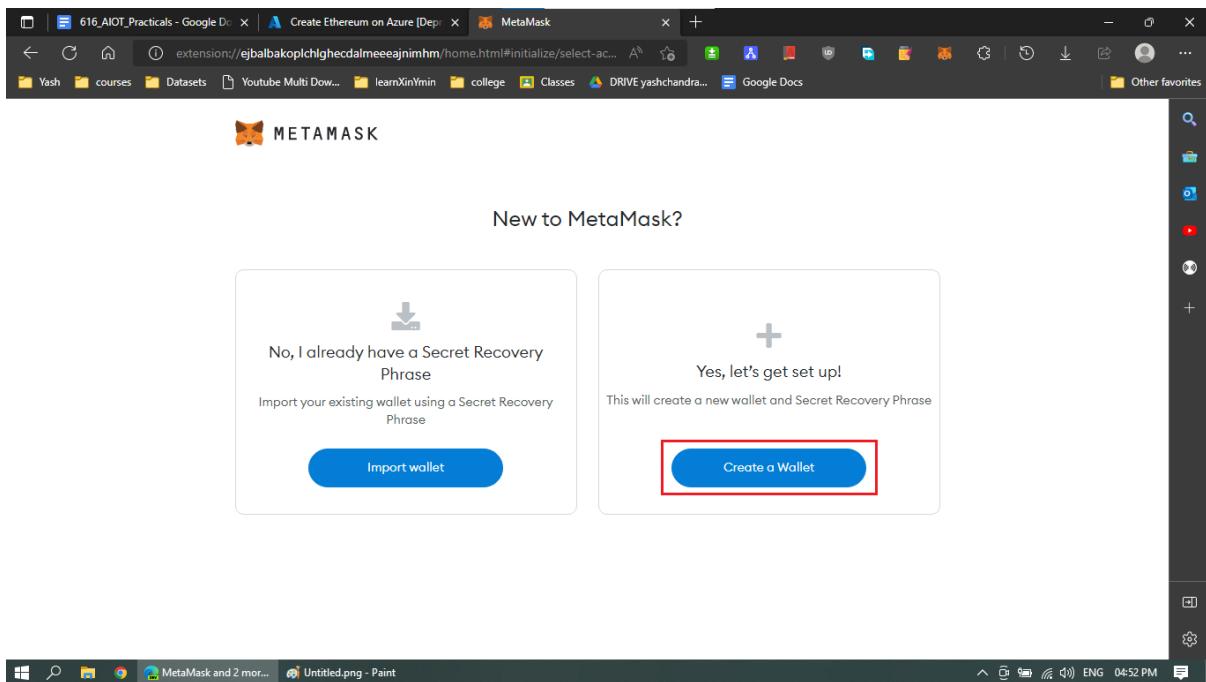
10. Click on get started.



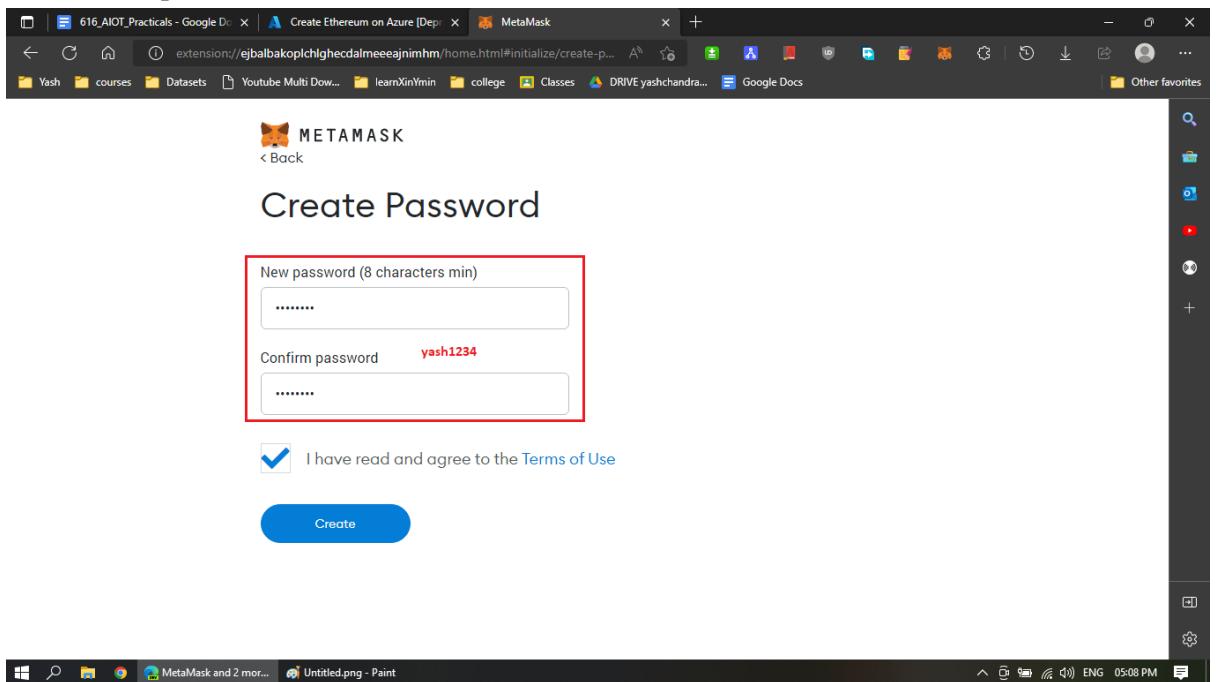
11. Click on agree



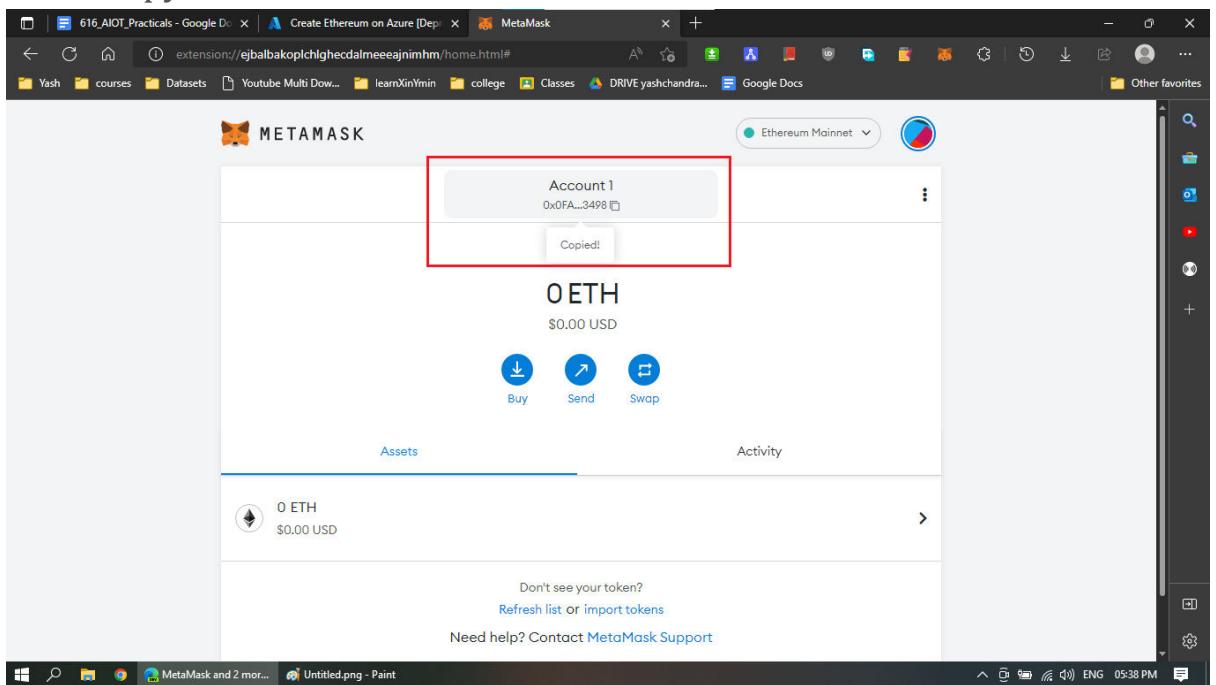
12. Click on create a wallet.



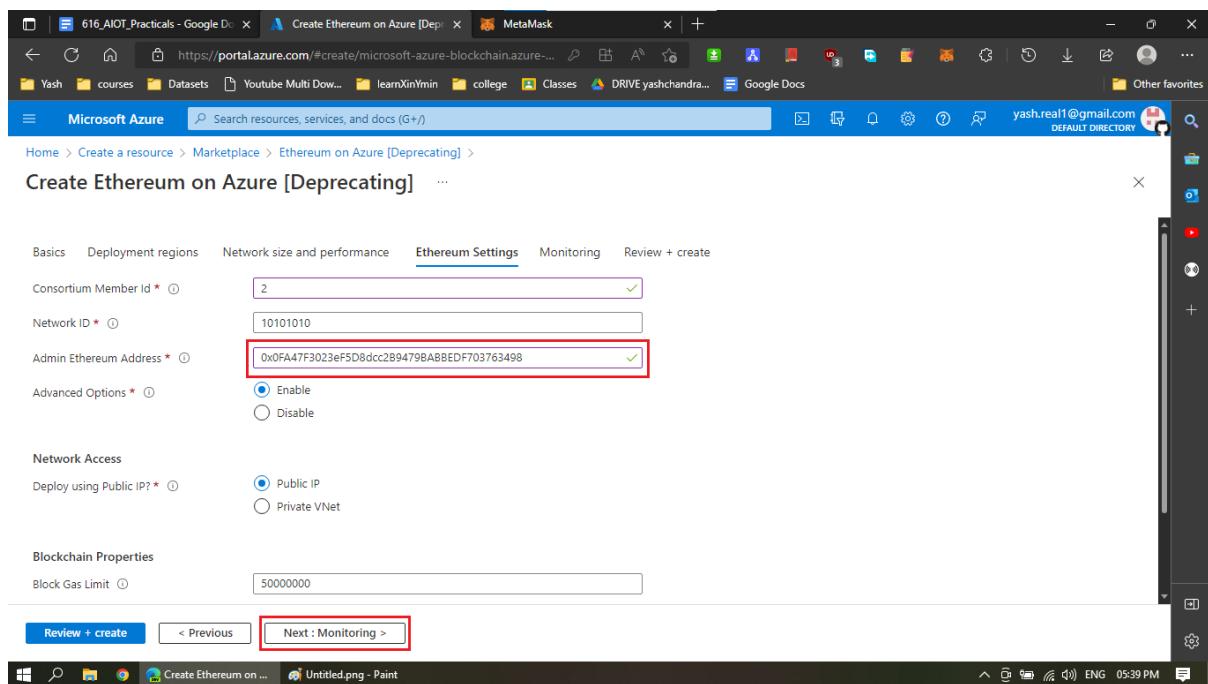
13. Set password.



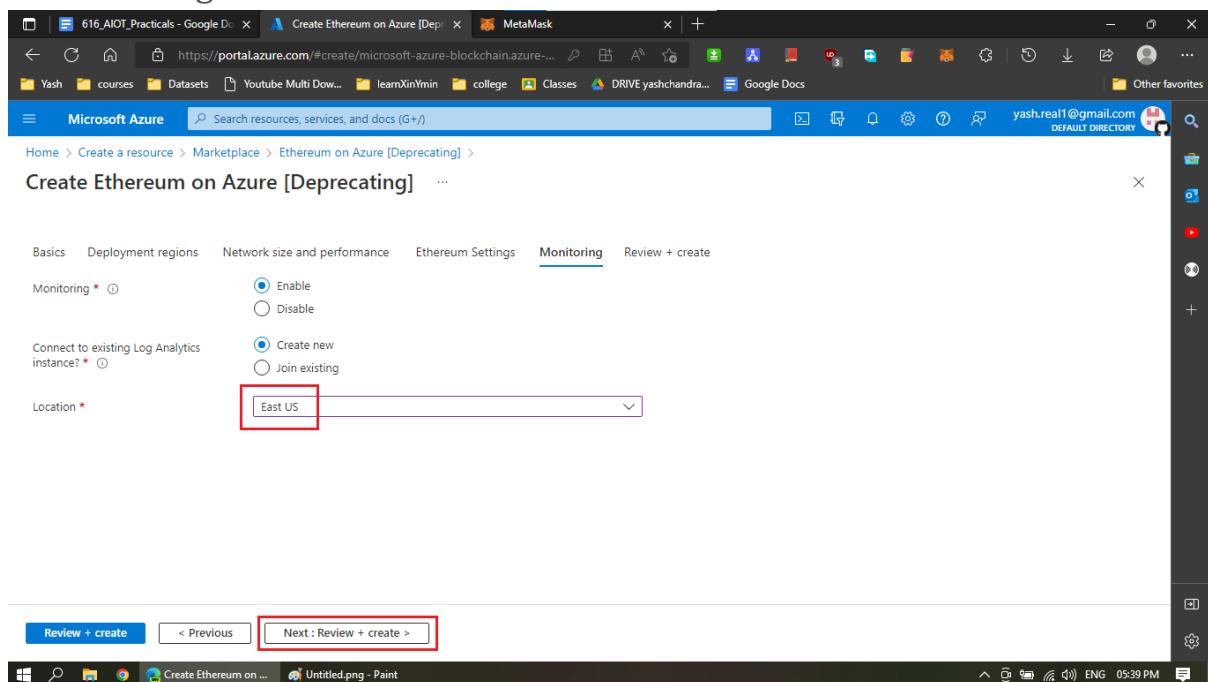
14. Copy account 1 address.



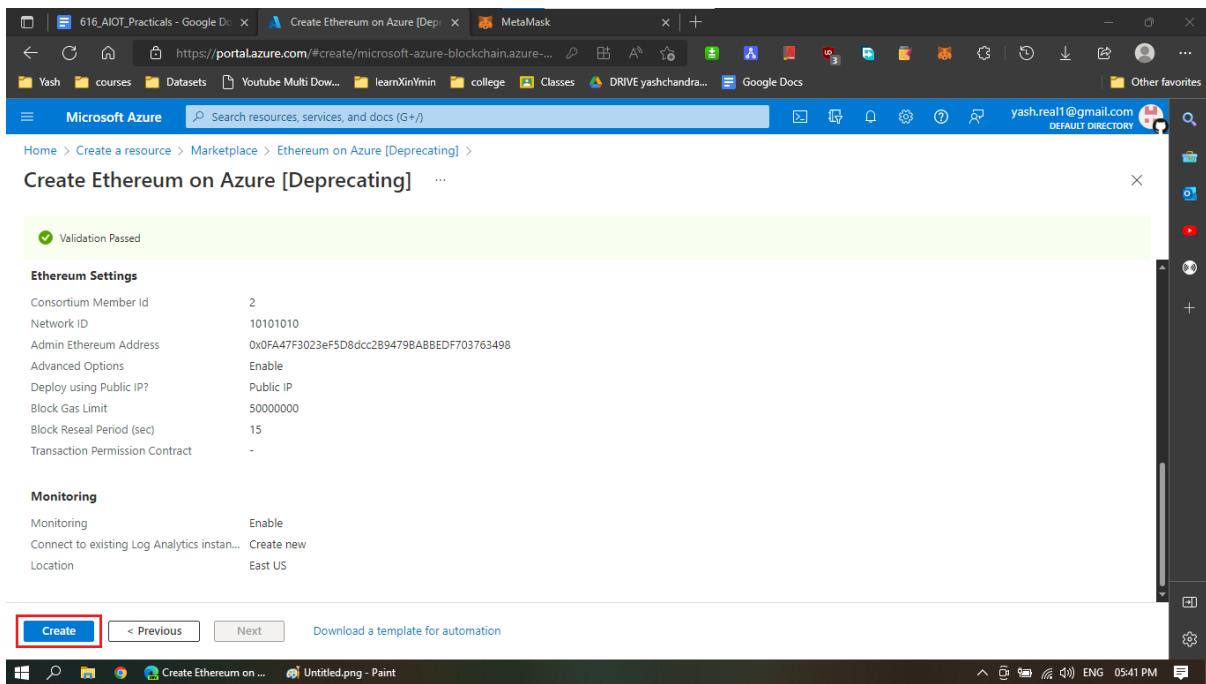
15. Enter address in azure and click on next



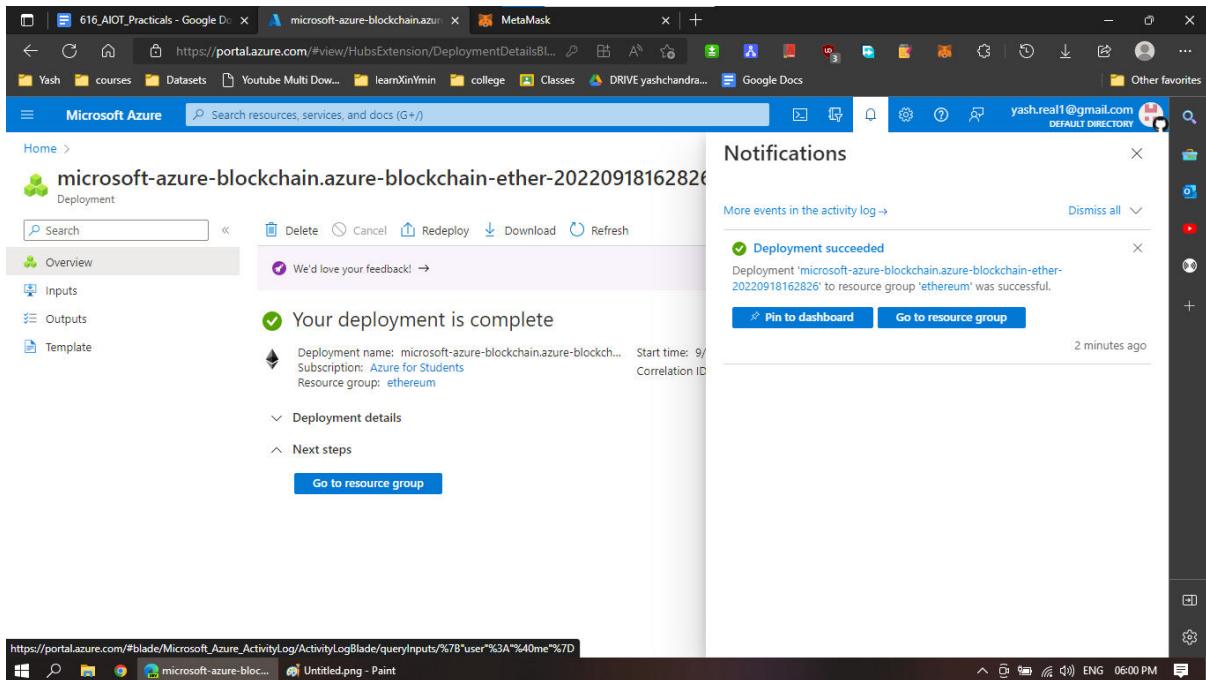
16. Set region and click on next.



17. Click on create.



18. Wait for it to be deployed.



19. Go to deployments

The screenshot shows the Microsoft Azure portal interface. The left sidebar shows the 'ethereum' resource group with various navigation options like Overview, Activity log, Access control (IAM), Tags, Resource visualizer, Events, Settings, and Deployments. The 'Deployments' option is highlighted with a red box. The main content area displays the 'Essentials' section with subscription information (Subscription ID: a91ed106-3abd-47df-80c5-1666cd032f23, Deployment count: 14 Succeeded) and a list of resources. The 'Resources' tab is selected, showing a table of 16 records with columns for Name, Type, and Location. Resources listed include Key vault, Public IP address, Log Analytics workspace, and Load balancer, all located in East US.

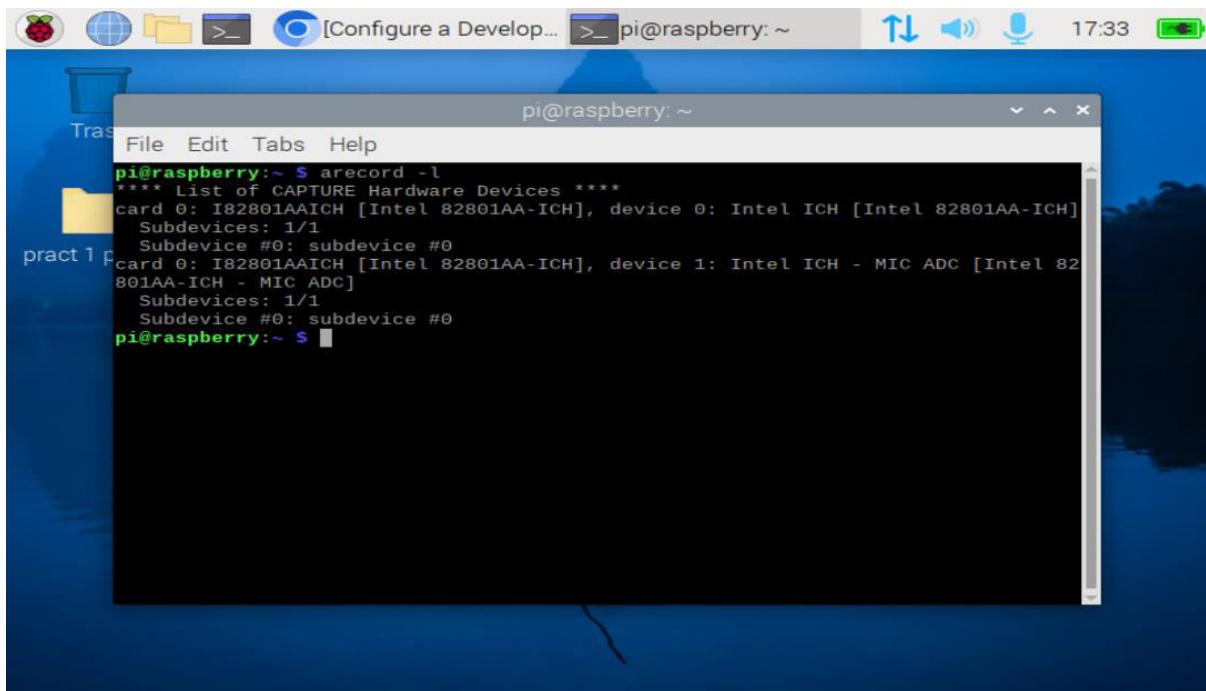
20. Check if everything is successful

The screenshot shows the Microsoft Azure portal interface, specifically the 'ethereum | Deployments' page. The left sidebar shows the 'ethereum' resource group with various navigation options. The 'Deployments' option is highlighted with a red box. The main content area displays a table of deployment history. The table has columns for Deployment name, Status, Last modified, Duration, and Related events. All entries show a green checkmark indicating success. The table lists 16 deployments, each with a unique name and timestamp.

Deployment name	Status	Last modified	Duration	Related events
vm-dep-reg1-config	Succeeded	9/18/2022, 5:57:24 PM	9 minutes 47 seconds	Related events
vm-dep-reg1-1-keyVaultAccess	Succeeded	9/18/2022, 5:46:18 PM	1 second	Related events
vm-dep-reg1-0-keyVaultAccess	Succeeded	9/18/2022, 5:45:58 PM	1 second	Related events
vm-dep-reg1-publicIP	Succeeded	9/18/2022, 5:44:25 PM	21 seconds	Related events
vm-dep-reg1	Succeeded	9/18/2022, 5:47:29 PM	3 minutes 30 seconds	Related events
vnet-gateway-deploy	Succeeded	9/18/2022, 5:43:58 PM	1 second	Related events
network-resources-lb0	Succeeded	9/18/2022, 5:43:39 PM	8 seconds	Related events
deployOMS	Succeeded	9/18/2022, 5:43:45 PM	1 minute 56 seconds	Related events
storageDeploy	Succeeded	9/18/2022, 5:43:25 PM	1 minute 36 seconds	Related events
pid-7e345a23-57ce-438f-916d-f5...	Succeeded	9/18/2022, 5:41:49 PM	1 second	Related events
network-resources-deploy	Succeeded	9/18/2022, 5:43:46 PM	1 minute 58 seconds	Related events

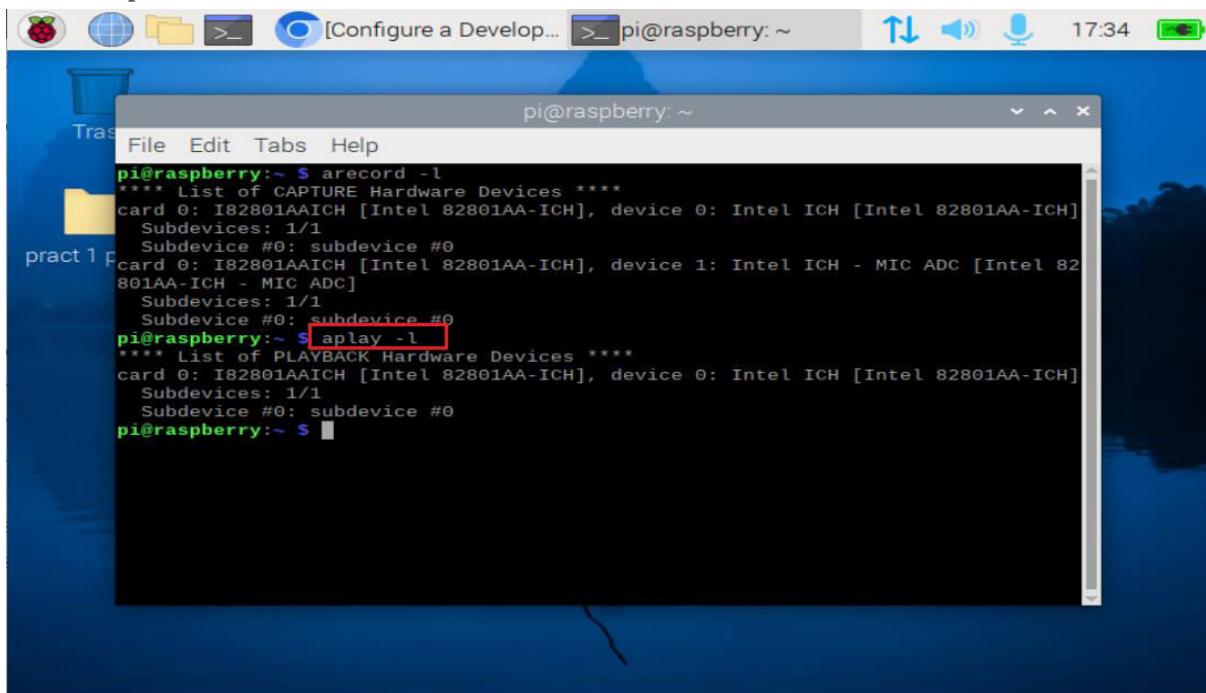
Practical – 7: Building Google Assistant with Raspberry Pi

1. Check hardware for recorder



```
pi@raspberry:~$ arecord -l
**** List of CAPTURE Hardware Devices ****
card 0: I82801AAICH [Intel 82801AA-ICH], device 0: Intel ICH [Intel 82801AA-ICH]
Subdevices: 1/1
Subdevice #0: subdevice #0
card 0: I82801AAICH [Intel 82801AA-ICH], device 1: Intel ICH - MIC ADC [Intel 82801AA-ICH]
Subdevices: 1/1
Subdevice #0: subdevice #0
pi@raspberry:~$
```

2. Check speakers' hardware



```
pi@raspberry:~$ arecord -l
**** List of CAPTURE Hardware Devices ****
card 0: I82801AAICH [Intel 82801AA-ICH], device 0: Intel ICH [Intel 82801AA-ICH]
Subdevices: 1/1
Subdevice #0: subdevice #0
card 0: I82801AAICH [Intel 82801AA-ICH], device 1: Intel ICH - MIC ADC [Intel 82801AA-ICH]
Subdevices: 1/1
Subdevice #0: subdevice #0
pi@raspberry:~$ aplay -l
**** List of PLAYBACK Hardware Devices ****
card 0: I82801AAICH [Intel 82801AA-ICH], device 0: Intel ICH [Intel 82801AA-ICH]
Subdevices: 1/1
Subdevice #0: subdevice #0
pi@raspberry:~$
```

3. Create .asoundrc file

A screenshot of a terminal window titled "pi@raspberry: ~". The window shows a command-line session where the user has run several commands to list audio hardware devices and then created a configuration file:

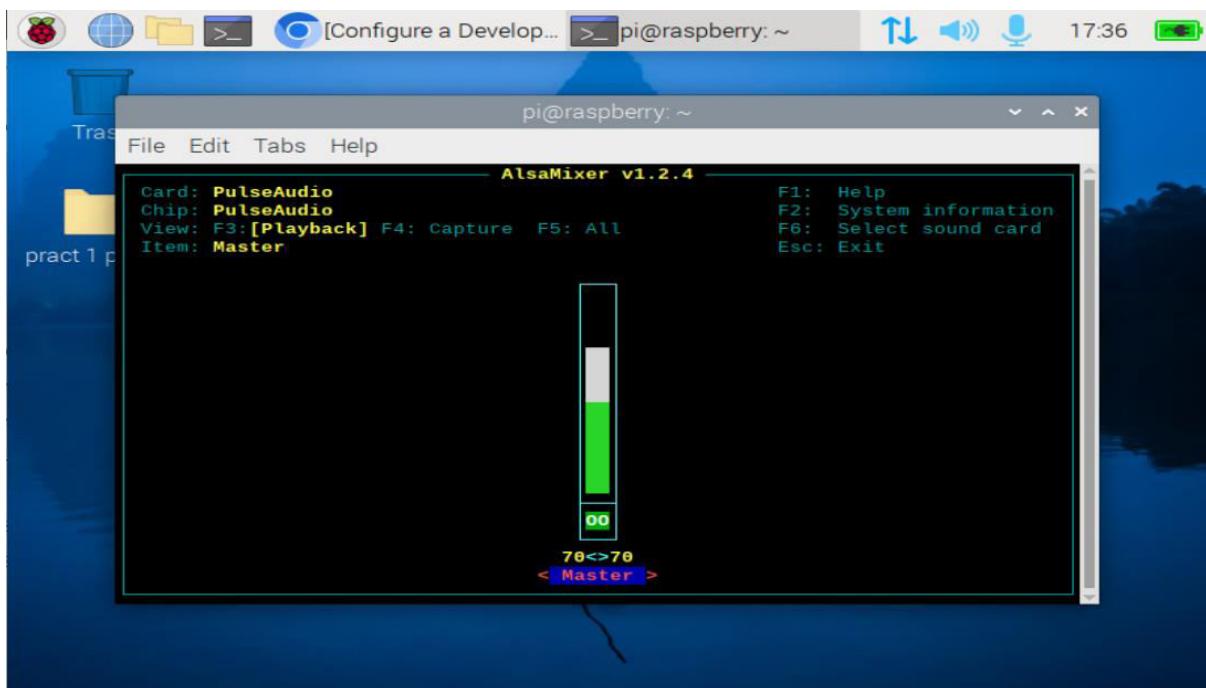
```
pi@raspberry:~ $ arecord -l
**** List of CAPTURE Hardware Devices ****
card 0: I82801AAICH [Intel 82801AA-ICH], device 0: Intel ICH [Intel 82801AA-ICH]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
card 0: I82801AAICH [Intel 82801AA-ICH], device 1: Intel ICH - MIC ADC [Intel 82801AA-ICH - MIC ADC]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
pi@raspberry:~ $ aplay -l
**** List of PLAYBACK Hardware Devices ****
card 0: I82801AAICH [Intel 82801AA-ICH], device 0: Intel ICH [Intel 82801AA-ICH]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
pi@raspberry:~ $ nano /home/pi/.asoundrc
pi@raspberry:~ $
```

4. Open alsamixer

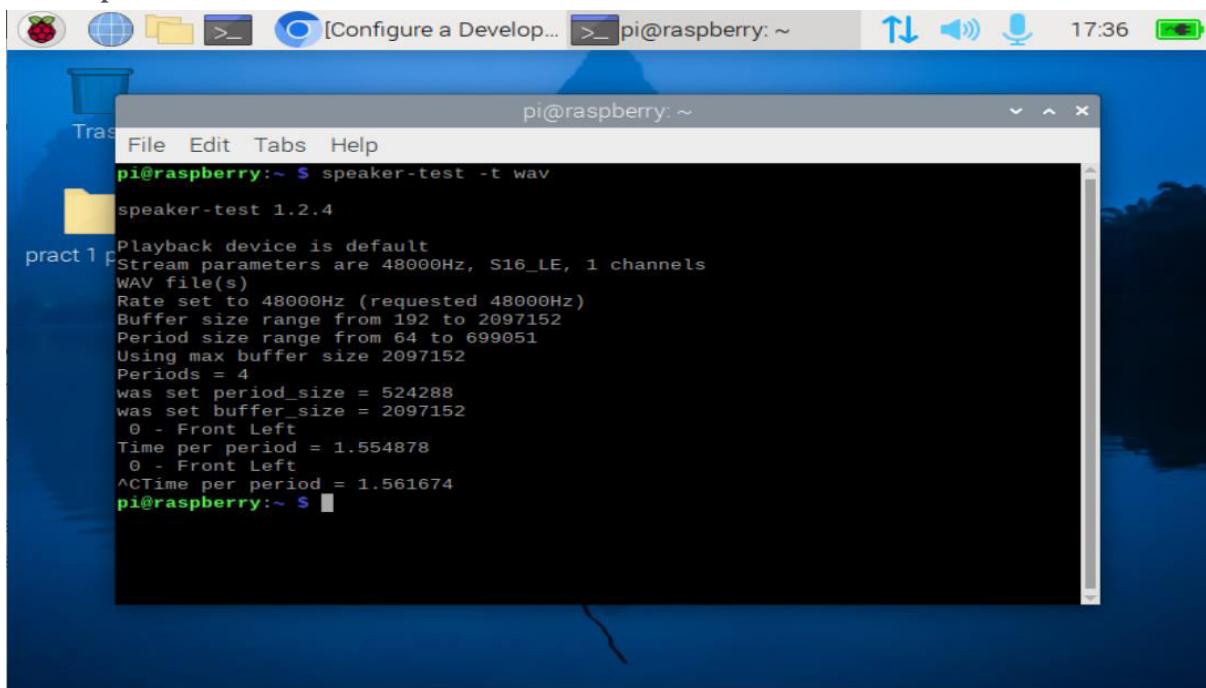
A screenshot of a terminal window titled "pi@raspberry: ~". The window shows a command-line session where the user has run several commands to list audio hardware devices and then opened the alsamixer application:

```
pi@raspberry:~ $ arecord -l
**** List of CAPTURE Hardware Devices ****
card 0: I82801AAICH [Intel 82801AA-ICH], device 0: Intel ICH [Intel 82801AA-ICH]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
card 0: I82801AAICH [Intel 82801AA-ICH], device 1: Intel ICH - MIC ADC [Intel 82801AA-ICH - MIC ADC]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
pi@raspberry:~ $ aplay -l
**** List of PLAYBACK Hardware Devices ****
card 0: I82801AAICH [Intel 82801AA-ICH], device 0: Intel ICH [Intel 82801AA-ICH]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
pi@raspberry:~ $ nano /home/pi/.asoundrc
pi@raspberry:~ $ alsamixer
pi@raspberry:~ $
```

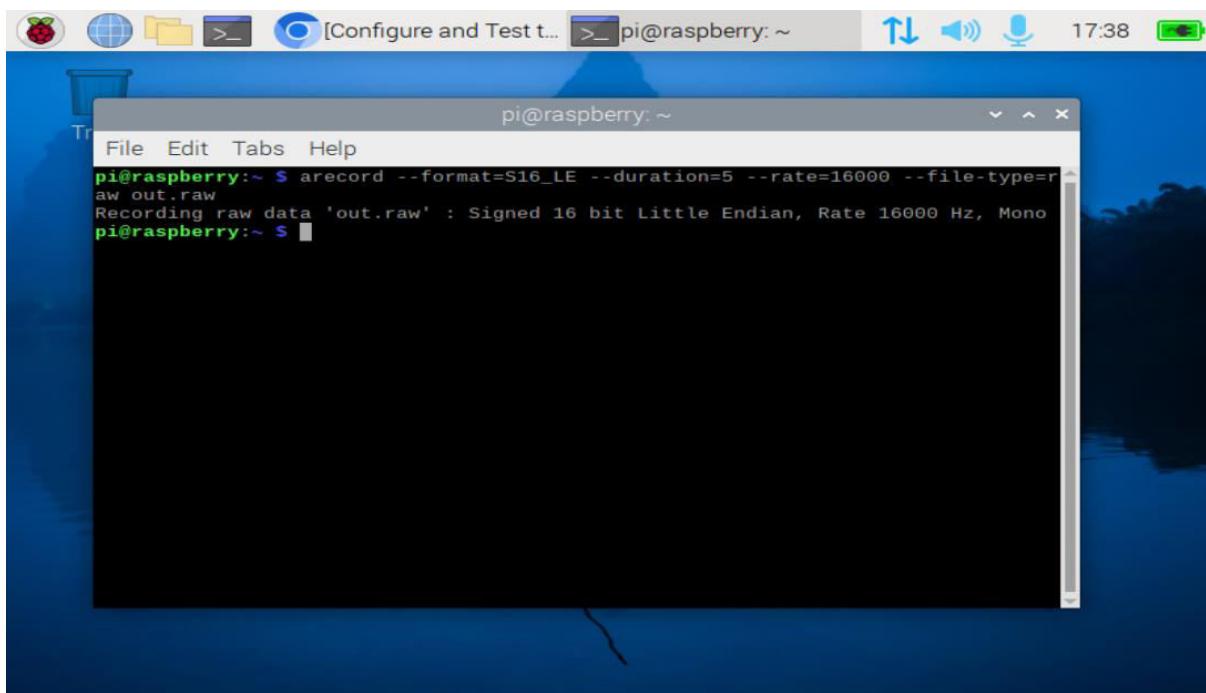
5. Set volume to 70



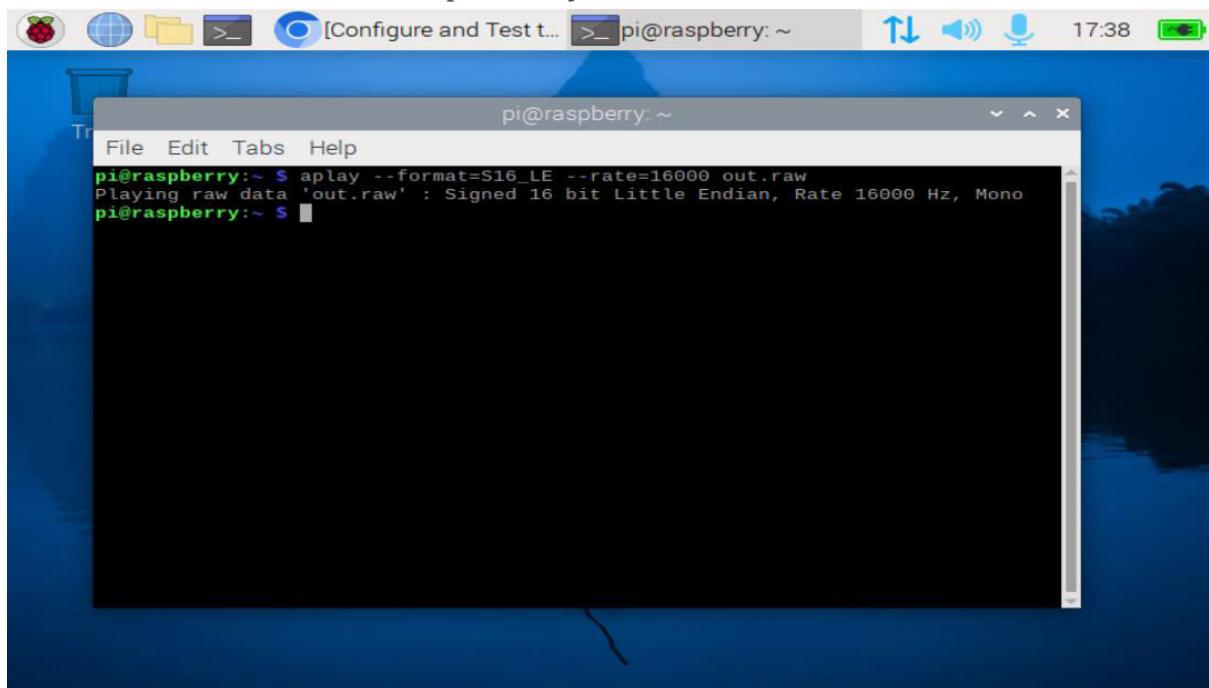
6. Test speaker



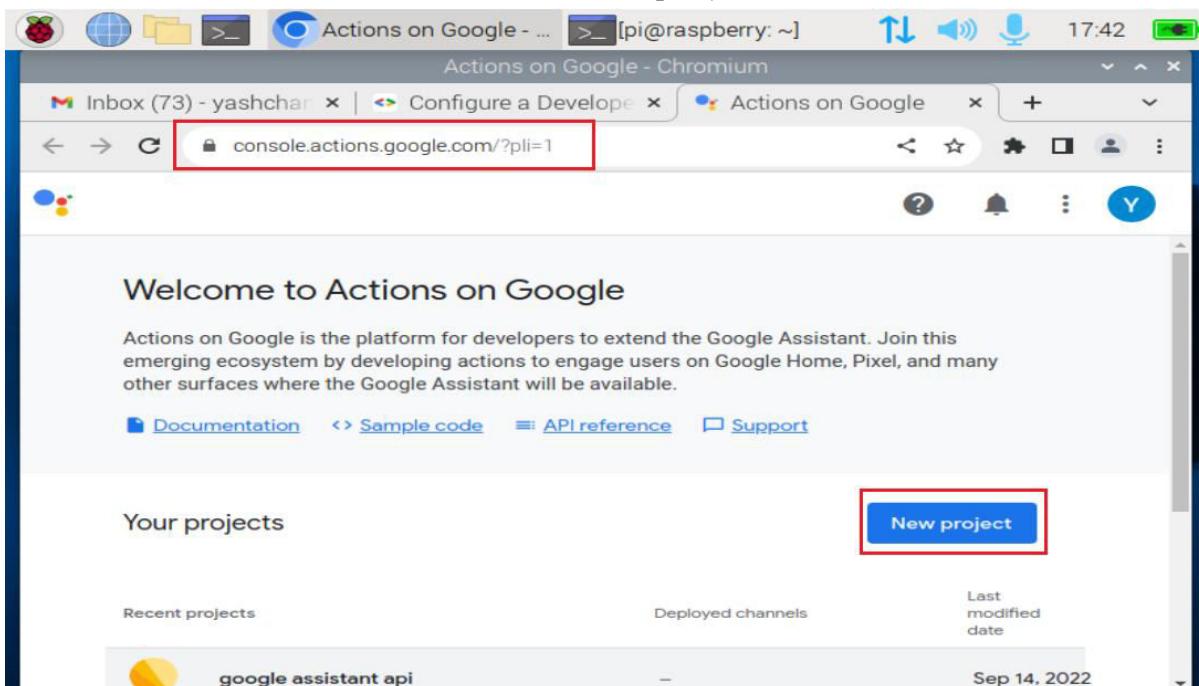
7. Record on mic



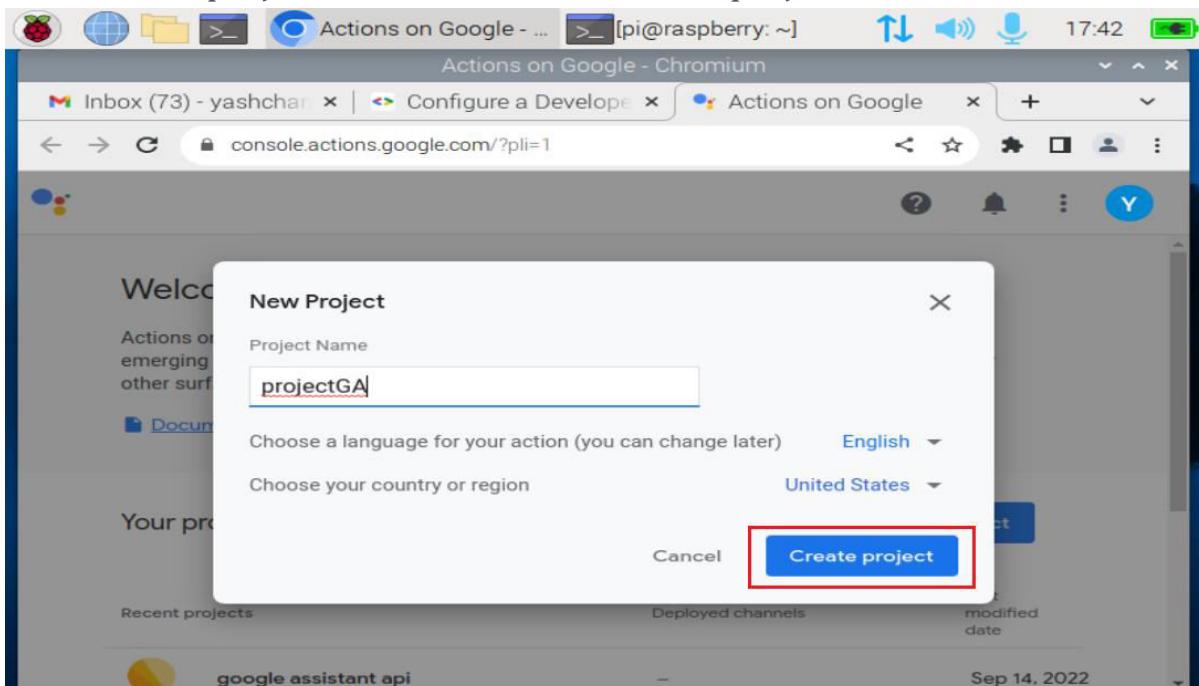
8. Check if it was recorded perfectly.



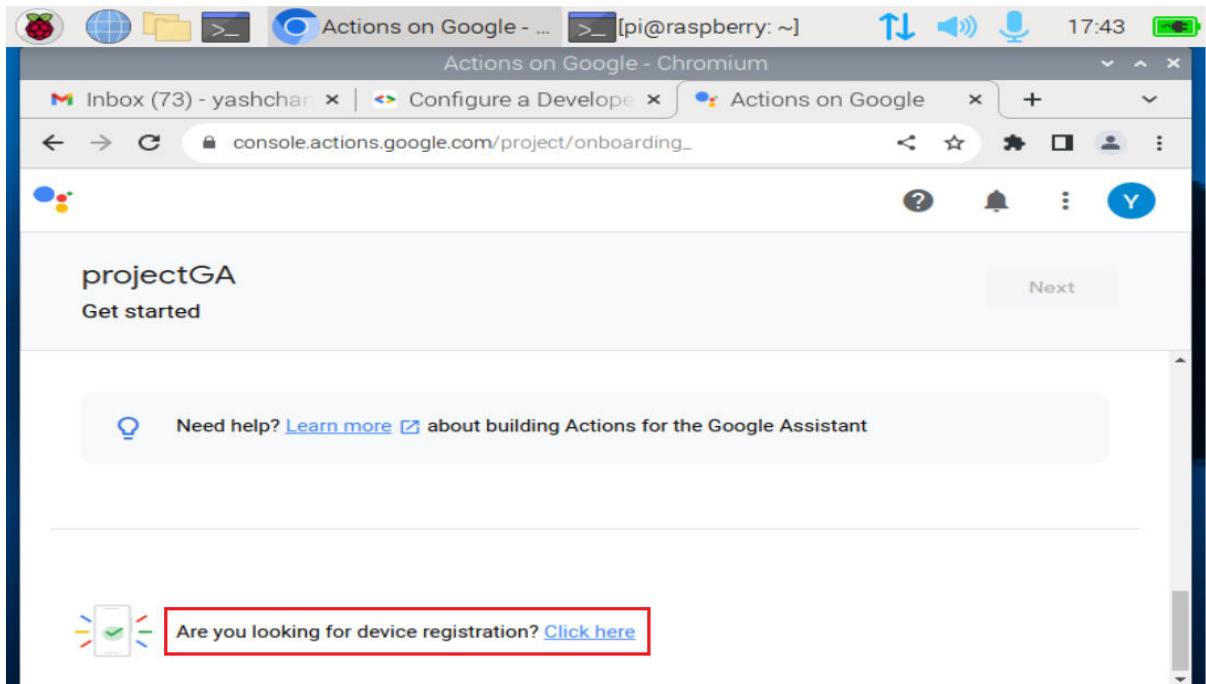
9. Go to action console and click on new project



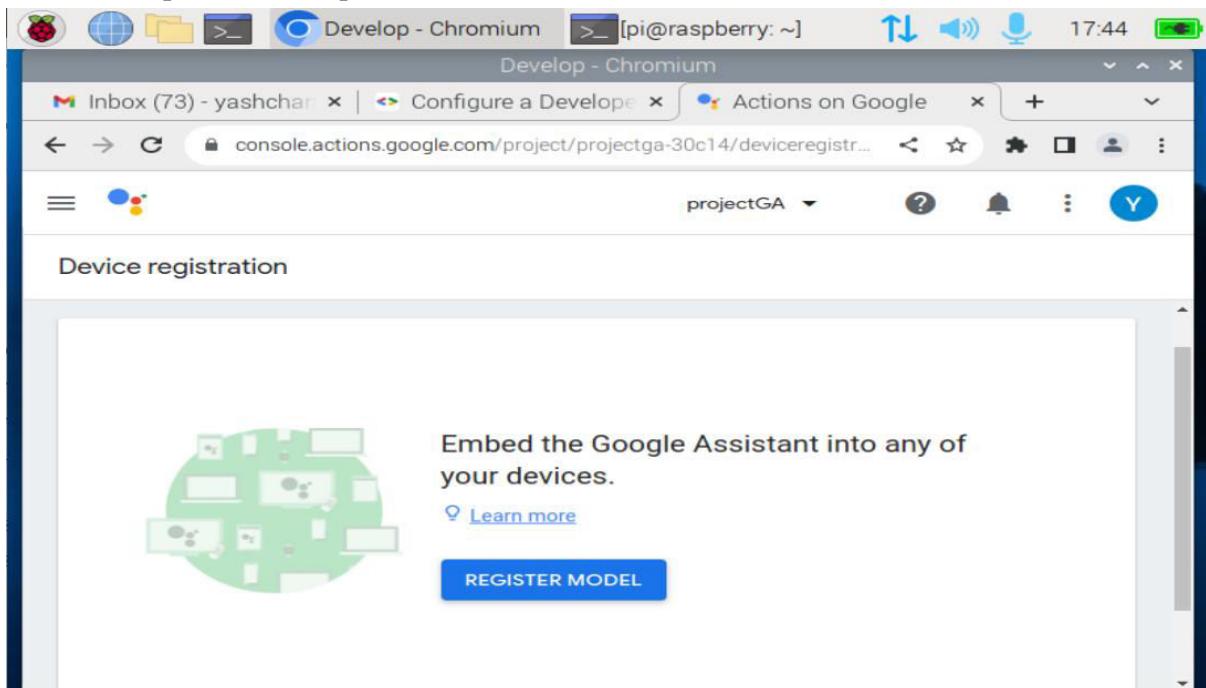
10. Set project name and click on create project



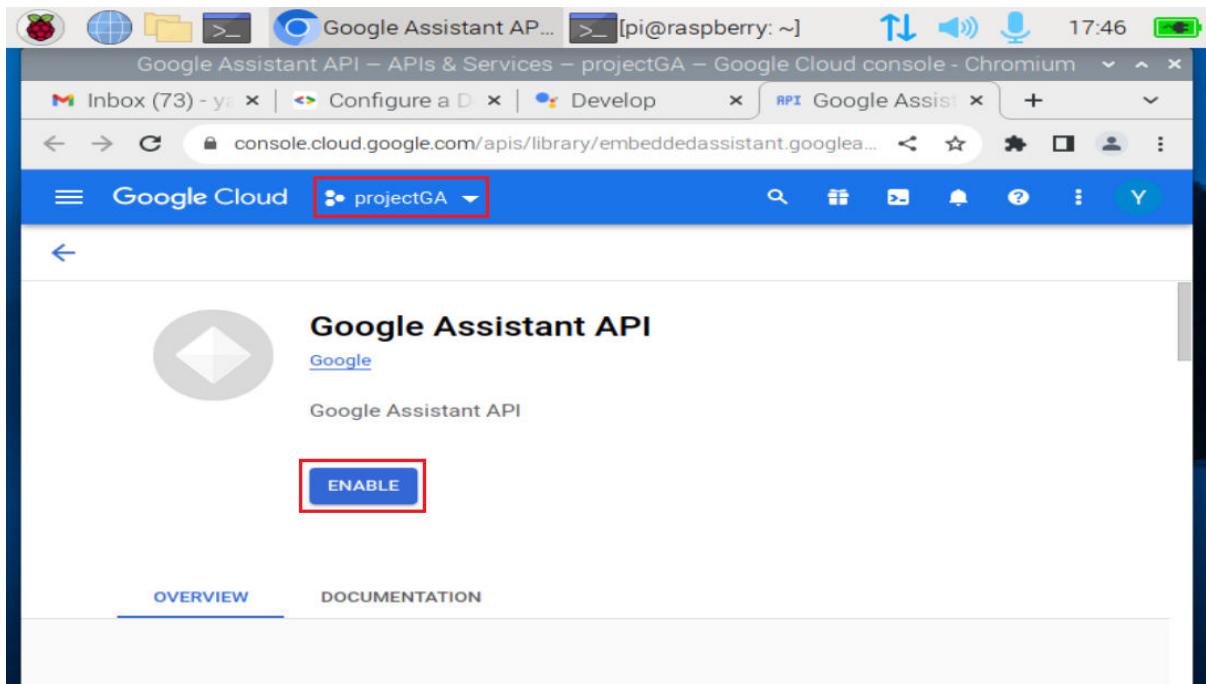
11. Navigate to bottom of the page and click on click here in are you looking for device registration



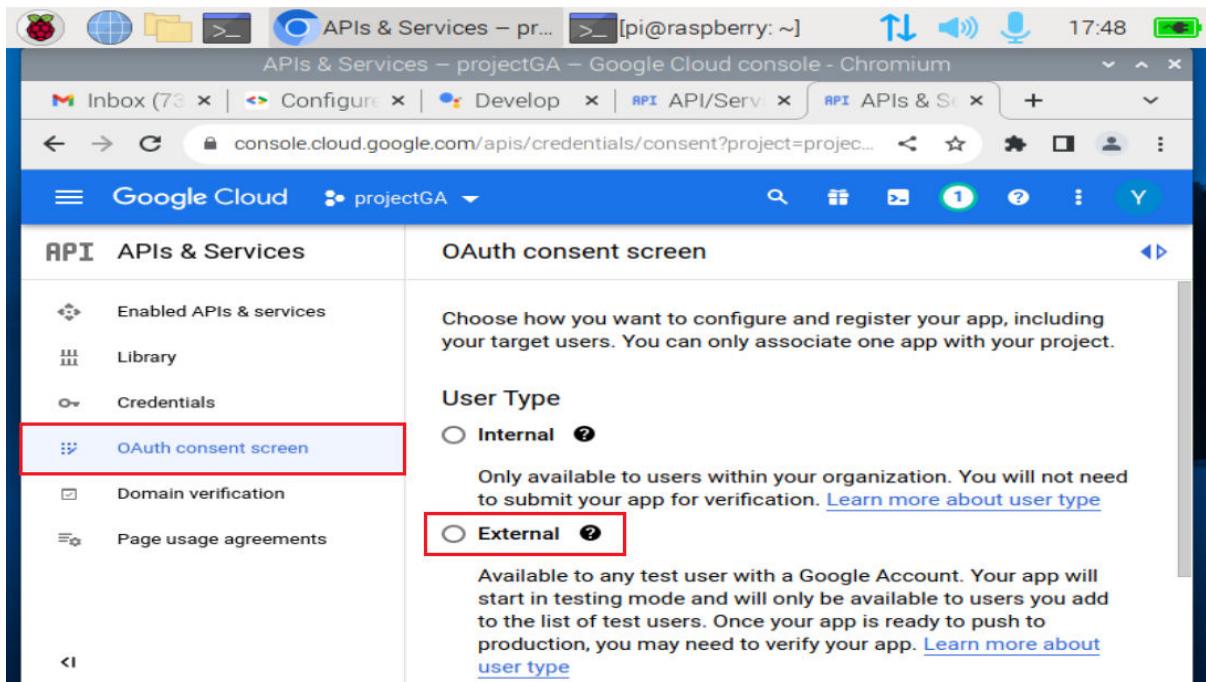
12. Keep this tab opened



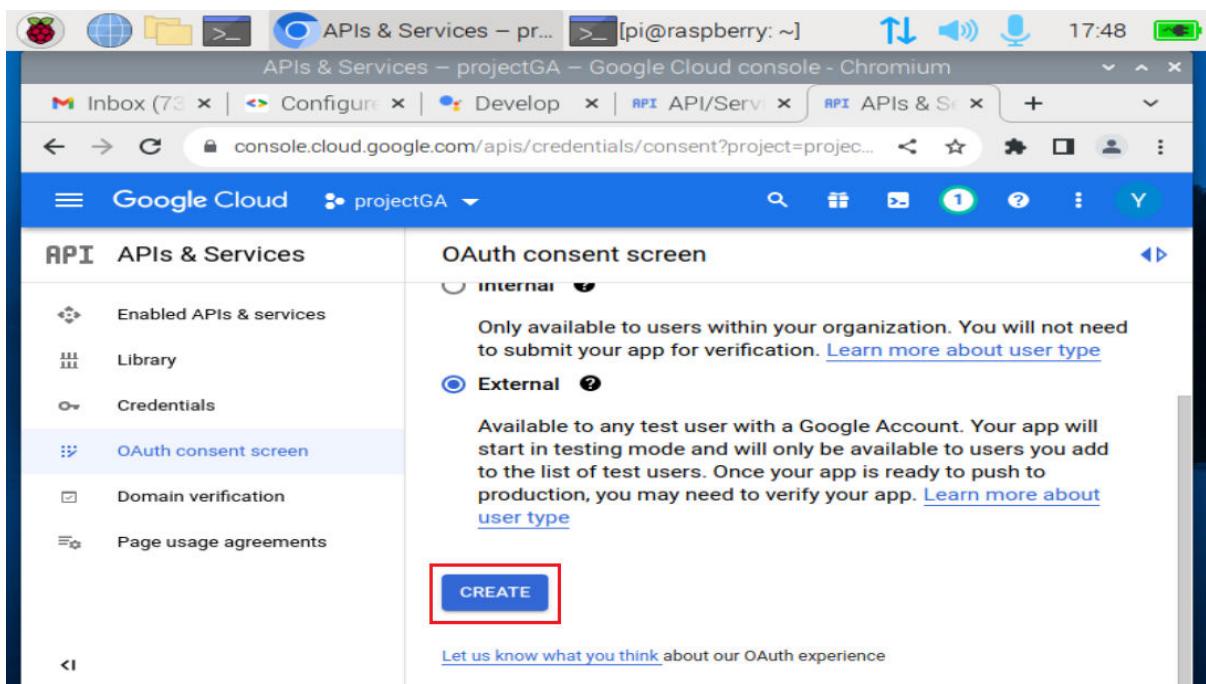
13. Go to cloud console and check if your project is there and click on enable



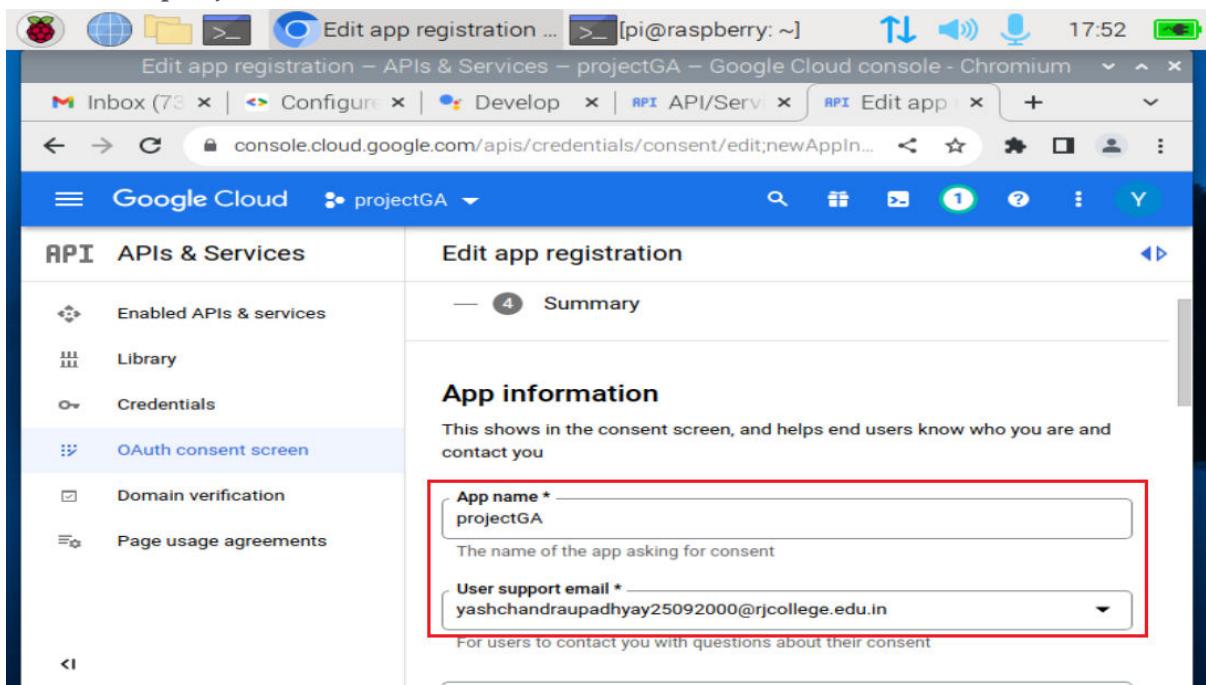
14. Click on oauth consent screen and click on external



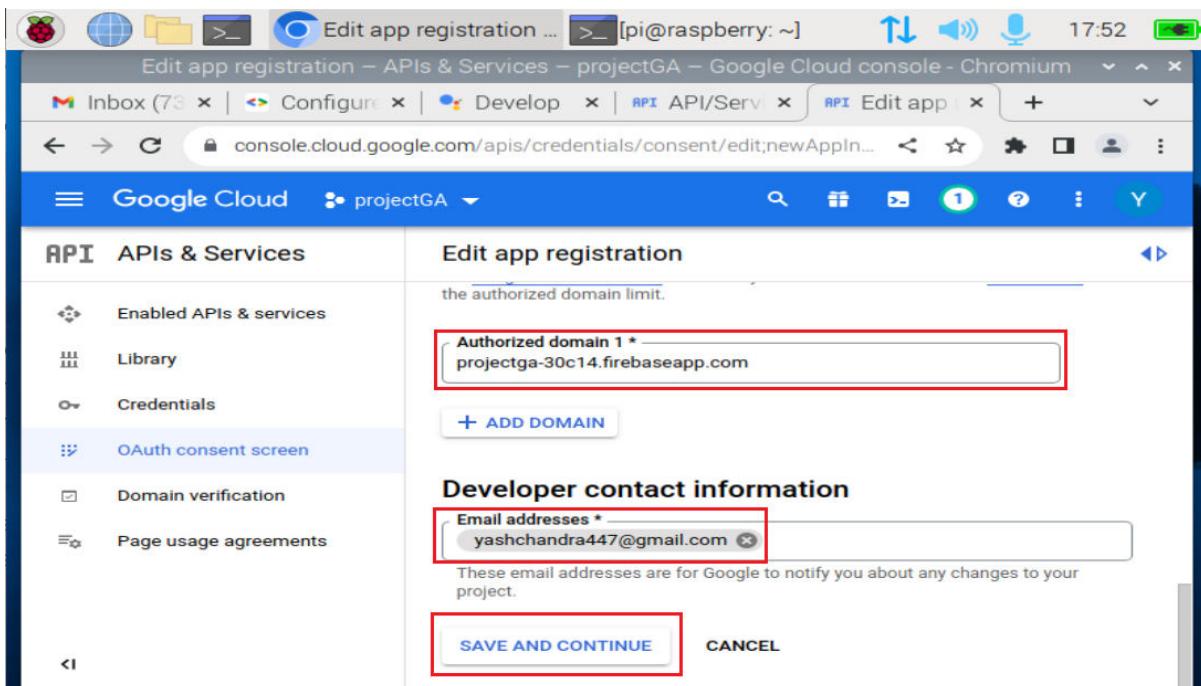
15. Click on create.



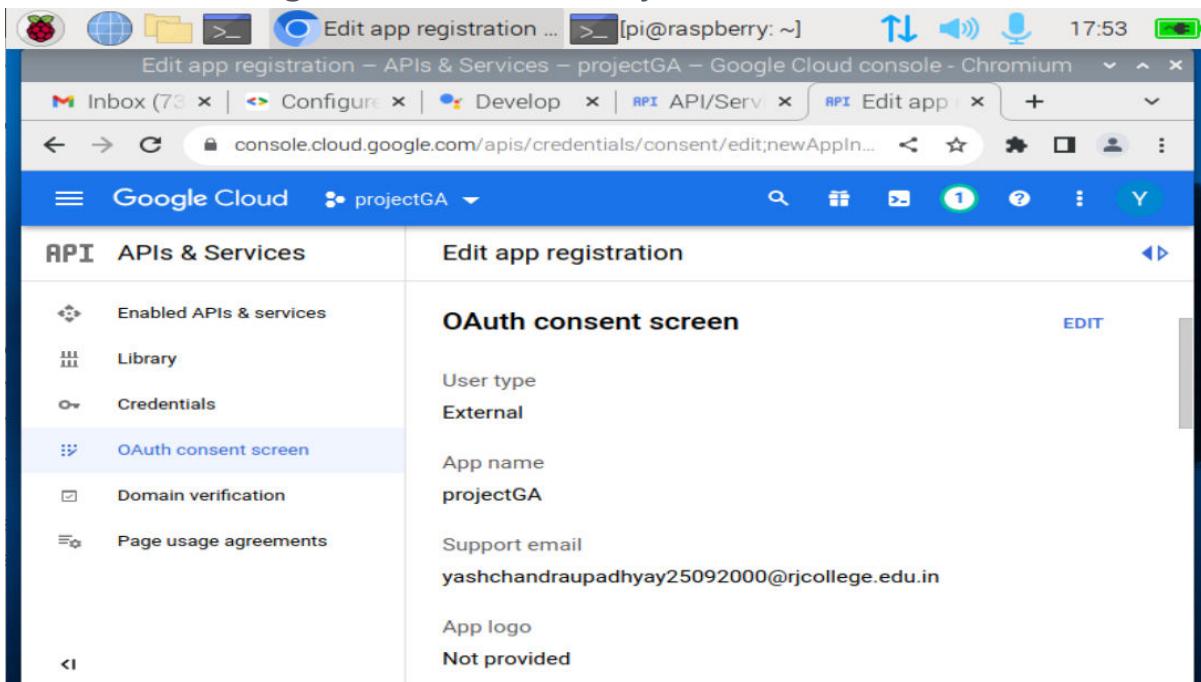
16. Set project name



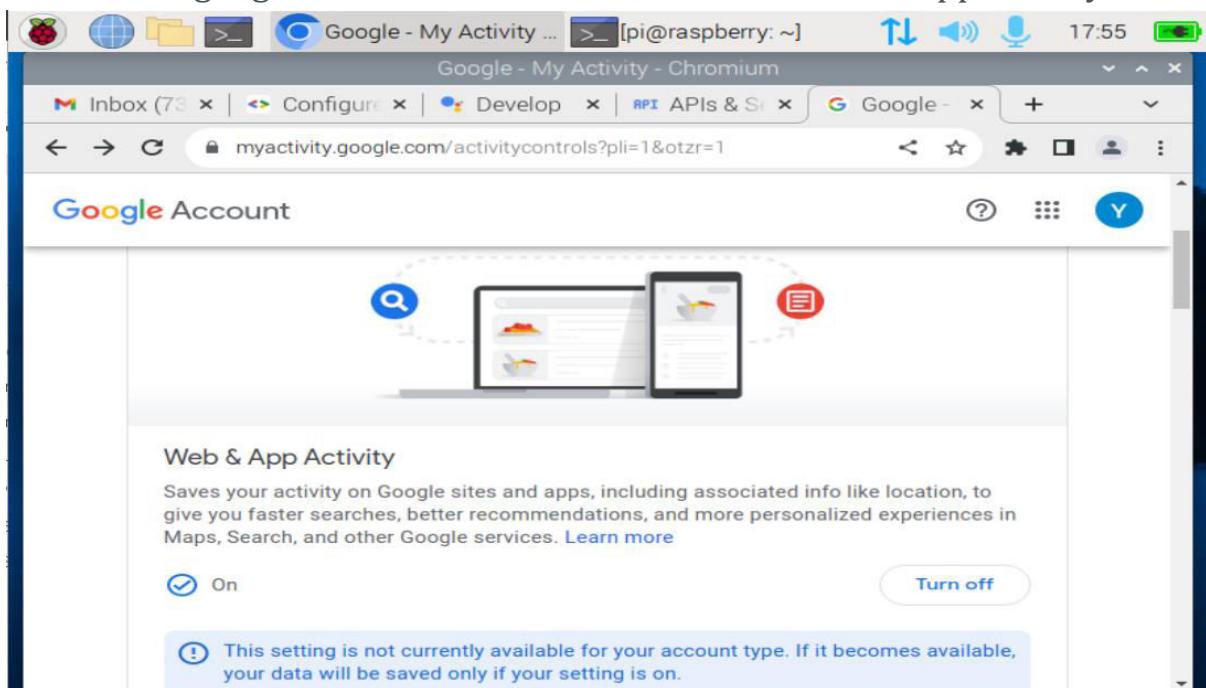
17. Save and continue all next screens



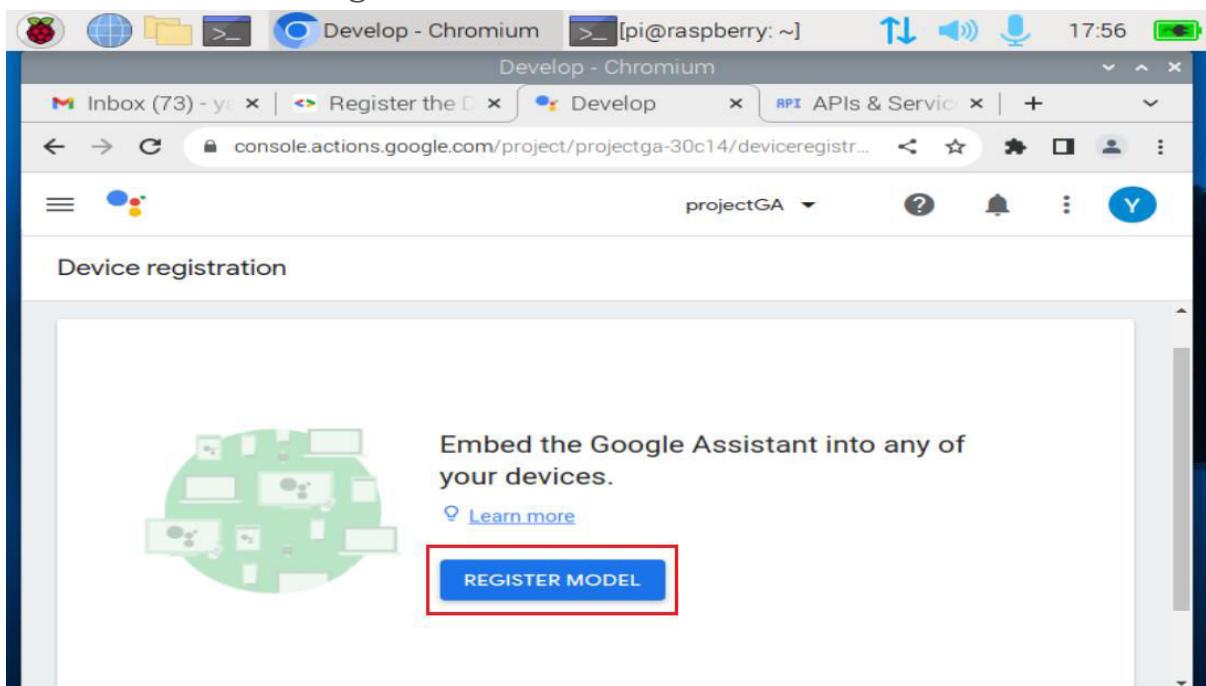
18. Click on go to dashboard in very bottom



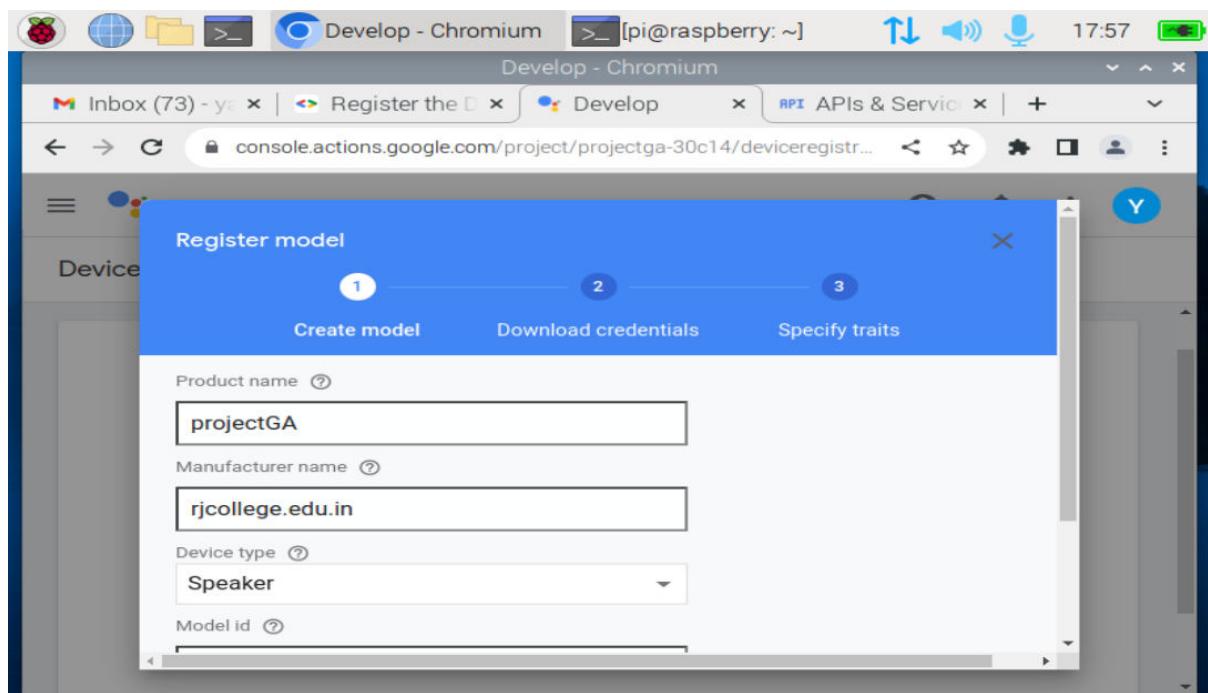
19. Go to google account activities and enable web and app activity



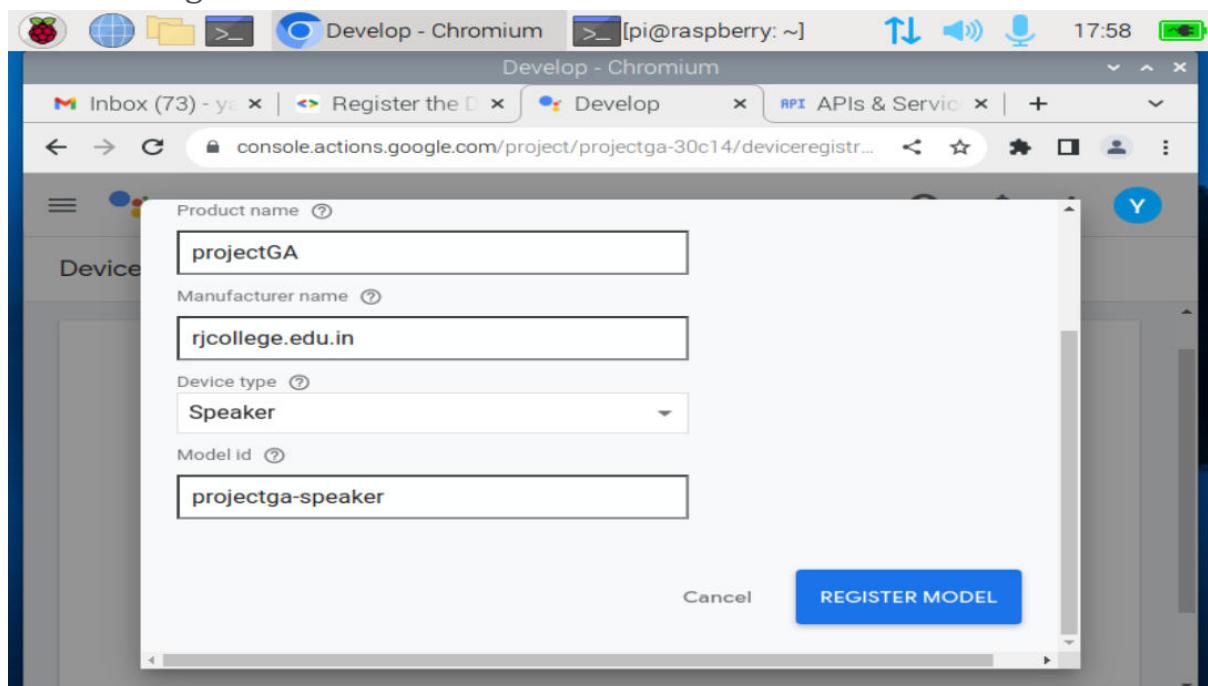
20. Now click on register model



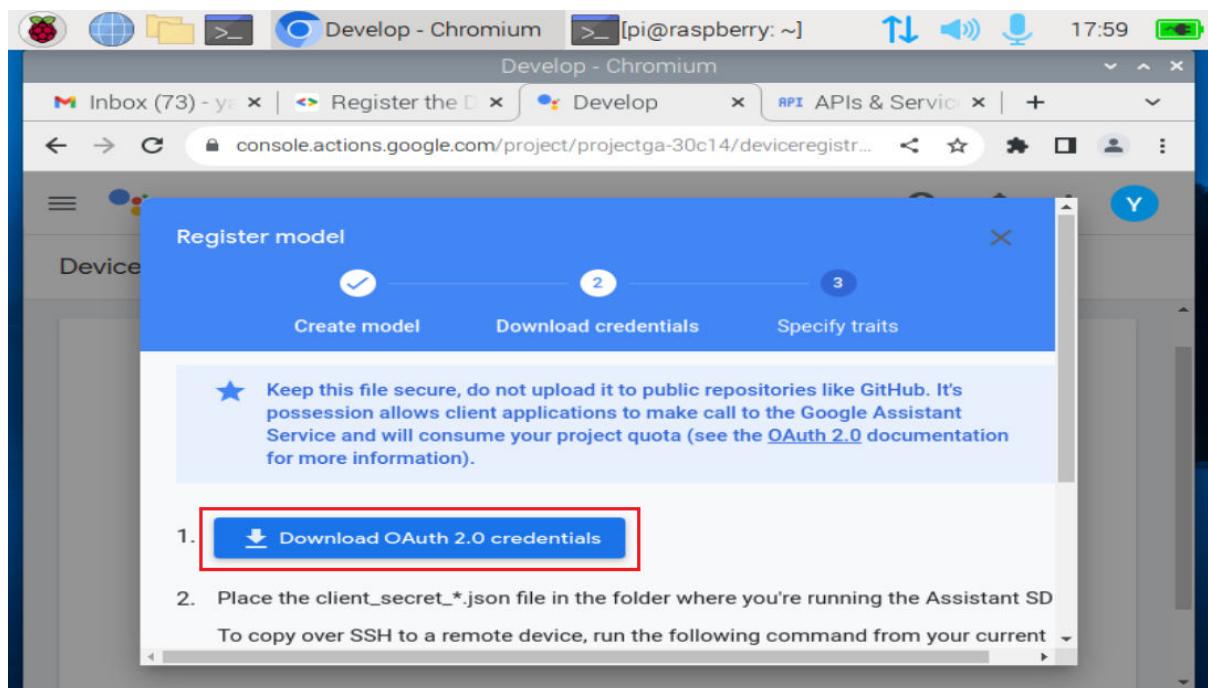
21. Give device model name



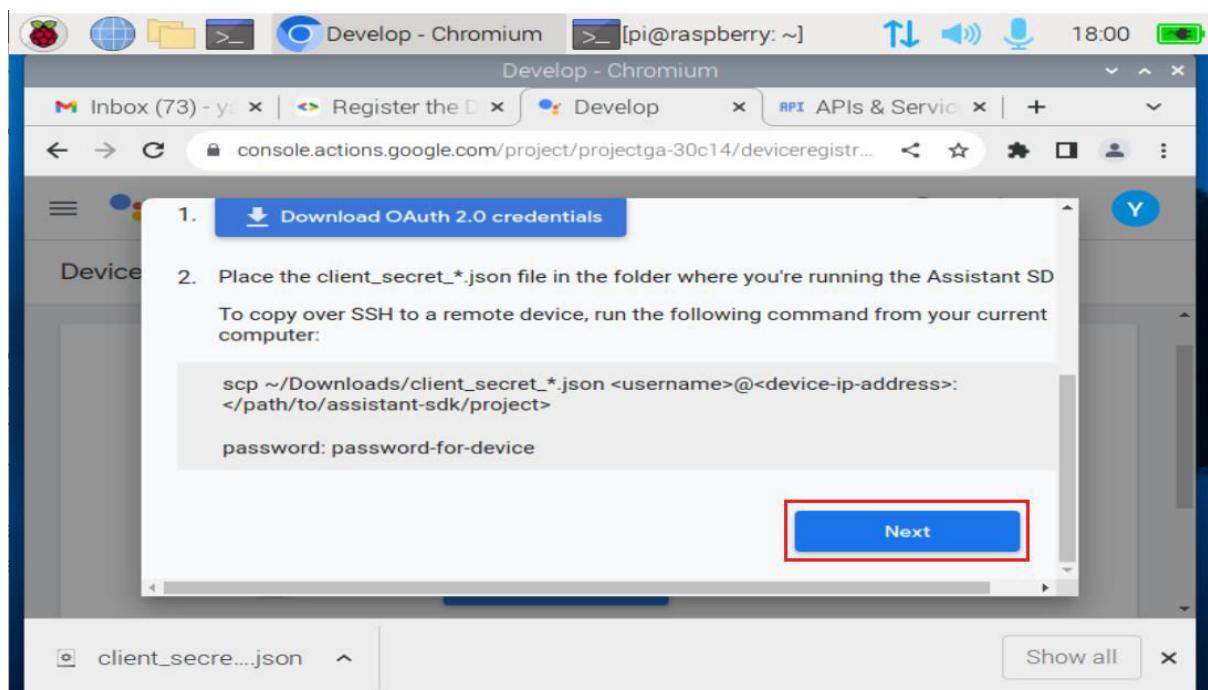
22. Change model id and save it



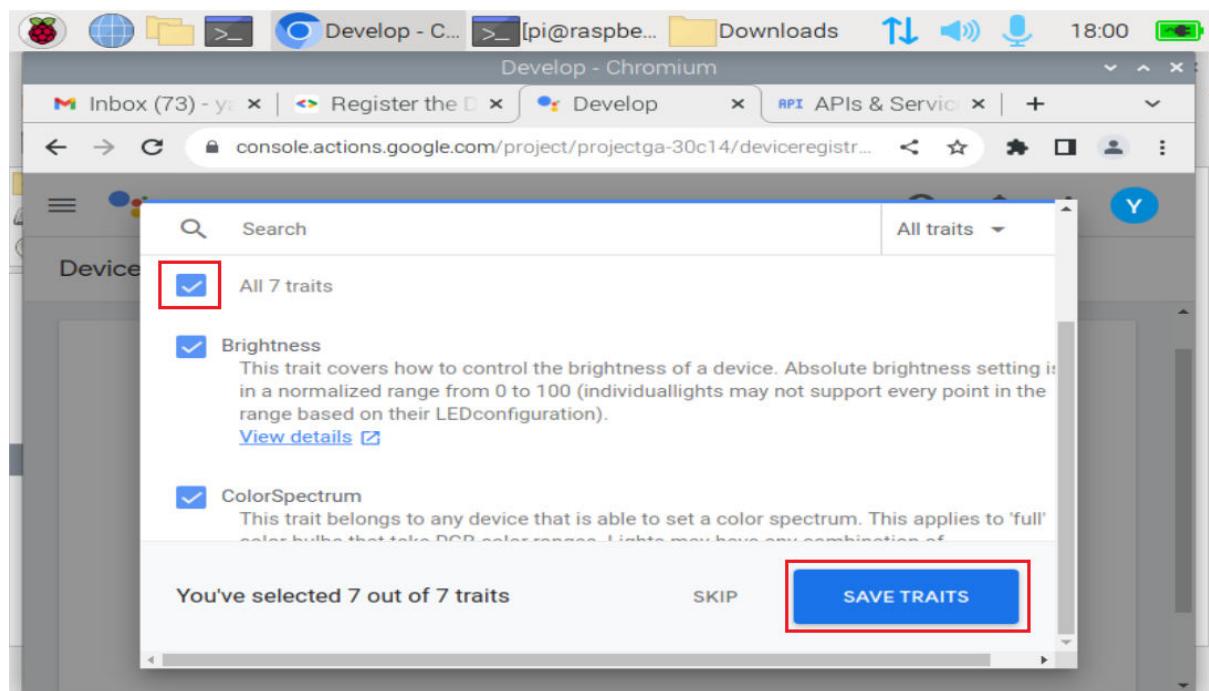
23. Download credential file



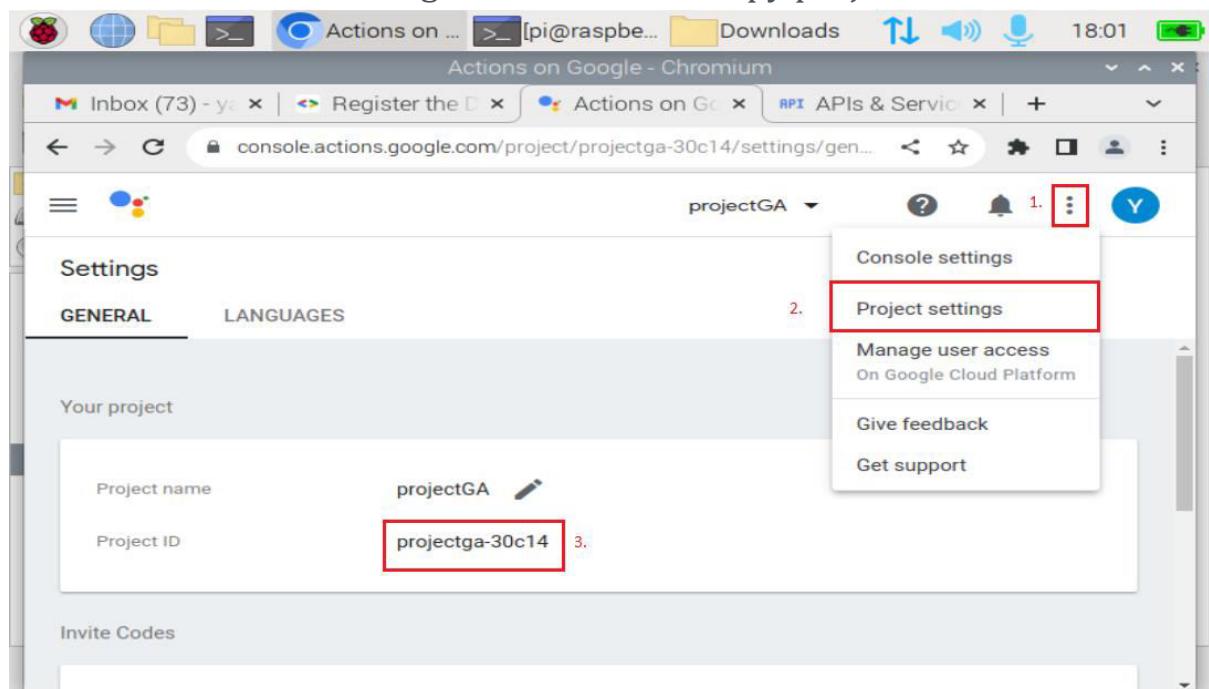
24. Click on next



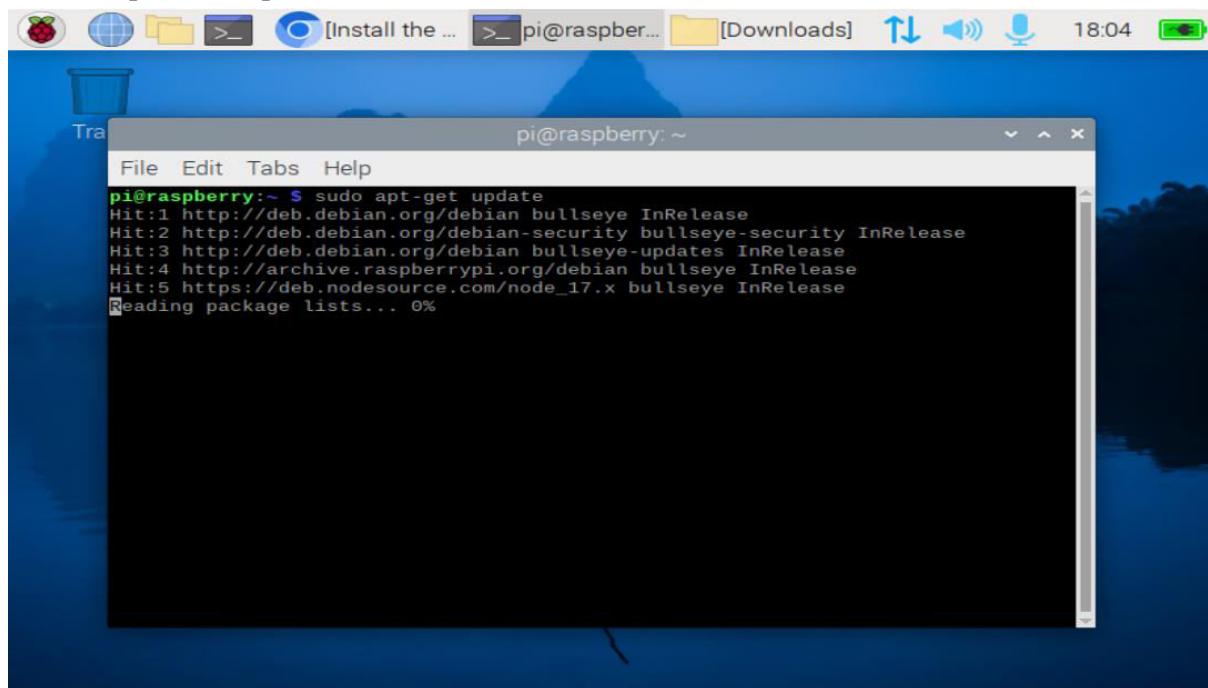
25. Select all traits and click on same traits



26. Click on 3 dots on right hand side and sopy project ID

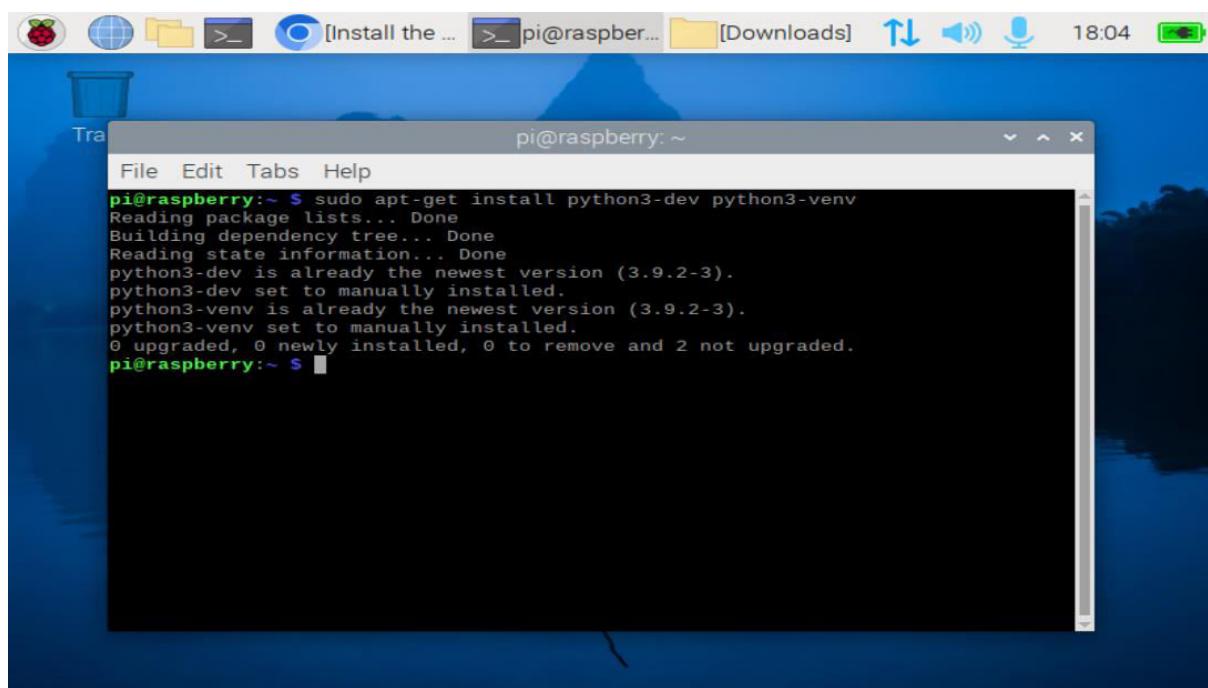


27. Update repo



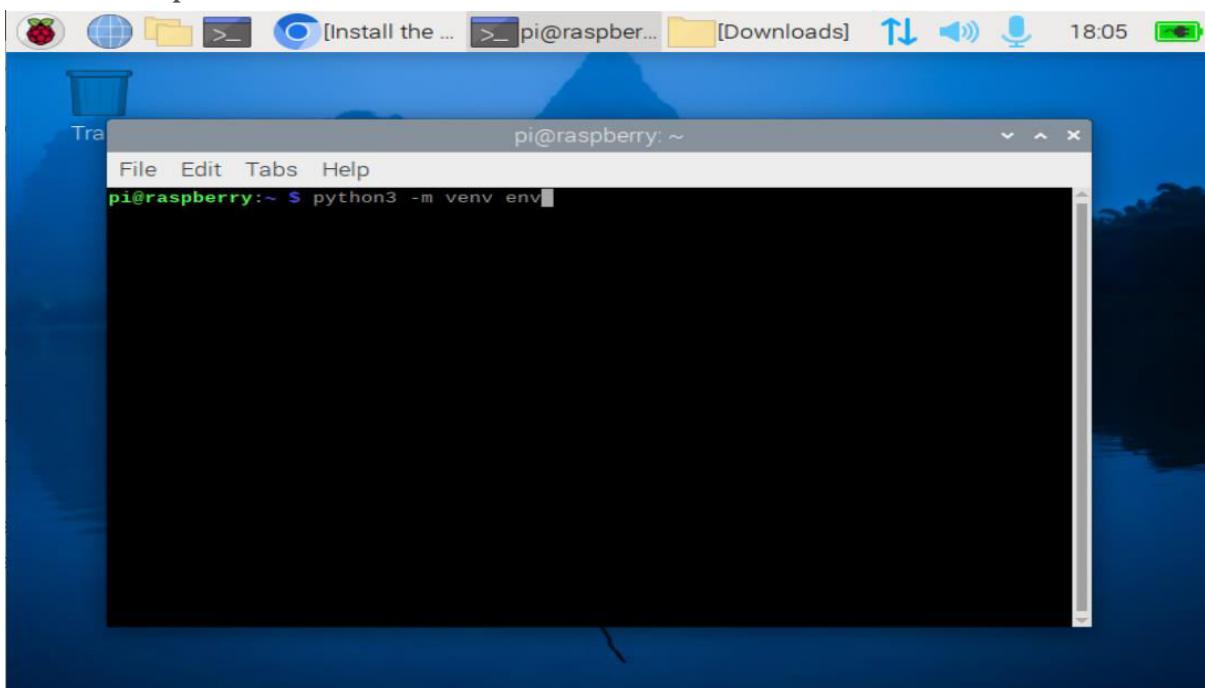
```
pi@raspberry:~ $ sudo apt-get update
Hit:1 http://deb.debian.org/debian bullseye InRelease
Hit:2 http://deb.debian.org/debian-security bullseye-security InRelease
Hit:3 http://deb.debian.org/debian bullseye-updates InRelease
Hit:4 http://archive.raspberrypi.org/debian bullseye InRelease
Hit:5 https://deb.nodesource.com/node_17.x bullseye InRelease
Reading package lists... 0%
```

28. Download venv

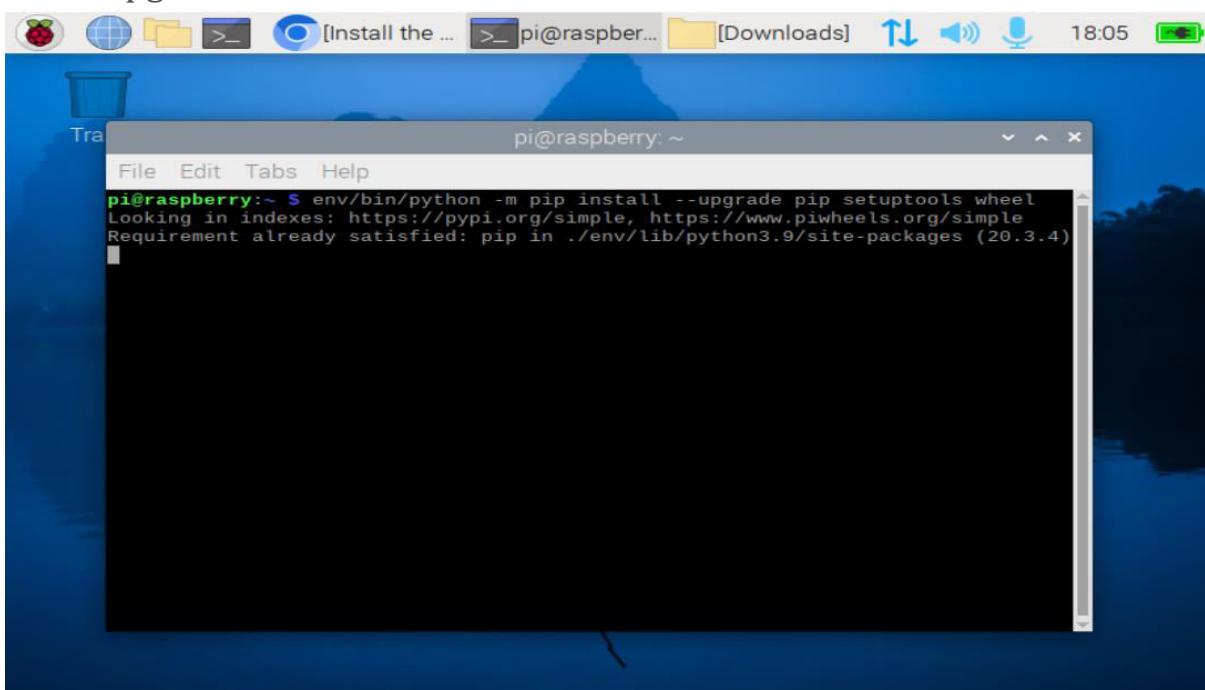


```
pi@raspberry:~ $ sudo apt-get install python3-dev python3-venv
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
python3-dev is already the newest version (3.9.2-3).
python3-dev set to manually installed.
python3-venv is already the newest version (3.9.2-3).
python3-venv set to manually installed.
0 upgraded, 0 newly installed, 0 to remove and 2 not upgraded.
pi@raspberry:~ $
```

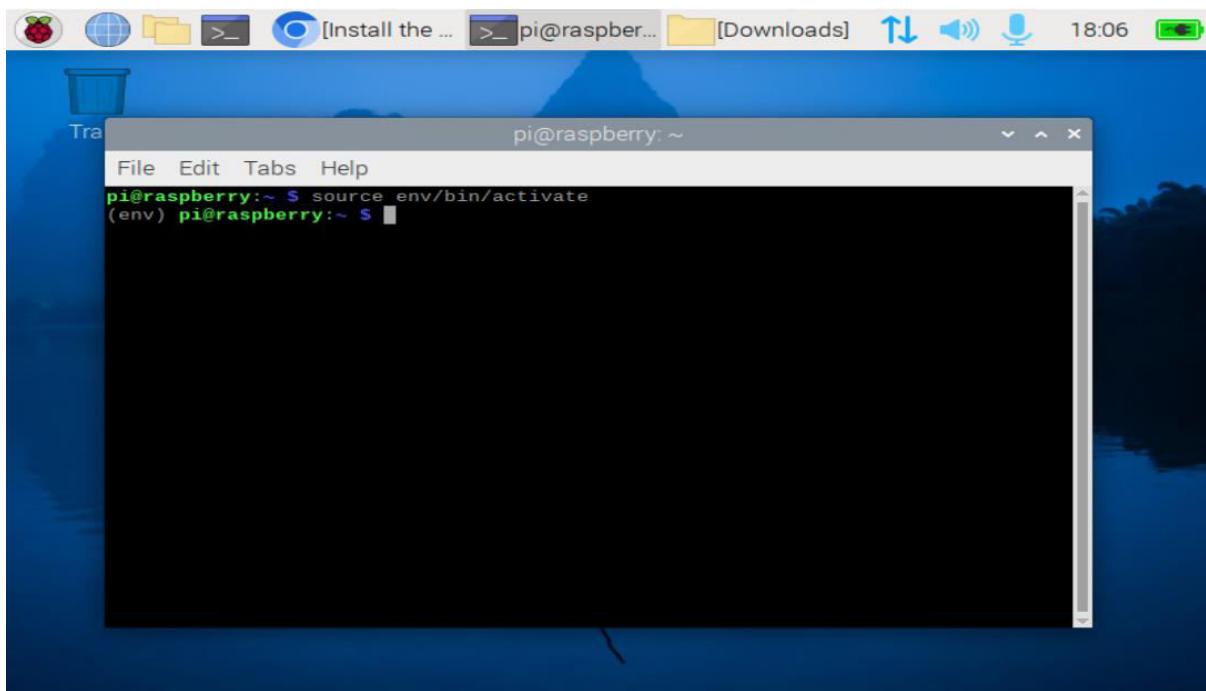
29. Setup venv



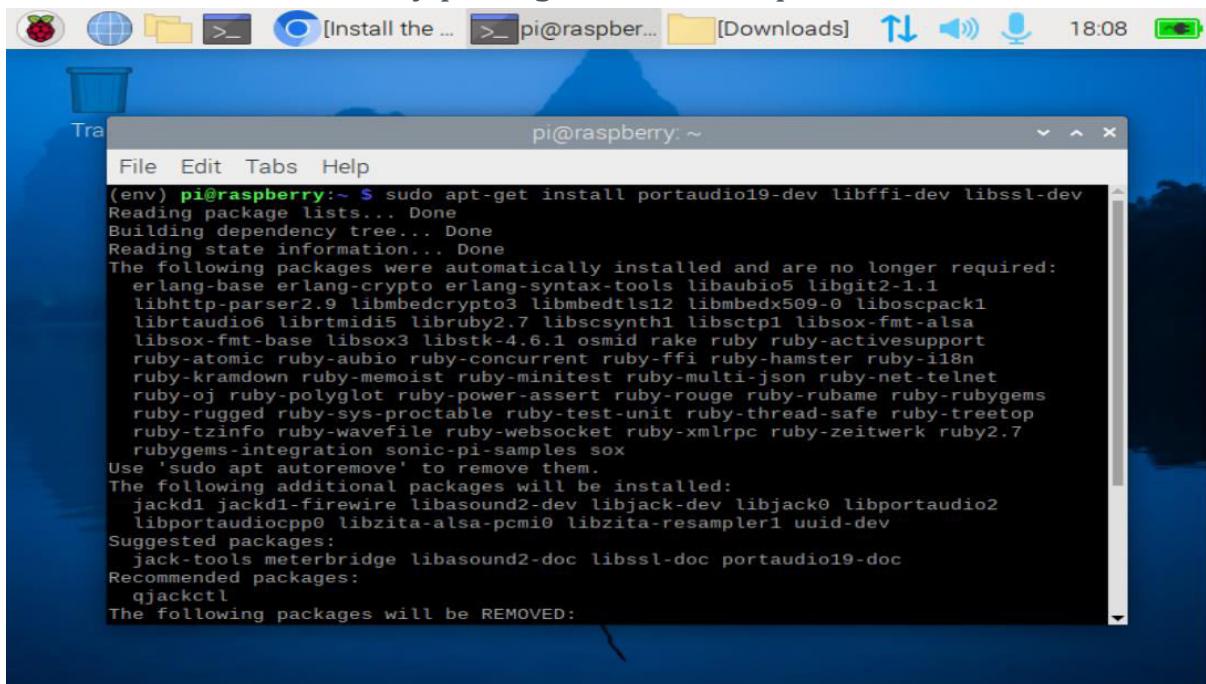
30. Upgrade some tools



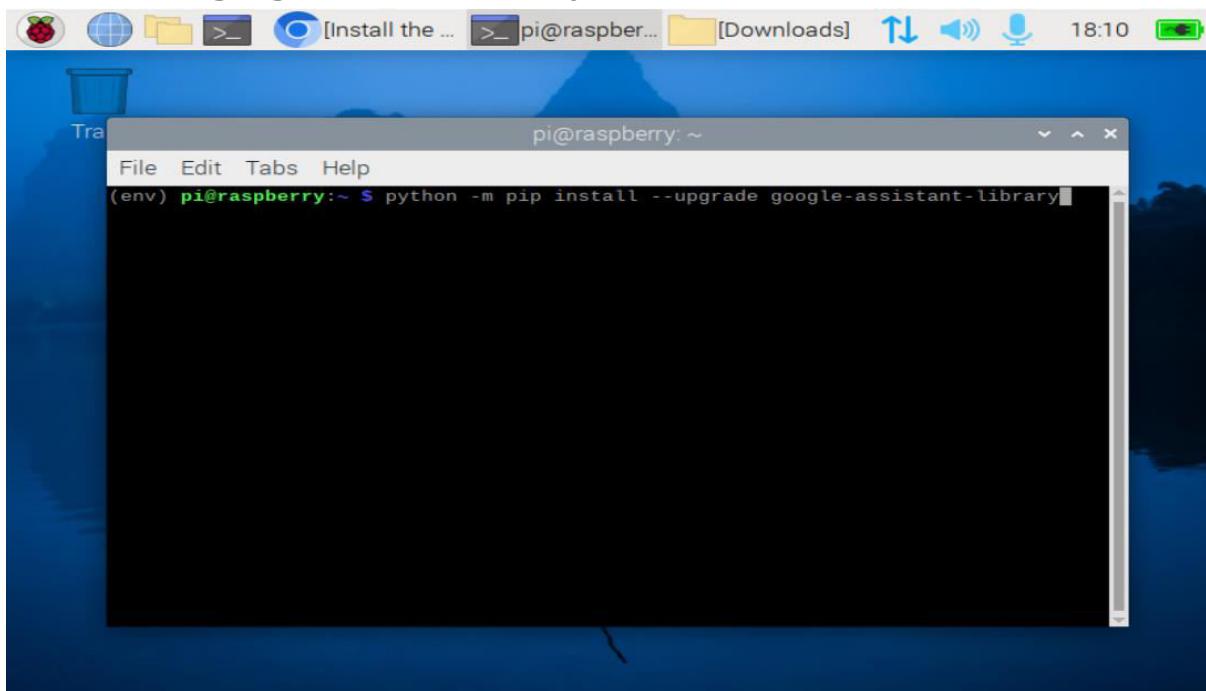
31. Activate venv



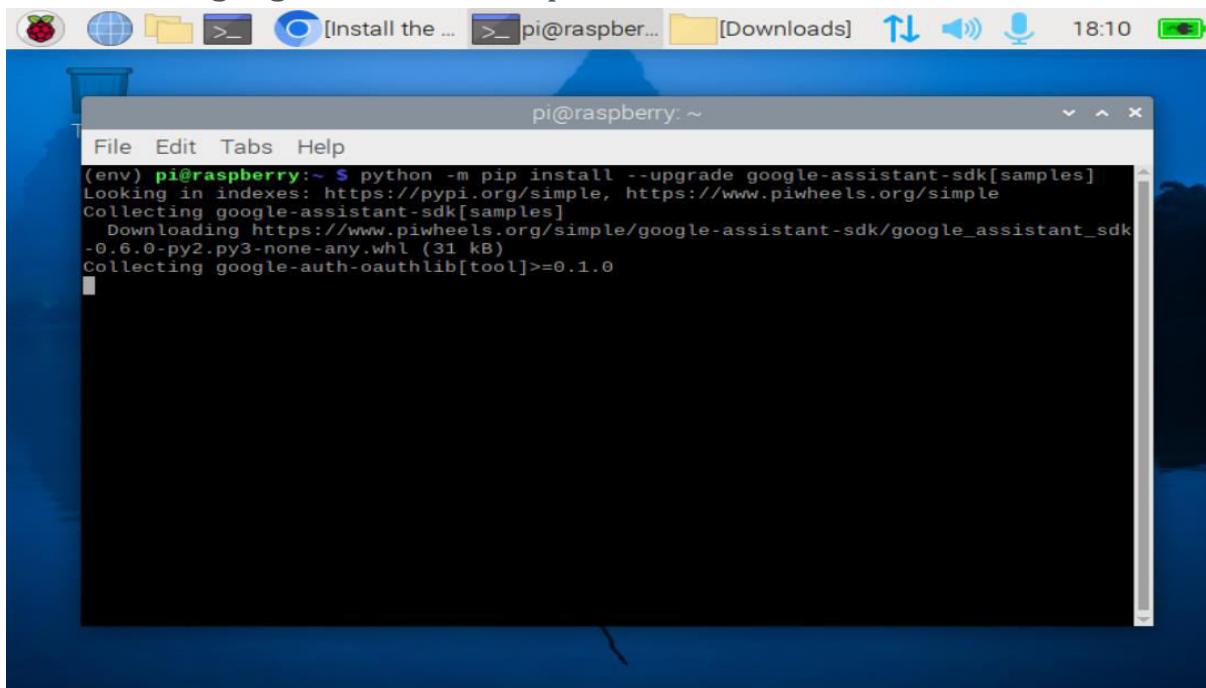
32. Download necessary packages for text to speech



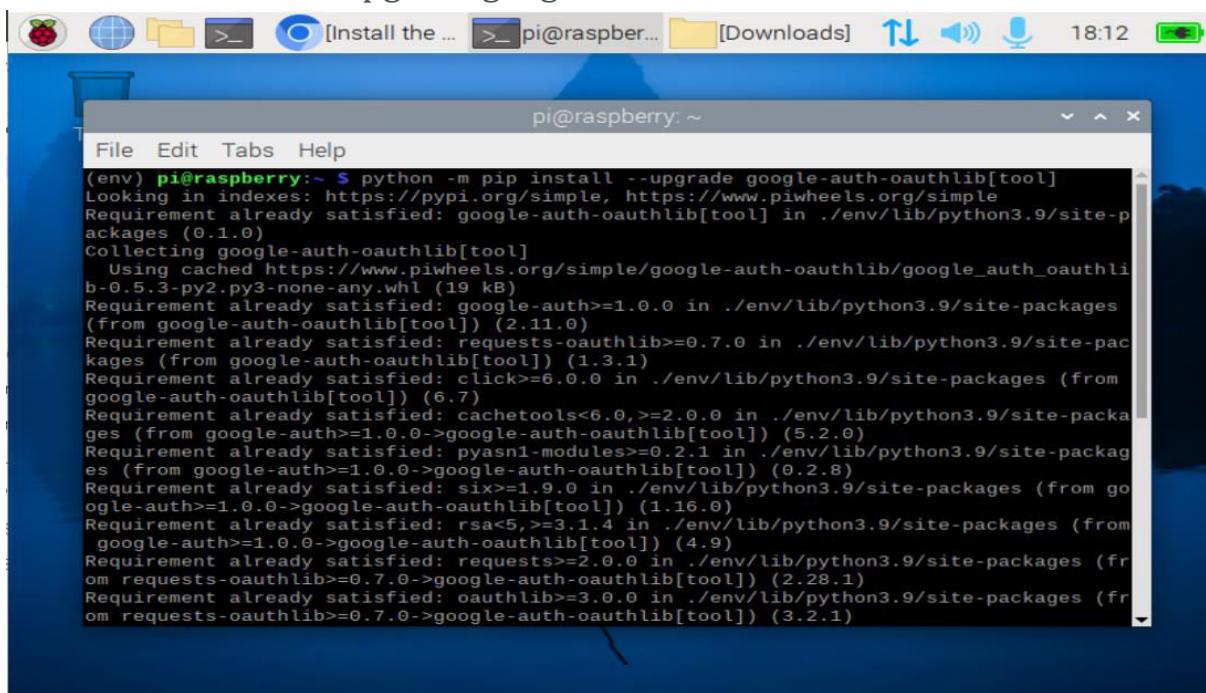
33. Install google-assistant-library



34. Install google-assistant-samples

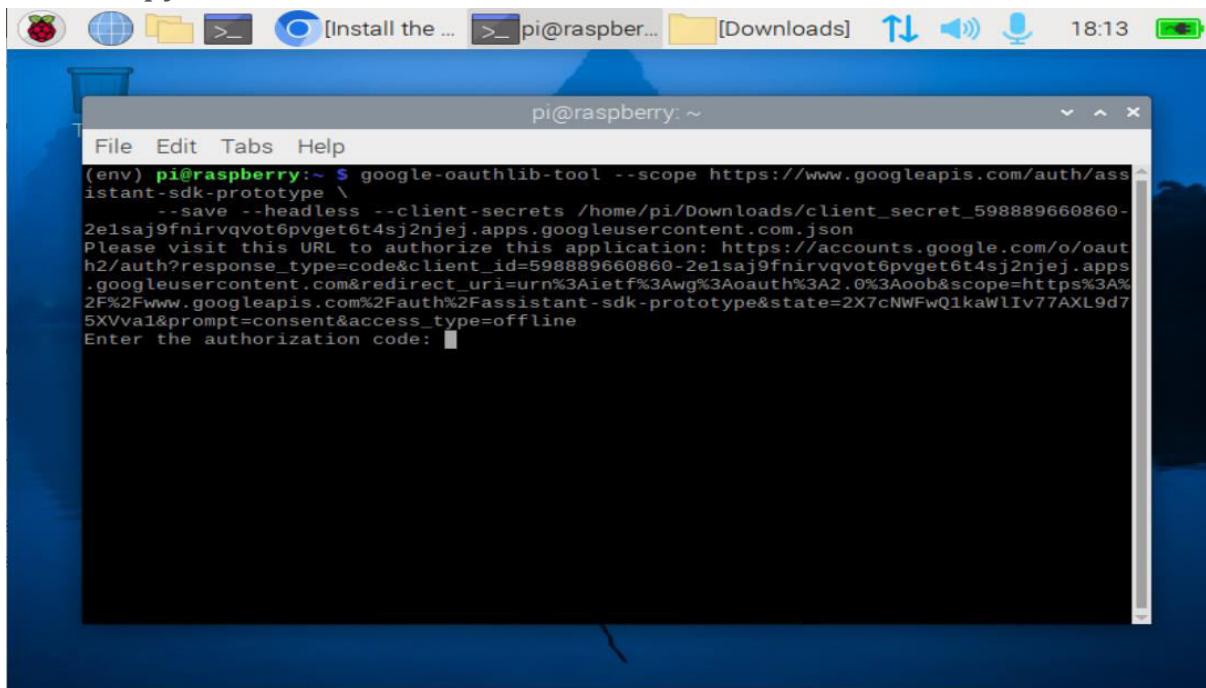


35. Download and upgrade google auth oauthlib tools



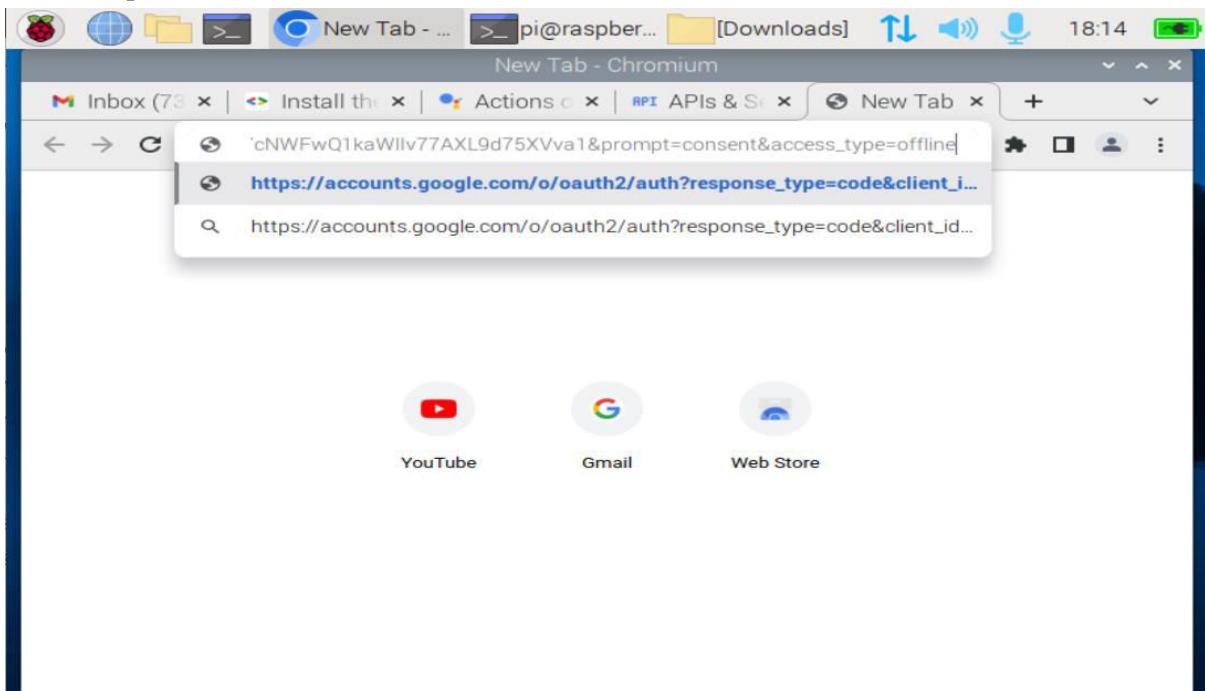
```
pi@raspberry: ~
File Edit Tabs Help
(env) pi@raspberry:~ $ python -m pip install --upgrade google-auth-oauthlib[tool]
Looking in indexes: https://pypi.org/simple, https://www.piwheels.org/simple
Requirement already satisfied: google-auth-oauthlib[tool] in ./env/lib/python3.9/site-packages (0.1.0)
Collecting google-auth-oauthlib[tool]
  Using cached https://www.piwheels.org/simple/google-auth-oauthlib/google_auth_oauthlib-0.5.3-py2.py3-none-any.whl (19 kB)
Requirement already satisfied: google-auth>=1.0.0 in ./env/lib/python3.9/site-packages (from google-auth-oauthlib[tool]) (2.11.0)
Requirement already satisfied: requests-oauthlib>=0.7.0 in ./env/lib/python3.9/site-packages (from google-auth-oauthlib[tool]) (1.3.1)
Requirement already satisfied: click>=6.0.0 in ./env/lib/python3.9/site-packages (from google-auth-oauthlib[tool]) (6.7)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in ./env/lib/python3.9/site-packages (from google-auth>=1.0.0->google-auth-oauthlib[tool]) (5.2.0)
Requirement already satisfied: pyasn1-modules>=0.2.1 in ./env/lib/python3.9/site-packages (from google-auth>=1.0.0->google-auth-oauthlib[tool]) (0.2.8)
Requirement already satisfied: six>=1.9.0 in ./env/lib/python3.9/site-packages (from google-auth>=1.0.0->google-auth-oauthlib[tool]) (1.16.0)
Requirement already satisfied: rsa<5,>=3.1.4 in ./env/lib/python3.9/site-packages (from google-auth>=1.0.0->google-auth-oauthlib[tool]) (4.9)
Requirement already satisfied: requests>=2.0.0 in ./env/lib/python3.9/site-packages (from requests-oauthlib>=0.7.0->google-auth-oauthlib[tool]) (2.28.1)
Requirement already satisfied: oauthlib>=3.0.0 in ./env/lib/python3.9/site-packages (from requests-oauthlib>=0.7.0->google-auth-oauthlib[tool]) (3.2.1)
```

36. Copy url

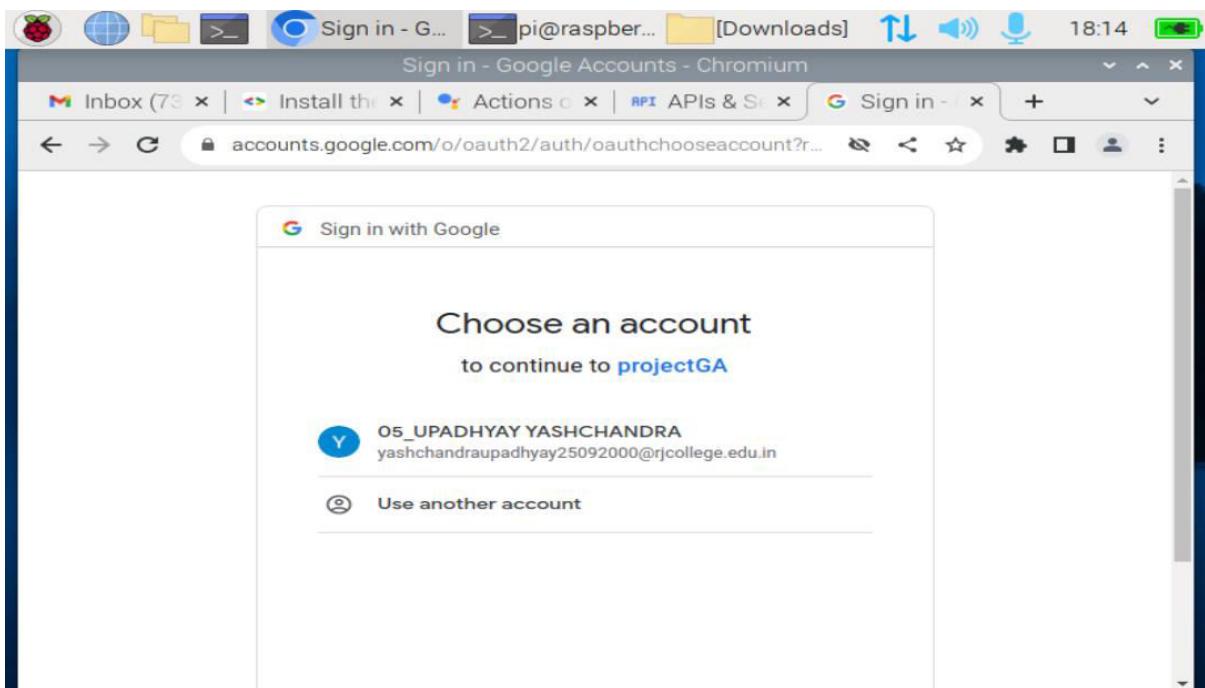


```
pi@raspberry: ~
File Edit Tabs Help
(env) pi@raspberry:~ $ google-oauthlib-tool --scope https://www.googleapis.com/auth/assistant-sdk-prototype \
--save --headless --client-secrets /home/pi/Downloads/client_secret_598889660860-2e1saj9fnirvqvot6pvget6t4sj2njej.json
Please visit this URL to authorize this application: https://accounts.google.com/o/oauth2/auth?response_type=code&client_id=598889660860-2e1saj9fnirvqvot6pvget6t4sj2njej.apps.googleusercontent.com&redirect_uri=urn%3Aietf%3Awg%3Aoauth%3A2.0%3Aoob&scope=https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fassistant-sdk-prototype&state=2X7cNWFwQikaWlIv77AXL9d75XVva1&prompt=consent&access_type=offline
Enter the authorization code: ■
```

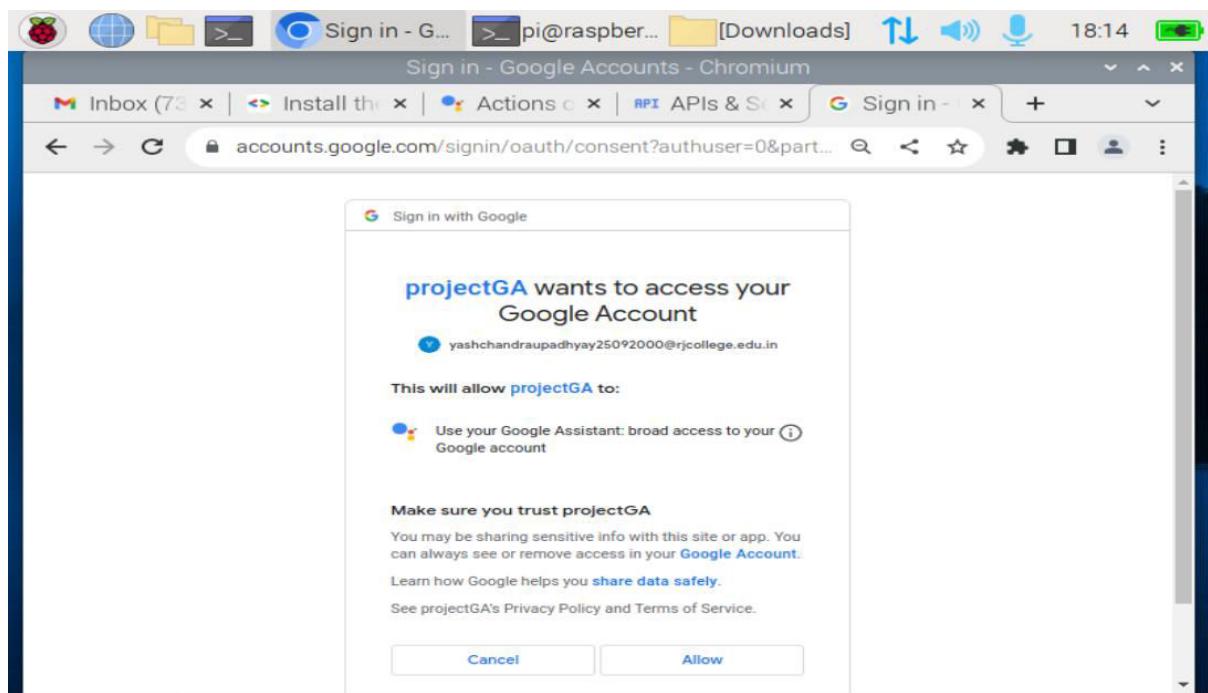
37. Open in new tab.



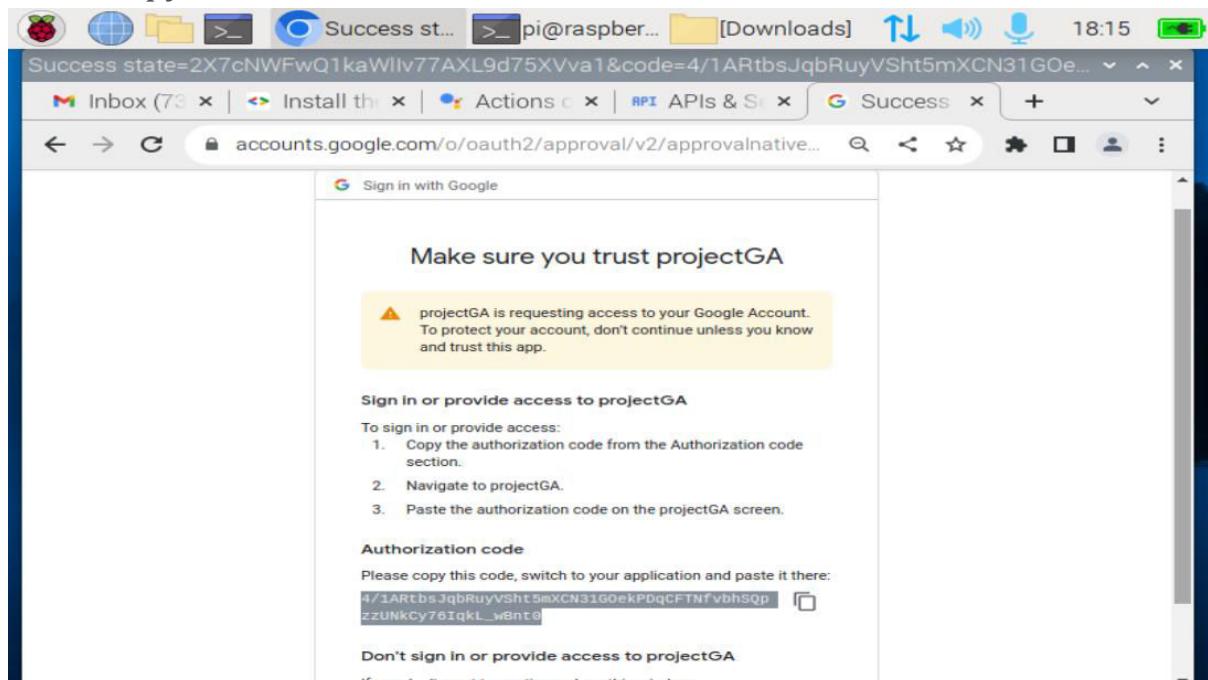
38. Select account



39. Click on allow



40. Copy code



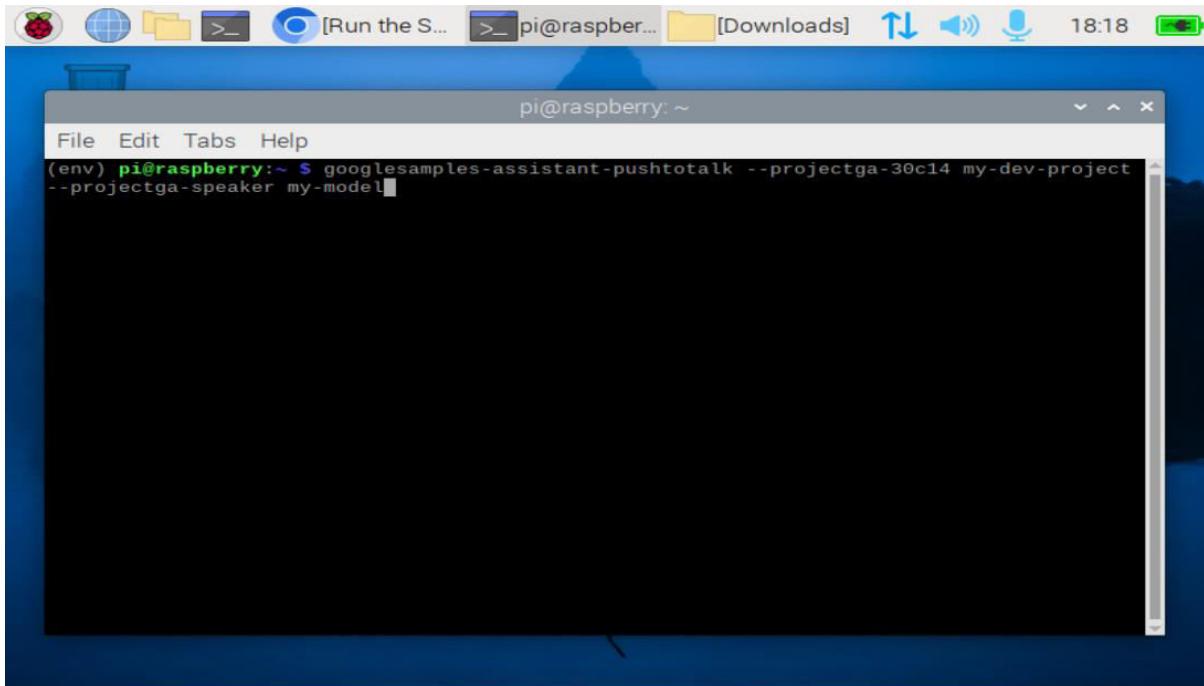
41. Enter code.

```
pi@raspberry:~ $ google-oauthlib-tool --scope https://www.googleapis.com/auth/assistant-sdk-prototype \
--save --headless --client-secrets /home/pi/Downloads/client_secret_598889660860-2e1saj9fnirvqvot6pvget6t4sj2njej.json
Please visit this URL to authorize this application: https://accounts.google.com/o/oauth2/auth?response_type=code&client_id=598889660860-2e1saj9fnirvqvot6pvget6t4sj2njej.apps.googleusercontent.com&redirect_uri=urn%3Aietf%3Awg%3Aoauth%3A2.0%3Aoob&scope=https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fassistant-sdk-prototype&state=2X7cNWFwQ1kaWlIv77AXL9d75XVval&prompt=consent&access_type=offline
Enter the authorization code: 4/1ARTbsJqbRuyVsht5mXCN31G0ekPDqCFTNfvbhSQpzzUNkCy76IqkL_wBnt0
```

42. Wait for it to be finished.

```
pi@raspberry:~ $ google-oauthlib-tool --scope https://www.googleapis.com/auth/assistant-sdk-prototype \
--save --headless --client-secrets /home/pi/Downloads/client_secret_598889660860-2e1saj9fnirvqvot6pvget6t4sj2njej.json
Please visit this URL to authorize this application: https://accounts.google.com/o/oauth2/auth?response_type=code&client_id=598889660860-2e1saj9fnirvqvot6pvget6t4sj2njej.apps.googleusercontent.com&redirect_uri=urn%3Aietf%3Awg%3Aoauth%3A2.0%3Aoob&scope=https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fassistant-sdk-prototype&state=2X7cNWFwQ1kaWlIv77AXL9d75XVval&prompt=consent&access_type=offline
Enter the authorization code: 4/1ARTbsJqbRuyVsht5mXCN31G0ekPDqCFTNfvbhSQpzzUNkCy76IqkL_wBnt0
credentials saved: /home/pi/.config/google-oauthlib-tool/credentials.json
(pi@raspberry:~ $ )
```

Run following program to interact with google assistant



Practical – 8: Face Detection using IoT device. (Pi Camera or anything else)

Capturing Images with Raspberry Pi and Pi Camera

- The Camera Module is a great accessory for the Raspberry Pi, allowing users to take still pictures.

Hardware Guide:

- For completing this lesson, you will require the Camera Module along with your initial raspberry pi setup.

Camera Module:

The Raspberry Pi Camera Board plugs directly into the CSI connector on the Raspberry Pi. The camera is supported in the latest version of Raspbian, the Raspberry Pi's preferred operating system.

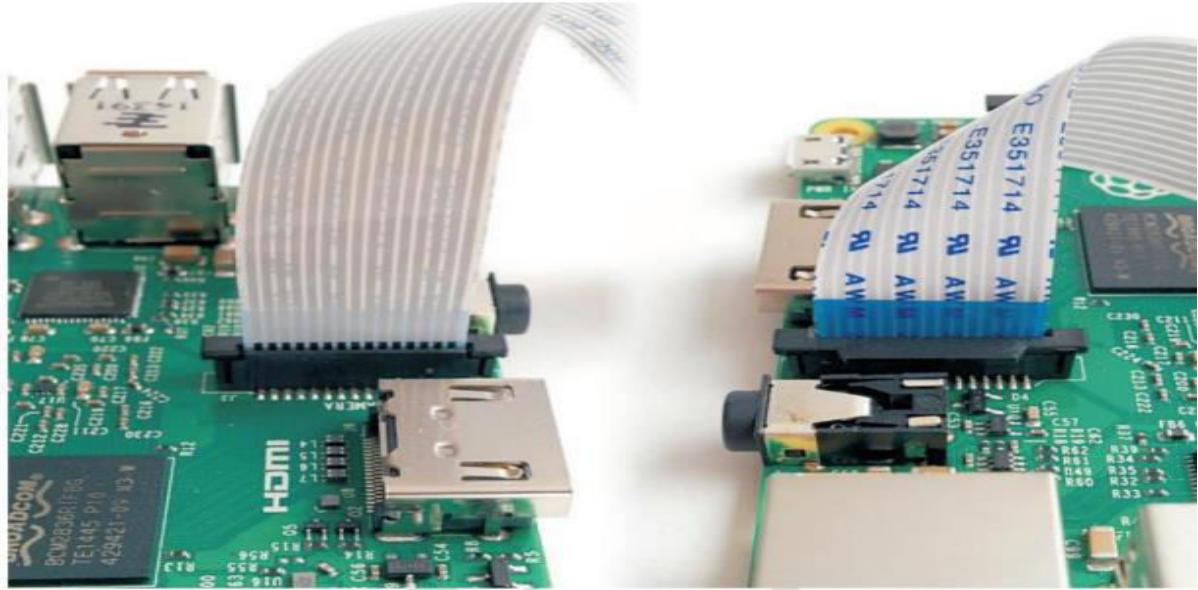
The Raspberry Pi Camera Board Features:

1. Fully Compatible with Both the Model A and Model B Raspberry Pi
2. 5MP Omnivision 5647 Camera Module
3. Still Picture Resolution: 2592 x 1944
4. Video: Supports 1080p @ 30fps, 720p @ 60fps and 640x480p 60/90 Recording
5. 15-pin MIPI Camera Serial Interface – Plugs Directly into the Raspberry Pi Board
6. Size: 20 x 25 x 9mm
7. Weight 3g
8. Fully Compatible with many Raspberry Pi cases

Connect the Camera Module

First of all, with the Pi switched off, you'll need to connect the Camera Module to the Raspberry Pi's camera port, then start up the Pi and ensure the software is enabled.

1. Locate the camera port and connect the camera



2. Start up the Pi.

3. Open the Raspberry Pi Configuration Tool from the main menu.
Ensure the camera software is enabled. If it's not enabled, enable it and reboot your Pi to begin.

Software Guide:

Now your camera is connected and the software is enabled, you can get started by capturing an image. You can capture an image by just typing a single line command. Open terminal window and type the command as follows:

```
$ sudo raspistill -o /home/pi/Desktop/image.jpg
```

This command will capture an image and store it at the specified location (here the location specified is /home/pi/Desktop) with the specified name (here the name is 'image.jpg').

You can even write a code in Python to capture an image using raspberry pi camera. Open Python3, create a new file and type the code as follows:
Code.

```
#Camera Program
from time import sleep
from picamera import PiCamera

camera = PiCamera()
camera.resolution = (1280, 720)
camera.start_preview()
sleep(2)

camera.capture('/home/pi/Pictures/newImage.jpg')
camera.stop_preview()
#end of code
```

Output:

Hurray! We have learned how to interface camera with raspberry pi and how to capture image. You can also take videos and do much more things.

