A

Project Report

On

"REVERSE VENDING MACHINE USING OPEN CV METHOD"

Submitted to JNTU, Anantapuramu for the partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

In

ELECTRONICS & COMMUNICATION ENGINEERING

By

V. Kamal Basha	**- 192P1A04A5**
N. Jhansi	**- 192P1A0470**
P. Bhavitha	**- 192P1A0483**
P. Chandrahas Sharma	**- 202P5A0410**
N. Naveen Kumar	**- 192P1A0474**

Under the Guidance of

Mrs.A.Sandhya Deepthi, M.Tech

Assistant Professor, Dept. of ECE

Submitted to

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOG

(Approved by AICTE New Delhi, Permanently Affiliated to JNTUA, (Anantapuramu)Accredited by NAAC & NBA, Recognized by UGC under the Section 2(f) & 12(b) of UGC Act, 1956

VIDYA NAGAR, PALLAVOLU (V), PRODDATUR-516360, Y.S.R (Dt), AP

2019 -2023

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(Approved by AICTE New Delhi, Permanently Affiliated to JNTUA, Anantapuramu)
Accredited by NAAC & NBA, Recognized by UGC under the Section 2(f) & 12(b) of UGC Act, 1956
VIDYA NAGAR, PALLAVOLU (V), PRODDATUR-516360, Y.S.R (Dt), AP

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that the project work entitled "**REVERSE VENDING MACHINE USING OPEN CV METHOD"**, is a bonafide record submitted by **, V.KAMAL BASHA, P. BHAVITHA, N. JHANSI, N.NAVEEN KUMAR, P. CHANDRAHAS SHARMA**is partial fulfillment for the award of Degree of Bachelor of Technology in "**ELECTRONICS AND COMMUNICATION ENGINEERING"** for the year of 2019-2023.

The work reported herein does not form part of any other thesis on which a degree has been awarded earlier.

Internal Guide

Mrs.A. Sandhya Deepthi, M.Tech
Assistant Professor
Dept. of ECE

Head of the Department

Dr.M.LakshmiKiran, M.Tech,Ph.D.,
Associate Professor & HOD
Dept. of ECE

External project viva-voice held on: _____

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ACKNOWLEDGEMENT

We acknowledge with appreciation and sincere gratitude to our Internal guide **Mrs**. **A.Sandhya Deepthi,M.Tech,**Assistant Professor and Department of Electronics & Communication Engineering for giving his valuable suggestions and constant encouragement and kind help.

We are thankful to our project Coordinator **Mr**.**C.Md.Aslam**,**M.Tech(Ph.D)** Associate Professor, Department of Electronics & Communication Engineering for giving his valuable suggestions and constant encouragement and kind help.

We express our deep sense of gratitude and thanks to **Dr**.**M.Lakshmi kiran**,**M.Tech,Ph.D,MISTE,IETE,**Head of the department of Electronics & Communication Engineering and Associate Professor for his benevolent attitude and help as head of the department.

At the very outset we wish to place on record our sincere thanks and gratitude **Dr.G.SREENIVASULAREDDY,M.Tech,Ph.D**Principal,Pallavolu,Vidyanagar,Prod datur who allowed us to complete this endeavor successfully.

We are much indebted to our secretary & correspondent **Dr.V.JAYA CHANDRA REDDY** garu for his effort in providing all the facilities and constant encouragement.

Finally we would like to thank our faculty members, trainers, Parents, friends all the people who have helped us directly or indirectly in the successful completion of this project.

PROJECT ASSOCIATES:

V. Kamal Basha	**-192P1A04A5**
P. Chandrahas Sharma	**-202P5A0410**
P. Bhavitha	**-192P1A0483**
N. Jhansi	**- 192P1A0470**
N. Naveen Kumar	**-192P1A0474**

CANDIDATE'S DECLARATION

We hereby declare that the work which is being presented in this dissertation entitled, **"REVERSE VENDING MACHINE USING OPEN CV METHOD"**, Submitted towards the partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Electronics and Communication Engineering, Chaitanya Bharathi Institute of Technology,Vidyanagar,Proddatur.

The matter embodied in this dissertation report has not been submitted by for the award of the degree.Further,the technical details furnished in the various chapters in this thesis are purely relevant to the project.

PROJECT ASSOCIATES:

V. Kamal Basha	**- 192P1A04A5**
P. Chandrahas Sharma	**-202P5A0410**
P. Bhavitha	**-192P1A0483**
N. Jhansi	**-192P1A0470**
N. Naveen Kumar	**-192P1A0474**

LIST OF CONTENTS

LIST OF FIGURES

ABSTRACT

Reverse vending machine is a concept or an idea which inculcate the habit of recycling the waste materials. It will be working by taking recyclable waste into the machine and gives a useful thing as a token of appreciation. The aim of this project is to design and fabricate a reverse vending machine which takes recyclable waste into the machine and displays a token of appreciation. The machine can accept a plastic bottle of 90mm diameter without cap and tin cans can be accepted and crushed and stored. The machine has a capacity of storing 50 plastic bottles and 50 tin cans. There basically two parts, one is the mechanical part and the other is the electronics part. The mechanical part is used to crush the recyclable waste which is kept in the machine so that more plastic and cans can be recycled and stored. The electronics part which consist of sensor and microcontroller, is used to take the correct input and segregate the waste into its respective categories and give a token of appreciation as a LCD display. The whole system is automated by the help of electronics. Combining both parts will give a reverse vending machine. Reverse vending machine will be working by taking recyclable waste into the machine and gives a use full thing as a token of appreciation. To encourage recycling process we are designing and manufacturing reverse vending machine.This project uses regulated 5V, 500mA power supply. Unregulated 12V DC is used for relay. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer.

CHAPTER 1

INTRODUCTION TO EMBEDDED SYSTEMS

1.1 INTRODUCTION:

Microcontroller are widely used in Embedded Systems products. An Embedded product uses the microprocessor (or microcontroller) to do one task & one task only. A printer is an example of Embedded system since the processor inside it perform one task only namely getting the data and printing it. Although microcontroller is preferred choice for many Embedded systems, there are times that a microcontroller is inadequate for the task. For this reason, in recent years many manufactures of general-purpose microprocessors such as INTEL, Motorola, AMD & Cyrix have targeted their microprocessors for the high end of Embedded market. One of the most critical needs of the embedded system is to decrease power consumptions and space. This can be achieved by integrating more functions into the CPU chips. All the embedded processors have low power consumptions in additions to some forms of I/O, ROM all on a single chip. In higher performance Embedded system, the trend is to integrate more & more function on the CPU chip & let the designer decide which feature he/she wants to use.

1.2 EMBEDDED SYSTEM:

Physically, embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure

In general, "embedded system" is not an exactly defined term, as many systems have some element of programmability. For example, Handheld computers share some elements with embedded systems such as the operating systems and microprocessors which power them but systems, because they allow different applications to be loaded and peripherals to be connected. Embedded systems span all aspects of modern life and there are many examples of their use. Telecommunications systems employ numerous embedded systems from telephone switches for the network to mobile phones at the end-user. Computer networking uses dedicated routers and network bridges to route data.

EXAMPLES OF EMBEDDED SYSTEM:

- Automated teller. machines (ATMS).
- Integrated system in aircraft and missile.
- Cellular telephones and telephonic switches.
- Computer network equipment, including routers timeservers and firewalls
- Computer printers, Copiers.
- Disk drives (floppy disk drive and hard disk drive)
- Engine controllers and antilock brake controllers for automobiles.
- Home automation products like thermostat, air conditioners sprinkles and security monitoring system.
- House hold appliances including microwave ovens, washing machines, TV sets DVD layers/recorders.
- Medical equipment.
- Measurement equipment such as digital storage oscilloscopes, logic analyzers and spectrum analyzers.
- Multimedia appliances: internet radio receivers, TV set top boxes.
- Small hand-held computer with P1M5 and other applications.

Programmable logic controllers (PLC's) for industrial automation and monitoring.

1.3 CHARACTERISTICS:

Embedded systems are designed to do some specific tasks, rather than be a general-purpose computer for multiple tasks. Some also have real-time performance constraints that must be met, for reasons such as safety and usability; others may have low or no performance requirements, allowing the system hardware to be simplified to reduce costs.

The software written for embedded systems is often called firmware, and is usually stored in read-only memory or Flash memory chips rather than a disk drive. It often runs with limited computer hardware resources: small or no keyboard, screen, and little memory.

1.4MICROPROCESSOR (MP):

A microprocessor is a general-purpose digital computer central processing unit (CPU). Although popularly known as a "computer on a chip" is in no sense a complete digital computer. The block diagram of a microprocessor CPU is shown, which contains an arithmetic and logical unit (ALU), a program counter (PC), a stack pointer (SP), some

working registers, a clock timing circuit, and interrupt circuits.

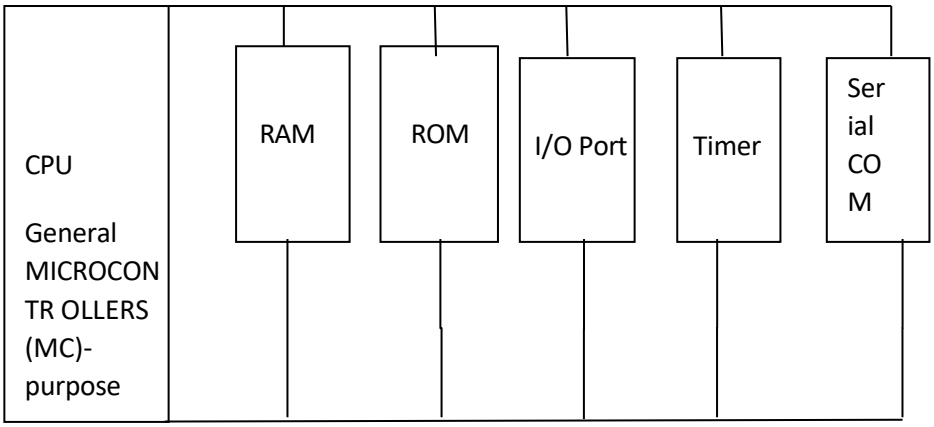


Fig 1.1 Block diagram of microprocessor

1.5MICROCONTROLLER (MC):

Figure shows the block diagram of a typical microcontroller. The design incorporates all of the features found in micro-processor CPU: ALU, PC, SP, and registers. It also added the other features needed to make a complete computer: ROM, RAM, parallel I/O, serial I/O, counters, and clock circuit.

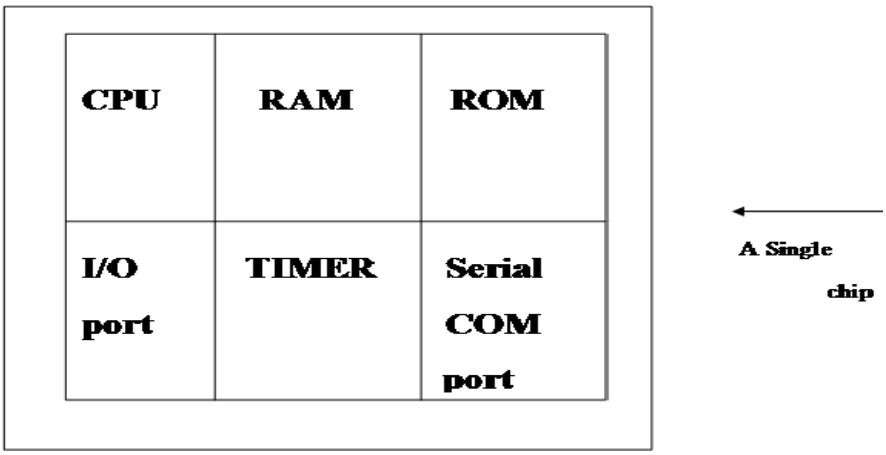


Fig 1.2 Microcontroller

1.6 COMPARISION BETWEEN MICROPROCESSOR AND MICROCONTROLLER

The microprocessor must have many additional parts to be operational as a computer whereas microcontroller requires no additional external digital parts.

1. The prime use of microprocessor is to read data, perform extensive calculations on that data and store them in the mass storage device or display it. The prime functions of

microcontroller are to read data, perform limited calculations on it, control its environment based on these data. Thus, the microprocessor is said to be general-purpose digital computers whereas the microcontroller is intended to be special purpose digital controller.

2. Microprocessor need many opcodes for moving data from the external memory to the CPU, microcontroller may require just one or two, also microprocessor may have one or two types of bit handling instructions.

PERIPHERALS:

Embedded Systems talk with the outside world via peripherals, such as

- Serial Communication Interfaces (SCI): RS-232, RS-422, RS-485etc
- Synchronous Serial Communication Interface: I2C, JTAG, SPI, SSC and ESSI
- Universal Serial Bus (USB)
- Networks: Ethernet, Controller Area Network, LAN networks, etc
- Timers: PLL(s), Capture/Compare and Time Processing Units
- Discrete IO: aka General Purpose Input/output (GPIO)
- Ana log to Digital/Digital to Analog (ADC/DAC)

TOOLS:

As for other software, embedded system designers use compilers, assemblers, and debuggers to develop embedded system software. However, they may also use soe more specific tools:

- Utilities to add a checksum or CRC to a program, so the embedded system can check if the program is valid.
- For systems using digital signal processing, developers may use a math workbench such as MATLAB, Simulink, Mathcad, or Mathematica to simulate the mathematics. They might also use libraries for both the host and target which eliminates developing DSP routines as done in DSP nano RTOS and Unison Operating System.
- Custom compilers and linkers may be used to improve optimization for the particular hardware.
- An embedded system may have its own special language or design tool, or add existing language such as Forth or Basic.
- Another alternative is to add a Real-time operating system .

CHAPTER 2

OVERVIEW OF THE PROJECT

2.1 INTRODUCTION

This first chapter is dedicated to the presentation of the preliminary study which amounts to the first stage of our project titled Reverse Vending Machine. First, we establish the business objectives that we aim to fulfill by capturing the project's goals. Next, we will introduce the project's context, data source identification and description and the system architecture.

In this thesis, a machine vision system based on multiple cameras has been developed for a reverse vending machine prototype. The multi-camera system enables high return speed and simplifies the mechanical structure of the reverse vending machine. With the camera-based system, various additional visual features, such as deposit and security markings, can be extracted from the captured images for verification unlike with traditional laser-based barcode scanners. Furthermore, with no moving parts, the system is virtually maintenance free. The machine vision system developed in this thesis has been a part of a larger Tekes funded New Knowledge and Business from Research Ideas [10] project. The project focused on developing a fast, low cost, easily maintainable and reliable reverse vending machine. The developed system consists of six Raspberry Pi -based cameras placed on a perimeter around the beverage container return chute for imaging the outer surface of a beverage container as it slides past the cameras and the barcode is extracted from the images. Ordinary PC hardware is used for the image processing together with the software developed as a part of this study.

With the developed multi-camera system, the beverage container barcode can be extracted from the camera images without rotating the container. Such solution simplifies the mechanics of the reverse vending machine by removing the rotating mechanism, thus increasing the reliability and maintainability. With the camera-based system, the beverage containers can also be fed into the reverse vending machine either top or bottom first, and since the barcode can be extracted without rotating the container, the returning process is less time consuming for the user than with conventional reverse vending machines. In the developed system, the beverage container identification relies on checking whether the

extracted barcode exists in a database of refundable barcodes. In addition, the database contains the requisite information about the beverage containers, such as the refund, the material of the container, the maximum allowed weight and the dimensions of the container. In the future versions, an additional seventh camera will be used for capturing an image of the whole container to verify its shape and dimensions to minimize the possibility of tricking the reverse vending machine, e.g., with invalid objects that have a valid barcode attached onto them.

2.2 EXISTING SYSTEM

In order to respond to the problem of waste management, an idea of creating an intelligent trash was made. This project offers a credible and hopeful solution to today's sustainable development goals. The main problem was the lack of sorting, which means that the waste is either burned or piled up in a landfill, so the main task of this machine is to capture the waste and the classifier according to their types : Plastic, glass, ...etc Sorting waste and recycling it are crucial issues of our century. It is therefore important that sorting becomes a daily gesture. Within Our Smart Reverse Vending Machines, we use a smart camera which recognize material. When an object is out in the receiver unit of the machine, electronic recognition system evaluates the object and compares it with models in the system database if it's classified as recyclable the machine accepts the objects and stores it separately depending on material. By compressing plastic and aluminum waste, the machine provides more space for the waste material.

2.3 PROPOSED SYSTEM

This the user matrix number and quantity of recycled empty bottle. This machine also developed to boost recycling activities among the student. Instead, there are several objectives as follows

- Leasing machines to organizations: it creates a great buzz monthly and would be an efficient back easily. For long term, it's more profitable then resell model.
- Managing program model could be established by distributor within various profit generation.
- CO-OP model mainly aims to work with recycling companies and waste collection investment from these companies, and they can supply materials continuously.
- Geo-localization can be very useful to companies and to the project in this case, because the habits of each type of client.

2.3.1 BLOCK DIAGRAM OF PROPOSED SYSTEM

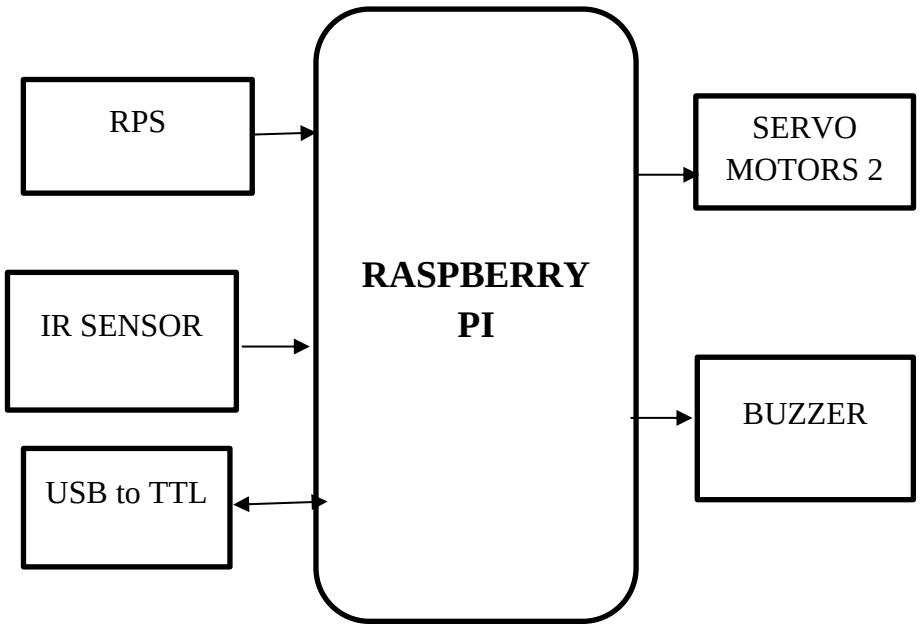


Fig 2.1 Block Diagram

2.3.2 HARDWARE COMONENTS

- Power Supply
- Raspberry Pi
- IR Sensor
- Servo Motor
- LCD
- Buzzer

2.3.3 SOFTWARE COMPONENTS

- Python IDE
- Proteus

2.3.4 TECHNOLOGY USED

- Image Processing and Deep Learning

CHAPTER 3

TECHNOLOGY USED

3.1 IMAGE PROCESSING

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them. It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps:

- Importing the image via image acquisition tools.
- Analysing and manipulating the image.
- Output in which result can be altered image or report that is based on image analysis.

Low-level image processing algorithms include:

- Edge detection.
- Segmentation.
- Classification.
- Feature detection and matching.s

DIGITAL IMAGE PROCESSING

A digital image is a representation of a real image as a set of numbers that can be stored and handled by a digital computer. In order to translate the image into numbers, it is divided into small areas called pixels (picture elements). For each pixel, the imaging device records a number, or a small set of numbers, that describe some property of this pixel, such as its brightness (the intensity of the light) or its color. The numbers are arranged in an array of rows and columns that correspond to the vertical and horizontal positions of the pixels in the image. Digital images have several basic characteristics. One is the type of the image. For example, a black and white image records only the intensity of the light falling on the pixels. A color image can have three colors, normally RGB (Red, Green, Blue) or four colors, CMYK (Cyan, Magenta, Yellow, black). RGB images are usually used in computer monitors

and scanners, while CMYK images are used in color printers. There are also non-optical images such as ultrasound or X-ray in which the intensity of sound or X-rays is recorded. In range images, the distance of the pixel from the observer is recorded. Resolution is expressed in the number of pixels per inch (ppi). A higher resolution gives a more detailed image. A computer monitor typically has a resolution of 100 ppi, while a printer has a resolution ranging from 300 ppi to more than 1440 ppi. This is why an image looks much better in print than on a monitor.

3.2 OPEN CV

A digital image is a representation of a real image as a set of numbers that can be stored and handled by a digital computer. In order to translate the image into numbers, it is divided into small areas called pixels (picture elements). For each pixel, the imaging device records a number, or a small set of numbers, that describe some property of this pixel, such as its brightness (the intensity of the light) or its color. The numbers are arranged in an array of rows and columns that correspond to the vertical and horizontal positions of the pixels in the image. server is recorded. Resolution is expressed in the number of pixels per inch (ppi). A higher resolution gives a more detailed image. A computer monitor typically has a resolution of 100 ppi, while a printer has a resolution ranging from 300 ppi to more than 1440 ppi. This is why an image looks much better in print than on a monitor.

3.3 DEEP LEARNING

INTRODUCTION

Whether it is medical diagnosis, self-driving vehicles, camera monitoring, or smart filters, many applications in the field of computer vision are closely related to our current and future lives. In recent years, deep learning has been the transformative power for advancing the performance of computer vision systems. It can be said that the most advanced computer vision applications are almost inseparable from deep learning. In view of this, this chapter will focus on the field of computer vision, and investigate methods and applications that have recently been influential in academia and industry.

In this, we studied various convolutional neural networks that are commonly used in computer vision, and applied them to simple image classification tasks. At the beginning of this chapter, we will describe two methods that may improve model generalization, namely image augmentation and fine-tuning, and apply them to image classification. Since deep neural networks can effectively represent images in multiple levels, such layer wise

representations have been successfully used in images like the cover of this book. In the end, we conclude this chapter by applying the materials of this chapter and several previous chapters on two popular computer vision benchmark datasets.

IMAGE AUGMENTATION

In Section, we mentioned that large datasets are a prerequisite for the success of deep neural networks in various applications. Image augmentation generates similar but distinct training examples after a series of random changes to the training images, thereby expanding the size of the training set. Alternatively, image augmentation can the position of the object. We can also adjust factors such as brightness and colour to reduce a model's sensitivity to colour. It is probably true that image augmentation was indispensable for the success of Alex Net at that time. In this section we will discuss this widely used technique in computer vision.

COMMON IMAGE AUGMENTATION METHODS

In our investigation of common image augmentation methods, we will use the following 400×500 image an example.

Most image augmentation methods have a certain degree of randomness. To make it easier for us to observe the effect of image augmentation, next we define an auxiliary function apply. This function runs the image augmentation method aug multiple times on the input image img and shows all the results.

FLIPPING AND CROPPING

Flipping the image left and right usually does not change the category of the object. This is one of the earliest and most widely used methods of image augmentation. Next, we use the transforms module to create the Random Flip Left Right instance, which flips an image left and right with a 50% chance.

Flipping up and down is not as common as flipping left and right. But at least for this example image, flipping up and down does not hinder recognition. Next, we create a Random Flip Top Bottom instance to flip an image up and down with a 50% chance.

In the example image we used, the cat is in the middle of the image, but this may not target position. In the code below, we randomly crop an area with an area of 10% ~ 100% of the original area each time, and the ratio of width to height of this area is

randomly selected from 0.5 ~ 2. Then, the width and height of the region are both scaled to 200 pixels. Unless otherwise specified, the random number between a and b in this section .

CHANGING COLOURS

Another augmentation method is changing colors. We can change four aspects of the image color: brightness, contrast, saturation, and hue. In the example below, we randomly change the bright- ness of the image to a value between 50% (1 − 0.5) and 150% (1 + 0.5) of the original image.

Similarly, we can randomly change the hue of the image.

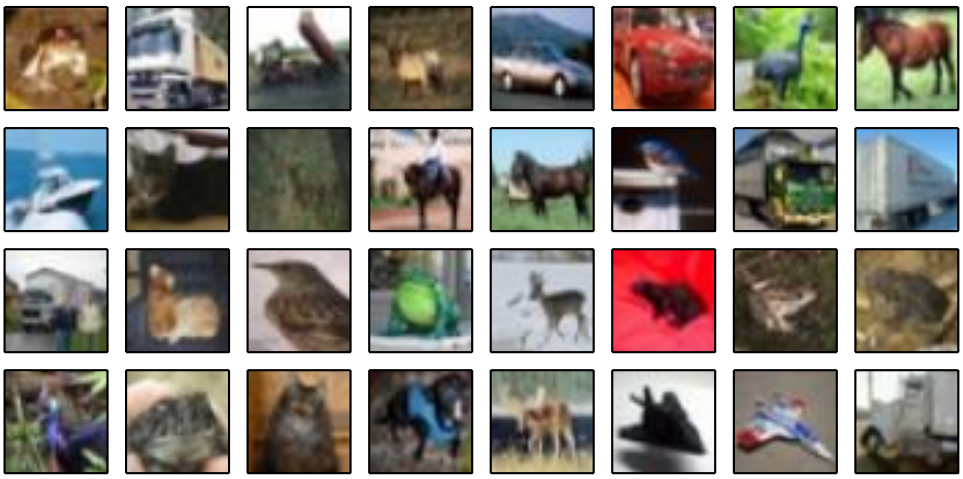
We can also create a RandomColorJitterinstance and set how to randomly change the brightness,contrast, saturation, and hueof the image at the same time.

COMBINING MULTIPLE IMAGE AUGMENTATION METHODS

In practice, we will combine multiple image augmentation methods. For example, we can com- bine the different image augmentation methods defined above and apply them to each image viaa Composeinstance.

TRAINING WITH IMAGE AUGMENTATION

Let us train a model with image augmentation. Here we use the CIFAR-10 dataset instead of the Fashion-MNIST dataset that we used before. This is because the position and size of the objects in the Fashion-MNIST dataset have been normalized,



while the color and size of the objects in theCIFAR-10 dataset have more significant differences. The first 32 training images in the CIFAR-10dataset are shown below.

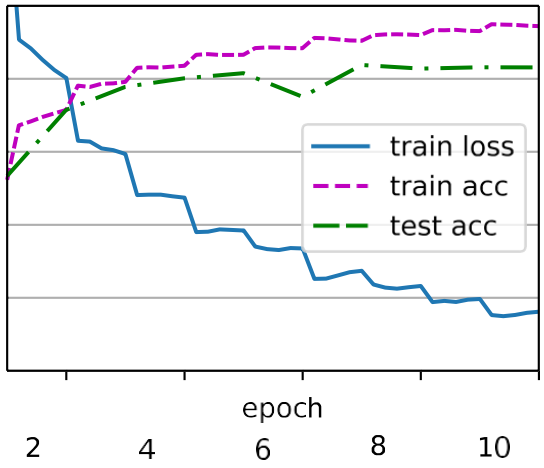
In order to a minibatch of images into framework, i.e., 32-bit floating point numbers between 0 and 1 with the shape of (batch size,number of channels, height, width).

MULTI-GPU TRAINING

We train the ResNet-18 model from Section 7.6 on the CIFAR-10 dataset. Recall the introductionto multi-GPU training in Section 12.6. In the following, we define a function to train and evaluatethe model using multiple GPUs.

Now we can defi the train with data function to train the model with image augmentation. This function gets all available GPUs, uses Adam as the optimization algorithm, applies im-age augmentation to the training dataset, and finally calls the train_ch13function just defined totrain and evaluate the model.

Let us train the model using image augmentation based on random left-right flipping.



SUMMARY

- Image augmentation generates random images based on existing training data to improve the generalization ability of models.
- In order to obtain definitive results during prediction, we usually only apply image augmentation to training examples, and do not use image augmentation with random operationsduring prediction.
- Deep learning frameworks provide many different image augmentation methods, which canbe applied simultaneously.

3.4 FINE-TUNING

In earlier chapters, we discussed how to train models on the Fashion-MNIST training dataset withonly 60000 images. We also described ImageNet, the most widely used large-scale image datasetin academia, which has more than 10 million images and 1000 objects. However, the size of the dataset that we usually encounter is between those of the two datasets.

Suppose that we want to recognize different types of chairs from images, and then

recommend purchase links to users. One possible method is to first identify 100 common chairs, take 1000 images of different angles for each chair, and then train a classification model on the collected image dataset. Although this chair dataset may be larger than the Fashion-MNIST dataset, the number of examples is still less than one-tenth of that in ImageNet. This may lead to overfitting of complicated models that are suitable for ImageNet on this chair dataset. Besides, due to the limited amount of training examples, the accuracy of the trained model may not meet practical requirements.

In order to address the above problems, an obvious solution is to collect more data. However, collecting and labeling data can take a lot of time and money. For example, in order to collect theImageNet dataset, researchers have spent millions of dollars from research funding. Although the current data collection cost has been significantly reduced, this cost still cannot be ignored.

Another solution is to apply transfer learning to transfer the knowledge learned from the source dataset to the target dataset. For example, although most of the images in the ImageNet dataset have nothing to do with chairs, the model trained on this dataset may extract more general imagefeatures, which can help identify edges, textures, shapes, and object composition. These similar features may also be effective for recognizing chairs.

STEPS

In this section, we will introduce a common technique in transfer learning: fine-tuning. As shownin Fig. 13.2.1, fine-tuning consists of the following four steps:

1. Pretrain a neural network model, i.e., the source model, on a source dataset (e.g., the Image Net dataset).
2. Create a new neural network model, i.e., the target model. This copies all dataset. We also assume that the output layer of the source model is closely related to the labels of the source dataset; thus it is not used in the target model.
3. Add an output layer to the target model, whose number of outputs is the number of categories in the target dataset. Then randomly initialize the model parameters of this layer.

4. Train the target model on the target dataset, such as a chair dataset. The output layer willbe trained from scratch, while the parameters of all the other layers are fine-tuned based onthe parameters of the source model.

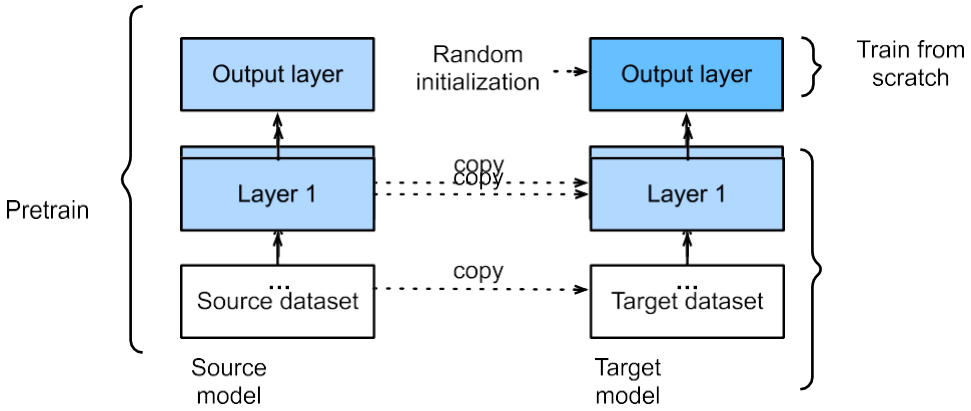


Fig 3.1 Fine tuning.

When target datasets are much smaller than source datasets, fine-tuning helps .

HOT DOG RECOGNITION

Let us demonstrate fine-tuning via a concrete case: hot dog recognition. We will fine-tune a Res Net model on a small dataset, which was pretrained on the ImageNet dataset. This smalldataset consists of thousands of images with and without hot dogs. We will use the fine-tuned model to recognize hot dogs from images.

Fine-tune

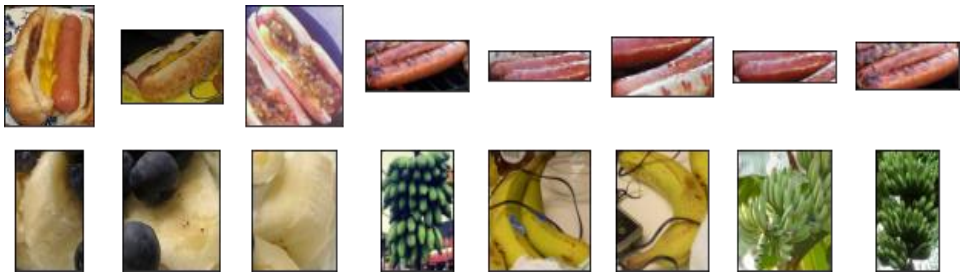
READING THE DATASET

The hot dog dataset we use was taken from online images. This dataset consists of 1400 positive-class images containing hot dogs, and as many negative-class images containing other foods. 1000images of both classes are used for training and the rest are for testing.

After unzipping the downloaded dataset, we obtain two folders hotdog/train and hotdog/test. Both folders have hotdog and not-hotdog subfolders, either of which contains images of the corresponding class.

We create two instances to read all the image files in the training and testing datasets, respectively.

The first 8 positive examples and the last 8 negative images are shown below. As you can see, theimages vary in size and aspect ratio.



During training, we first crop a random area of random size and random aspect ratio from the image, and then scale this area to a 224*224 input image. During testing, we scale both the heightand width of an image to 256 pixels, and then crop a central 224*224 area as input. In addition,for the three RGB (red, green, and blue) color channels we standardize their values channel by channel. Concretely, the mean value of a channel is subtracted from each value of that channel and then the result is divided by the standard deviation of that channel.

DEFINING AND INITIALIZING THE MODEL

We use ResNet-18, which was pretrained on the ImageNet dataset, as the source model. Here, we specify pretrained=Trueto automatically download the pretrained model parameters. If thismodel is used for the first time, Internet connection is required for download.

The pretrained source model instance contains two member variables: featuresand output. is to facilitate the fine-tuning of model parameters of all layers but the output layer. The member variable outputof source model is shown below.

As a fully-connected layer, it transforms Res Net's final global average pooling outputs model except that its number of outputs in the final layer is set to the number of classes in the target dataset (rather than 1000).

In the following code, the model parameters in the member variable features of the target the features are pre-trained on the ImageNet data setand are good enough, generally only a small learning rate is needed to fine-tune these parameters.

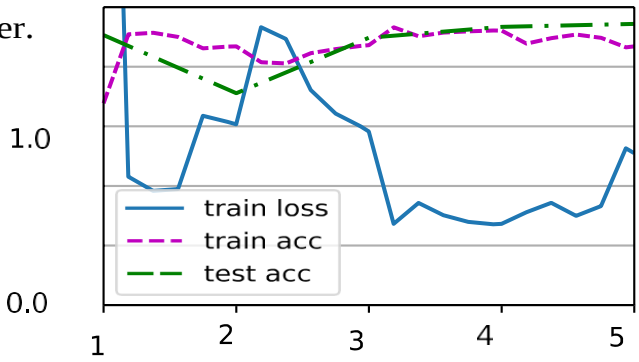
In the code below, the model parameters before the output layer of the target model instancethe source model. Since these model parameters were obtained via pretraining on ImageNet, they are effective. Therefore, we can only use a small learning rate to fine-tune such pretrained parameters. In contrast, model parameters

in the output layer are randomly initialized and generally require alarger learning rate to be learned from scratch. Let the base learning rate be η, a learning rate of 10η will be used to iterate the model parameters in the output layer.

FINE-TUNING THE MODEL

First, we define a training function train fine tuning that uses fine-tuning so it can be calledmultiple times.

We set the base learning rate to a small value in order to *fine-tune* the model parameters obtainedvia pretraining. Based on the previous settings, we will train the output layer parameters of thetarget model from scratch using a learning rate ten times greater.



For comparison, we define an identical model, but initialize all of its model parameters to randomvalues. Since the entire model needs to be trained from scratch, we can use a larger learning rate.

SUMMARY

- Transfer learning transfers knowledge learned from the source dataset to the target dataset.Fine-tuning is a common technique for transfer learning.
- The target model copies all model designs with their parameters from the source modelexcept the output layer, and fine-tunes these parameters based on the target dataset. Incontrast, the output layer of the target model needs to be trained from scratch.
- Generally, fine-tuning parameters uses a smaller learning rate, while training the outputlayer from scratch can use a larger learning rate.

3.5 OBJECT DETECTION AND BOUNDING BOXES

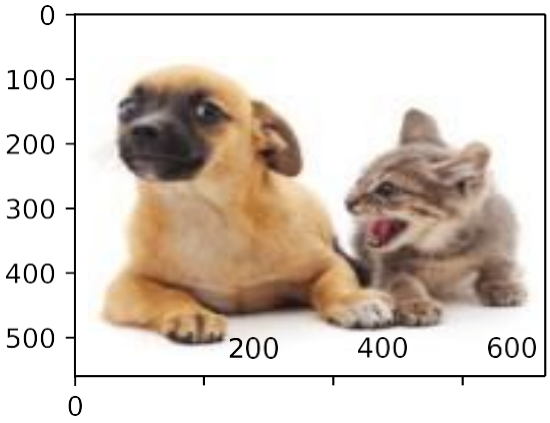
In earlier sections, we introduced various models for image classification. In image classification tasks, we assume that there is only one major object in the imageand we only focus on how to recognize its category. However, there are often multiple

objects inthe image of interest. We not only want to know their categories, but also their specific positionsin the image. In computer vision, we refer to such tasks as object detection (or object recognition).

Object detection has been widely applied in many fields. For example, self-driving needs to plantraveling routes by detecting the positions of vehicles, pedestrians, roads, and obstacles in thecaptured video images. Besides, robots may use this technique to detect and localize objects of interest throughout its navigation of an environment. Moreover, security systems may need todetect abnormal objects, such as intruders or bombs.

In the next few sections, we will introduce several deep learning methods for object detection. Wewill begin with an introduction to positions (or locations) of objects.

We will load the sample image to be used in this section. We can see that there is a dog on the leftside of the image and a cat on the right. They are the two major objects in this image.



BOUNDING BOXES

In object detection, we usually use a bounding box to describe the spatial location of an object.The bounding box is rectangular, which is determined by the x and y coordinates of the upper-leftcorner of the rectangle and the such coordinates of the lower-right corner. Another commonlyused bounding box representation is the (x, y)-axis coordinates of the bounding box center, and the width and height of the box.

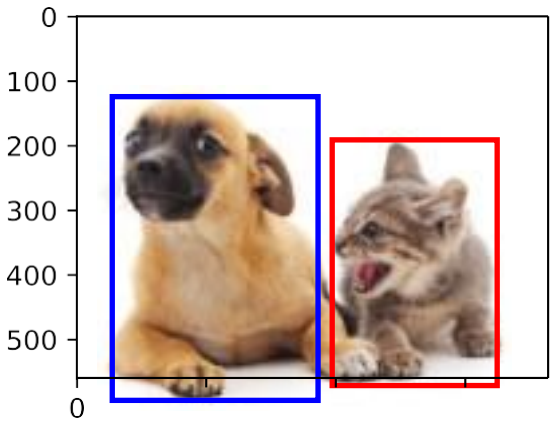
Here we n is the number of bounding boxes.

two bounding box conversion functions by converting twice.

Let us draw the bounding boxes in the image to check if they are accurate. Before

drawing, wewill define a helper function. It represents the bounding box in the bounding boxformat of the matplotlibpackage.

After adding the bounding boxes on the image, we can see that the main outline of the two objectsare basically inside the two boxes.



CHAPTER 4

HARDWARE IMPLEMENTATION

HARDWARE COMPONENTS ARE

- Power Supply
- Raspberry PI
- IR Sensor
- Servo Motor
- Buzzer

4.1 POWER SUPPLY

In this project we have power supplies with +5V & -5V option normally +5V is enough for total circuit. Another (-5V) supply is used in case of OP amp circuit.

Transformer primary side has 230/50HZ AC voltage whereas at the secondary winding the voltage is step downed to 12/50 Hz and this voltage is rectified using two full wave rectifiers the rectified output is given to a filter circuit to fitter the unwanted ac in the signal. After that the output is again applied to a regulator LM7805 (toprovide+5v) regulator. WhereasLM7905 is for providing –5Vregulation. Z (+12V circuit is used for stepper motors, Fanand Relay by using LM7812 regulator same process like above supplies).

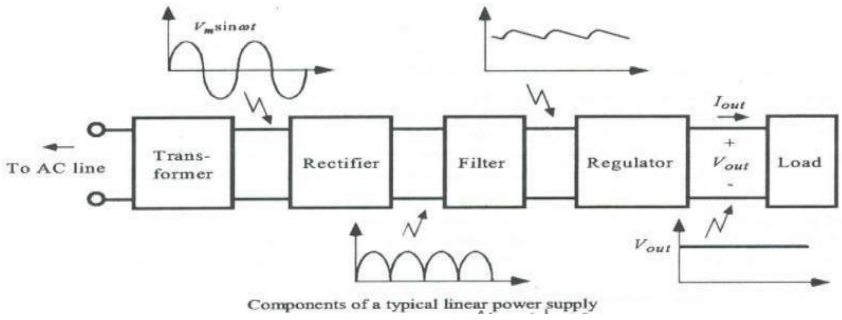


Fig 4.1 RPS

TRANSFORMER

Transformers are used to convert electricity from one voltage to another with minimal loss of power. They only work with AC (alternating current) because they require a changing magnetic field to be created in their core. Transformers can increase voltage (step-up) as well as reduce voltage (step-down).

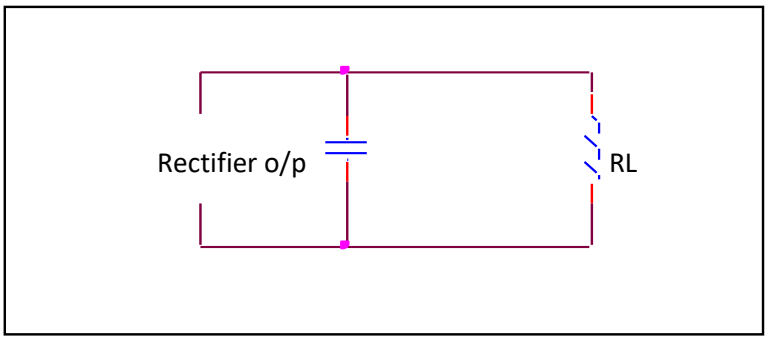
Alternating current flowing in the primary (input) coil creates a continually changing magnetic field in them on core. This field also passes through the secondary (output) coil and the changing strength of the magnetic field induces an alternating voltage in the secondary coil. If the secondary coils connected to a load the induced voltage will make an induced current flow. The correct term for the induced voltage is 'induced electromotive force' which is usually abbreviated to induced e.m.f.

RECTIFIERS

The purpose of a rectifier is to convert an AC wave form into a DC wave form (OR) Rectifier converts AC current or voltages into DC current or voltage. There are two different rectification circuits, known as 'half-wave' and 'full-wave' rectifiers. Both use components called diodes to convert AC into DC.

FILTERS

A filter circuit is a device which removes the ac component of rectifier output but allows the dc component to the load. The most commonly used filter circuits are capacitor filter, choke input filter and capacitor input filter or pi-filter. We used capacitor filter here.



The capacitor filter circuit is extremely popular because of its low cost, small size, little weight and good characteristics. For small load currents this type of filter is preferred. It is commonly used in transistor radio battery eliminators.

Fig 4.2 Capacitor

4.2 RASPBERRY PI

In this modern age when computers are sleek, Raspberry Pi seems alien with tiny codes printed all over its circuit board. That's a big part of Raspberry Pi's appeal. Let us have a look at what we can do with this appealing circuit board.

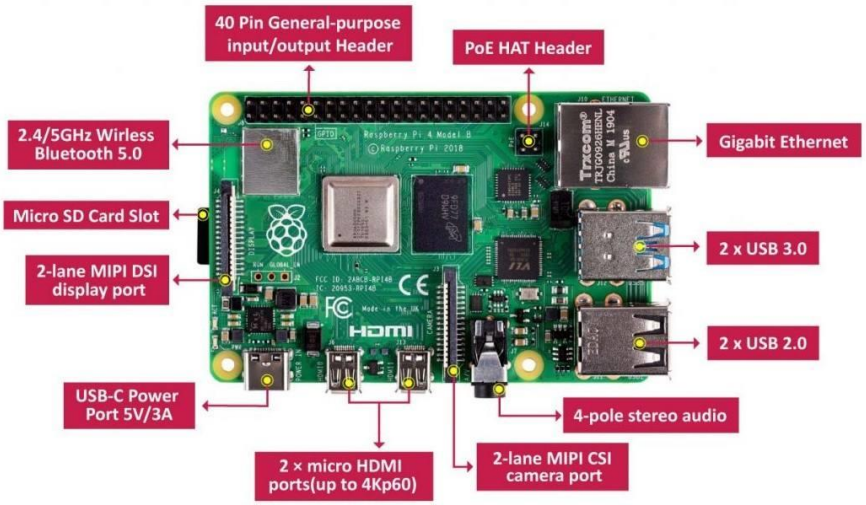


Fig 4.3 Raspberry PI Pin Description

USES

Like a desktop computer, you can do almost anything with the Raspberry Pi. You can start and manage programs with its graphical windows desktop. It also has the shell for accepting text commands.

We can use the Raspberry Pi computer for the following:

- Playing games
- Browsing the internet
- Word processing
- Spreadsheets
- Editing photos
- Paying bills online
- Managing your accounts.

The best use of Raspberry Pi is to learn how a computer works. You can also learn how to make electronic projects or programs with it.

It comes with two programming languages, **Scratch** and **Python**. Through GPIO (general-purpose input output) pins, Raspberry Pi can be connected to other circuits, so that you can control the other devices of your choice.

REQUIREMENTS

To use your Raspberry Pi board, you need to buy a few other bits and pieces. Following is the checklist of what else we might need:

Monitor

The Raspberry Pi uses a high-definition multimedia interface (HDMI) connection for video feed, and you can connect your monitor directly with this interface connection, if your monitor has an HDMI socket.

Television

In the similar way, if you have High-Definition Television (HD TV), you can also connect it to your Raspberry Pi using an HDMI socket. It will give you a crisper picture.

USB hub

Depending on the model, Raspberry Pi has 1, 2, or 4 Universal Serial Bus (USB) sockets. You should consider using powered USB to connect other devices to your Raspberry Pi at the same time.

Keyboard and Mouse

Raspberry Pi only supports the USB keyboards and mouse. If you are using keyboards and mouse with PS/2 connectors, you need to replace them with Raspberry Pi.

SD or MicroSD card

As we know that the Raspberry Pi does not have a hard drive, so we need to use SD cardsor MicroSD cards (depending on the model) for storage.

USB Wi-Fi adapter

If you are going to use model A and A+ then, you need to buy a USB Wi-Fi adapter for connecting to the internet. This should be done because these Raspberry models do not have an Ethernet socket.

External hard drive

If you want to share your collection of and movies, you need to use an external hard drive with your Raspberry Pi model. You can connect the same by using a powered USB cable.

Raspberry Pi Camera Module

The Raspberry Pi camera module originated at Raspberry Pi foundation. It is an 8MP (megapixel) fixed focus camera that can be used to shoot high-definition video and take still photos. For wildlife photography at night, it provides another without an infrared filter.

Speakers

The Raspberry Pi has a standard audio out socket. This socket is compatible with headphones and speakers that use a 3.5mm audio jack. We can plug headphones directlyto it.

Power supply

For power supply, it uses a Micro USB connector. Hence theoretically, it is compatible with a mobile phone and tablet charger.

Cables

Following are some of the cables, which you need for the connections to the Raspberry Pi computer:

- HDMI cable
- HDMI-to-DVI adapter, if you are using a Digital Visual Interface (DVI) monitor.
- RCA cable, if you want to connect to an older television.
- Audio cable
- Ethernet cable

COMPATIBLE AND INCOMPATIBLE DEVICES

To minimize the cost, the Raspberry Pi models are designed to be used with whatever accessories we have. But, as we know that in practice, not all the devices can be compatible.

You need to check for compatible and incompatible devices as incompatible USB, keyboards and mouse can cause problems.

You can find the list of compatible and incompatible devices at https://elinux.org/RPi_VerifiedPeripherals.

Before you get started with your Raspberry Pi board, you need to provide with an OS (operating system). Linux is the most frequently used OS on the Raspberry Pi.

For using an OS, we need to create a Secure Digital (SD) or MicroSD card with an OS on it. The prerequisite for setting up the SD or MicroSD is a computer having an internet connection and the ability to write to SD or MicroSD cards.

4.2.1 OPERATING SYSTEM

NOOBS SOFTWARE

NOOBS means new-out-of-box software and it is the easiest way to get started with the

Raspberry Pi. It is easy to copy NOOBS to your SD or MicroSD card. Once copied, it provides us with a simple menu for installing various operating systems.

There is an option to buy a card with NOOBS already installed on it, but it is always usefulto know how to create your own NOOBS cards.

DOWNLOAD NOOBS

Follow the below given steps to download NOOBS:

Step 1: Go to the website www.raspberrypi.org/downloads/noobs

Step 2: Select from the two versions of NOOBS available. Version 1 is the main versionand includes Raspbian. This is the officially supported OS, which you can use even withoutany network connection.

Another option is to choose the OS from the menu. You can download and install the OS from the menu, if you have a network connection. It is always recommended to download NOOBS for your first OS.

MICROSD CARD FORMATTING

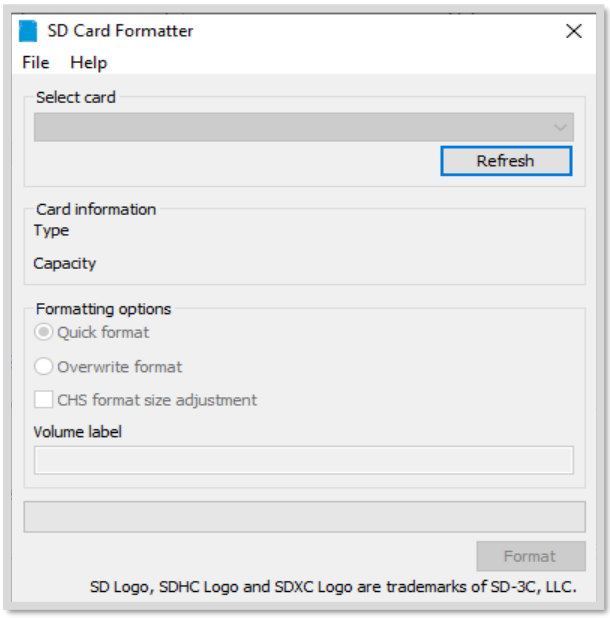
Before downloading and installing OS, we first need to format our SD or MicroSD card. We can use an application program, called SD card Formatter, from SD Association. The latest version is SD Memory Card Formatter 5.0.1.

For Windows and Mac, it can be downloaded from the link https://www.sdcard.org/downloads/formatter/.

Let us see how we can format the SD card by using windows, Mac OS, and Linux.

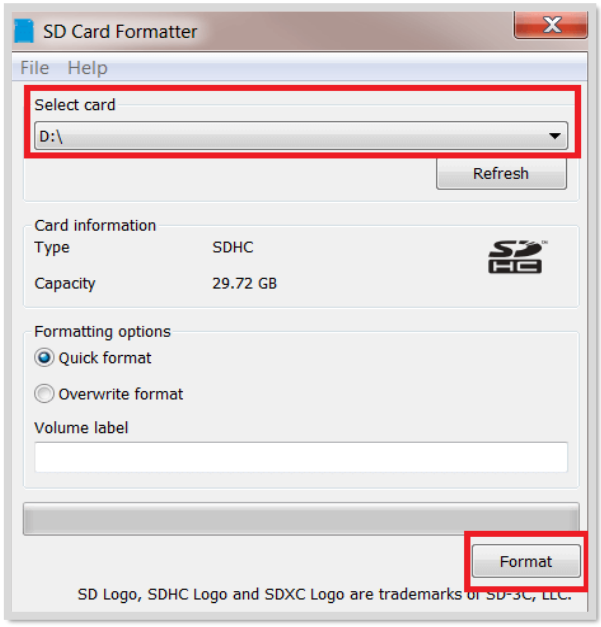
USING WINDOWS

Step 1: Download and install the SD formatter application. It will be as follows:



Step 2: Next, we need to select the drive in which we have our SD High Capacity SDHC/SDXC card. Once selected, click on the format button to format it.

The following screen will appear:



Step 3: The program will ask for the confirmation. You need to click **yes** to confirm the format process.

Step 4: Once the format process is completed, your SD card will be formatted completely.

USING MAC OS

The process of formatting is similar as we did in windows. You just need to download and install the Mac version of SD card formatter.

USING LINUX

We will be using the **GParted** application program, which is an open-source partition manager for Linux.

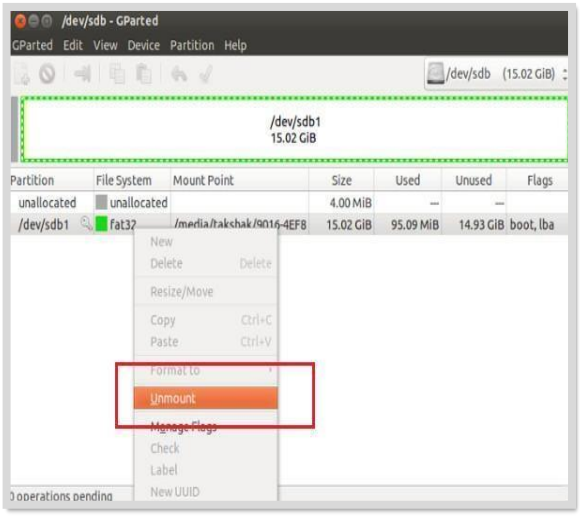
Use the steps given below to format a SD card in Ubuntu software:

Step 1: Download and install the **GParted** application by using the terminal as follows:

```
sudo apt-get install gparted
```

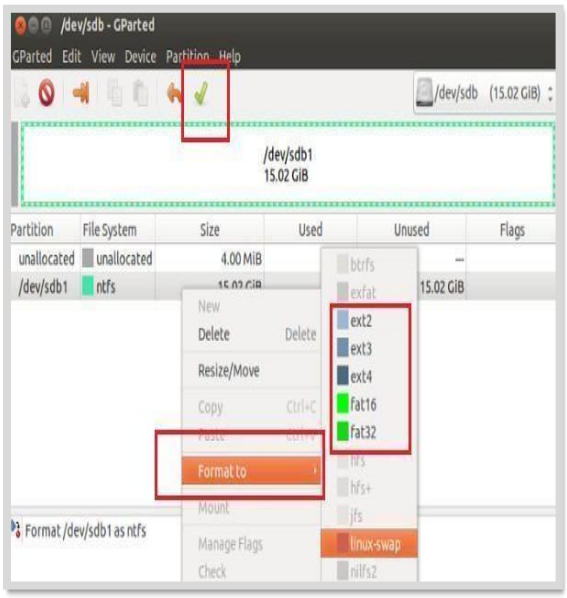
Step 2: Once installation is completed, you need to insert the SD card. Next, by using Unity dash, launch the **GParted** application.

Step 3: You will get the screen as below, which shows the partitions of the removable disk. But before starting the formatting, we need to unmount the disk by right-clicking onthe partition as shown below:



Step 4: After unmounting, we need to right click on it, which will show us the **Format to** option. Now from the list, you can choose whatever type of file system you want on the disk.

After selecting the drive to format, you need to click on the **Tick sign** as shown below:



Step 5: It will show you a couple of warnings and the format procedure will be started.

INSTALL NOOBS TO MEMORY CARD

Now, you have a formatted card and the .zip file that was downloaded from the Raspberry website. Hence, you can install NOOBS on your card.

On windows PC, you can simply double click the .zip file. It will open the file. Once opened, you can select all the files and copy them to your formatted card.

Similarly, on a Mac OS, you can see the folder that contains all the files by double clicking on the NOOBS .zip file. Now, click on the **Edit menu** and select all. Drag all the files onto your SD card.

In the same way, on Linux we can use the desktop environment to copy the NOOBS .zip files to our SD card.

FLASHING A MICROSD CARD

Some operating systems (OS) may not be available through NOOBS. One of them is the Reduced Instruction Set Computer (RISC) OS.

For creating a card for such an OS, we need to first download the OS as an image file. Once an image file is downloaded, we need to use the process called flashing your card. Later on, the single file can be converted into all the files which we need on our card (SDor MicroSD).

To download the OS images, we can find the links at the website https://www.raspberrypi.org/software/.

Now to flash the card or you can say burning an image to the card, we can use an OS image flasher **Etcher**. It is available for windows, Mac OS and Linux at https://www.balena.io/etcher/.

4.2.2 CONNECTING RASPBERRY PI

It is quite easy to connect Raspberry Pi. Let us understand about the same in detail in thischapter.

PORTS AND SOCKETS

You should make sure that you have to face your Raspberry Pi in the right way. Most components and sockets, with the help of which you connect it, are sticking out at the topside whereas the back side is relatively flat. The spiky GPIO (general-purpose input output) pins should be at the top left.

Let us have a look at the diagrams below representing the location of connectors and main integrated circuits (ICs) on the Raspberry Pi boards.

The source of the diagrams is https://core-electronics.com.au

Diagram 1

Following is the diagram for **Raspberry Pi Model B:**

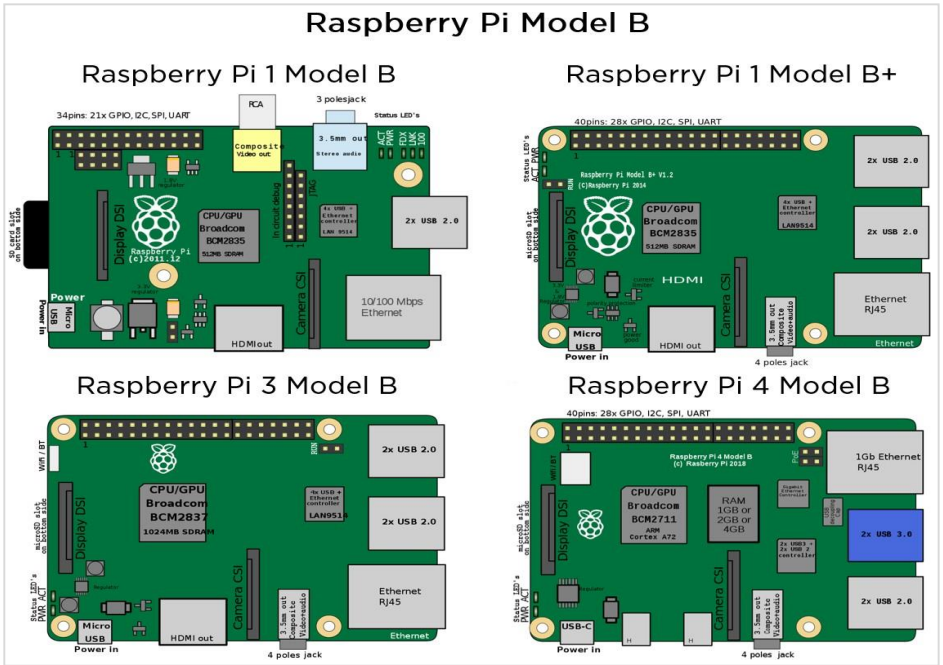


Diagram 2

Following is the diagram for **Raspberry Pi Model A:**

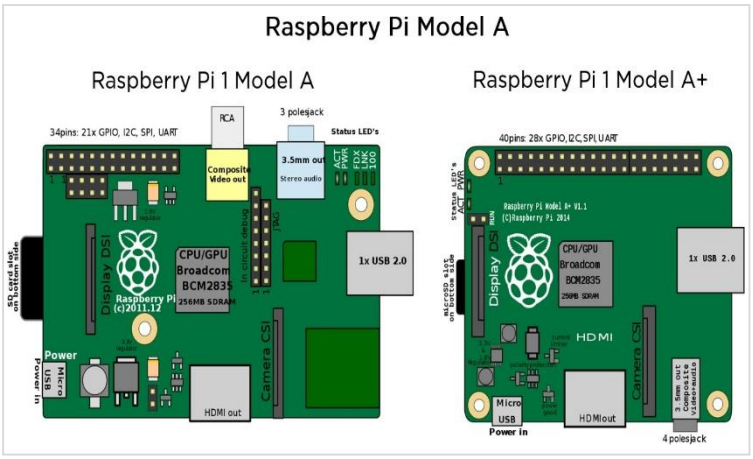
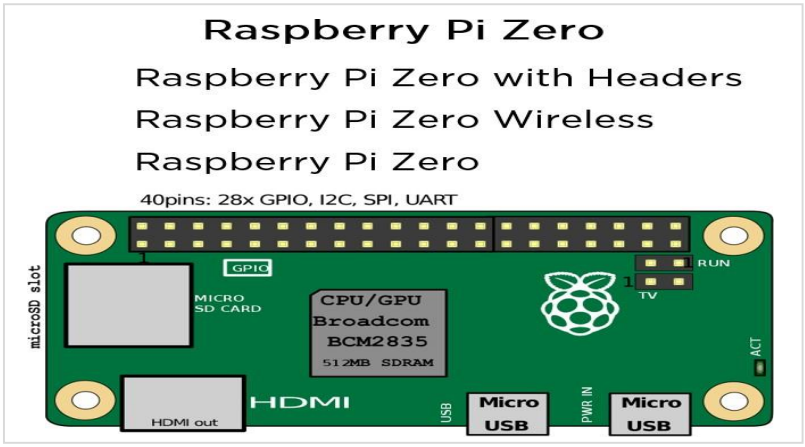


Diagram 3

Following is the diagram for **Raspberry Pi Zero**:



INSERT SD OR MICRO SD CARD

As we have discussed, you need an SD or MicroSD card with OS to get started with Raspberry Pi. We have also discussed how you can create one, in the previous chapter. Now, it is time to insert that card and get started.

If you are using **model 2, 3, A+, or B+** then, you need to turn your Raspberry Pi circuit board, so that the underside is at your side and you can see that.

You can see, there would be a metal MicroSD card slot on the **left side** of the board. Slide your card into this slot.

On the other hand, if you are using **Model A or Model B**, you need an SD card and you need to flip your Raspberry Pi over. Now, slide the SD card while facing the **label side** above. After that you need to gently press the card home.

And we know that the models **Pi Zero and Zero W** have the MicroSD card slot mounted on the top surface of the board. To insert the card, you need to put the label side facing you.

ON RASPBERRY PI ZERO

The Raspberry Pi model camera socket uses a different width of cable and you can buy that cable separately. You can also get that cable with the official Raspberry Pi Zero case.You can check the board and the camera have similar sockets for the cable.

To open the connector, you just need to gently press the connector between your finger and thumb. The camera connector is on the right of the Raspberry Pi board.

To connect the cable with the camera, insert the cable with the shiny contacts facing the camera front. And on the Pi Zero board, insert the cable with the shiny contacts facing theflat side of the board i.e., the **bottom side.**

ON OTHER RASPBERRY PI MODELS

To connect the camera on other boards, you need to hold the ends in between your fingerand thumb. Then, gently lift the board and it will move apart to make a gap. This is the place, where you will insert the cable of the camera.

At the end of the camera's cable, you can see there are silver connectors on one side. Nowhold the cable in such a way that this side faces to the left.

Once done, insert the cable into the connector on your Raspberry Pi board. Press it gentlyand then press the socket back together again and your board is ready with the camera.

CONNECT RASPBERRY PI TO DEVICES

The respective processes to connect your Raspberry Pi board to different devices is explained below in detail. Let us begin by understanding how to connect a display deviceto your Pi board.

DISPLAY DEVICE

Depending on the screen type, you have two ways to connect the display device to your Pi board. In these two ways, we are assuming that you are going to use either monitor or television. Apart from these two ways, there is an official Pi touchscreen that connects using the display socket. Let us check how we can connect an HDMI display and television,as

explained below.

HDMI OR DVI DISPLAY

The HDMI connector is on the top surface of your Raspberry Pi board. But for the Raspberry Pi Zero model, you need to use an adapter that converts Mini HDMI to an HDMI socket. For connecting, insert one end of the HDMI cable in the board or Pi ZERO connector and the other end into your monitor.

On the other hand, if you are using a DVI display, an adapter should be used.

TELEVISION

If the TV you are using is having a HDMI socket, you can use that for optimal results. Butif in case, your TV does not have an HDMI socket, you need to use the composite video socket.

On the Raspberry Pi Model-A and Model-B, the composite video socket is placed on the top edge of the board. It is a round, yellow-and-silver sockets.

On other models, Raspberry Pi 3, Pi 2, and Model B+, the same socket as the audio outputcan be used as a composite video socket. It is placed on the bottom of the board.

One thing you should note is that you will need to use a special **RCA cable** for this socket. Connect one end of the RCA cable to the **audio output socket** and the other end to **Videoin** socket of the TV.

If you are using Pi Zero or Zero W boards then, you need to solder your own connector tothe board, where it is labelled TV. This should be done because, both these boards do nothave composite video socket.

KEYBOARD AND MOUSE

On Raspberry Pi Model B+, Model Pi 2, and Model Pi 3 the keyboard and mouse can be directly connected. They should work fine. But for earlier models of Raspberry Pi, you should use an external USB hub to connect keyboard and mouse.

Because with this, the devices will not draw too much power from the Pi board, and we can reduce the risk of heat and other problems caused by devices.

On the other hand, for Raspberry Pi Zero, Model A, and Model A+, we must use a USB hub, since these boards have only one USB socket.

AUDIO DEVICES

Raspberry Pi's audio socket is a small black or blue box. On Model A and Model B, it is stuck along the top edge of the board. Whereas, on Model B+, Pi 2 and Pi 3, it is stuck along the bottom edge of the board.

If you have connected an HDMI TV, then you do not need to connect a separate audio cable, as the sound is routed through your HDMI cable.

On the other hand, if you have earphones or headphones with a 3.5mm jack, you can directly plug them into the audio socket.
Alternatively, it is recommended to use a suitable cable, as shown in the below figure. The cable has Pi's 3.5mm jack on the left and stereo input/output plugs that feed into many stereos shown on the right.

INTERNET ROUTER

All the Raspberry Pi models other than Model A, A+, and Zero have an Ethernet socket. You can find the socket on the right edge of the Raspberry board. To connect to the internet, you can use a standard Ethernet cable in this socket.

In case if you are using a router with DHCP (Dynamic Host Configuration Protocol) support, your Raspberry Pi will automatically connect to the internet.

On the other hand, if you have a Wi-Fi adapter then, you can plug into a USB socket of Raspberry Pi and it will be ready to use whenever you turn on your board.

POWER

Once you are done with connecting all the necessary and required devices, it is time to connect your Raspberry Pi to power and turn it on. For this, you need to use the Micro USB power socket.

To safeguard your board from damage, you need to provide a steady **5v of power**. Keepin mind that Raspberry Pi board has no on/off switch. It means, whenever you connect itwith power, it will start working.

If you want to turn it off, you just need to disconnect it. So, if you want to save your data,you should proceed with caution and should shut down the Raspberry Pi first.

TURN ON RASPBERRY PI

Connect with the power and turn on your Raspberry Pi board. There will be a rainbow of colors on screen. Afterwards, it will start to run the NOOBS software on the Memory card. You will get a choice of OS to install.

RASPBIAN

Raspbian, a version of a Linux distribution called Debian, is the distribution that is recommended by the Raspberry Pi foundation. It has been optimized for the Raspberry Pi board.

Most of the Raspberry Pi users start with Raspbian and it includes:

- Graphical Desktop software.
- Web browser.
- Development and programming tools like Scratch, Python etc.

It has two versions, one with the PIXEL desktop and other is termed as Raspbian Lite, witha more minimal installation.

LIBR EELEC AND OSMC

Both are the versions of Kodi media center. They are mainly used for playing music and video.

RISC OS

It is an alternative to Linux OS, which most of the people use on the Raspberry Pi. It hasa GUI (Graphical User Interface). In 1987, it was created by Acorn Computers and now- a-days, it is maintained and managed by RISC OS open Limited.

DATA PARTITION

If you use the Data Partition option, it will give you an option to sort the data. The sorteddata can be accessed by various Linux distributions.

LAKKA

It is a retro gaming system that includes emulators for a range of vintage home computerssuch as Commodore 64 and Amiga, Amstrad CPC, ZX Spectrum and various Atari machines.

It also includes emulators for a range of game consoles such as Nintendo machines and Sony PlayStation. Although the Bomberman clones and 2048 games are included but, if you want to use Lakka, you need to get the games separately.

Plug your USB with games files and you will be ready to get games into Lakka.

RECALBOX

It is another game system. It also includes emulators for Super Nintendo Entertainment System (SNES), Nintendo Entertainment System (NES), Game Boy Advance, PC Engine, and Sega Master System. The shareware version of a famous game called Doom is also included in the Recalbox game system.

SCREENLY OS

As the name implies, it is a digital signage system. It enables the users to use a RaspberryPi with a connected HD screen as a digital sign. Here, OSE refers to Open-Source Edition.

It enables the following to be displayed on the screen:

- Videos
- Images
- Web pages

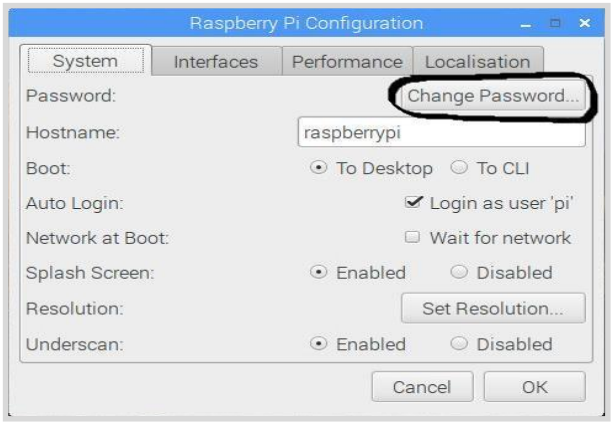
Screenly OSE is also suitable for displaying the advertisements and information in public areas like shops, schools, offices, shopping malls, railway stations, etc.

WINDOWS 10 IOT CORE

As the name implies, it is the version of Windows which is designed to support the IoT (Internet of things) devices. It is actually different from the windows desktop experience we are familiar with.

Once installed, it will give us the following two versions:

- **RTM version:** It is the release to manufacturing (RTM) version. It is recommendedto use because it is a stable version as compared to the Pre-release version.
- **Pre-release version:** Another is pre-release version, which is less stable as compared to RTM version.



TLXOS

This is ThinLinX's thin client software. It is a trial version and enables the Raspberry Pi to work as a virtual desktop. By using ThinLinX, we can also manage one or more Raspberries centrally.

4.2.3 CONFIGURATION

In this chapter, we will learn about configuring the Raspberry Pi. Let us begin by understanding how to configure Raspberry Pi board in Raspbian.

RASPBIAN CONFIGURATION

For configuring Raspberry Pi in Raspbian, we are using Raspbian with PIXEL desktop. It is one of the best ways to get Raspbian started with the Raspberry Pi. Once we finish booting, we will be in the PIXEL desktop environment.

Now to open the menu, you need to click the button that has the Raspberry Pi logo on it.This button will be in the top left. After clicking the button, choose **Raspberry Pi configuration** from the preferences.

CONFIGURATION TOOL

Following is the configuration tool in PIXEL desktop:
By default, the configuration tool opens to its system tab which has the following options:

- **Change Password:** The default password is **raspberry.** You can change it by clicking the change password button.
- **Change the hostname:** The default name is **raspberry pi**. You can also change it to the name, which you want to use on the network.
- **Boot:** You can choose from the two options and control whether Raspberry Pi boots into the desktop or CLI i.e., command line interface.
- **Auto Login:** With the help of this option, you can set whether the user should automatically log in or not.
- **Network at Boot:** By choosing this option, you can set whether the pi user is automatically logged in or not.
- **Splash screen:** You can enable or disable it. On enabling, it will display the graphical splash screen that shows when Raspberry Pi is booting.
- **Resolution:** With the help of this option, you can configure the resolution of your screen.
- **Under scan:** There are two options, enable or disable. It is used to change the sizeof the displayed screen image to optimally fill the screen. If you see a black border around the screen, you should disable the under scan. Whereas, you should enablethe under scan, if your desktop does not fit your screen.

There are three other tabs namely Interfaces, Performance, and Localization. The job of interface tab is to enable or disable various connection options on your Raspberry Pi.

You can enable the Pi camera from the interface tab. You can also set up a secure connection between computers by using SSH (short for Secure Shell) option.

If you want to remote access your Pi with a graphical interface then, you can enable Real VNC software from this tab. SPI, I2C, Serial, 1-wire, and Remote GPIO are some other interfaces you can use.

There is another tab called Performance, which will give you access to the options for overclocking and changing the GPU memory.

The localization tab, as the name implies, enable us to set:

- The character set used in our language.
- Our time zone.

- The keyboard setup as per our choice.
- Our Wi-Fi country.

CONFIGURE Wi-Fi

You can check at the top right, there would be icons for Bluetooth and Wi-Fi. The fan-shaped icon is on the Wi-Fi. To configure your Wi-Fi, you need to click on that icon. Once clicked, it will open a menu showing the available networks. It also shows the option to turn off your Wi-Fi.

Among those available networks, you need to select a network. After selecting, it will prompt for entering the Wi-Fi password i.e., the Pre-Shared Key.
If you see a red cross on the icon, it means your connection has been failed or dropped. To test whether your Wi-Fi is working correctly, open a web browser and visit a web page.

CONFIGURE BLUETOOTH DEVICES

We can use wireless Bluetooth devices such as keyboard and/or mouse with Pi 3 and Pi zero W because these models are Bluetooth-enabled. In PIXEL desktop, you can set up your Bluetooth devices easily.

Following are the steps to configure the Bluetooth devices:

- First, make your device discoverable for pairing.
- Now, you need to click on the Bluetooth menu at the top right of the screen. It is aligned to the Wi-Fi button.
- Now, choose the Add Device option.
- The Raspberry will start searching for the devices and when it finds.

DATA PARTITION SETUP

As we know that data partition is that area on your memory card (SD or MicroSD) which can be shared by various distributions. One of the best examples of use of a data partitionis transferring the files between distributions.

The data partition has the **label** data.

You can use this labeled data to make a directory point to it as follows:

Step 1: First, you need to boot the Raspberry Pi into Raspbian.

Step 2: Now, click the Terminal icon to get to the command line.

Step 3: Next, type the command **mkdir shared**. It will create a directory named **shared**.

Step 4: Write the command **sudo mount -L data shared**. This command will point the directory to the shared partition.

Step 5: Write the command **sudo chown $USER: shared**. It will set the permission for writing in this shared folder.

Step 6: Now, to go to this shared folder, you need to type the command **cd shared**.

Once all the files are created in this shared folder, they will be available to all the distributions that have the permission to access the data partition.

4.3 IR SENSOR

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation.

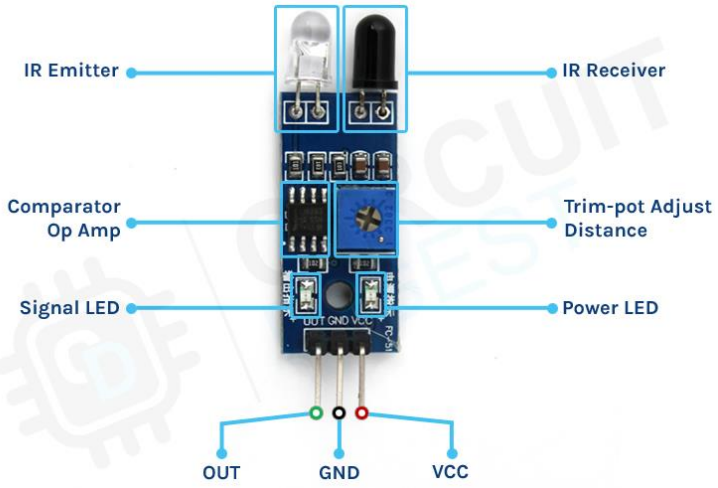


Fig 4.5 IR Sensor

These types of radiations are invisible to our eyes, which can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode that is sensitive to IR light of the same wavelength as that emitted by the

IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

Working Principle

The working principle of an infrared sensor is similar to the object detection sensor. This sensor includes an IR LED & an IR Photodiode, so by combining these two can be formed as a photo-coupler otherwise optocoupler. The physics laws used in this sensor are planks radiation, Stephan Boltzmann & weins displacement.

IR LED is one kind of transmitter that emits IR radiations. This LED looks similar to a standard LED and the radiation which is generated by this is not visible to the human eye. Infrared receivers mainly detect the radiation using an infrared transmitter. These infrared receivers are available in photodiodes form. IR Photodiodes are dissimilar as compared with usual photodiodes because they detect simply IR radiation. Different kinds of infrared receivers mainly exist depending on the voltage, wavelength, package, etc.

Once it is used as the combination of an IR transmitter & receiver, then the receiver's wavelength must equal the transmitter. Here, the transmitter is IR LED whereas the receiver is IR photodiode. The infrared photodiode is responsive to the infrared light that is generated through an infrared LED. The resistance of photo-diode & the change in output voltage is in proportion to the infrared light obtained. This is the IR sensor's fundamental working.

Once the infrared transmitter generates emission, then it arrives at the object & some of the emission will reflect back toward the infrared receiver. The sensor output can be decided by the IR receiver depending on the intensity of the response.

Types of Infrared Sensor

Infrared sensors are classified into two types like active IR sensor and passive IR sensor.

Active IR Sensor

This active infrared sensor includes both the transmitter as well as the receiver. In most of the applications, the light-emitting diode is used as a source. LED is used as a non-imaging infrared sensor whereas the laser diode is used as an imaging infrared sensor.

These sensors work through energy radiation, received & detected through radiation. Further, it can be processed by using the signal processor to fetch the necessary information. The best examples of this active infrared sensor are reflectance and break beam sensor.

Passive IR Sensor

The passive infrared sensor includes detectors only but they don't include a transmitter. These sensors use an object like a transmitter or IR source. This object emits energy and detects through infrared receivers. After that, a signal processor is used to understand the signal to obtain the required information.

The best examples of this sensor are pyroelectric detector, bolometer, thermocouple-thermopile, etc. These sensors are classified into two types like thermal IR sensor and quantum IR sensor. The thermal IR sensor doesn't depend on wavelength. The energy source used by these sensors is heated. Thermal detectors are slow with their response and detection time. The quantum IR sensor depends on the wavelength and these sensors include high response and detection time. These sensors need regular cooling for specific measurements.

4.4 SERVO MOTOR

The servo motor is an assembly of four things: a normal DC motor, a gear reduction unit, a position-sensing device, and a control circuit. The DC motor is connected with a gear mechanism that provides feedback to a position sensor which is mostly a potentiometer. From the gearbox, the output of the motor is delivered via servo spline to the servo arm. For standard servo motors, the gear is normally made up of plastic whereas, for high power servos, the gear is made up of metal.

Fig 4.8 Servo Motor

A servo motor consists of three wires- a black wire connected to the ground, a white/yellow wire connected to the control unit, and a red wire connected to the power supply.

The function of the servo motor is to receive a control signal that represents a desired output position of the servo shaft and apply power to its DC motor until its shaft turns to that position.

ADVANTAGES

- High efficiency.
- High output power relative to their size.
- More constant torque at higher speed.
- Closed-loop control.
- Quiet operation.
- Highly reliable.
- High ratio of torque to inertia.
- High acceleration.

4.5 BUZZERS

Buzzer is usually like an alarm. Whenever we press the switch button it gives an output like an alarm sound and then activates the machine. Buzzer contains of two pins. The negative end is connected to the data pin of microcontroller. The positive end is connected to the Vcc in the microcontroller.

Fig 4.11 Buzzer

CHAPTER 5

SOFTWARE COMPONENTS

5.1 PYTHON IDE

SETTING UP PYTHON

This book is about programming computers with Python. You could read this book from cover to cover without ever touching a keyboard, but you'd miss out on the fun part—coding!

To get the most out of this book, you need a computer with Python installed on it and a way to create, edit, and save Python code files.

IN THIS CHAPTER, YOU'LL LEARN HOW TO:

- Install the latest version of Python 3 on your computer
- Open **IDLE**, Python's built-in **I**ntegrated **D**evelopment and **L**earning **E**nvironmentLet's get started!

5.1.1 A Note on Python Versions

Many operating systems, including macOS and Linux, come with Python preinstalled. The version of Python that comes with your operating system is called the **system Python**.

The system Python is used by your operating system and is usually outof date. It's essential that you have the most recent version of Python so that you can successfully follow along with the examples in this book.

Important

Do not attempt to uninstall the system Python!

You can have multiple versions of Python installed on your computer. In this chapter, you'll install the latest version of Python 3 alongside any system Python that may already exist on your machine.

Note

Even if you already have Python 3.9 installed, it's still a good idea to skim this chapter to double-check that your environ- ment is set up for following along with this book.

This chapter is split into three sections: Windows, macOS, and Ubuntu Linux. Find the section for your operating system and follow the steps to get set up, then skip ahead to the next chapter.

If you have a different operating system, then check out *Real Python*'s "Python 3 Installation & Setup Guide" to see if your OS is covered. Readers on tablets and mobile devices can refer to the "Online Python Interpreters" section for some browser-based options.

WINDOWS

Follow these steps to install Python 3 and open IDLE on Windows.

Important

The code in this book is tested only against Python installed as described in this section.

Be aware that if you have installed Python through some other means, such as Anaconda Python, you may encounter problemswhen running

INSTALL PYTHON

Windows doesn't typically come with a system Python. Fortunately, installation involves little more than downloading and running the Python installer from the Python.org website.

Step 1: Download the Python 3 Installer

Open a web browser and navigate to the following URL: https://www.python.org/downloads/windows/

Click *Latest Python 3 Release - Python 3.x.x* located beneath the "Python Releases for Windows" heading near the top of the page. As of this writing, the latest version was Python 3.9.

Then scroll to the bottom and click *Windows x86-64 executable in- staller* to start the download.

Note

If your system has a 32-bit processor, then you should choose the 32-bit installer. If you aren't sure if your computer is 32-bit or 64-bit, stick with the 64-bit installer mentioned above.

Step 2: Run the Installer

Open your Downloads folder in Windows Explorer and double-click the file to run the installer.

A dialog that looks like the following one will appear:

It's okay if the Python version you see is greater than 3.9.0 as long asthe version is not less than 3.

Important

Make sure you select the box that says *Add Python 3.x to PATH*.If you install Python without selecting this box, then you can run the installer again and select it.

Click Install Now to install Python 3. Wait for the installation to finish,

then continue to open IDLE.

OPEN IDLE

You can open IDLE in two steps:

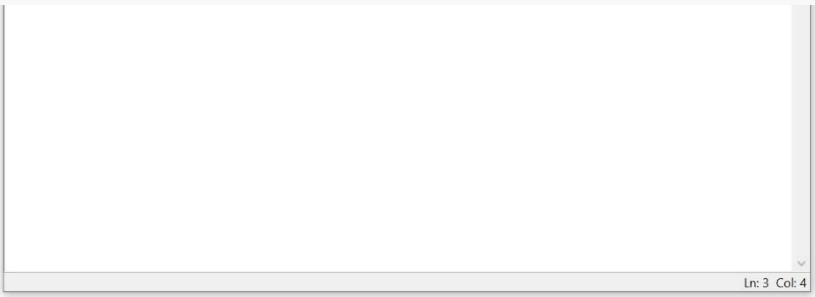
1. Click the Start menu and locate the Python 3.9 folder.

2. Open the folder and select *IDLE (Python 3.9)*.

IDLE opens a **Python shell** in a new window. The Python shell is an interactive environment that allows you to type in Python code and execute it immediately. It's a great way to get started with Python!

Note

While you're free to use a code editor other than IDLE if you prefer, note that some chapters, especially chapter 7, "Finding and Fixing Code Bugs," do contain material specific to IDLE.



The Python shell window looks like this:

At the top of the window, you can see the version of Python that is running and some information about the operating system. If you see a version less than 3.9, then you may need to revisit the installation instructions in the previous section.

The >>> symbol that you see is called a **prompt**. Whenever you see this, it means that Python is waiting for you to give it some instructions.

Interactive Quiz

This chapter comes with a free online quiz to check your learning progress. You can access the quiz using your phone or computer at the following web address:

Now that you have Python installed, let's get straight into writing yourfirst Python program! Go ahead and move on to chapter 3.

MacOS

Follow these steps to install Python 3 and open IDLE on macOS.

Important

The code in this book is tested only against Python installed as described in this section.

Be aware that if you have installed Python through some other means, such as Anaconda Python, you may encounter problemswhen running

INSTALL PYTHON

To install the latest version of Python 3 on macOS, download and runthe official installer from the Python.org website.

Step 1: Download the Python 3 Installer

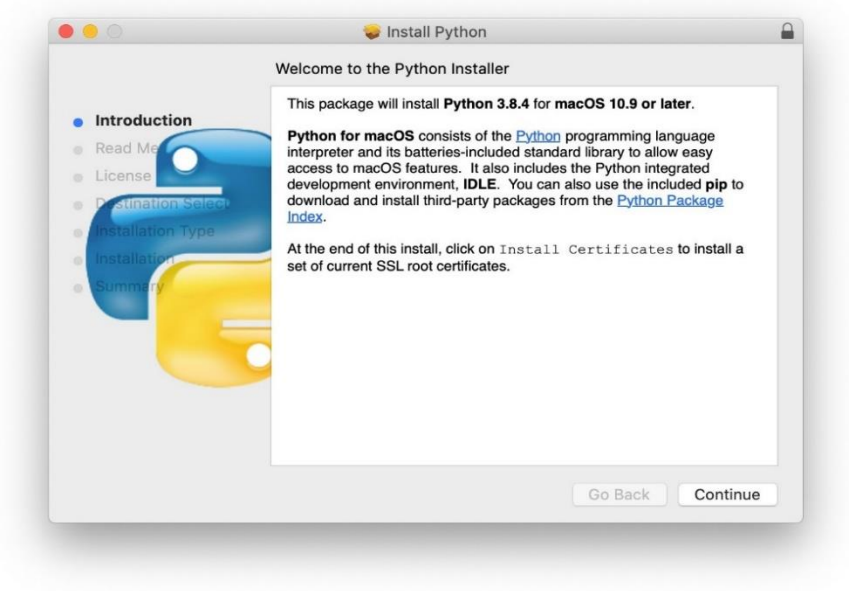
Open a web browser and navigate to the following URL: https://www.python.org/downloads/mac-osx/

Click *Latest Python 3 Release - Python 3.x.x* located beneath the"Python Releases for Mac OS X" heading near the top of the page. As of this writing, the latest version was Python 3.9.

Then scroll to the bottom of the page and click *macOS 64-bit installer*
to start the download.

Step 2: Run the Installer

Open Finder and double-click the downloaded file to run the installer.A dialog box that looks like the following will appear:



SSSS

Press **Continue** a few times until you are asked to agree to the software license agreement. Then click **Agree**.

You'll be shown a window that tells you where Python will be installedand how much space it will take. You most likely don't want to change the default location, so go ahead and click **Install** to start the installation.

When the installer is finished copying files, click **Close** to close the installer window.

OPEN IDLE

You can open IDLE in three steps:

1. Open Finder and click *Applications*.
2. Double-click the Python 3.9 folder.
3. Double-click the IDLE icon.

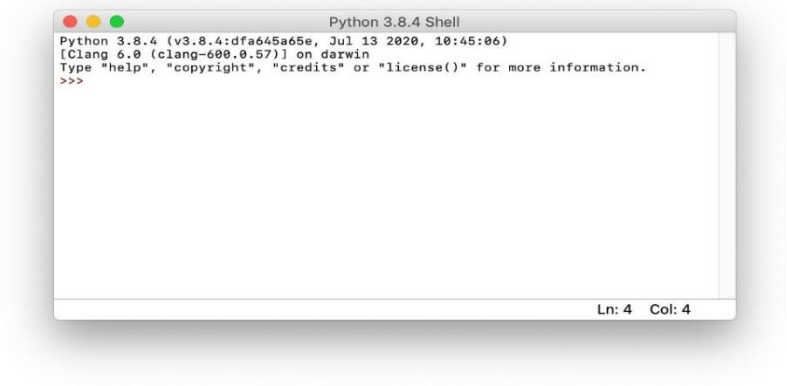
IDLE opens a **Python shell** in a new window. The Python shell is an interactive environment that allows you to type in Python code and execute it immediately. It's a great way to get

Note

While you're free to use a code editor other than IDLE if you prefer, note that some chapters, especially chapter 7, "Finding and Fixing Code Bugs," do contain material specific to IDLE.

started with Python!

The Python shell window looks like this:



At the top of the window, you can see the version of Python that is running and some information about the operating system. If you see a version less than 3.9, then you may need to revisit the installation instructions in the previous section.

The >>> symbol that you see is called a **prompt**. Whenever you see this, it means that Python is waiting for you to give it some instruc- tions.

Interactive Quiz

This chapter comes with a free online quiz to check your learn- ing progress. You can access the quiz using your phone or com- puter at the following web address:

Now that you have Python installed, let's get straight into writing yourfirst Python program! Go ahead and move on to chapter 3.

UBUNTU LINUX

Follow these steps to install Python 3 and open IDLE on UbuntuLinux.

Important

The code in this book is tested only against Python installed as described in this section.

Be aware that if you have installed Python through some other means, such as Anaconda Python, you may encounter problemswhen running

INSTALL PYTHON

There's a good chance that your Ubuntu distribution already has Python installed, but it probably won't be the latest version, and it may be Python 2 instead of Python 3.

To find out what version(s) you have, open a terminal window and try the following commands:

```
$ python --version

$ python3 --version
```

One or more of these commands should respond with a version, asbelow:

```
$ python3 --version
Python 3.9.0
```

Your version number may vary. If the version shown is Python 2.x or a version of Python 3 that is less than 3.9, then you want to in-stall the latest version. How you install Python on Ubuntu depends on which version of Ubuntu you're running. You can determine your local Ubuntu version by running the following command:

```
$ lsb_release -a

No LSB modules are available.
Distributor ID: Ubuntu
Description:    Ubuntu 18.04.1 LTS
Release:        18.04
```

Look at the version number next to Release in the console output, and follow the corresponding instructions below.

Ubuntu 18.04 or Greater

Ubuntu version 18.04 does not come with Python 3.9 by default, butit is in the Universe repository. You can install it with the following commands in the Terminal application:

```
$ sudo apt-get update

$ sudo apt-get install python3.9 idle-python3.9 python3-pip
```

Note that because the Universe repository is usually behind the Python release schedule, you may not get the latest version of Python
3.9. However, any version of Python 3.9 will work for this book.

Ubuntu 17 and Lower

For Ubuntu versions 17 and lower, Python 3.9 is not in the Universe repository. You need to get it from a Personal Package Archive (PPA). To install Python from the deadsnakes PPA, run the following com- mands in the Terminal application:

```
$ sudo add-apt-repository ppa:deadsnakes/ppa

$ sudo apt-get update

$ sudo apt-get install python3.9 idle-python3.9 python3-pip
```

You can check that the correct version of Python was installed by run- ning python3 --version. If you see a version number less than 3.9, then you may need to type python3.9 --version. Now you can open IDLE and get ready to write your first Python program.

OPEN IDLE

You can open IDLE from the command line by typing the following:

```
$ idle-python3.9
```

On some Linux installations, you can open IDLE with the followingshortened command:

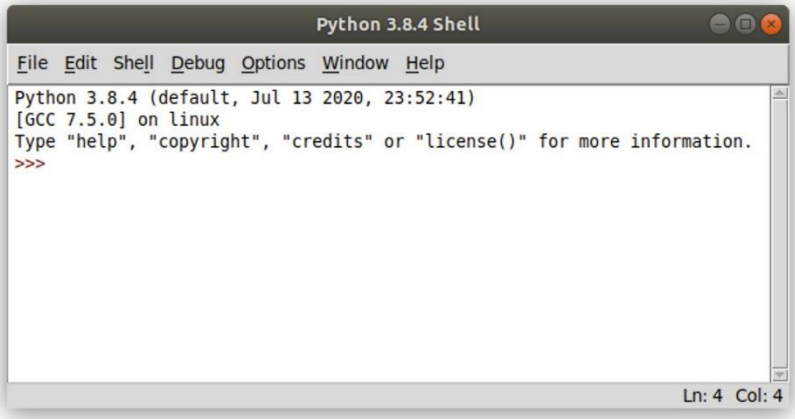
```
$ idle3
```

IDLE opens a **Python shell** in a new window. The Python shell is an interactive environment that allows you to type in Python code and execute it immediately. It's a great way to get started with Python!

Note

While you're free to use a code editor other than IDLE if you prefer, note that some chapters, especially chapter 7, "Finding and Fixing Code Bugs," do contain material specific to IDLE.

The Python shell window looks like this:



At the top of the window, you can see the version of Python that is running and some information about the operating system. If you see a version less than 3.9, then you may need to revisit the installation instructions in the previous section.

Important

If you open IDLE with the `idle3` command and see a version lessthan 3.9 displayed in the Python shell window, then you'll needto open IDLE with the `idle-python3.9` command.

The >>> symbol that you see in the IDLE window is called a **prompt**. Whenever you see this, it means that Python is waiting for you to give it some instructions.

Interactive Quiz

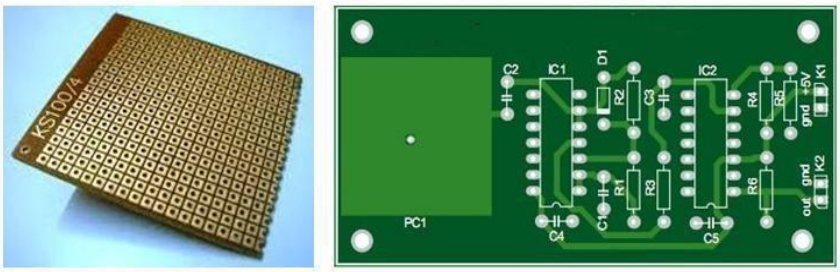
This chapter comes with a free online quiz to check your learn- ing progress. You can access the quiz using your phone or com- puter at the following web address:

Now that you have Python installed, let's get straight into writing yourfirst Python program! Go ahead

5.2 PROTEUS

5.2.1 INTRODUCTION:

Generally, we are listening the words PCB's, PCB layout, PCB designing, etc. But what is PCB? Why we are using this PCB? We want to know about all these things as an electronic engineer. PCB means Printed Circuit Board. This is a circuit board with printed copper layout connections. These PCBs are two types. One is dotted PCB and another one is layout PCB. The two examples are shown in below.



Dotted PCB Layout PCB

Fig 4.1 Dotted PCB and Layout PCB

What is the main difference between the dotted PCB and layout PCB?

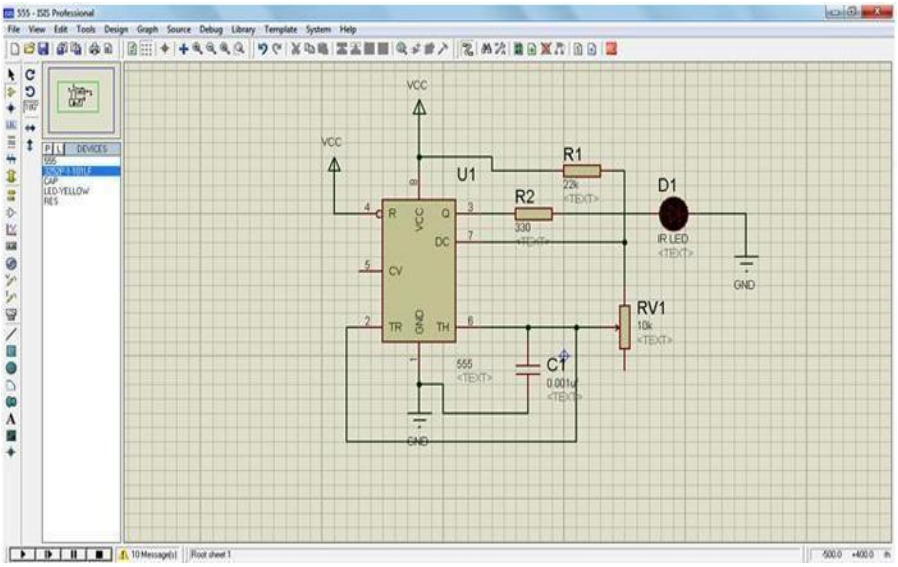
In dotted PCB board only, dots are available. According to our requirement we can place or insert the components in those holes and attach the components with wires and soldering lid. In this copper layout of our circuit and solder the components in the correct places. It is simple to design, take less time to design, no shortages, looking nice and perfect.

Up to now we have discussed about types of PCB's and difference between the types. Now we can discuss about PCB designing software. There are so many PCB designing software's available. Some are Express PCB, eagle PCB, PCB Elegance, free PCB, open circuit design, zenith PCB and Proteus etc. Apart from remaining Proteus is different. Proteus is design suit and PCB layout designing software. In Proteus we can design any circuit and simulate the circuit and make PCB layout for that circuit.

5.2.2 Introduction to Proteus:

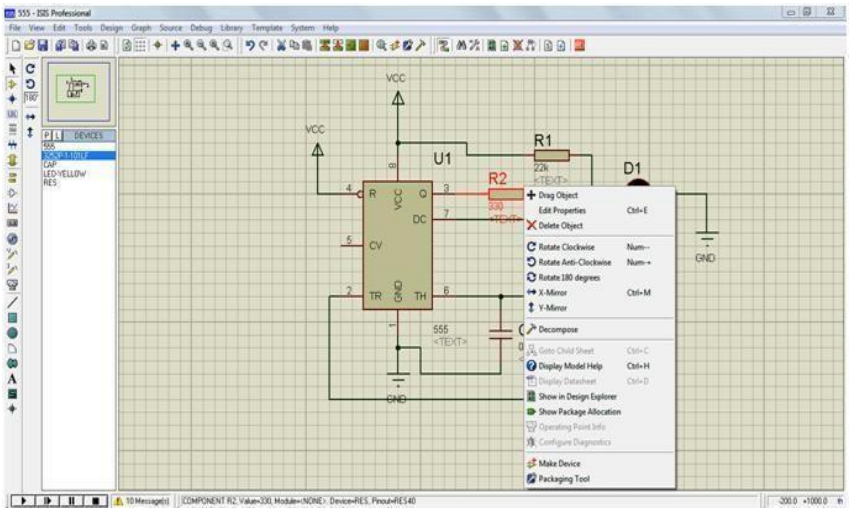
Proteus professional is a software combination of ISIS schematic capture program and ARES PCB layout program. This is a powerful and integrated development environment. Tools in this suit are very easy to use and these tools are very useful in education and professional PCB designing.

As professional PCB designing software with integrated space-based auto router, it the curser at the component pin end then draw the connections with that pen symbol. Connect all the components according to circuit then that designed circuit is show in below image.



If any modifications want to do to the component place the mouse point and click on right button then option window will open. That is shown in below figure.

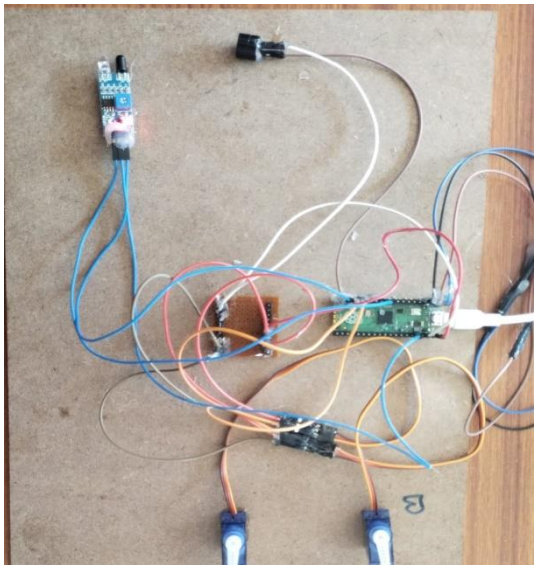
After completion of designing save with some mane and debug it. This is virtual simulation means without making circuit we can see the result in virtually through this software and we can **design the PCB layout** to our required circuit with this software.



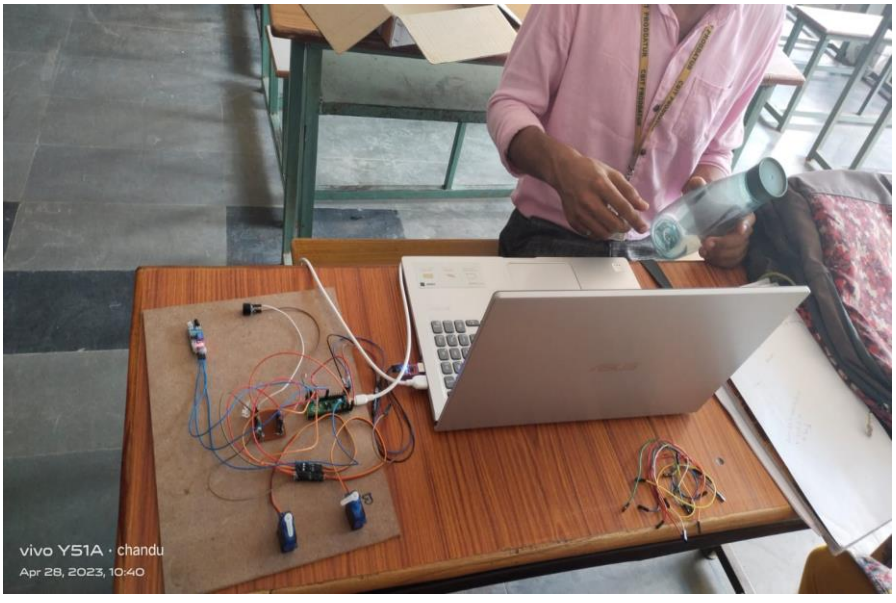
CHAPTER 6

RESULT AND DISCUSSION

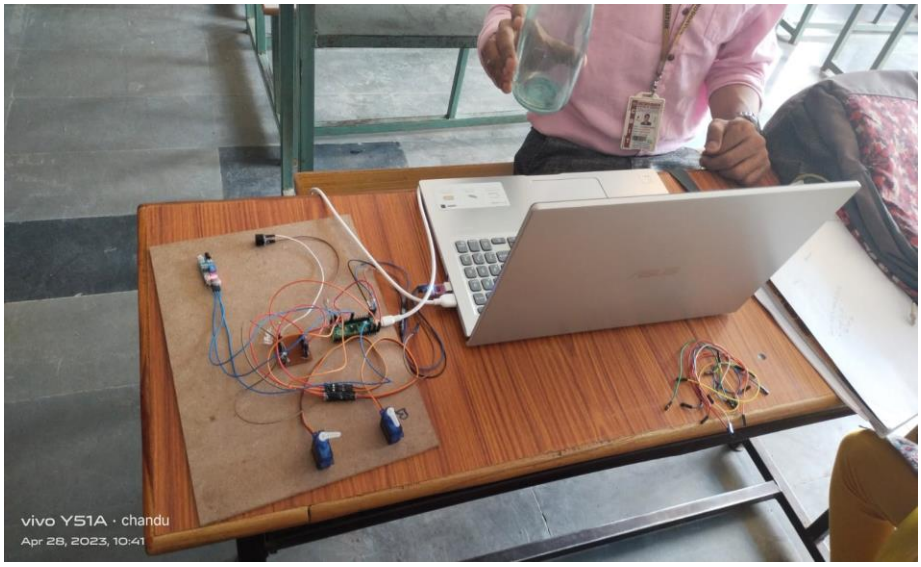
Stage1-Before capturing the items.



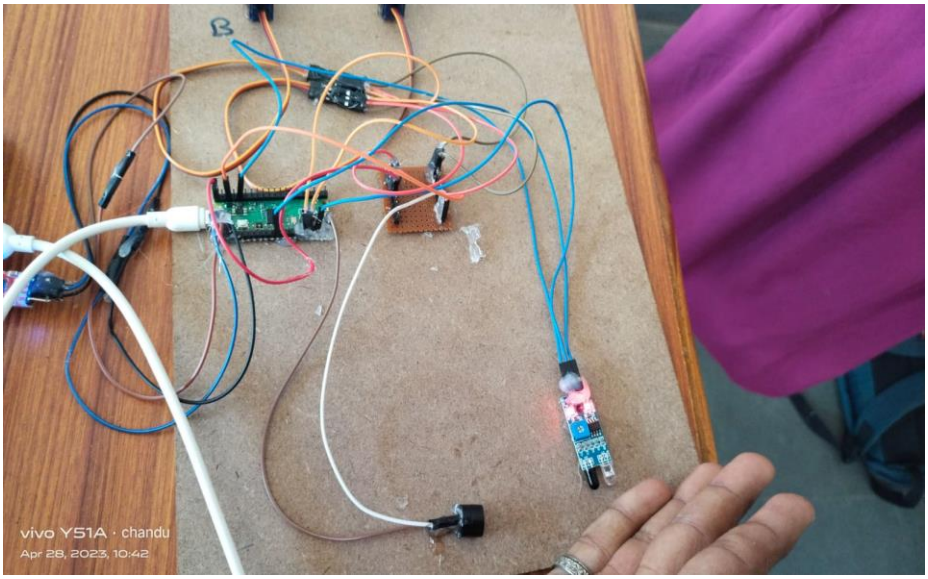
Stage2-When the Wrong Item is detected**.**



Stage3-When the Bottle is Detected.



Stage4-IR Sensor detects when the Bottle Bin is filled.



CHAPTER 7

ADVANTAGES AND APPLICATIONS

7.1 ADVANTAGES

- Most Convenience
- Cost Savings
- More Environmental Benefits

7.2 APPLICATIONS

- Colleges
- Malls
- Cinema Halls
- Bus Stand
- Railway Station

CHAPTER 8

CONCLUSION AND FUTURE SCOPE

Usage of Reverse Vending Machines in cities is a perfect way to solve various problems and gain substantial benefits. The common point is that improving the ecology is a primary goal for the society today. The recycling of waste contributes greatly to the cause, and, therefore, implementing effective garbage collection systems can make an important positive impact on the ecological situation in the cities. Apart from the overall cleanness of the city, it is also important to point out the reward-based system for the citizens and the public image benefits from implementing the systems. Last, but not least, the economical viability of these activities. The income created by selling the collected empty beverage containers for further recycling is capable of covering all the costs of implementation and creating of a sustainable profit flow.

While the developed system currently has lower recognition accuracy than the tested commercial reverse vending machines due to lighting issues, the return speed is, either top or bottom first unlike with the existing rotation-based systems. Furthermore, the developed recognition unit design simplifies the mechanics of the reverse vending machine. The camera-based system and the chute have no moving parts making the system virtually maintenance free.

CHAPTER 9

REFERENCE

1) https ://www.acorecycling.com/b-1-smart-reverse-vending-machine.
2) https ://www.snapmunk.com/reverse-vending-machine-recycling.
3) https ://www.raspberrypi.org/documentation/configuration/raspi
4) REXAM, "Annual report 2013" (Cited: Feb. 7th 2015), Available: http://www.rexam.com/files/reports/2013ar/assets/downloads/Rexam_ Annual_Report_2013.pdf.
5) The Bottle Bill Resource Guide, "Beverage Container Deposit Laws Worldwide" (Cited: Feb. 10th 2015), Available: http://www.bottlebill.org/ legislation/world.htm.
6) PALPA, "Kaikki kier¨a¨a – Palpan vuosijulkaisu 2013" (Cited: Feb. 10th, 2015), Available: http://www.digipaper.fi/palautuspakkaus/120034/.
7) Infinitum, "Deposit facts of 2013" (Cited: Feb. 10th 2015), Available: http://infinitum.no/english/deposit-facts-of-2013.
8) K. Holmen, J. S. Rognhaug, J. Rype, "Device for handling liquid container," U.S. Patent 6 678 578, January 13, 2004.
9) A. Nordbryhn, "Device for generating, detecting and recognizing a contour image of a liquid container," U.S. Patent 5 898 169, April 27, 1999.