كلية الهندسة بحلوان

جامعة حلوان

HELWAN UNIVERSITY

Faculty of Engineering at Helwan

The Program of Communications and Information Engineering

Egyptian advisors

Prof: Zaki Nossair

Dr: Hesham Mahmoud Zarif

Italian advisor

Dr: Dario Assante

Presented By

Mahmoud Saad Gaber Abouelnaga
Yara Ashraf Mohamed Esmail
Youssef Ahmed El-Sayed El-Tonbary
Nourateldien Sherif Mohammed Sobhy
Mostafa Ahmed Abdel-Azim

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ABSTRACT

Living normally is the least right of all people. Also, everyone
Looking for an independent and private life without anyone's help.

Not only does Alzheimer's disease steal the right to live normally, but it also steals all memories and experiences, so they need help to help them overcome these difficulties.

This is the reason for studying Alzheimer's disease and entering into the application of the technological development we live in to serve and help the affected people.

This is a time of unprecedented promise in the quest to end Alzheimer's disease.

Today, states and their institutions are increasing philanthropic support for Alzheimer's research, fostering a dynamic community of Alzheimer's disease scientists, and securing increased federal funding for research—all useful in finding new treatments to stop, slow, and prevent Alzheimer's disease. Alzheimer's patients need a tool that activates the parts of the brain responsible for memory and slows down its damage processes, through applications to identify people, medicines, and dates of taking them, in addition to placing it in a controlled environment to avoid any harm or danger. over here Il Compagno is one device that has all possible ways to help Without the need for permanent facilities, its main role is to reduce the disease and prevent the spread of damage.

Il compagno is an assistant for Alzheimer's patients. It is smart glasses that help Patients get rid of all their problems and I don't need any help
From anyone inside or outside the home.

CONTACTS

Full name	Phone Contact	Email
Mahmoud Saad Gaber Abouelnaga	0 102 448 5959	mahmoudabouenaga15994@gmail.com
Yara Ashraf Mohamed Esmail	0 111 005 4034	yara.ashraf1963@gmail.com
Nourateldien Sherif Mohammed	0 115 298 6180	Snoura614@gmail.com
Youssef Ahmed El-Sayed El-Tonbary	0 112 599 4008	tonbary2000@gmail.com
Mostafa Ahmed Abdel-Azim	0 114 203 5986	var313ahmed@gmail.com

Table 1: contacts

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TABLEOF ACRONYMSAND DEFINITIONS

AD	**Alzheimer's disease**
OCR	**Optical Character Recognition**
NLP	**Natural Language Processing**
STT	**Speech To Text**
TTS	**Text To Speech**
IOT	**Internet OF Thinks**
ML	**Machine Learning**
DP	**Deep Learning**
NN	**Neural Network**
ANN	**Artificial Neural Network**
DNN	**Deep Neural Network**
TTFF	**Time-To-First-Fix**
BBR	**Battery Backed RAM**
GPS	**Global Positioning System**
PHR	**Personal Health Record**
HCR	**Handwriting Character Recognition**
API	**Applicant Programming Interface**

ASCII	**American Standard Code for Information Interchange**
LSTM	**Long Short-Term Memory**
RNN	**Recurrent Neural Network**
PCR	**Printer Character Recognition**

Chapter 1 INTRODUCTION

1.1 What is Alzheimer’s Disease?

Alzheimer's disease is a type of dementia that affects memory, thinking, and behavior. Eventually, symptoms become severe enough to interfere with daily tasks.

Figure 1-1: Alzheimer's symptoms

1.1.1 Understanding Alzheimer's disease and dementia

Alzheimer's disease is the most common cause of dementia, which is a general term for loss of memory and other cognitive abilities serious enough to interfere with daily life. Alzheimer's disease accounts for 60-80% of dementia cases. Alzheimer's is not a normal part of aging. The largest known risk factor is increasing age, and most people with Alzheimer's disease are 65 years of age or older. Alzheimer's disease is considered younger Alzheimer's disease if it affects a person under 65 years of age. A younger-onset may also be referred to as early Alzheimer's disease. Younger people with Alzheimer's disease can be in the early, middle, or late stages of the disease.

Alzheimer's disease worsens over time. Alzheimer's disease is a progressive disease, in which symptoms of dementia gradually worsen over several years. In its early stages, memory loss is mild, but in the later stage of Alzheimer's disease, individuals lose the ability to hold a conversation and respond to their environment. On average, a person with Alzheimer's lives 4 to 8 years after diagnosis, but can live up to 20 years, depending on other factors.

1.1.2 Alzheimer's disease symptoms

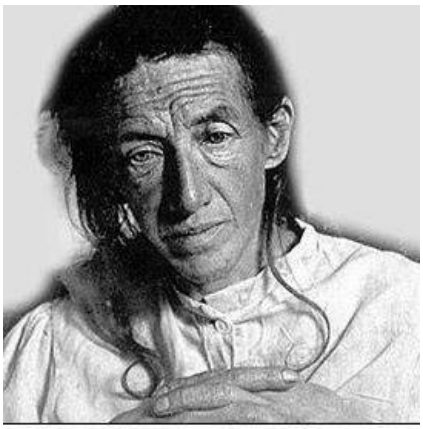
The most common early symptom of Alzheimer's disease is difficulty remembering newly acquired information.
Just like the rest of our bodies, our brains change as we age. Most of us eventually notice some slowness in thinking and occasional problems remembering certain things. However, severe memory loss, confusion, and other major changes in the way our brains work may be a sign of brain cell failure.
People with memory loss or other possible signs of Alzheimer's disease may find it difficult to realize they have a problem. Signs of dementia may be more noticeable to family members or friends. Diagnostic methods and early intervention are improving dramatically, and treatment options and sources of support can improve quality of life.

1.2 History of Alzheimer's Disease

It is estimated that nearly 500,000 new cases of Alzheimer's disease will be diagnosed this year in the United States. **Every 3 seconds, someone in the world develops dementia**.

Alzheimer's disease (AD) is the leading cause of dementia in the elderly, and affects about 15 million people worldwide. 400,000 ALZHEIMER'S PATIENTS IN EGYPT. The first symptom is usually a pernicious memory impairment. As the disease progresses, there is an increased impairment of language and other cognitive functions. Problems occur in naming and finding words, and then in oral and written comprehension and expression. Visual, analytical, and abstract thinking abilities, judgment, and insight are affected. Behavioral changes may include delusions, hallucinations, irritability, agitation, verbal or physical aggression, wandering, and brushing. Ultimately, there is a loss of self-hygiene, eating, dressing, first aid abilities, incontinence, and motor impairment.

Alois Alzheimer



Auguste Deter

Figure 1-2: Alois Alzheimer

In 1906, German physician Dr. Alois Alzheimer first described "a peculiar disease" — one of profound memory loss and microscopic brain changes — a disease we now know as Alzheimer's.

Today, Alzheimer's is at the forefront of biomedical research. Researchers are working to uncover as many aspects of Alzheimer's disease and other dementias as possible. Some of the most remarkable progress has shed light on how Alzheimer's affects the brain. The hope is this better understanding will lead to new treatments. Many potential approaches are currently under investigation worldwide.

1.3 Problem Definition

People with Alzheimer's disease face a big problem in living normally because they always need a companion to help them remember things, places, types of medications and when to take them.

1.3.1 The first job they can't do is that dealing with a device with buttons is very confusing as they forget their children and their families, as it is important to revitalize their memory by recognizing people and telling them their names.

1.3.2 The second function is that they need to take care of themselves continuously and regularly; Where it is difficult for them to remember its types and dates, in addition to the fact that their vision is greatly impaired, and thus will make their ability to read weak.

1.3.3 The third function is that they are sometimes unable to determine their destination, as they enter a state of delusion and loss of the moment, and therefore it is important to determine their location to make it easier for their families to identify their location easily.

1.3.4 The fourth function is that they need to take notes of their work or appointment or something to remember them later and they can't do.

1.3.5 The fifth function is that they need to be watched as they are at risk if they are alone.

1.4 What are the 7 Stages of Alzheimer’s Disease?

A person with Alzheimer's disease can be helped to support by learning more about how the condition progresses.
There is no cure for Alzheimer's disease, so it is helpful to know what to expect so you can plan to meet the patient's needs. There are no hard and fast lines between the light and medium
stages, but over time, you can expect quick changes.

1.4.1 Stage 1: Normal Outward Behavior

Alzheimer’s disease usually starts silently, with brain changes that begin years before anyone notices a problem. they won't have any symptoms that you can spot. Only a PET scan, an imaging test that shows how the brain is working, can reveal whether they have Alzheimer's.

1.4.2 Stage 2: Very minor changes

You still may not notice anything wrong with your patient behavior, but they may pick up small differences, things that even a doctor hasn't discovered. This can include forgetting words or misplacing things.
At this point, the exact symptoms of Alzheimer's disease do not interfere with their ability to work or live independently.

1.4.3 Stage 3: Slight dip

At this point you begin to notice changes in your loved one's thinking and reasoning, such as:
Forget something they just read
Asking the same question over and over again
He has more and more trouble making plans or organizing
I can't remember names when meeting new people
Here the Il Compagnocan help be a "memory" for them, making sure bills are paid and appointments arrive on time.

1.4.4 Stage 4: Moderate rejection

During this period, the thinking and reasoning problems that you noticed in the third stage become more noticeable, and new problems appear.

1.4.5 Fifth stage: moderate steep slope

Here the patient may begin to lose his place and time. They may have trouble remembering their address, phone number, or where they are going.
This is where the GPS tracking feature comes in. It can help them get dressed and maintain a sense of independence.

1.4.6 Stage 6: steep slope

As Alzheimer's disease progresses, a person may recognize you by faces but forget names. They may also mistake one person for another, for example, thinking that his wife is their mother. Delusions may arise, such as thinking that they need to go to work even if they no longer have work.You may need to help them go to the bathroom.

1.4.7 Seventh stage: very severe landing

Many basic abilities in a person with Alzheimer's disease, such as eating, walking, and sitting, diminish during this time. At this point, people with Alzheimer's disease need a lot of help from caregivers. Many families find that they can no longer take care of their loved ones at home as often as they would like to. So they need to move to nursing homes that provide professional day and night care.

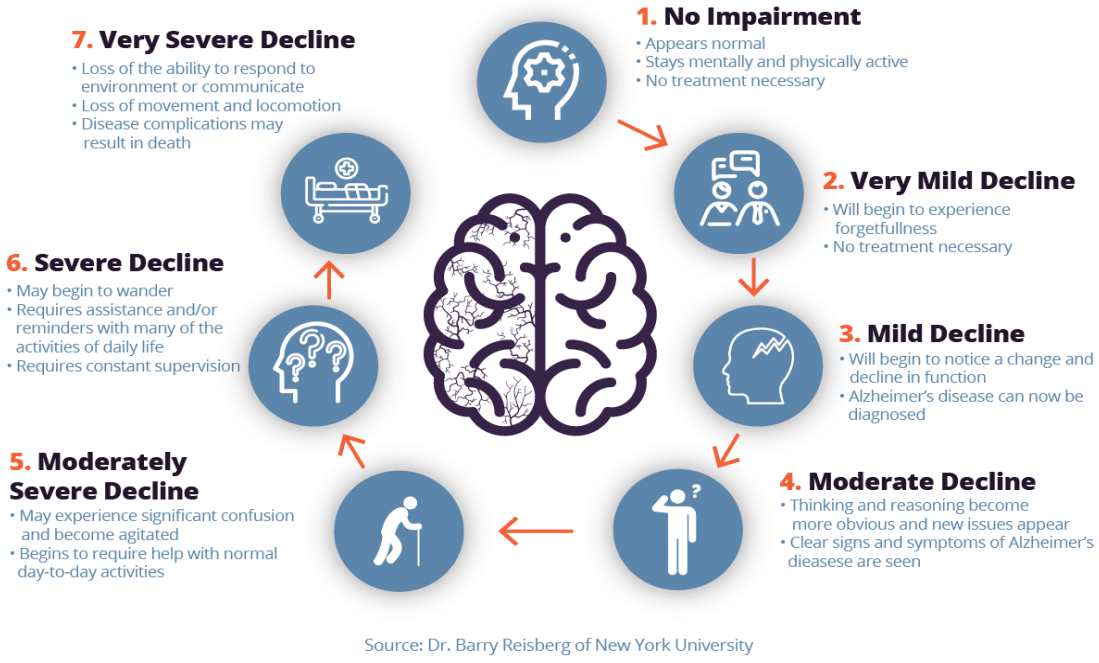


Figure 1-2: the 7 Stages of Alzheimer's Diseas

1.5 Available Solutions

In the late stages of the disease, the patient cannot accept dealing with any external factors, as he loses the ability to perceive. All global efforts in scientific research did not reach scientists to a definitive cure.

The development and spread of the disease can be prevented by:

1.5.1 Constant reminders to people

The use of facial recognition technology by identifying the distinctive features of each of them Person's face, recognize a person's face, to tell him his name.

1.5.2 Take his medication

This is done by helping him identify the medicine and also reminding him of the times for taking it, and hiding it in case he took it beforehand.

1.5.3 The most important factor is safety.

Sometimes it is difficult to have an accompanying person with the patient, and to ensure safety, the Il compagno will be the device accompanying him at home and outside.

- Determine his location so that he can return safely home, and his family can locate it on the map.
- When he is at home, there must be something that remains safe, by monitoring him by placing some sensors that alert in case of danger. For example, not remembering to turn off the cooker may cause a fire.

1.6 Goals

Our main goal is to build a self-contained local system that can help Alzheimer's patients and be their companion to facilitate their daily lives in the simplest and most convenient way and also to keep them in the early stages of the disease as much as possible.

1.7 Objectives

1. Create a simple device that the user can handle as easily as using it Voice commands instead of buttons.
2. The device should be able to recognize people and then tell them their name in an easy way.
3. The device must be able to record the times of taking medicines and the news if the medicine was taken in the past.
4. It must be able to make the user under constant supervision
5 . Many features must be combined into one device, so that it can be used as a file separate device.
6 . Basic requirements to the design:

- Comfortably in using
- User-friendly interface

1.8 Project Phases

Figure 1-3 : Project Phases

1.1. Design Specifications:

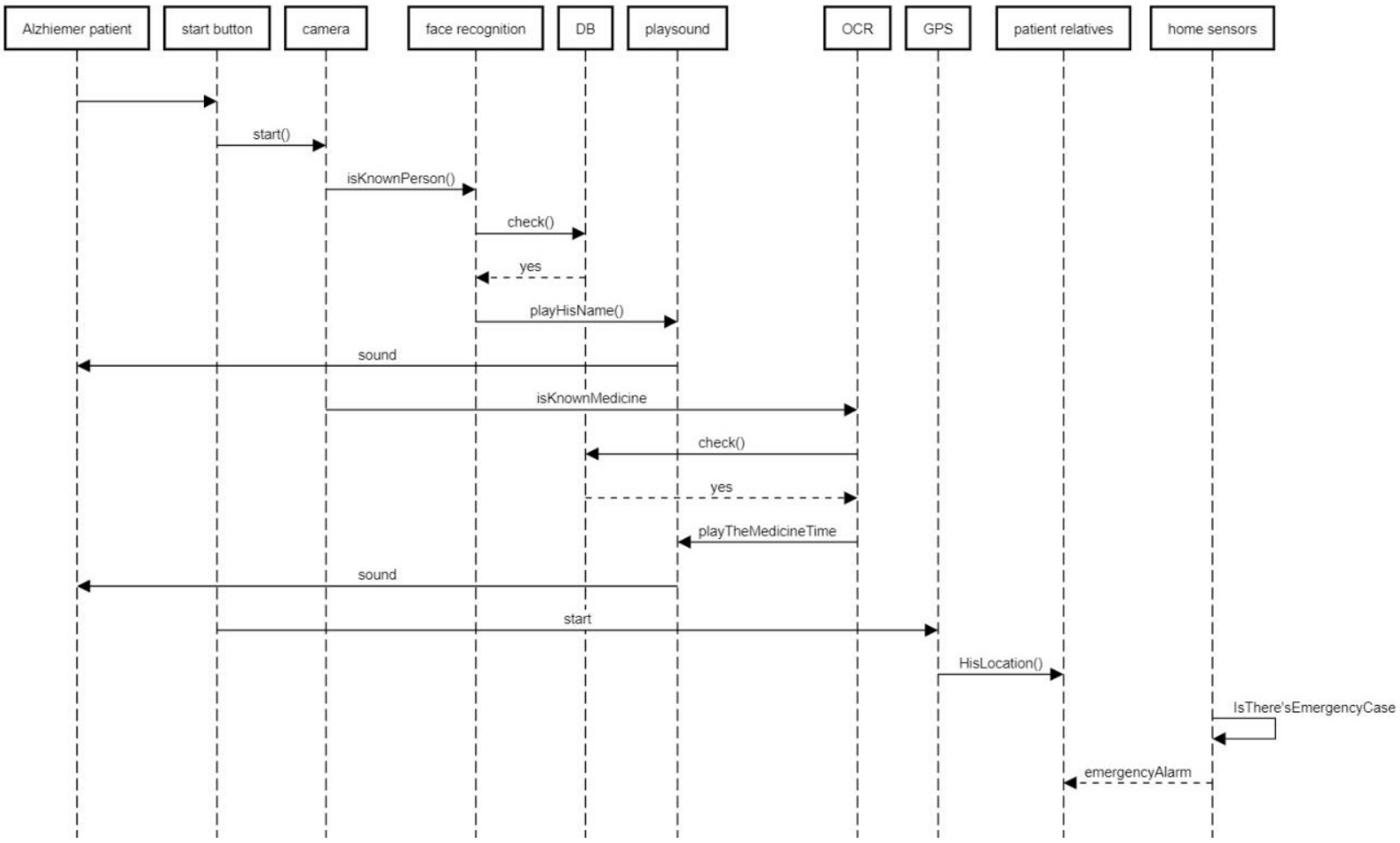


Figure 1-2: Sequence Diagram

Chapter 2

Face Recognition System

2. Face Recognition System

A face recognition system is a technology that able to match human faces from digital images or video frames to facial databases. Although humans can recognize faces without much effort, face recognition is a challenging pattern recognition problem in computing. The face recognition system seeks to identify the face, which is three-dimensional and changes appearance with facial lighting and expression, based on its two-dimensional image. To finish this computational task, the face recognition system performs four steps. The primary face detection is used to segment the face from the background of the image. In the second step, segmented facial images are adjusted to take under consideration facial poses, image sizes, and photographic properties, like lighting and grayscale. The aim of the alignment process is to enable proper localization of facial features within the third step, extraction of facial features. Features like eyes, nose, and mouth are shown and measured in pictures to represent the face. The vector features a strong face then, within the fourth step, is matched to the face database.

2.1 Necessary Background:

2.1.1 Digital Image Processing:

In computer science, digital image processing is using image processing on Digital images. Digital image processing has a lot of advantages on analog image processing. It allows many algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are outlined over two dimensions (perhaps more) digital image processing may be modeled in the compose of multidimensional systems.

Tasks of Digital Image Processing, Digital image processing deal with:

- Classification
- Feature Extraction
- Multi-scale signal analysis
- Pattern recognition Techniques are used in image processing:
- Image restoration
- Independent component analysis

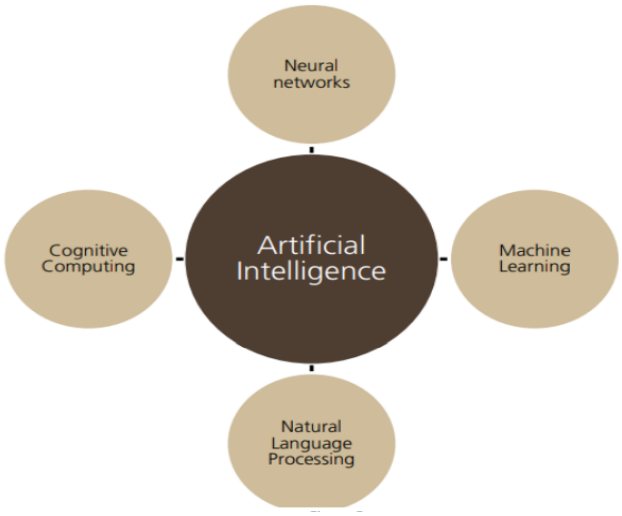
- Linear filtering
- Neural networks
- Partial differential equations
- Pixilation
- Point feature matching
- Principal components analysis
- Self-organizing map

2.1.2 What is Artificial Intelligence?

- AI (AI) is typically defined as the science of making computers do things that need intelligence when done by humans.
- A.I is that the study of ideas that enable computers to be intelligent.

2.1.3 Machine Learning

It is the study of statistical models and algorithms that computer systems use to implement a special function effectively without using explicit instructions, relying on patterns and inference instead. It is displayed as a subset of AI. Machine learning algorithms construct a mathematical model based on training data, known as "sample data", to make guesses or decisions without being explicitly programmed to implement the function. Machine learning algorithms are used in a large variety of applications, such as computer vision and email filtering where it is infeasible to develop an Algorithm of specific instructions for implementing the task. Machine learning is relative to computational statistics, which focuses on applying predictions using computers. The study of mathematical optimization delivers theory, application domains and methods to the domain of machine learning. Data mining is a domain of study within machine learning and focuses on exploratory data analysis through unsupervised learning. Machine learning is also referred to as predictive analytics in its application across business problems.



2.1.3.1 Types of Machine Learning:

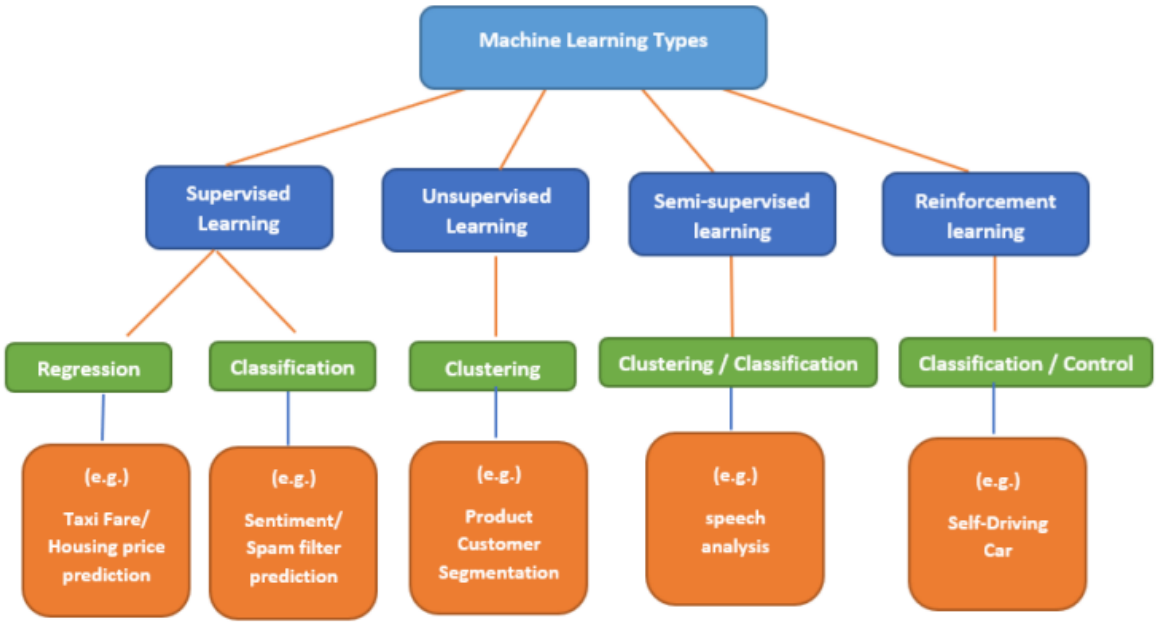


Figure 1-3 :Types of Machine Learning

A. Supervised:

All data is categorized while the algorithms learn to predict the output from the input data by training from dataset then the learning stops when the algorithm obtain reasonable level of performance. We have input variables (A) and output variable (B), and we apply an algorithm to map function between input and output B = f(A).

Supervised learning grouped into regression and classification problems:

- Classification: A classification problem is when the output variable is a category.
- Regression: A regression problem is when the output variable is a real value.

B. Unsupervised:

All data is uncategorized while the algorithms learn to direct structure from the input data. That we have input data (A) and no corresponding output variables. The goal is to be able to find the structure or relationships between different inputs so there is no a teacher but the algorithms are left to discover interesting structure in the data.

Unsupervised learning can be grouped into clustering and association problems:

- Clustering: where you want to detect the inherent groupings in the data.
- Association: where you want to discover rules that describe large segment of your data.

Therefore, all Machine Learning counts as AI, but not all AI counts as Machine Learning.

2.1.3.2 Techniques of Machine Learning

From the study of Pattern Recognition and Computational Learning Theory in AI, we examined the study and construction of algorithms of Machine Learning that can make predictions on data and learn from it.

Such Algorithms can be represented in the following Techniques:

1. Bayes technique.
2. Single nearest neighbor.
3. K-nearest neighbor.
4. Adaptive decision boundary.
5. Adaptive discriminate function.
6. Sequential multi input single output.
7. Sequential multi input multi output.
8. ANN.

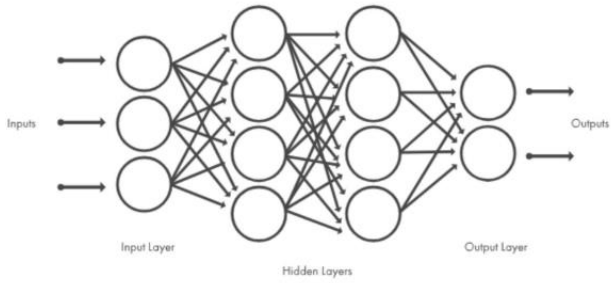
So, as the evolution of ANN, it has been used in different tasks such as Computer. Vision, Speech Recognition, Machine Translation, Medical Diagnosis...etc.

2.1.4 Neural Networks

Neural Networks are one of the kinds of Machine Learning. They are composed of a set of algorithms that are loosely designed after the human brain to be able to notice patterns by translating sensational data through a designed machine understanding by identifying or clustering the original input. These patterns identify vector numbers that must be converted into real-world data which can be images, sound, or text. Neural Networks help in assorting and clustering. Furthermore, it helps to group unidentified data according to similarities among the input examples, and they classify data when they have a labeled dataset to train on.

2.1.5 Deep learning

Deep learning (also detected as deep hierarchical learning or structured learning) is a section of a fringe family of machine learning methods based on ANNs. Learning can be unsupervised, supervised, or semi-supervised Deep learning architectures such as deep belief networks, deep neural networks, convolutional neural networks, and recurrent neural networks have been applied to fields including speech recognition, computer vision, audio recognition, natural language processing, bioinformatics ,social network filtering, drug design, machine translation, material inspection, board game programs and medical image analysis where they have generated results comparable to and in some cases superior to individual scientist.



Artificial Neural Network (ANN) was motivated by information processing and distributed communication nodes in biological systems. ANN have many differences from biological brains. Specifically, neural networks tend to be symbolic and static, while the biological brain of most living organisms is analog and dynamic.

2.1.5.1 Types of Deep Learning:

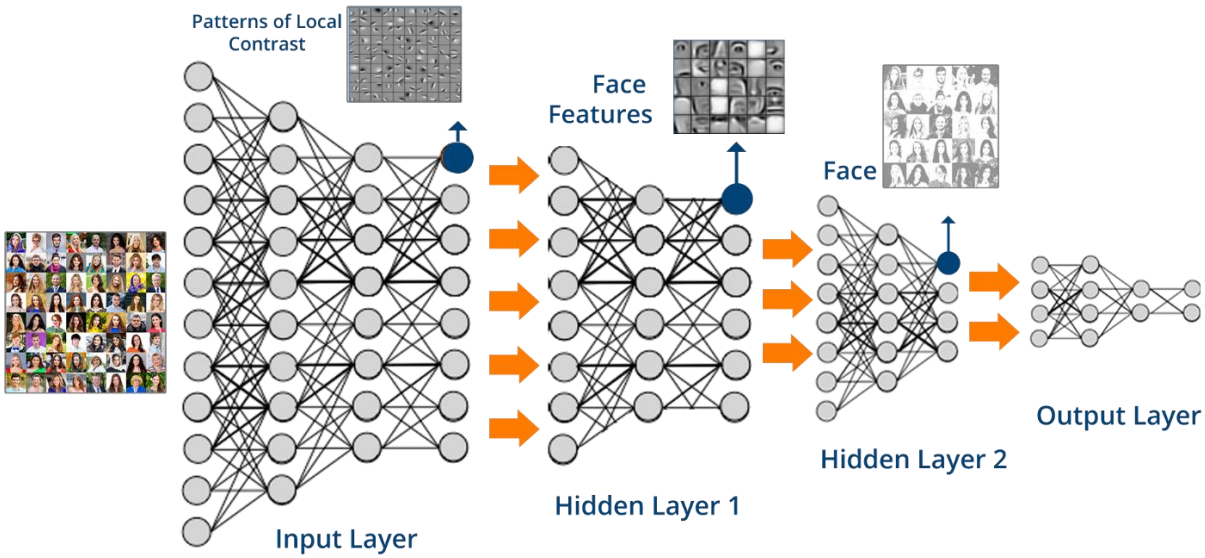


Figure I-3 Types of Deep Learning

1. A Recurrent Neural Network: A standard neural network that has been extended across time because its structure depends on feed-forward connections that deal with forward connection. A recurrent network connection could feed back into the next layers in the same time step. RNN is recommended for recognizing sequences of the input such as speech signal or text. It has cycles for feedback that allows RNNs to adhere memory of past inputs and shape problems in time. One of the common types of RNN model is LSTM (Long Short-term Memory) Network.

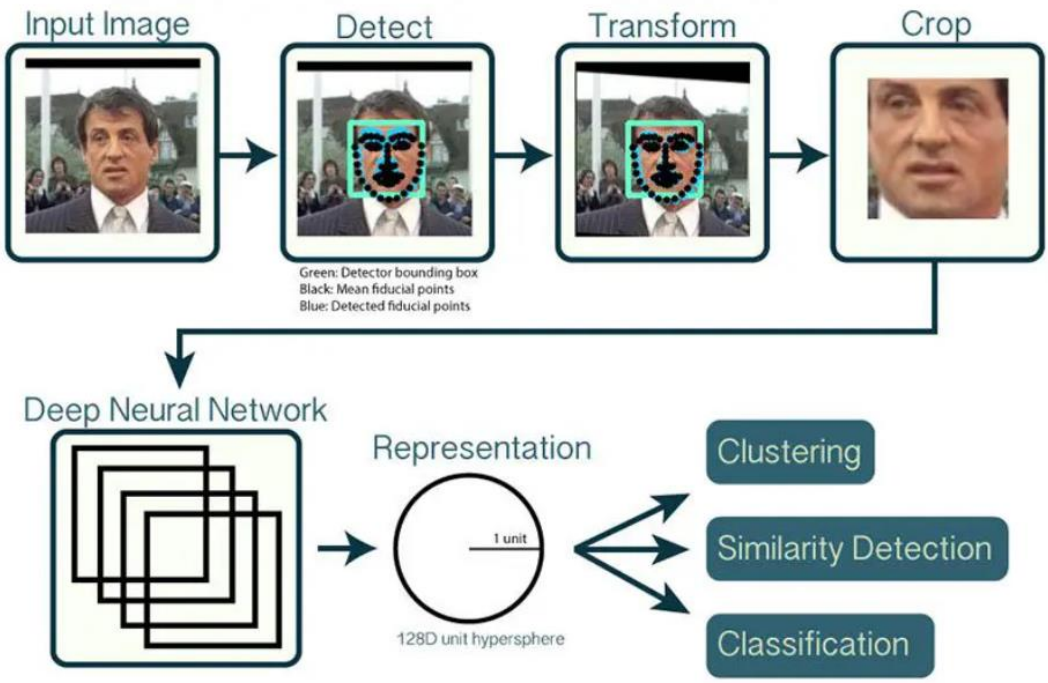
2. A Recursive Neural Network: Recursive Neural Networks is as Recurrent Neural Networks in dealing with variable length input. The main difference is that its network is like a hierarchical tree that has the ability to processed hierarchically the training dataset. The main problem of this type is Deconstructing scenes from recognized images. The repeatable phenomenal of this deconstruction purpose in identifying the objects in the scene and the objects relate to form the scene.

3. Convolutional Neural Network: It is the essential type or architecture of neural network; it learns features in the data through the convolutions that detect the edges of an object recognized on the image, it is recommended for object recognition with

images and image classification that learns to identify faces, individuals, street signs, and many other aspects of visual data. The power of CNNs in image recognition. That's why it is one of the main reasons that strengthens the use of deep learning. It'll be discussed in detail in the following section where to identify its use in our venture.

4.Deep Neural Network: it is networks that have an input layer, an output layer and at least one hidden layer in between. Each layer does a specific type of sorting and ordering in a process that some refer to as "feature hierarchy." One of the key uses of these sophisticated neural networks is dealing with unlabeled or unstructured data. The phrase "deep learning" is used to describe these deep neural networks, as deep learning represents a specific form of machine learning where technologies using aspects of artificial intelligence try to classify and order information in ways that go beyond simple input/output protocols.

2.2 Face recognition and Face detection using the OpenCV



The face recognition is a technique that identify or verify the face from digital images or video frame. A human quickly identifies the faces without much effort. It is an effortless task for us, but it is a difficult task for a computer. There are various

complexities, such as low resolution, occlusion, illumination variations, etc. These factors highly affect the accuracy of the computer to recognize the face more effectively. First, it is necessary to understand the difference between face detection and face recognition.

Face Detection: The face detection is generally concerned with finding the faces (location and size) in an image and extracting them out to be used by the face recognition algorithm.

Face Recognition: The face recognition algorithm is used in finding the unique features that are described in the image. The facial image is already extracted, cropped, resized, and converted in the grayscale.

There are various algorithms for face detection and face recognition. Now we will learn about the process face detection using the HAAR cascade algorithm

2.2.1 Basic Concept of HAAR Cascade Algorithm

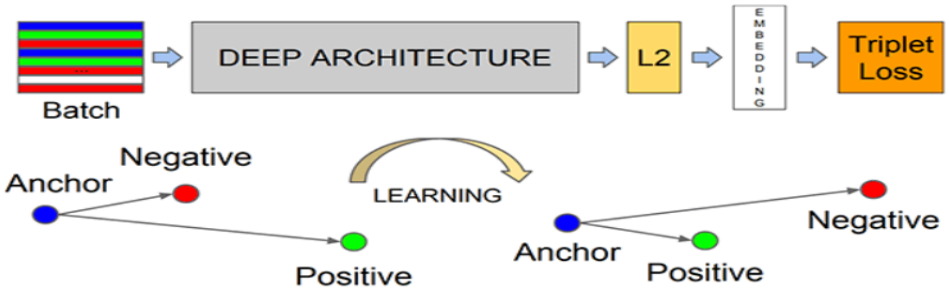
The HAAR cascade is a machine learning approach in which a cascade function is trained with a lot of positive and negative images. Positive images are images that consist of faces, and negative images are those without faces. In face detection, image features are being treated as a numerical information extracted from the pictures that can distinguish one image from another.
We apply each feature of the algorithm on all the training images. Every image is given an equal weight at the start. It finds the best threshold which will categorize the faces to positive and negative. Errors and misclassifications may take place. We select the features with a minimum error rate, which means these are the features that best classify the face and non-face images.
In order to calculate the plenty of features all possible sizes and locations of each kernel are used.

2.2.2 HAAR-Cascade Detection in OpenCV

OpenCV provides both the trainer and the detector for the classificaton. The classifier can be trained with any object like cars, planes, and buildings by using the OpenCV. There are two primary states of the cascade image classifier, the first one is training and the other is detection. OpenCV provides two applications for training the cascade classifier **opencv_haartraining** and **opencv_traincascade**. These two applications store the classifier in different file formats.

A set of samples are needed for training. There are two types of samples:

- **Negative sample:** It is related to non-object images.
- **Positive samples:** It is a related image with detect objects.



2.2.3 Face recognition using OpenCV

Face recognition is a simple task for humans. Successful face recognition means effective recognition of the inner features (eyes, nose, mouth) or outer features (head, face, hairline). Now the question is that how the human brain encodes it?
David Hubel and Torsten Wiesel **found** that our **mind** has a **specialized** nerve cells responding to unique local feature of the scene, such as lines, edges, or movement. Our brain combines these different sources of information into an useful patterns; we don't see the visual as scatters. We can define face recognition in one simple sentence, "Automatic face recognition is all about taking out those meaningful features from an image and putting them into an useful representation and performing some classification on them.
The basic idea of face recognition is based on the geometric features of the face. It is the feasible and most intuitive approach for face recognition. The first automated face recognition system was described in the position of eyes, nose and ears. These positioning points are called features vector (distance between the points).

The face recognition is achieved by calculating the **Euclidean** distance between feature vectors of a probe and reference image. This method is effective in illumination change by its nature, but it has a drawback. The correct registration of the maker is very hard.

The face recognition system basically can operate in two modes:

- Authentication or Verification of a facial image
  It compares the input facial image with the facial image related to the user, which requires authentication. It is a 1vs1 comparison.

- Identification or facial recognition
  It compares the input facial images from a dataset to find the user that fits with that input face. It is a '1' vs 'N' comparison.

2.2.4 What You'll Need Facial Recognition?

Raspberry Pi Model 3B+, but What is Raspberry Pi ?

Unlike a traditional computer, which hides its inner workings in a case, a Raspberry Pi has all its components, ports, and features out on display – although you can buy a case to provide extra protection, if you'd prefer. This makes it a great tool for learning about what the various parts of a computer do, and makes it easy to learn what goes where when it comes time to plug in the various extras – known as peripherals.

2.2.4.1 How to Set Up a Raspberry Pi for the First Time:

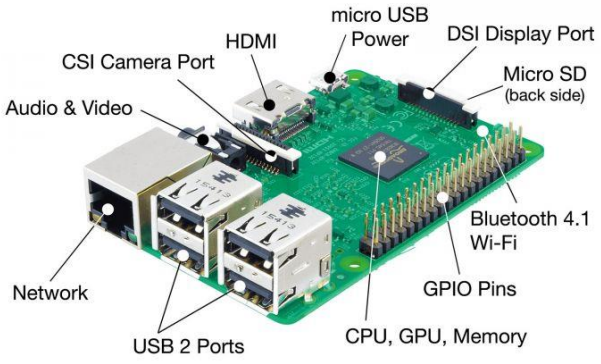
- A power sources
- A microSD card (at least 8GB)
- A keyboard (wired or wireless)

- A mouse or other pointing device (could be built into the keyboard)
- A monitor or TV to connect to (via HDMI)
- HDMI cables

2.2.4.2 The Raspberry Pi's components:

Like any computer, the Pi is made up of various different components, each of which has a role to play in making it work .

- The first, and arguably most important, of these can be found just above the centre point on the top side of the board, covered in a metal cap: the system-on-chip (soc), The name system-on-chip is a great indicator of what you would find if you prised the metal cover off: a silicon chip, known as an integrated circuit, which contains the bulk of the Raspberry Pi's system. This includes the central processing unit (CPU), commonly thought of as the 'brain' of a computer, and the graphics processing unit (GPU), which handles the visual side of things.



- A brain is no good without memory, however, and on the underside of the Raspberry Pi you'll find exactly that: another chip, which looks like a small, black, plastic square. This is the Pi's random-access memory (RAM). When you're

working on the Pi, it's the RAM that holds what you're doing; only when you save your work will it be written to the microSD card. Together, these components form the Pi's volatile and non-volatile memories: the volatile RAM loses its contents whenever the Pi is powered off, while the non-volatile microSD card keeps its contents.

- The Raspberry Pi's random-access memory (RAM) Turning the board over again you'll find another metal lid to the upper-right, this one featuring an etched Raspberry Pi logo, this covers the radio, the component which gives the Raspberry Pi the ability to communicate with devices wirelessly. The radio itself acts as two main components, in fact: a Wi-Fi radio, for connecting to computer networks; and a Bluetooth radio, for connecting to peripherals like mice and for sending data to or receiving data from nearby smart devices like sensors or smartphones.

- The Raspberry Pi's ports, The Raspberry Pi has a range of ports, starting with four Universal Serial Bus (USB) ports to the middle and right-hand side of the bottom edge. These ports let you connect any USB-compatible peripheral, from keyboards and mice to digital cameras and flash drives, to the Pi. Speaking technically, these are known as USB 2.0 ports, which means they are based on version two of the Universal Serial Bus standard.

- The Raspberry Pi's Ethernet port, To the left of the USB ports is an Ethernet port, also known as a network port, you can use this port to connect the Raspberry Pi to a wired computer network using a cable with what is known as an RJ45 connector on its end. If you look closely at the Ethernet port, you'll see two light-

emitting diodes (LEDs) at the bottom; these are status LEDs, and let you know that the connection is working.

- The Raspberry Pi's HDMI port is the High-Definition Multimedia Interface (HDMI) port, which is the same type of connector you'll find on a games console, set-top box, and TV. The multimedia part of its name tells you that it carries both audio and video signals, while high definition tells you that you can expect excellent quality, You'll use this to connect the Raspberry Pi to your display device, whether that's a computer monitor, TV, or projector.

- The Raspberry Pi's micro-USB power port which you'll use to connect the Raspberry Pi to a power source. The micro-USB port is a common sight on smartphones, tablets, and other portable devices. So, you could use a standard mobile charger to power the Pi, but for best results you should use the official Raspberry Pi USB Power Supply.

- The Raspberry Pi's GPIO header, you'll find 40 metal pins, split into two rows of 20 pins, this is the GPIO (general-purpose input/output) header, a feature of the Raspberry Pi used to talk to additional hardware from LEDs and buttons all the way to temperature sensors, joysticks, and pulse-rate monitors.

- The Raspberry Pi's microSD card connector, There's one final port on the Raspberry Pi, but you won't see it on the top. Turn the board over and you'll find a microSD card connector on the opposite side of the board to the display connector. This is the Raspberry Pi's storage: the microSD card inserted in here contains all the

files you save, all the software you install, and the operating system that makes the Raspberry Pi run.

2.2.4.3 Getting started with your Raspberry Pi:

We are going to use some stuffs such as:

- USB power supply – A power supply rated at 2.5 amps (2.5A) or 12.5 watts (12.5W) and with a micro-USB connector. The Official Raspberry Pi Power Supply is the recommended choice, as it can cope with the quickly switching power demands of the Raspberry Pi.

- microSD card with Raspbian – The microSD card acts as the Raspberry Pi's permanent storage; all the files you create and software you install, along with the operating system itself, are stored on the microSD card. An 8GB card will get you started, though a 16GB card offers more room to grow. Using a card with Raspbian, the New Out-Of-Box Software, pre-installed will save you some time; otherwise see Appendix A for instructions on installing Raspbian on a blank microSD card.

- USB keyboard and mouse – The keyboard and mouse allow you to control the Raspberry Pi. Almost any wired or wireless keyboard and mouse with a USB connector will work with the Raspberry Pi, though some 'gaming' style keyboards with colourful lights may draw too much power to be used reliably.

- HDMI Cable – The HDMI cable carries sound and pictures from the Raspberry Pi to your TV or monitor. There's no need to spend a lot of money on an

HDMI cable. If you are using a computer monitor without an HDMI socket, you can buy HDMI to DVI-D, DisplayPort, or VGA adapters; if you want to connect your Raspberry Pi to an older TV which uses composite video or has a SCART socket, use a 3.5 mm tip-ring-ring sleeve (TRRS) audio/video cable.

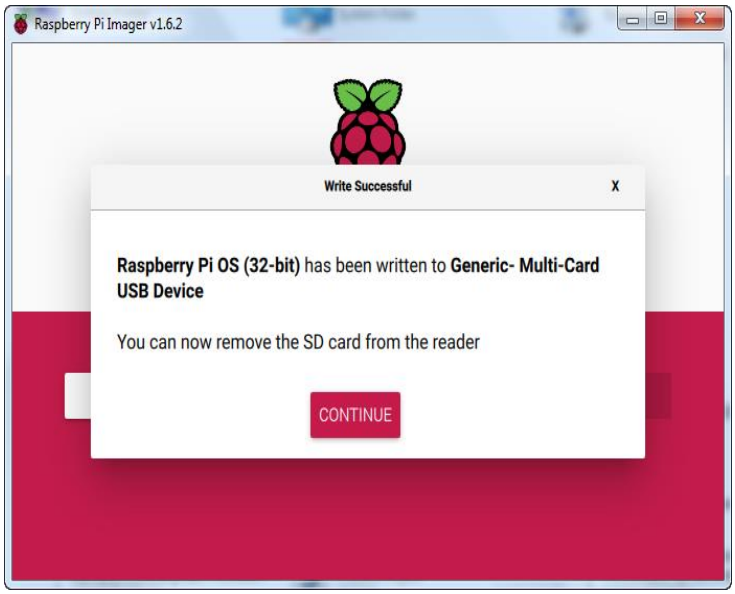
- Ethernet cable – HDMI cable can be replaced with Ethernet cable.

2.2.4.4 What is Raspbian and how to get it started:

Raspbian OS : Download and Install

Raspbian OS is the official operating system for Raspberry Pi , it is based on the famous Linux Debian operating system , it is well known for the availability of many programs for many purposes which can be downloaded for free.

How to get it started: We can find more than operating system on the official website of Raspberry Pi , we are going to pick Raspbian OS out , after installing it we are going to extract it using WinRAR to get a file by this name ‘wheezy-raspbian.img’ , then we are going to connect the USB reader to the PC and install the Raspbian OS on the SD card using Win32 Disk Image Writer , finally we are ready to get it started by putting the SD card in the SD card connector and the giving the power to the Raspberry Pi by connecting it with the USB power supply , with all the other devices(Keyboard – Mouse – Display) connected .



2.2.4.5 SSH(Secure Shell) :

How it works :

It is well-known that to regulate Raspberry Pi and to move with the entomb face we'd like a keyboard and a mouse, however with SSH we will control it while not a keyboard nor a mouse connected, it works as AN external terminal , therefore you'll access the statement of a Raspberry Pi remotely from another laptop or device on a similar network mistreatment SSH.

The Raspberry Pi can act as a foreign device: you'll connect with it employing a CLIENT on another machine.

You only have access to the statement, not the total desktop atmosphere. For a full remote desktop, see VNC, SSH is considered as 2 elements SERVER and CLIENT.

1. set up your local network (SERVER) and wireless connectivity:

Make sure your Raspberry Pi is correctly discovered and connected. If you're victimization wireless networking, this may be enabled via the desktop's programme, or victimization the command .

If you're not victimization wireless property, plug your Raspberry Pi directly into the router.

2.2.5 Setting Up Open-CV and Facial Recognition from Scratch

terminal commands

1	pip install picamera[array]
2	sudo apt-get update
3	sudo apt-get upgrade
4	sudo apt install cmake build-essential pkg-config git
5	sudo apt install libjpeg-dev libtiff-dev libjasper-dev libpng-dev libwebp-dev libopenexr-dev
6	sudo apt install libavcodec-dev libavformat-dev libswscale-dev libv4l-dev libxvidcore-dev libx264-dev libdc1394-22-dev libgstreamer-plugins-base1.0-dev libgstreamer1.0-dev
7	sudo apt install libgtk-3-dev libqtgui4 libqtwebkit4 libqt4-test python3-pyqt5
8	sudo apt install libatlas-base-dev liblapacke-dev gfortran
9	sudo apt install libhdf5-dev libhdf5-103
10	sudo apt install python3-dev python3-pip python3-numpy
11	sudo nano /etc/dphys-swapfile
NOTE	the change the number on CONF_SWAPSIZE=100 to CONF_SWAPSIZE=2048
12	sudo systemctl restart dphys-swapfile
13	git clone https://github.com/opencv/opencv.git
14	git clone https://github.com/opencv/opencv_contrib.git
15	mkdir ~/opencv/build
16	cd ~/opencv/build
17	cmake -D CMAKE_BUILD_TYPE=RELEASE \ -DCMAKE_INSTALL_PREFIX=/usr/local \-D OPENCV_EXTRA_MODULES_PATH=~/opencv_contrib/modules\-D ENABLE_NEON=ON \-D ENABLE_VFPV3=ON \-D BUILD_TESTS=OFF \-D INSTALL_PYTHON_ EXAMPLES=OFF \-D OPENCV_ENABLE_NONFREE=ON \-D CMAKE_SHARED_LINKER_FLAGS=-latomic \-D BUILD_EXAMPLES=OFF ..
18	make -j$(nproc)
19	sudo make install
20	sudo ldconfig
21	pip install face-recognition --no-cache-dir
22	pip install imutils
23	sudo nano /etc/dphys-swapfile
NOTE	The change the number on CONF_SWAPSIZE = 2048 to CONF_SWAPSIZE=100
24	sudo systemctl restart dphys-swapfile
25	git clone https://github.com/carolinedunn/facial_recognition

❖ **code to take pictures from raspberry pi**

headshots_picam.py

```
1  import cv2
2  from picamera import PiCamera
3  from picamera.array import PiRGBArray
4
5  name = 'yara' #replace with your name
6
7  cam = PiCamera()
8  cam.resolution = (512, 304)
```

headshots_picam.py

```
17         cv2.imshow("Press Space to take a photo", imag
18         rawCapture.truncate(0)
19
20         k = cv2.waitKey(1)
21         rawCapture.truncate(0)
22         if k%256 == 27: # ESC pressed
23             break
24         elif k%256 == 32:
```

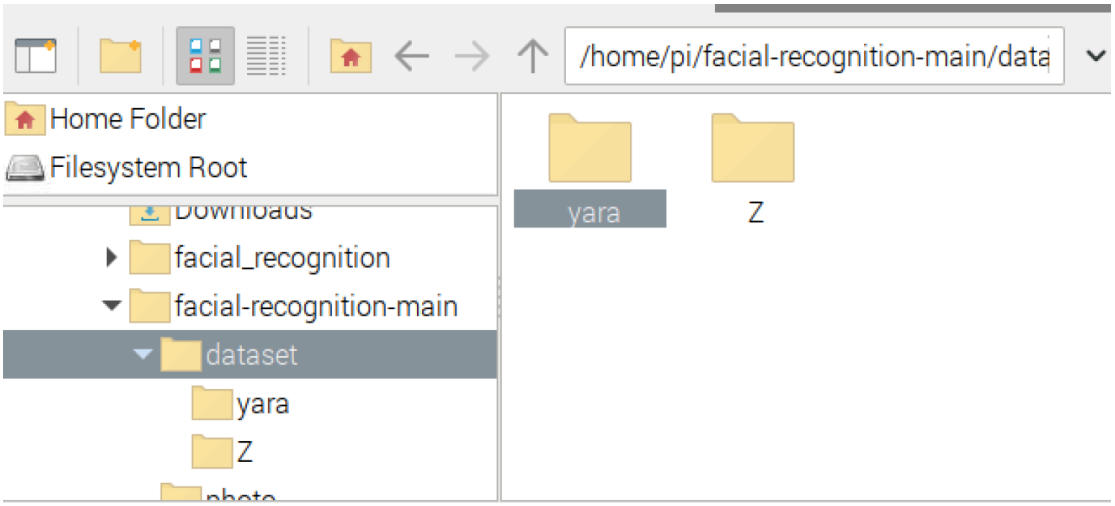
headshots_picam.py

```
9  cam.framerate = 10
10 rawCapture = PiRGBArray(cam, size=(512, 304))
11
12 img_counter = 0
13
14 while True:
15     for frame in cam.capture_continuous(rawCapture, fo
16         image = frame.array
```

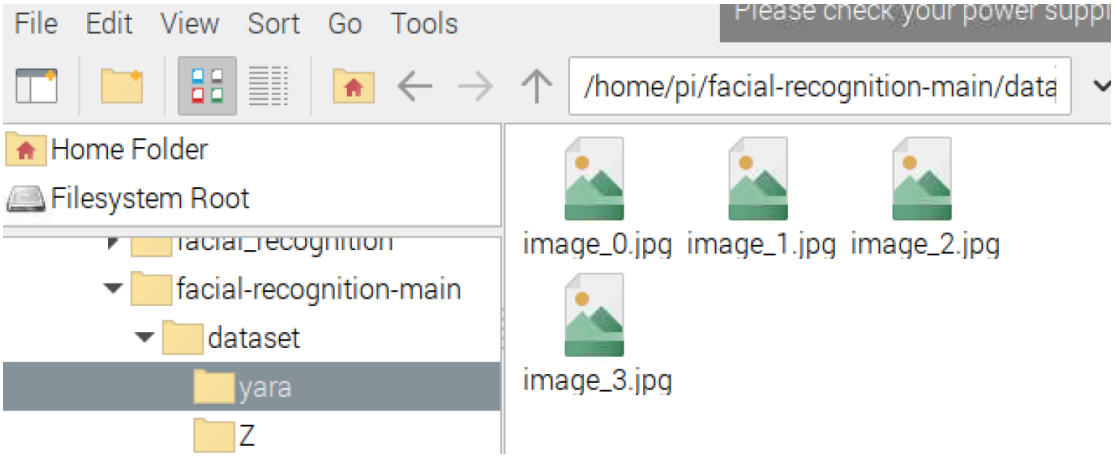
headshots_picam.py

```
25             # SPACE pressed
26             img_name = "dataset/"+ name +"/image_{}.jp
27             cv2.imwrite(img_name, image)
28             print("{} written!".format(img_name))
29             img_counter += 1
30
31     if k%256 == 27:
32         print("Escape hit, closing...")
```

❖ **After replacing the name with my name I have to create directory with my name to store the images in it.**



❖ **Then run the code and take photos then they going to store at the directory.**



2.2.5 Code to train the pictures

```
#! /usr/bin/python

# import the necessary packages
from imutils import paths
import face_recognition
#import argparse
import pickle
import cv2
import os

# our images are located in the dataset folder
print("[INFO] start processing faces...")
imagePaths = list(paths.list_images("dataset"))

# initialize the list of known encodings and known names
knownEncodings = []
knownNames = []

# loop over the image paths
for (i, imagePath) in enumerate(imagePaths):
    # extract the person name from the image path
    print("[INFO] processing image {}/{}".format(i + 1,
        len(imagePaths)))
    name = imagePath.split(os.path.sep)[-2]
```

```
25
26      # load the input image and convert it from RGB (OpenCV ordering)
27      # to dlib ordering (RGB)
28      image = cv2.imread(imagePath)
29      rgb = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
30
31      # detect the (x, y)-coordinates of the bounding boxes
32      # corresponding to each face in the input image
33      boxes = face_recognition.face_locations(rgb,
34          model="hog")
35
36      # compute the facial embedding for the face
37      encodings = face_recognition.face_encodings(rgb, boxes)
38
39      # loop over the encodings
40      for encoding in encodings:
41          # add each encoding + name to our set of known names and
42          # encodings
43          knownEncodings.append(encoding)
44          knownNames.append(name)
45
46  # dump the facial encodings + names to disk
47  print("[INFO] serializing encodings...")
48  data = {"encodings": knownEncodings, "names": knownNames}
```

❖ **After running the training code.**

```
pi@raspberrypi:~ $ cd facial_recognition
pi@raspberrypi:~/facial_recognition $ python train_model.py
[INFO] start processing faces...
[INFO] processing image 1/12
[INFO] processing image 2/12
[INFO] processing image 3/12
[INFO] processing image 4/12
[INFO] processing image 5/12
[INFO] processing image 6/12
[INFO] processing image 7/12
[INFO] processing image 8/12
[INFO] processing image 9/12
[INFO] processing image 10/12
[INFO] processing image 11/12
[INFO] processing image 12/12
[INFO] serializing encodings...
```

❖ **Face recognition code:**

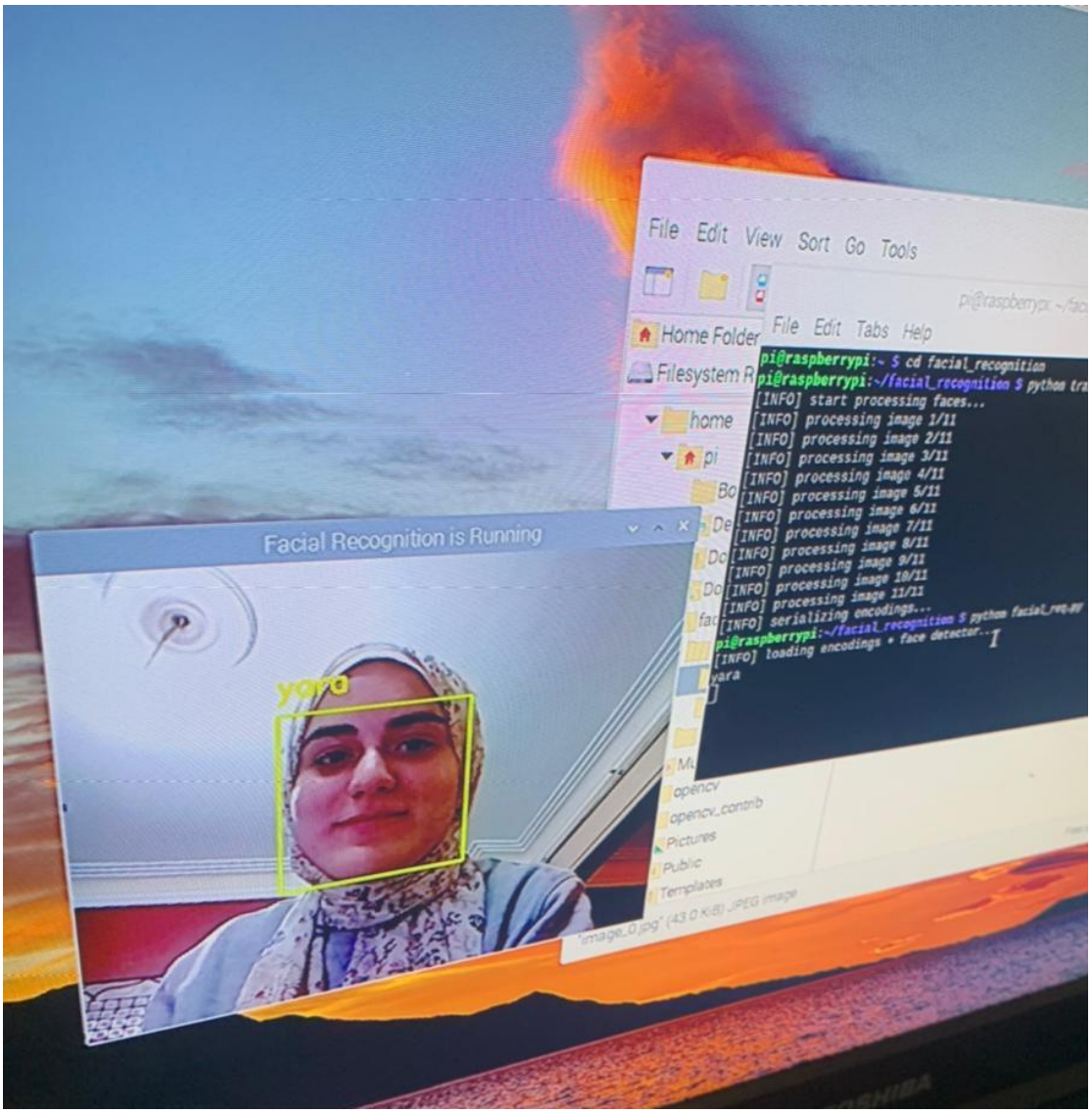
```
#! /usr/bin/python

# import the necessary packages
from imutils.video import VideoStream
from imutils.video import FPS
import face_recognition
import imutils
import pickle
import time
import cv2

#Initialize 'currentname' to trigger only when a new person is ide
currentname = "unknown"
#Determine faces from encodings.pickle file model created from tra
encodingsP = "encodings.pickle"

# load the known faces and embeddings along with OpenCV's Haar
# cascade for face detection
print("[INFO] loading encodings + face detector...")
data = pickle.loads(open(encodingsP, "rb").read())
```

```
vs = VideoStream(usePiCamera=True).start()
time.sleep(2.0)

# start the FPS counter
fps = FPS().start()

# loop over frames from the video file stream
while True:
    # grab the frame from the threaded video stream and resize it
    # to 500px (to speedup processing)
    frame = vs.read()
    frame = imutils.resize(frame, width=500)
    # Detect the fce boxes
    boxes = face_recognition.face_locations(frame)
    # compute the facial embeddings for each face bounding box
    encodings = face_recognition.face_encodings(frame, boxes)
    names = []

    # loop over the facial embeddings
    for encoding in encodings:
        # attempt to match each face in the input image to our known
        # encodings
        matches = face_recognition.compare_faces(data["encodings"],
            encoding)
```

```
51          name = "Unknown" #if face is not recognized, then print Unknown
52
53          # check to see if we have found a match
54          if True in matches:
55              # find the indexes of all matched faces then initialize a
56              # dictionary to count the total number of times each face
57              # was matched
58              matchedIdxs = [i for (i, b) in enumerate(matches) if b]
59              counts = {}
60
61              # loop over the matched indexes and maintain a count for
62              # each recognized face face
63              for i in matchedIdxs:
64                  name = data["names"][i]
65                  counts[name] = counts.get(name, 0) + 1
66
67              # determine the recognized face with the largest number
68              # of votes (note: in the event of an unlikely tie Python
69              # will select first entry in the dictionary)
70              name = max(counts, key=counts.get)
71
72              #If someone in your dataset is identified, print their name on the
                    screen
73              if currentname != name:
```

```
            if currentname != name:
                currentname = name
                print(currentname)

        # update the list of names
        names.append(name)

    # loop over the recognized faces
    for ((top, right, bottom, left), name) in zip(boxes, names):
        # draw the predicted face name on the image - color is in BGR
        cv2.rectangle(frame, (left, top), (right, bottom),
            (0, 255, 225), 2)
        y = top - 15 if top - 15 > 15 else top + 15
        cv2.putText(frame, name, (left, y), cv2.FONT_HERSHEY_SIMPLEX,
            .8, (0, 255, 255), 2)

    # display the image to our screen
    cv2.imshow("Facial Recognition is Running", frame)
    key = cv2.waitKey(1) & 0xFF

    # quit when 'q' key is pressed
    if key == ord("q"):
        break

    # update the FPS counter
    fps.update()

# stop the timer and display FPS information
fps.stop()
print("[INFO] elasped time: {:.2f}".format(fps.elapsed()))
print("[INFO] approx. FPS: {:.2f}".format(fps.fps()))

# do a bit of cleanup
cv2.destroyAllWindows()
vs.stop()
```

❖ **After running the code :**



Chapter 3

OCR

3. OCR

3.1 A simple representation of OCR deployment on raspberry pi

The Raspberry Pi is employed for machine learning projects or as a surveillance camera. Here, text that the application finds interesting can frequently be found in photographs. So that we can use a program to analyze the text, we want to extract and convert this information. The Raspberry Pi can likewise perform this kind of text recognition, and it is not even hard. Either from static photos or a webcam live stream, we read text. We will examine how and what we will need to use the Raspberry Pi to accomplish text recognition.

3.2 Required Components Before You Start

The main part of the application is purely software-based. Therefore, we only require a small amount of hardware to set up the text recognition. We will need and use the following components.

- Powerful Raspberry Pi
- Raspberry Pi camera
    - alternatively: USB webcam*
- Power connection: micro-USB cable and USB adapter

Screen, keyboard, and mouse can be used, but since we work remotely on the Raspberry Pi, we do not necessarily need them.

Therefore, you should have set up your Raspberry Pi accordingly, as well as enabled SSH and established a remote desktop connection. After that, we can start directly.

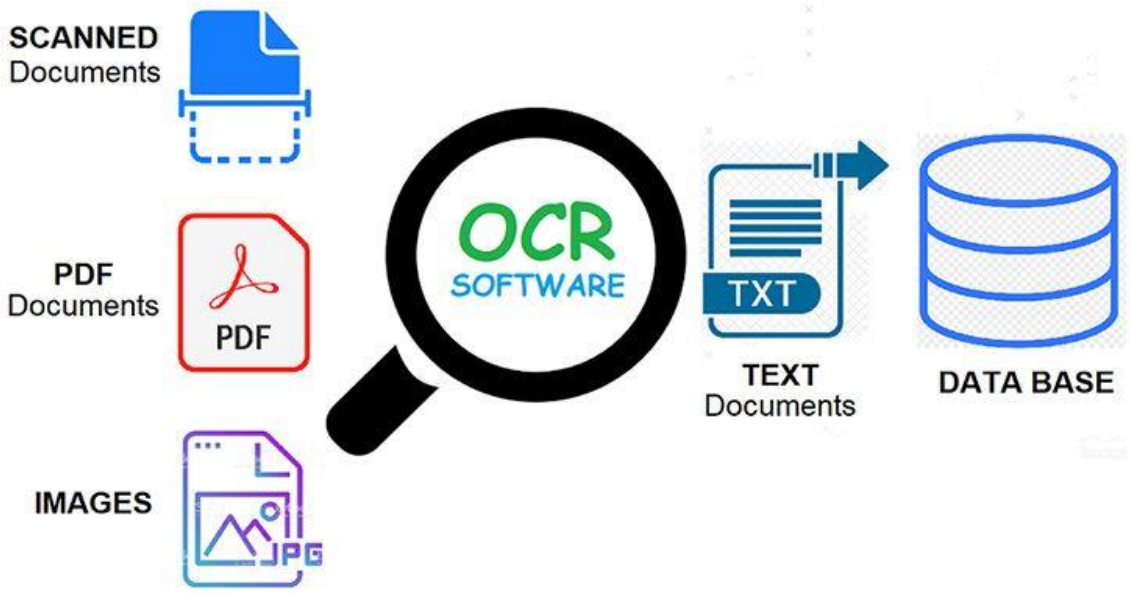
3.3 What is Optical Character Recognition (OCR)?

Text recognition is another name for optical character recognition (OCR). It is a group of technologies that takes data from scanned documents, camera photos, and image-only PDFs and uses it for new applications. The original material can be accessed and edited by using OCR software, which isolates letters on the image, turns them into words, and then turns the words into sentences. Furthermore, it does away with the requirement for human data entry. Why is it necessary to convert these materials into data? An analogy may be useful in this situation. It is merely an image of the document if you use your smartphone to snap a photo of it. The words on the page cannot be searched. The words in the photograph are analyzed by OCR software, which then transforms them into characters just as if you had typed them yourself. Those translated characters are now valuable information that can be forwarded to systems, kept alongside the document to make it easier to look for them in the future, or in our case, utilized as a database that our model can access.
OCR systems transform physical, printed documents into machine-readable text by combining hardware and software. Text is normally copied or read using hardware, such as an optical scanner or specialist circuit board. In this case, the optical scanner is the raspberry pi camera, and the specialized circuit board is the raspberry pi board. Software typically handles the advanced processing after this.

OCR as a process consists of several sub-processes to perform as accurately as possible. The subprocesses are:

- Pre-processing of the Image
- Text Localization
- Character Segmentation
- Character Recognition
- Post Processing

The sub-processes in the list above of course can differ, but these are steps needed to approach automatic character recognition. In OCR software, it is main aim to identify and capture all the unique words using different languages from written text characters.



3.4 Operation Procedures

3.4.1 Pattern recognition

- By employing this method, the computer attempts to identify the full character and compares it to the character matrix contained in the software. This method is often referred to as matrix matching or pattern matching. This method's disadvantage is that it depends on the input and saved characters having the same font and scale. Look at the image below; it shows the OCR-A, the first font designed for OCR in the 1960s and featuring uniformly sized letters. This font was used to print all checks so that banking computers could process them.

Fig: OCR pattern recognition

- Scan2CAD applies Neural Networks to the task of pattern matching. Neural networks work in an analogous way to the human brain. They learn to

recognize shapes and patterns from a range of examples. Scan2CAD includes a feature allowing the user to train their own Neural Networks to recognize font styles unique to their drawings.

3.4.2 Feature extraction

- By employing this method, the computer attempts to identify the full character and compares it to the character matrix contained in the software. This method is often referred to as matrix matching or pattern matching. This method's disadvantage is that it depends on the input and saved characters having the same font and scale. Look at the image below; it shows the OCR-A, the first font designed for OCR in the 1960s and featuring uniformly sized letters. This font was used to print all checks so that banking computers could process them.

3.5 OCR Challenges

3.5.1 Scene Complexity

In a typical setting, there are numerous items that can be photographed, including symbols, buildings, and paintings. Text recognition is exceedingly difficult because of these things' resemblance to text in terms of their shapes and looks.

3.5.2 Conditions of Uneven Lighting

We frequently take pictures in a natural setting, which produces asymmetrical lighting and shadows. Another difficulty with OCR is that it diminishes desired image features, which leads in less reliable detection, segmentation, and recognition outcomes.

3.5.3 Rotation

Since the point of view for the input image from a camera, hand-held device, or other device is not fixed like a scanner input, it is possible to see text lines twisting or skewing from their original alignment.

3.5.4 Blurring and Degradation

The focusing of the digital camera is crucial because many digital cameras are designed to operate at a range of distances. Character sharpness is necessary for the optimum character segmentation and recognition accuracy.

3.5.5 Aspect Ratios

Different aspect ratios exist for text. Text might be short, like on road signs, or it can be long, like in video captions, location, scale, and length.

3.5.6 Rotation

The point of view for the input image captured from a camera on a handheld device or other gadgets is not fixed like a scanner input, so text lines may be seen to be skewing or spinning from their original alignment.

3.5.7 Fonts

OCR is further complicated by varied text styles and typefaces, making it challenging to carry out OCR operations like segmentation. It is challenging to accurately recognize characters because of the differences and numerous sub-spaces they create in different fonts.

3.5.8 Approaches

Now that we are aware of how the OCR technology's underlining functions, we must comprehend the various methods and options that can be used to achieve the goals that were depicted; however, it should be noted that these methods were selected to maintain the project's scope and may vary from one scope to another.

3.5.9 Google Cloud Vision

One of the fastest and most accurate OCR engines available is in contradiction with the project's requirement to create a locally based system that is independent of external resources and networks to access its services.

3.5.10 Tesseract

Is an open-source optical character recognition engine that is regarded as the best and most widely used OCR library. Tesseract looks for templates in words, letters, and phrases made up of pixels. It employs a two-step process known as adaptive recognition. One data step is needed for character recognition, and a second stage is needed to fill in any missing letters with letters that are appropriate for the word or phrase context. It complies with the project's scope and will deliver adequate speed, time, and accuracy.

For the above stated reasons Tesseract OCR was our choice for the implementation of our Audible Text feature.

Tesseract OCR

Tesseract is an open-source text recognition (OCR) engine, available under the Apache 2.0 license. It can be used directly, or -for programmers- using an API to extract printed text from images. Tesseract does not have a built-in GUI, but there are several available from the 3rdParty page. It is also compatible with many programming languages and frameworks through wrappers. It can be used with the existing layout analysis to recognize text within a large document, or it can be used in conjunction with an external text detector to recognize text from an image of a single text line.

1. Operation Procedures

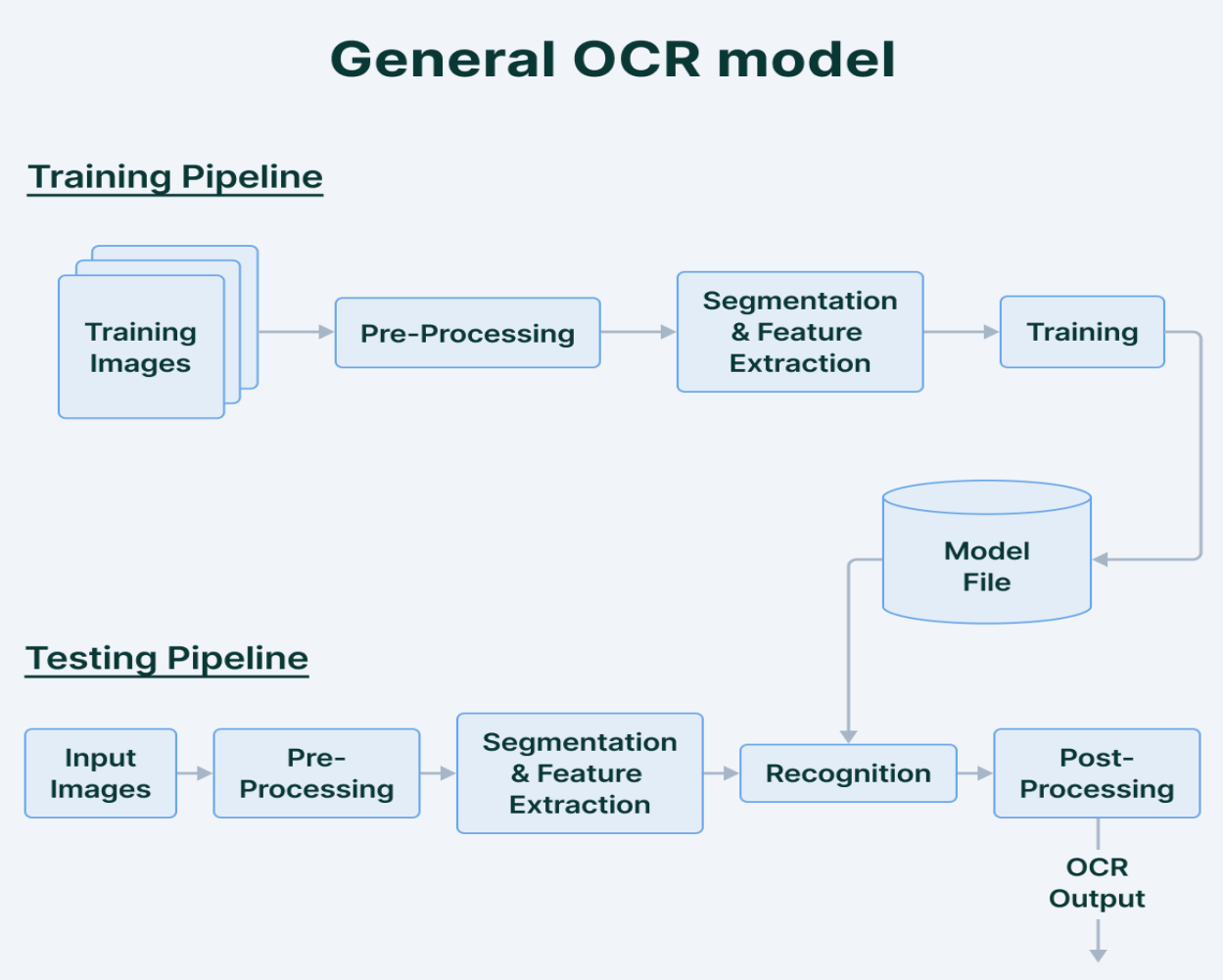


Fig: OCR process flow

LSTMs are great at learning sequences but slow down a lot when the number of states is too large. There are empirical results that suggest it is better to ask an LSTM to learn a long sequence than a short sequence of many classes. Tesseract developed from OCRopus model in Python, which was a fork of a LSMT in C++, called CLSTM. CLSTM is an implementation of the LSTM recurrent neural network model in C++, using the Eigen library for numerical computations. Legacy Tesseract 3.x was dependent on the multi-stage process where we can differentiate steps:

- Word finding
- Line finding
- Character classification

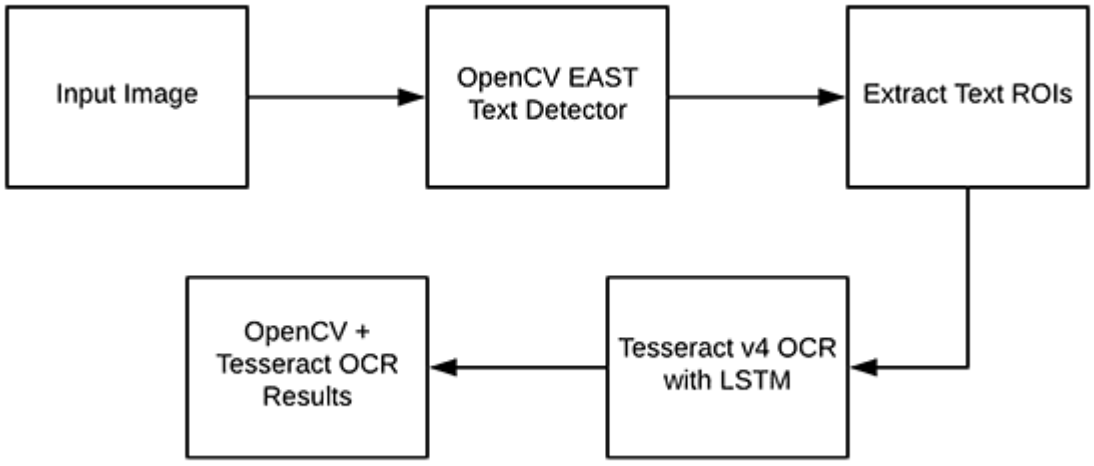


Fig: OCR pipeline

Text lines were grouped into blobs, and the lines and regions were then examined for fixed pitch or proportional text to locate words. Depending on the type of character spacing, text lines are divided into words in a variety of ways. The process of recognition then continues in two passes. First, each word is tried to be recognized individually. Then, as training data, each acceptable word is provided to an adaptive classifier. The adaptive classifier then can correctly identify text further down the page.

Code cleanup and the addition of a new LSTM model were efforts made to modernize the Tesseract tool. Boxes (rectangles) made from the input image are processed line by line and fed into the LSTM model to produce the output. The illustration below shows how it functions.

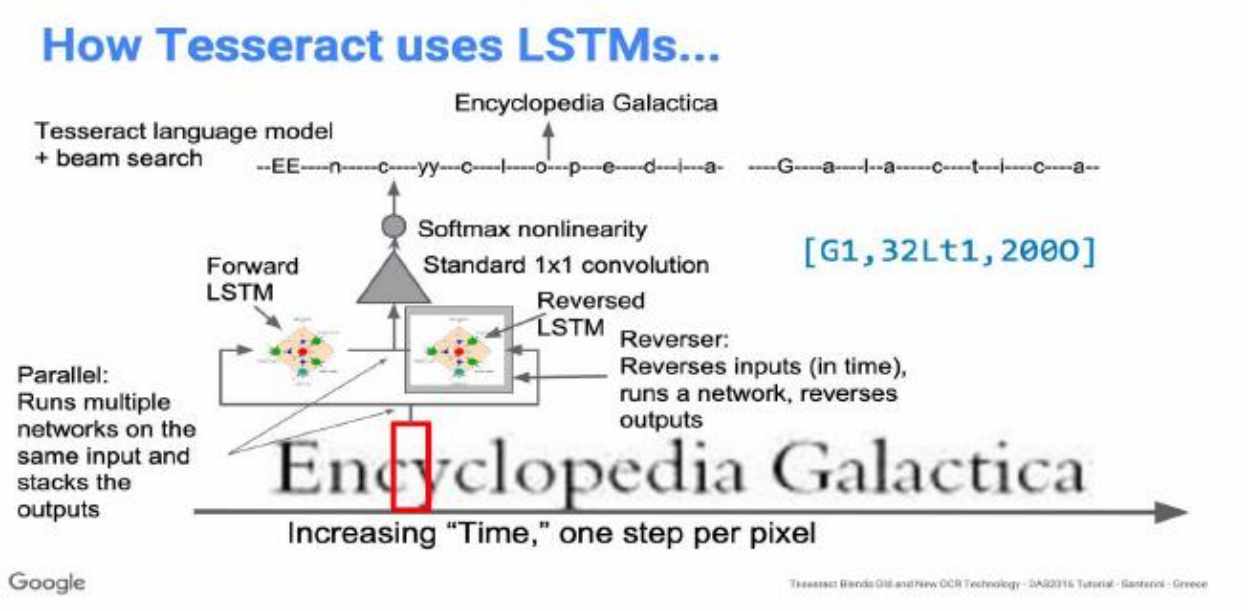


Fig: LSTM layout

2. Limitations of Tesseract

Tesseract functions best when there is a clear separation between the foreground and background texts. It can be exceedingly difficult to guarantee this kind of setup in real life. Tesseract may produce output that is of inferior quality for several different causes, such as background noise in the image. The recognition outcome is better when the image quality (size, contrast, and lighting) is better. To enhance the OCR results, some preprocessing is necessary. Images must be scaled suitably, have maximum image contrast, and be horizontally aligned. Tesseract OCR is quite powerful but does have the following limitations:

- The OCR is not as accurate as some commercial solutions available
- Does not do well with images affected by artifacts including partial occlusion, distorted perspective, and complex background
- It is not capable of recognizing handwriting
- It may find gibberish and report this as OCR output
- If a document contains languages outside of those given in the -l LANG arguments, results may be poor
- It is not always good at analyzing the natural reading order of documents. For example, it may fail to recognize that a document contains two columns and may try to join text across columns
- Poor quality scans may produce inferior quality OCR
- It does not expose information about what font family text belongs to.

3. Conclusion

The impact of deep learning on computer vision has practically reached every aspect of character and handwriting recognition. Unprecedented text recognition

accuracy has been achieved using deep learning-based models, significantly surpassing that of conventional feature extraction and machine learning techniques. Tesseract performs well when document images follow the next guidelines:

- Clean segmentation of the foreground text from background
- Horizontally aligned and scaled appropriately
- High-quality image without blurring and noise

The latest release of Tesseract 4.0 supports deep learning-based OCR that is significantly more accurate. The OCR engine itself is built on a Long Short-Term Memory (LSTM) network, a Recurrent Neural Network (RNN).
Tesseract has excellent accuracy and font variability due to its thorough training, making it ideal for scanning clean manuscripts. If you need to scan books, documents, or printed text on a crisp white background, Tesseract is the tool to use.

What are the challenges with reading a medical record?
There are several challenges in reading a medical record with OCR. Quality varies, especially fax quality. There are also millions of different document formats that need to be read. Handprinted characters and legibility of physician writing can also cause challenges. OCR is not easy. In fact, OCR of medical records with traditional OCR solutions is impractical at best. However, combining OCR, AI and ML changes the game. The adaptive, learning nature of the AI/ML combined with OCR overcomes most of the challenges listed above. It is now technically practical to read medical record documents and convert these images to usable, searchable data.

What kind of results can I expect?

Another common question I get is, “What kind of accuracy am I likely to achieve?” Simply stated, like miles per gallon on your car, actual mileage varies. Same with OCR. So, what have I learned in my 25 years of working on this problem?

1. **Strategy over technology:** Establishing expectations and a strategy is key. While many customers look to technology and tools first, it is more valuable

to understand that success with OCR is an incremental journey, not an event that happens once you buy the right product. OCR requires a plan.

2. **Show Me:** It is common for OCR software vendors to make many claims about their products. No problem. It is quite simple to determine if the claims are true. Run a series of tests on real documents and show the results. At BRYJ, we do this as a part of every project and believe it is a critical step before purchase. Your vendor should not charge you to prove their product works on your documents.
3. **Start Simply:** OCR can be complex; your first projects should not be. Start with a simple initial project that creates a foundation for the future while delivering some meaningful return on investment. Your first project should take less than three months, or it is too big.

How does optical character recognition work?

A scanner is used by optical character recognition (OCR) to process a document's physical form. OCR software turns the document into a two-color or black-and-white version after all pages have been copied. The scanned-in image or bitmap is examined for bright and dark parts, with the light areas being classified as background and the dark areas as characters that need to be recognized. After processing the black regions, alphabetical or numerical digits are discovered. During this phase, you usually focus on one character, word, or section of text at a time. Then, one of two algorithms—pattern recognition or feature recognition—is used to identify the characters.

When examples of text in different fonts and formats are provided to the OCR program, pattern recognition is used to compare and identify characters in the scanned document or image file.

When the OCR uses rules pertaining to the characteristics of a particular letter or number to recognize characters in the scanned document, this process is known as

feature detection. Characteristics include things like how many curved, crossing, or angled lines there are. For instance, the capital "A" is recorded as two intersecting diagonal lines with a horizontal line running through the center. A detected character is translated into an ASCII code (American Standard Code for Information Interchange), which computer systems employ to handle additional operations.

The structure of a picture of a document is likewise examined by an OCR program. It separates the page into sections that include text blocks, tables, and graphics. Words are first separated from lines to form lines, and then characters. After identifying the characters, the algorithm compares them to a collection of pattern images. The computer displays the recognized text to you after analyzing all potential matches.

The benefits of optical character recognition

The fundamental advantage of optical character recognition (OCR) technology is that it makes text searches, editing, and storage simple, which simplifies data entering. OCR makes it possible for companies, people, and other entities to keep files on their PCs, laptops, and other devices, ensuring constant access to all paperwork.

The benefits of employing OCR technology include the following:

- Reduce costs
- Accelerate workflows
- Automate document routing and content processing
- Centralize and secure data (no fires, break-ins or documents lost in the back vaults)

- Improve service by ensuring employees have the most up-to-date and accurate information
- Can be used in health care field (this is what our project based on)

OCR and AI "Read" Medical Records

We frequently discover that the prescriptions being given to patients are not properly prepared, and the diagnostic reports being given cannot be checked without the doctor's involvement due to a lack of medical understanding. The patient's safety has been compromised as a result, and occasionally doctors are not available for the necessary amount of time to monitor reports, which puts patients' lives in danger. To distinguish between handwritten and printed text in prescriptions and reports, the HCR (Handwriting Character Recognition) and PCR (Printer Character Recognition) approaches have been applied. Image processing techniques have also been used to enhance images and produce reliable results. OCR technology today offers written characters in high-quality photos with greater than 99 percent accuracy. However, as you can see in the accompanying image, the variety of human writing styles, spacing variations, and inconsistencies of handwriting lead to less precise character recognition. As a result, technologies that read handwriting cannot be as accurate as OCR systems on typed text. However, because of the ongoing study in this area, handwriting recognition has become more accurate thanks to the introduction of extremely complex algorithms that address this issue.

A personal health record (PHR) is an electronic tool that allows users to access, manage, and share their health data1. PHRs can help people take a more active part in their own health and offer patients decision-making support to help them

manage chronic illnesses. A PHR system's fundamental role is data collecting, and manually entering PHR data can be time-consuming and error prone. Giving people access to their own electronic health records (EHRs), which has been or is being implemented in certain industrialized nations, is therefore a more realistic method for gathering PHR data. For instance, many people in the US can use Blue Button to access and download their own EHR data. And in England, all patients will have online access to the EHR data that their general practitioners hold by 2015

Can OCR and AI "Read" Medical Records?

Yes, OCR can be remarkably effective in reading all types of healthcare documents, including medical records and pharmaceutical labels, is the quick response. Understanding how the technologies operate and some of the ongoing difficulties with utilizing OCR to read medical documents are equally crucial.

Why would I want to use OCR for medical records?

The folks this project was created for are everything. The individuals we discuss are suffering from a chronic illness called Alzheimer's disease. As we have already demonstrated, Alzheimer's disease is a degenerative neurologic disorder that results in brain shrinkage and the death of brain cells. It is the most typical cause of dementia, characterized by a steady deterioration in mental, behavioral, and social abilities that impairs a person's capacity for independent functioning.
OCR is our entry tool of the medical drug doses timing to date base so we can remind those with Alzheimer disease to take their medicines in the appointed time for it.

How would I want to use OCR for medical records?

1. The data acquisition process

   Using the OCR deployed model and the raspberry pi camera we can get the data needed which specify the following:

   - The medical drug product name
   - The dose
   - The appointed time

2. The data management process

   The data will be saved in a data base format on the server associated with the raspberry pi

3. Data extraction process

   At the appointed time, the model will remind the patient by firing an alarm showing the drug name, the dose on the screen

❖ **Real-time code associated with OCR**

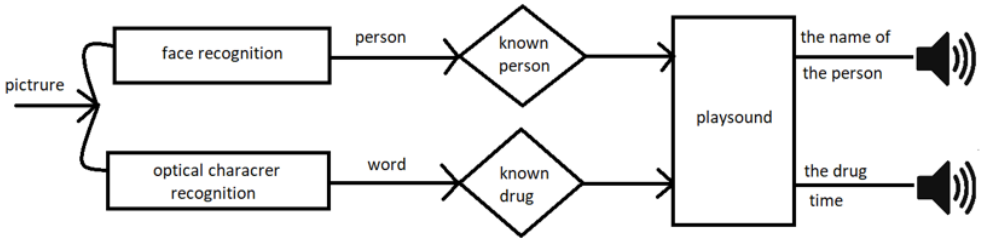
```python
import cv2
import pytesseract
from pytesseract import Output

cap = cv2.VideoCapture(0)
cap.set(cv2.CAP_PROP_BUFFERSIZE, 1)

while True:
    # Capture frame-by-frame
    ret, frame = cap.read()

    d = pytesseract.image_to_data(frame, output_type=Output.DICT)
    n_boxes = len(d['text'])
    for i in range(n_boxes):
        if int(d['conf'][i]) > 60:
            (text, x, y, w, h) = (d['text'][i], d['left'][i], d['top'][i], d['width'][i], d['height'][i])
            # don't show empty text
            if text and text.strip() != "":
                frame = cv2.rectangle(frame, (x, y), (x + w, y + h), (0, 255, 0), 2)
                frame = cv2.putText(frame, text, (x, y - 10), cv2.FONT_HERSHEY_SIMPLEX, 1.0, (0, 0, 255), 3)

    # Display the resulting frame
    cv2.imshow('frame', frame)
    if cv2.waitKey(1) & 0xFF == ord('q'):
        break

# When everything done, release the capture
cap.release()
cv2.destroyAllWindows()

```

Chapter 4 play sound

4. play sound

4.1 Objectives

The play sound feature has been used in two important parts in the project, Face Recognition and Optical Character Recognition: after Face Recognition, voice data bearing the name of the person identified is played on the speakers, but for OCR the name and dates of the drug identified are pronounced and played on speakers.



4.2 what is the playsound

The playsound module is a cross platform module that can play audio files. There are no dependencies on this.

It's simple to play sound in Python. Several modules are available that can play sound files (.wav). these modules work cross platform (Windows, Mac, Linux). The simplicity of use and supported file formats are the primary differences. They should all work with Python 3. Unless you specify a path, the audio file should be in the same directory as your Python program.

4.3 installing playsound

The code

- There is only one function in playsound module is **playsound().**
- The path to the file containing the sound we want to play is the only argument needed. It could be a *URL* or a *local file*.

- The second argument, **block**, is optional and by default has the value True. In order to have the function run **asynchronously**, we can change it to False.
- It can work with both **WAV** and **MP3** files.

4.3.1 code for wav

```
# import required module
from playsound import playsound

# for playing note.wav file
playsound('/path/note.wav')
print('playing sound using  playsound')
```

4.3.2 code for mp3

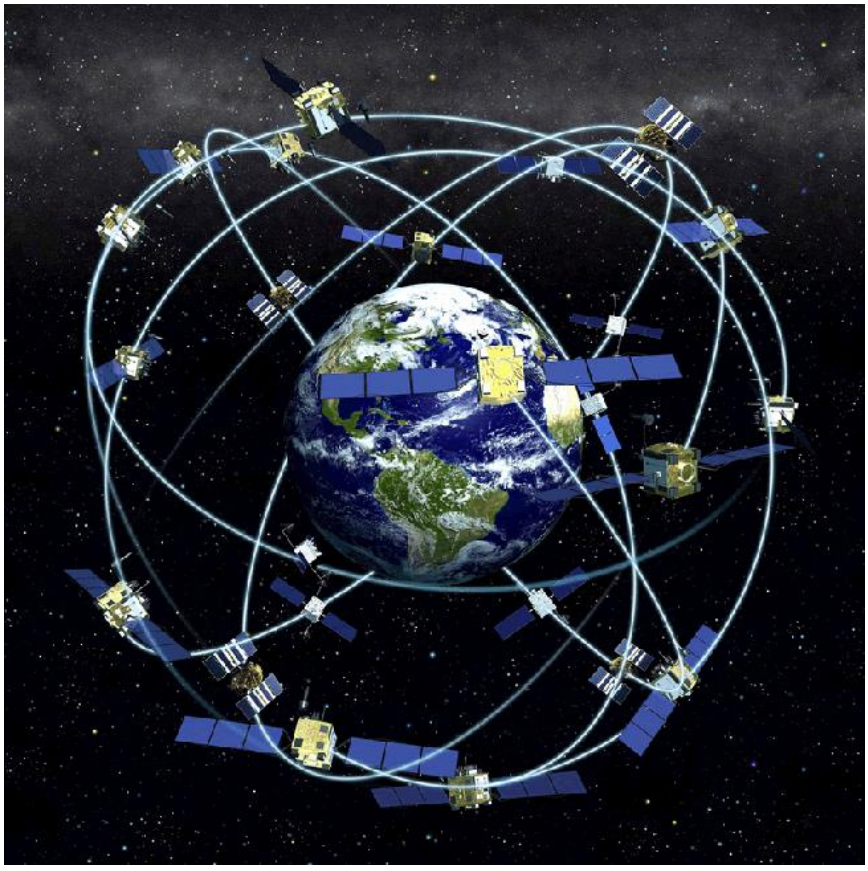
```
# import required module
from playsound import playsound

# for playing note.mp3 file
playsound('/path/note.mp3')
print('playing sound using  playsound')
```

Chapter 5 GPS

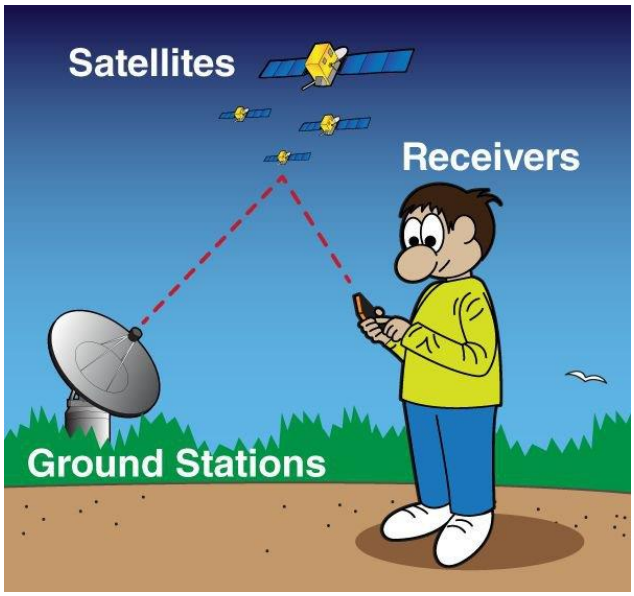
5. GPS

5.1 Description of GPS?

The Global Positioning System (GPS) is a satellite-based navigation system which is made up of at least 24 satellites. GPS works in any weather conditions, anywhere in the world, 24 hours a day, with no fees or setup charges. The U.S. The satellites were initially launched into orbit by the Department of Defense (USDOD) for military purposes, but in the 1980s, they became accessible for civilian usage.



5.2 How GPS works



In a precise orbit, GPS satellites make two daily orbits around the planet. GPS receivers can decode and calculate the precise location of a satellite based on the unique signals and orbital parameters that each satellite transmits. This information and trilateration are used by GPS receivers to determine a user's e xact location. Essentially, the GPS receiver measures the distance to each satellite by the amount of time it takes to receive the transmitted signal from the satellite.
In order to calculate our 2-D position (latitude and longitude) and track movement, The GPS receiver must be locked on to the signal of at least 3 satellites. Your 3-D position can be determined by the receiver when 4 or more satellites are viewable (latitude, longitude and altitude). Generally, The GPS receiver may track 8 or more satellites, but that depends on the time of day and where you are on the earth. Once your position has been determined, the GPS unit can calculate many information, such as:

- Speed
- Tracking
- Distance of trip
- Distance to destination
- Sunrise and sunset time
- And more

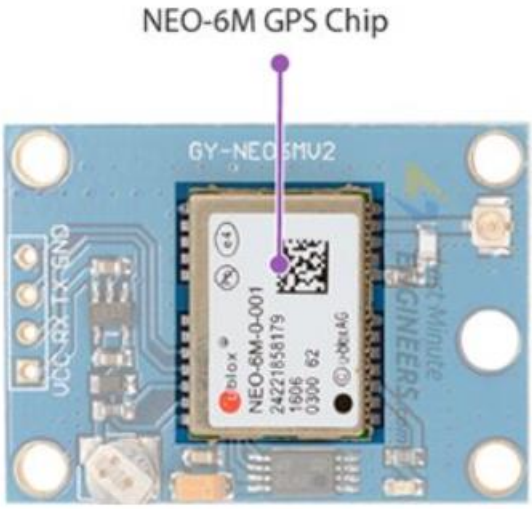
5.3 GPS feature our on the project

The GPS tracking feature is used for the Alzheimer's patient to ensure his safe return to home, and his family can determine his location on map, and his location is displayed on a portable screen with him to help him return or go wherever he wants. We use ublox NEO-6M GPS Module to detect the position

5.5 Hardware Component Overview

5.5.1 NEO-6M GPS Chip

At the Center of the module is a GPS chip from U-blox – NEO 6M.



The chip is less than the size of a postage stamp, but it has a surprising number of features.

It can track up to 22 satellites across 50 channels and outperform the industry's highest level of tracking sensitivity 45 mA current.
Unlike other GPS modules, it can update the location 5 times with 2.5m horizontal position accuracy in a second. The U-blox 6 positioning engine has a Time-To-First-Fix (TTFF) of less than 1 second.
The data pins of the NEO-6M GPS chip are broken out to a 0.1″ pitch headers. It contains the pins which is used for communication with the microcontroller over the UART. The NEO-6M module supports baud rates from 4800bps to 230400bps with a default baud of 9600.

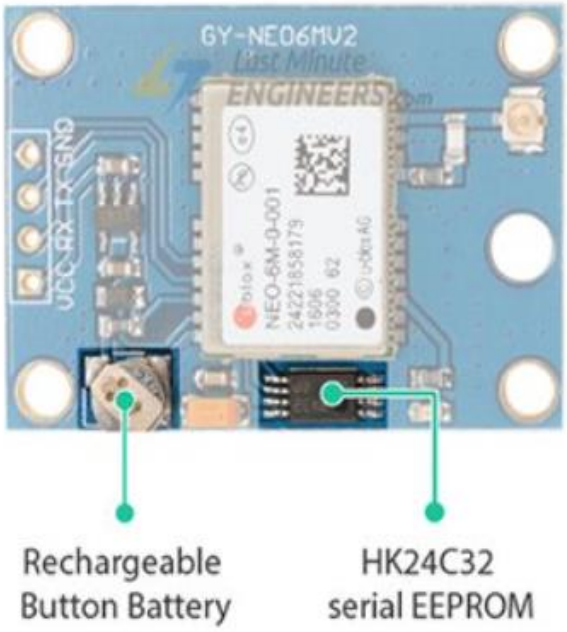
The Module Specifications

Receiver Type	50 channels, GPS L1(1575.42Mhz)
Horizontal Position Accuracy	2.5m
Navigation Update Rate	1HZ (5Hz maximum)
Capture Time	Cool start: 27sHot start: 1s
Navigation Sensitivity	-161dBm
Communication Protocol	NMEA, UBX Binary, RTCM
Serial Baud Rate	4800-230400 (default 9600)
Operating Temperature	-40°C ~ 85°C
Operating Voltage	2.7V ~ 3.6V
Operating Current	45mA
TXD/RXD Impedance	510Ω

5.5.2 Position Fix

The NEO-6M GPS module has an LED that displays the 'Position Fix' state. Depending on the condition it is in, it will blink at various rates:

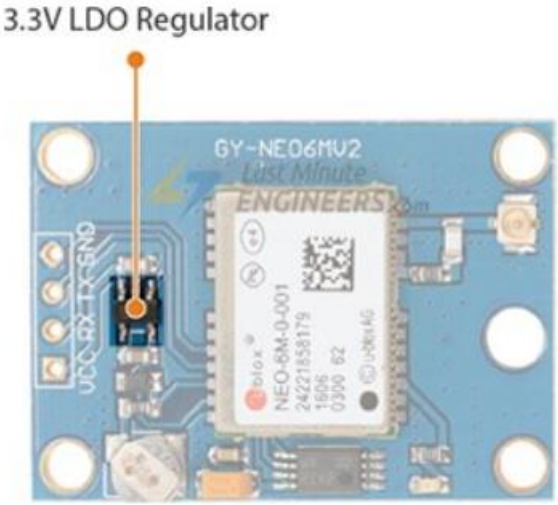
- No blinking –searching for satellites.
- Blink every 1s – Position Fix is found (enough satellites can be seen by the module).



5.5.3 (3.3V) LDO Regulator

The operating voltage needed for the NEO-6M chip ranges from 2.7 to 3.6V. this module comes with MICREL's MIC5205 Ultra-Low Dropout 3V3 regulator.

The logic pins are also 5-volt tolerant, so we can easily connect it to raspberry or any 5V logic microcontroller without using a logic level converter.



5.5.4 EEPROM & Battery

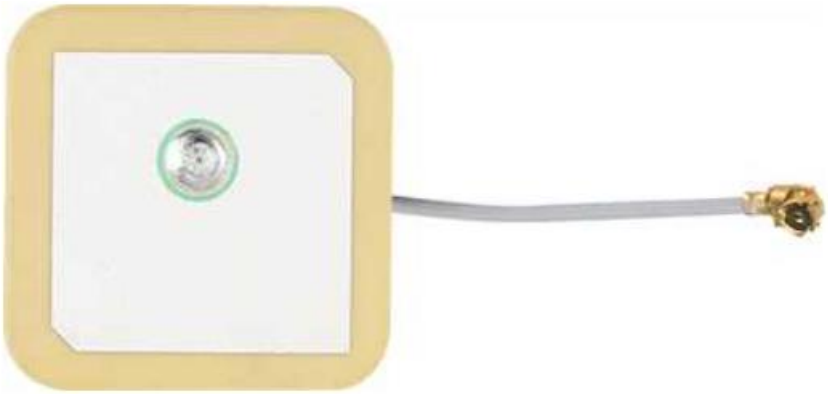
The module is capable with HK24C32 Two Wire Serial EEPROM. It is 4KB in size and connected via I2C to the NEO-6M chip
The module also has a rechargeable button battery that acts as a super-capacitor.

EEPROM and battery together help to keep the BBR (Battery Backed RAM). BBR contains latest position data (GNSS orbit data), clock data and module configuration. But it is not for permanent data storage.
Since the battery keeps the clock and last position data, Time-To-First-Fix (TTFF) is significantly reduced to 1s. This makes position locks much quicker. The GPS

always starts cold when there is no battery and takes longer to establish the first GPS lock.

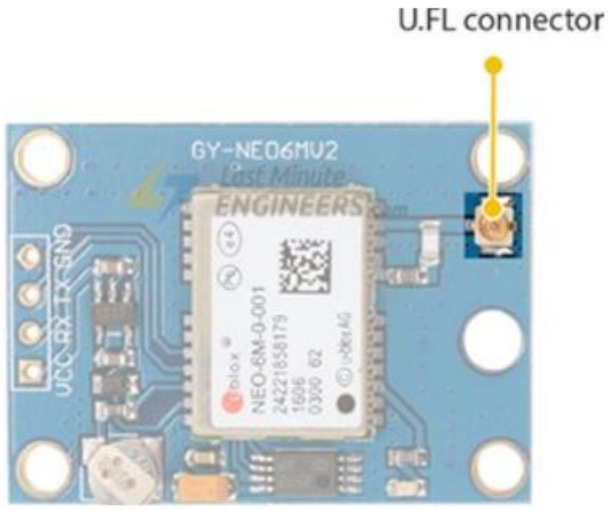
5.5.5 Antenna

The module comes with -161 dBm sensitivity patch antenna to recieve radio signals from GPS satellites.



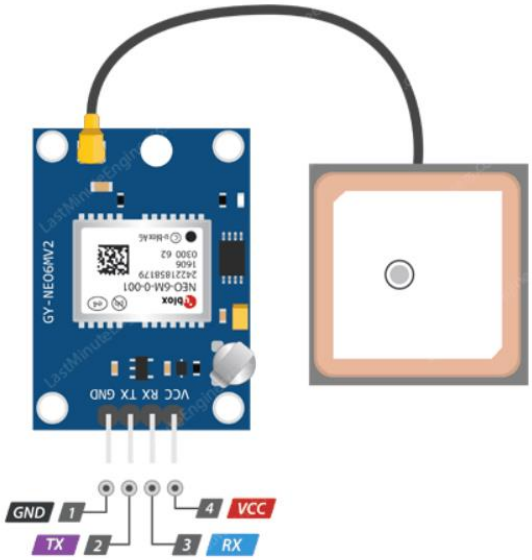
This antenna fits into the module's tiny U.FL connector with a snap.

The patch antenna is great for our project. But if we want to get more sensitivity and accuracy, we can also snap-on any 3V active GPS antenna.

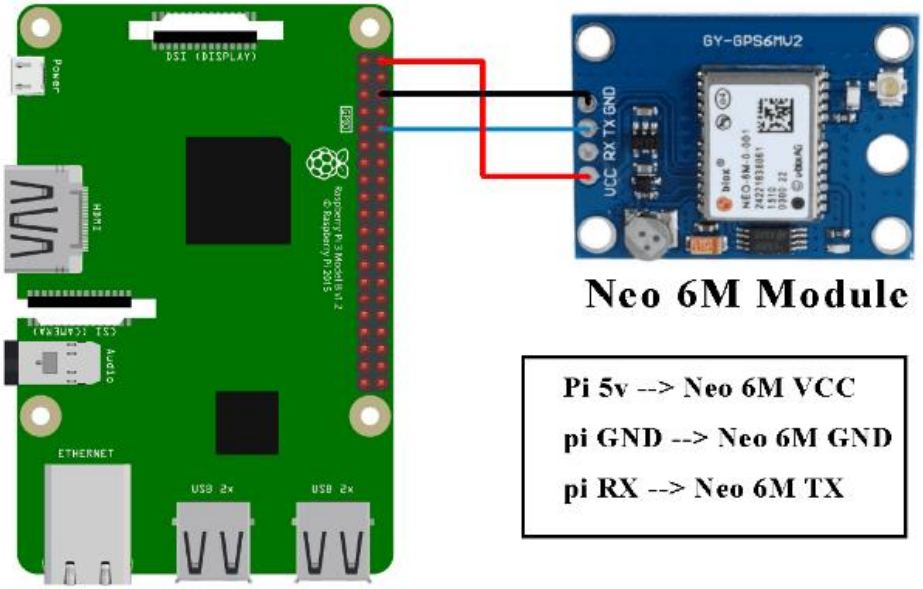


5.5.6 NEO-6M GPS Module Pinout

The NEO-6M GPS module has 4 pins that connect it to our microcontroller.



5.6 Wiring a NEO-6M GPS Module to Raspberry Pi



5.7 Software on raspberry pi

5.7.1 Receive data from the GPS module:

1. Install the last Raspbian OS in a memory card.

2. Insert the memory card into raspberry pi.
3. Now we need to modify few things. At first, we need to edit the /boot/config.txt file by writing the command

```
sudo nano /boot/config.txt
```

❖ At the end of the file add

```
dtparam=spi=on
dtoverlay=pi3-disable-bt
core_freq=250
enable_uart=1
force_turbo=1
```

4.Raspbian uses the UART as a serial console and so we need to turn off that functionality.

```
sudo cp /boot/cmdline.txt /boot/cmdline_backup.txt
```

❖ Now to edit that file

```
sudo nano /boot/cmdline.txt
```

❖ Replace the content with

```
dwc_otg.lpm_enable=0 console=tty1 root=/dev/mmcblk0p2 rootfstype=ext4 elevator=deadline fsck.repair=yes rootwait quiet
```

5.After rebooting the raspberry pi now it's time to check how our GPS module is working.

Make sure that the blue LED in the Neo 6M is blinking. Basically, the blinking of blue LED means that its receiving the data perfectly

❖ When it is blinking, run the following command:

```
sudo cat /dev/ttyAMA0
```

❖ The raw data of the position

```
$GPVTG,,T,,M,0.508,N,0.941,K,A*22
$GPGGA,191355.00,2240.36611,N,08826.15904,E,1,06,1.51,4.5,M,-54.0,M,,*72
$GPGSA,A,3,22,31,16,32,03,26,,,,,,,3.66,1.51,3.33*04
$GPGSV,4,1,13,01,16,251,18,03,40,313,31,10,05,151,,14,43,068,*7E
$GPGSV,4,2,13,16,53,176,15,18,14,225,,22,56,291,37,23,15,311,18*73
$GPGSV,4,3,13,26,73,109,34,27,04,172,,29,00,063,,31,38,029,19*72
$GPGSV,4,4,13,32,29,092,22*4A
$GPGLL,2240.36611,N,08826.15904,E,191355.00,A,A*69
$GPRMC,191356.00,A,2240.36576,N,08826.15878,E,0.156,,140719,,,A*73
$GPVTG,,T,,M,0.156,N,0.289,K,A*22
$GPGGA,191356.00,2240.36576,N,08826.15878,E,1,06,1.51,4.4,M,-54.0,M,,*78
$GPGSA,A,3,22,31,16,32,03,26,,,,,,,3.66,1.51,3.33*04
```

5.7.2 setup for writing code

This cod is parsing the raw data and get the latitude and longitude for the location.

1- install a python library

```
sudo cat /dev/ttyAMA0
```

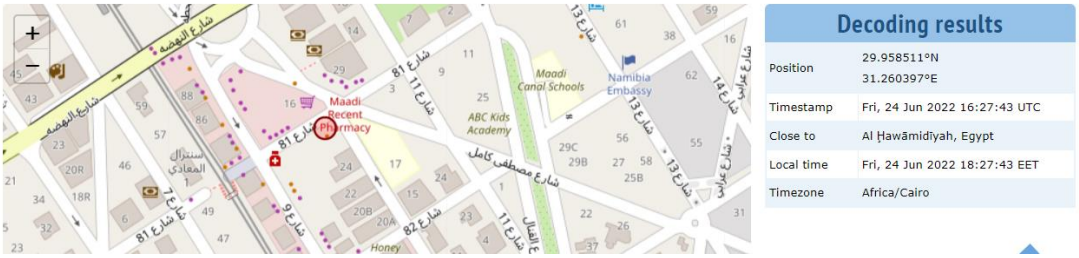
2- write the code

```
import serial
import time
import string
import pynmea2

while True:
    port="/dev/ttyAMA0"
    ser=serial.Serial(port, baudrate=9600, timeout=0.5)
    dataout = pynmea2.NMEAStreamReader()
    newdata=ser.readline()

    if newdata[0:6] == "$GPRMC":
        newmsg=pynmea2.parse(newdata)
        lat=newmsg.latitude
        lng=newmsg.longitude
        gps = "Lat=" + str(lat) + "lng=" + str(lng)
        print(gps)
```

- The output for my location is

```
Lat=29.958511 lng=31.260397
Lat=29.958511 lng=31.260397
Lat=29.958511 lng=31.260397
Lat=29.958511 lng=31.260397
Lat=29.958511 lng=31.260397
Lat=29.958511 lng=31.260397
```

3-Write the latitude and longitude an any maps to get the real location



To transmit the location latitude and longitude to the patient relatives we are going to use free cloud called “Pantry Cloud”

5.8 Pantry Cloud

Pantry Cloud is a JSON storage cloud service that offers a free tier. It is incredibly easy to sign up to Pantry Cloud and send data to it from a Raspberry Pi.
Pantry Cloud is great for Raspberry Pi projects that need to save amounts of data to the cloud. 100mb of storage are available on Pantry Cloud.
The Data that transmitted from the Raspberry Pi to Pantry Cloud can be accessed by any device using the API key. The API key is given to when you first create an

account (no password needed). Reconnecting with a cloud service that doesn't require a password is considerably simpler.

5.8.1 **setup Pantry Cloud on Raspberry Pi**:

Provide an email address on their website to get a free API key (no password required) then doing the following steps

1. Import the JSON library
2. Gather some JSON data
3. Find out the details of the API
4. Send data to the API

Step 1: Import the JSON library
Data sent to a REST API is typically in a JSON format. JSON ‘s format is easy to write out by hand, but Python has a convenient built-in library to make sure we’re working with JSON in a correct format.
The built-in JSON library in Python allows you to work with JSON without having to know the syntax and character requirements of putting together JavaScript Object Notation(JSON) string. Writing **import json** to import the library

Step 2: Gather data
Our approach to generating some JSON data will be to:

1. Setup a dictionary object to hold the reading
2. Create a loop where we generate new readings of the GPS positioning
3. Convert the data to JSON

Step 3: Find the API details
Each API has slightly different ways of communicating with it, but in general we need the following pieces of information:

- A URL for sending data to.
- A URL for reading data from.
- An API key, usually unique to the user.

We must have “basket” in the Pantry cloud to put the data into.
we can name the basket after getting the API key from their website.

URL for sending data to	PUT request: htttps//getpantry.cloud/apiv1/pantry/the_PANTRY_ID/basket/YOUR_BASKET_NAME
URL for reading data from	GET request: **https://getpantry.cloud/apiv1/pantry/the_PANTRY_ID/basket/**YOUR_BASKET_NAME
API Key	THE_PANTRY_ID

Step 4: Send data to the API

The next step is to setup our Python to connect to the API. By following steps

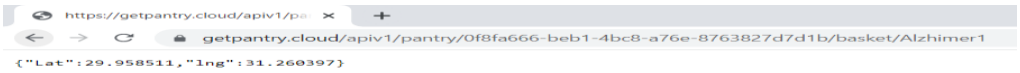
1. Import requests
2. Give the *requests* module our API information
3. Completing a 'request' with our API (to store or get data)

```
import requests

url = "https://..."
our_headers = {...}
our_payload = our_data
response = requests.put(url, headers=our_headers, data=our_payload)
```

❖ The final code to upload the positioning measures

```
import serial
import time
import string
import pynmea2
import json
import request

url="https://getpantry.cloud/apiv1/pantry/0f8fa666-beb1-4bc8-a76e-8763827d7d1b
    /basket/Alzhimer1"
headers={}

while True:
    port="/dev/ttyAMA0"
    ser=serial.Serial(port, baudrate=9600, timeout=0.5)
    dataout = pynmea2.NMEAStreamReader()
    newdata=ser.readline()

    if newdata[0:6] == "$GPRMC":
        newmsg=pynmea2.parse(newdata)
        lat=newmsg.latitude
        lng=newmsg.longitude
        gps = "Latitude=" + str(lat) + "and Longitude=" + str(lng)
        readings = json.dumps(gps)
        response= request.put(url,headers,readings)
        print(gps)
```

❖ Now we can open the link for pantry cloud to get the data


https://getpantry.cloud/apiv1/pa
getpantry.cloud/apiv1/pantry/0f8fa666-beb1-4bc8-a76e-8763827d7d1b/basket/Alzhimer1
{"Lat":29.958511,"lng":31.260397}

Chapter 6 IOT

6. IOT

6.1 Objectives

This project is trying to develop a design, prototype, and software for multi purpose control devices in home and list supported interfaces. The project should be quickly to setup, low power consumption, achieving safety for patients, and easy to control over user interface.

The main objective of home automation and security is to help handicapped and aged people that will enable them to control home appliances and alert them in critical situations.

improve the quality of life and convenience in the home. Other goals are greater security and more efficient use of energy thanks to connected, remote-controllable devices. Home appliances, such as the washing machine, lights or the coffee maker, can be time controlled.

6.2 What Is IOT?

The internet of things, or IOT, is a network of connected computing devices, mechanical and digital machinery, items, animals, or people that may exchange data across a network without requiring human-to-human or human-to-computer interaction.

The term "thing" refers to any natural or artificial object that can be given an Internet Protocol (IP) address and has the ability to transfer data over a network, including people with implanted heart monitors, farm animals with biochip transponders, cars with built-in tier pressure monitors, and other examples.

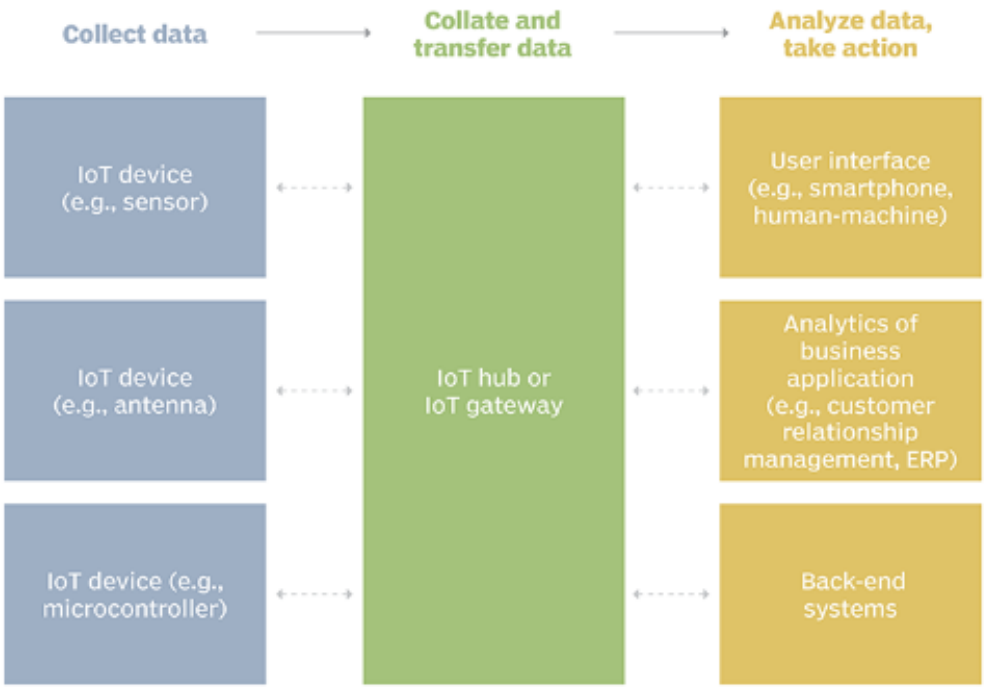
Organizations across a range of industries are increasingly utilizing IoT to improve operational efficiency, better understand customers, and provide greater customer service, better decision-making, and a rise in the company's value.

6.3 How does IOT work?+

The Internet of Things (IoT) ecosystem is made up of web-enabled smart devices that use embedded systems, such as processors, sensors, and communication gear, to gather, send, and act on the data they get from their surroundings. By connecting to an IoT gateway or other edge device, which either sends data to the cloud for analysis or analyses it locally, IoT devices exchange the sensor data they collect. These gadgets converse with other similar devices on occasion, acting on the data they exchange. Although individuals can engage with the devices to set them up, give them instructions, or retrieve the data, the gadgets accomplish the majority of the job without their help.

People who use the internet of things can live and work more intelligently and have total control over their life. IoT is crucial to business in addition to providing smart home automation devices. With the help of IoT, organizations can see in real time how their systems actually function, gaining insights into anything from equipment performance to supply chain and logistics activities.

Businesses may automate procedures and save money on labor thanks to IoT. Additionally, it reduces waste, enhances service delivery, lowers the cost of manufacturing and delivering items, and provides transparency into customer transactions.



6.4

Hardware

6.4.1 ATmega 32 Microcontroller

The high-performance, low-power Microchip 8-bit AVR® RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 54/69 general purpose I/O lines, 32 general purpose working registers, a JTAG interface for boundary-scan and on-chip debugging/programming, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a universal serial interface (USI) with start condition detector, an 8-channel 10-bit A/D converter, programmable watchdog timer with internal oscillator, SPI serial port, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching one MIPS per MHz, balancing power consumption and processing speed.

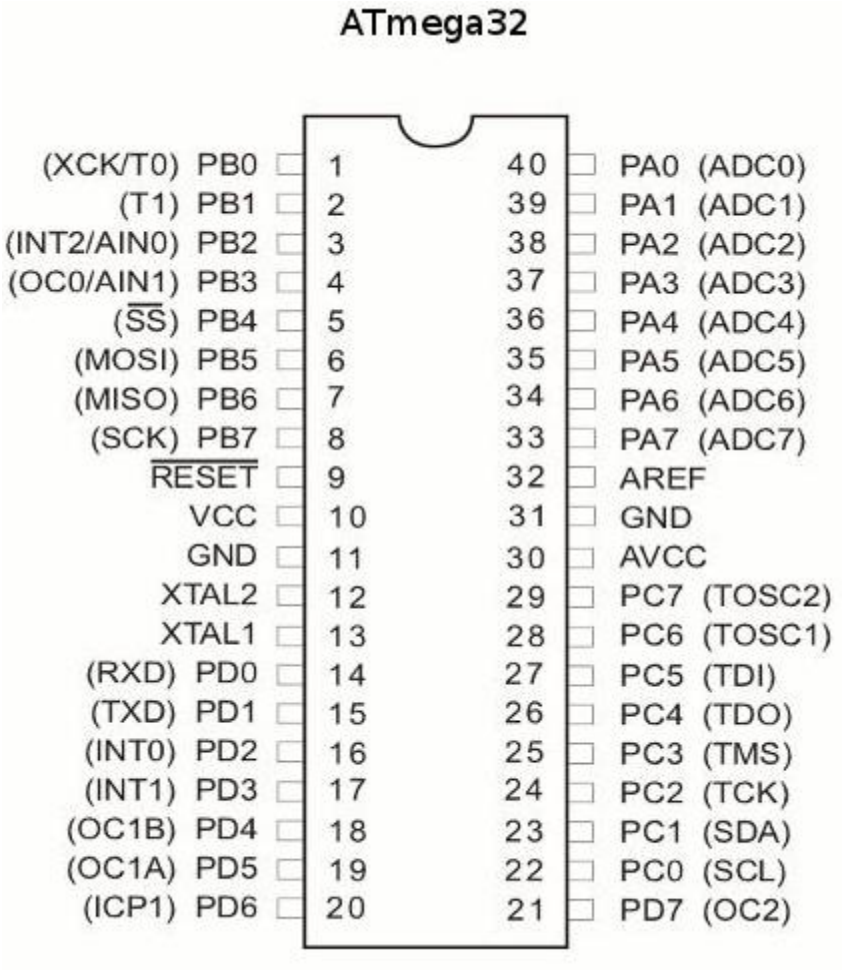
KEY FETUERS

Consider some general features of ATmega32 microcontroller is:-

- 2 Kilo bytes of internal Static RAM
- 32 X 8 general working purpose registers
- 32 Kilo bytes of in system self programmable flash program memory.
- 1024 bytes EEPROM
- Programmable serial USART
- 8 Channel, 10 bit ADC
- One 16-bit timer/counter with separate prescaler, compare mode and capture mode.
- Available in 40 pin DIP, 44-pad QFN/MLF and 44-lead QTFP
- Two 8-bit timers/counters with separate prescalers and compare modes
- 32 programmable I/O lines
- In system programming by on-chip boot program
- Master/slave SPI serial interface
- 4 PWM channels
- Programmable watch dog timer with separate on-chip oscillator

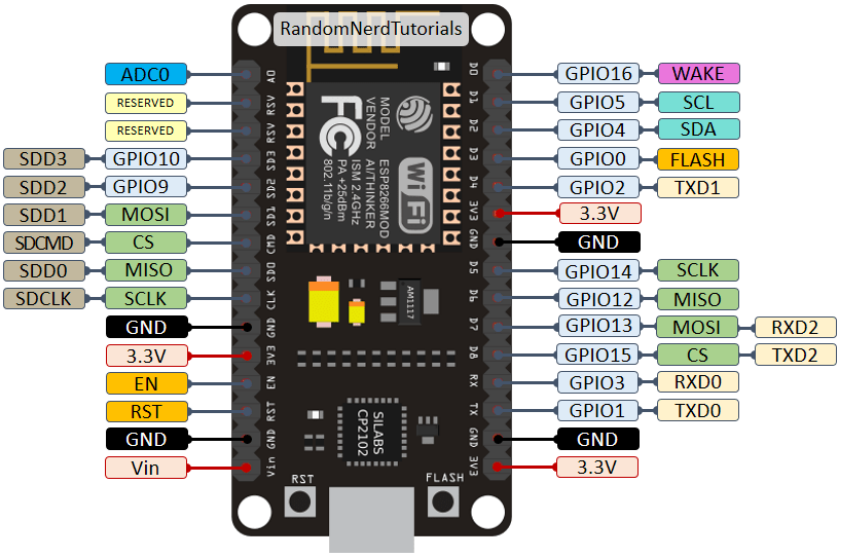
6.4.2 Special Microcontroller Features:

- External and internal interrupt sources
- Six sleep modes: Idle, ADC noise reduction, power-save, power-down, standby and extended standby.
- Power on reset and programmable brown-out detection.
- Internal calibrated RC oscillator



6.4.3Esp 8266 Microcontroller (WIFI module)

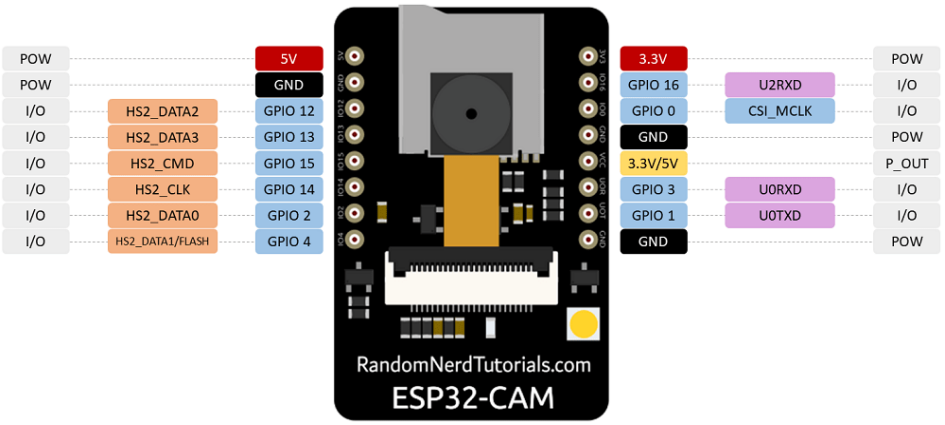
The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all WiFi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.



This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existance interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. In the Documents section below you will find many resources to aid you in using the ESP8266, even instructions on how to transform this module into an IoT (Internet of Things) solution!

6.4.4ESP 32 camera



The ESP32-CAM is a small size, low power consumption camera module based on ESP32. It comes with an OV2640 camera and provides onboard TF card slot.
The ESP32-CAM can be widely used in intelligent IoT applications such as wireless video monitoring, WiFi image upload, QR identification, and so on.

Features

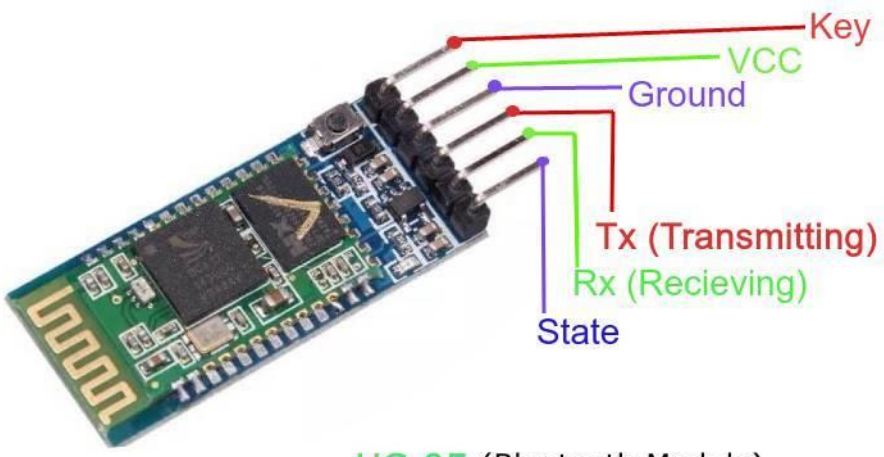
- Onboard ESP32-S module, supports WiFi + Bluetooth
- OV2640 camera with flash
- Onboard TF card slot, supports up to 4G TF card for data storage
- Supports WiFi video monitoring and WiFi image upload
- Supports multi sleep modes, deep sleep current as low as 6mA
- Control interface is accessible via pinheader, easy to be integrated and embedded into user products

Specifications

- WIFI module: ESP-32S
- Processor: ESP32-D0WD
- Built-in Flash: 32Mbit
- RAM: Internal 512KB + External 4M PSRAM
- Antenna: Onboard PCB antenna
- WiFi protocol: IEEE 802.11 b/g/n/e/i
- Bluetooth: Bluetooth 4.2 BR/EDR and BLE
- WIFI mode: Station / SoftAP / SoftAP+Station
- Security: WPA/WPA2/WPA2-Enterprise/WPS

- Output image format: JPEG (OV2640 support only), BMP, GRAYSCALE
- Supported TF card: up to 4G
- Peripheral interface: UART/SPI/I2C/PWM
- IO port: 9
- UART baudrate rate: default 115200bps
- Power supply: 5V
- Transmitting power:
- 802.11b: 17 ±2dBm(@11Mbps)
- 802.11g: 14 ±2dBm(@54Mbps)
- 802.11n: 13 ±2dBm(@HT20,MCS7)
- Receiving sensitivity:
- CCK,1Mbps: -90 dBm
- CCK,11Mbps: -85 dBm
- 6Mbps(1/2 BPSK): -88 dBm
- 54Mbps(3/4 64-QAM): -70 dBm
- HT20,MCS7(65Mbps, 72.2Mbps): -67 dBm
- Power consumption:
- Flash off: 180mA@5V
- Flash on and brightness max: 310mA@5V
- Deep-Sleep: as low as 6mA@5V
- Modern-Sleep: as low as 20mA@5V
- Light-Sleep: as low as 6.7mA@5V
- Operating temperature: -20 ℃ ~ 85 ℃
- Storage environment: -40 ℃ ~ 90 ℃, <90%RH
- Dimensions: 40.5mm x 27mm x 4.5mm

6.4.6HC-05 Bluetooth module



HC-05 (Bluetooth Module)

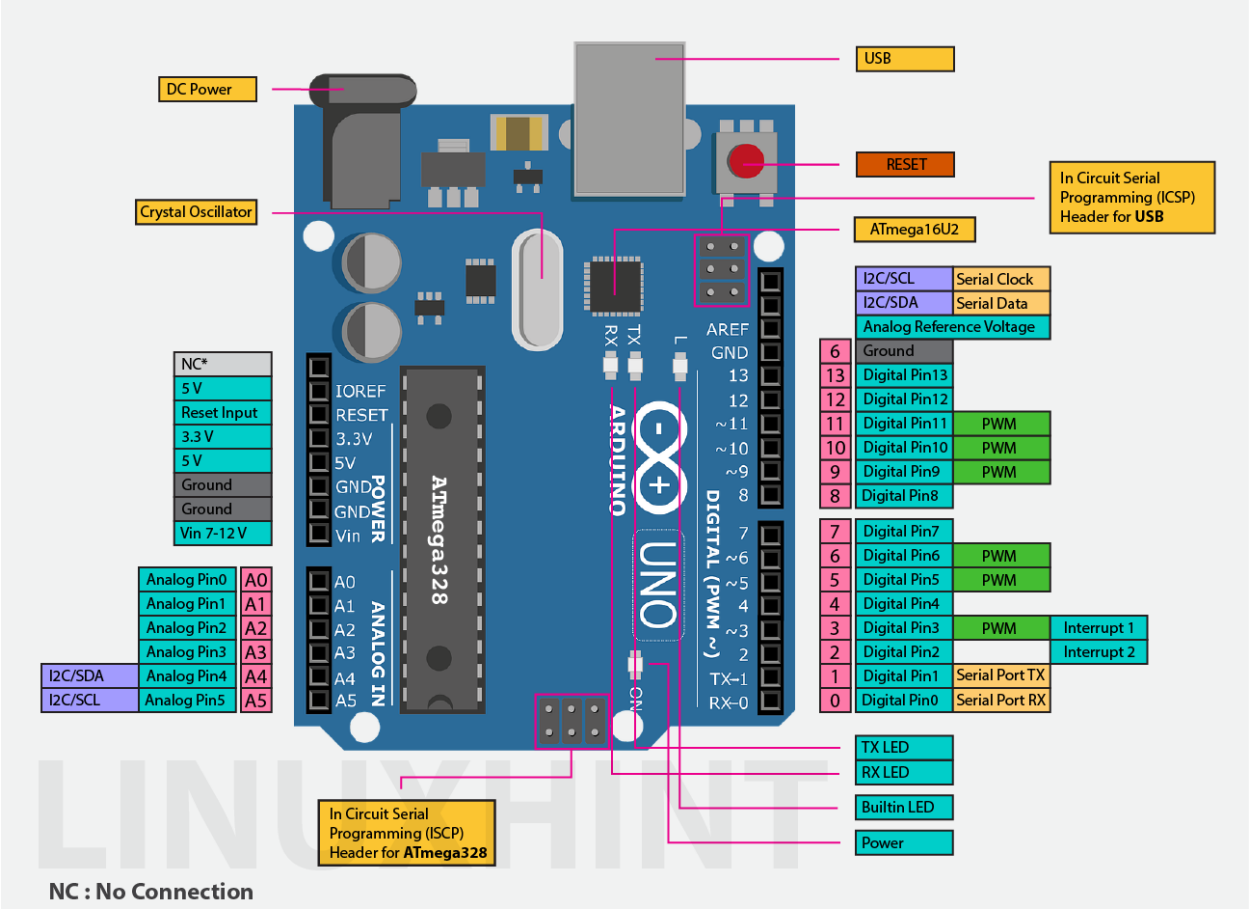
The HC-05 is a popular module which can add two-way (full-duplex) wireless functionality to your projects. You can use this module to communicate between two microcontrollers like Arduino or communicate with any device with Bluetooth functionality like a Phone or Laptop. There are many android applications that are already available which makes this process a lot easier. The module communicates with the help of USART at 9600 baud rate hence it is easy to interface with any microcontroller that supports USART. We can also configure the default values of the module by using the command mode. So if you looking for a Wireless module that could transfer data from your computer or mobile phone to microcontroller or vice versa then this module might be the right choice for you. However do not expect this module to transfer multimedia like photos or songs; you might have to look into the CSR8645 module for that.

Specifications

- Serial Bluetooth module for Arduino and other microcontrollers
- Operating Voltage: 4V to 6V (Typically +5V)
- Operating Current: 30mA
- Range: <100m
- Works with Serial communication (USART) and TTL compatible
- Follows IEEE 802.15.1 standardized protocol

- Uses Frequency-Hopping Spread spectrum (FHSS)
- Can operate in Master, Slave or Master/Slave mode
- Can be easily interfaced with Laptop or Mobile phones with Bluetooth
- Supported baud rate: 9600,19200,38400,57600,115200,230400,460800.

6.4.7Arduino Uno



Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use

the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments.

Features of Arduino UNO

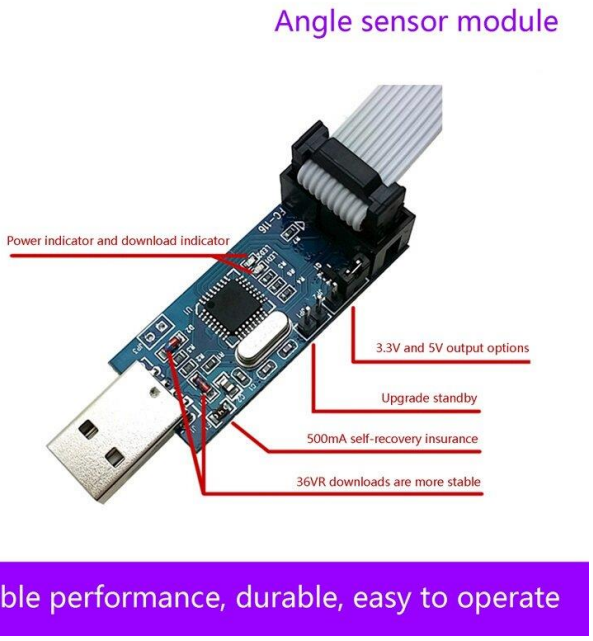
1. The board contains the USB interface support that enables the board to act as a serial device and provide the functionality to connect the board to other interfaces. The USB interface is also used to provide power supply to the board.

2. In the Arduino UNO board, there is a chip placed that is directly plugged to the USB port and acts as a virtual type serial port for the computer system. By this, communication becomes very smooth and helps the board to connect to various types of computer systems.

3. The microcontroller used in the Arduino UNO board ATMega328 is easy to available and can be used easily. The board contains other components like PWM pins, timers, external interrupts or internal interrupts, and other types of sleep modes.
4. The board is provided as an open-source tool that has its own advantage as a large number of users use this board and help to troubleshoot other problems related to the board. By this, the debugging activities related to the project become easy steps.
5. The pins used in the board act as an oscillator that has a frequency of around 16 MHz that is beneficial for most of the applications. The speed of the microcontroller does not change by this.
6. The board has another feature of voltage regulation that helps to regulate the power supply on the board. The board can be provided power supply directly without using

external power and USB port can be used for this purpose. The 12V power supply can be used as an external power supply for the board.
7. The Arduino UNO pins contain thirteen digital and six analog-type pins in it. The pins provide the functionality to the board to connect the hardware to the board. The computer capability can be increased using these pins
8. The tool has also one ICSP connector which helps to make the USB port bypass and connect the Arduino directly and act as a serial device.
9. The board has a total of 32 KB size flash memory that is used to store the data in it.
10. The board has also one LED fitted inboard to make the debugging process easy and help to find the bugs in the code.
11. And the board has also one reset button that helps to restart the program using the board.

6.4.8USBASP



These AVR programmers are based on Thomas Fischl's USBasp design and connect to your computer's USB port. Not only are they quite compact (70x20mm), but the design is really elegant. The USB interface is achieved by using an atmega8 processor and the rest is done in firmware.

Being an Open source hardware (OSHW) project, released under the GNU General Public License, you are free to download the schematic and firmware from Thomas's website, but then you have a chicken and egg problem. In order to load the USBASP firmware onto the atmega8 on the programmer, yes you guessed it, you need an AVR programmer. Much easier to buy one fully built and programmed.

Some of the features include:

Allows you to read or write the microcontroller EEPROM, firmware, fuse bits and lock bits

Support for Windows, Mac OS X and Linux (will work on

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Some of the features include:

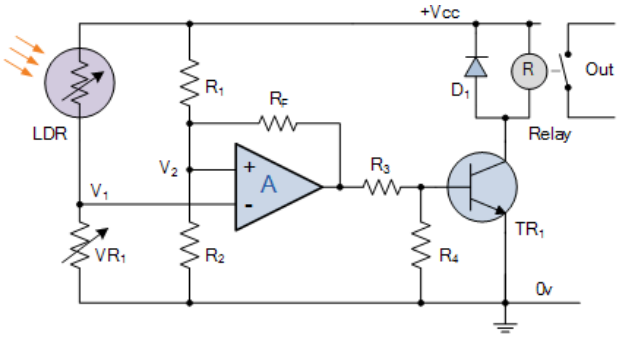
Allows you to read or write the microcontroller EEPROM, firmware, fuse bits and lock bits
Support for Windows, Mac OS X and Linux (will work on Windows 8.1)
5 KB/sec maximum write speed
Software controlled SCK option to support targets with low clock speed (< 1.5MHz)
10 pin ISP interface (conforms to standard ISP 10-pin pinout)
The latest Window Drivers are fully signed, so you can use them on Windows Vista and above without any issues. The driver will work on both 32 and 64 bit platforms. On Linux And Mac OS X no kernel driver is required, just use AVRdude and specify the correct port.
Size: 70 x 20 x 9mm
Supported Software: AVRDude 5.2 or higher

6.4.9Sensors:

The main purpose of sensors is to collect the wanted signals, then the sensor layer sends signals to the second layer.
Types of sensors used:

a. LDR

As its name implies, the Light Dependent Resistor (LDR) is made from a piece of exposed semiconductor material such as cadmium sulphide that changes its electrical resistance from several thousand Ohms in the dark to only a few hundred Ohms when light falls upon it by creating hole-electron pairs in the material.
The net effect is an improvement in its conductivity with a decrease in resistance for an increase in illumination. Also, photoresistive cells have a long response time requiring many seconds to respond to a change in the light intensity.
Materials used as the semiconductor substrate include, lead sulphide (PbS), lead selenide (PbSe), indium antimonide (InSb) which detect light in the infra-red range with the most commonly used of all photoresistive light sensors being Cadmium Sulphide (Cds).

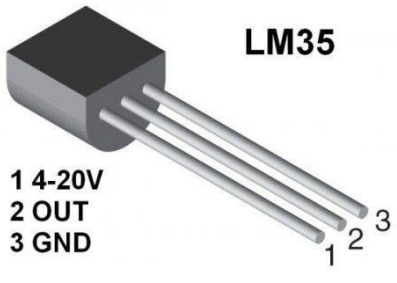


Cadmium sulphide is used in the manufacture of photoconductive cells because its spectral response curve closely matches that of the human eye and can even be controlled using a simple torch as a light source. Typically then, it has a peak sensitivity wavelength (λp) of about 560nm to 600nm in the visible spectral range.

b. Temperature Sensor “LM35”

LM35 is a precession Integrated circuit Temperature sensor, whose output voltage varies, based on the temperature around it. It is a small and cheap IC which can be used to measure temperature anywhere between -55°C to 150°C. It can easily be interfaced with any Microcontroller that has ADC function or any development platform like Arduino.

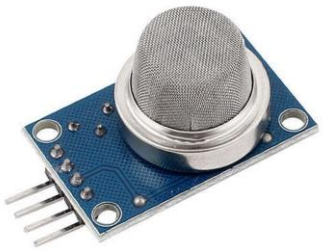
LM35 Sensor Features



- Minimum and Maximum Input Voltage is 35V and -2V respectively. Typically 5V.
- Can measure temperature ranging from -55°C to 150°C
- Output voltage is directly proportional (Linear) to temperature (i.e.) there will be a rise of 10mV (0.01V) for every 1°C rise in temperature.
- ±0.5°C Accuracy
- Drain current is less than 60uA
- Low cost temperature sensor
- Small and hence suitable for remote applications
- Available in TO-92, TO-220, TO-CAN and SOIC package

c. Gas Sensor "MQ2"

MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide. MQ2 gas sensor is also known as chemiresistor. It contains a sensing material whose resistance changes when it comes in contact with the gas.



Features

- Operating Voltage is +5V
- Can be used to Measure or detect LPG, Alcohol, Propane, Hydrogen, CO and even methane

- Analog output voltage: 0V to 5V
- Digital Output Voltage: 0V or 5V (TTL Logic)
- Preheat duration 20 seconds
- Can be used as a Digital or analog sensor
- The Sensitivity of Digital pin can be varied using the potentiometer

6.4.10 Actuators:

is a device that produces a motion by converting energy and signals going into the system.

Types of Actuators used:

a. Electromechanical relay

Relay is an electromechanical device that uses an electric current to open or close the contacts of a switch. The single-channel relay module is much more than just a plain relay, it comprises of components that make switching and connection easier and act as indicators to show if the module is powered and if the relay is active or not.

Single-Channel Relay Module Specifications

- Supply voltage – 3.75V to 6V
- Quiescent current: 2mA
- Current when the relay is active: ~70mA
- Relay maximum contact voltage – 250VAC or 30VDC
- Relay maximum current – 10A

b. Servo Motor

A servomotor (or servo motor) is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback.

SG-90 Features

- Operating Voltage is +5V typically
- Torque: 2.5kg/cm
- Operating speed is 0.1s/60°
- Gear Type: Plastic
- Rotation : 0°-180°
- Weight of motor : 9gm
- Package includes gear horns and screws

6.5 Software Used

1. Eclipse SDK
    - Embedded system layer receives the wanted signal from the sensors used then sends it to the actuators using Bluetooth.
2. Putty: UART Enable
3. MIT App inverter (Android Application):
    - Android application receives data from the Bluetooth layer, also in this layer there is a signal analyzer which extracts the important information from the signal and transforms this signal to graph. Then the android application sends the useful information and the raw data used to draw the graph to the server using specified API.