الكلية التقنية الهندسية
قسم هندسة تقنيات الأجهزة الطبية

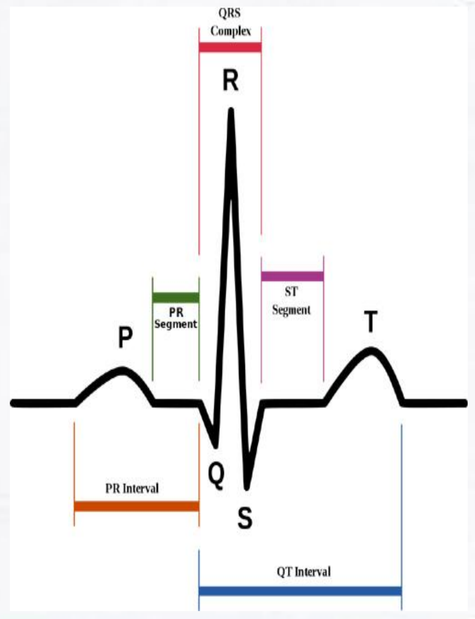
# Design and Implementation of Portable Electrocardiograph

**SUPERVISOR :** Lec. Dr. Taif Alawsi

**STUDENT :** Ali Razak Kadhem

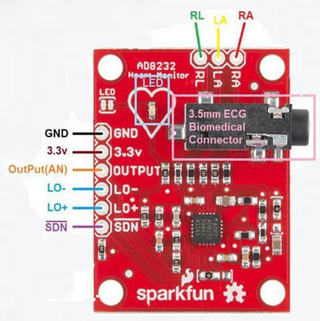
## ABSTRACT :

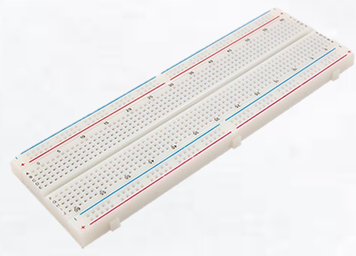
Heart diseases are becoming a big issue for the last few decades and many people die because of certain health problems. This can be prevented by analyzing or monitoring the electrocardiogram (ECG) signal at the initial stage. So we present this project, i.e ECG Monitoring with AD8232 ECG Sensor & Arduino with ECG Graph. The AD8232 is a neat little chip used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram. Electrocardiography is used to help diagnose various heart conditions. So in this project, AD8232 ECG Sensor was interfaced with Arduino and the ECG signal was observed on a serial plotter or Processing IDE.



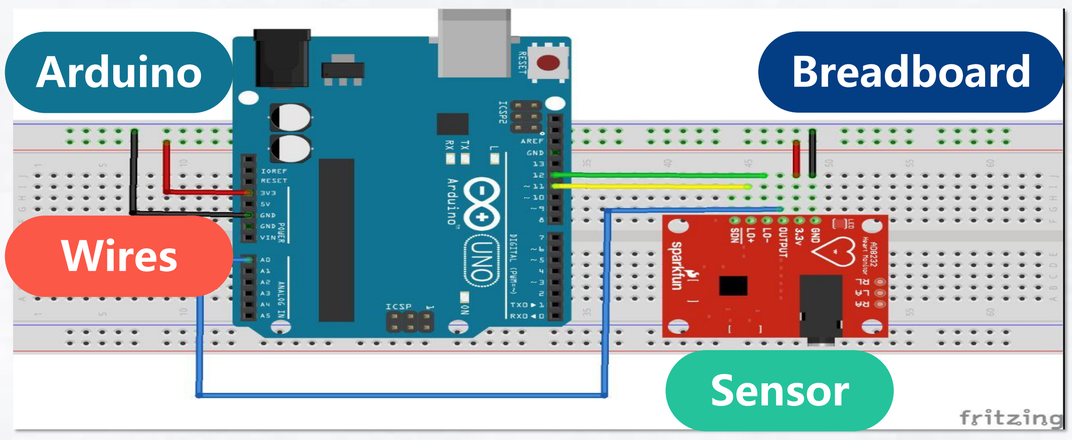

## Components :

1. Arduino Uno
2. Breadboard
3. connecting wires
4. ECG sensor AD8232

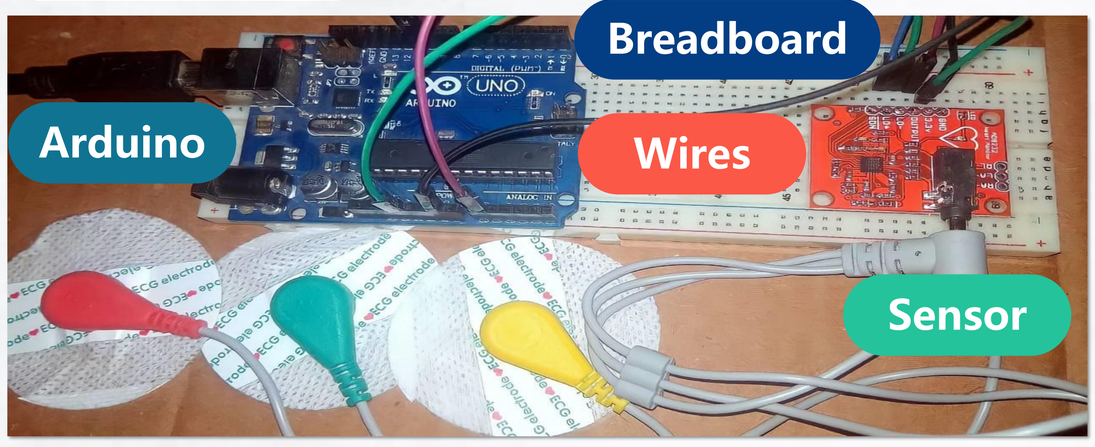


## Circuit Diagram :




## Final Model :




## Operation :

The AD8232 module allows recording the electrical activity of the heart, by obtaining an electrocardiogram or ECG. ECG sensor obtain signals from heart beats because electrical signals are transmitted through specific pathways within the heart, causing the heartbeat. This electrical activity can be collected through electrodes placed on the skin, specifically on the front of the chest, on the arms and legs.

## Electrocardiogram :

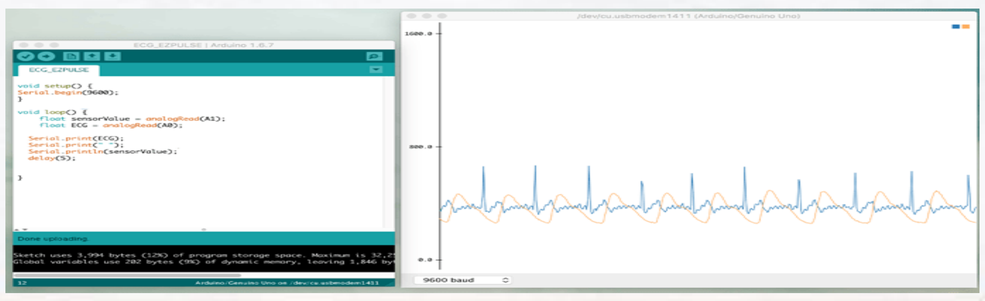
ECG can be analyzed by studying components of the waveform. These waveform components indicate cardiac electrical activity. The first upward of the ECG tracing is the P wave. It indicates atrial contraction. The QRS complex begins with Q, a small downward deflection, followed by a larger upwards deflection, a peak (R); and then a downwards S wave. This QRS complex indicates ventricular depolarization and contraction. Finally, the T wave, which is normally a smaller upwards waveform, representing ventricular re-polarization.

## References :

[1] World Health Organization. Global Atlas on Cardiovascular Disease Prevention And Control. Policies, Strategies and Interventions. Iraq. 2011. Available from: www.who.int.

[2] Serhani MA, Kassabi HTE, Ismail H, Navaz AN. ECG Monitoring Systems: Review, Architecture, Processes, and Key Challenges. Sensors. 2020;20. Available from: https://dx.doi.org/10.3390/s20061796

## Code:



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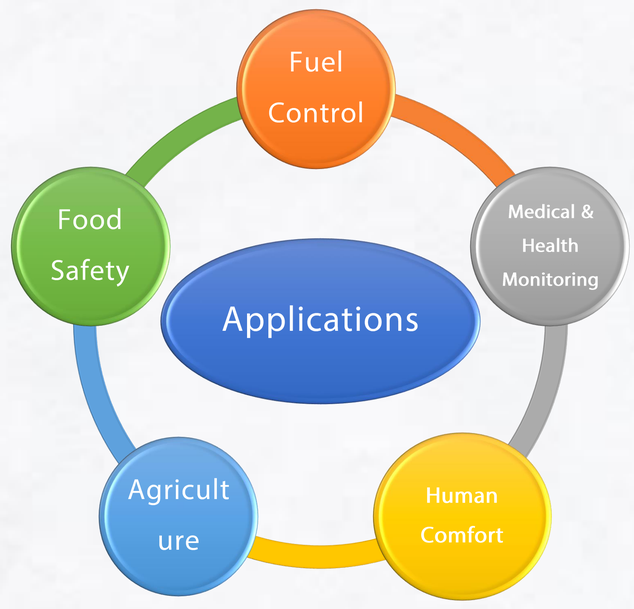
# Design and Implementation of Real-Time Temperature and Humidity Sensor

**SUPERVISOR :** Lec. Dr. Taif Alawsi

**STUDENT :** Furqan Ali Abbas

## ABSTRACT :

In this project, we implemented a circuit for the temperature and humidity monitoring of the environment and display it on the LCD screen which gives an updated reading every specific period. The goal of the project: To learn to use the temperature and humidity sensor to read and send data to the Arduino and work on data collection.



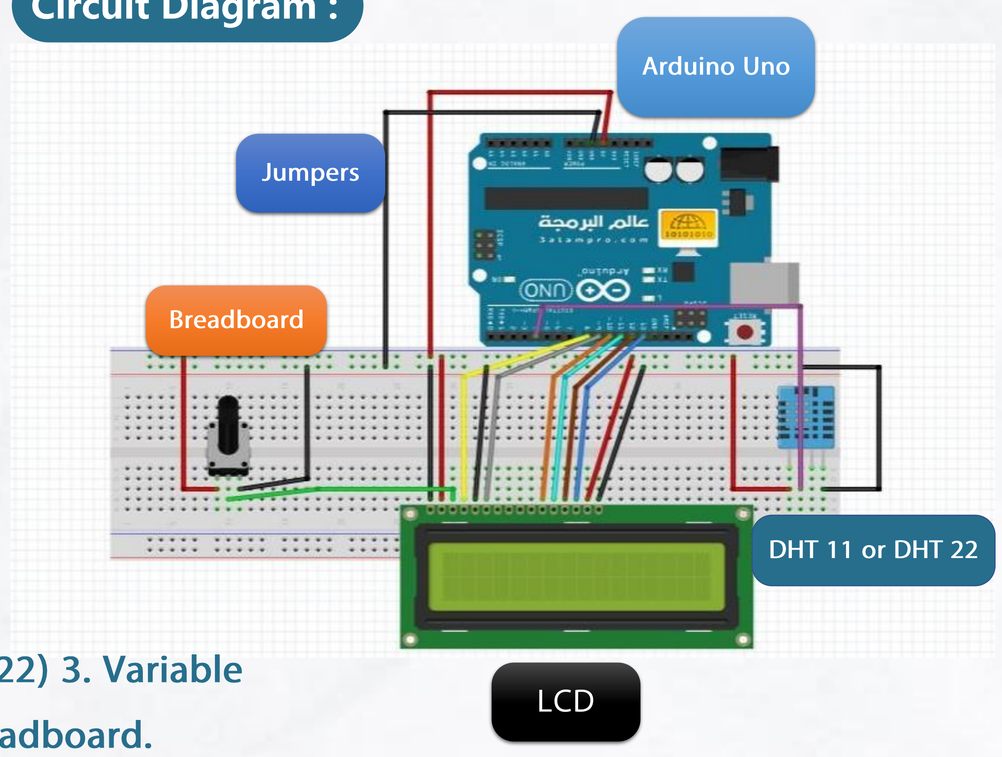

## Operation :

The Arduino UNO and the DHT11 (temperature and humidity sensor) were employed for displaying the ambient temperature and humidity on the LCD screen. After connecting the wires as in the circuit diagram, the program will do all the work. A special library called "DHT" was download from the web and uploaded to Arduino.

## Components :

1. Arduino Uno 2. Temperature and Humidity Sensor (DHT11 or DHT22) 3. Variable resistor 4. Liquid Crystal Display (LCD 2 * 16 ) 5. Jumper wires. 6. Breadboard.

## Circuit Diagram :




## DHT11

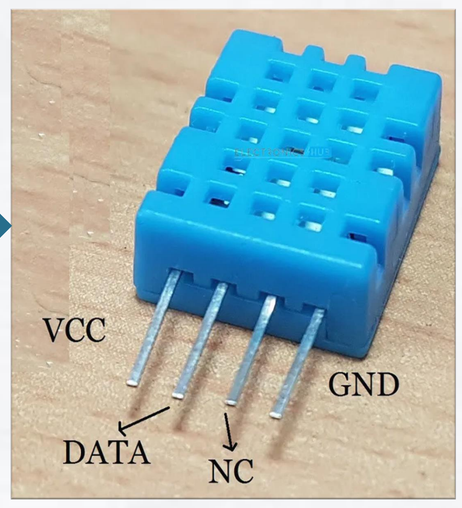
Code

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(4, 5, 0, 1, 2, 3);
byte degree_symbol[8] =
                  {
                    0b00111,
                    0b00101,
                    0b00111,
                    0b00000,
                    0b00000,
                    0b00000,
                    0b00000,
                    0b00000
                  };
int gate=11;
volatile unsigned long duration=0;
unsigned char i[5];
unsigned int j[40];
unsigned char value=0;
unsigned answer=0;
int z=0;
int b=1;
void setup()
{

lcd.begin(16, 2);
 lcd.print("Temp = ");
 lcd.setCursor(0,1);
 lcd.print("Humidity = ");
 lcd.createChar(1, degree_symbol);
 lcd.setCursor(9,0);
 lcd.write(1);
 lcd.print("C");
 lcd.setCursor(13,1);
 lcd.print("%");
}

void loop()
{
```

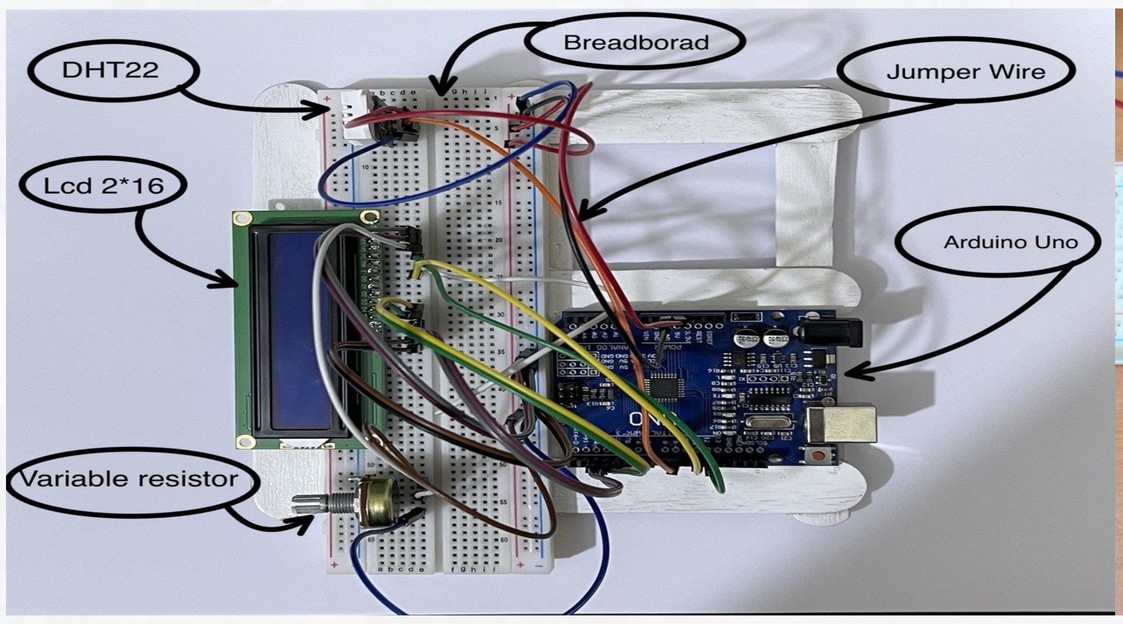
DHT 11

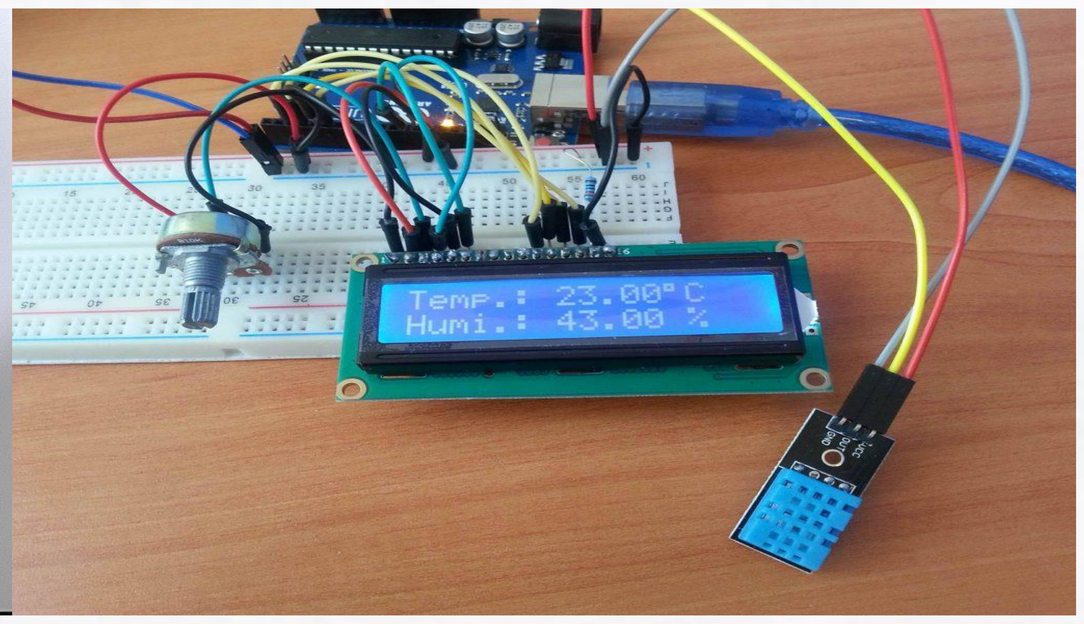



## References :

Hubert Henry Ward, 2022, Programming Arduino Projects with the PIC Microcontroller: A Line-by-Line Code Analysis and Complete Reference Guide for Embedded Programming in C, APress, USA.

## Final Model :



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# Design and Experimental Verification of Oximeter Sensor for Real-Time Heart-Rate Monitoring

**SUPERVISOR :** Lec. Dr. Taif Alawsi

**STUDENT :** Ali Qassim Hashim

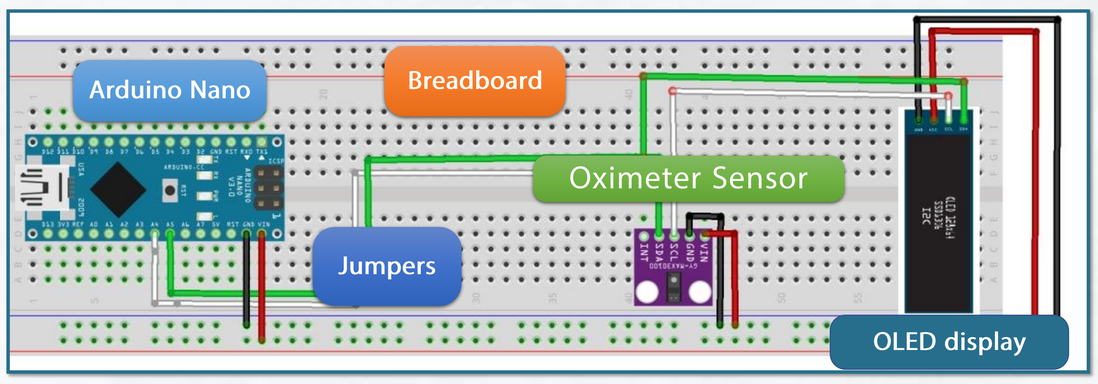
## ABSTRACT :

To solve the problem of disturbing the existing heart rate and oxygen detector, a portable heart rate oximeter is proposed in this project. The device can detect and display the heart rate value and blood oxygen percentage of the human body at any time. The instrument gets rid of the burden of traditional medical devices, which greatly reduces the size of the instrument and is easier to carry. The heart rate oximeter designed in this project is smart and portable. It has a wide range of practical applications.

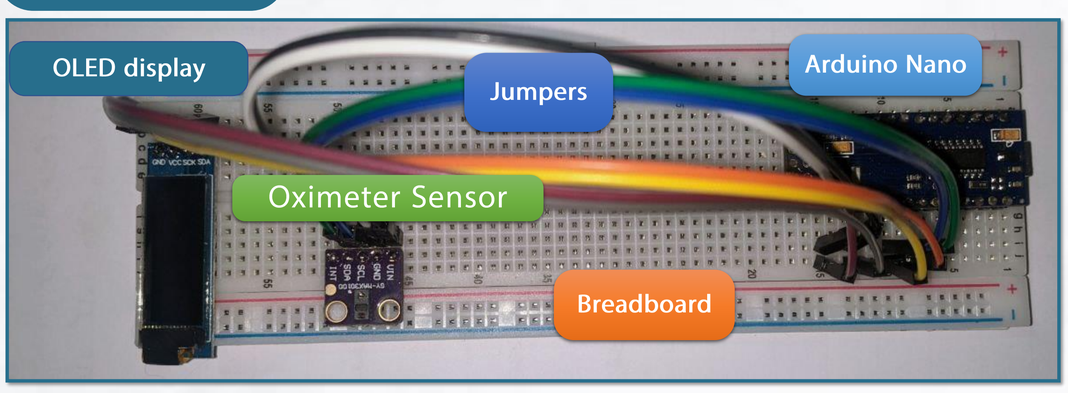
## Operation :

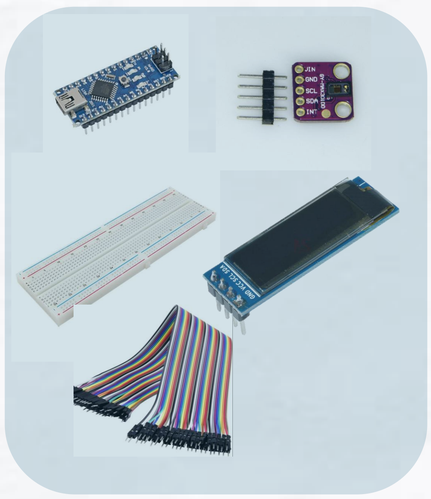
To measure the heart rate and the percentage of oxygen in the blood, we place the finger on the sensor, and the sensor will send infrared waves and they will pass through the finger, and as it is known, the waves will collide with the oxygen in the blood and be reflected to the sensor. The Arduino will process it and give the oxygen percentage, as well as the number of heartbeats per minute, and display it on the OLED screen, as shown in the readings images.

## Circuit Diagram :

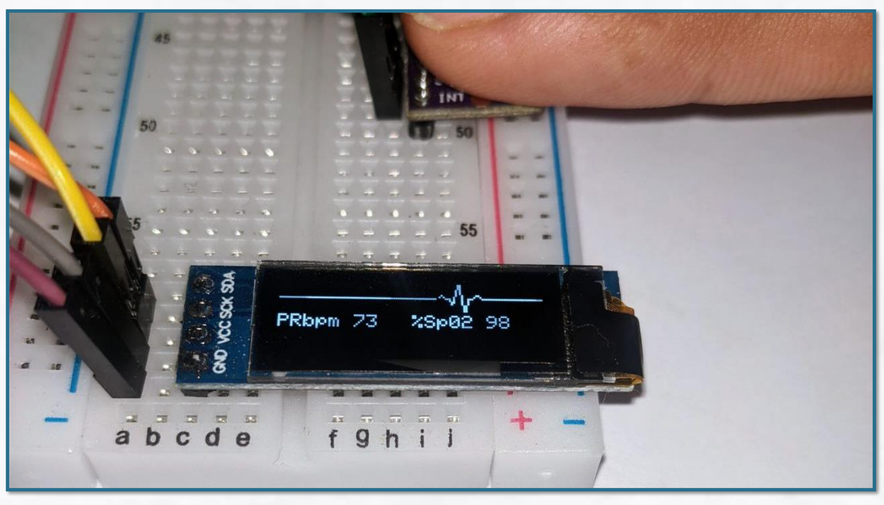



## Final Model :

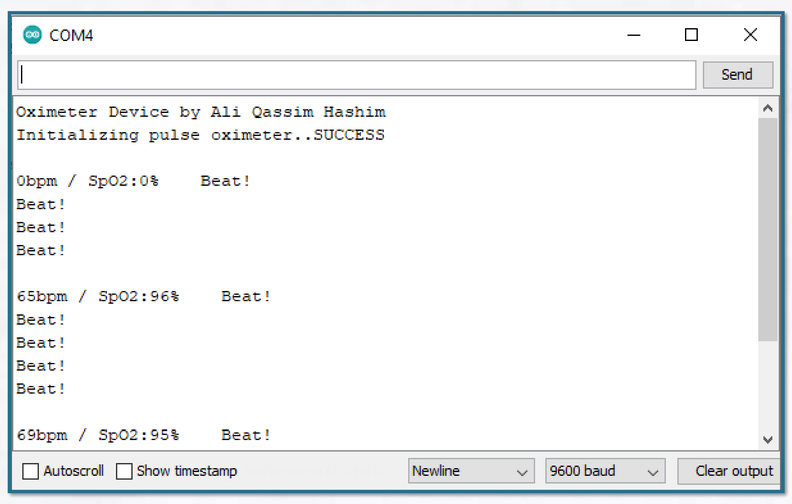


## Results (a) On-Screen Display :




## Results (b) PC Monitoring :




## Components :

1- Arduino Nano 2- GY-MAX30100 Oximeter Sensor 3- 0.91 inch OLED Display 4- Jumper Wires 5. Breadboard

## References :

1. Hubert Henry Ward, 2022, Programming Arduino Projects with the PIC Microcontroller: A Line-by-Line Code Analysis and Complete Reference Guide for Embedded Programming in C, APress, USA.

2. Jeremy Blum, 2022, Exploring Arduino®: Tools and Techniques for Engineering Wizardry, (2nd Ed.), John Wiley & Sons, Inc. 10.1002/9781119405320.

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# Design and Implementation of Smart Stick for Visually Impaired People

**SUPERVISOR :** Lec. Dr. Taif Alawsi, Eng. Sura

**STUDENT :** Kadhim Osama Kadhim

## ABSTRACT :

The smart stick comes as a proposed solution to enable visually impaired people that have difficulties in detecting obstacles and dangers in front of them during walking. We seek in our project to provide a smart stick that is affordable and suitable for visually impaired people. The smart stick sounds an audible alarm when there is an obstacle at 30 cm away from the stick, thus enabling the visually impaired people to avoid them before impact.

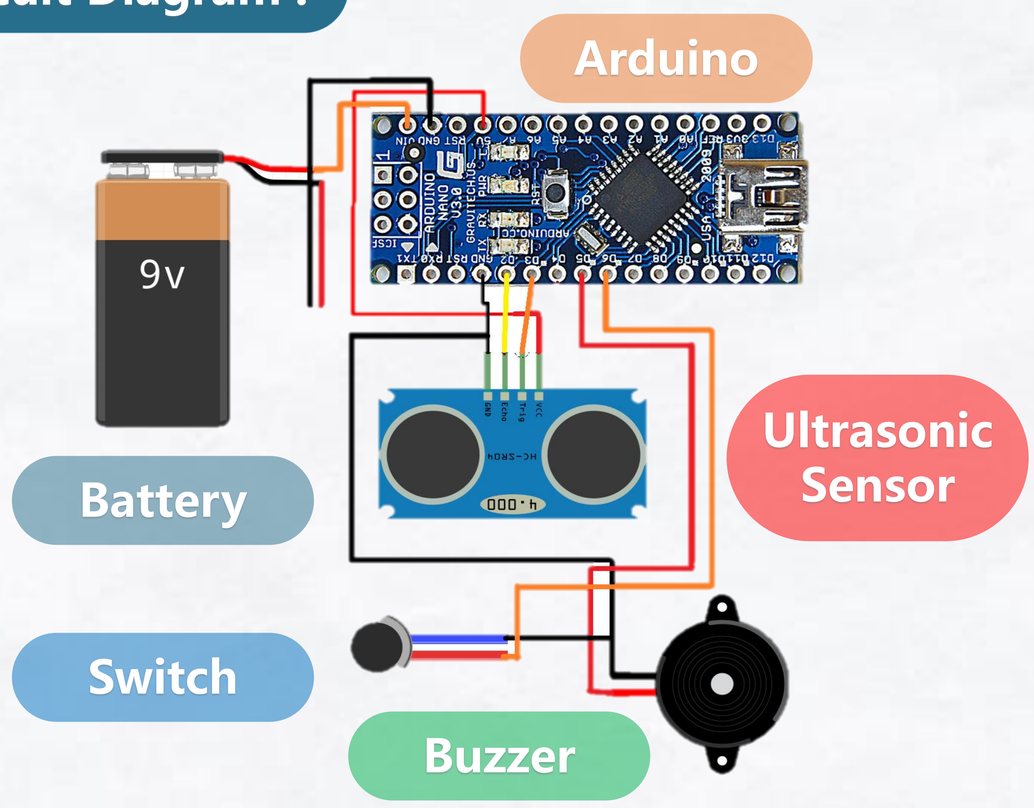
## Objective :

The main objective of this project is to help visually impaired people to walk with ease and to be warned whenever their walking path is obstructed with obstacles.

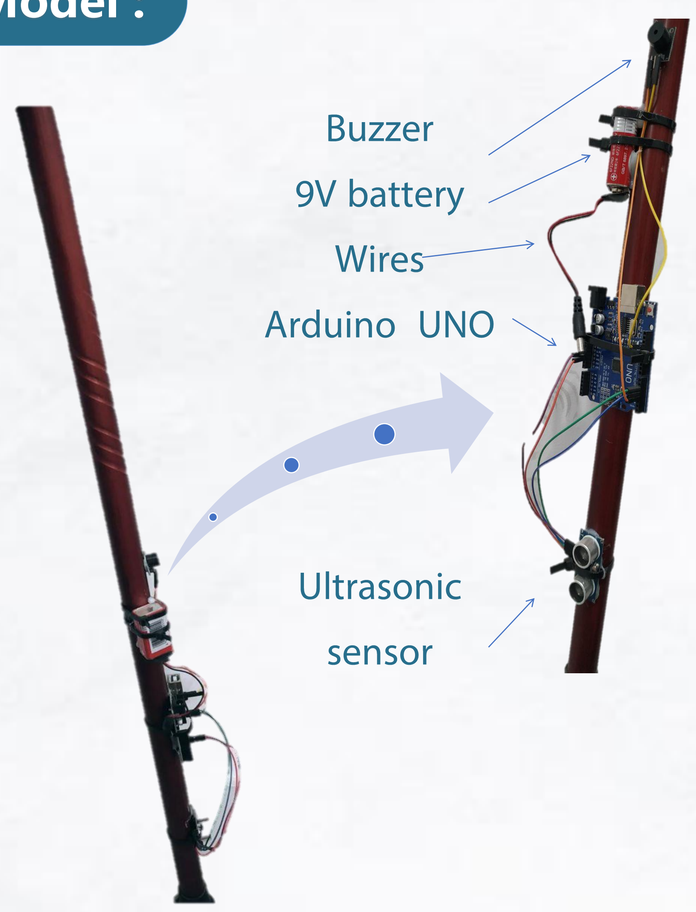
## Methods :

The system is designed to act like an artificial vision and alarm unit. It consists of five components: ultrasonic sensor, buzzer, 9V battery, switch and microcontroller (Arduino Uno) to receive the sensor signals. The electronic system has been controlled using Arduino UNO. When the switch is on the top of the stick; the ultrasonic sensor will immediately send the signal from the transmitter. However, when the signal impacts the level surface it reflects back to the sensor`s receiver. Therefore, the Arduino will send a pulse to the actuators (in this case, the vibrating motor and the buzzer) to

## Circuit Diagram :




## Final Model :




## Conclusions :

The smart walking stick, constructed with utmost accuracy, will help the visually impaired people to move from one place to another without the need of external help.. The advantage of the system lies in the fact that it can prove to be a low cost solution to millions of visually impaired people worldwide.

## References :

Hubert Henry Ward, Programming Arduino Projects with the PIC Microcontroller: A Line-by-Line Code Analysis and Complete Reference Guide for Embedded Programming in C 1st ed. Edition, APress, USA, 2022.

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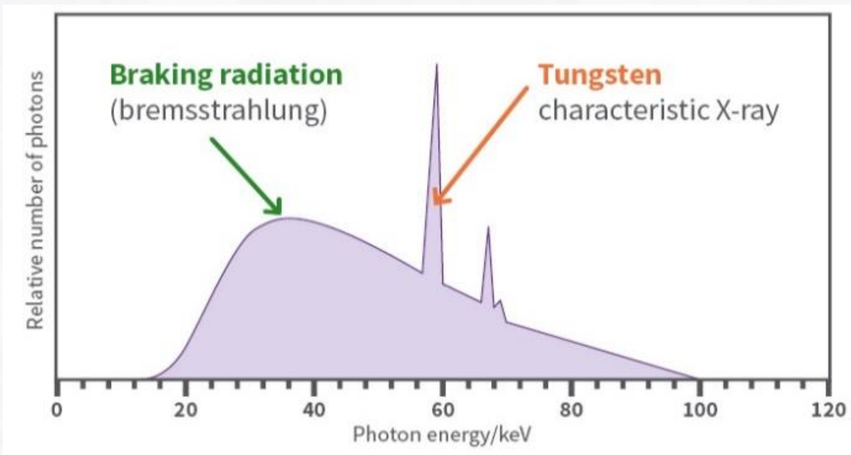
# DIGITAL X-RAY SYSTEM

SUPERVISOR : Lec. Dr. Taif Alawsi

GROUP : Furqan, et al.

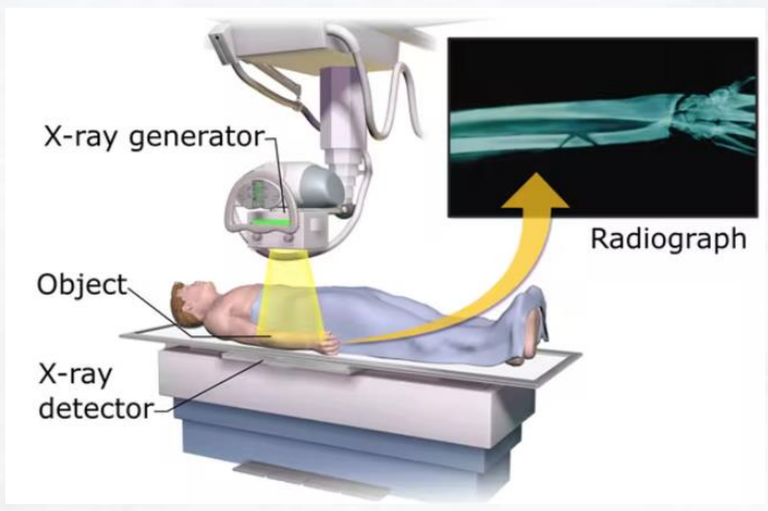
## INTRODUCTION :

X-rays are a type of electromagnetic wave radiation. X-ray images show the parts of your body in different shades of black and white. This is because different tissues absorb different amounts of radiation. Calcium in bones absorbs x-rays the most, so bones look white. Fat and other soft tissues absorb less and look gray. Air absorbs the least, so the lungs look black.




## X-RAY OPERATION :

X-ray imaging exams are recognized as a valuable medical tool for a wide variety of examinations and procedures. They are used to: noninvasively and painlessly help to diagnose disease and monitor therapy; support medical and surgical treatment planning; and guide medical personnel as they insert catheters, stents, or other devices inside the body, treat tumors, or remove blood clots or other blockages.



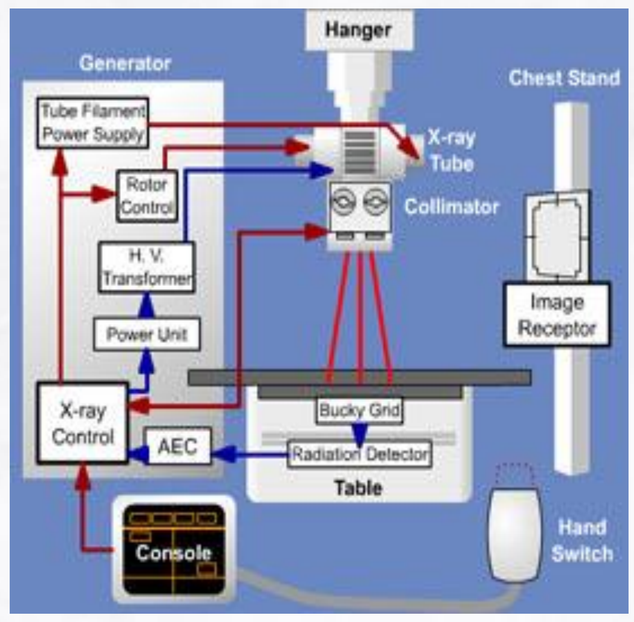

To create a radiograph, a patient is positioned so that the part of the body being imaged is located between an x-ray source and an x-ray detector. When the machine is turned on, x-rays travel through the body and are absorbed in different amounts by different tissues, depending on the radiological density of the tissues they pass through.

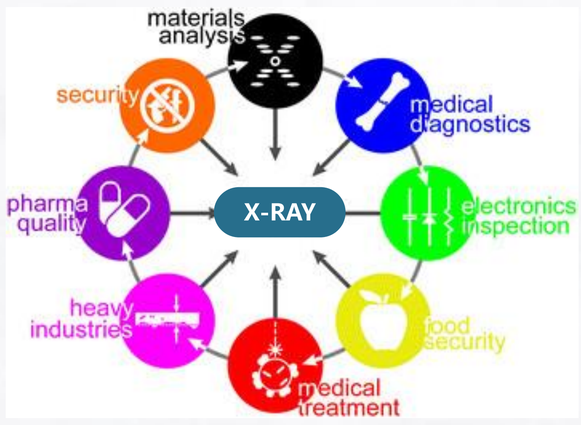
## X-RAY COMPONENTS :

1. X-Ray Tube
2. High-Voltage Generator
3. Control console
4. Cooling system
5. Collimator
6. Bucky
7. Chest Stand
8. AEC (Automatic Exposure Control)
9. Image Receptor
10. Detector

## X-RAY APPLICATIONS :

1. Medical Diagnostics
2. Pharma Quality
3. Material inspection
4. Security
5. Medical Treatment
6. Electronics Inspection
7. Heavy Industry
8. Food Safety



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# Design and Implementation of Alarm System for Security and Surveillance Applications

**SUPERVISOR :** Lec. Dr. Taif Alawsi

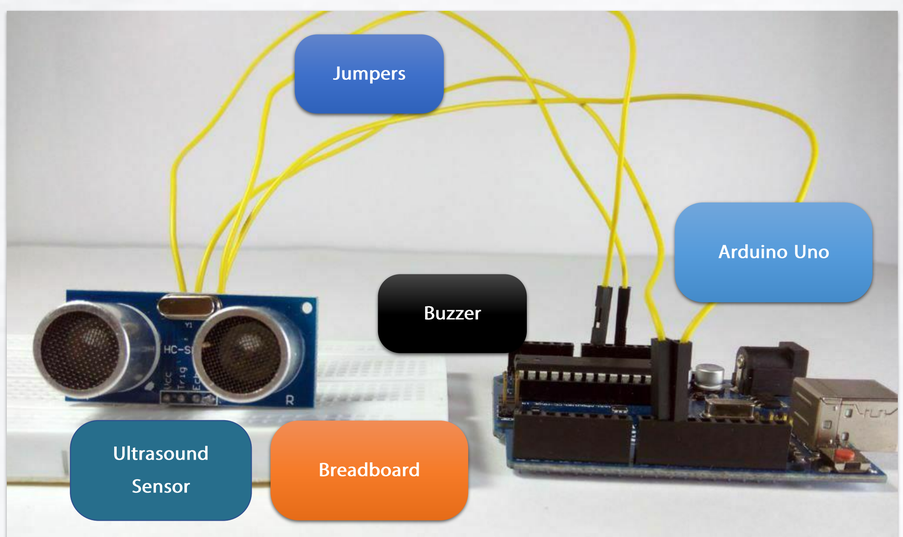
**STUDENT :** Rawan Abdul Amir Hashim

## ABSTRACT :

When someone enters a protected place or crosses through the door or window, an alarm circuit is activated sounding an alarm. The circuit contains an Arduino, an ultrasonic sensor, and a buzzer. The task of the sensor is to send and receive ultrasonic waves. When there is a cut in the path of these ultrasonic waves, the resultant value changes in the serial port monitor commanding the Arduino circuit to signal the buzzer for alarm.

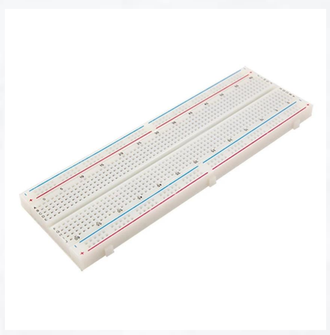
## Operation :

This project is an ultrasonic-based security alarm. It is distance sensitive, so the buzzer beeps faster if the object is near and it beeps slowly if the object is far. The buzzer and ultrasonic sensor are mounted on the breadboard. Take two wires from the Arduino one for 5V and the other for GND and connect it to the breadboard. (Trig pin - pin 6 of Arduino) (Echo pin - pin 5 of Arduino) (GND - GND pin). The positive terminal of the buzzer was connected to pin 2 and the negative terminal was connected to GND.




## Components :

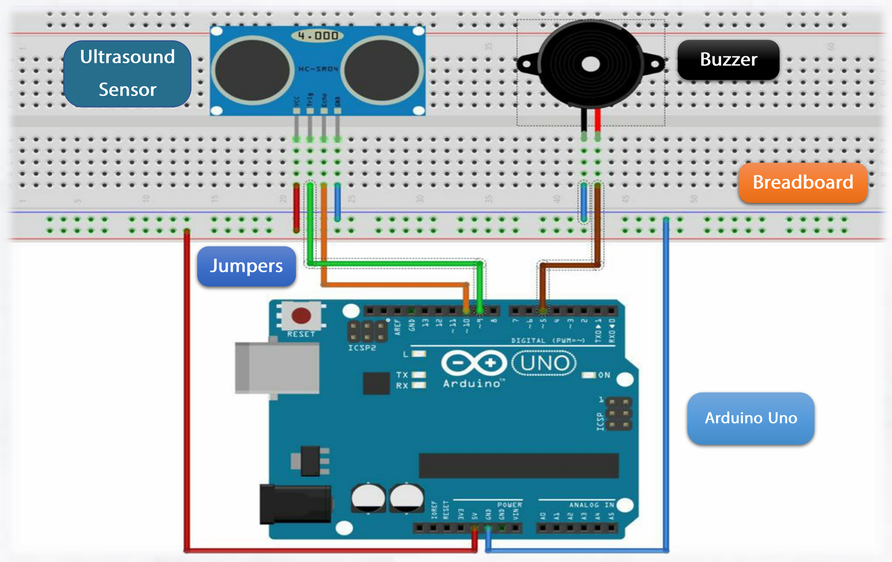
1. Arduino uno
2. Breadboard
3. Ultrasonic sensor
4. Jumper cables
5. Buzzer



## Programming Code :

```
#define trigPin 11

#define echoPin 12

int Buzzer = 8;

int led = 10;

void setup() {

Serial.begin (9600);

pinMode(trigPin, OUTPUT);

pinMode(echoPin, INPUT);

pinMode(Buzzer, OUTPUT);

pinMode(led,OUTPUT);

}

void loop() {

int duration, distance;

digitalWrite(trigPin, HIGH);

delayMicroseconds(1000);

digitalWrite(trigPin, LOW);
```

## Circuit Diagram :




## References :

1.Jerry Silver, 2009, 125 Physics Projects for the Evil Genius, 1st Ed., McGraw-Hill.

2. Hubert Henry Ward, 2022, Programming Arduino Projects with the PIC Microcontroller: A Line-by-Line Code Analysis and Complete Reference Guide for Embedded Programming in C, APress, USA.

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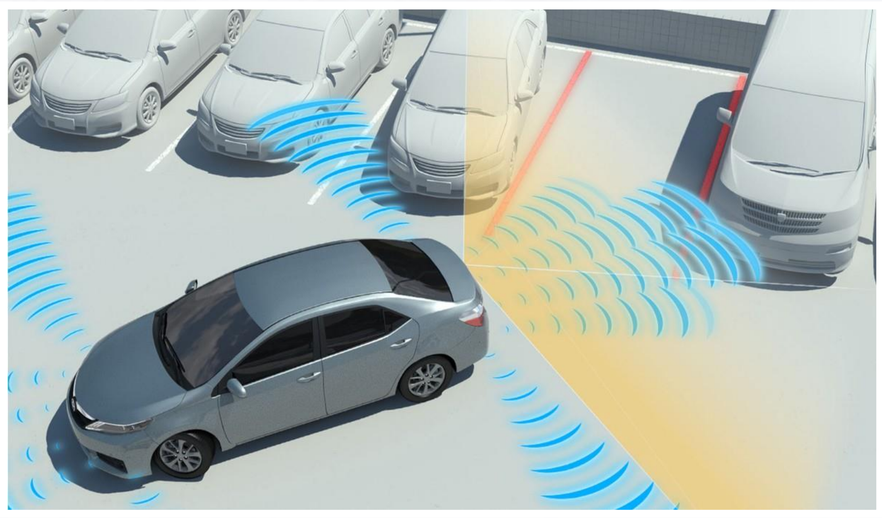
# Design and Implementation of Car Parking Alarm System

**SUPERVISOR :** Lec. Dr. Taif Alawsi

**STUDENT :** Ali Razak Naeem

## ABSTRACT :

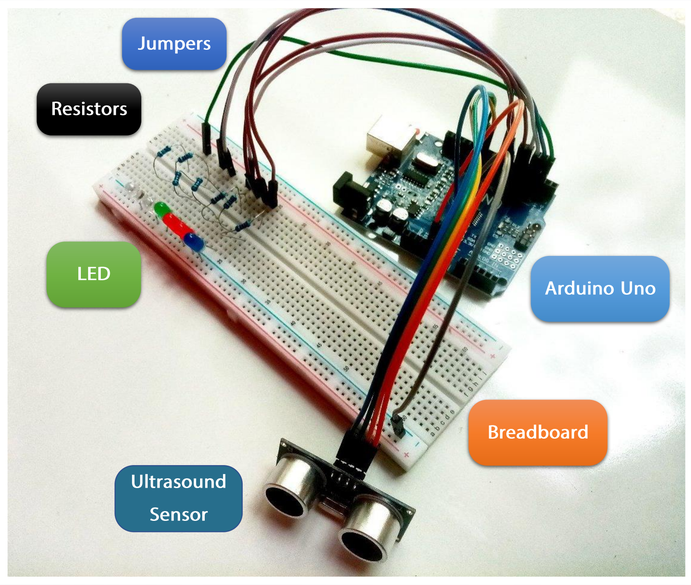
Sometimes it is difficult to park the car well, because of the driver's inaccuracy and the lack of assistive technology. This will lead to accidents. Arduino has provided a simple solution through which we can develop a technology that can help in car parking. Using a ultrasound sensor that senses objects near the car and gives an alert to the driver through colored lights.



## Operation :

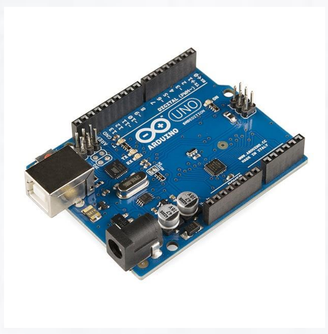
When the car approaches a certain object, such as a car, a wall, etc.; the ultrasound sensor in the back of the car gives a signal to the driver using LEDs located in front of the driver. Which is distinguished by their colors to give the distance between the car and the object behind it (each color indicates a certain distance). For example, the white color indicates that the vehicle is far away, the green color indicates that the vehicle is at an average distance, and the red color indicates that the car is 5 cm away from the body and the vehicle is almost involved in an accident.

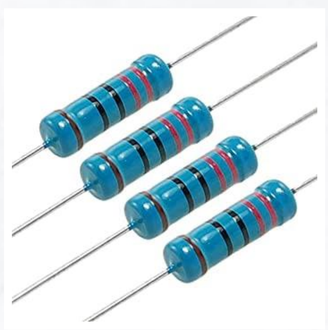
A circuit as shown here was implemented to provide a safe parking. The code was uploaded to the Arduino IDE and the circuit functions well.

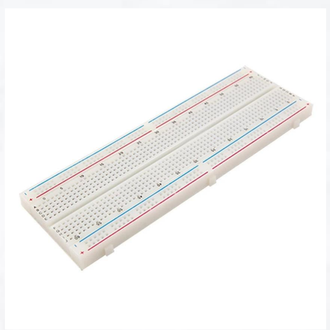



## Components :

1. Arduino uno
2. Breadboard
3. Ultrasonic sensor
4. Jumper cables
5. 1k ohm resistor (7)
6. LEDs (7)







## Programming Code :

```
const int trig = 11;
const int echo = 12;

const int LED1 = 2;
const int LED2 = 3;
const int LED3 = 4;
const int LED4 = 5;
const int LED5 = 6;
const int LED6 = 7;
const int LED7 = 8;

int duration = 0;
int distance = 0;

void setup()
{
  pinMode(trig , OUTPUT);
  pinMode(echo , INPUT);

  pinMode(LED1 , OUTPUT);
  pinMode(LED2 , OUTPUT);
  pinMode(LED3 , OUTPUT);
  pinMode(LED4 , OUTPUT);
  pinMode(LED5 , OUTPUT);
  pinMode(LED6 , OUTPUT);
  pinMode(LED7 , OUTPUT);
 ……etc.
```

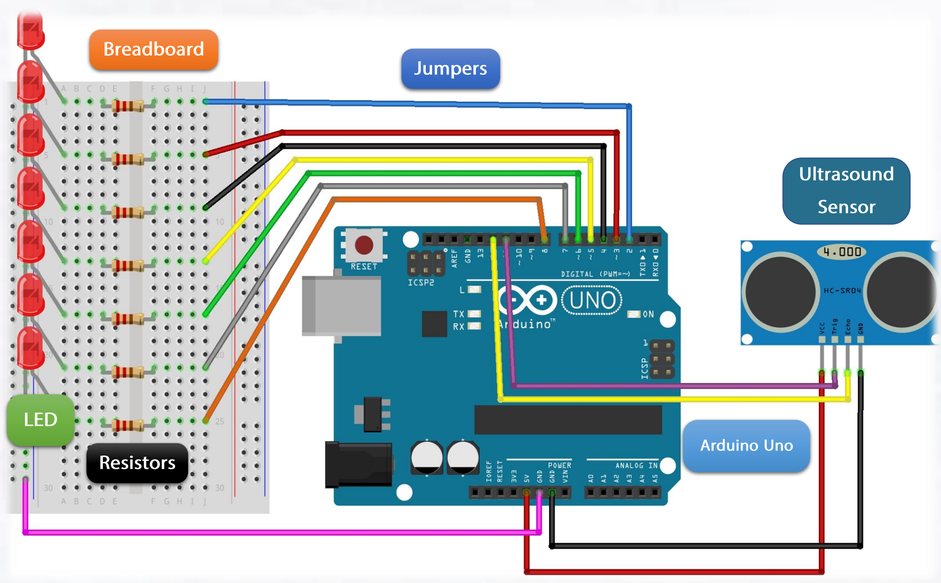
## References :

1.Jerry Silver, 2009, 125 Physics Projects for the Evil Genius, 1st Ed., McGraw-Hill.

2. Hubert Henry Ward, 2022, Programming Arduino Projects with the PIC Microcontroller: A Line-by-Line Code Analysis and Complete Reference Guide for Embedded Programming in C, APress, USA.

3. Jeremy Blum, 2022, Exploring Arduino®: Tools and Techniques for Engineering Wizardry, (2nd Ed.), John Wiley & Sons, Inc. 10.1002/9781119405320.

## Circuit Diagram :



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# Design and Implementation of an LED Memory Game

**SUPERVISOR :** Lec. Dr. Taif Alawsi

**STUDENT :** Fatima Ali Moussa

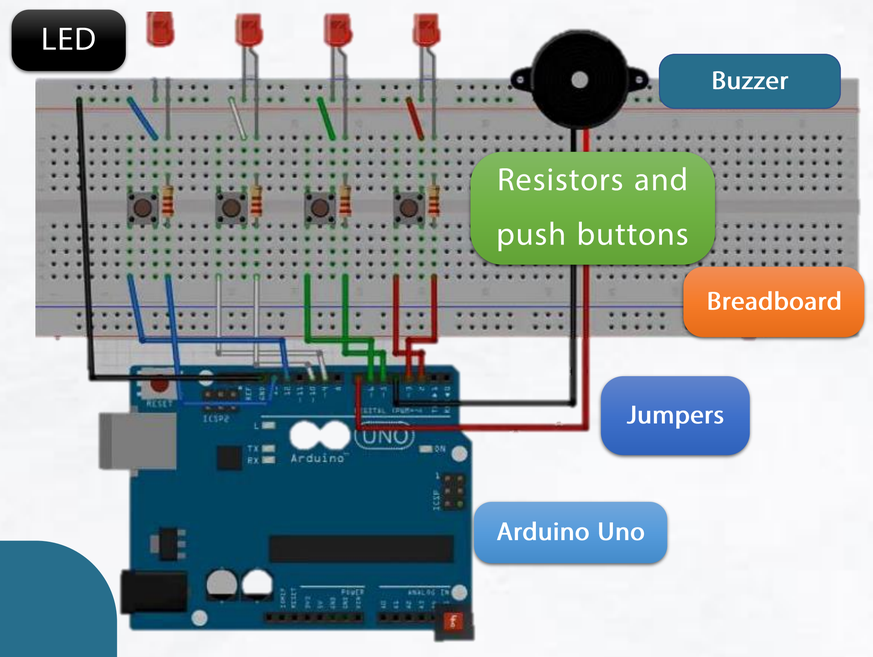
## ABSTRACT :

One of the most critical things in life is a strong memory. To maintain and train the memory psychologists advise us to play memory games. Thus, we designed and implemented the memory game with Arduino circuitry. The memory game helps children and people with memory impairment to develop and maintain a healthy memory.


## Operation :

The device is operated by pressing one of the buttons on the board. The device gives one specific color at the beginning and asks you to press the button related to the color to move to the second stage, and each stage becomes more difficult, as it reaches more than 10 colors at once. Indicating game over and loss when you are not able to memorize the steps.

## Circuit Diagram :




## Programming Code :

```
#define CHOICE_OFF      0 //Used to control LEDs

#define CHOICE_NONE     0 //Used to check buttons

#define CHOICE_RED  (1 << 0)

#define CHOICE_GREEN    (1 << 1)

#define CHOICE_BLUE (1 << 2)
#define CHOICE_YELLOW   (1 << 3)
```

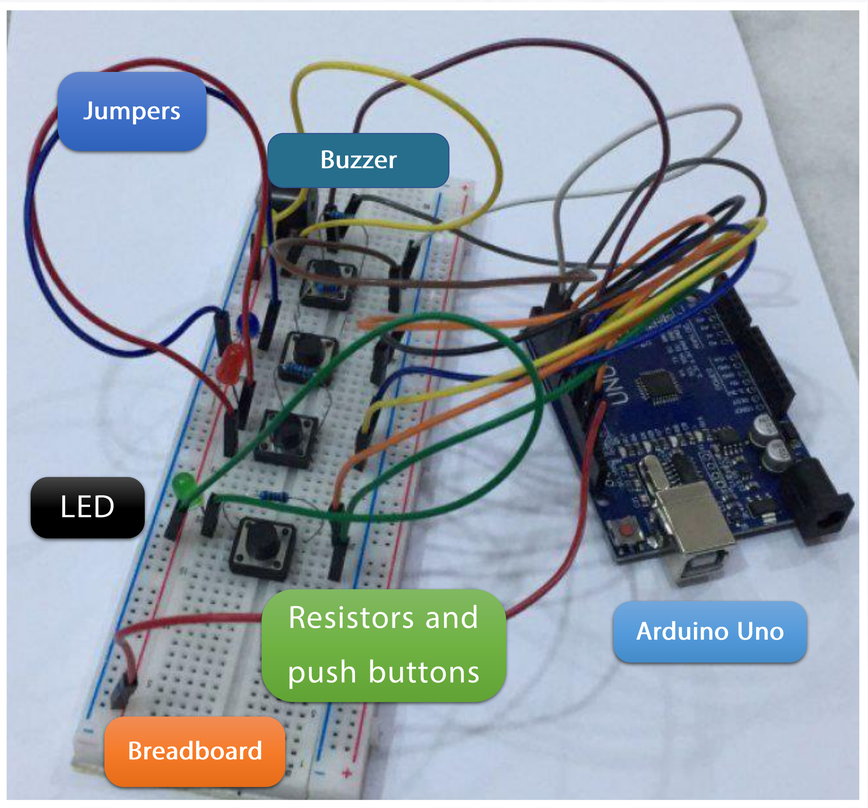
```
#define LED_RED     10

#define LED_GREEN   3

#define LED_BLUE    13

#define LED_YELLOW  5
```

```
// Button pin definitions

#define BUTTON_RED    9

#define BUTTON_GREEN  2

#define BUTTON_BLUE   12

#define BUTTON_YELLOW 6

// Buzzer pin definitions
```

## Components :

1. Arduino Uno 2. Buzzer
3. Resistor 4. Push Button
5. Jumper wires. 6. LED
7. Breadboard.

## Final Model :




## References :

1. Hubert Henry Ward, 2022, Programming Arduino Projects with the PIC Microcontroller: A Line-by-Line Code Analysis and Complete Reference Guide for Embedded Programming in C, APress, USA.

2. Jeremy Blum, 2022, Exploring Arduino®: Tools and Techniques for Engineering Wizardry, (2nd Ed.), John Wiley & Sons, Inc. 10.1002/9781119405320.

الكلية التقنية الهندسية
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# Design and Implementation of Radar Control with Arduino Circuit

**SUPERVISOR :** Lec. Dr. Taif Alawsi

**STUDENT :** Abdul Rahman Saud

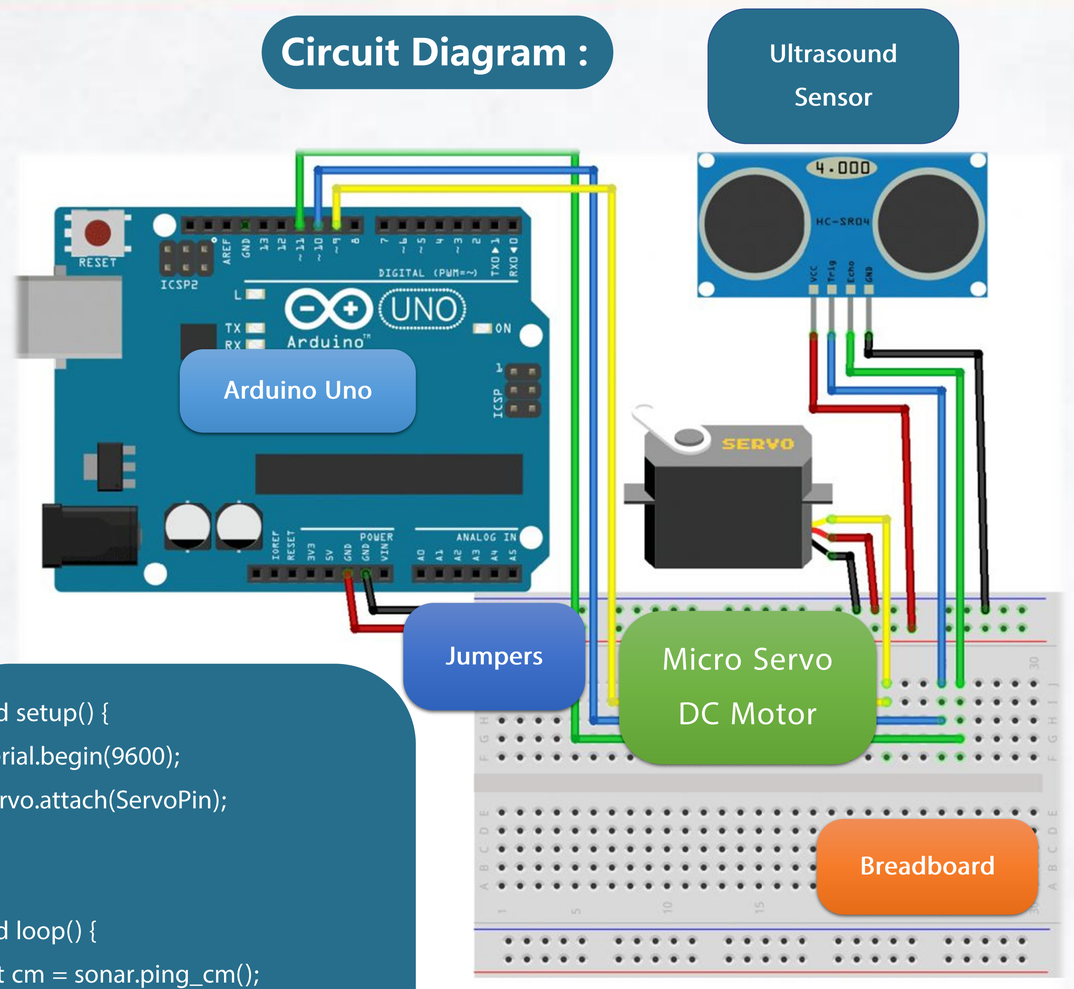
## ABSTRACT :

Often we need devices and techniques that help us know the distance between objects to help us in various fields, especially engineering and military fields and many others. Through the Arduino, it is possible to create a device that shows us the distance of the objects from the sensor, but with small distances

## Operation :

Using the sensor connected to the Arduino, the circuit can determine the location of objects at a distance of more than 20 cm. Whenever the object approaches the sensor, the motor gives its reading that the object approached a certain distance, for example, 10 cm. Then, the Arduino can determine object position and their distance from the sensor.

## Circuit Diagram :



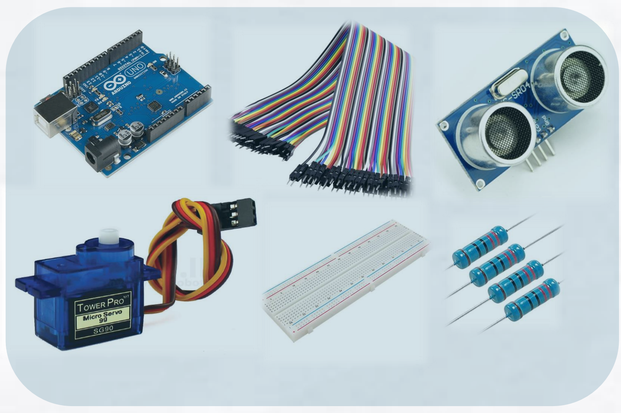

## Programming Code :

```
#include <Servo.h>

#include <NewPing.h>

const int ServoPin = 10;
const int TriggerPin = 6;
const int EchoPin = 7;

// 100 = maxDistance
NewPing sonar (TriggerPin, EchoPin,
100);
Servo servo;
```

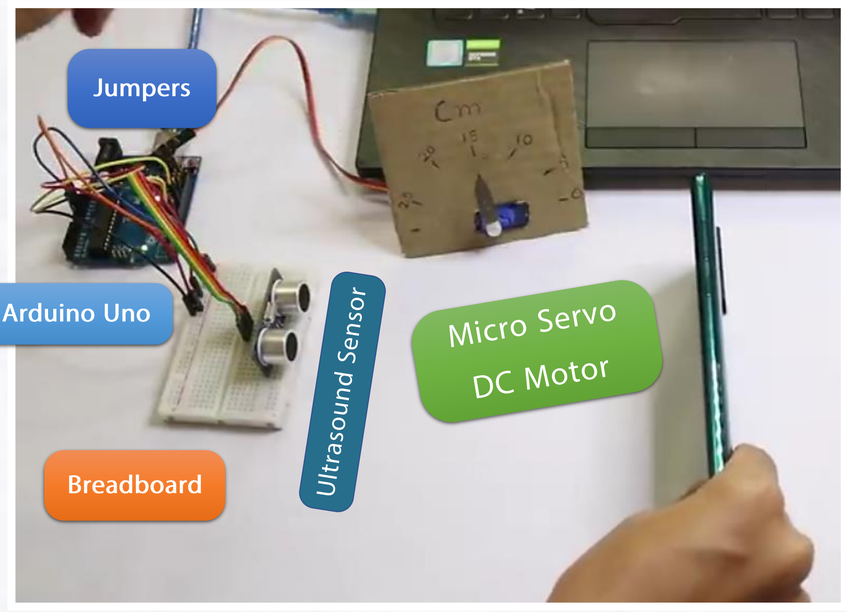
```
void setup() {
  Serial.begin(9600);
  servo.attach(ServoPin);
}

void loop() {
  int cm = sonar.ping_cm();
  Serial.println(cm);
 int angle = map(cm, 2, 15, 15, 100);
  servo.write(angle);
  delay(50);
}
```

## Components :

1. Arduino Uno
2. Ultrasound sensor 3. Resistor
4. Micro Servo DC Motor
5. Jumper wires. 6. Breadboard.



## Final Model :




## References :

1. Hubert Henry Ward, 2022, Programming Arduino Projects with the PIC Microcontroller: A Line-by-Line Code Analysis and Complete Reference Guide for Embedded Programming in C, APress, USA.

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# Dental Laser Device

SUPERVISOR : Lec. Dr. Taif Alawsi

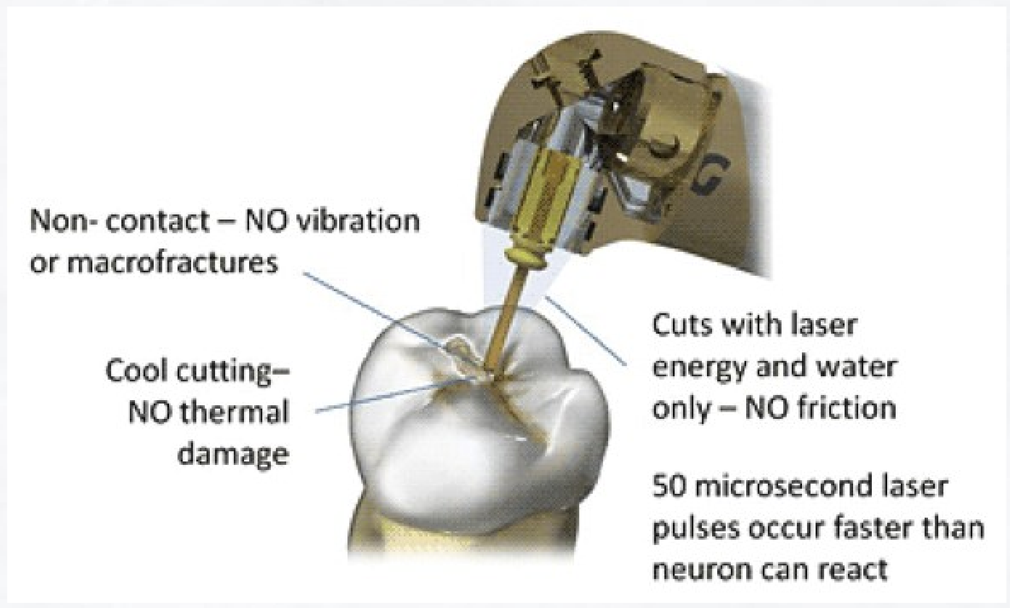
GROUP : Ahmad Sabah , et al .

## INTRODUCTION :

Lasers provide new powerful tools that is characterized by a bloodless field and applied in most branches of dentistry. There are many types of lasers, such as Gas, Chemical, Dye, Metal-vapor, Solid-state and Semiconductor laser. Each laser type has its own unique features, advantages and disadvantages. While one laser may be suitable for some procedures, it will be unsuitable for others, so it is important for the dentist to have a background information about this technology and its uses in dentistry.

## Operation:

All lasers work by delivering energy in the form of light. When used for surgical and dental procedures, the laser acts as a cutting instrument or a vaporizer of tissue that it comes in contact with. When used in teeth-whitening procedures, the laser acts as a heat source and enhances the effect of tooth-bleaching agents.



## Components:

1- AC Power Source 2- Water Inlet and Outlet 3- Leakage Protection 4- Main Body 5- Emergency Stop 6- Laser Arm 7- Laser Head 8- Control Screen

## Uses :

1- Tooth decay: Lasers are used to remove decay within a tooth and prepare the surrounding enamel for receipt of the filling.

2- Gum disease: Lasers are used to reshape gums and remove bacteria during root canal procedures.

3- Biopsy or lesion removal: Lasers can be used to remove a small piece of tissue (called a biopsy) so that it can be examined for cancer. Lasers are also used to remove lesions in the mouth and relieve the pain of canker sores.

4- Teeth whitening: Lasers are used to speed up in-office teeth whitening procedures. A peroxide bleaching solution, applied to the tooth surface, is "activated" by laser energy, which speeds up of the whitening process.

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# Laser-Assisted in Situ Keratomileusis (LASIK)

**SUPERVISOR :** Lec. Dr. Taif Alawsi, Eng. Noor

**GROUP :** Hawraa, et al.

## INTRODUCTION :

Laser-Assisted in Situ Keratomileusis (LASIK) means modifying the shape of the cornea by using a laser. A precise instrument called a microkeratome is used to remove a thin layer from the surface of the cornea, except for a small part of it that keeps it attached to the eye and is moved back. The inner corneal tissue (estimated according to the type and degree of the visual defect) and then, the surface layer of the cornea is returned to its normal position to fuse without the need for any surgical stitches.

## LASIK OPERATION :

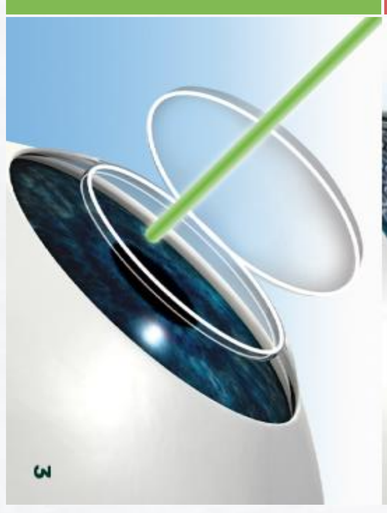
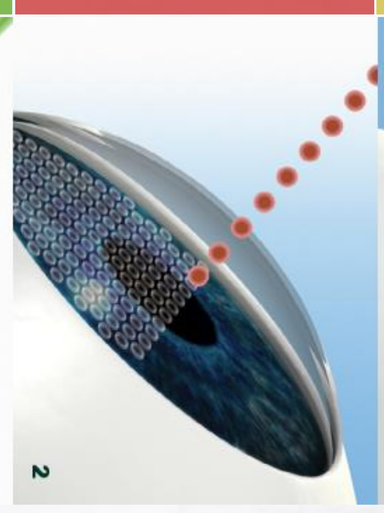
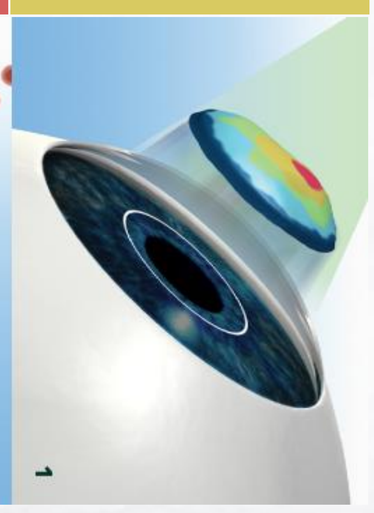
During LASIK surgery, a special type of cutting laser is used to precisely change the shape of the dome-shaped clear tissue at the front of your eye (cornea) to improve vision. In eyes with normal vision, the cornea bends (refracts) light precisely onto the retina at the back of the eye. But with nearsightedness (myopia), farsightedness (hyperopia), or astigmatism, the light is bent incorrectly, resulting in blurred vision. Glasses or contact lenses can correct vision, but reshaping the cornea itself also will provide the necessary refraction.

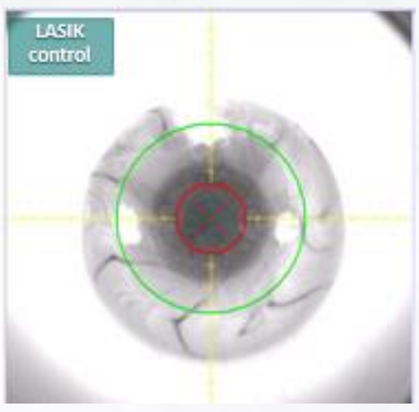
## LASIK COMPONENTS :

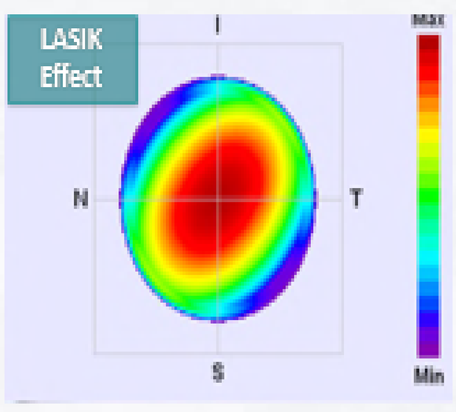
1- Excimer Laser
2- Slit Lamp
3- Microscope
4- Switches
5- Patient Table
6- Control Unit
7- Power Supply
8- Fluence Detector
9- Screen

## LASIK USES :

1. Correction of myopia
2. Correction of hyperopia
3. Actual cure for astigmatism

| 3. Cornea Reshaping | 2. Laser Flap Creation | 1. Individualized Measurement |
|---|---|---|
|  |  |  |



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# Magnetic Resonance Imaging (MRI)

**SUPERVISOR :** Lec. Dr. Taif Alawsi, Eng. Sura

**GROUP :** Abdullah Razzaq, et al.

## INTRODUCTION :

Magnetic resonance imaging (MRI) is a medical imaging technique that uses a magnetic field and computer-generated radio waves to create detailed images of the organs and tissues in your body. Most MRI machines are large, tube-shaped magnets. When you lie inside an MRI machine, the magnetic field temporarily realigns water molecules in your body. Radio waves cause these aligned atoms to produce faint signals, which are used to create cross-sectional MRI images — like slices in a loaf of bread. The MRI machine can also produce 3D images that can be viewed from different angles.

## MRI Operation :

The nuclei of atoms show magnetic properties, so they can orient themselves in a magnetic field by acting as small magnets; allowing scientists to monitor these particles and see even the smallest details, and how they behave. The nuclei resonate at specific frequency when a broad spectrum of radiofrequency waves is applied this is known as resonance. Each vertex is the number of nuclei that resonate at each specific frequency -this is known as signal intensity- so the more nuclei resonate, the higher the intensity. The value of each frequency or tone gives information about the circumference of the atom.

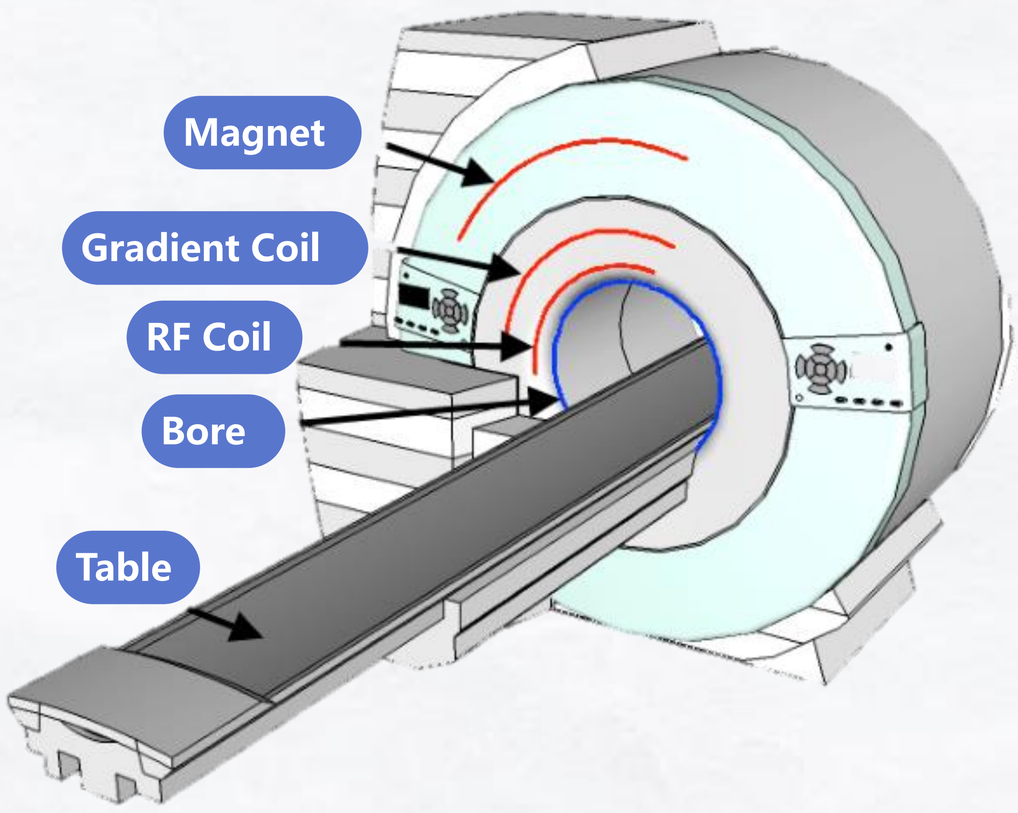


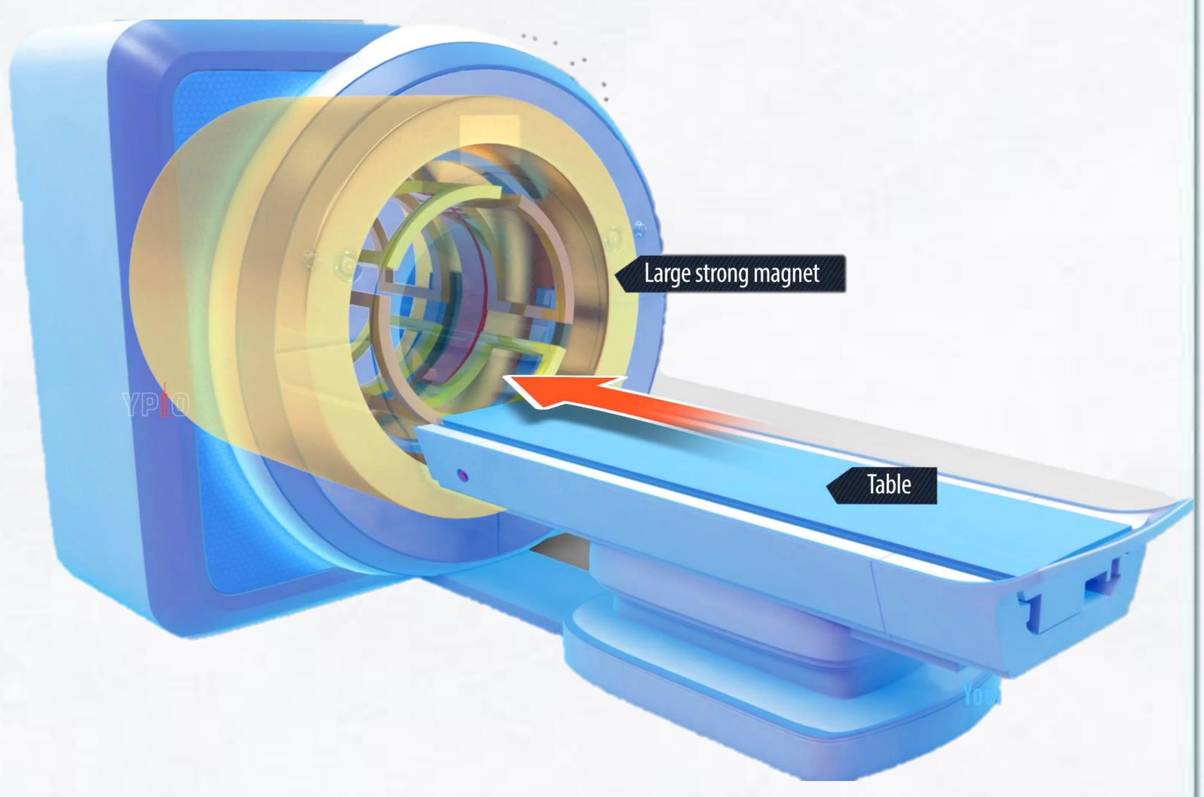
## MRI Components :

1- Strong Magnet 2- Source of radio waves
3- Radio wave reader, generator, and booster
4- Variable magnetic field controller
5- PC 6- Control unit 7- Digital converter
8- Radio pulse programmer 9- Power Supply
11- Film, 12- Insulator 13- Patient table

## MRI Applications :

1- Diagnosis of stroke
2- Fractures and brain tumors
3- Spinal injuries Soft tissue injuries
4- Imaging of the veins and arteries
5- Neuroimaging of the brain
6- Liver and bile duct imaging
7- Imaging of spinal deformities



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# Nuclear Magnetic Resonance Spectroscopy (NMR)

**SUPERVISOR :** Lec. Dr. Taif Alawsi, Eng. Naba'a

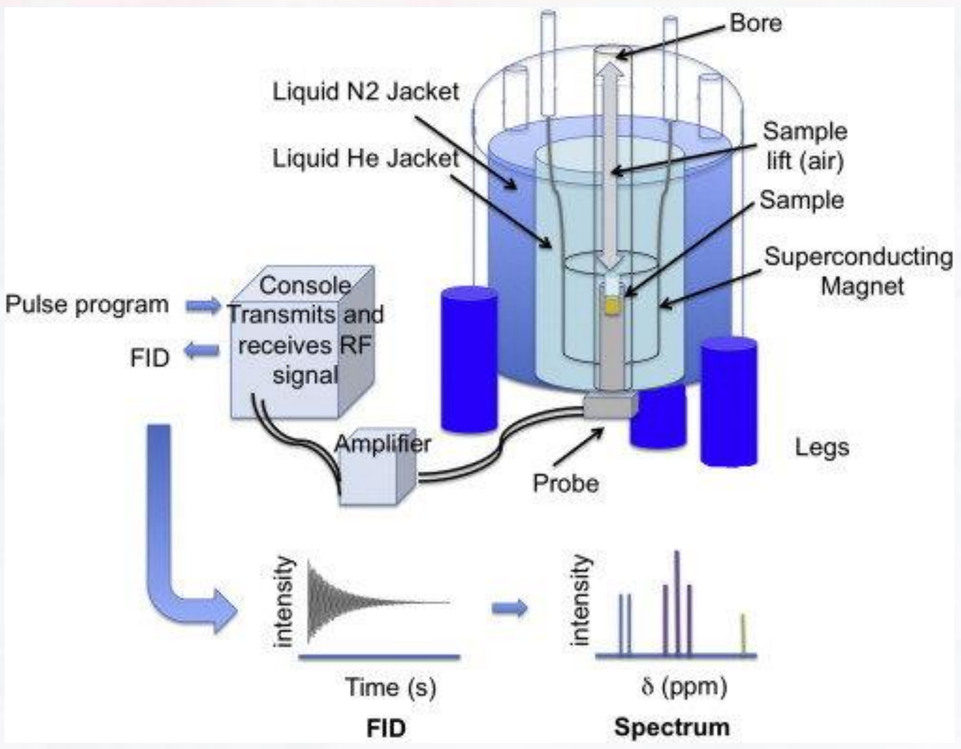
**STUDENT :** Hamza Kasm Fezza

## INTRODUCTION :

Nuclear magnetic resonance spectroscopy (NMR spectroscopy) is one of the most widely used techniques by chemists and biologists to identify molecular structures. It relies on the phenomenon of nuclear magnetic resonance, which means the intramolecular magnetic around an atom in a specific molecular changes the resonance frequency. Thus, different atoms within one molecule could have different resonance signals and could be detected by the equipment.

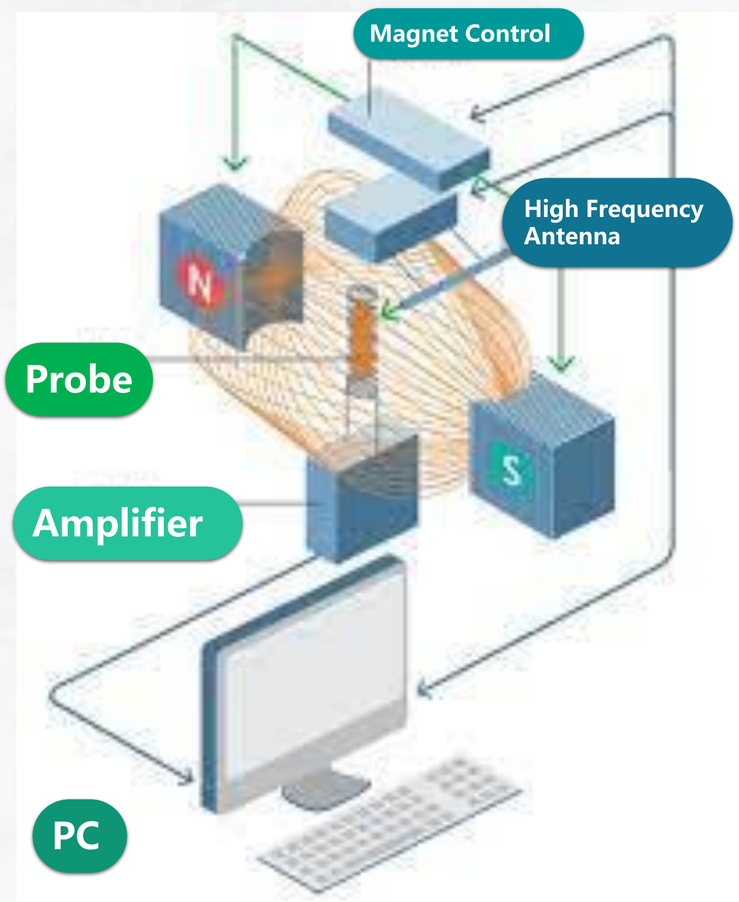

## Operation :

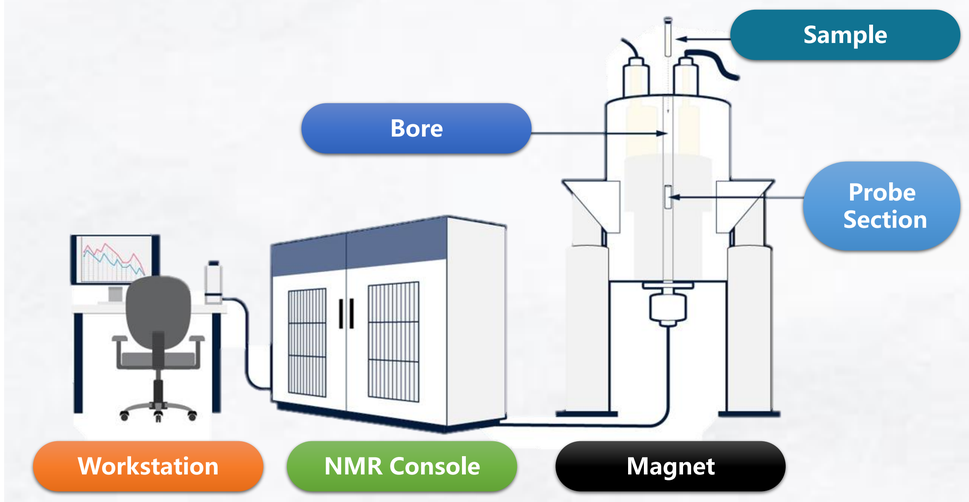
For NMR study, samples should first dissolve in deuterated solvent and prepared in a thin-wall glass tube (NMR tube). Then the NMR tubes should be installed with a spinner and put into the NMR spectrometer. Typical high resolution NMR spectrometers are relatively large and expensive, which have a liquid helium-cooled superconducting magnet to generate up to several Tesla magnet fields (Figure 1 source). They are controlled by a computer, which has a great number of pre-designed methodologies. After selecting the analytic method, such as 1H standard test, the spectra will be automatically generated.




## Components :

1- RF source, gate, amplifier, oscillator.
2- Filter pulse programming.
3- Probe.
4- Magnets.
5- Control Unit.
6- PC
7- Power Supply.
8- High-Frequency Antenna.



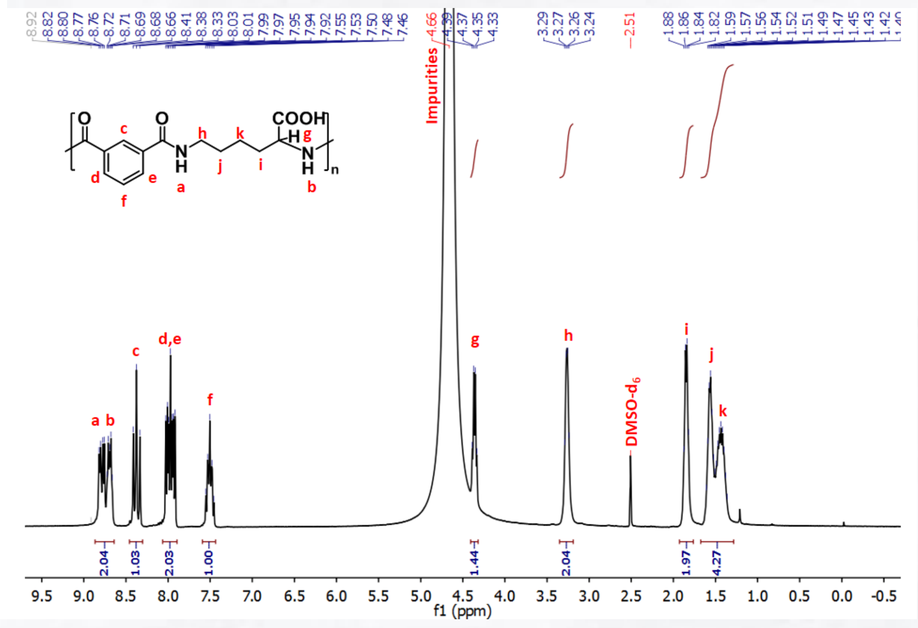




## Uses :

To study the physical, chemical, and biological properties of matter. Chemists use it to determine molecular identity and structure. Medical practitioners employ magnetic resonance imaging (MRI), a multidimensional NMR imaging technique, for diagnostic purposes.

## NMR Signal :

The figure shows that every specific peak (or peaks) with different chemical shift and unique shape is corresponding to a H atom (or H atoms in the same chemical environment). In this way, we can deduct the molecular structure by NMR spectra. Sometimes, when the target molecule is quite complex, we need more information from 13C spectra or even 2D NMR spectra. In my study of hyperbranched polymers, NMR could be a useful tool to demonstrate the structure details, such as branching degrees or grafting density.



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قسم هندسة تقنيات الأجهزة الطبية

# Optical Coherence Tomography (OCT)

**SUPERVISOR :** Lec. Dr. Taif Alawsi, Eng. Naba'a

**GROUP :** Zainab , et al .

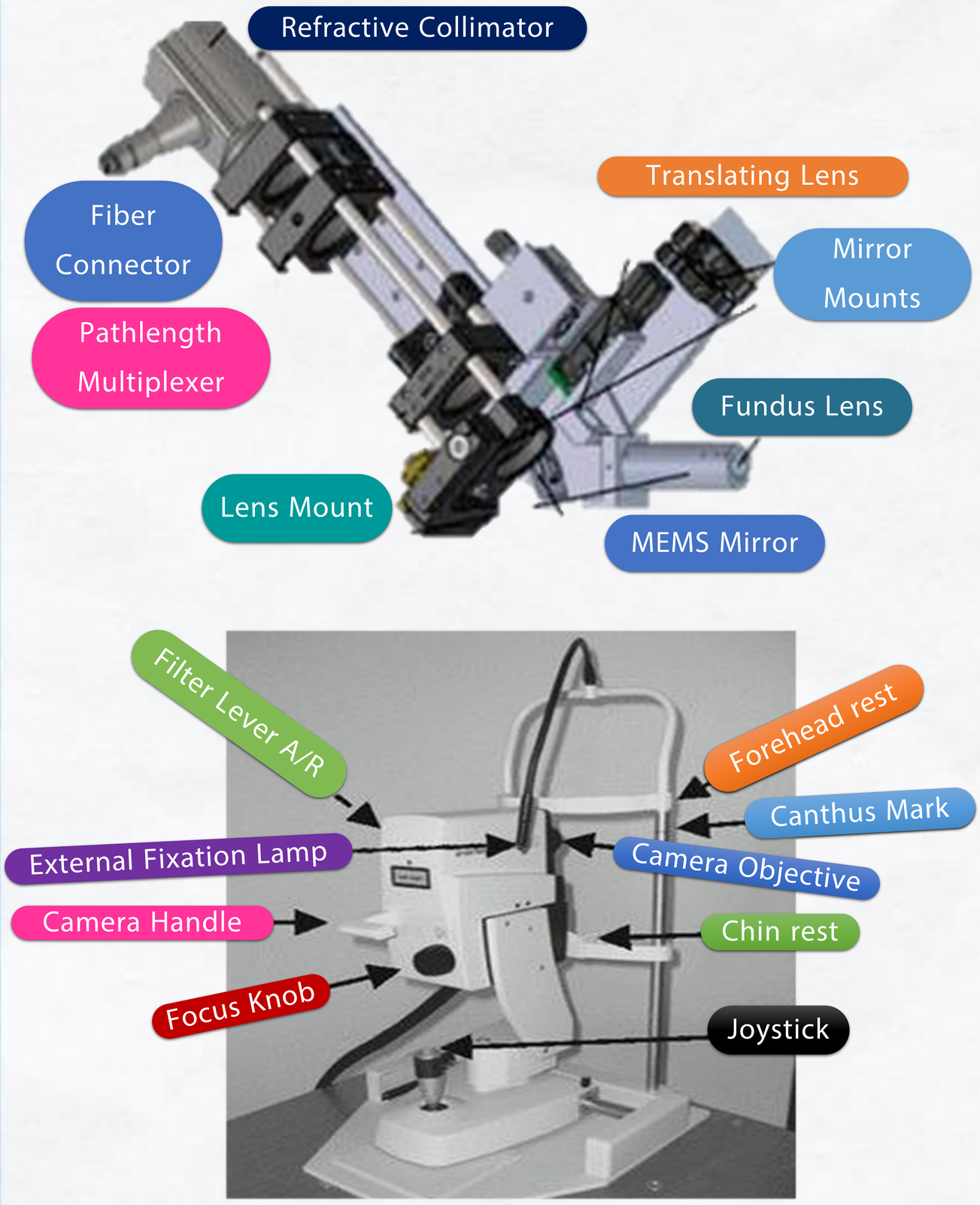
## INTRODUCTION :

Optical Coherence Tomography (OCT) is a non-invasive diagnostic instrument used for imaging the retina. It is the technology for the future because it can enhance patient care. It has the ability to detect problems in the eye prior to any symptoms being present in the patient. With an OCT, ophthalmologists can see a cross-section or 3D image of the retina and detect the early onset of a variety of eye conditions and eye diseases such as macular degeneration, glaucoma, and diabetic retinopathy (the top three diseases known to cause blindness).

## Operation :

The ophthalmologist puts eye drops to expand the pupil of the eye, where the drops work to expand the pupil and facilitate the examination of the retina. The patient sits in front of the OCT and places his/her head on its support keeping it immobile. The device examines the eye without touching it and takes about 5-10 minutes. The eye may be sensitive to light for several hours after the examination.

## Components :




## Applications :

**Ophthalmology:** To obtain high-resolution images of the retina, anterior segment, photoreceptor integrity and axon thickness.

**Cardiovascular disease:** Angiography of the external arteries.

**Oncology:** To detect cancer and cancer nearby lesions.

**Dermatology:** To diagnose skin cancers.

**Dentistry:** Detecting white spots in the enamel.

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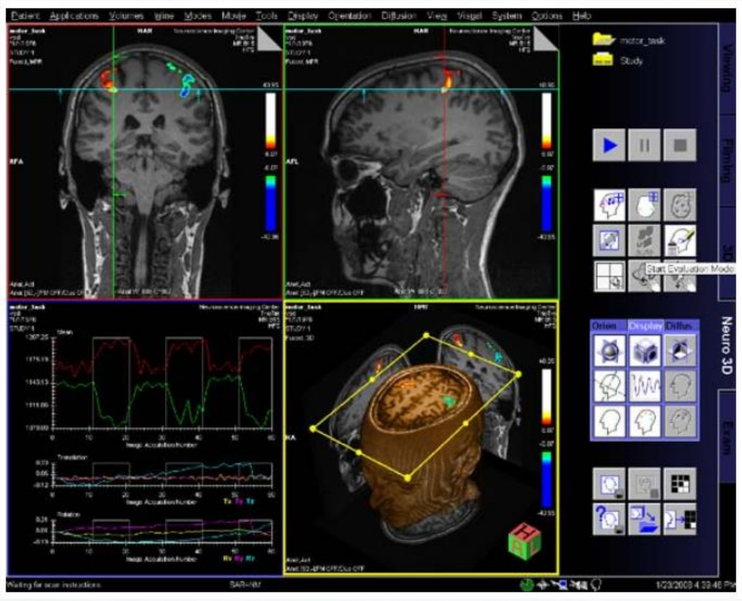
# FUNCTIONAL MAGNETIC RESONANCE IMAGING (fMRI)

SUPERVISOR : Lec. Dr. Taif Alawsi

GROUP : Mustafa, et al.

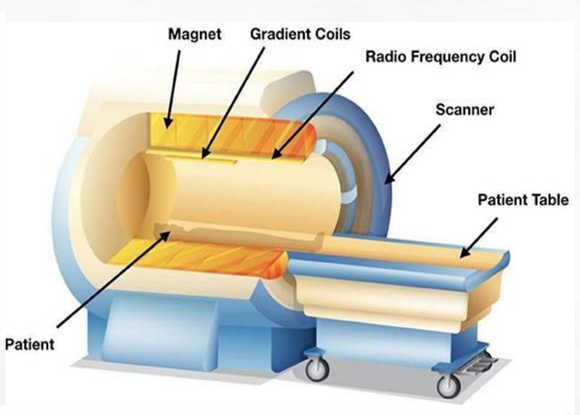
## INTRODUCTION :

Functional magnetic resonance imaging (fMRI) is a medical diagnostic device that operates by detecting the changes in blood oxygenation and flow that occur in response to neural activity. When a brain area is more active than the others; it consumes more oxygen. Thus, blood flow increases to the active area to meet the oxygen demand. It can be used to construct 3D activation maps indicating which parts of the brain are involved in a certain mental process.




## fMRI OPERATION :

The cylindrical tube of an MRI scanner houses a very powerful electromagnet. A standard research scanner has a magnetic field strength of 3 Tesla's (T) which is about 50,000 times greater than the Earth's magnetic field. The magnetic field inside the scanner affects the magnetic nuclei of the atoms. Normally atomic nuclei are randomly oriented, but under the influence of a magnetic field, the nuclei become aligned with the direction of the field. The stronger the field the greater the degree of alignment. When pointing in the same direction, the tiny magnetic signals from individual nuclei add up coherently resulting in a signal that is large enough to measure. In fMRI, it is the magnetic signal from hydrogen nuclei in water (H2O) that is detected. The key to MRI is that the signal from hydrogen nuclei varies in strength depending on the surroundings. This provides a means of discriminating between grey matter, white matter, and cerebral spinal fluid in structural images of the brain.

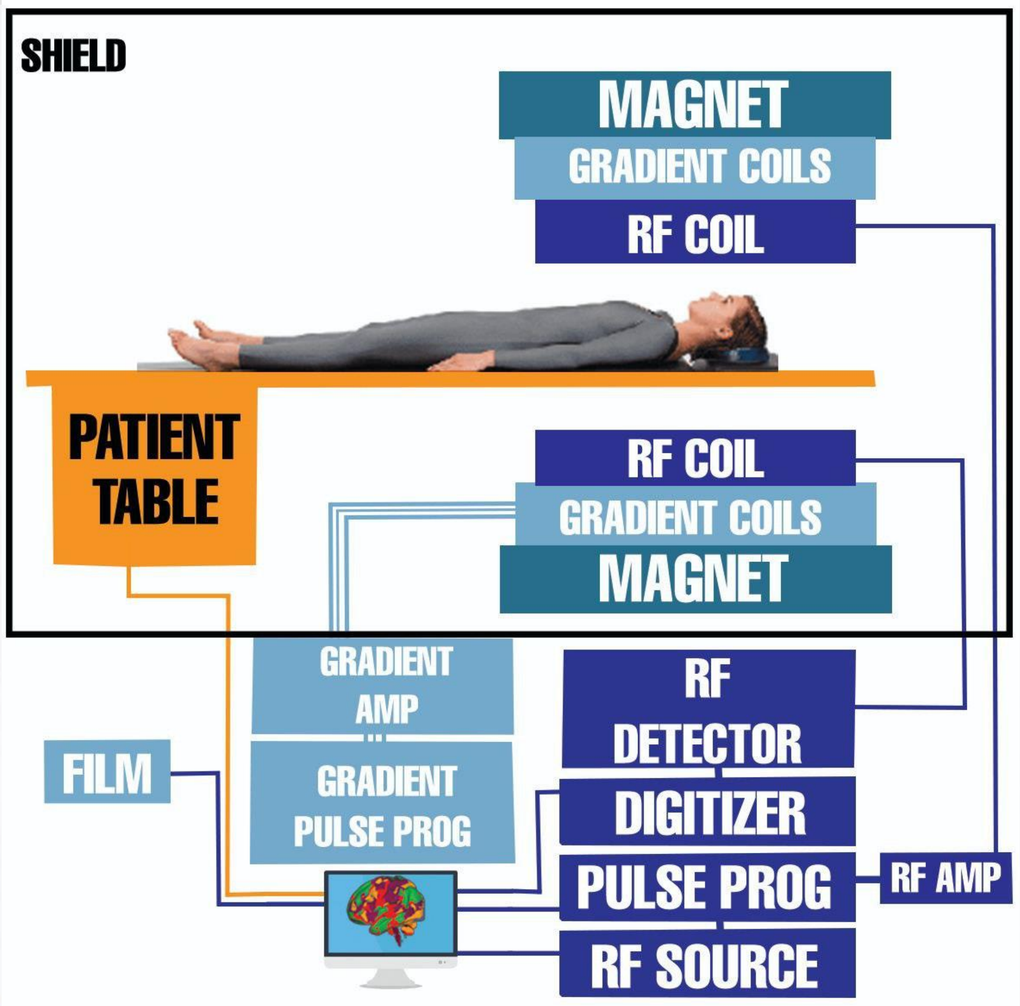



## fMRI COMPONENTS :

1- Strong Magnet
2- Gradient Coils
3- Radio-Frequency Coil
4- Scanner
5- Patient Table
6- Control Unit
7- Power Supply
8- RF Source, Signal, Detector
9- Screen

## fMRI USES :

1. Enlargement of blood vessels in the brain.
2. Multiple sclerosis.
3. Spinal cord injuries.
4. Infections.
5. Brain attack.
6. Enlargement of the head.
7. Tumors
8. Bleeding
9. Acromegaly.
10. Growth problems



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# Gas Chromatograph (GC)

**SUPERVISOR :** Lec. Dr. Taif Alawsi

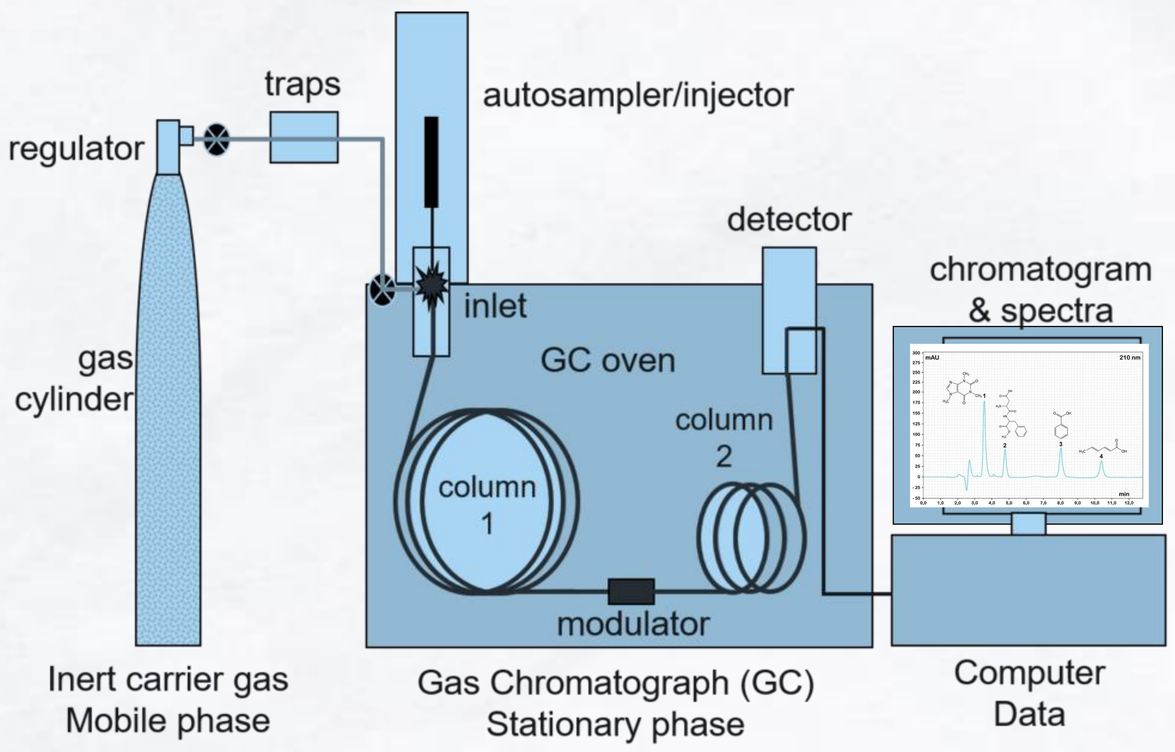
**GROUP :** Furqan, et al.

## INTRODUCTION :

A gas chromatograph (GC) is an analytical instrument that measures the content of various components in a sample. The analysis performed by a gas chromatograph is called gas chromatography. Gas chromatography is the process of separating compounds in a mixture by injecting a gaseous or liquid sample into a mobile phase, typically called the carrier gas, and passing the gas through a stationary phase.


## Operation :

The sample solution injected into the instrument enters a gas stream which transports the sample into a separation tube known as the "column." (Helium or nitrogen is used as the so-called carrier gas.) The various components are separated inside the column. The detector measures the quantity of the components that exit the column. To measure a sample with an unknown concentration, a standard sample with a known concentration is injected into the instrument. The standard sample peak retention time (appearance time) and area are compared to the test sample to calculate the concentration.




## Components :

1. Injection port
2. Column
3. Carrier gas flow control equipment
4. Ovens and heaters
5. Integrator chart recorder
6. Detector

## Uses :

1. Food analysis.
2. Quality control.
3. Research.
4. Forensics.
5. Measuring air pollution.
6. Blood alcohol analysis.

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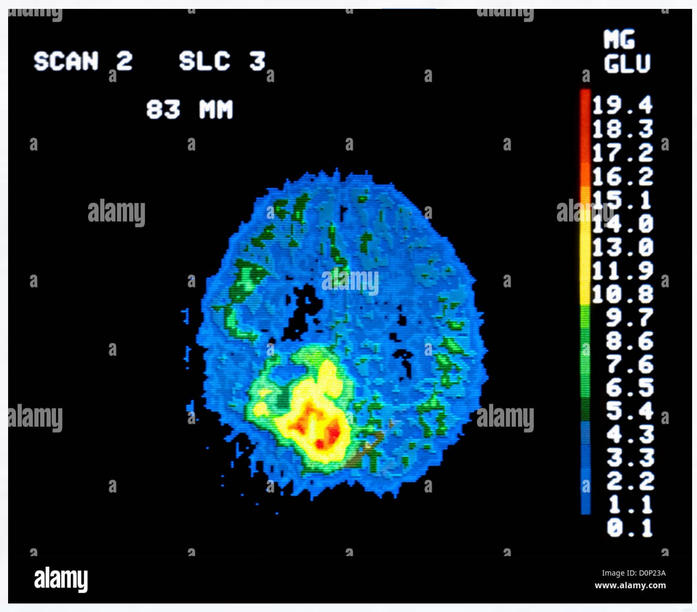
# Positron Emission Tomography (PET)

SUPERVISOR : Lec. Dr. Taif Alawsi

GROUP : Ahmad Hassan , et al .

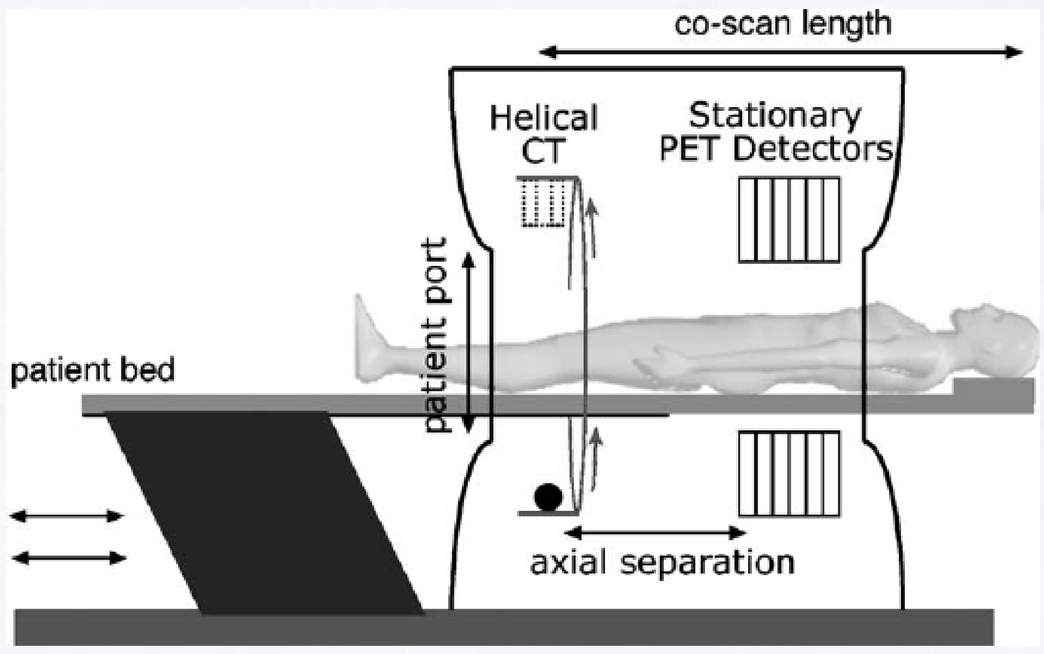
## INTRODUCTION :

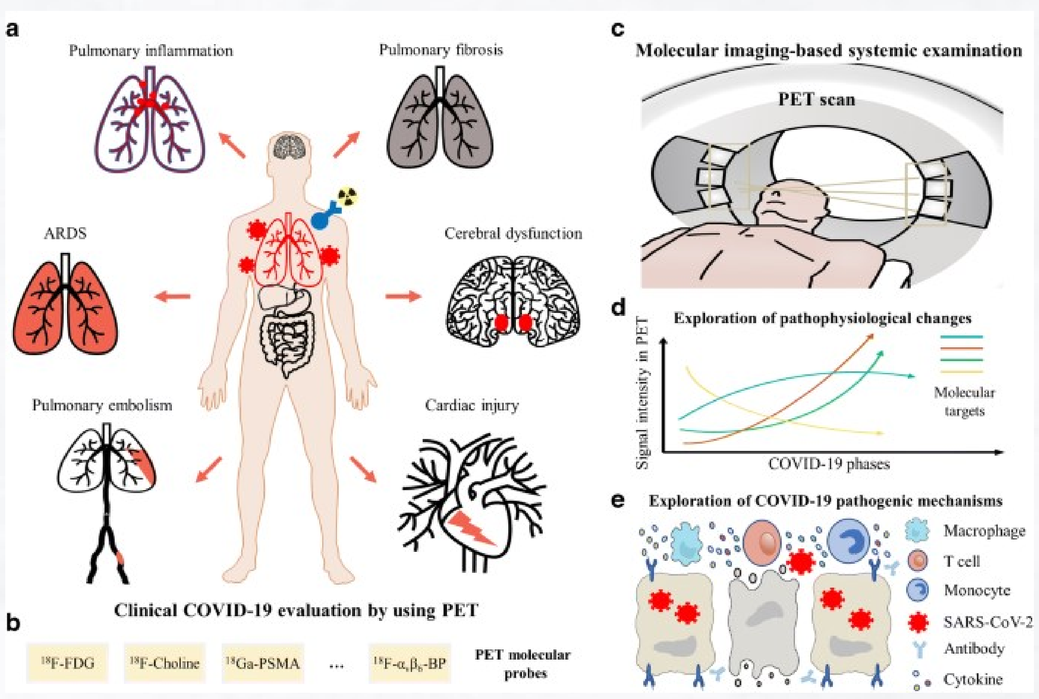
Positron emission tomography (PET) is a type of nuclear medicine procedure that measures metabolic activity of the cells of body tissues. PET is actually a combination of nuclear medicine and biochemical analysis. Used mostly in patients with brain or heart conditions and cancer, PET helps to visualize the biochemical changes taking place in the body, such as the metabolism (the process by which cells change food into energy after food is digested and absorbed into the blood) of the heart muscle.



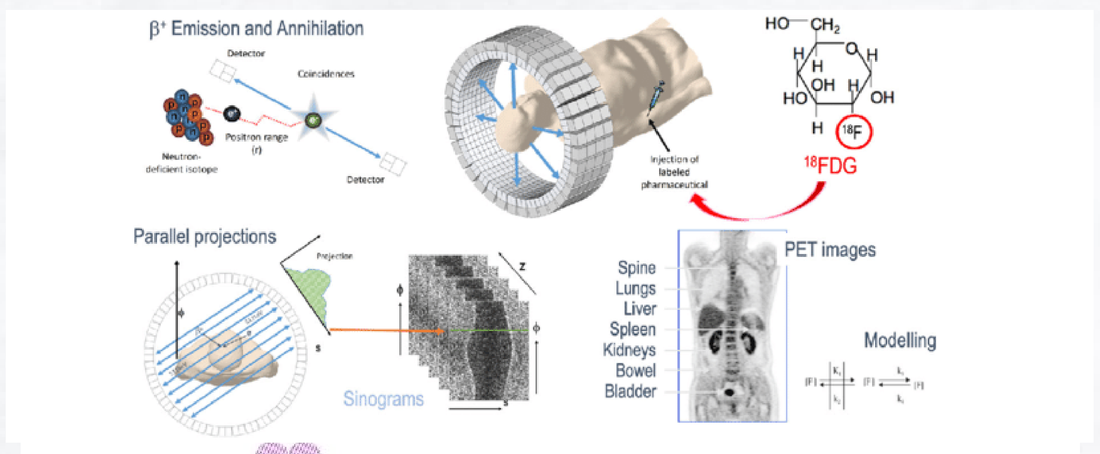

## Operation:

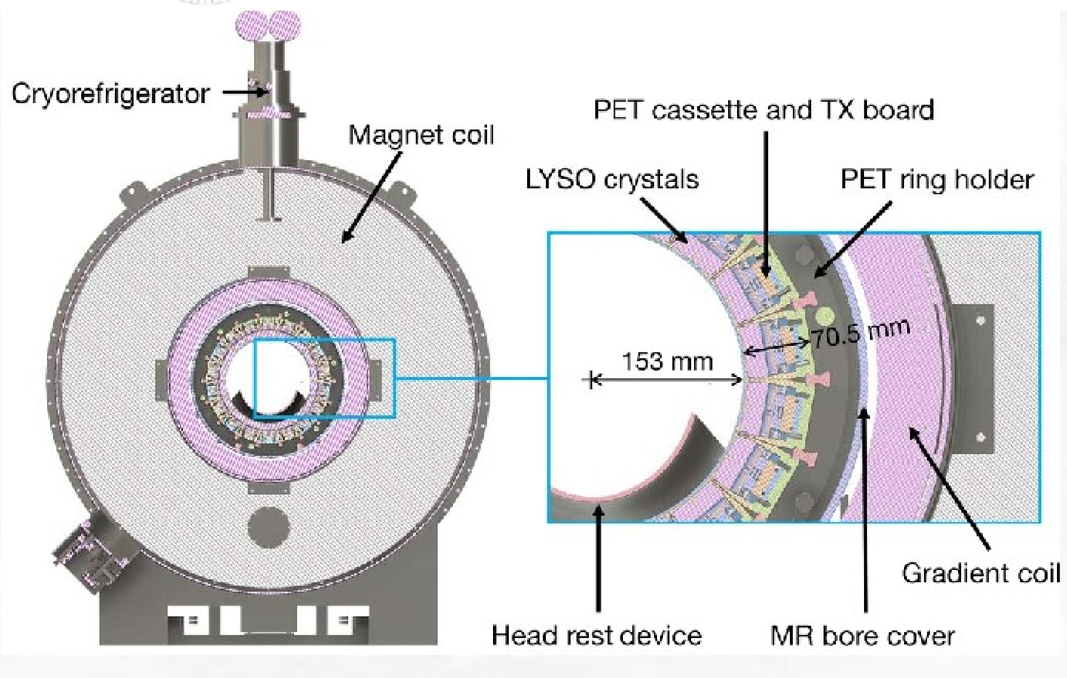
PET works by using a scanning device (a machine with a large hole at its center) to detect photons (subatomic particles) emitted by a radionuclide in the organ or tissue being examined.




The radionuclides used in PET scans are made by attaching a radioactive atom to chemical substances that are used naturally by the particular organ or tissue during its metabolic process. For example, in PET scans of the brain, a radioactive atom is applied to glucose (blood sugar) to create a radionuclide called fluorodeoxyglucose (FDG), because the brain uses glucose for its metabolism. FDG is widely used in PET scanning.




## Components:

A PET system has three major components: - a particle accelerator with targets for production of the positron-emitting isotopes; - chemistry modules for synthesis and labelling of the desired tracers; - and a PET camera for in-vivo measurements of the distribution of the tracer in the body.

## Uses :

In general, PET scans may be used to evaluate organs and/or tissues for the presence of disease or other conditions. PET may also be used to evaluate the function of organs, such as the heart or brain. The most common use of PET is in the detection of cancer and the evaluation of cancer treatment.

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قسم هندسة تقنيات الأجهزة الطبية

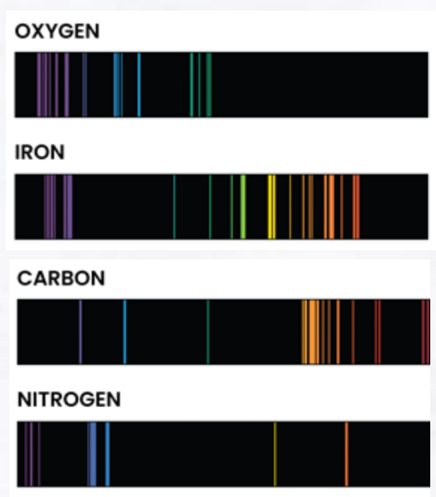
# SPECTROPHOTOMETER

SUPERVISOR : Lec. Dr. Taif Alawsi

GROUP : Abdul Ghani, et al.

## INTRODUCTION :

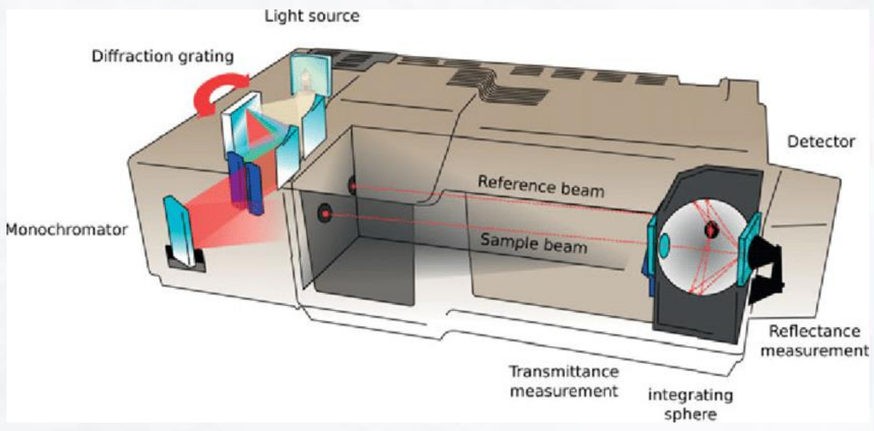
A spectrophotometer is an instrument that measures the amount of photons (the intensity of light) absorbed after it passes through sample solution.
It calculates the amount of chemical substance (concentrations) by measuring the intensity of light detected. Depending on the range of wavelength of light source.





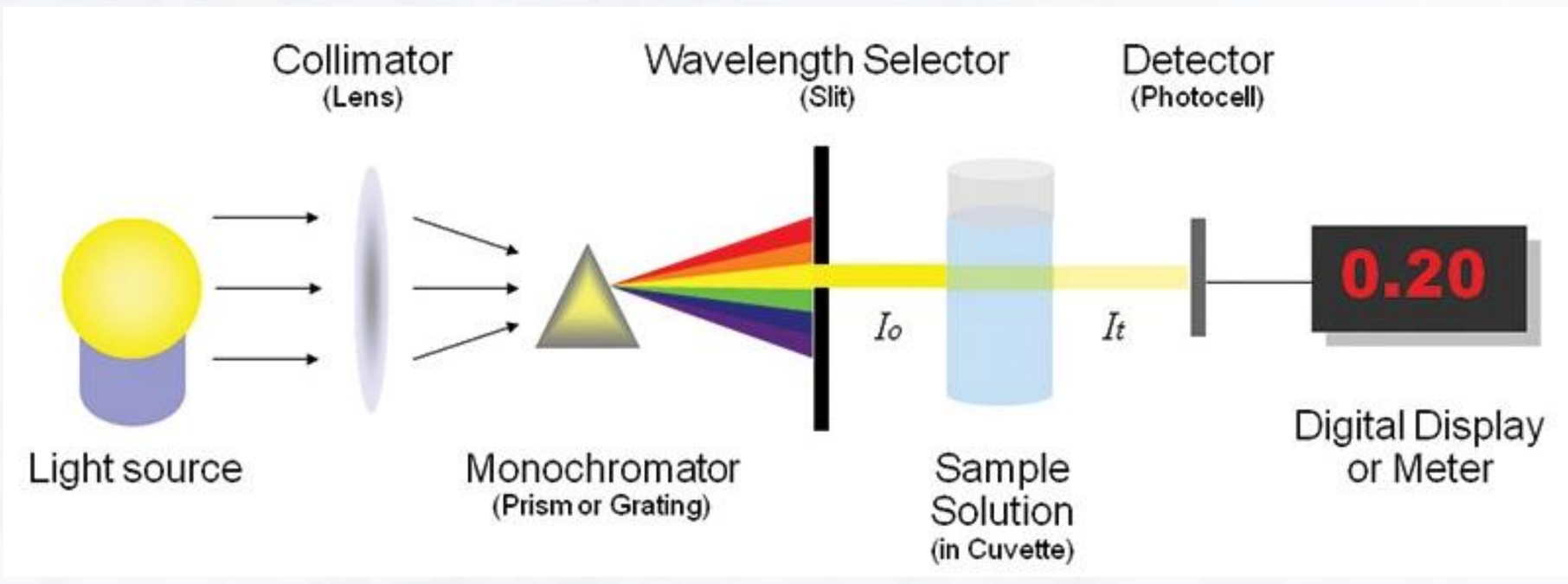
## OPERATION :

Single beam spectrophotometers are cost-effective and have the potential to perform better, as they do not need to expend energy splitting the beam. However, these devices are less stable. Moreover, they require more work, as users must provide a reference to standardize the device before using it.
Double beam spectrophotometers compare the light intensity of the spectrum from a sample to a reference beam. Applications that require stability, speed, and automation rely on double beam spectrophotometers and are expensive.




## COMPONENTS :

It consists of a light source, a monochromator, a sample chamber containing a cuvette, a detector (such as a photomultiplier tube or photodiode) to detect the transmitted light, a digital display, and a data analysis software package.




## APPLICATIONS :

- Quantifying concentrations of compounds
- Determining the structure of a compound
- Finding functional groups in chemicals
- Determining the molecular weight of compounds
- Determining the composition of materials

## USES :

- Food science
- Biochemistry research
- Medical diagnostics
- Forensic science
- Water and air analysis
- Industrial applications

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# COMPILERS

SUPERVISOR : Lec. Dr. Taif Alawsi

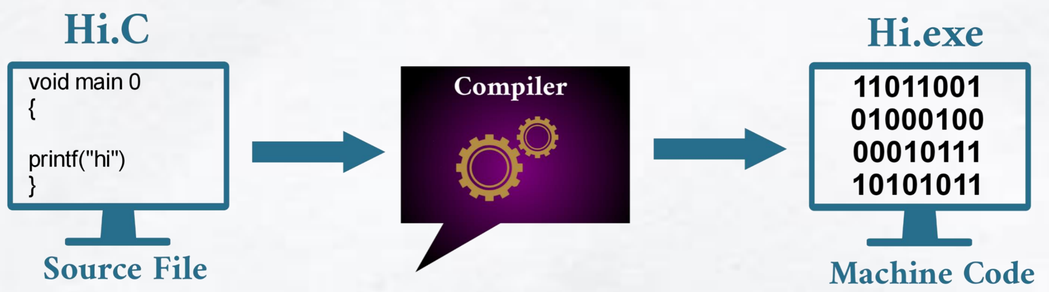
GROUP : Hussein, et al.

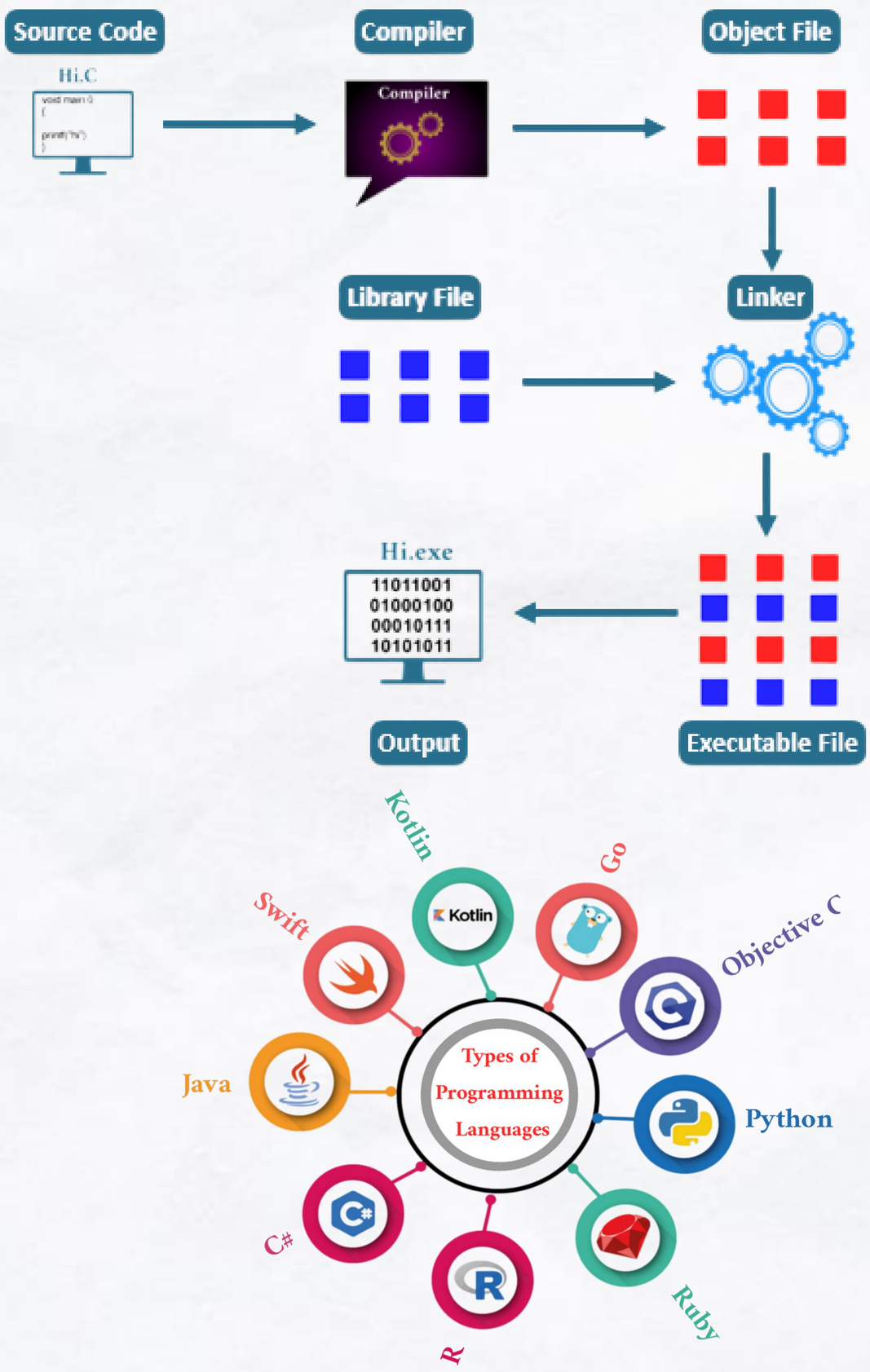
## INTRODUCTION :

A compiler is a program that converts code written in one programming language into another. It might take code written in Ruby and turn it into C, or code written in JavaScript and turn it into Machine Code. The code accepts as input is known as the source language. The code that it outputs is known as the target language. Most programming languages are written for people to understand and be able to write. Unfortunately, computers don't understand humans very well, so languages that are easy for us to read or write are impossible for computers to read and understand.

## COMPILER OPERATION :

A compiler takes the program code (source code) and converts the source code to a machine language module (called an object file). Another specialized program, called a linker, combines this object file with other previously compiled object files (in particular run-time modules) to create an executable file. So, for a compiled language the conversion from source code to machine-executable code takes place before the program is run. This is a very different process from what takes place for an interpreted programming language. This is somewhat simplified as many modern programs that are created using compiled languages make use of dynamically linked libraries or shared libraries. Therefore, the executable file may require these dynamically linked libraries (Windows) or shared libraries (Linux, Unix) to run.




## COMPILER TYPES :

1. Traditional Compilers (C, C++, and Pascal)
2. Interpreters (LISP, SNOBOL, and Java1.0)
3. Cross-Compilers
4. Incremental Compilers Converters (COBOL to C++)
5. Just-In-Time (JIT) Compilers (Java, Micosoft.NET)
6. Single-Pass Compiler
7. Multi-Pass Compiler
8. Ahead-of-Time (AOT) Compilers (.NET ngen)
9. Binary Compilation

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# ALGORITHM

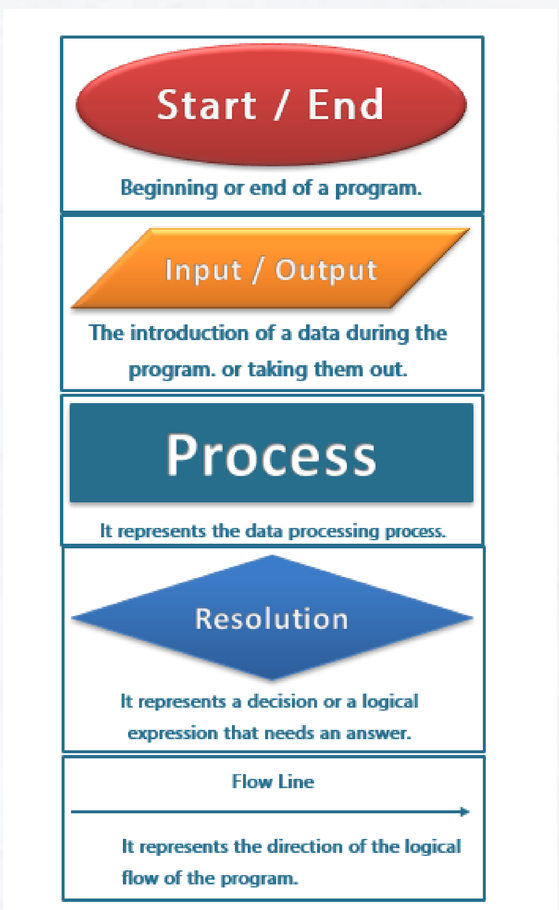
SUPERVISOR : Lec. Dr. Taif Alawsi

GROUP : Mohammad, et al.

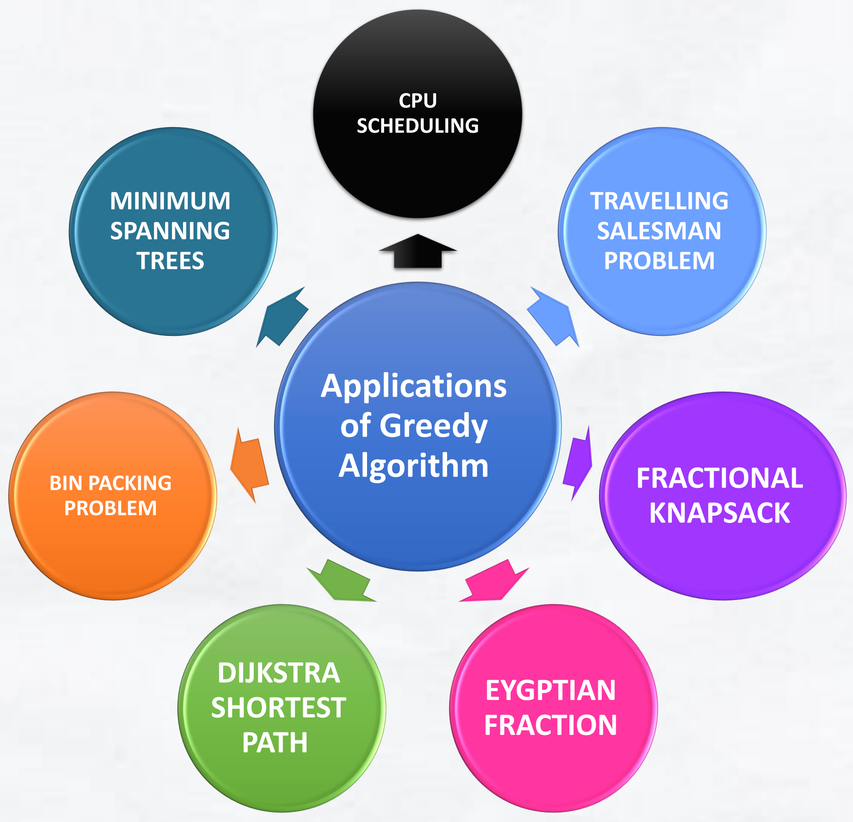
## INTRODUCTION :

It is a procedure or formula for solving a problem, based on conducting a sequence of specified actions. A computer program can be viewed as an elaborate algorithm. In mathematics and computer science, an algorithm usually means a small procedure that solves a recurrent problem. Algorithms are widely used throughout all areas of IT (information technology). A search engine algorithm, for example, takes search strings of keywords and operators as input, searches its associated database for relevant web pages, and returns results.

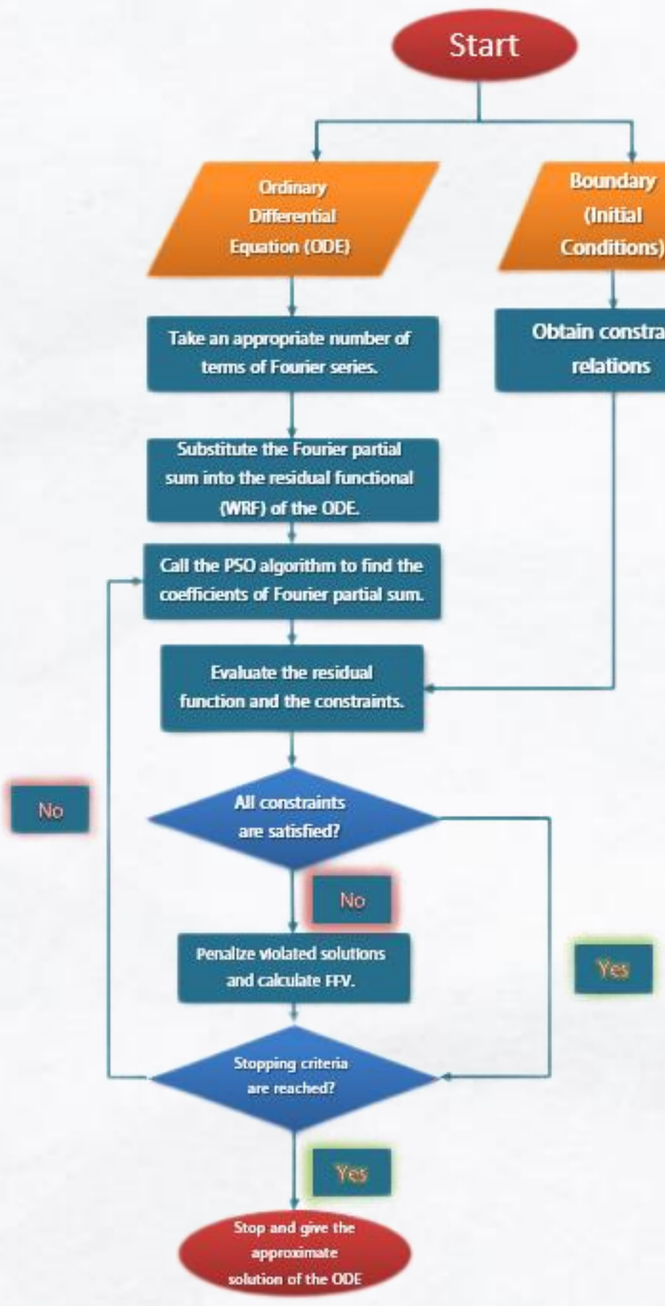
## FLOW CHART OPERATORS :



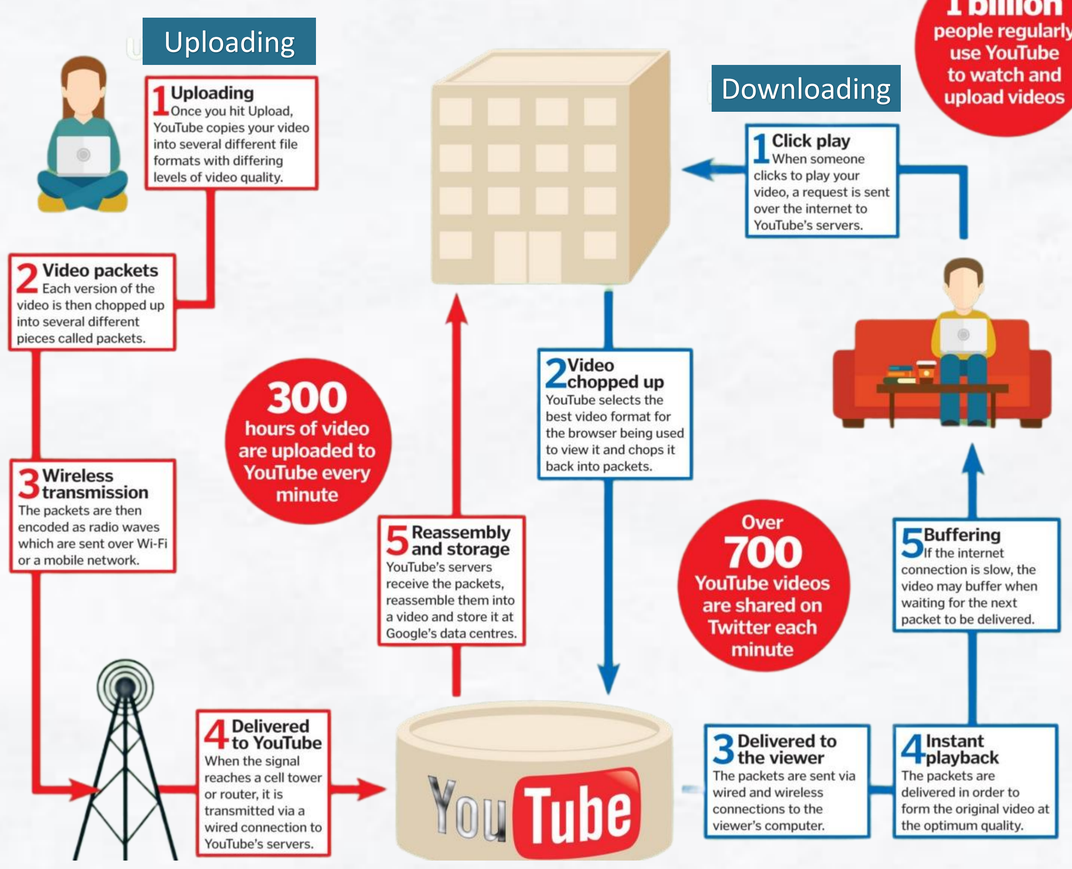

## APPLICATIONS :




## SOLVING ODE IN ALGORITHM :




## YOUTUBE ALGORITHM :




## TERMS :

ODE : ORDINARY DIFFERENTIAL EQUATION
PSO: PARTICLE SWARM OPTIMIZATION
FFV: FITNESS FUNCTION
WRF: WEIGHTED-RESIDUAL FUNCTION

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# Operating System (OS)

SUPERVISOR : Lec. Dr. Taif Alawsi

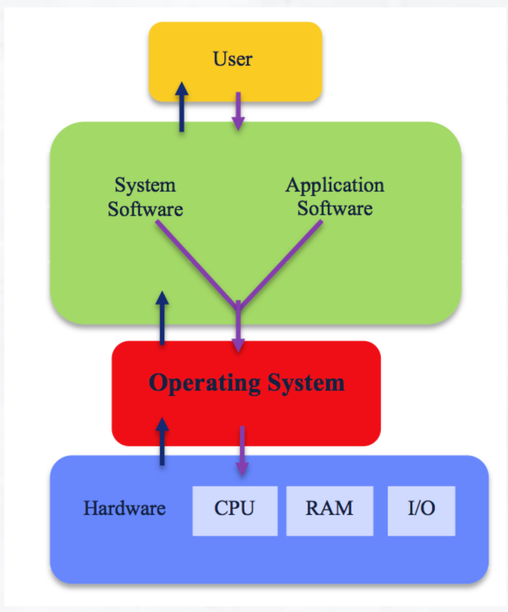
GROUP : Doaa, et al.

## INTRODUCTION :

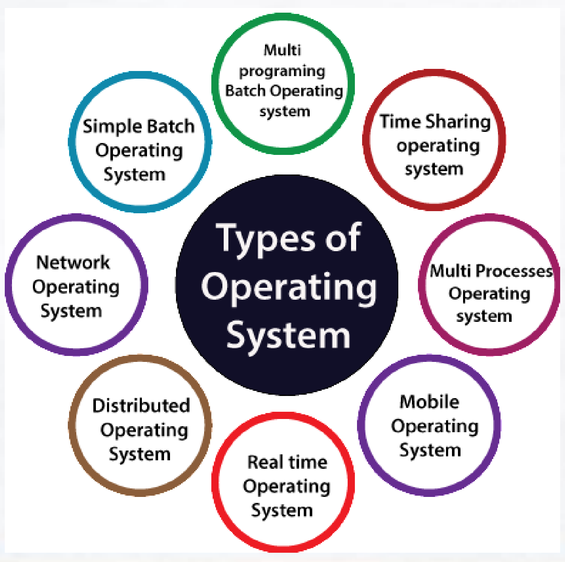
An operating system (OS) is software that acts as an interface between the end-user and computer hardware. There exist different categories of OS in the computer and other devices such as tablets, mobile phones, and other interfaces, including Batch, Multitasking/Time-Sharing, Multiprocessing, Real-Time, Distributed, Network & Mobile OS. Personal Computer Operating Systems were first developed in the late 1950s to manage tape storage.


## How does it work?

The operating system (OS) manages all of the software and hardware on the computer. It performs basic tasks such as file, memory, and process management, handling input and output, and controlling peripheral devices such as disk drives and printers. Most of the time, there are several different computer programs running at the same time, and they all need to access your computer's central processing unit (CPU), memory, and storage. The operating system coordinates all of this to make sure each program gets what it needs.

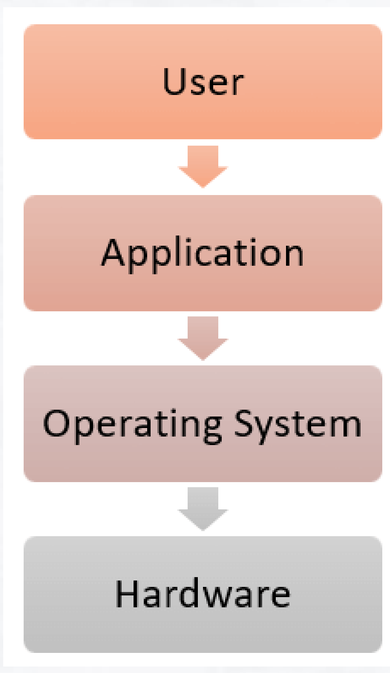


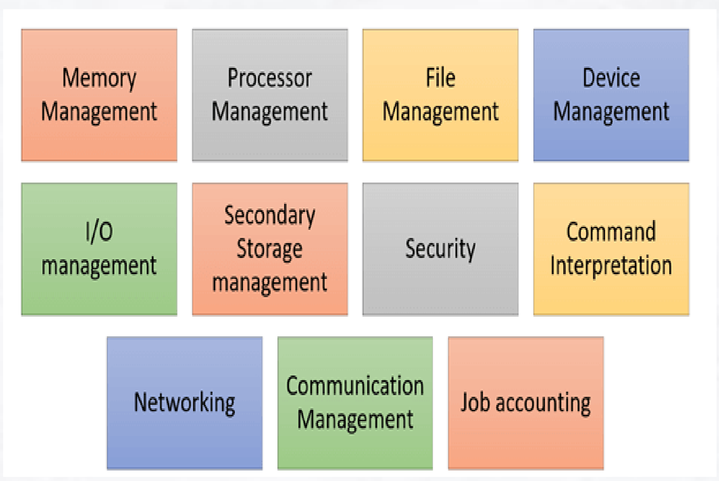

## Types of OS




## Features of OS

- Protected and supervisor mode.
- Allows disk access and file systems Device drivers Networking Security
- Program Execution
- Memory management Virtual Memory Multitasking
- Handling I/O operations
- Manipulation of the file system
- Error Detection and handling
- Resource allocation
- Information and Resource Protection




## Functions of OS

- Process Management: It helps OS to create and delete processes. It also provides mechanisms for synchronization and communication among processes.
- Memory Management: It performs the task of allocation and de-allocation of memory space to programs in need of these resources.
- File Management: It manages all the file-related activities such as organization storage, retrieval, naming, sharing, and protection of files.
- Device Management: It keeps track of all devices. This module also responsible for this task is known as the I/O controller. It also performs the task of allocation and de-allocation of the devices.
- I/O System Management: It hides the peculiarities of the hardware device from the user.
- Storage Management: It includes primary storage, secondary storage, and cache storage. Instructions and data must be stored in primary storage or cache so that a running program can reference them.
- Security: It protects the data and information of a computer system against malware threats and authorized access.
- Command Interpretation: It interprets commands given by the acting system resources to process those commands.
- Networking: A distributed system is a group of processors that do not share a memory, hardware devices, or a clock. The processors communicate with one another through the network.
- Job Accounting: Keeping track of time & resources used by various jobs and users.
- Communication Management: Coordination and assignment of compilers, interpreters, and other software resource of the various users of the computer systems.

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# Ventilator

**SUPERVISOR :** Lec. Dr. Taif Alawsi, Eng. Sura

**GROUP :** Ali, et al.

## INTRODUCTION :

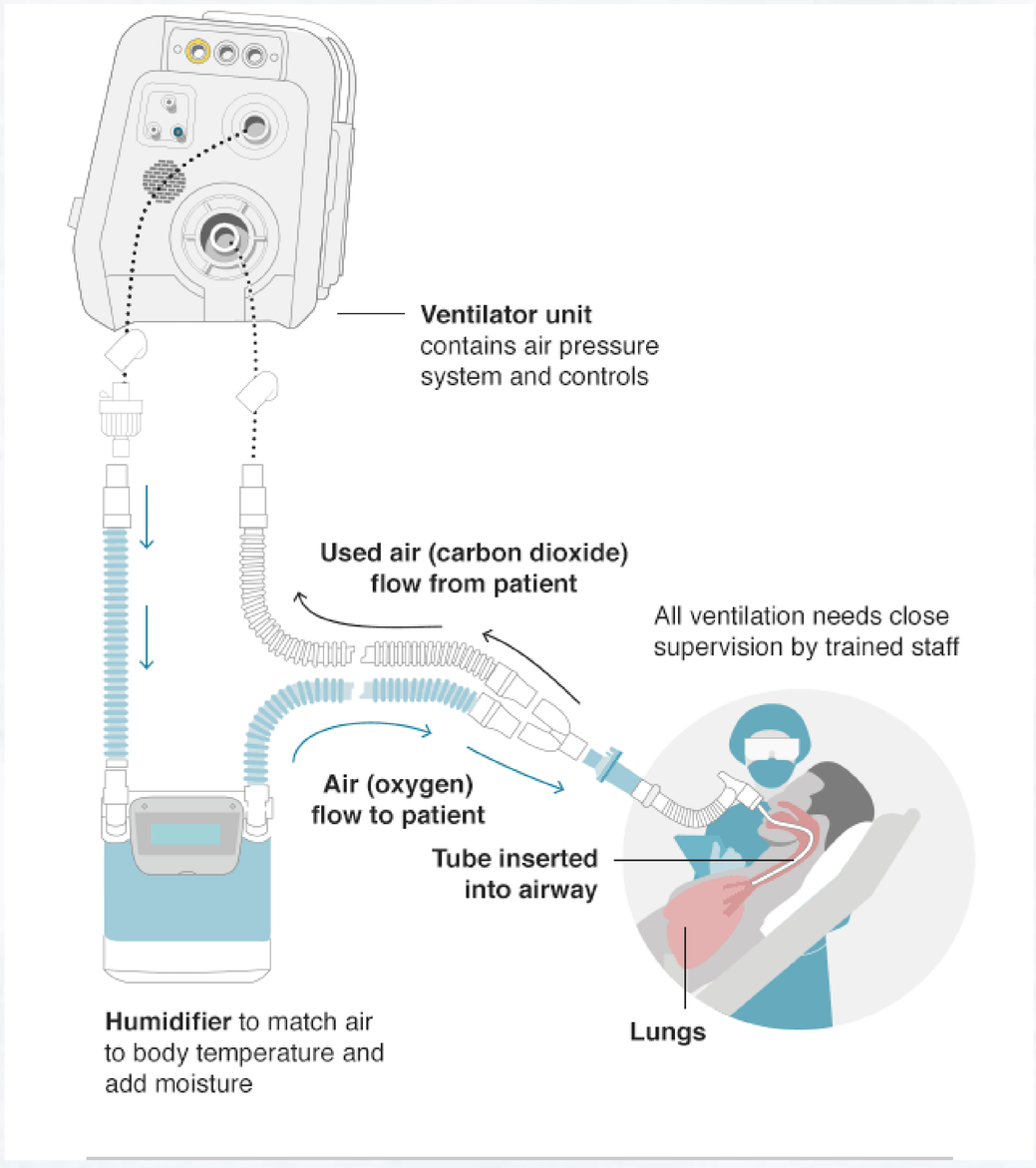
A ventilator is a medical device that provides mechanical ventilation by moving breathable air into and out of the lungs, to deliver breaths to a patient who is physically unable to breathe, or breathing insufficiently. Ventilators are computerized microprocessor-controlled machines, but patients can also be ventilated with a simple, hand-operated bag valve mask.

## Operation :

- Ventilator uses positive pressure to blow air, with additional oxygen as required by the patient through a tube into the patient's respiratory system.
- The air is warmed and moistened as it passes through the humidifier.
- Airflow into the mask over the patient's nose or mouth.
- Exhaled air flows away from the patient.

## Uses :

- Strokes or head injuries.
- Asthma or chronic obstructive pulmonary disease.
- Acute respiratory failure syndrome.
- Sudden stop of blood.
- Septicemia.
- Pneumonia.
- Respiratory distress syndrome in newborns.
- Diseases that affect the nerves and muscles that control breathing.
- Covid-19


## Components :

1. Support arm. 2. Controls.
3. humidifier. 4. Air hose.
5. Patient monitor. 6. Ventilator unit.
7. Medical grade air compressor. 8. Y-piece.