

Palestine Polytechnic University
College of Engineering



Wrist-Mounted Glove for Deaf-Blind People

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الإهداء

السلام عليكم ورحمة الله وبركاته
”سبحانك اللهم لا علم لنا إلا ما علمتنا إنك أنت السميع العليم“
الصلاة والسلام على أشرف الخلق والمرسلين سيد البشر أجمعين سيدنا وحبیبنا النبی الأمي محمد بن
عبد الله صلوات الله وسلامه عليه وعلى صحابته الميامين
إلى أصل البدايات .. وأصل النهايات
، إلى مسرى محمد صلى الله عليه وسلم ومهد المسيح عليه السلام إلى أحب الأماكن إلى قلوبنا
إلى أرض الشهداء .. والأسرى .. والجرحى

إلى وطننا فلسطين

إلى القدس ، سيدة العالم ، عاصمة فلسطين الأبدية و التاريخية
إلى كل الكلام .. وأصل الكلام
إلى منبع الحب والحنان
إلى صانعات الأمم و مربيات الأجيال

إلى أمهاتنا الحبيبات

إلى منارة العطاء .. وشمس العمل المتواصل
إلى ضوء الليل .. و بوصلة النهار
إلى كل شيء يفنى في قلوبنا ولا يفنى إيماننا له

إلى أبائنا الأفاضل

لمن أمسك بيدينا وعلّمنا حرفا .. حرفا ، إلى من كانوا سندنا لنا ، إلى من لهم الفضل بإرشادنا إلى
طريق العلم والمعرفة إلى **أساتذتنا** الأفاضل كم نحن فخورون بكم
إلى **زملائنا وزميلاتنا** ، رفقاء درب مسيرتنا التعليمية
إليكم جميعاً ، نهديكم نجاحنا هذا آملين من المولى عز وجل أن نكون قد وفقنا فيه

Abstract

Vision and hearing are the most important sense for human, losing the vision make some difficulties for person, but at least he/she can hear, deaf-blind person cannot so it makes more difficulties cannot contact, many ways were used before like stick, guide, or even trained dog. and to solve the problem or even 80 % of it we started this project.

First of all the time for any person is important, for blind person we designed an audible clock that no need anybody to provide him/her the time, walking in the street using ultrasound waves helps the patient to avoid people, walls or any block. The main feature of this project is the vibration alarm system that alarming is for deaf and deaf-blind patients, while RFID is used for detecting the tags that were be in their id cards, wallets or as a keychain, using that module make the patient pick up his/her own suff.

الملخص

الرؤية و السمع من أهم الحواس في حياة الإنسان , هناك العديد من فاقدى البصر و السمع و حتى البصر و السمع معاً يعانون في الحياة اليومية , وقد صمم العديد من الأدوات لمساعدتهم في حياتهم اليومية , هذا المشروع يساعد في حل او بنسبة 80% المشكلة .

بداية الوقت مهم للجميع , ففي هذا المشروع تم تصميم سماعة صوتية لفاقدى البصر , دون الحاجة للمساعدة و تم استخدام الأمواج فوق الصوتية للمساعدة في في تفادي الناس او العقبات , و تم استخدام محركات اهتزازية للتنبيه المريض , كما أنه تم استخدام **RFID** للمساعدة في البحث و التقاط عن الأغراض الشخصية كالهوية و المحفظة و حتى المفاتيح .

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List of abbreviation

RFID: Radio Frequency Identification.
SASB: Smart Assist System for Blind People.
AMD: Age related Macular Degeneration.
UHF: Ultra-High Frequency.
LED: Light Emitting Diode.
DC: Direct Current.

Chapter One

Introduction

This chapter gives introduction about the project including motivation , project objectives , the importance of this project , some literature reviews , finally the schedule of the

1.1 Motivation

The estimated number of people visually impaired in the world is 285 million, 39 million blind and 246 million having low vision, 82% of all blind and 62% of low vision are 50 years and older. Also 15% of blind people , 30% of people with low vision and 28% of people visually impaired with age 14-49 years old and the rest they are under 14 and its shown in the following figure ^[1]

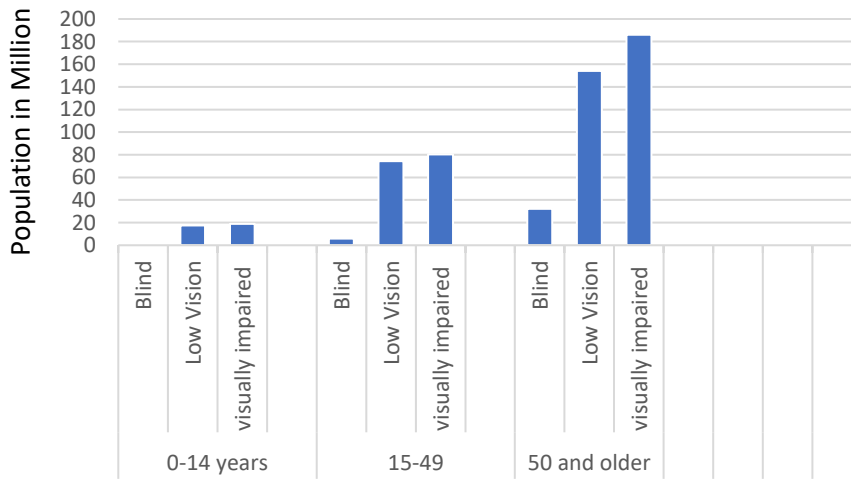


Figure (1.1) Number of People with visually impaired

There are 360 million persons in the world with disabling hearing loss (5.3% of the world's population). 328 million (91%) of these are adults (183 million males, 145 million females), 32 (9%) million of these are children. (Figure 1.2)^[2]

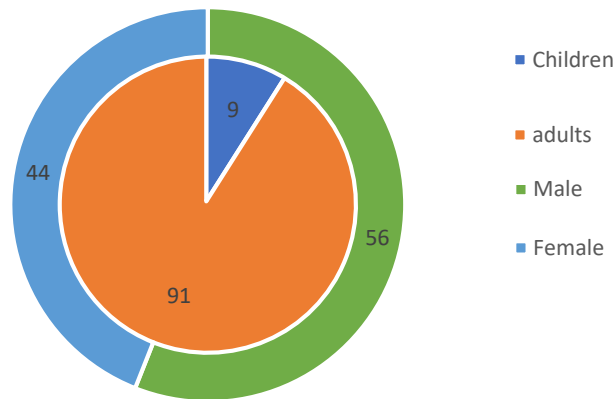


Figure (1.2) Hearing Loss in numbers

1.2 Project Objectives

The main objectives of this project are centered on designing and developing a special glove for blind-deaf people that has the ability to:

- 1- Design navigation system by using ultrasonic technology to detect obstacles, and vibration system to alarm them (navigation mode).
- 2- Programming a system using Radio Frequency Identification (RFID) and vibration alarm to find their stuff (detect mode).
- 3- Programming audible o'clock for blind people.

1.3 Project Importance

The importance of the project shows :

- 1- Help the deaf-blind people to navigate without a guide .
- 2- Can be used for all ages (kids and adults) .
- 3- Reduce the accidents that happens to them .
- 4- Find their own products (keys , wallet , ID card ...etc.) .
- 5- Enable blind people to know the time acoustic .
- 6- The cost associated with this design is definitely low .

1.4 Literature Review

In University of Annaba in January 2007 “ An Ultrasonic Navigation System for Blind People” by Mounir B. S. , Redjati A. , Mohamed F. and Mammam B. . Is to investigate the development of a navigation aid for blind and visually impaired people. This aid is portable and gives information to the user about urban walking routes to point out what decisions to make. On the other hand, and in order to reduce navigation difficulties of the blind, an obstacle detection system using ultrasounds and vibrators is added to this device.^[3]

“ULTRASONIC SENSORS GLOVES FOR BLIND PEOPLE USING LILYPAD ARDUINO ” by Abdulrahman A. , Areej A. , Sarah M. and Altaf A. in January 2016 in Kuwait . Presents a project idea to establish and provide ultrasonic gloves to blind people for guiding them to their right roads without the need for other people assistant. This has been done through Ultrasound waves that will be sent to the surrounding then it will be collected by detector in the gloves then to be sent as vibration or Audio signals to the blind’s so they can be aware of their surroundings.^[4]

Also in a previous graduation in Palestine Polytechnic University project “SASB” by Abed A.K B. , Ahmad A. T. and Ahmad M. F. in December 2014 . It presents an electronic smart navigation system for visually impaired and blind people, it detects the object around the patient , and use a speech feedback and vibration system to aware the user.

1.5 Table schedule

The following table shows the work in this semester

Table (1.1) Time schedule of spring 2017-2018 semester

Week \ Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Project Idea	■	■													
Proposal		■	■												
Searching for information		■	■	■	■	■	■	■	■	■					
sorting the information and documentation					■	■	■	■	■	■	■	■	■	■	
Draft Edition														■	
Print the thesis report															■

Table (1.2) Time schedule of winter 2018-2019 semester

Week \ Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Electronic chips buying	■	■	■	■	■	■									
Electronic chips testing					■	■	■	■	■						
Preparing circuit schematics							■	■	■						
Connecting circuits							■	■	■	■	■				
Programming									■	■	■				
Testing the system										■	■	■	■	■	
Preparing the documentation				■	■	■	■	■	■	■	■	■			
Submitting project documentation															■

Chapter Two

Anatomy and Functionality of Eye and Ear

The eyes assist in the monitoring function of the nervous system by receiving information about conditions on the surface of the body and the region surrounding it. This information is used to make proper responses that promote healthy survival and maintain the quality of life.

The ears help monitor conditions and provide information not only about the body, but also about conditions far from the body. Their functioning helps preserve homeostasis, contributes to learning, aids in communication, and provides enjoyment.

2.1 Anatomy and Functionality of Eye

Vision is by far the most used of the five senses and is one of the primary means that we use to gather information from our surroundings. More than 75% of the information we receive about the world around us consists of visual information. ^[5]

In 1912, the generally accepted average measurements of the eyeball diameters taken by various authors were 24.26 mm for the anteroposterior diameter, 23.7 mm for the transverse diameter, and 23.57 mm for the vertical diameter. ^[6] and the components shown in (Figure 2.1) that contain Pupil which for opening where light enters the eye , Sclera is the white part of the eye , Iris gives color to eyes while the cornea is the glassy transparent external surface of the eye and then the optic nerve is bundle of axons from the retina. ^[7]

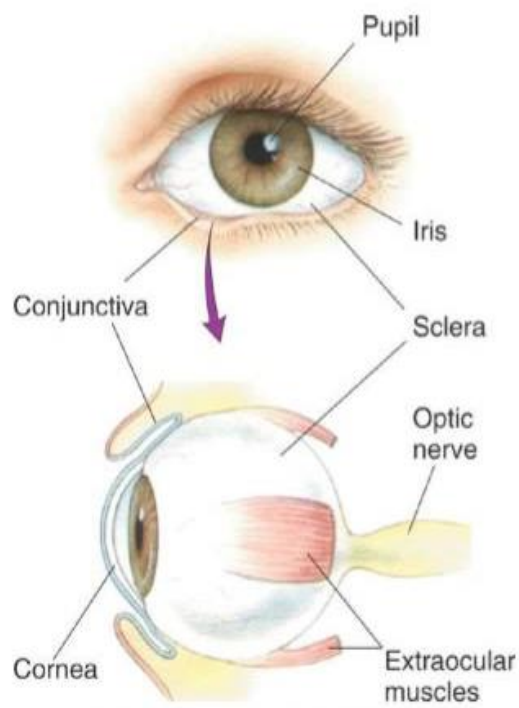


Figure 2.1 Eye Anatomy ^[7]

2.1.1 Image Formation

The eye is often compared to a camera. Each gathers light and then transforms that light into a "picture." Both also have lenses to focus the incoming light. Just as a camera focuses light onto the film to create a picture, the eye focuses light onto a specialized layer of cells.^[5]

When light rays reflect off an object and enter the eyes through the cornea (the transparent outer covering of the eye), you can then see that object, then the cornea bends, or refracts, the rays that pass through the round hole of the pupil. The iris opens and closes, making the pupil bigger or smaller. The light rays then pass through the lens, which changes shape so it can further bend the rays and focus them on the retina. The retina, which sits at the back of the eye, is a thin layer of tissue that contains millions of tiny light-sensing nerve cells. These nerve cells are called rods and cones because of their distinct shapes.^[8]

2.1.2 Blindness

The three main causes of blindness : cataract, trachoma and glaucoma are responsible for more than 70 % of the global blindness .First of all the cataract which mean a loss of the normal transparency of the crystalline lens due to an opacity, Cataract surgery, including the implantation of an intra-ocular lens, may restore the visual acuity to near normal levels , A real restoration of the vision and a real improvement in the quality of life is obtained; furthermore adult scan return to their work. That is why the volume of cataract surgery has increased worldwide.

Another reason is the trachoma There are some 146 million cases of active disease due to infection with Chlamydia trachomatis. Repeated eye infections cause trichiasis and hence corneal blindness . There is no medical treatment once the cornea has lost its transparency , Trachoma can be prevented through surgery for trichiasis , azithromycin , facial cleanliness and environmental improvement .

Also glaucoma is not a single disease but rather a group of disorders that have common features such as cupping and atrophy of the optic disc, characteristic visual field loss and often an increased intra-ocular pressure . There is no preventive treatment for glaucoma, but visual loss can be avoided if glaucoma is detected and treated at a nearly stage. All people should be instructed about this disease because people who are aware of this disease are more motivated to have them screened for this condition and all people should have their eye pressure checked regularly. Other causes of blindness Childhood blindness , Onchocerciasis (river blindness) , Ocular injuries and Diabetes mellitus .^[9]

Globally the principal causes of visual impairment are uncorrected refractive errors and cataracts, 43% and 33 % respectively. Other causes are glaucoma, 2%, age related macular degeneration (AMD), diabetic retinopathy, trachoma and corneal opacities, all about 1%. A large proportion of causes, 18%, are undetermined. The causes of blindness are cataract, 51%, glaucoma, 8%, AMD, 5%, childhood blindness and corneal opacities, 4%, uncorrected refractive errors and trachoma, 3%, and diabetic retinopathy 1%, the undetermined causes are 21% and the following figure explains .^[1]

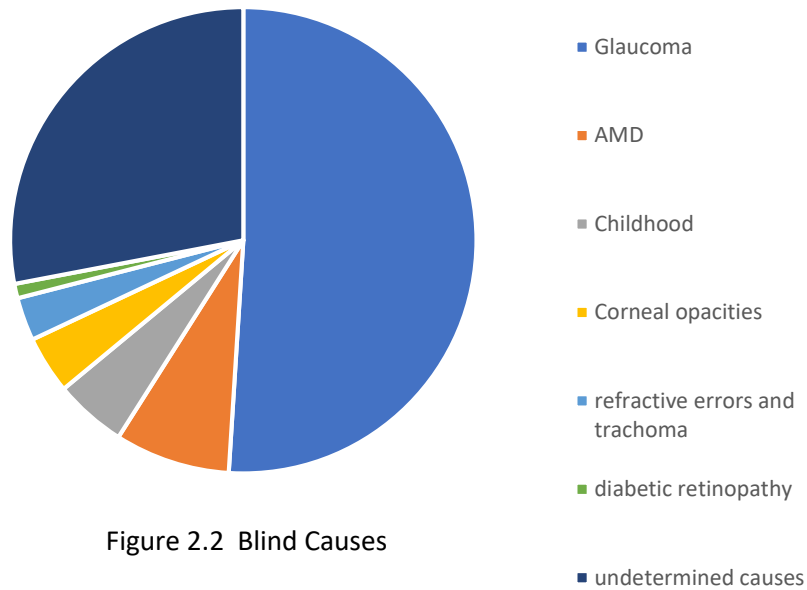


Figure 2.2 Blind Causes

2.2 Anatomy and Functionality of Ear

Hearing is one of the major senses and like vision is important for distant warning and communication. It can be used to alert, and communicate pleasure and fear. It is a conscious appreciation of vibration perceived as sound. In order to do this, the appropriate signal must reach the higher parts of the brain. The function of the ear is to convert physical vibration into an encoded nervous impulse. It can be thought of as a biological microphone. Like a microphone the ear is stimulated by vibration: in the microphone the vibration is transduced into an electrical signal, in the ear into a nervous impulse which in turn is then processed by the central auditory pathways of the brain .^[10] Our ears contain many parts, include the outer ear , middle ear (tympanic cavity) and inner ear . and the following figure shows the ear anatomy .

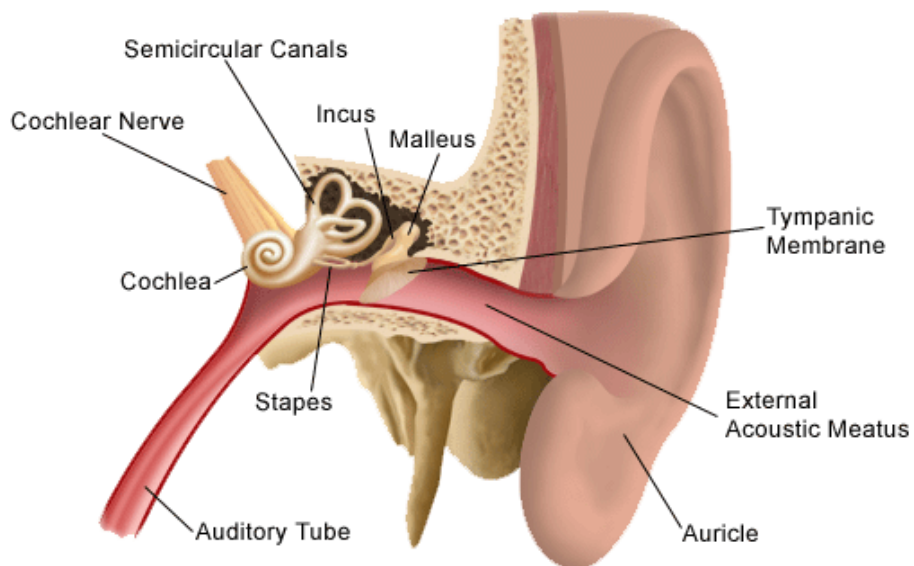


Figure (2.3) Ear Anatomy^[11]

External or outer ear starts from the auricle which is the outside part of the ear then the tube that connects the outer ear to the middle ear and finishing with the tympanic membrane (also called the eardrum) the tympanic membrane divides the external ear from the middle ear .

Middle ear (tympanic cavity) which contain the ossicles that are three small bones that are connected and transmit the sound waves to the inner ear. The bones are called : Malleus , Incus and Stapes then the eustachian tube is a canal that links the middle ear with the back of the nose. The Eustachian tube helps to equalize the pressure in the middle ear.

The nerves for hearing in the cochlea , also the receptors for balance in the vestibule and semicircular canals . all of these in the inner ear .

2.2.2 How do we hear ?

Hearing starts with the outer ear. When a sound is made outside the outer ear, the sound waves, or vibrations, travel down the external auditory canal and strike the eardrum . The eardrum vibrates. The vibrations are then passed to three tiny bones in the middle ear called the ossicles. The ossicles amplify the sound and send the sound waves to the inner ear and into the fluid-filled hearing organ (cochlea). Once the sound waves reach the inner ear, they are converted into electrical impulses, which the auditory nerve sends to the brain. The brain then translates these electrical impulses as sound. ^[11]

2.2.3 Hearing Loss Causes

Permanent hearing losses are less common than temporary hearing losses. There are many causes of permanent hearing losses. These include genetic, infectious, drug-related, physical trauma and structural causes.

genetics although there are many reasons why permanent hearing loss may occur, genetics is the most common. Genetic testing may help determine if the hearing loss is genetic. This information may allow better treatment and management of the hearing loss, and predict the chances that future children will have hearing loss.

infections new vaccines have prevented some hearing loss caused by infections. However, other infectious causes still exist , during pregnancy : Infections caused by viruses (herpes, rubella) , Syphilis , Toxoplasmosis . also after birth by bacteria (meningitis, syphilis) or viruses (measles, mumps) .

While the drugs and other chemicals can also cause hearing loss. Some drugs can affect the fetus, while others are harmful after birth , during pregnancy : Alcohol , Medications like Accutane , chemotherapy and after birth it may be by Ototoxic drugs .

Also the ear is a delicate structure and can be easily damaged in a number of ways, such as head injuries and exposure to loud noise . and sometimes the cause of hearing loss cannot be identified , and this cause cannot be understand for example a higher incidence of hearing loss has been seen in newborn babies with many different risk factors such as lengthy stay in the Neonatal Intensive Care Unit , high levels of bilirubin ,low oxygen levels . ^[12]

Chapter Three

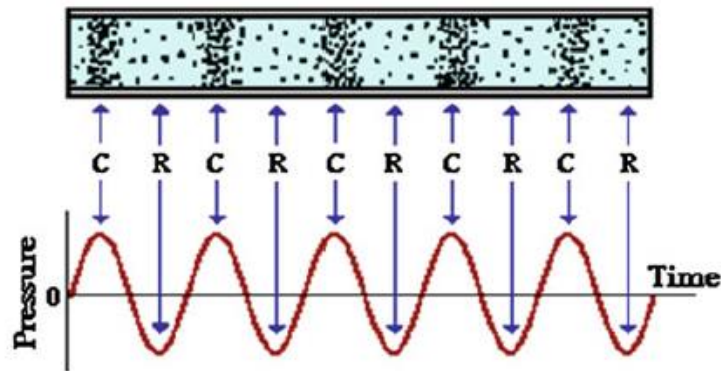
Background Theory

This chapter is divided into four main sections ; first one talks about ultrasound and its own physics the second illustrates vibration and the vibration motors and the third sections talks about the Radio Frequency Identification (RFID) , and the fourth the last section talks about microcontroller which will be used as controlling unit.

3.1 Ultrasound

Ultrasound waves are similar to sound waves, where both travel through a medium. Ultrasound waves consist of high-frequency sound waves that are inaudible to human beings. The frequency of the ultrasound waves is normally above 20 kHz. However, some creatures such as bats can hear as well as generate the high frequency ultrasound waves.

As the sound waves travel through the air, they produce vibration in the air particles which changes the density and pressure of the air particles along the direction of motion of the wave. If a sound wave is moving from left to right through air, particles of air will be displaced both rightward and leftward as the energy of the sound wave passes through it. If the source of the sound waves vibrates sinusoidally, the pressure variations are also sinusoidal. The figure (3.1) -where “c” stands for compression and “R” stands for rarefaction- illustrates the propagation of the sound waves produced by a fork. Patterns of high and low pressure points will be created in the air by the vibration of the fork. These patterns of varying pressure points can be observed using a sound wave detector.^[13]



Figure(3.1) Ultrasound physics^[13]

3.1.1 Basic Characteristics of Ultrasonic Waves

Velocity of wave propagation is expressed by multiplication of frequency and wavelength. The velocity of an electromagnetic wave is 3×10^8 m/s, but the velocity of sound wave propagation in air is as slow as about 344m/s (at 20°C). At these slower velocities, wavelengths are short, meaning that higher resolution of distance and direction can be obtained. Because of the higher resolution, it is possible to get higher measurement made large accuracy. The surface dimension of the ultrasonic device can be easily to obtain accurate radiation.

In order to detect the presence of an object, ultrasonic waves are reflected on objects. Because metal, wood, concrete, glass, rubber and paper, etc. reflect approximately 100% of ultrasonic waves, these objects can be easily detected. Cloth, cotton, wool, etc. are difficult to detect because they absorb ultrasonic waves. It may often be difficult, also, to detect objects having large surface undulation, because of irregular reflection. And the velocity of sound wave propagation “C” is expressed by the following equation

$$C = 331.6 + 0.6 T \text{ (m/s)} \quad \dots \text{ Equation (3.1)}$$

where T=temperature (°C) That is as sound velocity varies according to circumferential temperature, it is necessary to verify the temperature at all times to measure the distance to the object accurately.

The strength of ultrasonic waves propagated into the air attenuate proportionally with distance. This is caused by diffusion loss on a spherical surface due to diffraction phenomenon and absorption loss, that energy is absorbed by medium. As shown in Figure (3.2) the higher the frequency of the ultrasonic wave, the bigger the attenuation rate and the shorter the distance the wave reaches [14]

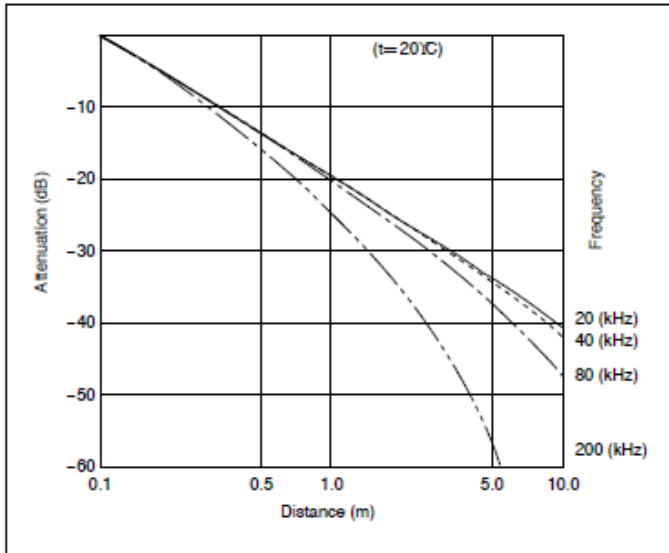


Figure (3.2) Attenuation Characteristics of Sound Pressure by distance.[14]

3.1.2 Ultrasonic principles

The first one talks about the reflection of ultrasound pulses by structures within the body is the interaction that creates the ultrasound image. The reflection of an ultrasound pulse occurs at the interface, or boundary, between two dissimilar materials, as shown in the figure (3.3). In order to form a reflection interface, the two materials must differ in terms of a physical characteristic known as acoustic impedance Z . Although the traditional symbol for impedance, Z , is the same symbol used for atomic number, the two quantities are in no way related. Acoustic impedance is a characteristic of a material related to its density and elastic properties. Since the velocity is related to the same material characteristics, a relationship exists between tissue impedance and ultrasound velocity. The relationship is such that the impedance, Z , is the product of the velocity, v , and the material density, Y , which can be written as

$$\text{Impedance } (Z) = (Y) \times (v) \quad \dots (3.2)$$

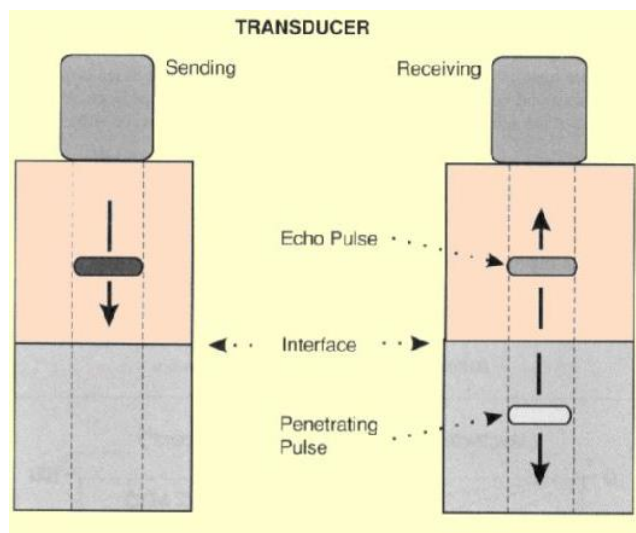


Figure (3.3) Reflected ultrasound between two objects

At most interfaces within the body, only a portion of the ultrasound pulse is reflected. The pulse is divided into two pulses, and one pulse, the echo, is reflected back toward the transducer and the other penetrates into the other material, as shown in the above figure. The brightness of a structure in an ultrasound image depends on the strength of the reflection, or echo. This in turn depends on how much the two materials differ in terms of acoustic impedance. The amplitude ratio of the reflected to the incident pulse is related to the tissue impedance values by

$$\text{Reflection loss (dB)} = 20 \log (Z_2 - Z_1)/(Z_2 + Z_1). \quad \dots (3.3)$$

The amplitude of a pulse is attenuated both by absorption and reflection losses. Because of this, an echo returning to the transducer is much smaller than the original pulse produced by the transducer.^[15]

Second method by emitting short, high-frequency sound pulses at regular intervals by ultrasound sensor. These propagate in the air at the velocity of sound. If they strike an object, then they are reflected back as echo signals to the sensor, which itself computes the distance to the target based on the time-span between emitting the signal and receiving the echo.

As the distance to an object is determined by the following equation

$$Distance = Velocity \times Time/2 \quad \dots\dots (3.4)$$

Measuring the time of flight and not by the intensity of the sound , ultrasonic sensors are excellent at suppressing background interference. Virtually all materials which reflect sound can be detected, regardless of their color. The following figure shows the second method which will be used in this project.^[16]

The speed of sound changes according to the surrounding temperature. The speed of sound in atmosphere reaches 331.45 m/s at 0 °C. The speed of sound in terms of temperature can be determined with the following equation:

$$C_{air}(t) = C_0 + kt \quad \dots\dots (3.5)$$

where, C_{air} is the speed (m/s) of the sound in air,

t : is the air temperature in degree Celsius,

k : is the rate at which the speed changes with respect to the temperature, which is approximately 0.607 m/s at every change of 1 °C in temperature.⁽¹³⁾

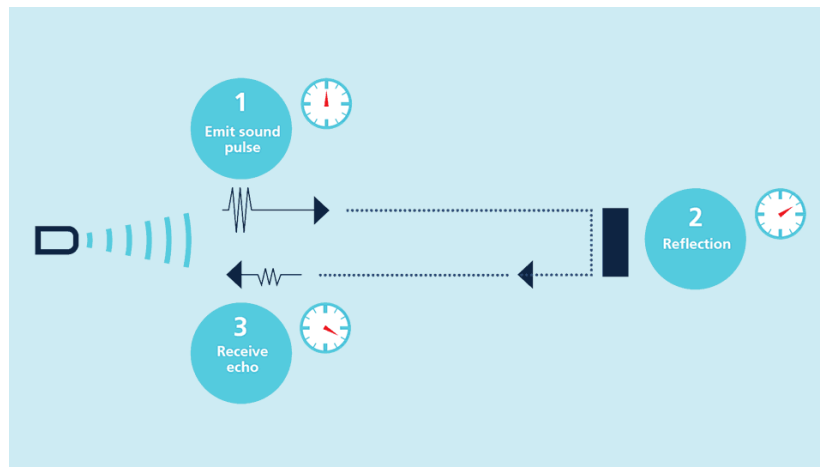


Figure (3.4) Ultrasound waves reflected^[16]

3.2 Vibration

Any motion that repeats itself after an interval of time is called vibration or oscillation. The swinging of a pendulum and the motion of a plucked string are typical examples of vibration. The theory of vibration deals with the study of oscillatory motions of bodies and the forces associated with them

Oscillation is the repetitive variation, typically in time, of some measure about a central value (often a point of equilibrium) or between two or more different states.

The main causes of setting up vibratory motion in a body are unbalanced centrifugal forces, elastic nature of system, external excitations, winds, and dry friction between mating surfaces.^[17]

Vibration movement can be generated by piezoelectric or electromagnetic, many of vibration piezoelectric energy harvesters demonstrated in the literature; the designs of most vibration piezoelectric energy harvesters were based on monospar, but in fact, the high output and micro-size could not be obtained at the same time. On one hand, the pursuit of high output power leads to the size of the beam that is bigger and bigger. On the other hand, high output power always needs a high frequency vibration source. However, there are not many high frequency vibration sources in actual application. The frequency of ambient vibration sources is typically 100~300Hz.^[18] The electromagnetic vibration generator consists of two ring shells which enclose the coil and are permanently connected to the base of the device. The armature consists of two permanent magnets housed between the two pole discs and with opposite poles axially arranged. The magnets are fixed in central position by means of special leaf springs which are also permanently connected to the base of the device. When an AC-voltage is applied to the excitation winding the unlike poles of the armature and magnetic body attract each other, and the frequency of the arc-shaped armature movement corresponds to the frequency of the AC-voltage applied.^[19]

3.2.1 Vibration motor

Vibration motor is a compact size coreless DC motor used to inform the users of receiving the signal by vibrating, without sound. Vibration motors are widely used in a variety of applications including cell phones, handsets, pagers, and so on. The main features of vibration motor is the magnet coreless DC motor are permanent, which means it will always have its magnetic properties (unlike an electromagnet, which only behaves like a magnet when an electric current runs through it); another main feature is the size of the motor itself is small, and thus light weight. Moreover, the noise and the power consumption that the motor produce while using are low. Based on those features, the performance of the motor is highly reliable.

The vibration motors are configured in two basic varieties : coin (flat) and bar (cylindrical) . there are some components in both of their internal constructions .

Bar-type Vibration Motor (cylinder shape), this vibrating motor is essentially a motor that is improperly balanced. In other words, there is an off-centered weight attached to the motor's rotational shaft that produces a centrifugal force while rotating. This unbalanced force displaces the motor. Its high speed displacement makes the motor to wobble, which is known as the "vibrating". The wobble can be changed by the weight mass you attach, the weight's distance to the shaft, and the speed at which the motor spins. What's more, the centrifugal force, which is generated by the rotating an unbalanced weight, causes the motor vibrate in 2 axis (Z axis and X axis).

Moreover, increasing the voltage supplied to the motor will increase its speed, and therefore the vibration frequency, as well as the vibration amplitude, and the following figure shows the components of bar-type vibration motor.

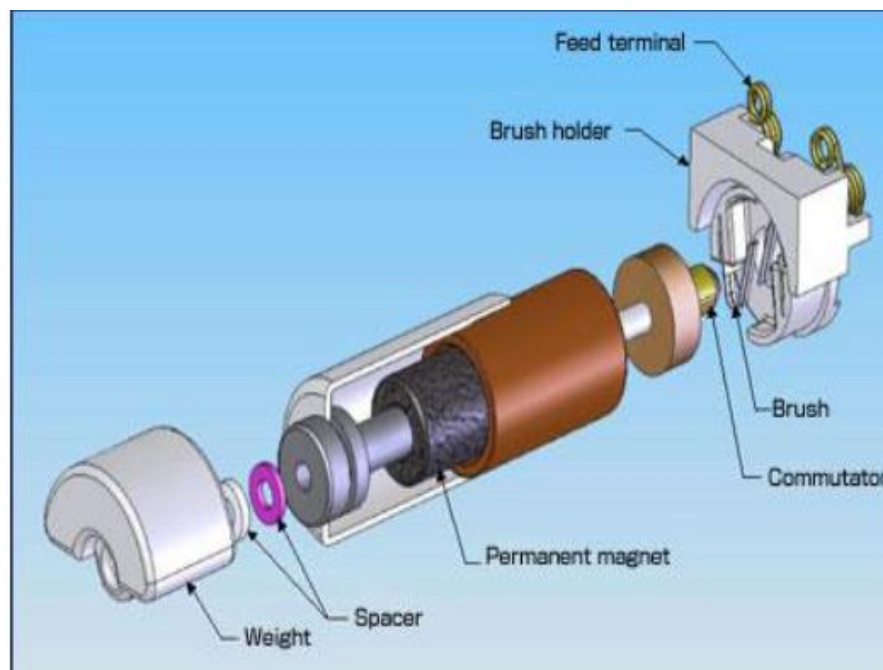


Figure (3.5) Structure of bar-type vibration motor ^[20]

The need for smaller, thinner designs led to the adaptation of brush motor technology into the coin-type vibration motor figure (3.6). Similar to the bar-type vibration motor, coin-type vibration motor is comprised of a weight, a ring magnet, rotor with commutation points attached in the front and coils assembled on the back, and power supplied brushes attached to the ring magnet.

The commutation points, which are the yellow part on the bottom pic, are in contact with the end of the brushes. It will energize the electrical coils in the rotor. Energizing the coils produce a magnetic field and it is strong enough to interact with the ring magnet integrated into the stator, causing rotation. A force is generated due to the magnetic field.

This force causes the weight to displace. The repeated displacement of the weight produces a varying force which is felt as vibration. The commutation points are used in changing the polarity pairs, so that as the rotator moves, the coils are constantly reversing the polarity.^[20]

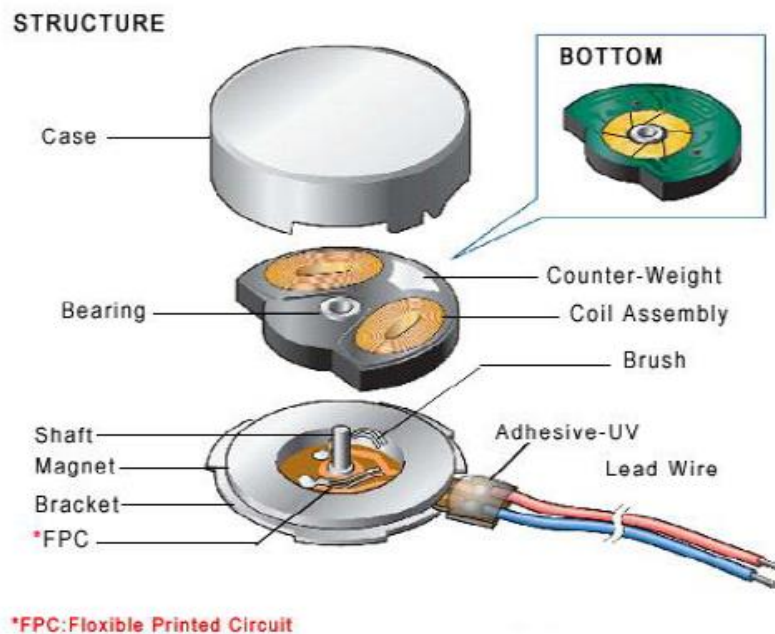


Figure (3.6) structure of flat vibration motor ^[20]

3.3 Radio frequency identification (RFID)

Radio-Frequency Identification (RFID) is the use of radio waves to read and capture information stored on a tag attached to an object. A tag can be read from up to several feet away and does not need to be within direct line-of-sight of the reader to be tracked.

3.3.1 Principle of operation RFID

A RFID system is made up of two parts: a tag or label and a reader. RFID tags or labels are embedded with a transmitter and a receiver. The RFID component on the tags have two parts:

a microchip that stores and processes information, and an antenna to receive and transmit a signal. The tag contains the specific serial number for one specific object.

To read the information encoded on a tag, a two-way radio transmitter-receiver called an interrogator or reader emits a signal to the tag using an antenna. The tag responds with the information written in its memory bank. The interrogator will then transmit the read results to an RFID computer program. ^[21]

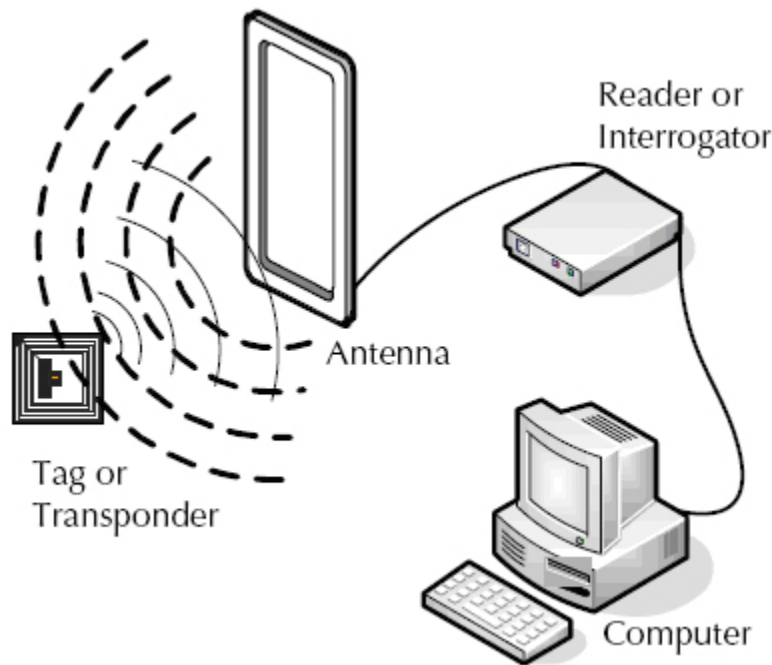


Figure (3.7) Principle of operation RFID ^[21]

3.3.2 RFID Types

Every RFID system can be broken down by the frequency band in which it operates. Whether it is low, high or ultra-high frequency – there are many other categories of RFID systems as well. The following table for comparing between low, high and ultra-high frequency

Table (3.1) RFID types

RFID Type	Low frequency	High frequency	Ultra- High frequency
Frequency range	30-300KHz	3-30 MHz	0.3-3 GHz
Distance range	Less than 10 cm	10 – 100 cm	Up to 12m
perused speed	Lowest	High	Highest
affectability to impedance	delicate to radio wave impedance	Moderate	Most touchy to impedance

There are another two major categories of RFID systems – active and passive. Every tag has its own particular transmitter and power source. In most of the cases, the power source is a battery. Active tags show their own sign to transmit the data put away on their microchips, active RFID systems regularly work in the ultra-high recurrence (UHF) band and offer a scope of up to 100 m , active tags are utilized on expansive items, for example, rail autos, enormous reusable holders, and different resources that should be followed over long separations.

In passive RFID systems, the reader and reader antenna send a radio sign to the tag. The RFID tag then uses the transmitted sign to control on, and reflect vitality back to the reader. .^[22]

3.4 Arduino

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 or finger on a button 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 , based on Processing.

The Arduino software is easy to use and flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics. Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instrument , There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy to use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems. In the following figure shows different types of arduino.^[23]

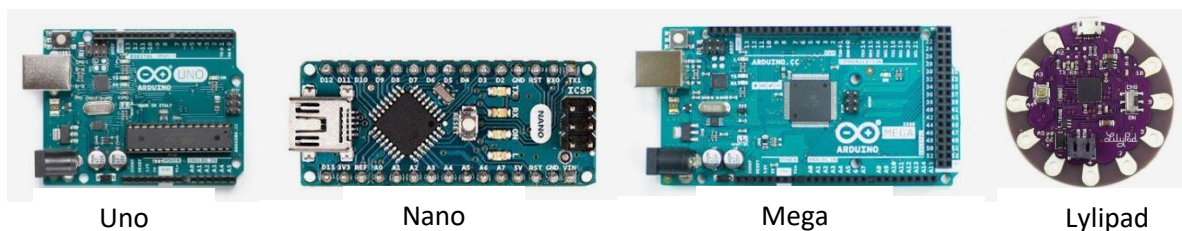
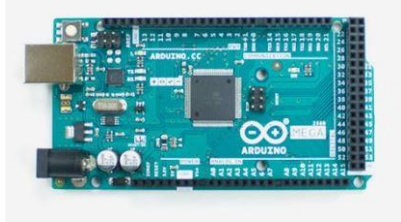
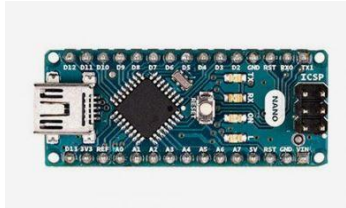



Figure (3.8) Different types of Arduino

The following table shows the difference between the arduinos which are most common used .

Table (3.2) Differences between main three types of Arduino [24]

Arduio name	Mega	Nano	Uno
			
CPU speed	16MHz	16MHz	16MHz
Analog Pins	16	8	6
Digital Pins / PWM	54/15	14/6	14/6
Input Voltage	7-12 v	7-9v	7-12v
Size	101.52*53.3 mm	43.18*18.54 mm	68.6*53.4 mm
Price	38.5\$	22\$	22\$

These features deciding the most suitable Arduinos in this project and the next chapter shows more details about them , how they used and the modules that are connected to them .

Chapter Four

System Design

In this chapter , a general process for designing the systems described .A system consisting of the interconnected component is designed to achieve a desired purpose . The generic block diagram of an embedded system shown in figure (4.1) .

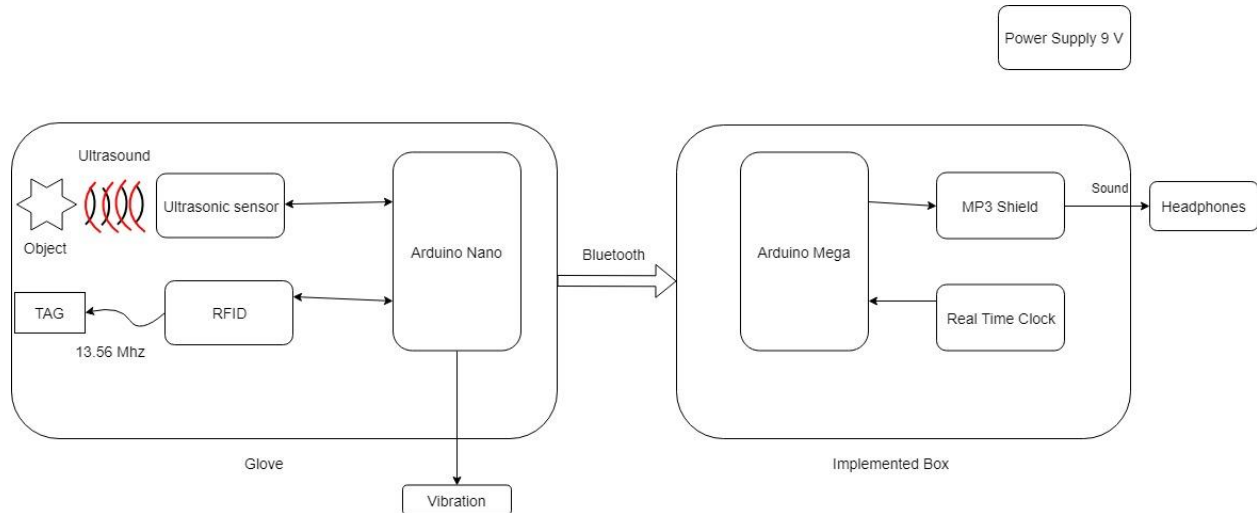


Figure (4.1) General Block diagram

The system divided into two categories , the first one is implemented on the glove where ultrasonic sensor sends and receives ultrasound waves after triggering by arduino nano. The distance is measured by Arduino nano by measuring the time taken to receive the echo . The RFID used to find the patient own, the vibration motors used as alarm system

The second category contains two modules first one real time clock after adjusting the time it keeps counting the second is MP3 shield which plays the time clock audible .And it is implemented in box fixed in the strap.

4.1 Controlling unit

The control unit is the system brain which sends orders and receives data from other system components. Two control units Arduino nano , and Arduino mega are used . The following sections describe their function.

4.1.1 Arduino nano

The reasons that Arduino nano used for the glove : small , not heavy , enough pins for the modules and components that connected to the Arduino nano .

The Arduino Nano can fulfill the system requirements ; it powered via the Mini-B USB connection, 6-20V unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). The power source is automatically selected to the highest voltage source ,

Each of the 14 digital pins on the Nano can be used as an input or output. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 k Ω .

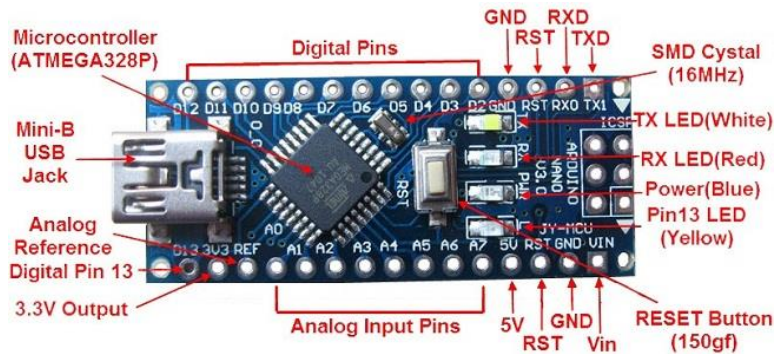


Figure (4.2) Arduino Nano components^[26]

4.1.2 Arduino Mega

The reasons that Arduino mega have been used the memory bigger than memory in the Arduino uno , MP3 shield easily connected to the Arduino mega .The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno .^[27]





Figure (4.3) Arduino Mega^[27]

4.2 Ultrasonic sensor

A portable ultrasonic sensor with four meter range and relatively high time response is required to measure object distance. After studying several types of sensors, HC-SR04 and Maxsonar series sensors are found the best. The following table shows their features.

Table (4.1) HC-SR04 and Maxsonar series main features.

	HC-SR04	Maxsonar series
Brand name		
Power supply	5V Dc	5.5V
Current consumption	15mA	2mA
Range	2-400 cm	15.24 -645 cm
price	4\$	30\$
Ranging accuracy	3mm	1 inch (25.4 mm)

Comparing the features of the sensors in the table, ultrasonic ranging module (HC - SR04) is the best transducer to use in the project, the ranging accuracy can reach to 3mm. The principle of the sensor starts with trigger sending for at least 10µs high level signal then the module automatically sends eight 40 kHz and detects whether there is a pulse signal back.

The following figure shows how to connect the mentioned ultrasonic sensor in this system with the processing unit used.

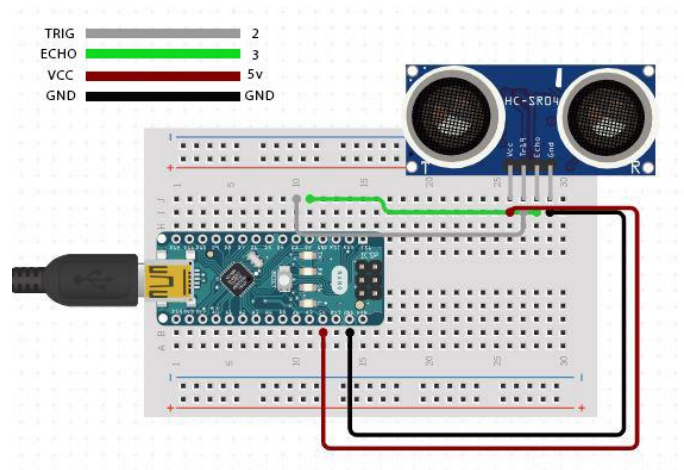


Figure (4.4) HC-SR04 module connection with Arduino nano

4.3 Radiofrequency identification module (RFID)

In order to help blind patients to find their stuff and tags, the most common RFID module is MFRC522: it has several features such as easy to use and affordable cost.

The MFRC522 is a highly integrated reader/writer IC for contactless communication at 13.56 MHz also its buffered output drivers for connecting an antenna with the minimum number of external components and it's the most common RFID module used also relative cheap. Figure (4.5) shows the RFID module and different types of the tags

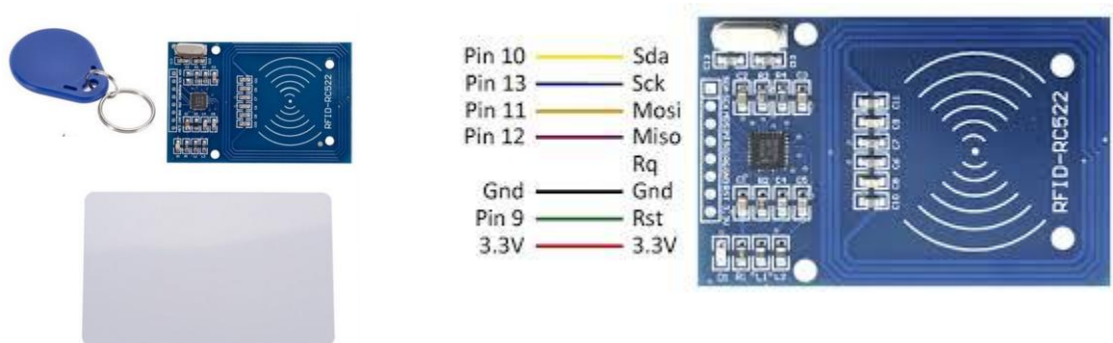


Figure (4.5) RFID Module and some tags

The following figures shows the RFID module and the Arduino nano connection

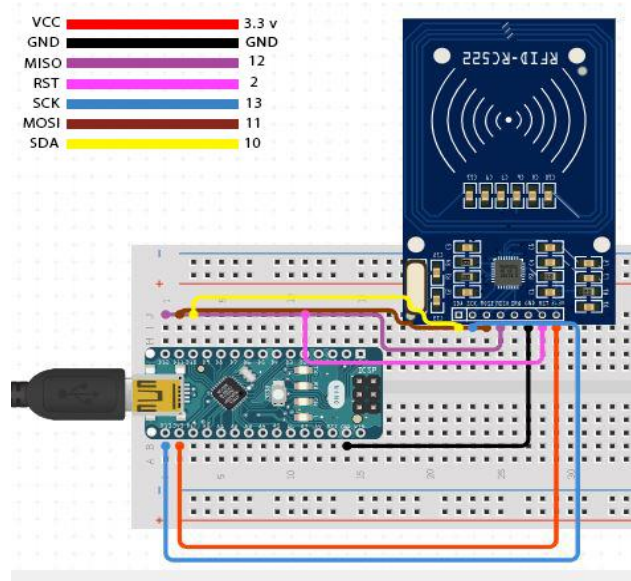
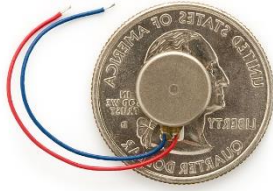


Figure (4.6) RFID module connection with Arduino nano

4.4 Vibration Motor

A vibration motor is necessary in this project to alarm the deaf-blind patient with alarm when obstacles appears. ROB-08449 coin vibration motor is chosen in this project as it has several features summarized in the following table.

Table (4.2) main features for ROB-08449

Vibration Motor ROB-08449	
RATED VOLTAGE = 3v	
RATED CURRENT = 60mA	
Diameter 10mm	
Weight 1.2 gram	
Price = 5\$	

The following figure show the connection of the DC vibration motor used it the system with the processing unit.

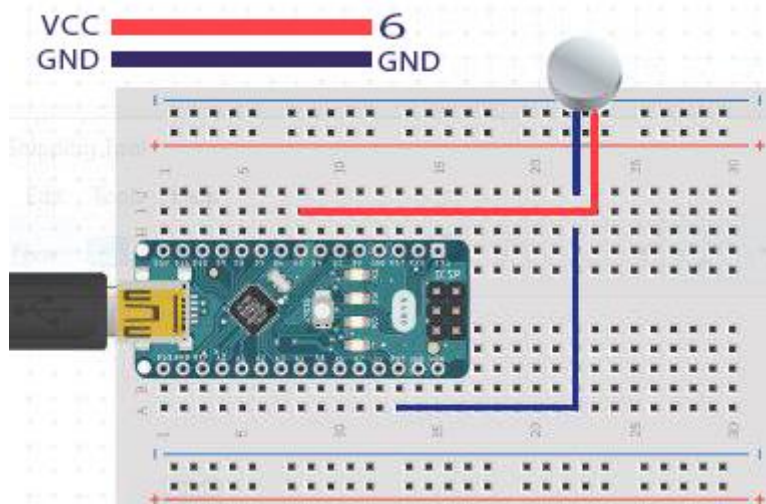


Figure (4.7) DC vibration motor connection with Arduino nano

4.5 MP3 Shield

In order to provide the blind patient with audio time . The pin out is directly compatible with Arduino and also can be used with other microcontrollers, with input Voltage 5V , the following figure shows the MP3 Shield (VS 1053).



Figure (4.8) MP3 Shield (VS 1053)

MP3 shield connected with Arduino mega which 13 , 12 , 11 ,10 are SCK , MISO , MOSI ,SS must be connected with the 52, 50 ,5,53 pins sequential which are SCK ,MISO , MOSI ,SS in the Arduino mega , and that's what the following figure shows

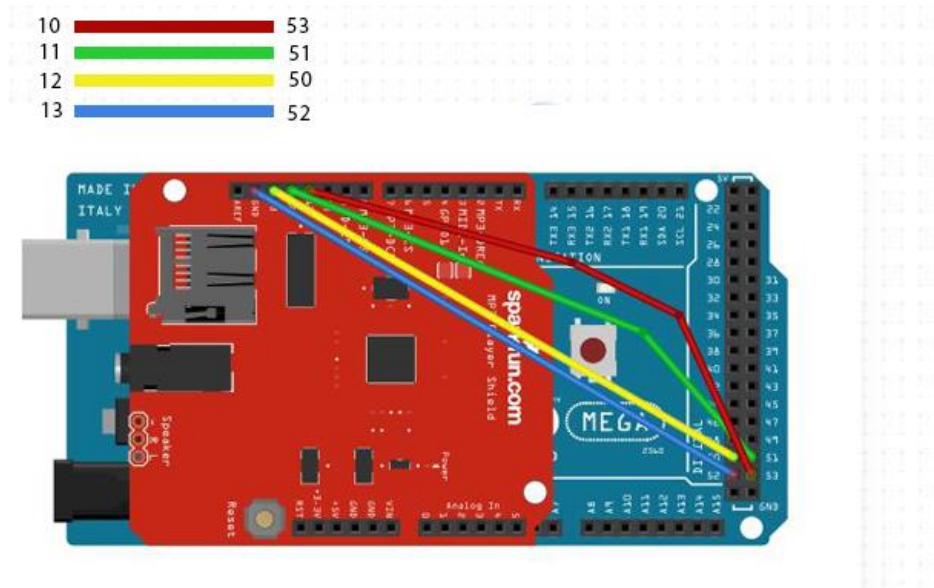


Figure (4.9) MP3 Shield (VS 1053) connection with Arduino mega

4.6 Bluetooth module HC-05

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup]. Modulation with complete 2.4GHz radio transceiver and baseband.it used to connect the Arduino mega (box) with Arduino nano (glove) And the following figure shows the hc-05 module and the pins .

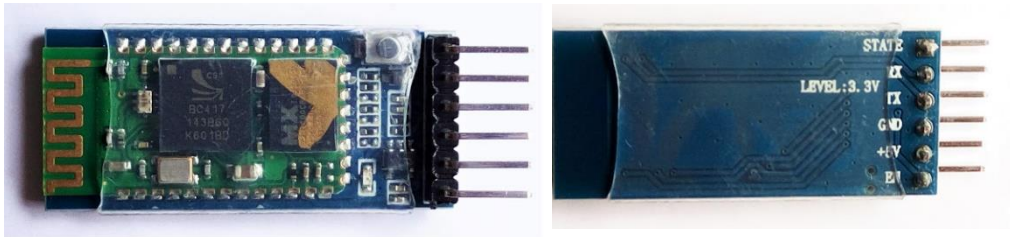


Figure (4.10) HC-05 Bluetooth module

The following figure shows the HC-05 connection with Arduino mega and Arduino nano , while the red wire 5v and black one is ground the pink is TX and the blue RX

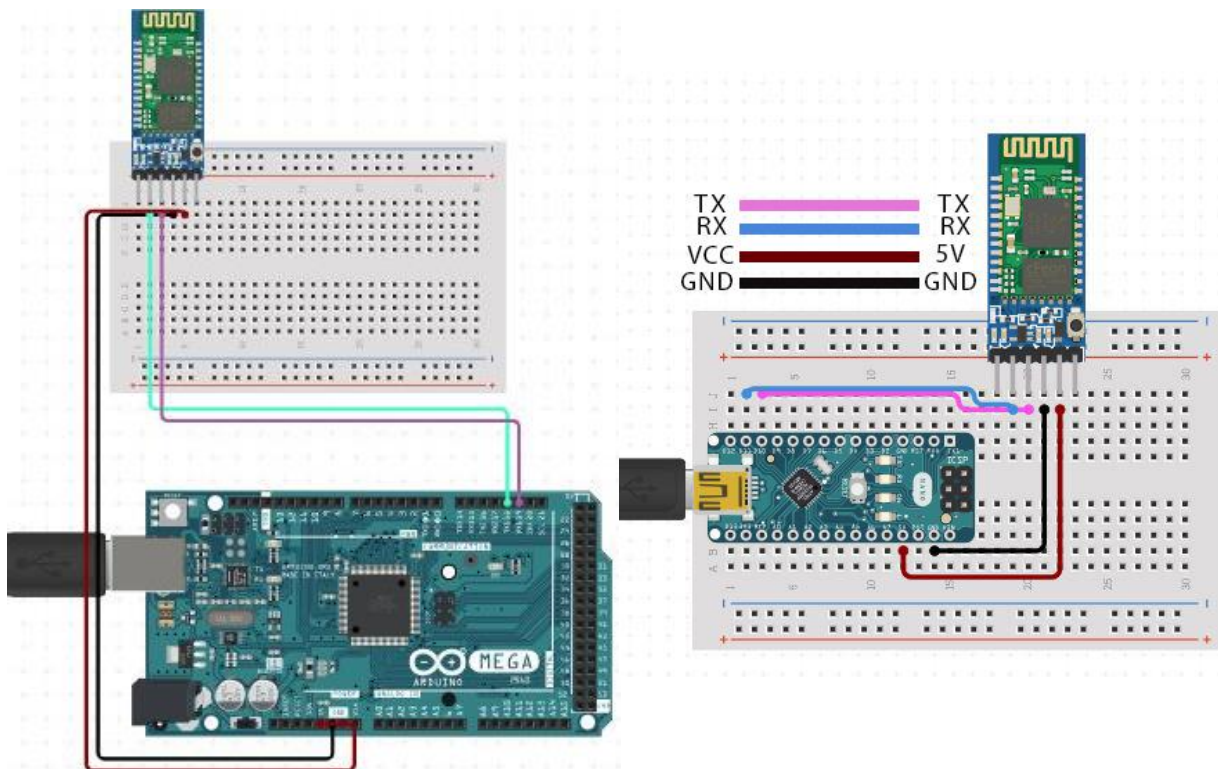


Figure (4.11) HC-05 connection with processing units

4.7 Real-Time Clock (RTC)

The DS3231 is a low-cost real-time clock (RTC), it maintains seconds, minutes, hours, day, date, month, and year information. The date at the end of the month is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The following figure shows the DS3231 module and its pins

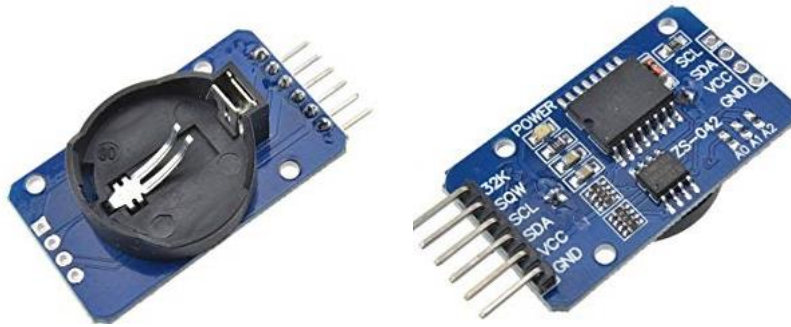


Figure (4.12) DS3231

This module is connected to the Arduino mega which is the processing unit (2) and the following figure shows the connection of the DS3231 with Arduino mega

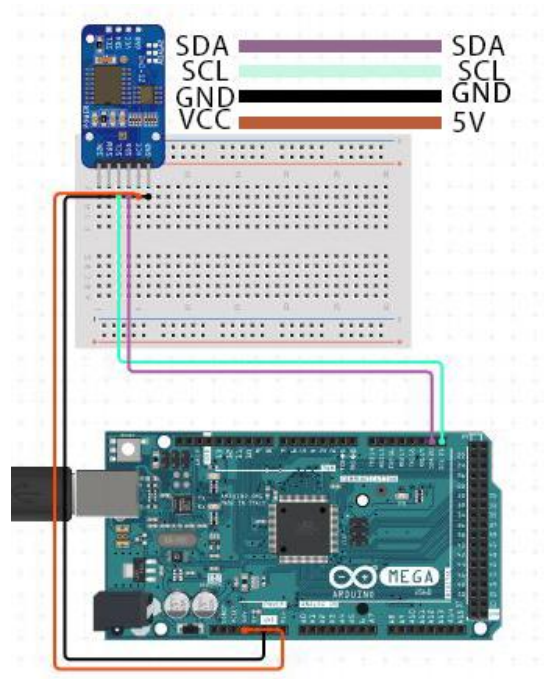


Figure (4.13) DS3231connection with Arduino mega

4.8 Power supply

After using these previous modules the power consumption can be determined by the following equation

$$P = I * V \quad \dots (4.1)$$

Where : P is the power (mWatt) , I is the current (mA) , V is the voltage (v) .

Table (4.3) Power consumption for glove components .

Component	Quantity	Power consumption	Total Power Consumption (mWatt)
Arduino nano	1	9v * 19mA	171
Ultrasonic sensor	2	5v * 15mA	150
RFID module	1	3.3v * 30mA	99
Vibration Motors	2	5v * 60mA	360
HC-05 module	1	5v * 40mA	200
			Total = 980

Table (4.4) Power consumption for box components.

Component	Quantity	Power consumption	Total Power Consumption (mWatt)
Arduino mega	1	9v * 20mA	180
RTC	1	5v * 200 μ A	1
Mp3 Shield	1	5v * 50mA	250
HC-05	1	5v * 40mA	200
			Total = 631

There is two batteries will supply each subsystems 9v and 1200mA.

The run time for the project for each subsystem calculate by the following equation

$$\text{Runtime} = \frac{(10 * \text{Ampere Hours})}{\text{Load in Watts}} \quad \dots (4.2)$$

Runtime for implemented glove is 12.24 hours, while for implemented box is 19 hours

4.9 System Circuit

The system is implemented in two subsystems : one in the glove shown in figure(4.14) and other in box , shown in figure (4.15)

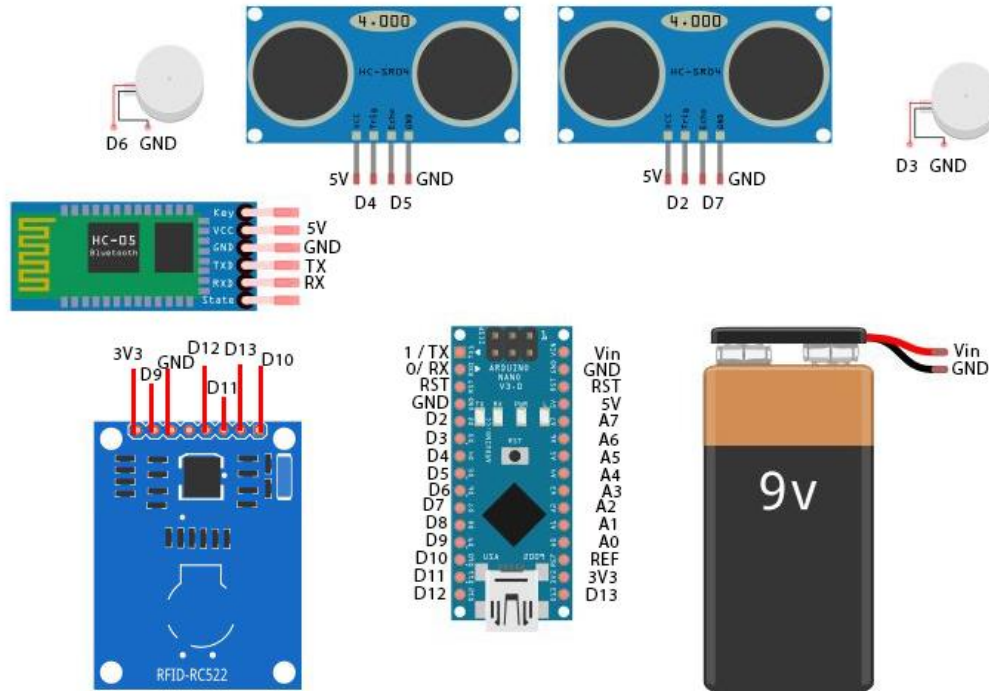


Figure (4.14) Glove Circuit

The second part which is the implemented box shows in the figure (4.15)

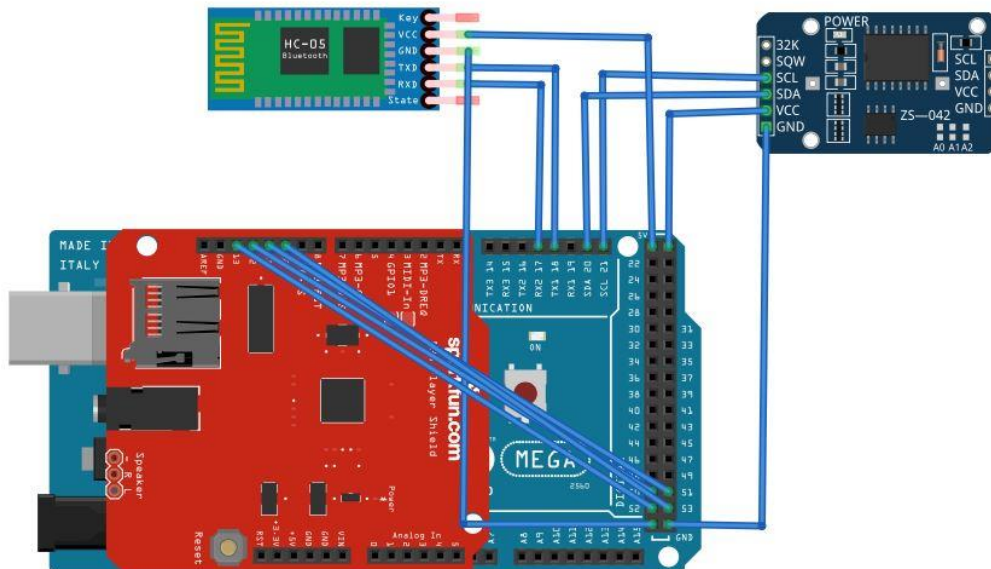


Figure (4.15) Implemented Box Circuit

4.10 Flowchart

The system starts with default mode which is a home mode as it shows in the flow chart this mode has short ultrasonic range and RFID module turned off to save power, the second mode which is called navigation mode is for navigation out of the patient's house the ultrasonic changes for long range and RFID still turned off, else the third mode which turned off the ultrasonic modules and turn on the RFID. the following flow chart illustrates the steps of running the system. The audible clock is activated in all modes.

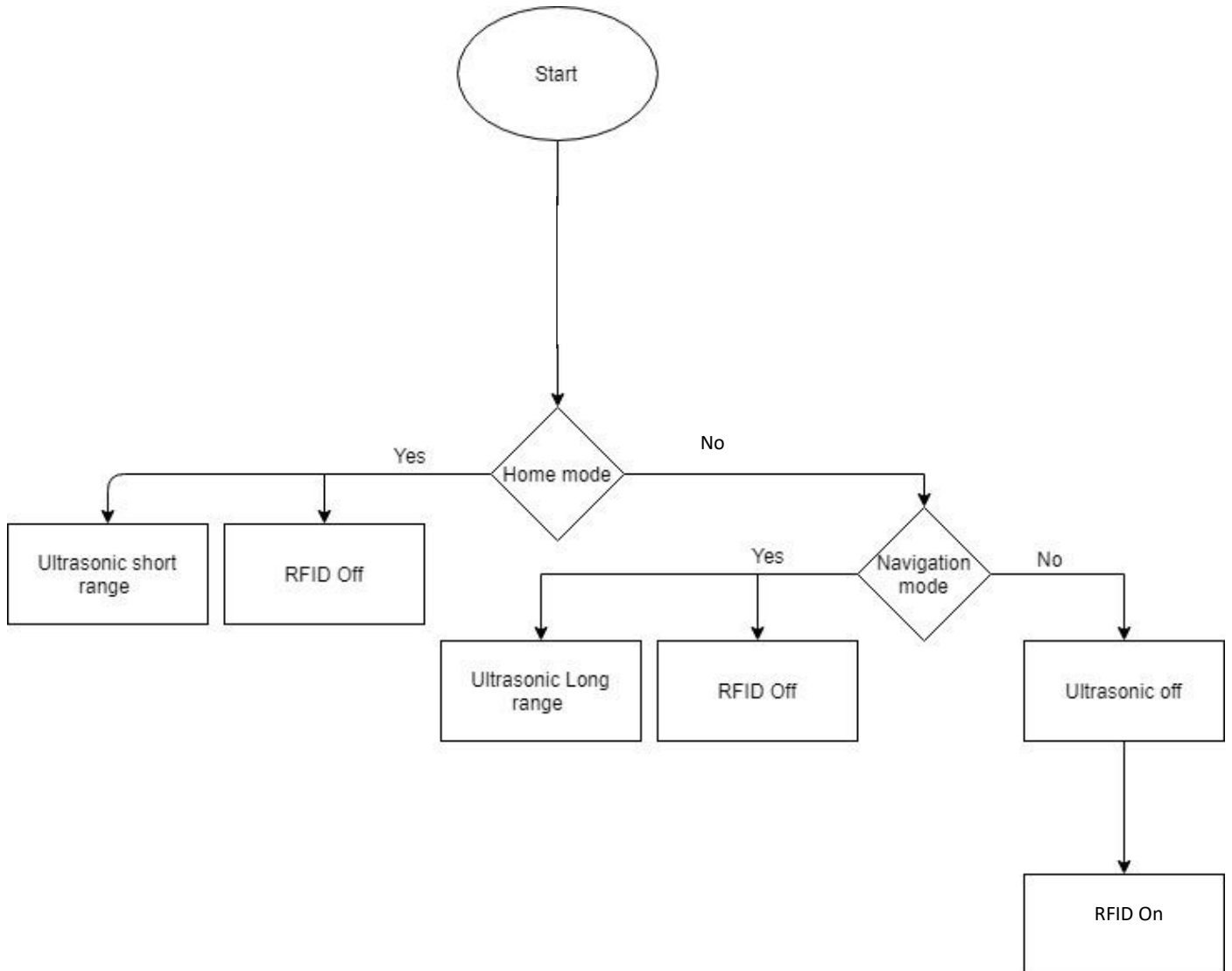


Figure (4.16) System Flow chart

Chapter Five Implementation, Experiments and Results

The project components have been connected and tested , in this chapter shows each component of the project connected with the Arduino , starting with ultrasonic sensors then to the RFID after that the real time clock (RTC) with Arduino mega and the MP3 shield finally the Bluetooth modules with each Arduino .

5.1 Ultrasonic

Ultrasonic modules have 4 pins which as shown in the previous chapter , the following figure shows how two ultrasonic modules connected with the Arduino nano ,while the white wires are trigger and red ones echo which are connected to digital pins while the yellow vcc and orange is ground .

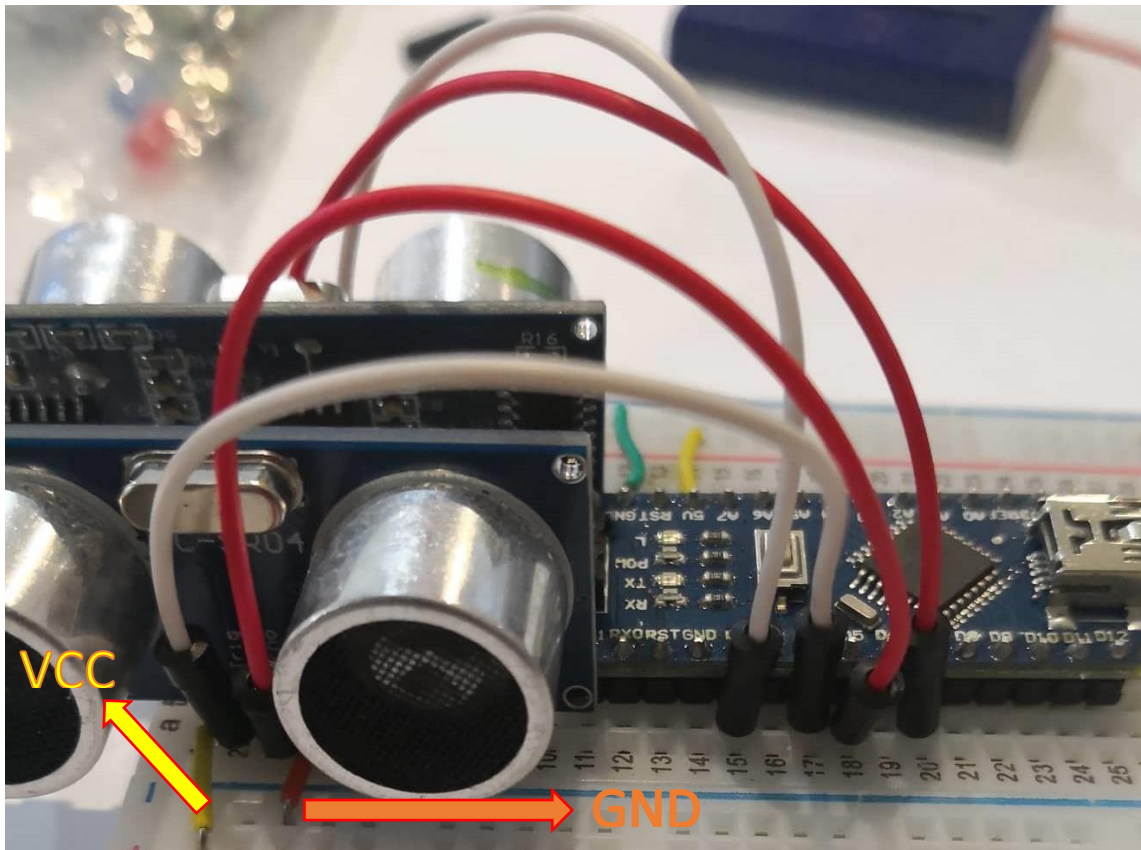


Figure (5.1) HC-SR04
connected to Arduino nano

The figure (5.2) shows the distance that have been calculated by the Arduino after measured the time that has been traveled from transmitter to the object then back to the receiver.

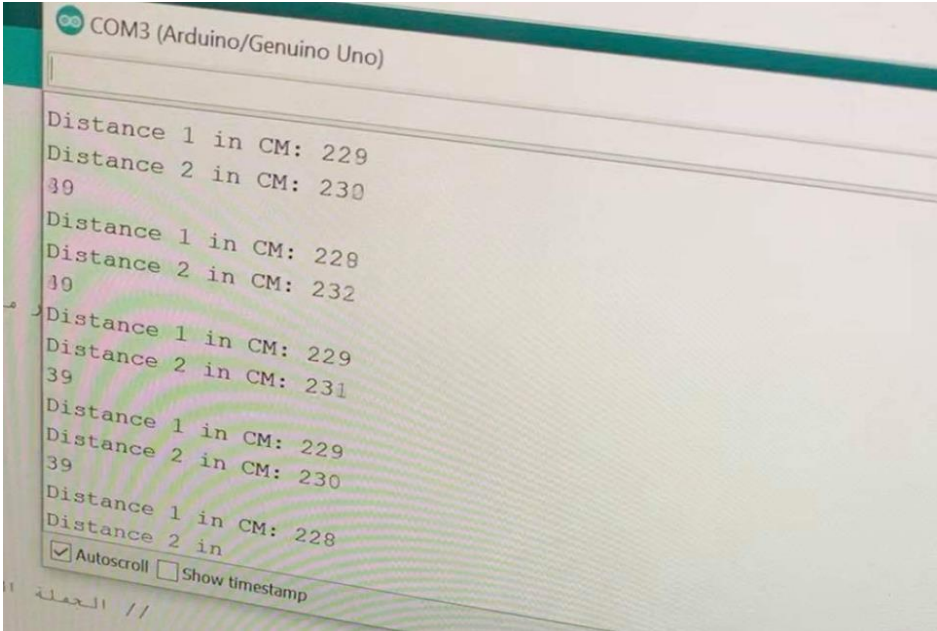


Figure (5.2) Ultrasonic distance measured

While the figure (5.3) shows the output voltage which it's the required for the vibration motor which used as an alarm system for the patient.

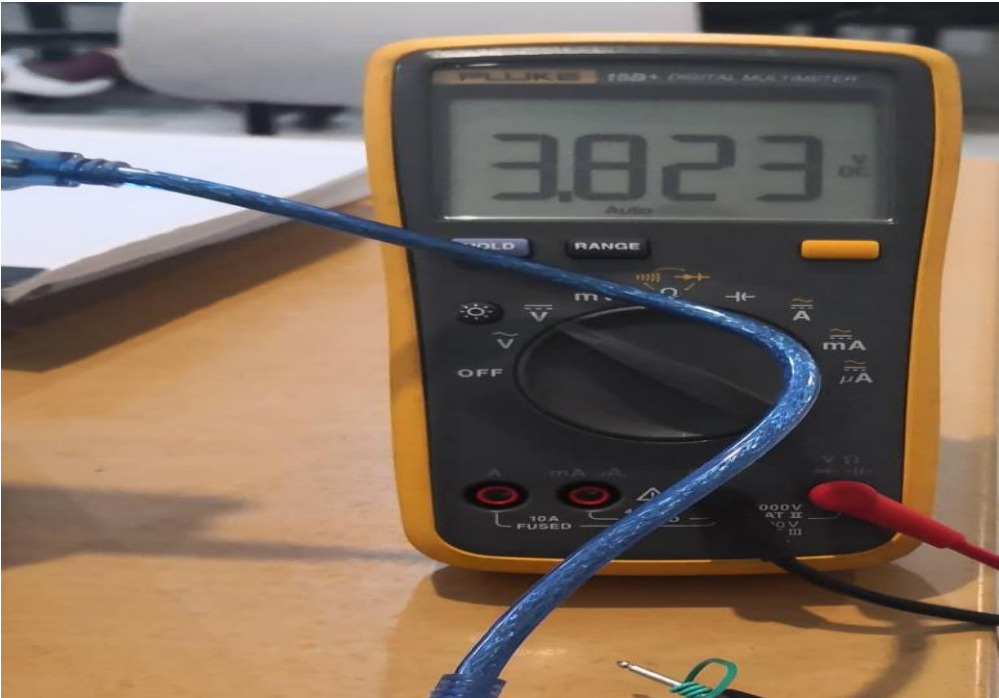


Figure (5.3) digital output

5.2 RFID

The RFID module detect the tags which will be in their stuff like keys , ID cards , wallets ... etc , and the following figure shows how the RFID module was connected to the processing unit (1) . as shown in the figure (4.6) the pins have been connected to the arduino nano

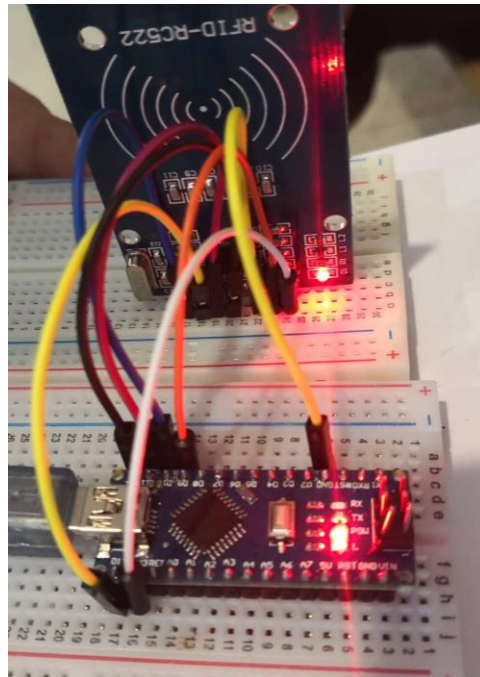


Figure (5.4) RFID connected to Arduino nano

As illustrates before when tag is detected , the serial monitor will show that the tag has been detected as shown in this figure

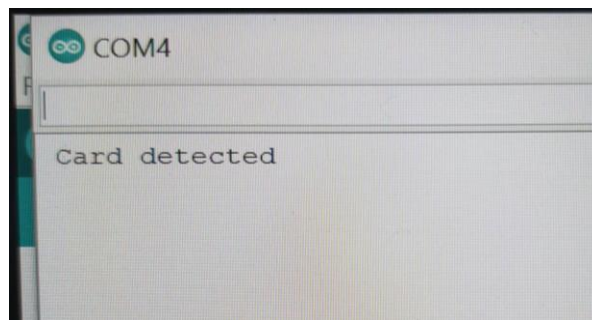


Figure (5.5) detected tag on serial monitor

5.3 Real Time Clock (DS3231)

The DS3231 connecting with the processing unit (2) , shown in the following figure

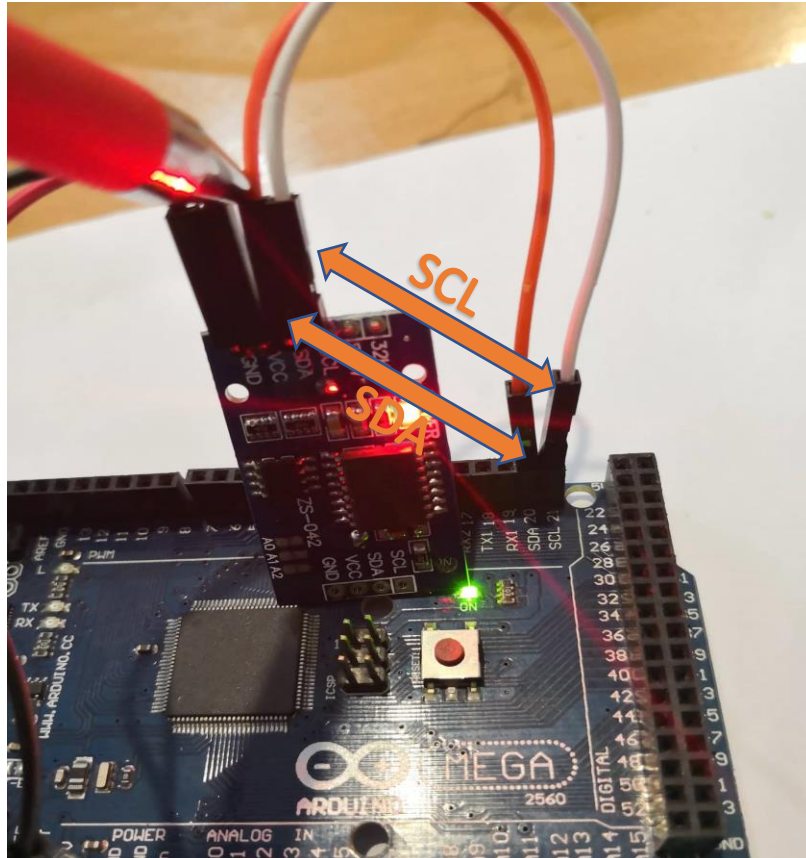


Figure (5.6) DS3231 connected with Arduino mega

After programming the module the output on the serial monitor was as shown in the following figure

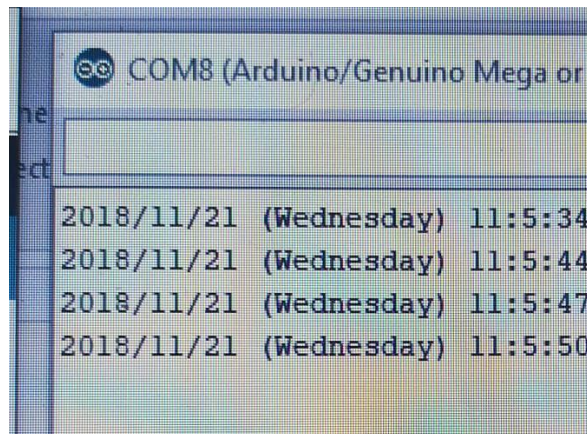


Figure (5.7) DS3231 Output on serial monitor

5.4 MP3 Shield (VS 1053)

This module is the biggest module in the project and its connected to the processing unit (2) to make it fixed on the Arduino mega digital pins 13 , 12 , 11 ,10 which are SCK , MISO , MOSI ,SS must be connected with the 52, 50 ,5,53 pins sequential which are SCK ,MISO , MOSI ,SS in the Arduino mega , and the following figure shows how the module connected to the Arduino mega .

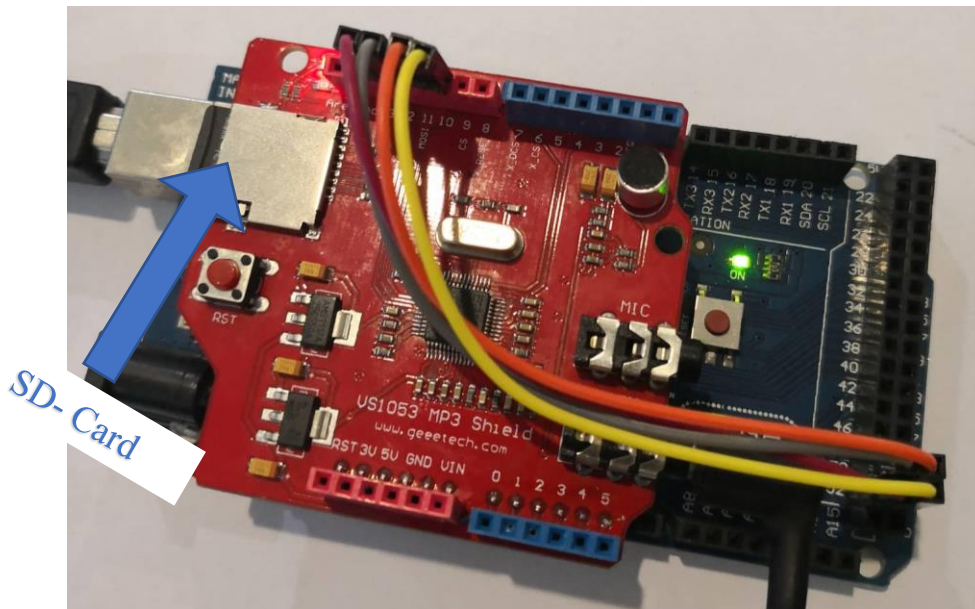


Figure (5.8) VS1053 with Arduino mega

5.5 Bluetooth HC-05

HC-05 used to send data from Arduino nano (processing unit (1)) to the Arduino mega
And the figure (5.9) shows how was the HC-05 connected to the Arduino nano which the red wire vcc , black ground , yellow for TX and green one for RX

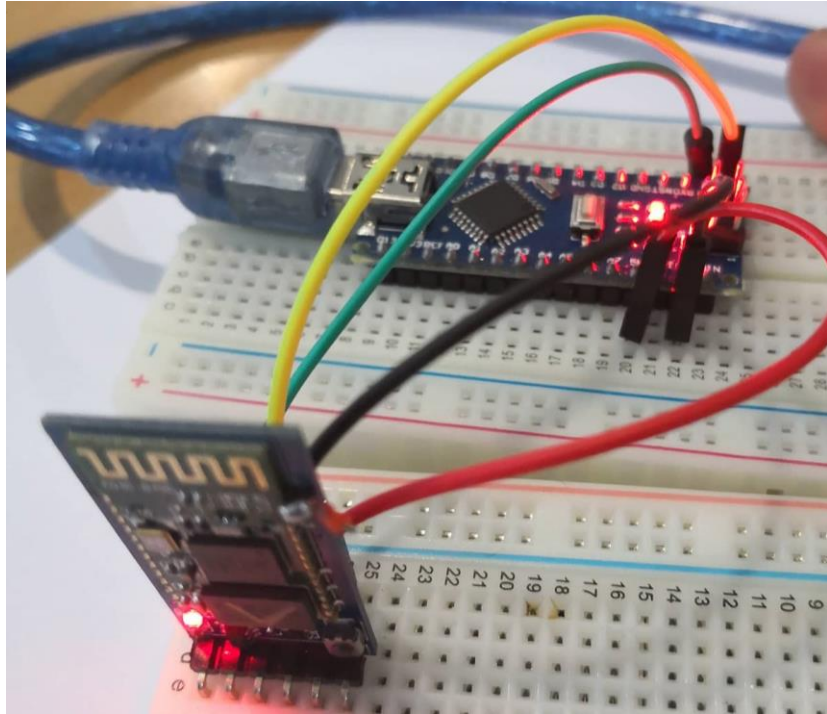


Figure (5.9) HC-05 connected to arduino nano

And the following figure shows the HC-05 connected to the Arduino mega which the TX yellow RX green and red for VCC black for the ground.

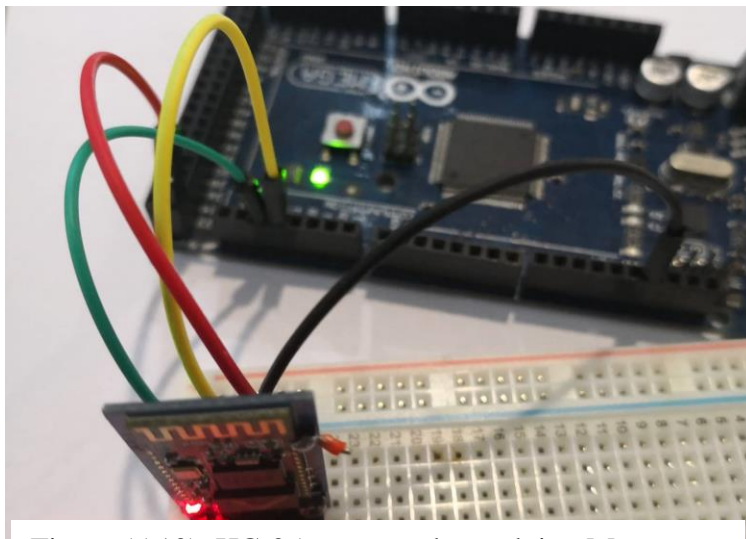


Figure (5.10) HC-05 connected to arduino Mega

Chapter Six

Result and Recommendations

This chapter contains the result of the project, conclusion, and some recommendations for this project and future work, at the end of this chapter shows the challenges that we had this semester.

6.1 Project result

The previous chapter shows the results of each module by side, after connecting all modules with each other as explained in the block diagram chapter four, the response time for alarming system is unnoticeable, the range for detecting the RFID tags is around 7 cm and the module has been tested and worked well after put the tag in the wallet or in the ID card the distance for detecting tag decreased, changing the modes immediately, the audible clock is late by less than 15 second that's because the time takes for adjusting the module.

6.2 Conclusion

The following points shows the conclusion of this project :

- The navigation system has been built using ultrasonic sensors which measure the time traveled to the obstacles and back, while using a vibration motors to alarm deaf-blind patient
- Mp3 shiled worked well and provide the blind patient the time with accuracy less than 15 seconds
- Three modes changed immediately and changes the warning distance between home and navigation mode also in the third mode the ultrasonic sensors don't work and RFID module works to detect the tags.

6.3 Recommendations and future work

In order to proceed with this project or develop it , we recommend with some points :

- Adding GPS module that may the family of the patient track him/her .
- Add GSM module that also can receive voice calls which can deaf patients receive calls from their family , friends .. etc.
- Improve the sound system using wireless headphones.

6.4 Challenges and solutions

In this semester while connecting the project components we had some challenges that have been solved .

- SD-card module that has been suggested in the intro , doesn't work for sound files , it has been replaced with mp3 shield (vs1053)
- The mp3 shield (vs1053) doesn't fix with Arduino nano , it has been replaced with Arduino uno .
- The code for implemented box doesn't work on Arduino uno because of low memory for it ,so it has been replaced with Arduino mega .
- Wireless headphones idea , changed with wired headphones because its compatible with MP3 shield (vs 1053)

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