DESIGN AND IMPLEMENTATION OF AN ARDUINO BASED SIGNALLING SYSTEM FOR PHYSICALLY CHALLENGED PERSONS

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APPROVAL CERTIFICATE

The project titled "**Design and Implementation of an Arduino based Signalling System for Physically Challenged Persons**" submitted by Tasnia Jahed Joyantee, Roll No.: 1013160005, Session: 2013-2014 has been accepted on 20 September, 2020 as satisfactory in partial fulfillment of the requirement for the degree of Master of Engineering on Electrical, Electronics and Communication Engineering.

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The project report (fully or partially) has not been submitted for any degree or diploma in any university or institute previously.

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Date: 20 September 2020

DEDICATION

To my family

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ABSTRACT

Humanity is the prime concern for the mankind to make a beautiful and peaceful world. Physically challenged children and elderly persons are part of our families and part of this society who need special care for their healthy lives in this technologically developed world. There are many care organizations and agencies which provide health care to the physically challenged persons but this mainly happens in developed countries. In developing and under-developed countries, many physically challenged persons face accidents such as heart attack, slipping on floor, fire breakout etc. Incident may also happen in houses where little children and elderly persons are left with caregivers because their parents and other family members are at work. During accidents, emergency contact persons, hospitals and ambulances should be notified immediately, and this is done by this project which has Arduino Uno in its architecture. Depending upon the nature of accident, emergency contact person can also contact with ambulance or fire service station and can give instructions as required. Utilization of Arduino Uno is the key to maximize performance and efficiency of the project. Focus has been kept on preparing a multi-role, user-friendly and cost-effective model for physically challenged persons. It has also been included that there are children who have special needs and this project has been developed to be of help in specific scenarios such as, children with special needs being left with caregiver at home but somehow child is outside of specified perimeter and thus, parents who are at workplaces are notified about the situation right away. To develop the proposed system, significant scopes in this field are available for future research work.

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LIST OF ABBREVIATIONS

2G	Second Generation
CAD	Computer Aided Design
CNS	Central Nervous System
CPU	Central Processing Unit
CVD	Cardiovascular Disease
DNA	Deoxyribonucleic Acid
DVD	Digital Video Disc
EEPROM	Electrically Erasable Programmable Read-Only Memory
EPROM	Erasable Programmable Read-Only Memory
GBD	Global Burden of Disease
GHz	Giga Hertz
GMSK	Gaussian Minimum Shift Keying
GND	Ground
IEEE	Institute of Electrical and Electronics Engineers
IHME	Institute for Health Metrics and Evaluation
I/O	Input Output
KHz	Kilo Hertz
LED	Light Emitting Diode
LINUX	Lovable Intellect Not Using XP
mA	milli Ampere
MHz	Mega Hertz

PC	Personal Computer
PCB	Printed Circuit Board
RAM	Random Access Memory
RF-EMR	Radio Frequency Electromagnetic Radiation
RFID	Radio Frequency Identification
RX	Receiving Connection
SIM	Subscriber Identity Module
SMS	Short Message Service
SMPS	Switched-mode Power Supply
TDMA	Time Division Multiple Access
TX	Transmitting Connection
USB	Universal Serial Bus
V	Voltage
WHO	World Health Organization
Wi-Fi	Wireless Fidelity

CHAPTER 1

INTRODUCTION

1.1 Introduction of Project

The world we live in has declared cardiovascular disease as one of the primary reasons behind death of people. Over 20 million deaths have been classified as a result of cardiovascular disease. Moreover, this disease keeps several million people disabled by its effects. Every country has agreed to the fact that there is a time delay between the very first cardiac arrest and the phone call to get the much needed medical service. Even though it may seem like a not so much of an important factor, doctors confirm that this delay plays a huge significance among patients, establishing the fact that it may very well have terminal consequences in the long run.

After analyzing data which deals with incidence, distribution and control of diseases from different hospitals and medical studies of several parts of the world, it is clearly visible that if heart disease is detected early, the treatment too can be provided early causing the fatality rate towards reduced proportion. This early detection and early treatment is more effective for patients than having improved care after hospitalization.

This is why methodological approach should be applied in real life to lower time before treatment starts. Cardiovascular patients must remain under continuous observation of family members. But the family members can be outside of home to complete different tasks. In case of any abnormalities faced by cardiovascular patient including heart attack, the system of the project will immediately send text to the nearest family member so that the family member can contact with the hospital closest to home and inform about health condition of the patient and tell them to arrange for an ambulance.

Now another point needs to be discussed which requires attention of own family members. In the last decade, a rise has been seen in the number of children born with special health care needs, these children are called special children. Children with special health care needs are those who have or are at larger probability for a chronic physical, developmental, behavioral, or emotional condition and who also require health and related services of a type or amount beyond that required by children generally.

When the families give the best effort to create and develop a nurturing environment for their special children, they face challenging situations mostly because the feature of their disabilities is significantly diverse from that formerly reported. This is why the factors needed to be taken under consideration should include insinuations for interdisciplinary routine as well as the varying pattern of early childhood disability. One of the difficulties faced by parents is special child going out of the house without informing any other member. This is a very serious issue since nowadays, parents are away from home for at least 8hours per day due to their work, and they appoint baby-sitter or a close relative such as grandparent of the child lives with them who looks after the child. During this environment which seems to be secured for the child, what sometimes happens is that the special child tries to go away from home without telling anyone anything, and fleeing of the child may happen when the person who looks after the special child may be in the bathroom or may be in another room for some chore they need to complete. This problem creates high anxiety in parents' minds as they know the risk of special child being alone outside the house – they will not be able to perfectly socialize with others, they will not be able to seek help from others, they will not be able to tell others that they need to make a phone call to parents. This anxiety increases parents' chances of having heart diseases later in life.

This project confers another function which can be of help during fire breakout. Fire can

cause serious damage. Many things of home may be severely damaged by flames, smoke, water and heat. When a fire breaks out even after taking pre-cautions, it is very important to stop the fire at the very first moment. Fire alarm helps to alert the family members inside home to try to put out the fire. Nowadays, both parents work outside their home and during their office hours, they keep their children under surveillance of caretakers. If fire breaks out and the children are of the age when they do not understand much of what to do during such incident, the caretaker must be given instruction of using this project where pressing only a button will send signal to the children's parents that a fire has broken out. Then parents will immediately contact with fire department service to let them know about the situation and their home address.

1.2 Literature Review

Many in depth researches have been conducted for understanding the types of accidents that happen each day. For example, when it comes to falls, it's seen that elderly people mostly face this accident due to various reasons such as aging, weakened balance, declining of cognitive quality [1]. History of earlier falls and environmental circumstance are also noteworthy causes behind falls of senior citizens of a country. Now, if an incident of fall is not taken care of as soon as the fall happens, this fall can lead to other health related problems such as bruising, bone fracture and traumatic brain injury [2, 5]. Because of the falls, geriatric people need to visit hospitals quite many times and they sometimes do not recover fully to their pre-accidental state of health [6, 7]. Also, the treatments usually take long time to have positive effect on the patients, so their mental as well psychological states do not always stay aligned to balanced condition. This is why it is very important to inform about the fall related incident to the nearest kin as soon as it happens. It is also very much needed to inform the nearest family member the moment a cardiac arrest happens to the

senior member of the family. Apple Company has wide range of wristwatches which can keep track of heart rates and can save information regarding irregular rhythms of heart [3]. But, this device cannot send alert message or call if need rises. Also, Helpline Company from UK has its own devices which can be set up at senior citizens' homes [4]. These devices can send signal when a senior person presses button of device while feeling uncomfortable at home. But this device has one drawback and that is, if a senior citizen has fallen on the floor accidentally and cannot press button of device, this device does not automatically provide signal to the nearest kin.

During an accident such as cardiac arrest or any other sudden cardiovascular issue, people tend to reach for their mobile phones to make calls. But mobile phone itself has negative impact on human bodies as it radiates harmful radiation [8, 9, 13]. Moreover, calling from mobile phone is not a feasible possibility when a person is experiencing cardiac arrest.

Recently, many families around the world are dealing with special children and while learning about the correct parenting attitudes and practices, parents do sometimes have anxiety if supervision on the special child is a little less than usual and if at that time, special child goes out of the home. Also, if children and the caretaker are in trouble such as fire breakout but the fire alarm for some reason takes more time to work, parents need to know about such incidents immediately.

Keeping all of the above incidents in mind, planning this project includes the necessity for a single elaborated system that takes care of all abovementioned problems. Design is made with a thorough look at an Arduino Uno based model which the research showcased in this project. The project includes scenarios such as cardiac arrest, falling on the floor accidentally, special child going outside of home alone, child inside home alone while there is fire breakout. The project gives solution to all these incidents with its designed device.

1.3 Objectives

Upon studying the literature review and designing the project, few objectives have been decided. Thus, in order to fulfil the project, the definite objectives of this endeavor are:

i. To develop a multi-role user-friendly, cost-effective model for physically challenged persons.

ii. To carry out performance analysis using C language to overcome limitations and finally redesign a user-friendly, cost-effective system model.

1.4 Organization of the Project

This project shows how Arduino Uno can make a difference to create multi-role device to aid physically challenged persons. The performance of this project is needful for social service agencies as well as for families who deal with child with special needs on daily basis. The organization of the project is as follows:

Chapter 2 has background and motivation for creating this project.

Chapter 3 provides the impact of cellular devices on human health.

In **chapter 4**, Arduino Uno and the needful components for the project have been discussed.

In **chapter 5**, thorough discussion has been included to explain how the project works and why the device of this project is influential in daily life.

Chapter 6 gives a conclusive outlook on this project and provides directions on possibilities for future work.

CHAPTER 2

BACKGROUND AND MOTIVATION

2.1 Introduction

Most of the families in these days have grandparents who have become patients of high blood pressure. While the parents of today tend to live in capital city in order to earn livelihood, the grandparents prefer to live in the rural areas. It is seen that only one grandparent is alive at village home and the children of him/her appoint caretaker to look after him/her at village home. There are times when the caretaker goes to own rural home and during this time, the senior citizen lives inside of home alone. It is very likely that this senior citizen faces sudden heart attack or may accidentally fall on the floor while he/she is alone in own place. It is fact that heart attack happens to body when a blockage is in the blood flow to a part of the heart. The blockage exists often because of a blood clot. The reason behind the blockage is mainly from plaque, meaning a build-up of fat, cholesterol and other substances. Existence of plaque makes coronary arteries thicker and harder, eventually making it difficult for the arteries to supply heart with blood.

The plaque may break open and if it does and a blood clot is formed that blocks the blood-flow, a heart attack occurs. This is how the heart muscle supplied by that artery starts to die. Damage goes on increasing the longer an artery stays blocked. The result is permanent heart damage once the heart muscle dies.

The health status of senior citizens such as grandparents as well as parents must always be taken seriously because heart and blood vessel diseases have been recognized as number 1 killer disease in many countries. One in every 34 seconds, a person dies from heart and blood vessel diseases and this is how there are more than 400000 deaths per year from these

diseases. Reports from the world portray that some heart attacks are sudden and intense but most of the attacks start very slowly, making the person feel mild pain or uneasiness. Below are some of the symptoms that can mean the person is experiencing heart attack:

a. Squeezing, uncomfortable pressure, fullness or pain in the center of chest. It may last more than a few minutes, or it has the continuity of going away and coming back.
b. Pain or discomfort in both of the arms or in one arm, in jaw, neck, back or stomach.
c. Having shortness of breath coupling with or without chest uneasiness.
d. Other symptoms such as nausea, breaking out in cold sweat or light-headedness.

The plan while designing this device was not want to prepare a device which will catch the signal from heart and send it to nearest hospital. This is because the hospital may get signal even though heart condition is not severe enough. If heart condition is not fatal but hospital still receives signal, then the situation may be that the hospital has already sent ambulance to the patient's home. This total scenario is a waste of time and fuel and thus, not enough cost-effective. So, during designing the project, my intention was to inform the closest of the family members so that they can take necessary step immediately after having text from the project's device. This project plan has a portable device which can be worn over arm. The portable part is a slightly large in size but there is scope for improvement in future researches. I have also heard about an incident where the family has child with special needs and the child went outside of home without saying anything to anyone. Parents became very anxious during the time when everyone was searching for the child. So, I kept in mind that incident and thought of preparing a device which would send signal to the parents immediately if the child with special needs goes outside of a specified parameter.

There are more accidental incidents that take place around the world every day, and these events also made me think about adding more to this project. Because of my grandmother's health, cardiovascular disease is the primary motivation discussed in this chapter, then falling on the floor accidentally is also discussed among other incidents.

2.2 Cardiovascular Disease

A sudden heart attack looks like the picture as shown in figure 2.1.

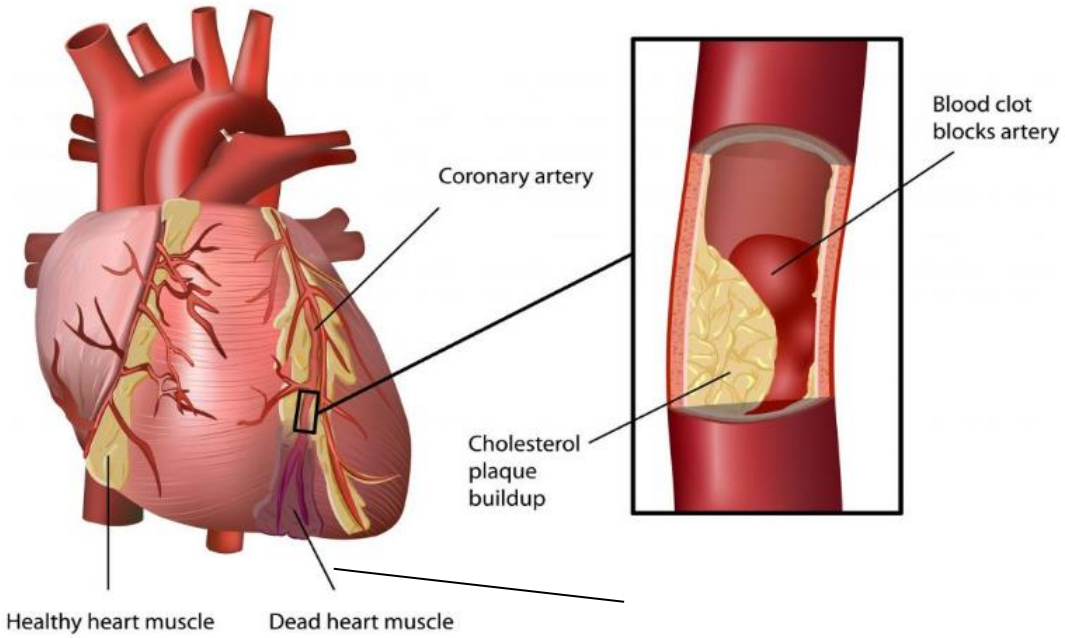


Figure 2.1 : How heart looks when there is clot in blood flow [1]

The term cardiovascular disease explains a range of diseases that affect blood vessels and the heart. When a person has high blood pressure such as most senior citizens of a country, it is necessary that their heart condition should be checked every four to six months because senior citizens are more likely to have cardiovascular disease. Other problems that are initiated from cardiovascular ill state are – coronary heart disease (heart attack), heart failure, cerebral-vascular disease (brain stroke) etc. Globally, this is the topmost reason behind death.

2.2.1 Death from cardiovascular disease by age

From the graph below, it is seen that around the world approximately 18 million people in 2017 from cardiovascular diseases. Almost 65 percent of deaths happened to the people aged 70 and above. Less than 30 percent of the deaths from cardiovascular diseases happened to the people in the age group of 50 to 69. The last section of those being dead from some kind of cardiovascular disease is the age group of 15 to 49 while it is noted that the percentage of children under the age of 14 having death from Cardiovascular Diseases is small. It means that the senior citizens are highly prone to embrace their death because of cardiovascular disease.

Deaths by age from Cardiovascular disease in the world

Source: Institute for Health Metrics and Evaluation

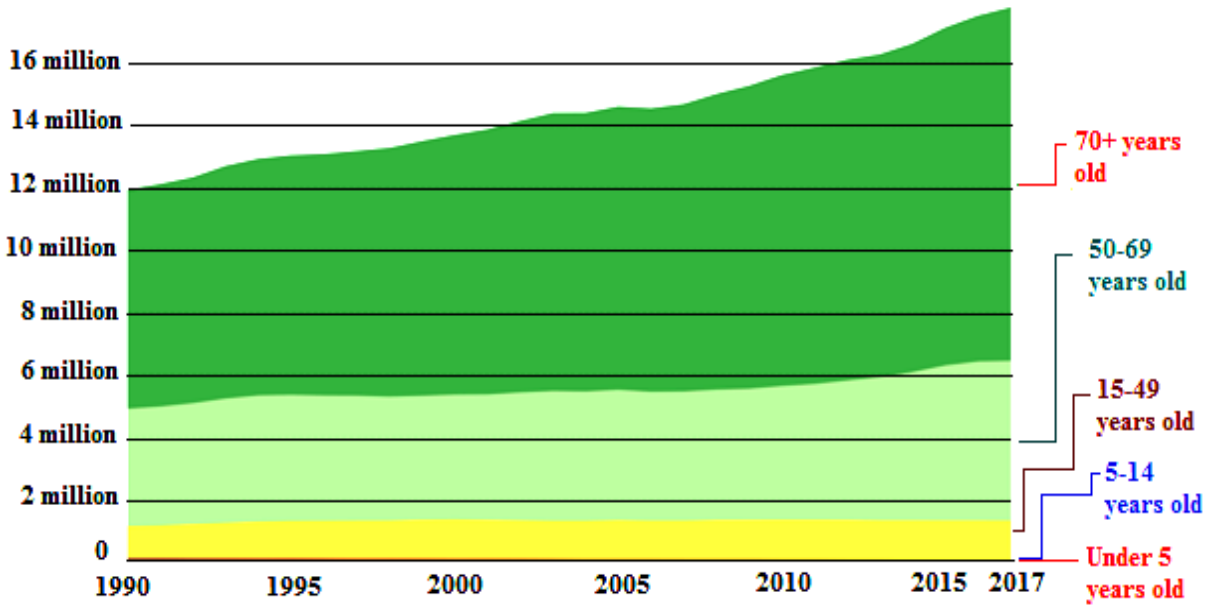


Figure 2.2 : Graph on cardiovascular disease death by age [2]

The graph in Fig. 2.2 shows CVD death numbers per 100 thousand individual persons each year. The age-standardization is done to understand the probability that a person will most possibly die from CVD after a certain age so medical check-up should be started after a specific age. The cardiovascular disease numbers are also different based on countries.

Below is another graph which shows an East-West division in CVD death rates. This rate is substantially in low rate across North America as well as in Western-Northern Europe. But the Eastern Europe, Africa and Asia have much higher cardiovascular disease death rates. Moderate rate is seen across most of Latin America.

2.3 Falling of Elderly People

People who are of 60 years and above are categorized under ‘elderly people’. A very common incident that elderly people face is falling and falls around the world have the largest mortality rates, specifically in the elderly people aging 85 years and above. In 2019, the world we live in has roughly 143 million elderly persons and this number is predicted to be tripled within the year 2050 by reaching almost 426 million. When an elderly person falls, the key concern becomes their physical wellbeing as well as psychological difficulties. Falls are considered as one of the most serious problems in the ‘Geriatric Giants’ that may initiate any of the followings:

a. Immobility
b. Instability
c. Incontinence
d. Impaired intellect/memory

Figure 2.3 : Accidental fall of senior citizen on the floor [4]

Among the geriatric population, falls are seen and accepted as a very significant cause of mortality and morbidity. These falls are of two types – slips and trips. People can go through events which cause a person to fall to the ground in opposition to their will [5] or can make a person fall all the way down to ground or hitting an item while falling [6]. Each of these kinds can initiate deficit of consciousness, abrupt beginning of paralysis (as in a stroke) and seizure of epileptic kind. A person can experience recurrent fall which is defined as falling at least two or more falls in a six months-time, and fall can be defined simply as a spontaneous but sudden change of position.

2.3.1 Study and analysis of falls:

From US National Institutes of Health and their Division of Injury Epidemiology and Control [7], it is seen that in the category of people aging over 75, falls has been identified as the main leading reason of accidental death. In the people aging from 65 to 74, people die of falls which is the second major cause of accidental deaths. For men as well as female, percentage of death from falls increases along with age. The age group of 65 to 74 sees men having more death rates than women do from falls, but women after the age of 75 years are more prone to death from falls than men of 75 years and above. Many families do not find it necessary to report to hospital or doctor about the falls of elderly people because a lot of families tend to think that falls are a normal addition to old age. This is not a wise decision at all.

2.3.1.1 Risk factors of falls

Due to falls, there are several risk factors even though 50-66% falls happen inside the patient's house.

a. Intrinsic factors. A healthy system of life ensures sense of balance as well as stability including the way of walking, standing and sitting. If there is any sort of age-

related change, it may harm the healthy system of life as well. Sharp visual, sensing similarity and dissimilarity during comparison, perception of depth and adaptation with darkness decline with aging. Inability occurs in elderly people even to respond to walking on an uneven surface. Elderly people who face falls and go on with life even with fractures, it has been seen that their average body mass index becomes lower than usual healthy period. Elderly people who exercise regularly are in the group of 12% people facing fractures whereas 48% people of non-exercising elderly people get fractured because of falls.

b. Extrinsic factors. While studying the factors that can add to the risk of falls, environmental factors also play important role either by independently raising the risk, or by getting in contact with fundamental factors. Risk becomes larger than normal times when there is change of natural state of nature such as walking on slippery surface or being transferred to a new home.

c. Situational factors. The possibility of falls may become bigger from few specific activities or choices such as – wearing high heels while walking, at night rushing to the bedroom when there is not enough lighting present or when the elderly person is not entirely wide awake, running towards the telephone to answer it etc.

2.3.1.2 Complications after falls

Elderly people falling repetitively are afflicted with increased rate of injury, hospitalization and demise of life. Frequently falling creates other problems in the elderly people such as - fear of falling, fear of being hospitalized again and again, having physical functionality towards diminished stage. More than 50% of falls end up into physical damage. Because of falls, hypothermia and dehydration are two important issues that elderly people experience if they stay on the floor for longer period of time upon falling.

2.3.1.2.1 Bedsores or pressure sores

Pressure sores or bedsores are a type of injury which happens to a person if a specific part of skin is found to be under amplified pressure (in the case of falling of an elderly – lying on the cold floor for extended period of time) thus having the skin as well as the underlying tissue broken down. This can happen within 30 minutes of being on the floor. The procedure of having pressure sores is that the additional strain creates a blockade for blood to reach the affected skin's area and it leads that area to feel famished of the needful oxygen and nutrients. These sores can vary for an elderly to feel uneasy to very painful to life threatening depending on the length of time being left on the floor after fall.

2.3.1.2.2 Hypothermia

If an elderly person falls on the floor and lies there for very long time because he/she is not in a position to be on own feet by self, there will be risk of hypothermia or risk of catching sickness like pneumonia. Thus, if the other family member is not informed right away about the fall, immediate help cannot reach the elderly person sooner than later.

2.3.1.2.3 Dehydration

After a fall when no one else is at home, elderly person may feel dehydrated after being on the floor for very long time because of not being capable of standing up. This dehydration may lead to bad health condition if a close contact is not informed immediately about the accident.

The substantial impact on the mental state of the elderly person who falls on the ground is also very alarming. The American Journal of Epidemiology has researched and found out that the elderly people living in fear of falling again after their first fall lessen their continuing quality of life. The anxiety and panic attack the old people but the ratio is like

this – the terror of falling is roughly 30% in those elderly persons who have never experienced fall in their lives, and the percentage is a high rate of 60% in those elderly persons who have fallen at least once in their lifetime.

If a senior citizen falls once, he/she turns out to be less fluid in own walking and becomes more reliant on other than before. He/she starts to lessen own daily normal activities. Each day, the elderly person feels more afraid of falling and lowers the activities from daily life, thus making body's muscles weaker each day which in the long run causes more falls. Below is a graph which shows the unintentional fall death rates per 100,000 elderly persons in the USA, which clearly gives the notion that more and more elderly people are dying from unintentional fall and because of being left on the floor for longer period of time. This has been declared by WISQARS (Web-based Injury Statistics Query and Reporting System) panel of Centers for Disease Control and Prevention – US Department of Health and Human Services.

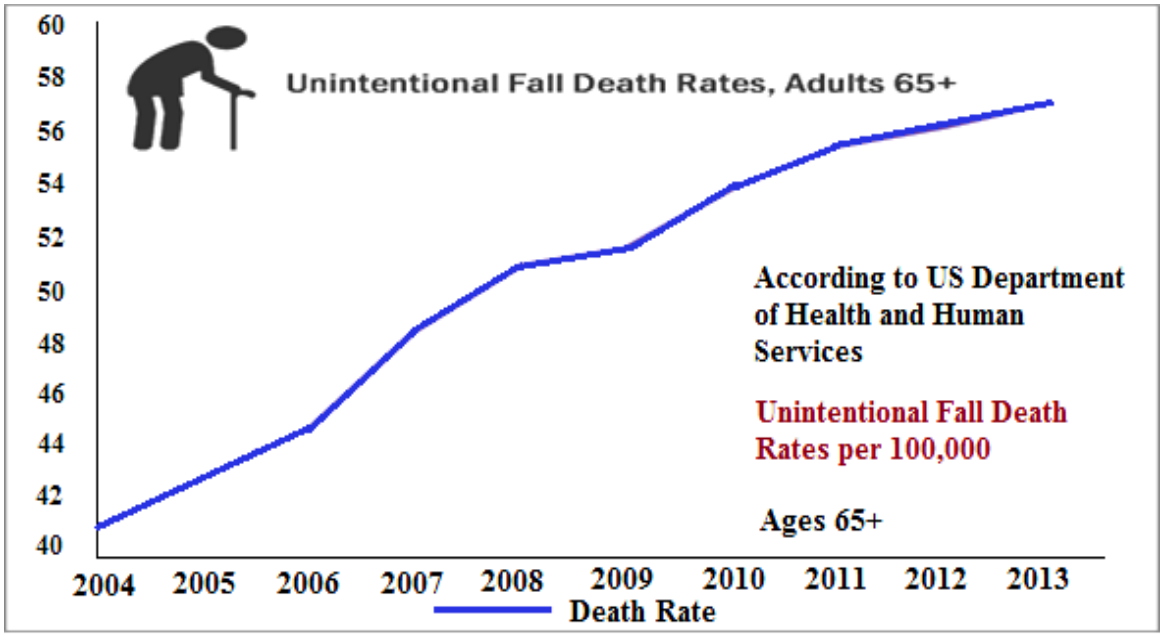


Figure 2.4 : Unintentional fall death rates per 100,000 Adults aged 65+ in US

Now if the device of this project is set at homes, it will be the best solution for the elderly people living alone at their children's home while the offspring is at office or educational

institution. If an elderly person falls and cannot get up on own feet by self, calling the ambulance is not the most necessary thing to do because at first, it needs to be confirmed that the fall has done severe injury to health and then the ambulance needs to be informed. So, the nearest of kin getting signal automatically from the device of this project is very helpful. The mobile phone is not needed to be in the hands of the fallen person at all to place the call.

2.4 Fire Breakout

Fire is a very speedy corrosion of a material in the process of discharging energy from own arrangement to its adjacent place in the outward appearance of heat. During this process of burning, heat and light and fume get released. Fires get initiated when a flammable material combining with a satisfactory amount of oxidizer as oxygen or any other compound that is rich in oxygen is open to a source of either heat or air temperature above the ignition point for the fuel. Fire gets increased from all these factors present in appropriate percentage.

Incidents of fire outbursts have been on the rise in past decade. The initiation of fire happens in general from a single fuel object. Burning object creates smoke and this smoke takes form of smoke cloud which gradually acquires the upper layer of space. The heat generated by the fire is transported by smoke cloud and directly into the layer of smoke, thus the layer of smoke itself increases in depth and it intensifies temperature as well. Other objects catch fire from the originated object either because of the radiation coming from flames of the firstly ablaze object or from the layer of smoke. If the room that caught fire is small, the unburned objects catch fire almost at the same time. If the room that caught fire is quite large, the close objects consecutively get ignited as well, but this ignition depends mainly on the arrangement of fuel, composition and available ventilation.

One of the major causes that has been recognized to start fire is the gas which is in the kitchen area. Many people do not pay heed to check after cooking if they have turned off the gas or not, because during dry weather fire from stove may touch any other stuff adjacent to the stove, causing spread of fire. Other reasons behind fire outbreak are electric sparks, power surge, carelessly disposing cigarettes after smoking, contaminated fuel etc.

The experts of Global Burdens of Disease (GBD) of USA have collected information which states that fire safety largely depends on factors such as, how an individual acts during fire breakout, how quickly an organization decides on what to do during fire outbreak, the mindset of people while being exposed to fire, how well a building is prepared to tackle such incident etc. This project helps the children left with caretaker in the home who do not understand much how to call or ask for help during a fire breakout.

2.5 Children with Special Needs

Not every child born in this world requires the same attention and care throughout their life. There are children who are born with special needs are either have or are at high risk of chronic developmental, physical, emotional condition. These children may have been born with incurable illness or a syndrome, or with extreme cognitive impairment, or with severe psychiatric issues. There are also children with special needs who struggle immensely with learning, who have serious food allergies, developmental delays. Some special children have panic attacks as well. Thus, children with special needs face challenges that are more difficult for them to solve than the usual typical children, and this is why these children need extra support from their families. Additional guidance helps them to achieve academic, emotional, social milestones such as housing system, employment, finances etc. In order for the children with special needs to fulfill own potential, early intervention is important that is a procedure to assess the developmental abilities of the special child. In general, families having children with special needs go

through a journey of a lifetime that is both financially as well as emotionally challenging. This is why it is very necessary to remain patient and to not be overwhelmed as all the emotional states are an ongoing natural part of the whole process. With passing time, acceptance comes slowly but certainly. This is the time when full family can focus on planning how the helping process will progress so that child with special needs can reach fullest potential with developed skills. But, these children must be under strict supervision of family members. In today's world, there are families where both parents have to work to earn livelihood and to maintain cost of family.

If working parents have a child with special needs, then they keep their children under supervision of either one of their closest family member – it may be the child's grandparent, or a nanny. Thus, few benefits of using Arduino project are as follows:

a. Before the use of this Arduino project

Home is the specified area that is safe for special child. If the special child goes out of own home without saying anything to anyone, the parents may not be aware of this incident right away because the person who is supposed to look after the child is perhaps busy in another chore. As it is difficult for a special child to communicate with other persons, he/she may not be able to inform other people outside home that he/she is lost and needs help to return home.

b. After the use of this project

The project has two parts, one is called main device and the other is the portable part. Once the portable part of this project is worn by the special child, parents can be informed about child being outside specified safe area immediately by this device.

2.6 Chapter Summary

The scenarios above explains the significance of this project, and the impact this project can have on family life around the world. To ensure safety of children, to ensure safety of aged persons with health condition, this project is definitely needful. In the next chapter, the impact of cellular technology on human health has been discussed to understand how this technology affects human life.

CHAPTER 3

IMPACT OF CELLULAR TECHNOLOGY ON HUMAN HEALTH

3.1 Introduction

Alexander Graham Bell and Sumner Tainted were the brain behind formulating the wireless technology back in 1880 [8]. Over the years, the world has seen many kinds of wireless devices being used by people to communicate with each other. Now is the time when mobile phone and wireless network in reality have become part of regular life. Wi-Fi devices that are used everywhere do the job of exchanging meaning sending as well as receiving of data via wireless medium. Familiar Wi-Fi devices that people use on habitual basis are cell phone, audio player, tablet PC, digital camera and PC. IEEE standard 802.11 is the base of the wireless devices.

At present time, people are using more wireless devices every day and it is because the wireless devices do not require physical cable for communication purpose. These devices use electromagnetic radiation to make communication through sending as well as receiving data such as sound data or network data by air. Very detrimental radiations get emitted from the wireless devices making human body affected in harmful ways. These radiations have harmful effect on human body for the reason that people cannot see nor feel the presence of such radiation which is present due to the wireless devices kept with or around us. Our bodies are penetrated by these radiations and gradually the cell's deoxyribonucleic acid (DNA) becomes affected as well. Due to the ionizing radiation DNA of cell can really be altered.

To establish connection among the wireless devices, different kinds of radiation are applied. As radiation of each kind typically has distinguishing wavelength in addition to

distinct frequency, the range of frequency for radiation has been known as having array from 3 kHz to 300 GHz. Technology these days has almost all types of wireless beneficial devices that are hands free phone, cell phone tower, tablet pc, wireless router, laptop etc. Diseases such as male infertility, miscarriage risk, brain tumor, ear hearing impairment, effect on fetus, increasing risk of cancer, Parkinson's disease, Alzheimer's disease, heart disease, asthma, insomnia, leukemia, high blood pressure, birth defects, rheumatoid arthritis are known to be either caused by or intensified by the harmful radiations emitted from wireless devices. Some symptoms instigated by radiations are sleep disturbance, headache and fatigue.

There are diseases that increasingly start to be intensified from the radiation and they are discussed below starting from describing radiation.

3.2 Radiation

Radiation is the type of energy which originates from unstable atom. It is the form of wave particles. When it comes to transfer or spread, radiations transfer or spread in the form of particle or wave or rays through the space. Ionizing and non-ionizing are the types of radiation. It has been seen that ionizing radiation is composition of high energy waves that can easily remove or move the electrons from the molecules, atoms leading the increase of many diseases by damaging cells. If non-ionizing radiations are taken into account, they are directly liable of transmission of sending as well as receiving of electromagnetic radiation or sound energy or heat energy but this type of non-ionizing radiation does not break the chemical bond. Medical test on humans teaches that, little amount of ionizing radiation is not very much injurious, but if the amount of ionizing radiation is high, people may face sickness as severe as cancer as well. DNA is known as the genetic material of cell and it is responsive to ionized radiation. Because of the ionizing quality in radiation, the DNA of cell can be modified.

The electromagnetic radiation can be taken to being split and divided into other numerous types of radiation. The radio wavelength exists from 0.5 centimeter to 30,000 meter. When the electromagnetic radiation owns frequency under the range of 0.3 Giga Hertz to 300 Giga Hertz, it is then labeled as Microwave radiation. If the relating between the frequency range and the wavelengths are taken into account, it is seen that the frequency range links to the wavelengths amid one millimeter and one meter. There are also radiations which belong in between microwave radiation and the radiation of visible light. These are named Infrared radiation. Science has categorized Infrared in three classes, they are – "near" infrared radiation, "mid" infrared radiation and "far" infrared radiation. The visible light in reality has been found in between the infrared radiation and ultraviolet of the electromagnetic spectrum. It in fact is the tiniest portion of electromagnetic spectrum that spread from cosmic beams. The visible light has the attribute of visibility for these two reasons:

a. It has frequency of 4×10^{14} to 8×10^{14} cycles per second or Hertz.
b. It has wavelength of almost 740 to 380 nanometers.

From comparison between ultraviolet light wavelength and visible light wavelength, the result is that ultraviolet light has shorter wavelength than visible light wavelength which is why human eyes cannot comprehend this sort of waves. There are few insects though that can see these waves and one of such kind is bumblebee. Ultraviolet light owns a range of frequency starting from 8×10^{14} to 3×10^{16} Hertz. People in general have heard mostly about the X-ray which is basically an ionizing radiation having sufficient energy to eject electron from atom or molecule. The X-rays have the feature of changing the gene, chromosomes and few other body-cell components. Having high frequency and very small wavelengths are Gamma waves' trait. Gamma rays wavelengths can offer quite large packets of energy which is known as the photons of no charge at all, and the rays get

generated in the time of breakdown of atomic nuclei. Wavelength of gamma rays is 100 picometers whereas the frequency of gamma rays is more than 10 exahertz (1×10^{18} hertz).

3.3 Possible Diseases Due to Radiation of Wireless Devices

There are various kinds of diseases that either start from radiation of wireless devices, or these diseases become more critical because of the radiation. Some of such cases are explained below:

3.3.1 Tumor in brain

Brain tumor is a mass of abnormal tissue that is not supposed to be inside of a healthy functioning brain. Many of the bodily cells either die because of tumor, or they get substituted by other cells and more tumors. Tumors can be of two types – malignant and benign, and both of them can be caused from being exposed to electromagnetic radiation.

The radio frequency electromagnetic radiation (RF-EMR) from the wireless mobile phones induces oxidative stress and directly produces changes in DNA shape. This is why the condition can become such that the electromagnetic field exposure may elevate the occurrence of brain tumor. When using cell phone while talking, it is actually quite close to brain and the radiation can penetrate inside human brain as deep as 4 to 6 cm if phone is kept near ears for long period. Because of the actions of radiations the hippocampus and pineal gland are affected by decreasing in their protein kinase C which is a type of protein that is involved in controlling functions of these kinds of proteins, and melatonin activity. The reason behind tumor formation from using cell phone occurs gradually and because cell phone is used in a very close contact with the brain. Timing is a significant factor in this scenario, means that if cell phone is used one hour per day continuously for about 10 years or above, then there is high chance of having brain tumor. If cell phone is used to talk each day for few hours keeping the phone near ears, brain tumor is highly likely to start

being formed and the microwave frequencies that a cell phone has, changes brain DNA and micronuclei. The cell phone, if not in use, still has its microwave frequencies active. Children are more prone to be affected from the cell phone's microwave frequencies because bodies of young people are still under growth, their cells are dividing more; they have a thin skull and brain. The radiation of cell phone damages the blood brain barrier, which increases the instigation of brain tumor [9].

3.3.2 Impairment of ears

A normal human has own hearing ability going downwards with age, but it happens in very slow pace so this is why the elderly people can feel the hearing disability that their hearing ability has gone weaker than the others. There are quite many causes behind initiation of ear impairment earlier than the aging process.

Cell phone's electromagnetic waves have effect on the hearing of humans. Hearing power can be damaged due to long term use of cell phone with high frequency. Most of the cell phone users use the right ear to listen as compared to the left ear. Researches from Dr. Allison Catlett Woodall, audiologist from University of Arkansas for Medical Sciences has come to conclusion that the cell phone radiation damages the inner ear if cell phone is used for long term. Cell phone use exceeding 60 minutes per day could result in lasting damage such as high frequency hearing loss, and this damage activates the cochlear receptor through the same process which involved in the normal hearing, that describes the "clicks" which are heard by the people that exposed to the microwave radiation. Thus, doctors say about the young people that most of the young people between the ages of 18 to 25 suffer from the loss hearing function due to more use of cell phone and other gadgets. 16000 hearing cells are present in each of inner ear. When cells do not get regenerated, hearing problems take place. If a person uses cell phone every day from two to three hours, he or she is will be at partial deafness risk within 3 to 5 years. Nowadays, a large number of

people in their 20s work in marketing as telephone-consulting professionals. They keep on hearing piece connected to their ears or talk over phone by holding it against ear. In few years, they start feeling ear pain which later slowly turns into tinnitus – ringing or buzzing in the ears [10]. As we have been seeing the increase in the usage of cell phone, the possibility of biological negative effects due to the cell phone emitting radiofrequency also is on the rise, it is because radiofrequency consists of magnetic fields and oscillating electricity which interact negatively with the cells of plants, human beings and animals. The RF-EMR are being used for the wireless communication devices and this RF-EMR is more inclined towards causing high blood pressure, short term memory loss, brain tumor, sleep disturbances. Radiofrequency focuses in tissue called auditory nerve which is close to the cell phone while talking takes place [11].

3.4 Additional Effects on Health from Wireless Devices

Even though there are trifling alteration, all the above information provides us with confirmation that there are potential harmful radiations emitted by wireless devices. Medical doctors revealed that people in general should keep using their wireless devices to the minimum because these devices in actuality have negative effect on body. The research that has been done to prepare this project has shown the fact that if people use the abovementioned wireless devices for very long time, these people may face bigger risk because prolonged using of such devices can cause permanent damage to health which may not be repaired by doctors later in life. The doctors have given warning to users of wireless devices because the radiations from these devices penetrate body and damage the DNA [12]. Almost 99% responses from the doctors are in favor of detrimental effects and it happened because the doctors were supervising those kinds of patients.

With each day's increasing usage of wireless devices, the strength of radiation varies from device to device, thus listing the devices with radiation's strength as - mobile phone (1800

Mega Hertz and 3G technology operate between 1900 Mega Hertz to 2200 Mega Hertz), laptop (1000 Mega Hertz to 3600 Mega Hertz), Wi-Fi (2450 Mega Hertz), Tablet PC (2.4 GHz) and Bluetooth devices (2.4 GHz). It is a known fact that cellular phone is a very important invention of science and technology, still the emission of harmful radiation from cellular phone has given the drive needed to understand more on this subject. From studying different articles and research papers, it has also been found out that functions of central nervous system (CNS) become affected from high frequency radiation [13]. The reason behind CNS being affected is because of phone antenna proximity to the area of head that gets severe heating. People having lower efficiency in hearing has been found in researches which showed that these people were exposed to mobile phone radiations more from using their phones for prolonged time. According to the researches, it was possible to associate about 34.59% of problems with impaired hearing, ear warmth and ear-ache, there were 23.07% effect on ear that was found during research, 23% hearing problem found due to the cell phone [14]. It has also been found out that there is about 5.04% of problem of decreased and blurred vision due to the mobile phone. From the research articles on brain tumor, it has been observed that there is 32.3% chance of brain tumor because of keeping cell phone long time close to ears [15]. World Health Organization (WHO) also has published report on cell phone radiation which says that the cell phone radiation has 40% effect on brain tumor. Alzheimer's disease is also linked to effects of cell phone keeping near head and ears. The electromagnetic field from cell phone has effect on human health and there are other diseases from electromagnetic field such as immune system damage, Parkinson's disease and heart problems [16]. From researches run at the department of Epidemiology of UCLA School of Public Health, University of California, Los Angeles, CA, USA, it is confirmed that there is effect of cell phone radiation if babies are exposed to cell phones too much and these effects are discovered later in the children's lives. So,

the research obtains results from mothers who use cell phone and laptop, their unborn baby's brain development are affected from radiation of these devices and this is why behavioral difficulties such as emotional and hyperactivity problems around the age of school entry of these affected children are on the rise.

3.5 Chapter Summary

Above reasons are why the project of mine showcases the procedure of keeping mobile phone away from body when there is no specific requirement of keeping it close to body. Also, the Bluetooth that has been used in this device is very safe and included in the portable part of the project. Instead of wireless cellphone, Bluetooth technology has been used in this project along with Arduino and a small remote each of which has almost zero radiation, so this project is safer than keeping cellphone close to body.

Another reason of making this project is the cost. Although mobile phone users reach for the cell phone when they need to make any kind of contact with outside and though it's true that there are different types of signal delivery systems in the society today, these architectures are quite complex to create and also the cost does not appear lucrative enough for people in general. The need of sending multiple signals from one single device is becoming a necessity day by day. If we establish multiple models giving them the trait of being portable from which each will distribute data and information to its target contact, the system becomes that the person inside the home must be able to bear each of those devices with him, thus the person will naturally feel exhausted. Also, if a special child needs to understand a specific dangerous situation like going outside home without telling anyone, it may make him feel overloaded with information, he may not be able to fully comprehend the dangers of going outside alone. The parents of special child should have access of always understanding if their child is inside the safe nest, in such case closed circuit television camera comes helpful enough, but still the cost is higher than many

people’s interest in investing in those cameras. Since it is very difficult to keep different devices adjacent to body for each purpose, this project showcases the stipulation of making a centralized model which will be helpful for families having senior citizens with sickness as well as for working parents who have their children at home.

CHAPTER 4

COMPONENTS OF PROJECT

4.1 Introduction

All essential components needful to design and construct the project are discussed in this chapter. These components are Arduino Uno, printed circuit board, liquid crystal display, global system for mobile communication, subscriber identity module, buck converter, Bluetooth module, sound sensor module, tilt sensor, transmitter receiver module, jumper wire and adapter. The central element is Arduino Uno. This Arduino is actually a small microcontroller board with a universal serial bus (USB) plug to attach to personal computer (PC) or laptop. It is known to have variety of affiliation sockets that may be wired to external electrical devices like motors, light-weight sensors, loudspeakers, microphones, optical device diodes, relays and more. Arduino can either be powered through the USB affiliation from PC, from a power provided or from a 9 volt (V) battery. While trying to work with Arduino, it is seen that it can be controlled from PC or programmed by PC. After getting programmed by PC, it can be disconnected and it can work autonomously.

The style of the board has open supply and it suggests everyone that any person is fully allowed to form Arduino-compatible boards. There is explanation for low prices that Arduino board costs, and the explanation is competition in market. There are basic boards which get supplement from accessory shield boards. In order to plug in the necessary shield boards, it should be noted that top of Arduino board has plug point where the accessory shield boards can be connected. Arduino programming language is quite simple to use by any individual on computer with Windows operating system or LINUX operating system or Macintosh operating system.

4.2 The Arduino Family

While studying backgrounds and traits of Arduino boards, it is clear that there are indeed various types of boards under Arduino family. Different kinds of Arduino boards are given below:

a. Duemilanove
b. Diecimila
c. Mega
d. Nano
e. Lilypad
f. Roboduino
g. Freeduino
h. Seeeduino
i. Femtoduino
j. Ruggeduino
k. Teensy

4.2.1 Selection of Arduino Uno

There are reasons behind selecting Arduino Uno for this project. First of all, the price of Uno is not very expensive, so within reasonable price the core component of the project is acquired. The second reason is its open source hardware feature. This feature enables users to plan and create own kit with the help of the one which is already available, and use it as reference source. Another important reason of picking Uno is its compatibility with all operating systems like Windows, Macintosh, LINUX etc. As the Uno has open source software feature, it is very much appreciated by the skilled software developers as well because they can utilize the Arduino code to be merged with existing programming language libraries and thus, these can be extended further and can be modified as per need.

Arduino UNO has another significant advantage and that is easy specification of being connected with the CPU of a computer and it uses serial communication over USB. It has built in reset circuitry as well as built in power, both are needful for developing projects.

4.3 Arduino Uno and Brief Description

Arduino Uno in photographs are shown below:

Figure 4.1 : An Arduino Uno board [17]

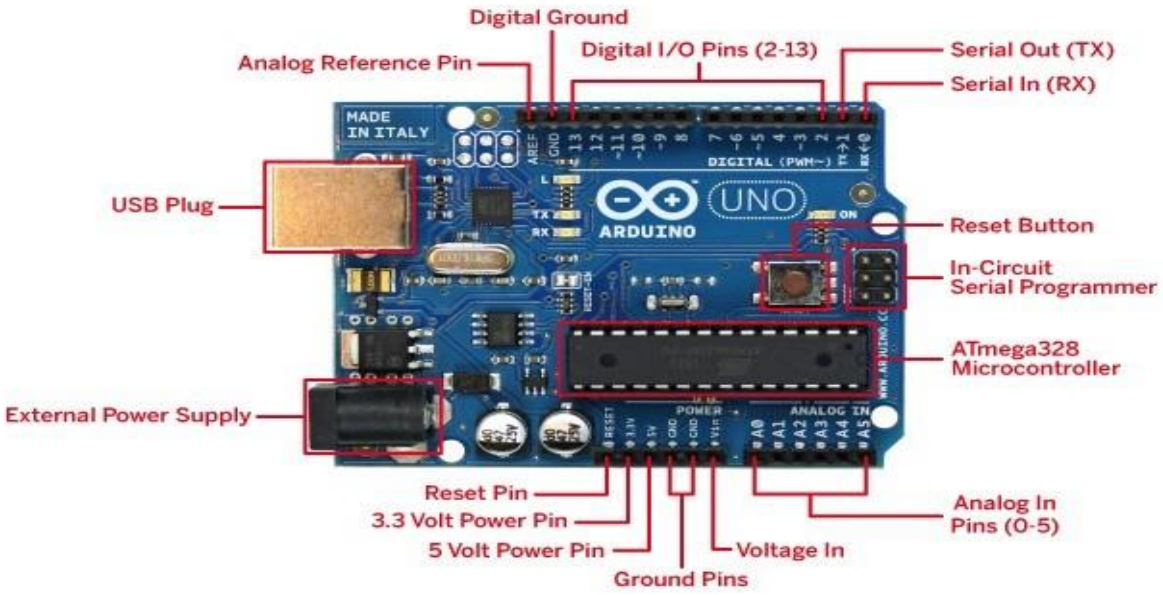
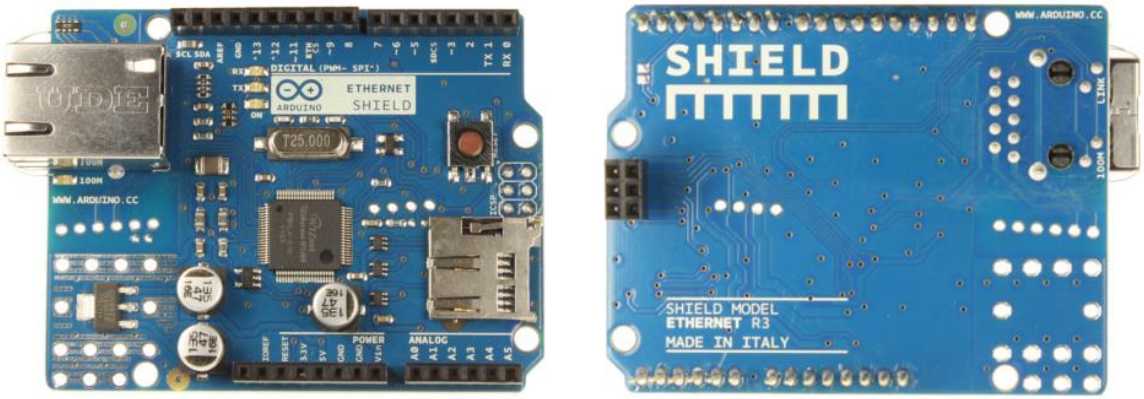


Figure 4.2 : Detail view of Arduino Uno [17]



Arduino Ethernet Shield R3 Front Arduino Ethernet Shield R3 Back

Figure 4.3 : Arduino Uno with an Ethernet shield [18]

Description of Arduino Uno board and functions of its different parts are given below:

4.3.1 Microcontroller:

Microcontroller is known as the heart of Arduino. Every other thing found on the board is related to having the board powered up as well as getting it to correspond with computer. A microcontroller is actually a very small computer in the form of a tiny chip. It has everything needed to work and a very interesting thing is that, it even has quite more than what the first home computers had. The inside of it has many things such as – a processor, flash memory for saving programs, input and output pins, a kilobyte or two random access memory (RAM) for storing data, a few kilobytes of erasable programmable read-only memory (EPROM). If the microcontroller has to be connected to the other electronics, its input/output pins help in this regard.

Analog signal means it has voltage at a pin and digital means having signal of on or off switch. From the inputs, analog and digital both can be read. Having voltage at pin and having switch signal mean that there actually is prospect of having connected to several kinds of sensor for sound, light, temperature etc.

As there are inputs, there also is output. The outputs can easily be either analog or digital. Here, if a pin is set to 0 volts, it means it is off, and if it has 5 volts, that means it is on. The light-emitting diodes (LEDs) can be turned on or off precisely. But higher power devices as motors can also be controlled by the output. The higher power devices can come forward to give an analog output voltage. Thus, it can be said that the output of a pin can be set to an exact voltage, which lets organizing motor's speed or a light's brightness, rather than just turning it on or off.

The microcontroller chip is rectangular in shape and black in colour having 28 pins. A dual inline (DIL) socket is selected to fit the microcontroller chip into it. This chip can simply be substituted in the DIL socket. ATmega328 is known as the 28-pin microcontroller chip which is used on the Arduino Uno board. Block diagram of figure 3-2 shows the key features of the device clearly.

The device has a core which controls everything which goes on within the device, and that core is called the central processing unit (CPU). This CPU is the brain of the device. It does the fetching of program instructions from flash memory where the instructions are stored and then it executes them. This procedure of fetching may include fetching data from working memory which is random access memory (RAM), it may also include changing the fetched data and then putting it back. Moreover, it may mean transforming one of all the digital outputs from 0V to 5V. The Electrically Erasable Programmable Read Only Memory (EEPROM) has the characteristic of being non-volatile, which matches with the memory type of flash memory. Even when the device is turned off and on, it will keep in itself what is in the EEPROM. The difference between flash memory and EEPROM is that, flash memory in reality helps to store program instruction (from sketches) whereas EEPROM stores information that is necessary to reset or during the power being turned off.

Several sets of microcontrollers are produced by microcontroller manufacturers, and these microcontrollers are categorized into distinct families. When companies create microcontrollers, they keep in mind about the enthusiasm of electronics hobbyists who work with Arduino, and they also target customer demands such as microcontrollers in cars, DVD players, washing machines, air-fresheners, children's toys etc.

4.3.2 Powering up Arduino Uno

Right after obtaining an Arduino board, most of the times it is pre-installed with a sample Blink program. The function of the Blink program is to make the small built-in light emitting diode (LED) flash. The letter L is marked on one of the LEDs, and it is done so that it becomes effortless to understand this L marked LED is wired up to one of the digital sockets having input output facility on the board. Digital pin 13 has the LED connected to it and this is how pin 13 gets restricted to existing as the option of being used as an output. As the LED consumes little quantity of current, the connector is in connection with all other different features. When it is needed to have Arduino actively running, the only thing required is to provide it with some energy. So, the next step is having it connected into the USB port of computer which is the most trouble-free method to give it energy. Type-A to type-B kind of USB lead is necessary for this. In general, a computer uses this identical kind of lead to be connected with a printer. From checking the connections, if it is found that all is functioning as they should be, the LED should flicker. In the market, nowadays new Arduino boards have the Blink sketch built in with them, in order that it can be established that the board works. Only supplying power to Arduino board with the help of USB will not make it function. The Arduino software must be installed. After installing the Arduino software, the platform needs to be checked to decide which USB driver should be utilized at that moment. This is when a program should be uploaded to the Arduino board.

4.4 Electronic Components of the Project

After the Arduino Uno, the other electronic parts that are needed to make the project are described below:

4.4.1 Printed Circuit Board (PCB)

Printed Circuit Board (PCB) mechanically provides support to electronic elements and it creates connection electrically among electrical components. This happens by the usage of conductive tracks as well as pads including other etched feature such as one or more than one layer of copper sheet having lamination onto and/or between layers of sheet of non-conductive substrate. In order to electrically connect and to mechanically clasp them, all the components are usually soldered onto the PCB. Printed circuit boards are seen to be a part of various electrical products including the kind named passive switch box. There is wire wrap and point-to-point formation which can be considered as substitutes to PCB but these have become unpopular and are not being used as much as before. Printed circuit boards have the requirement of extra design effort to lay out the circuit but construction and compilation can be programmed automatically. Specially concentrated CAD software is known to be able to be doing most of the work of design.

Printed circuit board is selected for this project because for one, the price is not expensive and secondly, it works not only very well but also really fast while having other components being wired and mounted on it. The layout can be finished once even though there are huge numbers of PCBs to be fabricated. If a company wants, it can make these boards manually in smaller numbers although the benefit will be in reduced rate.

A printed circuit board can have one single side with copper layer, it can have two sides and both sides having copper layers. There are also PCBs having multiple layers such as outer layer and inner layer both of copper. As multi-layered PCBs have the disadvantages

of having its repair, analysis and field modification of circuits extra complex, this is why single-sided one copper layer printed circuit board has been selected in the project.

4.4.2 LCD

LCD means liquid crystal display which is a device that displays text and numbers. To make LCD work, its own library functions needs to be used to measure and display sensor data on the LCD.

4.4.2.1 Basics

I2C LCD is taken as standard to display text as well as numbers, and this is why the name "character LCD" is given. This module has a small chip along with a potentiometer so that it can adjust the LED backlight easily. The advantage of a regular I2C LCD is its writing which is really simple. Just two data pins can organize the LCD.

4.4.2.2 Using a 16x2 character LCD with Arduino

The LCD has small rectangles and each rectangle is created off of a grid of 5 x 8 pixels.

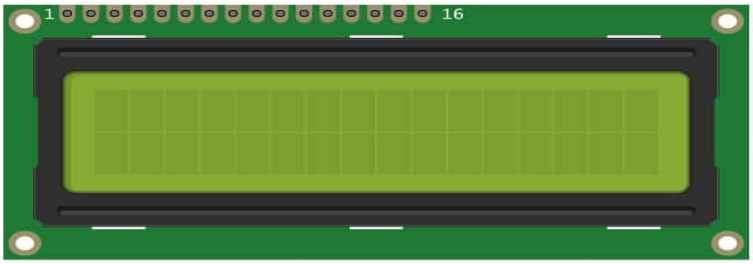


Figure 4.4 : LCD [18]

4.4.2.3 Adjusting the contrast of the LCD:

When wiring up the LCD is complete, the contrast of display should be adjusted accordingly. There is a little sized potentiometer on the I2C module which can be turned on with a tiny screw-driver. From the Arduino, the USB connector is supposed to be connected with the USB point to provide power to the LCD. Now, the backlight of the LCD

will be lit up. The LCD can have rectangles appeared on it by rotating the potentiometer. Next step is working with Arduino library because this library has multiple built-in functions that help to program for the LCD easily.

4.4.3 GSM

In the ground of cellphone technologies, incredible change and updates are happening. This project has used GSM technology of 2nd generation technology. GSM has seen its successful development and application all over the world in the past few decades. Although we have seen 3rd and 4th generation of cellular network on the rise and towards the 5th generation, the experience of 2G in the mobile arena has been categorized as well worthy to be selected for the project. This digital technology has proved to have traits of spectral efficiency and sound performance with development in features like data communications and speech security through high standard of transmissions. It also works very well with Integrated Services Digital Network (ISDN) technology. Other advantages of second-generation cellular technology includes enhanced security, radio-magnetic spectrum, extended battery life. 2G network has Global System for Mobile Communications (GSM) standard which is one of the main standards. Time division multiple access (TDMA) is known to be the base of GSM. It is also the most widely used form of 2G technology. Voice is at first deconstructed in bits in digital format and after that, transmission of it is done through the medium of individual channel of data. Upon its arrival at the other end of the channel, reconstruction is done to get the actual data back to original form.

The system which is applied by ISDN is Pulse Coded Modulation. GSM uses a combination of Time Division Multiple Access and Frequency Division Multiple Access so that GSM can divide the radio spectrum bandwidth.

A very significant feature of GSM is the Short Message Service (SMS) and it has succeeded to draw attention of people. SMS is a procedure that has dual direction to send short but alphanumeric message. It goes through the process of store-and-forward. Another feature that is important is the level to which its network is deemed to be safe as well as protected. Speech and data – both are encrypted so that no one can eavesdrop during communication and any Subscriber Identity Module (SIM) card can be inserted in the GSM technology.

4.4.3.1 Modulation:

GSM system works smoothly because the modulation scheme selected for it is Gaussian Minimum Shift Keying (GMSK). The GMSK modulation technique helps to reduce the chances of adjacent channel's interference into the system.

4.4.4 Buck converter

Step-down converter is known as Buck Converter which is basically a DC-to-DC power converter. It does the job of stepping voltage downwards from its own input supply to the output load, all the while stepping current upwards. Buck converter has power supply system that has switched-mode including two semiconductors on the very least. Switched-mode power supply (SMPS) also has at least a single energy cache element, an inductor for induction, a capacitor or a combination of these two. Capacitors which are filters-inclusive are generally added up to a converter's input of supply-sided filter as well as load-sided output filter to decrease ripple from voltage.

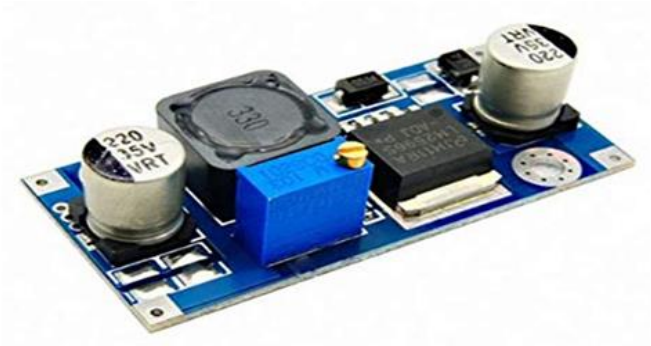


Figure 4.5 : Buck converter [19]

Buck converters are helpful and effective to perform task of changing main supply voltage towards lower than before voltage if need rises. The base of a buck converter is current inside of an inductor which is controlled by two other switches that generally are a diode and a transistor. The assumption is that the voltages at input as well as output stay stable over the course of one full cycle while inductor has no series resistance thus output capacitance becomes infinite. This is how it is considered that the diode and the switch both have no drop of voltage when it is on and no flow of current when it is off.

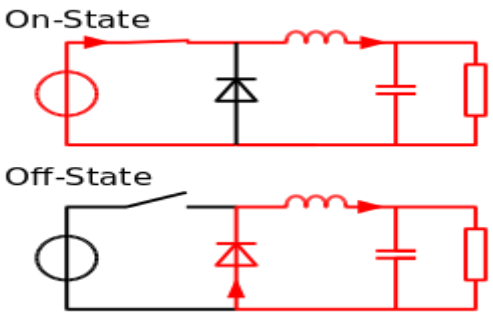


Figure 4.6 : Two circuit configurations of a simple buck converter [20]

The diagram shows that when the switch remains close, the state is called on-state. When the switch is seen open, the state is then called off-state.

4.4.4.1 Working mechanism of buck converter

The concept of buck converter can be explained from the current and the inductor's voltage relation. At the starting, the off-state of the switch is open and then the current is zero. Later when the switch goes to its first closed stage that is on-state, the current starts to be increased. The inductor at the same time will initiate producing an opposing voltage that is across its own terminals. The voltage drop situation reacts with the voltage at source, thus it decreases the net overall voltage across load. With time, the current changing rate goes low while the voltage across inductor goes down, which makes the load voltage go up. During the current change, if switch is opened then a drop of voltage across inductor will take place. At the time of off-state of switch, the voltage source will get removed and the

current will go down. Decreasing current will then produce voltage drop across inductor which is the opposite to the drop at the on-state, which will make the inductor a source of current. Saved energy at the inductor starts to support the current through the load and as this current flows during the input voltage is not connected. At the time of off-state, the inductor starts discharging its own stored energy towards the rest circuit. If the switch is kept in closed state before the inductor becomes fully discharged state (on-state), the voltage which is at the load will always be bigger than zero.

4.4.5 Bluetooth

The Bluetooth module that is used in the project is HC-05 bluetooth module.

Figure 4.7 : Bluetooth HC-05 [21]

Bluetooth module HC-05 can be set to either master or can be set to slave as needed for the project a person is working on. This is a highly admired and widely used Bluetooth module for Arduino related wireless communication project works.

Few of its characteristics are given below:

a. Model: HC-05

b. Band: 2.4 GHz

c. Set Power: Low

d. Usage Medium: Wireless Communication

e. Input Power: + 3.6V ~ 6V (DC) (generally 5V)

f. Module: Serial for Arduino

g. Operating Current: 30mA

h. Range: less than 100 meters

i. Operation: Master, Slave, Master/Slave mode

The pin configuration is an important factor for the Bluetooth module so that it becomes easy to pair it up with other parts of a device. Upon correct configuration of pins, the Bluetooth will work properly and will be component of having the whole device give signal to other segments. Table 4.1 below shows pin names and descriptions of Bluetooth module.

Table 4.1: Pin Configuration of Bluetooth Module

Pin number	Pin name	Description
1	Enable / Key	This pin is used to toggle between Data mode (set Low) and AT command mode (set High). By default, it is in Data mode.
2	Vcc	Powers the module. Connected to +5V supply voltage.
3	Ground	Ground pin of module, connected to system ground.
4	TX-Transmitter	Transmits Serial data. Everything received via Bluetooth will be given out by this pin as serial data.
5	RX-Receiver	Receives Serial data. Every serial data given to this pin will be broadcasted via Bluetooth.
6	State	The state pin is connected to on board LED, it can be used as a feedback to check if Bluetooth is working properly.

4.4.5.1 Using of HC-05 Bluetooth module

The HC-05 Bluetooth module has a whole wireless functionality of having two-way opportunity to incorporate to the project. To establish wireless communication between two microcontrollers such as Arduino, or to form communication wirelessly with devices such as mobile phone, this module is generally used. This HC-05 can transfer data from mobile

phone or from computer to microcontroller, or can do the opposite. Powering of the module with 5 volts and connecting the points are shown below:

4.4.6 Sound sensor module

A microphone sound sensor is selected to use in this project to detect sound. It also provides a calculation of loudness of sound that it senses. In the market, a large range of sensors are present. The most commonly used sound sensor module is given below which is used with Arduino:

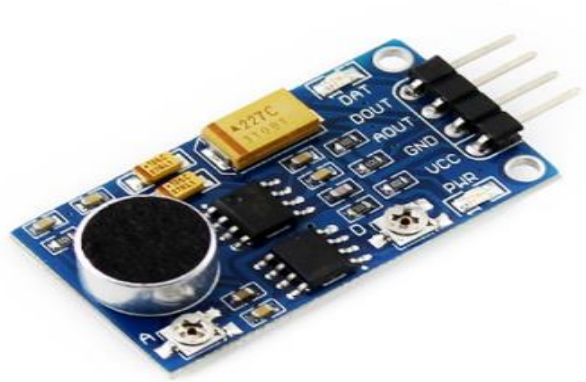


Figure 4.8 : Sound sensor [22]

The sensor module has one potentiometer that is built-in inside so that it can regulate and correct and alter the sensitivity of the digital output pin.

Table 4.2: Pin Wiring of Sound Sensor

Pin	Wiring to Arduino
A_o	Analog pins
D_o	Digital pins
GND	GND
VCC	5V

Sound sensitive light is connected to microphone so that microphone detects intensity of sound around it and then upon intensity, light will be on at LED when intensity is above specific threshold.

4.4.7 Tilt sensor

Tilt sensor is an element that identifies tilting of a thing. This sensor has the phenomenon of similarity to any pushbutton that gets initiated through a distinct mechanism. It basically is an environmental-friendly variety of any mercury switch there is. Inside it, there is a ball of metal which transforms two of its pins from off to on and on to off depending on the state of the sensor.

Pull-up resistor can be used in tilt sensor and then the sensor can be connected to a digital input pin, the pull-up resistor works to activate the pins. The board has resistor of one kilo. The sensor when detects an object's orientation, it provides a specific output of either high or low as per orientation of object.

Arduino Uno of this project gets interfaced with tilt sensor and a LED is connected to it which is also connected to the sending of emergency text to the nearest of kin. If the sensor becomes active from a tilt, the LED will be lit and emergency message will be sent immediately.

Figure 4.9 : Tilt sensor [23]

The above figure is of a tilt sensor module with base of mercury switch. It assigns high result at its own output pin when tilt happens. Generally it needs five volts of input (DC). It has ground, input and output just like many other three-terminal devices. The outer shell is of glass tube with two electrode while the inside has liquid mercury ball. If the container of glass tube tilts and gets slanted towards a direction other than usual, then the liquid mercury ball closes and opens its circuit for the LED to be lit.

4.4.7.1 Working mechanism of tilt sensor

In the image below, during the non-tilted position the sensor provides low at output. This happens as the liquid form of mercury puts a completion to the circuit by joining the two electrodes. During output is kept on low, the LED that is on-board remains ON.

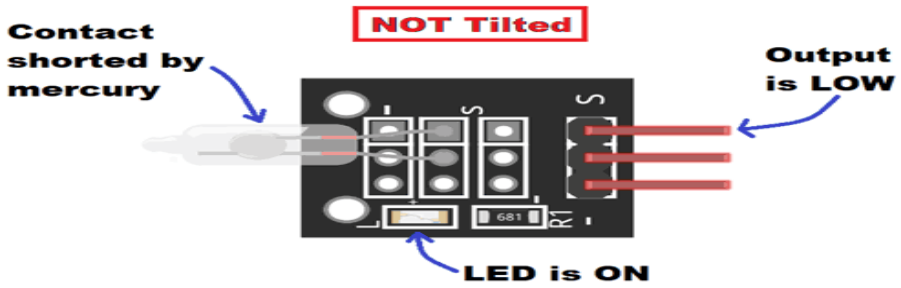


Figure 4.10 : When Sensor is not tilted [23]

When the sensor goes towards an angle or a particular direction, the contact of the metal electrodes gets broken by the liquid mercury, thus the circuit becomes open. Therefore, output has high result and the LED on the board becomes off.

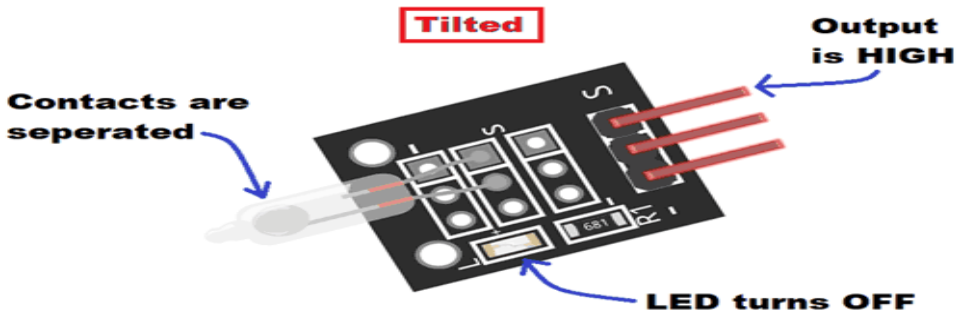


Figure 4.11 : Sensor when it is tilted [23]

4.4.8 Transmitter Receiver module

For sending and receiving data, we have used RF module in this project which is 433 Mega Hertz RF transmitter and receiver modules. Here, two things are kept in mind while creating this project – one is, the device should operate upon crossing a certain distance, and another is, a specific sum of information should be transferred within a data rate.

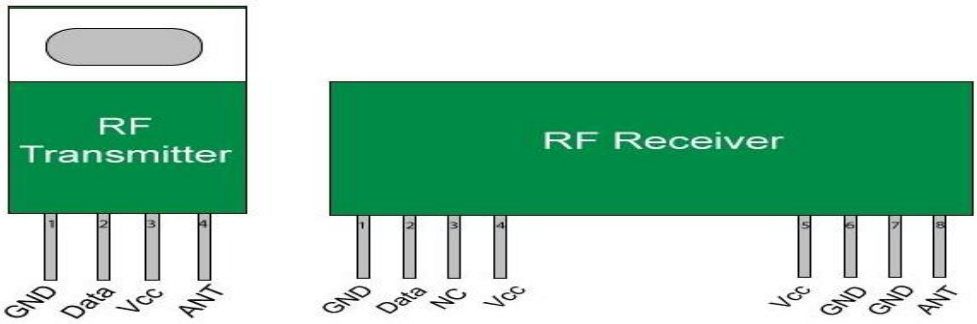


Figure 4.12 : RF Transmitter Receiver module [24]

In this module, the transmitting part does not draw any power while transmitting zero logic and at the same time, it suppresses the carrier frequency. This is why the battery loses very low power as transmitting part uses up considerably little battery power. When there is logic one from zero is being sent, carrier remains turned on at about 4.5 milli ampere current having only 3 volts of power supply into it. The data then goes in serial method from transmitting end to the receiving end. For transferring of data, the transmitting end and the receiving end both are accordingly interfaced to other two microcontrollers.

RF Module Features:

a. Transmitting frequency range 433.92 MHz

b. Receiving frequency 433 M

c. RF receiver modulation: ASK

d. Transmitting supply voltage 3volts to 6 volts

e. Very little power consumption

f. Receiving end support current 3.5 milli ampere

g. Transmitting end output power 4 volts to 12 volts

h. Typical frequency at receiving end 105

i. Operating voltage at receiving end is 5 volts

4.4.9 Adapter

The kind of adapter used in project is 9 volt DC having 250 milli-ampere and 2.1 millimeter plug while having the center pin as positive.

Figure 4.13 : Adapter

The other characteristics of adapter are that, it has to be essentially a DC adapter and that it should be in the range of 9 to 12 DC volt. Moreover the current output must have a minimum level of 250 milli-ampere. The Arduino will have different things connected to it such as Light Emitting Diode, Liquid Crystal Display etc. so the adapter selected for this should bear the ability to work at the least 500 mA to 1 Ampere. Even if the Arduino board shows the input voltage limit is 20 Volt, deciding to opt for a 9 Volt or 12 Volt DC adapter is the best option because voltages have tendency to be converted to heat.

4.5 Chapter Summary

All the above-mentioned components are essential to give the model of this project an electrically realistic appearance. In the next chapter, how the project works is described.

CHAPTER 5

THE WORKFLOW OF PROJECT

5.1 Introduction

This chapter describes what the project does during different types of accidents mentioned in chapter three. The device has three parts – one is the main part which has adapter connection with electric board, second one is the portable one which can be with any senior citizen or with child with special need, the third part is a small remote with buttons A to D.

5.2 Project Block Diagram

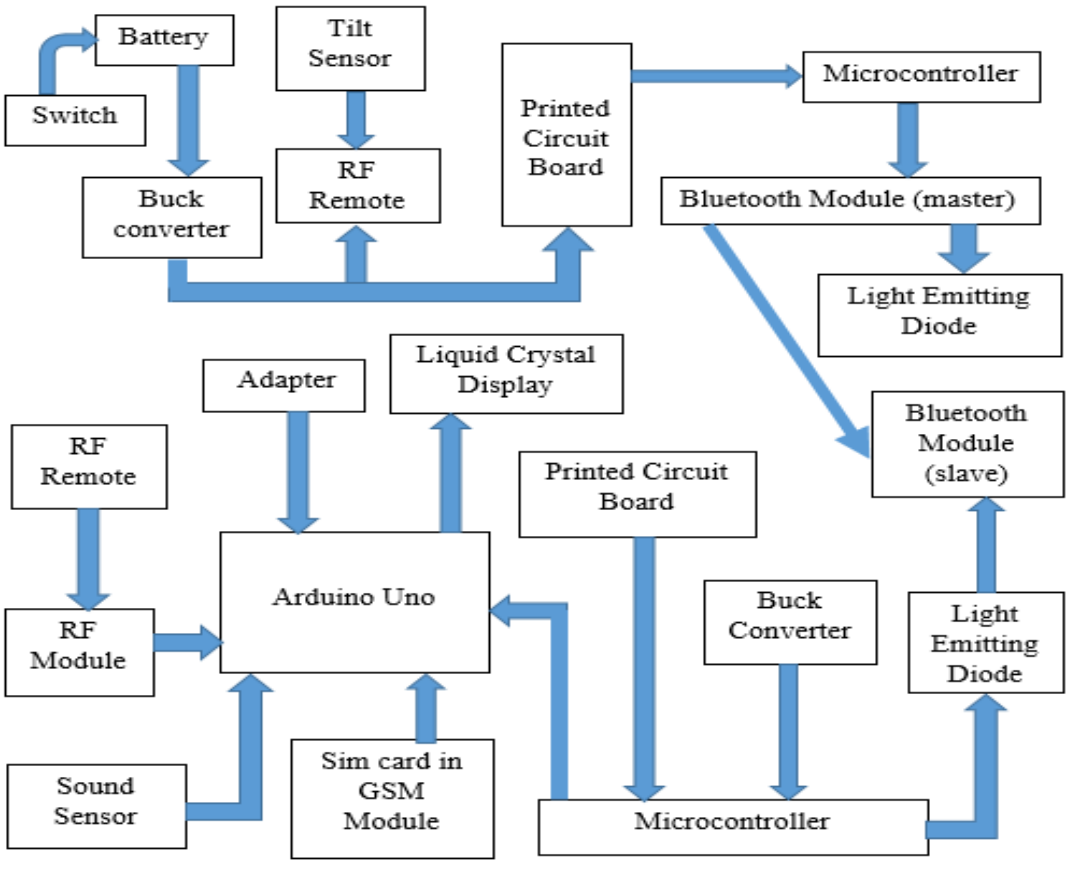


Figure 5.1 : Implemented Project Block Diagram

The overall workflow is given in the above figure 5.1. It shows the connections that are implemented in the project to make the project work efficiently. At first, the code is written

for Arduino and then it is uploaded to Arduino Uno via the cable it comes with in the package. After uploading of code is complete, the whole workflow can be checked to make sure each component is working properly. The whole time, this project needs to be connected to power with the help of adapter. The portable device should be turned on by clicking the switch placed on it. The portable device should be kept vertically straight and this device becomes switched on with the help of the batteries that are on the backside. This portable device has buck converter, the inside of remote and tilt sensor on it. As soon as the portable device tilts towards ground, tilt sensor sends signal to the microcontroller via its remote module because the microcontroller is connected to the master Bluetooth module. The master Bluetooth module sends the tilted signal to the main device's slave Bluetooth module through wireless communication. The slave Bluetooth module is connected to the main device's microcontroller which is also connected to the Arduino Uno board. Upon receiving signal from master Bluetooth module, Arduino Uno runs the code uploaded to it to understand which message needs to be sent immediately. Arduino Uno has connection with RF module, sound sensor, GSM and LCD. As soon as Arduino Uno receives signal from the remote through RF module that a button is pressed, it sends message or call as per the written and uploaded code. Arduino Uno does the same act of sending call and text after sound sensor gives signal to it that sound is beyond the limit set during coding. The device can perform multiple functions discussed as different cases.

5.3 Case 1 – Accidental Fall of Senior Citizen on the Ground

A senior citizen may live alone in a house for various reasons – it may be that own children are all outside to work, or to study, or it may be that senior person lives in the countryside while children live in another city for own occupation. In such cases, when the elderly person gets down from the bed to go to another room or washroom, he/she can easily bind the portable part in the arm.

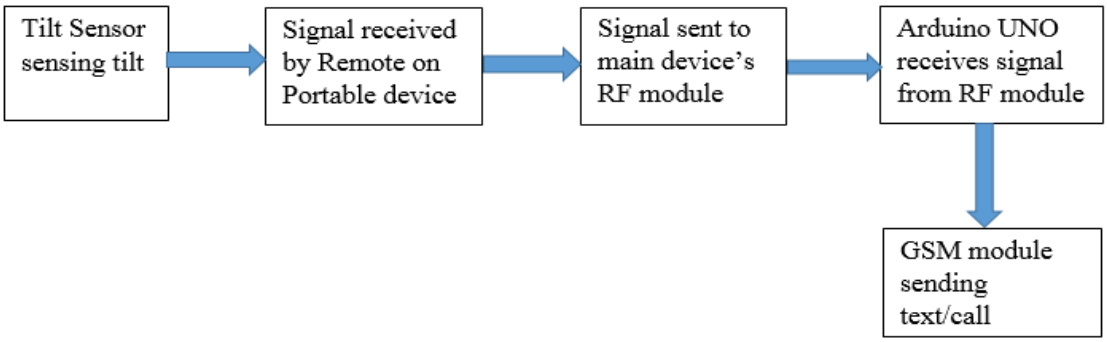
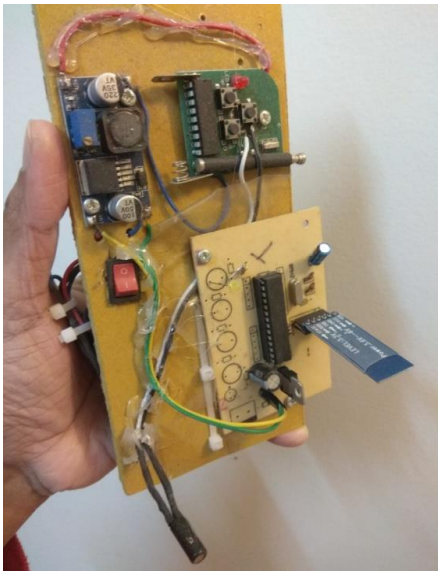
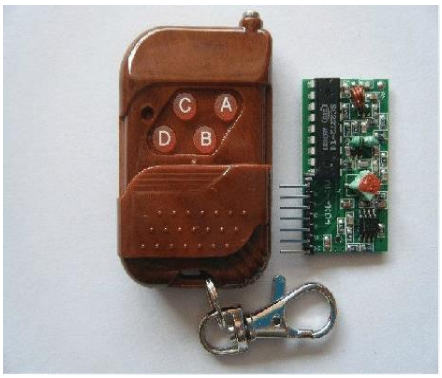


Figure 5.2 : Functional block diagram for Case 1

Now, even if that senior citizen falls on the floor accidentally, according to figure 5.2 the tilt sensor will send signal to the remote on the portable part. This remote sends this signal to main device's RF module. Arduino Uno then receives this signal from RF module and sends it to GSM module so that the SIM card of this module can proceed to deliver emergency text to the nearest of kin, in our case, to own child and the text reads – "**I fell on the ground and got injured. I cannot get up, cannot receive call, cannot open door. Need immediate help. – Tasnia's home**". If elderly person's nearest kin lives in the same city/village, he/she can personally come and take to the hospital if health status is really critical, or can simply help the person to stand up if health status is not lethal. If the nearest kin lives in another city, he/she can definitely call neighbor of the elderly person and request to check up on the fallen person immediately, even if it means breaking the door from outside to get inside of the house. The nearest kin is selected as one of the closest family member and not the hospital because of the reason that, it may be the senior citizen's fall is not a life-threatening one and it may mean that he/she simply needs help to stand on own feet, so that the problems discussed in chapter three such as – hypothermia, dehydration do not affect the fallen citizen. The whole scenario is much more planned if the nearest kin is selected as one of the family members.

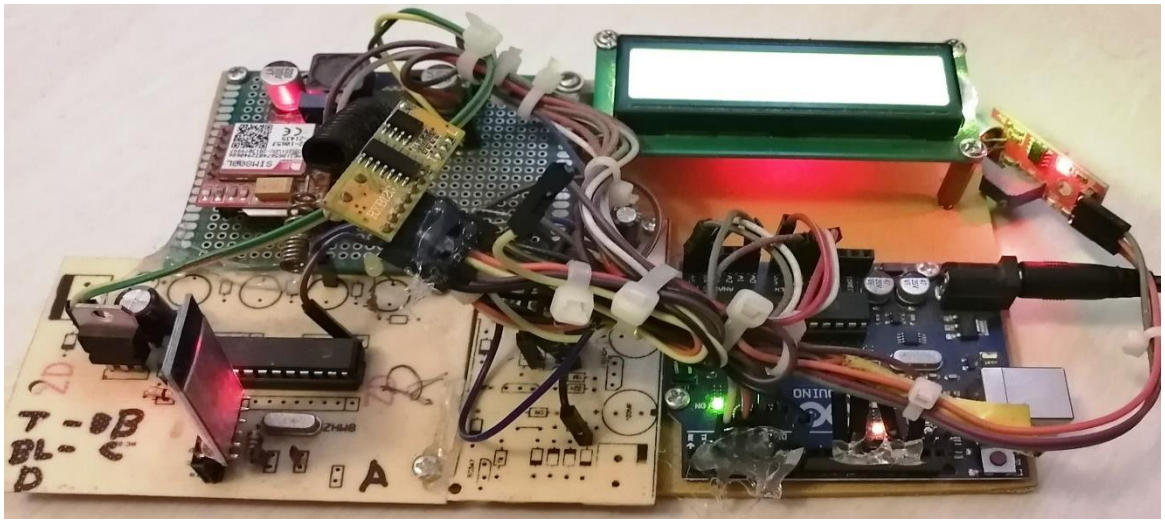


or



Portable device

RF remote



Main Device with Arduino Uno

Figure 5.3 : Diagram of workflow

So, the figure 5.3 tells that the button A of the remote does the same as the tilt sensor described at figure 5.2. Remote helps in the case when elderly citizen does not want to bind the portable one on the arm, so he/she can keep the remote on any pocket of own dress and by pressing button A after falling on the ground, the emergency contact person will get notified.

5.4 Case 2 – Heart Attack

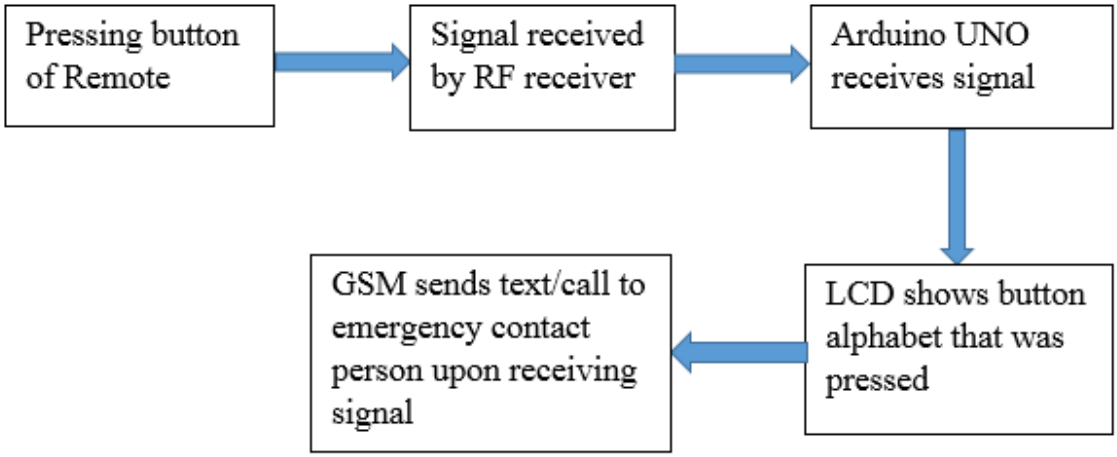


Figure 5.4 : Functional Block diagram for Case 2

The remote has button B which sends the text – "**I just had a heart attack. Quickly arrange an ambulance for me. I cannot receive phonecall, cannot open door. – Tasnia's home**". When elderly citizen is having a heart attack, he/she doesn't have the time to reach for the phone, opening the contact list, selecting the number to dial. This is why the project makes it an important point that, only pressing a button will give necessary message to the nearest family member who is the emergency contact person for the elderly living alone in the house. Figure 5.4 shows that, after pressing button of remote, signal gets sent to RF receiver of main device. This RF receiver delivers this signal to Arduino Uno and Arduino Uno is connected to the LCD. LCD shows which button (in this case, button B) was pressed and since GSM is connected to Arduino Uno, GSM sends text to emergency

contact person. Upon receiving the text, the emergency family member will still make a phone call to the elderly person to check if he/she actually have just had an attack and if the phone call is not answered, then the emergency contact person will call neighbor to check up on the senior citizen. The neighbor should be notified about breaking the door from outside as elderly citizen is unable to answer the door in this situation. Upon confirmation from neighbor, emergency family member will decide to call for ambulance service to reach the specific address.

5.5 Case 3 – Fire Breakout

Sound sensor is for the children who live inside home but with nanny to look after them. It may be the case that both of the parents of a child work at their respective offices and they have no other alternative but opting for a nanny. The nanny may be from a family that is not much educated, so she may not be able to call from a mobile phone when there is an emergency. This project helps when the child of the house is very little and does not know how to operate a phone, and the nanny also does not know much about system of mobile phone. There is possibility of fire breakout in the house, other kind of accident may also happen in the house. Usually, the key to the outside of the home is with the parents of the child for their safety. So, this project includes another significant system – a sound sensor.

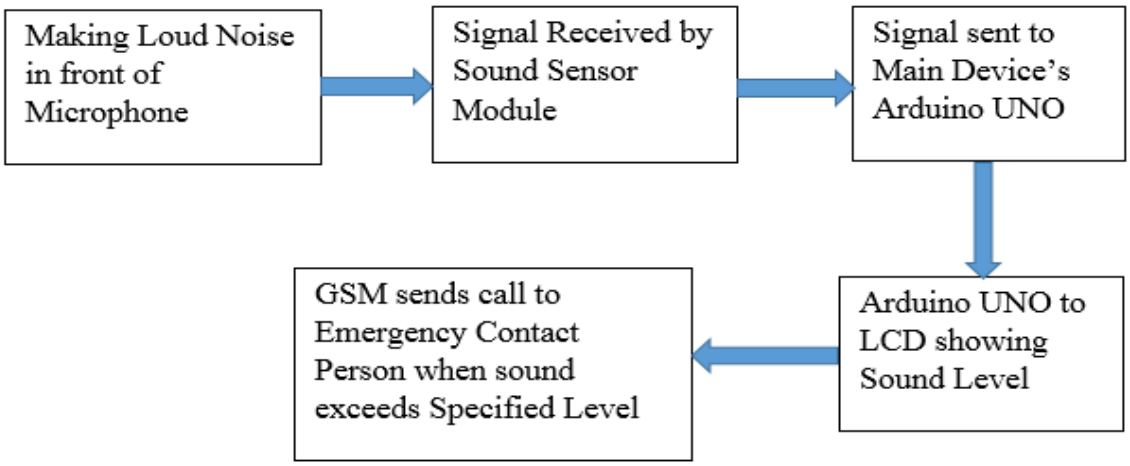


Figure 5.5 : Functional Block diagram for Case 3

If there is an incident that is problematic such as breaking out of fire or any other accident, then the child as well as the nanny can go close to the first part of the project and scream in front of the sound sensor. It is shown in figure 5.5 that, Arduino sound detection sensor detects the sound signal which is above the set point selected during the project preparation. Sound is sensed with the help of the microphone and when the sound exceeds the set point, it will then trigger a call to the parents' phone which cannot be received. But this call works as an alarm to the parents that their child is in danger inside their home. Remote button system is also present and pressing button D of the remote sends this text to the parents – "**I'm stuck at my place and in danger. I don't have keys of the door and don't know how to call. Please send help immediately.**" After receiving this text or after receiving the first call from sound sensor, parents will call to the home phone and be certain of the kind of problem the child and the nanny are in, and can take next important step accordingly. If the problem is of breaking out of fire the parents will most certainly contact with the fire department office and give them home address, they will also inform their neighbors so that they help the kid and the nanny in the home and also the neighbors should be alarmed so that they do not face fire spread. Moreover, it may be that the problem is of some other kind and not of fire breakout - basin is not working properly, kitchen sink is not working, fridge is not working, electric board in one room is having sparks for fault in the line etc. When the parents are certain about the type of problem the child and the nanny are facing, they will decide what the next choice will be for the safety and protection of them.

5.6 Case 4 – Special Child Going Out of Specified Parameter

This project includes a significant scenario with the children with special needs. In general, the children with special needs always have at least one person with them to look after their daily activities. While building this project, it was kept in mind that the person who looks

after the child with special needs may be in the bathroom or may be in the kitchen to prepare food. In the meantime, the child may go outside the home without telling anyone anything.

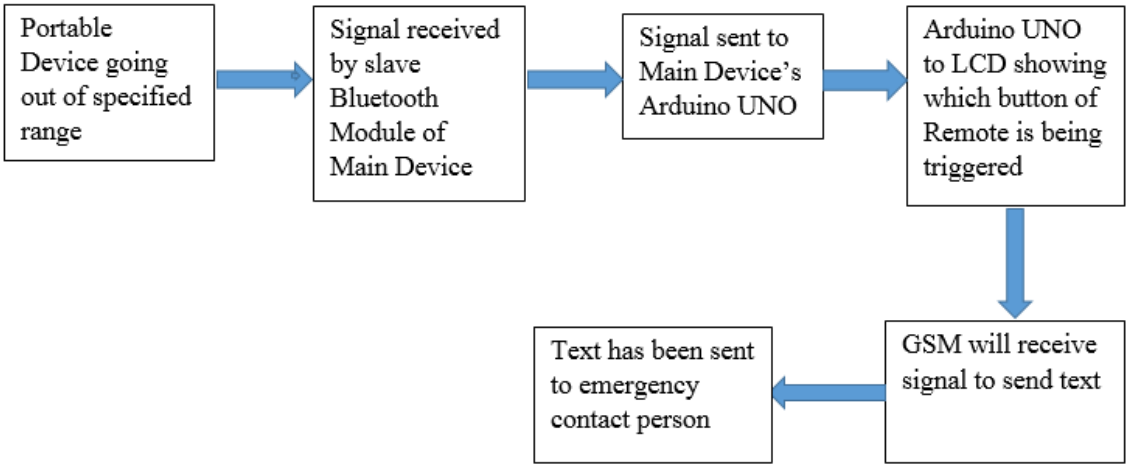


Figure 5.6 : Functional block diagram for Case 4

Figure 5.6 explains the scenario of case 4. In this scenario, if the child has the portable part of the project attached on one arm, it will send signal to Bluetooth module of main device that the portable part is outside of the specified range. This signal gets sent to Arduino Uno and Arduino Uno then gives signal to LCD that actually which button of the remote (in this case, button C) is getting triggered to send text from Sim card of GSM module. Text will be sent to the parents if the special child goes outside the specific parameter (in this case, 100 meter from the main part of the project which is connected to the electric board with the adapter). The text reads – "**Child is outside home. Take necessary step immediately.**" Receiving this text will make the parents call own home and be certain of the child's current location – he/she may be in the stairs just outside the door. This part of the project is very crucial, but also the portable part may be a bit large in size for the child with special needs. So, there is room for development – the next step of development is making the portable part very tiny so that this can be implemented inside a finger ring, so that there is no issue of binding the portable part on the arm.

5.7 Making Project More Diverse

The project can be more diverse by making a few changes. Few examples are given below:

a. This Arduino project can be turned into a radar system by excluding tilt sensor and sound sensor. The inclusions the version of radar system will need are Servo motor and ultrasonic sensor.

b. There are many projects which need measuring angles with respect to ground. This project can be used to measure angle with respect to the ground and all we need to add to the project is an accelerometer and an ultrasonic sensor.

c. If there is plan to make this project into a color sensing one, then a color sensor with photodiodes is needed to be included in the device. When light enters the array of photodiodes, it goes to current-to-frequency converter and then the output goes to Arduino board. Upon checking with the code that is already uploaded, the specified LED beams up.

d. Another technological advancement can be done with this project by altering a few components and that is, radio frequency identification (RFID) system which is widely used in various industries. RFID system is helpful to perform tasks like tracking books in libraries, tracking personnel, in the tollgate systems etc. To implement this with Arduino, a proximity sensor is essential to understand if a door is open or if it is closed, and a servo motor is important to know about the lock mechanism of door.

e. By adding a buzzer, a keypad and an ultrasonic sensor, we can make the Arduino into an alarm system. It detects movement so when a person or an object moves and passes the sensor, the buzzer starts activated and makes loud sound. After entering specified password, the sound can be turned off.

5.8 Chapter Summary

This chapter gives detailed view of the model of the project and thoroughly explains how the project comes to help of senior citizens, little children and children with special needs. Next chapter discusses the major contributions made by this project and the future works that can be done from further research based on this project.

CHAPTER 6

CONCLUSION AND FUTURE WORKS

6.1 Conclusion

The project's development included many hours of research and in-depth studies to meet the plans regarding the problems mentioned in chapter two and chapter three. Three main parts are taken into account to have them merged together and these are – the hardware part, the programming part and the wireless communication between the devices.

Selecting this project has truly been a significant addition to the degree as well as personal fulfillment because the issues discussed in the report are currently faced by people all over the world and thus it has a potential future. Communication technology is a branch of engineering which sees continuous expansion in its arena and it also looks out for scopes to enrich areas like comfort of the users, accessibility, security, cost effectiveness.

To sum up, it can be said that I have studied important parts of my degree, have applied knowledge from the studies in the project and made it keeping in mind the target users of the market so that the project can be marketed if needed.

6.2 Major Contribution

The project considered different problems that people face around the world and provides solutions to these problems. Senior citizens living in a house alone will have the benefit of using this project as the project sends signal when they fall on the floor accidentally. Majority of senior citizens also have health issue of cardiovascular disease, so keeping the remote of this project inside pocket of dress will come of help if there is cardiac arrest happening when senior citizen is alone in the house. Only pressing a button of the remote will send information to the nearest kin about heart attack. This project also helps the small children who live in the house with their caretakers while parents of the small children are

outside to complete different tasks. If there is breakout of fire or any other problem at house and the child in the house is of the age when he or she does not know how to use mobile phone, this project comes to help such child as it has the sound sensor detector. Loud sound from the child in front of the sound sensor detector sends information to the parents staying outside for their work and thus, parents can be informed of the incident as soon as it happens. This project also is very much helpful for the parents who have special child in their lives and who live in constant anxiety when both of the parents stay outside of home to finish their works. As this project provides signal to parents whenever special child goes outside of the specific safe parameter, parents around the world can feel more secured than before just by using this project. Thus, people with cardiovascular disease, people who accidentally fall on the floor, sending information of incidents such as fire breakout, sending signal when child is outside safe parameter – all these can be achieved from this project.

6.3 Future Works

Although the project prepared with the base of Arduino Uno offers different advantages, it still is a part of technological world and we all know that there is always thriving possibilities of making improvements. The possible future works that can be done upon further research are:

a. As there are growing requirements from business world, many innovative ideas and inclinations in regard with Arduino can be expected in coming days.
b. Arrangements and systems that provide various solutions as well as information also entail upgrades. The Arduino project can in future have more intricate scenarios with upgraded solutions to provide as soon as the scenarios happen.
c. Future development scopes can include but not limit to adding resources to the system such as information storage facility.

d. Reducing the size of project without losing its core abilities as well as improving overall quality are achievable during further development.

e. Studying market, analyzing the necessities of people around the globe and trying to come up with more Arduino Uno based devices so that lives of people become easier and in tranquility.

References:

[1] https://diseasesandconditions.net/heart-attack/; accessed on 20 June, 2020.

[2] https://ourworldindata.org/burden-of-disease; accessed on 24 June, 2020.

[3] https://apple.com/apple-watch-series-5/health; accessed on 25 June, 2020.

[4] https://www.helpline.co.uk/blog/why-is-a-quick-response-so-important-when-the-elderly-fall/; accessed on 27 June, 2020.

[5] A. F. Ambrose, G. Paul and J. M. Hausdorff, "Risk factors for falls among older adults: A review of the literature", *Maturitas*, vol. 75, issue 1, pp 51-61, May 2013.

[6] W. Filler and M. Harris, "Falls and Traumatic Brain Injury Among Older Adults", *North Carolina Medical Journal*, vol. 76, issue 2, pp 111-114, 2015.

[7] M. Stenhagen, H. Ekstrom, E. Nordell and S. Elmstahl, "Accidental fall, health- related quality of life and life satisfaction: A prospective study of the general elderly population", *Archives of Gerontology and Geriatrics*, vol. 58, no. 1, pp 95-100, 2014.

[8] R. S. A. Larik, G. A. Mallah, M. M. A. Talpur, A. K. Suhag, and F. A. Larik, "Effects of Wireless Devices on Human Body", *Journal of Computer Science & Systems Biology*, pp 119-124, 2016.

[9] O. S. Ayanda, A. A. Baba and O. T. Ayanda, "Use of Mobile Phones and Cancer Risk", *Asian Pacific Journal of Cancer Prevention*, vol. 13, no. 1, pp 403-406, 2012.

[10] A. Christ, M. Douglas, J. Nadakuduti and N. Kuster, "Assessing Human Exposure to Electromagnetic Fields from Wireless Power Transmission Systems", *IEEE*, vol. 101, no. 6, June 2013.

[11] K. A. Al-Abduljawad, "Effects of the mobile phones on the hearing function of users", *Bahrain Medical Bulletin*, vol. 30, no. 2, pp 72-74, 2011.

[12] H. Nishiyama, M. Ito and N. Kato, "Relay-by-smartphone: realizing multihop device-to-device communications", *IEEE Communications Magazine*, vol. 52, pp 56-65, 2014.

[13] P. Philip, S. K. Bhandary, R. Aroor, V. Bhat and D. Pratap, "The effect of mobile phone usage on hearing in adult population", *Indian Journal of Otology*, vol. 23, no. 1, pp 1-6, 2017.

[14] F. A. Mohamed, A. A. Ahmed, B. M. A. El-Kafoury and N. N. Lasheen, “Study of the Cardiovascular Effects of Exposure to Electromagnetic Field”, *Life Science Journal*, vol. 8, no. 1, 2011.

[15] D. Li, H. Chen, J. R. Ferber, R. Odouli and C. Quesenberry. “Exposure to Magnetic Field Non-Ionizing Radiation and the Risk of Miscarriage: A Prospective Cohort Study”. *Scientific Reports,* vol. 7, 2017.

[16] A. S. Uddin and J. Ferdous, “Radiation exposure of cell phones & its impact on human health-a case study in South Asia (Bangladesh) and some recommendations”, *Journal of Theoretical and Applied Information Technology*, vol. 19, pp 15-21, 2010.

[17] https://www.arduino.cc/en/Main/ArduinoEthernetShieldV1; accessed on 28 July, 2020.

[18] https://create.arduino.cc/projecthub/arduino_uno_guy/i2c-liquid-crystal-displays-5b806c; accessed on 30 July, 2020.

[19] https://projectshopbd.com/product/dc-dc-step-down-buck-converter-lm2596/; accessed on 31 July, 2020.

[20] https://en.wikipedia.org/wiki/Buck_converter; accessed on 1 August, 2020.

[21] https://www.electronicwings.com/sensors-modules/bluetooth-module-hc-05-; accessed on 2 August, 2020.

[22] https://www.waveshare.com/sound-sensor.htm; accessed on 3 August, 2020.

[23] https://circuitdigest.com/microcontroller-projects/arduino-tilt-sensor-interfacing; accessed on 3 August, 2020.

[24] https://www.elprocus.com/rf-module-transmitter-receiver/; accessed on 5 August, 2020.

[25] https://en.wikipedia.org/wiki/Jump_wire; accessed on 6 August, 2020.