Eye controlled wheelchair model

A graduation project report submission
In partial fulfilment of the requirements for the award of the degree
Bachelor of Science

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ABSTRACT

This project presents a system to control a wheelchair using the movement of the eye, by detecting the eye by using a phone's camera through a mobile application. The eye movement technique is to record the eye movements, then determine the place where the eye movement goes, and after that the chair moves to this point. Example: If a person wants to move forward, with the help of UI from a mobile application he could choose the forward direction and same for all directions.

And this technology aims to serve people who suffer from muscular dystrophy or paralysis diseases to make them able to move and to make them able to communicate with others to improve their psychological state by not leaving them alone in their room because this causes other diseases such as depression, which leads to death.

Thus, people who have some kind of severe motor disability would be able to control a wheelchair with the help of this technique, acquiring some autonomy in locomotion. According to the results obtained, this technique was a promising alternative to be considered.

ACKNOWLEDGMENTS

Primarily we would like to thank God for giving us knowledge and ability to do this project. We are using this opportunity to express our gratitude to everyone who supported us throughout this project. The success and final outcome of this project required a lot of guidance and assistance from many people, and we are extremely privileged to have got this all along the completion of our project. We are thankful for their aspiring guidance, invaluably constructive criticism and friendly advice during the project work. We are sincerely grateful to them for sharing their truthful and illuminating views on a number of issues related to the project.

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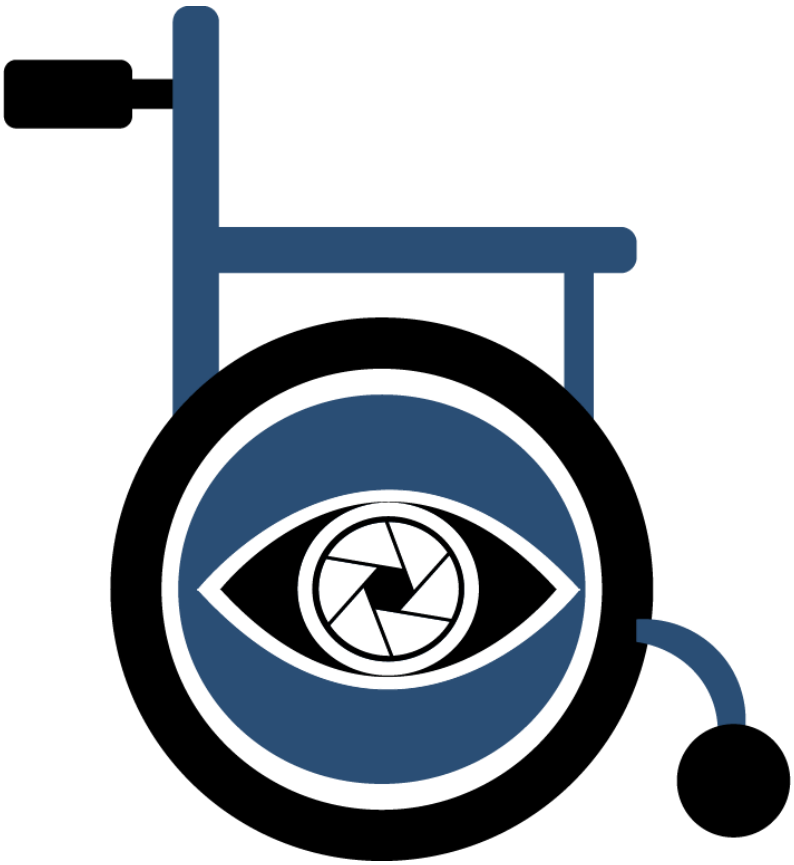
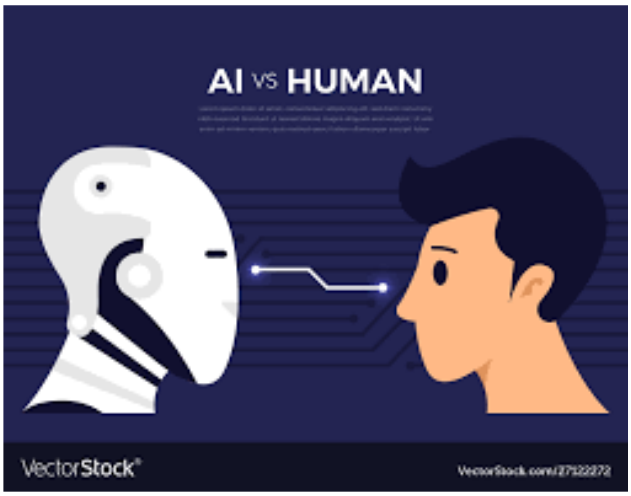
CHAPTER ONE



1.1. Overview

Artificial intelligence as an academic discipline [1] was founded in 1956. The goal then, as now, was to get computers to perform tasks regarded as uniquely human: things that required intelligence, so it's all about the simulation of human intelligence, it is an approach to make a computer, a robot, or a product to think how smart human think. Initially, researchers worked on problems like playing checkers and solving logic problems



If you looked at the output of one of those checkers playing programs you could see some form of "artificial intelligence" behind those moves, particularly when the computer beat you.

Artificial intelligence, then, refers to the output of a computer. The computer is doing something intelligent, so it's exhibiting intelligence that is artificial.

The term AI doesn't say anything about how those problems are solved. There are many different techniques including rule-based or expert systems. And one category of techniques started becoming more widely used in the 1980s: machine learning.

The reason that those early researchers found some problems to be much harder is that those problems simply weren't amenable to the early techniques used for AI. Hard-coded algorithms or fixed, rule-based systems just didn't work very well for things like image recognition or extracting meaning from text.

The solution turned out to be not just mimicking human behavior (AI) but mimicking how humans learn.

1.2. INTRODUCTION

Today, many people suffer from many diseases, including muscular dystrophy and paralysis, whether total or half or any part of the body. These people suffer a lot because they are unable to deal with other people, and some of them suffer from other diseases such as depression and psychological diseases. Others negatively affect him and his health because most of the time he is left alone, unable to move or speak, and this is harmful to him and causes death in most cases.

According to the census data provided by the Brazilian IBGE in 2010, which shows the statistics of the population with disabilities every 10 years, there are approximately 4,560,048 persons with disabilities in Brazil. Of these 45 million, 2.33% (about 1 million) are people with severe motor impairments. Data provided by the World Health Organization showed that more than one billion people suffer from some form of disability. This represents about 15% of the world's population.

Worldwide, there are more than 1,000 million people with disabilities and they constitute approximately 15% of the world's population (ie 1 in 7 people is disabled). The number of people with disabilities will continue to rise due to an aging population and an exacerbation of chronic health conditions in the world. National disability patterns are influenced by trends in health conditions, environmental factors and other factors - such as road traffic accidents, falls, violence, humanitarian emergencies such as natural disasters and conflict, diet, and drug use.

Despite the magnitude of this problem, there is a lack of awareness and scientific information regarding disability problems. There are few documents that provide compilations and analyzes of the ways in which countries have developed policies and responses to meet the needs of people with disabilities.

So after reading this you now know how bigger of this problem, Therefore, we decided to look for a solution to this problem, and we concluded that the common solution for all types of these diseases is the eye, because the eye is the only thing capable of movement in a person who suffers from total paralysis and is the most dangerous and most problematic disease because this person is unable to speak or Moving anything in his body except the eye, so we decided to create a device capable of moving people with special needs through the eye.

1.3. Problem Definition

The main problem is for people who can't move their limbs except their eyes, and they must be in good mentally, people who have spinal cord injury, as this person cannot move or communicate with anyone, and in order to improve his moving or communicating with environment, there must be another person with him to serve and help him, and when this person is not present, he becomes isolated.

1.4. Project objectives

The main purpose of this project is to help people with ALS (Amyotrophic lateral sclerosis) to communicate with other and to move around their home with wheelchair.

1.5. SOFTWARE AND HARDWARE TOOLS

1.5.1. Software tools:

1- Python

The main programing language to use in AI projects

2- OpenCV

An open-source computer vision and machine learning software library that we use for image processing and performing computer vision tasks like body detection and body tracking.

3- Anaconda

A distribution of python (like an environment) used for scientific computing.

4- PyCharm

an integrated development environment used in computer programming specifically for python.

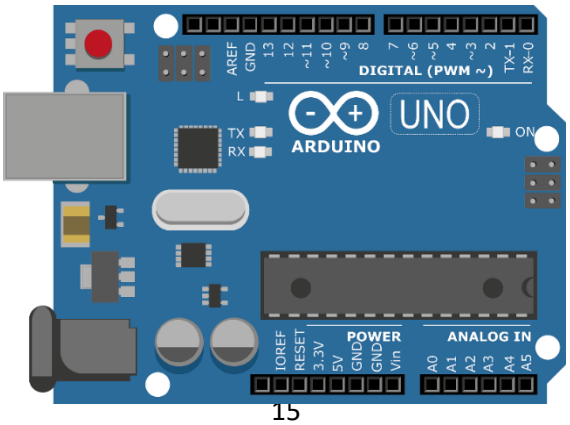
5-Flutter

it is Google's portable UI toolkit for building beautiful, natively-compiled applications for mobile, web, and desktop from a single codebase.

1.5.2. Hardware tools:

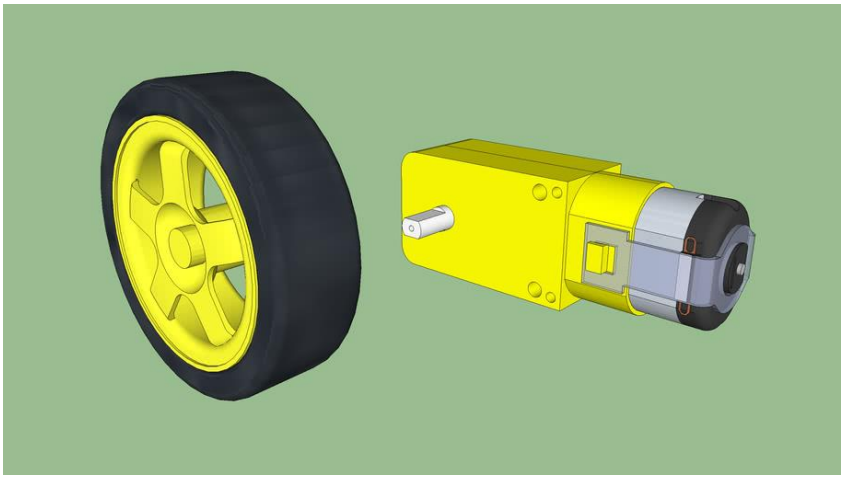
1. **Arduino uno**

The Arduino[7] Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc and initially released in 2010.



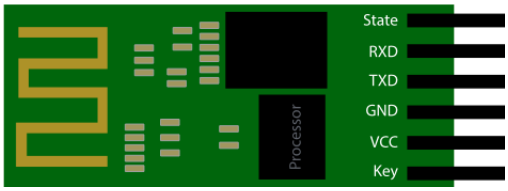
2. 4 gearmotor with wheels

A gearmotor [10] (or geared motor) is a small electric motor (AC induction, permanent magnet DC, or brushless DC) designed with an integral (non-separable) gear reducer (gearhead) attached



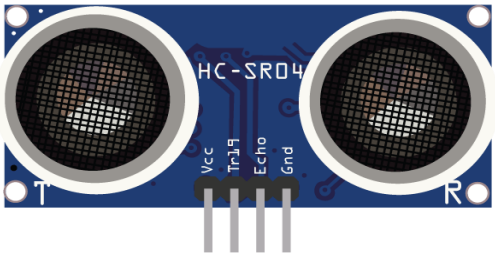
3. Bluetooth module (HC-05)

The Bluetooth module [11-12] (HC-05) is a device which is used for short range wireless communication to the respective connected device. which can communicate in two ways. Which means, it is full-duplex.



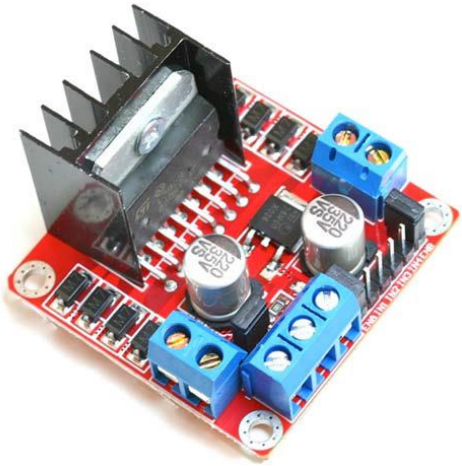
4. **Ultrasonic sensor**

An ultrasonic sensor [13] is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves and converts the reflected sound into an electrical signal



5. **Motor driver(L298N)**

This dual bidirectional motor driver (L298N) [14]is based on the very popular L298 Dual H-Bridge Motor Driver Integrated Circuit. The circuit will allow you to easily and independently control two motors of up to 2A each in both directions



6. **Smart phone with camera**

Any smart phone with camera to capture the patient's eye

7. **Wires**

some wires to connect the components with each other

1.6. SYSTEM FUNCTIONS

User requirements should describe functional and non-functional requirements so that they are understandable by system users who don't have detailed technical knowledge.

1.6.1. Functional requirements

A functional requirement, in software and systems engineering, is a declaration of the intended function of a system and its components. Based on functional requirements, an engineer determines the behavior (output) that a device or software is expected to exhibit in the case of a certain input. A system design is an early form of a functional requirement.

In the proposed project,

- The software must be able to receive input from the user (by camera).
- The software must detect eye movement quickly
- The system shall be available during the working hours without failure.

1.6.2. Non-functional requirements

A non-functional requirement defines the quality attribute of a software system. They represent a set of standards used to judge the specific operation of a system. Example, how fast does the website load?

A non-functional requirement is essential to ensure the usability and effectiveness of the entire software system. Failing to meet non-functional requirements can result in systems that fail to satisfy user needs.

It allows you to impose constraints or restrictions on the design of the system across the various agile backlogs. Example, the site should load in 3 seconds when the number of simultaneous users is > 10000. Description of non-functional requirements is just as critical as a functional requirement.

Basically, Non-functional requirements describes how the system works, while functional requirements describe what the system should do.

- **Performance:** Useful value deliverable to stakeholders.
- **Quality:** How well a system performs.
- **Availability:** The readiness of a system to do its work.
- **Security:** The ability of the system to survive attack.
- **Usability:** How easy a system is to use.
- **Response Time:** Retrieval Timing, Transaction Timing

1.7. Expected Outcomes

A prototype that can move by eye control that by giving it (with mobile application access to the camera using camera to detect eye movement and move the wheelchair depend on eye tracker classification) an order to implement it and moving the chair from point to another and it will be a map it will have your daily routine to make it much easier for the people

CHAPTER TWO

Related works….

2.1. Overview

In this chapter, some projects and similar works made by both large companies and startup companies which are related to wheelchair will be discussed, pointing to the advantages and drawbacks of each one and the methodologies which are applied to make their own models and applications, the discussion contains also a cooperative study which differentiate and rate these projects and apps based on the technology which was used.

2.2. History

Wheelchairs are one of the most effective and widely used types of medical support devices today. They are used in hospitals, retirement homes and private dwellings. There are dozens and dozens of wheelchair types. They are manual or electric power. They are made for indoors or outdoors, and there are countless customizable features that allow you to choose the perfect wheelchair configuration to meet your functional and comfort needs.

Needless to say, wheelchairs have come a long way since the first iterations. There is uncertainty about when the first wheelchair was invented and who invented it.

“It is uncertain as to what can be considered the first wheelchair, or who invented it. The first known dedicated wheelchair (invented in 1595 and called an invalid’s chair) was made for Phillip II of Spain by an unknown inventor. In 1655, Stephen Farfler, a paraplegic watchmaker, built a self-propelling chair on a three-wheel chassis,” says Mary Bellis

Britannica web site, estimates the first wheelchair was invented between the 6th and 4th centuries BCE. They theorize it was possibly invented along with the creation of wheeled furniture and wheelbarrows.

As you can see, there is some ambiguity about the origins of the wheelchair. In this blog, we’ll take a look at the history of the wheelchair. We’ll go over a timeline of the key developments and innovations that have led to the modern version used by millions of people today.

The wheelchair has seen many iterations over the decades. Here is a timeline of the history of the development of the wheelchair:

- 5th century BCE: The earliest record of a device resembling a wheelchair dates back to China. Early versions came from wheeled furniture designs. It's believed the Chinese used wheelbarrows to move disabled people around.
- 12th century: It's believed the concept of the wheelbarrow and crude versions of the wheelchair began to be used around this time in Europe.
- 1655: The first self-propelled wheelchair is developed. It was invented in Germany by disabled watchmaker Stephan Farfler. His design included three wheels and he could move it with the use of a rotary handle on the front wheel. Around the same time frame, German inventor and mechanic, Johann Hautsch, developed a series of rolling chairs.
- 1760: The bath chair was created by English inventor James Heath. It became a popular way to transport people with illnesses and disabilities, even though it was initially designed for women. The design is similar to a rickshaw. It had a three- and four-wheel design, and it could be pushed or pulled. Other designs were developed so people could be pulled by horse.
- 18th century: Wheelchairs began to become a normal fixture in medical catalogues. They were advertised as transportation devices for patients. They resembled armchairs with two larger wheels at the front and a smaller wheel at the back.
- 1901: The basic chair was invented. It closely resembles the modern design of wheelchairs used today. It had a seat, footrests and four wheels – two smaller wheels at the front and two larger at the back.
- 1932: The folding wheelchair was introduced. It's one of the biggest design breakthroughs in the device's history. It was invented by Harry Jennings for his friend. The folding design and tubular steel chair with a cross frame became the standard design. This model allowed people to use the wheelchair outside of the home, hospitals and care facilities. Later designs built on Jennings concepts and were focused on decreasing weight of the chair and improving its overall performance.
- 1950: After World War II, demand for wheelchairs spiked. There were thousands of wounded veterans who needed mobility assistance. A Canadian, George Klein, saw the need and invented the electric wheelchair

for veterans. The original design was a standard wheelchair with a motor added. Later designs had the motor and battery built into the chair under the seat. Additional developments in ergonomics, controls, comfort, and performance were created as new technologies were developed.

- 1980: Niche wheelchair designs began to come to market. During this time, the rigid wheelchair was created. It was intended for athletes. They are self-propelling and some can reach speeds of up to 30 km/hr.

Until now, work is being done to develop this wheelchair to make it more suitable for many patients with all kinds of diseases, and to develop it in a way that is better and easier to use and make it cheap so that all classes of society can buy it to make there social justice and equality between the rich and the poor. And this what our project scoop about.

Because Many solutions have been developed as attempts to provide greater independence for people with paralysis or people who have muscular dystrophy and are unable to move, including the primitive wheelchair that needs someone to push it from behind and has been updated to be moved manually by a control device In the handle of the chair until it was reached that he can move the eye by having a webcam that takes eye movements and translates them into movements in order to make people suffering from diseases such as paralysis able to move anywhere.

But this solution was not worthy because it was expensive and not all people were able to buy it, so there was inequality, and to reduce this problem, we thought about the following, since in the present day all people in the world have smart phones and most of them are good at dealing with them well for that We thought that we would create a program through which the phone’s camera can be accessed and from it it monitors the movement of the eye and the creation of a device that takes eye movements from the phone, whether it is connected to a wire or not connected with wires, takes those signals and moves the chair with them, and this device is installed on any wheelchair, whether Was it old or modern to reduce the cost to people and make it available to everyone and not to a particular class.

And he can also go to certain places in the house with one eye movement, where if he wants to go to another room in the house other than the one in which he is, he can do a certain specific movement and the chair will connect him to this specific point.

So we will use the phone's camera through application and we will detected the eye movement by using the machine learning and computer vision and send the movement to device to make the chair move from place to another.

2.3. Literal Review

2.3.1. Powered wheelchair controlled by eye-tracking system 2006

2.3.1.1. Overview

In 2006 a group of Taiwanese engineers developed a "Powered Wheelchair controlled by Eye-Tracking system". They used pupil-tracking goggles linked to a computer in order to translate gaze direction into chair movement (Figure 1)

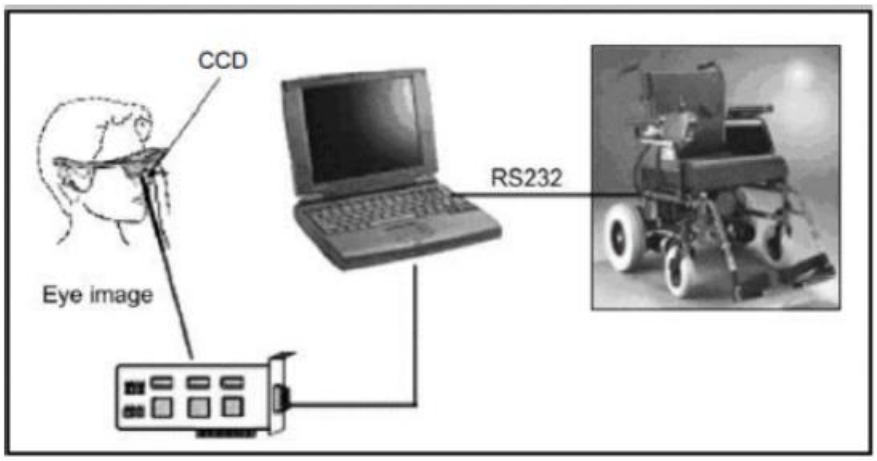
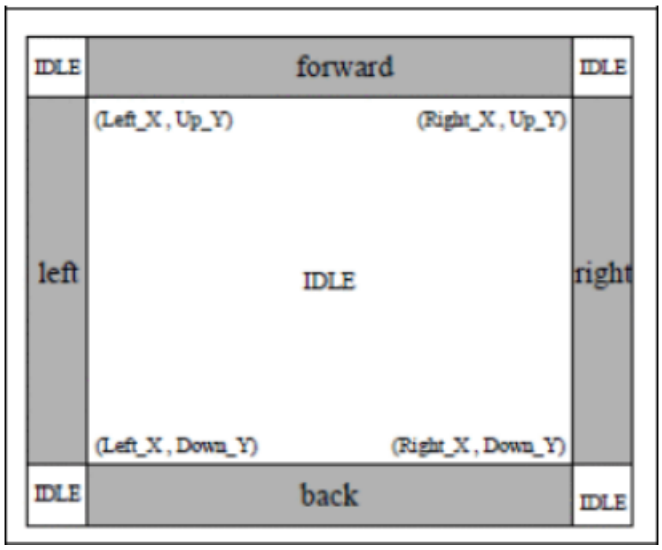


Figure 1

This technique allows for consistent Eye-Tracking regardless of head movement. The user's eyes would be mapped to a position point within the screen shown in Figure 2.



2.3.1.2. methodology

they use the optical-type eye tracking system to control powered wheelchair. The user's eye movements are translated to screen position using the optical-type eye tracking system. The pupil-tracking goggles with a video CCD camera and a frame grabber analyzes a series of human pupil images when the user is gazing at the screen. A new calibration algorithm is then used to determine the direction of the eye gaze in real time. they design an interface with nine command zones to control powered wheelchair. The command at the calculated position of the gazed screen is then sent to move the powered wheelchair.

2.3.1.3. Advantage:

- Was one of the first solution
- Make the user less reliable on other people

2.3.1.4. Disadvantage:

- become quite difficult to control
- cost more
- The pupil-tracking goggles doesn't comfortable for long time
- Need to computer

2.3.2. Eye controlled wheelchair 2015

2.3.2.1. Overview:

Spinal injury is the most common cause of quadriplegia, though there are many diseases that can produce the same result - inability to produce controlled movement in any of your limbs or head. For people in this situation independent control of their wheelchairs is not possible – the technology just isn't available. Independent mobility increases quality of life significantly, and it's loss is keenly felt by those robbed of it, through accident or disease.

The scale of the problem is enormous. ALS is responsible for only a tiny fraction of the people in this situation, yet there are five thousand ALS sufferers at any one time in the UK alone, and twenty thousand in the US. Most of them will end up sat immobile in their wheelchairs, unable to move on their own. Eyedrivomatic could help most of them.

2.3.2.2. Methodology:

To create an inexpensive and accessible way for people with motorized wheelchairs to take control of their mobility via eye movement, using open-source methods as much as possible.

2.3.2.3. Advantage:

• Easy to use and install

• Safe

• Expandable - the system is able to control other external devices according to the needs of the user

• Totally open, both open hardware and open-source software

• Capable of being built at home - by an unskilled person

• Good solution for electronic wheelchair with joystick

2.3.2.4. Disadvantage:

• Not suitable for all wheelchair

• Doesn’t have obstacle sensors

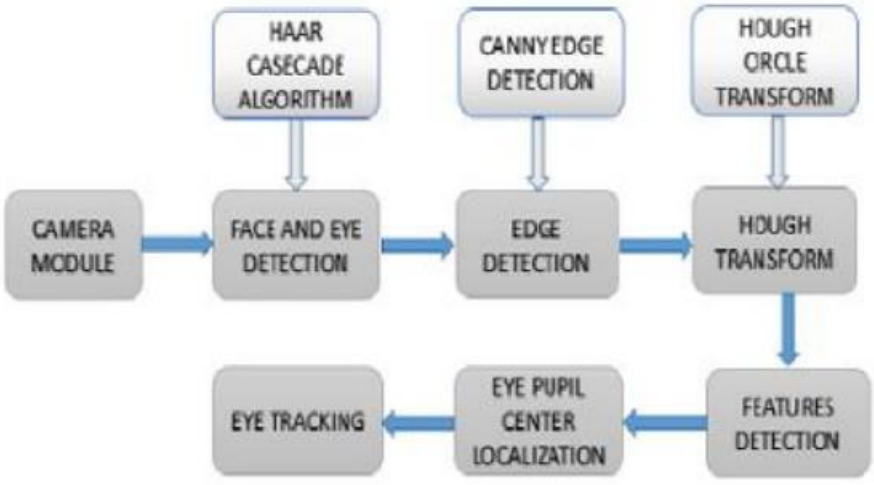
2.3.3. Eye Gaze Controlled Wheelchair 05, May-2020

2.3.3.1. Overview

Eye gaze wheelchair is a unique technique executed mainly for the disabled persons who are fully paralyzed. In this system manual control of wheelchair is being replaced be automatic control i.e. controlled by the eyeball movement, so that the patients feel free and less or no difficulty in their movements. Continuous image is captured with the help of webcam which further undergoes several image processing techniques, to detect the position of eye pupil Haar cascade algorithm is being implemented with the resultant of the image processing technique wheelchair moves accordingly. DC motor is mounted to the wheels for easy motion of the wheelchair. The ultrasonic sensor is mounted to the wheelchair so that it detects any obstacles in the path of its movements and wheelchair stops movement as per sensor command.

2.3.3.2. Methodology

System Overview The basic fundamental of the proposed system is eye tracking and detection of eye movement. To detect the location of eye pupil Haar cascade algorithm is used this technique comprises of several stages which are implemented to find the eye movement and also for face and eye detection, color switching, object tracking, Hough transform, edge detection and motion detection. Initially system captures image by making use of webcam. First step is the algorithm accurately detects the face of the user, if there is a greater number of faces it displays the error in runtime. According to the algorithm the system represents the user face in specific area of indicated image. Several process of image processing techniques is performed for eye pupil tracking. Fig.1. shows the process of the system.



2.3.3.3. Advantage:

Make the user less reliable on other people.

2.3.3.4. Disadvantage:

- The system displayed a delay of about 4 seconds due to a delay in disk drives.
- View the moving picture to view the moving picture.

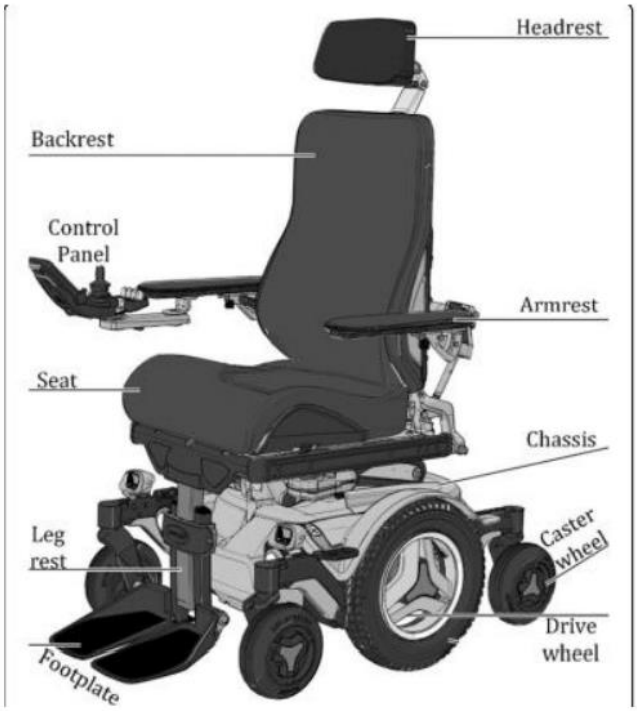
2.3.4. Eye-gaze control of a wheelchair mounted 6DOF assistive robot for activities of daily living (2021)

2.3.4.1. Overview

In recent times, eye gaze has been introduced to control graphical user interfaces directly. Eye gaze-controlled interfaces have been used for people with a severe motor impairment who cannot use the alternative computer peripherals. In this research, we developed a control architecture for an eye-gaze control of a wheelchairmounted assistive robot for activities of daily living (ADL) of individuals with upper limb impairment. Functional impairments of the Upper or Lower Extremities (ULE) are common in the elderly. We demonstrated the usability of using this eye-gaze system to control a robotic arm mounted on a wheelchair in activities of daily living for people with disabilities. We found high levels of acceptance with higher ratings in the evaluation of the system with healthy participants.

2.3.4.2. Methodology

In this study, our research objective is to design an eyetracking assistive robot control system capable of providing targeted engagement and motivating individuals with a disability to use the developed method for selfassistance activities of daily living. The graphical user interface is designed and integrated with the developed control architecture to achieve the goal.



2.3.4.3. Advantage:

- It makes it easier for the patient to do a lot of things, not just movement
- very accurate
- Make the user less reliable on other people.

2.3.4.4. Disadvantage:

- Complicated and difficult to use
- The cost is very high
- Need to computer and XARM

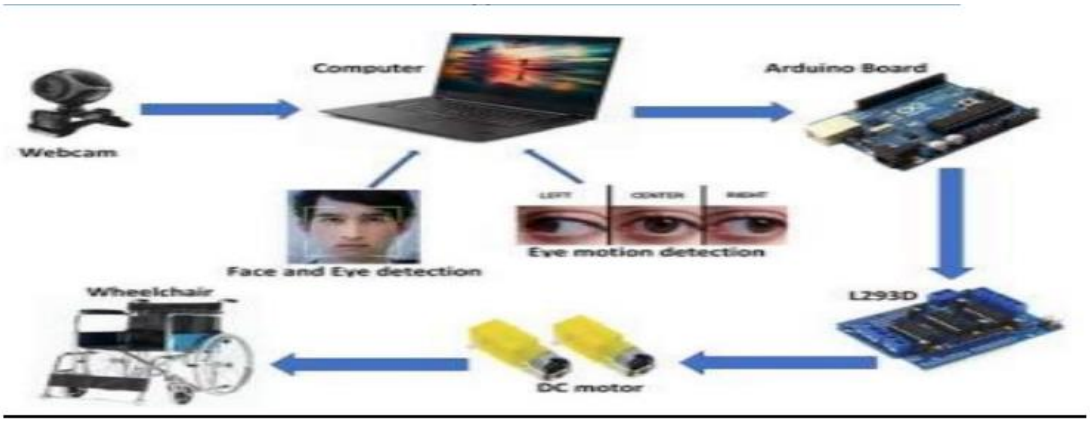
2.3.5. Wheelchair Control System based Eye Gaze 6, 2021

2.3.5.1. Overview

The inability to control the limbs is the main reason that affects the daily activities of the disabled which causes social restrictions and isolation. More studies were performed to help disabilities for easy communication with the outside world and others. Various techniques are designed to help the disabled in carrying out daily activities easily. Among these technologies is the Smart Wheelchair. This research aims to develop a smart eye-controlled wheelchair whose movement depends on eye movement tracking. The proposed Wheelchair is simple in design and easy to use with low cost compared with previous Wheelchairs. The eye movement was detected through a camera fixed on the chair. The user's gaze direction is obtained from the captured image after some processing and analysis. The order is sent to the Arduino Uno board which controls the wheelchair movement. The Wheelchair performance was checked using different volunteers and its accuracy reached 94.4% with a very short response time compared with the other existing chairs.

2.3.5.2. Methodology

The proposed system is simple and has low-cost components, as shown in Fig. It is based on taking the user's face image. Getting the eye's location and then determining `the pupil's direction which has a different value. The obtained values are transmitted to the Arduino board connected to a wheelchair to control its moving directions. The designed Wheelchair consists of an integrated circuit called L293d and a motor of the type of DC that works from 3 to 6 V.



2.3.5.3. Advantage:

- Wheelchair Simple in design and easy to use bit original Previous Wheelchairs.
- Make the user less reliable on other people.

2.3.5.4. Disadvantage:

- cost more
- Need to computer

2.3.6. Eye-Movement-Controlled Wheelchair Based on Flexible Hydrogel Biosensor and WT-SVM 2021

2.3.6.1. Overview:

To assist patients with restricted mobility to control wheelchair freely, this paper presents an eye-movement-controlled wheelchair prototype based on a flexible hydrogel biosensor and Wavelet Transform-Support Vector Machine (WT-SVM) algorithm. Considering the poor deformability and biocompatibility of rigid metal electrodes, we propose a flexible hydrogel biosensor made of conductive HPC/PVA (Hydroxypropyl cellulose/Polyvinyl alcohol) hydrogel and flexible PDMS (Polydimethylsiloxane) substrate. The proposed biosensor is affixed to the wheelchair user's forehead to collect electrooculogram (EOG) and strain signals, which are the basis to recognize eye movements. The low Young's modulus (286 KPa) and exceptional breathability (18 g m−2 h −1 of water vapor transmission rate) of the biosensor ensures a conformal and unobtrusive adhesion between it and the epidermis. To improve the recognition accuracy of eye movements (straight, upward, downward, left, and right), the WT-SVM algorithm is introduced to classify EOG and strain signals according to different features (amplitude, duration, interval). The average recognition accuracy reaches 96.3%, thus the wheelchair can be manipulated precisely.

2.3.6.2. Methodology:

To achieve eye movement control in wheelchairs, we have performed the following three aspects of work: the fabrication of a flexible hydrogel biosensor, signal classification, and the manipulation of a wheelchair. The biosensor is responsible for collecting the wheelchair user's EOG and strain signals. After being processed by the peripheral circuit, signals will be input into the laptop (Surface Pro 7) in digital form. The application of the classification algorithm enables different eye movement states to be identified. Eventually, the laptop generates instructions to drive stepper motors, and then control the wheelchair

2.3.6.3. Advantage:

- Easy to use
- Safe

2.3.6.4. Disadvantage:

- Not suitable for all wheelchair
- must have a laptop (Surface Pro 7)

2.4. Comparative Study

work	Benefits	Drawbacks
Powered wheelchair controlled by eye-tracking system 2006	• Was one of the first solution • Make the user less reliable on other people	• become quite difficult to control • cost more • The pupil-tracking goggles doesn't comfortable for long time • Need to computer
Eye controlled wheelchair 2015	• Easy to use and install • Safe • Expandable - the system is able to control other external devices according to the needs of the user • Totally open, both open hardware and open-source software • Capable of being built at home - by an unskilled person • Good solution for electronic wheelchair with joystick	• Not suitable for all wheelchair • Doesn't have obstacle sensors
Eye Gaze Controlled	Make the user less reliable on other people.	• The system displayed a delay of about 4 seconds due

Wheelchair 05, May-2020		to a delay in disk drives. • View the moving picture to view the moving picture.
Eye-gaze control of a wheelchair mounted 6DOF assistive robot for activities of daily living (2021)	• It makes it easier for the patient to do a lot of things, not just movement • very accurate • Make the user less reliable on other people.	• Complicated and difficult to use • The cost is very high • Need to computer and XARM
Wheelchair Control System based Eye Gaze 6, 2021	- Wheelchair Simple in design and easy to use bit original Previous Wheelchairs. - Make the user less reliable on other people.	- cost more - Need to computer
Eye-Movement-Controlled Wheelchair Based on Flexible Hydrogel Biosensor and WT-SVM, 2021	• Easy to use • Safe	• Not suitable for all wheelchair • must have a laptop (Surface Pro 7)

2.5. Problem Definition

The main problem is the help of people who have muscular dystrophy or paralysis, as this person cannot move or communicate with anyone, and in order to move or communicate with anyone, there must be another person with him to serve and help him, and when this person is not present, he becomes isolated.

2.6. Research Objectives

the main purpose of this project is to help people with ALS (Amyotrophic lateral sclerosis) to communicate with other and to move around their home with wheelchair.

CHAPTER THREE

System Analysis….

3.1. Overview

Systems development is systematic process which includes phases such as planning, analysis, design, deployment, and maintenance. Two major phases of this process are The System Design & the System Analysis, Where:

System Design is a process of planning a new business system or replacing an existing system by defining its components or modules to satisfy the specific requirements. Based on the user requirements and the detailed analysis of the existing system, the new system must be designed. In other words, System Design is like the blueprint for a building: it specifies all the features that are to be in the finished product.

But before this planning can be done, we must thoroughly understand the old system and determine how computers can best be used to make its operation more effective, that's where System Analysis comes, where:

Systems Analysis is a process of collecting factual data, understand the processes involved, identifying problems and recommending feasible suggestions for improving the system functioning. This involves studying the business processes, gathering operational data, understand the information flow, finding out bottlenecks and evolving solutions for overcoming the weaknesses of the system so as to achieve the organizational goals.

The major objectives of systems analysis are to find answers for each business process: What is being done, how is it being done, who is doing it, when is he doing it, why is it being done and how can it be improved? It is more of a thinking process and involves the creative skills of the System Analyst.

3.2. Introduction

System Analysis refers to the process of examining a business situation with the intent of improving it through better procedures and methods. It relates to shaping organizations, improving performance and achieving objectives for profitability and growth. The emphasis is on systems in action, the relationships among subsystems and their contribution to meeting a common goal. Looking at a system and determining how adequately it functions, the changes to be made and the quality of the output are parts of system analysis. Organizations are complex systems that consist of interrelated and interlocking subsystems. Changes in one part of the system have both anticipated and unanticipated consequences in other parts of the system. The systems approval is a way of thinking about the analysis

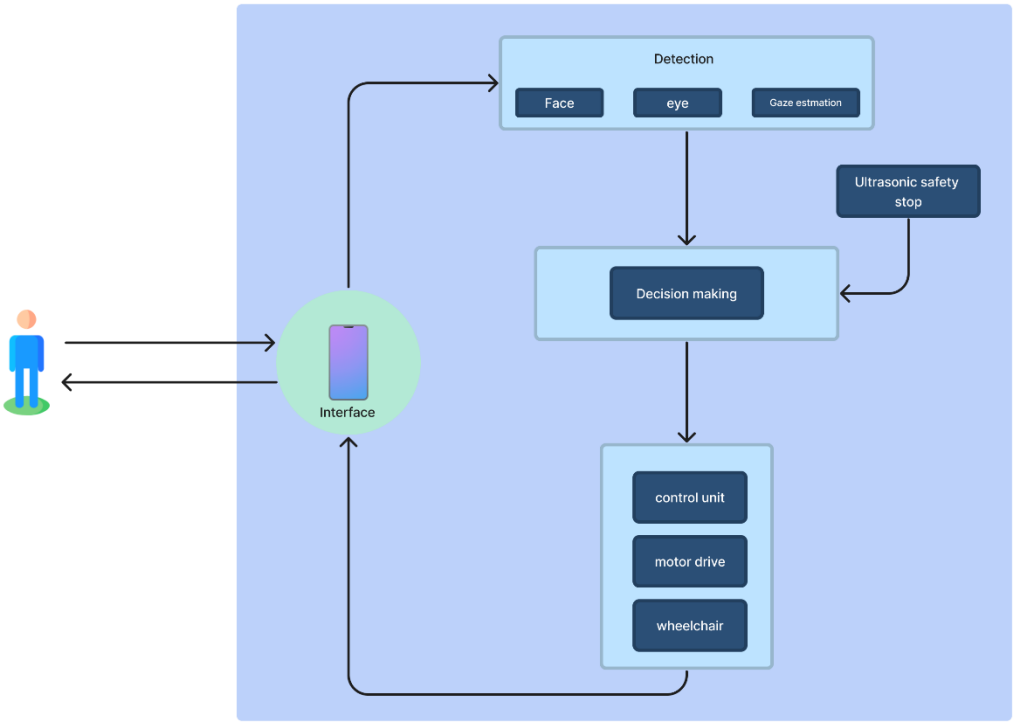
and design of computer based applications. It provides a framework for visualizing the organizational and environmental factors that operate on a system. When a computer is introduced into an organization, various functions' and dysfunction's operate on the user as well as on the organization. Among the positive consequences are improved performance and a feeling of achievement with quality information. Among the unanticipated consequences might be a possible threat to employee's job, a decreased morale of personnel due to back of involvement and a feeling of intimidation by users due to computer illiteracy. The analyst's role is to remove such fears and make the system a success. close look at all.

3.3. System study

The word "SYSTEM" covers a very broad spectrum of concepts. System analysis and design for information systems were found in general systems theory, which emphasizes a close look at all parts of a system. General systems theory is concerned with "developing a systematic, theoretical framework upon which to make decisions." It discourages thinking in a vacuum and encourages consideration of all the activities of the organization and its external environment. Pioneering work in general systems theory emphasized that organizations be viewed as total systems. The idea of systems has become most practical and necessary in conceptualizing the interrelationships and integration of operations, especially when using computers. Thus, a system is a way of thinking about organizations and their problems. It also involves a set of techniques that helps in solving problems.

3.4. system architecture

A system architecture is the conceptual model that defines the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system. A system architecture can consist of system components and the sub-systems developed, that will work together to implement the overall system.



3.5. UML DIAGRAMS

UML (Unified Modeling Language) is a standard language for specifying, visualizing, constructing, and documenting the artifacts of software systems. We will use some UML diagrams here to give a better view about our system. It's a rich language to model software solutions, application structures, system behavior and business processes. There are 14 UML diagram types to help you model these behaviors.

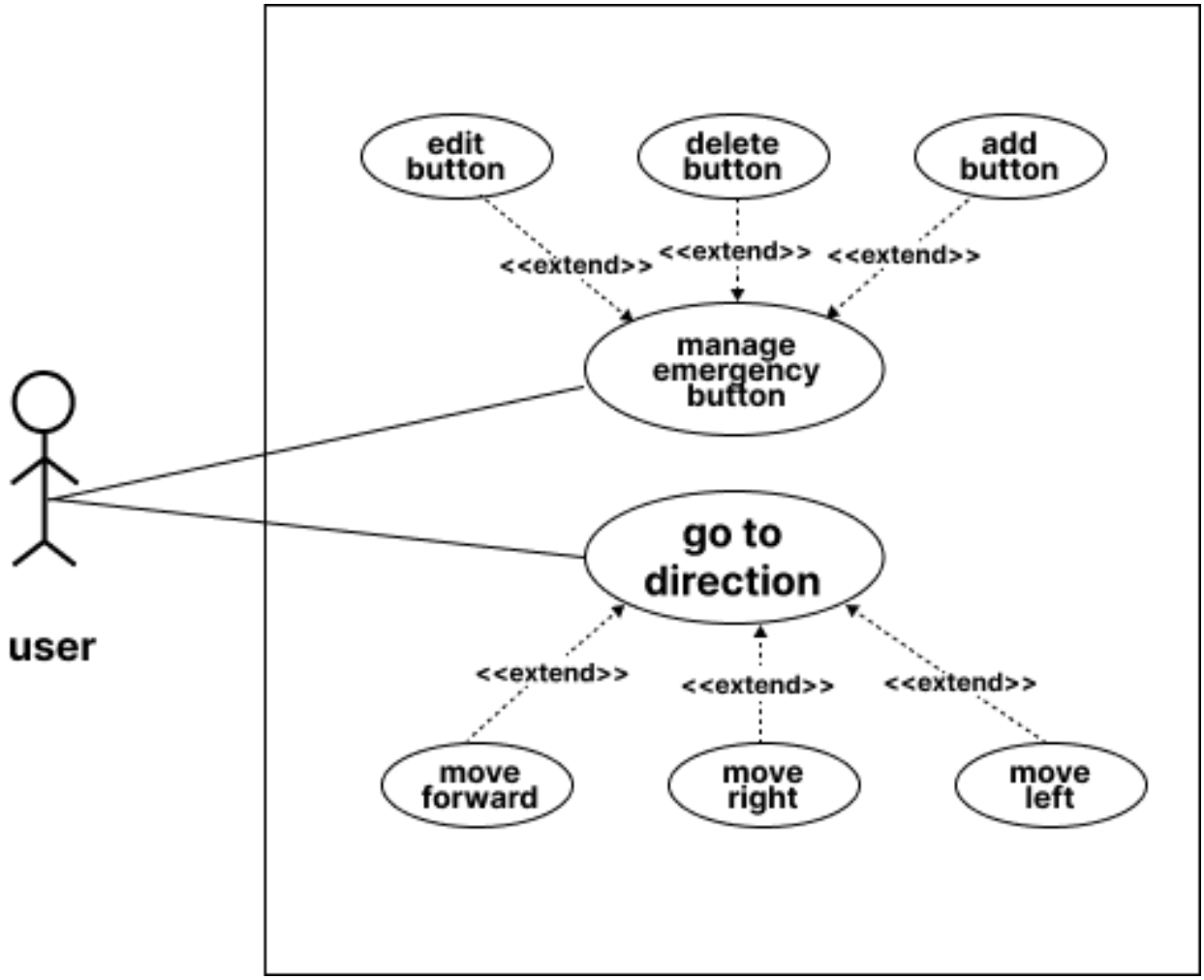
There are two main categories: structure diagrams and behavioral diagrams.

We will discuss 7 UML diagrams in our system.

3.5.1.USE Case Diagram

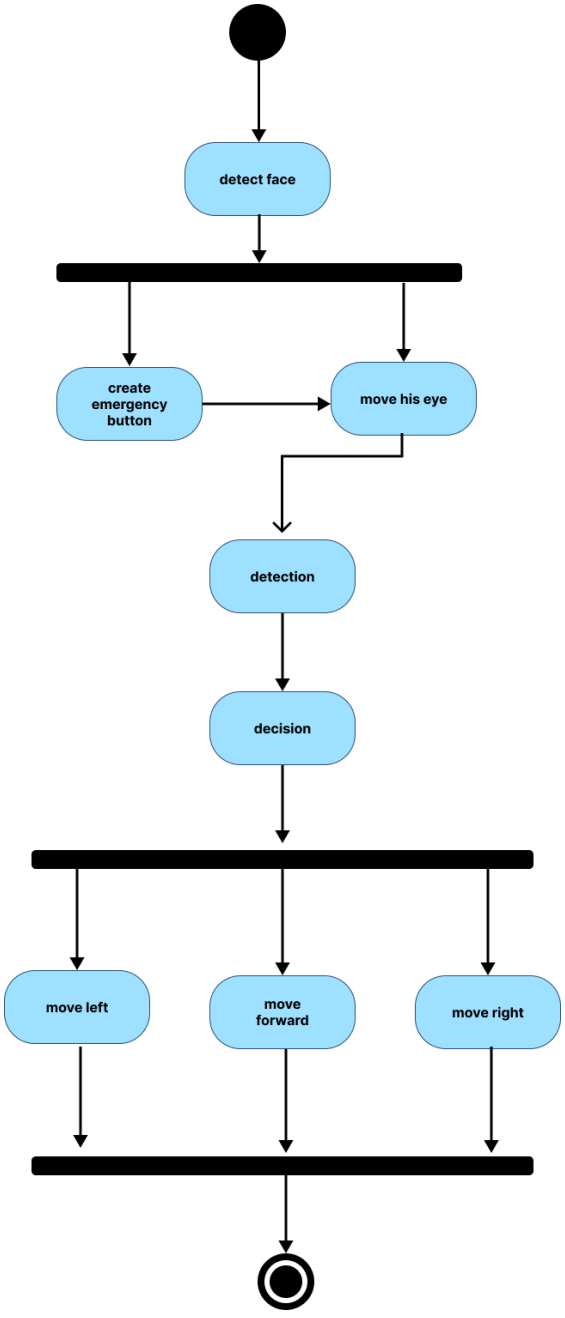
As the most known diagram type of the behavioral UML types, use case diagrams give a graphic overview of the actors involved in a system, different functions needed by those actors and how these different functions interact.

Use Cases is a collection of related scenarios that describe actors using system to support a goal, it overviews the usage requirements for a system. They are useful for presentations to management and/or project stakeholders. The Following figure describes the interface of the system. It shows the operation between the User and the system.



3.5.2.Activity diagram

Activity diagrams are typically used for business process modeling, for modeling the logic captured by a single use case or usage, or for modeling the detailed logic of a business rule. Although UML activity diagrams could potentially model the internal logic of a complex operation it would be far better to simply rewrite the operation so that it is simple enough that you don't require an activity diagram. In many ways UML activity diagrams are the object-oriented equivalent of flow charts and data flow diagrams from structured development.



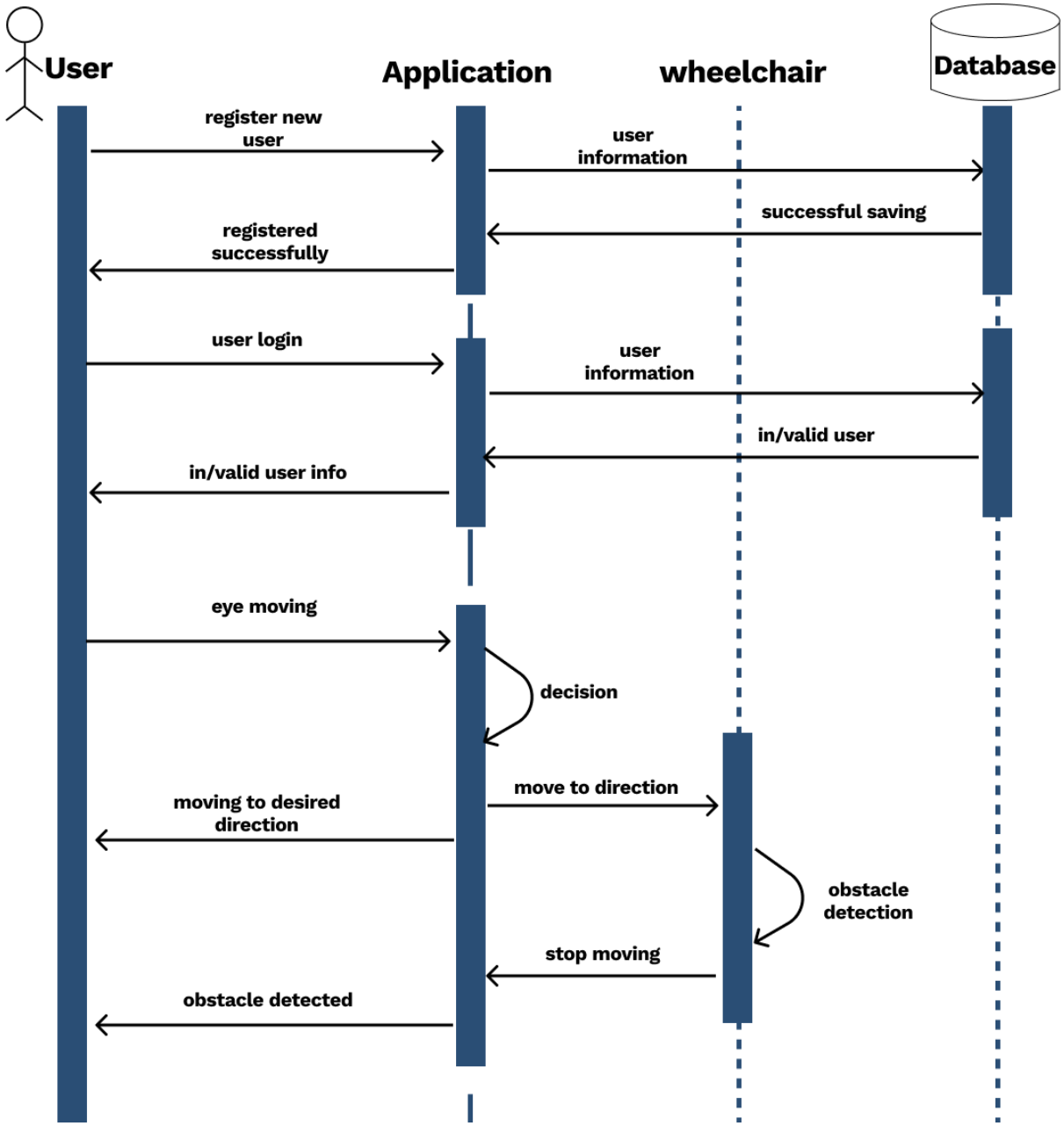
3.5.3.Class Diagram

The class diagram is a static diagram. It represents the static view of an application. Class diagram is not only used for visualizing, describing and documenting different aspects of a system but also for constructing executable code of the software application.

The class diagram describes the attributes and operations of a class and also the constraints imposed on the system. The class diagrams are widely used in the modeling of object-oriented systems because they are the only UML diagrams which can be mapped directly with object-oriented languages. The class diagram shows a collection of classes, interfaces, associations, collaborations and constraints. It is also known as a structural diagram.

3.5.4.Sequence Diagram

Sequence diagrams model the flow of logic within your system in a visual manner, enabling you both to document and validate your logic, and are commonly used for both analysis and design purposes. Sequence diagrams are the most popular UML artifact for dynamic modeling, which focuses on identifying the behavior within the system. Sequence diagrams in UML show how objects interact with each other and the order those interactions occur. It's important to note that they show the interactions for a particular scenario. The processes are represented vertically, and interactions are shown as arrows.

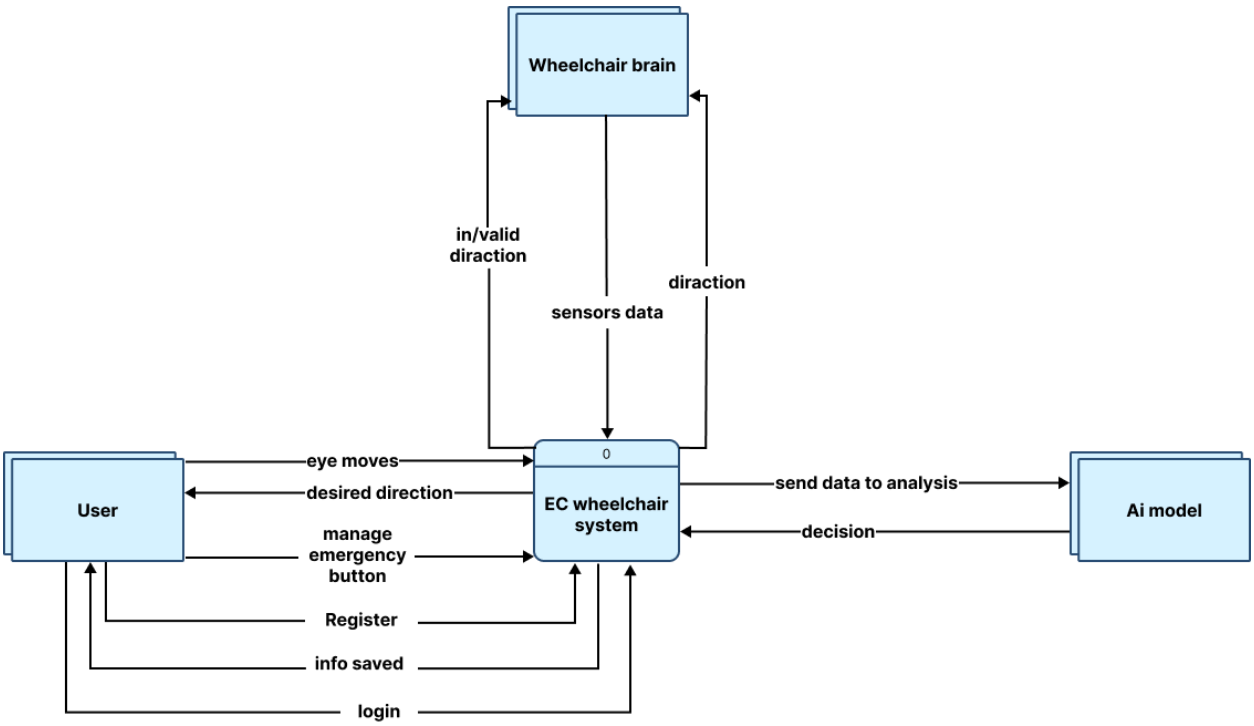


3.6. Data Flow Diagram

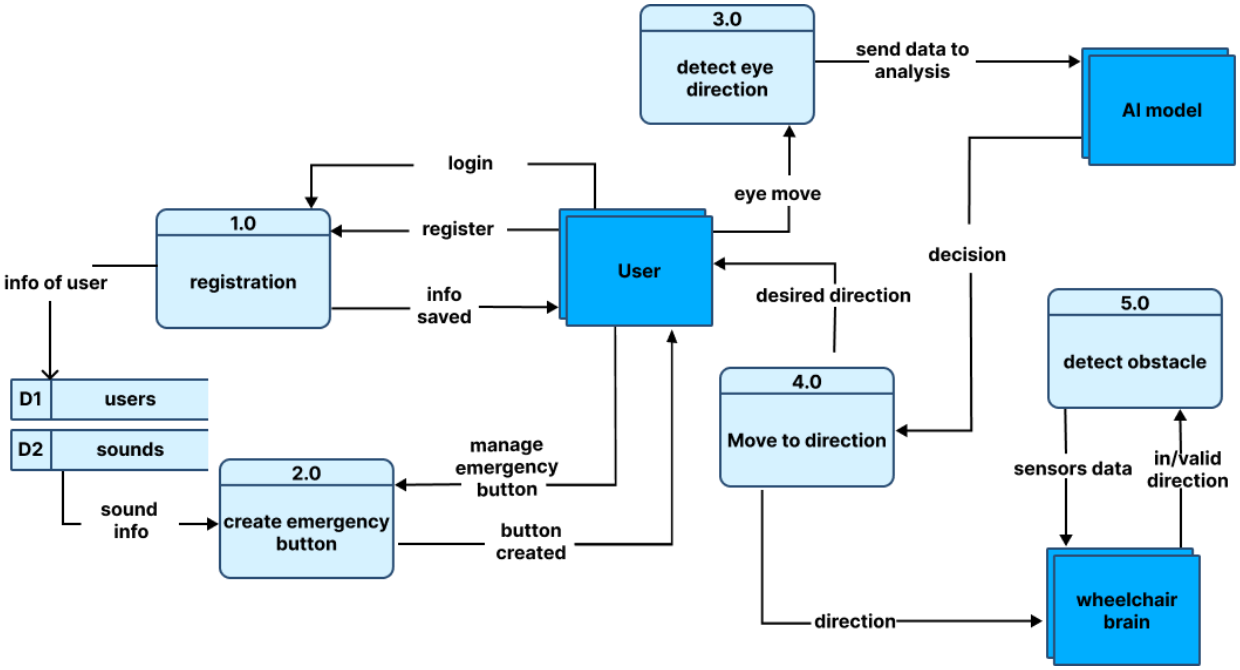
Data Flow Diagrams (DFD) helps us in identifying existing business processes. It is a technique we benefit from particularly before we go through business process reengineering. At its simplest, a data flow diagram looks at how data flows through a system. It concerns things like where the data will come from and go to as well as where it will be stored. Usually, it begins by drawing a context diagram, then drill down to a level 1 diagram with additional information about the major functions of the system. Then evolve to become a level 2 diagram when further analysis is required. Progression to level 3 is done if needed.

3.6.1.context diagram

A context diagram, sometimes called a level 0 data-flow diagram, is drawn in order to define and clarify the boundaries of the software system. It identifies the flows of information between the system and external entities. The entire software system is shown as a single process.



3.6.2.DFD level one



CHAPTER FOUR

PROPOSED SYSTEM

4.1 Overview

In the previous chapter, we discussed the analysis phase of the proposed system, and its procedural diagrams. In this chapter, we're going to preview the implementation and production phase components, and to discuss some of the smart used algorithms that makes up the core features of the entire system.

Our project core feature depends on a combination of AI model that detect gaze eye throughout mobile phone application and send the decision to Arduino kit and move the wheelchair. The system is designed to be intuitive and easy to use, allowing users to navigate their environment with minimal effort.

4.2 Introduction:

The proposed system is an eye-controlled wheelchair that allows people with mobility impairments to move around independently. This system uses eye tracking technology to detect the direction of gaze and translate it into movement commands for the wheelchair. The system is designed to be intuitive and easy to use, allowing users to navigate their environment with minimal effort.

4.3 System Methodology:

This project uses the agile methodology in which we work in a set of sprints to get the maximum effort and here is how our project works.

The system is based on a combination of hardware and software components. The hardware includes a wheelchair with motorized controls and an eye-tracking device that is used to detect the direction of gaze. The software is mobile application that includes a user interface that allows the user to control the wheelchair using their eyes.

The major component in the system is the user, we aim to improve users' lives through the wheelchair to make him able to move by himself and communicate with others.

The core 3 features are as the following:

- AI model
- Arduino kit
- Mobile application
  + Buttons to move the chair.
  + Emergency buttons

4.4 Algorithms Used:

The system uses an algorithm to translate eye movements into commands for the wheelchair. These algorithms are based on computer vision techniques that analyze the direction and duration of eye movements to determine the user's intended direction of travel. The algorithms are designed to be accurate and robust, even in challenging environments with low lighting or other sources of interference.

4.4.1 Implemented System Functions:

The system includes a number of functions that allow the user to control the wheelchair using their eyes. These functions include:

- Movement Control: The user can move the wheelchair forward, backward, left, or right by looking in some direction to choose the button of the screen.
- Obstacle Detection: The system includes sensors that detect obstacles in the user's path and automatically stop the wheelchair to prevent collisions.
- Emergency button: The system has included a lot of emergency buttons to help the patient if he had a problem or he is hungry or else he can press on of these buttons.

And here is some of implementation:

4.4.1.1Movement Control:

Face landmark detection is a computer vision task where we want to detect and track key points from a human face. This task applies to many problems. For example, we can use the key points for detecting a human’s eye position and eye-gaze. Also, we can use the key points for applying an augmented reality easier. And there are so many solutions that we can generate based on this task.

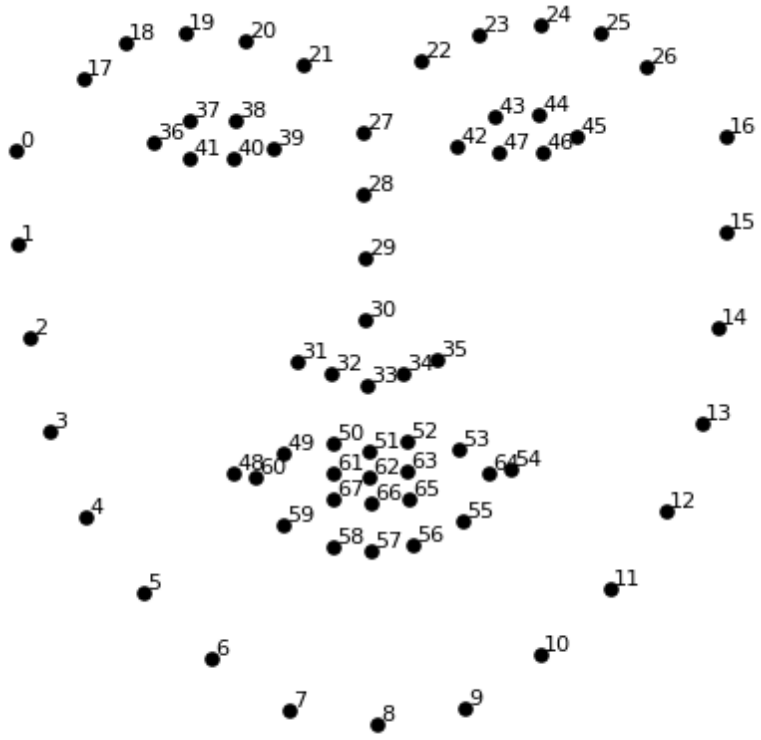
We can use prebuilt libraries like dlib, OpenCV, and media pipe. In this article,

Face Landmark Detection with Dlib:-Dlib is a library for applying machine learning and computer vision solutions. This library is based on the C++ language, but we can use a language like Python for using the library. One of the solutions that we can apply by using this library is face landmark detection.

4.4.1.1.1 Face landmark detection mechanism

As you can see from above, we initialize the face landmark detector by using the pretrained model. The model is based on ensemble regression trees because the model will predict continuous numbers. That model is trained on the iBUG-300 W dataset, where it contains images and their corresponding 68 face landmark points. In general, those landmark points belong to the nose, the eyes, the mouth, and the edge of a face.

Here is the visualization of the face landmark locations below:



4.4.1.2 The comparison between switch access and the ai model:

One of the main differences between switch access and the dlib model is the level of precision and control they offer. Switch access is generally a more straightforward and simple input method, but it may not provide as much granular control over the device as eye tracking using the dlib model. Eye tracking could allow for more precise and accurate input, such as picking out small targets or making subtle movements, which may be important for certain tasks or applications.

The main factor to consider is the cost and accessibility of each option. Switch access can be relatively inexpensive and easy to set up, as it mainly requires a switch and some software configuration. In contrast, using the dlib model for eye tracking may require specialized hardware and software, which can be more expensive and complex to implement. Additionally, some individuals may not be able to use eye tracking if they have visual impairments or conditions that affect their eye movements.

Switch access relies on the use of switches that can be activated by various means, such as a person's head, hand, or foot. This allows the user to input commands into a device, such as selecting items on a screen, typing text, or navigating menus. Switch access is particularly useful for people with limited mobility or dexterity, as it allows them to interact with technology more easily and independently.

On the other hand, the dlib model for tracking eye movements uses computer vision algorithms to detect and track the position of a person's eyes as they move. This can be used to control a computer cursor, select items on a screen, or perform other actions. The dlib model is often used as an alternative to traditional input devices like a mouse or keyboard and can be particularly useful for people with physical disabilities that affect their ability to use their hands.

4.4.1.2.1 The results

The reason that makes us to not used dlib model and take the path to use switch access in our project that when we used dlib in the desktop app we found that.

- Many failed detections of eye movement.
- Complex to set up with a mobile app.
- The size of dlib model is high which may be cussed may.

effect on the performance of the mobile ram that the camera used to detect the movement.

4.4.1.3 Obstacle Detection:

This is a some of code that we implement it:

These show how to calculate the distance.

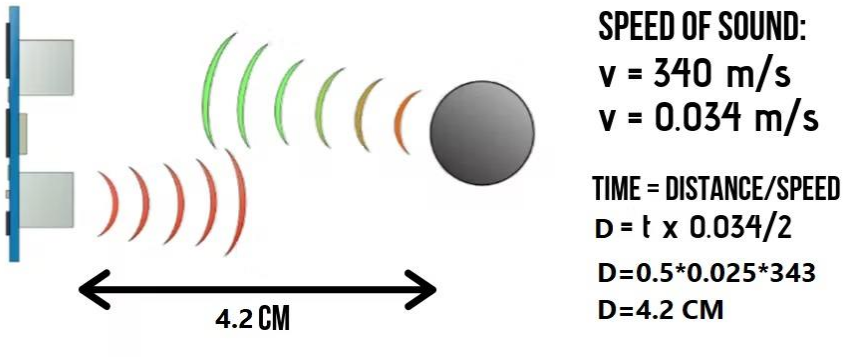
```
int cal_distance(){
  digitalWrite(trigPin, LOW);//clear echo
  delayMicroseconds(2);

   digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
   duration = pulseIn(echoPin, HIGH);
   distance = duration * 0.034 / 2;

   return distance;

  }
```

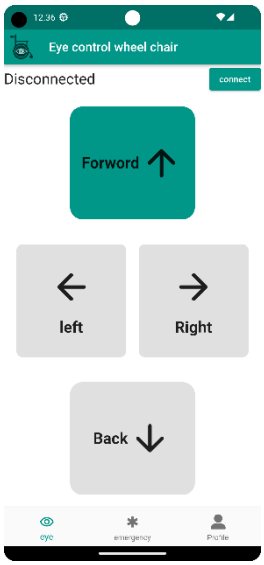
And this how the ultrasonic sensor work

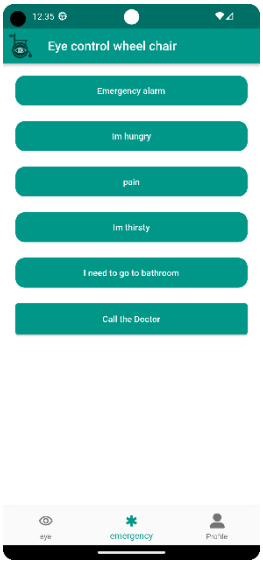


4.4.1.4 Emergency button:

This is a some of code that we implement it:

```
return  BlocConsumer<AppBloc, AppState>(
  builder: (context, state) {
    var userDataModel = AppBloc.get(context).userDataModel;
  return Padding(
    padding: const EdgeInsets.all(20.0),
   child: SingleChildScrollView(
     child: Container(
       width: double.infinity,
      child: Column(
        children: [
       mercy_button("assets/sound/emergency-alarm.mp3","Emergency alarm",15,true),
       SizedBox(height: 25,),
       mercy_button("assets/sound/hungry-ar.mp3","Im hungry"),
       SizedBox(height: 25,),
       mercy_button("assets/sound/pain-ar.mp3","pain"),
       SizedBox(height: 25,),
       mercy_button("assets/sound/thirsty-ar.mp3","Im thirsty"),
       SizedBox(height: 25,),
       mercy_button("assets/sound/bathroom-ar.mp3","I need to go to bathroom"),
       SizedBox(height: 25,),
       Container(
         decoration: BoxDecoration(borderRadius: BorderRadius.circular(20.0)),
         width: double.infinity,
         height: 50,
        child: ElevatedButton(
            onPressed:
                ()=> launch("tel://${userDataModel?.phone}")
          , child: Text("Call the Doctor")),  // ElevatedButton
      )  // Container
    ],
  ),  // Column
```





And here some of screen from the phone:

4.5 Techniques:

The system uses a variety of techniques to ensure reliable and accurate operation. These techniques include:

- Calibration: The system is calibrated to the user's individual eye movements to ensure accurate tracking and movement control.
- Feedback: The system provides visual and auditory feedback to the user to confirm their commands and provide information about the status of the wheelchair.
- Redundancy: The system includes redundant sensors and controls to ensure reliable operation even in the event of a failure or malfunction.

4.6 Study Sites:

The system was tested at several study sites, including hospitals and rehabilitation centers, to evaluate its performance and gather user feedback. These sites provided a variety of environments and scenarios to test the system's robustness and effectiveness.

4.7 Timeline Plan:

The timeline plan for the implementation of the system is as follows:

- Research and Development: 4 months
- Hardware and Software Integration: 3 months
- System Testing and Debugging: 2 months


ID
Name
2022
2023
Sep...
Oct 2022
Nov 2022
Dec 2022
Jan 2023
Feb 2023
Mar 2023
Apr 2023
May 2023
Jun 2...
1 seminar 1
2 planning
3 introduction
4 project objective
5 problem defination
6 related works
7 system architecture
8 project plane
9 presentation
10 seminar 2
11 system study
12 feasibility study
13 system requirements specification
14 system architecture
15 methodology
16 system analysis
17 seminar 3
18 Design
30 ui/ux
23 Develop functional specifications
24 Develop prototype based on functional
25 Design complete
19 Development
26 Identify modular/tiered design parameters
27 Assign development staff
28 Develop code
29 primary debugging
20 editing on the documntation
21 editing system architecture
22 presentation
31 seminar 4
32 finishing development
33 Testing

CHAPTER Five

RESULTS AND DISCUSSION

5.1 RESULT DISCUSSION:

In this section we will talk about the expected result at the beginning of the project and the real outcome of the project when we have finished it. Also, we will discuss and compare them to show the difference between the expected results and the actual ones.

5.1.1 Expected result:

First at the analysis and the planning phase we gathered all the information about what the requirements we need, what is the features we will use to complete this project 100%, we planned to make a wheelchair that the patient can controlled it with his eye throughout mobile application that can control it and he has an emergency button if he had some problem.

5.1.2 Actual result:

The actual result not much different from the Expected result we assumed before. Only the difference is that use an small prototype to make sure that all functionality of our project is completely done.

5.2 Functional Evaluation:

Functional evaluation is a critical step. We have conducted a thorough functional evaluation to ensure that our software application meets all the functional requirements that we have specified for our project. Throughout the evaluation process, we performed manual testing techniques to validate that all the functional requirements were implemented correctly. By performing regular functional evaluations during the development process, we were able to catch any issues early and ensure that our software is functional and meets the needs of our users. This has helped to ensure that our project is successful and that the software we developed is of high quality and meets the expectations of our stakeholders.

5.3 Discussion on Business Value:

The eye-controlled wheelchair project is a significant technological advancement that has the potential to provide various benefits to society. In this chapter, we will discuss the business value of the project and how it can be beneficial in terms of

cost, environmental impact, manufacturability, ethics, social and political impact, health and safety, and sustainability.

5.3.1 Cost:

One of the major benefits of the eye-controlled wheelchair is its cost-effectiveness. Traditional wheelchairs can be expensive, and maintenance costs can add up over time. However, the eye-controlled wheelchair eliminates the need for expensive hardware and significantly reduces the cost of maintenance. The user can control the wheelchair with their eye movements, eliminating the need for a joystick or other expensive hardware.

The component	Price
Ordinary wheelchair	3000 LE
The two main motors	6000 LE
Two Battery 12V 5A	1000 LE
Two controllers 24v 5A	1200 LE
charging circuits	500 LE
Arduino	380LE
Bluetooth module	125LE
Ultrasonic sensor	75LE
Other components	720LE
Total cost	13000LE

5.3.2 Environmental Impact:

The environmental impact of the eye-controlled wheelchair is also significant. Traditional wheelchairs require batteries and other components that can be harmful to the environment. However, the eye-controlled wheelchair is powered by the user's movement, eliminating the need for batteries or other harmful components. Additionally, the wheelchair's lightweight design reduces the amount of energy required to move it, making it an eco-friendly option.

5.3.3 Manufacturability:

The eye-controlled wheelchair's design is simple and can be manufactured using readily available components. This makes it easy to produce and distribute, reducing manufacturing costs and making it accessible to a wider range of users.

5.3.4 Ethics:

The eye-controlled wheelchair project is designed to provide mobility and independence to individuals with physical disabilities. By enabling individuals to control their wheelchair with their eyes, they can maintain their dignity and independence. This is an ethical consideration that is essential for people with disabilities.

5.3.5 Social and Political Impact:

The eye-controlled wheelchair can have a significant social and political impact. By providing individuals with disabilities with increased mobility and independence, they can participate more fully in society. This can lead to increased employment opportunities, greater social integration, and improved quality of life.

5.3.6 Health and Safety:

The eye-controlled wheelchair is designed with the user's safety in mind. The lightweight design reduces the risk of injury during transport, and the eye-controlled system eliminates the risk of strain or injury associated with traditional joystick controls. Additionally, the wheelchair's low center of gravity provides stability, reducing the risk of tipping over.

5.3.7 Sustainability:

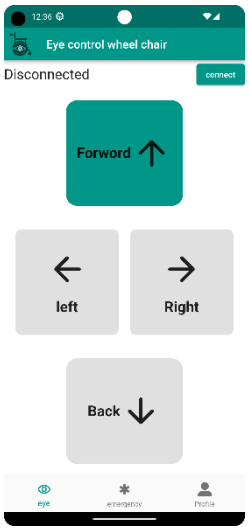
The eye-controlled wheelchair's sustainability is another significant benefit. The wheelchair's lightweight design reduces the amount of energy required to move it, making it a more sustainable option. Additionally, the eye-controlled system eliminates the need for batteries or other harmful components, making it a more environmentally friendly option.

The eye-controlled wheelchair project has the potential to provide significant benefits in terms of cost, environmental impact, manufacturability, ethics, social and political impact, health and safety, and sustainability. By providing individuals with disabilities with increased mobility and independence, they can participate more fully in society, leading to an improved quality of life.

5.4 Project Evaluation:

In these section we will talk about the whole project in details:

5.4.1 The mobile application:

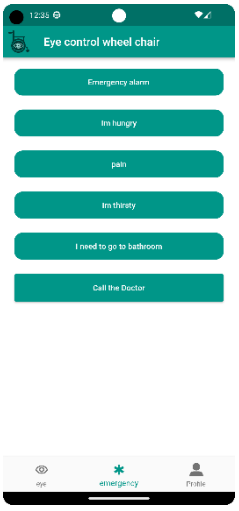


5.4.1.1 Home screen:

At the first, in the home screen as we see we had some buttons the user can with his eye to choose one of them to move the wheelchair.

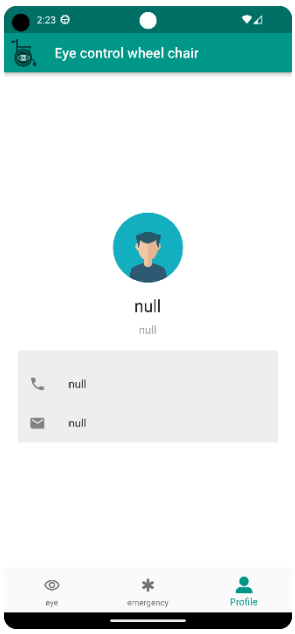
And also we had in the first the Bluetooth connection and it show you if the mobile application is connected or not .

5.4.1.2 Emergency screen:



In this screen we had a lot of buttons each one of them has specific role to do it. Like if the patient is hungry there is a button for that if he wants to go to the bathroom there is also a button for that and if he is in the home alone and need some help there is a button to call someone to help him.

5.4.1.3 profile screen:

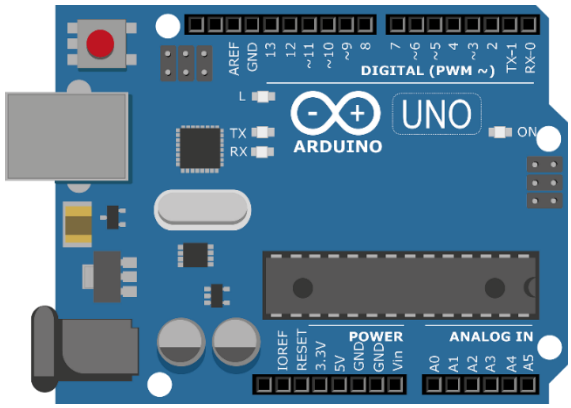


This screen show you the user info and the number of the emergency call in the emergency screen.

5.4.2 The Arduino kit:

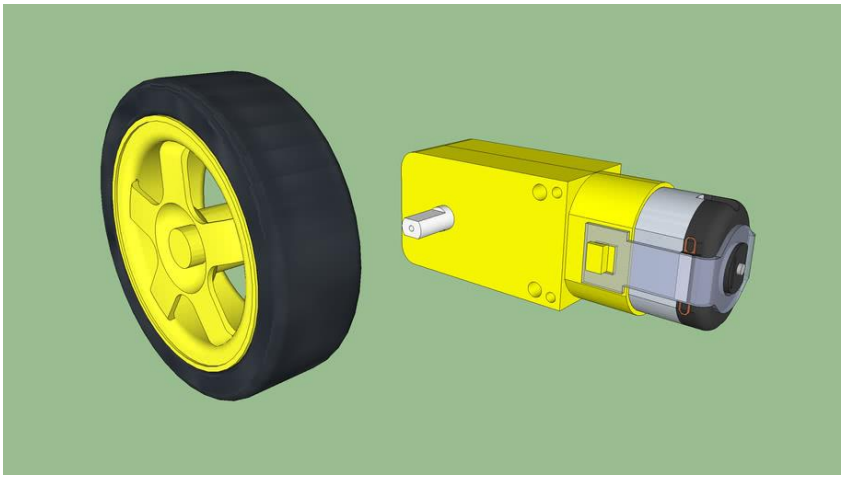
5.4.2.1 Arduino uno:

The Arduino[7] Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc and initially released in 2010.



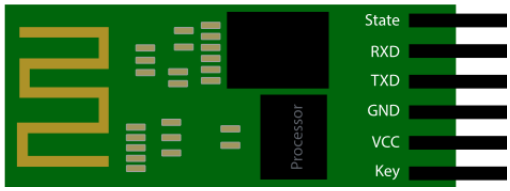
5.4.2.2 gearmotor with wheels:

A gearmotor [10] (or geared motor) is a small electric motor (AC induction, permanent magnet DC, or brushless DC) designed with an integral (non-separable) gear reducer (gearhead) attached



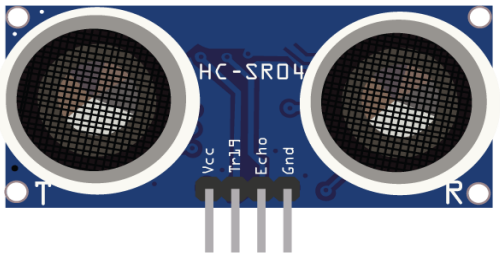
5.4.2.3 Bluetooth module (HC-05):

The Bluetooth module [11-12] (HC-05) is a device which is used for short range wireless communication to the respective connected device. which can communicate in two ways. Which means, it is full-duplex.



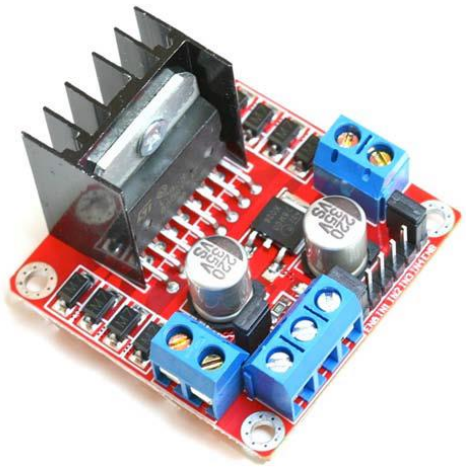
5.4.2.5 Ultrasonic sensor

An ultrasonic sensor [13] is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves and converts the reflected sound into an electrical signal



5.4.2.6 Motor driver(L298N):

This dual bidirectional motor driver (L298N) [14]is based on the very popular L298 Dual H-Bridge Motor Driver Integrated Circuit. The circuit will allow you to easily and independently control two motors of up to 2A each in both directions



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نموذج كرسي متحرك للتحكم في العين

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