Ministry of Education and Science of the Republic of Kazakhstan
Suleyman Demirel University

Akhanova Bagdina , Akkassin Assel , Bolekbayeva Anel ,
Yussupova Arailym

Realization of a special wheelchair with voice control system for people with disabilities

A thesis submitted for the degree of
Bachelor in Computer Systems and Software
(degree code: 5B070400)

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Abstract

This thesis describes the design of a smart motorized wheelchair with voice control using an embedded system. The proposed design supports a voice activation system for people with disabilities, including manual control. This thesis presents the Voice Wheelchair for a physically disabled person, where a voice command controls the movement of the wheelchair. The voice command is sent through a cellular device with Bluetooth, and the command is transmitted and converted to a string using the BT voice control for Arduino and transmitted to the SR-04 Bluetooth module connected to the Arduino board for wheelchair control. For example, when the user says "Forward", then the chair will move forward, and when he says "Back," the chair will move in the opposite direction and, similarly, "Left", "Right" to turn left and right, respectively, and "Stop" » to stop. This system has been developed to save the cost, time and energy of the patient. An ultrasonic sensor is also part of the design and it helps to detect obstacles in the way of the wheelchair that may interfere with the passage of the wheelchair.

Аңдатпа

Бұл құжатта интеграцияланған жүйенің көмегімен дауыстық бақылауы бар моторлы мүгедектер арбасының дизайны сипатталған. Ұсынылған дизайн қолмен басқаруды қоса, мүгедектерге арналған дауыстық іске қосу жүйесін қолдайды. Бұл құжат мүгедектерге арналған "Дауыстық мүгедектер" арбасын ұсынады, онда дауыстық команда мүгедектер арбасының қозғалысын басқарады. Дауыстық команда Bluetooth арқылы ұялы құрылғыға жіберіледі, ал пәрмен Arduino үшін BT дауыстық басқару құралын пайдаланып, жолға айналады және мүгедектер арбасын басқаруға арналған Arduino тақтасына қосылған SR-04 Bluetooth модуліне беріледі. Мысалы, пайдаланушы «Алға» деген кезде, орындық алға қарай жылжиды, ал «Артқа» дегенде, орындық қарсы бағытта қозғалады, сәйкесінше солға және оңға бұрылу үшін «Солға», «Оңға» және «Тоқтату» тоқтау үшін. Бұл жүйе пациенттің құнын, уақытын және энергиясын үнемдеу үшін жасалынған. Сондай-ақ, ультрадыбыстық сенсор дизайнның бөлігі болып табылады және мүгедектер арбасының өтуіне кедергі келтіруі мүмкін кедергілерді анықтауға көмектеседі.

Аннотация

В этом документе описывается конструкция умного моторизованного инвалидного кресла с голосовым управлением с использованием встроенной системы. Предлагаемый дизайн поддерживает систему голосовой активации для людей с ограниченными физическими возможностями, включая ручное управление. Этот документ представляет «Голосовое кресло-каталку» для человека с ограниченными физическими возможностями, где голосовая команда контролирует движения инвалидной коляски. Голосовая команда подается через сотовое устройство, имеющее Bluetooth, а команда передается и преобразуется в строку с помощью голосового управления BT для Arduino и передается в модуль Bluetooth SR-04, подключенный к плате Arduino для управления инвалидной коляской. Например, когда пользователь говорит «Вперед», тогда кресло будет двигаться вперед, а когда он говорит «Назад», то кресло будет двигаться в обратном направлении и, аналогично, «Влево», «Вправо» для поворота влево и вправо соответственно и «Стоп» для остановки. Эта система была разработана для экономии затрат, времени и энергии пациента. Ультразвуковой датчик также является частью конструкции, и он помогает обнаруживать препятствия на пути к инвалидной коляске, которые могут препятствовать прохождению инвалидной коляски.

Оглавление

Глава 1

Introduction

1.1 Background

The problem of helping people with limited physical abilities remains one of the most difficult, requiring society not only to understand it, but also to participate in this process of many specialized institutions and structures. The rehabilitation of people with disabilities is not only treatment and improvement of their state of health, but also the process of achieving a person's maximum independence in society. One of the devices most contributing to this are limb prostheses and electromechanical smart wheelchairs.

Despite the latest advances in science and technology have radically changed the lifestyle of a normal person, there are certain groups of people who could not benefit from this development. In particular, people with disabilities who move on wheelchairs with limited mobility still live a inferior life. A wheelchair with voice control is aimed at helping people with disabilities and physical disabilities, providing them with some kind of mobility that will help them a lot. Our wheelchair consists of a main control unit that allows the user to enter data in the form of a joystick or voice command. The controller unit then synthesizes the command and takes the necessary actions to move the wheelchair to a specific position.

1.2 Research

According to the Ministry of Labor and Social Protection, there are 680 thousand disabled people in Kazakhstan and 650 million people in the world, representing about 10 percent of the world's population, are disabled. Therefore, a particularly important task is the development of systems that would help people with disabilities to move freely, and thereby significantly improve their living standards. Existing systems are controlled using a push-button remote control and joystick or using a manual drive. But such systems are not convenient for people with disabilities with muscular dystrophy, severe cerebral palsy and other diseases of the musculoskeletal system. So we want to add a little function – voice recognition. Therefore, it is

necessary to develop systems that could be controlled by voice and put these systems into practice. The main requirement for these systems is their versatility, that is, the ability to install on any existing wheelchair with an electric drive, without significant structural changes. The second requirement is accessibility; the system does not have to be expensive.

A smart wheel chair aims to provide aid to those handicapped and physically challenged persons by providing them with some sort of mobility which would greatly help them. Smart wheel chair consists of a major controller unit which allows the user to provide the input in the form of remote controller as application form or a voice command. The controller unit then synthesizes the command and takes required action so as to move the wheelchair to the particular position. In the process of implementing the project, we conducted a small survey of people with disabilities and asked to answer our questions that sound like this:

1) What are the inconveniences of using a wheelchair?

2) Did you have to manage, move around without assistance? If answer is "yes what were the problems?

3) If you could, what features will help you facilitate when using a wheelchair?

We have received such answers: Object of research: problems of movement of disabled people of 1st and 2nd group.

Person A (age 65): Basically, wheelchairs are heavy, and it's hard for me to control on my own at this age, I don't have enough strength to control them, and I have to get help. No one can be with you 24 hours a day and would like to be implemented more convenient wheelchairs to make it easier to control.

Person B (age 19): I had to use a wheelchair when I was abroad, and there were several people with whom I communicate. And the first days it was difficult for me to manage myself, when after the operation I felt bad. It was difficult to ask strangers for help, and then the thought came that it was the 21st century, everyone had a smartphone in their hands, why not do something so that people could control by the phone.

Person C (age 25): I've been using a wheelchair for 5 years and I can say that today our country is inconvenient for people with disabilities. Transport is not adapted so that a disabled person can easily enter or exit the transport. The houses are not equipped, porches, especially for wheelchairs. I look at my porch - there are no conditions at all, no elevator. In the future I would like to eliminate all these problems, and at least somehow feel like a full-fledged person. Based on these answers, we think that our smart wheelchair, which has few functions, can at least make life easier for people with disabilities.

1.3 Relevance of our topic

Among the products intended for people with physical disabilities, technical equipment is allocated to a special class, compensating disorders of the human musculoskeletal

system, for example, canes, crutches, lower limb prostheses and wheelchairs. The wheelchair, unlike the others, is designed to control the disabled person independently, and not by an accompanying person. Wheelchairs can have a mechanical drive, in which the wheels are driven by hand force, as well as an electric drive, which includes: a battery, power converter, microcontroller, input device and gearbox. Such wheelchairs are designed to move not only indoors, but also on the street, so it is important that a convenient and reliable control system is incorporated in the microcontroller.

This thesis is intended as an idea to make life easier for those who are unfortunate enough to lose ability to move legs due to a significant amount of paralysis, accident, or old age. Many people with different abilities usually depend on others in their daily lives, especially when moving from one place to another. For wheelchair users, they constantly need someone to help them move the wheelchair. Their life is complicated by the fact that they lack an intuitive control system for their wheelchairs, which allows them to move independently. The use of an electric wheelchair provides a greater degree of independence for people with disabilities who cannot walk or drive a mechanical wheelchair alone, as this requires a lot of effort and help from others. The problem is that in some cases, disability leads to someone losing their ability to use their hands, so in this case, the method of controlling a mechanical wheelchair can be implemented using speech commands for patients without the help of hands, which leads to an interesting and promising result. But, nevertheless, the availability of intelligent wheelchair solutions is often limited due to the high cost and not very convenient operation. According to the proposed approach described in this document, an inexpensive, simple and friendly solution for the voice platform will be presented, which is user-friendly, fully customizable in accordance with the language the user speaks, and will help to expand the capabilities of the user independent mobility. Using a smartphone as the "brain" of a robot is already an active research area with several open possibilities and promising opportunities. Another highly successful technology, Bluetooth has changed the way digital devices are used at home or in the office, and converted traditional wired digital devices to wireless devices. This study is based on the design of voice-activated wheelchairs based on mobile platforms using Bluetooth technology, the development and implementation of solutions for wireless remote control. The project also includes the use of ultrasonic sensors to detect obstacles, and also notifies the system and stops the wheelchair before receiving further commands. This thesis presents the control of Smart Wheelchair using the Arduino Uno microcontroller and the Bluetooth module through the Android application.

1.4 The purpose and objectives of the study

The purpose of the our degree work is to study existing wheelchairs with electric wheels and develope prototype of a wheelchair with voice control system based on the Arduino microcontroller. We want to add voice recognition using Arduino, IOS program systems. Present problem : the lack of wheelchairs for the disabled, which are controlled by voice. Subject of study : devices based on voice-controlled microcontrollers. To achieve this goal it is necessary to solve the following tasks:

1) To study the existing electric drive systems on modern electric wheelchairs;

2) Select the hardware components of the system (controller, power converter, sensors, input device);

3) Develop a code for a wheelchair voice control system;

4) Develop an executable program for the controller in IOS;

5) Development of a wheelchair prototype based on the Arduino microcontroller, which converts a voice signal into a click of a button or movement of a joystick.

6) Program an automated wheelchair in an Arduino IDE

7) Check the performance of the implemented system and test the automated wheelchair disabilities by voice control;

Глава 2

Hardware Units

2.1 System Description

This project needs collaboration between two different domains. Therefore this chapter will introduce two different concepts. The first, which is the hardware part, will describe the main components that were used while the second will introduce software tools used for development applications.

The hardware architecture consists of an embedded system based on the Arduino Uno board, Bluetooth module HC-05, driver module L298N, 2 DC Motors, Ultrasonic Sensor HC-SR04, AMR Voice android application as voice recognition and IOS application as remote control. The Bluetooth module provides communication between the user through the Android phone and the system through a voice command sent to the constructor. The user speaks the desired command in the BT Voice Control for Arduino voice (AMR Voice Application) software application installed on an android phone that is connected via Bluetooth via the HC-05 Bluetooth module. The voice command is converted to an array of strings, and the string is transmitted to the Arduino Uno connected to it. As soon as the Bluetooth module receives the message, the sent command will be retrieved and executed by the microcontroller connected to it, and depending on the commands given to the engine driver, the engines will work accordingly. The system will interpret the commands and control the wheelchair accordingly through the android application AMR Voice. Meanwhile, the ultrasonic sensor works when the circuit is turned on, and makes sure that there are no obstacles on the track, and if there is any obstacle, it notifies the Arduino and stops the wheelchair until a further command is received from the user. The IOS application will be used as a remote controller that will give signals to arduino for moving forward, backward, left, right, and also have additional functions, such as a reminder, emergency calls, a map for the convenience of the user.

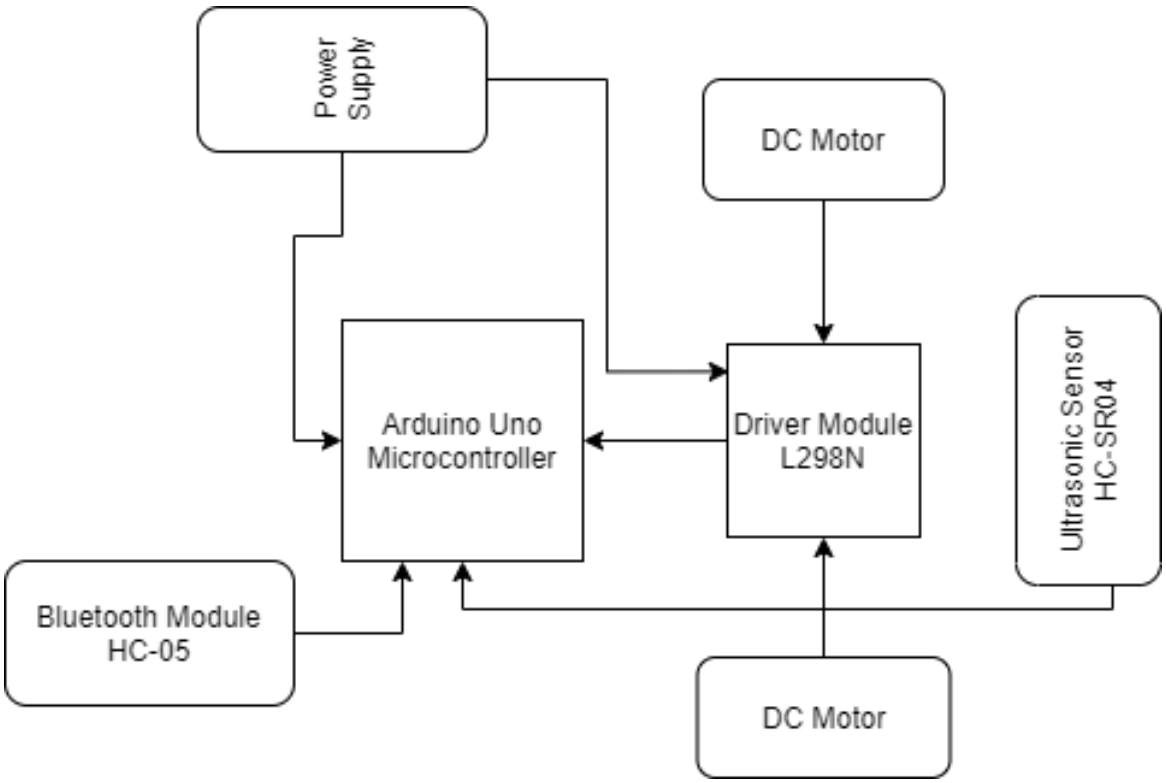

Рис. 2.1: Block Diagram of the project

2.2 Hardware Units: Arduino

Arduino is an open source platform used to create electronic projects. Arduino has as a physical programmable printed circuit board (mainly refers to the microcontroller) and piece of software or IDE (integrated development environment) that is used for recording and downloading computer code for a physical board. In the project, we chose Arduino UNO, because UNO is the the most reliable board for working with electronics and coding. And the UNO is the most used and documented board of the whole Arduino and Genuine family.

To implement a control system for an existing electromechanical wheelchair, it is necessary to supplement the system with the missing elements: a microcontroller, a master device and a power unit (driver for the H-bridge).

2.3 Hardware equipments

Used equipments to assembly our wheelchair. Right down below shown the list and an image of used equipments in our project.

The analog of this equipments shown in Appendix B.

Рис. 2.2: Arduino UNO with cable

Рис. 2.3: Battery

Рис. 2.4: Bearing Wheel

Рис. 2.5: Acrylic Platform

Рис. 2.6: Bluetooth module HC-05

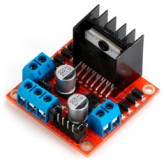

Рис. 2.7: Driver Module L298N

Рис. 2.8: Battery case

Рис. 2.9: DC Motor and wheel

Рис. 2.10: Sensor mount HC-SR04

Рис. 2.11: Set of fasteners

Рис. 2.12: Screwdriver

Рис. 2.13: Ultrasonic Sensor

Рис. 2.14: Wires MAMA-MAMA

Рис. 2.15: Plastic clamps

2.4 Assembly the robot prototype

In the previous part we introduced you hardware equipments of our Arduino project, and now using that components we will show you how we build our mini hardware robot prototype.

1 step: Our assembly begun with the installation of DC motors (1) on an acrylic platform (2) with the screws $M3 \times 6$ mm (3) to the platform. Then screws were tightened into aluminum blocks (4) through special holes on the platform.

2 step: Next, we attached Ultrasonic Distance Sensor HC-SR04 (1) to the bracket (2). Racks (3) are placed between the sensor and the bracket. The module is attached using $M1.6 \times 12$ mm (4) screws and M1.6 nuts (5). Screws are threaded through mounting holes and racks.

3 step: The Driver Module L298N (1) was mounted on brass racks (8 mm) using $M3 \times 6$ mm screws (3). The racks themselves are attached to the platform using $M3 \times 5$ mm screws, but on the other hand.

4 step: The Arduino UNO [analog] (1) board was attached, like the Driver Module L298N , to brass racks (8 mm) (2) using the $M3 \times 6$ mm screws (3), but in this case only three stands were used. The racks themselves are also attached to the platform using $M3 \times 5$ mm screws, but on the other hand. The bearing wheel was also attached on with brass racks (8 mm) using the$M3 \times 6$ mm screws in the same way.

5 step: In a known manner, a battery compartment was installed on brass racks. The assembly ended with the installation of the wheels (1) on the axis of the DC motors (2).

Our robot hardware is complete, now we need to give it its brains. In the next part we will show the robot software in C++.

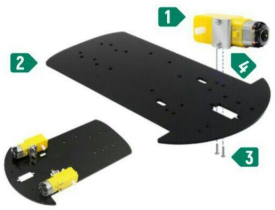

Рис. 2.16: Step 1

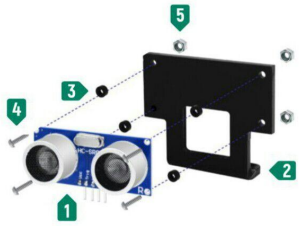

Рис. 2.17: Step 2

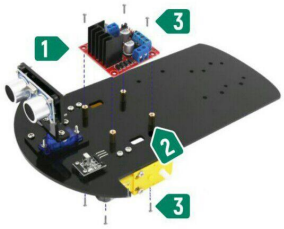

Рис. 2.18: Step 3

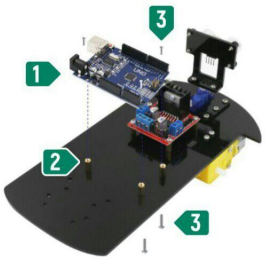

Рис. 2.19: Step 4

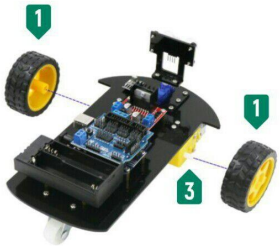

Рис. 2.20: Step 5

Глава 3

Software

3.1 Arduino Connections

Note: Here X is devices input pin, Y is Arduino UNOs input pin. X $\Longrightarrow Y$

1) Ultrasonic Sensor: Echo $\Longrightarrow A0, Trig \Longrightarrow A1, GND \Longrightarrow GND, VCC \Longrightarrow 5V$;

2) Bluetooth: TXD $\Longrightarrow RX, RXD \Longrightarrow TX, GND \Longrightarrow GND, VCC \Longrightarrow 3,3V$;

3) Module Driver L298N: ENA $\Longrightarrow 5, ENB \Longrightarrow 10, IN1 \Longrightarrow 2, IN2 \Longrightarrow 4, IN3 \Longrightarrow 7, IN4 \Longrightarrow 8$.

Dc motors are also connected to Module Driver L298N's OUT1, OUT2, OUT3, OUT4 pins. And module driver is connected to power supply respectively.

3.2 Arduino Source Code

Methods:

1) Set Speed(unsigned char Left,unsigned char Right): sets the speed of dc motors (wheels);

2) advance(): moves wheels forward;

3) turnR(): turns wheels right;

4) turnL():turns wheels left;

5) stopp(): stops wheels;

6) back(): moves wheels backward;

7) Ultrasonic Ranging(): calculates the distance between the robot and the environment.

Let us explain void loop() method of our Arduino sketch where the main logic is stored. First line of the code which says "while (BT.available())" checks if there is an available byte to read which is came from the Bluetooth(BT) port via android application. "delay(10);" added to make thing stable. Then there is a "char c" which takes the result of the BT.read() method and adds to "readvoice" to form a message.

```
void loop()
{
  while (BT.available()){
    delay(10);
    char c = BT.read();
    readvoice += c;
  }
```

Рис. 3.1: Void loop() method 1

```
if(readvoice == "*forward#"){
  while (readvoice == "*forward#"){
    H = Ultrasonic_Ranging();
    delay(300);
    if(H < 50){
      stopp();
    }
    else{
      advance();
    }
    while (BT.available()){
      delay(10);
      char c = BT.read();
      readvoice += c;
    }
  }
}else if(readvoice == "*back#"){
  back();
```

Рис. 3.2: Void loop() method 2

The main logic here is that if “readvoice” has a message, the program should check the string and compare with stored commands which are forward, back, right, left, back for 1 second, back for 2 seconds and etc. The most complicated part of checking the message was the “forward” part, because robot should avoid obstacles. So we say if the command is “forward” the program have to always check the distance, if the distance is small, the robot stops, else it goes ahead. Also in while loop there is a Bluetooth message check, so the program will know if human changed the command.

readvoice=;

In the end of the loop the message overwrites to an empty string.

3.3 IOS Programming

IOS is subsidiary application for our main project. It presents another controlling way of wheelchair. As nowadays all people using technology, we found our application definitely necessary. When disabled person are working or using smartphone, it would be easier or simpler to move with the help of this IOS application. And we added new features to our application. It is Calendar, Contacts and Location. Calendar helps for users to set the reminder. For example, users can write notes to not forget to take medicines or to go somewhere etc. And Location page help for users to send their location to people in Contacts page. If there would be reasons to send location to other people it will be easier to send right away with the help of our application. So by doing this application, we thought million times about convenience and comfort of people for whom we did this work. We are really hope that our little ideas to help people will do their life a little bit easier, simpler and happier.

Our iOS application is called «WeConnect» which fully reflects the essence of our project.We believe that our project is something that connects people with disabilities with their lives and gives them the opportunity to enjoy every moment.

3.4 Design of application

As a rule, it has 10 View Controllers that are designed to make the usage of application as comfortable as possible to our users.

1)Home Page : It is the first page. There we have button that launches the main control page.

2) Main Control Page : In Main Control we have buttons to control the motion of our Arduino wheelchair. The 5 different directions are possible here: left, right, forward, backward and stop. And right down below of this page we have 4 buttons: Location Page, Contacts Page, Calendar Page and About App Page.

3) Navigation Controller Page : The Navigation Controller helps to define users’ location and send to other people.It works with MapKit that allows us to

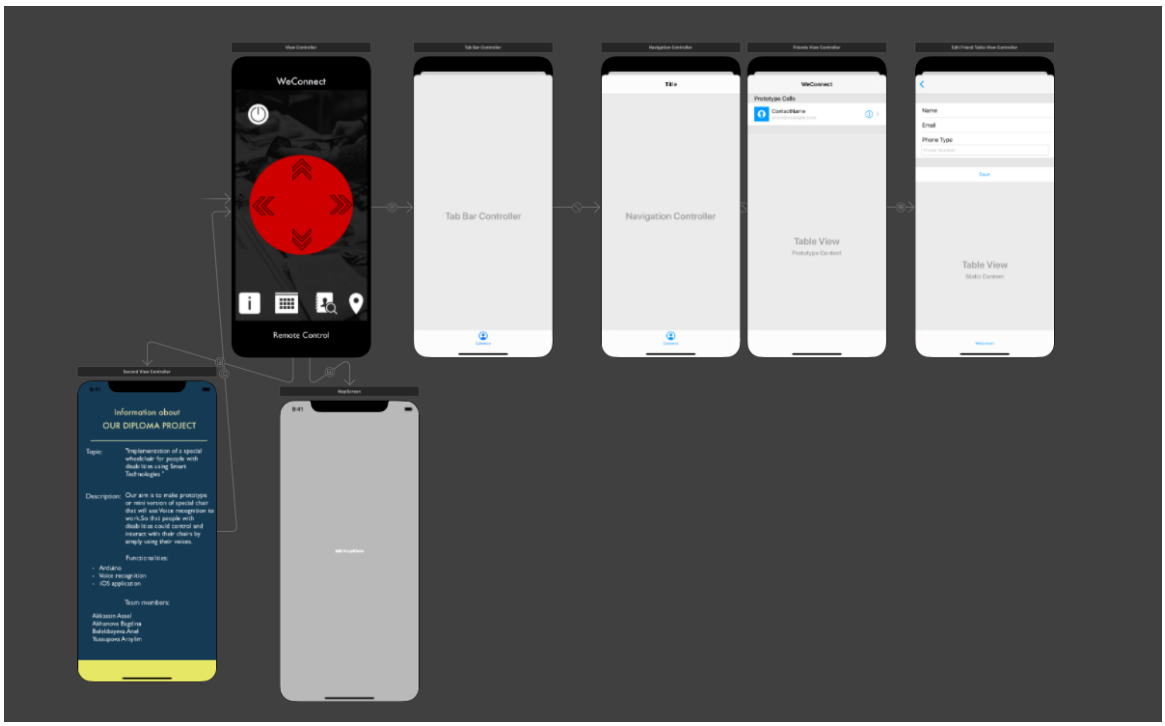

Рис. 3.3: Design of application

access the user location.

4) Table View Prototype View Page : In this page we have emergency contacts which will help people to prevent different situations.We added contacts of Fire Department and Police Department,Ambulance and Medical Call Centre.Also, our users can add their own favorite contacts to our application and access them whenever they want.

5) Calendar Page : In Calendar View Controller we added calendar that will show important occasions to our users.

6) About App Page : This page gives to our users full information about our application and diploma project.We believe that every person would like to know more about developers and history of our application.

3.5 Source code of IOS application

In our iOS application we have diferent functionalities and methods.

1) Main Controller

- application function - controls and sets the storyboard when it launches.

- requestAccess(for:completionHandler:)- Requests access to the user's contacts.

- UINavigationBar.appearance() - we can display app's navigational controls in a bar along the top of the iOS device's screen.

2) Contacts View Controller

- extension Friend - to fetch all contacts of the user.User Contacts contain such information as email,phone number,name and surname.

```swift
@UIApplicationMain
class AppDelegate: UIResponder, UIApplicationDelegate {
  var window: UIWindow?

  func application(_ application: UIApplication, didFinishLaunchingWithOptions launchOptions:
      [UIApplication.LaunchOptionsKey: Any]?) -> Bool {
    window?.backgroundColor = .white

    UINavigationBar.appearance().barStyle = .default
    UINavigationBar.appearance().barTintColor = .appBlue
    UINavigationBar.appearance().tintColor = .white
    UINavigationBar.appearance().isOpaque = true
    UINavigationBar.appearance().titleTextAttributes = [.foregroundColor: UIColor.white]
    UITabBar.appearance().tintColor = .appBlue

    CNContactStore().requestAccess(for: .contacts) { (access, error) in
      print("Access: \(access)")
    }
```

Рис. 3.4: Main Page

```swift
extension Friend {
  var contactValue: CNContact {
    let contact = CNMutableContact()
    contact.givenName = firstName
    contact.familyName = lastName
    contact.emailAddresses = [CNLabeledValue(label: CNLabelWork, value: workEmail as NSString)]
    if let profilePicture = profilePicture {
      let imageData = profilePicture.jpegData(compressionQuality: 1)
      contact.imageData = imageData
    }
    if let phoneNumberField = phoneNumberField {
      contact.phoneNumbers.append(phoneNumberField)
    }
    return contact.copy() as! CNContact
  }
```

Рис. 3.5: Contacts Page 1

3) Contacts View Controller - we have default emergency contacts that will appear everytime when user launches our application.

4)Location View Controller starts working with importing MapKit library.

Functions:

- let initialLocation - to set up the initial location

- mapView.centerToLocation - center the map in the initial location that we defined

- CLLocationDistance - the distance measurement from an existing location.

- init(center:latitudinalMeters:longitudinalMeters:)-Creates a new coordinate region from the specified coordinate and distance values.

5) Calendar View Controller

Functions:

- delegate.self - delegates send messages. We have to say where we want the messages to go. In our storyboard it goes directly back, so in this case we simply say x.delegate=self.

- tableView.reloadData() - reloadData() : Reloads the rows and sections of the table view.

```
  static func defaultContacts() -> [Friend] {
    return [
      Friend(firstName: "Fire", lastName: "Department", workEmail: "sos@example.com",
          profilePicture: UIImage(named: "1")),
      Friend(firstName: "Police", lastName: "Department", workEmail: "police@example.com",
          profilePicture: UIImage(named: "2")),
      Friend(firstName: "Ambulance", lastName: "", workEmail: "ambulance@example.com",
          profilePicture: UIImage(named: "3")),
      Friend(firstName: "Medical", lastName: "Call Centre", workEmail: "call@example.com",
          profilePicture: UIImage(named: "4"))]
  }
}
```

Рис. 3.6: Contacts Page 2

```
import UIKit
import MapKit

class MapView: UIViewController {
  @IBOutlet private var mapView: MKMapView!

    override func viewDidLoad() {
        super.viewDidLoad()

      let initialLocation = CLLocation(latitude: 43.238949, longitude: 76.889709)
      mapView.centerToLocation(initialLocation)

    }
  }
private extension MKMapView {
  func centerToLocation(
    _ location: CLLocation,
    regionRadius: CLLocationDistance = 1000
  ) {
    let coordinateRegion = MKCoordinateRegion(
      center: location.coordinate,
      latitudinalMeters: regionRadius,
      longitudinalMeters: regionRadius)
    setRegion(coordinateRegion, animated: true)
  }
}
```

Рис. 3.7: Location Page

```
    override func prepare(for segue: UIStoryboardSegue, sender: Any?) {
        let vc = segue.destination as! AddTaskController
        vc.delegate = self
    }

    func addTask(name: String) {
        tasks.append(Tasks(name: name))
        tableView.reloadData()
    }

    func checkBox(state: Bool, index: Int?) {
        tasks[index!].checked = state
        tableView.reloadRows(at: [IndexPath(row: index!, section: 0)], with: UITableViewRowAnimation.none)
    }
}

class Tasks {
    var name = ""
    var checked = false

    convenience init (name: String) {
        self.init()
        self.name = name
    }
}
```

Рис. 3.8: Calendar Page

Глава 4

Conclusion

Smart Wheel Chair is mechanical devices designed to provide self-mobility with the help of a user command. This reduces the user's human effort and power to drive wheels for a wheelchair. In addition, it also allows people with visual impairments or physical disabilities to move from one place to another. A smart wheelchair has gained a lot of interests lately. Devices are a boon for those who have lost mobility. In the past, various types of smart wheelchairs have been developed, but new generations of wheelchairs are being developed and used that use artificial intelligence and, therefore, it remains to tinker a bit with a user who uses a wheelchair. The project also aims to create a similar wheelchair, which will have a kind of intelligence and, therefore, will help the user in his / her movement.

The smart wheelchair was chosen for execution, as it included the development of an embedded system that worked in real time, and also because of the sensor that was to be used in it. Most modern day technologies use sensors for interactive input, and in this project we also tried to make the robot interactive and close to the person. In addition, we wanted to learn about the ultrasound sensor and its operation in detail, and also wanted to develop a quick and real-time project that can help other people. These conditions made Smart Wheel Chair a suitable project for us.

The completion of this project required full determination, as many things could go wrong. Since the mechanical structure was of great importance in this project, the creation of a mechanical structure proved to be a difficult task.

This project is developing the design and construction of the Smart Wheelchair using the Bluetooth module. The circuit works correctly to move like a command given by the user. After developing a scheme that allows physically disabled people to control their wheelchair using the Android application on their smartphones and controlling with IOS application, it has also been tested and verified. The detection of any obstacle is successfully controlled by the microcontroller. When a person turns on the circuit and starts moving, the ultrasonic sensor will detect any obstacle. This proposed system promotes the autonomy of people with disabilities and the elderly.

Приложение А

Hardware Decription

A.1 Definition of Hardware Equipments

1) Expansion board Sensor Shield - provides an easy way to connect sensors, servos and RS485 device to Arduino board. It expands Arduino's Digital I/O and Analog Input Pins with Power and GND. It also provides separate PWM Pins which are compatible with standard servo connector.

2) Driver Module L298N - The L298N is an integrated monolithic circuit in a 15- lead Multiwatt and PowerSO20 packages. It is a high voltage , high current dual full-bridge driver de-signed to accept standard TTL logic level sand drive inductive loads such as relays, solenoids, DC and stepping motors.

3) Sensor mount HC-SR04 - The HC-SR04 ultrasonic sensor uses SONAR to determine the distance of an object just like the bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package from 2 cm to 400 cm or 1" to 13 feet.

4) Microphone module with amplifier MAX9814 - microphone amplifier module is a step above the rest, with built in automatic gain control. The AGC in the amplifier means that nearby 'loud' sounds will be quieted so they don't overwhelm 'clip' the amplifier, and even quiet, far-away sounds will be amplified.

5) WI-FI Module ESP8266 ESP-01 - the ESP8266 ESP-01 is a Wi-Fi module that allows microcontrollers access to a Wi-Fi network. ... Thus, we can give a microcontroller internet access like the Wi-Fi shield does to the Arduino, or we can simply program the ESP8266 to not only have access to a Wi-Fi network, but to act as a microcontroller as well.

6) Bluetooth module HC-05 - is an entire system that incorporates not only the Bluetooth processor (the actual Bluetooth chip), but also all the other components required to make a Bluetooth radio work. This includes the antenna design required for the radio to communicate reliably and accurately.

7) DC Motor - is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields.

Приложение B

Arduino devices

B.1 Analogues of mini versions of our arduino devices

With the hope that in the future this project will become true in real life we found analog devices to our used mini versions. We researched all analogues and found their costs.

So in the next page you can see, in the first column mini versions that we have used doing our prototype smart wheelchair. And in the second column, the analogues of mini versions and their cost on Amazon platform.

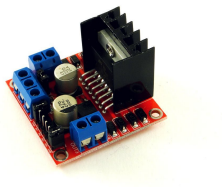

Рис. B.1: Mini version: Module driver L298N

Рис. B.2: Analog: Syren Regenerative Motor Driver Cost: $120 on Amazon

Рис. B.3: Mini version: DC Motor

Рис. B.4: Analog: Kohree 120 RPM Gear Box DC Motor Cost: $12 on Amazon

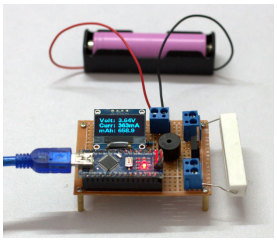

Рис. B.5: Mini version: Power Supply

Рис. B.6: Analog: eTopxizu DC Regulated Switching Power Supply 360W Cost: $19 on Amazon

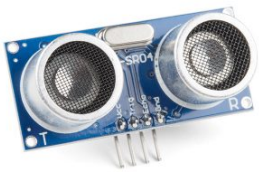

Рис. B.7: Mini version: Ultrasonic Sensor HC-SR04

Рис. B.8: Ultrasonic Sensor UM0090 Cost: $21 on Amazon