

Design and Application of Smart and Electrical Wheelchair and Charging Station for the Disabled Citizen

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Abstract

In this paper, the design and application of smart wheelchair and charging station for disabled citizen is realized. The first stage of the paper is to make the wheelchair used by our disabled citizens able to access smart home technology via the vehicle via touch screen. The ability of citizens with disabilities to call with direct access via touch screen is also in the wheelchair designed. Thanks to the touch screen placed on the vehicle, disabled citizens are provided with the control of smart automation to control many objects such as curtains and doors in the home. In the second part of the paper, a solar powered charging station is designed and installed in order to charge battery powered wheelchairs. In the charging station made a special card reader system and has the charger to charge the card with disabilities to actively and means are provided.

Key words: Electrical vehicle, solar energy, battery charging station, smart automation.

1. Introduction

Considering today's living conditions, there are many disabled citizens, and in fact, each person is a candidate for disability. However, it is our social responsibility to facilitate the lives of disabled citizens. Disabled people experience many problems in society, including disability. When a disabled or disabled relative was asked what kind of problems they faced and what their three most basic problems were, it was stated that the most significant problems were financial difficulties (22%), care / self-care difficulties (28%) and psychological problems (11%). In addition, 8.2% of disabled people have adaptation problems due to physical disability, 7.2% need rehabilitation services, 4.8% emotional problems, 3.8% home health problems, 3.4% ' 3 of them stated that they could not get adequate service from institutions, 3.4% had social and environmental problems due to their mentally handicapped children, 2.4% stated that they needed food aid and 1.9% had difficulty speaking [1].

With this paper, it is aimed to carry out a study in order to integrate our disabled citizens into the society and to ensure their harmony in developing technology. The starting point of this paper is to find solutions to these problems by addressing some of the existing problems at home and outside the home arising from the physical disabilities of disabled citizens. In the paper, our disabled citizens have been adapted to smart home technology, enabling disabled citizens to control home automation from their location. In addition, it is aimed to eliminate this problem with the charging unit that will be placed in different areas such as a square in case of a battery charging station is

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built on the road or in another place outside. The designed charging station can be activated with a special card for the disabled.

The study in [2] states that mistakes and deficiencies in urban planning push disabled people out of society and bring the society without barriers to the first place. The public regulations, especially in developing countries, are primarily aimed at people without disabilities. People with disabilities are considered to be a small minority group or add an additional cost to management. For this reason, disabled people cannot be provided with a service suitable for their disabilities and a suitable architectural construction is not realized. According to the study in [2], social areas are organized to separate the society from disabled people, and physically disabled people are pushed to live outside the society [2-3]. Separate schools or separate business areas are established for disabled people, disabled people are pushed to the outskirts of the city and they are excluded from public spaces [4-5]. As stated from different sources, the paper theme was created in order to eliminate many physical, residential and environmental factors and problems of our disabled citizens.

First of all, if we look at the history of wheelchairs; Wheelchair is a seat equipped with wheels and used by the sick and the disabled. It was invented by British inventor James Heath around 1750. The most commonly used wheelchairs have two large wheels placed at both ends of an axle under the seat and two small movable wheels located under the step on which the feet rest at the front end. While the first wheelchairs that could be moved by pushing from the back could be controlled by the seated person with the help of a curved bar attached to the front wheel, then manually rotatable circles were added to the spokes of the rear wheels.

Wheelchair; It is a tool used for the mobilization of people who cannot walk or move easily due to a physical discomfort or disability. It has wheels of various sizes. It is usually used by hands, but it can accommodate solutions that can be used with almost any part of the body according to specific needs. It has two types, battery-powered and manual in terms of movement. They can be specially designed for any size and any need. It can be controlled by its user, as well as its companion options. Users choose the size and power according to their needs. If it is used in narrow spaces, it may be preferred to have a compact structure, while if it is to be used in field conditions, its strength and durability come to the fore. There are dozens of sports made with wheelchairs and wheelchair models with different designs and features have been developed in line with the needs of each sports branch [6].

2. Materials and Method

In addition to being electric, the wheelchair built in the paper can also control smart home automation via a screen on the front panel. In Figure 1, the photograph of the electric and smart wheeled boat ready at the end of the paper is given.

In Figure 2, the working logic of the paper is shown as a block, and the working logic of the paper is provided to control a smart home automation from the touch screen on the wheelchair with bluetooth control. In order to increase efficiency, the losses of the circuit are minimized and the input voltage to be applied is cleared of harmonics as much as possible. In the smart electric chair, smart home automation was controlled with the touch panel, enabling disabled citizens to control doors, windows, natural gas valves, lamps and many smart household items when they come home. In addition, GSM control allows them to call the police, ambulance and their relatives when they

have a job at home or outside. The photograph of the touch screen interface on the electric wheelchair is given in Figure 3.



Figure 1. Touchscreen Electric and Smart Wheelchair

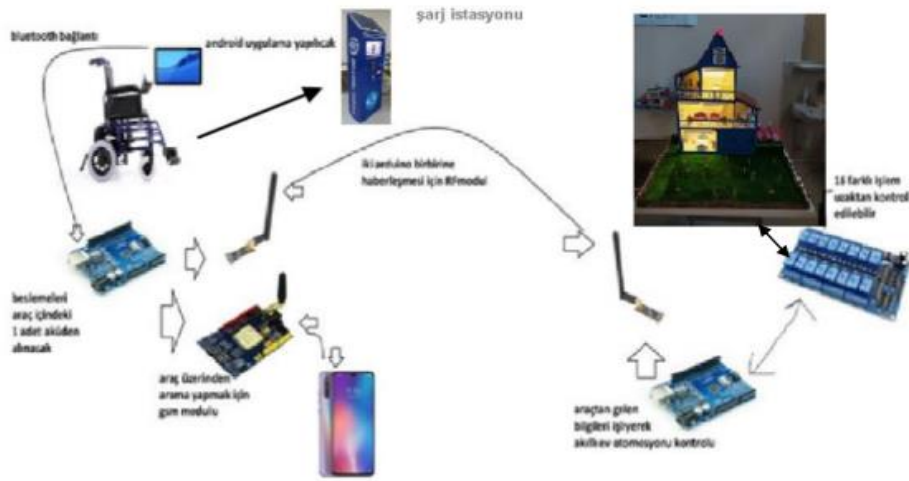


Figure 2. The Working Logic of Paper



Figure 3. Touch Screen Interface

In the control part of the wheelchair, control is made by using an Android application using a microcontroller card. In the charging unit part, an AC 220 / DC 24V power electronic converter was made and the necessary charger was designed. There is a lighting unit in the outer casing to attract the attention of the disabled. The working principle of the charger made; Converting the AC voltage taken from the network to DC voltage, and reducing the converted DC voltage to a lower voltage value by means of a DC-DC converter. The control of this converter is provided with the software designed using Arduino card. DC output is obtained by reading the card with a magnetic card reader (RFID) with Arduino. With the help of the solar panel, the spare battery is charged and the lighting around the charging station is carried out. Charging information and information about the station are reflected on the panel, with the help of the screen.

3. Results

Designing the control panel to be used on the vehicle and writing the necessary codes. Control panel consists of three Arduino, one GSM SHIELD and one NRF24L01 RF Communication systems. In order for the necessary devices to work, voltage values have been adjusted by using LM2596 Dc-Dc Reducer in the control panel. The data coming from the Android application is detected by the HC-06 Bluetooth module with a speed of 9600Kbaud and the action is decided.



Figure 4. Smart Battery Powered Chair Control Panel

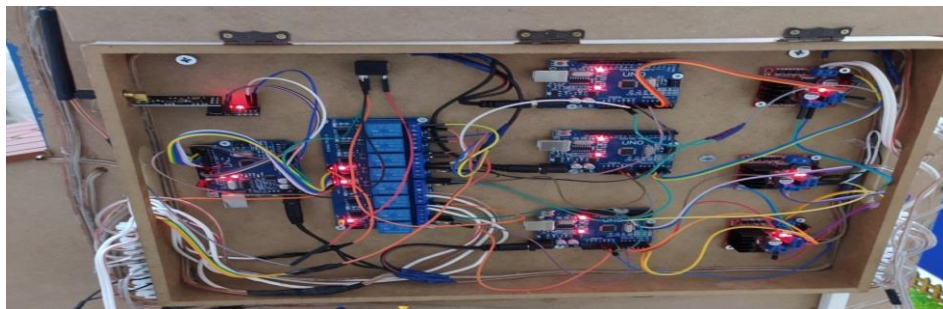


Figure 5. Smart Home Control Panel

The first Arduino processes the incoming data and if an operation is to be performed in the smart home automation, the Rf communication sends data to the second Arduino it is connected to. The second Arduino will process the incoming data and communicate with the smart home automation control panel at a speed of 2.4GHz and transmit the necessary data to the smart home automation

control panel to perform whatever is requested. If the data coming from the Android application is Emergency Call, the first Arduino transmits the data it detects to the third Arduino, and the call is performed over the GSM SHIELD at a speed of 4.5g. A loudspeaker and microphone were installed on the vehicle in order to carry out the search. The control panel on the vehicle is fed from a different source that does not belong to the vehicle. In other words, the system will not be affected in any way in case the vehicle runs out of charge or the vehicle breaks down.

Smart home automation has been realized by making smart home designs together with the control panel design. First of all, the smart home design, which is found below, has been started. After professionally building a three-storey house with a cnc machine, the decor and painting processes of the house were carried out. After the visual display of the smart house was completed, automation systems were made and assembled. The operations to be carried out in the smart home automation are the control of the individual lighting of the three floors, the control of the main entrance door of the house on the vehicle, the control of the garage door, the control of the garden lighting, the control of the garden automatic irrigation system, the control of all the roller blinds of the house, and finally, the operations of cutting off electricity from the natural gas in case of emergency. . These operations are performed according to the data from the android application in the smart wheelchair. The Rf communication receiver receives the data from the Rf communication on the vehicle in the control unit located in the smart home. The received data is processed in the first arduino and the relay card is controlled. It transmits the necessary data to three Arduino by opening and closing the required relay according to the operation to be performed.



Figure 6. Smart Home Automation

In this study, the battery chair with touch panel and charging station researches, which will facilitate the lives of our disabled citizens, are included. Our disabled citizens in developing housing technologies; To ensure the safety of life and property is to help them live their social lives better and to be involved in the society. As many researchers obtained from the research results, we have carried out studies to solve the problems that disabled people experience at home and outside. With the android touch screen where we will put a battery-powered chair, our disabled citizens will be able to open their doors, turn their lamps on and off, control smart home furniture,

open and close their curtains, and close their installations with instant access in case of any emergency at home, thanks to the smart module to be installed in their home. In addition, with GSM call commands to be placed on the touch screen, it will be able to call the police, ambulance and their relatives instantly in case of an emergency or when a possible bad situation is encountered outside.

At the same time, we have realized the smart charging station regarding the problem of battery-powered chairs running out of charge. With the widespread use of battery powered wheelchairs, various limiting problems such as battery technology, battery charging time and battery usage have emerged. For this reason, there are fast battery charging stations, display stations showing battery charge information and many battery charging stations. These stations charge the battery powered wheelchair fast, display battery information on the screen and charge it safely. With the advances in battery technology and the technological development of battery powered wheelchairs, it can be predicted that these vehicles and stations will greatly relieve the lives of disabled people in our daily lives. With this battery powered wheelchair charging station we will solve the battery charging problem of disabled people to a great extent. These stations are in areas where disabled people can easily reach; public institutions, city squares, shopping malls and universities etc. We aim to be established in collective settlements. Based on this, we are planning to eliminate the battery charging problem of disabled people in our school with the battery charger we have designed, and we have succeeded in establishing a battery charging station in our university campus.



Figure 7. Electric and Smart Wheelchair, Smart Home and Battery Charging Station Prepared for the Disabled

4. Discussion

The problem that our disabled citizens experience in their living spaces and outdoor environments is to find a solution in our paper, which we have done with the motto of a life without barriers. Our disabled citizens overcome these difficulties and enable them to use their right to a more comfortable and beautiful life. Our paper consists of two main parts. The first part is the problems that disabled citizens experience at their homes, and the second part is the problems our disabled citizens experience when they are not at home. In the first part, our disabled citizens design smart battery powered wheelchairs to provide smart home automation controls and to overcome some obstacles in their homes via battery powered wheelchairs and touch tablets. In this practice we have carried out, our disabled citizens have been given the right to live more reliable and spacious by increasing the quality of life in their homes. And in developing technology, they have been provided to benefit from technology by not leaving them behind. Another difference is that the control panel on the smart wheelchair can make calls via GSM Sheild in case of emergency, regardless of whether it is at home or outside. This helps our disabled citizens to be able to communicate in emergency situations, health or other problems. In the second part of our paper, our disabled citizens have the opportunity to walk around for a very short time due to the low battery capacity when they go out with a battery powered wheelchair. Our disabled citizens, who are competing with time, cannot move freely and comfortably as they wish due to these difficulties. For this purpose, by designing a battery charging station, it provides the opportunity for battery-powered wheelchairs to charge their vehicles free of charge in case of run-out or decrease. With the design of the battery charging station, our disabled citizens will be able to spend time as they want in the parks, gardens and squares when they go out, and then fill their vehicle charges at full capacity with the battery charging station. However, as can be understood, we offer our disabled citizens a life without disabilities.

Conclusions

In this paper, a smart electric wheelchair was designed and controlled in order to make the electric wheelchair vehicle used by the disabled citizens access the new generation advanced home technology via the vehicle via touch screen. Thanks to this smart system, disabled citizens are able to call the police, ambulance, fire brigade and their relatives with direct access on the touch screen in case of an emergency or in case of an emergency, as well as the ability of disabled citizens to control many objects on their chairs in a smart home system.

The second important point of the paper is the need to establish a charging station in the busy areas of the city in order to prevent disabled citizens from being stranded outside, considering that the batteries of wheelchairs run out in about 3 hours. As a result of the researches, it was planned to prepare an exemplary paper under the leadership of our university, since there is no such battery charging station in Erzincan province. For this reason, a solar-powered charging station was designed in order to charge the electric wheelchair, and it was planned to be built in the campus, a first for Erzincan province. The charging station, designed and implemented, has a special card reader system for disabled citizens, enabling disabled citizens to activate the charger and charge their vehicle with their card. The aim of our university is to enable disabled citizens to recharge their disabled cards free of charge when their battery-powered chairs are out of charge, and to make life easier for them.

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