The Android Application based Wheel-chair for Handicapped

Rohit Khot, Prof.Sachin Kulkarni

Abstract- **The "The Android Application based robotic wheel-chair for handicapped", consists of a standard powered wheelchair with an on-board processor and a graphical user interface. The project involves a basic foldable wheel chair; the chair is synchronized with a motor which drives the shaft for automated control. A special light weight design is made so that motors are easily interfaced with the wheelchair. Serpent industrial encoded motors with carbon brushes are used to drive the chair. To determine the position, velocity and direction of a motor shaft, encoders are used. They provide information for the precise control of a variety of applications, such as positioning in robotics. The motor is controlled using arduino nano chip which is mounted with Atmega 328 processor. The Arduino Nano can be powered via the Mini-B USB connection, up to 20V unregulated external power supply. The power source is automatically selected to the highest voltage source. The processor is interfaced with a standard Bluetooth module. An android based application with graphical user interface is prepared to connect to the arduino via. Bluetooth. The Bluetooth module has a LED indicator that shows connection status, when connected successfully. A lithium polymer charger is used connected to the motor. A battery of suitable size is used.**

Index Terms- **Robotic Wheelchair, Wheelchair Automation, Indoor Navigation, Navigation Control.**

Rohit Sheetal Khot with Sinhgad College of Engineering ,Vadgaon, E-mail-rohitkhot@icloud.com
Prof.S.A.Kulkarni with Mechanical Engineering Department at Sinhgad College of Engineering, vadgaon, Pune, E-mail-sakulkarni.scoe@sinhgad.edu

I. INTRODUCTION

The "The Android Application based wheel-chair for handicapped" is the development of a robotic wheelchair system that provides maneuver assistance in indoor and outdoor environments, which allows its user to drive more easily and efficiently. A robotic wheelchair is a semi-autonomous system. A robotic wheelchair can be used of the intelligence of the chair's user when there is difficult situations in navigating. A robotic wheelchair must navigate for long time without any problem. Successful interaction is one of the important things which will lead to more efficiency. Features may also include outdoor as well as indoor navigation with selection mode that can be automatic based upon the environment. The last few years have seen tremendous improvements with unmatched control of wheel chairs.

.

II. LITERATURE REVIEW

Some of the previous research on robotic wheelchairs has resulted in systems that are being restricted to some specific location. One of the restrictive assistive wheelchairs are systems that rely on map- based navigation. The system will perform efficiently only when a complete and accurate map is available; the map can be provided. This system requires the use of a magnetic ferrite marker lane for navigation. Once the wheelchair's user leaves the magnetic path, the technology of the assistive system is useless.

The controlling an automated wheel chair not only restricts the user to a particular building, but also it restricts the user to a particular indoor environment. [1] The sonar sensors installed on the chair facilitates navigation in the indoor office environments. The height of the sensors is the limitation as it prevents the system from being used outdoors on the grounds of inability to detect curbs. The people who are unable to drive a standard powered wheelchair have been empowered chair using sensor guidance and either the joystick or voice commands.

The TAO [2] has developed a robotic module for navigation that can be interfaced with standard can commercially available wheelchairs. It is based on computer vision to navigate in primarily an indoor environment, and limited outdoor situations. The TAO wheelchairs navigate in an autonomous mode, the user can override the robotic control with the joystick.

Next type of the wheel chair system [3][4] is based on a particular fixed magnetic path over which the wheel chair moves. This is fixed path system and requires already laid ferrite path for the chair navigation. This in turn implies that the wheels of chair are required to be made up of magnetic material. The system has a joy-stick controller with two directional front and back control.

III. PROBLEM STATEMENT

To design and implement a retrofit to a manual wheel chair so as to replace the current fully automatic wheel chair systems, which are navigation based and/or ferrite magnetic strip based

and /or map based. The proposed wheel chair has low maintenance and is easy to use, based on Android, which is very easy to access and use, leading to easy and mobile based navigation to work in any indoor or outdoor layout.

IV. THE BASIC WHEEL CHAIR.

The wheel chair has an overall height of 762 mm width of 1200mm and a folded width of 330mm size. The selected wheel chair is light in weight, foldable, weighing 30 kgs, and carrying weights up to 120 kgs. The drive wheels are of 600 mm in diameter. The wheels to move and control the direction of the motor are 500mm in diameter and made up of cast iron. The chair is supported by caster wheels of 60 mm diameter. The distance between two drive wheels is 600 mm. The foot rest is 300 mm ahead of the caster wheels. All These dimensions are particularly important as the retrofit has to accommodate the wide range of manual wheel chairs and is required to be so designed as to retain the 'Folding capability' of the wheelchair.

Wheel-chair technical specifications:-

- Seat height : 495mm(19.5”).
- Overall height : 762mm(30’).
- Overall width : 1220mm(48”).
- Folded width : 330mm(12.5”).
- Seat width : 610mm(24”).
- Seat depth : 457mm (18”) .
- Weight : 30kgs(66lbs).
- Capacity : 120kgs.

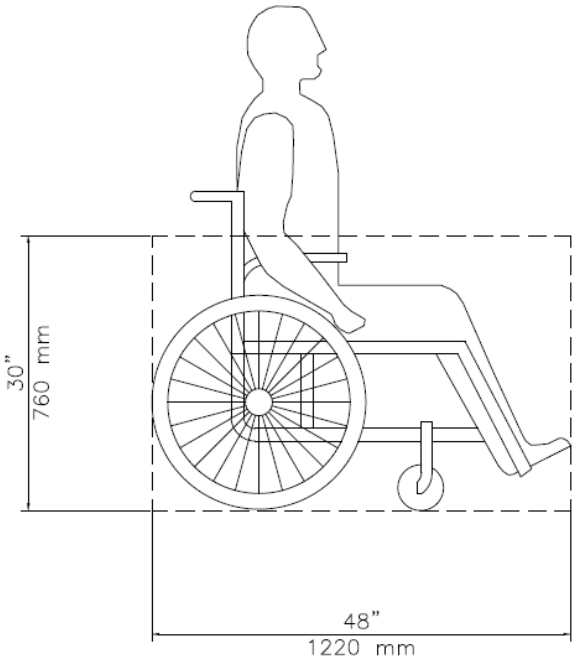

Figure 1.Side view-geometrical dimensions of wheel chair.

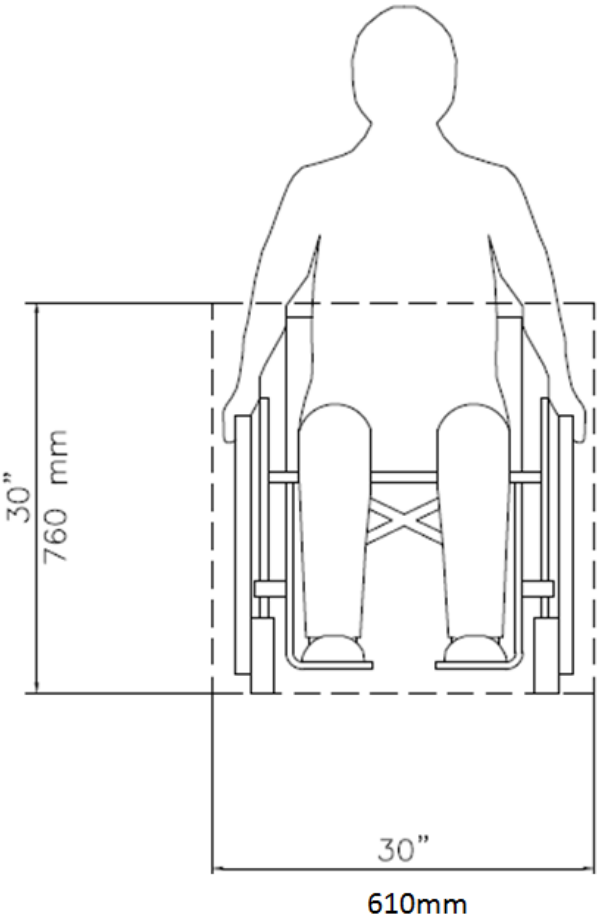

Fig 2.Frontview-geometrical dimensions of wheel chair.

V. Major system components

A. Arduino Nano

The Arduino Nano is selected as it is a small, complete, and breadboard-friendly board based on the ATmega328 Microprocessor, easy to connect, cost effective, readily available and it has 14 programmable i/o pins as required. The arduino software (IDE) is open source, on board programing facility with freeduiono, IC holder to burn BIOS chip and compatible with windows operating system. The processor on chip provides serial communication for faster data transfer required for faster accessing the motors and Bluetooth module. The arduino provides virtual communication port with software to connect to the computer USB port directly so no D-type connectors required. It works on readily available a Mini-USB cable connection which is used 6-20V unregulated external power supply as the required system.

B. LR7483

This is a high frequency synchronous converter with used normally for step-down voltage applications also used for rectification. This is a DC-DC rectifier .This IC has been selected as to it provides easy synchronization with the motors. This IC is commonly used for rectification applications for industrial motors.

C. JY-MCU Bluetooth Module

The bluetooth module on chair is used to connect to the android device. The connection is made at a frequency of 2.4Ghz ISM band that is 83MHz wide-band. Bluetooth Version 2.0+EDR (*Enhanced Data Rate*) 3Mbps is advantageous. It is easy to connect this module with any standard Bluetooth device, just search and key "1234" passcode. Baud rate: 38400 bps of delivered as for efficient bite rate capacity. Module requires no setup. Effective distance is up to 10 meter's. The connection is setup bluetooth module provides a simple interface for connecting to Arduino Nano. When the bluetooth on phone is connected the LED on bluetooth module starts to flash. The module provides feature to connect wirelessly with a PC or Bluetooth enabled device to transmit/receive embedded data such as GPS data, ADC voltage reading and other parameters. It has the following specifications and features.

D. The Android Application:-

The "bluetooth serial controller 16" application is used, to control the wheel chair. The application is available on playstore on any android device. The application supports bluetooth version 3.0 or above. The application uses bluetooth of device to connect to the bluetooth device of chair after the prompt password the device is connected. The application has graphical user interface with commands UP, DOWN, LEFT and RIGHT. Once the bluetooth is paired with wheel chair the application can be used to control the wheel chair. The bluetooth chip on chair gives signal by flashing once the device is connected.

E.DC MOTOR

1) Motor-Wheelchair interface:

A light weight motor is selected (1200gms) so that motors can be easily interfaced with the wheelchair. Chain drive mechanism motors are used. The advantage of using this system is the easiest method of interface, so the efficiency of motor is maintained. The interface is so designed that the folding capability of the wheelchair is retained, thus making the design more useful and desirable. Serpent industrial encoded motors with carbon brushes are used to drive the chair. Encoders are used to determine the position, velocity and direction of a motor shaft or other mechanical motion.

The motor is built in with encoders. Encoders are used to determine the position, velocity and direction of a motor shaft or other mechanical motion. They provide information required for the precise control of the chair. The encoders provide a method of orientation detection that's used as a reference point for position control. The encoder selected is a sensor that captures position information and relays that data to other devices. The position information can be determined using one of three technologies: optical, magnetic or capacitive. Optical encoders are the most accurate of the standard styles of encoders. So choosing an optical encoder, it's important that the encoder has extra protections built in to prevent contamination from dust, vibration and other conditions.

The without load motor maintains a rpm of 200rpm without load. While, the motor with load has a rpm of 100 rpm. Now, the working of motor for the movement of chair in right or left direction. In case of turning the chain in left direction the left motor rotates in reverse direction and right motor in forward direction. The motors employed have built-in optical incremental encoders. An incremental encoder only reads pulses to provide information about only relative motion of the shaft, and not angular position. The technical Specifications of motor are as under

- Shaft diameter : 9mm.
- Mounting diameter : 35mm x 5holes
- Motor diameter : 65mm.
- Motor Length : 170mm
- Motor weight : 1200gms
- Rated torque : 128kgcm
- Stall torque : 348kgcm
- No-load speed : 92rpm
- No-load current : 600mA.

2) Motor Mount details:

The motor is mounted on a steel sheet (35mm x 4 holes) which is welded to the lower section of rod attached to wheels as shown in figure 1. The distance of chain sprocket mounted on motor from inner side of wheel chair is 20 mm, the sprocket to motor is 35 mm and length of the motor length is next 355mm, thus leaving the gap of 200 mm between two motors.

E. *Battery:*

A good capacity battery is selected with supply of 10v and the is light in weight.

Technical specifications of battery

- Capacity : 4220mah
- Voltage : 11.1v.
- Size : L=13.4cms; B=4.1cs H=2.0cms.
- Weight : 330gms.

F. *Battery charger*

A standard lithium polymer battery charger is selected which is common used in every application these days. This charger has following features,

- AC 100~240v or 12V DC input.
- Microprocessor controlled.
- Delta-peak sensitivity.
- Individual cell balancing.
- Li-ion, LiPo and LiFe capable.
- Ni-Cd and NiMH capable.
- Large range of charge currents.
- Store function, allows safe storage current.
- Input voltage monitoring.
- Battery break in and cycling.

VI. Block diagram of system:-

The block diagram shows the first block is the controlling android device which sends signals to the wheel chair .The next block is arduino processor which accepts the controlling signals and follows out the program and send the signals to the motors via the driver IC as shown in figure. The arduino commands the motor through the driver IC. The signals DIRECTION, BRAKE and PWM are given by controller to motors for wheel chair movement control.

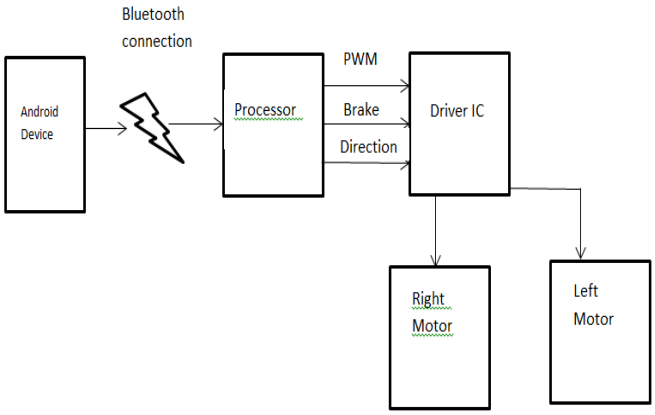

Fig 3. The block diagram of the System

VII.WORKING OF THE SYSTEM

The process starts as the user gives commands from the android device, to the wheel chair. The Android based "Bluetooth serial controller "application is connected to Bluetooth Module via bluetooth link. The Bluetooth module connected to arduino microcontroller board, receives character data from android application and transmits those characters to arduino. The Arduino which is directly interfaced with driver IC controls flow of PWM, w.r.t. DIRECTION and BRAKING.

The system works as follows

- The user is required to connect the android device with bluetooth module(JYC-MCU) on the wheel chair.
- User has to select mode direction command.
- User selects a navigational direction key (front, Back, Left, Right) on screen. Each key on screen is related to a character value (F, B, L, and R. When the key is pressed by the user, the character value is sent by the program and is transmitted to bluetooth module.
- The characters assigned for higher speed operation are(F,B,L and R) while for lower speed operation are (f, b, l, r). Thus, a single character value is generated for any single key press.
- Bluetooth module receives this character and sends it to arduino nano.
- The processor Arduino Nano receives the single character value and decides to run motor in forward direction or in reverse direction.
- When arduino receives 'F' or 'f', both ESC's thus both motor's receive PWM's, high DIRECTION and low BRAKE's.
- If arduino receives 'B' or 'b', both ESC's thus both motor's received PWM's, low DIRECTION and low BRAKE's.
- If arduino receives 'L' or 'l', both ESC's thus both motor's receive PWM's, left is reversed and right motor in forward direction.
- If arduino receives 'R' or 'r', both ESC's thus both motor's receive PWM's, right motor with reverse direction and left motor with forward direction.

The state table shown below explains the various states of mode of operation. Here, states of the system vary according to the key touched (front, Back, Left, and Right) on the android application. "F, B, L, R" are the sets of characters sent by Bluetooth module. Arduino nano can transmit PWM to Left or Right (L/R) motor at frequency between 0-255(256). The state of motor can be in determined with '1' as ON and '0' as OFF.

Table 1. State table of the system.

KEY		FRONT	BACK	LEFT	RIGHT
CHAR		F or f	B or b	L or l	R o r
PULSE	Left	[200]	[200]	[200]	[200]
PULSE	Right	[200]	[200]	[200]	[200]
DIR	Left	1	0	0	1
DIR	Right	1	0	1	0
BRAKE	Left	0	0	0	0
BRAKE	Right	0	0	0	0

VIII. CONCLUSION

This paper represents a usable, low-cost assistive robotic wheelchair system for disabled people. An indoor navigation system and a graphical user interface have been developed. The reactive system and does not require maps or planning. The system can be used in a variety of locations. The interaction between the user and the wheelchair is discovered. The ultra-sonic sensors are used for obstacle avoidance.

Finally, the system has an easily customizable user interface. A wide range of access methods can be used to control the system. The android application based wheel chair provides ease of use as compared to the wheel chairs available in market. The navigation is easy and suitable for indoor and external environments. The system is less expensive than the current market wheel chairs.

ACKNOWLEDGEMENT

I wish to express my warm and sincere thanks to Prof.S.A.Kulkarni, for his valuable guidance along with the care extended throughout the project. I thank SCOE,pune for providing facilities and resources for my project.

10. REFERENCES

[1] Richard Simpson, Simon Levine, David A. Bell , Lincon A. Jaros "NavChair: An assistive wheelchair Navigation system with automatic adaptation" ,1999 IEEE transactions on rehabilitation.

[2] Osamo Matsumoto and Kiyoshi Komoriya; Koji Toda ; Shigeki Goto; Tsutomu Hasate; Hideki Nishimura "TAO chair" ,2006 IEEE RSJ international conference ,Beijing.

[3] Hiro Wakaumi "Development of an automated wheelchair guided by a magnetic ferrite marker lane " ,Journal of Rehabilitation Research and Development Vol. 29 No. 1, 1992
Pages 27-34

[4] Smart wheelchairs: A literature review
Richard C. Simpson, PhD,
Department of Rehabilitation Science and Technology, University of Pittsburgh, Pittsburgh, PA

[5] Wen-Chang Cheng and Chia-Ching Chiang "The Development of the Automatic Lane following Navigation System for the Intelligent Robotic Wheelchair", 2011 IEEE International Conference on Fuzzy Systems June 27-30, 2011, Taipei, Taiwan

[6]Thomas R¨ofer and Christian Mandel "Controlling an Automated Wheelchair via Joystick/Head-Joystick Supported by Smart Driving Assistance ",2009 IEEE 11th International Conference on Rehabilitation Robotics:IEEE

[7]"Autonomous Wheelchair for Disabled People
G. Pires, N. Honório, C. Lopes, U. Nunes, A. T Almeida
Institute of Systems and Robotics
University of Coimbra, Polo II
3030 Coimbra, Portugal

[8]Tom Carlson and Yiannis Demiris "Robotic Wheelchairs: Scientific Experimentation or Social Intervention?"

[9]Axel lankenau and Thomas Rofer "A Versatile and Safe Mobility Assistant"

[10] Michael Baker, Holly A. Yanco "Automated Street Crossing for Assistive Robots ", Member, IEEE

[11] Naga phanindra 1, B. Suresh Ram2 " Wireless Remote Control Car Based on ARM7"M.Tech, Dept of ECE, CMR College of Engineering and Technology, Hyderabad, AP-India,

[12] Maged N. Kamel Boulos1, Ann C. Brewer2, Chante Karimkhani3, David B. Buller4, Robert P. Dellavalle" Mobile medical and health apps: state of the art, concerns, regulatory control and certification

[13] Yoshitoshi Murata, Kazuhiro Yoshida"Proposal of an Automobile Driving Interface Using Gesture Operation for Disabled People" Faculty of Software and Information Science Iwate Prefectural University,Takizawa, Japan