

Smart Wheelchair For Handicapped People Using Voice, Gesture & Touch Screen

Revati A. Solanke¹, Arti R. Salunke²

^{1,2}Department of Electronics Engineering, JNEC, Aurangabad, Maharashtra, (India)

ABSTRACT

This paper is to describe a smart wheelchair for physically challenged or elderly person (user) using inputs such as voice, gesture & touch screen commands via touch screen phone. With the help of this wheelchair, user can move without external help to anywhere they want, simply by speaking the direction name or by making the movement of the touch screen phone they will be provided with. It is also provided with obstacle avoidance facility, where the person may not be able to give proper command at the right time. If the user feels to be found in danger, a security threat message can be sent through the touch screen mobile phone to specified number.

Keywords: *Wheelchair, gesture, voice commands, handicapped, touch screen*

I. INTRODUCTION

With the increase of aged and disabled people, a huge variety of support devices and modern equipment has been build up to help improve their quality of life. Some patients which cannot control the wheelchair with their arms due to a lack of force face main problems such as orientation, mobility & safety. The general image of disability is the people in wheelchairs. The wheelchairs are used by people who find themselves unequipped to move without outside aid. The special needs of the elderly may differ from that of a handicapped person or a large individual but they all have “special needs” and often require some support to perform their daily routine. The handicapped people, who use a normal wheelchair for navigation, frequently need an external person to move around. In this busy world, the aged people may be left unaided or alone at home and also may not find an apt person for external help. Here comes the need of an automatic home navigation scheme, which consists of a wheelchair which can be used by the elderly and the handicapped people without the help of an external person. The proposed Home Navigation System (HNS) can be operated using voices and the gestures of the provided android mobile phone. An essential feature is that the personal security of the person who is using the wheelchair is also taken care. If the person feels painful or insecure, he can send a message to a predefined number using the speech to text (STT) function in the mobile phone.

II. RELATED WORK

It is reviewed that although some current wheelchair systems have embedded computers, they have inadequate computer control and require exact, low-level control inputs from the user; interfaces are similar to those found in passenger cars. Designers developed a smart wheelchair with intelligent controllers that let people with physical disabilities overcome these difficulties. By equipping the wheelchair with cameras, a laser range finder,

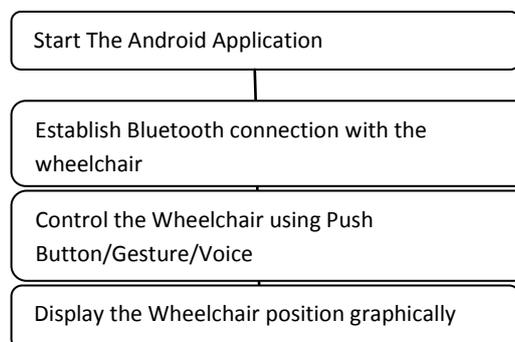
and on-board method, we give the user a flexible, intelligent control system. Account of the high risk of accidents with people and objects is taken in [2].

This paper explains and presents the preliminary results of a system that uses an infrared sensor to provide anti-collision and a timely system for a powered wheelchair that helps guide the user safely past obstacles. Paper [3] focuses on the navigation and guidance system of a powered wheelchair. We have developed a navigation unit with different levels of autonomy which realizes an active interaction of the user with the robotic aid.

A wheelchair for handicapped people developed within the UMIDAM I Project is explained in [4]. A needy-user recognition voice system and ultrasonic and infrared sensor systems has been included in this wheelchair. In this way we have acquired a wheelchair which can be driven autonomously or with using voice commands and with the possibility of avoiding obstacles or difficulty and downstairs or hole detection. Paper [5] explains the wheelchair system with user friendly touch screen interface. The ability to choose between physical operating mode and predefined operating mode uniquely presents capacity of the wheelchair to operate in multiple environments.

III. PROPOSED SYSTEM

3.1 Flow Chart of The Voice and Gesture Based Wheelchair



IV. SYSTEM DESIGN

Here we can understand the assembly and working of the model. System uses an Android or touch screen phone to communicate with the wheelchair and a desktop computer is used to observe the position of the wheelchair.

4.1 Hardware Description

The hardware consists of diverse components such as AVR ATmega32, a Bluetooth device, motor driver which is L293D, IC ULN2803, external device such as torch, two dc motors of 5 rpm each, MAX232 for serial communication between AVR and Bluetooth, 4 sensors for temperature, smoke, obstacle distance and light along with an android or touch screen phone and a remote computer which are explained one by one below

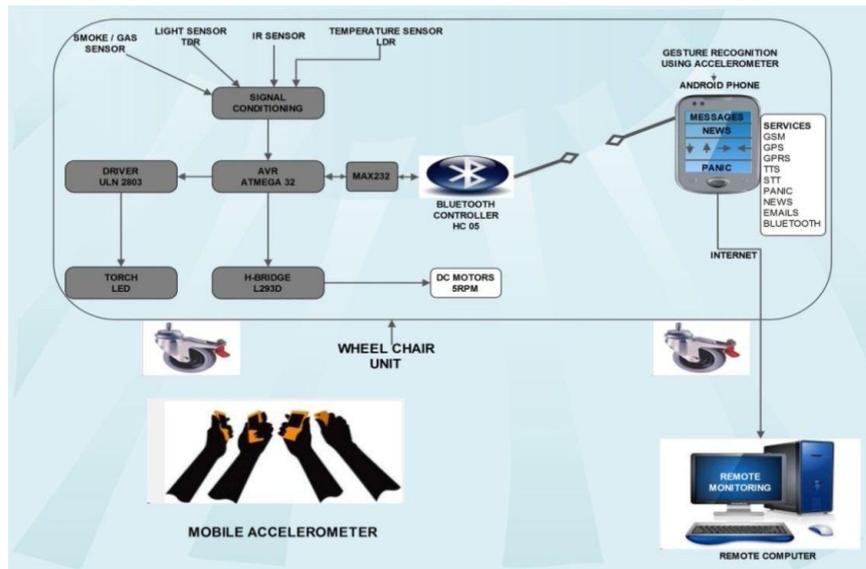


Fig.1. Block Diagram of System Operation

4.1.1 ATmega32

Fig 2 is the pin out illustration of the ATmega32 controller. The ATmega32 is a low-power Complementary metal oxide semiconductor (CMOS) 8-bit microcontroller based on the AVR improved RISC architecture. By implementing prevailing instructions in a single clock cycle, the ATmega32 gets throughputs approaching 1 MIPS per MHz allowing the system designers to optimize power consumption versus processing speed.

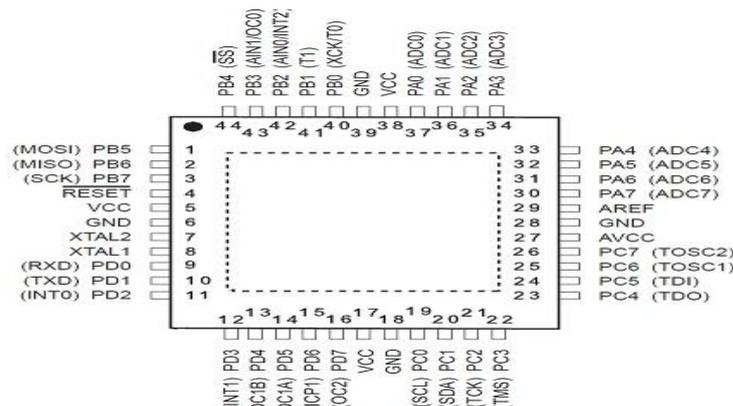


Fig. 2. ATmega32 Pinout

4.1.2 L293D

L293D is a dual H-bridge motor driver integrated circuit IC (integrated circuit). Motor drivers work as current amplifiers since they take a low-current control signal and provide a higher-current signal. This advanced current signal is used to steer the motors. Figure 3 below is the pin diagram of L293D. Allow pins 1 and 9 (matching to the two motors) should be high for motors to start operating. When an input is high, the related driver gets enabled. As a consequence, the outputs become active and work in phase with their inputs. Likewise, when the facilitate input is low, that driver is disabled, and their o/p (outputs) are off and in the high-impedance state.

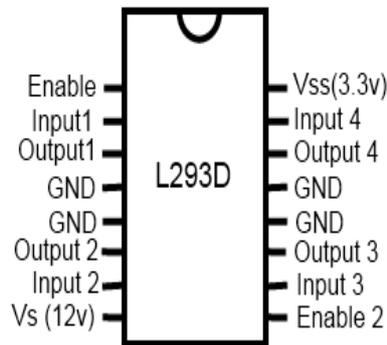


Fig.3. L293D Pinout

Normally, L293D motor driver can control 2 motor at one time or called is a dual H-Bridge motor driver. By using this IC (Integrated circuit) , it can interface DC motor which can be controlled in both counter clockwise and clockwise direction. The motor operations of 2 motors can be controlled by input at pins 2 & 7 and 10 & 15. Below is shown the pinout diagram of L293D motor driver.

Also that, with this L293D driver motor it will control 4 DC motors at 1 time but with fix direction of motion. L293D has peak o/p or output current of 1.2A and output current of 600mA per channel. Moreover for protection of circuit from back EMF output diode are included within the L293D. The output supply which is outer supply has a extensive range from 4.5V to 36V which has made L293D a top choice for DC motor driver. A simple illustration for interfacing a DC gear motor using L293D driver motor is shown below

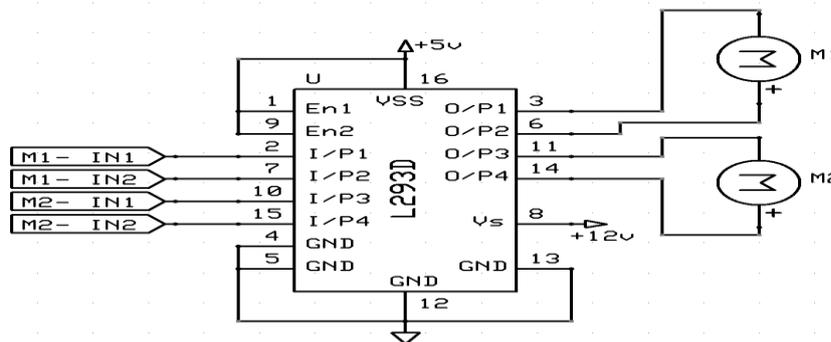


Fig.4. Schematic for Interfacing a DC Gear Motor Using L293D Driver Motor

4.1.3 MAX232

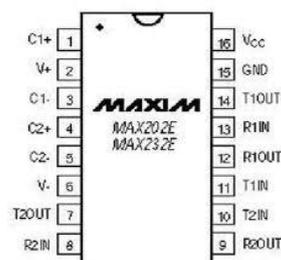


Fig.5. MAX232 Pinout

The MAX232 IC is used to change the TTL/CMOS logic levels to RS232 logic levels during serial communication of microcontrollers with PC. The controller works at TTL logic level (0-5V) whereas the serial communication in PC works on RS232 standards (-25 V to + 25V). This makes it hard to establish a direct link between them to communicate with each other. In the meantime link is provided through MAX232. Above fig 5 is the pin diagram of MAX232.

4.1.4 ULN2803

Featuring continuous load current ratings to 500 mA for each of the drivers, the Series ULN28xx high voltage (v_{tg}), high-current (c/t) Darlington arrays are preferably appropriate for interfacing between low-level logic circuitry and multiple peripheral power loads. Typical loads consist of relays, solenoids, stepping motors, magnetic print hammers, multiplexed Light emitting diode (LED) and incandescent displays, and heaters. Refer fig. 6 below for the pin explanation of the ULN2803.

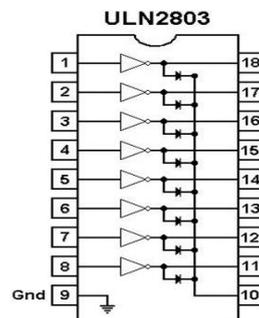


Fig. 6. ULN2803 Pinout

4.1.5 Sensor : Here we are used 4 sensors - proximity, smoke, temperature and light. Proximity and smoke detection uses Infrared technique, temperature is discovered by thermistor and light using LDR.

4.1.6 HC 05 serial port Bluetooth module

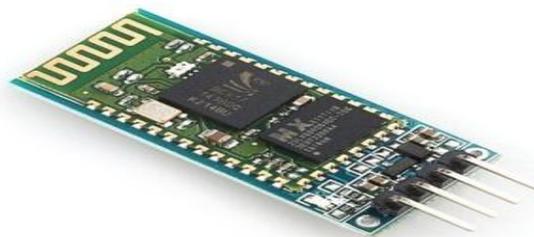


Fig.7.HC 05 serial port Bluetooth module

HC-05 module is a simple to use Bluetooth SPP (Serial Port Protocol) component, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully eligible Bluetooth V2.0+ Enhanced Data Rate EDR 3Mbps Modulation with whole 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External only chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint little as 12.7mmx27mm.It will be easier for overall design/development cycle. Figure 7 is the Hc 05 serial port Bluetooth module image.

4.1.6 Power Supply component:

The +5 volt supply is useful for both AC and DC circuits. DTL, TTL, and CMOS ICs will all operate well from a +5 volt supply. In addition, the +5 volt supply is useful for ckts or circuits that use both analog and digital signals in various ways. More essentially for our purposes, the +5 volt supply will be used as the primary reference for regulating all of the other power supplies we will build. This can be done very simply if we use opamp (operational amplifiers) as the controlling elements in the power supply circuits.

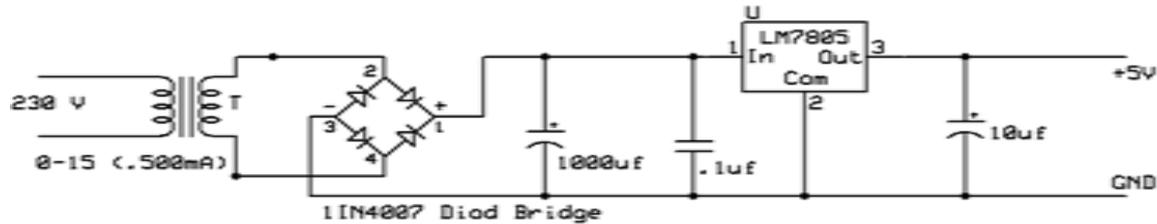


Fig.8. Schematic Diagram- Power Supply 5V

The +5 volt power supply is based on the commercial 7805 v voltage regulator IC. This integrated circuit (IC) contains the entire circuitry essential to accept any input voltage from 8 to 18 volts and generate a steady +5 volt o/p (output), to be precise within 5% or 0.25 volt. It also contains current-limiting circuitry and thermal overload protection, so that the IC won't be broken in case of too much load current; it will reduce its output voltage instead

4.2 Circuit Diagram

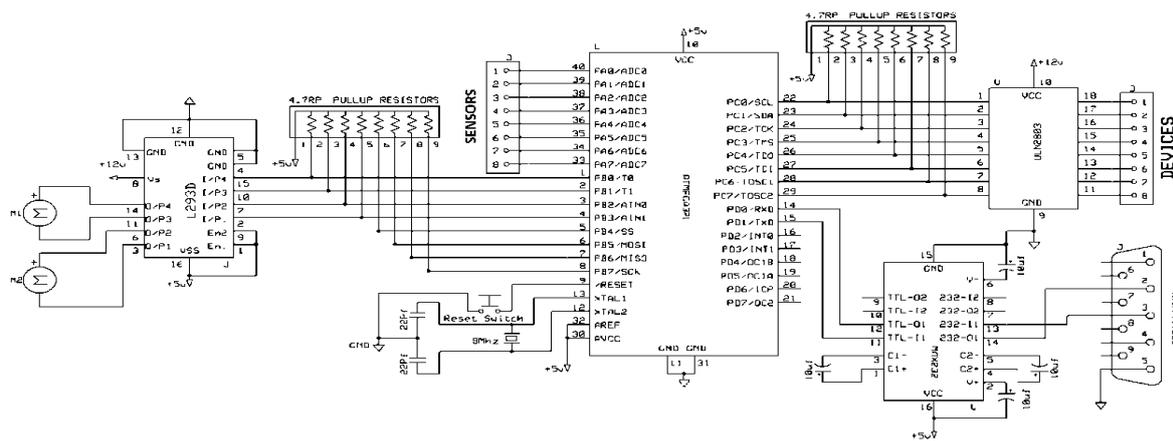


Fig.9. Circuit Diagram of the Wheelchair model

We have already discussed the functioning of the components which can be seen in the circuit diagram. This is all about the hardware component of the wheelchair model. Next we'll consider the software part of the system

4.3 Software Description

In the Software part of this system, first comes the android. This is a L phone inux-based operating system mainly designed for mobile devices such as smart phones and tablet computers utilizing Advanced RISC Machine (ARM) processors, uses JAVA as the programming language. NetBeans are well known to make the

GUI (Graphical User Interface) of the android application. In the end to communicate to a remote monitoring desktop, we used Servlets.

V. PERFORMANCE ANALYSIS

5.1 Systems Performance Analysis

There are 4 GUI (Graphical user interface) screens in this android function. Working of each is explained below-

Mobile Screen 1- Enter the IP address of remote monitoring desktop (Refer fig 10)

Mobile Screen 2- url of the news website, email id and password (Refer fig 11)

Mobile Screen 3- To connect via Bluetooth to wheelchair (Refer Fig 12)

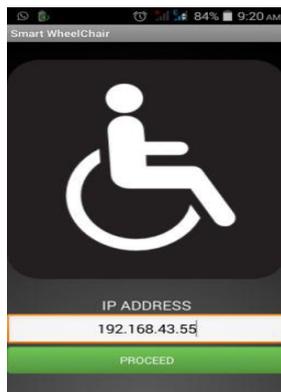


Fig.10. IST Mobile Screen



Fig.11.IInd Mobile Screen



Fig.12.IIIrd Mobile screen

5.2 GUI screens of the Android Application



Fig. 13. 4th GUI Screen

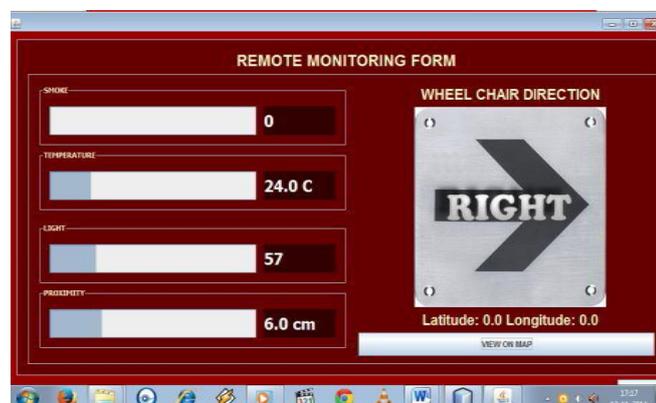


Fig. 14. Remote Desktop screen

On the fourth screen (refer fig 13), real operation of the wheelchair is controlled. Now the movement of wheelchair is controlled in three different ways - Push buttons, Gesture of the handset and voice. There is provision of buttons for sending a help seeking message and torch are also.

5.3 Monitoring on remote Desktop

Here on the remote desktop (refer fig 14), we can observe the 4 sensor values as shown in above photo. Secondly, the c/t (current) movement of the wheelchair and the latitude and longitude locations can be study. Along with this, a link to Google Map is given which can explain the position of the wheelchair on the Google map.

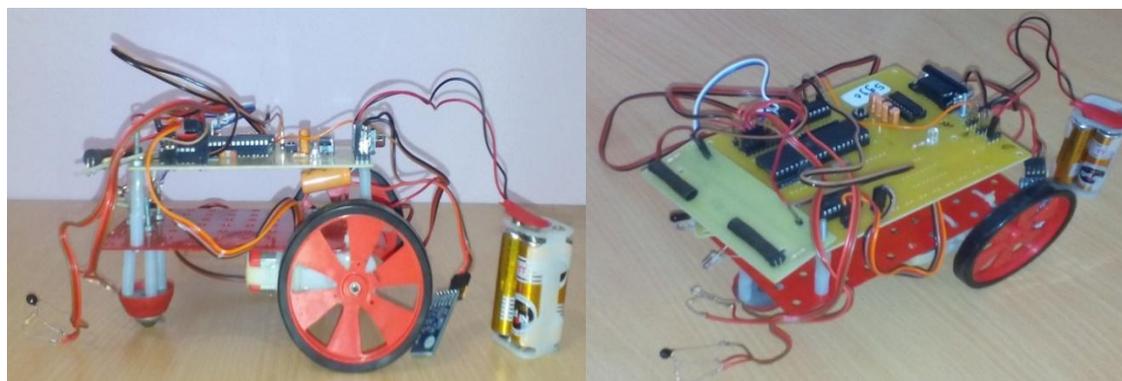


Fig. 15. Proposed System Hardware of Wheelchair For Handicapped People

VI. CONCLUSION

Here we have tried to provide a wheelchair for both elderly and the handicapped with a varied physical disability. Those who are unable to speak, but have their hands in working condition, can use the push buttons. Those who can't see on the screen of mobile phone, but once again, have their hands in working condition, can use the gesture controlled input where just by tilting the handset. Lastly, those who can pronounce a word can directly pronounce the command and navigate the chair.

VII. ACKNOWLEDGMENT

I am highly indebted to **Mrs. A. R. Salunke** (Assistant Professor at JNEC, Aurangabad) for her valuable guidance and constant supervision as well as for providing valuable information. I would also like to express my particular gratitude and thanks to her for giving us such attention and support.

REFERENCES

- [1] Sarangi P. Parikh, Valdir Grassi Jr., Vijay Kumar, Jun Okamoto Jr., "Integrating Human Inputs with Autonomous Behaviors on an Intelligent Wheelchair Platform", IEEE Computer Society-Vol. No. 22, Issue No. 02, pp. 33-41, March/April 2007.
- [2] Mihailidis A, Elinas P, Boger J, Hoey J., "An Intelligent Powered Wheelchair To Enable Mobility Of Cognitively Impaired Or Adults: An Anti-Collision System", Neural Systems and Rehabilitation Engineering, IEEE Transactions- Vol. No. 15, Issue No. 01, pp. 136-143, March 2007.
- [3] S. Fioretti, T. Leo, and S. Longhi, "A Navigation System for Increasing the Autonomy & the Security of Powered Wheelchair", IEEE Transactionson Rehabilitation Engineering, Vol. No. 8, Issue No. 4, December 2000.

- [4] Manuel Mazo, Francisco J. Rodriguez, Josi L. L, Zaro, Jesi Is Urei A, Juan C. Garcia, Enrique Santiso, Pedro Revenga and J. Jesi Is Garcia,
- [5] Ming-Ching Tsai; Kai-Sheng Wu; Po-Wen Hsueh. "Synchronized Motion Control for Power-Wheelchairs" Proc Int'l Conf. Innovative Computing, Information and Control (ICICIC), Dec. 2009, pp. 908-913.
- [6] Vasundhara G. Posugade, Komal K. Shedge, Chaitali S. Tikhe, "Touch-Screen Based Wheelchair System", ISSN: 2248-9622 Vol. 2, Issue 2, pp.1245-1248, Mar-Apr 2012
- [7] Richard Simpson, PhD, ATP; Edmund LoPresti, PhD; Steve Hayashi, PhD; Illah Nourbakhsh, PhD; David Miller, PhD, "The Smart Wheelchair Component System", Journal of Rehabilitation Research & Development, May/June 2004, Pages 429-442
- [8] http://www.ijirce.com/upload/2014/december/6_Voice.pdfJ. Padhye, V. Firoiu, and D. Towsley
- [9] Posada-GOMEZ; L. Sanchez-Model, G. Alor Hernandez, A. Martinez-Sibaja, A. AguilarLaserra . L. Leija-Salas, "A Hand Gesture System Of Control For An Intelligent Wheelchair", Proc Int'l Conf. ICEEE 2007, Sept 2007, pp. 68-71
- [10] S. P. Levine, D. A. Bell, L. A. Jaros, R. C. Simpson, Y. Koren, and J. Borenstein, "The NavChair assistive wheelchair navigation system," IEEE Trans. Rehab. Eng., vol. 7, pp. 443-451, Dec. 1999.
- [11] D. Lowe, "Distinctive image features from scale-invariant keypoints," International Journal of Computer Vision, vol. 60-2, pp. 91-110, 2004.
- [12] J. Y. WONG, THEORY OF GROUND VEHICLE, 3RD EDITION. JOHN WILEY AND SONS, INC., 2001, CH.4.5.