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Smart Robotic Wheelchair Using Arduino And Bluetooth Module

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Abstract: *The proposed system describes the design of a smart, motorized and voice-controlled wheelchair using an embedded system. The system design depicts the "Smart Wheelchair" that supports voice activation system for physically disabled and old aged people by incorporating voice commands which would control the movement of the wheelchair. The voice command is given through a cellular device such as cell phone having Bluetooth and the command is transferred and converted to the string for Adriano and is transferred to the Bluetooth Module SR-4.0 connected to the Adriano board for the control of the Wheelchair. When the user says "Go" the chair will move in the forward direction, the chair would move in the backward direction for "Back" and similarly "Left", "Right" for rotating it in left and right directions respectively and "Stop" to stop the wheelchair. This system is designed and developed to save cost, time, energy and dependence on the others for the movements of wheelchair-using physically handicapped person.*

Keywords: *Wheelchair, Adriano, Voice Control, Bluetooth, Robotic*

I. Introduction

The Robotic Wheelchair extends the capability of traditional powered machines by introducing control and navigational intelligence. These machines can ease the lives of many disabled people, particularly those with severe impairments by increasing their range of mobility. [1] For the differently disabled people, there are inventions of wheelchairs, which can be moved using hands. Some people move the wheelchairs using their own hands. Some have to rely on others [2]. But sometimes such people face many problems if they don't get any person to move their wheel chair or they may get tired [3]. This project "Smart Wheelchair using Adriano and Bluetooth module" aims to resolve the above mentioned issue. In this project we are going to make a wheel chair which can be controlled automatically using the voice commands. The system allows physically disabled person to control the wheelchair easily without the need to use the hands. The movement of the powered wheelchair depends on the motor control and drive system which consists of microcontroller and motor driving. Once the voice recognition system recognizes the voice commands with respect to the stored memory, the respective coded digital signals can be sent to the microcontroller. It then controls the wheelchair accordingly.

By the proposed approach, described in this paper, low-cost, simple and friendly solution for the voice controlled platform will be presented that is user friendly, fully-customizable according to the language spoken by the user and will help in enhancement of users independent mobility. Using a Smartphone as the "brain" of a robot is already an active research field with several open opportunities and promising possibilities [8]. Another recent and very successful technology, Bluetooth has changed how people use digital device at home or office, and has transferred traditional wired digital devices into wireless devices [7]. This research is based on Voice-controlled Wheelchair design based on mobile platforms, by means of Bluetooth technology, design and implementation of wireless remote control solutions. The project also incorporates use of ultrasonic sensors to detect obstacles within range of 4 meters and notifies the system and stop the wheelchair till further command. In this work, Smart Wheelchair control using Arduino Uno microcontroller and Bluetooth Module via android application is presented.

II. Related Work

G Azam and M T Islam, an anticipated system that helps to the self need of physically challenged and older people. It minimizes the manual attempt for acquiring and individuals to control the motion of a wheelchair. The author suggested this devise could be enhanced by providing the wireless communication facility, using sensors to sense an obstacle in the wheel chair. By humanizing this system, we directly enhance the lifestyle of the disabled people in the community. [1]

Andrej Škraba, proposed the system which controlled by using the voice command, the GUI is developed which is used in the web browser as well as on the mobile devices providing live video stream. The drawback of the planned approach is hidden in the user's inflexibility for practical innovations, particularly adopting

the design of rising control software that the cloud provides new possibilities.[2]

Imen Klabi, designed Fuzzy Logic Control of the wheelchair in such a way that it can be controlled easily with very less attempt from the patient. Author focused on non-conventional organize algorithm

developed using a PC interfaced with an embedded microcontroller platform. Experimental results are approved out on a wheelchair platform.[3]

Alexandre A.G. Martinazzo, this work deals with an Arduino-based open hardware project can be enhanced to turn out to be an industrial product with the identical excellence level of existing available devices. The ensuing product is programmed to be released to the public in the year 2016 and will enlarge the use of power wheelchairs in Brazil so that citizens with disabilities have access to such electronic equipment.[4]

Neal Seemiller, presented a novel dynamic model using WMR planning, control, and estimation systems. Author applied 3-D kinematics method. Derivation Simulation tests proved that dynamic models to be more functional, stable, and efficient than common alternatives. [5]

Neal Seegmiller and Alonzo Kelly, designed a system exceptionally mobile and named as wheeled mobile Robots (WMRs). In this experiment, simulation result shows that system run over 1K × faster than real time on an everyday PC. Experimental results shows that, once registered, this model predict movement accurately.[6]

In 2010, a Power Wheelchair Open Platform (PWOP) [9] was developed. It is an open hardware and free software project for power wheelchair electronics with an advanced module structure when compared to sit-and-drive devices. It provides Bluetooth connection, two controller ports (one for the main user, another for the caregiver) and infrared emission, all compatible with the most expensive modules available on the market. The PWOP project was designed to contribute to the Open Hardware community and to provide an inexpensive platform for research purposes, such as human interface development and prototype tests. It has been engineered around the Arduino platform to drive modern power wheelchair DC motors. Nevertheless electric wheelchair industry needs simple, robust, low cost control modules. Including all the PWOP features in a commercial module [9] would make the final product too expensive to replace common sit-and-drive devices. Therefore a bluetooth-enabled power wheelchair control module was developed based on the PWOP project and industry demands.

III. Proposed System

The previous system used the joystick and manual operations with Arduino and Bluetooth module. Robotic Smart Wheelchairs are smart machines that can be programmed and used in many areas such as industries, manufacturing, production lines or health, etc. These types of robots perform hard, dangerous, and accurate work to facilitate our life and make human life easier. They are used to improve our lifestyle. The idea of this project is to exploit robotics usage on healthcare field to help in mobility of disabled people. The system should have error-checking capabilities. With regard to real time performance, there is a need for a low intermission system, which is affected by the delay in processing and transmission. A Smartphone is a mobile phone built on a mobile computing platform, with more advanced computing ability and connectivity than a feature phone. Now a day's Mobile phones are more reasonably priced and resourceful hand held device which can be used to maintain shared actions in a society. Humans are anxiously working on finding new ways of interacting with machines. However, a major breakthrough was observed when gestures were used for this interaction.

In this project we use verbal communication in which particular commands are used [Left, Right, Go, Back]. It comprises of sound, voice variations, based upon the type of movements. They have been recognized through voice recognition application, ultrasonic sensor, Bluetooth and Arduino kit. Smartphone, a small yet powerful device is rapidly changing the traditional ways of human-machine interaction. Android OS has gained major among all the available mobile operating systems after being launched in 2008, overtaking all the market.

An Android Smartphone will act as remote controlled device for movement of the robot. An Android application will be developed for the same. The Bluetooth module will act as an interface between Smartphone and microcontroller. We will be using HC05-06 Bluetooth module for the system and slave will be Bluetooth module. Bluetooth module will give the commands given by Smartphone to the microcontroller. Microcontroller will act as the brain of the robot. The robot movement will be decided by the microcontroller. In this system we will be using microcontroller named Adriano Uno which contains mega 328p microcontroller chip.

Arduino has its own programming environment through which the microcontroller can be programmed. As our system is for travelling purpose we will be using a DC motor. It will generate high amount of power and torque which will be sufficient to drive a human being. A motor driver will be used to control the DC motor, will we connected to the microcontroller and the Bluetooth module will be connected to the same. In this proposed system we will be using any rechargeable battery to supply power to the electronic components of the system. Mainly the microcontroller and DC motor will be in need of power supply.

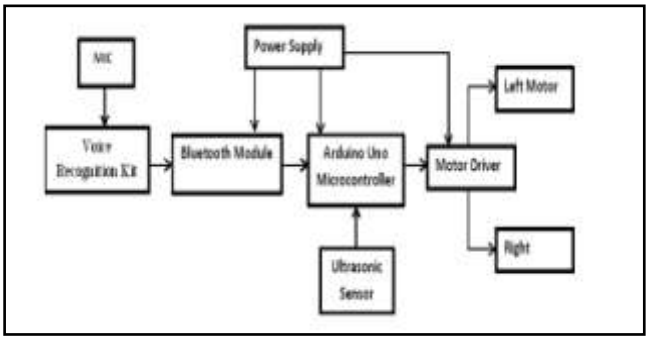

Figure 1: Block diagram of project

IV. Hardware Architecture

The system has two parts, namely; hardware and software. The hardware architecture consists of an embedded system that is based on Arduino Uno board, a Bluetooth Module, Motor Driver and an Android phone. The Bluetooth Module provides the communication media between the end user through the android phone and the system by means of voice command given to the android phone. The user speaks the desired command to the voice recognition software application installed in the android phone that is connected through Bluetooth with Bluetooth Module SR-04. The voice command is converted to an array of string and the string is passed to Arduino Uno connected to it. Once the Bluetooth Module receives the message, the command sent will be extracted and executed by the microcontroller attached to it and depending on the commands fed to the Motor Driver, the motors will function accordingly. The system will understand the instructions and direct the Wheelchair consequently via android application. Meanwhile, the ultrasonic sensor works while the circuit is on and makes sure the path has no obstacle and if any obstacle occurs it notifies the Arduino and stops wheelchair till additional instructions are procured from the user.

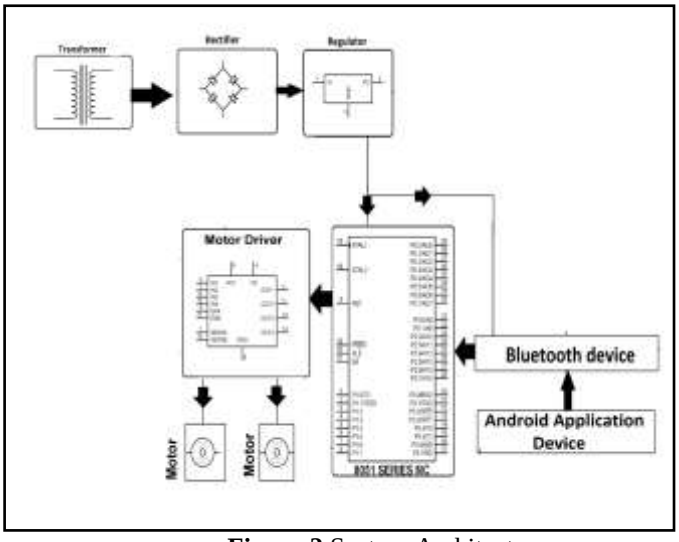

Figure 2 System Architecture

V. Conclusion

This project elaborates the design and construction of Smart Robotic Wheelchair with the help of Arduino and Bluetooth Module. The circuit works properly to move as the command given by the user. The developed system after conniving the circuit that enables physically disabled to control their wheel using an android application in their smart phones and it has also been tested and validated. The detection of any obstacle is successfully controlled by the microcontroller. As the person switches on the circuit and starts moving, any obstacle which is expected to lie within a range of 4 meters will be detected by the Ultrasonic sensor. This proposed system contributes to the self-dependency of differently disabled and older people.

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