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Voice Controlled Autonomous Wheelchair with inbuilt GSM: a Review

Akhil v mohan[1], Arjun r chandran[1], Sooraj SS[1], Syedali N[1], Vishnu Nampoothiri V[2]

[1]*Student, Department of Electronics and Communication Engineering*
Assistant Professor, Department of Electronics and Communication Engineering, Dr. APJ Abdul Kalam Technological University Kerala, India

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ABSTRACT –Development of anautonomous wheelchair with voice recognition based control system for physically disabled people who are unable to operate the wheelchair by hand is represented in this paper. Here the patient can operate the wheelchair using voice commands and the location of patient can be tracks using GPS module in the wheelchair that locates and sends the information to smartphone application via Firebase. Here the voice recognition module recognizes commands from the patient & operate according to it. This kit converts the voice commands to hexadecimal numbers and then the data is fed to the Wi-Fi module to control the wheelchair. Wi-Fi module controls the motor driver IC to move the wheels in desired direction. Motor speed can also be controlled in three stages-low, medium, high.This voice recognition system also have an obstacle detection system using an IR sensor & detect the obstacles.Here a smartphone application has been developed for the family members of patient to know about the location of the patient. As this system simultaneously offers voice operated wheelchair, motor speed control, obstacle detection, temperature sensor and GPS tracking of patient using android app, Hopefully it will be a more convenient system for the handicapped people worldwide.

Key Words: Voice Detection Module

I. INTRODUCTION

Amount of physically disabled people is increasing very rapidly day by day. From the report of the World Health Organization(WHO), it is stated that about 20% of the world population are disabled which occurs certainly because of accidents, paralyzed body & certain diseases.Therefore the use of wheelchairs also increases.

In the present world, there are wheelchairs which are operated by joystick control, but these may not be suitable for people whose hands are paralyzed or injured. For this purpose we generated a wheelchairs which can be operated by voice control.

Here a voice module is implemented which recognizes the person's voice & move according to his commands. The advances in speech recognizing technology have made it possible to control any electronics based device using voice command.The voice recognization module converts the voice from analog to digital with built in digital signal processing system that recognizes the voice command. Here we also uses a microcontroller which controls the left & right DC motors which in-turn controls the movement of the wheelchair.

Navigation assistance system is implemented in this wheelchair which would be more useful for patients suffering from diseases like autism.

II. LITERATURE REVIEW

A. Sasou and H. Kojima [2009] proposed a paper on Noise robust speech recognition technique applied to voice controlled wheelchairs [1]. This method can be used to detect the voice of a single person & also has the ability to reject the noises coming from the outside environment or to reject the receiving of the noises from the surrounding people. This method would be very useful when implemented in a wheelchair. It can also accurately detect the voice of the person using the wheelchair accurately while he is using the wheelchair in the outside environment like railway station, bus stops, stadiums, etc….To accurately detect the patient's voice, this voice detection system should placed in a certain position nearer to the wheelchair, i.e, exactly near in the handrest of the wheelchair. Here the voice of the patient can be stored in the voice detection system. To detect the voice of the patient by the system, the system converts the received voice into hexa-decimal values & the values are feed to the servo motors of the wheelchairs, which moves that wheelchair. This noise robust system is mostly useful for the people suffering with diseases like cerebral palsy. Because these people will be having difficulties of using headsets or microphone placed in head.

M. Petry, A. P. Moreira, L. P. Reis, and R. Rossetti[2011]proposed a method to describe the requirements of simulations needed in an intelligent voice driven wheelchair [2]. Simulation is the ability of the simulator to render high resolution textures, shaders, lighting and reflection. It include the forces acting on the wheelchair by gravity and collision. The important criteria for a simulator are programming language, sensor, External agent support, Multi thread support, physical engine etc. Here USARsim is recommended to use as simulator due to it's advantages comparing with RDS and Webots. USARSim provide very accurate simulations by this it improve the interaction between human and robot and also increase the obstacle avoidance of the robot. Most importantly, it consists of the simulation engine which is used to run the virtual robots competition within the Robocup initiative. USARsim is highly configurable and extendible. Users can easily add new sensors or model new robots also USARSim is platform independent and runs on Windows, Linux and MacOS.

Tsui, Chun Sing & Jia, Pei & Gan, John & Hu, Huosheng & Yuan, Kui. (2008) proposed a paper based on EMG-based Hands-Free Wheelchair Control with EOG Attention Shift Detection system [3]. This system represents a hands-free control system for a rechargable battery powered electric wheelchair, which works based on the signals received from the EMG (ElectroMyoGraphy). These EMG signals are recorded from the actions or activity from the eyebrow muscles. i.e, the wheelchair works according to the movement of the eyebrows. By using a simple Bluetooth connected device or Share-cast device or Screen mirrored device, we can obtain the one dimensional continuous EMG signals. These obtained EMG signals are then analyzed & translated into Multiple directional controlling commands. The controlling commands in here are Forward, Backward, Left & Right. More commands can be added according to the programming in the Arduino uno. These commands can only be supported by the wheelchair that have multi-directional control. Here the EOG (ElectroOculoGraphy) signal detection also works at the same time while recording the EMG signals. The EOG signals are used here to adjust the speed of the wheelchair by detecting the movements of the eyes. The system also helps the user to switch the eye gaze control to ON & OFF to avoid the system to control the un-interrupted movements of the eyes. This type of system is very easy to set-up.

D. Vikerimark and J. Minguez [2006] propose a paper for describing obstacle avoidance for mobile robots operate in 3d environment [4]. By this paper developed a robot that move autonomously with obstacle avoidance.For detecting the obstacles robot need a clear map of the surrounding environment, and that information is provided by sensors.An autonomous robot has many difficulties for this autonomous movement, first is the motion in 3d environment and second is scenarios are dense,cluttered and confined so this paper develop a technique that solve all these problems.Here Obstacle Restriction Method (ORM) is described for the movement of robot in 3d environment.In this method robot is a spherical object and the obstacle information is given in the form of points from the obstacle detecting sensors. These obstacle avoiding mnin robotic applications can be implemented in wheelchairs to detect & clear the path for moving the wheelchairs.

Yusuke Mori&Katashi Nagao [2020] proposed a method for Automatic generation of Multi-destination Routes for voice-controlled Autonomous Wheelchairs [5]. Autonomous navigation of multiple routes was a major challenge faced by the navigation system of wheelchairs. But the major crisis was that the Routes are very expensive. So to make the system more cost effective, here adopted a new method for Automatically generating the Optimal travel Routes. In the method, the route information is obtained by reversly playing the required driving data to estimate it's position, marker distance & angular displacement from the required information, and the travelling path will be stored in the system.Here the Image Grouping of the path surfaces is obtained from the stored data. The costs of routes are obtained based on the texture analysis of the path surface image grouping and analysis of the travelling path of the system.The cost effectivemulti-destination route is generated by conducting a route search using a cost-added route information. Then the newly implemented method will be compared with the method of cost surface analysis for which the cost of moving through any location is variable. Finally this method can generate travel routes that guarentees safety travelling path while using the voice operated autonomous wheelchair.

Manuel mazo [1995] proposed a method to describe Autonomous Wheelchair for Physically Disabled People with Voice detection, Ultrasonic and Infrared Sensor [6].The wheelchair was developed in basis of UMIDAM Project this was designed especially for physically disabled peoples. wheelchair is the most ubiquitous equipment used by people with lower limb disability. It helps them move freely without anyone support. Most of wheelchairs available in the market are manual in nature where some available with motorized option. This main aim for voice-controlled wheelchair is for independent movement those with both upper and lower limb

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disabilities. voice module and Arduino and sensor system is the key feature of this project recognition that is used to setup the desired voice command and output. An Arduino microcontroller processes the voice command from the voice recognition module and convert into suitable format thus the output of Arduino is given to the dc motors and thus the motors works according to the command given. Arduino acts as an intermediate agent between the voice recognition module and dc motor. Bluetooth module is used as the wireless transmission medium between the microcontroller and the voice recognition module and also eliminate long and messy wiring. This wheelchair is a combination of voice recognition module, ultrasonic and infrared sensor by this components, we can made a wheelchair which can move threw voice command and with feature like obstacle avoiding.

Manuel mazo and the research group of the [SIAMO] project proposed a method to describe Electronic Guidance Systems for degree of movement [7]. The combined System for Mobility has been developed to provide some degree of freedom in mobility to the wheelchair users who cannot easily operate conventional electrical unit. Sensor system and varies guidance system provide different mode of operation and ensure user safety. Among the various guidance there are total five chances have been analyzed, among those three of them have been develop for severe handicapped people it includes breath expulsion driving, head movements, and EOG commanding, in addition with digital joystick and control by voice. Breath expulsion and voice command technique have been continuously tested on different pattern and by different users with highly success results. Similarly controls like head movements and EOG have been tested at different condition with high success rate. The sensor system provide safety measure at low level. Ultra sonic sensor system made up of 32 transducer provide obstacle detection and wall collision etc. infrared sensor only used for indoor wheelchair because high solar radiation source from sun exist over there thus the wavelength of laser and solar are same due to this detection and sensing capacity of infrared sensor decreases. Navigation system has designed for navigation purpose for driving the wheel chair to destination point.

Manuel mazo ,r. barea, l. Boquete and E. lopez [2002] proposed a method to describe eye controlling autonomous wheelchair [8].Here control is dependent upon eye movement based on eye movement wheelchair moves. EOG technique is used to determine the position of eye in the socket. EOG technique also systemize ocular action to appropriate command and provide to the wheelchair for the motion of handicapped persons. In case of autonomous wheelchair some additional research and updates are restricted particular area based on environmental belief . But in case of EOG techniques there no such barriers. More application can be implemented by using EOG because this technique enhance or provide degree of freedom and mobility to physically disabled peoples. Therefore further updates will enhance or boost its potential to provide better serviceable in future.

Kamlesh Kukreti, Raghav Chabbra, Aditya ,Rahul Rawat, Vijay Kumar[2019] propose a paper describing voice controlled wheelchair based on T-mega [9].Physically handicapped people can't travel without the help of other people while using ordinary wheelchair, so by controlling that wheelchair by using voice commands then the patient can travel from one place to another place independently. This paper develop a low cost method for this objective.For this a microcontroller, Bluetooth module, control interface engine, transfer engine is needed.Here a T-mega 328 is used as microcontroller, it provides left ,right and also start and stop movement of the wheelchair. At-mega 328 is a single chip micro controller and It has a modified Harvard architecture 8-bit RISC processor core.In working bluetooth module is connected to the microcontroller and the wheelchair will move based on the voice commands given to the module. The wheelchair will move forward when high flag is given to the front engine and stop when low flag is given. High flag is provided to the left two engines to move in the correct way. By this physically handicapped people can travel without disturbing other people.

D. Anjaneyulu, M. S. Kumar [2015] proposed a method for Hand movements based control of an intelligent voice controlled wheelchair Using Accelerometer , obstacle avoidance Using Ultrasonic and IR sensors[10]. Wheelchair have played an importantrole in the both disabled people.As the number of handicapped people increases. The role of electric wheelchair is important enhance their mobility.The obstacle avoidance for the intelligent wheelchair based on multi sensor fusion.The proposal concept of the wheelchair consist of three axis accelerometer LCD display,DC motor,Relays,IR sensor, Ultrasonic sensor . Therefore the distance controlling sensor is IR sensor and hole detection using ultrasonic sensor.Accelerometer is mainly used in the wheel chair for the controlling the movement and direction. Next for DC motor are control of the signal received accelerometer from the wheelchair .PWM(Pulse Width Modulation) is the speed controlled of the component acting on the wheelchair.

Kok Seng Eu, Soon Loong Yong, K. Yap [2014] proposed a method for Fingers bending motion

controlled electrical wheelchair by using flexible bending sensors with Kalman filter algorithm [11]. The disabled people count are increases, therefore the difficulties to use the joystick. Because the controlling the joystick require a large force. This solution can be overcome the finger bending motion to control the electrical wheelchair. Main advantage of this paper to take signal noise that are caused by trembling finger motion. Therefore joystick controllers of the wheelchair have not to be helpful. Such as a voice recognition system is controlled in this, vision camera for head gesture detection, EEG(ElectroEncephaloGram) for brain signal detection, EOG(Electro-Oculo- Gram) for eye tracking and EMG(Electro-Myo-Gram) for muscle movement detection. Because trembling motion is caused the serious signal noise to overcome the implementation of kalman filter algorithm has been developed .In this kalman filter is electrical noise and dynamic pattern of the signals are also avoided or captured.

Head gesture recognition for hands-free control of an Intelligent wheelchair 2007: The role of electric wheelchair become important to enhance their mobility. As the number of handicapped people increases world widely the role of electric powered wheelchair is more important factor. The electric powered wheelchair is basically controlled by users for the joystick. Therefore it cannot be satisfy the needs of elderly and disabled users who restricted limp movements caused by disease such as Parkinson's disease. This paper is more used to handsfree control of system for intelligent wheelchair based on visual recognition of head gesture. Various research and developments on IWs have been carried out in the last decade, such as CALL Smart Wheelchair , Nav-Chair , UPenn Smart Wheelchair ,etc.. A robust head gesture based interface ,HGI is designing for vision based head gesture recognition of the wheelchair. HGI is the control of the central position of wheelchair and identify useful head gesture.

III. CONCLUSION

By concluding, we have analyzed different types of voice recognition & controlling based wheelchairs and their various level applications. In most of the cases the wheelchairs used are driven by joysticks. These types of wheelchairs can make many discomforts to many of hand injured or the peoples whose hands are paralyzed. To overcome those, here we adopted certain techniques which are useful for all types of disabled peoples like the head-gesture control wheelchairs, eye-lash control wheelchairs, mind-controlled wheelchairs, mobile application control using the GSM-module, etc,.Also we have added here certain more techniques to make it more comfortable with the user like the body temperature control based seat ventilation of the wheelchair. In this technique, as the body temperature of the patient suddenly deceases, the seat ventilation makes the body heat & stops when the body temperature reaches to a normal level. Also here we implemented a obstacle avoidance sensor with IR sensor in which the sensor detects the obstacles in front of it using the 3D detection technique & travel by avoiding the obstacles. This technique might be more useful for the blind peoples.

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