Voice Controlled Smart Wheel Chair

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***Abstract*—People who are physically impaired and have various physical disabilities encounter numerous difficult issues in their daily lives when commuting from one location to another, and occasionally they even have to use public transportation. need to rely on someone else to get from one place to another another. Over the past few years, numerous substantial initiatives have been made to create intelligent wheelchair platforms so that the user may do so with ease. without any misunderstanding in functioning. Our paper's primary goal is to construct the smart wheelchair for those with physical disabilities. This smart wheel chair with voice control and upgraded features like obstacle sensing, emergency buzzer will help to ease their life.**

***Index Terms*—Microcontroller, Ultrasonic, MFCC, Voice Recognition, DTW, PWM**

I. INTRODUCTION

A wheelchair that uses navigational technology to maneuver is referred to as a smart wheelchair. It can be moved without using human power by employing controls and an electric motor. The typical method of controlling the navigational controls is with a tiny joystick that is chin-operated joysticks, head switches, eye blinks, and other features that offer several functions of the wheelchair
The majority of physically challenged people utilize standard wheelchairs. They are operated manually or, if the patient is unable to do so, by a second person. If another individual is not present to provide assistance, this is quite challenging for that person. There is always a need for a second person in that scenario. The sufferers must rely on someone else as a result. What would happen if a wheelchair began to move in response to aural input such as left, right, forward, and backward? The impaired person is autonomous and can move anyplace he wants to go without assistance. The wheelchair can be moved without the need of hands. With the help of our "Smart wheelchair" project, we are attempting to put this idea into practice. The symbolism of the wheelchair is obvious from the name alone. This wheelchair responds to human inputs and travels in the desired direction. This wheelchair can be maneuvered by someone who is unable to operate a chair with their hands alone. This is a blessing for those who are disabled. The patient may now independently travel anywhere by utilizing this chair.The smart wheelchair also has obstacle detection and emergency buzzer.

II. RELATED WORK

The study field of intelligent wheelchair control is drawing the researchers' attention. The wheelchair is designed in particular for those who can only move their head and neck. An in-mouth position sensor is used to detect the motions. Also being researched are intelligent wheelchairs. These wheelchairs detect obstructions in the user's route. To sense the items, sensors are installed in the circuit. Along with sensors, these wheelchairs have a speech recognition circuit.
The majority of systems offer a variety of solutions to complete tasks that are thought to be challenging for a handicapped individual. We designed a voice command system to simplify and develop the control system in order to make using a wheelchair by impaired people much simpler and easier. With a few brief speech instructions, this voice command system aids in maneuvering the wheelchair. As a result of escalating conflict and an aging population, the number of physically handicapped persons in society has significantly increased during the past ten years. The requirement for upgrading the quality of life for such individuals has been of great concern. The main issue that handicapped, paraplegic, and crippled people have is their inability to move around without the use of an artificial method of transportation. Wheelchairs are the most popular and widely utilized solution in this case, although they have a number of drawbacks. A physically weak user cannot use a wheelchair on his own because of the amount of user effort needed to pull and push the wheels, as well as the lack of security and stability. He must rely on assistance from another person. This may be highly expensive given the hectic lifestyles of individuals in today's culture. A typical wheelchair cannot be used by someone who is unable to use their arms.
Although the traditional wheel chair, which requires the user to push it, has benefits like independence in movement, exercise, and cost-effective transportability, it also has drawbacks like ineffective assistance on inclines and irregular terrains, fatigue, and repetitive stress injuries. Present-day motorized wheelchairs eliminate these drawbacks. The joysticks on power wheelchairs that are located close to the arm rests make it easy to assist. However, the majority of patients are unable to move the joysticks due to limb damage. Therefore, in the suggested systems, voice instructions are used to move the wheelchair rather than a joystick. The system was able

to prevent collisions and mishaps thanks to the mounting of sensors, line detectors, and obstacle detectors. By adding a temperature sensor, the family and worried doctors will be informed about the patient's temperature. This allows the patient to walk around independently without the need for assistance, and it also provides the patient's family peace of mind with a collision prevention system.

III. Proposed Wheelchair System

The "Smart Wheelchair" has a Voice Recognition Module, a Micro controller, Ultrasonic sensor with obstacle detection, and Motor driver. The block diagram of the proposed model is shown in Fig. 1.

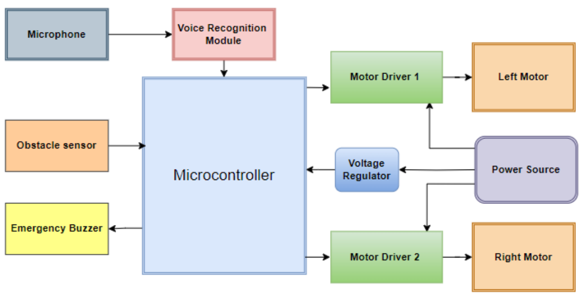

Fig. 1. Block Diagram of the Entire System

A voice recognition module Elechouse Voice Recognition Module is first trained by the voice of the patients for certain commands such as FORWARD, RIGHT, LEFT, BACK, STOP, HELP etc. The biggest advantage of out proposed system that it doesn't have any language barrier.Then according to the command recognised the microcontroller module takes the decision to execute the command through the motor dirvers.

IV. Methodology

A. Voice Command Recognition

The main task of this Voice controlled wheel chair is to recognize the voice commands of the patient. For this we used the ELECHOUSE Voice Recognition V3 module. First our system was trained with the patients voice. Our voice recognition system is not language specific it can be trained on any language and any with accent which makes our system viable for every region of the world. Also it takes only 5-10 minutes for a patient to train his voice commands with the wheel chair.

Training: V3 module supports up to 80 voice commands of any language of 1500 ms duration. During training the speech command is captured by the microphone and sent to the on board processor which applies signal processing techniques like MFCC to extract features of the voice commands and stores the feature vector as template.

Recognition: When a new voice command appears it's MFCC features are extracted and it is compared with the already stored MFCC features of the trained commands using methods like DWT(Dynamic Time Warping). The one with the highest confidence score is the recognized voice command.

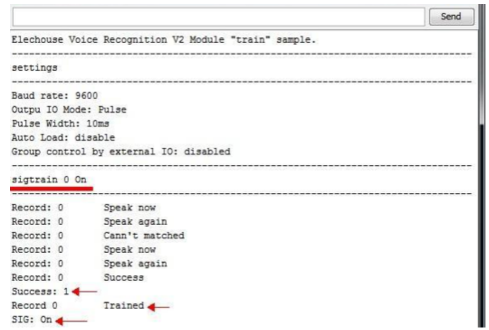

Fig. 2. Training with Serial Monitor

B. Command Execution

The voice command being recognized the wheel chair must execute the command. As stated in the previous section that our system can work on any language. Here we have used English and Bengali both. Our system has two separate motors for each wheel of the wheel chair. So, depending on the voice commands the motors are controlled by the microcontroller according to the algorithm.

TABLE I
Voice Command Interpretation

Command	Interpretation	Assigned Value	Left Motor	Right Motor
Shamne	Move forward	0	ON(+)	ON(+)
Back	Move Backward	1	ON(-)	ON(-)
Baame	Move Right	2	ON(+)	OFF
Daane	Move Left	3	OFF	ON(+)
Stop,Help	Stop and Emergency Buzzer	4	OFF	OFF

C. Motors and Motor Driver

To rotate the wheels of the wheel chair we have used two wiper motors each of 12V-7amp rating.
We used two BTS7960 motor dirves which are of H-bridge type. These are PWM controlled motor drivers. The RPWM and LPWM pins of the motor driver is connected to the output PWM pins of the microcontroller.

TABLE II
Motor driver configuration

RPWM	LPWM	Rotation	Movement
HIGH	LOW	CW	Forward
LOW	HIGH	CCW	Backward
LOW	LOW	NULL	Stop
HIGH	HIGH	NOP	Danger

NB: CW = ClockWise(+), CCW = Counter ClockWise(-)

D. Algorithm

Algorithm 1: How it works

```
#define G = 0 (shoja), B = 1 (back), R = 2 (dane), L =
  3 (bame), S = 4 (stop or help);
#define myVR object; // voice recognizer
int ret;
uint8_t buf[64];
while true do
    // Recognize voice command
    ret = myVR.recognize(buf); #takes voice
     command;
    if ret ¿ 0 then
        // Execute action based on
           recognized command
        switch buf[1] do
            case G do
                MoveForward;
            end
            case B do
                MoveBackward;
            end
            case L do
                TakeLeft;
            end
            case R do
                TakeRight;
            end
            case S do
                Stop or Buzz Emergency Buzzer;
            end
            otherwise do
                Serial.println("undefined");
            end
        end
    end
end
```

V. Components:

Elechouse Voice Recognition Module ELECHOUSE Voice Recognition Module is a compact and easy-control speaking recognition board.This product is a speaker-dependent voice recognition module. It supports up to 80 voice commands in all. Max 7 voice commands could work at the same time. Any sound could be trained as command. Users need to train the module first before let it recognizing any voice command.

For training purpose we used Arduino IDE and the serial monitor. This is very user friendly and only takes few minutes to train the patients voice

Microcontroller: Arduino UNO was used as the microcontroller module.The microcontroller was coded to drive the motors through the motor drivers.

Motor Driver: We used BTS7960 to drive the motors.It is a H-bridge motor driver.The main reason that we this motor driver is it's feature of withstanding high current.It can handle upto 43A current.

Motors: We used 12V wiper motors to drive the wheels.These motors can draw up to 7A current and are used in cars. These are locked rotor motors so they don't need any external breaking system. The wheels automatically breaks when there is no current flow in the motors.

Sensor: Ultrasonic sensor have been used for the purpose of obstacle avoidance. The threshold distance was set to 20cm user can modify this distance depending on the surroundings.

Buzzer: A 5 volt simple buzzer is been used as an emergency alert signal.

Power Supply: Two 12 volt 7 amp DC battery have been used as the main power supply. Also a dc buck converter was used to supply power to the microcontroller.

VI. Results

A. Voice Command Recognition Accuracy

The accuracy test of the voice recognition module was done in a room (less noisy environment). According to the datasheet of V3 module at ideal condition the accuracy is 99%.

TABLE III
ACCURACY SCORE FOR THE COMMANDS

Command	Command Count	Recognized Count	Accuracy(%)
Shamne	10	9	90
Back	10	10	100
Baame	10	9	90
Daane	10	10	100
Stop	10	7	70
Help	10	10	100

Overall Recognition accuracy is 91.67%.

B. Final Hardware Implementation

The code and the video of the wheel chair are made public. Github Link: Click Here

VII. The Wheel Chair

VIII. Features and Specifications

- Voice-controlled automatic wheelchair.
- Smooth speed variations for patient comfort.
- Collision avoidance, soft start and stop.
- Facility to command in any languages.
- Controlling the wheelchair using Bengali language.
- Voice command training is very user friendly and easy.

IX. Conclusion

In order for smart wheelchairs to be a commercial success and be widely utilised, there are a number of difficulties that manufacturers and researchers must overcome. Cost versus accuracy is a typical major problem. Affordable and sophisticated sensors can aid in resolving this issue. There are yet no smart wheelchairs that can be utilised for all different kinds of disabilities. Additionally, intelligent wheelchairs have to be able to keep an eye on the patient's condition and respond appropriately. Smart wheelchairs that are already on the market are simple to operate indoors, but they need to be supervised outside by a partner for safety. Additionally, research should be done on intelligent wheelchairs for mentally challenged persons to utilise independently.

X. Referance

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