© 2018 IJSRST | Volume 4 | Issue 5 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

Assistive Communication Tool for Patients with Motor Neurone Disease

Dr. G. Indumathi, V. Janani, S. Sabana Jasmin
Department of Electronics and Communication Engineering Mepco Schlenk Engineering College, Sivakasi, Tamil Nadu, India

ABSTRACT

The main aim of the system is to provide a solution for the speaking disability of the motor neurone diseases (MND) patients and also for the patients those who have been affected by one side paralysis due to stroke (CerebroVascular Accident). This system will enable them to express their thoughts to the people surrounding them. Already there are a lot of solutions exist to assist for patients suffering from MND and paralysis but they are very expensive. This proposed prototype will be cost effective. It consists of sensor to detect the cheek muscle movement, wireless transceiver unit, microcontroller and a software keyboard.

Keywords: MND (Motor Neurone Disease), Paralysis, Sensor, Wireless Transceiver.

I. INTRODUCTION

The most important aspect of life for any individual is to communicate with people surrounding them. But for differently abled people particularly those who are suffering from MND or stroke (one side paralysis) they can not only able to speak but also not possible to do some actions to express their thoughts. Because both stroke and MND are neurodegenerative disorders, means the death of both lower and upper motor neurons. This prototype is getting the input from cheek movement of the patient by using a touch sensor. This signal is transmitted wirelessly to the virtual scanning keyboard on the personal computer. For getting the input from the patient, various methods have been proposed and used. Chung-Min Wul and et al. [1] proposed a methodology to take the EOG (Electro Oculo Graphy) signals from the patients eye movement as an input to the communication system designed. Watcharin Tangsuksant and et al. [2] developed a electrooculography based system to type words on the virtual keyboard using voltage threshold algorithm. Here EOG signals is measured using two channels with six electrodes.Rui Zhang and et al. [3] proposed a system which uses EEG (Electro Encaphalo Graphy) signals from the patients to control the environment and uses laser range finder, encoder and Kinect sensor for the movement of wheel chair. Zheng Li and et al [4] proposed a system which uses three micro radar sensor mounted on a helmet to detect the users tongue and cheek movement. The array of micro radar act as proximity sensors and capture muscle movements when the patient performs the tongue gesture. In this paper is proposed, which enables them to communicate with the people. Section II explains the setup needed for experimentation purpose III explains the components used. Section IV and V explains the system developed.

II. SYSTEM CONFIGURATION

The system configuration is shown in Figure 1. A digital touch sensor is placed on the spectacles of the patientswhich is connected to the Arduino, an open source hardware. An RF transmitter is connected to the Arduino which will transmit the sensor value through air as the medium. An RF receiver receives the data and the Arduino will transmit the received data to the personal computer where the virtual scanning keyboard is running. In the virtual scanning keyboard, characters and some images are scanned continuously with the duration of 10 sec. When the signal is received, the virtual keyboard will display the currently selected character. After a word is formed, text to speech software which is integrated with scanning keyboard will give the speech output. The transmitter is placed on the wheelchair of the patient and the receiver side hardware and the PC (Personal Computer) will be placed at one arm distance of the patient so they can feel comfortable.

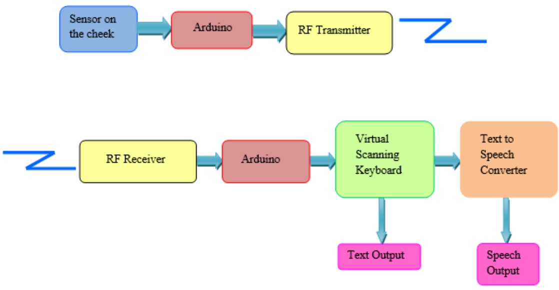

Figure 1. System Configuration

This proposed system helps the patient to communicate with the external world. They can their cheeks to make contact with the sensor when the desired character arrives on the virtual keyboard in the connected PC. This sensor provides a high (1) output and then the signal is transmitted to the PC so that the selected characters are displayed in the text field. Finally when the word is completed, the text to speech converter which is integrated with the virtual scanning keyboard gives the speech output.

III. SYSTEM MODULES

The proposed system includes the following modules

1. Arduino UNO of Transmitter side
2. Arduino UNO of Receiver side seperately
3. Touch Sensor – TTP223B
4. RF Transmitter and Receiver Module
5. Personal Computer (PC) with virtual keyboard.

a) ARDUINO UNO BOARD

Arduino UNO is a open source hardware. The PCB design of the Arduino UNO used Surface Mount Device (SMD) technology. It has 14 digital input/output pins and 6 analog inputs. Atmega328 is an 8 bit microcontroller, used in this open source. The main microcontroller has one Universal Asynchronous Receiver Transmitter (UART) module. The pins of the UART (TX, RX) are connected to a USB – UART converter circuit and also connected to pins 0 and 1 in digital header in the board. The USB – UART bridge consists of an IC Atmega16UC which converts USB signal to UART signal and vice versa.

b) TOUCH SENSOR

TTP223B is a capacitive touch digital sensor. It consists of 3 pins. Its dimensions are 4*3*2 cm. It detects the human contact based on the change in the dielectric constant (ε) value which influences the total capacitance value. The operating voltage is 2.0 volts to 5.5 volts. The output voltage is 4.75Vand the output current is 27.5mA when measured with multimeter. The response time of the sensor is 220ms.The touch sensor is shown in Figure 2.

Figure 1. Touch Sensor

c) RF MODULE

The RF module is a cost effective wireless communication module for low cost applications. RF module comprises of a transmitter and receiver that operate at a radio frequency range. Its frequency range is 315MHz to 434MHz. The transmitter input voltage is 3 – 12V and the receiver input voltage is 5V. It works on Amplitude Shift Keying (ASK) modulation technique.

d) VIRTUAL SCANNING KEYBOARD

A virtual scanning keyboard was designed using java. It contains a text field to display the selected characters. A set of characters which are arranged on the basis of frequency of occurrence while forming a word so that the word can be formed in a less time and images of some basic necessities of the patients for their daily life. It also contains some special symbols like @, &, etc. Figure 6 shows the virtual scanning keyboard.

Figure 6. Virtual Scanning Keyboard

In this design each character and image is scanned for 10 sec. A text to speech converter is integrated with this design and after the scanning of word completed, the corresponding text is converted to speech.

IV. PROPOSED SYSTEM DESIGN

The sensor is placed in such a way that it can be adjusted vertically. A plastic material is taken and at the top it is bent and fixed on the frame of the spectacles. It is placed in such a way that the bent part can be slided over the frame of the spectacles. A tapering is made inward in the plastic material so that the distance between the plastic material and the cheek is balanced. A slit is made at the tapered part of the plastic material and the sensor is placed on the slit by inserting a wire on the sensor hole. The same wire is tied on the opposite side of the slit so that the sensor is fitted on the plastic material. The slit height is greater than the sensor height so that it can slide over the slitted part. Thus the vertical adjustment can be achieved. If more adjustment is needed on the sensor, the adjustment size can be expanded. This vertical adjustment is used to reduce the distance between the sensor and the cheek. So that the patient can easily touch the sensor. The front and the left side view of the proposed sensor system module is shown in Figure 3 & Figure 4. The Figure 5 shows the sensor module placement in the frame on the spectacles.

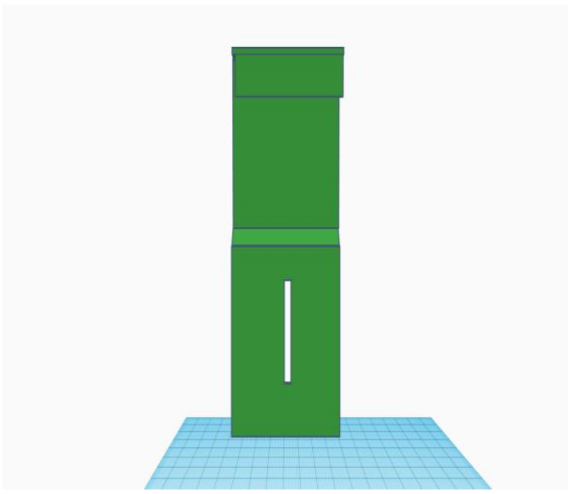

Figure 2. Front View of the proposed sensor system module

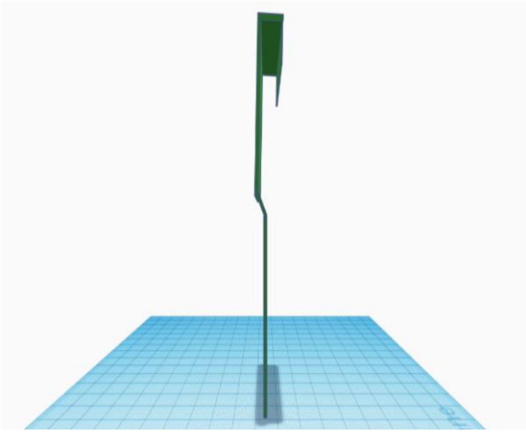

Figure 3. Left side view of the proposed sensor system placement

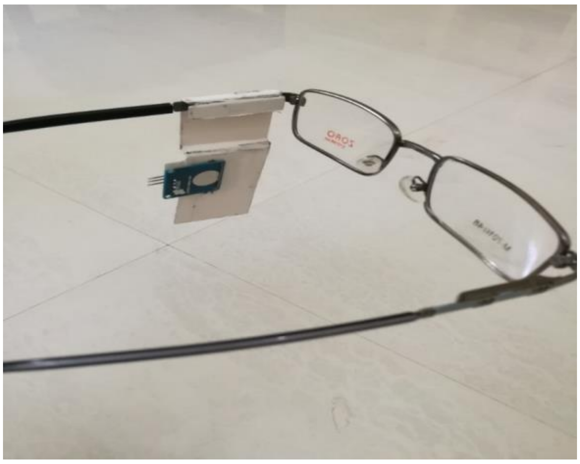

Figure 4. Sensor module on the frame of the spectacle

After sensing the cheek movement by using the sensor, the sensed value is transmitted through RF transmitter. At the receiver side, the received value is given to the created java GUI by UART serial communication. If the received value is High (1) the current character is displayed in the text field. If the word is completely framed, it is converted into speech by the text to speech converter which is integrated with the GUI. Figure 7 & Figure 8 shows the flow diagram to explain the working of transmitter and receiver module respectively.

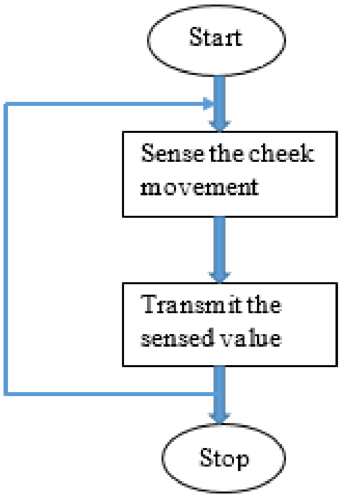

Figure 7. Flow diagram of Transmitter module

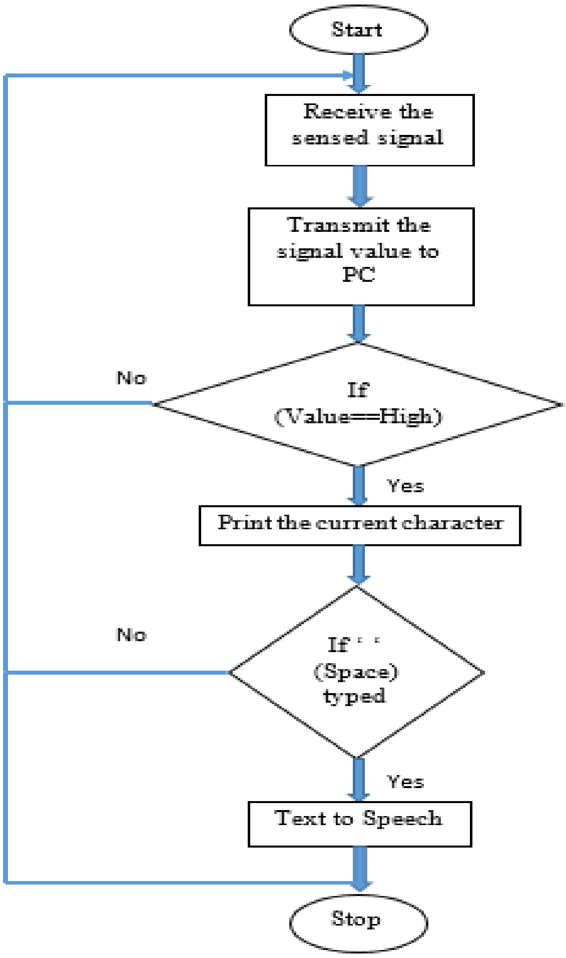

Figure 8. Flow diagram of Receiver module

V. CONCLUSION

In this paper, we present an assistive communication tool for patients. Even though they have speech disorder and neurodegenerative problem, they can be able to communicate with people around them. Since this system is cost effective even a common man can easily afford this. Further the work can be extended to reduce the scanning time. Also the work may be focussed towards to obtain the input from the patient in an effective manner to improve the accuracy.

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