



Design of Real – Time Assistive Device for Communication and Health Monitoring for Hemiplegia Patients with Mobile Interface

Lilly Mariyal P¹, Nivedha J², Sujitha Sharmila S³, Mrs. Suma AB⁴

^{1,2,3} Final Year UG students, Department of Bio-Medical Engineering, Alpha College of Engineering, Thirumazhisai, Chennai, Tamil Nadu 600 124, India

⁴ Assistant Professor, Department of Bio-Medical Engineering, Alpha College of Engineering, Thirumazhisai Chennai, Tamil Nadu 600 124, India.

Abstract: Hemiplegia is a condition that involves one-sided paralysis for higher age grouped people in specific and nowadays it causes lower and middle aged people also because of life style changes in the world. It mostly affects either the right or left side of the human body, occurs due to brain or spinal cord injuries and condition of the spinal cord. Hemiplegic patients suffer from muscle weakness on one side, muscle spasticity, poor fine motor skills, trouble walking, poor balance, and trouble grabbing objects etc.,. As a result, patients find difficulty in communicating to others regarding their basic needs and it offers a great challenge for healthcare providers and medical professionals in taking care of them. Hence, an effective communication assistive device as well as patient monitors system for hemiplegia patient to improve their quality of life has been proposed in this research. In this research integrating a communication device consisting of many sophisticated sensors like flex sensor embedded on a gloves fashioned system with gyro sensor along with the patient monitoring system to monitor various vital parameters like heart beat, SPO2 and body temperature. The collected information will be processed and compared with real-time settings according to the person and finally connected with mobile application for abnormality warning purpose. The device have numerous built in features to pass information to the care takers by messaging, RF transmitter and Blue tooth facilities features seamless data transfer between the two ends. Embedded Micro controller employed on both the ends to encode and decode data and delivers a presentable form of the inconvenience encountered by the patients. The proposed system improves the communication by ensuring the perfect connectivity between patient and care taker using by latest state of art techniques.

Keywords: EMC -Embedded Micro Controller, SPO2 – Saturation of Peripheral Oxygen, ESP32 – Espressif System 32, PICA- Porch Index of Communicative Ability, MTDDA- Minneapolis Test for Differential Diagnosis for Aphasia, RS232 – Recommended Standard 232

I. INTRODUCTION

Hemiplegia is a condition that leads to paralysis on one side of the body (Figure 1), causes weakness, problems with muscle control, and muscle stiffness and the degree of hemiplegia symptoms vary depending on the location and extent of the injury. If hemiplegia onsets before birth, during birth, or within the first 2 years of life, it's known as congenital hemiplegia. If hemiplegia develops later in life, it's known as acquired hemiplegia. Hemiplegia is non-progressive. Once the disorder begins, symptoms don't get worse. Among the enormous number of advancements done in the medical sector, very few actually focus on helping patients with disabilities to communicate. Here we propose a simple and effective way to solve the problem of physically handicapped or disabled patients. The main purpose is to replace the conventional approach of patient- nurse communication with modern technologies which is much faster. In the current

scenario, the patient has to be dependent on a family member /nurse who have to attend the patient constantly. Objective of this method is to make such patients independent to communicate with the nurse just by tilting a device located on the hand and fingers. Movement of the hand and finger in a particular direction will send the message to the mobile application and speak out the message specified in direction. Health parameters such as spo2, heart rate and temperature of the patient are continuously monitored. This is to ensure that the patient treatment is given at appropriate time. It also helps healthcare provider's faster access to accurate patient data. It also lowers the risk of re-hospitalization and reduces the Cost of Care for payer's patient.

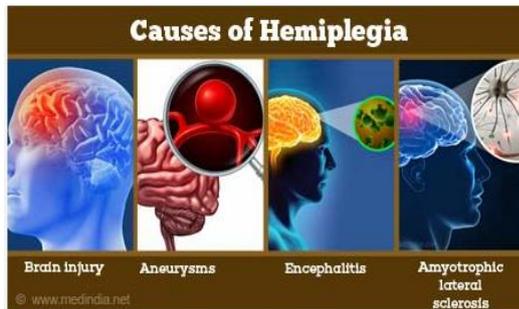


Figure 1 Causes of Hemiplegia

Hemiplegia happens mainly because of brain or spinal cord injuries and conditions, depending on the cause, hemiplegia can be temporary or permanent. Hemiplegia is paralysis of the muscles of the lower face, arm, and leg on one side of the body. In addition to motor problems other losses may occur eg. Sensation (Figure 2), memory, cognition. The most common cause of hemiplegia is stroke, which damages the corticospinal tracts in one hemisphere of the brain. Other causes of hemiplegia include trauma eg. spinal cord injury; brain tumors and brain infections.



Figure 2 Causes of Hemiplegia sensation and disorders

In regular practice Hemiplegia will affect either the left or right side of the body, whichever side of the brain is affected causes symptoms on the opposite side of the body. People can have different causes and symptoms like muscle weakness or stiffness on one side, muscle spasticity or permanently contracted muscle, poor fine motor skills, trouble walking (Figure 3), poor balance, trouble grabbing objects and more depends on the conditions. Children with hemiplegia may also take longer to reach developmental milestones than their peers. They may also use only one hand when playing or keep one hand in a fist.

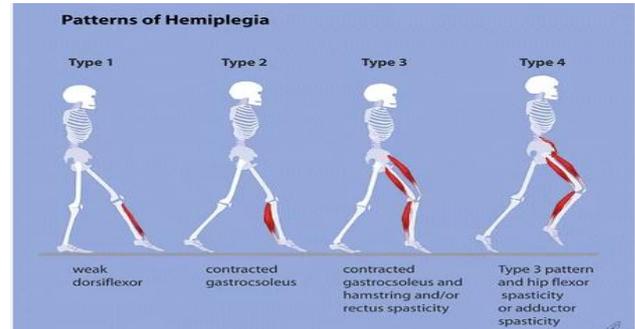


Figure 3 Causes of Hemiplegia a one side paralysis definition

If hemiplegia is caused by a brain injury then, the brain damage can cause or create the symptoms that aren't specific to hemiplegia, such as memory problems, trouble in concentrating, speech issues, behavior changes, seizures because of interrupting the normal connections between nerve cells and brain (Figure 4).

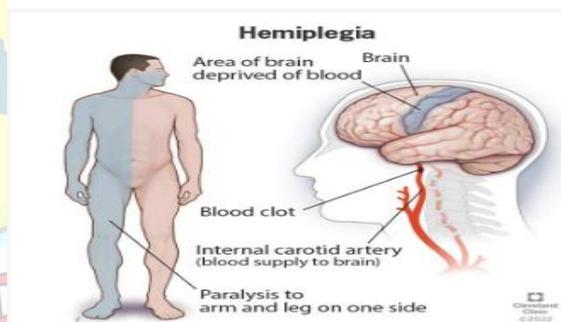


Figure 4 brain injury then, the brain damage

Various types of hemiplegia conditions evolved in the human body paralysis like Facial hemiplegia, Spinal hemiplegia, Contra lateral hemiplegia, Spastic hemiplegia, each one has its own causes and reasons but remedial measures have to be found. Many researches have been conducted by doctors by anatomical trial and engineers by electrotherapy and other assistive devices to support the sufferers. A huge treatment options are available in the hemiplegia treatment based on the severity of the problem and symptoms like Physiotherapy, **Modified Constraint-Induced Movement Therapy (mCIMT)**, **Assistive devices**, **Mental imagery**, **Electrical stimulation** and more. Assistive systems are the only system that enhances the mental health of the patients without any side effects. Electrical stimulation is the system called as Pulse Electro Therapy (PET) often employed in the current scenario along with assistive system as patient well care support system to recover from the symptoms.



II. LITERATURE SURVEY

Various Stages research have been conducted by many peoples to simplify the life of hemiplegia patients using available and affordable technologies by the below mentioned professionals ,the merits and limitations of their research have been evaluated.

Anjali A, Rithesh CH, Deepak K, Manikandan V. In 2019, The signal given by patients wirelessly through the gesture movement by body parts to the caretakers, the information. Hence the information will be displayed on the LCD. Each patient will have such a device installed on or around his body and all such patients will be centrally linked to the receiver at the caretaker side. This project will definitely help the people who are not able to do the full movement of the body.

Aparna Jagdale, MonaliTupe, Priyanka Minmine, Manjushri Rohekar, and Prof. N.R. In 2017, This paper gives us the development of a microcontroller chip based system for heartbeat, stress and temperature monitoring using Bluetooth module and mobile app. By this we can easily monitor the patient's status by using Bluetooth model and can send them SMS alert in critical conditions. In India many paralytic or disabled patients are dying because of heart attacks and reason behind this factor is that they are not getting proper help during the period. In order to assist them in a timely and appropriate manner, we would like to continuously monitor the health of patients. The fixed monitoring system can only be used when the patient is in bed. These systems are huge and are only available in intensive care hospitals. The system was developed for home use by patients who are not in critical condition but need to be monitored by a doctor or family in good time. In each critical condition, the SMS is sent to the doctor or a family member. So that we can easily save many lives by providing fast service.

Rohini Bhilare, Shradha Swamiet.AI In 2020, Implemented the prototype model for convey message as well as real time patient monitoring by using Arduino Microcontroller and ZigBee. It will detect the degree of movement by accelerometer and then display the message pre coded/set for that particular direction movement. It will also measure patient's blood pressure, body temperature and heartbeat rate.

Krushna patil, Aakanksha Gawande, Priyanka Ranit and Kajal Shirbhate In 2018. The main aim of the project is to implement a low cost reliable system which will help to establish communication between paralytic or disabled patients and a nurse. A patient can easily send messages to the nurse by just tilting an accelerometer connected to a body

part capable of movement. This angle of tilt is sent to a central controller which then initiates communication between the patient (transmitter) and nurse (receiver) and also decides which message is to be transmitted based on the tilt angle. Each patient will have such a device installed on or around his body and all such patients will be centrally linked to the receiver at the nurse side. Along with this a real time medicine reminder and an emergency buzzer to simplify the work of the nurse was implemented. Output is shown on LCD as well as in the form of recorded voice with the help of voice recorder & playback apr33a3. Our project provides a reliable, effective and simple yet important solution to various issues faced by nurses in traditionally communicating with disabled patients.

Bhilare Shradha Swami, Priyanka Deshmukh and Mr. Prasad R. Patil

In 2016, It is critical task to attending the patients in remote places in conditions of emergency is very critical task therefore real time and continuous to check system is essential for doctors to treat the patients when they are in need. This system implementing the prototype model for convey message as well as real-time patient monitoring system by using Arduino microcontroller and ZigBee.

III. PROPOSED METHODOLOGY

Patients find difficulty in communicating their basic needs and it offers a great challenge for healthcare providers in taking care of them. Hence, we propose a communication assistive device as well as patient monitor system for hemiplegia patient to improve their quality of life. We propose a system with transmitter and a receiver to convey messages. The wearable transmitter section will be worn by the patient in the hand which has voluntary muscular movement. It consists of set of five flex sensors which detect the finger movement. Flex sensor response time is 1.5 seconds. Flex sensor is fixed on patient's finger measures resistance as finger is bend. It is used along with resistor to make it an voltage divider circuit. This voltage divider measures voltage of 0 to 5 and gives an analog voltage. The analog voltage is sent to Esp32 microcontroller which has in built ADC (analog to digital converter). This ADC converts the analog signal to digital signal. The values are continuously read and coded by using embedded C the amount of deflection is directly proportional to its resistance.

Two terminal device changes its terminal resistance when the sensor is bent in one direction and is mounted on the fingers of the patients hand and a gyro sensor will be placed on the patient hand (MPU-6050) its senses rotational motion and changes in

orientation .Gyro sensor effectively measures the patients motion of the hand. The receiver end is a mobile application which can be used by caretaker, nurse. In receiver side a micro controller (ESP32) process the data and displays message on the mobile phone and also it produce the voice output when it receives signal from the gyro sensor and flex sensor. In this project we are integrating a communication device consists of flex sensor and gyro sensor. Along with the patient health monitoring system.

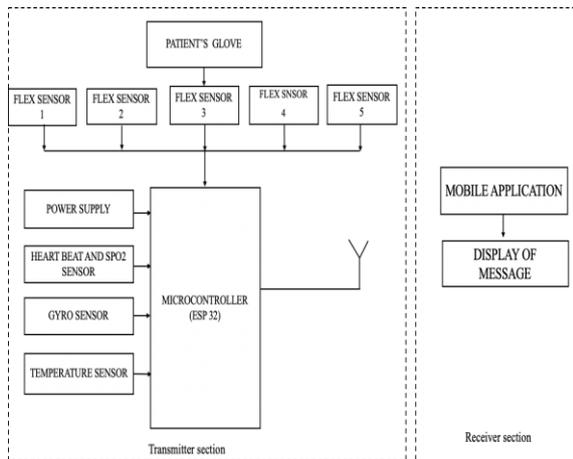


Figure 5 Block Diagram of the proposed system

The patient health is monitored using heart beat sensor (max30100), SPO2 sensor and temperature sensor(Figure 5) .Heat beat sensor issued to measure the heartbeat of the patient. SPO2 Sensor provides the measurement of oxygen saturation in blood. The temperature sensor is used to detect the body temperature of a patient. There is continuous measurement of the parameters such as heart rate, oxygen level and body temperature and its values are displayed on the mobile application and if it exceeds or lower than the normal level, an alarm message is displayed on the mobile application. The input is hand - finger positions which is different for each message is sent to microcontroller which also receives the continuously measured values of heartbeat, body temperature,spo2 levels by sensors. the microcontroller processes the data and values and output is the display of particular message patient wants to convey and alarm message will be display on the mobile application

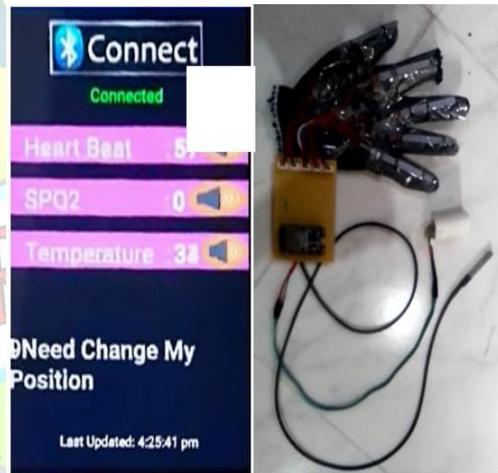
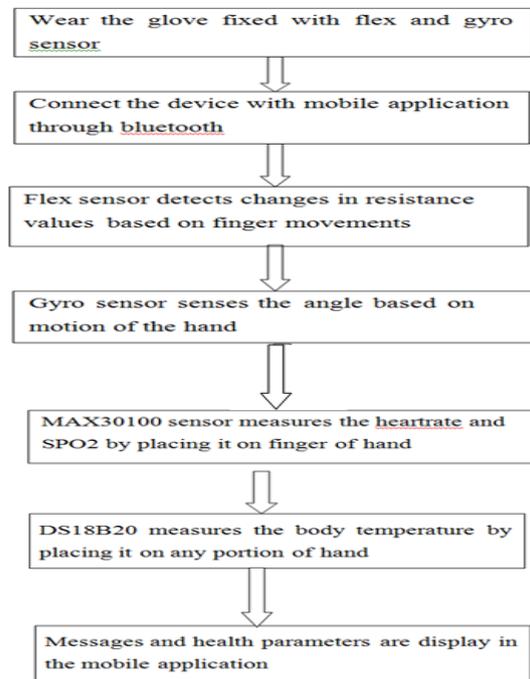


Figure 6 Flow chart and model of the proposed system

IV. Results And Discussion

The proposed project is implemented with 25 commands with movement of hand and bending of fingers are captured by the flex and gyro sensor. Health parameters of patient such as Spo2, heart rate and body temperature are monitored. Each finger of hand is fixed with a flex sensor and gyro sensor is placed on wrist of the hand. Flex sensor measures amount of deflection in terms of resistance and gyro sensor measures the angle of the hand. The particular message and health parameters values are continuously sent to display and speak out on mobile application. The proposed research have been



evaluated and command code generations are listed below as a result

List of commands

VALUES	NUMBER	MESSAGE
>=2000<=2000+>=2050	1	I need water
>=2000<=2000+>=2200	2	I need food
>=2000<=2000+>=2000	3	I need medicine
>=2000<=2000+>=2900	4	I need
>=2000<=2000+>=1400	5	I would like going topark
>2000<=10000+>=2050	6	Would you
>2000<=10000+>=2200	7	Could you read the News Paper
>2000<=10000+>=2000	8	I need to change my position
>2000<=10000+>=2900	9	I need to do my exercise
>2000<=10000+>=1400	10	I need fresh juice
>10000+>=2050	11	I need to see my friends
>10000+>=2200	12	I need to sleep
>10000+>=2000	13	I need to take rest
>10000+>=2900	14	Switch off the light
>10000+>=1400	15	I need to watch

		movies
<=2000>-10000+>=2050	16	I need
<=2000>-10000+>=2200	17	I'm not feeling well
<=2000>-10000+>=2000	18	I'm feeling tired
<=2000>-10000+>=2900	19	I need to listen music
<=2000>-10000+>=1400	20	Please call doctor
<-10000+>=2050	21	I don't like this
<-10000+>=2200	22	I want coffee
<-10000+>=2000	23	I want to know time
<-10000+>=2900	24	I want to see my family members
<-10000+>=1400	25	I need to change my dress

V. CONCLUSION

This system will be useful for hemiplegia patients as it will tackle the communication gap between them and normal people. Hand and finger movements is used to display particular message and also continuously monitor the health parameters. It requires only few components .It is cost effective and portable in size. It is Lightweight and flexible to the users. It enables real time translation of messages between hemiplegia patient and their caretakers. The ease of message conveyance is the main advantage of this system along with the health monitoring system, which displays the health parameters such as heart rate, body temperature and spO2. In this system we are incorporating the flex sensor to measure the resistance and gyro sensor to detect the angle of hand .Both the values will be sent to microcontroller(ESP32) which processes the data using embedded C programming and through Bluetooth the corresponding messages will be displayed on mobile application along with voice that speak out the messages. Our system successfully proves that it is an excellent approach for patient-nurse communication.



REFERENCE

1. Hoda El-Saied, Dept. of Electronics and Engineering Bowie State University 2011 Real Time Motion Detection using CELL BE .
2. Jong-Tack Kim, Jae-Yong Soh Healthcare Dept. South Korea 2013 Emergency Situation Alarm System Motion Using Tracking of People Like Elders Who Live Alone .
3. Rohini Bhilare, Shradha Swami Dept. of Electronics and Telecommunication, 2017 Motion Based Message Conveyer for Patients.University College of Research, Pune .
4. Yaoxuan Yuan, ZheZang, Wei Xi School of Electronics And Information 2017 SALM: Smartphone based identity authentication using Lip motion Characteristics Engineering Xi Jiaotong University.
5. M. Popa “Politehnica” University, Faculty of Automation and Computers, 2009 Hand Gesture Recognition Based on Accelerometer Sensors Timisoa

