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Communication Support And Physiologic Monitoring For Hemiplegic Patients Using Smart Glove

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ABSTRACT-

Hemiplegia, characterized by one-sided paralysis resulting from brain or spinal cord injuries, presents challenges in rehabilitation due to the often gradual and imperceptible nature of improvements. Our proposed project tackles this issue by incorporating various sensors flex, temperature, and pulse sensors to continuously monitor vital information that real time data shared in telegram application using internet of things. This technology not only captures nuanced details of temperature variations, and pulse variations but also enables patients to communication between hemiplegia to hemiplegia people and hemiplegia people to normal people effectively. The project stands out with its real-time communication feature using voice module to communicate with normal people to hemiplegia people and hemiplegia people to hemiplegia people via blinking the lamp. In the presence of abnormal conditions or significant changes in the patient's status, immediate alert messages are sent to caregivers and medical professionals. This ensures timely responses and tailored interventions. The integration of flex sensors for muscle movements, temperature sensors for body temperature variations, and pulse sensors for monitoring the wearer's heart rate collectively provides a comprehensive understanding of the patient's condition. By bridging the communication gap between hemiplegia patients and care givers, our project aims to revolutionize monitoring and support systems. Through real-time alerts and continuous data tracking, we aspire to significantly improve rehabilitation outcomes and enhance the overall quality of life for those grappling with hemiplegia.

INTRODUCTION:

Hemiplegia is a kind of weakness on one side of your body. This occurs due to the damagein brain controlling movement, hence the muscles will face troubles in functioning. It may affect your arm, leg or even face, making the patients feel difficulties in moving around. Usually, these results due to stroke or injuries in the brain. The already existing project focuses on bridging the gap between communication difficulties of the patient such as deaf-mute people and normal people by gesture-based communication. A wearable glove mounted with sensors and micro-controllers which generates the speech based on the input and in an emergency situation, the light will blink. The already existing project focuses on bridging the gap between communication difficulties of the patient such as deaf-mute people and normal people by gesture-based communication. A wearable glove mounted with sensors and micro-controllers which generates the speech based on the input and in an emergency situation, the light will blink. [1] The role of gloves is to promote communication support for individuals with disabilities by detecting hand gestures and converting the information from text to speech. Gloves are easy to use, promoting independence for physically impaired individuals. The project aims to develop a reliable, user-friendly, lightweight system to minimize challenges for hemiplegic patients and maintain their quality of life.[2]The interest in Smart gloves for virtual reality applications highlights the technical challenges in their design, particularly focusing on that. It provides a review of existing and upcoming devices, projects, and their performance, with insights into future developments in the field.[3]The significance of IoT and machine learning is to notice the challenges faced by individuals with disabilities, particularly those who are unable to communicate. It introduces a wearable smart glove that enables communication through taps, offering 12 different commands audible through an Android app.[4]Safety concerns in immersive virtual environments (IVE) by introducing a stand-alone hardware device that alerts if any emergency occurs. Utilizing distance sensors and vibrotactile actuators integrated into a head-mounted display (HMD), the device aims to provide efficient alerts while minimizing the user's difficulty situation.[5]The communication challenges faced by those who do not understand the sign language. It involves the need for advanced technology, such as displays and speakers, to translate gestures into speech or text to help effective communication between differently able individuals and those without disabilities.[6]The role of Smart Gloves in facilitating communication for disabled individuals by converting hand gestures into text and voice. Using motion sensors and a Raspberry Pi, the device translates gestures into text. The project aims to minimize challenges by providing a good communication system.[7]This device serves as both a communicator and a translator, enhancing flexibility in communication for deaf-mute individuals. Key components include gesture recognition, flex sensors, regional language support, and accelerometer technology[8].The paper focuses on speech-impaired and paralyzed patients by improving communication through the use of flex sensors. It describes a device that translates different signs, to text and voice formats. Flex sensors placed on gloves detect gestures, which are then converted to text data using analog-to-digital converters and micro controllers. [9] This abstract describes the creation of a smart wearable glove capable of wirelessly controlling a robotic hand. The glove incorporates a unique Moratorium structured AgNWs embedded conductive elastomer wire, providing stretch ability of approximately 50% and low resistivity (0.00075 [Math Processing Error]). This wire enhances reliability compared to traditional bonded metal wires when integrated into a bending sensor. The development also includes circuit design improvements and Bluetooth transmission, facilitating effective human-machine interfaces (HMIs) between humans and robots[10]

METHODOLOGY:

FLEX SENSOR 1:

S NO	Resistance values	Message indications(MSG)	Corresponding Messages
1	0-750	MSG 3	I need to use toilet
2	750-850	MSG 2	I am so hungry give me a food please
3	850-950	MSG 1	I am thirsty give me water please

FLEX SENSOR 2:

S NO	Resistance values	Message indications(MSG)	Corresponding Messages
1	0-750	MSG 6	I am tired I need to sleep
2	750-850	MSG 5	I am feeling tired, please treat me
3	850-950	MSG 4	Emergency alert

In our proposed project, we have attached two flex sensors to the smart glove. Each flex sensor has three predefined messages, which are essential for patients to express their needs. Patients are trained to associate each message with a specific degree of finger bending: 0 to 50, 50 to 110, and 110 to 180 degrees. When the finger bends within these degrees, the resistance in the flex sensor changes from 0 to 10k ohms. This change in resistance triggers the display of messages on an LCD screen and their vocalization through a speaker.

The data from the flex sensors are sent to an ESP32 micro controller, where the software, written in C++, processes the information. The Arduino IDE is used to program the ESP32 micro controller, which is supported through the installation of the ESP32 board package. Once installed, you can select the ESP32 board in the Arduino IDE to write and upload code, similar to other Arduino-compatible boards. The gesture movements are interpreted and displayed on the LCD or vocalized through the speaker.

If there is no response from caregivers, a relay triggers a lamp to blink three times, indicating the need for attention. Additionally, we utilize an IoT platform like Telegram Messenger to monitor vital parameters such as temperature and heart rate when caregivers or doctors are not nearby, enabling remote health monitoring as needed."

Six messeges in flex sensors.
I am thirsty give me water please
I am so hungry give me a food please
I need to use toilet
I am tired I need to sleep
I am feeling tired, please treat me
Emergency alert

SOFTWARE PROGRAM IN C++:

C++ programing

```
#include <WiFi.h>
```

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```
#include <WiFiClientSecure.h>
#include <UniversalTelegramBot.h>
#include <ArduinoJson.h>
#include "Arduino.h"
#include "HardwareSerial.h"
#include "DHT.h"
#include "DFRobotDFPlayerMini.h"
#include <LiquidCrystal_I2C.h>
const byte TXD2 = 17, RXD2 = 16;
HardwareSerial dfSD(2);
DFRobotDFPlayerMini myDFPlayer;
LiquidCrystal_I2C lcd(0x27, 16, 2);
int Bpm,totalColumns = 16,totalRows = 2;
#define relay 2
#define DHTPIN 4
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);
float t;
String MSg0 ="Smart Gloves for physiological monitoring and communication support in hemiplegic patients",MSg1="Iam thursty give me water please",MSg2 ="Iam so hungry give me a food please",MSg4="I am so tired i need to sleep",MSg6="I want to sit please lift me",MSg3="I need to use toilet",MSg5="I feeling pain in my body treat me please";
const char* ssid = "PROJECTHEMIPLEGIC";
const char* password = "0123456789";
unsigned long previousMillis = 0, interval = 30000;
#define BOTtoken "6389951255:AAGne8hIgWOkmTcNl9FvJSwGppZh3h8B1Os"
#define CHAT_ID "6332193023"
#ifdef ESP8266
  X509List cert(TELEGRAM_CERTIFICATE_ROOT);
#endif
WiFiClientSecure client;
UniversalTelegramBot bot(BOTtoken, client);
int botRequestDelay = 1000;
unsigned long lastTimeBotRan;
String getReadings(){
  String message = "Temperature: " + String (dht.readTemperature()) + " ยบC ¥n";
  message += "Heartrate: " + String (Bpm) + " BPM ¥n";
  return message;
}
//Handle what happens when you receive new messages
void handleNewMessages(int numNewMessages) {
Serial.println("handleNewMessages");
Serial.println(String(numNewMessages));
for (int i=0; i<numNewMessages; i++) {
// Chat id of the requester
String chat_id = String(bot.messages[i].chat_id);
if (chat_id != CHAT_ID){
bot.sendMessage(chat_id, "Unauthorized user", "");
continue;
    }

// Print the received message
String text = bot.messages[i].text;
Serial.println(text);
String from_name = bot.messages[i].from_name;
 if (text == "/start") {
String welcome = "Welcome, " + from_name + ".¥n";
```

```
welcome += "Use the following command to get current readings.¥n¥n";
welcome += "/readings ¥n";
bot.sendMessage(chat_id, welcome, "");
    }

if (text == "/readings") {
String readings = getReadings();
bot.sendMessage(chat_id, readings, "");
}
}
}

void setup(){
Serial.begin(115200);
lcd.init();
lcd.backlight();
initWiFi();
analogReadResolution(10);
client.setCACert(TELEGRAM_CERTIFICATE_ROOT);
dfSD.begin(9600, SERIAL_8N1, RXD2, TXD2);
if (myDFPlayer.begin(dfSD)) {  //Use serial to communicate with mp3.
Serial.println(F("begin:"));
myDFPlayer.volume(30);  //Set volume value. From 0 to 30

}
else{
Serial.println(F(" offline."));
}
myDFPlayer.volume(30);
dht.begin();
pinMode(relay, OUTPUT);
digitalWrite(relay,HIGH);
lcd.clear();
scrollMessage(1, MSg0, 300, totalColumns);
delay(3000);
}
void loop()
{
unsigned long currentMillis = millis();
if ((WiFi.status() !=WL_CONNECTED)&&(currentMillis - previousMillis >= interval)){
lcd.clear();
lcd.setCursor(0,0);
lcd.print("WifireConnecting");
lcd.setCursor(0,1);
lcd.print(millis());
WiFi.disconnect();
WiFi.reconnect();
previousMillis = currentMillis;
}

if (millis() > lastTimeBotRan + botRequestDelay)  {
int numNewMessages = bot.getUpdates(bot.last_message_received + 1);
while(numNewMessages) {
Serial.println("got response");
handleNewMessages(numNewMessages);
numNewMessages = bot.getUpdates(bot.last_message_received + 1);
}
lastTimeBotRan = millis();
```

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```
}
int pulseValue = analogRead(35);

if(pulseValue>550){
Bpm =60000/pulseValue;
}
delay(500);
lcd.clear();
lcd.setCursor(0,0);
lcd.print("HeartRate:");
lcd.print(Bpm);
lcd.print("BPM");
delay(500);
t= dht.readTemperature();
lcd.setCursor(0,1);
lcd.print("Temperature:");
lcd.print(dht.readTemperature());
lcd.print("*C");
delay(1000);
int flex1=analogRead(32);

if ((flex1 > 850) && (flex1 < 950)){
lcd.clear();
scrollMessage(1, MSg1, 250, totalColumns);
myDFPlayer.play(1);  //Play the first mp3

}
else if ((flex1 < 850) && (flex1 > 750)) {
lcd.clear();
scrollMessage(1, MSg2, 250, totalColumns);
myDFPlayer.play(3);  //Play the first mp3
}

else if ((flex1 < 750) && (flex1 > 0)) {
lcd.clear();
scrollMessage(1, MSg3, 250, totalColumns);
myDFPlayer.play(5);  //Play the first mp3
}
else {
lcd.clear();
lcd.setCursor(0,0);
lcd.print("Gesture1NotFound");
}
delay(500);
int flex2=analogRead(33);

if ((flex2 > 850) && (flex2 < 950)){
lcd.clear();
lcd.setCursor(0,0);
lcd.print("...Emergency!...");
lcd.setCursor(0,1);
lcd.print("......Alert......");
digitalWrite(relay, LOW);
delay(500);
digitalWrite(relay, HIGH);
delay(500);
digitalWrite(relay, LOW);
delay(500);
```

```
digitalWrite(relay, HIGH);
 delay(500);
 }
else if ((flex2 < 850) && (flex2 > 750)) {
cd.clear();
scrollMessage(1, MSg5, 250, totalColumns);
myDFPlayer.play(4);  //Play the first mp3
}
else if ((flex2 < 750) && (flex2 > 0)) {
lcd.clear();
scrollMessage(1, MSg4, 250, totalColumns);
myDFPlayer.play(2);  //Play the first mp3
}
else {

lcd.setCursor(0,1);
lcd.print("Gesture2NotFound");
}
delay(3000);
}
void scrollMessage(int row, String message, int delayTime, int totalColumns){

for (int k=0; k < totalColumns; k++) {
message = "  " + message;
}
message = message+ " ";
for(int position = 0; position < message.length(); position++){
lcd.setCursor(0, row);
lcd.print(message.substring(position, position + totalColumns));
delay(delayTime);
}
}

void initWiFi(){
WiFi.mode(WIFI_STA);
WiFi.begin(ssid, password);
while (WiFi.status() != WL_CONNECTED) {
lcd.clear();
lcd.setCursor(0,0);
lcd.print("WifiConnecting.");
delay(1000);
  }
lcd.clear();
lcd.setCursor(0,0);
lcd.print("WifiConnected");
delay(500);
```

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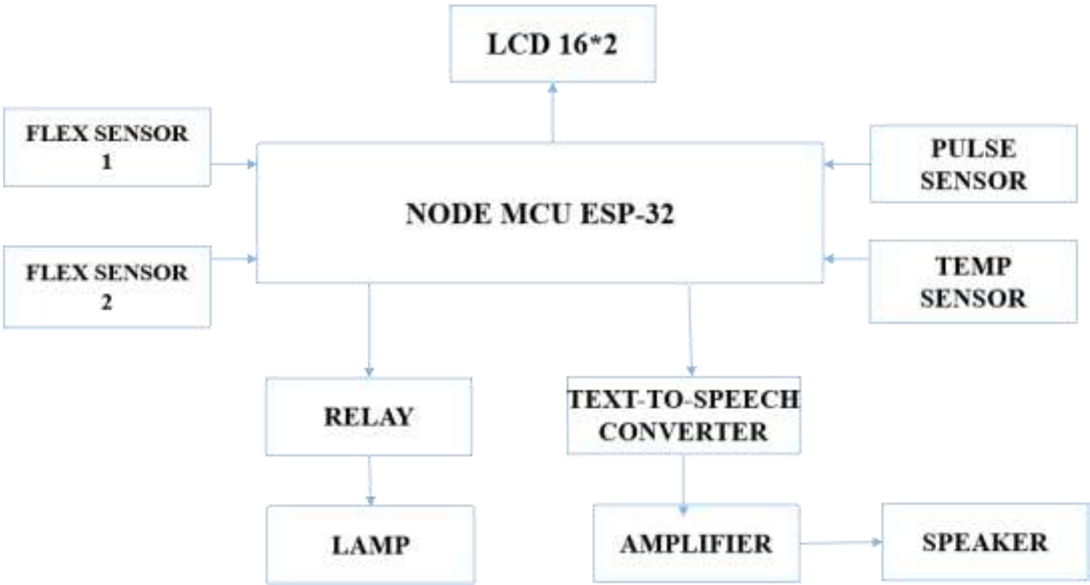
BLOCK DIAGRAM:



MATERIALS USED:

- Flex sensors
- Pulse sensor
- Temperature sensor
- LCD display
- Micro-controller
- Text-to-speech converter
- Speaker
- Relay
- Lamp

Flex sensor:

Fig1.Flex sensor

Flex sensor is integrated with the smart glove which is flexible. It is used to detect the finger movement. The resistance values get changed whenever the finger is bent. Corresponding to the resistance values, the MSG(message) is displayed on the LCD.
Also, it plays an vital role in triggering the lamp to blink through relay like the instructions displayed have not received any responses.

Health monitoring sensors:

Fig2.Pulse sensor

Fig 3.Temperature sensor

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Pulse sensors are used to monitor the patient's heart rate, providing valuable data for their healthcare provider. This can help in assessing the patient's overall health status and detecting any abnormalities in the heart rate.

Temperature sensor is integrated to measure the patient's body temperature. The readings are generated via IoT platforms like Telegram and displayed in the LCD display.

LCD Display:

Fig4.LCD display

The LCD display is an electronic device in which 16*2 is mostly preferred due to their less cost, easily programmable and simple to access. The heart rate, temperature readings and based on the resistance values the instructions are displayed whenever flex sensors detects the gesture movement.

Micro controller:
Micro controllers play a vital role like the brain for the glove. The flex sensors that detect the finger movement meanwhile the resistance is changed. Based on these values the instructions are displayed in the LCD. It receives an input from sensors and hence decides what to do with it (process of communication).

Text-to-speech converter and Speaker:
The text is displayed on the LCD display, further process is carried by micro-controller into speech through converter when there is no response (because the caregiver may be deaf-mute people). The speaker is an essential device used for communication, it provides instructions or alerts to the caregiver.

Relay and lamp:

Fig5.Relay

The relay triggers the lamp to blink as an emergency alert, when the speech is played and there is no response from the caregiver.

ADVANTAGES:
- Cost-effectiveness.
- High sensitivity.
- Low power consumption.
- Smart gloves should be comfortable and have prolonged wear.
- It is simple to maintain and favorable to environment.
- Smart gloves free from contaminants maintain hygiene to prevent skin irritation or infections.

Fig 6: Final Product Kit

APPLICATION:

- This is a unique device used by both hemiplegic patients and those who are not able to communicate.
- It is accessible to everyone.
- The temperature sensor and a pulse sensor have been integrated that helps in monitoring temperature and heart rate.
- Collecting the data by analyzing the sensors and responding immediately to both patients and healthcare providers.
- Provide an emergency alert by blinking the lamp when the patient in requirement while no response from caregiver.

CONCLUSION:

In conclusion, the project we propose aims to provide a solution to patients with hemiplegia, a problem that everyone faces. It is used to continuously monitor vital information from the body by combining various sensors, including flexibility, heart rate, and temperature sensors. Using IoT to share data through platforms like Telegram not only captures details but also facilitates seamless communication between patients and healthcare providers or caregivers . Remote monitoring of vital health parameters can be taken when needed in emergency. The special features of our project lie in communication using a text converter, a voice module using a speaker, and flashing lights to facilitate communication. If an abnormal condition occurs in the patient's body, an alert is immediately sent to the medical professional via IoT platform(telegram). We use various sensors to determine the patient's condition. The main goal of this project is to monitor and support hemiplegic patients thus increases the Patients life quality.

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