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Smart Assist System Module for Paralysed Patient Using IoT Application

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Abstract

Those who are hearing impaired or hard of hearing face the most difficult challenges as a result of their handicap. To establish a bond or commit to something, people should be able to express their ideas and feelings via open channels of communication. To solve such issues, simple, transportable, and accurate assistive technology will probably be developed. The glove with sensors and an Arduino microcontroller is the major focus. This system was developed specifically to translate sign languages while analyzing gesture locations using smart technologies in custom gloves. The micro-controller identifies certain hand motions using sensors attached to gloves and converts sensor output data into text. Their capacity to converse may be aided by their ability to read the text on the mobile IOT application. Also, it aids in automating the houses of people with paralysis. It has the capacity to assess biological indicators like pulse and temperature as a patient monitoring device. The system will be put into place with the intention of enhancing the quality of life for people with disabilities and providing additional assistance in bridging the communication gap. It has a low price tag and a small design.

Keywords: Sensors, IOT, paralyzed, disabilities, gloves

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1.Introduction

The global population is 8 billion. A recent survey conducted by the World Health Organization (WHO) revealed that out of the global population of 8 billion people, around 1 billion people are experiencing some kind of impairment. A disability encompasses any kind of physical or psychological impairment. Approximately 2.78% of individuals in our nation have difficulties articulating their speech with clarity [1]. Some individuals find it challenging to communicate with others.

Individuals with hearing impairments strive to communicate using sign language, yet only a small fraction possess this skill. They struggle to effectively communicate with unfamiliar individuals [2]. They hold the concept that a communication block occurs when communicating with others, limiting them from freely sharing their emotions and sentiments [3].

As a consequence, the recommended answer is the creation of a gadget known as a hand assistive system for those who are hearing impaired or hard of hearing. This project tries to overcome the obstacles that the hearing-impaired confront. The major purpose of this program is to overcome the communication gap between the general population and hearing-impaired people. The suggested technology turns their hand movements into a speech that is usually understood to decrease this barrier [4].

This contraption is constructed of gloves, flex sensors, and an accelerometer. Stroke sufferers, paralyzed people, and patients who have recently undergone surgery are unable to use their hands or carry out their usual chores [5].

They should depend on others because they are incapable of caring for themselves. The fundamental purpose of this study is to construct a smart hand glove with a number of sensors linked to it, including flex sensors, MPU6050 sensors, pulse sensors, and other sensors required to collect biological data [6]. These sensors can recognize a particular person's hand motion. The Arduino Nano microcontroller will receive input as soon as the hand motion is recognized [7].

We have a default database in the microcontroller where we have every single unique recognition with the necessary messages preserved. After analyzing the sensor input, the microcontroller displays the output message that matches the database [8].

Via the Blynk software, hearing-impaired users may receive text messages on their cellphones. In addition, people may view their temperature, blood pressure, and pulse rate [9]. We can supply home automation to folks with physical limitations so they can carry out their own duties. They'll grow less dependent as a consequence [10].

2. Related Works

In this study, gloves must be fitted with sensors, such as a flex sensor, accelerometer, and touch sensor, that can distinguish distinct sign language gestures. Fingers are fitted with flex sensors that monitor how much they flex in response to motions [11]. An accelerometer is positioned in the palm to measure the hands' position along the X, Y, and Z axes. To detect any contact, touch sensors are positioned in the spaces between the fingers [12]. The sensor data is routed to an Arduino UNO board for further processing before being Bluetooth-transferred to an Android phone [13]. We will receive text as data. The text data is subsequently translated to voice using the Google text-to-speech converter [14]. The major mode of communication for hearing-impaired people is sign language. Although it conveys information graphically, it still has grammar and vocabulary`, exactly like any other language. The difficulty occurs when hearing-impaired people attempt to speak with others using these grammars in sign language. This is due to the fact that ordinary people often lack acquaintance with these grammars. A person who is hearing challenged or has problems speaking or hearing can only communicate using sign language [15].

The use of sign language by people with physical limitations helps them convey their thoughts and feelings more clearly [16]. In this work, cutting-edge sign language identification technology has been utilized to detect the alphabets and motions of sign language. Using computer vision and neural networks, we can recognize signs and output the corresponding text [7].

This study illustrates how to identify motions using a flex sensor that is largely linked to a hand glove. This is meant to recognize a few words and the English alphabet before blending those sounds into speech using speakers. Essentially, this technology is based on microcontrollers and smart gloves [18]. Information from a flex detector that detects finger movement is transferred into a microcontroller-based system, which then turns it into a voice that can be detected as human [19].

Helpful solutions that suit the special requirements of people with disabilities are one of the many areas where embedded systems show significant promise. This technology develops a "Smart Glove" that a person wears that detects basic hand gestures and translates them into electrical signals using motion sensors, and when the signal processing is complete, the signal displays on the computer display in the form of text [20]. The Flex sensing element is employed in this system as a motion-detecting element. This technology makes use of a microcontroller that is an improved version of the microcontroller, the remembering board, which makes it incredibly portable and compact [21].

3. Working Methodology

Communication between hearing-impaired, mute, or paralyzed groups and ordinary people is eased by sign language. The purpose of this program is to lessen the communication gap that exists between the disabled population and the rest of society [22].

The system incorporates IOT-based technology, which enables intelligent applications. To monitor finger flexion, hand orientation, and pulse rate, respectively, the user wears a smart hand glove equipped with the relevant sensors, such as a flex sensor, accelerometer, and pulse sensor [23].

Attach the Arduino to each flex sensor. Also integrated into the system is a WiFi module. For stability and compactness, these connections may be machined onto a printed circuit board (PCB), generating a lightweight glove module [24]. Due to the resistance value changing when it is bent, the flex sensor has a predetermined limit value [25].

The Arduino gets the resistance value as a voltage. To determine whether each finger is bent or not, interpret these. Recognition of hand gestures thus completes the requisite responsibility [25].

On a hand with a microprocessor, an accelerometer and gyroscope are placed. Yaw, pitch, and roll readings are given by the accelerometer [27]. They may also be related to motions to carry out specific tasks based on specified conditions. These sensors transmit their readings to the microcontroller [28]. This data is handled suitably by the microcontroller and delivered over the ESP32 WiFi module [29].

People may use the Blynk app to access this system as a mobile application. For those with paralysis, particularly stroke sufferers and those who have undergone surgery, home automation results in the immobility of body parts other than the hands. This leads to the message they are aiming to get across to the typical individual [28, 29].

A pulse sensor that captures the patient's pulse rate and an MPU6050 sensor with an integrated temperature sensor are also included in the study. The system employs an efficient design to transform sign language into text, messaging, and home automation applications [30, 31].

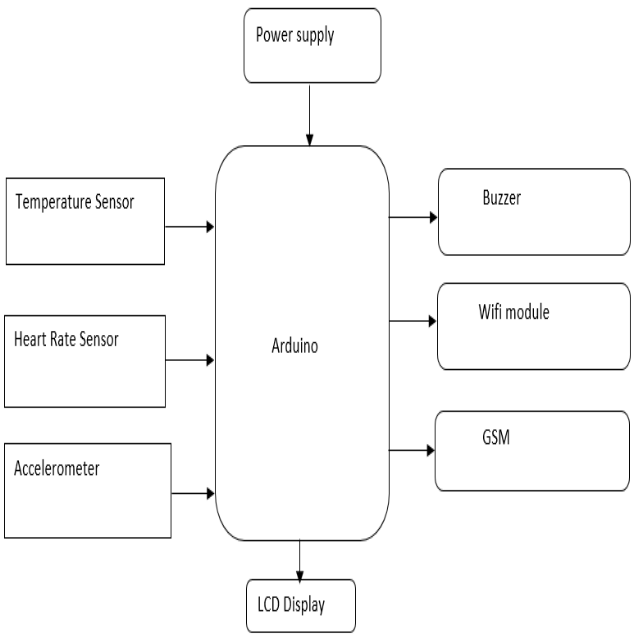

Figure 1. Block Diagram

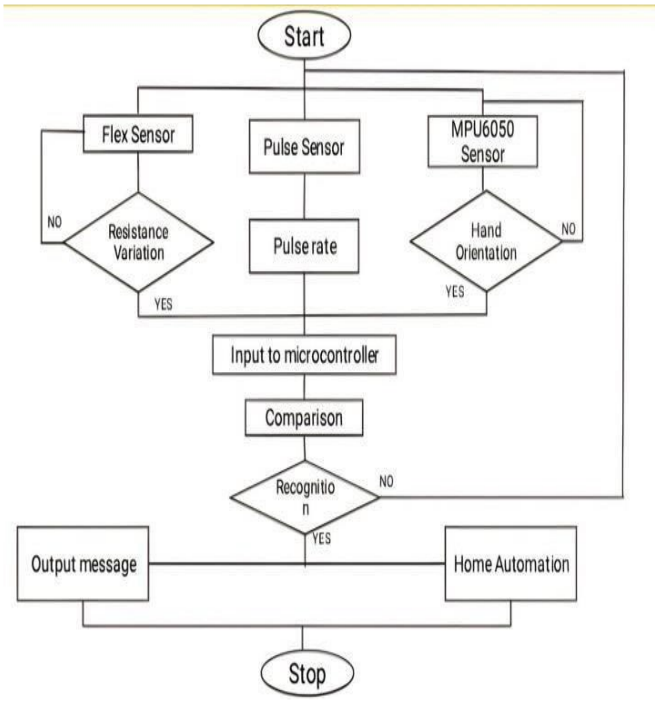

Figure 2. Flow Chart

The flow chart for the system has been given here to make the flow of the research easier to understand.

3.1 Algorithm

Step 1: Gloves are worn by patients.
Step 2: Hand gesture data are sensed by the sensors integrated on hand gloves. Step 3: Sensed data are transmitted to the arduino microcontroller.
Step 4: Compare the values that need to be inside the bounds of the programmed database's predefined range.
Step 5: If the data falls within a certain range, the message will be transmitted after being recognized by the Wifi module.
Step 6: Through the blynk app the text / message will be displayed on the mobile screen along with biological parameters.
Step 7: Home automation will also be done from the processed data from recognition of hand gestures of patients.

3.2 System Architecture

The accompanying graphic displays the planned architecture of this developed system to be constructed using IOT-based technology to give the correct results. It has been put through a lot of tests and trials in order to come to credible conclusions. By looking at the sensor output, we can properly anticipate the outcome. It comprises the formulation of the existing design and techniques for finding out whether one or more solutions are practical.

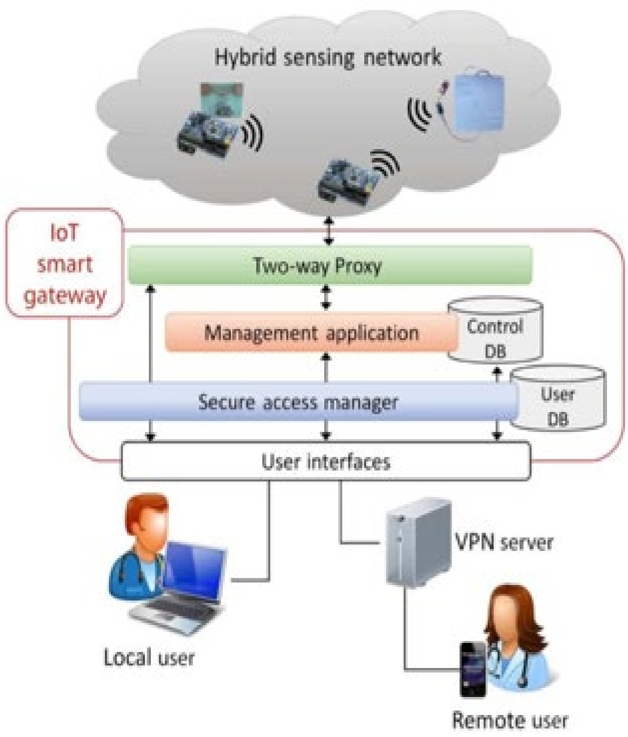

Figure 3. Flow Chart

4. Result & Discussion

4.1 Flex Sensor Analysis

To begin with, we monitored patients' bending hands using two integrated flex sensors on the smart hand gloves. When bent, flex sensors' resistance values vary. The resistance from the sensor's data was transformed into voltage using the voltage divider device. In order to compare the sensed data to the microcontroller's default database, the microcontroller analyzes the data and transmits it to a computer. The flex sensor voltages must fall within particular ranges, as mentioned in the table below, in order to produce an alphabet (for a test example, we utilized alphabets from A to E). We have undertaken a number of test scenarios across a variety of categories in order to achieve the desired output from the sensors.

4.2 Test Case 1

To show the alphabet on the serial monitor on the Arduino IDE platform, we will employ both the flex sensors, referred to as flex sensor 1 and flex sensor 2. When we attempt to bend the rest flex sensor into a different position, resistance fluctuates. When flex sensors 1 and 2 are sufficiently bent, a voltage output will be created. The voltage levels of flex sensors depend on how they are bent. The first and second flex sensor voltages are 0.74 and 1.23 volts, respectively.

At those voltage levels, the serial monitor will show the matching letter, as seen in the picture. The final image is displayed below as a result, and this change in resistance is translated to voltage using the voltage divider rule. This voltage value of 1.18 volts therefore dictates how the letter B is displayed on the serial monitor. The result is displayed in the image below.

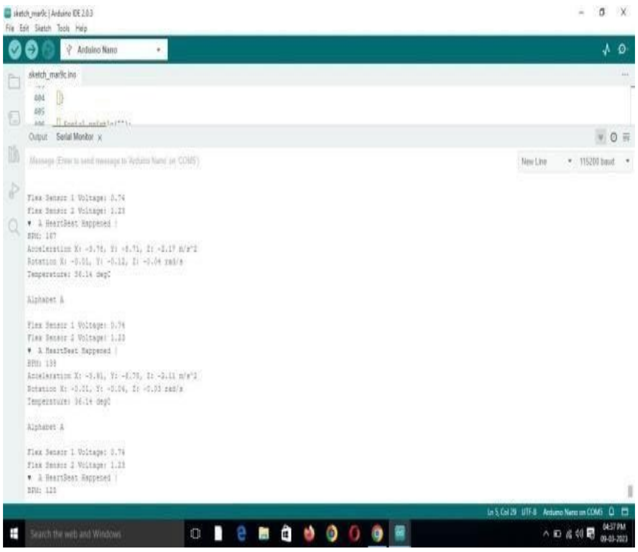

Figure 4. Test Case 1

4.3 Test Case 2

To detect motion in this instance, the flex sensor 1 must be bent all the way to its deepest point. The connected flex sensor 2 for the smart glove will thereafter be at rest. Flex Sensor 1 experiences a change in resistance.

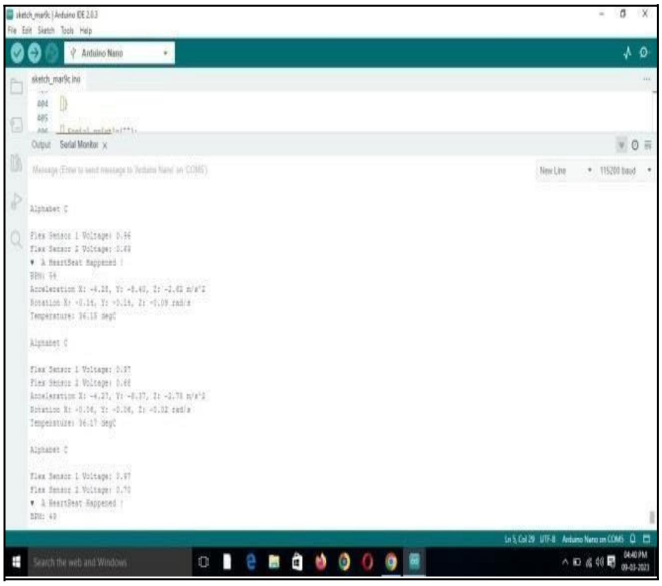

Figure 5. Test Case 2

4.4 Test Case 3

The sample is now only slightly bending at flex sensor 2 for the change in resistance value, while flex sensor 1, which is supposed to be in a resting position, is not moving. The output voltage of the Flex Sensor 2 is thus 0.68 volts. Thus, as shown in the accompanying picture, the results of printing the letter C on the screen.

As a consequence, we have done a few test cases below to demonstrate their relevance in collecting the output from flex sensors. A table has been constructed with the additional test situations. We have merely completed the flex sensor analysis thus far. Nevertheless, we also need to collect the findings from the other sensors. Lastly, we will predict the essential expected result from this system to successfully serve the patient.

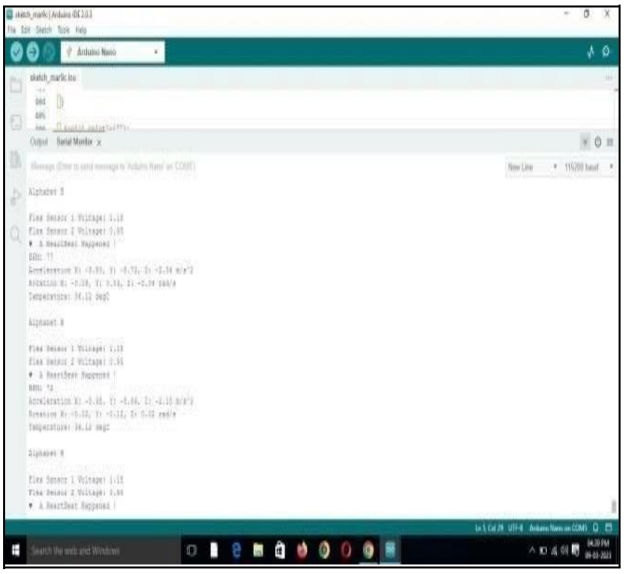

Figure 6. Test Case 3

Table 1: Analysis of Flex Sensor Output

S. NO	Sensor	Sensor 1 Status	Sensor 2 Status	Sensor 1 Value	Sensor 2 Value	Alphabets
1	Flex Sensor	Active	Active	0.77	1.19	A
2		Active	Rest	1.11	0.92	B
3		Bend	Active	0.99	0.70	C
4		Bend	Active	1.15	1.39	D

5. Conclusion

We created a smart hand glove for sign language translation in the proposed system. People with and without disabilities will be motivated to engage and learn about themselves as a consequence. Because many technologies have progressed, they have added extra features that increase the quality of life for individuals with impairments. The smart-design glove contains sensors and other aspects that allow it to offer precise results. The gadget may connect to an Android phone and allow message exchange using IOT-based technologies. By upgrading home automation systems, it allows people with paralysis to handle electrical appliances with simple hand gestures. The Smart-Glove is risk-free, lightweight, inexpensive, and easy to use. We are positive that the notion will help patients live more easily in general and that it will enable people with disabilities to enjoy fulfilled lives.

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