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School of Electrical Engineering

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INSTRUMENTATION

J-Component Project Report
on

Real-time IoT controlled glove for hemiplegia condition using phalange movement

Submitted by

19BEI0020, Apurva Patel,

apurva.patel2019@vitstudent.ac.in

19BEI0053, Sanskriti Binani,

sanskriti.binani2019@vitstudent.ac.in

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Under the guidance

ofDr. P.

Mahalakshmi,
Professor, SELECT, VIT-Vellore.

Abstract:

Finger movement is the foremost utilized way to communicate for listening and talking for crippled individuals. Around 10% of crippled(hemiplegic) individuals utilize hand movement and particularly finger movement as their major mode of passing on messages. We plan a wearable hand glove that will make finger development justifiable to machines by interlinking the phalange motion to ordinary capacities. When the fingers are moved, development will be identified concurring to substantial development. Thus, the corresponding assignment will be embraced by the computer. The flex bend sensors are utilized to measure the flexion of fingers. An 8-bit microcontroller is used to process the sensor information. Intended users control the system by wearing an instrumented glove fitted with flex or bend sensors for controlling. The viability of the proposed arrangement is additionally showed within the document.

Keywords: - Hemiplegic patient, Wearable hand glove, Phalange motion, flex sensor, 8-bit microcontroller, ESP8266

Introduction: -

The paralytic society or the community often have to be dependent upon others for performing even the most basic activities of a day-to-day life such as switching on and off lights and fans or opening and closing the doors of the room. It is not possible for the caretaker to be around all the time. So in this project, we aim to design and develop a glove integrated with flex sensors and IoT that detects the movements or the gestures made by the patient to perform certain activities even when the person in charge is not present.

The Flex Sensor technology is based on resistive carbon elements. These are sensors that change resistance when bent. This change in resistance can either be increasing or decreasing depending on the type of flex sensors used. When the substrate is bent, the sensor produces a resistance output correlated to the bend radius, the smaller the radius, the higher the resistance value. This concept shows that if flex sensors are placed at the joints of fingers, they can be used to determine whether fingers are bent or not. Given five fingers with two states each, one for bent and one for relaxed, finger gestures could easily be given a numeric code which be used as command signals for device control and virtual simulation.

Through the creation of a controller that uses flex sensors that allows the user to define gestures for device control commands wirelessly, various technological applications based on alternative ways for device control can be implemented. In our project we use two flex sensors. One to control the servo motor which demonstrates the opening or the closing of the door and the other performs two activities depending upon the degree to which the finger is bent. If the value obtained from the flex sensor is in the range of 0-100, the patient can control the switching of lights and for values above 100 degrees an emergency trigger is initiated through which the patient can send an emergency message to the person in charge. For this we are using the IFTTT applet and an ESP8266 microcontroller to send the data from the flex sensor to the IFTTT platform.

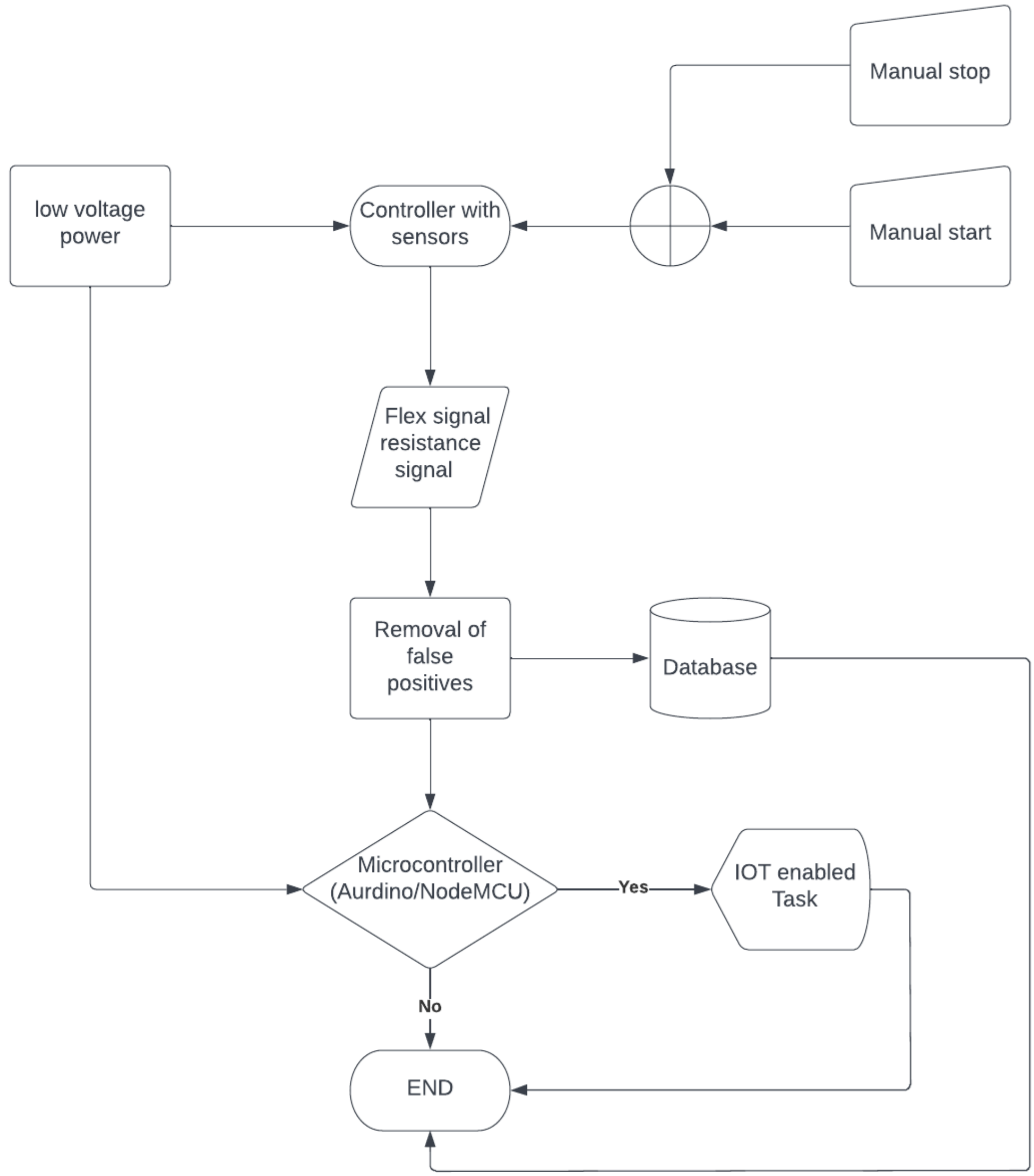
Literature review:

Sr. no.	Year	Author	Title	Work
1	2016	Rami N. Khushabaa, Ali Al-Timemy, Sarath Kodagodaa	Combined influence of forearm orientation and muscular contraction on EMG pattern recognition	In this paper,It was observed that the classifer that measures the angle of the muscle activation patterns perform better than the one measuring the amplitude. An accuracy upto 91% was achieved when the classifier trained with EMG signals collected multiple forearm orientation with medium muscle contraction.
2	2017	Yamik Mangukiya, Brij Purohit, Kiran George	Electromyography(EMG) sensor controlled Assistive Orthotic Robotic Arm for Forearm Movement	This study presents an orthotic robotic arm that can help in retraining flexion and extension movements of forearm of person affected by stroke. It was designed to assist the elbow movements of hand using signals acquired from wrist movements and elbow movements.
3	2019	Xiaoke Chai, Zhimin Zhanga, Kai Guana	A hybrid BCI-controlled smart home system combining SSVEP and EMG for individuals with paralysis	In this study, EMG signals were associated with occlusal movement (contact between teeth) to design a smart home control system for individuals with paralysis. In order to control the different devices, three EMG patterns were defined on the basis of the duration and the number of clenches.
4	2019	Yurii VASYLKIV, Ali NESHATI, Yumiko SAKAMOTOa	Smart Home Interactions for People with Reduced Hand Mobility Using Subtle EMG-Signal Gestures	This paper mainly aims at developing a finer EMG-based hand gesture interaction to control a set of smart-home lights using the MYO Armband in the simulated room environment. MYO airband is a wireless armband that contains 8 medical grade stainless steel EMG sensors and a highly sensitive nine-axis IMU.
5	2020	Rachana Bhaskaran Venugopal, T Rajalakshmi, Arjun Suresh	EMG based Signal to Control Home Appliances by Partially Paralyzed People	In the proposed study, the signal acquisition was carried out using EMG module RKI2401 which was tested in 7 individuals. Further the acquired signal was processed using Arduino Software, thereby home appliance (light) was controlled using two-way relay circuitry.

Objectives:

1. To control level 1 complexity tasks using phalange flexion.
2. To control distant objects remotely to assist hemiplegic patient.
3. To remove false positives from obtained signals and utilize it to generate control signals.

Methodology:



In this project, the flex sensors are adjusted on the fingers of the patient. We have demonstrated using two flex sensors. When the patient bends its fingers, the flex value is obtained which ranges from 0 to 1024. Since, a wide range of values are obtained from these sensors, we can allocate different tasks for different range of values. One flex sensor is used to control the servo motor, with the bending and the relaxation of the finger, the motor rotates clockwise or anti-clockwise. This can be used to demonstrate the locking and the unlocking of the door. The other flex sensor has been divided into two ranges. The first set of the range where the finger bends between 0 to 100 degrees, the patient can control the switching of the lights and with the movement of the same finger but the bending ranging above 100 degrees, an emergency trigger message is sent to the person in charge. The IFTTT applet is used to keep a track of the values sent by the microcontroller ESP8266 to the applet. Whenever, the value crosses 100, the triggering message is sent.

Circuit Connections: -

The flex sensors are connected in voltage divider circuit. One end of flex sensor in connected to a supply of 5V from the Arduino Uno/Nano and other single strand wire is connected to the static resistor (the resistor used here is 120 kilo ohm). While one end of resistor is connected to the sensor it is also connected to the analogue read pins or input pins and these act as input values which need to be computed. The other end of resistors needs to be connected to the common ground terminal of Arduino or to that of a ground of a battery.

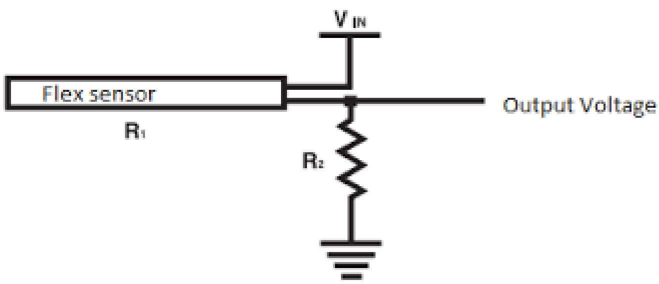
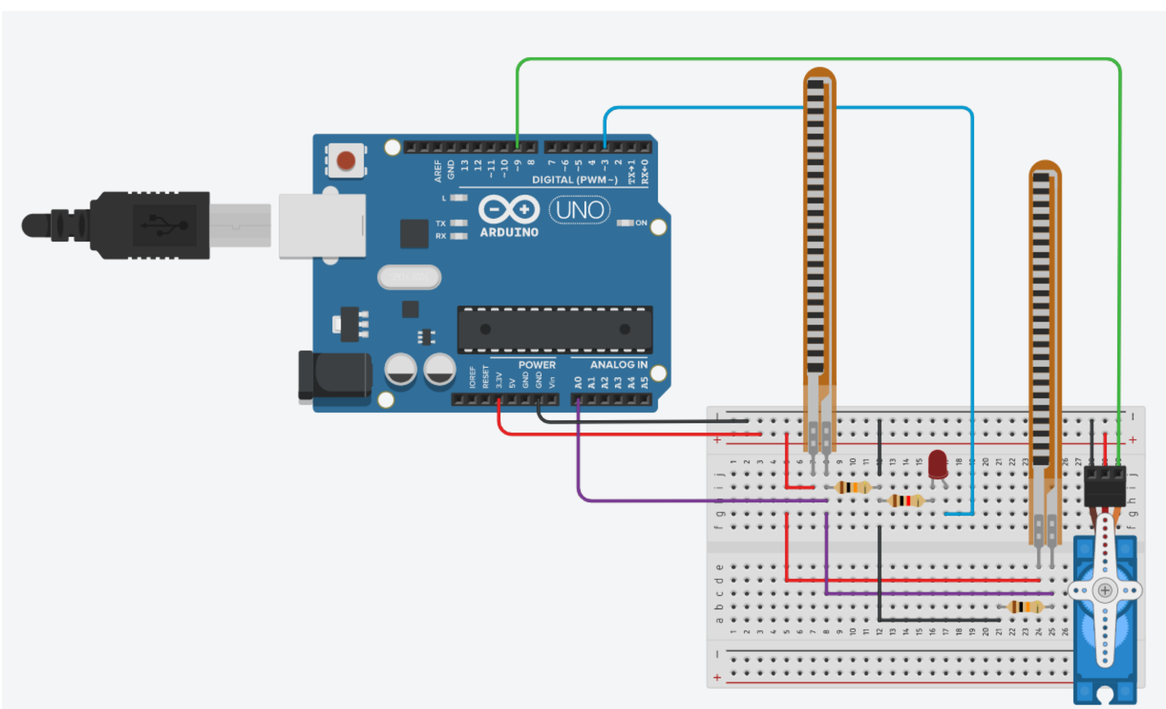


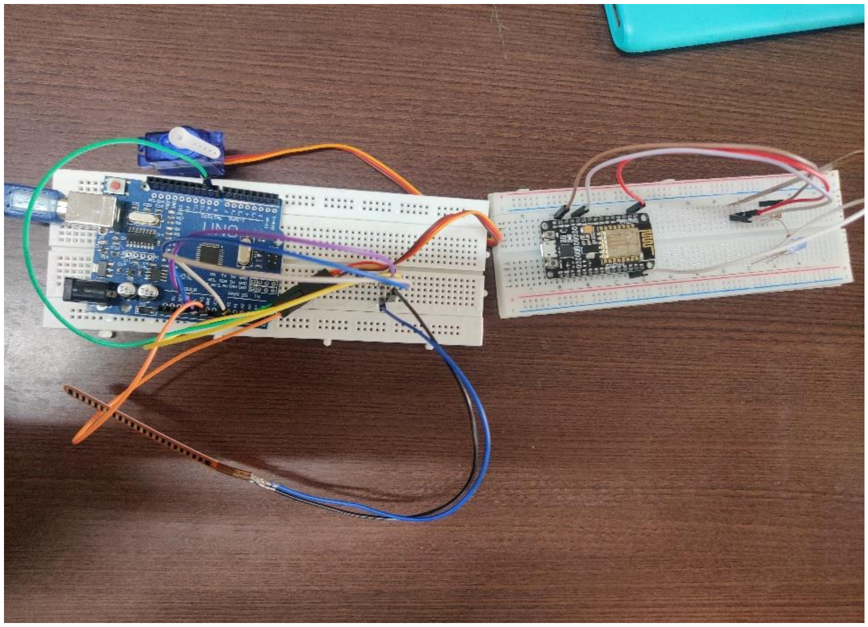
Figure 1:
Circuit connection scheme

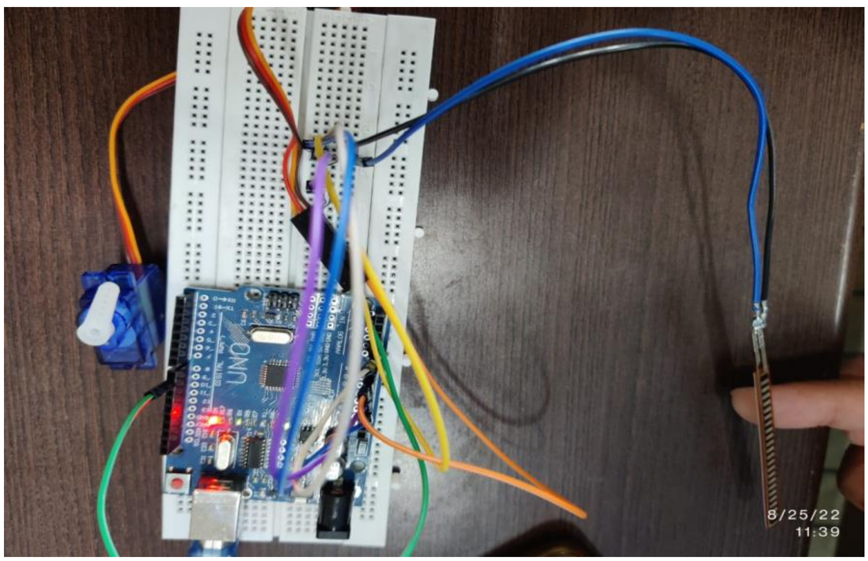
$$V_{out}=V_{in} \times \frac{R_2}{R_1 + R_2}$$

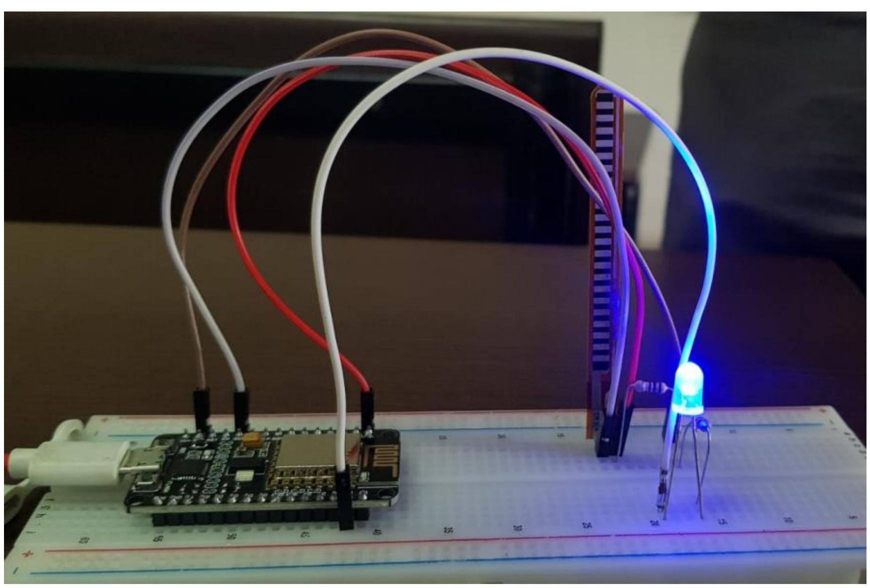
Project connections and Proof of concept: -



Connections







Results Obtained:

1. Generated accurate and precise control signals.
2. Highly reliable device for hemiplegic patients.
3. Low-Bandwidth functioning of controller.

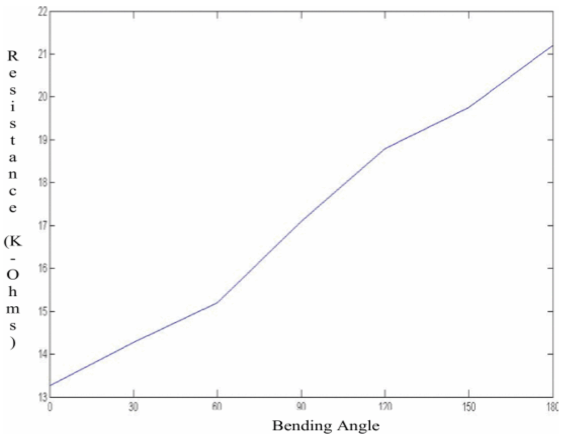


Figure 2:
Plot of flex sensor resistance based on bending angle

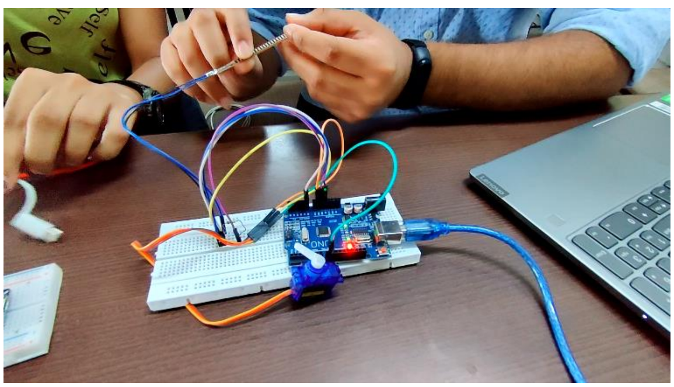


Figure 3:
Position of servo arm when no flex

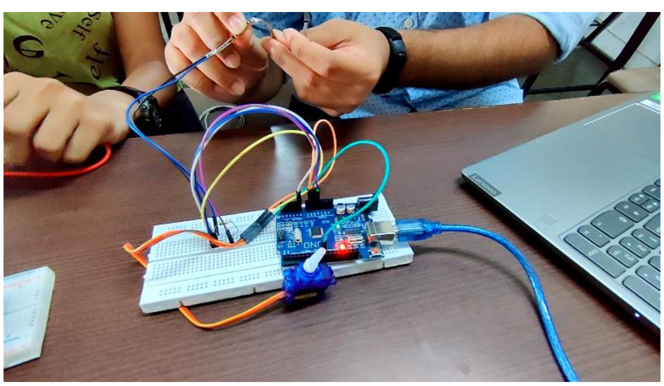
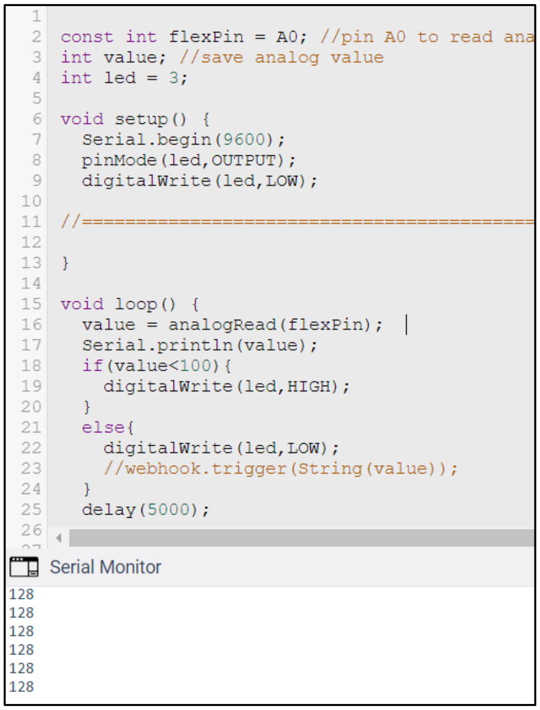


Figure 4:
Position of servo arm when 90-degree bend



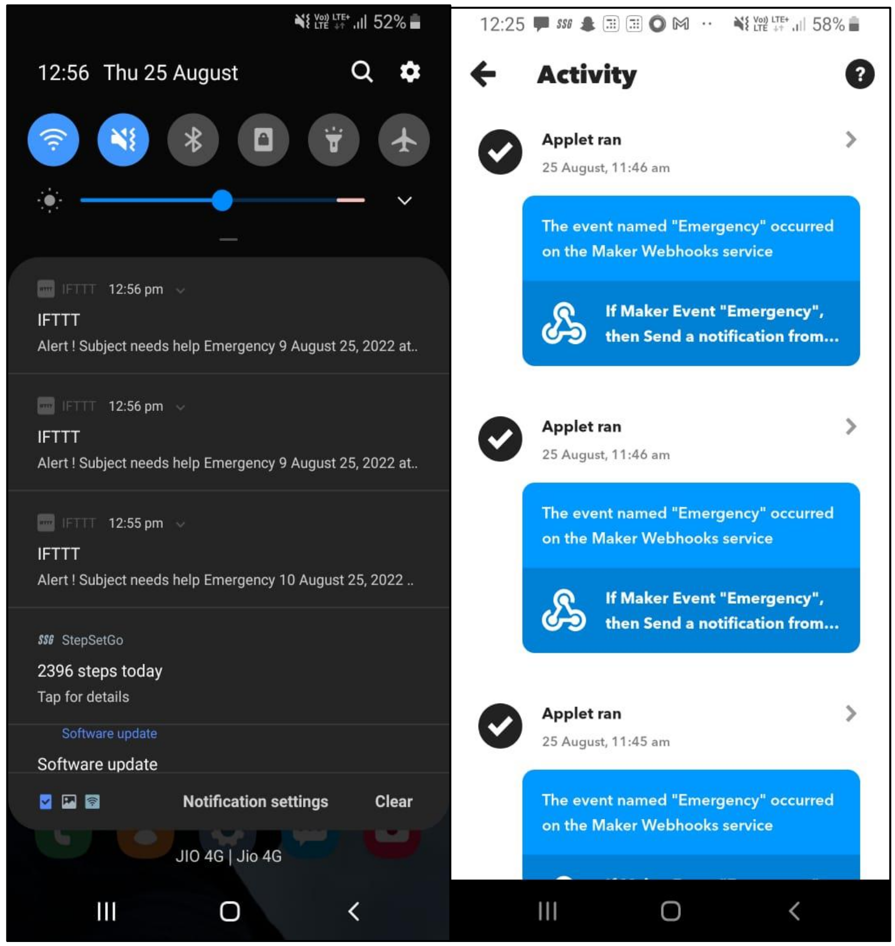


Figure 5:
Messages and Notifications received from emergency trigger when the flex value goes above 100

Conclusion

Hemiplegia is a condition in which one side of the body is paralyzed. This project was built to help the patients suffering from this condition, to enable them to perform very basic day-to-day activities without being dependent on others. With an emergency trigger integrated along with IoT, the patient can reach out for help whenever needed. Hence, not leaving the patient completely unmonitored.

Project Video link:
https://drive.google.com/file/d/1yviYP3eh15l94pa5UYXFenmKoZcb_UYh/view?usp=sharing

Social Outcomes of the project:

1. To minimize sense of abnormality among hemiplegic patients.
2. Generate reliable product with precise control in low budget.
3. To control devices using IOT enabled devices.

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Name: Apurva Patel
Register Number: 19BEI0020
VIT E-mail: **a**purva.patel2019@vitstudent.ac.in
Alternate E-mail: apuanupatel3509@gmail.com
WhatsApp Number: +91-7227003509
Hostel Block and Room No.: M 823
Residence address with pincode: 22 Trilok Row House, Opp Bhaskarpandya community hall, Sandesh press road, Bodakdev, Ahmedabad-380054

Name: Sanskriti Binani
Register Number: 19BEI0053
VIT E-mail: sanskriti.binani2019@vitstudent.ac.in
Alternate E-mail: sanskriti.binani11@gmail.com
WhatsApp Number: +91-9772124202
Hostel Block and Room No.: D 606
Residence address with pincode: 33A, Canal Circular Rd, Swarnamani Apts, Block-Oriana, flat – 19OC, Kolkata - 700054