Design and Implementation of Monitoring system for Paralysis patient using IoT

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Abstract

Internet of things represents a catch line of smart applications. At the same time, it plays a leading role in the health care systems, as it provides the connectivity of the distant patients, who are not able to express their concerns. In this modern era there are a lot of technologies that are being used in different healthcare fields for paralyzed people. This paper proposed a model for paralyzed patient by considering Arduino with the integration of gyro and flex sensors for the patient hand and finger and feet movement. Patient can easily be connected with this device by sending his message to caretaker only by moving their hands into respective directions, or they can send their message by moving their fingers and feet. Through this device paralyzed patient will be able to convey their messages to caretakers, so they can assist the patient timely. This system will enhance the medical care to those patients who are even not able to convey their message because of paralysis condition.

Keyword: Internet of things, healthcare monitoring, wearable devices, gyro sensors, flex sensors

1 Introduction

Advancement in IoT technologies has made human life much simple and easier. These IoT technologies have also created a major impact in the field of medical in terms of patient and caretaker connectivity. These IoT technologies provide various benefits such as data accuracy, reduces manual work. It also helps to increase the quality of life in a healthy way. Now a day people are suffering from various diseases such as heart attack, damage in the nervous system, trauma, brain tumor, damage in spinal cord and severe head injury due to serious accident causes paralysis. Paralysis is a loss of muscles functioning in a part of a person's body. Paralyzed patients need a proper care and attention. This should be monitored continuously and treated properly. For continuous monitoring of paralyzed patient's health, physical care is quite difficult and uncomfortable for the patient, doctor and the care taker to communicate with patient, communication with a paralyzed patient is the most difficult task, because they need run time proper care in order to save their lives. In case of unavailability of the caretaker or healthcare staff we need a connection from which patient can easily communicate and send messages to care taker. To reduce these difficulties paralysis patient health care system is accommodated. By adopting paralysis patient healthcare system communication between the paralyzed patient and the caretaker get much easier and there is no requirement for the patient's caretaker to visit them frequently, when the patient send their message according to their need by tilting

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their hands in different directions, at that time they can visit their patient easily when they receive messages sent by the patient by moving their hands in certain direction as connected [1,2]. The most enormous use of IoT is in healthcare system which provide facilities of health and environment as per their requirement [3]. For personal healthcare, medical awareness and fitness related activities use the healthcare systems these obtained a great approval over recent years. IoT devices enabled the paralyzed patient to be monitored by their medical provider remotely from distance [4].

2 Literature Review

IoT improves the internet and physical device connectivity, among other things as well. The main purpose of this connectivity of huge scale is to enabling the information of any object from anywhere. [5]. In IoT, the objects are integrated with some intelligent sensors, these sensors, sense the environment in order to get the meaningful information, after receiving this data they examined and processed further for the necessary action [6]. IoT is also used in health care systems. Sensors monitor the patient even-if the patient is in hospital, at home or staying anywhere else [6]. There is a persistent need for continuous interaction with the technologies, however the paralyzed patients can't interact with these gadgets like laptops, cellphones, tablets and notepads but there is a more devices that can act as a solution to interact with these machines, but they are expensive like google glasses, it is not possible for every paralyzed patient to connect and interact with these gadgets. To overcome this problem, [9] authors proposed a retina controlled device called "Eye-com". This device is constructed from cost effective IoT devices such as Micro controller Arduino, accelerometer, X-bee wireless sensor and IR diodes. This device easily ascended on the glasses. By using this device paralyzed patient can easily interact with the machines by simple head movements and their eye blinks [10-13] Proposed a prototype include three health sensors i.e. Galvanic Skin Response Sensor, Heart Pulse Sensor, Body Temperature Sensor, these sensors are combined together into a system with Arduino UNO to sense the health parameters of the patient's body and Raspberry Pi collect the data into a server and then transfer it to the cloud server. [11] Authors designed a glove which is helpful for quiet people and paralyzed patient as well as for the detection of the heart attack. In this health care system gloves uses are fitted with the Flex Sensor in three dimensions in order to collect data from every position and hand motion to differentiate and determine each and every word from specific sign. In [12] the system is proposed to serve the paralyzed patients hand movement issues. In this system patients wear the sensor gloves to recognize the movement of fingers to control the home appliances, like smart tv, fridge, ac and door locks, also it monitors the patient's heart rates and body temperature if it varies with actual value, heart rate of the patient exceeds then the buzzer will be activated and the system will send the message to care taker through GSM module [14]. IoT is a heart of all innovative domains like it worked in surveillance monitoring, supply chain management and healthcare monitoring, these capacities are integrated with IoT with the respected management vendor systems, these three categories with more applications are discussed in Figure1.

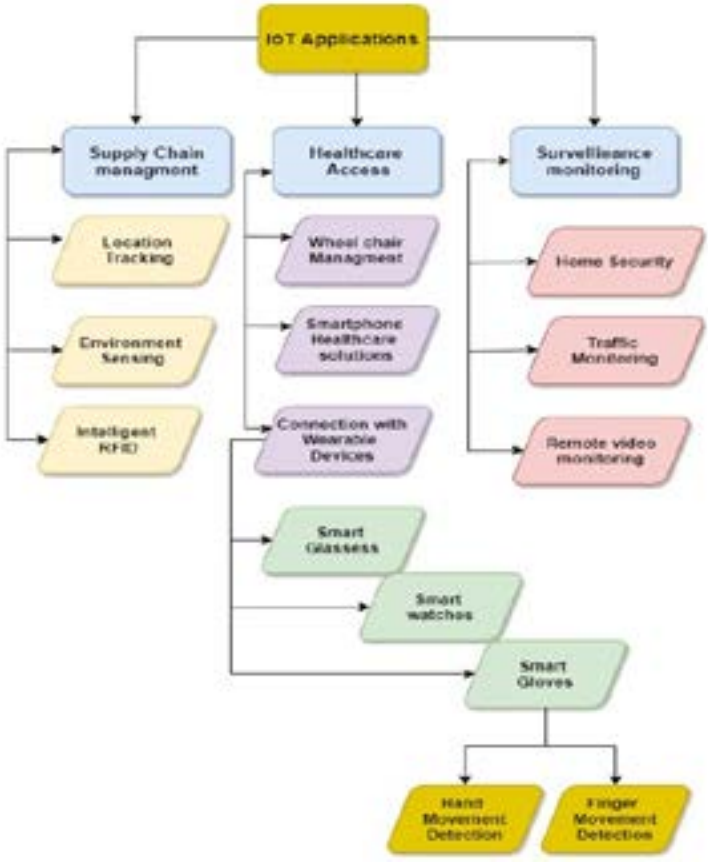

Figure 1: Taxonomy of IoT applications

Table 1: Comparison between Existing IoT Healthcare Monitoring Devices

Ref	Year	IoT Devices	Components
[7]	2020	Adaptive & Flexible Brain Energized Full Body Exoskeleton	Electroencephalogram (EEG)
[8]	2020	Soft Robot	Flex Sensor, Pressure Sensor
[9]	2019	Eye-Com	ADXL335
[10]	2019	Fitness Tracker	Heart-Pulse Sensor, Arduino UNO, Raspberry-Pi
[11]	2019	Gloves	Flex Sensor
[12]	2018	Sensor Gloves	LM-35, Flex Sensor, Voice Processor(APR33A3)
[13]	2018	Fitness Tracker	LM-35 Temperature Sensor, Heartbeat Sensor, Eye-Blink Sensor, Accelerometer Sensor
[14]	2017	Hybrid Wheel Chair	BNO-055 Module, ARM Cortex M3
[15]	2017	Eye-Blink	TCRT 5000
[16]	2016	Smart Gloves	Flex Sensor, Inertial Measurement Unit (IMU)

Some further work has been done in the healthcare sector by using IoT in order to monitor patient's health. In past, there are various point of views proposed to develop health care systems for the patients. For example, [7] proposed an adaptive and flexible brain energized full body exoskeleton to assist the paralyzed patients. It designates the design, testing and control of exoskeleton to support the patients in their daily basis activity. In this system, the signals of brain taken by the sensor called "EEG" i.e.: Electroencephalogram to control the movements of the Exoskeleton. Another work proposed by [8] is a health monitoring system for the patients using GSM module and IoT (Internet of Things). In this proposed system, the health parameters implemented are: Temperature Sensor (LM-35), Heartrate Sensors, Eye-blink Sensor and Accelerometer sensor. By using these implemented parameters, patient wellbeing can be easily monitored. In this system GSM module used for message sending to predefined caretaker contact number in order to get proper information of the patient from the distance. Some other work is also designed to cover and improve the functionality of the wheel chair system for the paralyzed patient [28]. In this system the additional functionality like sensors network error handling, speed handling in non-straight roads, emergency stop and confirmation of command function are tested for both environments i.e. indoor and outdoor. The demand of constant improvement in daily living for the paralyzed patient becomes more motivation to develop some new technologies to cure the difficulties faced by the paralyzed patient. In this paper a blink sensor device is developed which used to operate the home appliances easily without any somatic or human help. The system consists of four embedded electronics like TCRT 5000 as the eye blink sensor which can measure the intensity of IR bounced back on the eye, Bluetooth, Arduino adaptable microcontroller and RF link pair module [15]. The idea in [16] proposed smart gloves and hand recognition which can recognize and convert sign languages to voice output. The glove embedded with some flex sensors that enables to recognize the finger movements and IMU to distinguish the hand movement in each direction.

3 Proposed Methodology

Our proposed and implemented system are designed in which patient can convey their necessities through message by using hand movement, finger movement and feet movement. The movement is detected by using gyro MPU6050 which is connected to gloves as a product Arduino Uno. Flex sensors are used for the detection of the finger movement and gyro sensors is placed at the hand of the patient to sense the any changes in the patient hand. The system is bound in three significant tasks. These are to send messages in order to communicate and understand patient's requirement through hand movement, finger movement and feet movement, after the movement of any of them i.e. Hand, finger and feet, the system will inform the caretaker to the needs of the patient.

4 Implementation

Our system helps to communicate paralyzed patients to their attendant using hand gestures and feet gestures. The gyro MPU6050, flex sensor and aluminum foil are mounted on the

gloves with the help of connecting wires to the Arduino. for the detection of hand and finger movement, as shown in Figure 2 (a,b), whereas gyro MPU6050 is mounted on belt to detect the feet movement, all these are communicating and sending messages to the caretaker, these messages are "pre-coded" that is "call to doctor"," I need medicine" "I need water" with the help of connecting wires to Arduino UNO.

Figure 2: hand gloves (a) and Feet Belt (b)

Table 2: Hardware Components Comparison

References	GSM module sim 800L	Arduino	Gyro MPU
[17]	×	✓	×
[18]	×	×	×
[19]	✓	✓	✓
[20]	✓	×	×
[21]	✓	✓	×
[22]	×	×	✓
[23]	✓	✓	×
[24]	✓	×	✓
[25]	×	✓	✓
[26]	✓	✓	×
[27]	✓	×	✓

5 Proposed System

We have designed a health care system for the paralyzed patient, by using thesmart gloves, through these gloves patients can easily send their disquieting messages to their assigned caretaker by the movements of their hands, fingers, and feet. In this paper, Arduino UNO is used to collect the raw data as well as a processor, for the communication between the caretaker and the patient, SIM 800L is also employed. To sense the movements of hand and fingers smart

gloves are designed in which gyroscope MPU 6050 and flex sensors are integrated with the gloves. If the patient desires to any food they can tilt their hands in the right direction if they feel necessities of medicine they can also tilt their hand to the left, same as for water they can tilt their hand in an upward direction, and in case of emergency they can tilt their hand downwards. The collected information used for message sending to the attendant's phone through the GSM module, in this way the attendant can easily respond to the needs of the patient. The flow diagram of the proposed model is shown below in Figure 3.

A Proposed Flow chart

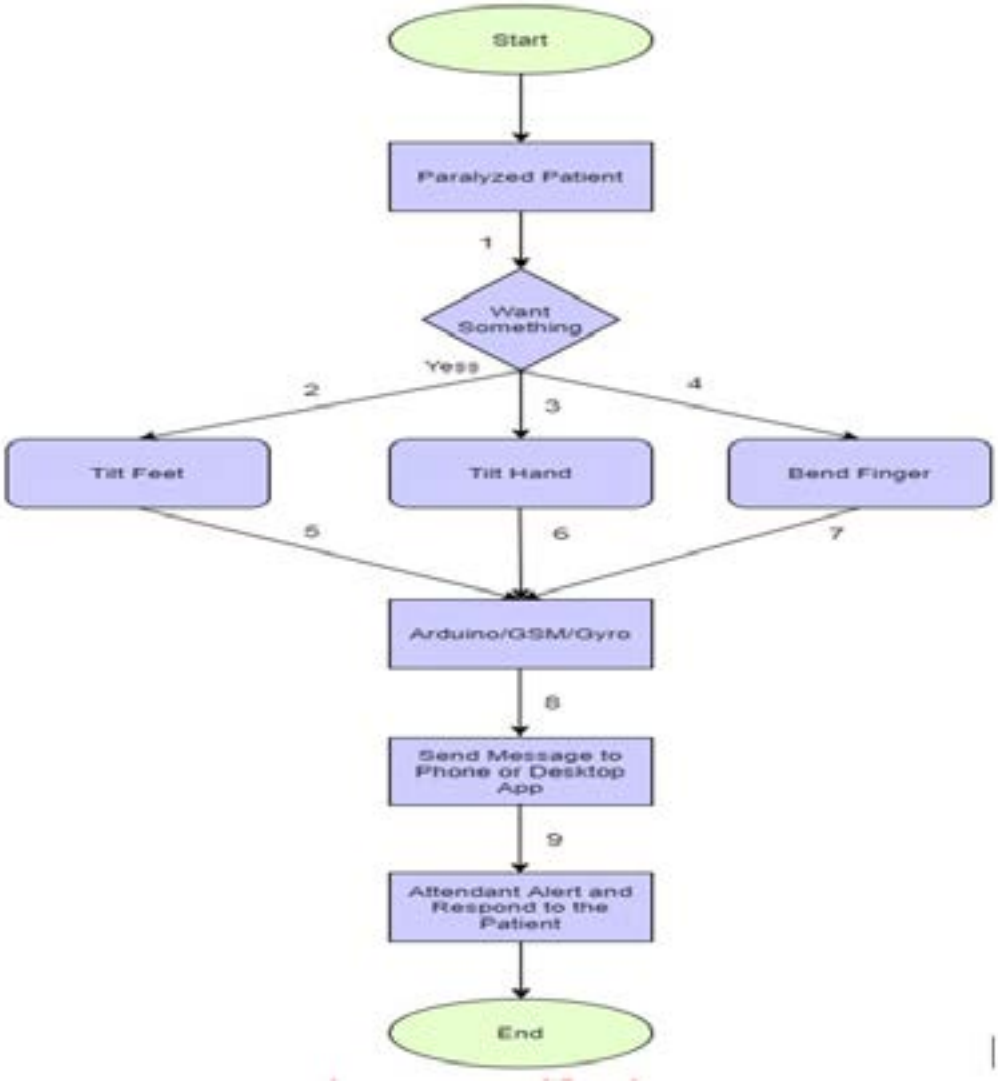

Figure 3: proposed flow chart

Figure 3 representing the flowchart for the working flow of proposed model i.e. initially, it is coupled with the basic power supply to Arduino for receiving the input signal, if the patient needs anything like he has an emergency or if he needs water, food, or medicine then they need to tilt their hands or foot in a particular direction. For example, if a paralyzed patient can move

his hand easily so he wears smart gloves in which we use a gyro sensor and tilt their hand in the particular direction as required, or if the patient's hand is not working then he can bend a particular finger as per their needs. If both hands and fingers are not working patient can wear a belt in their feet and move their feet in a different direction to send the message. We have designed a desktop app (in our future work) and in the hardware module integrated a GSM module from which attendant can get the message from the patient as an alert form and respond to the patient and full fill their needs.

6 Conclusion

Paralyzed patient faces difficulties to convey their messages to the caretakers for fulfill their needs because they are unable to express their problems and needs properly. To overcome this difficulty faced by the paralyzed patient, we have implemented a paralysis patient healthcare system using IoT and GSM. In this proposed system messages are conveyed by the paralyzed patient to the caretaker, by using gyro gloves, if the patient tilts their hand or fingers or feet GSM module triggered to send message to the predefined caretaker's contact numbers. In future we will integrate this implemented system to desktop screens and android app for the remote monitoring as well.

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