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AN IOT BASED AUTOMATED COMMUNICATION SYSTEM FOR PARALYZED PATIENTS USING SIMPLE HAND GESTURES

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Abstract--- Paralysis is the inability to move muscles on their own. This is caused as a result of damage in the nervous system therefore the message passing between the brain and the muscles is not proper. Paralysis can be caused due to various reasons like diseases like Parkinsons disease, multiple sclerosis, Guillian Barre Syndrome, stroke, etc. It is also caused by accidents which results in the spinal cord injury or broken necks damaging the nervous system. Our proposed system is to help the paralyzed patient to convey the basic requirements and emergency messages by just moving the finger to display the required message in order for the patient to be motivated as much as possible. It also consists of a buzzer to alert the attender when a message is displayed

Keywords---data pre-processing, mapping technique, classification using KNN algorithm, Arduino UNO, microcontroller, hand gestures, SVM classifier, accelerometer, dynamic time warping(DTW).

I. INTRODUCTION

Numerous health monitoring systems are present which makes it easy for the doctors to monitor the patient vitals, but there aren't many systems that are used for the communication of the paralysed patients, the proposed system helps to overcome these difficulties. Though there are a few approaches that assists the paralyzed patients to get used to their life with paralysis, by helping them live their lives independently, the problem is that these types of devices are quite large and are extremely expensive. They are mostly available only at the hospitals and aren't used at home or other places based on their convenience. A patient affected by paralysis loses their ability to communicate which prevents them to express their basic needs. The inability to communicate is due to damage caused in vocal cords. This happens when impulses to larynx are disrupted due to the damage caused in the nerves which goes to the vocal cord. The proposed system helps paralysed system helps paralysed patient to communicate and express their basic needs using simple hand gestures which does not require much of the muscle movement. Each finger represents messages which is displayed along with beep sound when a patient bends the finger or a combination of fingers. Our proposed system is to help the paralyzed patient to convey the basic requirements and emergency messages by just moving the finger to display the required message in order for the patient to be motivated as much as possible. It also consists of a beep sound to alert the attender when a message is displayed.

II. RELATED WORK

A sensor based device which is wearable on one hand recognizes 26 letters almost accurately deciphers the sign language of hand gestures for English alphabets [3]. A smart wheelchair is designed such that in the first module it acts as guiding system and helps in movement of the patient. The system notifies and displays information regarding the patient which is stored in cloud for future use.[6]. The data from 3 axes is used for feature extraction and recognition. The data from Y-axis is used to spot a particular gesture. Following this, to detect a gesture, the segmentation algorithm is used. This algorithm is used to exactly recognize the part of the hand that initiated the gesture. [2].Gesturing is an alternative way of communication for vocally affected people. In this wearable device. Using various sensors , the hand gestures are captured and are converted to American sign language alphabets using machine learning and with the help of a Bluetooth module, these are displayed on the module application which also converts the text to speech [1]. Our proposed system converts English alphabets obtained as result of gestures provided by the patient and translated into voice output achieved by using trajectory recognition algorithm for recognizing alphabets. Voice RSS is used to generate voice output. The trajectory recognition algorithm consists of stages such as row data extraction, signal processing, feature generation, feature extraction, feature selection, classified construction. The impulse signals obtained from hand is captured using convolutional neural network (CNN) The hand recognition sensor uses IQ signals transmitted from transmitter, received by the receiver which is used by the CNN network to classify the reflected waveform. This system uses 6 hand gestures form ASL[7]. This paper proposes a system that converts identified signals into actions using 2 interfaces namely distance sensor interface for actions such as volume control, scrolling, keyboard shortcuts. The actions of the mouse is controlled using user's fingertip. The system uses binary crystal growth algorithm for its working and the recognition algorithm used for recognizing gestures [5].This paper proposes a device which interprets sign language for English alphabets. The data is collected using data collection module, then data is mapped to its corresponding sign and sign is converted into alphabets. This system uses the dynamic time warping (DTW) and nearest mapping algorithm which translates data into English alphabet and compare the acquired data with trained data set to identify the most appropriate sign.[9].

III. PROPOSED SYSTEM

In this paper, proposed system identifies simple movements of the finger to express the patient's requirements. The sensors can measure the acceleration of the body on which it is attached to and thus finds the angle at which the device is tilted. The microcontroller maps the input voltages and then provides a range for each movement of the finger. A message which is predefined corresponding to the basic requirements and emergency purposes for the patients is stored in the ranges assigned to the particular movement of a sensor. The device is fitted on the patient's hand. The patient is first trained to understand what message will be displayed while folding each finger. Hence the patient just needs to bend a finger or a combination of fingers when he needs any help. When the patient bends a finger the orientation of the accelerometer sensor changes thereby a change in voltage occurs. The value obtained is taken as input to the device. A predefined message such as "call the doctor", "pain", "need food", "medicine", etc .is stored for each range of values produced by the sensors. When the stable value of the sensor changes the system detects the value and using the mapping technique the corresponding messages are displayed. The beep sound erupts when a message is displayed, to alert the attendant. Thus it thereby motivates the patient to communicate his basic needs.The proposed system helps the patient to be motivated as much as possible. This system can be altered for communication based on how serious the person is affected. Our proposed system can also be accessed anywhere based on the patient's own comfort. The proposed system is designed to work efficiently than the existing system as it uses KNN algorithm which is far more efficient and produces better accuracy and correctness which helps in better mapping of the messages.

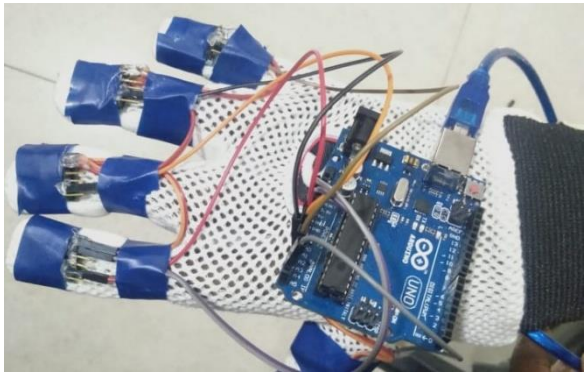


Fig.1 Working model

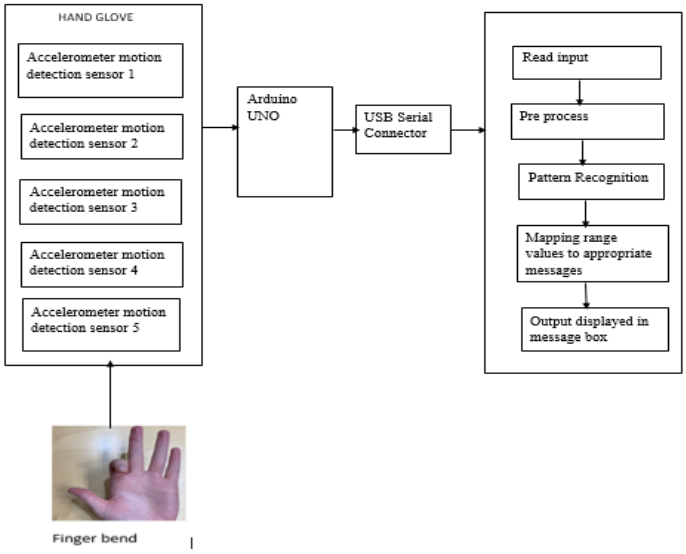


Fig.2 Block Diagram of the proposed system

IV. IMPLEMENTATION

The proposed system helps in communication for the paralyzed patients using simple hand gestures. The accelerometers are mounted on the gloves such that each accelerometer pertains to each finger. These accelerometer are connected with the help of connecting wires to the Arduino UNO which is Atmega 32B. The initial or stable value of the accelerometer changes when the direction of the accelerometer is changed. According to this value the messages that is pre-coded such as “call the doctor” or “emergency” is displayed .The beep sound propels the system in order to alarm when the message is displayed to alert the attendants of the patient.

A. Data preprocessing

Data preprocessing is the important step where the primary data is converted into efficient format. The resulting data set which has not been analyzed well leads to false outputs. The data obtained from the user can be incomplete, inconsistent, lack in something, abrupt, may require filtering or may even contain some errors. They need to be resolved in order to be used for further processing often, data pre-processing is the most important phase of a machine learning project. If there is much useless and missing information present or

meaningless data then the discovery of training phase becomes difficult. Data preprocessing is divided into 3 steps data cleaning, data transformation, data reduction.

The result of data pre-processing is the final training set. Data pre-processing is calculated as crucial part as it directly has an impact on the accuracy rate of the project. In this module, the range values obtained from the accelerometer readings are classified into two namely the bent values and the default values.

B. Classification using KNN algorithm

The k-nearest neighbors (KNN) algorithm is a simple, most used algorithm widely used to solve classification and regression problems. KNN is used to calculate closeness between data and calculate the distance between points on a graph. This algorithm is used to find the distance between a particular data and all other data in the dataset, then picks up the most used data or takes average of the data used the most.
It is commonly used as it is easy to interpret and can be calculated in a short time.

In our project, this algorithm is used to classify the values into either default value or bend value. Since the paralysis can be caused by various reasons it can affect the patient in various ways. The orientation of the accelerometer changes from patient to patient based on how seriously the patient is affected as some patients can make only feeble movements. Hence the KNN is used to compare the value obtained against the different ranges of the values in the dataset thereby derives an exact value and thereby maps the pre-defined message to the particular value obtained.

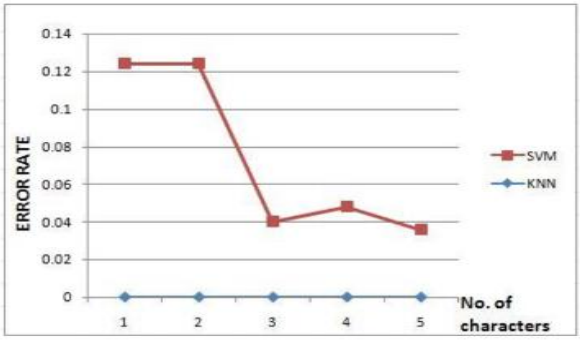
C. Mapping Technique

Mapping technique is defined as process of transfer of data from the storage to the CPU memory. The main purpose of mapping is matching process where messages in one dataset is mapped to the messages in the other set. In our proposed system the direct mapping technique is used. It the simplest and quickest of all the other mapping techniques. The performance of it is directly proportional to the hit ratio. In general, it can be defined as the method of finding the destination address in cache where we have to put the data from the main memory of a particular address.

Here this paper illustrates that the simple mapping technique is used to map the sensor value produced by the bend of the finger to a predefined message. With the bend of each finger a sensor value is produced. For the values produced by each finger and the combination of fingers a pre-defined message is allocated. Upon comparing with all the sensor values produced by each finger, the appropriate sensor value among the other sensor values is mapped to the predefined messages. As the messages are predefined, each finger is assigned a message based on the sensor value generated from the finger. This way the patient will be able to convey the basic needs thereby be motivated.

V. PERFORMANCE ANALYSIS

Performance analysis is used to evaluate working of software program. The aim is to ensure the program is working at optimum efficiency and to find any issues that will affect the efficiency. It can be further categorized into data collection, data visualization and data transformation. It also takes into account other vital factors which includes accuracy, simplicity, flexibility, intrusiveness abstraction. Performance analysis is used to test the data sets which are organized, grouped and aggregated that the data structures could be understood. Historical data sets are used to test the performance. Statistical metric are used to test and analyse the data. These datasets have innumerable data points that are aggregated using different statistical approaches.



In the existing system, SVM algorithm is used to identify the gestures. The system uses KNN algorithm for identifying gestures which increases the accuracy of the overall performance of the system. The graph depicts the comparison of error rate between the SVM and KNN algorithm.

Single characters can be again combined in the KNN classifier into continuous form as initial test sample but in the SVM classifier it is not possible to combine more than two characters because it is a binary classifier. In SVM there is a chance of miss classification of the characters with error rate but in KNN the error rate is absolutely zero and no miss classification of characters will occur. Correct rate is 97% for KNN that is all the characters are correctly classified without misclassification

VI. EXPERIMENTAL RESULT

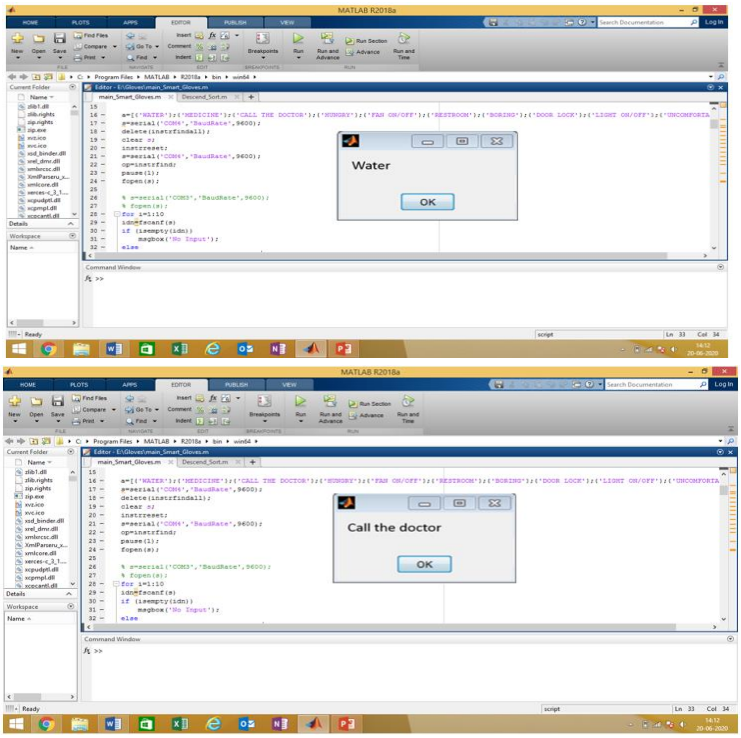


Fig.3. Emergency messages displayed

VII. CONCLUSION

Though there already exists several systems to monitor the paralyzed patient's health, there are not many systems that focuses on the communication of them. Our proposed system bridges the gap between these patients with others through communication and helps the paralyzed to relieve their stress by revealing their thoughts and also helps to keep them as motivated as possible. It is also cheap enough to afford without much debt.

VIII. FUTURE WORK

The future work can be made for the proposed system by making the results more efficient. This can also be made possible by using a Bluetooth module or through messaging services where the attendant gets a text message of what the patient wants and can act accordingly. This project can be further modified such that this system can be used for the paralysis patient whose hands are paralyzed but the other parts of the body is working properly. For example, the diplegia patients, whose hands are paralyzed but are able to move their legs and also vocally affected.

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