

# Geriatric Assist- Telecare Using EEG and Kinect Sensor for Elderly and Disabled People

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## ABSTRACT:

Today, tele-healthcare systems are becoming an enormous daily resource for the elderly and disabled. By utilizing the Kinect sensors, remote observing has become simple. Likewise, the sensors information is valuable for the further improvement of the gadget. This framework is intended for the evaluation and the executives of different neurological diseases. The telemedical framework is created to screen the psycho-neurological condition. Individuals with handicaps and the old regularly experience access issues to fundamental administrations. Analysts today are focusing on rehabilitative advances in light of human-PC interfaces that are nearer to social-ability to appreciate people on a profound level. The objective of the review is to assist old and incapacitated people with mental restoration utilizing AI strategies. Human mind action is noticed utilizing electroencephalograms, while client development is followed utilizing Kinect sensors. Chebyshev channel is utilized for highlight extraction and sound decrease. Using the autoencoder method, order is conveyed out by a CNN with a precision of 95% and higher in light of move learning. A superior personal satisfaction for more established and incapacitated people will be accomplished through the utilization of the recommended framework continuously. The subject being monitored is wearing the proposed device.

## 1.INTRODUCTION:

Nowadays, the number of elderly and disabled people is increasing day by day. Many conditions, including amyotrophic lateral sclerosis, people with disabilities, and the elderly, make it difficult to perform simple daily tasks. Scientists have tried to solve the problems of the elderly and the disabled in their daily lives by introducing some of the latest communication technologies related to the human brain into smart home support. A brain-computer interface (BCI) is a technique that

converts brain movements into digital form that can be used to read the user's thoughts and perform the desired action without moving any part of the user's body. Researchers are interested in the field of mental rehabilitation because of the growing population, the lack of qualified therapists, the expansion of scientific knowledge and the need for new technologies. Elderly people and people with disabilities find it difficult to live their daily lives due to physical and mental health problems. According to a survey in China, more than 9% of

the total population was over 65 in 2015, and this figure is expected to increase to 20% between 2017 and 2037. According to a survey in India, 8.4% of adults are over 65 years old. More than 60 people died from cognitive impairment in 2020. Cognitive rehabilitation is a set of interventions designed to treat disorders and enable people to perform learned tasks. The term neurorehabilitation was first used in modern society. Currently, it is widely used in clinical practice equipment for rehabilitation treatment. The technology uses brain-computer interaction to implant electrodes on the subject's head (BCI) to monitor brain activity and provide real-time data. The EEG is a simple device to use. Face, voice, fingers, iris, and gestures are just some of the features that the Kinect sensor detects and identifies. For early disability detection and subsequent correction, the Kinect sensor effectively separates human skeletal data from movement and posture patterns. To collect brain and signal data, the proposed work combines hybrid sensors based on EEG and Kinect sensors. The Chebyshev filter is also used in noise filtering. The next step is a self-learning convolutional neural network for classification, followed by image extraction with selective autoencoders. The proposed method is very beneficial, it collaborates in the mental rehabilitation of elderly and disabled people motivation, it was intended for the elderly and disabled.

The plan is proposed by:

- i) Neurological disorders are conditions in which symptoms affect the way the brain processes emotions and feelings.
- ii) Treatment for the disabled is progressing rapidly.
- iii) The recovery process will be severely hampered by the current system.

The originality of the proposed solutions and contributions by comparing the proposed system with existing approaches, several issues were addressed. The proposed approach offers the following benefits: It describes the novelties in the

planned activities and the contributions of the existing systems.

- i) To better extract features from EEG and Kinect data than current approaches, the proposed work uses an auto-encoder.
- ii) Transfer learning is used to classify errors as existing methods of operation become more efficient.
- iii) A feature extraction and classification combining autoencoder and transfer learning methods has been improved, as described in the existing literature.

The proposed approach will provide access to less mobile health services, so the proposed process will be used in private e-health. People living in smart cities and rural areas will benefit from the systems planned now. Other benefits include reduced exposure to pathogens, lower overall healthcare costs and ease of use.

## 2. LITERATURE SURVEY

The rehabilitation exercises the use of Kinect know-how have remained us approximately the health-care motivational determinants for aged folks as AAL studies has grown and reinforced. This feature consists of handling patients, physicians, and bodily therapists, and it maintains affected person documents and statistical statistics gleaned from rehab periods the use of the 3-d Kinect recreation. "Game Up" for stability, flexibility, and leg power is every other such suggestion. The trouble discovered turned into that the use of Kinect makes you worn-out due to the fact the sport required you to face on one foot and lift your fingers above your head. Additionally, 3-d video games are hired in addition for the rehabilitation of neuropsychiatric illnesses. The recreation is controlled routinely with the aid of using a multiagent device, minimizing the requirement for human participation to supervise the execution of software program activities. Another has a look at makes use of Kinect strategies and a low-fee inertial dimension unit to

research the motions withinside the higher limb and decorate frame coordination. The literature on gesture detection has defined a number of strategies for figuring out human frame actions the use of video cameras over the years. From the mental point of view of the way human beings understand and use gestures to the kinesiology point of view of the way gestures feature mechanically, the pc pics have been targeted on the way to symbolize excessive-stage duties and spatial interactions for human models. At this time, the best answer for enhancing identity is a 3-d digital digicam i.e., Microsoft Kinect. Additionally, this sensor consists of a Green, Red, and Blue digital digicam, a 4-microphone array, and a intensity sensor making an allowance for the processing of full-frame 3-d movement seize in addition to the popularity of human faces and voices.

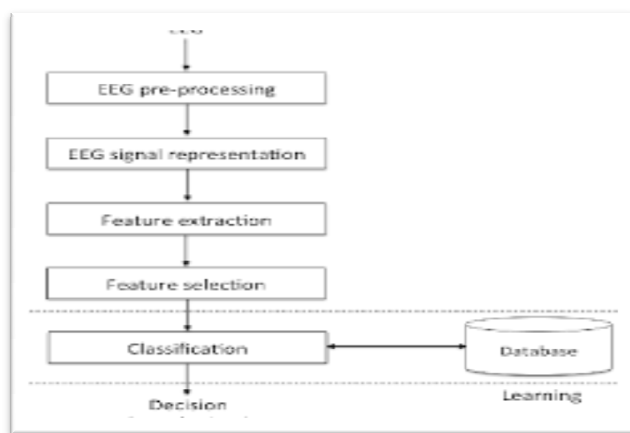


Fig.1. Proposed method for Eldo care.

The 25 frame joints are calculated in 3-d area with the aid of using the Kinect sensor the use of skeletal tracking. Codifying all of the strategies from the uncooked sensor records is needed to perceive a primary gesture. A series of traits and thresholds on joint vicinity are used withinside the rule-primarily based totally method to song motions. Based in this framework method, it's miles possible to layout a hard and fast of regulations that explain the motions to understand at a excessive stage of abstraction. One such framework is FAAST, which allows full-frame herbal interplay to

govern arbitrarily programmed with the aid of using adjusting gesture sensibility thru threshold values and mapping those gestures to key and mouse events. Another instance is FUBI, which permits you to specify asset of motions with the aid of using placing extra particular picks in a specification language primarily based totally on XML. Unfortunately, those frameworks don't remember versions in person heights and positions in the Kinect popularity field, in addition to in person motion speeds and ability degrees. Additionally, the detection of complex gestures becomes a categorization issue. In this situation, supervised device studying algorithms are used to bring statistics approximately the problem with the aid of using classifying or labelling a gesture. This is why each gesture is tagged to create a classifier that makes use of schooling units of the gestures and assesses how comparable a brand-new movement is to every taught gesture. Therefore, utilising the skeletal records from Kinect, various frameworks hired Dynamic Time Warping, Decision Trees, and Support Vector Machines (SVMs) for movement popularity. Addition-ally, EasyGR is a device examined on seven gesture recognizers that useful resource in reducing the paintings required withinside the improvement of gesture popularity and improves the overall performance and accuracy of gesture popularity. With and without EasyGR support, metrics along with code size, time spent, and the same old of the constructed gesture recognizers have been compared. The consequences verified that the approach turned into viable and reduced the attempt had to put into effect a gesture classifier the use of Kinect. Studies at the effective and terrible influences of gambling video games at the human mind are simplest beginning. Cognitive load is a intellectual technique used to gauge a person's intellectual nation at any given time. When mind complexity rises, the cognitive burden rises as well, and vice versa. Electroencephalography, which entails making use of electrodes to the pinnacle in a number of settings, may be used to degree cognitive stress. For the evaluation and

control of numerous neurological illnesses, a telemedical device is being evolved to reveal the psycho-neurological condition. People with disabilities aren't a homogeneous group, and that they address a number of troubles daily. People with disabilities and the aged often experience get admission to troubles to crucial services. Researchers these days are focusing on rehabilitative technology primarily based totally on a human-pc interface this is toward social-emotional intelligence. The intention of the have a look at is to assist vintage and disabled folks with cognitive rehabilitation the use of device studying strategies. Human mind hobby is discovered the use of electroencephalograms, whilst person motion is tracked the use of Kinect sensors. The "ReHoration" device for digital automated manipulate and tracking of family traits, hobby, and packages is inexpensive, easy to use, energy-saving, and minimum maintenance.

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the bulb, the BC547 resistor, the 1N4007 diode, the five V relay, the two pins terminal block, the 220 V AC energy It is easy for the stop person to apply the 433 MHz radio frequency, that's hired as each a transmitter and a receiver to seize signals. The primary intention of our bankruptcy is to function healthcare and domestic home equipment the usage of kinds of automation: command primarily based totally the usage of Telegram Bot and EEG-primarily based totally mind-pc interfaces. The mind-pc interface makes use of EEG to accumulate facts, a bandpass to clear out facts among 12 and one hundred Hz, impartial issue evaluation to get rid of artifacts, the Fast Fourier theorem to extract and pick features, and command reputation to translate the facts. The circuit is evolved the usage of the ESP8266 Node MCU and Relay on the microcontroller in the end techniques were optimized. Another technique is to apply the to be had Telegram Bot to deal with the domestic automation device. This technique is only for folks who are bodily healthy and may use the Bot for controlling domestic automation. Completely-locked-in-syndrome (CLIS) is induced because of a few contaminations i.e., amyotrophic lateral sclerosis (ALS), a sort of motor neuron disease. This trouble changed into addressed using the EEG signals whilst a human thinks approximately a few precise emotions and imagination. ANN changed into used for these paintings, wherein the dataset changed into cut up with five, 4, and three imaginations withinside the pre-processing step. A normal accuracy of 80–one hundred% changed into executed for spotting 5 imaginations the usage of LVQ and FFNN classifiers. The “Eldo-care” endorsed take a look at collects mind and gesture facts even as lowering noise with the aid of using combining EEG and Kinect Sensor. For characteristic extraction and selection, the Chebyshev clear out, autoencoder, and classification, switch studying primarily based totally convolution neural community is applied.

### 3.PROPOSED WORK

The three stages of the proposed approach are most often used to recognize speech disorders. First, two sensors i.e., the Kinect sensor and electroencephalogram are used to collect data. The operation of the sensors in the system is initially described here to mandate the proposed method illustrates how the EEG sensor and the Kinect sensor can both capture data from the scalp of the human brain. Noise is eliminated with a Chebyshev filter using an autoencoder that also separates the side functions of the raw Kinect distance and angle data set, important features of raw EEG data are acquired. The crucial step is classification, which comes after the data collection, denoising and feature removal. Convolutional neural networks are used for classification; mental activity, physical activity and identifying the problem in the brain is a frequent deep learning strategy. After detection due to disabilities, treatment may be recommended to improve the patient's condition quality of life.

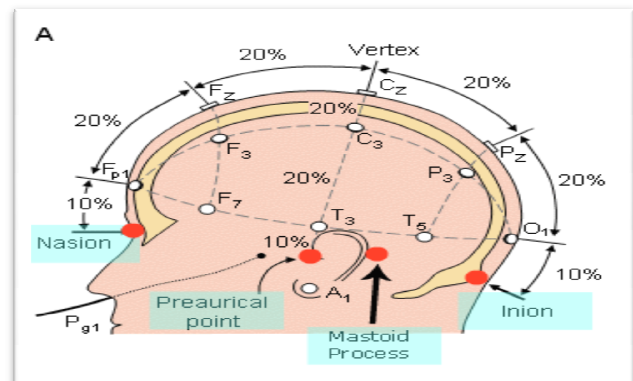


Fig.2. Electrode placement of the standard 10-20 EEG system.

#### 3.1. Data collection with electroencephalography

In the planned system, data about the person is collected from scalp using a non-invasive device called the BioNTech Voyager, and brain activity is monitored using electroencephalography (EEG). As can be seen, conventional 10-20 EEG systems collect information from different areas of the brain. After collecting the information, it sends electrical impulses to the brain through a brain-computer interface.



### 3.2. Data set collected by the Kinect sensor

The Kinect sensor monitors 25 body parts, including Neck, head, shoulders, back, right and left elbow, right and left Wrists, right and left thumb, right and left hand, right and End of left hand, end of right and left hand, middle back, bottom of back, Right and left hip, right and left knee, right and left ankle, Left and right left ankle and left and right left ankle. The 25 properties mentioned above are visible in a radius of 4 meters and two additional features, facial appearance and voice, are similar used to monitor the activities of subjects to identify people with disabilities.

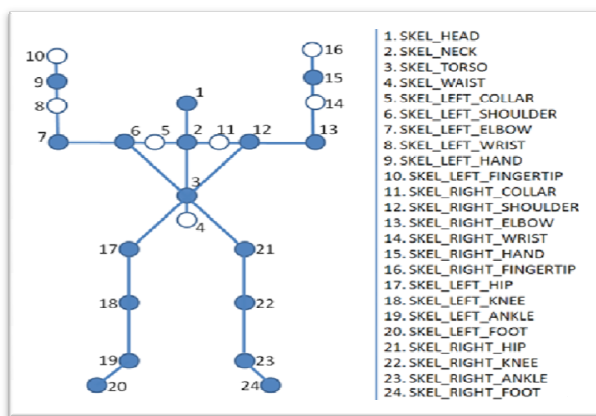


Fig.3.Kinect sensor skeleton-tracker.

### 3.3. Previous treatment

#### 3.3.1. Analysis

Using filtering as the first step in preprocessing, is used to remove unwanted signals in the EEG signal. In this study, for cleaning, a Chebyshev filter is used here, which shows the bandpass filter for the sixth order of the Chebyshev II filter with a 30 dB band stop.100 Hz is the relaxation cutoff frequency, which corresponds to 0.6 rad per sample.

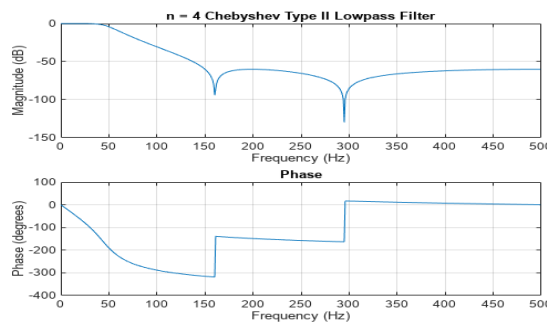


Fig.4.Filtering making use of Chebyshev filter 2.

$$G(F_0, F_1) = \frac{1}{\sqrt{1 + E^2 T_n^2(\frac{F_0}{F_1})}} \quad (1)$$

Here, E is the ripple factor, F0 and F1 are the cutoff frequencies, and Tn is the nth order Chebyshev polynomial and G is a victory A gain between -1 and 1 is usually indicative to a proportional change in signal amplitude or size.

since Tn alternates between -1 and to  $\frac{1}{\sqrt{1+B^2}}$

Here,

$$B = \frac{1}{\sqrt{10 \frac{S}{10} - 1}} \quad (2)$$

In equation (2), y is the stop loss and B is the band permeable filter.

#### 3.3.2. Feature separation

Using Euclidean geometry and compound angles of human bodies, the properties of the Kinect sensor are used to calculate the distance. EEG characteristics are measured with an autoencoder.

Equation (3) shows that the distance (D) that connects two places in Euclidean space equal the “norm translation from one point X to point Y”.

$$D(R, S) = \|\vec{RS}\| \quad (3)$$

the angle between R and S, two non-zero vectors, as calculated by the formula in equation (4)

$$\theta = \left( \frac{RS}{\|R\| \|S\|} \right) \quad (4)$$

Illustrates five processes involved in feature extraction, process using an autoencoder. feature  $D_s \neq D_t$

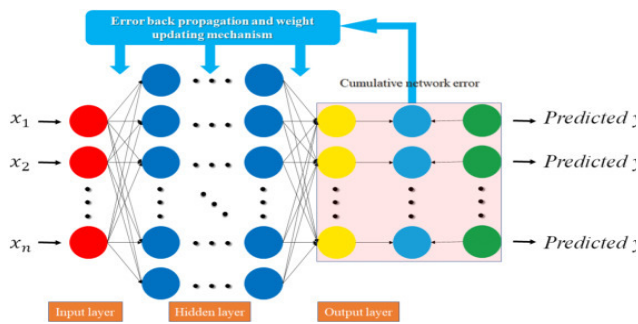


Fig.5.Extraction of features using an auto encoder.

Stage 1 starts with the input by extracting features with an autoencoder using transfer learning as the classification mechanism. Input layer followed by encoder in stage 2, code generator in stage 3, decoder in stage 4 and output in stage 5 which is stored in output nodes.

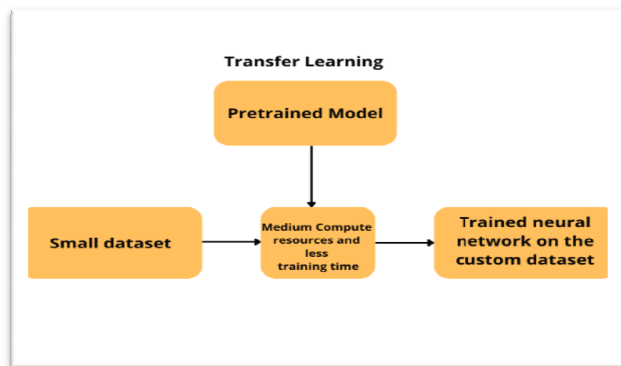


Fig.6. Utilizing transfer learning as a classification mechanism.

### 3.4. Classification

To solve new problems related to this, the classification is trained deep learning technique as said above,

$$T = \{t_1, t_2, t_3 \dots T_n\} \in T. \quad (5)$$

$$Z = \{T, P(T)\} \quad (6)$$

Target domain  $C_t$ , source domain  $C_s$ , learning task  $D_s$  and learning function  $D_t$ , where  $C_s > C_t$ .

It shows how the input attributes are collected and is transferred using the source model to the source before the training data is transferred and sent to the source model. Equation (5) shows that F is a feature space, while Equation (6) shows that C represents the interval and P represents the marginal probability distribution (T).

## 4. TEST RESULTS

The current model was created and stimulated by MATLAB 2021B. We focus on the classification results This area.

### 4.1. Feature separation

Signs and attributes of brain signals collected by electrode placement for a typical 10-20 EEG system is shown in Table 1. It also shows property values.

Electrodes	Mean	Median	Standard Deviation	Entropy	Power	RMS
C1	31.23	51.03	35.12	80.23	74.02	0.20
C2	3.95	5.69	6.13	76.32	65	0.53
C3	7.76	9.01	8.09	65.89	93.25	0.65
P1	79.32	91.2	21.12	90.30	62.31	0.38
CP1	61	45.36	20.04	75	68.03	0.21
CP2	32.62	41.23	23.50	22	8	0.81
CP3	79.86	60	36	83	57.36	0.89
FT2	8.2	24	4.26	85	90	0.6
T1	54.96	48	46.32	62	75.36	0.75
RC2	30	31	3.96	34	90	0.52

Table1: The features and labels of the electrodes collected from the EEG sensor.

The categories of prerequisite	Number of samples	Mental features and movements
Asleep	175	drained arm, behind the cheek
Upright	200	welcoming arms and vivacious
Strolling	182	Continue with purpose.
Thirsty	150	Finger with lips close by and thirsty
Chew	156	Finger with its mouth open and a hungry
excretion	192	moving my hands and urgently urinating
Pee	70	Urge to urinate quickly and head movement
Calling the Physician	200	rapid hand motion and urgency
Relax	200	Nothing

Table2: The features and labels from the Kinect sensor

Here, the average is calculated using equation (7). On the contrary the median value is calculated by

equation (8). The standard deviation is calculated using Equation (9) and the entropy calculation is done by equation (10). The power is calculated using equation (11). We list the root mean square (RMS) value using Equation (12). With cross validation and auto coder, all 1600 records was organized for nerve training as per the requirements.

$$\text{Mean} = \frac{\text{Sum of all the numbers of the dataset}}{\text{The number of element}} \quad (7)$$

$$\text{Median} = \text{Middle value of the dataset} \quad (8)$$

$$\text{SD} = \sqrt{\frac{\sum(\text{Each value from dataset} - \text{Mean})^2}{\text{The size of the dataset}}} \quad (9)$$

$$\text{Entropy} = \text{Signal randomness} \quad (10)$$

$$\text{Power} = \frac{\text{Signal value}}{\text{Signal length}} \quad (11)$$

$$\text{RMS} = \frac{\sum(\text{Each value from dataset})^2}{\text{The number of the dataset}} \quad (12)$$

Figure 3 shows the skeletal tracking structure of the Kinect sensor. The Kinect sensor training function setting is displayed in Table 2. The table covers types of needs, sample sizes and related drives, and mental characteristics.

#### 4.2 Classification

The patient became labelled as being in a dozing condition for the primary trial, status for the second trial, strolling for the third trial, consuming for the fourth trial, ingesting for the 5th trial, urinating for the 6th trial, calling for a health practitioner for the 8th trial, and resting for the ultimate trial, as proven.

It demonstrates that 4 non-identical algorithms determine accuracy, precision, recall, and mean error rate 20 instances for each epoch. Accuracy, precision, recall, F1-Score, mean error rate is proven in equations (13), (14), (15), (16), and (17). In this case, "True Positive," is indicated as T P, "True Negative," as T N, "False Positive," as F P and "False Negative" as F N.

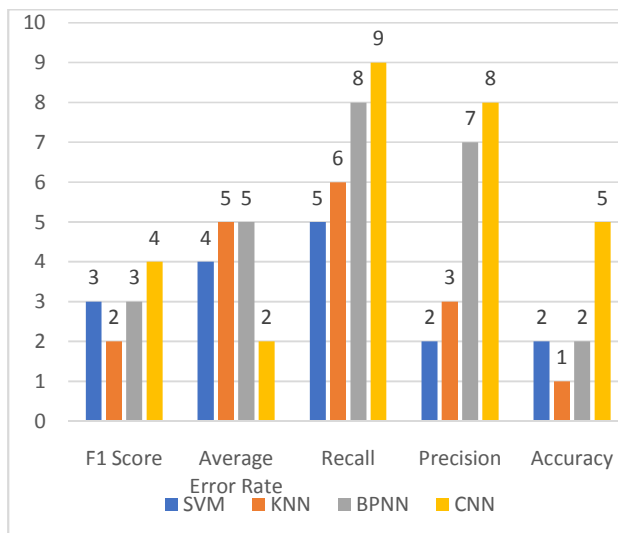


Fig.7. Evaluation of performance for the proposed system.

The confusion matrix shows the convolution neural multiclass classifier which classifies as healthy, medium healthy, and not healthy. The prediction of confusion matrix suggests 53.3% positive prediction, and decreased within the false positive prediction. As not healthy low as 40%, and medium healthy prediction is multiplied to 46.7%, wherein the not healthy percent is likewise multiplied within the false positive 26.7% in comparison to true positive 13.3%.

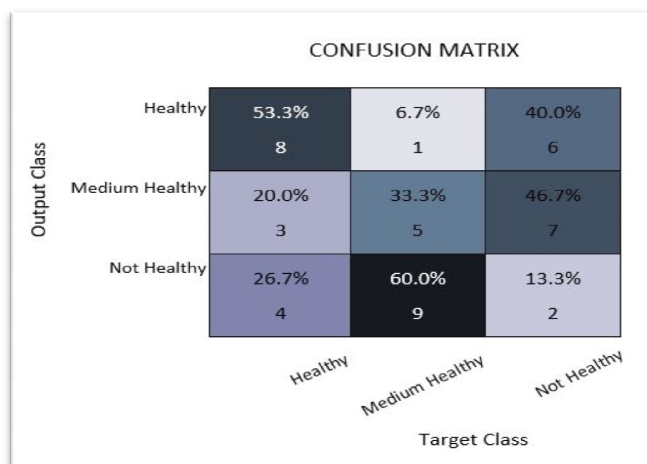


Fig.8. Confusion matrix table for Convolution Neural Multiclass Classifier.



## 5. SUMMARY AND FURTHER WORK

The proposed project is called a telehealth system used to monitor the psycho-neurological condition of patients during treatment in the rehabilitation process and is used for the elderly and disabled. This is a good result and would be very useful for the current society. Brain activity will be monitored in the planned study use of EEG in mental illnesses, epilepsy disorders, cognitive stress etc. The Kinect Sensor is used to record whole 3D body movement, recognizes gestures and faces. Transfer learning is a safe method to manage multiple jobs at the same time. Here, convolutional neural networks combined with a transfer learning method performed classification with 95% accuracy and advanced. The patient can benefit from an early diagnosis of cognitive impairment to improve memory and reduce stress. The planned study would lead to a new form of cognitive rehabilitation for the elderly and disabled, works as a telehealth care and monitoring system that monitors the psycho-neurological status of patients during rehabilitation. In the future, brain, body and heart control will be combined with Kinect sensors, ECG, EEG, EMG and PPG sensors. We also suggest using some IOT sensors to collect and store sensor data it could give us the advantage of availability. The better proposed model is tested with more results target populations.

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