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A Comprehensive Review-Remote Monitoring System Based on Iomt for Neurological Disabilities

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Abstract

The vital source of the Internet of Things (IoT) in medical industries is said to be the Internet of Medical Things (IoMT). Currently, IoMT has exponential growth in remote monitoring systems (RMS), mainly for neurological disability patients. The main aim of IoMT is to proliferate the factors of electronic devices such as trustworthiness, efficiency, and accuracy. There exists enormous ongoing research in IoMT in this area, and huge devices are being approached. However, there are different types of neurological disabilities (ND) around the world, and countable IoMT remote monitoring systems were developed for the most common neurological problems. So, this article is fully concentrated on the study of different neurological problems and the RMS-IoMT. This review is essential for many biomedical and medical researchers, and it deals with the doctor's opinion and the importance of the IoMT system, common neurological disabilities, and the RMS-IoMT system's merits and demerits for neuro disorders.

Keywords: *Internet of Medical Things, Body Sensor Network, Remote Monitoring System, Neurological Disorder, Health Issues.*

1. Introduction

The Internet of Things (IoT) is the multiple interconnected physical devices that are connected to the internet. The interconnected physical devices are machines, devices, and computational objects [1]. IoT applications are smart agriculture, smart home, smart city, self-driven cars, smart grids, industrial automation and weather conditions, transportation, education, healthcare, etc. Some of the user-based merits of IoT are cost efficiency, increased productivity, enormous commercial prospects, enhanced client capability, and improved flexibility and alertness [2]. Mostly, IoT is concentrated in three major sectors such as industries, healthcare, and business [3]. Among, these sectors, this article is widely representing a study of IoT in the medical sector called as Internet of Medical Things (IoMT). An IoMT-based remote monitoring system is an assembly of numerous medical devices connected in the network over the internet. IoMT-based remote monitoring system framework consists of different phases [4]. The working of the remote monitoring system of IoMT first collects the patient's data through sensor devices such as smart wearable or implanted devices attached to the body using a body sensor network (BSN). Then, the collected data of patients are forwarded to the mobile applications and provide an alert to the patients regarding their health [5,6]. During the serious problem of patients, doctors or further medical desires are suggested using smartphones. In the case of the patient's normal condition,self-care steps are to be taken. Many health problems are solved using IoMT such as heartache, neurological problems, eyesight, and some skin. However, this study concentrated on IoMT-based remote monitoring systems for many neurological disorders.

Neurological disorders are defined as syndromes that distress both the brain and nerves in the body and spinal cord [7]. The symptoms range of neurological disorders is structural, biochemical, and electrical abnormalities present in the brain and spinal cord[8]. Some of the common symptoms of neurological disorders are headaches occurring for a while, different variations in headache, memory loss, sight loss, muscle weakness, back pain persisting to feet, slurred speech, etc [9]. The nervous system disorders are infections, functional and structural disorders, and vascular disorders. Recently, these NDs are diagnosed, treated, and managed by the most popular RMS-IoMT.However, the researchers developed more RMS–IoMT for the most common ND. Thus, in this article, the study of RMS-IoMT for neuro disabilities is reviewed.

The rest of this paper deals with the common RMS-IoMT devices or models for all health problems in section 2. Section 3 defines the list of neurological disabilities (ND) and section 4 is about the merits and demerits of RMS-IoMT for specific ND. Section 5 is about the discussion of the doctor's suggestion and RMS-IoMT-ND. The final section is the conclusion of the review article.

2. Literature Review

2.1. Transformation of IoMT into RMS (RMS-IoMT)

2.1.1. Vital Signs Monitoring Wearable

Vital signs monitoring wearable is a type of wearable health device (WHD) (as shown in Figure 1). The human body has numerous variety of psychological motions which are monitored using the conversion from electrical symbolic to biochemical producing only the humanoid biosignals, which shows the health status of humans. Diabetes, heart conditions, and hypertension affect the majority of the elderly population [10]. As a result, heart monitors are essential for cardiac patients because they monitor arrhythmia and alert healthcare providers to potential complications. Some consumer wearable devices, including Smart Watches, enable regular active monitoring as well as heart monitoring [11].

Fig 1. Vital Signs Monitoring Wearable

2.1.2. Therapy Wearable

Therapy is normal among patients who have had joint substitution medical procedures or stroke therapy. Such a basic stage impacts the recuperation interaction of an individual and right now absolute attention to detail should be given. Wearable devices come into play when patients either remain in rehabilitation facilities or opt to do so [12].

2.1.3. Medication Surveillance

The course of action includes treatment; The main problem is making sure you take your medication at the right time so your body can heal. It has been discovered that nearly 60% of adults fail to take their medications on time and nearly 50% of US citizens take only one type of medication (Figure 2).

Patients can be changed to take their medications on time with these monitoring devices. Through portals, the modern pill dispenser connects patients and physicians, allowing patients to receive medication notifications. In general, they learn about the dosage so that patients don't miss any of their prescribed medications [13][14].

Fig 2. Medication surveillance

2.1.4. Behavioral Health Monitorisation

Mental health issues typically affect college students. However, the apparent stigma associated with the issues may prevent them from seeking assistance. Sensors and machine learning algorithms have been developed by engineers to identify symptoms of extreme anxiety. Students are provided with all the resources they need to unwind with this device (Figure 3), which is compatible with Smart Watches [15].

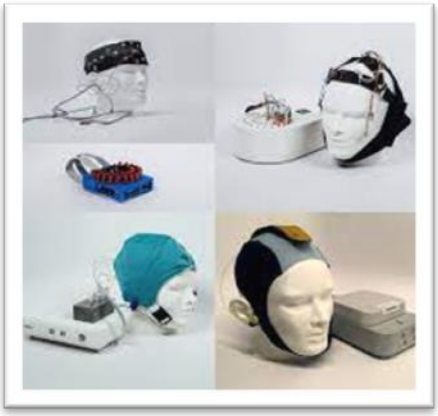

Fig 3. Behavioural Health monitorisation

The above discussed devices are IoMT transformations of RMS devices for common health monitoring systems. The challenging task of RMS arises selected queries before it designing and appearing in the market are,
How much amount of medical data captivity is necessary?
Which type of patients prefers RMS?
How does RMS complete its billing for revenue creation?
For these queries, the studies delivered some answers which related to those queries and make the researchers experience a wide view of the IoMT sector.

Query 1: How much medical data captivity is necessary?

A data approach is essential when examining high-acuity patients. This includes the frequency of data collection as well as the captured vital signs.

Query 2: Which type of patients more prefers RMS?

The majority of important RMS platforms can adapt to various clinical use cases. After surgery, they provide post-acute care and oversee chronic conditions like asthma and heart failure.
What conditions are on your RMS list now and for the future before choosing a vendor? Otherwise, you might find a way out that doesn't meet all of your needs. Being aware of the patient's RMS priority list also helps to rotate the technology in stages without overwhelming the clinical staff.

Query 3: How RMS completes its billing for revenue creation?

A practice's best revenue-generating strategy is RSM. However, proper solutions and support are required to make a lot of money. This kind of RSM system will check to see if billing and usage are always done correctly.
These are the fully defined RMS-IoMT devices and task challenging queries were discussed. This study is concentrated on RMS-IoMT devices for neurological disorders alone. So, the remaining part of the article follows with common neurological disorders, RMS-IoMT-ND and the final is a discussion of doctors and RMS-IoMT-ND.

2.1.5. Most common of Neurological Disabilities

There are many different bacterial, viral, and parasite illnesses that can impact the neurological system. Some examples of these infections are Mycobacterium tuberculosis, Neisseria meningitides, West Nile Virus, Zika Virus, and the human immunodeficiency virus (HIV). Neurological symptoms might be caused either by the immunological response to the infection or by the infection itself. Migraines affect more than 15 percent of the population throughout the world.

2.1.6. Alzheimer's disease

Alzheimer's disease is by far the most typical kind of dementia. A condition that progresses over time, beginning with modest memory loss that can make it difficult to carry on a conversation and react to one's surroundings. In Table 1,Alzheimer's disease impacts a variety of regions of the brain, including those that are responsible for thought, memory, and language. It is possible for it to have a major impact on a person's ability to carry out their regular activities [16].

Table 1. Alzheimer's disease

Symptoms	Memory loss Confusion
Alzheimer’s disease progression is commonly categorized into five clinical stages	the preclinical phase, mild cognitive impairment, early-stage dementia, moderate dementia, and advanced or severe dementia
Period of Life span	On average (4-13) years

2.1.7. Amyotrophic Lateral Sclerosis

ALS, also referred to as Lou Gehrig's disease, is a gradually worsening neurodegenerative condition that primarily affects motor neurons—nerve cells located in the brain and spinal cord that govern voluntary muscle movements. Motor neurons are the target of this extremely rare neurological illness. Muscles that we choose to move, such as those used for chewing, walking, and talking, are referred to as voluntary muscles. ALS is a form of a disease that affects the motor neurons (Table 2). Because of their deterioration and eventual death, motor neurons are unable to communicate with the muscles as the disease progresses. This causes the muscles to become weakened, to start twiddling (known medically as fasciculations), and to degrade (known medically as atrophy). After a certain point, the brain will no longer be able to initiate and direct voluntary motions [17].

Table 2. Amyotrophic Lateral Sclerosis

Symptoms	Muscle weakness Faint sensation throughout body Can't speak or speech is not clear
Stages	4 stages Starting (muscle twitching Middle (affected muscles leads to paralyzed) Late (lungs muscle is affected) End (due to breathing ,person expired)
Period of life span	On average (5-10)

2.1.8. Acute Spinal Cord Injury

The group of nerves that connect the brain to the rest of the body is called the spinal cord. Traumatic injury is the cause of acute spinal cord injury (SCI). The spinal cord may be transected, bruised, or partially torn depending on the severity of the injury. SCI is more prevalent in young adults and men.

Below the level of the injury, SCI causes a decrease or loss of movement, sensation, and organ function. The cervical and thoracic regions are the most frequently injured areas. SCI is a common reason for children's and adults' permanent disability, and death are shown in Table 3 [18].

Table 3. Acute Spinal Cord Injury

Symptoms	Accidents happens at damaging the disc (C2 /C3) Muscle weakness, spasticity, breathing, digestive etc.
Causes	Accidents Vehicle accident Sports accident Diving accidents etc
Stages	Acute illness lasting less than 48 hours Subacute (lasting between 48 and 15 days) The intermediate phase lasts from 15 days to six months. Continuous for more than a year
Period of life span	Age – 20 (upto 35 years)

2.1.9. Autism Spectrum Disorder(ASD)

Contrasts in the mind are thought to be the underlying cause of autism spectrum disorder (ASD). People who have autism spectrum disorder (ASD) often have a strong aversion to social interaction and connection, as well as restricted or monotonous patterns of behavior or interests. In Table 4 People who have autism spectrum disorders (ASD) may also have varying approaches to learning new things, moving around, or concentrating [19].

Table 4. Autism Spectrum Disorder(ASD)

Symptoms	Communication Trouble in social communication
Stages	3 Stages ASD stage 1- Trouble interacting with others, Not good at organizing and planning their lives ASD stage2 -difficulty communicating verbally, a limited range of interests, and frequent, repetitive behaviors. ASD stage 3-stage and stage 2 are too dense here. people won't be able to talk to each other or have social interactions.
Period of life span	Average person age (>= 55)

2.1.10. Brain Tumor

A brain tumor is defined as an abnormal growth or proliferation of cells that may occur within or around the brain. CNS malignancies include cancers of the brain and spinal cord. When brain tumors grow, they may interfere with brain function and health by compressing the surrounding nerves, blood vessels, and brain tissue.. Primary tumors are those that originate in an organ other than the brain. Table 5,Secondary tumors, also referred to as metastatic brain tumors, are cancers that originate in another part of your body and then spread to your brain. Secondary tumors can also be called "metastatic" brain tumors [20].

Table 5. Brain Tumor

Symptoms	High Headache Not clear vision Confusion and seizures
Stages	Stage 1 - less aggressive Stage 2 -slow growing cells Stage 3-anaplastic Stage 4-fast grow
Period of life span	Age < 15 (5 years) Age 15 to 39 (4 years) Age > 40 (2 years)

2.1.11. Cerebral palsy

The ability to move, as well as to maintain balance and posture, can be negatively impacted by a collection of conditions known collectively as cerebral palsy (CP). CP is the condition that affects children's motor development more frequently than any other. The brain is referred to as the "cerebral" organ. Palsy is a term that relates to difficulty or weakening in the muscles. The underlying causes of CP are an abnormal development of the brain or damage to the growing brain that leads to a loss of muscle control in a person are shown in the Table 6 [21].

Table 6. Cerebral palsy

Symptoms	Exaggerated reflexes Involuntary motions
Stages	5 stages Spastic Ataxic Athetoid Hypotonic Mixed
Period of life span	Age > 50 less chance to live

2.2. Epilepsy and Seizures

2.2.1. Epilepsy

Epilepsy is a disorder of the central nervous system marked by irregular brain activity, which may result in seizures, unusual sensations or behaviors, and occasionally a loss of consciousness.Anyone is at risk for developing epilepsy. Epilepsy affects people of all ages, races, and nationalities, and it can strike either males or females.

2.2.2. Seizures

There is a lot of variety in the symptoms that can accompany seizures. Some epileptic patients will just look into space for a few seconds during the onset of a seizure, while others will frequently jerk their limbs or legs. A person may not definitely have epilepsy just because they have had one seizure. In order to establish a diagnosis of epilepsy, it is customarily necessary to document the occurrence of at least two seizures that are unprovoked and that take place at least 24 hours apart are shown in the Table 7 [22].

Table 7. Epilepsy and Seizures

Symptoms	Abnormal behavior Loss of consciousness Anxiety & depression
Stages	3 stages Prodrome &aura Ictal Post-ictal
Period of life span	On average life span is 15 years

2.2.3. Headache

A pain in the head of any kind is referred to as a headache. Headaches can be localized to a single spot on the head, spread out across the entire scalp from a central point, or have the appearance of a vise. Additionally, they can appear on either one or both sides of the head.A headache can feel like a constant throbbing in the head, a dull aching in the head, or a severe pain in the head. Headaches can last anywhere from a few minutes to several days, and they can start all of a sudden or build up over the course of a few hours are shown in Table 8 [23]. Four types of Headaches are, Migraine headache, Tension headache, Hypnic headache, Cluster headache.

Table 8. Headache

Symptoms	Headache (fore head, back head ,up head)
Stages	4 Stages Prodrome Aura Attack Post-drome
Period of life span	Age 10 to 55 years – 53 years of life

2.2.4. Parkinson's diseases

Parkinson's disease is a degenerative ailment that gradually worsens over time and impacts the neurological system as well as the sections of the body that are controlled by nerves. In the early stages of Parkinson's disease, it's possible that your face will show few or no expressions at all. It is not recommended that you walk with your arms swinging. It's possible that your words will become slurred or mumbled. Your symptoms will become more severe as your Parkinson's disease will continue to worsen over time are shown in the Table 9 [24].

Table 9. Parkinson's diseases

Symptoms	Tremor in hand Slow movement Balance loss
Stages	4 Stages Non-motor aspects of experiences in day to day life Motor aspects of experiences in day to day life Motor inspection Motor complications
Period of life span	Lead normal life expectancy

2.2.5. Learning Disabilities

A wide range of learning issues is collectively referred to as learning disabilities or learning disorders. A child with a learning disability is not lazy or stupid, and it has nothing to do with intelligence or motivation. The majority are as intelligent as everyone else. They simply have different wiring in their brains, and this difference affects how they process and receive information are shown in the Table 10 [25].

Table 10. Learning Disabilities

Symptoms	Reading issues in childrens Poor memory Complication in speaking time Complexity in paying attention
Stages	4 stages Input Integration Storage Output
Period of life span	Normal life expectancy

2.2.6 Neuromuscular Disorders

Because of issues with your body's nerves and muscles, neuromuscular diseases affect how your muscles work. Muscle weakness is the most common symptom of these diseases are shown in the Table 11 [26].

Table 11. Neuromuscular Disorders

Symptoms	Muscle wastage Muscle weakness Muscle pain Breathing difficulties
Period of life span	20-35 years of life span

2.2.7 ADHD

ADHD is one of the neurodevelopmental disorders that affect children at an alarmingly high rate. In most cases, the symptoms appear throughout childhood and continue into maturity. Children who have attention-deficit hyperactivity disorder will affect their regulating activity levels are shown in the Table 12 [27].

Table 12. ADHD

Symptoms	Restricted Attention Hyperactivity
Stages	3 Stages Inattentive type Hyperactive-Impulsive type Combined type
Period of life span	15 years of life expectancy

3. Methods

Study Of Rms-Iomt Devices /Process/ Models For Each Neurological Disabilities [41][47][49][52].

Table 13. Study Of Rms-Iomt Devices /Process/ Models For Each Neurological Disabilities

Neurological disabilities	RMS-IoMT device/Models/Process
Alzheimer's disease	IoMT architecture for automatic detection and decision of Alzheimer Using brain MRI scan data as a 3D view Combination of textural, statistical, and shape as feature classifying prototype Organizing the Alzheimer's stages in dual classes such as binary class & multi-class [28]
	Smart Biomedical Assisted System An electronic gadget composed clock to observe the strength of patients. Composed of two units, one for patients and another one for patient caretaker This gadget has connected Global Positioning System (GPS) to follow the patient's location It reminds the patient's medicine intake time It holds "call" option in emergency time [29]
	The post-diagnosis dementia model is named "DEMENCARE" The edge computing device is used to observe the patients internally Doctors look for keen observation of whether any changes appear in normal actions Patients' action and performance metrics are present apart from the local area Patients different type of data is carried over and innovative ways are obtained to handle patients in good infrastructure [30]
Amyotrophic Lateral Sclerosis (ALS)	Telemedicine - IoMT Connected Care Platform(Ticuro reply) During COVID-19,this model was essential for the patients outside the hospital Experimentation was carried out in Tertiary ALS center One to one talk between patient and neuro specialist were carried out using this device where video call is included through the internet This device advises the patient , while modifying the patient's medication It alleviates the practical and metabolic and shows saturation in psychological[31].
	Telehealth service in framing a model for ALS monitoring and coaching User-based approach ,holds the conversation between patients & neuro specialists through online The application based model is self-monitoring module User-friendly and understand to all kinds of people This model saves user data and provides doctors' advice regarding the patient's health issues. Message and notification alerts are present for user comfortability Next check-up updating is forwarded by the present nurse in the application [32]
Acute Spinal Cord Injury	ICT-based health management services In conjunction with the establishment of household appointment working therapy, the use of respiratory and urinary care devices enabled data acquisition, which was then entered into a smart device. Necessary the researchers and clinicians had easy access to the entered data. Any concerning outcomes from the collected data were communicated to the clients. They were then instructed to check in with their providers to see if they needed any immediate medical attention Specialized seating system cushions and digital handbike ergometers are currently in development[33].
	Heuristic Hock Transformation based on the numerical method A novel method for correctly and quickly diagnosing numerous bone lesions that is based on the Gautschi-Blur Model (HHTGM). The auto crop is then precisely added to the spine section through normal disposal and vertical screening. A further analysis of spinal precariousness, also known as vertebral breaks, has been carried out in this work with experimental outcomes using the IoMT Platform[34].
Autism Spectrum Disorder(ASD)	IoT system (IoMT) for ASD -affected children The primary objective is to monitor their EEG (Electroencephalographic) waves with a smartphone. The cap's EEG probes aid in detecting their brain waves. Using the antenna in the IOT module with GSM, the recorded brain signals are transmitted to the cloud. The developed application sees those signals because the cloud functions as a storage system. Using this system, the therapists and the guardian can monitor their children and comprehend the complexities of their behavior. Each autistic child has distinct strengths and talents. Their abilities have the potential to advance to a certain level through the use of this application[35]. Additionally, this application aims to improve their vocabulary and communication skills.
	(AI +IoT+sensors) for ASD children for cognitive ability A sensor-based AI-enabled Internet of Things system that uses heart rate data to predict a child's state. It sends it to a parent via a mobile app with feelings and expected behavior. The system might be able to offer the child a brand-new virtual environment.

	To help them become better at making eye contact with other people. The approach taken by the system is based on methods that have emphasized the development of social communication skills Particularly in young children, so that they can interact more with others[36].
	IoT devices for Echoic skills in ASD children We designed ASPECT, an Alexa-powered skill, to explore how effectively a digital voice assistant could recognize and assess the verbal responses of children with Autism Spectrum Disorder (ASD). The study involved nine young participants, each formally diagnosed with ASD, who took part in 30 interactive sessions aimed at encouraging vocalizations and echoic speech. Throughout the sessions, children responded to verbal prompts delivered by an Echo device, engaging naturally with ASPECT. What made ASPECT unique was its ability to not only recognize spoken words but also evaluate them in real-time—much like a therapist would—by providing immediate scoring and feedback on each response[37].
Brain Tumor	Cloud-IoMT+SVM for classification & Detection of Brain Tumor (Support Vector Machine) The pre-processing of MRI images of a person will take place after the images have been taken using MRI technology. In the beginning, the examination of the patients is carried out by means of medical devices that are connected to the Internet of Things. When conducting classification processes, the best support vector machine (SVM) model should be utilized. In order to filter the features, an improved gravitational search algorithm combined with a genetic algorithm (IGSAGA) model is utilized. The findings have been validated using the BRATS dataset as a benchmark, and the experimental results have shown that the predicted model is more successful than the alternative.[38].
	Cloud-IoMT+CNN(Convolutional Neural Network) In order to obtain the input MRI brain images, medical equipment is utilized; on the other hand, data transmission to the cloud is handled by Internet of Things (IoT) devices. The D-CNN model may be implemented in the cloud for the purpose of diagnosing diseases and determining whether a brain tumor is benign or malignant. The given D-CNN model makes use of a benchmark dataset collection from the BRATS 2015 challenge datasets. Having an accuracy of 98.07 percent, a sensitivity of 97.17 points, and a specificity of 98.77 points. The model that is provided reaches the highest level of performance possible for a classifier [39].
	IoMT+EDNN(Entropy based Deep Neural Network) 4 modules of the IoMT-EDNN module include, preprocessing, feature extraction, and feature selection and classification Beginning removes the image's noise and commotion. After that, the pre-processed release images are used to extract functional characteristics such as SFTA, geometric, and LBP. First, the denoised image is transmitted to the skull-stripping procedure so that the brain area may be extracted. Determine which traits are the most desirable by employing the Adaptive Grill Herd (AKH) Learning Optimization technique. Finally, the suggested EDNN is able to classify brain images as either normal or pathological depending on the features that were collected from them. The EDNN classifier is adjusted with entropy-based standardization in order to regulate the abundance cross-over from the more profound layer of the brain organization to the most extreme pooling layer [40].
	IoMT +SDNN (Support value- based Deep Neural Network) Initially, imagery derived from IoT innovations as well as clinical photographs are compiled into a database for research purposes. The skull of the brain being processed is removed during the preprocessing phase in order to facilitate brain area extraction. The effective features, such as entropy, geometry, and texture features, are retrieved by using the preprocessed output images as a starting point. Lastly, but certainly not least, the suggested support value-based adaptive deep neural network (SDNN) distinguishes between normal and abnormal brain images by using the features that were derived from them. [41].
Cerebral palsy	IoT4CP The framework relies on a sensor shield that is connected to a cloud platform and collects sensor data. The microcontroller sends data from the sensors, which measure things like heart rate and muscle contraction, to a Google Firebase cloud storage platform through a gateway. This study shows the first real-time analyses that can be run within this framework, and it sends data without any problems in an average of 1.77 seconds [42].

	Internet + Assistive technology + Researcher support A head pointer and an individually configured Apple iPad were included in the assistive technology, allowing the man to select screen icons linked to preferred websites directly. These sessions provided the man with opportunities to practice using the iPad®. Progress was evaluated based on his independence, engagement, task performance, satisfaction with his performance, and overall contentment with the use of the head pointer, iPad®, and the intervention program. The man reported improved performance throughout treatment and active participation in each session [43].
Epilepsy and Seizures	Federated Learning Framework for Epilepsy and Seizures Obtained information from the EEG signals present in IoMT by utilizing fog computing A simple and efficient spatiotemporal transformer network is described in order to assist in the process of cooperatively learning spatial and temporal representations based on the local data contributed by each member. During training, a greedy method is used to select the ideal fog node to serve as the coordinator node in charge of global aggregation. This reduces the reliance that the IoMT has on the central server. The proposed Fed-ESD makes use of fog nodes that are located in different locations to serve as local aggregators for applications that are similar to those of the IoMT [44].
	Front-end circuitry in addition to the Seizure Predictor Tag (ForeSeiz) in addition to the Enhanced Convolutional Neural Network in addition to the Fletcher Reeves Algorithm (FRA) in addition to the Phase Transition Predictor (PTP) in addition to the Kullback -Leibler divergence. The model was trained and tested on EEG recordings from CHB-MIT, NINC, and SRM by employing the transfer learning method. As a result, the model achieved an accuracy of 97% and a false prediction rate of 0.12 FP/h. Furthermore, a Premium Seizure Prediction Horizon (PSPH) of 66.52 minutes before to the start of seizures is included. A mobile application called SeizPred APP has been developed, and it is compatible with Firebase cloud. This application was designed to be used with seizure prediction. To maintain track of the states of epileptic patients for future reference by doctors, and if a seizure is predicted, the caretakers are instantly advised to take any necessary action [45]. To keep track of the states of epileptic patients for future reference by researchers.
	IoMT + VLD+SRA For seizure onset detection, the proposed model continuously analyzes neural signals and extracts hypersynchronous pulses. A seizure is declared if the number of pulses exceeds a predetermined threshold value within a certain time frame. The SRA improves the accuracy of the seizure detector by reducing false detections. System-level simulations and consumer electronics proof of concept were used to validate the design. The proposed seizure detector boasts a specificity of 97.5 percent and a sensitivity of 96.9%, respectively. When compared to many current methods, the use of minimal circuitry may result in lower power consumption. Other sensor modalities, wearable or implantable solutions, or a combination of the two, can be utilized with the proposed strategy [46].
Headache	IoMT+Deep Learning (DL)+Blockchain =DON-B-STRESSED DON-B-STRESSED, abbreviated as DON a System for the Detection of StrEss that Is Secure, Updated in Real Time, and Reliable Based on Blockchain This is based on the concept that the well-known worries about the adverse consequences of long-term stress may be avoided, which would be supported by the fact that this is the case. By merging the aforementioned technologies, such as IoMT for the collecting of user data, DL for the accurate prediction of patients' stress levels, and smart contracts implemented on blockchain for the secure transaction of health checks and financial transactions. The DL part has been tested on WESAD, a publicly accessible dataset for wearable stress and affects detection, and the LOSO generalization scheme produced an accuracy of more than 99 percent. This indicates that the tailored, secure, accurate, and quick real-time system that we have developed for the early detection of stress signs utilizes multimodal data from both a chest-worn and wrist-worn IoMT device [47].
Parkinson’s diseases	IoT +Fast Health Interoperability Resources(FHIR) A health data collection platform that uses FHIR (Fast Healthcare Interoperability Resources) to store and transmit Parkinson's patients' foot pressure data. A large number of Parkinson's patients' foot pressure can be collected using the platform. In Parkinson's disease patients, abnormal behaviors like walking patterns, tilt, and stride length instability can be identified using the collected data. This study's findings make it possible to accurately diagnose and treat Parkinson's disease [48].
	IoT +Compressive Sensing Patients with Parkinson's disease whose brains have been implanted with a chip known as Electroencephalography (EEG),. It functions as a wearable device, with the intention of working their bodies generally with the assistance of artificial life to their neurons. This is necessary for individuals who are unable to communicate with others due to this disease. Because dead neurons prevent them from receiving alerts in a timely manner, making it impossible for them to

	correctly transmit messages to the brain. It will introduce an architecture that uses multiple chips to work on the brain. These chips will help send signals and become a mediator or transmitter that sends to do work [49].
	IoT-based remote monitoring architecture Combination of IoT and telemedicine for consulting the medical experts, diagnosis, and overall patient monitoring through the network which can be connected all over the area. Wearable devices were tied to patients' hands and it collects information about movement and tremor analysis. It was monitored using mobile applications to corporate the patient's data in both audio and video format which was stored in an API package. API package holds web portal and databases for later use [50].
Learning Disabilites	IoMT +CNN .For the purposes of feature extraction and classification, this work makes use of the IDCNN model, which is a combination of the DCNN algorithm and the Inception module. The classification performance of the IDCNN model can be significantly improved by utilizing the moth flame optimization (MFO) method. The experimental findings obtained through the OIDCNN-OPMDD method are subjected to the investigation and scrutiny of specified situations. The findings of the experiment revealed that the OIDCNN-OPMDD model performed significantly better than those of other DL models [51].
	IoMT Re-learning, like many other aspects of e-health and independent living, can benefit from IoMT enhancement in multiple ways. The possibility of measuring progress in the various relearning branches is one aspect. There is also the possibility of monitoring re-learning for cognitive and motoric re-learning, which can be used to evaluate exercises and prevent accidents. In addition, the development of technology as a whole has the potential to support the andragogyheutagogy idea of self-directed learning and realize the concept of relearning at any time and from any location [52].
Neuromuscular disorders	IoMT A completely original Internet of Medical Things (IoMT) system that will make it possible for physicians to do remote monitoring and patients to get biofeedback therapy in the comfort of their own homes. The suggested architecture and user-centric design process will incorporate a brand-new sensing probe, mobile application, and cloud-based web application. These components will all be built with the end user in mind. The activities involved in biofeedback training served as the focus of a case study. In comparison to the IoMT data, the clinical gold standard, high-definition anorectal manometry, was utilized. The suggested IoMT has the potential to be utilized for anorectal biofeedback therapy in the home setting and has the potential to give anorectal pressure profiles comparable to clinical manometry [53].
Attention Deficit Disorder and Hyperactivity (ADHD)	IoMT The Internet of Things, or IoT, is one of the solutions that has a lot of potentials to provide this autonomy because we can provide multiple devices, like ones that can monitor our body temperature or blood pressure, without having to go to a hospital. An IoT-based solution for assisting an adult with ADHD in their daily activities is presented in this work. A tool that can recall activities and possibly misplaced objects has been developed in response to this. A questionnaire that was distributed to specialists served as the foundation for the evaluation of the proposed solution. The results so far indicate that the tool has a great potential to assist ADHD sufferers [54].
	IoT sustenance systems User-based model and are user friendly which are helpful while creating innovative Before developing the model, the prototype of the IoT support system is developed for ADHD Patients wear a smartwatch as a wearable device, collect medical-related data from patients, and using Bluetooth it was connected to the mobile application and is transferred to patients' knowledge [55].

This research utilizes a review-based, interpretivist, and qualitative methodology, arranged around secondary data sourced from various peer-reviewed articles, case studies, and technology applications [57]. It is best classified as a descriptive, thematic literature review with a strong focus on the classification and contrasting analysis of RMS-IoMT devices used in handling different neurological disabilities. The study recognizes and understands the str ucture, execution, and applicability of IoMT-based remote tracking systems such as smart biomedical-assisted systems, cloud-integrated IoT architectures, and AI-enabled wearable devices. By synthesizing results across multiple conditions—including Alzheimer's, ALS, ASD, and cerebral palsy—the study aims to extract patterns, strengths, and limitations of these technologies in healthcare environments. This interpretive approach provides a broader und comprehension of how present technologies can be improved or repurposed for future system design, especially in underdeveloped regions where medical infrastructure is limited. It also main features multi-step problem-solving frameworks across various neuro disorders to notify future execution sstrategies in biomedical engineering and e-health research.

4. Result and Discussion

Mainly, when a person is affected by any kind of neurological disability, the communication between the patient and doctor is a too complicated and very challenging task. So, this IoMT plays a vital role in helping and assisting doctors. Study Of Rms-Iomt Devices /Process/ Models For Each Neurological Disabilities [41][47][49][52] are shown in the Table 13.
The ultimate advantage is healthier and longer lives, the greatest treatment and prevention of disease, and monitoring the development of children and old parents. The significant improvement in the patient's health will trigger an automatic alarm, which will save both lives and a significant amount of time. IoT's resources, as well as those of other IoT devices. Facilitate easier living conditions. Affordable healthcare is available. The prognosis for the patient is looking much better. Figure 4, Real-time disease management and surveillance systems. The whole quality of life is enhanced. The delivery of the medication occurs on time. The family members of the patient will be updated with their care. Purity of form. Cost effectiveness. User friendliness. Medical professionals have an easy time managing patient records. Saving time, money, and other resources while simultaneously improving one's energy efficiency is referred to as "energy efficiency."off-hours medical services based on the Internet of Things.
In addition, IoMT does not make it simple for doctors to decide that surgery is necessary for their patients because the doctor is the one who ultimately decides whether or not surgery is required. This RMS-IoMT is only authorized to deliver services and goods that are in some way connected to healthcare. However, the responsibility lies with the physicians. The doctors are able to monitor their patients with the assistance of this, but the doctors are unable to follow the advice provided by the IoMT.It's only a safety measure to take with the patients. [56][58].

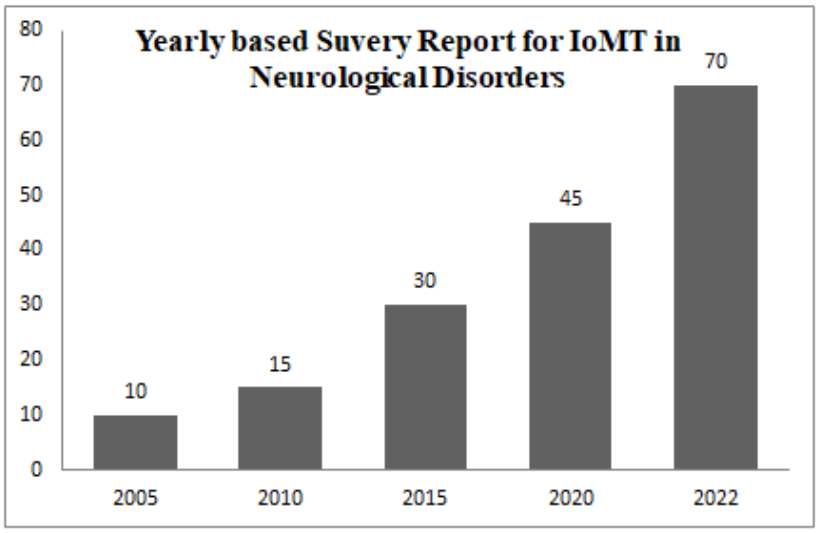

Fig 4. Survey report of IoMT -ND

The integration of IoMT into healthcare, specifically for neurological disabilities, presents an evolving model in medical observing sand patient engagement [59]. Through the review of various models and systems, it is evident that the application of remote monitoring tools extends far beyond simple data collection—it establishes a foundation for personalized, proactive, and preventive neurological care.
A notable result of this study is the emergence of condition-specific IoMT frameworks. Unlike generic health monitors, the reviewed RMS-IoMT systems are tailored to the distinctions of neurological disorders. For instance, systems used in autism focus on sensory input and behavioural patterns, while those for Parkinson's disease track gait and motor function variations over time. These systems aren't just data-driven—they are behavior-sensitive, modifying their responses and alerts based on patient-specific thresholds and progression levels.
Another critical insight is the role of cloud combination and data analytics in driving clinical decisions. IoMT devices now use real-time cloud platforms to store patient data, allowing healthcare suppliers to remotely access trends, analyze deviations, and adjust treatment plans instantly [60]. In neurological disorders where conditions may deteriorate quickly—such as acute spinal cord injuries or epilepsy—this capacity can be lifesaving [61]. Real-time understandings ensure not just monitoring, but dynamic care management.
The symptoms manifest themselves in stages. The initial indicator may be a tremor that is so slight that it is only evident in one hand. Despite the fact that the condition can also cause stiffness or a slowdown of movement, tremors are one of the most typical symptoms. Disorders of the nervous system affect hundreds of millions of people all over the world. More than six million individuals pass away every year as a result of having a stroke, and more than ninety percent of these deaths take place in nations with poor or middle incomes. Over sixty million people all over the world are living with epilepsy. Around 50.5 million individuals are currently living with dementia around the world, and 8.1 million new cases are identified each year. The most common kind of dementia is Alzheimer's disease, which may be responsible for up to 75 percent of all cases [62].

5. Conclusions

Thus the review article of RMS-IoMT for ND is very effective for researchers in the field of medical and engineer.The major outcome of this manscript is to concentrate on process of designing a devices for montoring the neuro disorders which are not available in the medical infrastructure. To frame a RMS -IoMT,the researchers are equipped with concept of biomedical and instrumentation concepts.The data of neurodisorder patients are mostly covers with images.The images are taken from medical equipments are MRI and CT. Enomorous research were taken for ND, however ND differ based on ages and from this survey article , the authors were confined to

have to find a wide research gap with multi steo problem solving techiques uing IoMT.In the future, this study will be concentrated on any one disorder to cure with maximum effort

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