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IoT Inspired Brain Disorders Monitoring and Detection

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Abstract: ***Today's rapid changes in technology bring immense competition in work life that in effect perturb the work-personal life balance. This pampered disharmony involuntarily creates stress in human lives. Once the stress is uncontrolled, it will cause severe diseases including neurological disease, ageing effect, cardiovascular disease etc. Amongst these vulnerable diseases, brain disorder is considered more severe one as our control section when becomes scared, the entire body functions will be hampered from their equilibrium state. Most cited brain disorders are Alzheimer and Perkinson disease. There has been tireless effort to detect Azheirmer and Perkinson as well as bipolar diseases and their proper treatment for a decade but the befitted solution is under development. Also the busiest lifestyle may also discard human beings to keep in touch with their parents. The senior citizens are often suffered from these two diseases. In this regard, our aim is to investigate a realistic as well as compatible solution to administer the brain disorders. Internet of Things (IoT) is considered as most efficient and energy saving technology that can provide easy and remote monitoring of target problem. The number of sensors and IoT devices along with applications is used for monitoring the health condition of patients. These devices will monitor the movement of targeted patients at home or out of their homes. Based on their behavior and movement, the treatment will be provided to Alzheimer's patients. In this review paper, we are trying to response the unanswered question " Is Brain disorder properly detected and prevented?". Our attempt is to figure out possible solutions using Internet of Things (IoT) over the problem. The paper will highlight recent development in IoT based brain disorder therpy and attempt to harbinger the process of way-out.***

Keywords: Brain disorder, Alzheimer and Perkinson disease, Internet of Things (IoT), Sensors, Brain disorder therapy, Cloud computing

I. INTRODUCTION

Today's stressful life inculcates lots of unwanted deleterious heath issues among which neurological disorders are turning out to be life threatening disease. The rapid urbanization and specially COVID-19 pandemic stimulates more mental work rather than physical activities.

The human physiological metabolism is largely perturbed due to excessive work from home culture as a result, different health issues may arise. Apart from this, the economic downfall due to COVID-19 pandemic, unbelievable stress arise that may creates neurological disorders. In addition to these severe cases, ageing effect and heredity may invite different brain disorders. Among the brain disorders, Alzheimer's disease becomes the most rampant neurological malady today. Mostly older ones suffer from this type of disease, commonly known as dementia. The outcome of this disease is inability to perform daily tasks independently and therefore the patients need family members' care for their behaviour. This uneven situation can be administered by hiring nurse but the process is expensive for mostly middle class and lower middle class families. As India's major population is from middle class so the detection of Alzheimer and other brain disorders is of prime interest nowadays. Also due to busy schedule of earning members of a family, it will not be possible to monitor on spot monitoring human activities.[1] In this regard, electronic detection and monitoring of Alzheimer disease are demanding lots of acceptance in this scenario. The electronic detection of brain disorders is basically performed by a series of sensors inbuilt in home and the monitoring could be realized by Internet of Things (IoT) and cloud computing. In this method, the extra cost spent on hiring nurse will be cut down. Diverse electronic gadgets such as smartwatches, sensors, and actuators are to be installed at the home where Alzheimer patients are staying and thus these devices can monitor the patient. The data transfer from these sensors might be a vital issue as the distorted data can lead to improper treatment of the respective patient. The secured data transfer is implemented through different protocols such as WebSocket and HTTP. Different sensors such as pulse sensor is used for monitoring the heart rate in real-time. The sensed data will be stored in cloud and based on demand the data can be fetched. In this review, IoT based Alzheimer disease detection and monitoring is presented along with the challenges produced are elaborately discussed. [2]

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II. OBJECTIVES

The main objectives of this project are following –

1) A combination of advanced detection technology is required to produce an accurate health monitoring system with advanced capabilities to provide low-cost comprehensive monitoring.
2) The sensed data should be displayed in a user-friendly manner on an LCD display and also on webpage or apps. By this patient's relatives can observe the patient's physical movement from anywhere using their personal devices.
3) Data from different part of the body can be observed, weather it is operating in right way or not.
4) By analyzing the data, we can make a good decision for patient's batter health.

III.OVERVIEW OF ALZHEIMER'S DISEASE

Alzheimer's disease is a progressive neurologic disorder that causes the brain to shrink (atrophy) and brain cells to die. Alzheimer's disease is the most common cause of 60-70% of dementia — a continuous failure in thinking, behavioural and social skills that affects a person's ability to function independently. The most common early symptom is difficulty in remembering current events or activities. The cause of Alzheimer's disease is not understood properly. There are many environmental and genetic risk factors associated with its development. The strongest genetic risk factor is from an allele of APOE. Other risk factors include a history of head injury, clinical depression, and high blood pressure. The disease process is largely associated with amyloid plaques, neurofibrillary tangles, and loss of neuronal connections in the brain.[13] A probable diagnosis is based on the history of the illness and cognitive testing with medical imaging and blood tests to rule out other possible causes.[5] Initial symptoms are often mistaken for normal aging. Examination of brain tissue is needed for a definite diagnosis, but this can only take place after death.[13] Good nutrition, physical activity, and engaging socially are known to be of benefit generally in aging, and these may help in reducing the risk of cognitive decline and Alzheimer's; in 2019 clinical trials were underway to look at these possibilities. There are no medications or supplements that have been shown to decrease risk.

IV. IoT AND CLOUD COMPUTING

The Internet of Things (IoT) is basically connection between Internet and Physical objects or 'Things' that are embedded with sensors , software and others. It is generally associate setting within which objects, animals or folks are supplied with distinctive identifiers and therefore the ability to transfer information over a network while not requiring human-to human or human-to-computer interaction. IoT has evolved from the convergence of wireless technologies, Micro Electro Mechanical Systems (MEMS) and therefore the net. The idea may additionally be named because the net of Everything. A thing, within the Internet of Things, will be an individual with a cardiac monitor implant, a eutherian mammal with a chip electrical device, associate automobile that has intrinsic sensors to alert the motive force once tire pressure is low -- or the other natural or semi synthetic object which will be assigned associate scientific discipline address and supplied with the flexibility to transfer information over a network. Cloud Computing is a on-demand web services via pay as you go pricing model . Cloud Computing in IoT works as part of a collaboration and is used to store IoT data. The Cloud is a centralised server containing computer resources that can be accessed whenever required. Cloud Computing is an easy travel method for the large data packages generated by the IoT through the Internet.Thus, the role of *cloud computing in IoT* is to work together to store IoT data, providing easy access when needed.[2,3]

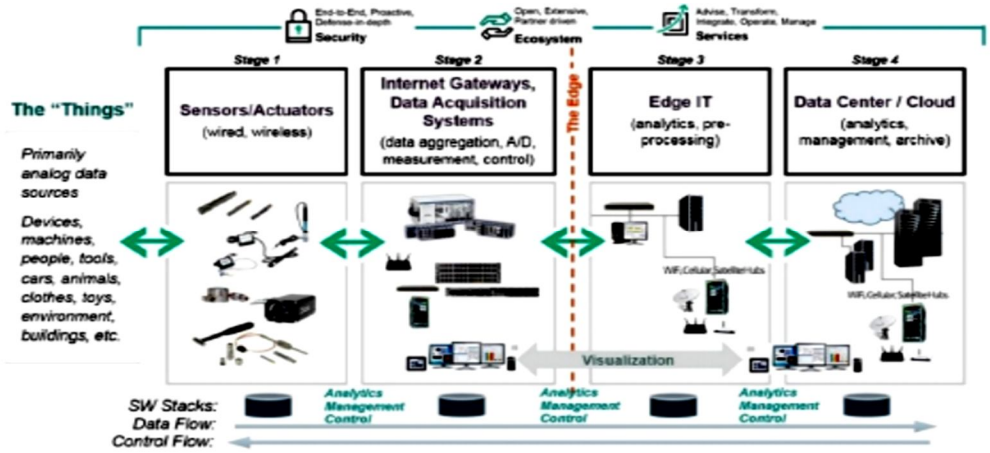


Figure 1. Architecture of Internet of Things (IoT) and Cloud computing

V. CLINICAL CARE

IoT-based surveillance systems are used for hospitalized patients whose physiological status requires ongoing attention. These surveillance systems use sensors to collect patients' physiological information, which is analyzed using gateways and applications in cloud computing, and ultimately, the results are stored on the cloud server. This information is then transmitted wirelessly to professionals for analysis on a digital basis. It is unnecessary to control the vital signs of patients at regular intervals by a health professional using the Internet of Things. In other words, the Internet of Things creates an automatic, continuous flow of health information and vital signs for patients. Thus, the quality of medical care is enhanced through continuous attention, which reduces the cost of care and eliminates the need to permanently monitor the patient.[3,4]

VI. REMOTE MONITORING

A. Telecommunication Of Patient Care System Using Remote Monitoring

As can be seen in Figure above, patients' health data can be safely collected using these solutions. Various types of sophisticated sensors and algorithms are used to analyze data and then to share data and results through wireless communications. Medical professionals can remotely provide patients the necessary recommendations to maintain their health.

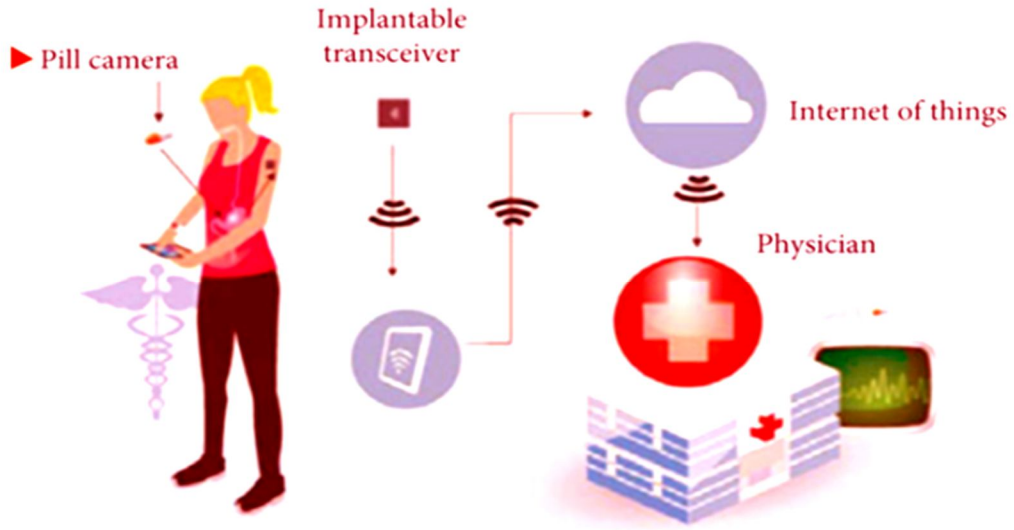


Figure 2. Remote monitoring of Brain disorders by IoT

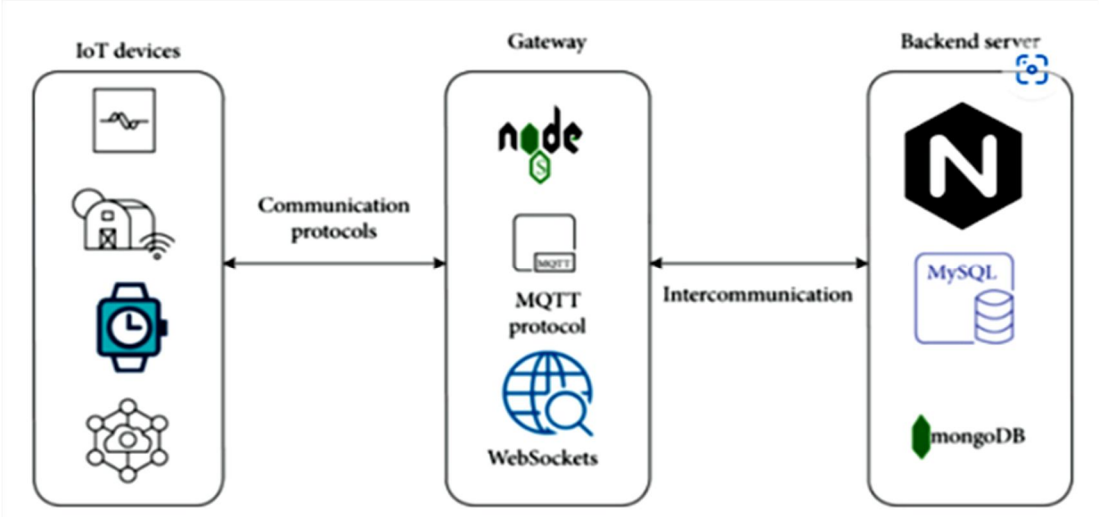


Figure 3. Different protocol based IoT communication.

In the above system, different types of devices are used like sensors, smart stickers on cloths of those peoples, smartwatches, smart cameras, and smartphone apps. As the heterogeneous devices are being used so that all have different ways of communication, some of them are using Message Queuing Telemetry Transport (MQTT), HyperText Transfer Protocol (HTTP), or WebSockets for fetching the required information. All the methods are developed in NodeJS for communication between these IoT devices. The smartwatches are used for the fetching of heartbeat blood pressure, temperature level, and diabetes level information into the proposed system. Based on the defined thrash hold for each mentioned disease, the alert will be generated to concerned persons against the patient's identification number and name.[5,6]

VII. ADVANTAGES AND LIMITATIONS

A. Advantages

1) Development of social liability.
2) Possibly, declining treatment costs.
3) Extend the self-dependency of the patient at the residence.
4) Increase physical and psychological health of the patients.
5) Possible saving of money on expensive treatments for the community.

B. Limitations

1) Deficiencies in the observance of cultural and social differences.
2) Lack of IoT monitoring devices .
3) Primarily, big amount of financing is required.
4) Concerns regarding the privacy and security of the data

VIII. CONCLUSIONS

One of the greatest human problems is the development of a variety of diseases, including Alzheimer's, in the old age of people all around the world. In the last decade, for unknown reasons, the number of people with this disease has been rising worldwide. Numerous studies have been conducted by researchers around the world, but the real reasons which cause the disease are still unknown. On the other hand, despite the pharmacological and nonpharmacological treatments which are suggested by physicians and researchers to help these patients, virtually none of those treatments can completely prevent the disease from progressing. Since caring for these patients is needed at all times (24 hours per day), it takes a lot of patience for the family and ultimately is economically costly. On the other hand, the Internet of Things (IoT) has rapidly received popularity throughout the world in the last decade. This technology can continuously monitor Alzheimer's patient's behaviors at home and abroad and inform the geographical location and occurrence of the accident and critical conditions to family members and healthcare personnel. In this paper, we have proposed a novel solution for tracking activities and monitoring the health condition of patients with the help of IoT devices. This devices' communication has been secured with the recommended standards for the MQTT, WebSocket, and HTTP for the IoT application. The data has been collected from different types of devices and sensors to get accurate information regarding the patient's health condition. To keep in view the security and privacy issues of data, it is secured during transit and at rest. With this solution, transportation and medical facilities can be provided to them. The state-of-the-art administration dashboard has been developed for monitoring, device status alert generation rules, and live tracking of patients and vehicles for them with the help of Google maps. Our proposed system has a 95% accuracy ratio for the emergency alerts and condition of patients regarding their blood pressure, heartbeat, or sugar level. This will help health departments of any country to provide health facilities rapidly and perfectly to their patients.

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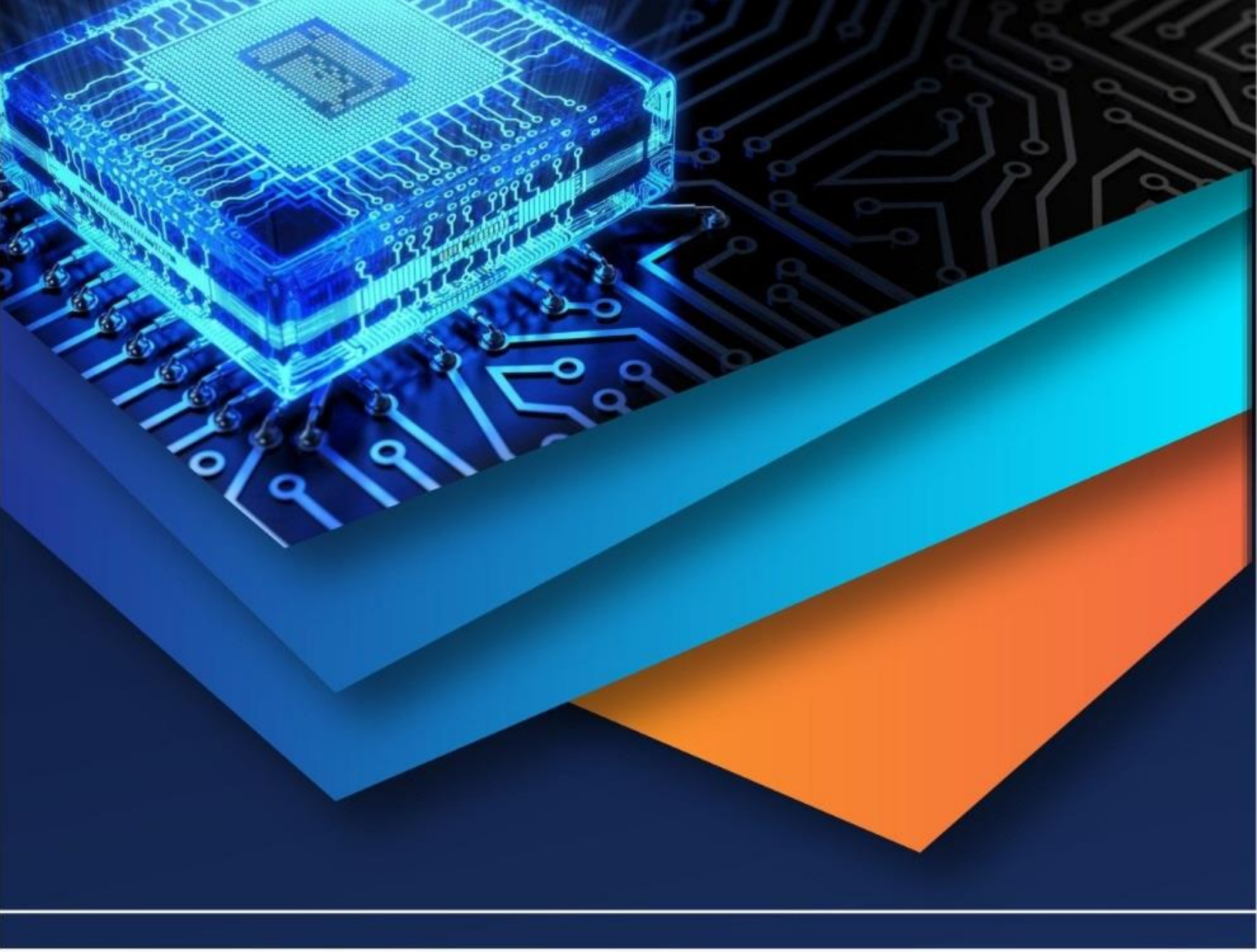
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