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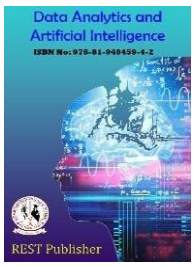

Smart IOT for Mental Health and Well Being

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Abstract: *This chapter discusses usage of IOT devices for achieving mental health. Mental health concerns with addressing various ailments such as stress, anxiety, depression disorders, sleep patterns, etc. IOT sensors and actuators can be employed in both disease detection and disease prevention. The ethical issues relating to data, privacy, and the effect of IOT sensors and actuators on human health must also be investigated in order to provide a holistic approach towards patient well-being and health must also be investigated in order to provide a holistic approach towards patient well-being and health.*

Keywords*: Smart Health, Monitoring, IOT, Wearable-devices, Body-Area-Network.*

1. INTRODUCTION

In this section, the evolution of IOT is discussed along with the different enabling technologies that aid in smooth working of IOT devices. These technologies, when applied in conjunction with medical devices, provide various tools that facilitate patient treatment and cure.

Internet of Things (IOT): IOT has ubiquitous applications involving many areas and fields of day-to-day life. It has further been extended as Internet-Of-Everything (IOE) to put sensors and actuators in all the entities, including humans [1]. The technological evolution henceforth involves cross-domain creation of different products. These products include the development of recommendation systems for providing different advice and directions for the prospective users. This trend hence incentivizes the need to adopt a holistic approach towards the generation of different products as well as processes [2]. The technological evolution however neglects the ethical and moral issues. These must also be addressed simultaneously for sustainable development and better patient care.

IOT-Medical (IOT-M): IOT-M deals with employing IOT-based devices to medical domain and industry. IOT-M based devices are deployed at hospitals, medical centers for the purpose of facilitating data management and data driven services in the medical industry.

Converging Technologies: Edge computing and Federated Learning technologies form the backbone of large scale processing of data. The data generated from the source, when ported to the destination servers, require a lot of time and usage of resources. The computing done at the edge or at a location near to the source helps to overcome this hurdle. Federated Learning entails training, creation of models in a distributed environment [2].

These twin technologies, when employed in medical settings, can help facilitate a variety of tasks. The edge computing devices can provide quick feedback to the doctors, while the federated learning systems can create different types of models. These models include recommendation systems advising various facets of the medical domain.

2. MENTAL HEALTH AND WELL BEING

In this section, different means through which mental health can be achieved are discussed. This includes disease detection and disease prevention.

In disease detection, there are two categories, as outlined in Figure 1. Disease detection can be done at the early stage or later, when the diseases become stronger. The treatment during the later stage takes more time; hence, it is

imperative that disease detection is done in its early phase only. IOT sensors and actuators can aid in disease detection according to the type of disease. IOT sensors can help in monitoring patients' health and providing various real-life data information about the patient. The different stages of disease detection are given in figure 1. IOT sensors can also provide various recommendations based on the data collected and models generated. The edge computing devices can leverage these processes [3]. The data got from the patient's information can provide for early or late disease detection.

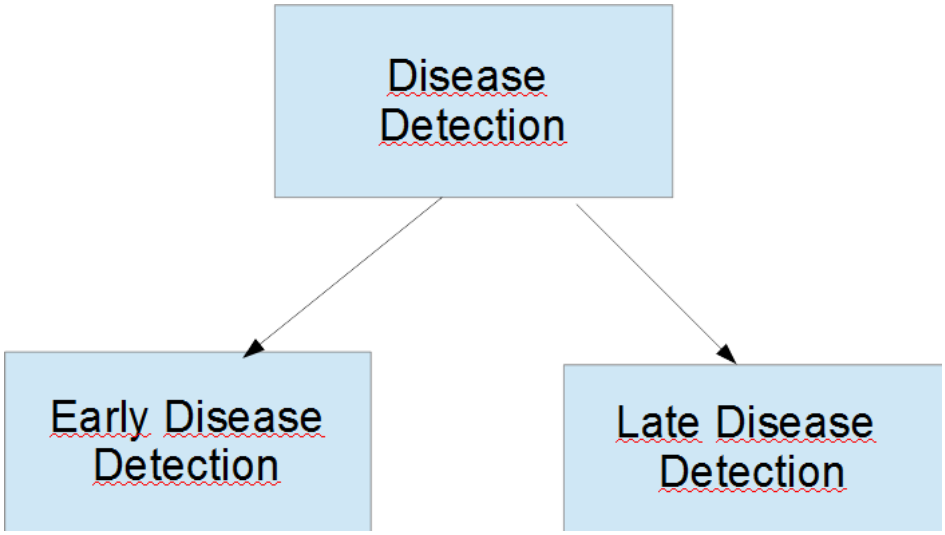

FIGURE 1. Disease detection

Disease Detection: In the specific instance of mental health, there are stress, anxiety, depression, sleep disorders, and ADHD syndrome disease, which can be detected using IOT based devices [4] [5]. Stress detection can be done early by using various sensors to monitor different body or related parameters. These include an amount of sweating, social isolation, mood swings, and social anxiety [4] [5] [13]. IOT devices can help in altering and increasing social awareness to overcome all the stress-related issues.

Disease prevention: Patient's disease can also be prevented by making use of IOT devices. IOT devices can provide data related to real-time monitoring and recommendations, which can be used for disease prevention. There has also been a surge in employing IOT-based recommendation systems for the purpose of increasing disease monitoring integrated with day-to-day devices such as diaries [4]. The recommendation system can provide advice to doctors based on real time data and already-trained models. A mechanism can also be provided to provide holistic remedial measures from across different segments of medical treatment, including Allopathic, Ayurvedic, homeopathic, and Naturopathy [4]. In order to achieve mental health, social contact must be made available at regular intervals. A mechanism can be evolved to increase monitoring and prevent diseases at earlier stages by incorporating preventive remedies such as social contact for mental health.

3. ISSUES IN IMPLEMENTATION OF IOT IN MENTAL HEALTH

Data Acquisition: Patient's data is a major source for creating the AI/ML/DL models for performing predictive as well as prescriptive analytics. The data can be acquired from a distributed environment or a single source. The data acquisition must be standardized and consistency maintained across different facets of data. The data being collected relates to humans. Hence, the data must be adhering to privacy and other humanitarian issues that may arise. Once data is acquired, issues of ethics, outsourcing, moral values, and theft must also be considered. The countries and unions all over the world have regulated data acquisition by introducing laws and regulations. The European Union (EU) has introduced General Data Protection and Regulation (GDPR) in order to check how data is collected. These laws specifically address the privacy of the individual and right to recall the data sent to the data collection authority.

Training and Model Creation: Training involves using computer algorithms and techniques to create models. Specifically these models include Machine Learning, and deep learning models for predicting future trends and patterns in mental health and well-being. Model creation relies on efficient data preprocessing tasks like feature engineering in order to produce an efficient, high-quality model. Model creation involves making use of ML/DL algorithms to produce models for prediction and analysis of patient's health.

Ethical Considerations in IOT Integration with Mental Health: Ethical consideration includes moral and ethical ways of handling and using data. Once the data is sourced, the data may need to be prepared to hide patients' personnel data. In this context, it is pertinent to mention the use Federated Learning system's which facilitate distributed learning tasks after hiding the patient's information. FL systems research has been initiated by Google for this purpose.

Ethical issues also include assessment of devices used to treat mental-disease. These devices must not be the very reason for the cause of other diseases. There have been researchers pointing out diseases such as stress, brain tumors, and cancer being caused by IOT devices [14-16].

4. CONCLUSION

This chapter provides an introduction to how IOT devices are used for the mental health and well-being of patients. The converging technologies followed by model creation and ethical issues related to IOT deployment are also discussed. The ethical issues must also be addressed and taken care-of when providing products to the prospective customers. This will ensure that the product is accepted by the customer's in a long run. The future work must entail conducting a holistic study considering all the issues canvassed in the book chapter. This study can be done at micro(patient) level, macro(hospital) level also.

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