Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 03, March-2019

Depression: A Survey on the Indian Scenario and the Technological Work Done

Asma Vaseem
Department of Computer Science & Engineering
Amity University
Noida, India

Dr. Shilpi Sharma
Department of Computer Science & Engineering
Amity University
Noida, India

***Abstract*— Depression is a crucial public health concern in India expanding at a very fast pace. It is affecting people of all age groups, male or female, urban or rural, educated or uneducated and even employed or unemployed. The silent suffering of depression goes highly unnoticed and is expanding very swiftly among the people. Depression is closely related to multiple non-communicable diseases, substance abuse disorders, dietary disorders and also suicide. In India, a large number of people are committing suicides due to depression each year. Despite this, there is a lot of stigma around the word 'depression' in our society and there are very less measures, treatment and services for helping people cope with such a common mental disorder. With the advancement of technology, sensors today have become an extensive part of everyday life. From our mobile phones sensors to accelerometers, the new actuator based technology has established its base from every corner and aspect in our day to day lives. Various researchers are trying to detect and treat depression with the use of sensors, IoT and other technology. It is expanding largely from the market opportunities perspective and investments are being made on it from various major market competitors as well. In this paper, we are inspecting diverse ways in which the researchers are trying to help people by detecting depression. The major challenges coming in the way to a perfect solution are also highlighted.**

Keywords:- Internet of Things, depression in India, suicides, mental health disorders, smart healthcare, healthcare systems.

I. INTRODUCTION

Depression is the unwavering feeling of sadness, exhaustion and anxiety along with various physical complaints. A person can feel low or sad for a couple of days due to various daily issues but when this feeling persists for more than three to four weeks, it converts into a form of mental disorder called Depression. Depression is a non-communicable disease and can be cured with the correct dosage of medicines and sometimes lifestyle changes. However, if went undiagnosed and untreated, can lead to suicides.

Suicide is one of the major health challenges in 21st Century, increasing all the more with digitization. WHO has been measuring the number of suicides around the world since 1950. After an analysis of the last 50 year segment i.e. from 1950 to 2000, there has been a shift in the countries which were on the top of the suicide list including Japan, Hungary, and Lithuania etc. However, the overall pattern of suicide mortality has been relocated from Western to Eastern Europe. And thereafter is transposing towards Asia. India and China have become the largest contributors of the number of suicides in the world [1].

In India, suicides due to depression have become a common threat to public health among all age groups. In the 15 years or above age group, the nationwide totality of deaths due to suicide was estimated to be 187000 in 2010, which is quite above than was reported in police crime official statistics. Even in women ageing around 15 or above, suicide has become the major cause of mortality. The major cause of deaths due to suicide was by consuming poison [2].

Internet of things (IoT) is a fairly simple notion of taking all the things and connecting it to the internet. Things refer here to the objects which can be a mobile phone, a vehicle or a computer. However, when seen technically, Internet of Things is a system of co-related objects communicating with each other and sharing information without both interactions, i.e., a human-human or a human to computer. It is an inter connected network comprising of devices like Radio frequency Identification Tags (RFIDs), sensor devices, mobile devices etc. and store and exchange data with the connected devices.

This concept of connected smart devices started with a Coke Vending Machine at the Carnegie Mellon University which was the first ever device connected to the internet, and was able to report to its inventory as to how many drinks are available [3]. This was followed by a paper published by Mark Weiser [4] which gave the concept of ubiquitous computing and how it will become a part of everyday life of people over the years without coming into much notice.

With the advancement of technology, the initially called cellphone became a smartphone performing a large number of tasks such as reading books, social networking, watching a movie, listening to music, shopping, health monitoring etc. IoT devices fluctuate from tiny chips to robot-like units that can hitch into various devices and office machines enabling the user to collect some data from it or completely access it. IoT is being used in a wide area of applications including the domains of transportation, healthcare, personal, social, logistics, smart environment to name a few. From smart cars and bicycles to raw material purchasing, production, storage and even after sales service has been outdone with the help of IoT [5]. Monitoring of putrefiable goods such as vegetables and fruits, dairy products and meat while transporting from one place to another, can be done with the help of pervasive computing and sensor technologies at various levels of the food supply chain [6][7]. This not only maximizes profits but also maximizes the reduction of the greenhouse gas emissions. Mobile ticketing is also becoming a popular means to buy the tickets for movies, transportation services et cetera with the advancement if IoT [8].

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 03, March-2019

Internet of Things is establishing its base from every corner and aspect in our day to day lives. It is expanding largely from the market opportunities perspective and investments are being made on it from various major market competitors. The enabling communication technologies such as Bluetooth LE, NFC, RFID, Z-Wave and LTE-A are being used extensively in IoT [9].

Internet of Medical Things (IoMT) is becoming a common paradigm with so many advancements in the medical industry. This has increased the life expectancy of people especially in the developed countries [10]. The Internet of Health Things [11] or Internet of Medical Things [12] or Smart Healthcare [13] as it being called is combining the reliability and safety of conventional medical devices used for the treatment of chronic illnesses with the dynamicity and generality of Internet of Things. IoMT is providing solutions for addressing the requirements of both the ageing population as well as patients with chronic diseases and providing patients mobility in contrast to the telemedicine systems [12].

The paper is structured into six sections. Section II provides the compilation of the technological advancements executed by various researchers in detecting depression or treating it. The major works have been depicted in Table I. Section III provides the overall examination of the review performed. The result is depicted in Section IV. The conclusion of the work has been summarized in Section V, followed by the future work in Section VI.

II. LITERATURE REVIEW

India is a country with a whopping population of 133.92 crores (2017) [14]. In 2010, of all the surveyed deaths, near about 3% people who died were ageing 15 years or above , complementing to about 187 000 suicide deaths in India. It is strange to find out that more suicides have occurred in the states where education of people is higher and are richer states (many states of the southern India) in comparison with the states having people below primary education [2]. Depression is a silent killer and is often ignored by individuals, their family members and sometimes even by physicians. There can be many causes of depression resulting from personal life issues and professional life issues, from parenthood, from health problems, poverty etc. most of the time the symptoms of depression are very noticeable and maverick. It has become a prevalent cause of suicide among all age groups whether it is teenagers, adults or elderly people. According to the world wellbeing association reports, India is standing out among the most depressed nations on Earth. 36 % Indians experience depression at some point of their lives.

There has been an expansion in the suicides in the age group of 13-20 with the advent of social media and smart phones [15]. A depressed adolescent many not show very loud and obvious signs of depression but still may be suffering from it. In [15], the authors have proposed the system architecture for detecting clinical depression by speech features for adolescents. The recognition system for depression was built on MATLAB and signals are processed through hanning window. They performed a series of experiments and formulated a 90.58% accuracy with the TEO and Glottal feature when taken in a fusing combination.

IoT is not the outcome of a single major scientific advancement. It emerged as a result of several complimentary capabilities development which include identification, sensing, actuation, processing of different information, localization, addressability et cetera [16]. Enhanced wireless technologies for instance, Wi-Fi, Zigbee, Bluetooth and 6LoWPAN have enlarged the ability of exchange of information to and from different objects. In [17], the authors have thrown some light on the applications of IoT and its benefits in healthcare industry. They have identified eight major benefits of IoT in healthcare including reduction of treatment costs, reduction in human error, removal of geographical barriers, early detection of chronic disorders, enhanced drug management, minimization of paperwork and hence save environment, immediate medical attention and better outcomes of treatment. The number of IoT devices connected to the internet will reach more than 50 billion by 2020 [18].

Wearable IoT (WIoT) can be described as the infrastructure that connects various sensors for tracking human factors such as behavior, health, wellbeing and other data. With the help of various tiny wearable body area sensors (WBAS) and internet connected gateways, medical information can reach to physicians where data is collected, managed and monitored. The authors in [19] have extended the concept of WIoT and identified its architectural components along with the support of cloud and big data. WIoT has the power to transform the healthcare by early detection of diseases, lower cost of treatment and efficient means to monitor the treatment and the patient remotely. There is a growing demand of wearable devices in the market which vary from smart watches such as fitness tracking Fitbit watches, Apple watch, Empatica smart watch, glucose monitors such as Dexcom G6, cardiac monitors such as Zio patch, etc.

The authors in [20] design a PSYCHE garment which is basically a monitoring system. This system or garment is highly effective in terms of cost, is portable, takes in multiple parameters and is based on textiles. This garment can observe physiological signals during regular day to day activities and analyze the heart rate, breathing rate, heart rate variability and outlaying of body energy through pins connected to portable electronics. However, a particular disease wasn't taken into account by them in this study.

For the ageing population of Mexico dying mainly due to depression [21], the authors have proposed an empirical approach to design a prototype which will detect the depression state of a person using context awareness, gesture recognition and e-Health. The variation in the health of elders is reflected in their Activity Daily Living (ADL) which keeps a record of the day to day activities such as eating, going to the toilet, bedtime, bathing etc. They have detected depression by the lack of physical activity in an adult.

In [22], authors have proposed a layout to monitor a depressed patient's health using three tri-axial accelerometers, a barometric pressure sensor for sensing in the foot and a smart phone in a remote health care system. The nodes are mobile and communication is reliable. The location of the patient will be extracted in the form of

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 03, March-2019

coordinates from the android application (to be developed) installed on the patients phone. An alarm is triggered as soon as the patient is found to be in the danger zone for more than a stipulated threshold time. The patient's zone, posture and sleeping status are constantly being monitored.

In [23], the authors propose a system which is Intel Curie based and a protocol stack for the user end equipment. They throw a light on four IoT architectures for healthcare systems which include mHealth, 6LoWPAN and IEEE 11073 standard based architecture. There are various systems designed for individual monitoring of parameters such as blood glucose monitoring systems, temperature monitoring systems, healthcare systems for elderly, electrocardiogram heart monitoring systems etc.

The authors in [24] have given a complete survey of the work done on elderly healthcare considering various age groups, sample sizes of data and disabilities in elderly people and acknowledging what has been done in the work and how the goal of providing better healthcare is accomplished using neural network, support vector machine classifier, hidden Markov model, RFID technology etc. They proposed a theoretical framework elaborating on the concepts of Performance Expectancy (PE), Facilitating Conditions (FC), Effort Expectancy (EE), Technology Anxiety (TA), Perceived Trust (PT), Social Influence (SI), Perceived Cost (PC) and Expert Advice (EA) and presented a hypothesis. The output is acquired in Asian context.

Predicting depression accurately is a major concern till date and hence in [25], the authors propose a model for depression prediction considering Apriori algorithm and association rule mining and 500 individuals with diverse factors of depression. Authors in [14] used EEG signal processing for depression level prediction. They used the links between sleep and depression to process a model. Insomnia is extremely common in depressed people. Three quarters of depressed patients have sleep disorders, including insomnia and hypersomnia. The symptoms of sleep disorders and alcoholism cause a major impact on quality of life, thus increasing the risk of suicides. The results they acquired through ANFIS were slightly better than the results of nprtool classifier. Depression and suicides are becoming a major health concern. With the help of Linear Predictive Coding (LPC) and Parameters based method, the authors in [26] have prepared a model of emotional speech recognition algorithm using Tamil language. The best recognition rate obtained was 90% with the help of LPC algorithms.

Author in [27] depicted four major types of story with which young people can sense their own depressive attitude and solitude as a part of their life. The stories were taken with respective of a track with the instances as of 'Growing up on a side track' type, 'Falling off from it' type, 'Missing it' type and of 'Questioning it' type. The discussion has been focused on the inner narrative point of view and the lived narrative point of view. Several ways to improve the psychological conditions of the people, for instance, child protection, promoting equality, providing career counseling, detection and prevention of bullying has been depicted. This can reduce the number of people going into the trap of depression and eventually suicide.

The authors in [28] have used speech features for depression analysis as a speech signal can be measured by non-expensive means, can provide the maximum information and can be measured from far distances. Analysis of speech has been performed using the acoustic features such as prosodic, glottal, spectral, cepstral which tend to have physiological phenomenon and Teager energy Operator (TEO) tends to have perceptual phenomenon. On these features, various classifications are used and results are obtained. Various more methods for analysis are described in this research. However, non-linear features tend to provide more precision and are more extensively used.

Fisher vector algorithm has been applied for computation and Local tetra pattern (LTrP) feature extraction algorithm on the face of patients for detecting depression in [29]. Various steps are involved in detecting clinical depression such as preprocessing of the input face image, calculating the 8 bit patterns which are developed at each center pixel, magnitude patterns, applying fisher vector encoding on temporal segments followed by classification. The outcome comes as depressed and non-depressed and comparison is done in terms of three parameters i.e. sensitivity, specificity and accuracy.

In [30], text based emotion artificial intelligence is used for measuring the depressed tweets on a social media platform, twitter. They used Support Vector Machines and Multinomial Naïve Bayes Algorithm for comparison of F1 score and accuracy measures. Twitter data was taken into account and Naïve Bayes delivered better results than SVM. However, the results were not very accurate as compared to the depression detection by physicians and physiologists as people tend to use short forms instead of complete words these days, especially on social media platforms like twitter where there is a word limit. Also, there is notable noise in the data collected.

The authors in [31] have used Electroencephalogram Gram (EEG) signals and processed these signals through MATLAB. They suggested a depression detection system which extracted EEG signals from the database, converted the signals into ASCII or text file, extricated the EEG bands by Welch method and hence passed on the result to ANFIS and nprtool after applying Log PSD Mean and standard deviation. After the process of training and testing the data, the sleep disorders and alcoholic disorders are classified within the depression domain. ANFIS was found to provide better results than nprtool.

In [32], I-Vector technique and fuzzy membership functions have been selected to uncover depression level in twenty patients. For simulation MATLAB 2013A with a toolbox for signal processing is used. Comparison between the algorithms is performed based on accuracy, balanced classification rate, peak signal to noise ratio, F-Measure and specificity. Before processing, is becomes necessary to remove silence present in the audio signals for increasing the accuracy. Fuzzy membership functions proved to be much better with an accuracy of 97%.

The authors here in [33] focus on distinguishing the level of depression being experienced by the depressed. EEG signals are taken into account and features are extracted to train the neural network. Thereafter, emotion recognition is

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 03, March-2019

implemented to identify depression levels through facial analysis. At the end, they conclude that the combination of EEG signals and facial expressions produce a better result as compared to the individual algorithms in differentiating the depressed from the control patients.

With the detection of level of depression in an individual, the authors managed to provide a system to suggest remedies for lowering the level of depression in [34]. A therapy chatbot is used in this research which can act as a therapist or a friend or a well-wisher. Depressed people don't wish to visit a therapist; however, they can share their feelings with an appealing virtual therapist instead of having an alone miserable time. T-bots are very useful and can serve as a personal assistant, psychiatrist, brawl depression, can provide feedback, can identify the level of depression, can provide the therapy level etc. The MOST model has been applied in various studies. A personal nurse named Florence can remind of the medicines to be taken at various intervals during the day. Increased user satisfaction is the need of the hour for extending chatbot results.

In [35], an Android application has been developed for both patients and therapists to provide Cognitive Behavioral Therapy (CBT). The pen-and-paper CBT tends to be embarrassing and troublesome for most people and they are generally not willing to adhere to it. Medical health apps provide a lot of convenience in monitoring ones' own health and access this information anywhere and at any time as and when required. There are around 97,000 medical health applications currently but maximum applications are of bad quality. The authors have given an effective description for an Android application named as CBT Assistant after observing the CBT applications already available in the market.

Private health information of any patient is highly sensitive information which cannot be leaked on any circumstances. However, breaching is the most common crime being committed these days [17]. The main challenges in designing a highly efficient IoT based healthcare system are the issues of user data security and privacy. There is no elementary method which adopted will solve the problem of security and privacy along with quality outcomes. The authors in [36] explored the healthcare systems based on their state of privacy. The major challenges and open issues in the IoT area include security and privacy accompanied by performance, reliability and management [9]. Other challenges can be data volume, data complexity, data interpretation, fault tolerance and power supply to wireless devices [16].

The major work done has been arranged in the ascending order of the year and listed in the Table I.

TABLE I. REPRESENTING THE TECHNOLOGIES USED AND WORK DONE BY VARIOUS RESEARCHERS IN VARIOUS PUBLICATIONS.

S. No	Research Paper	Year of publication	Major Technologies used	Work Done
1.	[20]	2010	Introduced a PSYCHE garment (Personalized Monitoring Systems for Care in Mental Health).	Initiated a PSYCHE garment which could observe physiological signals during daily activity and evaluate heart and breathing rate, heart rate variability and expenditure of energy through pins connected to portable electronics. They aimed at determining the signal trends indicating critical events and prevent them.
2.	[26]	2012	With the help of Linear Predictive Coding (LPC) and Parameters based method, the authors have prepared a model of emotional speech recognition algorithm using Tamil language.	To train the samples, artificial neural network and back propagation has been used. LPC coefficients came out to be more accurate compared to the energy and average values and they obtained the best recognition rate of 90% using LPC algorithms.
3.	[28]	2013	Used speech features for depression analysis	Analysis of speech has been performed using the acoustic features. On these physiological and perceptual features, various classifications are used and outcome is obtained.
4.	[25]	2014	Proposed a model for depression prediction using Apriori algorithm and association rule mining	A model is tested for 500 individuals with various depression factors. The common depression factors and the cut of value were obtained.
5.	[33]	2014	EEG signals and emotion recognition is applied on facial expressions.	The main focus is on distinguishing the level of depression being experienced by the depressed patient and differentiate between depressed and control patients through facial analysis.
6.	[31]	2014	Electroencephalogram Gram (EEG) signals have been used and result is processed through the ANFIS and nprtool.	They suggested a depression detection system to differentiate different sleep disorders as well as alcoholics and controls.
7.	[35]	2014	An Android application named CBT Assistant has been developed.	CBT Assistant provides better ways to perform CBT than the existing CBT apps. Patients can access the level of anxiety, can set reminders and use the button of panic in case of attacks with the help of this application. They provide mobile worksheets which are very entertaining.
8.	[22]	2016	A healthcare system is designed using tri-axial accelerometer and a barometric pressure sensor.	A consistent eye is kept on the patient's zone, posture and sleep status. The app will also send alerts for checking the weight and height every seven days to calculate the BMI Index. They have also talked about keeping a computer as a virtual doctor with all the medical records.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 03, March-2019

9.	[32]	2016	I-Vector technique and fuzzy membership functions	A comparison between these two techniques has been performed to uncover depression level in twenty patients and fuzzy membership function outdid themselves with an accuracy of 97%.
10.	[30]	2017	Text based emotion artificial intelligence along with Support Vector Machines and Multinomial Naïve Bayes Algorithm	Text based emotion artificial intelligence is used for measuring the depressed tweets on a social media platform, Twitter.
11.	[23]	2018	Proposed a system which is Intel Curie based and a protocol stack.	They have portrayed different IoT architectures along with various body monitoring sensors.
12.	[24]	2018	The goal of providing better healthcare is accomplished using neural network, support vector machine classifier, hidden Markov model, RFID technology etc.	To obtain an output in Asian context, India, Thailand, Indonesia and Malaysia were taken into consideration. The analysis noted eight remarkable predictors with a total variance of 81.4% by final measured construct.
13.	[34]	2018	A Therapy chatbot has been taken into consideration and its advantages have been stated.	T-bots are very useful and can serve as a personal assistant, psychiatrist, brawl depression, can provide feedback, can identify the level of depression, can provide the therapy level etc. Importance and efficiency of T-bots has been highlighted.
14.	[29]	2018	Fisher vector algorithm for computation and Local tetra pattern (LTrP) feature extraction algorithm have been used.	These are applied on the face of patients for detecting depression.

III. OBSERVATION

Acute depression is often less difficult to detect than mild depression which often goes undetected. Mental disorders have been stigmatized a lot by the society in India and hence people do not want to go see a doctor or a psychiatrist even if they feel the need to. Children, adolescents, adults as well as elders all are suffering from different form of stress weather it is separation of parents, academic pressure, work pressure or performance, disturbed family relations and also some prolonged health problems. Due to population growth and ageing, these problems are only increasing with each passing year and if not paid attention, will result in the huge losses. Researchers are putting a lot of effort on trying to invent a feasible mechanism to detect depression at an early stage but there are some drawbacks to all methods. Many algorithms such as speech detection algorithm, face recognition algorithms, Support Vector machines, Naïve Bayes algorithm, Markov method, etc. have been used in by various researchers to detect depression or help the depressed patients. An important part of the emerging IoT technology, chatbot is becoming a really popular means to performing tasks today. However, therapy chatbot are yet to be made up to the mark.

IV. RESULTS

In India, above the age of 18 years, one person in every 20 persons have suffered with depression once at least in their span of life which is a total of 45 million people suffering with depression in 2015. People suffering from depression are at 1.52 time greater risk to die as compared to the general people who are not suffering from any mental disorder [37]. Researchers in various fields have been trying to detect depression in diverse age groups by blending different technologies together. Speech features, facial expressions, text patterns on social networking sites all have been considered for detecting depression or providing aid to the people suffering from depression. Wearable IoT technology, Smart healthcare, Artificial intelligence, EEG signal processing, etc. are all trying to detect depression. In this paper, a detailed review has been presented as to what all means have already been adopted to detect depression. However, there is still this uncertainty in detecting depression by a single precise method and calculation due to the lack of a straightforward way to detect it.

V. CONCLUSION

There are many types of depression namely postpartum depression, bipolar depression, seasonal affective disorder and psychotic depression to name a few. However, if undetected at a certain point can take a toll on life and persons suffering from it can take adverse decisions to end their life. The non-availability of up to date services is leading to losses in the economic growth of the country. Therefore, efficient methods to detect mental disorders and treat them need to be invented and should reach the people so that the stigma behind mental disorders decreases and people can cure their daily problems and be productive.

VI. FUTURE WORK

Based on this analysis, some technologies and sensors can be combined together to detect depression. Sensors and gadgets with more of the new IoT can be utilized for creating a model that could help the people to detect depression and can hence visit the doctors and psychiatrists. Chatbots can also be used for detection and recovery of depression. Various technologies integrated can lead to a solution for effectively detecting depression.

REFERENCES

[1] Värnik, Peeter. "Suicide in the world." International journal of environmental research and public health 9.3 (2012): 760-771.
[2] Patel, Vikram, et al. "Suicide mortality in India: a nationally representative survey." The lancet 379.9834 (2012): 2343-2351.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 03, March-2019

[3] The Coke Machine Article, https://www.cs.cmu.edu/~coke/history_long.txt
[4] Weiser, Mark. "The Computer for the 21 st Century." Scientific american 265.3 (1991): 94-105.
[5] Atzori, Luigi, Antonio Iera, and Giacomo Morabito. "The internet of things: A survey." Computer networks 54.15 (2010): 2787-2805.
[6] Ilic, Alexander, Thorsten Staake, and Elgar Fleisch. "Using sensor information to reduce the carbon footprint of perishable goods." IEEE Pervasive Computing 8.1 (2009).
[7] Dada, Ali, and Frédéric Thiesse. "Sensor applications in the supply chain: the example of quality-based issuing of perishables." The Internet of Things. Springer, Berlin, Heidelberg, 2008. 140-154.
[8] Broll, Gregor, et al. "Perci: Pervasive service interaction with the internet of things." IEEE Internet Computing 13.6 (2009): 74-81.
[9] Al-Fuqaha, Ala, et al. "Internet of things: A survey on enabling technologies, protocols, and applications." IEEE Communications Surveys & Tutorials 17.4 (2015): 2347-2376.
[10] Christensen, Kaare, et al. "Ageing populations: the challenges ahead." The lancet 374.9696 (2009): 1196-1208.
[11] da Costa, Cristiano André, et al. "Internet of Health Things: toward intelligent vital signs monitoring in hospital wards." Artificial intelligence in medicine (2018).
[12] Gatouillat, Arthur, et al. "Internet of medical things: A review of recent contributions dealing with cyber-physical systems in medicine." IEEE Internet of Things Journal 5.5 (2018): 3810-3822.
[13] Dey, Nilanjan, et al., eds. Internet of Things and big data analytics toward next-generation intelligence. Springer International Publishing, 2018.
[14] World Bank Open data of population, https://data.worldbank.org/indicator/SP.POP.TOTL
[15] Parekh, Pallavi R., and M. M. Patil. "Clinical depression detection for adolescent by speech features." 2017 International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS). IEEE, 2017.
[16] Mattern, Friedemann, and Christian Floerkemeier. "From the Internet of Computers to the Internet of Things." From active data management to event-based systems and more. Springer, Berlin, Heidelberg, 2010. 242-259.
[17] Singh, Pawan. "INTERNET OF THINGS BASED HEALTH MONITORING SYSTEM: OPPORTUNITIES AND CHALLENGES." International Journal of Advanced Research in Computer Science 9.1 (2018).
[18] Evans, Dave. "The internet of things: How the next evolution of the internet is changing everything." CISCO white paper1.2011 (2011): 1-11.
[19] Hiremath, Shivayogi, Geng Yang, and Kunal Mankodiya. "Wearable Internet of Things: Concept, architectural components and promises for person-centered healthcare." Wireless Mobile Communication and Healthcare (Mobihealth), 2014 EAI 4th International Conference on. IEEE, 2014.
[20] Paradiso, R., et al. "Psyche: personalised monitoring systems for care in mental health." Engineering in Medicine and Biology Society (EMBC), 2010 annual international conference of the IEEE. IEEE, 2010.
[21] Almeida, Edwing, Marco Ferruzca, and María del Pilar Morales Tlapanco. "Design of a system for early detection and treatment of depression in elderly case study." International Symposium on Pervasive Computing Paradigms for Mental Health. Springer, Cham, 2014.
[22] Saha, Jayita, et al. "A framework for monitoring of depression patient using WBAN." Wireless Communications, Signal Processing and Networking (WiSPNET), International Conference on. IEEE, 2016.
[23] Kumar, Niharika. "IoT architecture and system design for healthcare systems." Smart Technologies For Smart Nation (SmartTechCon), 2017 International Conference On. IEEE, 2017.
[24] Pal, Debajyoti, et al. "Internet-of-Things and Smart Homes for Elderly Healthcare: An End User Perspective." IEEE Access 6 (2018): 10483-10496.
[25] Jena, Lambodar, and Narendra K. Kamila. "A Model for Prediction of Human Depression Using Apriori Algorithm." Information Technology (ICIT), 2014 International Conference on. IEEE, 2014.
[26] Rajeswari, A., et al. "Improved emotional speech recognition algorithms." Wireless Communications, Signal Processing and Networking (WiSPNET), International Conference on. IEEE, 2016.
[27] Issakainen, Mervi, and Vilma Hänninen. "Young people's narratives of depression." Journal of Youth Studies 19.2 (2016): 237-250.
[28] Mantri, Shamla, et al. "Clinical Depression analysis Using Speech Features." 2013 6th International Conference on Emerging Trends in Engineering and Technology. IEEE, 2013.
[29] Kulkarni, Prajakta Bhalchandra, and Minakshee M. Patil. "Clinical Depression Detection in Adolescent by Face." 2018 International Conference on Smart City and Emerging Technology (ICSCET). IEEE, 2018.
[30] Deshpande, Mandar, and Vignesh Rao. "Depression detection using emotion artificial intelligence." 2017 International Conference on Intelligent Sustainable Systems (ICISS). IEEE, 2017.
[31] Mallikarjun, H. M., and H. N. Suresh. "Depression level prediction using EEG signal processing." 2014 International Conference on Contemporary Computing and Informatics (IC3I). IEEE, 2014.
[32] Rani, Barkha. "Detecting depression: A comparison between I-Vector technique and fuzzy membership functions." 2016 International Conference on Inventive Computation Technologies (ICICT). Vol. 1. IEEE, 2016.
[33] Katyal, Yashika, et al. "EEG signal and video analysis based depression indication." 2014 IEEE International Conference on Advanced Communications, Control and Computing Technologies. IEEE, 2014.
[34] Sharma, Bhuvan, Harshita Puri, and Deepika Rawat. "Digital Psychiatry-Curbing Depression using Therapy Chatbot and Depression Analysis." 2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT). IEEE, 2018.
[35] Michelle, Tan Qiao Yi, Stan Jarzabek, and Bimlesh Wadhwa. "CBT Assistant: mHealth App for Psychotherapy." 2014 IEEE Global Humanitarian Technology Conference-South Asia Satellite (GHTC-SAS). IEEE, 2014.
[36] Sharma, Sagar, Keke Chen, and Amit Sheth. "Toward practical privacy-preserving analytics for iot and cloud-based healthcare systems." IEEE Internet Computing 22.2 (2018): 42-51.
[37] India, In. "World Health Day 2017: Depression-Let's talk." Indian J Soc Psychiatry 33 (2017): 5-6.