A Study of Smart Healthcare – a Survey

Mamta Rani

Assistant Professor

Department of Computer Science

Gopichand Arya Mahila College, Abohar

Distt. Fazilka, Punjab, 152116

Mamtakamboj2012@gmail.com

Abstract- Today's humans are more susceptible to diseases that might lead to death, such as high cholesterol, high blood pressure and obesity, as a result of an increase in sedentary lifestyles and dietary changes. Heart problems can result from diets high in saturated and trans fats. Therefore, it is crucial to recognize illness-related symptoms as soon as feasible in today's world. On the hospital-provided datasets, numerous machine-learning methods have been built and used. These algorithms analyze the data and forecast the likelihood of health-related issues. The various machine learning algorithms and their uses in the field of healthcare are surveyed in this research.

Keywords: ECG, Healthcare, Robot Surgeries, Smart Watches, Telemedicine

I. Introduction

AI was introduced in healthcare in 1970 with the invention of MYCIN program which was specifically designed to identify blood infections [1]. With the advancement in technology American Association for Artificial Intelligence was formed which was specifically focused on the research in AI. Due to technological advancement now a days it became easy to early diagnose illness by monitoring behavior of human body. Various devices have been developed using machine learning algorithms which are now a days used in medical industries. This technology also sparked the creation of a number of wearables, including smart watches that can track diabetes, blood pressure, heart rate, and other conditions Equipment for automatic surgery has been created with extreme accuracy and precision. Healthcare chatbot usage increased dramatically. Healthcare chatbots are now quite useful since they help patients by providing prescriptions and different dietary advice without requiring them to visit hospitals. By 2030, it is predicted that AI will have a $15 trillion influence on the global economy, with the healthcare sector seeing the biggest gains. [1].

Machine Learning Algorithms

Various machine learning algorithms are: -

A. Supervised Learning

The process of supervised machine learning involves training on labeled data that is then used for output prediction. In these learning algorithms are recursively trained on predefined classes. When the values of the predictor characteristics are known but the value of the class label is unknown, the resulting classifier is used to assign labels to the classes [3]. Various supervised learning algorithms include Regression, Classification etc.

B. Unsupervised Learning

In unsupervised learning there is no predefined class, the inputs are given to the machine. Inputs are trained on unlabeled data and produce results without any supervision. [4]. Clustering and Dimensional reductions are the example of unsupervised learning.

C. Semi-supervised Learning

Semi- supervised learning is a hybrid learning combining the features of supervised and unsupervised learning. This learning deals with the small labeled and large unlabeled data, example of this learning are text document classifiers, in which large number of labels are not possible. This technique is best suitable for complex problems having combinations of labeled and unlabeled data **[5].**

D.   Reinforcement Learning

This is learning through trial and error. In this learning decisions are dependent on previous decisions, so the decisions are assigned with labels. One if the example of this learning is design of algorithm to play a chess game. [6]. The most popular algorithms in this category are Q-learning, SARSA (State–Action–Reward–State–Action), DQN (Deep Q Net) and DDPG (Deep Deterministic Policy Gradients).

E. Transduction

Learning from the particular to the particular and is contrasted with inductive from the particular to the general and deductive from the general to the particular. In transduction learning, to be more specific, rather than treat the general function f(x) as the final goal, we seek the particular function values f(xi) for an unlabeled data set $\{x_{n+1}, …, x_n + n_0\}$ that is (in addition to the labelled data) available during training. This scenario was motivated by the principle of trying to avoid solving a more general problem as an intermediate step [7].

3. *Applications of AI in Healthcare*

The Internet of Things is a possible solution to relieve the stress on healthcare infrastructures and has become a prominent research issue in recent times [8]. Various wearables and healthcare equipment has been developed to aid to the healthcare practitioners and patients. These includes:

I. *Smart Watches*

In order to continue monitoring of physical activities and behavior various wearable devices have been developed which capture the important parameters include heart rate, blood oxygen Saturation (SpO2), Blood Pressure (BP), ECG, Ballistocardiogram, ECG, Body Temperature, Physical Activities and Posture. Various task performed by these wearables are: Sleep Pattern Monitoring, Fall Detection, Heart Rate/ Blood Pressure Monitoring, Step Counting, Fitness Tracking and Spatial Detection etc. Working of smart watch is explained in Fig. 1.
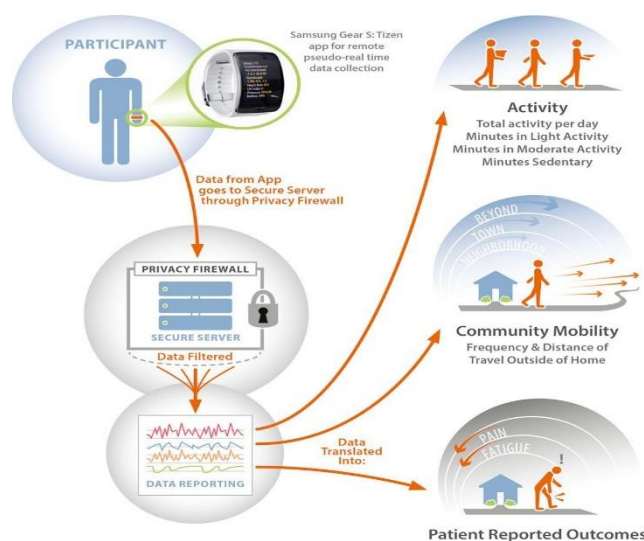
Fig. 1: Smart Watch Working Model

Various applications of smart watches are:

A. *Sleep Pattern Monitoring*

There are many types of sleep order, Obtrusive sleep apnea (OSA) is the most common sleep disorder which causes you to repeatedly stop and start breathing [11]. OSA consists of the obstruction or partial blockage of the upper respiratory tract for at least 10 seconds and that prevents proper oxygenation of the blood [12], even over 20-30 times an hour of sleep. OSA can be classified as severe (interruption is

30 times or more per hour), mild (between 15 to 30 times interruption per hour) and lower (5 to 15 times per hour). Research reveals that between 13 and 32% of people over 65 suffer from OSA [13]. So, it becomes very important to monitor sleep pattern and identify if any kind of sleep irregularity is there. Various sleep monitoring devices available in the markets are: The Flex monitor, ResMed Apnea Link, ResMed Home Sleep Test and Qura etc.

B. Fall Detection

The fall in the elderly is a major public health problem as it causes many disabling fractures [15], but also has dramatic psychological consequences which reduce the independence of the person [16,17]. These devices include the automatic feature to detect fall for people who are prone to falls. Various fall detection devices available are Philips Lifeline, Medical Guardian, Bay Alarm Medical, Lifefone and Medical alert etc. These devices play a very important role for elderly people who are prone to fall sleep, these systems produce alert signals. These systems can also be embedded in vehicles, so that driver can be alerted if they fall asleep while driving.

C. Heart rate/ blood Pressure Monitoring

Now a days people are suffering from common health problems, so it becomes very important to monitor are blood pressure and heart beat rate in order to identify and kind of abnormal behaviors. These healthcare wearables play a vital role. These systems even can send signals to the relatives regarding serious heart problems. Working of this system is explained in Fig.2, where the various sensors sense the temperature, heart beat rate, ECG has been sensed and supplied to Raspberry PI-2, a small computer, which then analyses the data and produce various pattern.
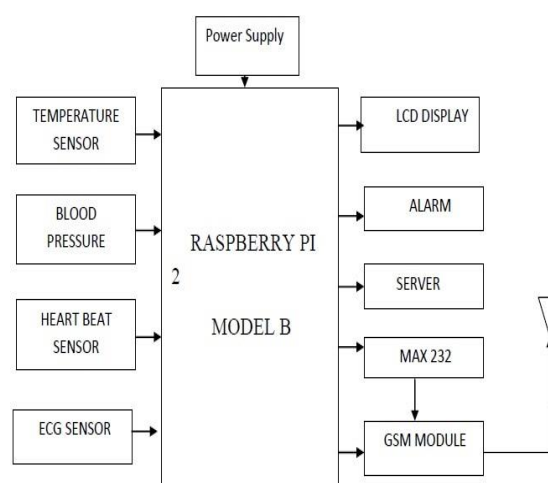
Fig. 2: Raspberry PI 2 Model B for Heart Problems

II. Radiology

Radiology is a branch of medical science which uses imaging technology and radiation to make diagnoses and treat disease. It has benefited greatly from the advances of physics, electronic engineering, and computer science [20]. Radiology can be categorized as diagnostic radiology and interventional radiology. Deep learning algorithms of AI has played a very important role in image recognition. AI methods automatically recognizing complex patterns in imaging data and providing quantitative, rather than qualitative, assessments of radiographic characteristics [21].

II.   Robotic Surgery

The surgery which is done with the assistant of robots with more precision and accuracy. Fully automatic surgery robots are still in experiment stage and experiments are going on animals. One of the articles published in johns Hopkin university has shown the success of robotic surgery performed on soft tissue of a pig without human intervention, which was a step towards fully automated surgery. One of the best-known robots for robot assisted surgery is Da Vinci robot. The da Vinci teleoperated robotic system is based on a master–slave control concept. It consists of two major units. The surgeon's console unit houses the display system, the surgeon's user interface and the electronic controller. The second unit consists of four slave manipulators, three for telemanipulation of surgical instruments and one dedicated to the endoscopic camera [22]. Fig.3 shows the model of Da Vinci robot.

Fig. 3: Da Vinci Robot

III.   Telemedicine

Telemedicine is the application of transferring medical information in through interactive digital

communication to perform consultations, medical examinations and procedures, and medical professional collaborations at a distance [23]. This facility assists the patient to avail medical services at their ease. The main objective of telemedicine is filling the gap of accessibility and communication in medical fields. Virtual visit with health care provider, remote patient monitoring, robotic assisted surgery from a remote location, use of medical bots etc. are the various uses of telemedicine in healthcare.

IV.　Psychiatry

Two successful programs are detailed: PARRY, a model of paranoid processes developed by K. M. Colby and EMYCIN, an expert system for the pharmacological management of depressive disorders developed by B. Mulsant and the present author (1984) [24]. A recent study examined AI's ability to distinguish between an individual who had suicidal ideation vs a control group[25]. A study from the University of Cincinnati looked at using machine learning and natural language processing to distinguish genuine suicide notes from "fake" suicide.

4.　Conclusion

Machine learning techniques plays a very important role in healthcare system, it helps in making healthcare facilities cheaper, effective and more personalized. This paper summarized the various machine learning algorithms and various applications of machine learning in healthcare. With the advancement of machine learning techniques, healthcare field is rapidly growing and there is a lot of scope of research in this field. Further we can explore AI in Heart diseases, Psychiatry, Radiology, Telemedicine and can peep into the various in and out of these subfields using AI.

5.　References

[1]　　　XSOLIS Insights, Feb 2, 2021 6:00:00 AM, The Evolution of AI in Healthcare.

[2]　　　Jiang, F., Jiang, Y., Zhi, H., Dong, Y., Li, H., Ma, S., … Wang, Y. (2017). Artificial intelligence in healthcare: past, present and future. Stroke and Vascular Neurology, 2(4), 230–243.

[3]　　　Nasteski, Vladimir. (2017). An overview of the supervised machine learning methods.

[4]　　　Ghahramani, Z. (2004). Unsupervised Learning. Lecture Notes in Computer Science, 72–112.

[5]　　　Van Engelen, J. E., & Hoos, H. H. (2019). A survey on semi-supervised learning. Machine Learning.

[6]　　　D. Zhang, X. Han and C. Deng, "Review on the research and practice of deep learning and reinforcement learning in smart grids," in CSEE Journal of Power and Energy Systems, vol. 4, no. 3, pp. 362-370, September 2018.

[7]   Theiler, J. (2014). Transductive and matched-pair machine learning for difficult target detection problems. Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XX.

[8]   Gahlot S., Reddy S.N.R. and Kumar D., "Review of smart health monitoring approaches with survey analysis and proposed framework", IEEE Internet Things J., vol. 6, no. 2, pp. 2116-2127, Apr. 2019.

[9]   Zhang Y. T. and Poon C. C. Y., "Health informatics: Unobtrusive physiological measurement technologies", IEEE J. Biomed. Health Informat., vol. 17, no. 5, p. 893, Sep. 2013.

[10]   Kheirkhahan, M., Nair, S., Davoudi, A., Rashidi, P., Wanigatunga, A. A., Corbett, D. B., … Ranka, S. (2018). A Smartwatch-Based Framework for Real-Time and Online Assessment and Mobility Monitoring. Journal of Biomedical Informatics.

[11]   Yacchirema, D. C., Sarabia-Jacome, D., Palau, C. E., & Esteve, M. (2018). A Smart System for Sleep Monitoring by Integrating IoT With Big Data Analytics. IEEE Access, 6, 35988–6001.

[12]   K. P. Strohl and S. Redline, "Recognition of obstructive sleep apnea.," Am. J. Respir. Crit. Care Med., vol. 154, no. 2, pp. 279– 289, 1996.

[13]   M. Glasser, N. Bailey, A. McMillan, E. Goff, and M. J. Morrell, "Sleep apnoea in older people," Breathe, vol. 7, no. 3, pp. 248– 256, 2011.

[14]   Noury, N., Fleury, A., Rumeau, P., Bourke, A. K., Laighin, G. O., Rialle, V., & Lundy, J. E. (2007). Fall detection - Principles and Methods. 2007 29th Annual International Conference of the IEEE Engineering in Medicine and Biology Society.

[15]   Sadigh S, A Reimers, R Andersson, L Laflamme "Falls and fallrelated injuries among the elderly: a survey of residential-care facilities in a Swedish municipality". J. Community Health. 2004 Apr;29(2):129-40.

[16]   Gostynski M., "Prevalence, circumstances and consequences of falls in institutionalized elderly; a pilot study", Soz Praventivmed.;36(6):341-5, 1991.

[17]   Ryynanen OP, SL Kivela, R Honkanen, P Laippala "Falls and lying helpless in the elderly". Z Gerontol.; 25(4):278-82, 1992.

[18]   M. Patil, A. Madankar and P. D. Khandait, "Heart Rate Monitoring System," 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS), 2019, pp. 574-576.

[19]   Seminarly.com, Sep 03, 2022, Patient Health Monitoring System using IOT Devices.

[20]   Wang S, Summers RM. Machine learning and radiology. Med Image Anal. 2012 Jul;16(5):933-51.

[21]   Hosny A, Parmar C, Quackenbush J, Schwartz LH, Aerts HJWL. Artificial intelligence in radiology. Nat Rev Cancer. 2018 Aug;18(8):500-510.

[22]   Freschi, C., Ferrari, V., Melfi, F., Ferrari, M., Mosca, F., & Cuschieri, A. (2012). Technical review of the da Vinci surgical telemanipulator. The International Journal of Medical Robotics and Computer Assisted Surgery, 9(4), 396–406.

[23]   E. Dinya and T. Tóth, "Health Informatics: eHEALTH and TELEMEDICINE," Presentation, Semmelweis University Institute of Health Informatics, 2013.

[24]   Servan-Schreiber, D. (1986). Artificial intelligence and psychiatry. Journal of Nervous and Mental Disease, 174(4), 191–202.

[25]   Roy, A., Nikolitch, K., McGinn, R. et al. A machine learning approach predicts future risk to suicidal ideation from social media data. npj Digit. Med. 3.

Mamta Rani

Assistant Professor

Gopichand Arya Mahila College, Abohar, Punjab 152116