Analysis of Critical diseases from ECG signal using Artificial Intelligence: A Review.

Leena B Chaudhari[1], Dr.Dhananjay E. Upasani[2,] Dr.Anupama Deshpande[3]

[1]Research Scholar, *Shri Jag*dishprasad Jhabarmal Tibrewala University, Jhunjhunu, Rajasthan, India.

[2]Associate Professor, MIT School of Engg., MIT ADT University, Pune, India.

[3]Professor, Shri Jagdishprasad Jhabarmal Tibrewala University, Jhunjhunu ,Rajasthan, India.

Abstract: Health data analysis is usually based on a comparison of derived health measures to predefined thresholds. Symptoms can be observed if a value is above or below a threshold. Early detection of signs of heart failure allows the prediction of strokes of heart failure and can therefore prevent these. So identifying "accurate" criteria is the most important task. The accuracy of an experiment depends strongly on the accuracy of the criteria used. Congestive heart failure (CHF) occurs when the heart cannot pump sufficient blood for a stable physiological condition. CHF usually occurs when the coronary artery blockage causes the heart tissue to become acidic. The data used to analyze data such as Linear Regression, Missing Enrollment Data, Search Signal, Clinical Data Protection Programs, and Early Adaptive Alarm. In this article, the program tracks the heart disease patients, predicts atrial fibrillation and ventricular fibrillation, and alerts patients when the critical condition occurs.

1. INTRODUCTION

According to the World Health Organization (World Health Organization, 2016), chronic diseases such as coronary heart disease, cancer, chronic obstructive pulmonary disease and diabetes mellitus type 2 constitute the leading cause of mortality in the world, representing about 60% of all deaths. Chronic diseases are primarily attributable to heart failure, currently the main cause of death in most western countries. The 2016 Heart Disease and Stroke Statistics update of the American Heart Association (AHA) reported that 15.5 million people in the USA suffer from cardiovascular disease, this prevalence increasing with age for both women and men[1]. In Europe, in the last 12 months the prevalence of people reporting heart problems was 9.2% for both sexes [2]. In particular, in Italy cardiovascular diseases are the main cause of death, responsible for 44% of all deaths. Deaths due to cardiovascular diseases in India increased from 1.3 million in 1990 to 2.8 million in 2016, and more than half the deaths caused by heart ailments. Healthcare is a pending matter that challenges worldwide [3]. The severe socioeconomic situation suffered by an important part of developed countries is providing greater pressure to find more cost-effective solutions to the provision of health and social care. Slices in government spending, an increasing population of pensioners and a growing unemployment rate, are critical factors that add urgency to the need of finding new healthcare solutions. Moreover, healthcare systems in developing countries confront serious difficulties in providing care and assistance, mainly due to scarcity of personnel and resources.

1.1 Perceptions of available health care

During the last years, several concepts have emerged as part of the new healthcare era. Medicine 2.0, Health 2.0/3.0, ePatient, and eDoctor, among other more established terms such as eHealth, telehealth, or telemedicine, are widely disseminated examples of these concepts. Most of the ideas behind these novel domains are devoted to increase patients' Self-management, procure preventative care, and enhance health professional expertise. Particularly fundamental to this renovated healthcare paradigm is to make patients more participatory of their care process. To that end, patients should be equipped, empowered, enabled, engaged, emancipated, equals, and experts [4]. Likewise, social networking, social media, and virtual reasoning are meant to be primal enablers of the new health generation. Personalized social networks may foster the definition of supportive virtual communities, within which individuals can help one another understanding and managing different kinds of health-related issues. This idea takes advantage of the collectivity to support patients and family caregivers in their feelings of loneliness, reassure them in their behavior and daily efforts, and validate adopted medications, devices, and health services [6]. Although these innovative tools are truly interesting to promote a more personalized and independent healthcare, a crucial aspect that may not be approached through web technologies is corporeal monitoring. Body monitoring deepens into the patients' physiology, biological conditions, and behavioral aspects, which are utterly necessary to have a precise understanding of their status and particular necessities. According to the traditional health care model, patients 'monitoring is normally relegated to sporadic doctor visits or institutionalization, which goes against the principles of proactivity, independence, accessibility, and cost-effectiveness. Oppositely, embracing these principles arises mobile Health (mHealth). mHealth is an emerging and rapidly developing field that builds on a wide range of mobile technologies such as smartphones, tablets, and portable health devices to support community and clinical health data retrieval, delivery of healthcare information, or direct provision of care. Most interestingly, mHealth covers technological solutions for the monitoring of patients' behavior and vital signs. The potential of mHealth stems from the capacity of making technology portable or even wearable [7]. Accordingly, systems may be used in an ubiquitous manner and provide seamless monitoring capabilities. As an example, remote health monitors may continuously inform caregivers or practitioners to respond fast in the event of an emergency [8] or a change in the patients' conditions. Furthermore, not only could these devices be useful to enhance medical tasks but also to make them possible.

These systems may become much valuable in regions where the trip to a care center takes several hours or a few doctors must assist thousands of patients. In this regard, mHealth emerges as a means to provide greater access to healthcare services to a broader segment of population. The evolution of electronics, getting smaller and cheaper, is supporting the access to more affordable solutions that satisfactorily overcome traditional communication barriers stemming from old-fashioned technologies. It is important to notice that even when mHealth technologies may not be in principle expected to be defrayable by low-income nations, reality shows that there exists a rapid rise of penetration in these countries. In fact, more than half of worldwide new smartphone users belong to developing countries, owing to the expansion of low-end smartphones, with the fastest growth on the Asian continent.

1.2 Atrial Fibrillation arrhythmia and its stages.

Atrial fibrillation (AF) has been described by physicians as the commonest cardiac arrhythmia in clinical routine, with an estimated prevalence of 1.5%–2% of the general population in the developed world [12]. More than six million people in Europe and three million people in the USA suffer currently from this arrhythmia [12]. It is also expected that its prevalence will double in the next 50 years. Today, three different types of AF are clinically stratified depending on the episode duration. The arrhythmia can then be classified into paroxysmal AF (PAF), persistent or long-standing persistent AF and, finally, permanent AF. In the first stage, PAF terminates spontaneously, at most within seven days of onset. In general, paroxysmal episodes usually increase in frequency and duration over time. On the other hand, persistent AF duration is longer than seven days, evolving to its long-standing form if it lasts more than 12 months.

An external intervention, such as electrical cardio version or catheter ablation, is normally required to revert the arrhythmia [12]. Finally, in the more evolved stage of AF and with the aim of avoiding the risks of further unsuccessful attempts of restoring sinus rhythm (SR), both\ the patient and the clinician make a joint decision considering the arrhythmia as permanent AF. In this case, only interventions to control the heart rate are pursued . Although AF itself does not represent a life-threatening condition, it adversely affects the blood flow dynamics and predisposes to thrombus formation within the atrium [12]. In fact, the presence of AF is associated with a five-fold risk of stroke and a three-fold incidence of congestive heart failure, thus provoking that AF patients have twice the risk of death than healthy people of the same age [12].

1.3 A state of fibrillar contraction, Ventricular fibrillation.

Ventricular fibrillation is the rapid, disorganized, and asynchronous contraction of ventricular muscle. In 1887, Mac William described "a state of fibrillar contraction constituted by a rapid succession of in coordinated peristaltic contractions, and in 1914, used the term ventricular fibrillation to describe what he considered the cause of sudden death. On the surface electrocardiogram, ventricular fibrillation is characterized by the absence of clearly defined QRS complexes. It most often occurs in patients with structural cardiac abnormalities. However, in some patients, manifest heart disease is absent, and the cause of the arrhythmia cannot be identified or can only be ascertained by extensive evaluation (e.g., genetic analysis). Great attention has been given to ventricular fibrillation because it represents the final common pathway for death in most patients who experience out-of-hospital cardiac arrest, and its rate of recurrence is about 30% in the first year in successfully resuscitated patients. Because the specific causes of ventricular fibrillation are discussed in other chapters, this chapter provides a more general overview of the clinical problem and its management. Ventricular fibrillation (VF) is an important cause of morbidity and sudden death (SD), yet it is one of the most difficult arrhythmias to effectively treat. The implantable cardioverter defibrillator (ICD) offers prolonged survival by protecting against death due to arrhythmia and is the gold standard treatment for primary and secondary prevention for at-risk patients. However, device implantation does not affect the underlying substrate. Furthermore, up to 20% of patients with an ICD experience recurrent episodes of VF or electrical storms, resulting in multiple device therapies, which not only deteriorate the quality of life1 but also increase associated mortality. Antiarrhythmic drugs such as amiodarone, β-blockers, and lidocaine have been used for life-threatening arrhythmias, including VF, but their efficacy has not yet been demonstrated on a large scale. Moreover, they are associated with various side effects, which often outweigh the uncertain prognostic benefit.

2. LITERATURE REVIEW

Afef Mdhaffar, Ismael Bouassida Rodriguez, Khalil Charfi, Leila Abid[4] ; the author has presented a novel predictive analysis approach for cardio vascular diseases, called CEP4HFP. It can be used to predict heart failure strokes.CEP4HFP is based on using a CEP engine to continuously run analysis rules on collected health data. The used analysis rules are defined on the basis of several discussions with cardiologists and typically rely on comparing extracted health parameters to thresholds. The novelty of CEP4HFP is that thresholds are automatically calculated and updated at runtime, while using threshold customization approach.

A. Dhillon, S. Majumdar, M. St Hilaire [1], introduces an edge-computing based Complex Event Processing (CEP) architecture for Remote Patient Monitoring (RPM) which is an important issue in the context of remote healthcare. In this architecture, the detection of complex events, that may indicate impending health problems, is performed on a mobile device that receives data from sensors attached to the body of a patient. The detected complex events are sent to a back-end hospital server running on a cloud for further processing. Current state-of-the-art RPM techniques use the mobile device as an IoT gateway agent to forward data streams from health sensors to a remote hospital server where complex events are detected. A drawback of this existing methodology is that the mobile phone always needs to remain connected to the hospital server.

Ayman Ibaida and Ibrahim Khalil [5] ; Since ECG is huge in size sending large volume data over resource constrained wireless networks is power consuming and will reduce the energy of nodes in Body Sensor Networks (BSN). Therefore, compression ofECGs and diagnosis of diseases from compressed ECGs will play key roles in enhancing the lifetime of body sensor networks. Moreover, discrimination between ventricular Tachycardia and Ventricular Fibrillation is of crucial importance to save human life. Existing algorithms work only on plain text ECGs to distinguish between the two, and therefore, not suitable in BSN. VT and VF are

often similar in patterns and infiltration of noise and improper attribute selection in compressed ECGs will make it even harder to classify them properly. In this paper, a supervised attribute selection algorithm called Correlation Based Feature Selection (CFS) is used to filter the unwanted attributes and select the most relevant attributes. Then use the selected attributes to train and classify VT and VF using Radial Basis Function (RBF) Neural Network and k-nearest neighbour techniques.

Gu. Xu, Do. Wang and Sh. Deng [12] ; proposed real-time heart monitoring techniques, taking into account the cost, ease of use, accuracy, and security of data. The system is conceived to provide an interface between doctor and patients for two-way communication. The aim of this work is to assist remote cardiac patients in obtaining the latest medical services, which otherwise could not be possible due to the low doctor-patient ratio. The developed monitoring system is then estimated for 40 people (ages 18 to 66 years) using wearable sensors, the holding device (Fig. smart phone under the supervision of experts).

Balazs Hidasi and Domonkos Tikk [6] ; presents an Edge-Computing-Based complex event processing (CEP) Architecture for remote patient monitoring (RPM), which is an important issue in the context of remote health. In this, they identify of complex events that may indicate impending health problems is performed on a mobile device that receives data from sensors attached to the patient's body. Identified a set of activities and sent to the hospital server in the cloud for further processing.

3. DISCUSSION

Above survey shows that the analysis of health data is usually based on the comparison of health measures extracted at predefined thresholds. Symptoms can be detected when a measurement is above or below a threshold. Early detection of heart failure symptoms reinforces the prediction of stroke and can therefore prevent it. The most important task is therefore to define "precise" thresholds. The accuracy of an analysis strongly depends on the precision of the thresholds used. The goal of the paper is to implement a system for people suffering from chronic diseases that enable the collection, sharing and exchange of physiological data, such as blood pressure, heart and respiration rate and ECG signals. Define an analysis approach that automatically computes and updates health thresholds values at runtime and predict heart failure strokes by detecting related symptoms by notifying the cardiologist and the patient when a heart failure stroke has been predicted. Also it will compute automatically and update thresholds according to recorded historical data that can be visualized whenever the user wants and are sent to the medical specialist.

4. CONCLUSION

Develop system for people suffering from chronic diseases. The system can be used to predict heart failure strokes. It can be helpful for CHF patients through daily monitoring along with guidance and feedback. Feature values of data are calculated using the principal component analysis (PCA) techniques. Rules are based on discussion with cardiologist and comparing extracted parameters with threshold. This technique can be used for the prediction of Atrial Fibrillation and Ventricular Fibrillation.

5. REFERENCES.

[1] A. Dhillon, S. Majumdar, M. St Hilaire and A. El. Haraki; "MCEP: A Mobile Device Based Complex Event Processing System for Remote Healthcare"; Conference: IEEE International Conference on Internet of Things, [2017].

[2] A. Javari and M. Jalili, "A Probabilistic Model to Resolve Diversity Accuracy Challenge of Recommendation Systems", Knowledge Information System, volume-44, no.3, [2015].

[3] A. Manashty, J. Light, and U. Yadav, "Healthcare event aggregation lab (HEAL), aknowledge sharing platform for anomaly detection and prediction", in Proc. 17thInt. Co. Inf. E-Health Netw, Appl. Services (HealthCom), Boston, MA, USA, pp.648-652, [Oct. 2015].

[4] Afef Mdhaffar, Ismael Bouassida Rodriguez, Khalil Charfi, Leila Abid, and BerndFreisleben, "CEP4HFP: Complex Event Processing for Heart Failure Prediction";IEEE TRANSACTIONS ON NANOBIOSCIENCE, VOL. 16, NO. 8, [2017]

[5] Ayman Ibaida and Ibrahim Khalil, "Distinguishing Between Ventricular Tachycardia andVentricular Fibrillation From Compressed ECGSignal in wireless Body Sensor Networks", 978-1-4244-4124-2/10/$25.00 ©2010 IEEE

[6] Balazs Hidasi and Domonkos Tikk, "Initializing matrix factorization methods on implicit feedback databases"; Universal Computer Science, vol. 19, no. 12, [2013].

[7] Chien Chen, and Jonathan Woodbridge, "A Remote Patient Monitoring System for Congestive Heart Failure", Journal of Medical Systems, Volume-35, No. 5, PP.1165-1179, [2011].

[8] F. Alqadah, Ju. Hu and H. F. Alqadah, "Biclustering Neighborhood Based Collaborative Filtering Method for Top-n Recommender Systems", Knowledge Information System, Springer, [2015].

[9] Federica Censi, G. Calcagnini, C. Ricci, R. P. Ricci, M. Santini, A. Grammatico, and P. Bartolini, "P-Wave Morphology Assessment by a GaussianFunctions-Based Model in Atrial Fibrillation Patients", IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING, VOL. 54, NO. 4, APRIL 2007

[10] Federica Censi, Giovanni Calcagnini, Eugenio Mattei, Alessandro Ricci, Ivan Corazza, ElisaReggiani, Giuseppe Boriani, "Beat-to-beat variability of P-wave in patients suffering from atrialfibrillation", 978-1-4577-0220-4/16/$31.00 ©2016 IEEE

[11] Francesco Nocera, Tommaso Di Noia, Marina Mongiello, Eugenio Di Sciascio,"Knowledge-Enabled Complex Event Processing-based platform for health monitoring",SEMAPRO 2016 : The Tenth International Conference on Advances inSemantic Processing, [2016].

[12] Gu. Xu, Do. Wang and Sh. Deng, "Exploring User Emotion in Microblogs for Music Recommendation", Expert Systems with Applications, Volume-42, Page No.:9284–9293, Elsevier, [2015].

[13] Ha. Park, M. Ishteva, and R. Kannan, "Bounded Matrix Factorization for Recommender System", Knowledge Information System, Springer, [2014].

[14] Jamie A Ward and UrsAnliker, "AMON: A Wearable Multi-parameter MedicalMonitoring and Alert System "' IEEE Transactions on Information Technology inBiomedicine, Volume. 8, No. 4, PP. 415-427, [2004]

[15] Kuan Zhang, Ee Peng Lim, and David Lo, "Mining Indirect Antagonistic Communities from Social Interactions"; Knowledge and Information Systems, Volume 35, Issue 3, pp 553–583, Springer, [2013].

[16] Manuel García, Juan Ródenas, RaúlAlcaraz, José J. Rieta, "Application of the relative wavelet energy to heartrate independent detection of atrial fibrillation", 0169-2607/© 2016 Elsevier Ireland Ltd.

[17] MdSaiful Islam, MdMahmudul Hasan, XiaoyiWang , Hayley D. Germack, and Md Noor-E-Alam, "A Systematic Review on Healthcare Analytics: Application and Theoretical Perspective of Data Mining", Healthcare 2018, 6, 54, [2018].

[18] Minki Hwang, Junbeum Park, Young-Seon Lee, Jae Hyung Park, Sung Hwan Choi, Eun Bo Shim, and Hui-Nam Pak, "Fibrillation Number Based on Wavelengthand Critical Mass in Patients WhoUnderwent Radiofrequency CatheterAblation for Atrial Fibrillation", IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING, VOL. 62, NO. 2, FEBRUARY 2015

[19] O. Banos, C. Villalonga, M. Damas, P. Gloesekoetter, H. Pomares, and I. Rojas,"PhysioDroid: Combining wearable health sensors and mobile devices for a ubiquitous,continuous, and personal monitoring", Sci. World J., vol. 2014, Art. no.490824 [2014].

[20] P. Kakria, N. K. Tripathi, and P. Kitipawang, "A real-time health monitoring systemfor remote cardiac patients using smart phone and wearable sensors", Int. J.Telemed. Appl., vol. 2015, Art no. 8, [Jan. 2015].