Review of Detection of Congestive Heart Failure using Deep Ensemble Technique

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Abstract— One of the main causes of death is a heart attack or heart failure. Which most of the time never unleashes its symptoms before it happens. So the prediction of heart failure in medical science is still a mysterious field. There are many physical parameters that are responsible for heart failure, according to medical science. Some of them are weight, high cholesterol, high blood pressure and many more. Complex event processing (CEP) engines consider most of these physical attributes to predict possibilities of heart failure. In order to learn the prediction scenario, CEP engines find enormous past data. Therefore, supplying huge information to the CEP engines and other deep learning frameworks is difficult most of the time. In this paper, we will propose a good way to predict the heart failure conditions using Fuzzy c-means technique and Logistic regression model. This will empower by Hidden Markov Model and Fuzzy Logic.

Keywords: Heart Failure, CEP Engine, Deep learning

I. INTRODUCTION

The heart is one of the most vital organs in the Human body. Most vertebrates and other animals require the assistance of a continuously beating heart to stay alive. The heart is an essential organ to pump blood into the body, the oxygen-rich blood provides oxygen and other vital nutrients to different organs and their cells throughout the body.

As it is an essential organ of the body, it is necessary for survival that the heart keeps on beating. When the heart is unable to provide a requisite supply of blood to the body, it disrupts the essential functions of various organs inside the body. Therefore, heart failure is a major cause of concern.

There are different categories of heart failure, for most people the cardiac muscle weakens and is incapable of supplying sufficient blood to the organs due to stiffening or hardening of the cardiac muscle. The heart failures are classified as chronic or long-term and acute or short-term.

Certain subsections of arrhythmias can also conclude in heart failure. Most of the time, these are introduced after a heart attack, as the cardiac muscle is still recuperating from the infarction. There are also hormonal changes that affect the health of the heart such as an underactive or overactive thyroid that regulates the metabolism of the whole body, could initiate a series of events that lead to heart failure.

The most common factor that is afflicting a number of people is alcohol and drug abuse, as it leads to the corrosion and reduction of the strength of the body. Many drugs and smoking cause the blood vessels to harden and constrict, requiring more effort from the heart and inflicting an increasing amount of pressure on the cardiac walls. Smoking is also the leading cause of lung and other forms of cancer. As chemotherapy is the most widely used treatment against most types of cancer, it is also one of the leading causes of heart failure.

There are a number of different forms of heart failure that can occur depending upon the cause of affliction. As there are two parts of the heart, left and right, which provide oxygenated blood to the respective sides of the body, the failure can be in either of the two sides. Left-sided failure can affect the collection of oxygenated blood from the lungs and any weakness would cause the blood to flow back into the lungs causing fluid build-up. The right-side failure can occur due to the left side failure that puts undue pressure and has to work harder than ever to compensate for the weal left ventricle. The right side is responsible for providing most of the blood to the lower half of the body, weakening of this side would lead to the accumulation of blood in the lower abdomen and legs.

Heart failure can also be classified according to the volume and density of the cardiac muscles. There are essentially two processes by which the heart pumps oxygenated blood to the body, the systolic and diastolic, systolic is marked as the higher reading in a blood pressure monitor, which refers to the force by which the heart pumps blood to the organs, whereas, diastolic pressure is the pressure exerted between the systolic beats. Therefore, diastolic heart failure is marked by the hardening of the cardiac muscles, resulting in a lowered capacity of the heart to store blood. And systolic on the other hand occurs when the heart is enlarged, due to a previous heart attack the walls are unable to contract completely which results in a lower pressure, which is insufficient to circulate the blood in the entire body.

Heart failure is a debilitating disease that can cripple an individual, as a weak heart reduces the ability of the body to function properly, and the organs get asphyxiated and are unable to keep up the normal functioning of the heart. Any person can be afflicted with heart failure, but there are certain lifestyle choices and ailments that increase the likelihood of an individual to be diagnosed with heart failure. Most of the diseases that damage the heart, such as, Hypothyroidism, Hyperthyroidism, anaemia, etc. are capable of increasing the probability of heart failure. Lifestyle choices such as consuming food with high cholesterol or fat, smoking, overweight and a sedentary lifestyle are all leading causes of heart failure and increase the risk of heart diseases.

Heart failure can be detected through various means. Heart failure is identified through a couple of systems that keep recurring for an individual afflicted with the malady. The symptoms comprise heart palpitations or irregular heartbeats, swelling of the lower body parts such as the feet and ankles due to accumulation of blood, shortness of breath excessive fatigue due to overexertion of the weakened heart, sudden weight gain etc. If any of these symptoms arise, it is suggested that the person should take immediate medical assistance and start medication.

The doctors have a set of tests that can confirm and diagnose the individual with heart failure. The doctor can ask for a chest X-ray examination, which provides an image of the heart and the surrounding organs for a closer and non-invasive examination of the organ. Initially, an ECG or Electro-cardiogram can be performed, which measures the electrical activity and represents it in the form of a wave. This wave can be studied by the doctors to examine for any irregularities in the waveform. An extensive form of this test is the Halter monitoring, in which a slew of electrodes is attached to the patient and monitored for extensive periods of time, such as a day or two, to catch any irregularities that happen less periodically.

In case of a blockage of a blood vessel or the stiffening of the muscles, the doctors need to closely examine the heart, therefore, an angiogram is conducted. This is done by inserting a catheter into a blood vessel and navigating it to the heart. This method gives the flow of blood through the heart and can also determine if there are any blockages that are affecting the heart's performance.

During serious cases, doctors need a close examination of the heart. As surgery would be quite invasive and the patient should be healthy enough to survive it. Therefore, the doctors perform an echocardiogram. Echo-cardiograph is a technique very similar to ultrasound, the physician utilizes sound waves to produce images of the heart, that can be used to diagnose any abnormality in the valves or the heart more precisely. It can detect blood retention or pooling, the condition of the aorta and also visualize the blood clots formed in the blood vessels. This technique is valuable in determining defects in the hearts of new-born babies.

II. LITERATURE SURVEY

This section of the literature survey eventually reveals some facts based on thoughtful analysis of many author's work as follows.

1) L. Fanucci, S. Saponara, T. Bacchillone, M. Donati, P. Barba, I. Sanchez-Tato and C. Carmona [1] Address the issues faced by patients of CHF (Chronic Heart Failure) and their subsequent re-hospitalization rates. As the cases of elderly and CHF patients being hospitalized after remission is on the rise, the authors have discovered that the exact cause lies in the hospital's inability to constantly monitor the patient's vital signs after discharge. As the destabilization is erratic and would rarely be detected in the periodic visits. To ameliorate this issue, the authors propose a biomedical monitoring system that, with the help of electronic sensors, that allows the medical professionals to monitor the patients from the comfort of their homes. The developed system has been proven to be effective in detecting anomalies early and subsequently reducing the number of re-hospitalization.
2) O. Banos, C. Villalonga, M. Damas, P. Gloesekoetter, H. Pomares and I. Rojas [2] Introduces a system for health monitoring with the help of wearable biomedical sensors. Due to exponential advancement in technology and mobile devices, it is far easier to keep an eye on the inner workings of the body. It is especially useful for sportspersons, Patients suffering from a certain ailment. The utilization of wearable biomedical sensors can enable continuous, portable assessment with personalized care. The researchers therefore, developed a system for amalgamation of various types of sensors with an Android app, Physio Droid, that enables seamless connectivity of all the wearable biomedical sensors with the app interface. Physio Droid enables ubiquitous and constant monitoring of heartbeat, blood pressure, ECG etc. that can be easily operated through the means of an app, by the user or the physician alike.
3) U. Anlikeret al. [3] Describes a wearable, ubiquitous medical alert and monitoring device for high-risk patients with respiratory and cardiac ailments. The wearable device has sensors for the continuous and unobtrusive collection of vital data such as heart rate, blood oxygen levels etc. the collected data is then transmitted to the medical center via a cellular connection. The device has also been designed to monitor intelligently, multiparameter medical emergency detector, that keeps constant vigilance on the patient's well-being and alerts the authorities in case of an emergency situation. The researchers implemented this device on a collection of 33 patients with excellent results.
4) P. Kakria, N. K. Tripathi, and P. Kitipawang [4] Explores the concept of online telemedicine systems and their usefulness in monitoring the patients well being in real-time. Due to exponential advances in electronics and sensor technology, small, unobtrusive wearable devices can be produced that can examine a patient's vital signs remotely. This data can then be transmitted to the medical centers for evaluation. This procedure saves the patient visit and the physicians valuable time, while constantly providing monitoring to help identify any irregularities that might be a sign of an underlying issue. The proposed system was evaluated on 40 patients equipped with a wearable sensor and an android device for transmission. The results indicate that the system is highly efficient and reliable.
5) T. Heinze, R. Wierschke, A. Schacht, and M. von Lo¨wis [5] Introduces the advancements in wearable technologies and medical sensors that enable pervasive and continuous monitoring of patients. Due to the exponential increase in telemonitoring devices, the influx of medical data has been on the rise. The comprehension of the monitoring data becomes an increasingly difficult task. Conventionally there are two methods to interpret data, statistically and utilizing established theories in a rule-based approach. The researchers present a hybrid approach that aggregates both the methods with the addition of machine learning. The proposed technique is viable as it reduces the number of false negatives encountered.
6) W.-Y. Chung, S. Bhardwaj, A. Punvar, D.-S. Lee, and R. Myllylae [6] Presents an innovative analysis technique for the health care of patients or elderly, at home with the help of wireless sensors. The researchers designed a wellness monitoring system for analyzing and recording accelerometer and ECG with the help of wireless wearable sensors. This method can help recognize

potential medical complications and emergencies. The ECG with the help of software on the server-side, can detect T-wave, QRS complex, P-wave and arrhythmias. The movements are monitored with the help of the accelerometer.

7) A. Jayswal, X. Li, A. Zanwar, H. H. Lou, and Y. Huang [7] Explores the concept of sustainability in the design of production systems working in energy or chemical-based systems. Most of the issues that plague these systems regarding sustainability are bottlenecks. As sustainability is a diverse subject, various design factors have to be held accountable to be able to achieve it efficiently. The researchers propose a method based on fishbone diagram and Pareto analysis, by implementing greater efficiency, environmental concerns and economic constraints. The authors validated their claims by application of this method on a bio-diesel production environment.
8) M. Saeed et al. [8] Presents an extensive database that has been curated by the researchers to have an efficient multi-parameter monitoring system that intelligently supervises the patients in Intensive care units. The database was meticulously collected for 25,328 stays at the intensive care unit, with parameters such as laboratory data, ventilator and drip rate settings, radiology reports, vasoactive medication, nursing progress notes, discharge summaries etc. for the dataset. A sub-category of patients was automatically identified according to their Health Insurance Portability and Accountability Act standards and was listed accordingly for their stay. The dataset is a very large and diverse collection that contains detailed clinical data, an invaluable asset for the community.
9) V. Vaidehi, R. Bhargavi, K. Ganapathy, and C. S. Hemalatha [9] Presents a system for monitoring geriatric patients who stay at home alone. This kind of patient requires continuous monitoring with the help of biomedical sensors. The collected data has to be transmitted to the concerned doctors, therefore, the SWE sensor web enablement is utilized for this purpose to make the sensor data available to the medical practitioners. The proposed system helps identify the correlation between the sensor data and develop a set of rules for determining the patterns that can be dangerous for the patient. The proposed system is highly efficient and extremely helpful in reducing the response for emergencies.
10) R. Pathak and V. Vaidehi [10] Explores the shortcomings of a wireless health monitoring system based on wearable technology. As most of these implementations process the data in batches to increase battery efficiency but that does not reflect well with the patient's state at that time. Therefore, the researchers propose CRHMS. A CEP based Remote Health Monitoring system that associates different sensor data with spatiotemporal limitations for the detection of abnormalities. The sensors used are GPS, Heart rate monitors, blood pressure, accelerometer etc. The proposed was validated in comparison to the conventional methods and it significantly outperformed the traditional techniques.

III. EXISTING SYSTEM

The physiological parameters that are monitored are blood pressure, temperature, heart rate, respiration rate, oxygen saturation, and ECG. It illustrates the specifications of various physiological sensors and the acceptable range of values for the vital parameters. It describes the other sensors used. An accelerometer is used to detect the activity like walking, exercising, sitting of the person and RFID reader and RFID tags are used to identify the location of the person. Wearable sensors for health monitoring comprises of various types of miniature sensors. The biosensors measure the physiological parameters like heart rate, blood pressure, respiration rate, oxygen saturation percentage, ECG, activity recognition etc. The environmental sensors are used to identify parameters like light, location etc. The data collected from the sensors is aggregated and communicated via a wireless media to a medical center.

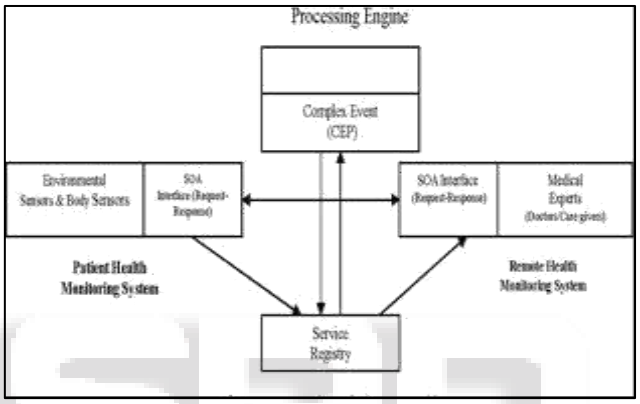

Fig. 1: Remote Health Monitoring System architecture

Service-oriented Architecture (SOA) approach is chosen to overcome problems such as interoperability, independency and re-usability. SOA is the collection of small and large size services that are distributed and independent. SOA facilitates communication between services. The main goal is to develop a tele-health monitoring system which implements a service-oriented architecture-based platform, involving the integration of heterogeneous sensor networks and the communication between the networks in a distributed way.

IV. PROPOSED SYSTEM

To enhance the process of prediction of heart failure conditions using Fuzzy c-means technique and Logistic regression model. Will empowered by Hidden Markov Model and Fuzzy Logic. Usage of Hidden Markov Model on clustered data, which will selective using information gain, always raises the quality of the process in heart failure predictions.

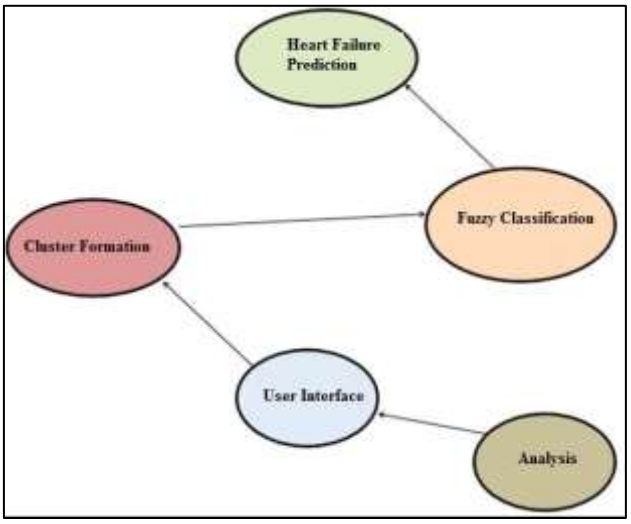

Fig. 2: Task network

The proposed methodology presents a novel idea to improve the detection process of heart failure conditions using Logistic regression and HMM model on a bundle of data. And finally this process will have catalyzed by the Fuzzy Logic to unleash the probability of the heart failure conditions.

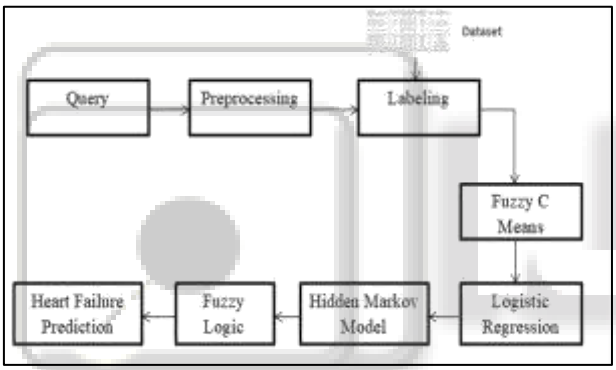

Fig. 3: Proposed system Architecture

This project is for the end users who are willing predict the heart failure condition for the given input query. This is having following characteristics: End User

- User- Register
- User- Login
- User – Feed query data
- User- perform prediction
- User- Analyze results

A. Communication Interfaces

Our system's diff erent modules are communicating with one another on the following scenarios:

1) From Query feeding to the pre-processing module.
2) From pre-processing module to Feature extraction module.
3) From feature extraction module to Fuzzy c-means module.
4) From Fuzzy c-means module to logistic regression module.
5) From logistic regression module to HMM module.
6) From HMM module to Fuzzy Logic module.

V. CONCLUSION

Heart failure is being considered as one of the most common and cruel reasons for death, which suddenly takes away the life of an individual that leaves behind the mountain of sorrow. So the prediction of heart failure has had more importance in the health care system for a long time. So some systems use some predefined learning models to predict the heart failure condition for the given input of data.

So, this paper will propose a good way to predict the heart failure conditions using Fuzzy c-means technique and Logistic regression model. This will empower by Hidden Markov Model and Fuzzy Logic.

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