Cloud-based Hybrid Method for Prediction of Long Term Survival after Liver Transplantation: A Review

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Abstract: Analysts, researchers, and organizations say cloud computing has an impact on a wide range of businesses, and how those businesses are practiced and how they will be used in the future. Large technology companies are already investing millions of dollars to build infrastructure, services, tools, and applications to make cloud computing easier for consumers, organizations, and businesses. It remains to be seen how cloud computing affects the healthcare business because it is very diverse, complex and unique. In addition to these, the rising cost of healthcare solutions is another major concern. Efforts have been made to reduce these costs for consumers, and it will also improve clinical and qualitative outcomes for patients. The cloud computing is contributing in the healthcare industry. The present state and trend of cloud computing in healthcare is investigated in this paper.

***Index Terms* – Cloud Computing, Liver Transplantation (LT), Amazon Web Services (AWS) cloud.**
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I. INTRODUCTION

The biggest changes in the business model of cloud computing appeared and today 80% of the world's business is projected to move to the cloud by 2020. Many organizations that do not have enough resources to invest and build infrastructure and platforms to deploy their applications. Cloud has an infrastructure designed to allow consumers to deploy and execute their applications. They also have different platforms with multiple operating systems so consumers can build, test and deploy their applications in virtual servers [1]. Also, cloud provides a highly scalable environment to effectively manage the load. Since infrastructure and platforms are already built and available, consumers and organizations can save a lot by not having to invest in or maintain these infrastructures. Some of the larger organizations are investing in the creation of their private clouds by leveraging their existing infrastructure and tools. Cloud computing is a recent and fast-growing area of healthcare development. Cloud computing can play an important role in curbing the costs of medical consolidation, resource optimization and beginning of a new era of innovation. Current trends are focused on accessing information anytime, anywhere, which can be achieved by moving medical information to the cloud. This new delivery model can make healthcare more efficient and with lower technology budgets, but its challenging to keep patient information confidential [2].

Machine learning methods for classification are healthcare research that provides inexpensive means of performing diagnosis, expectation, or detection of a particular outcome. With increasing numbers of electronic clinical databases, as the cost of manual processing increases, a machine learning application may be needed to detect rare conditions, unnecessary steps, and unexpected results of health. Therefore, it is necessary to increase the predictive power of machine learning methods by increasing the sensitivity of low-frequency patterns without reducing specificity. Human Liver Transplantation (LT) is a therapeutic treatment that insists on end-stage liver disease. Huge advances in LT are shedding light on people who need to survive. Prognosis of survival is an important factor in determining the success of liver transplant surgery [3]. In LT the surgical result depends on various factors such as disease severity, donor organs, availability, immunosuppression, and survival prognosis.

In medicine, the medical experts get the judgment of outcome of LT based on Model for End Stage Liver Disease (MELD) score. MELD consists of three parameters, namely creatinine, bilirubin and international normalized ratio (INR), where creatinine in women is lower than in Men [4] [5]. Another difficulty with assessing MELD is that creatinine varies with the patient's body weight [6]. A large number of logistic regression models and traditional statistical methods are also used for prediction of patient survival after LT. To overcome the problem with local minima and solve nonlinear problems; Artificial Neural Network (ANN) functions are superior to conventional statistical methods and logistic regression models [7]. ANN models are nonlinear models that can solve problems using conventional models and obtain results with high accuracy [8].

II. LITERATURE SURVEY

Sindhu Mani, Sanjay P. Ahuja and Jesus Zambrano [1], the question is whether the cloud computing of the present state and trend of the paper exhibition is a problem. Analysts, researchers, and organizations note that cloud computing has affected a wide range of businesses, and how those businesses are practiced. Large companies are already investing hundreds of millions of dollars

in infrastructure, services, tools, and application building. The cost of healthcare services is increasing and is a major concern. Efforts have been made to reduce these costs for consumers and those issues that contribute to cloud computing. Cloud computing improve clinical and qualitative outcomes for patients in the healthcare industry. Dennis Toddenroth, Hans-Ulrich ProkoschJan Christoph, Ines Leb, Lena Griebel, Felix K opcke [2], the paper gives an overview of the state of cloud computing in healthcare and to identify areas of interest beyond general medical research in healthcare sector. This adds an increasing interest and there are only a few successful implementations so far, and many articles simply use the term" cloud " synonymously to use virtual machines or web applications without the described benefits of the cloud paradigm. The biggest threat to healthcare adoption is the involvement of external cloud partners: many security and data protection issues have yet to be resolved. Until now, cloud computing has been preferred more for special, individual features such as elasticity, pay-per-use, and wide network access, rather than as a cloud paradigm in itself.

H. R. Doyle et al. [3], in the early stages of liver transplantation, the results of trustworthiness were measured. At the same time, the early intervention of the occasion which was affected by the fate of the failure was related to the high morbidity and mortality rate of the transfusion. The purpose of this study was to analyze the relationship between the patient and the transplant outcome and the total number of patients in the early postoperative period of 148 individuals who had been in private healthcare in the past. Transplant insufficiency is defined as a re-transplant of a patient who died within three months of surgery. S. S. V. Chandra and C. G. Raji [4], the author proposed liver transplantation model. The survival rate for liver transplantation was assessed using an artificial neural network model. Data from this study was collected from the United Network for Organ Sharing transplant registration. The main objective of the study is to develop a short-term survival prediction model for liver patients

B. Parmanto and H. R. Doyle [5], paper, investigate a variant of the recurrent neural network with backpropagation in time (BPTT) algorithm for predicting liver transplant failure based on a sequence of time series of clinical observations. They used a 6-cross-validation procedure to measure network performance. The dataset was split into a learning set and a test set by maintaining the same percentage of positive and negative cases in the original set. The effect of the network complexity by over fitting is examined by constructing two types of networks. For each type of Network, 10 individual networks were trained in the learning set and used to form committees. M. Cruz-Ramírez, C. Hervás-Martínez, J. C. Fernández, J. Briceño, and M. De La Mata [6], to address the problem of organ allocation. A neural network model derived from the radial basis function, and neural has been developed using genetic algorithm. This system allows medical professionals to assign organs.

S. S. V. Chandra and C. G. Raji [7], computer-based medical expectations are becoming increasingly important as medical records increase every day making manual handling harder. Also, people who are not able to understand patterns from these huge amounts of data will have to use machine learning tools. This paper proposes an artificial neural network model to cope with the problems of organ allocation and survival prediction. This model uses a pair of appropriate donor recipients to use ten times the cross-validation time for training and medical data. Bahareh Khosravi [8], the historical cohort study used clinical data from 1,168 patients undergoing liver transplant surgery (from March 2008 to March 2013) at the organ transplant Center of Shiraz Namazi hospital, Shiraz, southern Iran. The Kaplan-Meyer method was used to estimate the probability of survival in different years.

Table 2.1: Survey Table

Sr. No	Paper Title	Authors	Description	Advantages	Disadvantages
1	Early death or retransplantation in adults after orthotopic liver transplantation	H. R. Doyle et al.,	Derived an expression using logistic regression analysis for the survival prediction after LT	Calculates Graft failure possibility in liver patients.	Failed to produce the accuracy after LT due to lack of rich dataset
2	Artificial Neural Networks in Prediction of Patient Survival after Liver Transplantation	S. S. V. Chandra and C. G. Raji	They proposed Artificial Neural Networks model for the defining 3-month mortality of liver transplant patient and for that, they use a united network of organ sharing dataset	Reliable prediction of outcomes early after liver transplantation would help improve organ use.	Slow performance and time-consuming.

3	Recurrent neural networks for predicting outcomes after liver transplantation: Representing temporal sequence of clinical observations	B. Parmanto and H. R. Doyle	Proposed recurrent neural networks with the help of backpropagation through time algorithm based on a time series the sequence of medical data.	The networks were capable of learning the time series problem and achieved good performances of 90% correct classification on the learning set and 78% on the test set.	Failed to provide accuracy in the prediction of survival after LT with lack of large datasets
4	Predicting patient survival after liver transplantation using evolutionary multi-objective artificial neural networks	M. Cruz-Ramírez, C. Hervás-Martínez, J. C. Fernández, J. Briceño, and M. De La Mata,	Introduced a radial basis function (RBF) network model using multi-objective evolutionary algorithm (MPENSGA2) to define the problem of organ allocation and survival prediction.	This system is a useful tool that aids medical experts in the allocation of organs.	failed to forecast survival for a long time Imbalance between Supply and demand Unfortunately results in many waiting-list deaths.
5	Predicting the Survival of Graft Following Liver Transplantation using a Nonlinear Model	S. S. V. Chandra and C. G. Raji	An artificial neural network model to address the problem of organ allocation as well as survival prediction.	Achieve high-accuracy for predicting the best outcome of patients following liver transplantation.	It gives high accuracy but this technique is time-consuming.
6	Five years survival of patients after liver transplantation and its effective factors by neural network and Cox Proportional Hazard Regression Models	Bahareh Khosravi	The proposed model to find out the survival of patients (two years old and above) after liver transplantation using neural network and Cox Proportional Hazards (Cox PH) regression models.	The accuracy of the prediction rate for ANN and Cox PH methods was equally 92.73%.	This technique had a potential limitation. Incomplete registration information in the hospital records of patients was problematic.

III. METHODOLOGY

Medical databases contain a large amount of patient data, as this data is clinical information gathered from various data sources related to patients. Since liver transplantation is a curative surgical procedure for patients suffering from end-stage liver disease, predicting survival after liver transplantation is of great importance. To predict survival, an appropriate selection of signs and methods is necessary. Figure 1 shows the proposed system architecture.

The system proposed a cloud-based hybrid method predicts the long-term survival of liver transplant patients. Data 256 attributes collected 389 attributes, the United Nations Organ Sharing (UNOS) Registry to save the forecast. Tenfold cross-validation (CV) /used medical input in the database, which reported on the United Network of Organ Sharing database. To perform a dimensionality reduction in a large database, a major Principle component analysis (PCA) ranking was done. Attribute relationship is recognized and proved by various association governance mining techniques using such a priori algorithms. Confirming the results, we compared the rules generated by the association rules mining algorithm, before and after PCA is also performed. The proposed efficient and accurate artificial neural network (ANN) model predicts the long-term survival of liver patients who undergo liver transplantation (LT), and then the predicted data is uploaded to the Amazon Web Services (AWS) cloud. Tenfold CV was used medical input set, which is obtained from the united network of organ sharing databases.
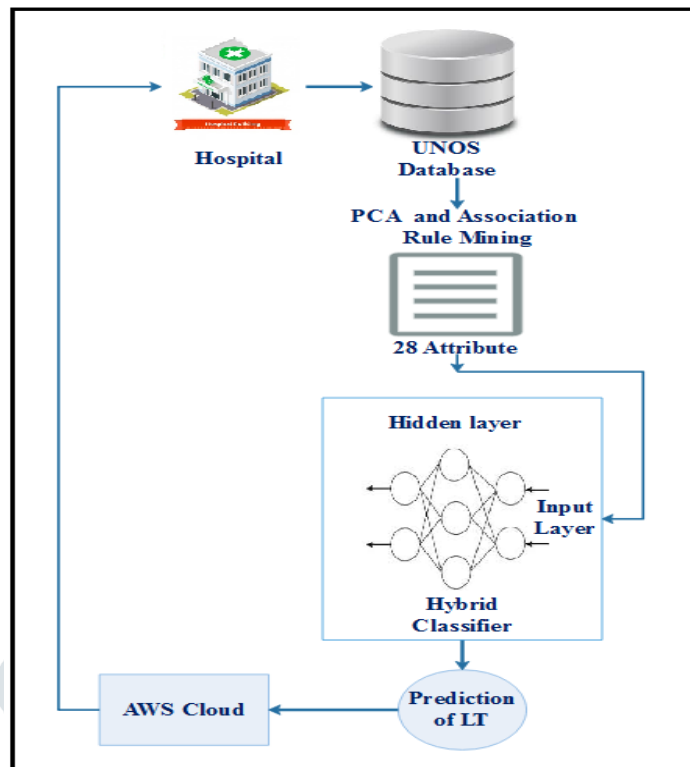
Fig.1: Proposed System Architecture

IV. CONCLUSION

The current trend of cloud computing implementation in the medical field is to improve and solve many Joint Information problems in medical organizations, and also to reduce costs. Standardized cloud applications will bring obvious benefits to patients, doctors, insurance companies, pharmacies, imaging centers, etc. When information is exchanged between medical organizations, better results are obtained. Liver transplantation is a difficult process in the field of organ transplantation. The proposed system is used to measure the long-term survival of patients with LT. The system uses cookies to ensure that we give you the best experience. The most important attribute of the high correlation is that PCA, which is used to reduce the number of dimensions. It is a kind of learning system. In the case of the proposed model, the survival rate of patients with liver disease is analyzed.

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