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A systematic review of artificial intelligence and machine learning techniques used in neonatal care

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Abstract**—***This paper reviews the research work done in the neonatal care using artificial intelligence and machine learning techniques. Newborn babies up to 28 days are called as neonatal. NICU(Neonatal Intensive Care Unit) is a special unit in the hospital which provide care for babies born prematurely or having low birth weight or having specific medical conditions.NICU is equipped with advanced technology and trained staff to provide best possible care to their miniature Patients. These patients are continuously being monitored and hence generate huge amount of data in their stay period to NICU. thus artificial intelligence can help these units in providing medical care in different aspects such as early disease detection, survival prediction, decision making for starting with a treatment. Premature births is still one of the most serious health issue according to World Health Organization.(WHO).This paper presents the collective overview of research done in this domain which will be helpful for those willing to do further research. at the end of the paper some future research areas are also discussed.*

Keywords—Artificial Intelligence, machine learning, neonatal care, NICU, CNN.

I. INTRODUCTION

The term neonate is used for the children who are newborn and less than age of 28 days. Some neonates need special care because of the complications during their birth such as low birth Weight, premature birth, congenital anomalies etc. There is a special unit which takes care of critical needs of neonates also called as Neonatal Intensive Care Unit. This unit is generally equipped with highly efficient healthcare professionals along with advanced technology. Premature birth is still one of the 10 most common causes for death of a newborn. Also sepsis, heart dysfunction, breathing inability is also a major concern for little ones. Although the patients in NICU cannot talk they are continuously being monitored with different sensors like heart rate monitors, ECG, body temperature and so on. So huge data is collected for these tiny patients. This data if analyzed properly using machine learning algorithms, it can definitely have some meaningful improvement in the treatment plan. Thus the idea is to use data generated by neonates in their stay at NICU for prediction and analysis of different medical conditions. In this paper a systematic review is conducted about the research work being done in the area of machine learning and artificial intelligence to get an insight of results obtained in the research work. This paper will give a collective information about the research in neonatal care using machine learning. It will be helpful for the researchers who are newly introduced and interested for further research. This paper is organized in different section where first section gives brief description about the NICU data. In the coming sections different research reviews are elaborated in detail. Finally conclusion gives the insight of research which is been done and future scope is written in a direction where new researchers can pick up the problem and start solving it for betterment of the society. This review paper will give meaning to an age old saying that "every single newborn life is precious".

II. LITERATURE REVIEW

A. Approach for research review

The keywords like machine learning, neonatal care was searched in IEEE explore. There were total 14 papers related to these two keywords. Out of these 6 recent papers were studied thoroughly. In the following sections research work done in the machine learning techniques and their applications in the neonatal care will be explained.

B. Machine Learning for analysis of neonatal data

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The Rudresh D. Shirwaikar et al[1] have discussed different techniques for neonatal data analysis using supervised learning. This paper explores different supervised learning techniques in healthcare along with their pros and cons. Supervised learning techniques can be classified into two types such as slow learners(k nearest neighbors) and fast learners(decision tree, support vector machines and neural networks) depending on their response. Their paper gives an insight of all the techniques with previous research work which happens to be a key helpful ingredient to a new research fellow such as importance of preprocessing of the data.

III. NEONATAL CARE UNIT APPLICATIONS OF MACHINE LEARNING

Before The special ward in the hospital dedicated to children below age of 28 days is called as NICU.(Neonatal Intensive Care Unit). Every patient is monitored continuously in this unit. It generates huge data every day. The analysis of this data helps in prediction of diseases very efficiently and way before the conventional clinical biomarker methods. Jacqueline van Druten[2] et al have used the methods of machine learning for prediction of Necrotizing Enterocolitis(NEC).NEC has remained one of the major cause of death in preterm infants. They have suggested combined approach of deep learning and machine learning for better accuracy.sonographs and x-ray images provide numerous features which can be extracted through deep learning and can be collectively combined with machine learning techniques for prediction of NEC.

ZainebKefi[3] et al have explained how the prediction of mortality can be effectively done in the early hours after the child is born. They used demographic data, biomarkers and signal measurements as data and applied different machine learning algorithms. They have got better accuracy, almost 95% with Linear Discriminant Analysis (LDA) algorithm. In their research, the accuracy of mortality prediction time is 87% with the use of galaxy random forest method.

YifeiHu[4] et al have explained in their paper that convolutional neural networks can be effectively used in early detection of sepsis. Preterm newborns have weak immune system and can get infected easily which leads to the sepsis. Sepsis is also one of the leading reasons for neonatal deaths. A deep learning network is trained using convolutional Neural Networks and the paper claims that it is a feasible model for early detection of the sepsis than the conventional clinical biomarkers approach. This paper gives the importance in terms of how the early detection can prevent a neonate from being given a wrong antibiotic treatment.

TABLE 1
COMPARISON BETWEEN DIFFERENT METHODS

Sr. No.	Paper Name	Comments
01.	Supervised Learning Techniques for Analysis of Neonatal Data	Various papers with different classifiers have been reviewed in this paper for different parameters. It concludes that in neonatal domain, Support vector machine, decision trees and neural networks emerge as efficient classifiers.
02.	A Proposed Machine Learning Based Collective Disease Model to Enable Predictive Diagnostics in Necrotizing	This paper represents use of CAD for effective classification and for predictive diagnosis in Necrotizing and claims to be time saving, cost and resource efficient.
03.	The early prediction of neonates mortality in Intensive Care Unit	This paper compares differentclassification algorithms with 31 and 17 parameters for predicting neonatal mortality. The results of latent Dirichlet allocation (LDA) algorithm outperforms prediction with other classifiers. 95%
04	An Application of Convolutional Neural Networks for the Early Detection of Late-onset Neonatal Sepsis	In this paper author has given viability of using convolutional neural networks in prediction of sepsis in neonates.

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IV. CONCLUSION

After The area of effective neonatal care using machine learning is needed to be explored more by the researchers. There is a huge scope because all the NICU in the country have state of the art latest technology to measure the important parameters from neonates and this data can be carefully analyzed for prediction and analysis of different diseases and can help doctors in deciding the treatment plan.

There is still a lot of scope for research in neonatal care using deep learning because very few standard papers are available which analyze the sonographs and neonatal X-Rays. Also the machine learning techniques can be used to predict the morbidity rate of neonates. The pretem infants have low weights and underdeveloped organs. Their brain development is not complete. These parameters can be analyzed using machine learning tools. Also, many of the neonates have respiratory challenges. Using a systematic research, a machine learning model can be developed which will direct the doctors about amount of oxygen to be given. In the NICU, currently milk is given to neonates by manually calculating their need. This can also be automated using machine learning which will help nurses to predict the amount of milk given to patient. Collective data can also give insight into long term effects of NICU stay on the children when they grow up such as brain functioning, motor skills etc. This research area which collaborates technology with neonatal care has lot of potential research work that needs to be explored.

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