Research Journal of Computer Systems and Engineering

ISSN: 2230-8571, 2230-8563

Volume 02 Issue 01 - 2021 (January to June)

Page 40:45

Maternity Risk Prediction Using IOT Module with Wearable Sensor and Deep Learning Based Feature Extraction and Classification Technique

Dr Sk Hasane Ahammad
Computer Science & Communication Engineering;Signal Processing
Koneru Lakshmaiah Education Foundation and Assistant Professor
ORCID ID-0000-0002-2587-4164
ahammadklu@gmail.com

Dr.Nikhitha Yathiraju
Computer Science & Communication Engineering
University of Cumberlands
ORCID ID-0000-0003-1908-3267
nikhitha.yathiraju6743@ucumberlands.edu

Article History

Received: 22 January 2021
Revised: 14 April 2021
Accepted: 19 May 2021

Abstract

Pregnancy is term used to describe the period of development of a fetus in the uterus of a woman, which is a period of about 9 calendar months, 40 weeks, or 280 days. Detection of pregnancy risk at an early stage significantly increases the survival rate. This paper proposes the maternity risk prediction through IOT module based wearable sensor and prediction of abnormal data collected from the wearable sensor and pre-historic data using DL based feature extraction as well as classification techniques. Here attributes like age, weight, BMI, fetus heart rate, current month, medical history of mother has been considered. Overall, results of experiments show that performance of proposed technique increases. Because AUC is a statistic that considers the entire FPR range, using it as a stopping criterion for early halting could also prevent us from developing a model that provides the best TPR at 10% FPR.

Keywords: Pregnancy, machine learning, IOT, AUC, TPR, FPR, feature extraction and classification

1. Introduction:

In the field of medicine, cutting-edge engineering techniques have been crucial in assisting doctors in efficiently achieving the required results. Without the use of engineering technology, the medical sector cannot function effectively, endure, or improve upon its current state.Clinical research seeks to comprehend the underlying workings of the human body better throughout time [1]. The techniques for preventing or treating problems make it possible to prevent the majority of maternal deaths [2].Baby's heart rate In the utero period, the average FHR ranges from 120 to 155 BPM. The heart rate of a healthy foetus is typically normal, however it is possible for there to be a beat-to-beat* variation of between 5 and 14 beats per minute [3].

2. Review of Literature:

According to a Maternal-Fetal Network study, a woman who has previously given birth prematurely at 26 weeks but who has a normal cervical length and a negative foetal fibronectin status has an 8% chance of PTB in her subsequent pregnancies [4].A logarithmic sensitivity index is used to optimise for both sensitivity and specificity when mining skewed data, and receiver operating characteristic (ROC) curves are automatically calculated[5].Multilayer perceptron based on a FFBPNN learning method employing hyperbolic tangent transfer function with a weight-elimination option [6] was successful in the authors' experiments with a range of ANN architectures during the previous ten years.Medical data mining uses the multilayer perceptron ANN with one hidden layer extremely frequently [8.9]. Higher order statistics can be calculated using the hidden layer because it is thought that medical data is nonlinear in nature and has numerous unidentified interactions [10].

3. Methodology:

In the proposed system, the study is about best prediction for the pregnancy as normal or abnormal. The parameters that are consider for the analysis of pregnancy are –age, weight, BMI, fetal heart rate, current month, history of mother. The pregnancy can be considered as normal if the above parameters are in normal range and the fetal movements are continuing with normal rate. The overall architecture for proposed method is shown in figure 1.

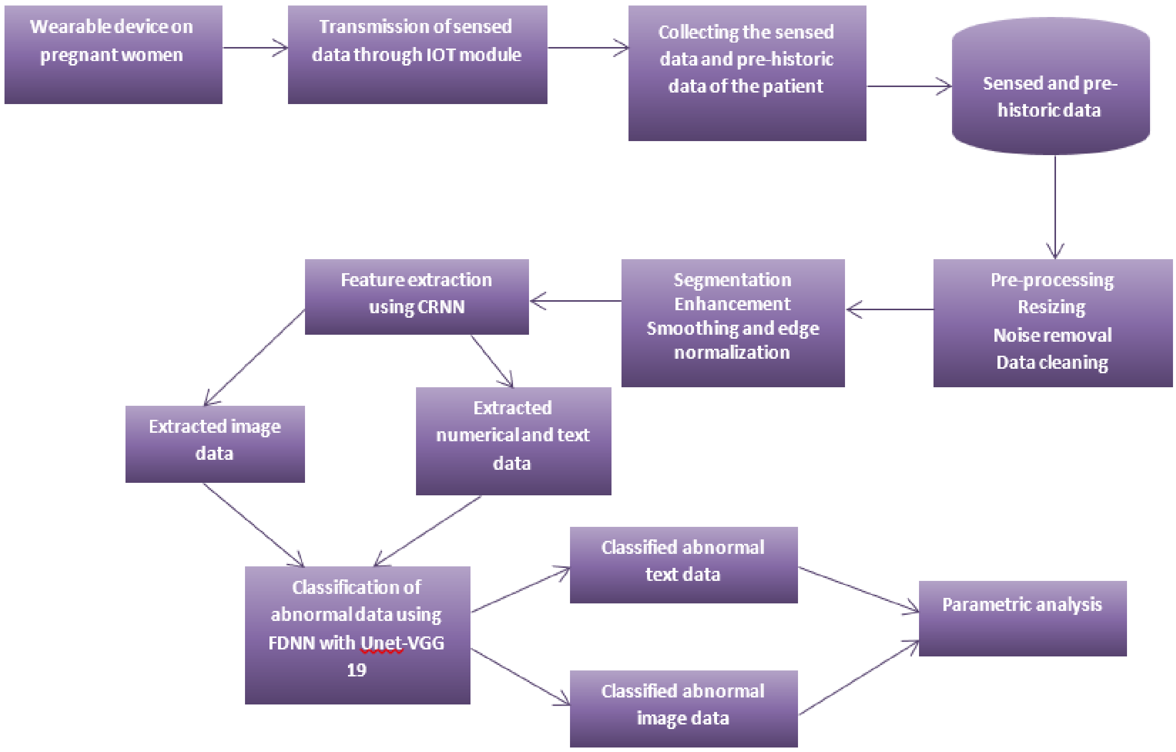

Figure 1: proposed architecture

The above figure shows the overall architecture for proposed maternity risk prediction. Initially the data has been collected by the patient’s wearable device and it has been transmitted by IOT module to the database of the hospital. In this proposed work, we also collect the particular patient’s pre-historic data and create the dataset with numerical data and image data. This data has been initially pre-processed for removal of unknown attributes, resizing the image, noise removal and data cleaning. The image data feature vector has been extracted using CNN and text, numerical data feature vector has been extracted using RNN. These extracted image and text feature vector has been classified using fast deep neural network wok U-Net_VGG-19 deep learning architecture.

FEATURE EXTRACTION:

CNN Based Image Feature Extraction:

The proposed CNN feature extraction for risk prediction of maternity image dataset by LeNet-5 is illustrated in Fig. 2.

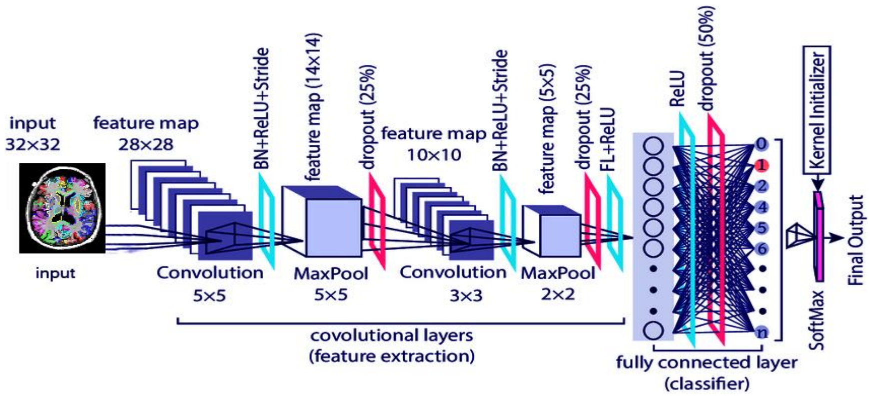

Figure 2.CNN image feature extraction architecture

First, a convolution layer with six 55 filters and a stride of 1 is applied to a 32x32x1 image to produce an output matrix of 28x28x6. The feature map is shrunk from 3232 to 2828 with a stride of 1 and no padding. The dimension is then lowered by a factor of 2 and average pooling with a filter width and stride of 2 is taken, resulting in 14 14 6. Another convolution layer is also employed, this time with sixteen 5 5 filter rows, creating an output matrix of 10 10 16. A second pooling layer is then added, and the final output matrix is 5516.

3.2 U-NET-VGG-19architecture:

In order to categorise photos, we will first use a convolutional neural network in which the input images are processed through a number of layers. We will attempt to fine-tune the U-NET-VGG-19 models after creating them from scratch using the image augmentation technique. In order to categorise images and assess accuracy for training and validation data, we will use one of the pre-trained models, U-NET-VGG-19.The implementation architecture of U-NET-VGG-19is given in below figure 3.

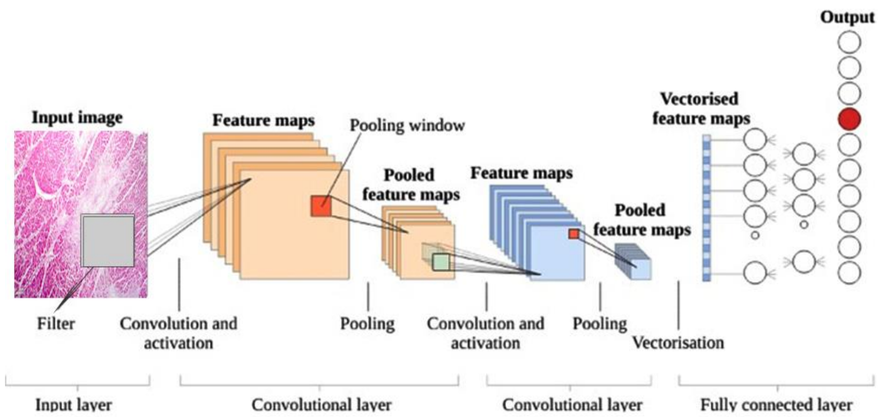

Figure 3: Implementation architecture of U-NET-VGG-19

A sort of artificial neural network called a convolutional neural network employs multiple perceptrons to analyse picture inputs and has learnable bases and weights for various visual components that can be used to separate them from one another. One benefit of employing a convolutional neural network is that it takes advantage of the input images' local spatial coherence, which enables them to have less weights since some parameters are shared. There is no doubt that this approach is effective in terms of complexity and memory.

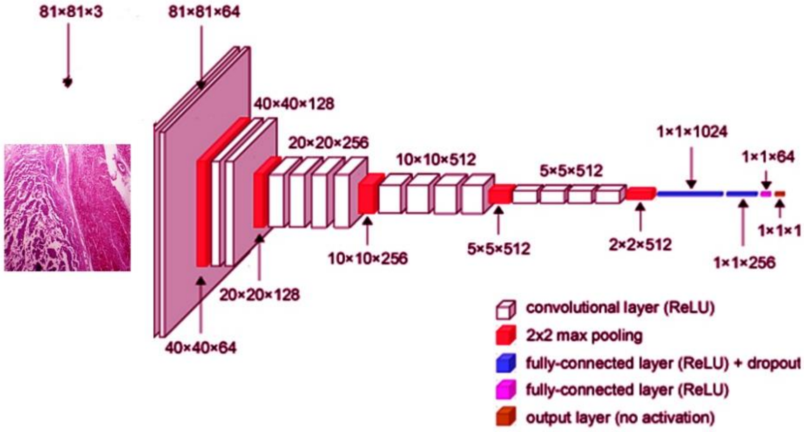

Figure 4: U-NET-VGG-19Structure

The minority output class 1 (i.e., having a risk for pregnancy) fared better for the proposed U-NET-VGG-19 model than the output class 0.

4. Performance analysis:

Below is an illustration of the performance analysis of the suggested method. Accuracy, precision, recall, F1 score, and AUC are the factors that should be taken into account while evaluating a parameter. The various performance indicators have been evaluated using output that has been categorised. Clinical datasets are predicted to be used in the evaluation of the proposed methodology. By randomly selecting test data from dataset as the result data, the performance of the model is examined.

Table 1. Comparison of Performance of Proposed (FDNN-GD system and Existing Algorithm

S.NO	Techniques	Random Forest	Neural Networks	KER	Proposed
1	Accuracy	85	88	91	95
2	Precision	71	73	75	77
3	Recall	61	63	65	68
4	F1-Score	55	58	61	63
5	AUC	52	55	59	61

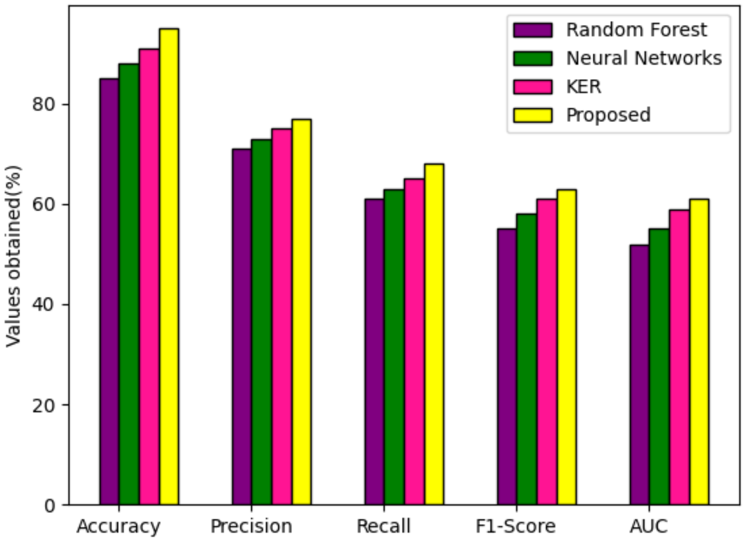

Figure 5: Overall comparison

Instances from Statistics of Training and Test Sets datasets have been used to estimate the classifier's results, which have then been used to classify instances with same observation. Performance measures of various techniques, including RF and NN, are compared with proposed KGER-DNN technique. Table 3 compares performance in terms of accuracy, precision, recall, F1-score, and AUC. It has been calculated using Actual and Predicted values from Confusion Matrix's Objective of Classes, and it is shown as a percentage.

Conclusion:

In this study, we examined the various methods for predicting the risks and consequences of gestation. These forecasts aid in avoiding all difficulties and can provide the doctor more understanding. This means that framework can act as a decision support system for doctors.This data has been initially pre-processed for removal of unknown attributes, resizing the image, noise removal and data cleaning. The image data feature vector has been extracted using CNN and text, numerical data feature vector has been extracted using RNN. These extracted image and text feature vector has been classified using fast deep neural network wok U-Net_VGG-19 deep learning architecture.

Reference:

[1] Wicaksono AP, Badriyah T, Basuki A. Comparison of TheDataMining Methods in Predicting The Risk Level of Diabetes. EMITTER International Journal of Engineering Technology. 2016 Aug 3;4(1):164-78.

[2] Fahrudin TM, Syarif I, Barakbah AR. Data Mining Approach for Breast Cancer Patient Recovery. EMITTER International Journal of Engineering Technology. 2017 Jul 23;5(1):36-71.

[3] Nagendra, Vinayaka, et al. "Evaluation of support vector machines and random forest classifiers in a real-time fetal monitoring system based on cardiotocography data." 2017 IEEE Conference on Computational Intelligence in Bioinformatics and Computational Biology (CIBCB). IEEE, 2017.

[4] Permanasari, Adhistya Erna, and AkhsinNurlayli. "Decision tree to analyze the cardiotocogram data for fetal distress determination." 2017 International Conference on Sustainable Information Engineering and Technology (SIET). IEEE, 2017.

[5] Hoodbhoy, Zahra, et al. "Use of machine learning algorithms for prediction of fetal risk using cardiotocographic data." International Journal of Applied and Basic Medical Research 9.4 (2019): 226.

[6] Bhatnagar, Divya, and PiyushMaheshwari. "Classification of cardiotocography data with WEKA." International Journal of Computer Science and Network-IJCSN 5.2 (2016).

[7] Tang, Haijing, et al. "The Design and Implementation of Cardiotocography Signals Classification Algorithm Based on Neural Network." Computational and mathematical methods in medicine 2018 (2018).

[8] Cooray, S. D., Boyle, J. A., Soldatos, G., Wijeyaratne, L. A., &Teede, H. J. (2019). Prognostic prediction models for pregnancy complications in women with gestational diabetes: a protocol for systematic review, critical appraisal and meta-analysis. Systematic reviews, 8(1), 1-10.

[9] Akbulut, A., Ertugrul, E., &Topcu, V. (2018). Fetal health status prediction based on maternal clinical history using machine learning techniques. Computer methods and programs in biomedicine, 163, 87-100.

[10] vanMinde, M. R., Blanchette, L. M., Raat, H., Steegers, E. A., & Kroon, M. L. D. (2019). Reducing growth and developmental problems in children: Development of an innovative postnatal risk assessment. PloS one, 14(6), e0217261.