# Heart Defect Detection in Fetus

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## ABSTRACT

*To determine the complications, anomalies of fetus ultrasonography is performed during pregnancy of a woman. Therefore, finding a sign for a more definite anatomic study of the embryo. Ultrasound can identify the majority of major structural fetal abnormalities. Minor anomalies in 15% new-borns. Greater number of new strings cause greater chance of having major birth defects. The aim of the project is to build and train the model to effectively detect the abnormalities using the ultrasound images of the fetus at the early stages. As many of the structural anomalies can be treated if detected in early stages, the manual diagnosis requires considerable effort, time consuming and is prone to misdiagnosis. Therefore, using a software can avoid misdiagnosis and reduce overall time and effort.*

***Keywords:*** *Ultrasonography, Structural Abnormalities, Fetal Anomalies, Trimesters, Convolutional Neural Network, Image Processing.*

## Introduction

The abnormalities of the heart is the most common congenital defect in fetus. Deep Learning is rapidly used in medical diagnosis in recent years. It can detect the abnormalities and diseases more quickly and accurately than manual diagnosis by humans. Fetal ultrasound screening is a challenge to achieve consistent result with manual operations since the position of the fetus in mother's womb varies. It is also time consuming, requires more effort. This may prone to misdiagnosis. Therefore, deep learning approach is used to avoid misdiagnosis and it also reduces overall effort and time. Fetal cardiograph can be performed in the first trimester. The ascending and descending aorta, pulmonary artery are successfully performed within 13 weeks of gestation. The various parts of the fetus are identified at different weeks. The foundation of the umbilical cord is identified at 8-10 weeks. The digestive tract is identified in the general position by 12 weeks.

### A. Proposed System Contributions

The main contribution in the proposed system is as follows

- To detect the defects earlier so that they can be treated earlier.

## II. Related Work

H. Chen, et. al, [1] discussed about detection of standard cross-section of fetus using a composite neural network. The standard cross-section procurement is a humongous work task and it also requires administrator outfitted with an exhaustive information of fetal life structures. In this way, programmed approaches are exceptionally requested in clinical practice to ease the responsibility and lift the assessment proficiency. The programmed discovery of standard planes, and the generally low picture quality. Dissimilar to past examinations which were explicitly intended for individual physical standard planes,

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individually, we present an overall structure for the programmed recognizable proof of various standard sections from US recordings. Unmistakable from traditional way which is used to devise the task carefully assembled visual highlights for identification, the developed system investigates between-plane element learning with an original composite structure of the convolutional and intermittent brain organizations. The further location the issue of restricted preparing information, a model perform multiple tasks which is a learning system, is executed to take advantage of common sense across location assignments of unmistakable norm planes for the expansion of component learning.

M. Feng, L. Wan, Z. Li, L. Qing and X. Qi et. al [2] Explained how the accurate measurement of the weight of fetus is integral for both the child and the mother. If the birth weight of the fetus is low that is less 2.5 kilograms or if the fetus has a high birth weight that is greater than 4 kilograms then the mother's will be associated with many short to long term health issues like high prenatal mortality index rate and may also lead to many chronic diseases. Because of the differences in the data sets heterogeneity body sizes, it can lead to many changes in the body of the fetus. They proposed a model based on the machine learning algorithms which can increase the accuracy of approximation of weight of the fetus. Synthetic Minority over-sampling technique which is generally known as SMOTE has been employed to solve that. The Support Vector Machine (SVM) is used for estimating the fetal weight. In the final step they used the Deep Belief network to get an accurate guess of the fetal weight. They used multiple ultrasonic parameters for this purpose. By using mean absolute percent error, they identified the risk. When the risk is found out the maternal and mortality, They can be decreased by undergoing through necessary treatments and the multiple precautions suggested by a doctor. These can also reduce the risk of developing disorders in mother's during pregnancy.

Gond Y et. al[3], explained about Fatal Congenital Heart Disease (FHD) is a momentous child congenital information. Echocardiography is the most commonly used method for screening heart malformation but it is difficult to obtain images of heart mainly for four-chamber view images and the position of fetus varies. So a new model called as DGACNN is proposed which recognizes FHD. DGACNN mainly consists of two part. One is Anomaly which is similar to ALOCC network. It is robust and has higher accuracy. The other one is GACNN. In this part four chamber heart video slices are trained so that the study can improve the FHD detection accuracy. The Anomaly outperforms ALOCC in screening the videos to obtain accuracy and stability. This model outperforms than other networks and expert cardiologists in recognizing FHD. Hence this method performs best to screen heart malformations. But the limitation of this model is the classification task is not sufficient for training the recognition model and it is difficult to annotate unlabeled time slices of videos.

S. Nurmainiet et. al [4], examined about exact evaluating for septal deformities is significant for supporting radiologist's interpretative work. The semantic division technique isolates districts that just hold back objects from a similar class. Interestingly, the fetal heart may contain different items like the atria, ventricles, valves and aorta. This study made use of the masking method of regional convolution neural network to handle the ultrasonic images of the fetus and utilize them to distinguish in heart dividers with many numbers of articles. It can be used to demonstrate a solid connection among the anticipated imperfections in the septal and the man normal accuracy. The fundamental advantage of using this model is that it effectively finds the aorta, 4 chambers of the heart and imperfections among restricted picture information. The primary constraint is that Cardiac separating embryos stays an issue requiring a group of specialists.

Komatsu M et al, [5] explained about their proposed A model on supervised object detection on the data which is normalized using a neural network which is convolutional technique used to find the cardiac abnormalities and the different unacceptable structures in the ultrasound videos of the fetus. They have taken a barcode like timeline on the basis of a particular time interval to visualize the defect of the fetus. To evaluate the performance of detecting cardiac abnormalities they utilized the cross-sectional videos. The main advantage of this model

is that the model SONO can detect the structural abnormalities and the defects in the cardiac substructures of the ultrasonic fetal videos. Its limitation is that training data consisted of only normal cases; however, further CHD data is needed as test data for the validity and reliability.

A. M. Oprescu, G. Miro-amarante, L. Garcia-Diaz, L.M. Beltran, V. E. Rey, M. Romero-Ternero et. al[6] The study of various patients leads to the discovery that there are many disorders that occur to the patient during the time of pregnancy can lead to a dangerous or a life-threatening situation to both the patient and the fetus. They also discovered that the emotional status of the patient can also have a high-risk factor. The proposed model can monitor the emotional status of the patient and find the problems that can occur. The enhancement of health and the health status of the pregnant women can be achieved by the usage of effective computing health devices.

R. Raut, A. Dikshit-Ratnaparkhi and D. Bormane et. al [7] The surveillance of the fetal heart beat is most important. The pregnant patients who have blood pressure and diabetes and many other problems can have high risk on their pregnancy. If the fetus development is not usual the pregnancy is also at risk. Monitoring of the fetal heart beat is a better indication to determine whether the preterm medicines are effective or not. The FECG signal is a very complex signal. It is highly contaminated with Maternal ECG noises or disturbances. In signal processing which is done by a Fetal electrocardiogram, the extraction is a complex task. Maternal ECG has a higher amplitude when compared to Fetal ECG. The time span and amplitude of the waves in ECG signal and Fetal heart rate used to determine the fetal life. This diagnosis is mainly helpful to take precautions if there are any abnormalities caused in early stage. We can get information concerned to fetal cardiac issues and also the nervous system issues from fetus. It is an effective approach in decreasing the maternal and mortality rates of the fetus. The research exploration for various techniques and algorithm used for the extrication of Fetal ECG.

C. Lin et al [8] Monitoring craniate vital sign throughout physiological state is very integral to help clinicians in creating additional timely choices. For analyzing defects of heart, the autoimmune observance of craniate heart functions mistreatment abdominal ECGs is useful. Thus, to robustly determine the craniate ECGs area unit too weak. Since the peaks of the heart functioning could have concealed inside the signal because of the state of the craniate vascular system, so it's a major necessity to boost craniate R-peak. To statistically produce the mask weight consistent with the distribution of neighboring intervals between every two of peaks 2 sets of scenarios of the R-peak improvement technique was planned and they were developed to evaluate the responsibleness of this method. Therefore, to increase the identification of the craniate heartbeat, a completely unique craniate: challenges with completely various modes of noise disturbance and R-peak rate of interval. The analysis says that the weight improves the precision of the R-peak finding rate by twenty fifth and reduce warning rate by 2 hundredth with dissonance disturbances and guarantee high R-peak rate of detection which is greater than 80%, particularly of gentle noise contaminate, the noise (rate per minute < 25% and noise amplitude magnitude relation < 1.5).

M. W. Rivolta, T. Stampalija, M. G. Frasch and R. Sassi et at [9] In Fetal Heart Rate monitoring the analysis of average acceleration and deceleration capacities which are determined by Phase-Rectified Averaging of the Signal is still a matter of concern and is undergoing investigation. The aim of this model is to elucidate some of the acceleration and deceleration behavior. The distinction between deceleration and acceleration is called as speed reserve (DR). The uneven and asymmetric trends are discovered with DR. The DR, when compared with acceleration, deceleration in respect to discriminatory power after correcting the signals power or deceleration area between the groups. The DR then displayed the higher discriminatory power. It is also outperformed normoxic fetuses at baseline. The results proved that the introduction of DR is superior than acceleration and deceleration risk stratification during labor.

## III. Proposed Methodology

For the process of the training the following model we have regarding one hundred twenty pictures of various categories like heart defect, moderate

defects and healthy heart. we tend to used Multi category Image Classifier to classify the photographs. during this classifier victimization inaudible pictures as input and also the model will predict the anomalies. Then the anomalies is treated and antepartum care is taken within the mother's female internal reproductive organ itself. If it's impossible, then the defects is cured when the birth.

In the proposed system the ultrasonic images of the fetus are taken and are fed as the input to the following image processing model. A Convolutional Neural Network which is classified as a deep learning technique and in the context of image processing it takes the input of a image and it assign importance or weights to various aspects of the image. The model of a Convolutional Neural Network includes connectivity pattern of neurons which is very much similar to the human brain. Every individual neuron respond to the activations in the hidden layers and it is known as the Receptive field. A CNN can easily capture the temporal dependencies and the spatial dependencies in the image data set. The model is extremely useful for image processing because the weights can be reused that is the system is trained in such a way that it can understand the sophistication of the data. Less feature losing is an importance of this model.

The convolution model is used to draw out the image features. The main features of the image include the edges of the heart. We can add several additional hidden layers to the model so that the network can easily adapt to images and can classify in a better way.

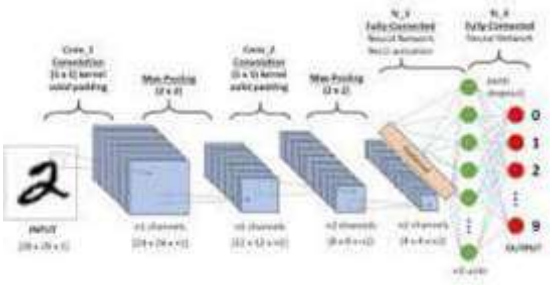

**Fig. 1. Shows the operation of the model**

ReLU (Rectified Linear Unit) is the activation function used in the model. It is the most widely used activation function in the Convolution Neural Networks now-a-days. The main dominance of ReLU over other activation functions is that the activation of all the neurons is not performed at the same time instead it transforms all the negative weights of the links to zero which makes the ReLU activation function very computationally effective when compared to the other functions and it also allows only a few amount to be fired at a particular time.

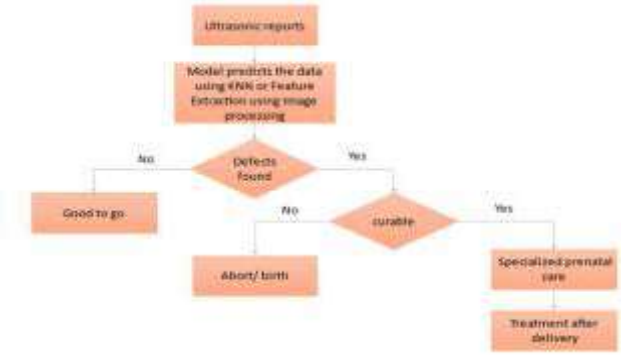


**Fig. 2. Process Flow Diagram**

The multiclass image classifier will classify all the images into two different classes which are the defect and healthy classes based on the features extracted from the Convolutional Neural Network model. It can perform the transfer learning which makes use of the pre-trained model and can apply it to the new image and classify the input image into any of the two classes mentioned above.

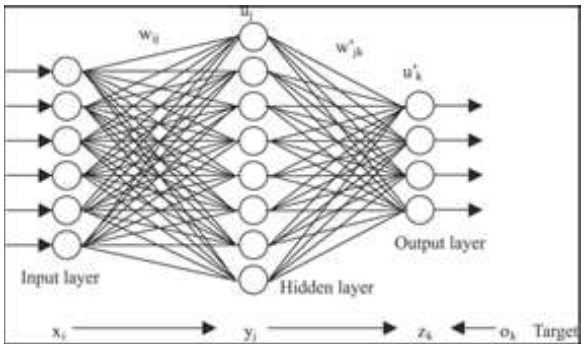


**Fig. 3. Multiclass Image Classifier**

## IV. Results And Analysis

The result screens for Image Processing are shown below.

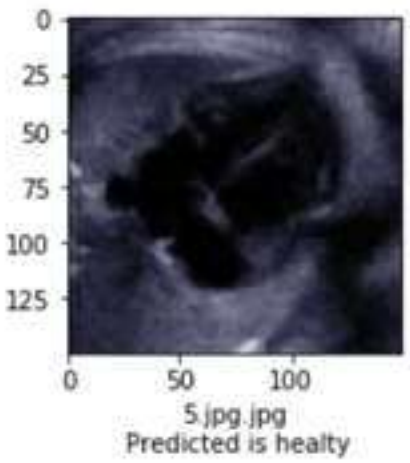


Fig. 4. This is the output of a fetus report. When the image is gone through the model the result as Healthy Fetus.

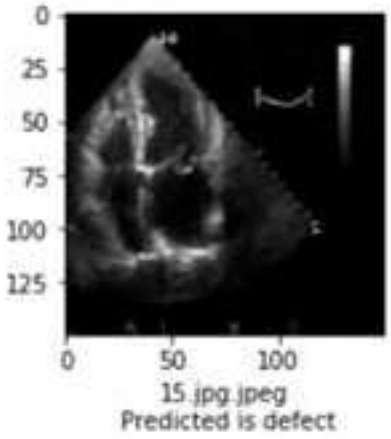


Fig. 5. This is the output of a fetus report. When the image is gone through the model the result as Defect Fetus.


Fig. 6. GUI to upload the Fetal Heart Image


Fig. 7. After uploading the Image

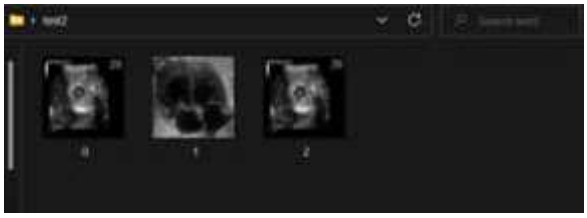

Fig. 8. Uploaded images into folder

## V. Conclusion and Future Work

From as the fetal structural defects are increasing day by day the need for more experienced doctors is also increasing. This proposed model will reduce the work of the specialist doctor and finds whether there are any defects in the fetal heart. The doctor can find the defects with more precision and the regarding treatments can be given to the patients. Not only doctors, the patients can also use this for fetus to find whether there are any abnormalities in the heart of the baby. Out future work is to enhance the precision of the model using image processing.

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