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EFFECTIVE WEIGHT PREDICTION ANALYSIS WITH IGP-CNN MODEL FOR CARDIOVASCULAR DISEASE

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ABSTRACT:

One of the most important organs of a human being is their heart. It contributes to the cleansing of the blood and increases its circulation throughout the body. Heart attacks are the cause of the greatest number of deaths on a global scale. Chest discomfort, a racing pulse, and trouble breathing were some of the symptoms that the patient experienced. On a regular basis, this information was investigated and analysed. To develop an efficient detection solution, we depicted an intuitive feature analysis in order to realise the weighted predictive features of the data indicating the various aspects of the regional changes for each aspect of condition. This has allowed us to create a solution that is effective. Heart failure is a disease that may be caused by a number of different causes, out of which we have established a total of 15 elements after comprehending the significance of the design requirements. We have a tendency to develop a solution in which unbalanced features are used in the classification process in accordance with the dataset that is selected. The implementation of the plan may be implemented using a dataset called Framingham that can be found on the Kaggle website. Machine learning techniques are used to successfully classify the results of intuitive feature analysis combined with a Gaussian predictive model to make predictions about heart attacks and diseases. In order to provide such elements, an intuitive model with GPM for the ensemble technique has been built, and its prediction weight characteristics have been shown to have effective loss. The total accuracy enhanced features were created using current examples that achieve up to 89% of their potential accuracy, whereas the suggested solution achieves 93% of its potential accuracy.

Keywords: Convolutional Neural Net (CNN), heart disease (HD), Machine learning (ML), Cardiovascular diseases (CVD)

INTRODUCTION:

The pandemic that is heart disease (HD) [1] has afflicted a significant number of people in a variety of countries all over the world. Because of this, heart disease is the most significant concern facing the public's health. When HD attacks a patient, the patient may suffer common symptoms such as shortness of breath, physical body

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weakness, and swollen feet [2]. [Note: Current diagnostic techniques for heart disease are ineffective in early detection for a variety of reasons, including their level of accuracy and the time it takes to perform them [3]. As a result, researchers are working hard to develop an efficient method for early detection of cardiac disease. Not only is it challenging and time-consuming to diagnose and treat cardiac illness when modern technology and skilled medical personnel are not easily available [4], but it is also difficult to identify heart disease in the first place. The current editors who was responsible for organising the review of this manuscript and providing her consent for it to be published, provided the most correct diagnosis possible. She also gave her approval for the paper to be published. In addition, getting the right therapy might end up preventing the loss of life for a very large number of people [5]. According to the European Society of Cardiology, more than 26 million people have been identified as having HD, and an additional 3.6 million people are identified with the condition [6]. [7] Research suggests that the majority of people living in the United States are affected by cardiovascular disease of some type. In the past, a doctor would diagnose HD by looking at the patient's medical history, the findings of a physical exam, and the symptoms that were generating concern. Today, however, there are other ways to diagnose HD. However, the data obtained by using this method of diagnosis are not reliable when attempting to identify HD individuals. [Citation needed] Furthermore, analysing it is difficult from both a monetary and a computational standpoint [8]. Therefore, in order to address these problems, work is now being done to build a diagnostic system that does not include invasive procedures and is instead based on classifiers obtained by machine learning (ML).

Problem Statement:

Even though the realization on the cardiovascular disease have been prone to the different forecasting methods indicating the dataset to improvise patients' disease detection to more accurate. The data processing and analyzation of the different researchers indicates on the real time data observed dataset from the website Kaggle indicating the detection rate. So, now the design on unbalanced and outliers have shown reasonable predicament to realize the importance of class balancing as depicted in the proposed model.

Objectives:

1. To improvise a solution analysis on IGP model to improve the overall imbalanced class features
2. To improve the overall accuracy of the design using Hybrid CNN model with dense and Normalized layers
3. Effective comparison of the design with other machine learning algorithms.

Overview:

This paper presents the overall perspective of the design indicating the Introduction of the Heart disease and attack. In section -2 the overall perspective of the different researchers' studies and its problems were analysed with their accuracy. In section -3 the overall proposed block diagram and its features of classification have been depicted

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and realized with effective weight features as proposed based on IGP model. In section IV overall results have been depicted with analysing the design. Finally, overall conclusive report has been depicted with its tabulated analysis for IGP-CNN.

LITERATURE SURVEY:

The coronary failure disorders connected to the possibility that detecting any specific cardiovascular disease at an earlier stage might avert these attacks are the leading cause of severe unnatural death around the globe, as well as in Asian nations, particularly in India. Those who are involved in the practise of medicine develop knowledge with the gift of a wealth of huge and extremely important data [9], but this information is not successfully used for forecasting purposes. Because of this, the analysis transforms the data into a dataset so that it may be used for moulding and exploitation by a variety of data processing methods. There is a requirement for medical professionals who are able to forecast cardiovascular disorders well in advance of the time when their patients are likely to develop any CVD. Drinking alcohol and smoking cigarettes, not getting enough exercise, having a high vital sign, having cholesterol levels that are dangerously high, eating a diet that is unhealthy and unhygienic, having a harmful relationship with alcoholic beverages, and eating foods with a high level of sugar content all contribute to an increased risk of having a heart attack. The term "cardiovascular diseases" (often abbreviated as "CVD") refers to a group of conditions that includes coronary heart disease, hypertensive heart disease, innate heart disease, various peripheral artery causes, rheumatic heart disease, and inflammatory type cardio disease. The primary objectives of information mining are the descriptions and prophecies linked with the data. The characteristics or the physiological variables[10] within the data set are used during the prediction of the processed data in order to determine a prediction probability or the future state values of an alternative attribute. The description will place an emphasis on finding a common pattern that can be recognised by humans and that characterises the information so that it can be comprehended by them.

The heart is a very important organ in the human body. It is responsible for the circulation of blood and the supply of nutrients to all of the body's organs. In the field of medicine, making accurate projections on the prevalence of cardiac diseases is a challenging endeavour. Machine learning [11], the Internet of Things, and deep learning are all examples of technologies that have been shown to be effective responses to problems in clinical management, biological communities, and healthcare more generally. They also help in the early diagnosis of sickness by effectively interpreting medical data, which is essential in this process. Methods of machine learning and deep learning that have been used to predict cardiac illness include Random Forest, Decision Tree, Naive Bayes, Artificial Neural Network, Support Vector Machine, Decision Tree, XGBoost, and K-Nearest Neighbor. K-Nearest Neighbor is another method. [12]This article provides a summary of earlier research in addition to an outline of the approach that is now in use.

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The heart is an essential organ found in all living things. Heart disease is perhaps the most lethal disorder in the world; it is characterised by an inability of the heart to pump an adequate amount of blood to the body's various tissues and organs, which may lead to death. Because the slightest error might result in exhaustion or even death, accurate prediction and diagnosis of heart-related disorders need an increased level of precision and accuracy. There are a significant number of deaths that are attributed to the heart, and the numbers are growing each day. The conventional approach to determining whether or not an individual has heart disease is not generally acknowledged as being a reliable method. In order to address the problem, it is essential to devise a method that can forecast diseases and increase people's awareness of them. Machine learning is a subfield of artificial intelligence (AI) that provides a distinguished service to forecast various sorts of occurrences by learning from observations of natural phenomena. This service has gained a lot of attention recently. Several different machine learning methods, such as decision trees, K-nearest neighbour [13], and AdaBoost, are used in this body of work. The primary objective of this study is to develop a method for illness prediction. Following the completion of the implementation of all of the algorithms, an assessment of the algorithms' correctness is carried out. On the Kaggle website, the dataset may be downloaded for free at any time.

The process of data mining consists of a collection of algorithms that may be carried out by various instruments. It provides an effective solution to a wide variety of current issues. The data mining that we are doing focuses on a variety of industries and the problems that they face. The healthcare industry is one of the most significant sectors, and it is in need of more sophisticated methods that can accurately detect diseases at earlier stages. The use of data mining techniques is helpful in accurately predicting illness. The J48 method combined with particle swarm optimization is recommended for use in the data mining model in order to provide more accurate predictions and classifications pertaining to cardiovascular disease (PSO). For the purpose of this study, a benchmark dataset is used. This dataset consists of 14 qualities, each of which may be classified into one of two categories. The findings of the experiments provide insight on how performance efficiency might be used in the diagnosis and categorization of cardiovascular disease.

This study in [14] reports & presents a clinical analysis of heart patient data in order to predict survival rates for patients with cardio-vascular disorders (CVD). The solution that has been offered would make it easier for medical experts to provide high-quality medical services to patients, including intense treatments. By examining the risks associated with them as well as other elements of the patient's lifestyle, such as their level of physical activity, level of smoking habit, and so on, our model calculates the odds of survival for patients who are suffering from any cardiovascular illness.

The survival rate prediction model that has been provided is an effective and cost-friendly option that will assist medical

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professionals in carrying out the medical operations that are the most suited for the symptoms that have been presented. In this study, an improved version of stochastic gradient descent, known as iSGD, is presented alongside the hinge loss function of the support vector machine (SVM). The results of the experiments demonstrate that the suggested prediction model is accurate when it comes to estimating the percentage of CVD patients who would survive their disease.

In contemporary times, forecasting cardiovascular illness has become one of the most challenging aspects of medical practice. In the most recent day, around one individual passed away per minute as a result of a heart problem. Machine learning is an essential component in the process of analysing a massive amount of data in the field of healthcare. Because predicting cardiac illness is a difficult task, the prediction process has to be mechanised so that risks associated with it may be minimised and patients can be forewarned. Consequently, in the proposed research [15] anticipates the likelihood of patients developing heart disease by using a number of machine learning techniques, including SVM, decision trees, logistic regression, and random forest, among others, and categorises patient risk. The purpose of this study is to give a comparative analysis that analyses the capabilities of a variety of approaches to machine learning. According to the data, the SVM algorithm has a greater efficiency of 94% compared to other applicable ML approaches than any of the others.

Cardiovascular illnesses, often known as heart diseases, are one of the main causes of death throughout the globe in today's contemporary civilization, in which a huge number of people adopt a sedentary lifestyle that is followed by a work cycle of eight hours.

The hospitals and other facilities that are part of the healthcare industry use computers to compile massive volumes of data about the patients and the conditions that they suffer from. This enormous information warehouse has a lot of information and expertise. The underlying links and patterns that are concealed inside the data are, for the most part, ignored. The diagnosis of cardiovascular disorders in patients is a challenging undertaking, and the number of medical professionals who are able to effectively forecast the onset of such diseases is small. This study [12-15] aims to construct a prediction algorithm by using data mining techniques and optimization procedures as its primary research methods. Data mining is the process of utilising a variety of methods to identify information or decision-making knowledge within a database and extracting these in such a way that they can be put to use in areas such as decision support, predictions, forecasting, and estimation. This process is known as "data mining." Particle Swarm Optimization is a method that we are going to use. It is an algorithm that is naturally distributed, and it works by having the solution to a problem emerge from the interactions of a large number of simple individual agents that are referred to as "particles." The data sources that are generally utilised and regarded as a de facto standard for the ranking of the

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reliability of heart disease prediction are the ones that we have used for experimental testing. In addition to that, we will be using a version of PSO with a constriction factor that has been somewhat adjusted and is referred to as "Constricted PSO." The findings that were obtained demonstrate that particle swarm data mining algorithms are competitive not only with regard to alternative evolutionary methods but also with regard to industry standard algorithms and that they are able to be effectively used for the prediction of heart disease.

DESIGN IMPLEMENATION:

1. **Block diagram:**

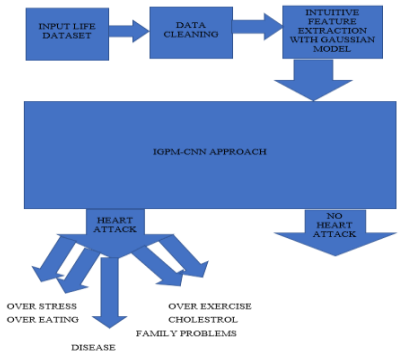

Figure 1: Representing the overall block diagram of proposed IGPM-CNN model

The proposed design implements the overall structural changes on the features with which every aspect as:

1. male
2. age
3. education
4. currentSmoker
5. cigsPerDay
6. BPMeds
7. prevalentStroke
8. prevalentHyp
9. diabetes
10. totChol
11. sysBP
12. diaBP
13. BMI
14. heartRate
15. glucose

From the above observations for the design, we have indicated 15 features that have to realize for the feature modelling based on Intuitive model with gaussian probability. In the figure 1, the block diagram depicts the design with five steps with which the heart attack is considered. The attack is calculated based on the 4 features such as BMI, HR, Cholesterol and Glucose. The overall intake features indicating class values for all aspects of the features are considered to realize the intuitive approach on the CNN model.

2. **Formulations**

To provide the loss and Effective model generation we have indicated an IGPM model with high dense features on the design realizing a 22 layers model for Improved accuracy from 65% to 70%. The overall dataset consisting of 4K data for the analysis with an uneven probability of the design results in higher accuracy. In order to balance the data, we have utilized SMOTE feature to balance the data for Im-balanced analysis as represented in the below figure 2.

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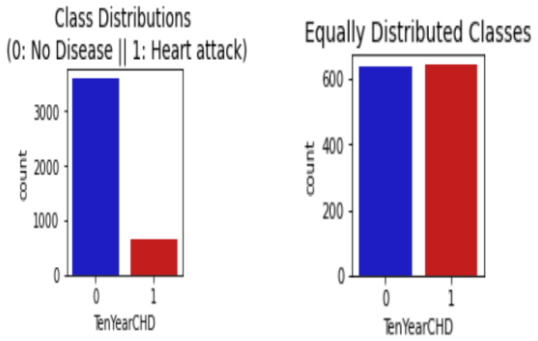

Figure 2: Representing a) Imbalanced Class labels and b) balanced class labels.

IGP MODEL:

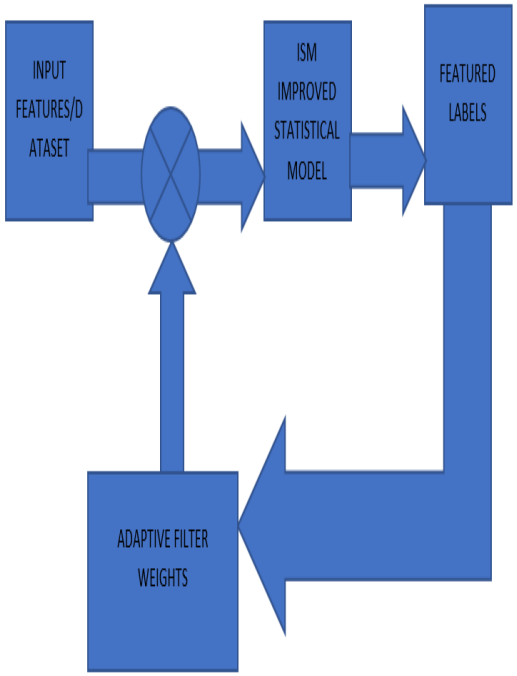

Figure 3: Proposed IGP block diagram weights estimation

The filter weight estimation of the proposed feature analysis is depicted below:

The effect of feature transfer function on the type of weights calculated via two datasets chosen and estimated its accuracy. For Dataset cardiovascular, our proposed design effective provides an IGP model with its linear prediction. The linear formulation for the recommender is given by:

$$R(i) = \frac{\sum_{i=1}^{N} P(x_i) * X_i + \sum_{j=1}^{N} P(y_j) * Y_j}{x_i * y_i} \quad (1)$$

$$O(i) = \frac{\alpha}{R(i)} + \frac{\beta}{R(j)} \quad (2)$$

The equation (2) is very similar to the design of TF function in equation (3) hence approximated with linear feature from (1).

$$TF = \beta * \frac{\sum_{i=1}^{N} x_i^8 * w_i}{\sum_{i=1}^{N} W_i^8 * \sum_{i=1}^{N} y_i} + \alpha * \frac{\sum_{i=k}^{N} x_i^{16} * w_{i-k}}{\sum_{i=1}^{N} W_i^{16} * \sum_{i=k}^{N} y_{i-k}} \quad (3)$$

Here β, α are the parameters for the similarity percentages, which could vary from (0, 1). Depending upon the above equation parametric, with the filter weights of W_i^{n1}, W_i^{n2} are estimated with different rating assigned for each similarity feature index.

ALGORITHM:

- *Step1: Improvise a scenario for each type of the Heart attack and non-attack features are separated.*
- *Step2: implicate the feature of the different solutions with each adaptive filtering for cleaning the NAN values and its relative changes observed in featured Model mention in Figure 2.*
- *Step3: Iterate the different featured labels with different conditional changes for each feature importance as mentioned with user choices.*

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- *Step4: Finally Estimate the weights using the IGP model for the different features and its accuracy of the design.*

PSUDO CODE FOR ALGORITHM1:

```
df['education'] = df['education'].replace(np.nan, np.mean(df['education']))
df['glucose'] = df['glucose'].replace(np.nan, np.mean(df['glucose']))
df['totChol'] = df['totChol'].replace(np.nan, np.mean(df['totChol']))
df['cigsPerDay'] = df['cigsPerDay'].replace(np.nan, np.mean(df['cigsPerDay']))
df['BPMeds'] = df['BPMeds'].replace(np.nan, np.mean(df['BPMeds']))
df['BMI'] = df['BMI'].replace(np.nan, np.mean(df['BMI']))
df['heartRate'] = df['heartRate'].replace(np.nan, np.max(df['heartRate']))
```

Figure 4: Representing the NAN removal feature in dataset.

RESULTS AND DISCUSSION:

The overall design phase of the implementation has been divided in 4 steps such as:

1. Data acquisition
2. Data plotting
3. Data balancing
4. Data prediction algorithm with IGP-CNN.

In data acquisition case we have implicated the data as mention in figure 5 indicating the overall features of the design implementing of prediction attack.

```
In [5]: df.describe()
Out[5]:
```

	male	age	education	currentSmoker	cigsPerDay	BPMeds	prevalentStroke	prevalentHyp	diabetes	totChol	sysBP
count	4238.000000	4238.000000	4133.000000	4238.000000	4209.000000	4185.000000	4238.000000	4238.000000	4238.000000	4188.000000	4238.000000
mean	0.429212	49.584946	1.978950	0.494101	9.003089	0.029630	0.005899	0.310524	0.025720	236.721585	132.352407
std	0.495022	8.572160	1.019791	0.500024	11.920094	0.169584	0.076587	0.462763	0.158316	44.590334	22.038097
min	0.000000	32.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	107.000000	83.500000
25%	0.000000	42.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	206.000000	117.000000
50%	0.000000	49.000000	2.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	234.000000	128.000000
75%	1.000000	56.000000	3.000000	1.000000	20.000000	0.000000	0.000000	1.000000	0.000000	263.000000	144.000000
max	1.000000	70.000000	4.000000	1.000000	70.000000	1.000000	1.000000	1.000000	1.000000	696.000000	295.000000

Figure 5: Representing the overall dataset features.

These features are realized with removal of NAN values based on the plotting feature using seaborn as mention in figure 5.

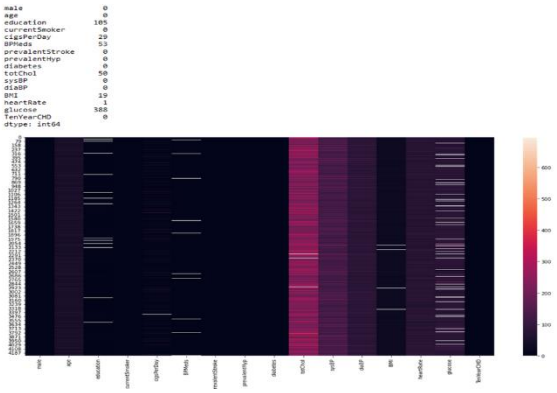

Figure 5: Representing NAN features for the dataset.

In figure 5 we have seen for seven different features are having NAN values indicating the overall design perspective. With this feature we have represented a solution to remove the NAN values using either max or mean values for the design. An effective feature of transformation with PCA analysis is performed with the balanced dataset with proper class labels.

In figure 6, we have presented the overall histogram plots for every feature with the characteristic label after balancing.

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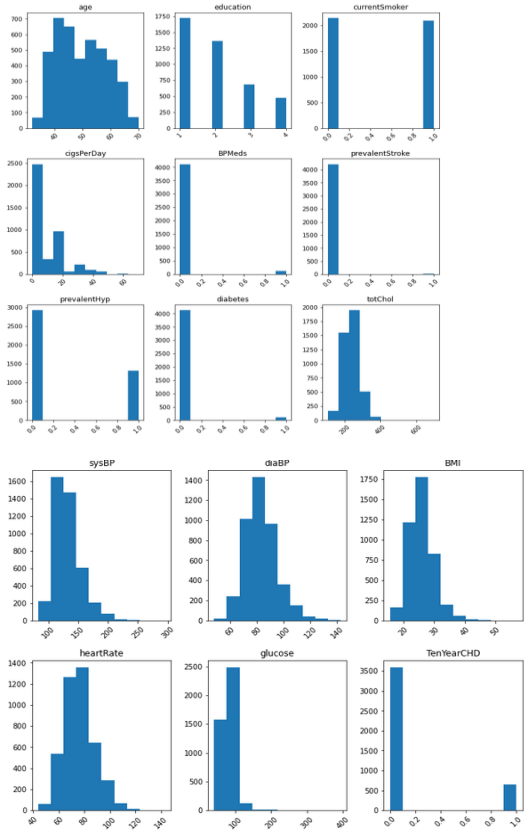
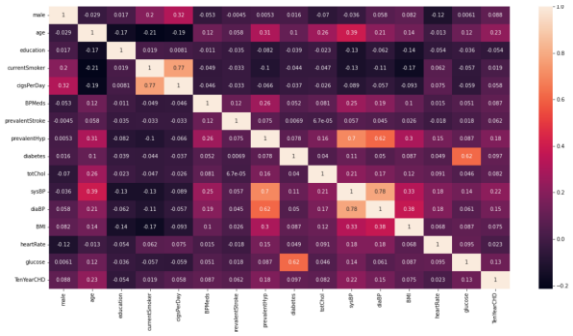


Figure 6: Representing the histogram plots.

The overall corelation plot before balancing is represented as shown in figure 7a. In figure 7b the correlation plot after balanced case is represented below. Both the cases are plotted after balancing and with its sub index case.



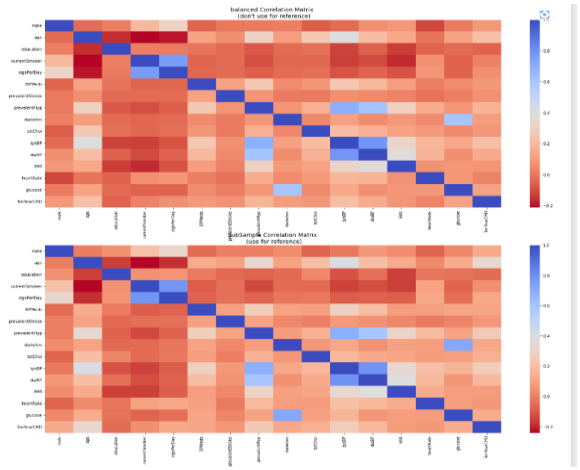


Figure 7a) Representing the overall correlational matrix for imbalanced case

Figure 7b) Representing the overall correlational matrix for balanced case.

```
Classifiers:  LogisticRegression Has a training score of 65.0 % accuracy score
Classifiers:  KNeighborsClassifier Has a training score of 60.0 % accuracy score
Classifiers:  SVC Has a training score of 65.0 % accuracy score
Classifiers:  DecisionTreeClassifier Has a training score of 57.99999999999999 % accuracy score
```

```
Best Validation Loss: 0.5823
Best Validation Accuracy: 0.7094
```

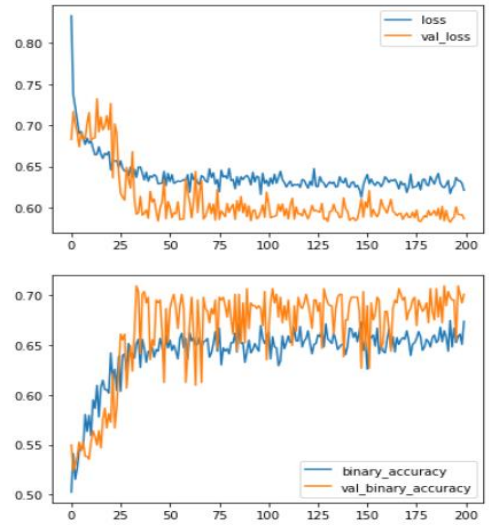


Figure 8: Representing the Accuracies plot for IGP CNN and machine learning algorithms.

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From the above figure we could see that our proposed algorithm with 5% improvement have been depicted without pruning the loss estimation and other layer improvements with CNN, RNN, X-ception net design.

Table 1: Representing overall Accuracies of the machine learning algorithms with proposed model IGP-CNN with and without balanced data analysis.

ALGORITHMS	ACCURACY (EXISTING) Without balanced class	PROPOSED (ACCURACY) With balanced class
LR	84.29	65
DT	82.36	57
SVM	81.26	65
ENSEMBLE-HYBRID	84.34	62.56
IGP-CNN	85.32	70.32

CONCLUSION:

Even though the imbalanced feature analysis has been implemented we have seen an overall accuracy observed for 70% for the proposed one. An intuitive feature model with predictive filter weights have implicated better than the existing algorithms even after balanced classification results. So, with this effective model we could state the different types of the attack can be predicted depending upon the filter characteristics. The overall tabulated accuracies proves that the effect change in filter characteristics indicating change in balanced data with best accuracy and improved version of 5% from SVM and LR. While DT and ENS-hybrid are farther with 9% above. Hence resulting our design with IGP-CNN more effective as mentioned in table-1.

SCOPE:

An effective loss model with Tunned parametric with SGD or ADAM features indicating the layer perspective have to analysed to improve the accuracy from 70-95%.

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