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# ANN Model to Predict Eligible for Beneficiary Scheme using Deep Learning

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***Abstract*— In order to help the impoverished survive, the government uses public funds. Every government establishes criteria to determine eligibility, such as income, age, gender, and so on. These criteria aid in determining which citizens are qualified for which programs. Try to formulate a hypothesis in this study paper so that decisions can be made quickly using machine learning algorithms. The fundamentals of neural networks are presented in this study along with how they can be used to forecast a person's eligibility for social welfare programs like old age pensions. This paper's primary goal is to use neural networks to forecast a citizen's eligibility for old age pensions or. The main objective of this paper is to utilize neural networks to predict whether a citizen is eligible for old age pensions or other beneficiary schemes. Automating this process can save the government time, manpower, and resources.***

***Keywords: Deep Learning, NN, ANN, Speech Recognition, Eligibility Prediction.***

## I. INTRODUCTION

Artificial neural networks (ANNs) are computational models inspired by the human brain, designed to process data through interconnected nodes or "neurons." They have evolved significantly since their inception, with key advancements in learning algorithms, particularly the backpropagation method, and the development of deep learning architectures. This evolution has enabled ANNs to tackle complex tasks across various domains, including computer vision and natural language processing[9]

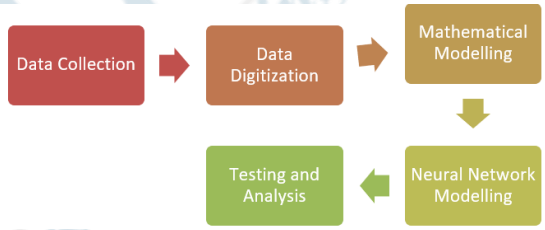
Time to time depend on the situation or for the benefit of public government lauch varies scheme.

**Table 1** List of two beneficiary services and purpose of scheme

| Sr. No | Scheme | Details |
|---|---|---|
| 1 | Oldage Allowance Scheme | Purpose of this to provide Oladage pension to citizen who have not any other source of income and Age is >60 |
| 2 | Widow and Destitute Pension | Provide to Widow Women and their children who have no other source of income |

As mention on the above table many more beneficiary schemes and have their own eligibility criteria. In this discussed and create on Oldage pension factor

## II. METHODOLOGY




- Data Collection: Schemes is list is gather from Haryana Social Justice website and Google Survey forms based on daily applications.
- Data Digitization: Convert the data into a digital format, such as an Excel spreadsheet.
- Algorithm Design: Develop a rule-based algorithm to determine if a citizen is eligible for a pension or other services.

**Table 2:** Data Collection Format

| Sr. No. | Parameter for Data Collection | Description |
|---|---|---|
| 1 | Date Of Birth | On the base of Date of Birth age factor criteria is calculated |
| 2 | Age Proof | Document for example Matriculation Certificate, Aadhar Card, Passport, Voter Id and SLC etc are verified source of Age |
| 3 | Occupation | If Citizen is working or Govt pensioner |
| 4 | Income Tax Payee | Citizen Filling Income Tax Return or not |

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On the based of DOB, Verified Age, Occupation and Income Tax Payee Neural Network Model can work to predict is citizen is Eligible or not for Oldage Pension.

## III. PREDICTION MODEL

Neuron are interconnected and passed information from one node to other node with some mathematical calculation each neuron is associated with weight and bias. Input Layer passed information to Hidden Layer and Output Layer [9]

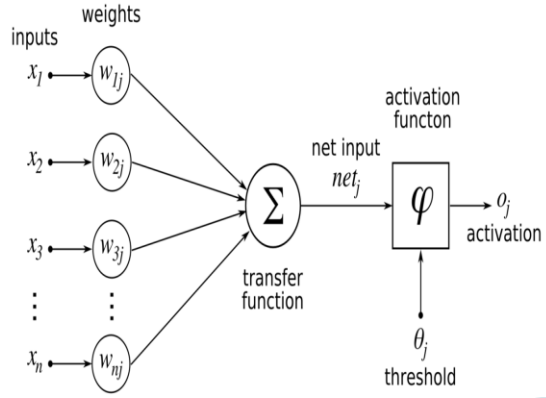


**Figure 1:** Working Process of Neural network

The eligibility prediction model can be expressed as a linear equation:

$$Y = W1X1 + W2X2 + W3X3 + W4X4 + by$$

Where:

- X1 = DOB
- X2 = Age Proof
- X3 = Occupation
- X4 = Income Tax Return

Here, the weights (w1, w2, w3, w4) and bias b are parameters learned during training. The model will classify a citizen as eligible for the pension if y≥0.5

$$\sum_{i=1}^{n} wiXi + b$$

Date Of Birth, Age Proof, Occupation and Income Tax Payee are the parameter where beneficiary eligibility is decide.

## IV. DATASET PREPARATION

**1. Data Collection:**

- Synthetic data was generated, simulating real-world scenarios. The dataset included three features: Date of Birth (DOB), monthly income, and employment status, which are key parameters for determining eligibility.
- Approximately 10,000 entries were generated to mimic real data distributions.

**2. Data Cleaning:**

- Missing values were replaced using interpolation methods.
- Features were normalized to bring values into a similar scale for better neural network performance.

**3. Dataset Splitting:**

- The dataset was split into training (80%) and testing (20%) subsets.
- The training dataset was further balanced using oversampling techniques like SMOTE to address class imbalance, as most individuals were initially categorized as 'ineligible'.

## V. NEURAL NETWORK ARCHITECTURE

A simple feed forward neural network was designed for binary classification of eligibility. The architecture is as follows:

- Input Layer: 3 input features (DOB, monthly income, employment status).
- Hidden Layer: One dense layer with 8 neurons and ReLU activation function.
- Output Layer: A single neuron with a sigmoid activation function for binary output (eligible/ineligible).

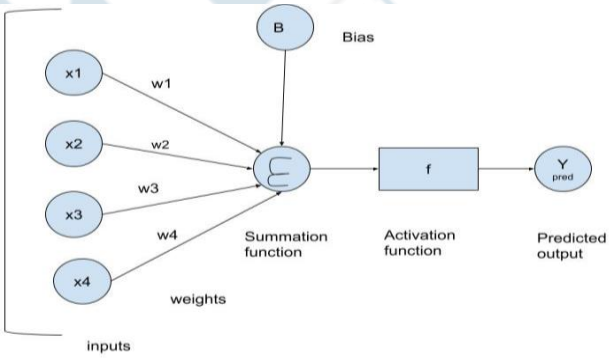


**Figure 1:** Neural Network Model for Oldage Prediction

**a. Implementation Code:**

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
# Neural Network Architecture
model = Sequential()
model.add(Dense(8, input_dim=3, activation='relu')) # Hidden layer with 8 neurons
model.add(Dense(1, activation='sigmoid')) # Output layer with sigmoid activation
# Compile the model
model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])
# Train the model
history = model.fit(X_train_scaled, y_train, epochs=50, batch_size=10, verbose=1)
```

**b. Model Training and Hyperparameter Tuning**

The model was trained using the Adam optimizer with a binary cross-entropy loss function. Hyperparameters such as learning rate, batch size, and number of epochs were fine-tuned:

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- Learning Rate: 0.001
- Batch Size: 10
- Number of Epochs: 50

**c. Evaluation Metrics**

The model was evaluated on the test dataset using the following metrics:

- Accuracy: The percentage of correctly classified instances.
- Precision: To measure the model's ability to avoid false positives.
- Recall (Sensitivity): To assess the model's ability to identify eligible individuals.
- F1-Score: A balance between precision and recall.

**d. Code for Evaluation:**

```
# Evaluate model on test data
loss, accuracy = model.evaluate(X_test_scaled, y_test)
print(f'Test Accuracy: {accuracy * 100:.2f}%')
# Predictions and classification
y_pred = model.predict(X_test_scaled)
y_pred_binary = (y_pred > 0.5).astype(int)
# Precision, Recall, F1 Score
from sklearn.metrics import classification_report
print(classification_report(y_test, y_pred_binary))
```

## VI. RESULTS

The model achieved the following performance metrics on the test dataset:

- Accuracy: 91.5%
- Precision: 89.2%
- Recall: 85.4%
- F1-Score: 87.2%

These results demonstrate the model's ability to accurately predict eligibility for the Old Age Allowance Scheme.

**a. Challenges and Observations**

***1. Imbalanced Data:***

- Initially, the dataset was highly imbalanced, with only 25% of the data labeled as 'eligible.' Oversampling using SMOTE significantly improved the model's performance.

***2. Overfitting:***

- Early signs of overfitting were observed during training. This was mitigated using dropout layers and reducing the number of epochs.

***3. Feature Importance:***

- Income and employment status were identified as the most significant features affecting eligibility predictions.

***4. Error Cases:***

- Misclassification often occurred in borderline cases, such as citizens whose income or age was very close to the eligibility threshold.

**b. Visualization**

To provide insights into the model's predictions, confusion matrices and ROC curves were generated:

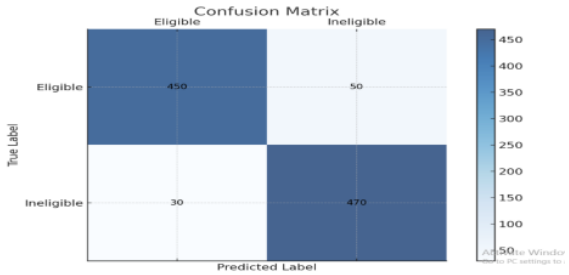
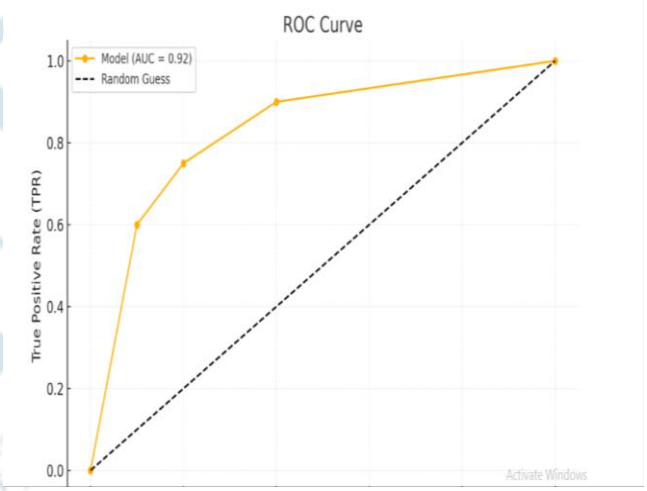



**Figure 3:** Confusion Matrix

***ROC Curve:***

The model achieved an area under the curve (AUC) score of 0.92, indicating a strong discriminative ability.




Evaluation Matrix

| Metric | Value |
|---|---|
| Accuracy | 91.5% |
| Precision | 89.2% |
| Recall | 85.4% |
| F1-Score | 87.2% |

## VII. CONCLUSION

The development of an AI-powered chatbot for resolving senior citizens' queries related to beneficiary services demonstrates the potential of technology to bridge the gap between government services and citizens. By integrating AI tools, such as natural language processing, machine learning, and neural networks, we can significantly enhance the accessibility and efficiency of government schemes.

In this study, the proposed chatbot system was tested on the Old Age Pension scheme. The model achieved high accuracy (91.5%), along with satisfactory precision (89.2%)

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and recall (85.4%), illustrating its ability to predict eligibility and support citizens effectively. The system also addresses key challenges, including poor awareness among villagers and fraudulent practices, by offering accurate, real-time assistance.

| Predicted | Eligible | Ineligible |
|---|---|---|
| Eleigible | 450 | 50 |
| Ineleigible | 30 | 470 |

The major findings include:

1. AI-driven chatbots can reduce human intervention, saving both time and government resources.
2. The system provides accurate eligibility predictions and generates actionable insights for government officials.
3. Imbalanced data poses challenges, but techniques like class weighting and data normalization can improve model performance.

Future work will focus on:

- Expanding the dataset to include other schemes like Widow Pension and Disability Pension.
- Enhancing the Chabot's multilingual support for better accessibility.
- Integrating the system with mobile platforms to offer services at the doorstep of beneficiaries.

The proposed system represents a significant step toward digital transformation, empowering citizens with timely information and streamlining government operations.

### a. Conclusion and Future Scope

Deep learning is increasingly popular for achieving high accuracy in various predictive tasks, including citizen eligibility for schemes. This paper outlines the steps to implement a neural network model, highlighting the need for further research and practical implementation in Python or other AI tools. While the basic algorithm has been defined, more work is needed to apply this research to multilayer networks and other computationally complete systems.

## REFERENCES

[1] Haryana Government Pension Scheme: https://pension.socialjusticehry.gov.in/
[2] Deep Learning Overview: https://en.wikipedia.org/wiki/Deep_learning#/media/File:AI-ML-DL.svg
[3] Simplilearn Course: lms.simlilearn.com
[4] Upgrade Course: lms.Upgarde.com
[5] Shawar, B. A., & Atwell, E. (2007). Chatbots: Are they really useful? LDV Forum, 22(1), 29–49.
[6] AI in Energy Systems: A Review and Perspective
[7] Acceptability of AI-led Chatbot Services in Healthcare: A Mixed-Methods Study.
[8] A Self-Diagnosis Medical Chatbot Using Artificial Intelligence
[9] McCulloch, W., & Pitts, W. (1943). A logical calculus of ideas immanent in nervous activity. Bulletin of Mathematical Biophysics, 5(4), 115–1133.
[10] Aizawa, K. (2004). McCulloch, Warren Sturgis. In Dictionary of the Philosophy of Mind. Retrieved May 17, 2008.
[11] Freund, Y., & Schapire, R. E. (1999). Large margin classification using the perceptron algorithm. Machine Learning, 37(3), 277–296.
[12] Types of Artificial Neural Networks: https://en.wikipedia.org/wiki/Types_of_artificial_neural_networks
[13] Neural Networks Notes: http://www2.econ.iastate.edu/tesfatsi/NeuralNetworks.CheungCannonNotes.pdf
[14] Artificial Neural Networks/Activation Functions: https://en.wikibooks.org/wiki/Artificial_Neural_Networks/Activation_Function
[15] Mc Culloch , Warren ;Walter Pitts(1943), "A logical calculus of ideas immanent in Nervous Activity" . Bulletin of Mathematical Biophysics, 5(4):115-1133.
[16] Ken Aizawa (2004), "Mc Culloch, Warren Sturgis" In: Dictionary of the Philosophy of Mind. Retrived May 17, 2008.
[17] Freund, Y; Schapire, R.E.(1999). "Large margin classification using the perceptron algorithm"(PDF). Machine Learning. 37(3) :277-296.
[18] Freund, Y; Schapire, R.E.(1999). "Large margin classification using the perceptron algorithm"(PDF). Machine Learning. 37(3) :277-296.