NAO ROBOT AS A PERSONALITY PREDICTOR AND ENHANCER

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Abstract - *Humanoid robotics has a wide range of applications in today's world. One such application is prediction of personality. As humanoid robots are an attempt to replicate humans, determination of personality is an important aspect for humanoid robotics as well as it's applications. This paper is about a demonstration of using a humanoid robot NAO for personality prediction. NAO is a humanoid robot developed by SoftBank robotics. The NAO acts as a human and has a conversation with the person whose personality is to be determined. Based on the conversation the person gets classified into one of the categories identified. The prediction is done in two stages. In the first stage the user has to answer some basic personal questions along with personality questions and then the Big5 model is applied on the response. Based on the output of stage one the next stage takes the Big5 parameters and user information as input and our Machine learning model is applied on the given input. The dataset used is taken from International Personality Item Pool's test data. The model is a combination of clustering and classification. The K means algorithm is used for clustering. The silhouette and Elbow methods are used for deciding the value of k. The final classification is done using the decision tree and people are classified into 4 different types. The accuracy obtained in classifying the people is 96.667 percent.*

Key Words: NaoRobot, Machine Learning, Personality Prediction, Big5 Model

1. Introduction

In this paper we focus to build a system that predicts the personality of a person based on the answers to personality questions and Big5 API using NAO robot and further classify the people according to input using machine learning model designed by us. This paper is based on converting the audio received to speech using IBM WATSON text to speech conversion then using the BIG5 Model to predict the personality of the individual and using the Machine Learning model to know in which cluster the individual belongs too. The Big5 is also called as Five Factor model of personality. It is the most accepted personality theory in the community. It is generally believed to be the most scientific way to differentiate between people. In this model, people are understood to have varying levels of key personality factors which drive our thoughts and behavior. Although personality traits cannot exactly predict behavior. The differences in the Big5 Traits help us to understand why people may react differently, behave differently, and see things differently from others in the same situation.

Personality Enhancers are very important, because it helps individual to know he/she and can try to self-improve. Personality Enhancers are also important for any screening process where the organization can know the personality of individual.

There have been many online personality enhancers, but they contain a very large set of questions and with only 4-5 options which are statically set. User can't input their own answers. Also, the process is too large and tiring. So this research overcomes the drawbacks where Nao Robot will act as a medium between user and personality enhancer model. There will be a set of some personality questions which the robot will ask to user by speech. User will simply answer the questions by speech and then the speech will be converted to text. After applying big5 the output will be generated and sent to user.

The whole process will be entertaining because user will get more comfortable and also user will just have to speak his/her answers. Also a report will be generated as an output which will contain the big5 traits of user.

2. Literature Survey

To build a system that takes audio as input and converts into the Speech and predicts the personality of the individual, suggests how to enhance the personality and produces the report as output. In order to proceed with our project, we need to consider different research work already done in this area so as to understand their research work, their outcomes and also understand the advantages and disadvantages of their work[1].

First paper we consider for our paper was - ''Speech-to-text and speech-to-speech summarization of spontaneous speech'', it was published in the year 2004 and this paper depicts How we can text to speech and speech to text for our paper using Naorobot to interact with the human[2]. The outcomes of this paper were that this paper presents techniques for speech-to-text and speech-to-speech automatic summarization based on speech unit extraction and concatenation.

Next paper we consider was related to Big5 model named 'What Do We Assess when We Assess a Big 5 Trait? A Content Analysis of the Affective, Behavioral[3], and Cognitive Processes Represented in Big 5 Personality Inventories .Since out personality prediction model is based Is based upon big5 module we need to considered in-depth research paper so that we that we can be accurate with our results. This paper was published in the year 2002 and explains what personality traits are and how Big5 helps to identify these traits in various people.

Next paper consider was also related to Big5 model and the different Personality traits present in Big5 model like - Openness, agreeableness, Extraversion, Neuroticism, Conscientious. This paper was published in the year 2011 named ''Predicting the form and direction of work role performance from the Big 5 model of personality traits''[4]. The authors collected measurements of personality from employees and supervisor ratings of performance. Openness to experience and agreeableness had opposing effects on individual proactivity – openness was positively related, whereas agreeableness was negatively related to this dimension.

The next part of this paper is to ask the accurate questions to which the user will reply and hence the model will process it to understand the personality of the currently using user. Hence for this work '' How to Test Questions About Similarity in Personality and Social Psychology Research'' paper was considered which was published in the year 2017''. The various types of personality questions can be used to determine the nature of a person. The questions should be from the personal life as well as from the person's surrounding to know how that person responds to things.

This paper also requests the humanoid robot -Nao to have an interactive interaction With the user and make the user comfortable while talking since we need to understand the personality of the person and making the person comfortable while speaking is very important so that the person can talk freely and express whatever his feelings and thoughts are. For this purpose, we considered the paper named ''CleverNAO: The intelligent conversational humanoid robot'' published in the year 2015[5]. In this paper, a chatbot is linked to a robot so that the robot could verbally speak what the chatbot's response is to a human.

Thus, considering the above five papers as a base before we moved ahead with the paper and completed our task of personality prediction.

1.1 What is Nao robot?

NaoRobot is an autonomous humanoid robot which was developed in the year 2015. The main purpose for which Nao Robot has been used for is in the field of education and research purpose in various institution and universities all over the world. NaoRobot weighing 5.3kg is a 58-cm tall robot. This robot similar to humans is able to move, see, walk, hear and even talk. Software of Nao robot are NAOqi and Choregraphe.For natural conversation and emotions of Naorobot the humanoid robot has an operating system called NAOqi. Running with the help of python, Choregraphe tool is a multi – performed desktop-based application with the help of which Nao robot timeline can be created based on which Nao robot performs actions. Having a virtual robot inbuilt inside the tool it allows to testify the code and actions on the virtual robot before applying it on the robot thus giving the users a room for error.
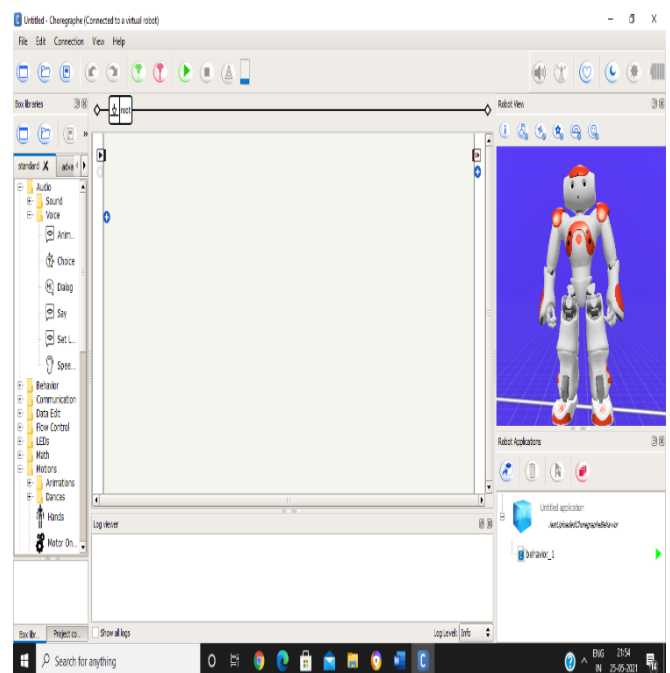

Fig -1: GUI of Choregraphe tool used for NaoRobot

1.2 Personality Prediction

Personality is a way to think, feel, and behave. Personality affects moods and opinions. It helps to distinguish one person from another and that can be observed in people's relations to the environment and to the society. The term personality prediction means to identify the type of persoanlity using the past data or collecting new sample data from people[6].

In this paper we have used the dynamic conversation with a NAO robot to identify the personality.The number of factors involved in prediction affects the forming of persoanlity clusters.The prediction is done using a combination of Big5 model and Machine learning.The parameters openness, concentiousness ,extraversion, agreeableness and neroticism along with age,gender are considered in this paper for the prediction.The identification of the type of person can be used in variety of applications. It is very important for recruiters to assemble all the relevant information regarding candidates during the recruitment process, so that the best hiring decisions can be made. A personality assessment can provide recruiters with deep insights that combined with other evaluation elements will significantly improve the candidate selection.It can also be used in social media platforms to recommend people of similar kind.Similarly professional platforms can use it to make groups of people with a common career goal.Thus personality prediction has different applications depending upon the available data and context of grouping that is to be done for prediction of type of personality.

Fig -2: Human brain with different features[7]

1.3 Prediction Enhancement

The enhancement of persoanlity is done by using the scores obtained in the processes. The scores are obtained based on the assesment which consists of 20 questions which are specific to presonality prediction.The scores are categorized as high and low.A low or high score doesn't neccesarily imply a weakness or strength.Different traits of Big5 have diffrent meaning of high and low.The causes and effects of the scores are given in this paper.For instance is the Big5 extraversion and openness is high that

will imply that the person is more extrovert and tends to make his opinion clear and also likes to explain an contradict the oppenents arguments.This now can again be good or bad and depends upon the context on which the prediction is made.Thus the enhancement made is a general type which states that the score is low or high and that implies what characteritics of the person.Thus the prediction and enhancement if used together can help to build a complete model for the personality and that will help the person to perform and think and perform as per their needs.

1.4 What is Big5 Model?

The Big Five personality traits was the model to establish the relation between personality and behaviors of different people[8]. The Big Five has been given this name because the model states that human personality can be identified and measured with these five parameters,each of them is different from the others in terms of the parts of personality. The Big Five model is also sometimes called OCEAN model owing to the initial letters of the names of these parameters.The five broad personality parameters are named as extraversion, agreeableness, openness, conscientiousness, and neuroticism[9]. Though the personality traits cannot exactly predict the behavior pattern, the variations in the Big five traits enables us to identify why people may react, behave and see things differently from other people in a particular situation.So this model tries to compare these major factors which are involved in personality difinition and provide us with the values.We can interpret the type of personality from these factors which are responsible for determination of personality. The five traits contribute to the five different behavioural and biological factors of human personality[10] .They are explained below:

Agreeableness: Agreeableness is the first personality trait of the big five personality model. A person who has a high level of agreeableness is usually very calm, friendly, and has a skill of dealing with others in various situations.

Conscientiousness: It is the third personality trait of the big five personality theory. A person having a high score in conscientiousness usually tends to have a high level of self-discipline.

Extraversion: The extraversion is the fifth personality trait of the big five model and contributes to human personality. Extraversion is related to social skills, amount of conversations that a person does, and level of excitement.

Neuroticism: It is the fourth personality trait of the big five model and is defined as an attitude towards depression,anxiety and self-doubt along with some other factors that are negative.

Openness: Openness is the fifth trait of the Big five model. It shows the extent of how open-minded a person is in his life.
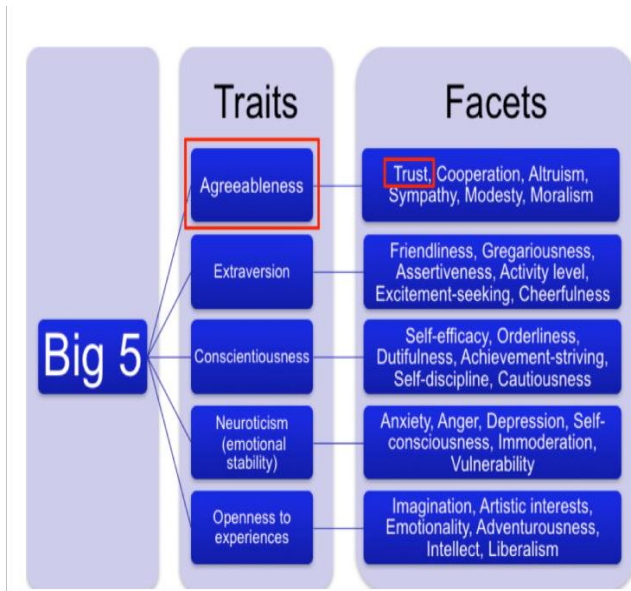

Fig -3: Big5 model and their different traits [7]

1.5 What is the basis on which personality will be predicted?

Personality prediction helps to understand a person's capabilities, their ability to handle a particular task and manage the workload and their ability to mix into a particular environment with ease. There is no right or wrong personality, every person has a unique personality suitable for certain kind of work. Hence it important for humans to understand their own personality in order to achieve success in life and for this personality prediction plays a vital role.

The 20 different questionnaires set to be used in this paper to predict the personality of a person using Nao robot and thus enhance the personality of a person by giving him appropriate suggestions and also suggesting them their like-minded group are stated below[11] –

1. Who has been your role model and why?

2. Who is the person who knows you the best?

3. What would your friends say about you and your friendship?

4. What is the question people ask you most often and what is your reply to it?

5. What is the thing you would never say to another person and why?

6. What has been your greatest achievement?

7. What has been your greatest failure?

8. What lessons have you learned from your greatest failure?

9. What are the things you're most proud of?

10. What things would you like to change about yourself?

11. If something in your house breaks, what is the first thing you will be doing?

12. What is the greatest obstacle which you are facing right now?

13. How do you like to "waste" your leisure time?

14. What is the ritual that helps you calm down and feel relaxed?

15. Which is your favorite place in the town?

16. What will you prefer – reading a book, watching a movie or a theatre play?

17. What has been the happiest period of your life?

18. What is your most treasured and beloved memory from your childhood?

19. What was your favorite sport or game when you were a child?

20. What is the greatest injustice that you have lived through?

1.6. Decision Tree –

One of the most famous classification techniques used in data mining and ML is decision tree. DT is basically used to predict the most likely outcome by learning from the training data and thus testing on the test data and thereby predicting new unseen data. DT as the name suggest, is a tree-like structure or graphical model. DT is basically an approach, that consists of conditional statements used in the algorithm[12]. DT helps to identify a particular strategy in order to reach the goal more efficiently and effectively.

Once provided with the attribute data along with their class labels, decision tree algorithm is able to generate a sequence of rules that will be

able to classify the data. Common usage of DT are seen in classification problem and research operations. Based on the desired outcome and the situation there are different sort of decision trees that can be used for example - Classification tree, Regression tree, Decision tree forest etc.

1.6. Why Decision Tree is more suitable than other models

DT algorithm is powerful tool used for prediction, regression, classification, data mining and interpretation. The greatest benefit of DT is understandability as well as flexibility. Some of the various benefits of DT are mentioned below[13] –

- Easy to read and interpret the data.
- DT makes the complex relation between attributes and class label simplified by dividing the attributes to sub-defined groups.
- High Speed and implementation simplicity.
- Lesser Data cleaning is required.
- DT is easily robust to outliers.

Though they are some disadvantages also compared to other model's DT has been one of most widely used algorithms over different models with higher accuracy most of the times.

1.7. Dataset:

The dataset is collected from the internation personality item pool. IPIP is an official site for the data related to personality and tests. The site includes over three thousand items and over two hundred and fifty different scales that have been derived from the items.The items and are in the public domain so anyone can edit or use the data their purpose.The dataset consists of scores of 307313 people having different types of personality scores.The data is used for training which is done using supervised and unsupervised approach.The data in table [2] below consists of following attributes:for

Table -1: Dataset Description

Attributes	Significance
Case_id	It denotes the identity of the person and is unique for all the people in the dataset.
Country	It denotes the country from which the person belongs.
Age	It deonotes the age of the person
Sex	It denotes the gender of the person i.e male and female
Agreeableness:	It denotes the score of Big5 agreeableness
Extraversion	It denotes the score of Big5 extraversion
Openness	It denotes the score of Big5 openness
Conscientiousness	It denotes the score of Big5 conscientiousness
Neuroticism	It denotes the score of Big5 neuroticism

Figure below shows the sample snapshot of the dataset having 9 columns representing the different attributes explained the the above table.

Fig -4: Snapshot of the dataset

2. Techniques

2.1. Methodology
Nao will talk to the users and will ask questions to users which will create a friendly atmosphere and user will also enjoy answering them and we can expect original answers from them.

Nao will ask set of 20 questions to user. The questions are in audio form. Later user will answer each one by one and that speech will be converted to text using IBM speech-to-text service. As we get the response we will keep on appending them to our text file.

Once the answers collected are converted in form of text and the text the transferred to the Big5 personality insights API of IBM Watson. This generates the scores of various big5 traits and collectively taken as input for our model. We later check all the 5 values and check their scores (high or low).

The values are stored as a tuple in a variable and will act as input to the Machine Learning model. The dataset attribute gender and age are normalized using min-max normalization. The average score is calculated using the five big5 attributes,normalized age and normalized gender.

The number of clusters are identified using elbow method and silhoutte method for k-means algorithm. Based upon values, the minimum value is selected as the number of clusters. The normalized average score and normalized gender are sent to the K-means model.Based on the input of the clusters are obtained and the cluster label get attached to the dataset.

The input tupple is given to decision tree and the cluster label get attached to the dataset. The input tupple is then given to decision tree classifier as input andd then the confusion matrix and accuracy is computed. Based upon the type of values the person is given a report in pdf format and it contains the description of various attributes of person and also suggestions to improve the scores.

2.1. Input:

The input is the first phase of this paper.Initally the basic detials of like age,gender and name are taken as input. The input is taken from the responses recieved by people based on the 20 personality detection questions.They are open ended questions and so require descriptive answers.The answers collected are converted in form of text and the text the transferred to the Big5 personality insights API of IBM Watson.This generates the scores of various big5 traits and collectively taken as input for our model.

2.3. Algorithm

- ❖ NAO robot greets and welcomes the person.
- ❖ NAO robot asks introductory questions such as name,age and gender and the responses are converted from speech to text using natrual language processing.
- ❖ The personality test begins and NAO robot asks the 20 personality detection questions defined at the backend.

- ❖ The response of the questions is converted to text after each question and stored in different files. Example for the first answer the response is stored in ans1.txt.
- ❖ The responses of all the files are combined into a single file and then are sent to the big5 API of the IBM Watson.
- ❖ The entire text then gets processed using the big5 model and the values of aggreableness,concientiousness,openness,extraversion and neuroticism are obtained as a response of the API.
- ❖ The values are stored as a tuple in a variable and will act as input to the Machine Learning model.
- ❖ The dataset attribute gender and age are normalized using min-max normalization.
- ❖ The average score is calculated using the five big5 attributes,normalized age and normalized gender.
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3. Implementation

3.1. Implementation

Manufactured by Aldebaran Robotics NaoRobot is an autonomous humanoid robot which was developed in the year 2015. The main purpose for which Nao Robot has been used for is in the field of education and research purpose in various institution and universities all over the world. NaoRobot weighing 5.3kg is a 58-cm tall robot. This robot similar to humas is able to move, see, walk , hear and even talk.

At first users are confused why Personality Enhancer using Nao? So the correct answer is as we have seen many Personality Enhancers online which takes a long 1 hour surveys and then display the out are really tiring. So that's why we introduced Nao as a medium. Nao will talk to the users and will ask questions to users which will create a friendly atmosphere and user will also enjoy answering them and we can expect original answers from them.

Nao will ask set of 20 questions to user. The questions are in audio form. Later user will answer each one by one and

that speech will be converted to text using IBM speech-to-text service. As we get the response we will keep on appending them to our text file.

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3.2. Advantages

- ❖ 1)The system be used to detect personality in any field like education, employment etc.
- ❖ 2)The system could be used by psychiatrist to determine type of their patients.
- ❖ 3)The system provides an overall accuracy of 96.667%.
- ❖ 4)No separate hardware requirements other than NAO and the connected laptop/PC.

3.3. Disadvantages:

- ❖ 1) Providing input to big5 model is a time-consuming process.
- ❖ 2) Recognition of speech may not be clear at times, for example two or three words can be missed in case of a long sentence.
- ❖ 3)The impact of country on personality could not be considered due to the complexity of the data (25-30 different countries).

4. CONCLUSION

Thus, the prediction of personality was done on basis of various features of a particular individual. The system takes into consideration the response of person on various personality prediction questions and produces a Big5 value set for a person. This set is then combined with the other inputs and attributes of the dataset. The average score is computed after normalization and k-means is applied. The labelled data is then passed to a decision tree and thus classification is obtained with an accuracy of 96.667 percent.Hence the three different types of clusters were identified and accordingly the people could be classified on basis of their personality.

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