HUMAN INTERACTION WITH NAO HUMANOID

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Abstract-This project defines about the NAO humanoid robot interaction with humans as a receptionist in an organization. It exhibits the face detection, speech recognition and human activities like walking and dancing. These tasks are achieved using stimulation software CHOREGRAPHE which is based on Graphical User Interface (GUI). The instinct of this project is to test NAO Humanoid Robot for interacting with humans in voice, movement and face activities.

Index Terms –NAO, Face Detection, Speech Recognition.

I. INTRODUCTION

This project defines about the strategies and operations of NAO Humanoid robot which are practically exhibited with the prototyped working model. This section explains the salient features of the NAO robot. The humanoid Robot NAO is a humanoid robot developed by a French Company called Aldebaran and later it is taken over by SOFTBANK ROBOTICS [1]. It is an open platform where the user can change all the embedded system software or just add some applications to make the robot adopt specific behaviors. The height of the NAO robot is 23 inches and it can walk on various varying slope surfaces and recognize faces & voices and even react to touch with emotions. The appealing appearance and features of the sophisticated sensor network, including two cameras, four microphones, a sonar range network, including two cameras and receivers, one mother board in head.

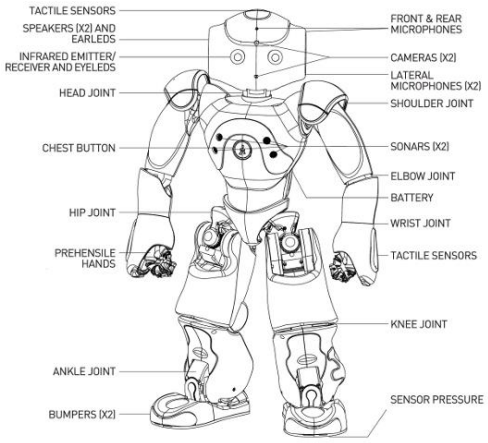


Fig.1: Appearance and features of NAO Humanoid.

TABLE I SPECIFICATIONS OF NAO:

Dimensions		1,210mm (height) × 425mm (depth) × 485mm (width)
Weight		28kg
Battery		Lithium-ion battery Capacity: 30.0Ah/795Wh Operation time: approx. over 12hrs (when using at shop)
Sensors	Head	Mic × 4, RGB camera × 2, 3D sensor × 1, Touch sensor × 3
	Chest	Gyro sensor × 1
	Hands	Touch sensor × 2
	Legs	Sonar sensor × 2, Laser sensor × 6, Bumper sensor × 3, Gyro sensor × 1
Moving parts		Degrees of motion Head (2°), Shoulder (2°) (L&R), Elbow (2 rotations) (L&R), Wrist (1°) (L&R), hand 5 fingers (1°) (L&R), Hip (2°), knee (1°), base (3°) 20 Motors
Display		10.1-inch touch display
Platform		NAOqi OS
Networking		Wi-Fi: IEEE 802.11 a/b/g/n (2.4GHz/5GHz) Ethernet × 1 (10/100/1000 base T)
Motion speed		Up to 3km/h
Climbing		Up to 1.5cm

NAO is a combination of hardware and software product merged with choregraphe program with GUI tool. The program facilitates with simple drag and drop boxes with coding to perform various tasks. The data is captured by the sensors and controlling the robot by the movement of libraries. It consists of 25 motors makes it to move freely in all directions. It

consists of two cameras which are helpful to see in the left and right directions. It has one inertial navigator makes it to move in an upright position or falling position. It consists touching sensors at chest, foot and head enables to feel the pressure-based touches. It consists of four directional microphone enables to hear the interactor voice. It is built up with two sets of receivers and transmitter which helps to easily adapt to automation applications. NAO has 25 degrees of freedom (DOF). The head part contains two DOF, five DOF in each arm, one DOF in pelvis, five DOF in each leg and two DOF at each hand. This enhanced DOF feature is used by NAO for free movement. A variety of communication equipment, including voice synthesizer, LED lights and two high fidelity loudspeakers are in the body of NAO. An Intel ATOM 1.6 GHz processor (in the head), running the LINUX kernel. It consists of a second CPU on the trunk. The power for the operations is provided from 48.6 KWh battery. The major merit of NAO than other robots is its pelvis kinematics design. Only one motor is required to drive the pelvis instead of three in classical design of its peers. This feature reduces the building cost and save space in the down part of the trunk.

II. RELATED WORK

This section summarizes the research of published works relevant to various activities of NAO by eminent researchers. Nur Ismarrubie Zahari modelled NAO in such a way that it helps a group of people or a community that suffers from Autism Spectrum Disorder [2]. Keizer et al. presented a research article which supports social engagement and interaction with multiple customers [3]. The research paper reports a successful implementation of the stimulation model [4].

Keizer et al. presented a research article which supports social engagement and interaction with multiple customers [5]. Selene et al. developed an intelligent system which manages hierarchical behaviors using a NAO robot for different personality traits [6]. The report explained an intelligent system to identify the behavior and personality of the humans by conducting interviews [7]. It developed a five-factor model to determine the reaction and personality of humans.

Atheer Alkhalifah has published a research paper which encourages kindergarten children in educational means and entertain the kids too.

Mohammed Azir has successfully published a research paper on construction of an infrastructure using NAO which helps to build the prototype of an unbuilt organization in order to insist the knowledge about the infrastructure which is going to be built.

III. METHODOLOGY

NAO can be either stimulated or programmed, The visual programming can be achieved by programming in various languages such as C, C++, Java and Python language. NAO is compatible with Windows, Mac OS and Linux [2]. The robot can be connected to a computer or laptop by using an Ethernet connection or WiFi connection. NAO has an embedded software called NAOqi [3]. It is a distributed environment which allows several distributed binaries, each containing several software modules to communicate together. NAOqi defines the following five main modules that allow interaction with the hardware elements on the robot:

NAOqi Core is responsible for the primary functions of robot operation.

NAOqi Audio Contains the software elements related to the audio of the robot.

NAOqi Movement module is the main tool allowing the robot to move.

NAOqi Camera module contains software elements related to the robot's vision.

NAOqi Sensors: This module contains software elements that serve to interact with the sensors on the robot.

Choregraphe is an intuitive graphical programming environment. When the software is launched, the graphic interface displayed on the screen. The application window is divided

into three zones First zone groups the list of available behaviors. Second zone allows the user to graphically lay out behaviors composed of library boxes and links between them and third zone is a graphical representation of NAO able to execute the implemented behavior.

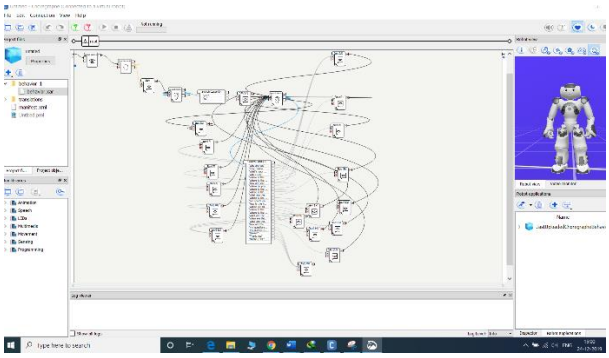


Fig.2: Application Window of Choregraphe GUI

IV. Experimental Results and Discussion

This section presents the approach proposed for the behaviors NAO model applied to various human interaction processes. The following illustrations describe what was technically done to implement and the components that were created to provide a bridge between the human and the robotic control software. In the third zone the picture of the NAO robot was displayed to ensure the execution of the Choregraphe software tool. Fig.3 describes the general information about the institution. The questions are given below the figures and answers are given in the say module which connected to each switch statement as shown

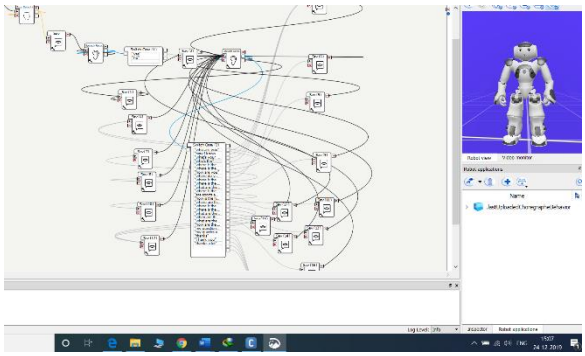
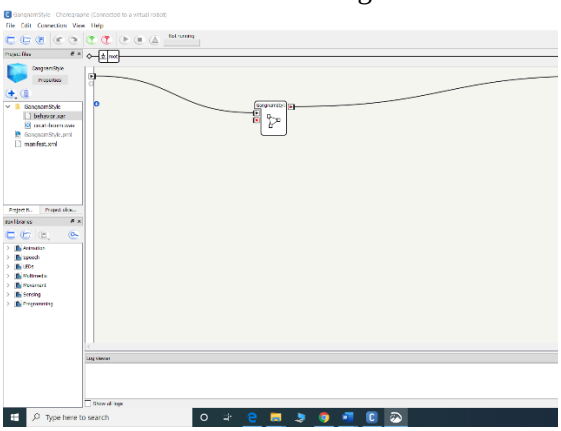


Fig.3: Robot answering as a receptionist

The Box starts when a signal is received on this input TEXT from Interview control module. The input of this module is a text string block. The Box sends a signal when the robot finishes talking (VOICE_END). The output signal is Boolean data type. Figures 3 illustrate the talk activities relevant to formal version, food and sports relevant conversation. The probable questions to which the NAO was trained, and the answers are given bellow the following figures. It is observed that the outcome of the NAO matches perfectly with the trained modules. The above figure illustrates the performance of the sensors located at the different parts of the NAO. It also interacts with the user about the location of the user and the impact of the pressure given by the user. The robot is able to identify and track the faces of the humans who are being training using recognition tools of the Choregraphe face detection box. The above figure shows the face detection module output in which the NAO was trained. It recognizes the human face as 3-D object which is displayed as a ball. In the above trails, it is inferred that the output of the trained NAO through Choregraphe tool box gave the optimal outputs.

In order to extend the functionality of the Humanoid robot not only it can interact with the people it can entertain people with Dance moves. The following activity is achieved and the stimulation is given below:



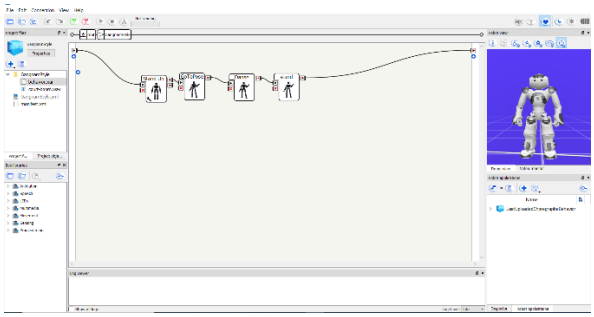


Fig.4&Fig.5: Stimulation for Humanoid Dance

The Nao Humanoid can also show the locations of a particular place inside an organization to its new clients as it acts as a receptionist. The overall stimulation of our working prototype is given below:

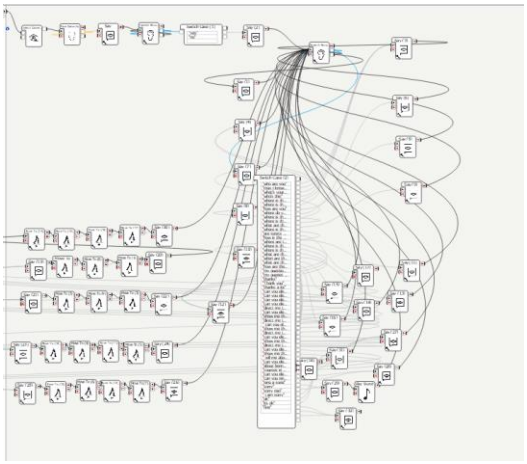


Fig.6: The overall stimulation which will integrate different behaviors of NAO Robot.

V. CONCLUSION

The humanoid robot NAO is able to detect face, voice and perform activities according to the human commands. The program for the robot is written using Choregraphe GUI tool. The project team trained the robot for different samples and demonstrate the outcome. It is observed that the robot has carried out the task exactly and the happiness index of the team was exemplary. It is a model hands on project for the demonstration of humanoid robot for day to day activities. It It is suggested to incorporate reinforcement learning for the random unknown trained samples and observe its performance.

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VI. REFERENCES

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VII. VIDEO REFERENCE

https://youtu.be/Vv2CgmbBPAA