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Development of a Communication Algorithm for Human Robot Interaction with a Mobile Robot

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ABSTRACT

This paper deals with the development of communication algorithm for Human Robot Interaction (HRI) to implement with a mobile robot used in any environment. The various studies reveal the need for an intelligent communication algorithm to be developed for precise execution of HRI. In this paper, a communication algorithm is developed which identifies the patient by means of, face detection or finger print module. The algorithm takes input from microphone and keyboard and the output for same is obtained from speaker, at the background a recorder records the whole interaction. The general information about the person can be obtained by interacting with them. This obtained information is recorded and saved to keep one's self updated. The algorithm can communicate in any environment and can also be use in offices, colleges and museums to greet the guests and people. The presented algorithm is currently implemented by using laptop and the experimental validation of the system will be done on a mobile robot available with the Mechanical department of SCOE, Pune. The algorithm communicates with any human being and can be use in any environment where there is a need of HRI.

Keywords— **Human Robot Interaction, Communication, Environment, Algorithm, Simulation.**

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I. INTRODUCTION

The service robotics industry around the world is playing a key role in economic transformation of several knowledge based economies which depend on innovation for growth. This makes it important to understand the tools which will be useful to bring about such benefits. It is extending from industrial fields to the living and working places such as homes, offices, restaurants, etc. As the robot is integrated into human habitats, interaction between human and robot is inevitably required. The human-like body parts, such as a head, eyes, and arms, will be used for non-verbal interaction in addition to natural language utterances to enable human-like interaction that is as simple as "talking to a person."

The aim is to develop service robot that needs a Human Robot Interaction (HRI) framework to effectively participate in any real time activity. The transfer of robots ecological niche from industrial fields to humans is accompanied not only with changes in the robots tasks, but also with changes in the interaction patterns between human and robot. These changes call for more active research in at least three areas: multi-modal, cognition, and emotional interaction. Work on

issues such as how to acquire socially sophisticated relationships, how to establish collaborative relationships, and how to exchange affective states has already commenced. Some experimental trials have been carried out to answer these questions. For example, Cog and Kismet

(2005) have studied and realized a sensible bi-directional social relationship between human and robot based on psychological and biological studies.

HRI is somewhat different from Artificial Intelligence (AI), which directly or loosely models human intelligence. HRI involves modelling of the linkage that connects human and robot intelligence, and is not limited to human intelligence alone. The Figure 1 shows service robot interacting with people. The conventional framework of robotics considers the interaction with the environment while the robot executes a pre-programmed task. Thus, this approach does not entail the capacity to interpret how HRI occurs in the context of a world domain. The current research in HRI can be classified into three themes. The first theme relates to studies and field trials understanding the psychology of HRI, the second theme relates to algorithms for affective computing for driving the HRI such as gaze tracking or faces tracking while the third theme concerns software engineering and programming language technologies for implementing the HRI design.

Figure 1 Service Robot interacting with people [2]

In this paper, a communication algorithm is developed which identifies the patient by means of, face detection or finger print module or RFID technology. The general information about the person can be obtained by interacting with them. The algorithm takes input from microphone and keyboard and the output for same is obtained from speaker, at the background a recorder records the whole interaction. This obtained information is recorded and saved to keep one's self updated. The algorithm can communicate in any environment and can also be use in offices, colleges and museums for interaction.

II. METHODOLOGY

The methodology presented provides an effective way to study human interaction with intelligent agents. Various algorithms are adopted by the researches for HRI.

A. Algorithm

The communication algorithm is a main source of any project. The algorithm gives the flow of project, in this paper the communication algorithm is develop with Java platform. The robot is designed to have a daily interaction with the user with each interaction lasting approximately three minutes. The nature of the interaction is helping an individual to track their information related to their work. The robot talks to an individual and guides them throughout the interaction, making small talk. The discussion is varied and changing with each interaction based on variables including time of day, particular person and state of the relationship between the robot and person, time since last interaction and the data that the user has input in previous days.

There are several features that are desirable for a robot to be used in a long-term HRI. The ability to look at the user or appear to do so is important for drawing a person's attention into the interaction. Robots in which the software that controls the human interaction is easily modifiable and is vital as many aspects of the interaction will need to be adjusted as experiments are conducted. Some set of features that enable social interaction e.g. eye contact, hand gestures, speech and speech recognition are needed, but the exact set depends on the type of interactions. All interactions are driven based on scripts and data in databases.

B. Design Concept

The main software system handles the control flow of an interaction and the communication between all subsystems.

The overall architecture is depicted in Figure 2. It shows the component, Language and Purpose. The main control system consist a Java language and the purpose is to control overall interaction. The basic flow is written to be easily modifiable, which allowed for rapid changes based on early and ongoing feedback that was solicited on the interactions with the system. There are a number of factors that can change what the robot says or does at a given instant. The software is written in Java and either instantiates subsystems as other Java classes or it uses sockets to communicate with them.

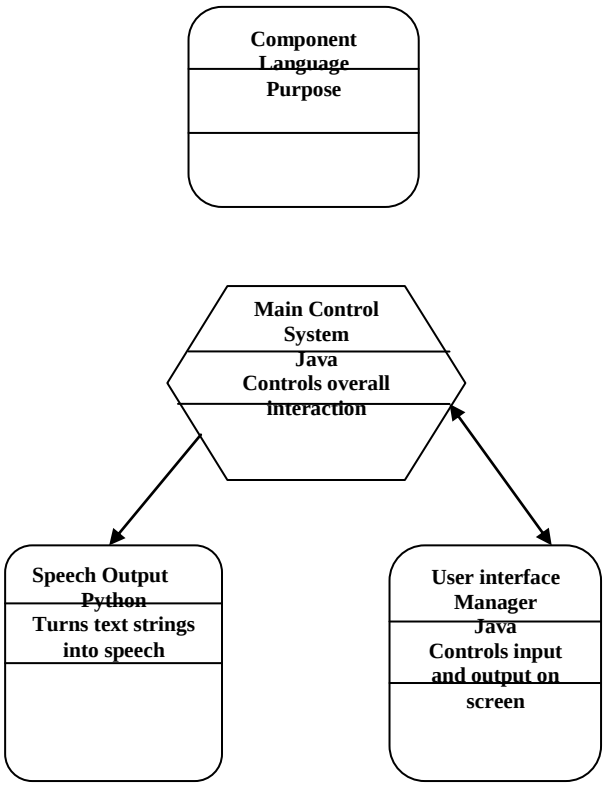

Figure 2 Overall architecture

C. System flow

The development of communication algorithm works, as the HRI needs to be interacting with people. The basic control flow is driven by the user. The user can select an option from the initial menu, which chooses the appropriate option to be run. When the robot identifies any person like by face detection, then it interacts with the person in two ways - option 1: Face to Face chat and option 2: Question stored chart. It depends on the person which option to choose and as the interaction start background recording also start. The recording is stored and saved which can be used whenever needed. There is also an option of play current recording which plays the latest recording and which can also be send to any wireless network for further work. This overall working is at present done on laptop. The below figure 3 shows the system flow diagram.

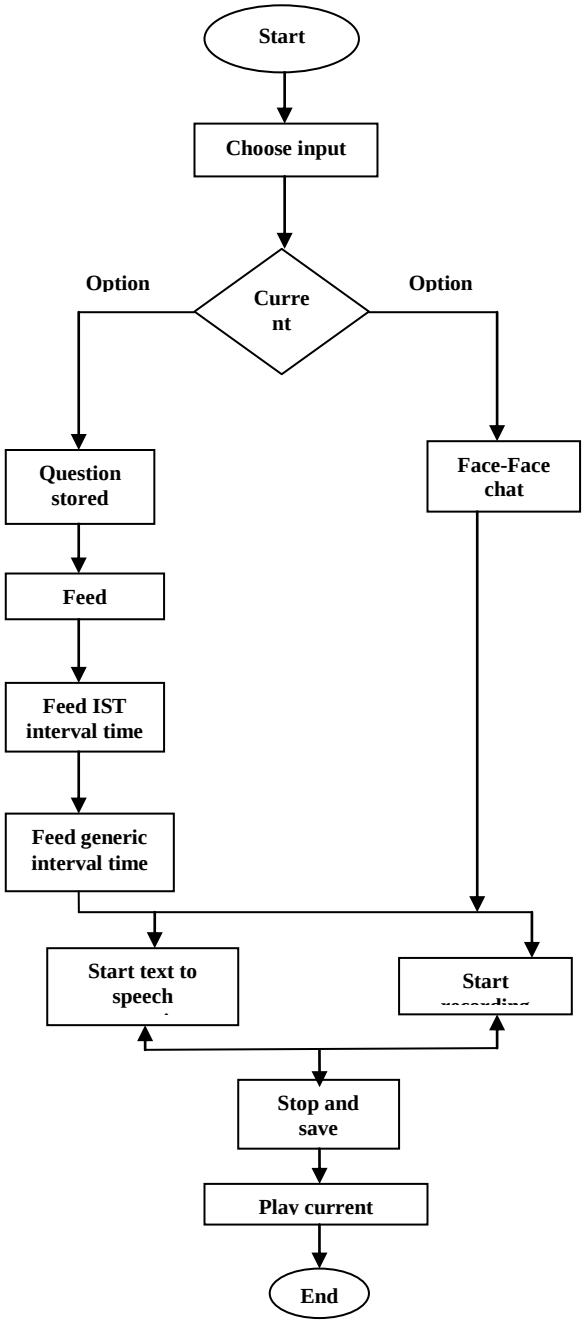

Figure 3 System flow diagram

III. RESULTS

The above algorithm is implemented on the Mobile robotic platform available at the Mechatronics laboratory of department of mechanical engineering, SCOE, Pune.
The Graphical User Interface made using Java programming for Text to Speech conversion and recording for the same conversation. The above figure 4 shows Mode selections - Text to speech synthesiser with recording form. When the form is open it asks to choose your type which displays two modes AUTO and REAL. The user can then select any mode of his choice and can operate the same.

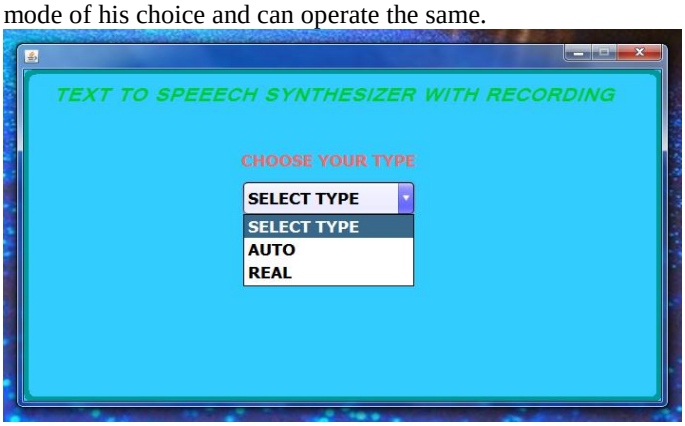

Figure 4 Mode selections – Text to speech synthesiser with recording

Mode 1: AUTO
In this option only one question should be taken as input and processed.

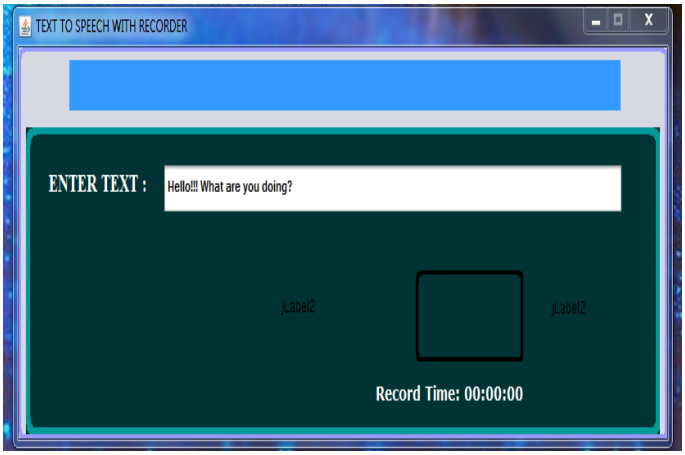

Figure 5 AUTO Mode

From the above figure 5, the text to speech synthesiser will take one input line and after clicking the Enter button it starts recording and playing the audio.

Mode 2: REAL
In this option a set of questions should be taken as input and processed.

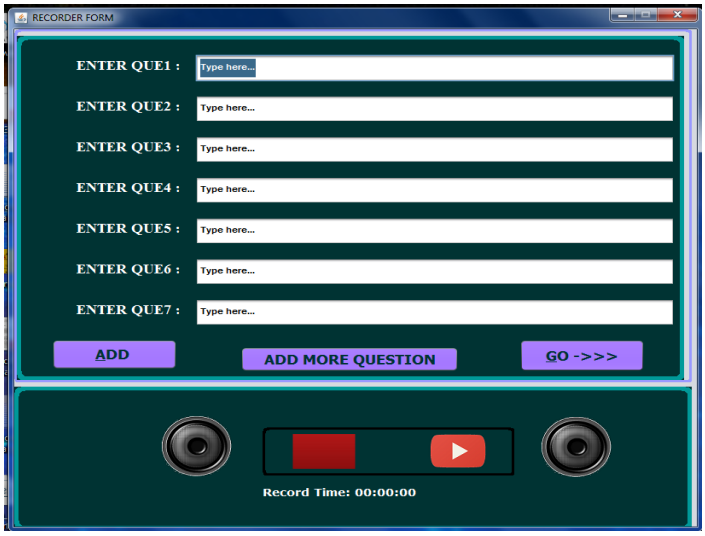

Figure 6 Recorder Form- In REAL mode

From the above figure 6, the text to speech conversions of a set of questions are shown. After the conversation is over, it will create a wave (.wav) file and stored in desired memory location. The file can be run whenever needed.

IV. CONCLUSION

The design concept shown above is presented in this paper. The designing helps to better understand how to run a-long term HRI what data to collect and how to analyse it. The algorithm is easy to understand and the interaction process is rapid. The working at present is done on laptop and the validation will be done on a robot which is available with mechanical department of SCOE, Pune. This GUI implemented in mobile robot can be used further in many applications like the patient- robot interaction system in hospitals, greeting people in museums, airport, cafe's etc.

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