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Smart Robotic Assistant Using IoT

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Abstract - *A Smart Robotic Assistant (RA) that will help human being a lot in multiple ways is developed. The area used is Internet of Things (IoT). The RA operates on human voice commands and gestures commands, given remotely by using an Android platform based smart IoT device like smart phone. The voice and gesture commands are converted to text form and is the communicated to the RA over a Wi Fi network. The RA is provided with mechanical arms to pick an object and place it in another location. An Arduino microcontroller based platform is used to develop this smart RA. The RA is capable of performing different operations like start/stop, move left/right, forward/backward, picking up object and placing it in another location. These peculiarities are really helpful for humans especially for elderly people. The applications of robotic assistant including homes , hospitals, industries etc.*

Key Words*: *smart robotic assistant, voice commands, gesture commands, Wi Fi network, Android based smart IoT devices.

1. INTRODUCTION

A robot is a machine especially one programmable by a computer .the robot is capable of carrying out a complex series of actions automatically. They are guided by an external control device. The branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing is robotics. Robots have replaced humans in performing repetitive and dangerous tasks.

An internet is an interconnected network providing a variety of information and communication facilities. The main advantage of internet is that it helps us to send messages quickly between computers around the world. The Internet of Things (IoT) is a concept in which surrounding objects are interconnected through wired and wireless networks without user intervention.

The smart RA developed here will perform its operations according to both gesture and voice commands. The operations performed are move forward, backward, left and right. The RA can pick and release objects too. This will help the elderly people very much. A 3d printed arm, an Arduino module and Wi-Fi module is used. A total of 4 dc motors are used 2 for movement of RA, 1 for up and down movement and 1 for picking and releasing object. Rechargeable lithium battery is used for carrying out these functions.

2. PROPOSED SYSTEM

Smart robotic assistants help human beings in reducing the manual efforts in day-to-day tasks and the risk to precious human lives in hazardous situations. In this paper, we discuss about a smart robotic assistant that operates on human voice and gesture commands, given remotely by using an Android platform based smart IoT device. The real-time signal processing of the voice commands is carried out using a MQTT (Message Queue Telemetry Transport) server. The speech command signal converted to text form is then communicated to the robotic assistant over a Wi-Fi network. The robotic assistant is developed on an Arduino micro-controller based platform.

2.1 Microcontroller

The first requirement for the design of the robot is the microcontroller. In this project, Intel Edison Arduino microcontroller has been used. The Intel Edison module is a SoC(System on Chip) that includes an Intel Atom 500MHz dual-core, dual-threaded CPU and an Intel Quark 100MHz microcontroller. Intel Edison Kit for Arduino provides the Arduino 1.0 pinout and standard connectors such as a micro USB connected to a UART, a USB OTG port that can be switched between a second micro USB device connector, a standard size USB host Type- A connector, a SD card holder, and a DC power jack. The Intel Edison Kit for Arduino makes possible to have 20 digital input/output pins, of which 6 can be used as analogue inputs.

3. WORKING

In this work, movements of the smart RA are controlled by voice and gesture commands given through a smart mobile phone using Android OS based platform.

The voice commands signal is converted to the text form. Using a smart IoT device, this text command is then transmitted to the Wi Fi module on-board the robot via MQTT server. The Wi Fi module receives the signal and then sends commands to the micro-controller, on-board the RA's body. The micro-controller in turn processes the commands

and controls all the 4 DC motors used for various movements. Voice commands make the control of RA easier for the humans, thus providing a better and user friendly interface. The accuracy of voice to text transformation depends upon the distance between the mouth and the smart IoT device, and the signal strength.

The schematic block diagram of the operation of RA is shown in Fig. 1, with the movements of RA's body, hands and arms. Human voice or gesture commands are given using an android based smart IoT device using Google's voice and gesture recognition system.

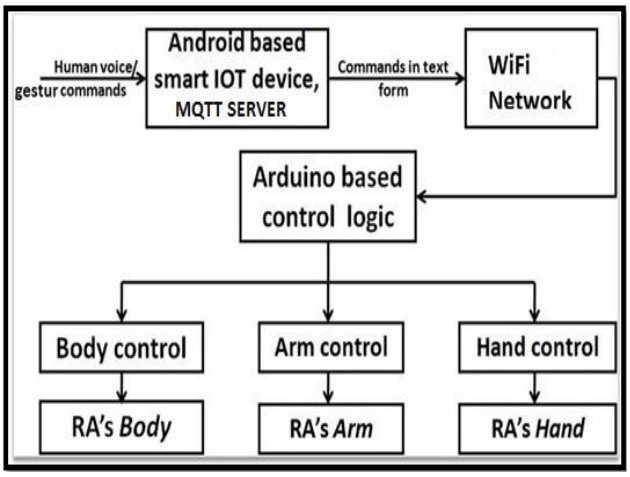

Fig -1: Schematic block diagram of *smart robotic assistant* (RA)

Smart IoT device is used here for wireless communication. A smart phone is used as an IoT device that uses Wi Fi. In the receiver side, the micro-controller ports are used as interface between the Wi Fi receiver and the RA. The movements of the RA's body, hands and arm are independent of each other and all can be controlled at the same time, since each function is controlled by motors. The main modules in the voice recognition system are:

GUI: It is used for interacting with the user. Basic structure of application is reflected in GUI.

Voice Recognition: For intelligent voice assistant application is done using Google Server. The conversion of acoustic speech into a set of words using a software component is the process done here. For a speech recognition system, its accuracy depends on differ in vocabulary size and confusability, modality of speech (isolated, discontinuous, or continuous speech, read or spontaneous speech), task and language constraints. The system consists of five modules: feature extraction, phone model training, dictionary preparation, grammar estimation, and sentence decoding.

TTS Engine: A **text-to-speech** (**TTS**) system converts normal language text into speech. Creation of synthesized speech can be done using the concatenation of pieces of recorded speech that are stored in a database. The output is given in the form of speech

The operations done by the smart RA is as follows, the RA moves forward when the voice command is forward, moves backwards when voice command is backward, moves right when voice command is right, moves left when voice command is left, arm moves up when voice command is up, arm moves down when command is down, RA pick object when command is pick, drops the object when command is drop.

Gestures have been an important means of communication in the physical world from ancient times, even before the invention of any language. In this era of machines taking control of every complex works, interactions with machines have become more important than ever. Robots are classified into two types: Autonomous robots like Line sensing or edge sensing robots, and Remote-controlled robots like Gesture controlled Robots.

The gesture commands like pinch, un pinch, swipe up, swipe down, single tap, double taps are given through mobile application and is converted using inbuilt gesture libraries. The commands obtained is transmitted to a robot via a Wi-Fi module of smartphone using an android app. Further, it is processed by a Arduino microcontroller embedded on the robot for its desirable motions. Robots can be used for performing various tasks that the humans are unable to perform due to size limitation, physical disability etc.

An android operated phone is used as the platform for the Java application to execute. An Intel Edison Arduino microcontroller is incorporated in the robot for the main computation and the main communication between all the modules. Then there is a motor driver that deals with the computation and functioning of the motors to turn the wheels essential for the movement of the robot. Last, but not least, a Wi Fi module is incorporated in the robot that serves as the means of receiving the data from the Smartphone which is processed in the Arduino to detect the direction of movement of the user's hand and move the robot accordingly.

The gesture commands drawn in the android platform and corresponding working is as follows swipe up: move forward, swipe down: move backwards, swipe left: move left, swipe right: move right, single tap: arm moves up, double tap: arm moves down, pinch: picks object, un-pinch: release object.

Fig -2: Smart Robotic Assistant

4. RESULT

From the observation, the working of RA depends upon:

- The bandwidth of Wi Fi module.
- Accuracy of Google's speech to text conversion.

The Smart RA has a wide range of applications in: Helping elderly peoples, Peoples having severe disabilities, Can be used as a pick and place robot in industries and laboratories.

5. CONCLUSION

In our proposed system, we are using a smart robotic assistant that will work according to voice command and gesture commands. The voice and gesture commands are converted to text form and are transmitted to the board. From there it is moved to the corresponding motors. Thus, the wheels are rotated. The RA will perform movement operation like move right, left, forward, and backward. The arm will move up and down also able to pick and release objects.

6. FUTURE WORKS

Future works that can exploit are the effect of the distance between the mouth and the smart IoT device on the performance of the robot, and the effect of noise on the speech to text conversion. The cost of the RA can possibly be reduced by using renewable source of energy. The RA provides for more development of applications based on android operating system. Such as, Application based on sensors. This opens door for wide range of possible similar applications such as automation of household tasks and remote starter for car, military applications, dangerous exploration environments. The weight carrying capacity of the robot can be increased by using a stronger metal of the arms, and the motors with higher torque. Also precision of its movement can be improved by using encoders in the error feedback path.

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