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Assistant Robot for the Elderly People Controlled Through Smart Watch

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Abstract: With the progress of ageing society, more elderly people are living alone. Due to work and school factors, family members are not always available at home to care for the elderly. It is dangerous if they suffer an accident at home alone. Therefore, attention has been gone to robot to help humans in relieving job. The robot can replace human mobilization for move so that the efficiency of wasted time will be less. Many things need to be noting what kind of robot control reliable to replace human work in mobilization. In this paper a smart humanoid voice controlled robot to serve the elderly people with at most efficient and reliable way is proposed. This robot is implemented using 3D printing technology and controlled by smart watch using WiFi technology. The person voice command is synthesised by android application in the smart watch, then the speech will be analyzed and converted into text. These processed commands would be sent to the robot via WiFi and analyzed by the microcontroller in the robot to take the correct action depended on the processing voice command. Also, the proposed robot will monitor the person's activities and status and warning him about any abnormal status and also reminding him about the necessary tasks.

Keywords: Robotics, Voice control, Smart Watch, Elderly People, Arduino, Bluetooth.

1. Introduction

The advent of new high-speed technology and the growing computer capacity provided realistic opportunity for new robot controls and realization of new methods of control theory. This technical improvement together with the need for high performance robots created faster, more accurate and more intelligent robots using new robots control devices, new drivers and advanced control algorithms [1].

Also smart watches were recently proposed to provide users with instant access to digital activity. The miniaturization of computing devices has enabled smart watches to perform almost all the functions of smart phones, including the making of telephone calls, and they can also be operated as stand-alone devices. Smart watches have two strong advantages over smart phones, namely, the mounting location, and the continuous contact with the skin [2]. They have light weight, and mounting on the wrist affords the user immediate access to messages, notifications, and other digital data. Their continuous contact with the wrist also enables their being used for tracking purposes and to obtain health information such as heart rate and oxygen saturation [3].

As the smart phone and smart watches becomes an integrated part of human daily life, especially in the medical environments where the elderly, the disabled and people that are living alone are required to be continuously under surveillance for the purpose of safety and emergency response at the right time, Therefore this paper has aimed to withstand the atmosphere and implemented of a smart robot that complete the tasks using speech and smart watch. Speech recognition is the process of automatically recognizing the spoken words of person based on information in speech signal [4]. It is a technology that aid to admit the challenge and it is a prominent technology for Human-Computer Interaction and Human-Robot Interaction for the future [5]. In this project a smart robot is proposed that controlled through voice command and smart watch. The voice

commands are received by the smart watch and then send to Arduino microcontroller to process these commands and send the final action to the robot. The rest of this paper is organized as follows: the related work is illustrated in section2. Section 3 explains the proposed algorithm in details. Section 4 includes the analysis results. Conclusion is presented in section 5.

2. Related Work

In this section a number of researches about the robot controlling through voice commands and smart devices have been illustrated.

The Robotic Arm developed in [6] involved a voice-control dialog system, speech recognition, and vocabulary design and speech synthesis feedback for user command confirmation. An Articulated Robotic Arm which is used in Industry was proposed by Sebastian van Delden and Andrew Whigham. It can be controlled by an android device in an industrial fixed setup. It can pick and place, and do some wielding works which human can't do [7]. Jorge Kazacos Winter [8] has developed a low cost and open source philosophy android controlled mobile robot. T. Maria Jenifer and his team were proposed a autonomous robot system which can sense the environment temperature and transfer the value to a php server via Bluetooth android application [9]. M. Selvam [1] has proposed a robotic system attached with wireless camera for the purpose of surveillance via Bluetooth technology. Ranjith Kumar Goud and B.Santhosh Kumar [10] have developed android controlled robotic architecture for pick and retaining of objects for bomb diffusion from safe distance. The researchers in [11] proposed a Spy robot is used for spying on the specific target. It comes in automatic and manual control obstacle detection. Also an autonomous robotic system that is designed and implemented to monitor environmental parameters such as temperature, humidity, air quality, and harmful gas concentration is proposed in [12]. The robot has GPS coordinates, and it can store data on the Thing Speak IoT platform. The mobile robot is controlled by a smartphone which runs an app built on the Android platform. The whole system is realized using a cost-effective ARM-based embedded system called Arduino and Raspberry Pi which communicates through a wireless network to the IoT platform. The robot car that proposed in [13] was created to assist elderly people at home. This system includes an Arduino Robot-Car (Arduino BOE-BOT) with ultrasound sensor, wireless networks (Wi-Fi), databases (MySQL), and Android based mobile application (APP). Internet of things and robot technology are hot topics in today's society. Conforming to this trend, the researchers in [14] designs and implements the remote control system of mobile robot based on cloud platform. A new system for persons with disabilities is proposed in [15] through robotic assistants.

Also the researchers used the smart watch technology in many fields such as in home automation; [16] proposes an efficient and a quick solution for controlling of various home appliances using a smart watch. This system is implemented through a raspberry pi board. And a robotics can be controlled remotely using smart watch applications, through the Bluetooth or Wi-Fi Technology as proposed in [17]. A machine learning model for indoor localization algorithm using global positioning system (GPS) and smart watch are proposed in [18].

3. Proposed System

The goal of this project is to build a smart humanoid robot which it is called (ASH robot) that can be controlled remotely using voice commands and smart watch by Google Assistance application. In this application a speech will convert into text then send to the robot which interprets it and make the correct action. The speech recognition software using in this application can analyze the sounds by filtering and digitizing it to a format to be read and analyzing its meaning. A general model for the proposed robot is shown in the following figure:

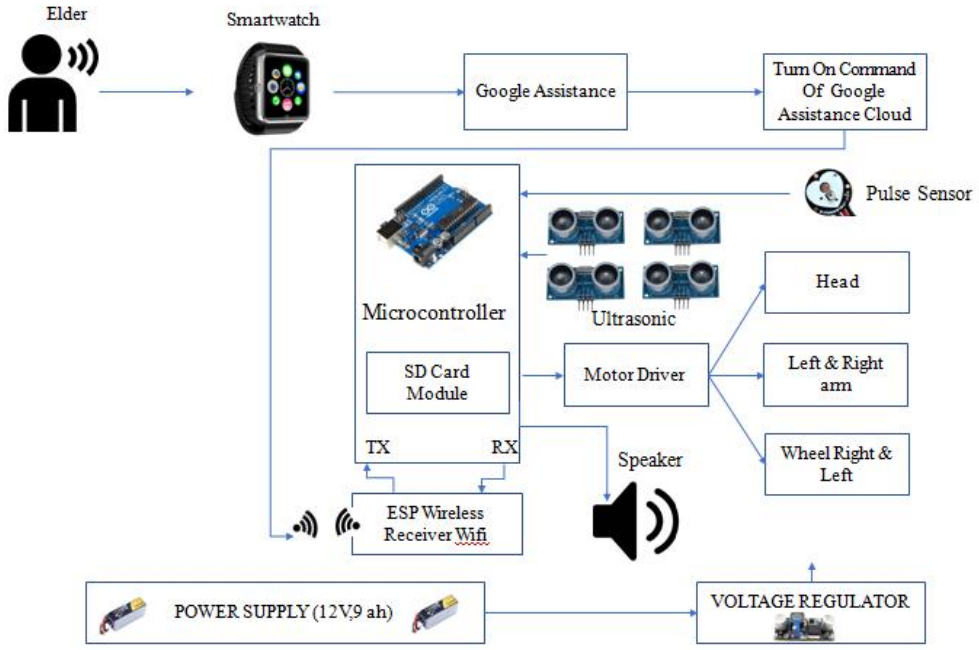


Fig. 1: General model for the proposed robot (Ash Robot).

3.1. Hardware Design

The robot's hardware design has a huge influence in order to obtain a reliable biped robot and must keep on mind add less weight as possible and been low cost. A brief description about each part of the proposed system is illustrated in the following subsections:

A- ASH Robot

Humanoid robot must design in a way that a body shape looks like the human body, Therefore, the robot body that consists of head, human body, two arms and two legs moving through wheels. The robot body is making by using 3D printing. A clear picture about the head, arm and the whole robot body are shown in figure 2, 3, 4 and 5.

The moving wheel is look like hover board that has 4 wheels as shown in figure 6. The first two wheels at right and left for moving and it is 9 inch wheels, the other two wheels are 5 inch wheels at the front and back. The reason for using 4 wheels is to make it stable and avoid obstacles.

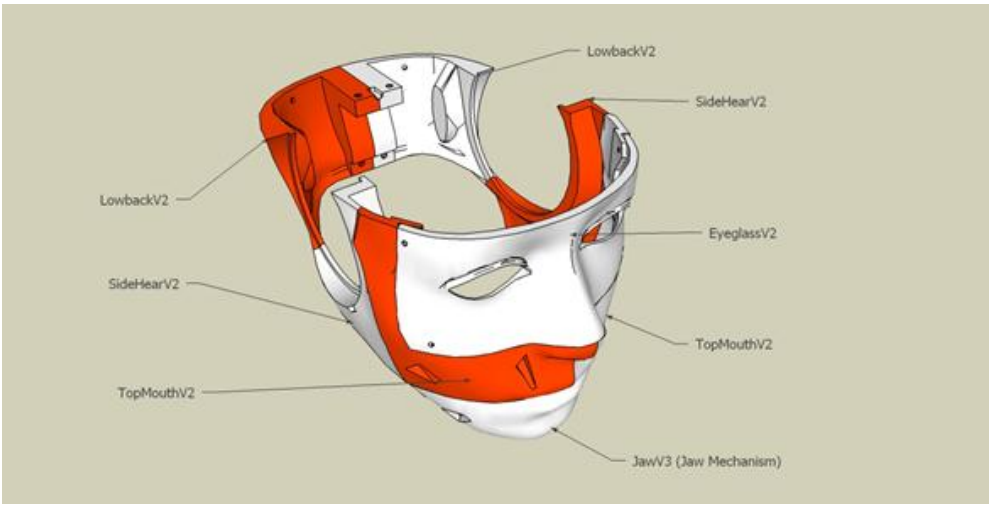


Fig. 2: Head of Ash Robot.

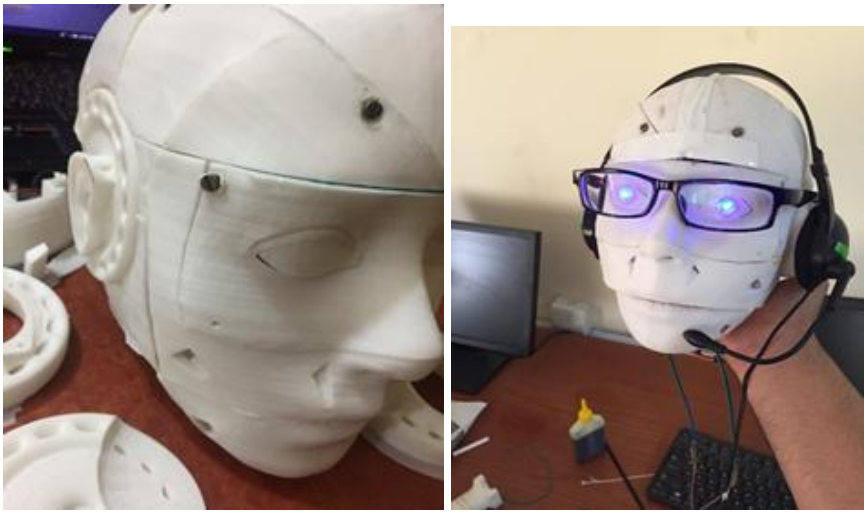


Fig. 3: Head of the ASH robot (3D printing).

Fig. 4: Hands (3D printing).

Fig. 5: Hover board for ASH robot standing.

B- Microcontroller

A programmable microcontroller that used to control the ash robot is arduino Mega, it is the best choice due to it is an open-source, flexible, suitable storage area and has digital and analog input/output pins.

C- Sensors

The type of sensors that used in ASH robot to achieve its goal is ULTRASONIC sensor and Heart Pulse sensor.

D- Servos

The servos type that had been used in ASH robot is MG995 Metal Gear Servo as shown in figure 5. ASH contains two servos motor, one of the servos is to move the jaw and the other for moving

neck right and left in 90 degree rotation and reverse it. While the arm has three servos motors, the first for base rotation, the second for shoulder rotation and the third one is for catching things and it is a gripper.

Fig. 6: MG995 servo motor

E- SD Card Module:

This module is used to read voice data from micro RAM that store all relatedvoice with wave format.

F- Microphone and Speaker:

A microphone is needed for input (from patient to robot) while speaker for output (from robot to patient).

G- ESP Wireless Receiver

This module is required to make the robot connect to the internet for controlling through smart watch. An ESP8266-12F wireless receiver module has been used here.

H. Voltage Regulator

A voltage regulator is used to regulate voltage level. When a steady, reliable voltage is needed, then voltage regulator is the preferred device. The type of voltage regulator used here to obtain a reliable voltage level is a step down switching voltage regulator as shown in figure 6.

Fig. 7: A Step Down Voltage regulator.

I- Power Supply:

All the previous components need a power supply. Therefore, two batteries with 12 volts and current of 9 Ampere are used. The first one is for DC drill motors and the other for all necessary components.

J- Smart Watch

A smart watch is a portable device that's designed to be worn on the wrist, just like a traditional watch. Since smart watch has efficient features like good battery life and answer message by voice, therefore a smart watch is used to control the ASH robot. A huawei smart watch has been used as a communication device to connect the elder person with the robot using Wifi Technology. The voice commands are given to the robot through the smart watch.

3.2. Software Design

Robot software design is the set of coded commands or instructions that tell a robot about what tasks to perform. Robot software is used to perform autonomous tasks. Many software systems and frameworks have been proposed to make programming the robot more easier task. In this paper the Ardunio Microcontroller is programming through Arduino software which is open-source software while the smart watch that used to control the robot through WIFI technology and using Google Assistant application. The Google Assistant is a virtual assistant developed by Google that is primarily available on mobile and smart home devices; it is built-in software inside smart watch. The voice command will send from Google assistant using internet to the Arduino Mega with ESP module connecting to it. For providing data to ESP a Webhook technique is used. A general flowchart that described the basic processes in the ASH robot will illustrated in the following figure.

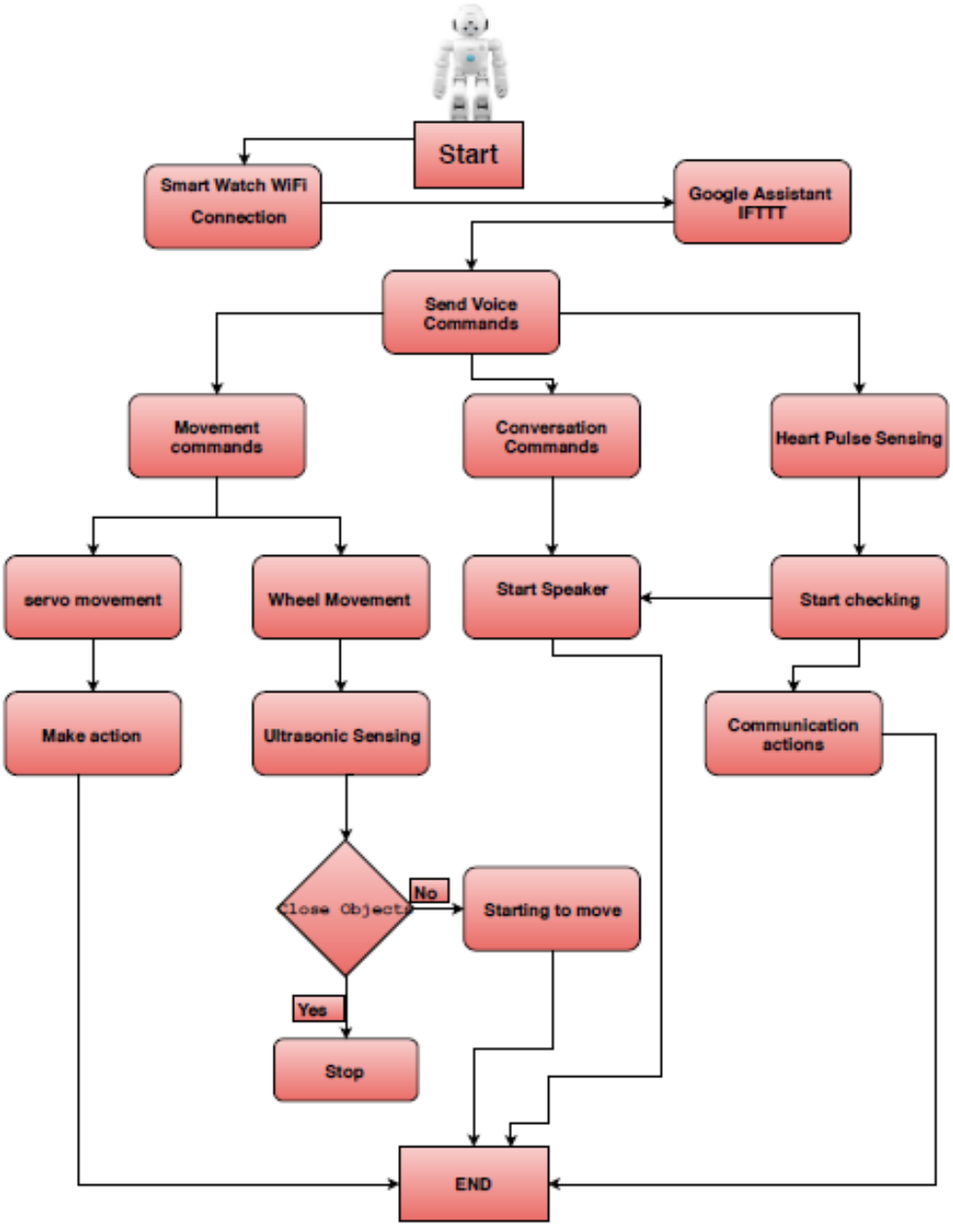


Fig. 8: Ash Robot Flowchart.

4. Results and Discussion

As mentioned before, the ASH robot has a humanoid structure like hands, head, body and legs, standing on hover board for movement. Some of the materials made by using 3D printing technology (head and hands), the body made of Manikin and the hover board made of iron board connected to four wheels (right and left connected to DC motors for the actual movement , the front and back wheels to balance the ASH robot). Also, it is illustrated before that there are two sensors in this robot, one for making distance measurement to avoid obstacles (using Ultrasonic sensor) and heart pulse sensor for measuring the heart pulse putting on legs on the body and eyes to have a better looking. Servo also used for making the hands and head movements; two servos for head and four servos for two hands. An overall picture of ASH robot is shown in figure 9.

Fig. 9: ASH Robot.

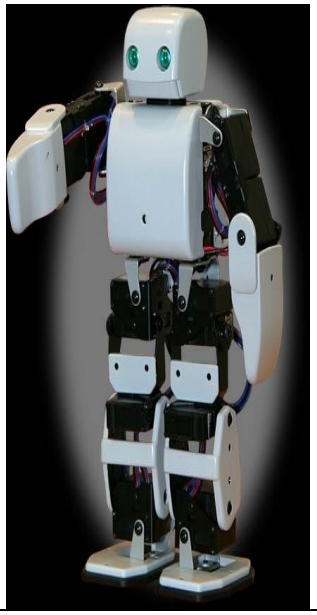
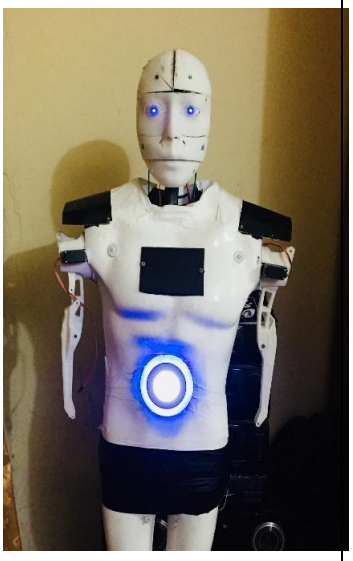
The ASH robot is controlling through voice commands that received and processed by the smart watch using WIFI technology as shown in figure 10. Another task doing by robot is monitoring the heart rate of the elder person through a plug-and-play heart-rate sensor which is Pulse Sensor Amped. ASH robot can make a conversation with the elder person and depend on the commands sending from person to robot a correct action is occurring.

Fig. 10: Controlling Ash Robot using Smart Watch Huawei.

Comparison with previous studies:

ASH robot has a feature distinct from other projects to solve specific issues, as illustrated in the following table.

Table 1: PLEN robot [19] & Neo Maelo [20] vs. ASH robot:

Features	Plen	Neo Maelo	ASH
Body	Small Sized Desk Robot in form of human.	Robot shaped in the form of a human but it is small sized robot.	Looks like a tall human.
Sensors	It does not feature any sensors or automatic software reactions to certain events, as it is entirely remote-controlled.	It does not feature any sensors or automatic software reactions to certain events.	Have an ultrasonic sensor that automatically make it stop or move and make decision.
Conversation	Does not support this feature.	making limited conversation like wake up that not need to talk with it	Can make conversation which help elder person and Autism patients.
Control method	Controlled using application by tapping on controls like joystick with restricted functions	Controlled using voice commands	Controlled using voice commands.
Connection	It controlled remotely using only Bluetooth.	Controlled using both Bluetooth and WIFI, work with only mobile phones.	Controlled using both Bluetooth and WIFI with different devices like smart phone and smart watch.
Picture			

5. Conclusion

ASH robot is a humanoid smart voice controlled robot that replaces the human effort to make tasks and help elder people by using a common technologies for connection, ASH robot is controlling by using the technique of transform voice into readable text data to make several actions. Also this robot helps elder person by measuring their heartbeat and telling them about the heartbeat results and if they are in safe mode or not. Finally robots cannot perform every job; today robots roles include assisting research and industry and as the technology improves, there will be new ways to use robots which will bring new hopes and new potentials.

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