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Implementation of IoT In Smart Robotics: A Survey

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Abstract- ***Here in this paper we develop a smart Robotic Assistant (RA) that will help human being a lot in multiple ways. The area used is Internet of Things (IoT). The RA can be accessed remotely using human voice commands and gestures. 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 controlled with the help of an android platform based IoT device like smart phones etc. The gestures and voice commands are processed using cloud server. The working of RA is as follows the gestures and human voice commands are converted to text form and are then communicated over a Wi-Fi network. 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.

Index Terms –Smart Robotic Assistant, Voice Commands, Gesture Commands, WiFi Network, Android Based Smart IoT Devices.

1.INTRODUCTION

For many people it is a machine that imitates a human—like the androids in Star Wars, Terminator and Star Trek: The Next Generation. However much these robots capture our imagination, such robots still only inhabit Science Fiction. People still haven't been able to give a robot enough 'common sense' to reliably interact with a dynamic world.

The type of robots that you will encounter most frequently are robots that do work that is too dangerous, boring, onerous, or just plain nasty. Most of the robots in the world are of this type. They can be found in auto, medical, manufacturing and space industries. In fact, there are over a million of these type of robots working for us today.

Well it is a system that contains sensors, control systems, manipulators, power supplies and software all working together to perform a task. Designing, building, programming and testing a robot is a combination of physics, mechanical engineering, electrical engineering, structural engineering, mathematics and computing. A study of robotics means that students are actively engaged with all of these disciplines in a deeply problem-posing problem-solving environment.

Smart assistant robots have many applications in the hospitals, to assist in surgeries that need high precision and accuracy. A robotic arm with 6 degrees of freedom is designed here, to follow some predefined instructions with high precision and accuracy. Another robotic arm is developed to help physically challenged people, elderly ones in moving an object from one place to another.

In this paper, we develop a smart robotic assistant that operates on human voice commands and gesture commands. Its effectiveness and limitations can be checked through different experiments. Further study is proposed for the effect of noise in background while giving voice commands and of the distance between the smart IoT device and mouth for effective operation of robotic assistant.

This paper is organised as follows in section 2literature review, 3 conclusion, 4 acknowledgement, 5 references.

2. LITERATURE REVIEW

2.1 The Multiple-Function Intelligent Robotic Arms

The multiple-functional robotic arms were designed and produced meets the six appointed show functions, which in turn highlights their stability, accuracy, and high level of performance according to actual operation. It also demonstrates its application for amusement, educational, and industrial needs; finally, the production cost of this robotic arm is low and the flexibility of use is high.
The characteristics of the robotic arms include:
1. The shoulder of robotic arm includes a pair of motor structures to enhance the ability to life weight. 2. The stability and accurateness of the robotic arm are optimized for the requirement of high performance throughout the whole structural design. 3. In order to increase the moving ability of the robot, the robotic arm was designed with a four wheeled transmission structure and track. 4. Two mimetic robotic arms work in concert to present the fancy shows. 5. Five kinds of machine hands were designed to meet the requirements of the six appointed functions.

2.2The Gesture Replicating Robotic Arm

The Gesture Replicating Robotic arm is a servo-controlled robotic arm which replicates gestures in a three dimensional environment. It makes use of cameras which detect the motion of one's hand in three dimensions. The cameras provide frames as input to the software which performs segmentation algorithms like background subtraction, colour detection and contour detection. Pixel to angle mapping gives the appropriate commands to the respective servo motors. Thus, replication of the human hand movements is done. Such lifelike robotic arms can be tele-operated to protect human workers in hazardous environments, such as on assembly lines, in space, undersea, and amid nuclear radiation.

2.3A hand-gesture-based control interface for a car-robot .

A 3-axis accelerometer is adopted to record a user's hand trajectories. The trajectory data is transmitted wirelessly via an RF module to a computer. The received trajectories are then classified to one of six control commands for navigating a car-robot. The classifier adopts the dynamic time warping (DTW) algorithm to classify hand trajectories
The somato-sensory interaction is one of the most user-friendly interactive interfaces for controlling objects. Recently, there have been many different hand gesture recognition systems, such as vision-based trajectory recognition systems and inertial-based trajectory recognition systems. No matter cameras or accelerators are used in the hand gesture systems; the core module is a hand gesture recognition algorithm. The dynamic time warping algorithm (DTW) and the Hidden Markov model (HMM) are two most popular algorithms employed to recognize hand gestures.

SYSTEM OVERVIEW:

Based on the interface, a user with a 3-axis accelerometer module attached to his or her wrist can directly use hand gestures to navigate a car-robot. The 3-axis accelerometer module senses the hand trajectories and then wireless transmitted to a PC via a RF module. Then the core hand gesture recognition module adopts the DTW algorithm to recognizes the trajectories. In the following, it sends a control command wirelessly to the car-robot's receiving module. The robot is then navigates according to the received command.
A user can control a car-robot directly by using his or her hand trajectories. In the future, we will directly use a mobile phone with an accelerometer to control a car-robot. We also want to add more hand gestures (such as the curve and slash) into the interface to control the car in a more natural and effectively way.

2.4 Design of a Low Cost PC interface Six DOF Robotic Arm Utilizing Recycled Materials

PC-interfaced low cost robotic arm has been designed which can be integrated with modern robotic arm based light weight lifting applications. Both manual and PC based controlling system have been integrated with the robotic arm to make the manipulator use-worthy in maximum applications. This designed robotic arm has six degree of freedom (DOF) which is modelled as four-link, with each joint connected with suitable DC gear-motor. Available parts from local market as well as used up elements from industrial machines and household appliances have been used for the implementation of the manipulator to lower the cost. For controlling the robotic arm, microcontroller based manual controlling system with PWM speed control along with relays has been used and DC gear motor has been integrated with PC based on parallel communication for PC-based controlling system. The weight of the complete structure is only 7.363 kg which is capable of lifting up to 1.5 kg.

2.5 A Mobile Robotic Arm for People with Severe Disabilities

Design of a mobile robotic arm for people with severe disabilities is implemented. This system is composed of a robotic arm, microcontroller, and its controller. The main body of the robotic arm can be contained in a briefcase to carry a laptop computer. Its weight is 5 kg, including two 12-V lead acid rechargeable batteries. This robotic arm can be also mounted on a wheelchair. To verify the performance of the mobile robotic arm system, some tasks, such as drinking tea task and eating task were experimentally performed by an able-bodied subject.

This system is composed of a main body of robotic arm, microcontroller, and its controller. The microcontroller, AT91SAM7S256, has a 32-bit ARM7TDMI RISC processor (Atmel Corporation), which is low-power, small, cost-effective, and excellent real-time interrupt response. It is embedded to the system. As can be seen in the robotic arm's main body is totally contained in a briefcase to carry a laptop computer. The robotic arm also can be mounted on a wheelchair. One of the fundamental concepts for the robotic arm system is portability. This feature allows users to enjoy not only having dinner with their companions in their houses but also eating out with them. The robotic arm system can be utilized when the users go on a trip, which enables them to try a variety of foods at restaurant as much as they wish while travelling

determine the position of the armature of the motors.

These servomotors are controlled by the pulse width modulation. The detachable gripper, the end effector.

It's opening and grasping is also controlled by the servomotor, which is attached to the wrist portion. To reduce the weight of the end effector of the robotic arm, some materials, such as carbon plate, balsa wood, and low foamable vinyl chloride, were used. Some of the important technical specifications of the mobile robotic arm. We have developed the controllers for the robotic arm system, e.g., head-controlled interface, eye-controlled interface, vision-based interfaces, and electromyogram (EMG)-based controller. These controllers are useful and applicable to control the mobile robotic arm. As a first step of this study, a notebook PC, which was connected to the microcontroller through anRS-232C cable, was used as the controller. Furthermore, a control program written in the form of C language was developed with gcc compiler. The program was then written into a flash memory of the microprocessor.

2.6 Robotic Arm Showing Writing Skills by Speech Recognition

Robotic arms are programmed robot manipulator with similar functions of a human arm. Several kind of high technology prostheses are available for doing the basic functions of human arm. Aim of the project is to develop a robotic arm which helps the physically handicapped person to write. The robotic arm is to be fitted to the patient's amputee hand, and will write down the words that the patient pronounces to the microphone. The special feature of this robotic arm is that it is fitted with a pen which performs the writing operations. This paper describes the design of the robotic arm, advantages and drawbacks of this arm.

The Programming and working of our robotic arm mainly consists of two parts. The first part involves receiving the speech signal from the user and converting it into a text form for further processing and second part consists of using this text data to obtain a suitable required mechanical action of the motors.

2.7 6-DOF PC-based robotic arm with efficient trajectory planning and speed control.

This paper introduces the design and development of 6-DOF (degree of freedom) PC Based Robotic Arm (PC-ROBOARM). The main context of the study is concerning a 6-DOF robotic arm, which is modelled as three-link, with each joint connected with a suitable servomotor. The robotic arm design and control solution is implemented by self developed computer software which is named as SMART ARM. It is a computer aided design and control solution for 6-DOF robotic arm which come with an user friendly graphical user interface (GUI). It allows user to model or design virtual robotic arm before building the real one. Therefore, the user can estimate the optimum size of actual robotic arm at the beginning so as to minimize the building cost and suite the practical environment. Furthermore, once the actual robotic arm has been built, the user can reuse the software to control the actual robotic arm in an effortless way without wasting time in constructing new control solution. The software also provides simulation feature. Through simulation in the GUI, the software assists greatly in visualizing the robotic arm trajectory planning. The PC-ROBOARM is actual robotic arm developed to prove the simulation results. The 6-DOF robotic arm design is based on PUMA (Programmable Universal Machine for Assembly) jointed-arm model. Both point-to-point motion and continuous path motion are tested in simulation and actual arm controls.

Basically, the SMART ARM has several core features. As SMART ARM has the capabilities of designing and controlling. Apart from them, it also provides a platform for advanced user to do point-to-point programming in order to manipulate the robotic arm to carry out specific job routine or perform a specific sequence of robotic arm actions. The programming command is self-develop, thus it is unique than other programming language. While learning new programming command, programmers often made syntax mistakes at the beginning. Hence, real-time syntax inspector is designed into the SMART ARM so as to check the user program from time to time.

2.8 Fast Response Search and Rescue Robot, Assisted Low Power WSN Net for Navigation and Detection.

It utilizes a stationary network of passive infrared sensor nodes interconnected through a multi-hop Zigbee network. The sensors are motion sensitive and using regional localization can be used for identifying the location of survivors or intruders based on the situation. The robot is controlled via a Wi-fi link which streams real time video back to the base station. The main processor is a TI Sitara AM335x ARM processor. It also acts as relay for the sensor data. Each node consists of three passive infrared detection circuits each covering a sector of 120 degrees and connects via the TI CC2530 ZNP chip. The raw PIR data is signal conditioned using an LM324 Op-amp. The nodes can be deployed easily due to their compact size. Their low power consumption and low cost makes them ideal for remote areas and can be deployed in large numbers.

2.9 AndroRC: An Android Remote Control Car Unit for Search Missions

The Andro RC is a remote control car (RC) unit controlled by a smartphone running on an Android application. The car is meant to be used in search missions in the occurrence of natural disasters. It is developed to autonomously avoid obstacles that are not visible to the user driver. The RC unit is developed based on a Tamiya 70112 Buggy car chassis set with an extra servo motor added to provide the left and right directions. The RC is equipped with an ultrasonic distance sensor, a camera, a Bluetooth receiver, a Wi-Fi transmitter, two 9-V batteries and two Arduino microcontroller boards (UNO and MEGA). The Arduino MEGA controls the propulsion and direction, while the UNO processes the information received from the distance sensor to stop the RC at a pre-defined distance. The Android application uses the embedded orientation sensor on the smartphone to determine the four directions (forward, backward, left and right) intended by the user; hence, rotating the smartphone to different directions results in to the corresponding propulsion of the RC unit. The control commands are transmitted to the RC unit through the Bluetooth communication. The Android application also receives (via Wi-Fi) and displays the information from the camera in real-time. The AndroRC was characterized and examined on bench-top settings.

2.10 An Infrastructure for Robotic Applications as Cloud Computing Services

Robotic applications are becoming ubiquitous. They are widely used in several areas (e.g., healthcare, disaster management, and manufacturing). However, their provisioning still faces several challenges such as cost and resource usage efficiency. Cloud computing is an emerging paradigm that may aid in tackling these challenges. It has three main facets: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). This paper focuses on the IaaS aspects of robotic applications as cloud computing services. It proposes an architecture that enables cost efficiency through virtualization and dynamic task delegation to robots, including robots that might belong to other clouds. Overlays and RESTful Web services are used as cornerstones. A prototype is built using LEGO Mindstorms NXT as the robotic platform, and JXTA as the overlay middleware.

Architectural Principles':

1. The first principle is the use of peer-to-peer (P2P) overlays for the communication between different IaaSs. We used P2P overlay because it provides distributed architectures, self-reorganization, and scalability.
2. The second principle is that the interaction interfaces of the IaaSs are Representational State Transfer (REST)-based. We selected REST because it is lightweight, standards-based, and can support multiple data representations (e.g., plain text, JSON, and XML).

3. CONCLUSION

In this paper, we have developed a prototype of a smart robotic assistant. It works on human voice commands and gestures which are given through a smart phone of android platform. Using an online cloud server voice commands and gesture actions are converted to text format. And are send to RA using WiFi transmitters. The Arduino based microcontroller receives the instructions and control the movements. A robotic arm is fixed for lifting and carrying objects from one place to another. DC motors are used for various movements in RA. Lithium battery is used for power up the components. Future scopes of this RA include developing a robot having military applications like targeting enemies, saving human life from risk, large scale industries etc. The cost can be reduced by using energies from renewable sources.

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