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WIRELESS VOICE CONTROLLED ROBOTICS ARM

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***ABSTRACT*- In today's world, in almost all sectors, most of the work is done by robots or robotic arm having different number of degree of freedoms (DOF's) as per the requirement. This paper deals with the Design and Implementation of a "Voice Controlled Robotic Arm". The system design is divided into 3 parts namely: Voice recognition module, Robotic Arm and Platform. Arm with Voice Recognition is to create a wireless voice controlled arm which can be operated through a range of 10 to 50 meters using ZIGBEE transmitter and receiver. Voice recognition is "the technology by which sounds, words or phrases spoken by humans are converted into electrical signals, and these signals are transformed into coding patterns to which meaning has been assigned". The different motions performed by robotic arm are: PICK and PLACE / DROP, RAISING and LOWERING the objects. Also, the motions performed by the platform are: FORWARD, BACKWARD, RIGHT and LEFT.**

Keywords: Voice recognition, DOF, zigbee Module, Gripper, stepper motor

I. INTRODUCTION

A robot may define as an electro-mechanical device, which is capable of sensing its surrounding and taking its decision (command).In general, robot must be able to move (by mechanical movement), it must be able to sense (by transducer) and it should be take decision (by remote control or artificial intelligence). A robotic arm is a robot manipulator, which can perform similar functions to a human arm.

Robotics arm is vital role of industrial application. Most robotics arm perform the task such as welding, trimming, picking, placing and painting etc.,

Moreover the biggest advantage of these arms is that it can work in hazardous areas and also in the areas which cannot be accessed by human

Few variants are **Keypad Controlled, Voice Control, Gesture Control**, etc. However, most of the industrial robots are still programmed using the typical teaching process which is still a tedious and time-consuming task that requires technical expertise. Therefore, there is a need for new and easier ways for programming the robots. The prime aim of this project is the platform started with movement as soon as the voice command receive by operator. if the voice is not audible then the alternative method is remote control accessing Robot

The goal of this paper is to develop methodologies that help users to control and program a robot, with a high-level of abstraction from the robot specific language i.e. to simplify the robot programming

II. RELATED WORK

In the robotics field, several research efforts have been directed towards recognizing human gestures.

Few popular systems are:

2.1 VISION-BASED GESTURE RECOGNITION

This Recognition system basically worked in the field of Service Robotics and the researchers finally designed a Robot performing the cleaning task. They designed a gesture-based interface to control a mobile robot equipped with a manipulator. The interface uses a camera to track a person and recognize gestures involving arm motion. A fast, adaptive tracking algorithm enables the robot to track and follow a person reliably through office environments with changing lighting conditions. Two gesture recognition methods i.e. a template based approach and a neural based approach were compared and combined with the Viterbi algorithm for the recognition of gestures defined through arm motion. It results in an interactive clean-up task, where the user guides the robot to go to the specific locations that need to be cleaned and also instructs the robot to pick up trash.

2.2 MOTION CAPTURE SENSOR RECOGNITION

This recognition technique made it possible to implement an accelerometer based system to communicate with an industrial robotic arm wirelessly. In this particular project

the robotic arm is powered with ARM7 based LPC1768 core. MEMS is a three dimensional accelerometer sensor which captures gestures of human-arm and produces three different analog output voltages in three dimensional axes. And two flex sensors are used to control the gripper movement.

2.3 FINGER GESTURE RECOGNITION SYSTEM BASED ON ACTIVE TRACKING MECHANISMS

The prime aim of the system (based on the above mentioned recognition methodology) proposed by the author is to make it feasible to interact with a portable device or a computer through the recognition of finger gestures.

Apart from the gestures, speech can also be other mode of interaction because of which this system can form part of a so-called Perceptual User Interface (PUI). The system could be used for Virtual Reality or Augmented Reality systems.

2.4 ACCELEROMETER BASED GESTURE RECOGNITION

This Gesture Recognition methodology has become increasingly popular in a very short span of time. The low-moderate cost and relative small size of the accelerometers are the two factors that makes it an effective tool to detect and recognize human body gestures.

Several studies have been conducted on the recognition of gestures from acceleration data using Artificial Neural Networks (ANNs)

III. TECHNICAL REQUIREMENTS

The technical requirements chosen as a basis for the efficient functioning of the system are as follows**:**

3.1 MICROCONTROLLER

PIC microcontroller is used as the hardware platform. It is the controlling unit, to which all other components (Voice recognition, Motors, RF modules etc.) are interfaced. Two such microcontrollers are used in this project, one at the Transmitting end and one at the Receiving end.

3.2 ZIGBEE MODULE

ZigBee is a specification for a suite of high-level communication protocols used to create personal area networks built from small, low-power digital radios. ZigBee is based on an IEEE 802.15 standard though its low power consumption limits transmission distances to 10–100 meters line-of-sight depending on power output and environmental characteristics, ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys.) ZigBee has a defined rate of 250 Kbit/s, best suited for intermittent data transmissions from a sensor or input device.That we used CC2500 transceiver module

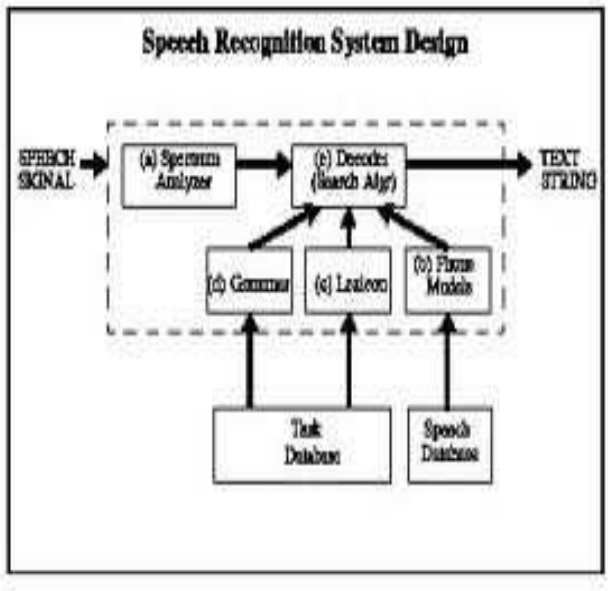
APPLICATIONS

- Home Entertainment and Control
- Wireless sensor networks
- Industrial control
- Embedded sensing
- Medical data collection
- Smoke and intruder warning
- Building automation

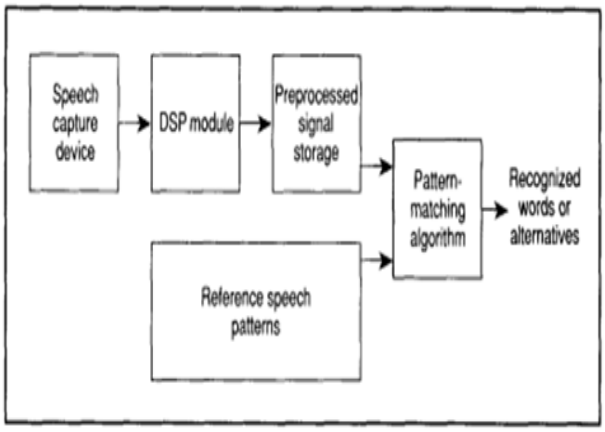
3.3 VOICE RECOGNITION

Speech recognition is the process of converting an acoustic signal, captured by microphone or a telephone, to a set of words. There two important part of in Speech Recognition

- Recognize the series of sound and
- Identified the word from the sound.



The most popular and dominated technique in last two decade is Hidden Markov Models. There are other techniques also use for SR system – Artificial Neural Network (ANN), Back Propagation Algorithm (BPA), Fast Fourier Transform (FFT), Learn Vector Quantization (LVQ), Neural Network (NN).



Hardware module is

- Voice Extreme Module
- HM2007 - Speech Recognition Chip
- OKI VRP6679 – Voice Recognition Processor
- Speech Commander - Verbex Voice Systems

The Spoken Language interface should be in English Language

- The robot should understand the task from the dialogue.
- The system should be speaker independent
- The robot should have some user feedback; such as, if the robot doesn't understand the user commands, it gives the user feedback - "I don't understand"
- The robot should understand the dialogue.

SENTENCE	PURPOSE
Forward	Move in forward direction
Backward	Move in backward direction
Right	Turn right
Left	Turn left
Upward	Move arm in upward direction
Downward	Move arm in downward direction
Pick	Arm gripper pick the object
Drop	Arm gripper drop/place the object

IV. OVERALL DESIGN OF THE SYSTEM

In this paper, a robotic arm with three degrees of freedom is designed, which is able to pick the desired object and place them at the desired location
Based on functionality, the system has been categorized into the following parts:-

Robotic arm
Platform
Communication system

[2] ROBOTIC ARM

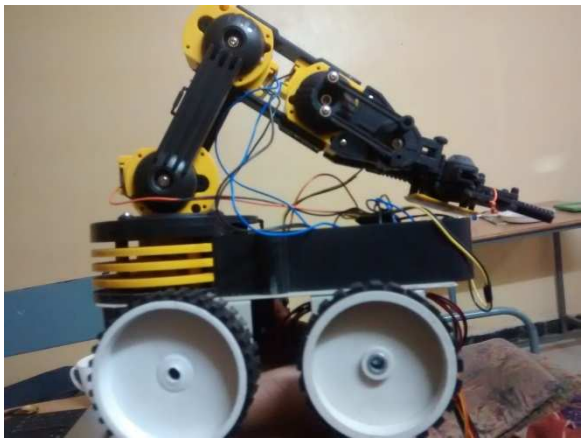
This is the vital part of the system as it is this part which does the Pick and Drop task of the project. The robotic arm is equipped with a Gripper (for picking and placing the objects) and an Arm (for raising and lowering the objects),Both the Arm and Gripper are equipped with Servo Motor to control the movement. These movements are synchronized with the voice commands of the user, operating the Robotic Arm. Also, the different voice commands, shown in Figure 4, are described below:

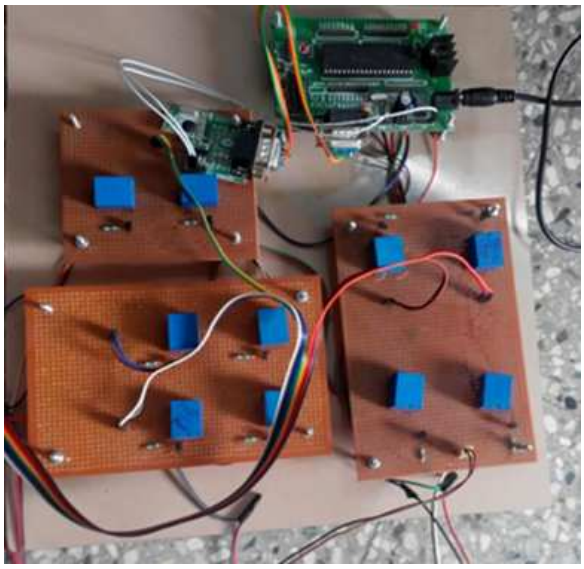
Downward: To Lower the Arm

Upward: To Raise the Arm

Pick: To close the Gripper Mouth so that it can pick the object

Drop: To open the Gripper Mouth so that it can place / drop the object





4.2 PLATFORM(ROBOTIC MOVEMENT)

Platform is nothing but that part of the project onto which the Robotic Arm is mounted. The platform is fitted with Stepper Motors and its movement is synchronized with the voice command of the user, operating the Robotic Arm. It is this part of the project which takes the entire project from one place to another.

Forward: To make the platform move in Forward direction

Backward: To make the platform move in Backward direction

Right: To make the platform take a turn towards Right

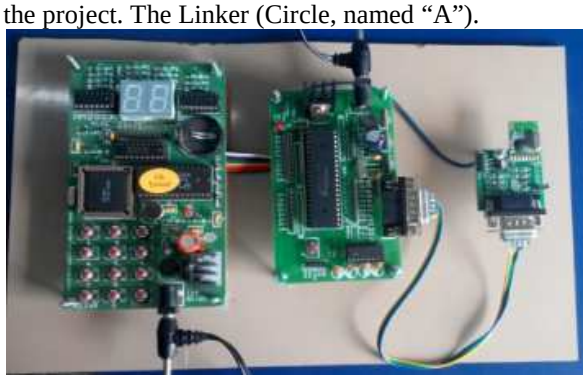
Left: To make the platform take a turn towards Left

4.3 COMMUNICATION SYSTEM(VOICE RECONGIZATION &ZIGBEE TRANSCEIVER)

This part is the heart of the entire project. Without an effective and reliable communication system, no system

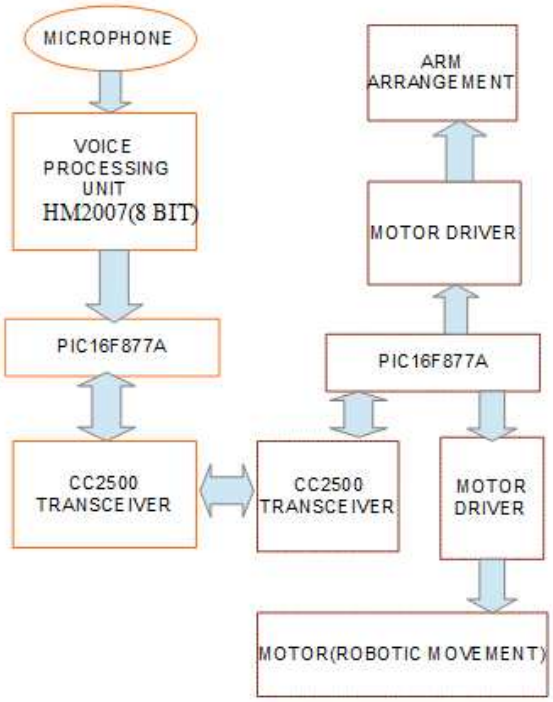
/ project can work. Similar is the case with this project also. The ZIBGEE Module, details of which are mentioned under Section 3.2, is the only communication equipment required in this project.

This Module is used to transmit the different voice commands or remote control made by the user (encoded in the form of 4-bit digital data) wirelessly to the receiver, which decodes the received 4-bit digital data and according to which the arm, gripper and platform moves. The block diagrams shown in depict the entire communication system of the project. The Linker (Circle, named "A").



BLOCK DIAGRAM

This block diagram show the connection between the Transmitter End (orange in color) and the Receiver End (brown in color)



V. CONCULSION

Human-Robot interaction is an important, attractive and challenging area in HRI. The Service Robot popularity gives the researcher more interest to work with user interface for robots to make it more user friendly to the social context. Speech Recognition (SR) technology gives the researcher the opportunity to add Natural language (NL) communication with robot in natural and even way. The working domain of the Service Robot is in the society -to help the people in every day's life and so it should be controlled by the human. Our future work will focus on introducing more complex activities and sentence to the system and also introducing the non-speech sound recognition, like footsteps (close), footsteps (distant) etc. Humans normally use gestures such as pointing to an object or a direction with the spoken language, i.e., when the human speaks with another human about a close object or location, they normally point at the object/location by using their fingers. This interface called multi-modal communication interface

VI. ACKNOWLEDGMENT

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