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MULTIMODAL INTERACTION FOR SERVICE ROBOT CONTROL

Vadije Uday[1], K.Vijaychand[2]

[1]M.Tech, Dept of ECE, Jayamukhi Institute of Technological Sciences, Narsampet, A.P., India

[2]Assistant Professor, Dept of ECE, Jayamukhi Institute of Technological Sciences, Narsampet, A.P., India

ABSTRACT:

Robotics has been an important assistive technology for the human being, making possible the existence of constant production lines with minimum error rates for the realization of repetitive tasks. In this proposed work we had present a robot model which can be controlled by using different methods. First method uses the image processing technique using constant background subtraction algorithm. In this method the robotic module will listen to the user's image gestures command and make a directional change according to that. Second method uses the voice signal processing method, in which for a human voice the robo can move . This total robotic module uses an ARM processor for the controlling section and microcontroller is used in the robotic section. For wireless communication between the two units we uses the IEEE 802.15.4 standard.

Keywords: ARM processor , Image processing technique, IEEE 802.15.4 , Voice processing.

1. INTRODUCTION:

At present, Robotics has been an important assistive technology for the human being, to do most of the task which is not possible by human at all time. This is an example of dual access robots, which in turn can be controlled in dual access method. One method uses the image processing method and another uses the voice signal processing. Now Robots are mainly used for the well being of humans and equipments. These robots can have mobility and the capacity to manipulate objects.. In home applications it do automatical monitoring and control. In automation , robots are used for working in highly dangerous areas which can harm a human. Thus, the application field of service robots can be classified in: 1.Human service (In highly hazardous environment). 2.Object service (For weight lifting and in machineries). 3.Other

autonomous tasks (surveillance, transportation, inspection, etc.).

So robots are having a vast application field in todays world.

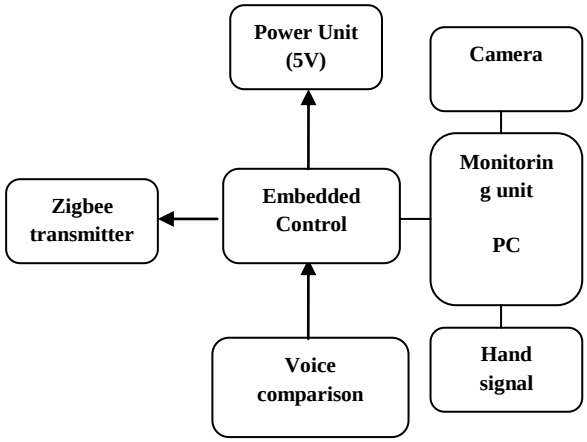

Fig a: DACR controller unit

In the above figure, control section of the proposed DACR unit is shown. In this proposed system, we are accessing the robot through wireless communication which in turn uses the zigbee transmission. For the first controlling method we uses the voice signal processing. In which the voice commands have to store already. When the robo receives any predefined voice signal from any user, then it will do the pre-programmed function.

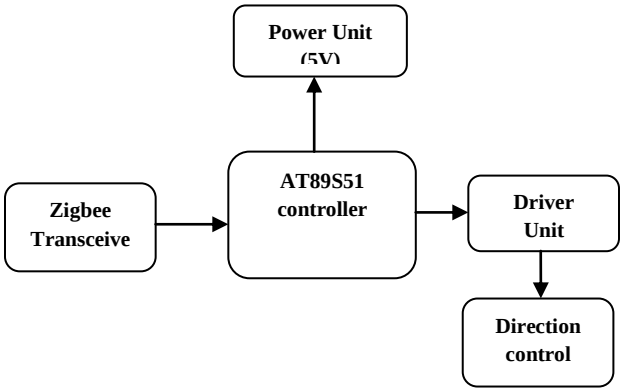

Fig b : DACR module section

I. IMPLEMENTATION

This proposed project mainly consists of DACR control section and DACR robo module section. All these units are discussed below.

DACR control section:

This service robo consists of LPC 2148 ARM core as main data acquisition system in which the various commands can be received and transmitted. As a result of image processing different signals are transmitted from the Matlab and it will be received through UART protocol of ARM core. Then these signals will be transmitted through the zigbee and it will reach the robot. In this project a background subtraction algorithm is used which will do the key role in the entire operation. For the hand gesture recognition system, we are using the MATLAB.

For capturing the image we need to use a camera which should support a **YUY2_640x480** format. Initially we have to take the data base hand gesture image and should store in the project folder. The supportable camera configuration in the MATLAB is given in the form of the following data function **vid=videoinput('winvideo',1,'YUY2_640x480');** Initially ten data base sample hand gesture image have to be stored for each finger position which have to be stored in the project folder to get the effective background subtraction.

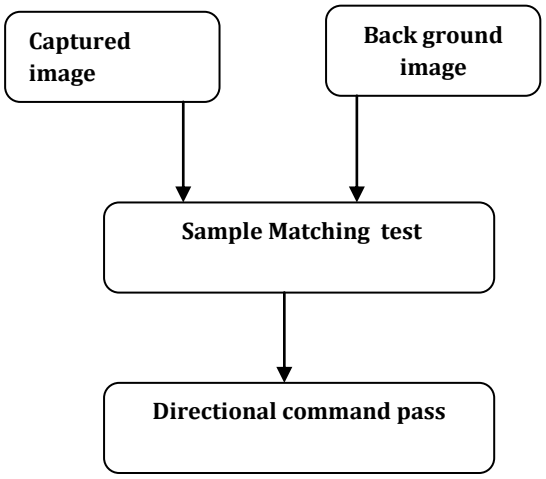

Fig c: DACR hand gesture detection

The software processing of the DACR robotic unit is shown on the above figure c.After processing through the above steps the direction control commands will be send to the ARM core for further processing. After receving these set of commands the robo will send these commands to the robotic module through IEEE 802.15.4 standard.

In the second method we uses the voice signal processing method. In this method the first we need to train the voice module with sample voice signal. The DSP processor will compare the frequency of the voice signal and it will store it in the memory block. So if the user gave any voice signal means the voice will be compared inside the processor and the commands will be passed to the robot module.

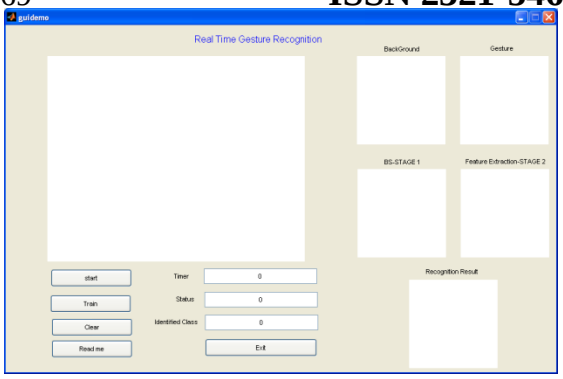

Fig: DACR image capturing gui window

In this window the image will be captured and the extraction work will be done according to the program.

LPC 2148:

The ARM7 family includes the ARM7TDMI, ARM7TDMI-S, ARM720T, and ARM7EJ-S processors. The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor solution. Optimized for cost and power-sensitive applications, the ARM7TDMI solution provides the low power consumption, small size, and high performance needed in portable, embedded applications. The ARM7TDMI core uses a three-stage pipeline to increase the flow of instructions to the processor. This allows multiple simultaneous operations to take place and continuous operation of the processing and memory systems.

Interrupt controller

The Vectored Interrupt Controller (VIC) accepts all of the interrupt request inputs from the User section and categorizes them as Fast Interrupt Request (FIQ), vectored Interrupt Request (IRQ), and non-vectored IRQ as defined by programmable settings.So

DACR system can able to separate the command signals. Through the PC different interrupt command will be passed by the user which in turns change the Robot direction. For this operation we need to configure the UART interrupt routine in the processor.

```
/********* UART0 Init ************/

VICIntSelect    = 0<<7;
VICVectCntl7    = 0x020 | 7;
VICVectAddr7    = (unsigned long)UART0_ISR;
VICIntEnable    = 1 << 7;
```

Table1: Configuration of UART IRQ

The Vectored Interrupt Controller (VIC) takes 32 interrupt request inputs and directly assigns them as vectored IRQ. VICIntSelect is a register which have the control of all interrupt registers. As we are using the UART0 interrupt and UART1 interrupt we have to just enable the 6^{th} and 7^{th} bit of the VICIntSelect register. After enabling for each interrupts separate slot have to be enabled for processing. So whenever an interrupt is coming from the User, then ARM processor can directly jumb to the interrupt routine to processing the command. This can be done with the help of VICVectAddr which holds the routine process location. Because of this facility DACR can handle the different interrupts from the user and can do the respective functions without any fault.

AT89c51:

The AT89C51 is a low-power, high performance CMOS 8 – bit microcomputer with 4 Kbytes of flash Erasable and Programmable Read Only Memory (EPROM). The device is manufactured using a Atmel's high-density nonvolatile memory technology and is compatible with the industry standard MCS-51tm instruction act and pin out. The on-chip flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with flash on a monolithic chip, the At89S51 is a powerful microcomputer, which provides a highly flexible and cost effective solution to many embedded control applications. When power is turned on, the circuit holds the RST pin high for an amount of time that depends on the capacitor value and the rate at which it charges. To ensure a valid reset, the RST pin must be held high long enough to allow the oscillator to start up plus two machine cycles.

Speech recognition module:

The HM2007 stores the "trained" word patterns used for recognition in external memory. For memory, the circuit uses an on board 8K X 8 static RAM. The main board has a coin battery holder that provides backup power to the static ram when the main circuit is turned off. This keeps all the trained words safely stored in memory (sram) so the circuit does not have to be retrained every time it is turned on. A fresh coin battery provides years of memory protection.

Applications:

- Command and control of appliances and equipment:
- Telephone assistance systems,
- Data entry
- Speech controlled toys,

The speech recognition system uses the following keypad structure. In that keypad, using the CLR button the internal SRAM can be cleared. After that, the memory block have to select to store the voice signal. Before giving the voice input, the user have to press the train button to store the voice frequency.

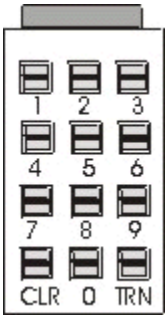

Fig d: Speech kit keypad section

Relay unit:

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches.

Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits, the link is magnetic and mechanical. Relays are very simple devices. There are four major parts in every realy.

They are

- Electromagnet
- Armature that can be attracted by the electromagnet
- Spring
- Set of electrical contacts

When a current flows through the coil, the resulting magnetic field attracts an armature that is mechanically linked to a moving contact. The movement either makes or breaks a connection with a fixed contact. When the current to the coil is switched off, the armature is returned by a force approximately half as strong as the magnetic force to its relaxed position. Usually this is a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly.

Wireless communication:

IEEE 802.15.4 Protocol:

The XBee/XBee-PRO RF Modules are designed to operate within the ZigBee protocol and support the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of data between remote devices. The modules operate within the ISM 2.4 GHz frequency band and are compatible with the following.

- **Advanced Networking & Security**
  - Point-to-point topology
  - point-to-multipoint topology
  - Self-routing, self-healing and fault-tolerant
  - mesh networking
- **Low Power**
  - TX Current: 295 mA
  - RX Current: 45 mA
  - Power-down Current: < 1 μA

III . CONCLUSION :

Finally in this project work ,we have done a DACR robot through wireless communication which in turn uses the zigbee transmission and can be controlled in different method. For the first controlling method we uses the voice signal processing. In which the voice commands have to store already. When the robo receives any predefined voice signal from any user, then it will do the pre-programmed function. Next method is based on the image processing method, in which according to hand gesture the robot can be controlled. This robo will be useful to do more activities in human life.

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