Multi-Task Surveillance Robot using ARM Controller

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ABSTRACT

At present there are robots which can be controlled through gesture, joystick, voice and some robots have other features. But in this paper there is a combination of features like controlling through voice and keypad, observing through camera. Multi-Task Surveillance Robot using Controller is implemented on embedded method. The program is simulated and tested in Keil software and dumped into the ARM7 board using Flash Magic tool. The robot can be controlled for directions through VRC and also for controlling the camera. This robot can be used in places where a human cannot go and also can observe live stream videos of surroundings through camera. For example sewages, caves and can send this robot as an observer to detect unauthorized persons.

Keywords- *Voice Recognition Circuit (VRC), Microcontroller, Flash Magic and Keil Software*

1. INTRODUCTION

Multi tasking is the art of doing things at the same time. The word multitasking and multiprocessing are used interchangeably. An example may be word processing at the same time the computer is plotting a complex graph in the background.

The aim of this project is to function the robot [1-3] in unstructured and dynamic environments and perform multiple tasks like sensing environmental changes and giving countermeasures, observing the surrounding activities through camera, taking its path by the recognition of voice or keypad used in observing military activities during war, gas leakage detection etc.. So, in case of emergency like some bomb attacks or related defence we can send this robot to spy on the terrorists and the hostages. And also can be used to send inside some dangerous caves, and few applications can be found in sewages.

2. OBJECTIVES

- The goal of our project is to function the robot in unstructured and dynamic environments.
- To train robot to work automatically and synthesize motion to achieve a given task by the user.
- To operate the robot by voice to control directions.
- Surveillance camera [4-6] is attached to examine the changes in the surroundings that come through Robot.
- Situational awareness: That is obstacle detection interrupting in all the directions of the robot.
- Multi-tasking: to detect gas leakages and fire, sensing surroundings, defence purpose, solving sewage blocking problems.

3. PREVIOUS EXISTING SYSTEM

A lot of work has been done earlier in the field of isolated word recognition. Using a traditional recognizer an accuracy of around 60% has previously been obtained for recognizing 20 voice commands with 0.9 seconds. As an input method for rapidly spreading small portable information devices, and advanced robotics' applications, development of speaker independent speech recognition technology which can be embedded on a single DSP chip has been developed by (Hoshimi/Yamada:1998). When the newly proposed noise robustness method was tested with 100 isolated word vocabulary speeches of 50 subjects, recognition accuracy of 94.7% was obtained under various noisy environments.

Earlier similar work in a limited input domain was done using *wireless* for e.g. remote control of electrical switches (this is currently one of the *ingenuity* problems). The information published in a newspaper report about a year ago (*The Hindu: Thursday Science & Technology Section*) about such a project. A suggested application was for hospitalized patients who usually are dependent on someone else for to switch on/off the lights, fan, etc., if the patient's is paralyzed. Obviously a voice based system ought to be used in such a case.

4. PROPOSED SYSTEM

Techniques presented advanced version of Voice recognition circuit (HM2007) in which the results are with an accuracy of 90% having recognized 40 voice commands with 1.2 seconds. In this project we are using user dependent circuit. The accuracy can be improved further and the system can be used for other application.

4.1 Methodology

We are taking the voice data from the microphone. This data is stored in HM2007, in the form of digital data in an array. Each input data stored has unique codes. These codes are transmitted to ARM via RF transmitter. RF receiver on the other side performs the exact opposite process as transmitter.

4.2 Project Limitations

Speech has difficulties to be recognized by an application. Speech is different for every speaker, May be fast, slow, or varying in speed. May have high pitch, low pitch, or be whispered. Have widely-varying types of environmental noise. Human resource is needed to control the robot [7-10]. Increasing the distance between transmitter and receiver would increase the cost of transmitter and receiver module.

4.3 Merits Of Proposed System

User friendly, Inbuilt debugger in arm controller, Fast response to inputs and Simple programming inputs.

4.4 Software Tools

Keil µ vision 4: The µVision from Keil combines project management, make facilities, source code editing, program debugging, and complete simulation in one powerful environment. The µVision development platform is easy-to-use and helping you quickly create embedded programs that work. The µVision editor and debugger are integrated in a single application that provides a seamless embedded project development environment. Flash Magic: It Windows software from the Embedded Systems Academy that allows easy access to all the ISP features provided by the devices.

5 PROJECT DESIGN

Project design is the model on the basis of which we proceed with the designing part. In this project we first came up with giving voice as inputs, so the voice commands are given to the Voice Recognition Circuit in which we previously train the board for our instructions.

The signals are communicated through RF transmitter and receiver pair and these signals are given to the ARM board which in turn controls the robot. The controlling of the robot includes the direction such as left, right, front and back. In addition the robot comprises the IR sensors for detecting the obstacle, and gas detection sensors are used in order to detect the gas leakages or any smokes, it can be designed for much more applications for multi tasking of the robot.

Voice Recognition Circuit

At the transmitter end the commands are given in the form of speech [19-20] by the Voice Recognition Circuit (VRC), which is given as the input to the wireless transmitter, here the VRC converts the voice command into the code which can be understood by transmitter. The voice recognition circuit (SR-07) uses a simple keypad and digital display to communicate with and program the HM2007 chip.

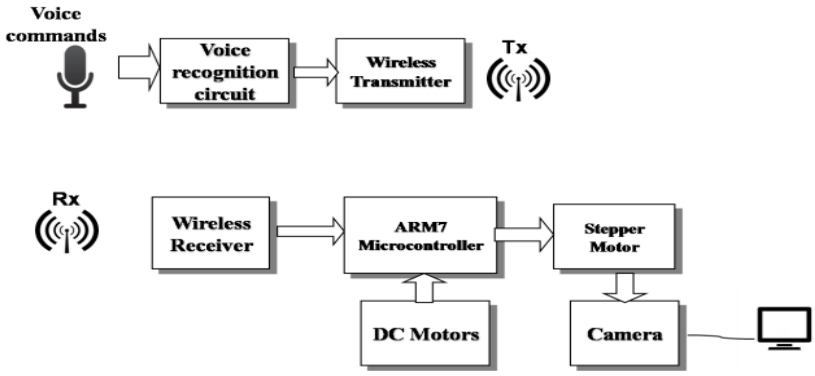

Fig.1: Project Model Block Diagram

Wireless Transmitter

A wireless *transmitter* is a device that's designed to broadcast signals to a receiver through an antenna. In our project wireless transmitter is used to transfer the voice commands given by the user to the receiver in order for the robot to get into its motion.

Wireless Receiver

A wireless receiver is a device that's designed to signals from the transmitter through antenna. We use here to receive the voice commands given by VRC to transmitter so that it is given to ARM7 TDMI processor as an input.

ARM7 TDMI Processor

ARM7TDMI is a processor [11] with 512K on-chip memory used for multiple tasks. This board is powered by USB port and does not need external power supply. It is ideal for developing embedded applications involving high speed wireless communication (Zigbee / Bluetooth / Wi-Fi), USB based data logging, real time data monitoring and control, interactive control panels etc.

DC Motor Driver Circuit

It is a driver circuit used at the receiver side, enables the dc motors connected to it to run in a particular directions commanded by the user like forward, backward, right, left, stop. It is connected to the ARM7 processor and requires supply of 12V.

Stepper Motor Driver Circuit

It is a driver circuit used at the receiver side, enables the stepper motor run. It is used in our project to guide the camera in rotating 360^0 to observe the environment through which robot crosses. It is connected to the ARM7 processor and requires supply of 12V.

Camera with RF

The camera [14] used at the receiver end will be able to spy the surroundings depending on our need. And this can be monitored on the display screen on our end so the user can take the particular action against any threat.

6. WORKING PRINCIPLE

In our project we are controlling our robot through voice commands. In prior the commands are trained through the HM2007 VRC (Voice Recognition Circuit) [12]. This command codes are converted into digital signals and sent through the 8-bit transmitter module. The signal from HM2007 is sent through D0-D3 pins for the transmitter module.

The digital signal from transmitter is received wirelessly through RF signals, and the received signal is processed in the RF Transmitter of D0-D3 pins. This signal will be the commands to control the robot through the ARM processor. The commands control the directions through the L293D DC motor driver circuit and control the camera through the stepper motor via ULN2803A Stepper motor circuit.

The signals from Receiver is given to the P0.16-P0.19 of LPC2148 and the output is given to the DC motor through L293D of P0.0-P0.3 here the directions are controlled like left, right, front and back.

Now the stepper motor is controlled by the ARM controller through ULN2803A via P1.16- P1.19 pins and this stepper motor is used to control the camera direction in clockwise direction to observe the surroundings. The camera used here is wireless RF camera which is mounted on the robot and controlled through stepper motor. The live streaming is observed through camera and this signal is sent through the antenna to the receiver which is connected to the TV through the AV cable and observed through the TV screen.

IR sensors are used to detect the obstacle and the signals are sent to the P0.8 for the front direction and P0.9 of back side sensor. The IR sensor is controlled in such a way that when an obstacle is detected it senses it and moves back. One more IR sensor is connected in front through P0.10 to detect the steep ways and to stop the robot.

Now coming to the gas detection sensor MQ5 it is directly connected to 5V supply and the sensor detects the LPG and other gases and the LED glows when the gas is detected. This MQ5 is highly sensitive to the LPG gases and less sensitive to other gases. All the Hardware components are interconnected by Soldering Iron.

7. ALGORITHM

Step1:Start
Step2:Train the HM2007 for the required commands.
Step3:If the error exists in the voice clear the board by pressing 99 and CLR button. And then retrain the VRC.
Step4:The signals are transmitted through RF wireless transmitter in the form of command codes.
Step 5: Transmitted signal is received through wireless receiver.
Step6:The program is simulated in Keil software and dumped into LPC2148 using flash magic, and the robot is operated for the particular program.
Step7: Set ports P0.16 – P0.19 with P0.8, P0.10 & P0.11 as inputs Set ports P0.0 – P0.3 and P1.16 – P1.19 as outputs
Step8:The program enters a While loop. It keeps executing until there is an input. If no input is given then it comes out of loop and jumps to Step 16
Step9:If input =0x00010000, robot moves front (P0.0 and P0.2 are high). If Front obstacle is detected it moves back and waits for next command. Control comes out of Step 9 when new command is given.
Step10:If input =0x00020000, robot moves back (P0.1 and P0.3 are high) If obstacle is detected backside it moves front and waits for next Command and control comes out of Step 10 when new command is given
Step11:If input =0x00030000 robot moves right (P0.1 and P0.2 are high)
Step12:If input =0x00040000 moves left (P0.0 and P0.3 are high)
Step13:If input=0x00050000 stepper motor rotates clockwise
Step14:If I =0x0006000 stepper motor rotates anti clockwise
Step15: After the comparison is done with all codes the loop flow jumps to step 8
Step16: When no input is given the control comes out of loop and stops the robot.
Step17: Stop

8. EXPERIMENTAL RESULTS

Results obtained under the new experimental conditions of input and output are called experimental results. The project has a conclusive result but for high performance applications can be added and for good flexibility.

8.1. Brief Explanation on Input and Output

At the input side, The 12V supply with 2A of current is given to the voice recognition circuit HM2007L from which four pins such as D0 – D3 are connected to the four pins of the RF Transmitter 0 – 3.
At the output side, The 5V RF receiver having four pins 0 – 3 is connected to the port 0 pins such as P0.16 – P0.19 of the ARM Controller. From the port 0 the pins P0.0 – P0.3 are connected to the four input pins of DC motor driver circuit L293D supplied with 12 V driven by ARM, where as its output pins are given to the DC motors. And from the port 1 pins P1.16 – P.19 of Arm are given to the Stepper motor driver circuit ULN2803 input pins, where as its output pins are given to the Stepper motor. The IR sensor which helps in detecting obstacles are given at the front, Back and bottom of the Robo Chassis to detect obstacles and move in the opposite direction respectively.

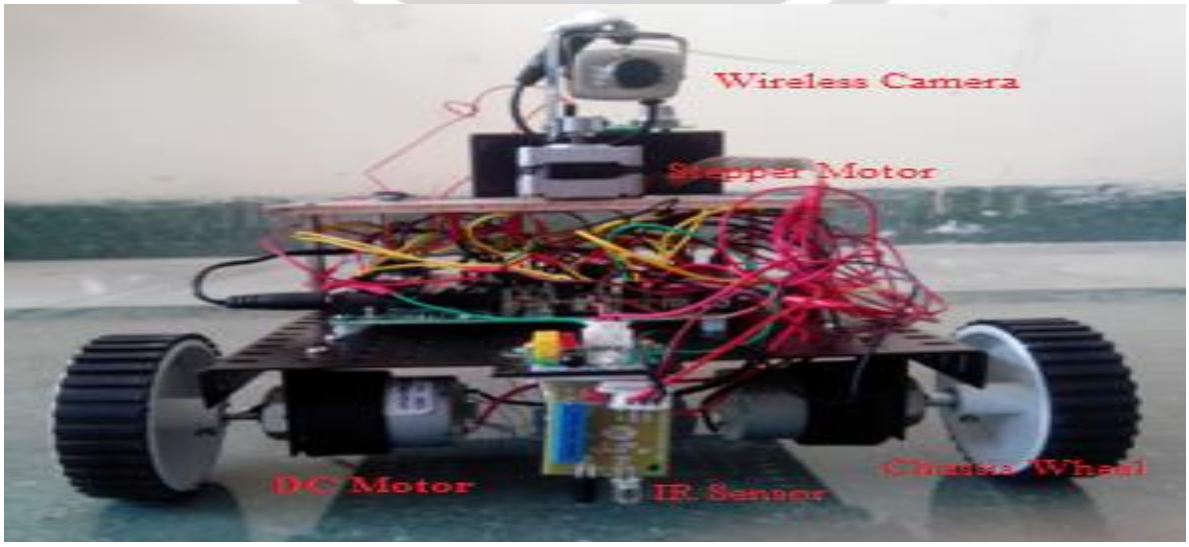

Fig.-2 : Multi-Task Robot Model

Fig- 3: Voice Recognition Circuit HM2007

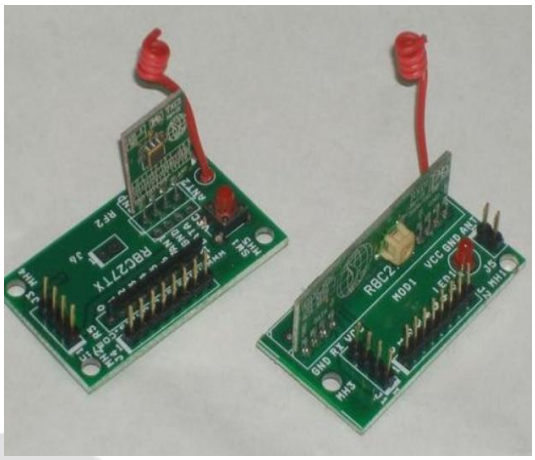

Fig-4: RF Tx and Rx

Fig-5: ARM Controller LPC2148

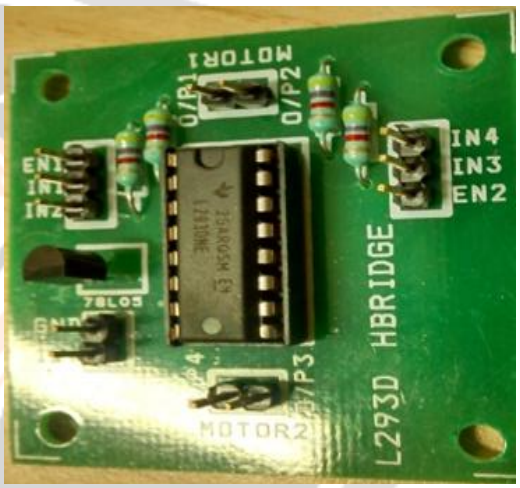

Fig-6: DC Motor driver circuit L293D

Fig-7: Stepper Motor driver circuit ULN2803

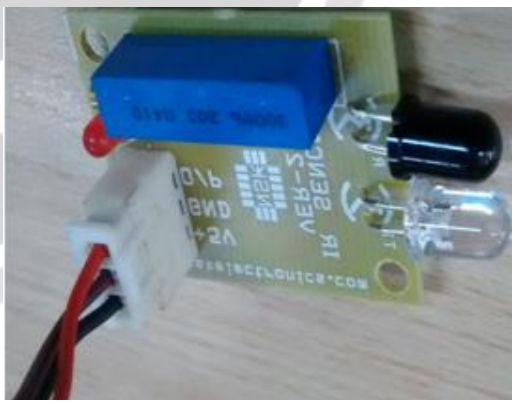

Fig-8: IR Sensor

Fig-9: RF Wireless Camera

Fig-10: RF Wireless Camera

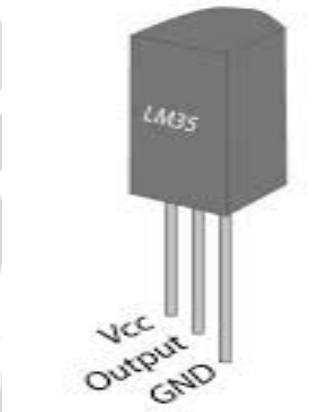

Fig-11: LM35 Temperature Sensor

Fig-12: Project Associates: From Left Sandhya M.S, Nischitha N, Prof. B.B.S Kumar, Karthik R & Ramesh L

8.2 Throughput

Productivity of a machine, procedure, process, or system over a unit period, expressed in a figure-of-merit or a term meaningful in the given context, such as output per hour is known as throughput.

Throughput of this project is as follows: In this project detecting things are made easy than with gesture, joy stick, remote controlled Robots as robot works only on ones own individual voice commands who had trained meaning other unauthorized persons are not allowed to guide the Robot where as using joy stick or remote

controlled any person can guide the Robot[13], [15-17] and as using RF wireless camera in this project it can spy through surroundings and user will be able to observe the live stream going on, like when we send through sewages with camera the blocked sewage pipes can be detected and respective counter measures can be undertaken.

9. CONCLUSION

The goal of this project was to develop a voice controlled robot with surveillance camera. The goals were fulfilled with quite good results. In this case ARM 7 Controller is used, which has a programming language that is easy to learn and implement. With fairly limited code it is possible to reach high robot control performance. The bottleneck of the performance lies on the voice recognition part of the system. For users with a strong accent the performance will not be very high.

For people with a good accent, and even for native speakers, it takes a while to learn how to speak to achieve good results. When this is learned, the voice recognition performance will be quite high, although not perfect. The performance can be increased by training the system to a specific voice. Also should have in mind what words can be confused. The security of the system can be increased, for instance by implementing a confirm mechanism. Still much of the performance results depend on the speech software, which hopefully will improve over the next years.

This is the most advance version of "pick n place robot" perhaps and most popular and widely used in recent industries. Arm is equipped with the camera which will transmit video in the database. And efficiency is more as detecting things are made easy than with gesture, joy stick, remote controlled Robots and using RF wireless camera in this project it can spy through surroundings and user will be able to observe the live stream going on comparing with past Robotic experiments.

9.1 Future Enhancement

At present this project consists of few applications such as observing the surrounding through camera, gas detection, temperature sensor etc. but there is availability for increasing the enhancement of the project by including more applications with extra features.
The distance of communication can increased by using high level RF Tx & Rx pair. Increase in the distance may require high investment. If the distance is increased we can send the robot for longer distance in sewages of also in war time to know about the traps. It can be used to detect humidity or water flow.

One of the disadvantages is if the gas is detected or to know the temperature we have to turn the camera to the sensor placed and observe the changes. But we can improve by giving an additional Tx & Rx pair to transmit the changes or values, and by using a 16 X 2 LCD display we can program to display the changes in the temperature and detections with commands given to the robot also.

Also by using the GSM/GPS we can locate the robot whereabouts i.e. where the robot is located at that instant and it should be controlled to come back to us which can be done only if the location is known and also the tracing path of the robot is necessary to locate it back.

Conclusively more applications can be added for this project for better performance and to give better results with less space and less cost. And it can also be configured to control through different means like gesture, voice, keypad or joystick which will be flexible for the user.

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