Voice Recognition Robot for Surveillance

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Abstract—A method of communication which could be easily recognized is speech when it acts as an interface for processes it becomes an additional advantage in artificial intelligence. In this paper, speech is used to control a robot with voice commands. Voice commands is a set of instruction given to the computer through microphone. Microcontroller Atmel 328 plays the major role in receiving samples as pulse width modulation(PWM) .The signals are transmitted and received using RF module. Raspberry pi 3 module acts as the brain of the robot, converts the signals into a set of programming language (python coding) recognized by robot. The movement of robotic vehicle is controlled by motor driver (L293d), DC gear motor, robotic wheel, and robotic ball. Motion of the robotic vehicle can be viewed through pi camera (capable of night vision) attached to the raspberry pi module and viewed in pc at the user end. Therefore, the proposed approach in this paper improves the robotic models used in surveillance to achieve greater robustness.

INTRODUCTION

The objective of this project is to implement automation of unmanned ground vehicle with the help of raspberry pi 3 model. The reason behind the project is to surveillance the large area where human beings could not complete the work efficiently or remote area . Especially in tunnels with 20 feet (6.1 m)long where it is impossible for the human to work through it. For example repairing in tunnel area, dangerous place for people, security purpose, tracking and so on. The vehicle can be designed according to the applications. Our aim is to control the vehicle's motion with set of voice commands which is displayed using Raspberry pi and the driver module(pi camera). This new method can be implemented in any kind of rugged area/place.

RELATED WORK

i. Robotic control with voice commands:
Speech commends were taken to the computer by microphone and made use of Artificial Neural Networks. Finally the comments were converted the form in which the robot can recognize and move accordingly [2] [5] [11]

ii. Robust speech recognition in the automobile:
The greatest degradation in recognition accuracy of voice was produced by interference from FM-radio talk shows.[2] [5] [1]

iii. Voice recognition robot control using android device:
Using Arduino board for voice controlling process so that Robot makes movement in desired direction [3] [4] [6]

iv. Voice Control Robot Using Android Application:
An ATMEGA32 microcontroller is used together with a Bluetooth device interfaced to the control unit for sensing the signals transmitted by any Android application[4][3][6]

v. Remote control of robotic arm using raspberry pi:
Raspberry pi is used for converting signals into instruction in which robotic vehicle would recognize [8] [9]
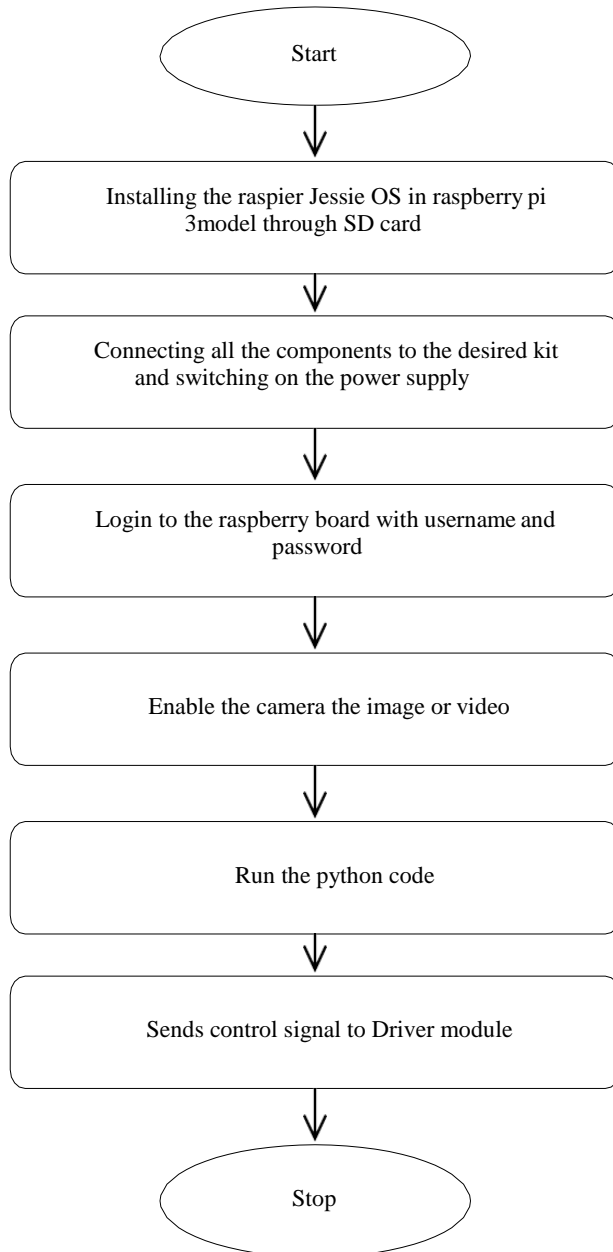
vi. War filed robot with night vision camera:
It focuses on building a RF based spying robot attached with wireless camera which has the ability to detect even in dark that can reduce the human victim in war filed[10]

PROPOSED METHODOLOGY

Using the raspberry pi module as a brain of the robot in an active research for filled with several open opportunities and promising, this paper presents a review of robot controlled by microcontroller. It is aimed to controller a robot with speech commands. The robot is able to recognize spoken commands to move correctly. To give a direction to robot, first the voice command is sent to the computer using a microphone. The computer recognizes the command by speech recognition system. And the computer converts the voice command to the direction command that predefined and recognizable by robot. When the robot get the direction command it moves according to spoken command. When we say voice control, the first term to be considered is speech recognition i.e. making the system to understand human voice. Speech recognition is a technology where the system understands the words (not its meaning) given through speech.

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FIG 1: FLOW DIAGRAM

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*A.EMBEDDED SYSTEM:*A An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real time computing constraints. Embedded is the part of a complete device which includes both hardware and mechanical parts. Embedded systems control many devices in common use today.

B.ROBOTICS: Robotics is the stem of mechanical engineering, electrical engineering and computer science that deals by the design, construction, operation, and application of robots, as well as computer systems intended the function such as control, sensory feedback, and information processing. These technologies deal with automated machines that can take the place of humans in dangerous environments as well as manufacturing processes, also it resembles humans in appearance, behavior. Nowadays robots are inspired by nature contributing to the field of bio- inspired robotics.

C.SURVEILLANCE: It is mainly used for surveillance. Surveillance robots were first introduced in the military for monitoring the enemy movements. After the implementation of these robots the loss of human life and resources were reduced to a great extent. In the mid 1980's these surveillance robots were introduced for various uses. They were not able to move from one place to another. Because of this surveillance was possible only for a certain area, and those robots performed only one function. But the modern day robots used now are able to do multiple tasks and can move to any extent.

D.VOICE: Speech plays an important role in our project. Instead of using complex different interfaces, speech is eider to communicate with computer. Voice controlled robot (VCR) is a mobile robot in which motions can be controlled by the user by giving specific voice commands. The speech recognition software running on a pc is capable of identifying the voice commands 'Run', 'Stop', 'Right', 'Left', 'Back' issued by the particular user. After processing the speech, the necessary motion instructions are given to the mobile platform via a RF link.
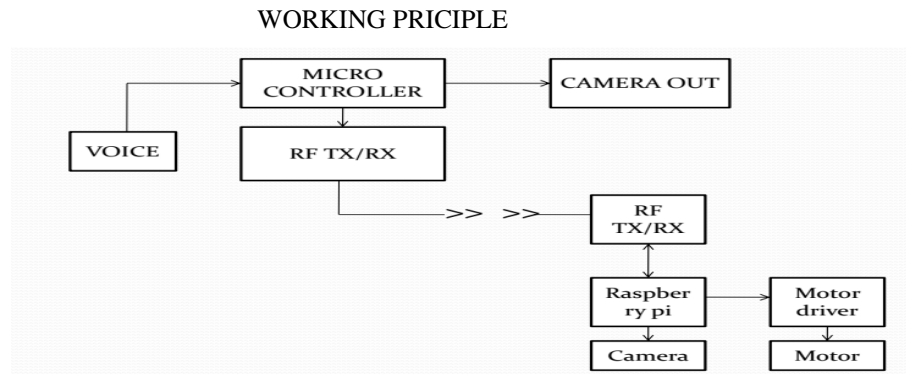
WORKING PRICIPLE

Fig-2: Block Diagram

Voice-controlled robotic vehicle is designed to be controlled by using human machine interface and voice commands for the remote operations of the robotic vehicle over long distance. An Atmega32 is used along with a voice recognition module for achieving required operation. The direction of the robotic vehicle's movement can be controlled by using voice commands. The voice commands are sent by the RF from the transmitting end towards the receiving end after passing the information through microcontroller (Atmel 32). Microcontroller also contains the display attached to it so that the movement of robotic vehicle is viewed from one place through pc.This movement of the robotic vehicle in a specific direction can be controlled using two motors that are motor driver and robotic motor. RF transmitter converts the commands the voice commands that are into encoded digital data, the acceptable ranges up to 200meters. The encoded data received at the receiver circuit is decoded to being sent Raspberry pi module which converts the encoded information into decoded format. Raspberry pi module also contains camera attached to it. This process is supported my motor driver and motor along with the DC motor attached to the robotic vehicle.

The voice controlled robot vehicle with long distance speech recognition project can be integrated with the help of inbuilt technology in Raspberry Pi3 module that facilitates the controlling of the robotic vehicle over longer distance. Raspberry pi kit provides a very long distance communication when compared to Rf technology, thus robotic vehicle can be controlled remotely from very long distance. Thus finally the robotic vehicle make the direction such as stop, forward, backward, left and right based on the commands received from the receiver.

I.   SPEECH RECOGNITION

We capture the speech signals coming from the microphone attached to the PC. The software running(Python coding) on PC processes the signals to recognize the voice commands like 'Run', 'stop', 'left', 'Right' and 'Back'. The software also provides the capability to train itself for the above mentioned commands. For training we use artificial neural networks. The software is written in using Raspberry-pi.

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II. WORD CAPTURING

The signals coming from the microphone is processed only when you speak something. The program waits until the sample value exceeds some threshold value (which can be adjusted by the user), when the program is triggered by a significant sample. After that to determine the actual boundaries of the word spoken, 'edge detection' is performed. Here the centre of gravity of the energy distribution of the signal is calculated and then from that point intervals where the amplitude level lies below a threshold level are removed. Finally a set of voice samples corresponding to a particular word is free from silent periods. Normally these kinds of system are known as speech controlled Automation Systems (SCAS).Our system is the prototype of the same. We are not aiming to build a robot which can recognize a lot of words. Our basic idea is to develop some sort of menu driven control of our robot, where the menu is going to be voice driven.

We are aiming to control the robot using following voice commands. Robot will be able to do these basic tasks.

SAMPLE INPUT OUTPUT

INPUT (Speaker speak)	OUTPUT (Robot does)
Forward	Moves forward
Back	Moves back
Right	Turns right
Left	Turns left
Stop	Stops doing current task

Robot which can do following basic tasks such as:-
1. moving forward
2. moving back
3. turning right
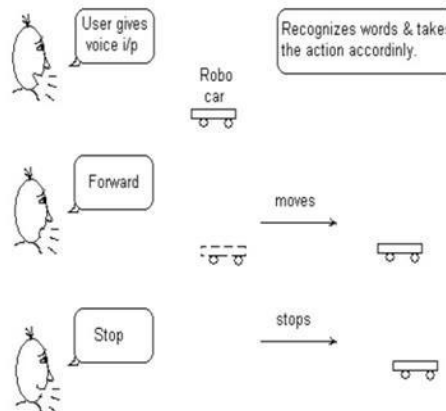4. turning left
5. stop(stops doing the current job)

Fig-2: Controlling The Robot Using Voice Cammands

III. RASPBERRY PI3

Raspberry pi is an ARM base recognition card which is sized as SBC (single board computer) and it is created by Raspberry pi foundation. Raspberry Pi runs based on GNU/Linux operating system. The Raspberry pi is series of small single board computers were primarily developed in the United Kingdom by the Raspberry pi foundation, it promotes the teaching of basic computer science in schools and in developing countries. According to the Raspberry Pi foundation over 5million Raspberry Pi's have been sold February 2015 making it the best selling British computer. Raspberry Pi foundation has announced a new version Raspberry Pi3, with Wi-Fi/Bluetooth support and a 64bit improved processor. Clock speed is about 1.2GHz and Ram capacity is 1GB.Raspberry power capacity is about 2.5W.

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Fig-3: Raspberry Pi 3 Module

IV. ARDUINO

Arduino is a processor containing hardware, software, and user community that designs and manufacture microcontroller kit for building digital strategy and interactive objects so as to sense and control objects in the physical world. The project's products are distributed as open-source hardware andsoftware. The boards are equipped with set of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits. The microcontrollers are typically programmed using features of programming such as languages c and c++. It is mainly aimed at providing a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators.
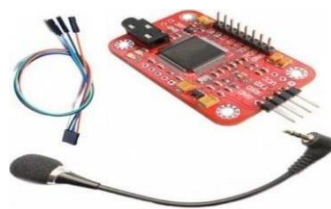
Fig4:Aurdino Module

V.MOTOR

It is a 60 RPM low cost single shaft DC geared motor. It is the most suitable for light weighted robot require small power. This motor has (69mmDiameterwheelforPlastic Gear Motors and (87mm Diameter) wheel for Multipurpose Plastic Gear Motors. Overload which usually protects gears from the sudden overload. Motor runs smoothly over the range of 2V to 12V and gives wide range of RPM, and torque.

Fig-5: Internals Of The Single Shaft For Plastic Gear Motor

BOARD

- The size of the pi2 and p3 are similar
- There is slight change in component placement to allow addition of Wi-Fi and Bluetooth along with SoC chip antenna in pi3

SYSTEM ON CHIP (SoC)

- Broadcom BCM2837 SoC
- Application processor
- 64bit quad core
- 1.2GHz
- ARM cortex A-53processor
- 400MHz
- Video core
- multimedia coprocessor

*CHIP ANTENNA:*A ceramic chip antenna is used by Wi-Fi and Bluetooth 4.1 SoC BCM43438.The chip antenna moves the indicator LED's that were present in pi2 to the lower side of PCB *REPOSITIONED Led's*: The ACT and PWRLED's are repositioned when compared to pi3 then compared to pi2 *WIFI/BLUETOOTH SoC BCM43438:*Wi-Fi and Bluetooth 4.1(classic and LE) are provided by Broadcom BCM43438 chip.

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Fig-6:Motor Mounting Kit Forplastic Gear Motor

SPECIFICATIONS

A.RPM: Ranges from 60 at 12V *B. Voltage*: Varies from 2V to 12V *C. Motor*: Weights 30gms *D. Matched wheels*: Ranges from 69mm Diameter Wheel for Plastic Gear Motors and 87mmDiameter Multipurpose heel for Plastic Gear Motors
E. Matched wheels for tank robot: Tank Track Links with 87mmDiameterMultipurposeWheel for Plastic Gear Motors

Voltage (V)	RPM (No load)	Current at no load(A)	Stall torque (kg/cm)	Stall current (A)
2	10	1.99	1.99	0.274
3	17	3.06	3.06	0.401
4	24	0.0046	4.13	0.476
5	29	0.051	5.23	0.672
6	34	0.054	Clutc	Clutch
7	40	0.056	Clutc	Clutch
8	45	0.062	Clutc	Clutch
9	51	0.067	Clutc	Clutch
10	54	0.070	Clutc	Clutch
11	57	0.073	Clutc	Clutch
12	60	0.083	Clutc	Clutch

Fig-7:Motor Performance in Terms of Rpm, Current At No Load and Stall Torque, Stall Current as a Function of Input Voltage

VI.VOICE RECOGNITION MODULE

Voice recognition is the technique to facilitate natural and suitable human-machineinterface using the voice recognition module. It extracts and analyses voice description of human delivered to a machine or computer through the mic. Voice recognition technique is generally classified into various types based on different criteria such as scope of the users, quantity of words used for recognition, openness of speaking. If the voice recognition level is more than 95%, then only the voice recognition is practically used.
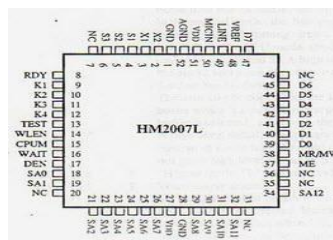

Fig-8: Pin Configuration of Voice Recogntion Module

WORKING:

Voice-controlled robotic vehicle is designed to be controlled by using human-machine interface and voice commands for the remote operations of the robotic vehicle over long distance. An Atmega32 is used with a voice recognition module for achieving required operation. The direction of the robotic vehicle's movement can be controlled by using voice commands. The voice commands are sent via the RF from the transmitting end to the receiving end. Thus, the robotic vehicle moves in forward, backward, left or right directions based on the commands received by the receiver.

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VII.L293D MOTOR DRIVER

DESCRIPTION: L293D is a Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors at the same time in any direction. It means that you can control two DC motor with a single L293D IC. Double H- bridge Motor Driver integrated circuit (*IC*).The l293d can drive little and quiet big motors as well, check the Voltage.

CONCEPT: It mechanism on the concept of H- bridge. H-bridge is a circuit which allows the voltage to be flown in also direction. Voltage require to changing its

direction for being able to rotate the motor in clockwise or anticlockwise direction, hence H-bridge IC are perfect for driving a DC motor. There are two allow pins on l293d. Pin 1 and pin 9, to drive the motor pin 1 and 9 need to be high. For driving the motor with left H-bridge we must enable pin 1 to high. And for right H- Bridge you require to make the pin 9 to high. If some of the either pin1 or pin9 goes low, then the motor in the corresponding section will suspend to working. It's similar to a switch.
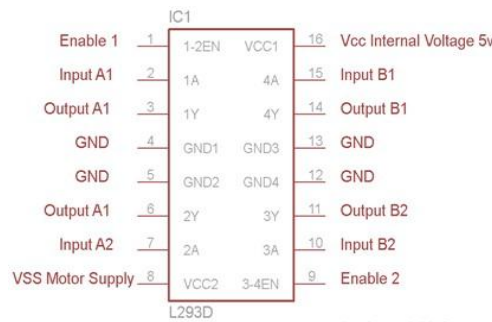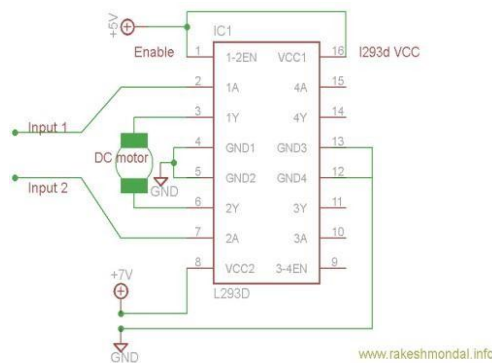

Fig-9:Pin Configuration Opf Motor Driver

Fig-10: Circuit Diagram For L293d Motor Driver
Ic Controller

VII.RF MODULE

An RF module (radio frequency module) is a little electronics device used to transmit and/or receive radio signals between two devices. In an embedded system it is often attractive to communicate with another device wirelessly. RF communications add in a transmitter or receive. Finally, radio circuits are usually subject to limits on radiated emissions, and need conformance testing and certification. RF modules may fulfil with a defined protocol for RF communications such as Zigbee, Bluetooth low energy, Wi-Fi, or they may implement a proprietary protocol.

TYPES OF RF MODULES

- Transmitter module
- Receiver module
- Transceiver module
- System on chip module

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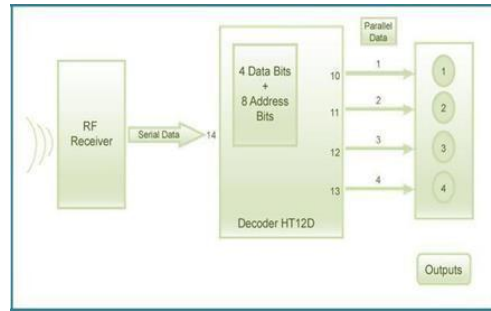**NCIECC - 2017 Conference Proceedings**

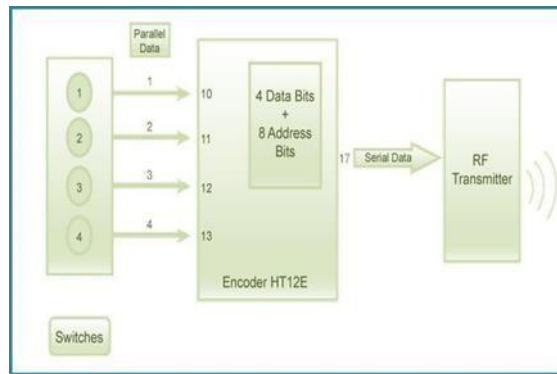Fig-11: Block Diagram Of Rf Transmitter Module

Fig-12: Block Diagram Of Rf Recevier Module

TRANSMITTER MODULES: An RF transmitter module is a little PCB sub-assembly able of transmitting a radio wave and modulating that wave to carry data. Transmitter modules are typically implemented alongside a micro controller which will supply data to the module which can be transmitted is an open source microcontroller from which there is no feedback presents

RECEIVER MODULES: An RF receiver module receives the modulated RF signal and then demodulates it. There are two types of RF receiver modules: super heterodyne RF receiver's module and super-regenerative RF receiver's module. Super-regenerative modules are typically low cast and low power designs using a series of amplifiers to take out modulated data from a carrier wave. Super heterodyne RF receiver module have a advantage over super-regenerative, they offer increased accuracy and stability over a large voltage and temperature range

TRANSCEIVER MODULES: An RF transmitter module incorporates both a transmitter and receiver. This circuit is characteristically considered for half- duplex operation, although full-duplex modules are available, typically at a higher cast unpaid to the added complexity.

SYSTEM ON A CHIP (SOC) MODULE: A SoC module is the similar as a transceiver module, but it is frequently made with an on board microcontroller. The microcontroller is typically used to handle radio data packet station or control a protocol such as an IEEE 802.15.4 compliant module. This type of module is characteristically used for design that needs additional processing into the host microcontroller.

Wireless protocols used in RF modules

- S-wave Smart Wave
- Zigbee
- Bluetooth low energy
- Wi-Fi
- IEEE 802.15.4

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VII.MICROCONTROLLER

ATMEGA-328 microcontroller contains 14input and output with both analog and digital pins, 6 analog inputs and remaining as the digital inputs. Power jack cable is used for connecting arduino board with the computer. Externally battery is connected with the arduino microcontroller for the purpose of power supply.

Arduino an open source microcontroller from which there is no feedback present at the microcontroller is an open source microcontroller from which there is no feedback present at the microcontroller is an open source microcontroller from which there is no feedback present at the microcontroller.

Fig-13: Arduino Atmega-328 Microcontroller

ATMEGA 328 microcontroller, which acts as a processor for the arduino board. Nearly it consist of 28pins.From these 28pins, the inputs can be controlled by transmitting and receiving the inputs to the external device. It also consist of pulse width modulation (PWM).These PWM are used to transmitting the entire signal in pulse modulation. Input power supply such as Vcc and Gnd are also used. These IC mainly consist of analog and digital inputs. These analog and digital inputs are used for the purpose of certain application..

IX.CAMERA

The PiNoir Camera is capable of capturing30 frames per second for 1080p video and unmoving image up to 5 megapixels, which is 2592x1944. The camera comes connected to a board with a fairly short ribbon cable close which you then join to the Raspberry Pi. The Raspberry Pi has a CSI port near the Ethernet port to connect the camera ribbon cable into.A 5-second delay will lead the actual image capture and the result will be saved into test.jpg. I found to the light setup was better with this delay, using a --timeout 100 parameter to receive the image after only a 100 millisecond delay resulted in an image with much poorer introduction.
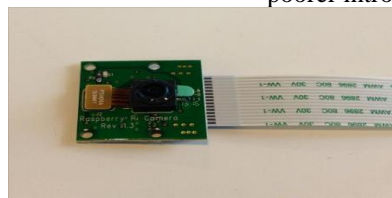

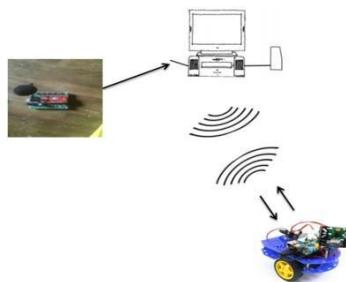Fig-14: Camera Module With Ribbon

Fig-15: Full Fledged Representation

OUTPUT

Following figure show the out which can be viewed at the pc from user end:

CONCLUSION

In this above project we have proposed a surveillance robot using microcontroller. One of the major advantage of using this robot is that ,it can be used in unmanned area from remote place without physical contact. In addition to this we can protect and save human lives which are irreplaceable.

This project will obtain further enhance if the range is increased from Wi-Fi to Wimax so that robotic vehicle can be operated over longer range from remote area. In addition it can be extended programming the robot for stair case climbing weight lifting releasing etc

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