iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 3 **Issue:** III **Month of publication:** March 2015

DOI:

www.ijraset.com

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Volume 3 Issue III, March 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Unmanned surveillance and rescue operations using Smartphone controlled Robot

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Abstract— The main objective of this project is to stipulate a surveillance robot under a unmanned condition. The robot entitles an on board video camera which is adjustable with servo motors, battery backup and features wireless interface to the human controller through smart phone interface. Solar panels accompanied with tilt sensors are available on board to have an lifetime operation to get maximum output power. Under surveillance & rescue conditions, it collects sound, images, pressure and video scenarios from the surroundings and transfer information using GSM/CDMA. The rotary encoder coverts the angular position into the digital signal from which the motor position can be controlled solar panels are embodied with the system for proper power supply in case of emergency. As this total system can be controlled from distance, it can be used effectively at a rescue operation to observe the condition of the victims and provide facilitation. Rescue team can prepare themselves with necessary appliances according to the situation after watching the inside scenario. This system can be a good surveyor for the rescue worker and will be helpful in nuclear reactors where accidents are prone to occur
Keywords— DTMF, Arduino, Tethered Dlink camera, Rotary encoder

I. INTRODUCTION

DTMF has become a medium for the implementation of controlling robots from distance. The common security system gives some protection via fixed cameras but still has some dead zone cannot be monitored. Our project use internet as the medium to create communication between user and robotic vehicle for which it is very much reliable. In general robots use RF circuits for the feature of wireless control, which have the imperfections of confined working province, finite frequency range and limited control . Use of a smart phone for monitoring can overcome these abridgements as it provides the advantages of robust steerage, enormous working range and interference free controlling scheme. Control of robot entangles some exclusive phases: perception, processing and action. In general, the preceptors are irrelevant types of sensor implicated on the robot, processing is performed by Arduino and the persuasive is accomplished by using dc motors. Due to the huge availability of mobile phone, Improvement of Network coverage, The existing infrastructure that supports mobile communication across the globe. The use of DTMF signals instead of Radio Frequencies (RF) signals. Dual Tone Multi Frequency (DTMF), a gentile communication clop for touch tone, is extensively used as a medium of remote control. DTMF signals are generated when pressing on the keypad button during a conversation is going on and the generated signals can be utilized to limit the digits. Individual tone is used for each digit. If two tones were used to represent a digit, the likelihood of a false signal occurring is ruled out. This is the basis of using dual tone in DTMF communication. There are 12 standard signals and 4 extra buttons “A”, “B”, “C”, “D”, which normally are unseen on telephone keypad. As we deal with the control using mobile phone, we have to consider these extra buttons. The use of these additional buttons is to prevent to control remote device. Each signal is comprised from two tones “low” and” high” as shown in the table.

	column 1 1209 Hz	column 2 1336 Hz	column 3 1477 Hz	column 4 1633 Hz
row 1 697 Hz	1	2	3	A
row 2 770 Hz	4	5	6	B
row 3 852 Hz	7	8	9	C
row 4 941 Hz	*	0	#	D

Table.1

If any button is squeezed on a keypad of a mobile phone or smart phone, a connection is drawn up that generates two tones at the identical time. Generated two tones identify the pressed key to controlled device. The calculation of the frequency for each keypad button is performed by adding the frequencies of a row and a column for every corresponding button. In order to generate the DTMF tone for button "5", we commingles a 770 Hz signal with a 1336 Hz signal

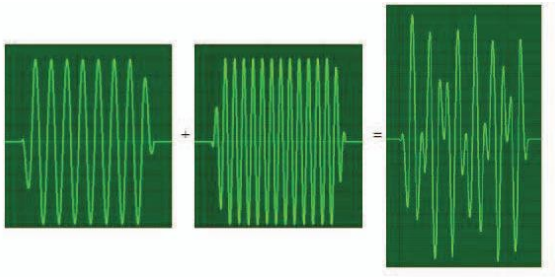

Fig.1

The above figure1 shows the out put of the frequency generator when button 5 is pressed and this is the way the out put is generated and this is detected by the other side.

770 Hz Sine wave + 1336 Hz Sine wave = DTMF Tone “5”

By using a web camera (Camera of the smart phone can also be used) position and distance of the moving object are obtained. Rotation angular and linear velocities are estimated using filters to predict the trajectory of a moving object. By using a single curvature trajectory the mobile robot can follow the moving object by estimating
trajectory of the moving object .

II. SYSTEM OVERVIEW

In this system there are some units as control unit, sensor unit, power supply unit etc. According to the suggested system, the robot is controlled by a smart phone from distance. Smart phone that is stacked on the robot will be kept in auto answer mode. After the generation of DTMF signal, decoder IC decodes the DTMF signal into its equivalent binary digit and this binary digits are dispatched to Arduino. Arduino is pre-programmed to take up decisions for the given input (Pressed button) and outputs the decision to motor driver IC.As shown in the figure two phones are connected to each other by a network provided and the information can be passed from one mobile to other in terms of frequency and the required operation can be performed

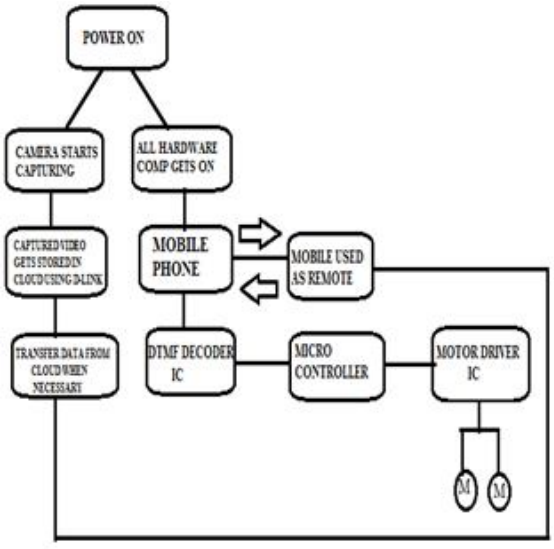

Fig.2

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This platform is controlled by a servo motor that it can rotate 360 degree.Auto answer mode is enabled in the smart phone and using 3G mobile Communication the scenario captured by the smart phone, can be observed by the controlling phone from distance.A solar panel is embodied with the system in case of emergency power failure. The system is so programmed that the solar panel will be recharged from natural light source and will provide supply in case of power failure and also the solar panel is provided with tilt sensor

III. HARDWARE AND SOFTWARE COMPONENTS

The system is based on some hardware and software components which are as follows:

A. Arduino

Arduino, an 8-bit Atmel AVR microcontroller is a singleboard microcontroller and is contemplated to construct the solicitation of interactive objects. It is used in this system because of its low power consumption and ability to work with the PWM signals. Apart from these it doesn't require D/A and A/D converters.

B. At mega 32 Microcontroller

ATmega-32, a low powered CMOS 8-bit microcontroller which is based on RISC architecture. It is used in this system as it has programmable flash memory, balanced power consumption, optimal processing speed and for its high performance.

C. MT8870 DTMF decoder

The MT8870D is the vital project of this system. It is used here mainly for decoding DTMF signals into corresponding DTMF signals. Digital counting technique is used to detect and decode DTMF signals into 4 bit binary code. It has the features of receiver integrating along with the band split filter and digital decoder functions.

D. L293D Motor Driver

The L293D is used for simultaneous, bi-directional control features. Another notability of this IC is the handling capability of minimal currents. Servo motors and dc motors are mainly used in this system.

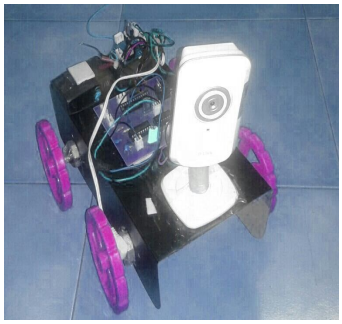
E. Sensors

Implemented sensors in this system are: Pressure Sensor, Nuclear Sensor, Tilt sensor

Tilt Sensor:

This sensor is used in this paper to tilt the solar panel to the angle having maximum intensity of sunlight. This tilt sensor makes the efficient usage of sunlight compared to prolonged constant angle of the panel .This sensor makes use of the LDR as a source to the measure the light availability in any direction. The resistance of LDR reduces as there is availability of more light this makes from mega ohms to they reduce to a range of few hundred ohms as the intensity of light increases this LDR .This signal is fed to Arduino depending upon this the servo motor are triggered to move .

F. D-LINK Camera



The Dlink camera connected to the robot is tethered with the onboard mobile phone. The Dlink has to be initially configured ,so that it answers only to a particular user's request in that way the security is improved .

G.Software

Software that are used in this project to run the system efficiently is "Arduino programming language" with the help of which the motor directions for the predetermined set of bit values are determined and correspondingly the signals are given through the PWM output ports to the motor driver IC.

H.Others

Apart from these equipment, we have used rotary encoder, smart phone, chassis, wheels.

The rotary encoder converts the rotational motion into electrical signals (analog/digital).It consists of the slotted disc coupled to the motor shaft. The photo detectors and the photo diode detects the change and the change is converted to binary signals which is fed into Arduino.

IV. CONSTRUCTION

There are some basic principles of constructing any robot. The number of motors used is a major mechanical constraint. Either a two-wheel drive or a four-wheel drive can be constructed. As four-wheel drive is more perplexing than two wheel drive, it provides more torque and better control. A chassis is used here in four wheel drive model is a 15×24 cm2 sheet made up of par ax and plastic wood.. Motors are fixed to the bottom of this sheet and the circuit attached on a PCB board is affixed on an even keel on top of the sheet. A platform is made using plastic wood at the middle of the chassis. A smart phone is seated upon on the platform for the purpose of monitoring the surroundings. Lighting arrangements are made with LDR, Diodes and transistors. And it is set in front of the system and an LCD screen is attached with temperature sensor is attached. The platform can be controlled by a servo motor. Obstacle avoiding circuits are prepared properly with Arduino, motor shield, motors or playing cars, wheels, ultrasonic distance sensors, servo motors etc. Some OFR are prepared with these elements : Reflectance Sensor Arrays, Ultrasonic/IR Sensors, Potential Freewheels, Wheels, Rotary Encoders, The guts: controllers, compass, processor, tracing mechanism w/servo, etc. Wheels are the important part for this system as we propose the system to be used in rescue operations. Figure 4 indicates the Arduino based robot with IR Radar

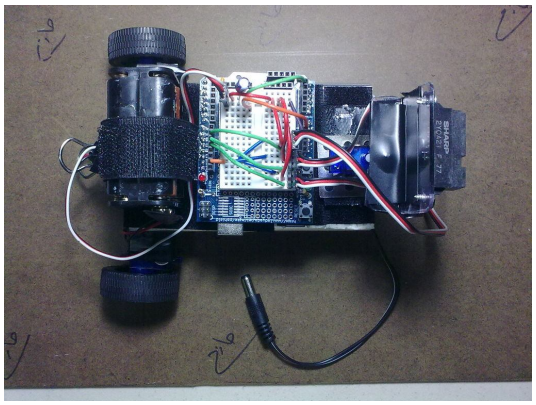


Fig.4 a the arduino based robot with IR Radar

Fig 4 b wheels used in the robot

V. WORKING

It is already stated that, when a call is made to the smart phone or cell phone stacked to the robot from the controlling phone, it comprehends DTMF signals on pressing the keypad buttons. When a button is pressed the robot perform actions as listed in Table. If key "6" (Binary equivalent 00000110) is pressed on the controlling phone, Arduino outputs "10001001" binary equivalent and the sends this code to the L293D motor driver IC. Motor driver IC passes the code to the motor and the motor takes right turn. The robot can now be controlled in the desired direction just by pressing the correct key. The temperature is programmed that for a particular temperature it will provide alarm and thus the rescue team can take precautionary steps from earlier, in case of nuclear sensors.

The DLINK camera relays the information through the smart phone via network communication, For further applications in military, the X band can be preferred over other civilian bands because of this one to one tethering of the camera and the phone present in the robot this can be made possible. It can be made more difficult to detect by RADAR with the help of RADARTAPES and EM absorbing materials the surface body is kept at an elevated angle of 45 degree to reflect back the RADAR signals.

BCD CODE	ACTION TAKEN BY THE MOTOR	PRESSED CODE
00000001	Forward Left	1
00000010	Forward	2
00000011	Forward Right	3
00000100	Left Turn	4
00000101	Brake	5
00000110	Right Turn	6
00000111	Reverse Left	7
00001000	Reverse	8
00001001	Reverse Right	9
00000000	Brake	0

VI. CONCLUSIONS

The primary purpose of smart phone operated robot is to be acquainted with the information in the locations where we cannot footpace. One to one secured communication, no traffic in fetching data can be achieved. Places like Line Of Control (LOC), hazardous places which are prone to natural calamities where rescue operations becomes unachievable by human beings. The radio detection and ranging is used to find any new threats in unmanned area.

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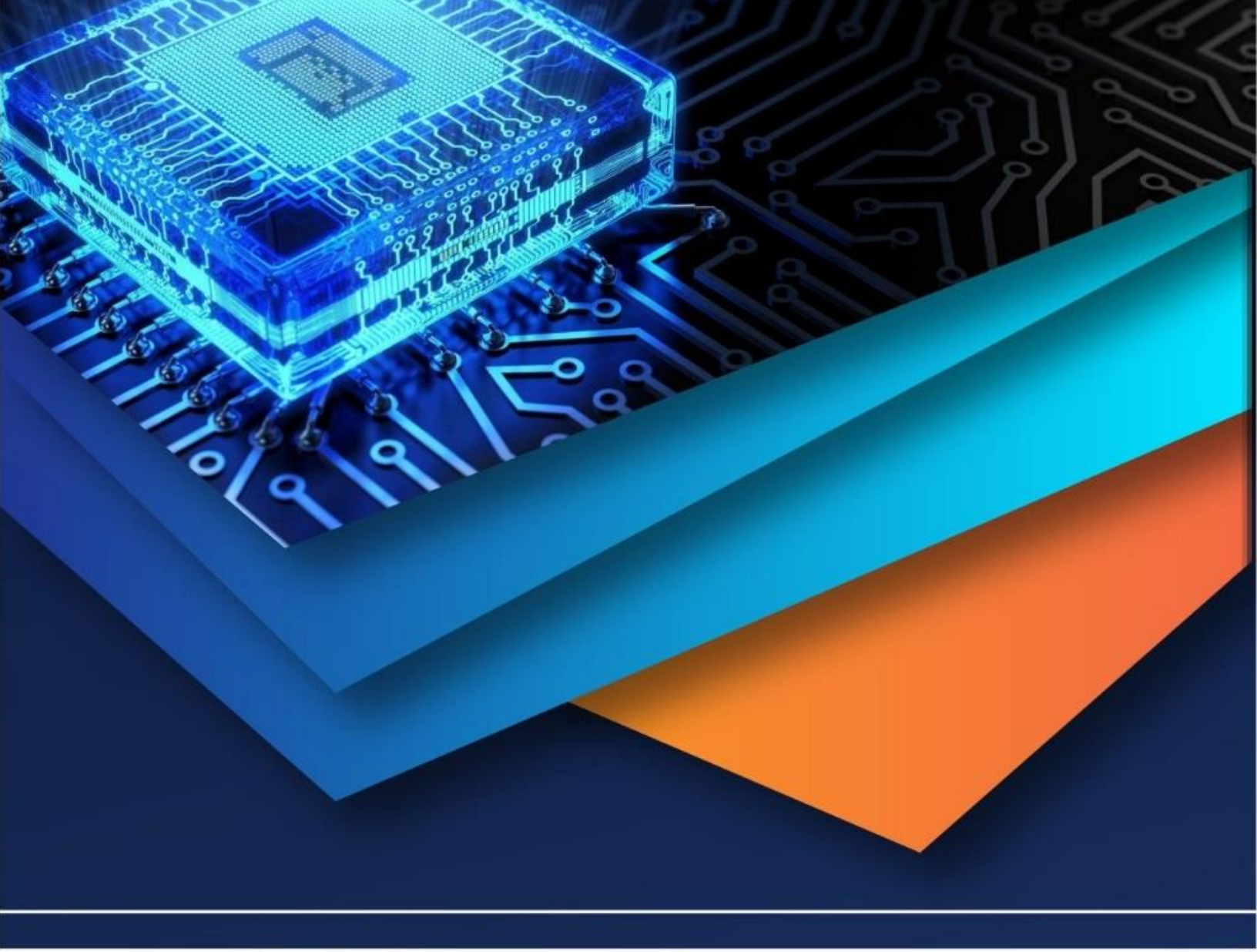

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