IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321- 5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 6, June 2018

Unmanned Ground Robotic Vehicle

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Abstract: The need for robotics was identified several decades ago. Since then considerable advancements has been made in this field. Unmanned patrolling vehicle is a product of such advancements. Such projects will help our soldiers to monitor the border areas especially in extreme weather conditions where it is onerous for the soldiers to survive, it also help to replace humans from perilous situations like handling explosives and in bomb disabling vehicles where small size is needed or where humans cannot easily go. There are several other applications of such devices like they can be used for search and rescue operations, perimeter patrol data collection, environmental hazard detection, entry and lock check, and gauge inspection.

Keywords: DTMF, RFID identification, PIR sensors, ultrasonic rangefinder, UGV, UMPV, reed switch, MQ5

I. INTRODUCTION

The quest into the field of robotics began several decades ago. People since then were really fascinated with the very idea and the development of the robots. As the time progressed there has been a huge advancement in the field of robotics. In Dec 2003,"Mobile Autonomous Robot Software" research program was started by the Pentagon in an attempt to develop more advanced military robots. Unmanned Patrolling Vehicle (UMPV) is specifically designed to be used in war field and for border security. Within that context, a tele-operated vehicle system is one in which navigational guidance is transmitted to the vehicle from an externally situated human operator; an autonomous vehicle is one which determines its own course using onboard sensor and processing resources; the name supervisory control is often given to the myriad of control schemes which combine inputs from both an external human operator and onboard sensors to determine the path [1]. The main aim behind this project is to design a robotic vehicle that will help our soldiers to monitor the border areas especially in extreme climatic conditions where it is difficult for the soldiers to survive and to monitor war field. Around the clock monitoring of the war field is also made possible with the help of such vehicles. Several features like RFID, DTMF, PIR sensors, reed switch, MQ5 and ultrasonic rangefinders have been added to make the design more
Effective and dependable

II. BLOCK DIAGRAM

A. Block Diagram of UMPV

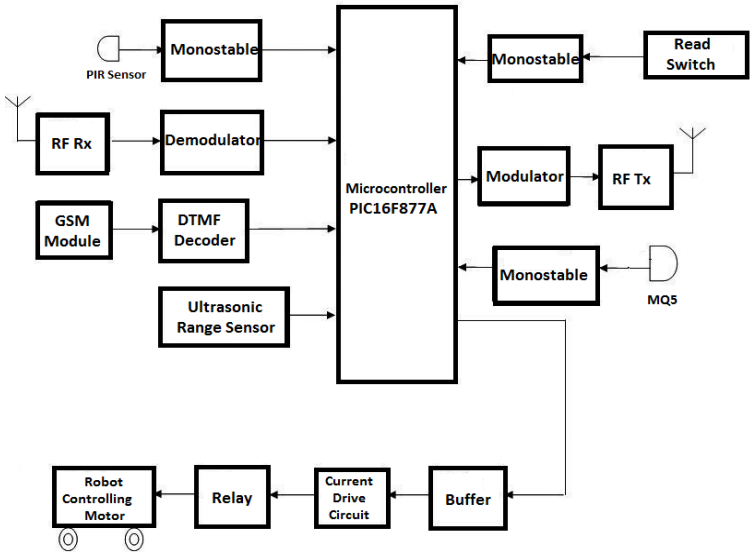

Fig. 1. Block Diagram of UMPV

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B. Block Diagram of Control Station

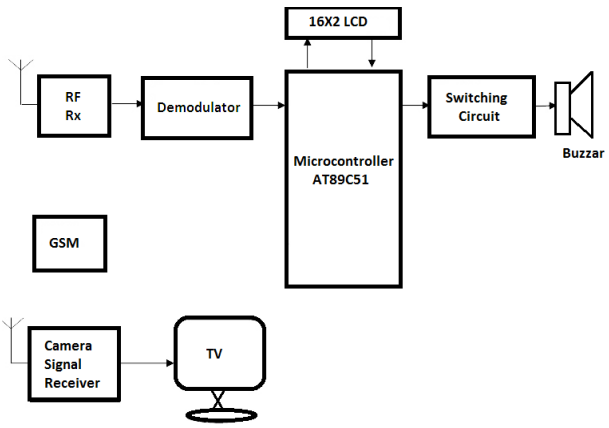

Fig. 2. Block Diagram of Controlling Station

III. OPERATION

Unmanned patrolling vehicle is designed to control wirelessly from the control room using DTMF (dual tone multi-frequency signal) of mobile phones. We can use the number buttons (2, 4, 6, 8) in mobile phone to control the forward, reverse, left, and right movement of the robot. The robot is fitted with a PIR sensor to find the human presence in border areas. Once the presence of human is detected it checks if the human detected is our soldier or not. To do so, a unique RFID (radio frequency identification) tag is provided to our soldiers that will help to identify our soldiers and enemies in border area. The robot is fitted with a RFID reader to detect the RFID tag. When the robot detects any human presence it will check for the RF ID tag to identify whether the person detected is our soldier or an enemy and accordingly the information is sent to the control station. The distance of the detected obstacle is determined using the range finder. The robot is also embedded with a wireless camera which will capture the live video and transmit it to the control station. With the help of this camera we can capture the image and track the movement of the enemy in border area. Microcontroller is the heart of the design which controls all the operations. PIC16F877A and AT89C51 are the microcontrollers used.

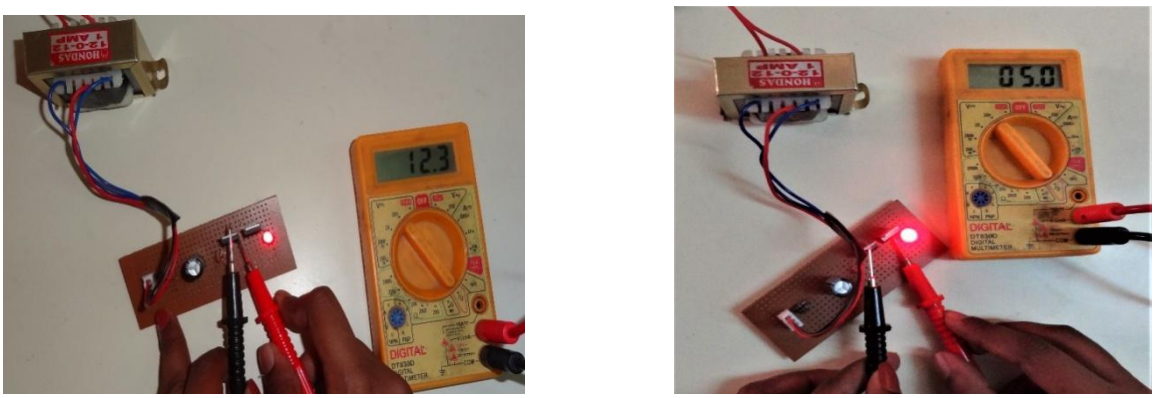

Fig. 3. Power supply circuit showing an output voltage of 12.3V and 5V DC from a input of 240V. 50 Hz AC supply

The design is been provided with various monostable circuit to prove a stable input to the microcontroller. This is because the output from various sensors like the PIR sensor, reed switch and MQ5 may vary. As we need to provide a stable input to the microcontroller, it is achieved by using monostable circuits. The controlled forward-backward and right-left motion of the unmanned patrolling vehicle is achieved using DTMF. DTMF decoder is used to decode the DTMF signals received from the mobile phone to control the robot. During its movement, the robot detects any human presence in the range of about 10m using the PIR sensors. The distance of the object from the UMPV is determined using an ultrasonic range finder. Buffer, drive and relay circuit is the part of the switching circuit. Such circuits are used for the automatic switching of the RF transmitter and robot motor. Relay is the actual switch in which the buffer and driver is used to drive the relay. The voltage needed for the operation of the circuits' used in the project is 12V and 5V. Current of 1A is required for the operation which is provided using the power supply

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IV. COMPONENTS USED

A. RFID tag and receiver

As Radio Frequency Identification (RFID)is suitable for various applications in different fields, it has become indispensable part of our daily lives. Currently, there is a wide range of RFID applications available in the contactless chip market for various fields such as aviation, healthcare, shipping, library system, product security, supply chain. An RFID system typically includes three parts: RFID tag, RFID reader and database. While the tag keeps information about an item, the reader can write and read the tag data recorded in a database [2]. With the recent advancements in RFID technology, active tags are more preferred. On the other hand, as an active tag has a built-in battery, it has a limited lifetime. Thus, effective utilization of energy is crucial for active tags [2]. This RFID uses electromagnetic fields to automatically identify and track tags that are attached to the objects [2]. This RFID tags can be active, passive or battery-assisted passive. In this project, we are providing unique RFID tag for our soldiers that will help to identify our soldiers and enemies in border areas. The robot is fitted with a RFID reader to detect the RFID tag. When the robot detects presence of a human, it checks for the RFID tag to identify whether the person detected is our soldier or an enemy.

RF module (Tx/Rx) is used for making the wireless communication, which could be used to drive an output from a distant place. RF module, as the name suggests, uses radio frequency to send signals. These signals are transmitted at a particular frequency and a baud rate. A receiver can receive these signals only if it is configured for that frequency. A four-channel encoder/decoder pair has also been used in this system. The input signals, at the transmitter side, are taken through four switches.

This radio frequency (RF) transmission system employs Amplitude Shift Keying (ASK) with transmitter/receiver (Tx/Rx) pair operating at 434 MHz's. The transmitter module takes serial input and transmits these signals through RF. The transmitted signals are received by the receiver module placed away from the source of transmission. The system allows one-way communication between two nodes, namely, transmission and reception.

The RF module has been used in conjunction with a set of four channel encoder/decoder ICs. Here HT12E & HT12D have been used as encoder and decoder respectively. The encoder converts the parallel inputs (from the remote switches) into serial set of signals. These signals are serially transferred through RF to the reception point. The decoder is used after the RF receiver to decode the serial format and retrieve the original signals as outputs.

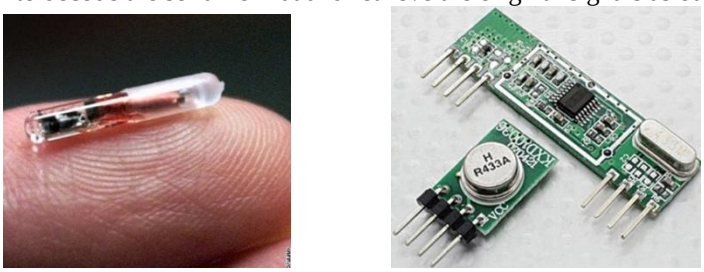

Fig. 4. RFID tag and RF transmitter-recieverz module containing the integrated antenna and microchip

B. DTMF (Dual tone multi frequency)

The Power Line Carrier Communication (PLCC) is the most extraordinary element of the telecommunication system. A PLCC works on the principle of varying the line current in proportional to sound. The transducer which converts sound waves to an electrical signal is called a microphone, and the one which does the reverse function is called a speaker/earphone. Signalling is the most critical function of any telecommunication system. The DTMF signals are sparse in the frequency domain. Hence the sparse signal corresponding to the DTMF signal can be recovered from fewer number of linear projections [3].

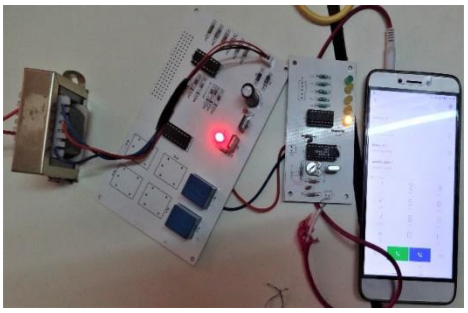

Fig.5. Practical circuit showing the working of DTMF module

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Normally alternating voltages of low value are used for signalling or ringing, as commonly referred. In modern Power Line Carrier Communications, the rotary dial has been replaced by pushbutton matrix dial. These Power Line Carrier Communications use ICs to generate the dc pulses. The pulse dialling is slower and susceptible to noise. It takes over 10 seconds to dial a 6-digit number. This is very slow as compared to the processing speed of modern electronic exchanges. Besides, it has the following limitations: The subscriber can signal only up to the exchange, and end to end or subscriber to subscriber signalling is not possible.
Only ten codes, i.e. from 0 to 9, are possible. Time required to dial each digit is different [3]. To overcome these limitations, modern telecommunication uses two distinct tones, which correspond to a particular number. This is called the Dual Tone Multi Frequency [DTMF] dialling. If one dials, say, number '5', then two tones, of 770 Hz and 1336 Hz is transmitted. These tones are sensed and decoded by the exchange and converted to the dialled digit, which is digit '5' in this case. The column pertaining to tone 1633 Hz is used for special facilities like flash, pause etc.

The DTMF signals transmitted over the FM Transmitter/Receiver units can be received and decoded using a DTMF receiver/decoder IC such as UM92870 or KT3170 or Motorola's MT8870 [3]. The decoded outputs can be suitably used along with certain additional circuitry to design a Call-Line-Identification-Product unit [popularly known as CLIP].

Hi-Group → Low-Group ↓	**1290**	**1336**	**1477**	**1633**
697	1	2	3	?
770	4	5	6	?
852	7	8	9	?
941	*	0	#	?

Fig.6. DTMF Matrix Key Pad

The four hexadecimal output obtained from the DTMF receiver/decoder IC corresponding to each digit on the FM Communication key-pad together with the associated dual-tone frequencies can be put-it in a table form for easy reference [3]. The frequencies allocated to the various digits and symbols of a push button keypad are internationally accepted standards and are shown in Fig. 5 [3].

The On-Cradle and Off-Cradle status of the handset can be detected, based on the voltage state, before the start of ringing (which is between 40 V and 52 V dc approximately). The voltage drops to 10 V to 12 V dc on lifting of the handset from the cradle. The ringing status can be detected with the use of either a coactively coupled rectifier bridge or an ac Opto-coupler (or even a dc opto-coupler with an external diode shunted in anti-parallel across the internal diode of the Opto-coupler together with a current limiting series resistor).

C. Ultrasonic Range finder

A range finder is a device that measures distance from the observer to a target, in a process called ranging [4]. Ultrasonic sensors are based on measuring the properties of sound waves with frequency above the human audible range [4]. They typically operate by generating a high-frequency pulse of sound, and then receiving and evaluating the properties of the echo pulse. flash, pause etc.

These range finders operate at best, at an angle of 30 degrees. They have electronic brick compatible interface and operates at 5 V dc supply. They are breadboard friendly and have a dual transducer. Another advantage of the ultrasonic range finder is that it has a ready Arduino library [4].

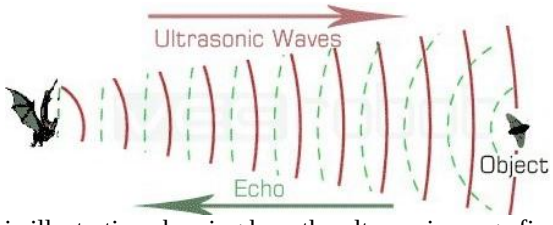

Fig.7. Basic illustration showing how the ultrasonic range finder works

D. PIR Sensor

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view [5]. PIR sensors work on the principle of pyroelectricity which causes them to respond to a change in incident radiation [5]. This property has been used in a wide range of applications including the detection of human beings in motion They are most often used in detectors. All objects with a temperature above absolute

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zero emit heat energy in the form of radiation. Usually this radiation isn't visible to the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose [5]. The term passive in this instance refers to the fact that PIR devices do not generate or radiate any energy for detection purposes. They work entirely by detecting the energy given off by other objects. PIR sensors don't detect or measure "heat"; instead they detect the infrared radiation emitted or reflected from an object [5].

Therefore, these sensors are used to detect the presence of human beings on the border security areas.

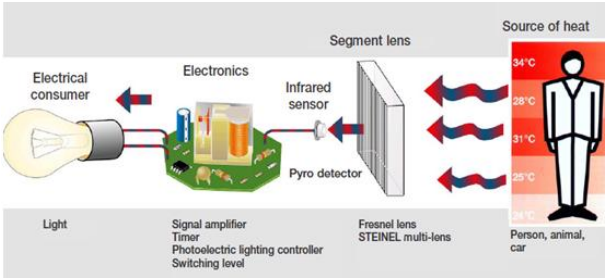

Fig.8. Working of PIR Sensor

E. Microcontroller AT89C51

AT89C51 is a 8 bit microcontroller (ALU). It has 4KB of internal ROM, 128 bytes of internal RAM and zero flash memory. It has 4 Ports, namely Port1, Port2, Port3 and Port4. Each port consists of 8 bits. It contains 32 I/O lines, two 16 bit timers, 1 serial communication port and 5 Interrupts (2 external & 3 internal).

AT89C51 is CISC based and works on Harvard architecture. As compared to 8051 microcontroller it has some additional features such as 4KB internal flash memory, multi time programmable i.e., it can be reprogrammed up to 1000 times and EEPROM.

All other features, pin configuration and architecture are same as 8051.

Pins 1 – 8: It is recognized as Port 1. Different from other ports, this port doesn't provide any other purpose. Port 1 is a domestically pulled up, quasi bi-directional Input/output port.

Pin 9: As made clear previously RESET pin is utilized to set the micro-controller 8051 to its primary values, whereas the micro-controller is functioning or at the early beginning of application. The RESET pin has to be set elevated for two machine rotations.

Pins 10 – 17: It is recognized as Port 3. This port also supplies a number of other functions such as timer input, interrupts, serial communication indicators TxD & RxD, control indicators for outside memory interfacing WR & RD, etc. This is a domestic pull up port with quasi bi-directional port within.

Pins 18 and 19: These are employed for interfacing an outer crystal to give system clock.

Pin 20: Titled as V ss– it symbolizes ground (0 V) association.

Pins- 21-28: It is recognized as Port 2 (P 2.0 – P 2.7) – other than serving as input/output port, senior order address bus indicators are multiplexed with this quasi bi-directional port.

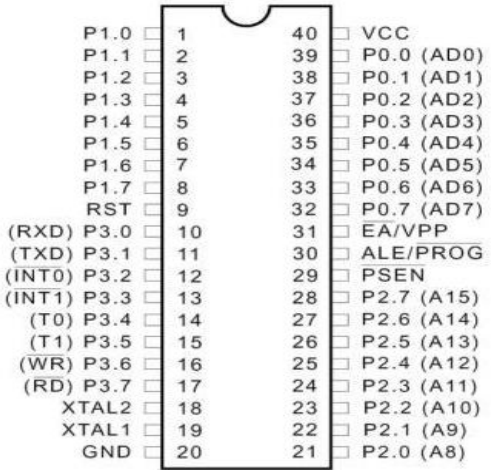

Fig. 9. Pin details of AT89C51

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F. Microcontroller PIC16F877A

It is a powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC architecture into an 40- or 44-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices.

The PIC16F877A features 256 bytes of EEPROM data memory, self-programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions. The synchronous serial port can be configured as either 3-wire Serial Peripheral Interface or the 2-wire Inter-Integrated Circuit bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications.

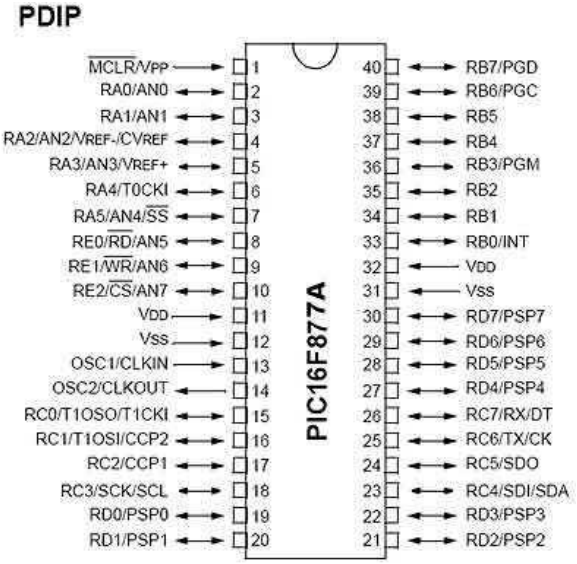

Fig10:Pin details of PC16F877A

G. Reed switch

The reed switch is an electrical switch operated by an applied magnetic field. It consists of a pair of contacts on ferromagnetic metal reeds in a hermetically sealed glass envelope. The contacts may be normally open, closing when a magnetic field is present, or normally closed and opening when a magnetic field is applied. The switch may be actuated by a coil, making a reed relay, or by bringing a magnet near to the switch [6]. Once the magnet is pulled away from the switch, the reed switch will go back to its original position.

Reed switches consists of two flexible ferrous metal blades sealed in a glass tube, with a small gap [6]. between their tips. When a permanent magnet or a current-carrying coil of wire is brought close by, magnet flux builds up in the contact gap, and once the magnet force attracting the blades together exceeds the spring force tending to pull them apart, the contact gap closes, completing an electric circuit between the two blades [6].

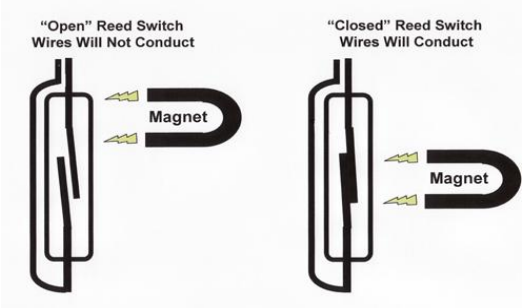

Fig. 11. Reed switch sensor operation

H. MQ5 SENSOR

The Grove - Gas Sensor (MQ5) module is useful for gas leakage detection (in home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol. Due to its high sensitivity and fast response time, measurements can be taken as soon as possible. The sensitivity of the sensor can be adjusted by using the potentiometer.

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The technical features of MQ5 are wide detecting scope, stability, long life, fast response and high sensitivity.

Fig. 12. MQ5 Sensor

I. Wireless Camera

A smart camera or intelligent camera is a vision system which, in addition to image capture circuitry, is capable of extracting application-specific information from the captured images, along with generating event descriptions or making decisions that are used in an intelligent and automated system [7]. A smart camera is a self-contained, standalone vision system with built-in image sensor in the housing of an industrial video camera. It contains all necessary communication interfaces, e.g. ethernet, as well as industry-proof 24 V I/O lines for connection to a PLC, actuators, relays or pneumatic valves [7].

Fig. 13. A sample of wireless camera

It is not necessarily larger than an industrial or surveillance camera. A capability in machine vision generally means a degree of development such that these capabilities are ready for use on individual applications. This architecture has the advantage of a more compact volume compared to PC-based vision systems and often achieves lower cost, at the expense of a somewhat simpler (or omitted) user interface [7].

V. CONCLUSION

UMPVs are the unmanned managed patrolling vehicles; they have transformed the idea of the land power in modern war times. They are less expensive, and they don't put the army at risk during war field. They can enter the environments which are dangerous to the human life and they can reduce the exposure risk of the army men. They, have low cost. They are cheaper to purchase, low fuel consumption and requires low maintenance than the regular vehicle. The UMPV can be used in spying in border security in extreme climatic condition. Moreover, they can be operated 24x7 hours, thereby increasing the efficiency of the entire surveillance system.

REFERENCES

[1] Douglas W. Gage, " UGV HISTORY 101: A Brief History of Unmanned Ground Vehicle (UGV) Development Efforts", Unmanned Systems Magazine Summer 1995, volume 13, no. 3, 1995.
[2] Fatih Karabacak, Hakduran Koc and Arif Ceber, "A Low Power Electronic Sticker for Vehicle Identification System using Proprietary Active RFID Wireless Protocol", International Conference Connected Vehicles and Expo (ICCVE-2013), 2013.
[3] Aneesh M Koya, Sudha Tt and Kala 0, "Compressed Sensing: An Approach to Real Time DTMF Signaling System", International Conference on Control Communication and Computing (ICCC-2013), 2013, pg 238 – 239.
[4] Bogdan kreczmer, " Ultrasonic Range Finder for Support of Human Gestures Recognition", 8th International Conference on Human System Interactions (ICHSI), 2015, 25-27 June 2015 IEEE Xplore 30 July 2015.
[5] Tarun Choubisa, Raviteja Upadrashta, Sumankumar Panchal, A. Praneeth and Ranjitha H. V, "Challenges in Developing and Deploying a PIR Sensor-Based Intrusion Classification System for an Outdoor Environment" IEEE 41st Conference on Local Computer Networks Workshops, 2016, pg 148.
[6] Stephen Day and Todd Christenson, "A High Aspect Ratio Microfabricated Reed Switch Capable of Hot Switching", 59th IEEE Holm Conference on Electrical Contacts (HOLM) , 22 - 25 Sept. 2013, IEEE Xplore 04 November 2013.
[7] A. Sprońska, J. Główka, M. Maciaś, M. Tanaś and G. Taberski, "The TALOS project – autonomous robotic patrolvehicles." Informatics Conference European Intelligence and Security, 2012, pg 360.