A Review on Rescue robots for- Military Application

P.S.Gowthaman[1], J.Gowthaman[2], L.Vadivel kannan[3], B.Moinudeen[4]

AssistantProfessor[123],Lecturer [4],

Department of Mechanical Engineering, PSNA College of Engineering&Technology, Dindigul,Tamil Nadu, India.

Abstract-The development of technology has come up with the invention of robots. They performing a various tasks in industry and also in everyday life. Probably the greatest achievement of robotics is cooperation between robots and humans. They helps to make a human life much easier especially than dangerous. One of the much concern is Defence area. Imagine the face of warfare with autonomous robotics Instead of our soldiers returning home in flag-draped caskets to heartbroken families, autonomous robots-mobile machines that can make decisions such as to fire upon a target, without human intervention and can replace the human soldier in an increasing range of dangerous missions from tunneling through dark caves in search of terrorists, to securing urban streets rife with sniper fire, to patrolling the skies and waterways where there is little cover from attacks, to clearing roads and seas of improvised explosive devices (IEDs) to surveying damage from biochemical weapons to guarding borders and buildings to controlling potentially-hostile crowds, and even as the infantry frontlines. These robots would be smart enough to make decisions that only humans now can and as conflicts increase in tempo and require much quicker information processing and responses, robots have a distinct advantage over the limited and fallible cognitive capabilities. They effectively doing the work of many human soldiers, while immune to sleep deprivation, fatigue, low morale, perceptual and communication challenges in the fog of war and other performance-hindering conditions. The rescue robots takes the job as a assistant of Soldier. They have capability to perform a mission remotely in the field without any actual danger to human lives. These kinds of the robots should decrease number of humans in military defence which affects at number of military casualties. Mostly Unmanned robotics is actively being developed for both civilian and military use to perform dull, dirty, and dangerous activities. The main objective of these paper Review a examples from the past and present and highlights the important requirements for robots in rescue applications followed certain limitations in design of robots.

Keywords-Robots, Unmanned ground vehicles, defence application.

I. INTRODUCTION

The Robot is a automatic mechanical device which is used to handle and resembling a human or animal. Robots are guided by computer program or electronic circuit theory. They replace human and performing a repetitive and dangerous tasks. The use of robots in military combat raises ethical concerns. The possibilities of robot autonomy and potential repercussions have been addressed in fiction and may be a realistic concern in the upcoming days. Basically Army Robot is capable of performing tasks such as locomotion, sensing the harmful gas, sensing the humans beneath the surface metal detection.

Fig 1.1 Army robot

Rescue robot is an autonomous robot comprising of wireless camera which can be used as a spy and Blue-tooth used to control it wireless. The Army robot is more efficient compared to the soldiers. Excellency of this robot is in being operated wireless from remote which offers no risk to the soldier lives. Robots are enhanced to be robust and sturdier giving the guarantee of success in the risk prone environment. Similarly more recently the development of Automated Guided Systems has resulted in the induction of autonomous robots in the industrial scenario which have been successfully used for fulfilling roles such as in logistics and materials handling. At the same time, a lot of work has been directed towards the development of intelligent navigation systems which allow maximum workspace adaptation and flexibility. Similarly work has also been directed towards the development of improved ultrasonic and optical or vision based sensors for compatible utilization with the advanced navigation guidance systems.

Autonomous service robots have following characteristics:

- Information acquisition from surroundings,
- Prolonged operation without human intervention,
- Moving from point A to point B without human assistance,

- Avoiding hazardous situation,
- Self recovery
- Awareness to critical objects as humans and vehicles.

II. LITERATURE REVIEW

Zhang,Yabin ding et al(2012)

In this paper, a vision-based control strategy to perform high speed pick-and-place tasks on automation product line is proposed, and relevant control software is develop. Using Delta robot to control a sucker to grasp disordered objects from one moving conveyer and then place them on the other in order. CCD camera gets one picture every time the conveyer moves a distance of *ds*. Objects position and shape are got after image processing. Target tracking method based on "Servo motor + synchronous conveyer" is used to fulfill the high speed porting operation real time. Experiments conducted on Delta robot sorting system demonstrate the efficiency and validity of the proposed vision control strategy.

Zamantyarab et al(2012)

These paper describe the Quadruped robots offer better maneu-verability. However a quadruped robot contains many joint actuators which have to operate in a coordinated fashion to achieve the desired locomotion. Joint actuations cause various degrees of disturbance on the robot body and may even destabilize the system. Thus a three dimensional dynamic model of a quadruped has been developed using the bond graph technique which can be interfaced with various controller models. The model contains a detailed sub-model for telescopic compliant legs. Results from simulations, animations and experiments are discussed. Turning motion at various leg speeds is studied for dynamic stability of the robot. The effect of leg compliance on locomotion parameters is studied which helps in selecting suitable compliance. Performance on energy efficient quadruped structure, energy efficient locomotion gait and foot trajectory have been carried out for designing an efficient quadruped.

Karabegovic1 et al (2012)

The author describes the Intelligent machines and systems with a different level of complexity are used today for performing the various processes in the industry and also everyday life. Service robots will change our daily lives sooner or later as assistants achievement of robotics is cooperation between robots and humans. Serving robots besides application for daily tasks also are applied for military actions. Most used service robots for military defence are unmanned ground vehicles. This type of robot is generally capable of operating out doors and over a wide variety of terrain, functioning in place of humans. Investigation shows increasing trend in implementation of service robots in defence. Service robots in defence 2005 takes share of 42,5% of total number of service robots, unlike 2010 where service robots in defence participated with 45%.Totalnumber of service robot installed units 13.741 in 2010 on defence go 6.125 units. Development in service robotic is going to use robots in every part of human lives in daily bases and application for tasks.

George m. pierce et al (2000)

In these article author demonstrate the Unmanned vehicles, whether air, land or sea, are one means to get our airmen, soldiers, marines, and sailors out of harm's way and are most likely a key driver to an upcoming revolution in military affairs (RMA) for all services. The major objective of the paper is to bring attention to of Tactical Mobile Robots (TMR) and hopefully encourage follow-on studies and to cultivate an enthusiasm to employ them correctly to help get our troops out of harms way and win battles. This study focuses primarily on the use of TMRs in the special operations environment. The paper discusses the current and immediate TMR capabilities; key logistics concerns regarding maintenance, supply, and transportation; and two possible scenarios, one in an unconstrained battlefield and the other in an urban environment. The data collected was primarily via conducting interviews and witnessing experiments and they highlight a few barriers, which must be addressed if unmanned platforms are to keep pace with congressional orders.

Yu bikovsky et al (2015)

This paper used a Allen algebra for a multi parametric modelling of robot and multi agent system. The general method of Allen-Givone algebra based MVLF construction is potentially very attractive for multi-parametrical models for its direct transformation of arbitrary table data into formal logic expressions. the completed minimization is warranted only for entirely specified function and the intermediate result Minimization procedure itself is entirely formal and does not use any hypotheses, concerning the data. Thus the basic subroutine for the search of subsuming terms and consensus calculations will not create problems. The formation of a heterogeneous logic model seems to be mainly realizable for MVLFs with the limited number of used combinations of input variables. In any way the minimization procedure should be carefully monitored during the debugging or learning of heterogeneous models.

N.Benmousa et al (2014)

These paper work consists to study and develop a three-axis piezo- resistive accelerometer having uniform sensitivities along to three axes. This sensor is made of a heavy proof mass and four long beams, allow us to obtain high sensitivities, by reducing the resonant frequencies.

Uniform axial sensitivities, with a transverse sensitivity, could be obtained using a three-axis sensor. The stress analysis of this sensor was performed in order to determine the positions of the piezo-resistances in the four flexure beams. This work presents a design and simulation of three-axis piezo-resistive accelerometer using MEMS technology. Most important aspect of Finite Element Analysis (FEA) in our design process is the analysis of the stress distribution in the four flexure beams. The stress analysis was performed in order to determine the positions of the piezo-resistances on these beams, and consequently to eliminate the transverse sensitivities for obtaining optimal three acceleration components. The model is used in the field of biomedical applications.

Sun Fueng et al (2012)

This paper deduced the nonlinear dynamic model of a quadrotoraerial robot, which was a VTOL (vertical tale-off and landing) unmanned air vehicle. Since that is a complex model with the highly nonlinear multivariable strongly coupled and under-actuated property, the controller design of it was very difficult. Aimed at attaining the excellent controller, the whole system can be divided into three interconnected parts: attitude subsystem, vertical subsystem. Then nonlinear control strategy of them has been described such as SDRE and Back stepping. Controller design was presented to stabilize the whole system. Through simulation result indicates, the various models have shown that the control law stabilize a quad-rotor aerial robot with good tracking performance and robot of the system.

Wei jing zen et al (2012)

The paper shows A robot technology progress and robot science activities, robot technology obtained in a fast development System uses the Atmega128 single-chip Atmel company as a core controller, was designed using a infrared to tube detection boundary, looking for each other, controller to tube receiving infrared data, and according to the data control motor state thus robot reached automatic control purposes. Against robot by single-chip microcomputer smallest system.

Yabin Ding et al (2012)

In this paper, a vision-based control strategy to perform high speed pick-and-place tasks on automation product line is proposed, and relevant control software is develop. Using Delta robot to control a sucker to grasp disordered objects from one moving conveyer and then place them on the other in order. CCD camera gets one picture every time the conveyer moves a distance of *ds*. Objects position and shape are got after image processing. Target tracking method based on “Servo motor + synchronous conveyer” is used to ful-fill the high speed porting operation real time. Vision system is used to get the position and shape of objects and “Servo motor +synchronous conveyer” is used to assistant the target tracking to ful-fill the pick and-place operation of the robot in real time, motion control system coordinate and plan the robot’s movement with the conveyer to complete the sorting task. Experiments demonstrate the efficiency and validity of the proposed control strategy.

Gianni Ferreiti et al (2007)

The paper presents the DEXARM Real-Time Simulation (DRTS) tool conceived to support the design and development of the controller of the Dexterous Robot Arm a lightweight 7-d.o.f space robotic arm An approach has proposed to develop real-time simulators of complex electromechanical systems by exploiting the most powerful non real-time modeling and control design tools. An open source general purpose operating system like Linux is used. Interface blocks to be included within the Simulink and Dymola Model and validation work carried out on a joint prototype in the early phase of the arm development process could be fully included in the real-time simulation model, achieving quite accurate and reliable results almost effortlessly. The end of real DEXARM controller can be interfaced to drive the arm real-time model for tuning, testing and checkout purpose. A significant effort has been devoted to create a human machine interface able to support the input of motion commands and force disturbances.

S.Bargavi et al (2008)

The objective of this paper is to minimize human casualties in terrorist attack such as 26/11. The combat robot has been designed to tackle such a cruel terror attacks. This robot is radio operated, self- powered, and has all the controls like a normal car. A wireless camera has been installed on it, so that it can monitor enemy remotely when required. They represents these days India is sick off massive terror attacks, bomb explosions at plush resorts. To avoid such disasters Technological power must exceed Human power. It take an initiative to design a model of an apt robot that meets combatant needs. So to avoid terror attacks, to ensure more security at the border and high density areas it’s wise to maintain a world class military technology in accordance with combatant needs. The construction of these robots will carry nation’s name, fame globally.

Dipak Patil et al(2015)

The main objective of our project is for Border security by using camouflage technology and has been successfully accomplished wireless using Blue-tooth module driven by an Android App. We used PIR sensor principle to detect men direction and distance of obstacle. By using PIR Sensor transmitter receiver we can detect the obstacle coming in path. Gas sensor and metal detector are also being used for sensing the toxic gases and the metal weapons if any. In this system camera is to transmit the

data from border to the official area or headquarters. In the scanning path if any obstacle or enemy is detected then firing starts and control action take place. Thus defense application it is possible to provide 24 hour security**.**

Ankita patel et al (2014)

This project controlled the robot system in a new economical solution and as well as it is used for different sophisticated robot application. The control system consists of Touch screen and Zig-bee modules, a microcontroller that collects and controls the robot. Spying area in military ground where enemy stay can be took before taking any action. Robot with a camera attached to it. The body of the robot consists of two wheels attached to geared motors. This proposed design and implementation touch screen controlled spy robot by using Zig-Bee technology will be used to control the robot using the touch screen from certain rang of distance using the Zig-Bee based wireless communication multiple flying robot very easily applications and extensions. protocol by this method we can easily control the multiple flying robot very easily.

Hemanth Reddy et al (2015)

This Paper reviews some notable examples from the past and Highlights important requirements for the rescue robots along with some limitations encountered in the design of robots Robot play a crucial role in the post of disaster rescue applications, Several robots are under development and some have been already deployed in some emergency situation though they are not performed to the expectations. The challenges faced by industry is to develop a robots more advanced, intelligent. Swarm robots or multi robots teams that work together with high communication and synchronization capable of extending communication and sensor network.

III. RESCUE ROBOTS

3.1 Technology Intelligent machines

The Current robot is an independent Four-wheel drive type device mounted with a Robotic arm, Camera, Motor, micro-controller, Gripper and an end-effecter plate along with necessary electronic control and power supply.Its motion is restricted to the plane of the structured workspace normal to the direction of gravity in order to neglect its effect on spatial velocity. In these Present work the modularity of these Autonomous robots is used for defence applications. It is ability to achieved a progress in hazardous environments and replace a Soldiers. Its motion is restricted to the plane of the structured workspace normal to the direction of gravity in order to neglect its effect on spatial velocity. Autonomous robots is used for defence applications.

Fig 3.1 Rescue robots

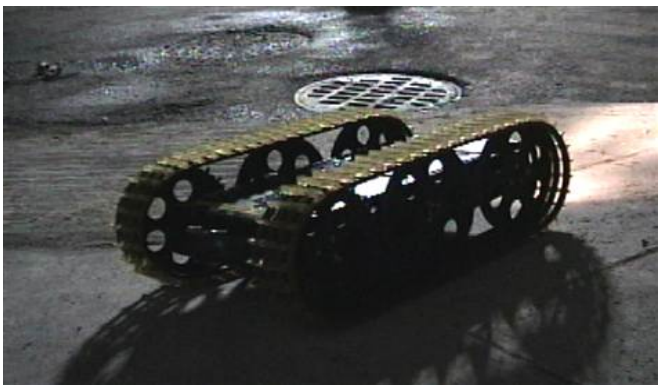

Fig 3.2 Inspecting the Hazardous area

An efficient robot for underground rescue operations should be a combination of (1) Unmanned Ground Vehicles (UGV) It works on the ground surfaces and can assist rescures find and interact with trapped victims in the areas were it dangerous for rescue personnel to enter. (2) Unmanned aerial Vehicles (UAV) It works without any contact with the ground surface and help in transport a medical aids to victims and to present a rough scenario of the accident site to rescue team.

Fig 3.3 Automated Guided Vehicle

Certain advantages of using Intelligent machine used in a war.

- No loss of human lives by replacing dangerous human task and/or removing humans from hazardous theatre.
- Reduce possible injuries or “Casualty Aversion” and Subsequent effect of casualty aversion is

reducing/eliminating the need for casevac and further medical intervention and/or lengthy revalidation.

- High level of delivery accuracy by robots. They do not experience fear or morale issues and can hence be more effective in combat and Overall effectiveness due to use of technological skills vs human skills
- Less or no extensive training needed and Less dependence on supplies (robots do not need food, warmth, oxygen or sleep)
- Maintaining home support for operations and Improve battlefield intelligence
- Increase battlefield communication speeds and Higher adaptive rate to terrain and conditions

There man dares not venture, robots have been put to use in environments that are hazardous for man. To rescue, pronto, robots work under dangerous conditions, for search and rescue after disasters Many researches today is focused on improving rescue functions of robots. We even make them during war. The faithful robots do not hesitate to tread the dreaded terrain of battlefields. Battle robots of different shapes and sizes were employed to defuse landmines, look for criminals hiding in caves, search for bombs beneath cars and in buildings.

3.2 Robot for Daily Tasks :

To know what tasks there are that could be done by search and rescue robots to aid rescuers. Although there are many tasks on the rescue site, robots should be used where human or canine rescuers are powerless or where robots can do tasks at hand more effectively.

Inspection and mapping: It is an especially important task in wide area rescue situations created by natural disasters. In these situations, assessment of situation is needed to launch search and rescue missions successfully. In this task unmanned aerial vehicles could be very useful. These is entirely broader than searching that robot have to provide the rescue team with general information about the situation and create a reference of the destroyed surroundings

Search is essential task: The robot Victims has to be found first in order to rescue them. In order to use robots for search in wide area Search &Research situations they have to do the work at least as efficient as humans can. Whether it is possible is a disputable question. However, there are big hopes that robots will aid search missions in urban search and rescue situations in a have searching in coal mines, Underground mining and dynamic environment to find dangerous hazard. For UGV the challenge is complexity of the environment, robots need to handle unpredictable information of vertical and horizontal objects. One mechanical problem in searching is that robots that stuck in the debris because of its unpredictable conditions.

The Small unmanned ground vehicles could penetrate the rubble deeper than humans or canine rescuers can, thus enabling the rescuers to find victims at a faster rate.

Other penetration situations: Robots' ability to penetrate rubble can be used for other purposes as well. This ability can be used to aid in structural inspection of the rubble by enabling more throughout and complete view. Also in-situ medical assessment could be provided using this ability.

Structural inspection:

Tele-presence: It is another robot application that could find its way in S&R situations. One way how to use tele-presence is to use a rescue robot as "ears and eyes" of a team member that is outside the rubble. This way the needs of the team could be communicated faster. Also, telemedicine could be very useful.

Logistics: Larger unmanned ground vehicles could also be used for logistics purposes. It could be fairly easily to adapt specific military transportation robots to be used as rescue robots. This could be one of the achievable tasks in a near future.

Hazardous situations: It could also benefit from robot use. Such manmade disasters as Chernobyl could've been treated more successfully if robots were used. Also robots could be able to start searching in places still burning and other situations where human rescuers are helpless. Some of these are similar to those of military robot applications but many are unique. Usually robots intended for other tasks are equipped and adapted to be used in search and rescue situations.

Debris Removal: Robots should be able to move heavier debris faster than it can be done manually, with small framework and without risking the lives of the fatalities or the human rescue team. It can be used in the way than it sense the situation using sensor to decide rubble too much danger to move can be moved or what pieces are in to much danger to move rescue robots are used to test stability and several conditions and decide it is safe for rescue team enter. The ex-skeleton robots serves the functions of rescue robots.

IV. BASIC ROBOT STRUCTURE

In these review paper they configured five sections such as Supply system, Communication system, Control system, Sensor system, Drive system

Fig 4.1 Basic structure of Robot

Supply System

The energy supply system is one of the major concern in working of Robots. The power supply system performs the energy to drive the controller and actuators. It may convert DC Voltage to DC Voltage required by the internal circuits of jobs or pump, compressor or it is help that may be generated by hydraulic or pneumatic power. The power system are indispensable while designing a robot system here the selection of power source should be primarily focus only to its impact on mechanism. The power supply perform the energy to drive controller and actuators.

Communication System

The network controlled poses the unique challenge that the communication is closed through end to end feedback loop. They perfoming the more tasks with the components of binary signals, analogue signals, parallel, interfaces, networks. In order to achieve the robot controllers have a range of different communication which are either provided The PLC is used to handle the communication.

Control System

The robot control system are enable to perform the instructions, the joint movements on robots must accurately be controlled. The tasks of robots system to execute the planned sequence of motions. The techniques of open loop, closed loop feed forward and adaptive control.

Drive System

In drive system they used a stepper motor and servo motors. The combination of drive system and feed back control to determines the dynamic response characteristics of the manipulator. They have a ability to control the switches between the velocities and other determine the weight of object.

Sensor System

The sensor system is one of the major components in robot structure. They have ability to see, touch, hear and move with the help of algorthim and feedback. They used a tactile sensor, force sensor, touch sensor etc. The sensor allows the robots to perform the function same as humans.

V. Hardware Specification

5.1 Accelerometer Sensor

Accelerometer is an electromechanical device which measures the acceleration. The accelerometer used here is a 3 axes accelerometer with high resolution measurement. The digital output is accessible through SPI or I2C digital interface and running at the supply voltage from 2.0v to 3.6v. is a small, thin, 3mm*5mm*1mm, 14 lead plastic package. The accelerometer can measure acceleration in one, two or three orthogonal axis. It can be used in anyone of the following modes. It can be used as a vibration sensor. It can be used as a sensor for tilt or orientation in two or three dimensions. This sensor is used to change the direction of the gun and camera. It gives the direction of velocity and position even it can measure both dynamic and static conditions of robot.

5.2 Stepper motor

The Stepper motor works on the principle of Faraday's law, Which states that whenever there is a change in the magnetic lines of force or magnetic flux, an induced current is produced. In these defence applications the stepper motor if just one winding of the motor is energized the motor will snap to fixed angle and then hold that angle until the torque exceeds the holding torque of the motor at which that point the rotor will turn, trying to hold at each successive equilibrium point. stepper motors can be viewed as a electric motor without commutators. Typically all windings in the motor are the part of stator and rotor is either a permanent magnet or in the case of variable reluctance motors a toothed block of magnetically soft material. All of the communications is extremely handled by motors and controllers. Typically controllers and motors designed so that the motor may be held in any fixed position as well as being rotated one way or other. Closely related in design to Three phase AC Synchronous motors are stepper motors.

5.3 D.C Motor

DC motor is used for movement and locomotion purpose of the rover. It has high revolution per minute and low torque. In general robotics requires low revolution per minute and high torque. Hence gearbox is used to achieve this configuration, which reduces the rpm and increases the torque. The operation is based on the principle of electromagnetism which states the magnetic field is generated by a current carrying conductor and when it is placed in an external field, it experiences a force proportional to the current in the conductor. The speed of the motor can be controlled by changing the voltage applied to the armature or by changing the field current.

5.4 Microcontroller.

Heart of the robot is a micro-controller. Micro-controller is used for controlling all the operation done by the devices which are interfaced to it. Micro-controller helps in transmission and reception of signals to be controlled. AT89C51 IC is used in this micro-controller for driving the robot. It is a Powerful microcomputer which provides a highly flexible and cost effective solution to many embedded control

the position of the gun. The driving of servo motor is done by using processor. LCD unit displays the acknowledgement for the corresponding actions performed by the receiver and also in the transmitter applications. The IC used in this is AT89C51 has 40 pins. This IC is a low power consumption IC having 8K byte of Flash memory and programmable memory. It also has an on chip Flash memory used for reprogramming. Micro controller is provided with the power supply of 5V through the power supply circuit. It has an additional crystal oscillator with

VI. CONCLUSION

Rescue robots are designed to perform daily tasks needed to help humans or for military purposes respectively. Today robots placed in all four quadrants. The military robot industries growing and push the national interest. These robots work in the future autonomously from a technical point of view but the weak point is machine is consider more faster .But at-least the human factor brings the need moral anchor. Tomorrows technology military assisted robot performs a variety of tasks. It is a time smart software and algorthim combined with new fast computing software make it possible. These robots are operated by remote and men in closed-loop in the Defence player should reduce the involvement of the humans with purpose to reduce the number of victims in military actions. Most used service robots for military are unmanned ground vehicles. These military robots kills the indiscriminately like landmines and bio chemical agent that are morally rejected. This type of robot is generally capable of operating outdoors and over a wide variety of terrain, functioning in place of humans.

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REFERENCES

[1] Yangzhao,"Performance of very small robotic fish equipped with CMRS Camera",Journal of Robotics,Osaka 2011, pp421-434.

[2] JindongLin, "Biological inspiration from Laraniform fish to multijoint robotic fish",Journal of Bio-engg ,2010, pp35-48.

[3] Tanaushi, "Paramaters groving SOM and its applications to a voice instruction leakage system"Journal of Robotics,2010,Japan.

[4] Martin peter chustiansen, " Robotic design overview using co-simulation and design space exploration" Journal of Robotics,2015, pp 398-402.

[5] DomenicoLingo, " Design and simulation of two robotic system for automaticartichoke harvesting" Journal of Robotics, pp 217-230.

[6] Klef, "Safety aspects for automatic guidance of agricultural and low cost machine,Martin luther university,Germany.

[7] Haochang shen, "Learning fast Quadrupted robots with the RC Power spline parameterization", Comell university, USA, 2012, Vol 12.

[8] Loannig, " Modelling and expect of untetelled Quadraped running with a boruding gait", McGill university,Canada.

[9] Petar Kormuskew, " Reinforcement learning in robotics applications and real world challenges", Journal of Robotics,2013, pp 122-148.

[10] Keum balchao, " Intellegent lead a novel HRI Sensor for guide robots", Journal of Sensors, June 2012.pp 8301-8318.

[11] Kinhuatlow, "Industrial robots programming simulation and applications"

[12] Ming Li, "Review of research on agricultural vechicle and Autonomous guidance"Ijabe.Org,Vol 2.

[13] Ronschafer, "Robotics to play major role in future andwar fighting "USA Fcom.

[14] JaiGalliott, "Military robots Mapping the moral landscape".

[15] Daeheui kim, Ryosuke Masuda, " Development with Rescue robot system with human body grasping function", School of information technology and electrics,Tokai university, 259-1292.Japan.