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Robotics as the Appropriate Measure for Improving National and International Security- Review

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Abstract: ***Robotics was identified by the 1990 department of defense critical technologies plan as vital to long term US defense capabilities. Robotics are incorporate in current weapon systems and will play a larger role in future complicated national and international systems. While defense and commercial development follow largely separate paths, a strong domestic industry is essential to maintaining involvement in the continuing overall development of robotic technology in producing technological military ammunitions and weaponry to scale up security matters. Robots are used extensively in the automotive industry, primarily for welding, painting and material handling applications. The electronics, aerospace, metal working and consumer goods industries are also major robot users. Integrated factory automation systems, to which robot technology is key, affect all type of manufacturing. In the near future, productivity and competitiveness in these industries will depend in large part on flexible automation through robotics. If this is adopted and implemented by the national and county governments, it will immensely impact on the improved security levels. However, in the current society, direct robot utilization by the military is still relatively small, but includes activities as varied and critical as explosive ordinance disposal, underwater research and recovery, biological and chemical defense and nuclear weapons application. It was confirmed that robotics adoption can effectively enhance the surveillance and intelligence at a rapid rate and therefore operation of sophisticated military machinery and equipment.***

Keywords: Robotics, national security, flexible automation, surveillance and intelligence

I. INTRODUCTION

In today's world there is an increasing need to create artificial arms for different inhuman situations where human interaction is difficult or impossible. They may involve taking readings from an active volcano to diffusing a bomb (Baudoin, et al, 2009). Nowadays, robots are increasingly being integrated into working tasks to replace humans especially to perform the repetitive task. In general, robotics can be divided into two areas, industrial and service robotics. International Federation of Robotics defines a robot as that which operates semi- or fully autonomously to perform services useful to the well -being of humans and equipment. These robots are currently used in many fields of applications including office, military tasks, hospital operations, dangerous environment and agriculture. Besides, it might be difficult or dangerous for humans to do some specific tasks like picking up explosive chemicals, defusing bombs or in worst case scenario to pick and place the bomb somewhere for containment and for repeated pick and place action in industries. Therefore a robot can be replaced human to do work (U.S Department of Commerce, 1991).

According to Frank et al (2004), a robotic arm is a robot manipulator, usually programmable, with similar functions to a human arm. The links of such a manipulator are connected by joints allowing either rotational motion manipulator can be considered to form a kinematic chain. The business end of the kinematic chain of the manipulator is called the end effectors and it is analogous to the human hand. As reviewed by Marques (2012), the end effectors can be designed to perform any desired task such as welding, gripping, spinning etc., depending on the application. The robot arms can be autonomous or controlled manually and can be used to perform a variety of tasks with great accuracy. The robotic arm can be fixed or mobile

According to Walker (2004), there are various ways in which a robotic arm may be controlled. In the past there have been many researchers working to control robotic arm through computer terminals, Joysticks, even interfacing them with the internet so they can be controlled from anywhere in the world. Usually most of the robotic arms are controlled by a central controller which makes uses of values taken in from the terminal that are entered by the user at the terminal to move the arm to a particular coordinates in space. This makes the control very difficult as the control values of the motors are very difficult to predict to achieve a particular movement and this is poor for adaption to unstructured environment.

A. Common Security Installations

1) *Intruder Alarms:* According to BS EN 50131-1 (2008), Intruder alarms have developed from a very limited specialist element of electrical installation work in high security buildings to the much wider market of schools, shops, offices, housing, etc. This is largely a result of the economics of sophisticated technology surpassing the efficiency of manual security. It is also a response to the increase in burglaries at a domestic level. Alarm components are an alarm bell or siren activated through a programmer from switches or activators. Power is from mains electricity with a battery back-up. Extended links can also be established with the local police, a security company and the facility manager's central control by telecommunication connection. Selection of switches to effect the alarm will depend on the building purpose, the extent of security specified, the building location and the construction features. Popular applications include: Micro-switch, Magnetic reed, Radio sensor, Pressure mat, Taut wiring, Window strip, Acoustic detector, Vibration, impact or inertia detector The alternative, which may also be integrated with switch systems, is space protection. This category of detectors includes: Ultrasonic, Microwave, Active infra-red, Passive infra-red Circuit wiring may be `open' or `closed'.The disadvantage of an open circuit is that if an intruder knows the whereabouts of cables, the detector circuit can be cut to render the system inoperative. Cutting a closed circuit will effect the alarm.
2) *Magnetic Reed:* Micro-switch is a small component which is easily located in door or window openings. It is the same concept and application as the automatic light switch used in a vehicle door recess, but it activates an alarm siren. A spring loaded plunger functions in a similar manner to a bell push button in making or breaking an electrical alarm detector circuit. The disadvantage is the constant movement and associated wear, exposure to damage and possible interference. Magnetic reed can be used in the same situations as a microswitch but it has the advantage of no moving parts. It is also less exposed to damage or tampering. There are, however, two parts to install. One is a plastic case with two overlapping metal strips of dissimilar polarity, fitted into a small recess in the door or window frame. Opening the door or window demagnetises the metal strips, breaking the continuity of the closed detector circuit (OsyPQ&sig2=MLwR5Eadu1Migmm01O5vFA&bvm=bv.94911696,d.ZGU).
3) *Radio Sensor, Pressure Mat and Taut Wiring:* Radio sensor are surface mounted to windows and doors. They transmit a radio signal from an integral battery power source. This signal is picked up by a central control unit or receiver, which activates the alarm circuit. As these sensors are `free wired' they can be moved, which is ideal for temporary premises or in buildings undergoing changes. A pocket or portable radio panic button transmitter is an option. The range without an aerial is about 60 m, therefore they can be used in outbuildings to a hard wired system from a main building. (Fred and Roger, 2007) Pressure mat are a `sandwich' with metal foil outer layers as part of a detector circuit. The inner core is a soft perforated foam. Pressure on the outer upper layer connects to the lower layer through the perforations in the core to complete the circuit and activate the alarm. Location is near entrances and under windows, normally below a carpet where a small area of underlay can be removed. Sensitivity varies for different applications, such as premises where household pets occupy the building (Fred and Roger, 2007). Taut wiring are also available as a window strip. A continuous plastic coated copper wire is embedded in floors, walls or ceilings, or possibly applied around safes and other secure compartments. As a window strip, silvered wire can be embedded between two bonded laminates of glass. Alternatively, a continuous self-adhesive lead or aluminium tape can be applied directly to the surface. In principle, it is similar to a car rear heated window. When the wire or tape is broken the closed circuit is interrupted which activates the alarm circuit (Fred and Roger, 2007)
4) *Ultrasonic and Microwave Detectors:* Ultrasonic equipment is simply a sound emitter and a receiver containing a microphone and sound processor. The sounds are at a very high frequency of between 20 and 40 kHz (normal hearing limit is about 15 kHz). Direct and indirect (reflected) sound distribution from the emitter to the receiver adopts a pattern which can be plotted as a polar curve. If an intruder encroaches the curve the sound frequency will be disturbed. The receiver then absorbs the original frequency, the frequency reflected off the intruder and a mixture of the two. The latter is known as the `beat note' and it is this irregularity which effects the detector circuit. Greatest detection potential is in the depth of the lobe, therefore this should be projected towards an entry point or a window(Fred and Roger, 2007). Microwave operates on the same principle as ultrasonic detection, except that extremely high radio waves are emitted at a standard 107 GHz. Emitter and receiver occupy the same unit which is mounted at high level to extend waves over the volume of a room, warehouse, office or similar internal area. An intruder penetrating the microwaves disturbs the frequency which effects the detector circuit. Unlike ultrasonic detectors, microwave detectors are not disturbed by air currents, draughts and ultrasonic sounds from electrical equipment such as computers. They are therefore less prone to false alarms
5) *Active Infra-red Detector:* Otherwise known as an optical system, it uses a light beam from the infra-red part of the electromagnetic spectrum. This is imperceptible to the human eye. The system is based on a transmitter and receiver. The

transmitter projects an invisible light beam at distances up to 300 m on to a photo-electric cell receiver. An intruder crossing the beam will prevent the light from activating the cell. The loss of energy source for the cell effects an alarm relay. Even though the beam has extensive range, this system is not suitable for external use. Atmospheric changes such as fog or birds flying through the beam can affect the transmission. Mirrors may be used to reflect the beam across a room or around corners, but each reflection will reduce the beam effectiveness by about 25%. Infra-red beams will penetrate glass partitions and windows, each pane of glass reducing the beam effectiveness by about 16%. The smarter intruder may be able to fool the system by shining a portable light source at the receiver. This can be overcome by pulsing the transmission, usually at about 200 pulses per second (Fred and Roger, 2007)

6) *Passive Infra-red (PIR) Detector:* These detectors use highly sensitive ceramic infra-red receivers to recognise radiation from a moving body. Wall-mounted detector units focus the radiation through a lens which contains curved facets to concentrate the radiation on to two sensors. Image variation between the sensors generates a small electrical differential to effect an alarm relay. These systems have enjoyed widespread application, not least the domestic market. Units of lower sensitivity can be used where pets occupy a home. A battery back-up energy source covers for periods of mains power isolation. PIR detectors can be used with other devices in the same system, e.g. radio pocket panic buttons, pressure mats, magnetic reeds, etc. PIR beam patterns vary in form and range to suit a variety of applications, both externally and internally (Fred and Roger, 2007).

II. COMMON APPLICATION OF ROBOTICS

Robotics was identified by the 1990 department of defence critical technologies plan as vital to long term US defence capabilities. Robotics are incorporate in current weapon systems and will play a larger role in future systems. While defence and commercial development follow largely separate paths, a strong domesic industry is essential to maintaining Us involvement in the continuing overal development of robotic technologgy in curbing security matters (Baudoin et al, 2012).

Robotics are used extensively in the automotive industry, primarily for welding, painting and material handling applications. The electronics, aerospace, metal working and consumer goods industries are also major robot users. Integrated factory automation systems, to which robot technology is key, affect all type of manufacturing (Jon et.al, 2005). In the near future, productivity and competitiveness in these industries will depend in large part on flexible automation through robotics.

It can be attested that robots adoption can effectively enhance the survaillance and intelligence at a rapid rate and therefore operation of sophisticated military machinery and equipment (Miles, 2012). Robots need to be trained only once and can thereafter efficently repeat the same action. Advancements in artificial intelligence, which are progressing at a higher rate, will allow robots to operate sophisticated military machinery and equipment and decrease the need for manpower in such applications. The electronic industries association, in its forecast of defense electronics market, names the use of autonomous systems (such as robotic vehicles/ aircrafts) as one of the major trends in electronic content of military systems.

According to the US Department of commerce report (1991), the department of defense is currently working in the area of robotic material handling systems for logistic application. The inroads made in the area of fiber- optic guided missiles (FOG-M) offer encouragement regarding the use of tele-operated systems. DOD is also succeeding in its efforts to develop a tele-operated mobile platform that can serve as an unmanned reconnaissance platform. In the conjunction with program, efforts are underway to control multiple platforms via a single mobile robotic command center (RCC). Another application of a tele-operated robot will be the development of Caled, a small vehicle capable of reconnaissance, surveillance and target acquisition operations for the infantry.

III.FLEXIBLE MANUFACTURING OF WEAPONS

According to Jon et.al (2005), robotics also play a vital role in flexible manufacturing which can be used to produce may products, including defense critical parts and weapon systems. Robot use in manufacturing results in more flexible manufacturing capabilities with shortened production lead times and enhanced quality. Further, inventories and associated carrying costs can be lessened, and in many cases, eliminated, and capital cost (except for software) can be reduced to zero for many new products. The increasing use of robots in production of defense related and the industrial base makes the availability of robots during a national security emergency critical to meet surge production requirements.

IV.CONCLUSIONS

Direct robot utilisation by the military is still relatively small, but includes activities as varied and critical as explosive ordinance disposal, underwater research and recovery, biological and chemical defense and nuclear weapons applications. Robotics technology also has rapidly growing applications in more complex weapon systems. Robotic mechanisms have a wide range of military applications in helicopters, ground vehicles, weapon systems and robotic work tables and devices. In addition articulated mechanical

devices are the major components in the military vehicles with rotating turrets , recoiling barrels and automatic ammunition handling equipment. Robotic systems are of special interest in the welding of tanks suspension systems, minefield breaching, refueling and reloading devices and armament systems. With the introduction of compound materials into the design of robotic arms, robots will be able to accomplish such tasks more rapidly and with less power consumption.

Explosive Ordnance Disposal (EOD) robots save the lives of soldiers and civilians every day. The TALONTM robot by Foster-Miller is the choice of many military EOD teams and civilian bomb squads. Others include PackBotTM, iRobot PackBot, HDE MURV-100 HDE, Pedsco RMI-9WT, Vanguard MK2-ROV, Cybernetix CASTOR, Mesa Robotics MATILDA, ROV Technology SCARABB IIA (Jon T. H. et.al (2005)

In general, robotics military applications will reduce the need for manpower, while improving human response times. Other benefits will result from the use of autonomous vehicles and unmanned aerial vehicles. Robotics can also be applied to remove crews from hazardous environment and exposed platforms, resulting to improved survivability.

V. RECOMMENDATIONS

A. The minimum robotics military applications that is in existance should be embraced and practiced to enhance-

1) Reduced need for manpower, while improving human response times through the use of autonomous vehicles and unmanned aerial vehicles.

2) Removal of crews from hazardous environment and exposed platforms, resulting to improved survivability.

3) Flexible manufacturing of defense critical parts and weapon systems with shortened production lead times and enhanced quality

4) Tele-operated robot capable of reconnaissance, surveillance and target acquisition operations

B. With proper regulations governing the possession and ownership of firearms, there should be government incentives to allow homes, social and public places to be installed with armed robotic manipulators that can initiate an action to intruders in enclosed environments where security apparatus cannot access with ease and in time to contain a situation .

C. Capital, human and infrustractural investment in the design, development and implementation of modern technological security approaches should be initiated by the learning and training institutions.

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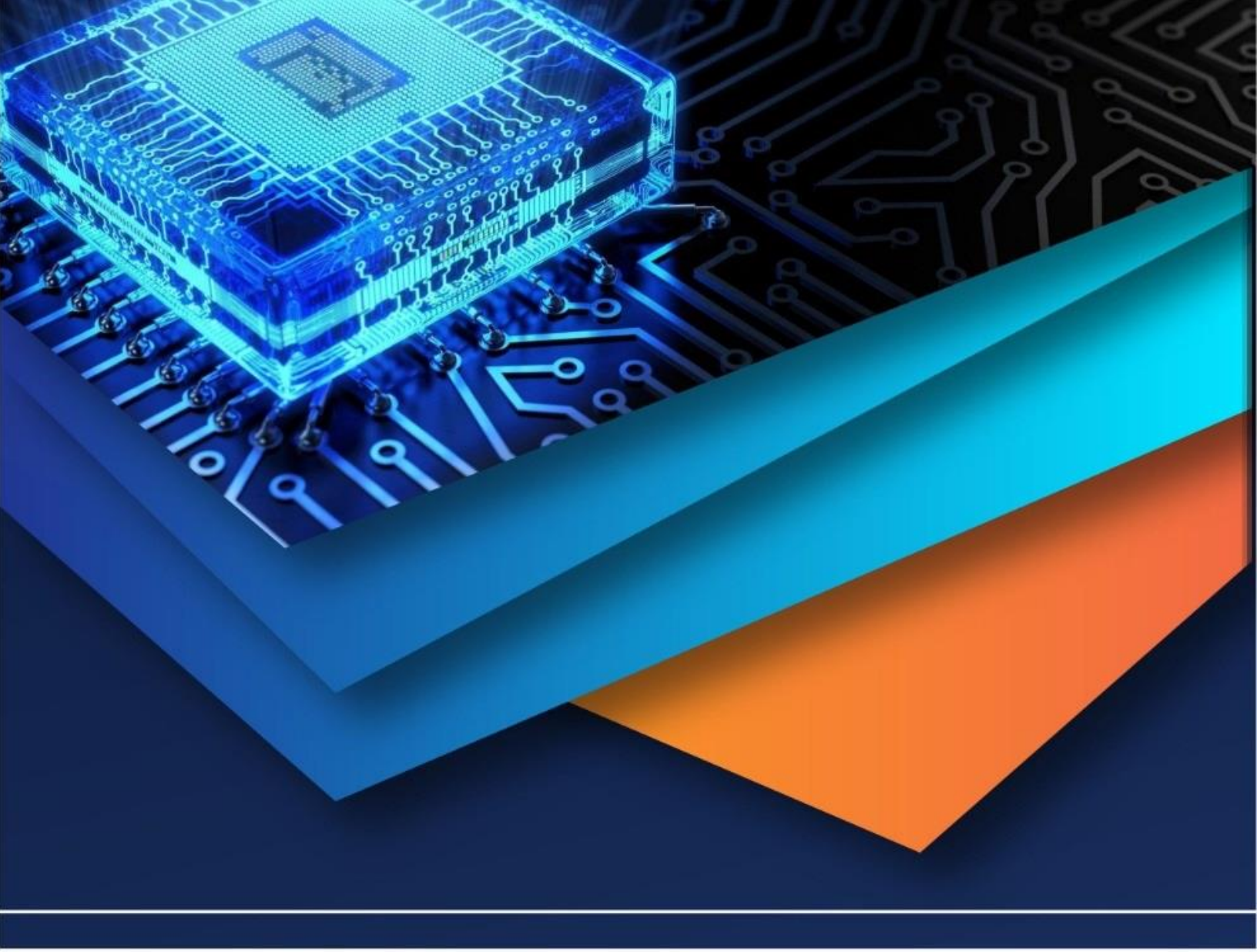

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