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Review Paper on Applied Technology in Military Defense System

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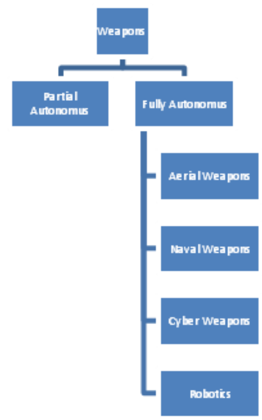
Abstract -The world is going through a technological and scientific revolution and the military organization are the primary drivers behind the revolutionary changes in technology. The impact of the computer-driven technological revolution on military capabilities and future potential has certainly become clear over the past quarter of a century. This paper showcases the study of some of the most recent technologies which are being used by the military organization all over the world to empower themselves.

I. INTRODUCTION - The growing challenge of security in World is one of the most concerns to all and every effort must be employedtocombatthischallenge.This working paper is an attempt to respond to that demand. It aims to clarify some basic understandings about autonomy. Technology plays a very vital role in the field of military defense system. This review paper is a showcase of how the technology has driven the defense system and what potential are there which can be future groomed in near future. In this review paper we have discussed some of the technology which are being used in the weapons such as in the autonomous weapons.

II. WEAPONS – As the concern of security has become one of the most challenging tasks for the military. The use of computer technology upon weapons has become one of the most important parts of military defense system. However, the technologies which are applied on the weapons are rapidly growing in order to make the most sophisticated and powerful weapons that can reduce the drawbacks of existing weapons.

Types Of Weapons – In the recent era of technology, the weapons can be categorized in two categories that is partial autonomous and fully autonomous weapons.

In this review paper we will focus on the fully autonomous weapons and the technologies which are applied on it.



Block diagram to show the categories of weapons

i. Autonomous Weapons - In simple terms 'autonomy' can be defined as the ability of a machine to execute a task or multiple tasks, without any human input, using interaction of computer programming with the environment. An autonomous system is by extension, usually understood as a system whether hardware or software that, once activated, can perform some tasks or functions on its own.

However, autonomy is a relative notion: within and across relevant disciplines, be it engineering, robotics or computer science, experts have a different understanding of when a system or a system's function may or may not be deemed autonomous. As previously identified by Scharre, these approaches can be sorted into three categories.

Categories of Autonomy are as follows:-

The human-machine command-and-control relationship

A very common approach for assessing autonomy relates to the extent to which humans are involved in the execution of the task carried out by the machine. With this approach the systems can be classified into three categories. Systems that require human input at some stage of the task execution can be referred to as 'semi-autonomous' or 'human in the loop'. Systems that can operate independently but are under the oversight of a human who can intervene if something goes wrong (e.g. malfunction or systems failure) are called 'human-supervised autonomous' or 'human on the loop'.

Machines that operate completely on their own and where humans are not in a position to intervene are usually referred to as 'fully autonomous' or 'human out of the loop'. The concept of 'sliding autonomy' is sometimes also employed to refer to systems that can go back and forth between semi-autonomy and full autonomy, depending on the complexity of the mission, external operating environments and, most importantly, legal and policy constraints.

The machine's decision-making process

A more technical approach to autonomy relates to the actual ability of a system to exercise control over its own behavior (self-governance) and deal with uncertainties in its operating environment.3 From this standpoint, systems are often sorted into three major categories: automatic, automated and autonomous systems. The label 'automatic' is usually reserved for systems that mechanically respond to sensory input and step through predefined procedures, and whose functioning cannot accommodate uncertainties in the operating environment (e.g. robotic arms used in the manufacturing industry).

Machines that can cope with variations in their environment and exercise control over their actions can either be described as automated or autonomous. What distinguishes an automated system from an autonomous system is a contentious issue. Some experts see the difference in terms of degree of self-governance, and view autonomous systems merely as more complex and intelligent forms of automated systems. Others see value in making a clear distinction between the two concepts.

III. APPLICATIONS OF AUTONOMY IN WEAPON SYSTEMS

Autonomy is a characteristic that can be attached to a large variety of functions in weapon systems. These may be sorted into five generic task areas: (*a*) mobility, (*b*) health management, (*c*) interoperability, (*d*) battlefield intelligence, and (*e*) use of force (see table 1).Mobilityincludes various types of functions that allow systems to govern and directtheir own motion within their operating environment. Key applications of autonomy for mobility include navigation, take-off and landing, obstacle avoidance, and return to base in case of loss of communication. health management, regroups functions that allow systems to manage their functioning or survival.

One example is power management: when a system detects that its power resources are low, it can engage and manage the process of recharging or refuelling completely independently. Other possible applications include autonomous fault detection and self-repair. interoperability (focusing here on machine autonomy) is concerned with the ability of a machine to execute a task in collaboration with other machines or humans. Swarming is one notable example of machine-to-machine collaboration consisting of making large numbers of simple or low-cost physical robots execute a task in concert, which can be done in a centralized or decentralized way.

A number of experts foresee that developments in swarming will have a fundamental impact on future warfare, as it would enable the application of force with greater coordination, intelligence, mass and speed. In terms of human-machine collaboration, one key con-crete application of autonomy is to enable the use of natural language (either speech or gesture) for command and control. Voice command and control is already in use in some weapon platforms, but so far it is limited to the execution of non-critical tasks.

Battlefield intelligence, refers to on-board functions that allow weapon systems to find and analyze data of tactical or strategic relevance on the battlefield. The data may then serve to guide decision making by either the operators or military command.

use of force- refers specifically to functions that enable weapon systems to search for, detect, identify, track or prioritize and attack enemy targets on the battlefield.

IV. WORKING OF AUTONOMY – Autonomy is about transferring data from environment and making it useful for the completion of certain task or multiple task. The autonomy can be applied into the defense system by using technology driven techniques. There are a lots of algorithms are available in the world of technology which are being use by the military to empower or to make the weapons more sophisticated and more intelligent.

V. ANATOMY OF AUTONOMY

A. Sensor – Sensors are the digital device that is being used to sense the outer environment and the data collected by the sensor is being received by the processors.

B. Processor - A suite of computer hardware and software that allows the system to interpret data from the sensor and transform it into plans and actions. The three most important technologies in this regard are computer chips, sensing software and control soft-ware that together form the 'brain' of the system

C. Network – It is used to create the communication between all the elements of anatomy.

D. Actuators and Effectors – It allows the system to execute in its operating environment.

These different components form the underlying architecture of autonomy. The actual characteristics of these underlying technologies will be different depending on the nature of the task and the operating environment. It should also be noted that technologies may be integrated within a single machine—which could be described as 'self-contained autonomy'—or distributed across a network of machines—which could be described as 'distributed autonomy'

VI. EXAMPLE THROUGH ALGORITHM ORCA (OPTIMAL RECIPROCAL COLLISION AVOIDANCE)

Collision avoidance is a fundamental problem in aviation and naval field. The problem can generally be defined in the context of an autonomous mobile robot navigating in an environment with obstacles and/or other moving entities, where the aircraft or ships employs a continuous cycle of sensing and acting. In each cycle, an action for the machine must be computed based on local observations of the environment, such that the robot stays free of collisions with the obstacles and the other moving entities, while making progress towards a goal, thus to avoid these kind of problem ORCA algoritham came into existence. Optimal reciprocal collision avoidance is an algorithm which is used in aviation and naval war ship. This algorithm is used to detect the path.

Steps of Algorithm are as follows

A) Details of aircraft or ship is entered such as length, height, weight, max and min speed etc.

B) the sensory optical device mounted into the aircraft or naval ship sense the environmental pressure such as the air, water pressure or the climatic condition.

C) the sensory optical device detect the path and makes the mark on the path routing chart.

D) If the sensory optical device detects any trouble the flag makes the counter at1 or else 0.

E) Same steps will run in loop until the goal achieved.

VI. DRAWBACK

The main drawback of ORCA algorithm is it is very sensitive. It totally depend on the sensory optical device if unfortunately the sensory device doesn't able to collect the data the whole algorithm may crash and can give the foul result, that can be harmful on the practical ground for the aviation controllers. Making self-driving vehicles capable of operating in highly diverse human environments, such as in a war zone is much more challenging because it is difficult— if not impossible—for a programmer to develop a model that will capture all possible combinations of events.

VII. CONCLUSION

A conclusion that can be drawn from this brief review is the importance of perception. It is the lack of perceptual intelligence that is impeding the advance of autonomy in some of the most critical applications areas of autonomy in weapon systems, namely mobility, interoperability, use of force and battlefield intelligence. For a number of experts, the solution to designing machines capable of advanced situational in the current progress of machine learning.

REFERENCES

1) https://www.hoover.org/research/technology-and-future-war

2) https://en.wikipedia.org/wiki/Revolution_in_Military_Affairs

3) https://plato.stanford.edu/entries/feminism-autonomy/

4) http://www.bu.edu/globalbeat/usdefense/Quille1298.html

5) https://www.weforum.org/agenda/2016/11/the-4th-industrial-revolution-and-international-security/

6) https://www.mda.mil/system/system.html

7) M. Zucker, J. Kuffner, M. Branicky. “Multipartite RRTs for rapid replanning in dynamic environments”. *IEEE Int. Conf. on Roboticsand Automation*, pp. 1603-1609, 2007.

8) T. Fraichard, H. Asama. “Inevitable collision states - a step towards safer robots” *Advanced Robotics* 18(10):10011024, 2004.