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INTERNET OF MILITARY THINGS: FROM ANCIENT WAR TO MODERN WAR

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ABSTRACT

The world has hosted many wars since its inception. There are different types of war. Long-term, short-term and so on. Most importantly, wars today can be divided into two categories: the Ancient War and the Modern War.

While the ancient war was based on manpower, the modern war is based on technology. More precisely, smart technologies. Given that technology is a condition for the interaction of technologies in a war situation, the Internet of Things technology attracts more attention. The introduction of Internet of Things technology to the military has given rise to the concept of the Internet of Military Things.

IoT technology is one of the indispensable technologies for the military. The most important element in the army is unity and communication. And it is the Internet of Things technology that gives the military this advantage. These connections between soldier-soldier, soldier-weapon, soldier-control center, control center-weapon are due to the Internet of Things technology. The article is aimed at studying the use of modern technologies in the military over IoT technology, which is the basis of modern warfare, the strength of the modern army.

Keywords Military, Modern, Ancient, War, Smart Technology, Internet of Things, Internet of Military Things

1. INTRODUCTION

At present, countries are working hard to smart technologies and manpower to further strengthen their armies. If the manpower can use technology properly, and if the technology is improved, then the army of that country will increase its strength.

It is known that in war conditions, the trajectory of the soldiers, the tactics of attack are developed by the military commander and the headquarters. While the military commander is advancing with the soldiers, it is always necessary to control the army remotely. This is done by the headquarters. For this reason, the headquarters must be in contact with both soldiers and weapons.

There are many technologies to do this. One of them and the most important is the Internet of Things technology.

As a result of the interconnection of technological devices via the Internet, the term Internet of Things technology has been included in the dictionary of technology. Although first introduced in 1982, this technology has become an integral part of human life, mainly since the early 2000s, and has been applied in many fields. One of the most important of these areas is the military.

The integration of Internet of Things technology into the military has helped strengthen the military.

2. MODERN MILITARY POWER RANKING OF COUNTRIES

Every year, the ranking of countries' military power is determined. Let's look at the ranking of military forces of the countries planned for 2021 [1].

Table 1

№	Country flags	Country names	Military strength (PWINDX*)
1		United States	0.0718
2		Russia	0.0791
3		China	0.0854
4		India	0.1207
5		Japan	0.1599
6		South Korea	0.1612
7		France	0.1681
8		United Kingdom	0.1997
9		Brazil	0.2026
10		Pakistan	0.2073
11		Turkey	0.2109

64		Azerbaijan	1.0472

(PWINDX *) = Power Index - more than 50 individual factors used to determine the score. The smaller the PWINDX value, the stronger the country's theoretical military capability. The perfect PWINDX score is 0.0000. This score seen as inaccessible points. As can be seen from the ranking, in fact, there is currently no country with this power.

According to the ranking, the military industry in which the most modern technology is used is the United States Army.

3. INTERNET OF MILITARY THINGS

The Internet of Things technology is applied in many areas and is variously named according to these areas. For example, the Internet of Things technology used in healthcare is called the Internet of Medical Things. The Internet of Things technology used in the military industry is called the Internet of Military Things.



Figure 1: Military Battlefield The Internet of Things is a network of sensors and IoT devices that use cloud and remote computing to create a combined combat power [3]

Recently, military activity has been increasing. New weapons tests, development, inspection, testing of new equipment, etc. Such cases have led to the widespread use of computer technology in the military.

The future of military warfare is evolving with the help of high technology, such as biometric wearable devices created by the EU to help soldiers recognize the enemy, achieve better results in combat, and gain access to

devices and weapons systems using rapid external computing [2].

The above are some of the advantages that technology, in narrow sense, Internet of things technology offers to the military. In general, let's list them as follows and look briefly at these areas:

- Identify the enemy
- Monitoring the physical (as well as psychological) condition of the soldier

- Synchronize (coordinate) soldiers with weapons systems and other devices, etc.

The Internet of Things is equipped with sensing and computing devices for soldiers' uniforms, hats, weapons systems and other equipment. With the help of this, any information is obtained with the necessary biometric indicators.

3.1. Identify the enemy:

It is not always easy to recognize enemy fighters in an unequal war. They may appear to be civilians or may have access to limited military bases by posing as individuals in the military.

Sensors are the technology that can prevent such cases. The task of the sensors here is to scan the biometric data of potential threats - in this case, such people are enemies - and show the soldier his identity. For this, biometric indicators such as face, fingerprint and eye can be scanned.

At this point, it should be noted that Edge Computing comes to the aid of Internet of Things technology.

Edge computing, for example, allows fingerprints from a weapon or bomb to be uploaded to a network and instantly identify the enemy [2].

3.2. Monitoring the physical and psychological condition of the soldier.

The help of biometrics does not end with identifying the enemy soldier. On the other hand, biometrics can also be used to send

information about a soldier's physical condition to the command center. This is done at the expense of devices placed on the clothes and hats of soldiers. These devices measure heart rate, body temperature, etc. are measurable devices. Timely transmission of such information to the center will help to make the right decision. For example, it is possible to save soldiers from a real death situation by withdrawing a group of physically exhausted soldiers and sending a physically strong group instead.

3.3. Coordinate soldiers with weapons systems and other devices.

Edge computing comes to the rescue in a situation like this. Thus, with its help, soldiers can enter vehicles and weapons systems. Also, combat conditions can be monitored by coordinated drones.

Contextual data can also be valuable in mobile device architectures, in short, to achieve performance optimization and operational adaptability of biometric systems that perform user identification / monitoring everywhere (on Internet of Things devices that can act as smart and mobile cyber weapons). In this scenario, contextual information may include information about the environment and terrain, lighting conditions, the soldier's physical condition (for example, collected through sensors included in a combat suit) and continuous activity (moving or resting as a sniper) [2].

There are some technologies that are evolving along with the Internet of Things technology, which will also have an impact on the military through the Internet of Things. These technologies:

- Artificial Intelligence and Big Data Analytics
- Sensors
- Processors and transmitters
- Cloud technology, etc.

3.4. Artificial Intelligence and Analytics – Artificial intelligence is one of the key components for the optimal use of IoT, as it allows efficient analysis of large amounts of data.

Defense/security intelligence is mainly in the form of open source intelligence (OSINT), logistics, support, exploitation, and war intelligence. It is based on expert systems that analyze about 80% of the information available on the Internet, other media sources and social networks.

Big Data analytics can scan a larger amount of data and at the same time reduce associated noise using artificial intelligence technologies such as machine learning. Logistics, support and maintenance benefit greatly from Big Data Analytics [4].

Military intelligence is expected to further develop the human-centered approach to the Internet of Things.

Due to the nature of firing on targets, it will always be necessary to identify people and

formalize the firing, especially when it comes to operations in civilian areas. In the field of unmanned armed systems, there are many ethical implications stemming from this need, which is expected to act as an obstacle to the rapid expansion of the EU military. For this particular market segment, it is important for a user to invest in the quality and quantity of sensors so that they can identify and identify their targets [4].

However, despite all this, artificial intelligence still faces certain problems. One of them is the cause-and-effect problem. This is explained by the fact that artificial intelligence makes it difficult to distinguish between a person holding a weapon and a person holding a weapon-like object. In this sense, artificial intelligence can identify a civilian or its own soldier as an enemy soldier instead of an enemy.

3.5. Sensors - are one of the most important components of IoT. We mentioned above one of the biggest benefits of sensors. Identify the enemy, study the physical condition of the soldier, etc. extremely useful in situations such as. Such sensors are a key part of health monitoring systems.

In addition, sensors increase their capabilities in conjunction with technologies such as radars, motion and sound detectors. With the help of sensors, a lot of information can be obtained in the air, sea and land without losing coverage and accuracy.

3.6. Processors and Transmitters –

Given that Military IoT is based on the existence of a secure, reliable, and capable network, powerful processors will remain a key component for the rapid processing of large data. In addition, with wireless data transmission through radio communication systems, transmitters need to be able to transmit larger amounts of data faster [4].

3.7. Cloud technology – the basis of any field is data, information. Much of this information is useful and needs to be kept secure for a long time. In this case, information storage technologies help people. One of them is cloud technology.

The defense industry is working on various solutions to technical issues related to the storage of large amounts of data [4]. Many companies, in turn, offer storage solutions.

In the civilian market, IoT is becoming a cloud battlefield. Amazon, Google, Microsoft, Alibaba and IBM are competing to provide a cloud infrastructure that will connect and manage the world's connected products [4].

4. LEADING COMPANIES IN INTERNET OF MILITARY THINGS TECHNOLOGY

According to GlobalData, the market size of the global military IoT industry will grow to \$ 317.8 billion by 2023, of which government and state-owned applications will account for more than 40% of the total market. C4ISR, Northrop Grumman, Boeing, Lockheed Martin, Thales, BAE systems, L3 Harris

technologies, etc. in the fields of cyber security and autonomy. Leading companies such as will continue to lead the global army in the Internet of Things market.

Let's look at 3 of the most hegemonic companies in the field of military production. Northrop Grumman ranks 5th, Boeing ranks 2nd and Lockheed Martin ranks 1st in the global ranking of defense companies.

4.1 Northrop Grumman – This is an international company founded in 1994 by a merger of Northop and Grumman. It is especially well known in the creation of defense systems. Thus, in 2010 it became the fourth largest company in the world in the field of defense industry.

Since April 2011, Northrop Grumman has been operating in four areas:

- ✓ Space systems,
- ✓ Electronic systems,
- ✓ Information systems
- ✓ Technical systems

The company's production area includes aircraft carriers, military aircraft, warships, missile missile systems, satellites and information technology systems.

4.2. Boeing – when you hear the name, many people think of planes with the same name. Although Boeing aircraft are mainly known as passenger aircraft, the company produces not only passenger aircraft, but also military aircraft.

Founded in 1916, the company is one of the leading manufacturers of military systems in the United States.

In addition, Boeing designs and manufactures rotor aircraft, electronic and defense systems, missiles, satellites, rocket launchers and advanced information and communication systems.

4.3. Lockheed Martin – A fighter jet is a plane that anyone who has nothing to do with the military can call it. F-16 Fighting

Falcon (F-16 Fighting Falcon). In short, the F-16. Speed, flight ceiling, battle radius, etc. is an aircraft that makes a name for itself with features such as the F-16.

It is especially known in our country. Because the sister country, Turkey, along with Israel, is the country that uses the F-16 the most in the world after the United States. F-16s are the most common fourth generation fighters in foreign countries.

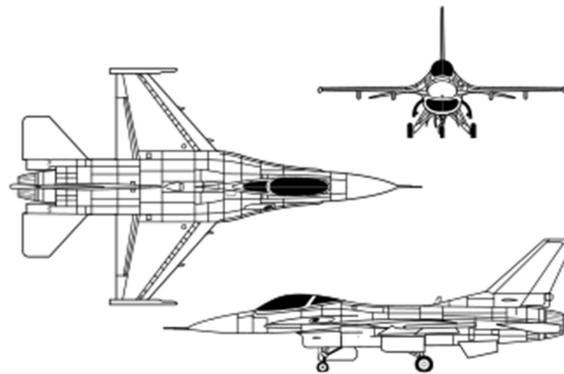


Figure 2: F-16 Fighting Falcon

Lockheed Martin is the manufacturer of the most widespread F-16 aircraft in the world. Lockheed Martin is a leader in its field, a multinational technology and aviation company founded in 1995 with the participation of Lockheed Corporation and Martin Marietta.

The company operates in five main areas: Aviation, Integration Systems, Combat Missiles, Firing Systems, Service Training Systems.

Another piece of equipment produced by this company is the F-35 Joint Strike Fighter. The

F-35 is a fifth-generation, stealth, single-pilot, single-engine military fighter jet co-produced by the United States and the United Kingdom. The fifth generation fighter is designed to destroy ground targets and conduct air combat. There are 3 main types of F-35s: F-35A - traditional take-off and landing option, F-35B - fast take-off and vertical landing option, and F35C - quick take-off option with a catapult designed for aircraft carriers. On July 31, 2015, the first F-35 squadron was declared ready for service after intensive testing and inspection in the United States.

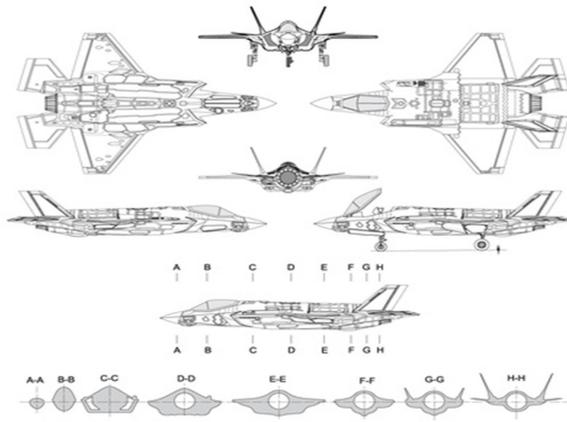


Figure 3: F-35 Joint Strike Fighter

5. APPLICATIONS OF THE INTERNET OF MILITARY THINGS

If we consider the military field as a whole, it consists of several sub-areas. In these areas, the Internet of Things is used in different ways in accordance with the requirements of the field.

Let's take a brief look at a few areas of military application where IoT devices have been or are likely to be used.

5.1. Logistics – One of the most important applications of sensors in the defense sector is logistics. With the help of sensors, the situation in any area is under control.

One of the most important systems is the US Army's RF-ITV1 system, which is designed to monitor the status of military cargo from the sender to the point of destination. The sending data is combined and processed with the data of the motion detector system (MTS2), which is equipped with localization data that provides the connection between the convoys and web-

based maps, and supports the logical sections of the report [5].

5.2 Military training – IoT devices can also be used during training. Different combat situations can be modeled in virtual reality. The positions and physiological condition of soldiers are detected by sensors during military training. The resulting video and audio data can then be evaluated at any time [5].

One of the corresponding virtual simulation systems is the MILES system.

The Multi-Integrated Laser Engagement System (MILES) is a training system that provides a real combat environment for soldiers participating in training exercises. Soldiers use MILES devices primarily to simulate the firing and effects of actual weapon systems in strength training, from staff to brigade level. These weapons systems include the M1 Abrams Tank, the Bradley Infantry, the M113 Armored Personnel Carrier, wheeled vehicles, and other non-firing targets. In addition, Basic MILES simulations address other auxiliary components such as anti-armor weapons, machine guns, rifles and control weapons [21].

5.3. Health monitoring – If we are talking about sensors, of course, the name of this area should be mentioned. As mentioned above, the physical condition of soldiers is monitored with the help of sensors.

An example of a system used here is the Tempus pro monitoring system. It is an

advanced system that can monitor virtual signals.

5.4. Energy Management, Smart Military Bases – IoT technology can be applied in military applications and can build smart military bases using the concept of smart cities already applied in practice. Smart military bases will be such facilities that are able to optimize the energy resources of military bases using the unique features of technology. These databases will contribute to the comfort of the employer of the database, monitor different events in the database and record the entry and exit of employees [5].

6. MODERN WEAPONS USED IN THE MILITARY FIELD

It is known that things have many components of Internet technology. The most important of these are sensors. For the military field with special. Among the information we have mentioned so far, the most noticeable are the sensors. We will also look at the application of sensors in the following weapons.

There are many weapons used in the military.

1. *Unmanned aerial vehicles*
2. *Unmanned surface vehicle*
3. *Laser protection system*
4. *Unmanned underwater systems*

6.1. Unmanned aerial vehicles (UAV)

– the most loyal friend of the Army. It is perhaps the technique that helps the living force the most. UAVs belong to the class of

drones. At this point, it is worth mentioning a brief theoretical background on drones.

In fact, many people equate drones and unmanned aerial vehicles. In fact, this is not the case. Yes, UAVs are drones, but not every drone is a UAV.

Drones can also be called land-based technology. Otherwise, if the drone flies, then the drone can be called a UAV. Not all flying drones are used in the military. Now back to the topic of UAV.

UAVs are a bit difficult to classify because they have very different characteristics. This difference is due to the abundance of configurations and components of UAV. Designation, size, function, flight distance, autonomous (autonomy) level, design and configuration, type of flight, purpose, tactical technical characteristics, type of power supply unit, payload, automation system, collision avoidance system, type of GPS navigation, differ in the protection system in the suppression of signals, the bandwidth of the radio frequency spectrum, data preparation, specialized software and other features [6].

In general, UAVs are divided into 4 groups: [6]

- 1) Micro (Lightweight) - these UAVs weigh less than 10 kg and can stay in the air for a maximum of 60 minutes. The height of the flight is 1 kilometer.
- 2) Mini (Small) - these devices weigh up to 50 kg and are in the air for 5 hours. The

altitude of the flight varies from 3 to 5 kilometers.

- 3) Midi (Medium) - UAVs weighing up to 1 ton are designed for 15 hours of flight. Such UAVs operate at an altitude of 10 kilometers.
- 4) Heavy - these types of UAVs weigh more than a ton and are designed for long-haul flights lasting more than a day. Flights can be operated at an altitude of 20 kilometers.

The UAVs feature a GPS satellite navigator and a programmable module. If the device is designed to receive, store and transmit data to the operator's console, then the module is additionally equipped with a memory card. Sensors are also used in UAVs. Let's take a look at two types of UAV, which are especially well-known in our country. IAI HAROP and BAYRAKTAR

6.2. IAI HAROP is an unmanned aerial vehicle (UAV) developed by the aerospace division of Israel Aerospace Industries. Kamikaze is also known as a drone. This drone is a drone in the anti-radiation category - it locks itself into the radio waves emitted by the target, mainly radars, and hits those targets. In addition, instead of carrying the main warhead, the drone itself is considered a warhead as a whole: it destroys itself by hitting the target. The drone either locates and destroys the target autonomously through its radar signal sensors, or is

controlled from a ground control center. If the target is not detected, the drone itself automatically returns to base [7].



Figure 4: IAI HAROP

HAROP is currently used in the Indian, Azerbaijani and Israeli armies.

IAI HAROP was used in the 44-day war between Azerbaijan and Armenia, which resulted in the victory of Azerbaijan, and successful results were achieved.

Earlier, HAROP was first used in military operations during the April fighting in Azerbaijan.

6.3. BAYRAKTAR AKINCI is a national unmanned aerial vehicle (UAV) manufactured by the Turkish company Baykar. Akinci drones, which have three artificial intelligence computers on board, simultaneously conduct ground reconnaissance, collect data and analyze it autonomously through sensors and high-sensitivity cameras, as well as transmit it to the command center. Another important feature is that these unmanned systems can be used in combat as a whole squadron, in autonomous mode, while the drones are in coordination with each other through artificial intelligence [8].

BAYRAKTAR TB2 is a Turkish operational-tactical, medium-altitude fighter national unmanned aerial vehicle (UAV). Produced by Baykar Makina [9].



Figure 5: Bayraktar TB2

It has fully autonomous ascent and descent with triple backup avionics systems and sensor connection architecture [10]. TB2 can carry guided anti-tank missiles and aircraft bombs [11].

These UAVs were used in Azerbaijan's 44-day struggle for Karabakh.

6.4. Unmanned surface vehicle – a combat vehicle that moves without a man. It is mainly used to enter dangerous areas where people should not enter. Mined areas are an example of this. It can be controlled by remote control device and its moving types via sensors. The main purpose of unmanned combat vehicle sensors is navigation, the other is to detect the environment. Sensors include compasses, odometers, inclination meters, gyroscopes, cameras for triangulation, laser and ultrasound ranges, and infrared technology.

Mine clearing facilities can also be considered unmanned surface vehicles.

Many unmanned combat vehicles have been developed: Type X, Nova 5, Hunter WOLF, Black knights, etc.

The Black Knights [16] are a prototype of an unmanned combat vehicle. This technique, which is currently being developed, has the appearance of a small tank. Combined with a 30 mm cannon and a 7.62 mm coaxial machine gun, it can be placed from a military transport aircraft, and this combat vehicle is a technique that can make great promises for the future.

However, some research is still ongoing due to problems with sensors, GPS, wireless communication. For this reason, the equipment has not been commissioned yet. Note that the equipment was designed by BAE systems.

6.5. Laser defense systems – designed to destroy enemy drones and armored vehicles. Large countries such as the United States, Russia, China, Israel and Turkey use laser protection systems.

Iron Beam is an Iron Beam laser defense system designed by Israeli Army contractor Rafael Advanced Defense Systems in 2014 and commissioned in 2020. This system is designed to be used to destroy missiles and unmanned aerial vehicles.

6.6. Unmanned underwater vehicles – as the name implies, these systems are a technique that can move in the seas and oceans, without a single human impact. The

technique is used in civil and military applications.

Unmanned underwater vehicles consist of two main groups, Wired-Controlled and Wireless-Autonomous. Remote-controlled vehicles are called Remotely Operated Vehicles, and wireless autonomous vehicles are called autonomous (autonomous) submarines [17].

Closer to its current form, the underwater Poodle was designed in 1953 by Dimitri Rebikoff. The first significant progress in the development of this vehicle was made by the British Royal Navy and the US Navy. Due to the lack of autonomy, it was generally used in the early years to destroy and clear mines and explosives. It has been used to map the ocean floor and locate sea mines [17].

Many countries are engaged in the underwater vehicles. Like Russia. One of Russia's projects is the POSEIDON unmanned underwater vehicle.

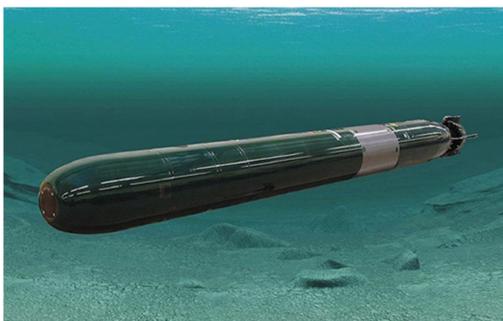


Figure 6: Poseidon

Poseidon is a new Russian unmanned underwater vehicle (UUV) with a nuclear warhead. In fact, it is an autonomous nuclear torpedo with an unlimited range. The Soviets began developing this weapon in 1989.

However, development was halted by the collapse of the Soviet Union and the end of the Cold War. However, in 2015, Russia noted that the equipment was reconsidered. It is planned to be commissioned in 2027.

Poseidon is designed for transportation and release by submarines. Its main role is to attract strategic enemy targets such as carrier combat groups and naval bases. Poseidon will approach its targets and detonate a nuclear warhead.

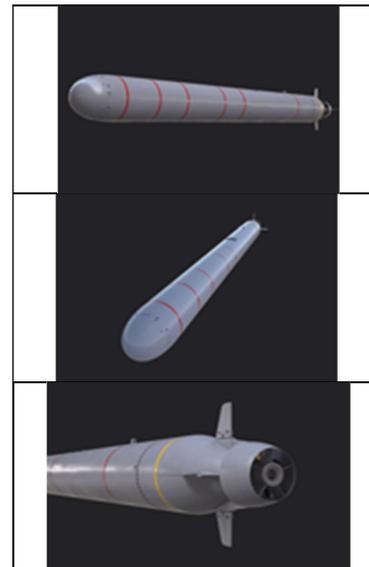


Figure 7: POSEIDON - Front, back and top view

7. CONCLUSIONS

- The Internet of Things connects devices to each other. We see and use connected devices in our daily lives. These devices are also called smart devices.
- Behind the normal life of the world, that is, on the other side of the curtain, there are wars. The right strategy or a strong human army is not enough to win a war today. In addition, techniques are important. But the

most powerful techniques are smart techniques.

- There must be communication between equipment, weapons and people on the battlefield. This is done with the help of IoT technology. As mentioned, information about both humans and weapons is scanned through sensors, which are one of the main components of IoT tracking. And the center is aware of this. It is at the expense of the connected devices that the center learns about a distant soldier, his physical condition or a distant technique. Therefore, IoT is also an indispensable technology in the military.
- By increasing the number of unmanned vehicles, armies will be able to maintain their manpower. But that doesn't mean people won't need it anymore. Because, as we mentioned above, these unmanned systems operate remotely under the influence of the human factor.
- The modern and most powerful military industry, or the most powerful army, is the army that unites manpower and technology. If countries can use it properly, they can win a lot of struggles. We must not forget that the era is the era of technology.
- Finally, it should be noted that the future development of the IoT will also contribute to the military

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