

Artificial Intelligence And Data Applications In Military Operations

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Abstract: *This paper aims to overview the artificial intelligence and data applications in offensive and defensive military operations and provide various insights on it. It also provides the ways how Artificial Intelligence and Data capabilities can be applied in military field with various examples. The extensive research on artificial intelligence and data applications in offensive and defensive military operations was conducted across various platforms in order to get data with great integrity. There are also case studies for Autonomous sentry gun and Indian Ministry of Defence Annual Report, which gives insight of Artificial Intelligence and Data concepts described in this research paper. The points in below paper acts as the understanding of through research of real-life applications of artificial intelligence and data in the defence operations and acts as the material to understand those specific points.*

Keywords: Artificial Intelligence, Data, Applications, military, operations

I. INTRODUCTION

According to John McCarthy (father of artificial intelligence): -

“It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable.”

Artificial intelligence is simulation of human brain working/ intelligence done by machines and/or software. This enables the military organizations / institute to adapt to the changing idea of strategic defensive and offensive military operations.

Artificial intelligence and data applications are becoming very crucial in offensive and defensive military operations. Artificial Intelligence's engagement in military resources is very crucial in development of military equipment and personnel

On other hand DATA is very crucial part in military operations as Data is backbone of any offensive and defensive strategies put together by planners in military. Similarly, data is used to predict the future requirements of equipment and operation strategies

It is very important to integrate Artificial Intelligence and data capabilities in digitalization of the modern militaries around the world. It can also be considered as an important pillar in national security of a country. This also includes representation of the data.

It can help planners to get proper visual representation of data and helping them in better decision-making sources.

II. METHODOLOGY

This research paper employs a qualitative research methodology to investigate the applications of artificial intelligence (AI) and data in military operations.

The resources around the internet are used for the successful completion of the paper. These resources range from: -

- Various case studies
- Research papers from well-known experts
- Reports from various government bodies.
- Data analysis, etc.

There are various limitations in topic, the main limitation is that the lack of material on specific applications. Those which are present are safeguarded by governments for protection of technology. Thus, the independent research must be done with available sources and material.

III. ARTIFICIAL INTELLIGENCE APPLICATIONS IN MILITARY

Artificial intelligence is intelligence—perceiving, synthesizing, and inferring information—demonstrated by machines, as opposed to intelligence displayed by humans or by other animals.

Artificial intelligence has various applications in military operations. Thus, can be explained using various standards.

Defensive strategies: -

Here the Artificial Intelligence systems used are used for self-defence against any external terrorist or institutional threat i.e., hackers' threat, spy threat, war, airstrikes, atom bombs, etc.

It can be also used for maintaining peace, surveillance, crowd management and society security.

- Cyber Defence Mechanisms (CDM)
- Missile Defence (MD) Systems
- Intrusion Prevention and Detection Systems (IP&D)
- Security Information and Event Management (SIEM)
- Data Loss Prevention (DLP) Systems, etc.

Offensive strategies: -

Here Artificial Intelligence systems are used for attacking other organizations or state, such that raids, surgical strikes, tactical bombing, air bombing, war, enemy neutralization, etc. can be carried out by the military organization of the country.

- Missile Launch System (MLS)
- Autonomous Weapons
- Intelligent Ammunitions
- Unmanned Aerial Vehicles (UAV)
- Electronic Warfare System.

Other Equipment: -

Other equipment includes systems used for both defensive, offensive and as well as for creating tactical advantage. Many of them can be used by walking soldiers or infantry in case of any operations.

Personal Protective Equipment.

- Helmet with AI integration.
- Kevlar with AI integration.
- Eye Protection with image processing capabilities.

Communication Equipment.

- Speech Recognition System.
- Noise Reduction Systems.

Tracking Systems.

- Portable Drone tracking systems.
- Target Tracking.

These sophisticated systems are mainly consisted of various Artificial Intelligence Algorithms in the codes of the systems and equipment. These codes are mainly written by scientists and developers in defence companies and institutions who are experts in their respective scope of their fields. These different types of algorithms are used for different types of systems mandated by the military organizations.

Examples:

- Machine Learning (ML) Algorithms
- Deep Learning Algorithms

- Natural Language Processing (NLP) Algorithms
- Reinforcement Learning: Reinforcement
- Learning (RL) Algorithms
- Genetic Algorithms
- Bayesian Networks
- Swarm Intelligence Algorithms

Almost every major military are investing in the Artificial Intelligence capabilities of their military in order to secure the national security. Thus, it is requirement for military organizations to increase the defence spending for Artificial Intelligence applications.

IV. DATA APPLICATIONS IN MILITARY

Data is an integral part of any intelligence and intelligence is what required for successfully executing any operations.

“Data is a collection of discrete values that convey information, describing the quantity, quality, fact, statistics, other basic units of meaning, or simply sequences of symbols that may be further interpreted.”

In today’s world corporate world is leader in extracting, managing and represent crucial data. Military organizations must inherit this knowledge from private sector in order to also use it effectively.

There are various types of data, military might be interested in collecting

Examples:

- Geolocation details
- Ammunition details
- Soldiers Details
- Previous operations
- Enemy details
- Resources details

Future required resources details

There are various types of data analytics used in real world which can be also used in military operations

Examples:

- Descriptive Analysis
- Predictive Analysis
- Perspective Analysis
- Diagnostic Analysis
- Network Analysis
- Clustering
- Segmentation
- Machine Learning
- Time Series Analysis

The military organisations must also consider various data analysis and management tools like:

Examples:

- Microsoft Power Bi
- R Studio
- Tableau
- Python Analysis
- SAS
- Apache Spark
- Excel (technical tools specifically)

Data analytics and management can be used to improve decision making in various defensive and offensive operations, increasing the probability of increasing the success rate of the operation.

Data analytics lifecycle is very crucial part of data management, it includes

- Data Discovery
- Data Preparation
- Model Planning
- Model Building
- Communication Result
- Operationalise

The main element after implementing data-based decision making is security. Data encryption is the key in this area. Data security must be taken seriously in this sector, and data security protocols implementation is must for it.

This can help us with what can be done to achieve best possible results for the particular cases.

This indicates the importance of credible data required. It also requires very specific type of personalized data which include mainly geospatial data which is mostly used by all 3 major branches of military.

Here Army may require proper Terrain Data, Navy may require Nautical data and Airforce may require air traffic data. But how can one make data available to the end personnel to understand, this is where data representation takes place.

This is where the operations planner will have proper insights of data and do proper decision making for more probability of success.

Major economies with their militaries like to collect relevant data to increase its capabilities and reliability.

Hence it is required to increase the Data management activities in the defence planning scope.

V. CASE STUDY – AUTONOMOUS SENTRY GUNS

Autonomous Weapons are the pioneer in the AI applications in military operations.

One of the modern bastions of autonomous weapons system is AUTONOMOUS SENTRY GUNS

A sentry gun is a weapon that is automatically aimed and fired at targets that are detected by sensors.

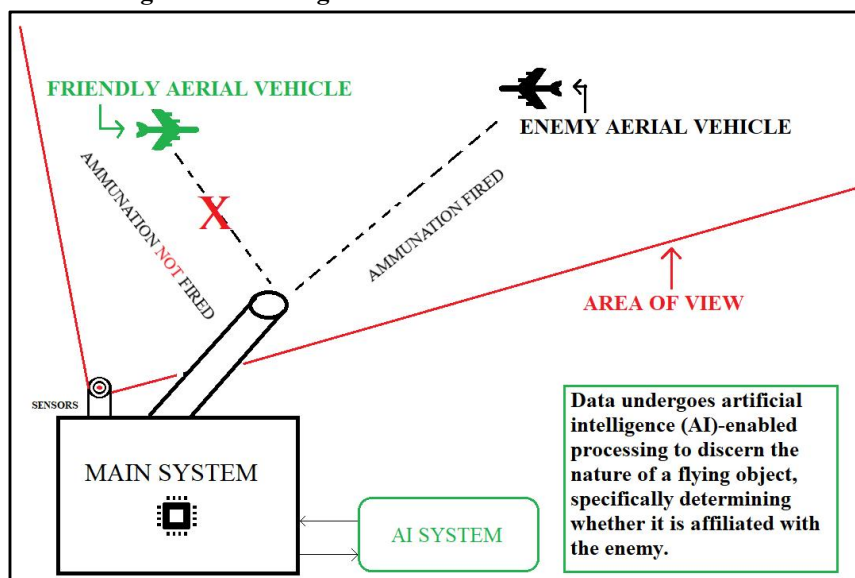
These sentry guns can be installed as for indoors as well as for outdoors usage for neutralizing unauthorized intruders.

There are also fixed sentry used for deflecting malicious aerial vehicles near military bases / installations. These all systems are equipped with image processing sensors and artificial intelligence.

They are also trained with relevant data and scenarios to avoid critical malfunctioning, using machine learning techniques.

The earliest functioning military sentry guns were the close-in weapon systems point-defence weapons, such as the Phalanx CIWS, used for detecting and destroying short range incoming missiles and enemy aircraft, first used exclusively on naval assets, and now also as land-based defences.

Figure 1: Working of AUTONOMOUS SENTRY GUNS



These Sentry Guns were designed to neutralize the incoming anomaly (drones, missiles, jets, terrorists, etc.) It uses sensors to detect these anomalies. These mainly consist of cameras, infrared, radio waves, etc. and usage of image processing techniques.

Data uses artificial intelligence (AI)-enabled processing to detect the nature of an anomaly, specifically determining whether it is affiliated with the enemy.

There are various versions of autonomous sentry guns developed by the various military organizations.

- Samsung SGR A1 by South Korea
- Sentry Tech by Israel
- Super aEgis II by South Korea

Although the Sentry Guns is very ambitious project in autonomous weaponry field, it needs more research in its scope of field. It still is not fully automatic due to security guidelines. As it is crucial military technology, not much open study is there on any platform.

VI. CASE STUDY - INDIAN MINISTRY OF DEFENCE ANNUAL REPORT

Indian Ministry of Defence Annual Report is perfect representation of how crucial data must be represented. These reports consist of structural formatting of data and data visualization used, which helps normal user to understand the factual information about Indian defence capabilities, expectations and initiatives.

This report has very satisfactory balance of normal data and visual representations of such, hence it is worth studying this report and encourage other government bodies and defence bodies to increase their level of data analysis.

Figure 2: There is a table of content to refer in case of studying any specific topic with its page numbers.

Table of Contents	
Departments and Organisations of Ministry of Defence	01
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Examples Of Data Representation from Indian Ministry of Defence Annual Report:

Figure 3: This data represents Wing-wise distribution of enrolled cadet strength as on September 30, 2019 from National Cadet Corps.

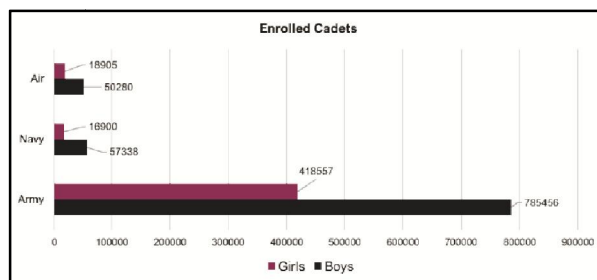


Figure 4: Value of Production (VoP) of Defence PSUs.

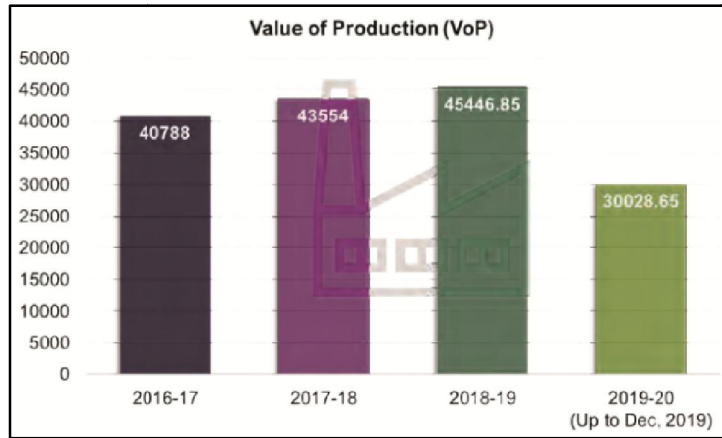


Figure 5: Value of Production of Defence PSUs

Name of DPSU	2016-17	2017-18	2018-19	2019-20 (Up to December, 2019)
HAL	17103	17553	18538	11916
BEL	9244	9706	11921	7924
BEML	2624	3227	3467	2110
BDL	5011	4641	3235	1657
GRSE	928	1342	1379	971
GSL	1030	1343	848	589
HSL	629	645	595	259
MDL	3523	4399	4649	3870
MIDHANI	696	698	815	732
Total	40788	43554	45447	30028

Figure 6: Flying Efforts of Indian Airforce for Enhanced Operational capabilities.

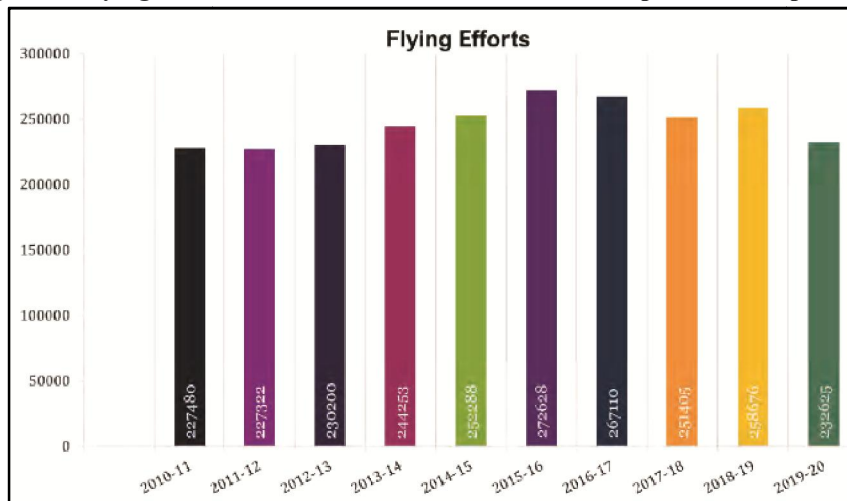
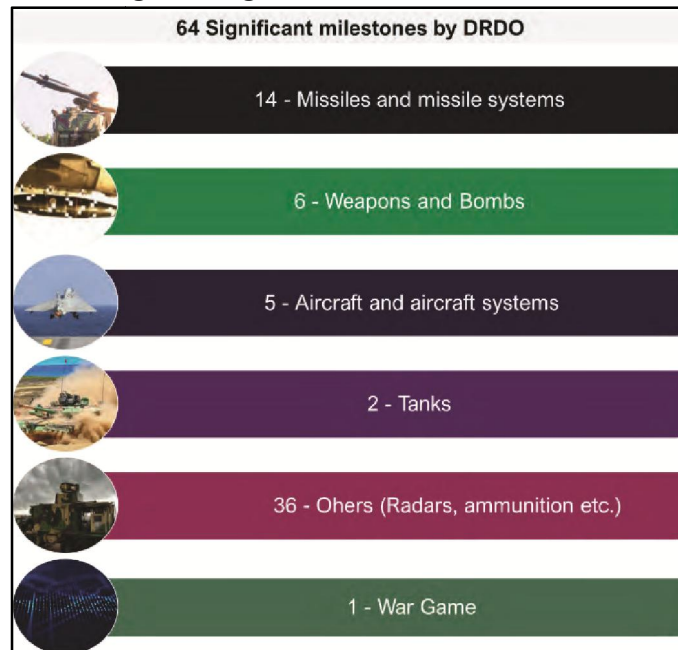


Figure 7: Significant Milestones of DRDO



These examples indicate the Defence Minister's aim to give people acceptable information properly, without any malicious intent to hide unnecessary things

VII. CHALLENGES AND FUTURE DIRECTIONS

The Main challenge is the lack of innovation. Artificial Intelligence requires large no of data to be studied, thus it is really hard to innovate in this field individually / small scale without any foreign intervention. i.e., using third party data sets.

Thus, future direction for Artificial intelligence and data applications in military operation must be to streamline the data collection and increase the data collection capabilities.

Also, we need to train more Artificial Intelligence experts and data scientists in defence sector to effectively implement the AI capabilities in the working system and develop working systems.

Development of new algorithms rate is slow due to the result of saturation of already developed algorithms.

We must focus on funding the algorithm development industry and also find new ways of data management, which will be eventually used military operations

VIII. CONCLUSION

The conclusion is that the world is changing, the manned vehicles are being replaced by autonomous vehicles. This can revolutionize the way of war. The future wars are to be fought by robots rather than humans.

We are successfully outsourcing violence to machines.

Artificial intelligence and data applications in military operations has potential to change the internal as well as external warfare. Communication systems can be developed more effectively using artificial intelligence integration. Development of Artificial intelligence algorithms is very crucial for development of new systems to be used for military operations and also the planning of future actions. Usage of various defensive and offensive systems with Artificial intelligence integration like UAVs, missile defence systems, missile detection systems, intrusion detection systems, etc. is increasing day by day, and there is the need to safeguard this crucial technology to be used by untrustworthy individuals.

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