Artificial Intelligence and Military Decision Making: Revisiting OODA Loop Framework (2024)

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Abstract

This article intends to argue on the importance of OODA loop framework for analysing the opportunities and challenges offered by Artificial Intelligence in the Decision-Making process. The article has re-visited the OODA loop conceptual framework as it was given out by John Boyd for four phases of actions to any military situation i.e. Observe-Orient-Decide-Act and linkage has been established of each phase with the relevant military domain of warfare. In the subsequent analysis the article intends to re-evaluate the impact of Artificial Intelligence (AI) on the OODA framework to highlight the relevance of each phase with technology infusion and changes thereof in Physical, Information and Cognitive domains. In the conclusive part of article, it is will be established that OODA framework continues to be relevant even today, however, its application has changed when viewed through the prism of AI and modern analytical tools.

Keywords: Artificial Intelligence, Information Domain, Cognitive Domain, OODA Loop, Moore's Law, Decision-Making, Decision Superiority.

Introduction

In the latter half of the 20th Century digital revolution had commenced. Consequently, Information Warfare took center stage of warfighting doctrines because of increase in information flow. In 1965, Gordon Moore observed that every second year the number of transistors in an electronic circuit board approximately doubled. He predicted that this phenomenon will continue to occur with further development. This observation is now known as MOORE's law. This development continued for subsequent years and impacted the military which started adapting to the enormous information and speed of evolution of technology. The Bitkom Research had predicted that this would lead to Big Data and the structures in the military will have to be changed to adapt to newer technologies. It was also predicted that initially military will have to borrow these structures from private organisations.[1]
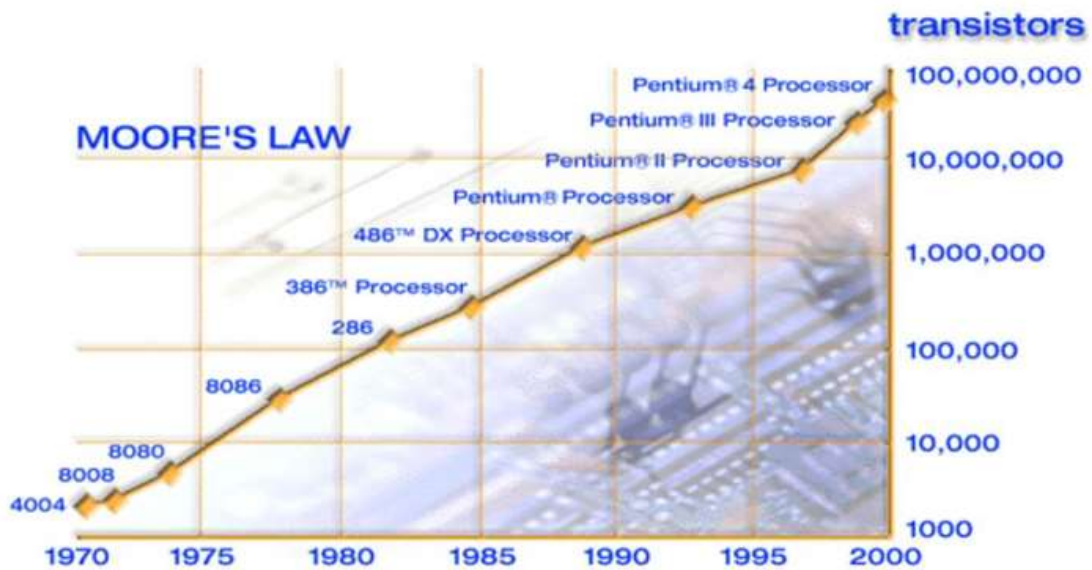
Figure 1: MOORE's Law Depiction

The acme of war fighting is to obscure own intentions while simultaneously find out opponents' intentions. Operate at faster tempo to generate rapid changing situations to the opponent and make it difficult for him to react at the pace, catch him in an unprepared state and destroy. The confusion and disorder will make the opponent commit mistakes, which must be exploited for own advantage. This in essence explains faster the OODA loop, greater the advantage.

Military strategists and leaders have declared that the country which attains AI maturity in warfighting earliest would dominate the global arena. The decision-making power currently seen through the prism of OODA (Observe-Orient-Decide-Act) will undergo a change due to integration of AI in the entire cycle. The machines and human teaming enabled with AI will act faster than adversary to gain operational and tactical advantage on battlefield.

Decisions are made through mental process with an analytical or intuitive approach. Military Commanders take decisions based on their experience from historic events, rationality, and intuition. However, in modern battlefield which is complex and unpredictable, decision making is more analytical, than intuitive. Commanders require informed decisions, based on facts and backed by data. Time being the essence in battle situations, AI would be the answer to the decision-making complexities in future.[2]

Existing OODA Framework

The OODA loop is theoretical research on decision-making by one Colonel John Boyd, a US Air Force

strategist, who post Korean War, deduced the reasoning and advantages of why US F-86 aircrafts had over the MIG aircrafts despite the latter being more maneuverable. According to the theory the advantage was attributed to the larger and wider glass canopy of F86 which allowed the pilots to clearly Observe and Orient faster than MIG pilots and consequently take faster decisions and actions. Since 1986, this theory has been to all individual and organisations, particularly in the Military. The objective of the theory is to be able to intrude the opponent's decision cycle and gain advantage by taking faster decisions. The graphic explanation to Colonel Boyd's theory of Decision-making is given below:[3]
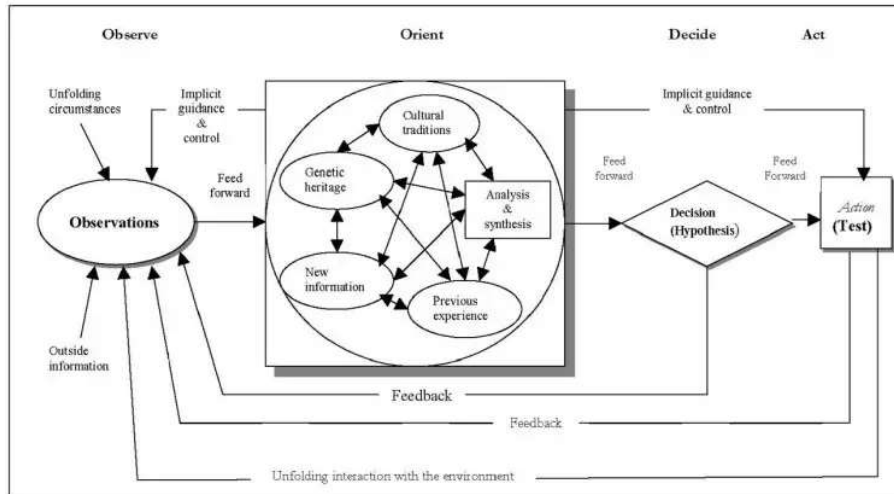
Figure 1: Colonel John Boyd's OODA Loop Depiction

In the existing framework there are limitations due to the inability of humans to go through each step faster and there is a limit to shorten the loop due to physical and cognitive ability of the operators or commanders. Machines with AI capabilities can perform the entire cycle almost instantaneously.

The above decision-making framework works on assessment of information, mental synthesis of the information in the relevant context and take appropriate decision to act. The acme of the success lies in the side which can process the OODA cycle faster than the other. If we can receive large data which can be processed much faster by a machine, the decision could be taken faster. This is where AI and Big Data becomes a gamechanger. In the era of technology race and AI competition, who can also have similar capabilities, leveraging AI and associated technologies in all the domains would have an advantage to act and react over the adversary.

Domains of Military Operations

Physical Domain is the domain where the kinetic actions occur and where military try and influence the outcome, be it land, sea, air, and EM spectrum. The characterization of this domain is made based on the capabilities, resources and measured with success rates. Influence of AI on this domain is going to be substantial. The observe, orient and act phases were part of this domain and were undertaken physically or influenced by a military soldier/commander.

Information Domain is the space where information exists. The domain where information is collected/created, curated, manipulated, and transmitted. It is this domain where data exists and which helps in decision making by the commanders. This domain was merely a medium of information and was largely based on the EM spectrum.

Cognitive domain is presently the human mind of a military soldier/commander. This domain helps converting information into a logical action based on perception, awareness, understanding, beliefs, and values. The attributes of this domain cannot be quantified. All components of cognitive domain are put through the filter or lens of human perception and abilities and is unique to everyone.

Impact of AI in the OODA Loop

AI and Machine Learning (ML) has illustrated the promise of dynamic integration into the human decision-making processes, the way no other technology till now has ever shown. In the most complex scenarios humans will not be involved directly and the AI systems will independently respond to the threats which are beyond the capability of human supervision. Today all countries are pursuing their AI agenda and there is no hidden fact that all countries are developing autonomous lethal weapons which would be used in future conflicts. And, technically each side's AI systems would be confronting the others and would outsmart the others' system and eventually try and get into the OODA loop of the adversary.[4]

The battlespaces will become faster and complex with AI-enabled systems, but the fundamental concepts will remain same i.e. OODA will remain relevant since opposing commanders will continue to Observe, understand the situation, and then Act. The difference this time is, that opponent is also doing it with same speed and using smart tools for decision making, which makes the scenarios more dangerous and complex which are difficult to predict.[5]

Observe: Proliferation of modern sensors, Satellite Feeds in real time, UAVs, drones, and other AI-powered systems have enabled large amount of data availability to a Commanders and soldiers on battlefield. This ability of real time situational awareness about opponents' movement and actions has made OODA loop to undergo a process re-evaluation. The Observe phase which was earlier in the physical domain has now shifted largely to information domain.

Processing Large Datasets: AI algorithms can now process, filter, identify pattern, predict threats, and provide the commander with courses of actions with precision.

Sensor Integration: The data received from multiple sensors and sources can be integrated using AI and converted into a comprehensive assessment of the scenario.

Real-Time Monitoring: AI powered systems can monitor situations in real-time, enabling swift reaction to changes

Orient: This phase covers both information as well as cognitive domains because to analyse large datasets we require faster computer systems and software tools which are enabled by AI. This phase which was largely in physical as well as cognitive domain, is also shifting towards information domain due to autonomy and ML capabilities.

Contextual Analysis: Once the data has been gathered, AI synthesizes and analyse the information through Machine Learning (ML) of historic data and supporting Algorithms and provides intelligence in the context of the scenario.

Predictive Analytics: AI identifies patterns and trends to generate predictive models resulting into anticipation of opponents' intentions and likely actions. AI and data analytics will provide commanders with deeper understanding of the battlefield scenarios

Identify Biases: AI can identify biases in the data and decision making and promote and objective effective strategic decisions with correct courses of actions for achieving success.

Decide: Decision Phase was earlier in cognitive domain but to automate the process and increase the reaction time and speed AI-enabled systems, it has to be shifted to information domain for;

Option Generation: AI algorithms will enable decision support by evaluating all operational scenarios to arrive at most suitable option for response/action.

Risk Assessment: The AI-enabled machine will be able to simulate all possible scenarios of the situation and carry out risk analysis.

Informed Decision: AI can provide the decision makers recommendations based on data analysis.

Act: The act phase can occur in the information domain if it is related to the cyber or network related operation. However, it can also be in physical domain in case of kinetic actions/responses.

Automated Actions: Autonomous Systems are gamechangers for the final **Act Phase,** wherein, AI facilitates and enhances speed, precision, and coordination of operations with minimal human intervention.

Real-time Responses: Automating military tasks and weapon system (with human-in-loop) can adapt to changing situations in real-time, optimize resource allocation and assist in maintaining operational Tempo in war by swift responses.

Advantages of AI in the OODA Loop

Faster Decision Making: AI can accelerate the decision-making process leading to faster responses to complex and changing scenarios.

Accuracy: Reducing biases and errors with accurate data analysis and predictive capability.

Enhanced Situational Awareness: AI can provide a comprehensive understanding of the environment enabling better decision.

Limitations

AI depends on the quality of data it is fed. If the data is not clean or curated, the outcome of data analysis is also likely to be biased and lead to errors.

Transparency is essential in AI generation. If the military does not share accurate and essential data, the result is also likely to be biased.

Effective human-AI collaboration is essential for decision making.

Technical Considerations for Faster Decision-making

Most essential consideration for quick and precise decision making is to have **AI integrated at the Edge**. It implies, that the AI-enabled systems are deployed along with the sensors or data sources. Edge deployment reduces the latency and increases flexibility in a rapidly changing environment. Edge also shrinks the Orient-Decide steps leading to faster decisions and actions. Basically, what it does is to send action commands using AI at edge framework and reduce latency.[6]

Discussion & Result

The integration of AI architecture with the OODA loop framework will revolutionise decision-making in the military and give the commanders an unprecedented advantage and ability to maintain operational edge, thereby ensuring superiority on the battlefield. AI is not just a tactical advantage, sooner or later it is going to become a necessity. Nations are investing heavily into AI and are constantly trying to tighten their OODA loop. Integrating AI into the military system is the only way to survive the new paradigm of warfare.[7]

Conclusion

AI can enhance decision making significantly when viewed in the OODA loop framework by providing accurate data analytics, pattern recognition and predictive capabilities. The challenges and limitations of AI systems need to be addressed ensuring effective human-AI collaboration and transparency. By integrating AI in OODA loop, military can make more informed decisions, respond faster to complex and changing scenarios and gain a competitive edge over adversaries.

The OODA loop is a powerful model to analyse military scenarios. The tool was based on the war situation and is ideal description of combat scenarios in all domains i.e. air, land, sea, space and cyber. In the current disposition, the orient and decision phase in in cognitive domain which has been taken over by machines, and the information domain has also changed due to use of AI and thereby increase in the speed of decision making. Most of the OODA phases have no shifted into the information domain and thus makes it important and relevant for future military operations. However, the information domain also has its weaker links and vulnerable to the cyber-attacks, leading to complete catastrophe, and hence needs to be protected.

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