

Emerging Technologies Capstone

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Emerging Technologies: IoT, Cloud Computing, and Artificial Intelligence

Technology continues to reshape how industries function, how societies connect, and how economies expand. Among the most influential are the Internet of Things (IoT), Cloud computing, and Artificial Intelligence (AI). While each of these technologies has developed along its own path, they are increasingly interconnected, forming intelligent systems that drive innovation and efficiency. I will examine the background, applications, implications, challenges, and future directions of IoT, Cloud computing, and AI, displaying each of their importance in shaping the future of technology.

The Internet of Things (IoT) describes a network of physical devices embedded with sensors, software, and connectivity that enables them to collect and exchange data over the internet. These devices can range from a single sensor reporting a single condition over the internet to consumer products such as smart thermostats and lightbulbs, wearable health monitors to industrial sensors in automobiles and commercial laundry equipment and more. The most meaningful feature of IoT is its ability to provide real-time data collection and remote management to connected devices, this allows businesses and individuals to monitor systems continuously and respond to conditions proactively. As Tripathy and Anuradha (2017) note in the preface, "Equipments are becoming more digitized and more connected, establishing networks between machines, humans, and the internet, leading to the creation of new ecosystems that enable higher productivity, better energy efficiency, and higher profitability" (p. xiii). Real-world applications include healthcare devices that track patient vitals and report them in real time to the patients' medical professionals, smart city infrastructure that manages traffic using road sensors or cameras to monitor road conditions and energy consumption, connected self-driving automobiles, and retail systems that automate sales and machine activity. The implications of IoT are significant. Industries gain efficiency through predictive maintenance, communities benefit from improved healthcare and convenience, and economies grow through

new business models and reduced costs. However, IoT also presents several challenges, especially in security and privacy. IoT devices are often rushed to market to beat out competitors without adequate safeguards and proper security, leaving them vulnerable to cyberattacks. IoT devices are placed in sensitive areas with cameras and microphones where security is important. Looking forward, IoT will be strengthened by the expansion of 5G wireless networks, the adoption of edge computing, and the development of stronger cybersecurity frameworks.

Cloud computing provides on-demand access to computing resources over the internet, offering scalability, flexibility, and cost efficiency. Organizations can choose from public clouds, private clouds, or hybrid cloud models depending on their needs. Key features include elastic resource allocation, pay-as-you-go pricing, and global accessibility. Cloud computing is widely used for hosting applications, storing data, enabling disaster recovery, and supporting collaboration tools such as Microsoft 365 and Google Workspace. Cloud computing is also used by individuals with utilities such as iCloud, Google Cloud, and OneDrive for mobile device backup and photo storage. Industries can scale rapidly without heavy infrastructure investments in server rooms, servers and backup generators, societies gain access to powerful computing resources, and economies are transformed by digital innovation. As Jamsa (2023) notes, “Cloud computing has become the backbone of modern IT, enabling organizations to innovate faster and operate more efficiently” (p. 27). Some ethical considerations include data sovereignty, compliance with regulations such as GDPR and HIPAA, and concerns about vendor lock-in. Many challenges remain in securing multi-tenant environments, ensuring safe and reliable connectivity, and increasing electricity generation to power the data centers that require an abundance of electricity for the servers and for climate control to keep resources at an optimal operating temperature. Future directions for Cloud computing include the growth of

serverless architectures, advanced integration with AI for intelligent services, and the increase of sustainable cloud initiatives aimed at reducing the environmental impact.

Artificial Intelligence (AI) encompasses systems that simulate human intelligence, including machine learning, natural language processing, and computer vision. AI's key features include pattern recognition, predictive analytics, automation of repetitive tasks, and real-time decision making. AI applications spread across multiple industries including healthcare systems use AI to analyze medical images, financial institutions use AI for fraud detection, and laundromat owners use AI to monitor machine activity and issue refunds upon reported errors. Self-driving autonomous vehicles utilize AI to monitor conditions in real time and make immediate decisions to maintain safe control of the vehicle. AI is driving productivity, innovation, and economic growth. AI raises ethical concerns such as algorithmic bias, job displacement, and the need for transparency in decision making. Baum (2023) emphasizes that "This creative breakthrough has the potential to transform nearly every industry, enhancing human creativity and pushing the boundaries of what machines can accomplish." (p. 3). Challenges for AI include the high costs of training models, the lack of explainability in "black box" algorithms, the risk of misuse and abuse and the massive amounts of energy needed for large implementations. Future directions of AI point toward integration with IoT devices and Cloud systems to create smart ecosystem, as well as advances in quantum computing that may accelerate AI capabilities.

Combined, IoT, Cloud computing, and AI represent three of the most significant emerging technologies shaping the future today. Each technology offers its own unique benefits, from IoT's real-time data collection to Cloud computing's scalable storage and AI's intelligent automation. Combined, they create a powerful system that will enable businesses to innovate, societies to improve quality of life, and economies to grow faster than ever before. These technologies also pose challenges in security, ethics, and governance that must be

addressed to ensure safe and responsible adoption. The technologies combined also puts a large strain on the electrical grid. By understanding current applications and future paths, we can begin to harness this technology effectively in our daily lives and professionals in their field can contribute to building a safe, connected, and intelligent world.

References

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