

# Emerging Technologies for Business Applications - A Review

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**Abstract:** It is evident from history that evolution of Business Applications is directly influenced by the advancement in technologies. From the literature it is experimentally witnessed that the productiveness, profit, and success of any business applications is dependent on the type of emerging technologies and practices adopted from time to time as per the requirement of the business systems and applications. In this paper authors have presented a study on a list of state of art emerging technologies and their impact on Business applications. In addition, the paper also presents the variety of state of art business applications being developed using emerging technologies.

**Keywords:** Artificial Intelligence, Business Applications, Blockchain, Cybersecurity, Digital Twin, Drones, Emerging technologies, Quantum Computing, Wearable Technology.

## I. INTRODUCTION

For past centuries, advancement in technologies has been propelling human advancement in many areas like Everyday lifestyle, health care, education, security, entertainment, transportation, agriculture, etc. Business systems and their applications are also one such prominent area. Innovations in Technology have given rise to new systems and applications that have revolutionized business practices, methods, and operations. From the earlier days of computing to the current era of Artificial Intelligence, Hyper Automation, Cloud Computing, Big Data Analytics, Blockchain, etc., technology-based business applications are evolving rapidly to keep pace with changing market demands and consumer expectations.

When the era of computing started, initially businesses used mainly computers for basic data processing tasks like accounting and payroll.

As time flew, the technology became more advanced and affordable, so, businesses began to see the capability of using computers for more complex tasks like inventory management, customer relationship management, and supply chain optimization.

In the 1990s, the boom of the Internet and the World Wide Web helped to emerge a new era of technology-driven business systems and applications. Websites and e-commerce platforms allowed businesses to easily reach customers all over the world, while email and instant messaging made it easier to communicate with employees, partners, and customers in real time. Online collaboration tools like video conferencing and project management software further transformed the way businesses operate and allowed teams to work together seamlessly from different locations.

In the 2000s, the growth of cloud computing brought about another major shift in the technology-driven business landscape. With the help of cloud computing, businesses no longer needed to invest in expensive hardware and software, as everything was hosted in the cloud and accessed via the internet. This made it easier for small and medium-sized businesses to compete with larger companies, as they could access the same technological resources without having to make a significant upfront investment.

In Today's generation, big data analytics and artificial intelligence are driving the evolution of technology-driven business systems and applications. It has the ability to collect and analyze vast amounts of data in real time, so businesses can make more precise decisions about everything from product development to marketing strategies. AI-powered chatbots and virtual assistants are also becoming more sophisticated, offering customers a more personalized and intuitive experience.

Looking at the pattern, it's clear that in the future, technology-driven business systems and applications will continue to evolve at an ever-increasing pace. The rise of blockchain and cryptocurrency, the Internet of Things, and quantum computing are just a few examples of emerging technologies that have the potential to transform the way we do business. As these technologies are fully developed, it will be exciting to see what new systems and applications they will enable and what impact they will have on the business world.

The evolution of business applications has been driven by advancements in technology and changing business needs. From early custom-built applications to today's emerging technologies, business applications have undergone significant transformation over the years and will continue to evolve as technology continues to advance.

## II. LITERATUR REVIEW

Emerging technologies have been transforming the way businesses operate, offering new opportunities for growth, productivity, profit, and efficiency. In recent years, advances in emerging technologies such as artificial intelligence, blockchain, Hyper automation and the Internet of Things (IoT) have gained significant attention in the world of business domains. The literature survey presented here aims to explore the latest research and developments in emerging technologies for business applications.

In this literature survey, the authors have examined the most important and promising emerging technologies for business applications as follows:

1. **Artificial Intelligence (AI):**

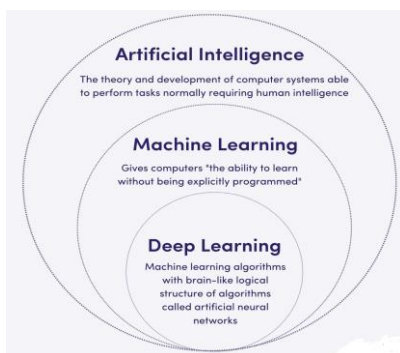
AI is the ability of machines to perform tasks with human intelligence, such as decision-making, reasoning, analyzing, object detection, object recognition, understanding and speaking in natural Language. AI is useful for business applications such as data analytics, machine vision and natural language processing. Some of the examples of usage of AI in business are marketing, research and development, production, and quality management. Areas of usage of AI to mention few are health care, agriculture, retail marketing, transportation, education, entertainment etc. Authors in the paper [1] have presented the impact of AI on marketing and sales as illustrated in table1 below:

**Table 1 :**

Product	Price	Promotion	Position
Predicting, designing, and developing new product	Creating products with prices as per the capability of the buyer.	Creating unique customer experience	New distribution channels
Personalization of the product		Personalization of communication	Continuous customer support
Automatic suggestions to the buyers		Creating new value and benefits to the costumers	Automatization of the sales
Creating added value to the costumer on adhoc basis		Decreasing disappointing effect	

2. **Machine Learning (ML) :**

ML is a subset of AI that involves training machines to learn from data and make decisions based on that data. Machine learning is the branch of computer science which helps computers learn without being explicitly programmed [2] .



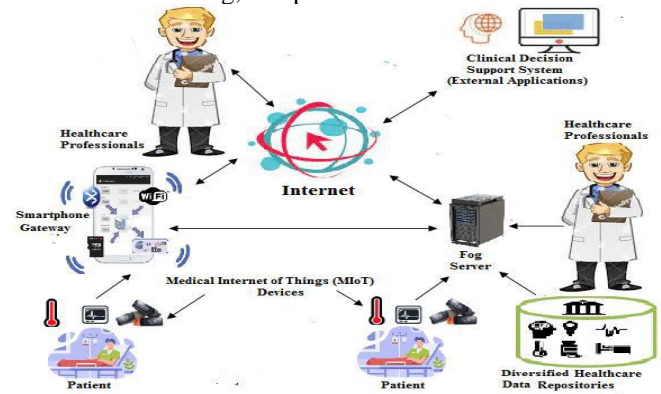
**Fig 1:** AI, ML and DL [ source: [levity.ai](http://levity.ai)]

“A computer program is said to learn from experience E with some class of tasks T and performance measure P if its performance at tasks in T, as measured by P, improves with experience E.” -Tom M. Mitchell. Machine Learning is development of algorithms and techniques instead of programming for performing functions. **Fig1** illustrates the relationship between AI, ML and Deep Learning.

ML is useful in business applications [3] such as drug discovery , disease predictions (health care), fraud detection, face recognition, targeted marketing, location based recommendations, product recommendations, online customer support, supply chain optimization, speech recognition and in automation industry.

3. **Internet of Things (IoT):**

IoT (Fig2) is a network of interconnected devices that can exchange data and communicate between any things. IoT enables physical devices to connect and exchange data through the Internet by gathering strategic information, thus creating opportunities for companies to be more efficient and responsive to market changes [4,5]. IoT is useful for business applications [6] such as smart city, smart home, smart transportation system, smart shopping area, smart industry, smart agriculture, smart livestock, smart logistics, smart environment, healthcare, smart education system, smart manufacturing, and predictive maintenance.

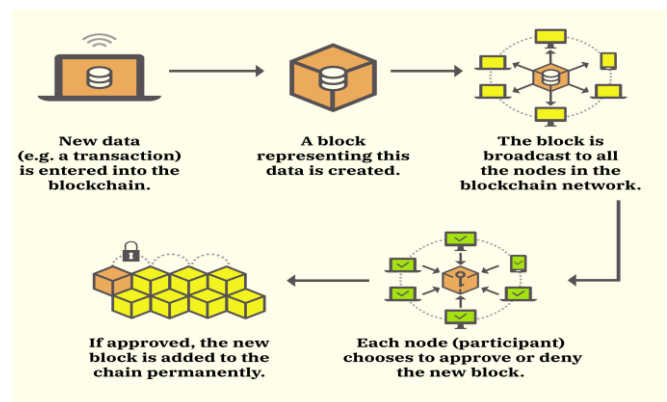


**Fig 2:** Internet of Medical Things [ Source : [researchgate](http://researchgate)]

4. **Blockchain :**

Blockchain [7] is a digitized, decentralized public data ledger intended to keep a record of every data transaction happening in its network for secure and transparent transactions. Every different user is a node who can maintain a copy of the ledger (Fig3). Each transaction on the blockchain database is verified by the users participating in the system, so a trusted third-party verification is not required .

Blockchain is useful for business applications such as cryptocurrencies, e-Government, healthcare, supply chain management, energy, banking, and digital identity verification.



**Fig 3:** Block chain Process [ Source : [Money.com](http://Money.com),]

## Edge Computing :

Edge computing (Fig 4) is the processing of data at the edge and directs computational data, applications, and services away from Cloud servers to the edge of a network. The content providers and application developers can use the Edge computing systems by offering the users services closer to them. Edge computing is characterized in terms of high bandwidth, ultra-low latency, and real-time access to the network information that can be used by several applications [9–11].

The most promising features of Edge computing are mobility support, location awareness, ultra-low latency, and proximity to the user [12]. These features make Edge computing suitable for different future applications like industrial automation, virtual reality, real-time traffic monitoring, smart home, smart sea monitoring, predictive maintenance and data analytics [13].

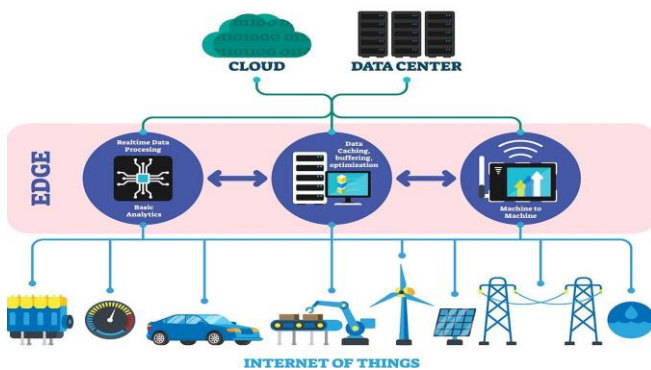


Fig 4: Edge Computing [Source:[codingninjas](https://www.codingninjas.com)]

## 5. Quantum Computing :

Quantum computing is a new type of computing that exploit principles of quantum mechanics, such as superposition, entanglement and interference, to represent data and perform operations on them. Both of these principles enable quantum computers to solve very specific, complex problems significantly faster than standard computers.[14-15]

Quantum computing is useful in business applications such as cybersecurity, cryptography, business big data analytics, artificial intelligence, data management, searching, optimization and simulation.

## 6. Augmented Reality (AR):

Augmented Reality (AR) is a technology that allows the superimposition of computer-generated digital data information in 3D to the real world, interactively, and in real time.[16]. In AR real world items are integrated in 3D model with film and audios, where an element that wants to communicate with enhanced specified AR is contacted by different channels such as smart phones, webcams or displays with the physical world.[17]

AR is useful for business applications such as therapy, archeology, education, medical, military, product visualization, retail (Fig 5) employee training and for navigation.



Fig 5: Augmented Reality in Retail [ Source: [bazaarvoice](https://www.bazaarvoice.com)]

## 7. Virtual Reality (VR):

VR is a technology that creates a completely immersive digital experience (Fig 6).

Virtual Reality (VR) is a technology that allows users to completely immerse themselves in a “virtual digital world”. Users fully immerse in a VR experience via a combination of technologies, including a Head-Mounted Display (HMD), headphones with sound/music and noise reduction, a rumble pad, joystick, or other device for manipulation/navigation of the Virtual Environment (VE). These systems follow the user’s head movements, giving the illusion of being surrounded by a virtual world [18]. In addition, VR can be defined as “A human-computer interface in which the computer creates a sensory-immersing environment that interactively responds to and is controlled by the behavior of the user” [19-20]



Fig 6: Student learning in VR[ source: [eduporium](https://www.eduporium.com)]

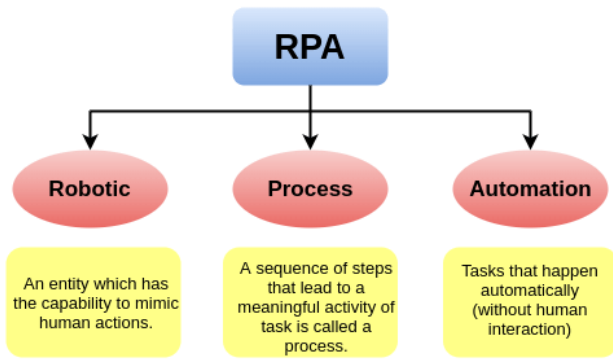
VR is useful for business applications such as Gaming, Entertainment, Education, Healthcare, Architecture, Design, Travel and Tourism, Military and Retail.

## 8. Robotic Process Automation (RPA):

RPA is a technology that uses software robots to automate repetitive tasks (Fig 7).

RPA is a technology based on software and algorithms aiming to automate repetitive human tasks. It driven by simple rules and business logic while interacts with multiple information systems through existing graphic user interfaces. Its functionalities is to automate the repeatable and rule-based activities using non-invasive software robot, called "bot" [21].

RPA is useful for many business applications such as data entry and processing, Finance, Accounting, Data Scrapping, Supply chain, logistics and customer service.



**Fig 7:** What is RPA? [ Source : <https://www.javatpoint.com/rpa>]

**9. Natural Language Processing (NLP) :**

NLP is a subset of AI that involves the interaction between computers and humans using natural language. NLP is a subset of Artificial Intelligence, devoted to make computers understand the statements or words written in human languages. NLP can be classified into two parts i.e. Natural Language Understanding (NLU) or Linguistics and Natural Language Generation (NLG) which evolves the task to understand and generate the text. [ 22]

NLP is useful for business applications such as Machine Translation, Email Spam detection, Information Extraction, Summarization, Question Answering etc.

**10. Digital Twins :**

Digital twins (Fig 8) are virtual representations of physical objects or systems. It is the twin of the digital information embedded in physical objects and throughout the lifecycle of a physical object, there is a link between virtual and physical entities [23].

In 2002, Michael Grieves, who introduced the concept of Digital Twin, defined it as ‘a set of virtual information constructs that fully describes a potential or actual physical manufactured product from the micro atomic level to the macro geometrical level’ [23-24].

Digital twins are useful in various industries for business applications such as Aerospace, Manufacturing, Healthcare, Energy, Automotive, Petroleum, Public sector, Mining, Marine, and Agricultural [25].



**Fig 8:** Concept of Digital twin [ Source: [ioscience](https://www.ioscience.org)]

**11. Cybersecurity:**

At present, activities and interactions related to economic, commercial, cultural, social, educational, public, private,

governmental at all levels are carried out in cyberspace [30]. Cyber attacks has become most challenging issue to be addressed. [31-32].

A company or organization based on cyber security can achieve high status and successes. Cyber-security includes practical measures to protect information, networks and data against internal or external threats. Cyber-security professionals protect networks, servers, intranets, and computer systems. Cyber-security ensures that only authorized individuals have access to that information (Ahmed Jamal et al., 2021) [32].

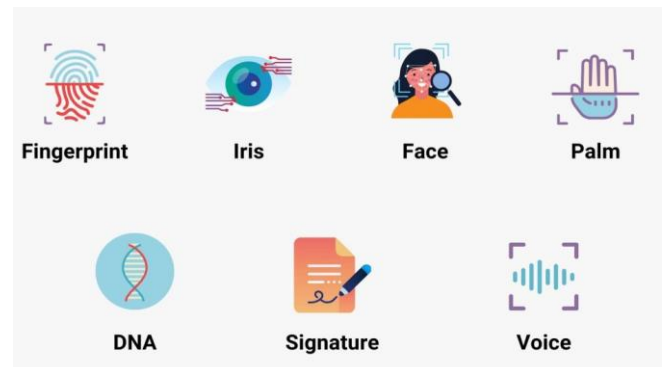
Some of the most common cybersecurity threats are : Viruses , DDoS, Malware, Worms, Trojan, Phishing, Social engineering, Ransomware, SQL Injection, etc.

Some of the important applications of cyber security are : Network security surveillance, Identification and access control, Software Security, Risk Management, Physical Security,

**12. Biometrics:**

Biometric identification is the use of unique physiological and behavioral characteristics such as face, fingerprint, iris and behavioral characteristics like hand written signature, gait and keystroke [33] (Fig 9).

Biometrics is useful for business applications such as access control , security, Border control , Law enforcement, Banking and financial services, Healthcare, elections, Attendance Tracking, etc.



**Fig 9:** Types of Biometric Authentication [ source : <https://swisscyberinstitute.com/blog/types-of-biometric-authentication-technologies/>]

**13. 3D Printing:**

3D printing is a technology that can create physical objects from digital designs. 3D printing is useful for business applications such as rapid prototyping and manufacturing.



**Fig 10:** 3D Printer [ source : <https://www.3ding.in/3dprinters/creality-cr-10-smart> ]



Added substance Manufacturing (AM) otherwise called 3D printing constructs three-Dimensional (3-D) strong articles. The object is fabricated layer-by-layer utilizing various materials such as polymers, composites, clay and metallic glues contingent upon the prerequisite utilizing computerized information from a PC. Fast prototyping, the primary arranged AM was created to quickly manufacture models.[35]

3D printers (Fig 10) can be used to print sensor, medical devices, artificial organs, buildings, houses, submersible, marine parts [35], etc.

#### 14. Robotics :

Robots (Fig11) are programmable machines that can perform human like tasks, either independently or under minimal human intervention or supervision. Robotics deals with the use of robots in various capabilities such as autonomous decision-making, design, construction, operation, etc.

Robotics is useful in many business applications such as logistics, manufacturing, healthcare, entertainment, education, and exploration [37-38].



**Fig 11:** Robotic arm packing the items [ **Source:** <https://howtorobot.com/expert-insight/articulated-robots> ]

#### 15. Drones :

Drones are unmanned aerial vehicles that can be used for a variety of applications such as inspection, surveying, humanitarian work, disaster risk management, research, and transportation [39-41]. The drones can be used for capturing real time imagery and sensor data of agricultural farm fields for data analysis.

As illustrated in Figure drones can be used more effectively in delivering (Fig 12) aid packages like medicines, vaccines, blood, disease test samples and test kits in areas with high contagion; and potential for providing rapid access to automated external [40-41].



**Fig 12:** Commercial Drones used for delivery service [ **Source:** [analyticsinsight](https://analyticsinsight) ]

#### 16. Autonomous Vehicles :

Autonomous vehicles are vehicles that can operate without human intervention and can sense the environment.

An autonomous vehicle can operate without requirement of any human control and can sense the environment. An autonomous car is sometimes called self – driving car, or driverless car. It uses a combination of sensors, actuators, machine learning systems, complex and powerful algorithms to execute software and travel between destinations without a human operator. “The sensors gather real – time data of the surrounding environment including geographical coordinates, speed and direction of the car, its acceleration and the obstacles which the vehicle can encounter”[43-44].

#### CONCLUSION

The emergence of new technologies has revolutionized the way businesses operate. The advancements in areas such as artificial intelligence, machine learning, big data, blockchain, and internet of things have provided unprecedented opportunities for businesses to enhance their efficiency, effectiveness, and profitability. Through the integration of these technologies into their operations, businesses can automate processes, gain insights into customer behavior, and streamline decision-making processes.

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