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Research Paper

Artificial Intelligence

Shivam yadav

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Intelligence is the ability to think and understand; when humans display intelligence, it often involves some consciousness and emotionality; we mix emotions with reasons to make decisions. Artificial intelligence is intelligence demonstrated by machines; It mimics cognitive functions. We as a human associate with human minds. The proponents of artificial intelligence developed it on the principle that human intelligence can be described in such a simple way that a machine can mimic and execute it. Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions.

Evolution of Al

Alan Turing changed history when he asked a simple question, "can machines think." Alan Turing's theory of computation suggested that shuffling symbols such as zero and one can simulate any conceivable act of mathematical deduction led to a "church-turing thesis." Church Turing's thesis emphasizes digital computers can process formal reasoning. But the term Artificial Intelligence came into the limelight in 1956 when an artificial intelligence research workshop was established at Dartmouth College.

Herbert Simon (CMU), John McCarthy, Marvin Minsky, and Arthur Samuel became founders of Artificial Intelligence research. By 1959 computers were learning checker strategies solving word problems in algebra, and speaking English New technology such as VLSI CMOS transistor technology changed the world of computer sciences by 1980

In the late 1990s and early 21st century Al began to be used in logistics data mining, medical diagnosis, and another area.

In 1997 deep blue became the first system to defeat world chess champion, Garry Kasparov. In 2008 google made breakthroughs in speech recognition (the technology used in modern-day speech translators). In 2014 google made the first self-driving cars.

Types of Al

Al is divided into two types:
Software Al: Virtual assistants, search engines, speech and face recognition, etc.
Embodied Al: Self-driving cars, drones, robots, etc.

Categorization of Artificial Intelligence

Artificial intelligence can also be divided into two different categories: weak and strong. Weak Artificial Intelligence embodies a system designed to carry out one job. Weak Al systems include video games and personal assistants such as Amazon's Alexa and Apple's Siri.

Robust Artificial Intelligence systems are systems that carry on tasks considered to be human-like.

These tend to be more complex and complicated systems. They are programmed to handle situations they may be required to problem solve without having a person intervene. These kinds of methods can be found in applications like self-driving cars or hospital operating rooms.

Narrow Al vs. General Al:

●**Narrow Al** describes an Al which is limited to a single task or a set number of jobs. For example, IBM's Deep Blue's capabilities, the chess-playing computer beat the world champion, Gary Kasparov, in 1997, were limited to playing chess. It wouldn't have been able to win a game of tic-tac-toe - or even know how to play.

●**General Al** describes an Al which can be used to complete a wide range of tasks in a wide range of environments. As such, it is much closer to human intelligence

Various Applications of AI

Health

Health-related Al applications' primary aim is to analyze relationships between prevention or treatment techniques and patient outcomes. Al programs are applied to diagnosis processes, treatment protocol development, drug development, personalized medicine, and patient monitoring and care. For example- Path Al is developing machine learning technology to assist pathologists in making more accurate diagnoses. Buoy Health is an Al-based symptom and cure checker. It uses algorithms to diagnose and treat illness.

Transport

Al can make traffic more efficient, ease traffic congestion, free driver's time, make parking more manageable, and encourage car- and ridesharing. As Al keeps road traffic flowing, it can also reduce fuel consumption caused by vehicles idling when stationary and improve air quality and urban planning

Manufacturing

Al can perform manufacturing, and quality control, shorten design time, reduce materials wastage, improve production reuse, and perform predictive maintenance. Al algorithms can also be used to optimize manufacturing supply chains, helping companies anticipate market changes. Robots are helping in manufacturing, optimizing sales paths, or predicting maintenance and breakdowns in smart factories.

Example: Bengaluru-based code labs are helping to create smart factories.

Food and Farming

Al can help in adopting sustainable farming practices; it can suggestthe appropriate use of fertilizers, and robots can help in removing weeds, lowering the use of herbicides

Eg:- Indian startupFasal is providing farmers with real-time data, and accurate resource predictions like sprays, irrigation, and other preventive measures.

E-Commerce Management

Al is being used in the industry in planning inventory, logistics, optimizing products, etc. It is being used in providing personalized recommendations to people suggesting products according to their needs.Eg. Indian startupBluebirch deals with the products that are returned by customers and focus on reselling these products.

Translators

Language translation software is very much dependent on the capabilities of artificial intelligence, functions like automated subtitling we often see on videos on youtube also use Al.

Cybersecurity

Al can help identify, detect and fight cyberattacks. For example, Logrhythm (An American security intelligence company) provides an end-to-end solution for companies and organizations to detect and respond to cybersecurity.

India and Al

NITI Aayog has adopted a three. Al-pronged approach - undertaking exploratory proof-of-concept projects in various areas, crafting a national strategy for building a vibrant Al ecosystem in India, and collaborating with various experts and stakeholders. NITI Aayog has partnered with several leading Al technology players to implement Al projects in critical areas such as agriculture and health.

The points highlighted in the reports are:

A. Artificial Intelligence and India

Al strategy needs to be premised on a framework that is adapted to India's H unique needs and aspirations, such a framework could be an aggregation of the following three distinct, yet interrelated components:

a. **Opportunity:** The economic impact of using Artificial Intelligence in India estimates India's annual growth rate to increase by 1.3 percentage points by 2035.

b. **Alfor Greater Good:** Social development and inclusive growth: Increased access to quality health facilities (including addressing the locational access barriers), inclusive financial growth for large population sections. It has hitherto been excluded from formal financial products.

Providing real-time advisory to farmers and helping address unforeseen factors towards increasing productivity, building smart and efficient cities and infrastructure to meet the demands of a rapidly urbanizing population are examples. It can be most effectively solved through the non-incremental advantages a technology such as Al can provide.

c**. Al Garage for 40% of the world:** Simply put, solving for India means solving for 40% or more of the world. An advanced Al-based solution for early diagnosis of tuberculosis (one of the top 10 causes of death worldwide), for example, I could easily be rolled out to countries in South East Asia or Africa, once developed and refined in India. Beyond healthcare, Al technologies in other sectors including agriculture, education, and mobility are set to transform the world. The commonality of issues about the above sectors across developing countries provides the ideal use case for developing Al solutions adapted for multiple markets.

B. Focus area for artificial intelligence in India

Healthcare

Healthcare is one of the most dynamic, yet challenging, sectors in India, and is expected to grow to USD280 billion by 2020, at a CAGR of upwards of 16%, from the current USD100 Billion. Nevertheless, it faces significant challenges in quality, accessibility, and affordability for a large section of the population:

a. Shortage of qualified healthcare professionals and services like qualified doctors, nurses, technicians, and infrastructure. Non-uniform accessibility to healthcare across the country with physical access continuing to be the primary barrier to both preventive and curative health services, and the glaring disparity between rural and urban India.

b. Affordability remains a problem with private expenditure accounting for -70% of healthcare expenses, of which 62% is an out-of-pocket expenditure, probably one of the highest in the world. A significant portion of hospital costs in both rural (-47%) and urban India (-31%) are financed by loans and the sale of assets.

c. Reactive approach to essential healthcare mainly due to lack of awareness, access to services, and behavioral factors implies It the majority of patients approach a hospital/physician only when a disease has reached an advanced stage

•The increased advancements in technology and interest and activity from innovators provide India's opportunity to solve some of its long-existing challenges in providing appropriate healthcare to a large section of its population. Al combined with robotics and **the Internet of Medical Things (loMT)** could potentially be the new nervous system for healthcare problems and help the government meet the above objectives.

Agriculture

Agriculture and allied sectors still account for 49% of India's workforce, 16% of the country's gross domestic product (GDP)13, and ensures food security to roughly 1.3 billion people. The Government of India has recently prioritized Doubling Farmers' Income as a National Agenda; putting considerable focus on supply chain perspectives in agriculture and market development in addition to productivity augmentation.

India has not been able to remove its exploitative dependence on resources on intensive agricultural practices altogether. Degradation of land, reduced soil fertility, increased dependence on inorganic fertilizers for higher production, rapidly dropping water tables and emerging pest resistance are some of the several manifestations of India's unsustainable agricultural practices.

The use of Al can rectify the above-mentioned problems and help in the efficient utilization of resources.

Education

In emerging countries, particularly, levels of education and literacy of the population play an essential role in the development and overall transition to an advanced economy. Estimates indicate It currently over half the population of the country is below the age of 25.

School education in India has seen substantial progress in recent decades, with efforts at both the Central and State levels, and substantive gains in enrolment have been achieved Gross Enrolment Ratio (GER) is 97% at the elementary level and 80% at the secondary level, as per recent figures. However, low retention rates and poor learning outcomes mar the impact of gains in enrollment.

Lowretention rates: Enrolment of children is of little use if children are not retained in the schooling system. The retention rate of 70.7% at the elementary level indicates one-third of enrolled children drop out before completing Class 8.

Poor learning outcomes: There is increasing concern about the low learning levels of children in school, and a new National Achievement Survey (NAS) shows over 60% of Class 5 students scored below 50% across subjects; and for a majority of the 31 States UTS tested, performance significantly deteriorated.

A recent survey found It the level of adoption of technology in schools is lacking and can be attributed mainly to the lack of teacher training provision of the ICT infrastructure. While 83% of the teachers surveyed use computers, the use is limited primarily to audio/visual display, or student practice.

Al can bring about changes in the sector by supplementing pedagogy and establishing systems to inform and support decision-making across stakeholders and administrative levels.

Several Al tools are being successfully used in other parts of the world, and they can be adapted to the Indian context to target specific challenge

Smart Mobility and Transportation

Mobility and transportation form the backbone of the modern economy due to their linkages with other sectors and their importance in domestic and international trade. Today's society demands a high degree of mobility of various kinds, to enable efficient and safe transportation of people and goods.

a. Autonomous trucking: Autonomous technology in trucking has the potential to transform the way we move goods today. Al can help increase safety and hauling efficiency through intelligent platooning.

b. Intelligent Transportation Systems: Through the use of an intelligent traffic management system including sensors, CCTV cameras, automatic number plate recognition cameras, speed detection cameras, signalized pedestrian crossings and stop line violation detection systems, and the use of Al, real-time dynamic decisions on traffic flows such as lane monitoring, access to exits, toll pricing, allocating right of way to public transport vehicles, enforcing traffic regulations through smart ticketing, etc. can be made. with Al suitable measures could be preemptively taken to prevent possible accidents.
c. Travel route/flow optimization: With access to traffic data at the network level, Al can help make smart predictions for public transport journeys by optimizing total journey time including access time, waiting time, and travel time.
d. Al for Railways: According to official figures, more than 500 train accidents occurred between 2012 and 2017, 53% due to derailment. Train operators can obtain situational intelligence through real-time operational data and analyze them in three dimensions: spatial, temporal, and nodal.
Recently, the Ministry of Railways, Govt. of India has decided to use Al to undertake remote condition monitoring using non-intrusive sensors for monitoring signals, track circuits, axle counters, and subsystems interlocking, power supply systems including the voltage and current levels, relays, timers.
e. Community-Based Parking: The availability of parking is a significant issue for Indian cities. Al can help optimize parking, likely by minimizing vehicle downtime and maximizing driving time. With the advent of electric vehicles, Al will be needed to mediate the complex vehicle grid interactions (VGI) and charging optimization.

Critical challenges to the adoption of Al in India

The initial analysis of focus sectors Healthcare, Agriculture, Education, Smart Cities, Infrastructure, and Smart Mobility and Transport, highlights the potential of Al tools and technologies in transforming the sectors and state of the Indian economy.
Taking the Healthcare sector as an example, enabling large-scale adoption would require at least the following factors to be addressed:
a. Absence of collaborative effort between various stakeholders: while India has adopted an electronic health record (EHR) policy, sharing data between various hospital chains remains a work in progress, since different hospital chains have adopted different interpretations of 'digitizing records.
b. Relevant data is unavailable and there is the absence of robust open clinical data sets; and
c. Concerns on privacy and security of data.
Similarly, each sector has its own set of problems. However, analyzing the focus sectors, the challenges are concentrated across common themes:
a. Lack of enabling data ecosystems
b. The low intensity of Al research
1. Core research in fundamental technologies
ii. Transforming core research into market applications
c. Inadequate availability of Al's expertise, human resources, and skilling opportunities.
d. High resource cost and awareness for adopting Al in business processes
e. Unclear privacy, security, and ethical regulations
f. Unattractive Intellectual Property regime to incentivize research and adoption of Al.
While by no means exhaustive, these challenges, if addressed expeditiously through the concerted collaborative efforts by relevant stakeholders, with the government platform a leading role, could lead to fundamental building blocks from the core of India's march towards leadership in Al.

Recommendations:

Research

India produced a whopping 2.6 million STEM graduates in 2016, second only to China and more than 4 times the USA's graduates, thus producing the requisite talent pool to drive innovation in emerging technologies. Disappointingly though, an overwhelming majority of Its talent pool is focused on routine IT development and not so much on research and innovation.
The Detailed Project Report of Inter-Ministerial National Mission on Interdisciplinary Cyber-Physical Systems (IM-ICPS) has suggested the following four-tier framework for promoting research focused on all aspects of the technology life cycle: research, technology deployment. translation, and management:
a. ICON (International Centers of New Knowledge): focusing on the creation of new knowledge through primary research,
b. CROSS (Centre for Research on Sub Systems): focusing on developing and integrating core technologies developed at the ICON layer and any other sources
C. CASTLE (Center for Advanced Studies, Translational Research, and Leadership): focusing on the development and deployment of application-based research and

d. CETIT (Centre of Excellence in Technology Innovation and Transfer): focusing on the commercialization of technologies developed

A far more simplified and agile approach is required to ensure a seamless, targeted, and accountable framework for promoting research. Hence the following two-tier integrated approach to boost both cores and applied research in Al is proposed.

A. CORES (Centres of Research Excellence in Artificial Intelligence): CORES will focus on the core research of Al and take on the mantle of executing the responsibilities of both ICON and CROSS in the IM ICPS framework. Thus, CORES will specialize in creating new knowledge through basic research and will be a source of fundamental knowledge/technologies. It will keep India prepared for the next generation of technologies.

B. ICTAl (International Centre for Transformational ArtificialIntelligence): ICT Als will provide the ecosystem for application-based technology development and deployment and take on the mantle of executing the responsibilities of both CASTLE and CETIT as per the IM-ICPS framework. It will be an industry-led initiative and expected to take on the top-level challenges identified or inter-ministerial projects calling for Al-based solutions.

Skilling

NASSCOM predicts by 2022, a startling 46% of the Indian workforce will be engaged in entirely new jobs that do not exist today or jobs that have radically changed skill sets. Some other sources estimate demand for Al and machine learning specialists in India is expected to see a 60% rise by 2021. An independent study estimates India will face a demand-supply gap of 2,00,000 data analytics professionals by 2025.

Re-skilling of the current workforce will require integration with relevant existing skilling initiatives, the building of new platforms that can enable improved learning, and novel methods of allowing large-scale employment generation through the promotion of Al.

a. Incentivizing the creation of jobs that could constitute the new service industry: To tackle the challenge of shifts in the services industry, it is essential to identify and promote the creation of jobs that may replace traditional IT-BPM sector jobs in the future

b. Recognition and standardization of informal training institutions: Implementation of recognized certificate courses through higher education institutions could be a significant boost to recognizing resources spent on re-skilling and holding these institutions to standards in the delivery of knowledge.

c. Creation of open platforms for learning: Initiatives such as the NASSCOM Future Skills Platform will play an instrumental role in the large-scale dissemination of requisite skills to some significant sections of the employed workforce. Online and self-learning platforms, such as Coursera and edX, can help learners access the best universities and institutions around the world.

d. Creating financial incentives for reskilling of employees: Initiatives in reskilling employees or allowing employees to undergo reskilling initiatives have a high opportunity cost for private companies and may affect their willingness to let their employees engage in the process at scale. It is thus suggested that co-funded models between the government and companies be explored, in the IT sector particularly. Financial incentives for private companies could include payroll taxes which are dedicated to subsidizing training opportunities.

Artificial Intelligence during the KumbhMela last year was especially notable, where smart video analytics was used for efficient traffic movement, security, and crowd management in Prayagraj. The Government of Odisha is also preparing to use Artificial Intelligence, Data Analytics, and Mobile Computing to analyze crime data and support investigation.

Artificial intelligence and Privacy:

Al will be the tipping point in the technological evolution of humanity, with human dependence on machines and algorithms for decision-making never being such profound. Thus, any strategy document on promoting Al necessarily needs to be conscious of the probable factors of the Al ecosystem that may undermine ethical conduct, impinge on one's privacy and undermine the security protocol. Appropriate steps to mitigate these risks need to be an integral part of any such strategy.

Big Data

Big Data is a group of data that is enormous in volume and increases exponentially with time. It is data with so large a size and complexity that none of the traditional data management tools can store it or process it efficiently. Big Data is data with colossal size.

It is beyond the ability of old-style interactive databases to capture, manage and process the data with low latency. Big data has one or more of the following characteristics: **high volume, high velocity, or high variety.** Artificial intelligence (AI), and the Internet of Things (IoT) drive data complexity through new forms and sources of data. For example, big data comes from sensors, devices, video/audio, networks, log files, transactional applications, web, and social media much of it generated in real-time and at an enormous scale.

In a theoretical sense, big data is a combination of structured, semi-structured, and unstructured data. Structured data can be stored, accessed, and processed in the form of a fixed format. Unstructured data with an unknown form or structure is classified as unstructured data. Semi-structured data can contain both forms of data.

Big data in India

The use of big data is by no means new in the country, with data mining techniques being used by the Indian government and corporations for some time now. However, for a country as large as India, data analytics has not been utilized to its fullest extent to aid with the planning, policymaking, or development of various sectors in the country such as agriculture and urban planning.

The use of data mining techniques as a part of Project Insight, identifying tax evaders, and using geo-tagging to zero-in Al companies are excellent examples of India tapping in on the potential of the data revolution.

Using agriculture as an example, big data could help study crop growth patterns, analyze the best times to plant that would yield the highest crop production, study weather, and seasonal patterns to determine the best planting times, and so forth.

Internet of things:

The Internet of Things, or loT, refers to the billions of physical devices around the world that are now connected to the internet, all collecting and sharing data. So if we take physical objects and connect them like with the help of software, sensors, or some other technology, we can make them communicate between themselves, we will describe it as the "Internet of things".

Some objects may themselves be filled with many smaller loT components like a jet engine filled with thousands of sensors collecting data and transmitting data back to make sure it is operating efficiently.

A lightbulb that can be switched on using a smartphone app is a load device.

IoT plays a leading role in evolving business and technology. According to a recent report, released by Zinnov in June 2020, loT investments in India were close to USD 5Bn in 2019 and are expected to go up to USD 15Bn in 2021.

Evolution Of 5G Technology:

5G is the fifth generation of mobile networks that have been designed to meet the tremendous growth in data and connectivity of modern societies. 5G is inferred for delivering faster connection and great capacity.

1G: They were the first generation of wireless cellular technology, they were analog technology standardsthat were introduced in the 1980s and continued to be used until replaced by 2G technology. The first commercial 1G mobile network in the world was launched by Nippon telephone and Telegraphycompany in Tokyo, Japan in 1979.

2G: 1G technology was based on analog transmission while 2G technology was based on digital transmission via multiplexing 2G capabilities by allowing multiple users on a single channel. It also enables SMS and MMS(multimedia messages).

3G: The third generation uses Universal Mobile Telecommunication System (UMTS) as its core network architecture It uses packet switching rather than circuit switching to allow data speeds up to 14 Mbps.

4G: Main difference between 3G and 4G is data rate, essential technologies that have made 4G possible are MIMO (Multiple Input Multiple Output) and OFDM (Orthogonal Frequency Division Multiplexing). The most important 4G standards are WiMAX and LTE.

4G LTE: While 4G LTE is a significant improvement over 3G speeds it is technically not 4G, 4G is predetermined standards for mobile network connection. 4G LTE is short for "Fourth generation long-term evolution." So it's actually two terms combined. First, "4G" represents the fourth generation of mobile technology, the next big advancement after 3G. And "long-term evolution," or "LTE," is industry jargon used to describe the particular type of 4G that delivers the fastest mobile internet experience.

5G: 5G is the fifth generation of mobile communications network, the most crucial feature of 5G is its low latency. Latency is the time taken for devices to respond to each other over a wireless network, 3G has a response time of 100 milliseconds, 4G has a response time of 30 milliseconds and 5G latency will be as low as 1 millisecond making 5G 60-120 times faster.

Evolution of Cryptocurrencies and Blockchain Technology

Blockchain technology: Blockchain is a digital ledger of transactions that is duplicated and distributed across the entire network of computer systems. It is a system of recording information in a way that makes it difficult or impossible to change, hack or cheat the system.

A simple analogy for understanding blockchain is Google Docs. When we create a document and share it with a group of people the document is distributed instead of copied or transferred. It creates a decentralized distribution chain that gives everyone access to documents at the same time, all modifications to the doc are being recorded in real time, making the changes completely transparent.

How Does Blockchain work?

Blockchain is a combination of three leading technologies:

1. Cryptographic keys
2. A peer-to-peer network containing a shared ledger

3. A means of computing, to store the transactions and records of the network.
Cryptographic keys consist of two keys Private key and a Public key. These keys help in performing successful transactions between two parties. Each individual has these two keys, which they use to produce a secure digital identity reference.
Secured identity is the most critical aspect of Blockchain technology. In the world of cryptocurrency, identity is referred to as a **'digital signature'** and is used for authorizing and controlling transactions.
The digital signature is merged with the peer-to-peer network; many individuals who act as authorities use the digital signature to reach a consensus on transactions, among other issues.
When they authorize a deal, it is certified by a mathematical verification, which results in a successful secured transaction between the two network-connected parties. Blockchain users employ cryptographic keys to perform different types of digital interactions over the peer-to-peer network.
In a Blockchain, each block consists of 4 main headers.
Previous Hash: It hash address locates the previous block.
Transaction Details: Details of all the transactions that need to occur.
Nonce: An arbitrary number given in cryptography to differentiate the block's hash address.
Hash Address of the Block: All the above (i.e., preceding hash, transaction details, and nonce) are transmitted through a hashing algorithm. It gives an output containing a 256-bit, 64-character length value called the unique 'hash address.'

Mining

In Blockchain technology, the process of adding transactional details to the present digital/public ledger is called 'mining.' Though the term is associated with Bitcoin, it is used to refer to other Blockchain technologies as well.
Cryptocurrencies
Cryptocurrencies are a digital form of money that run on a new monetary system, run that is not regulated by any centralized authority or tracked by a formal institution. There are many types of cryptocurrency with various functions. Each digital currency is supported by a decentralized peer-to-peer network called the blockchain regardless of each function. Blockchain technology ensures that all cryptocurrencies are kept track of, regardless of whether they are being held in a digital wallet.
Bitcoin was the first to market, setting up a system in which two people the sender and the receiver of coins - must sign off on payments to create a digital signature. Each person has a public and a private encryption key. Every transaction is verified for accuracy and the system is anonymous and transparent. At the center of infrastructure is the ledger.
A cryptocurrency has a ledger, where all transactions are made public so total visibility is provided.
The ledger is a list of entries in a database, nobody can change without fulfilling specific conditions. Nobody owns the ledger or the cryptocurrencyblockchain; instead, it is decentralized implying it is self-run and self-governed without the interference of outside parties.

Robotics

The primary era, of robotics research and development, was the mid-20thntury primarily in an Industrial environment where repetitive movements and lifting of heavy machines made the use of machines attractive over humans
Robots were mainly employed for tasks that were too dirty, distant, and dangerous for humans. Robotics as a discipline is the intersection of science, engineering, and technology that produces machines called robots.
With technology the scope of what is considered robotics has expanded, today we are seeing an evolved and expanded definition of robotics.
Earlier robots were mainly used to do simple repetitive workplaces like car factories. Right now, robots are used in exploring earth's harshest conditions, they are assisting in law enforcement they are assisting in almost every facet of healthcare.

Application of robotics:

1. Healthcare: Robots have already begun working in different domains ofmedical care in hospitals around the globe, especially in processes like sensory prostheses to help correct or assist physical movements, the use of microrobots to deliver medicines to a specific part of the body and so on.
For example, the Sawai Man Singh hospital in Jaipur tested a locally manufactured humanoid robot to deliver food and medicine to corona patients.
2. Agriculture: To lower costs and increase productivity the agriculture industry has been actively working to adopt different robotic technology forms. Farmers have already been using tractors and harvesters that are self-guided. Recently there has been a rise in the experimental use of autonomous systems that automate operations like thinning, mowing, spraying, and weed removal.
For example, Agribot is an agricultural bot designed by BITS Pilani Hyderabad students, which is designed to increase efficiency, speed, productivity, application, and accuracy of the work and minimizethe labor of the farmers. Its central area is involved in farming harvesting, spraying, seeding, and removal of weeds.

3. Space:
1. Development of a robot system for unstructured uneven terrain based on biologically inspired innovative locomotion concepts
II. Development of a multi-functional robot team usable for in-site examination and maintenance of infrastructure
III. Reconfigurable system for planetary exploration
IV. Image evaluation, Object recognition, and terrain modeling
V. Al-based support systems for scientific experiences
For example, "VyomMitra" is a female looking space fearing humanoid robot developed by ISRO to function on board the Gaganyaan, a crewed orbital spacecraft
4. **Electric mobility:** To test applications for electrical vehicles, develop battery charging technologies, and create intelligent, environmentally friendly, and integrated urban mobility.
For ex:- KUKA (a German manufacturer) has bundled experience and expertise in engineering, project management, process knowledge, commissioning, and service for the automated production of electric vehicles including their power terrain.
5. Manufacturing: Robotics play a significant role in the manufacturing landscape. Today, automated manufacturing solutions are a vital part of any operation that strives for maximum efficiency, safety, and competitive advantage in the market. Automation of repetitive tasks reduce the margin of errors to negligible rates and enable human workers to focus more on skill development and diverse work profile.
1. It creates efficiency from raw material handling to finished product packing
2. It can be programmed to operate 24*7 for continuous production
III. Robotic equipment's highly flexible and can be customized to perform even complex functions
6. Education: At least 15 universities and colleges in India are now offering robotics courses such as M.Tech in robotics, and M.Tech in automation.