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Applicability of Artificial Intelligence in Different Fields of Life

Shukla Shubhendu S.[1], Jaiswal Vijay[2]

[1]Asst. Professor, Department of Management, SR Group of Institutions, Lucknow, India
[2]Asst. Professor, Department of Computer Science, SR Group of Institutions, Lucknow, India

Abstract: ***The main purpose of this paper is to highlight the features of Artificial Intelligence (AI), how it was developed, and some of its main applications. John McCarthy, one of the founders of artificial intelligence research, once defined the field as "getting a computer to do things which, when done by people, are said to involve intelligence." The point of the definition was that he felt perfectly comfortable about carrying on his research without first having to defend any particular philosophical view of what the word "intelligence" means. The beginnings of artificial intelligence are traced to philosophy, fiction, and imagination. Early inventions in electronics, engineering, and many other disciplines have influenced AI. Some early milestones include work in problems solving which included basic work in learning, knowledge representation, and inference as well as demonstration programs in language understanding, translation, theorem proving, associative memory, and knowledge-based systems.***

Keywords: Artificial Intelligence, Knowledge based Systems

1. Introduction

AI is a branch of Computer Science concerned with the study and creation of computer systems. AI exhibits some form of intelligence:

- Systems that learn new concepts and tasks,
- Can reason and draw useful conclusions about the world.

AI systems also can understand a natural language or perceive and comprehend a visual scene, and perform other types of feats that require human types of intelligence.

1.1 What is Artificial Intelligence?

"Artificial intelligence is the study of ideas to bring into being machines that respond to stimulation consistent with traditional responses from humans, given the human capacity for contemplation, judgment and intention. Each such machine should engage in critical appraisal and selection of differing opinions within itself. Produced by human skill and labor, these machines should conduct themselves in agreement with life, spirit and sensitivity, though in reality, they are imitations."

In some books and authors also write about AI that The term "artificial intelligence" is defined as systems that combine sophisticated hardware and software with elaborate databases and knowledge-based processing models to demonstrate characteristics of effective human decision making. The criteria for artificial systems include the following:

- Functional: the system must be capable of performing the function for which it has been designed
- Able to manufacture: the system must be capable of being manufactured by existing manufacturing processes
- Designable : the design of the system must be imaginable by designers working in their cultural context; and
- Marketable: the system must be perceived to serve some purpose well enough, when compared to competing approaches, to warrant its design and manufacture.

Artificial intelligence dramatically reduces or eliminates the risk to humans in many applications. Powerful artificial intelligence software helps to fully develop the high-precision machine capabilities of robots, often freeing them from direct human control and vastly improving their productivity. When a robot interacts with a richly populated and variable world, it uses it senses to gather data and then compare the sensate inputs with expectations that are imbedded in its world model. Therefore the effectiveness of the robot is limited by the accuracy to which its programming models the real world.

2. Development of Artificial Intelligence

The field of artificial intelligence is relatively young. The creation of Artificial Intelligence as an academic discipline can be traced to the 1950s, when scientists and researchers began to consider the possibility of machines processing intellectual capabilities similar to those of human beings. Alan Turing, a British mathematician, first proposed a test to determine whether or not a machine is intelligent. The test later became known as the Turing Test, in which a machine tries to disguise itself as a human being in an imitation game by giving human-like responses to a series of questions. Turing believed that if a machine could make a human being believe that he or she is communicating with another human being, then the machine can be considered

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as intelligent as a human being. The term "artificial intelligence" itself was created in 1956 by a professor of Massachusetts Institute of Technology, John McCarthy. McCarthy created the term for a conference he was organizing that year. The conference, which was later called the Dartmouth Conference by AI researchers, established AI as a distinct discipline. The conference also defined the major goals of AI: to understand and model the thought processes of humans and to design machines that mimic this behavior. Much of the AI research in the period between 1956 and 1966 was theoretical in nature. The very first AI program, the Logic Theorist (presented at the Dartmouth Conference) was able to prove mathematical theorems. Several other programs were later on developed by taking the advantage of AI such as "Sad Sam,"(written by Robert K. Lindsay in 1960) that understood simple English sentences and was capable of drawing conclusions from facts learned in a conversation . The conclusions drawn depend on the data which is called knowledge Base (KB) in AI.

Another was ELIZA, a program developed in 1967 by Joseph Weizenbaum at MIT that was capable of simulating the responses of a therapist to patients. With more and more successful demonstrations of the feasibility of AI, the focus of AI research shifted. Researchers turned their attention to solving specific problems in areas of possible AI application. This shift in research focus gave rise to the present-day definition of AI, that is, "a variety of research areas concerned with extending the ability of the computer to do tasks that resemble those performed by human beings," as V. Daniel Hunt puts it in his 1988 article "The Development of Artificial Intelligence" (Andriole 52). Some of the most interesting areas of current AI research include expert systems, neural networks, and robotics.

3. Evolution of Sub disciplines of Artificial Intelligence

The following figure 1.1 shows the attachment of AI with other disciplines of Science. It shows how the AI is attached and important for other disciplines.

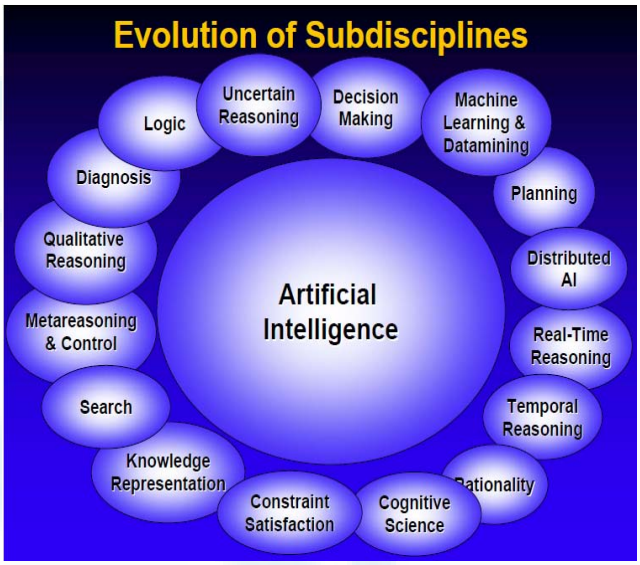

Figure 1.1: Attachment of AI with other disciplines of Science

3.1 Expectations: AI in daily life

- Communications
- Time management
- Health & safety
- Education
- Goals, informational needs
- Games, recreation, activities
- Products, purchases, marketing
- Opportunistic planning
- Augmentation of cognition

3.2 Expectations: AI in Science

- Automated discovery
- Design of experiments
- Triaging of resources
- Interpretation of data
- Probing complexity
- Biology, chemistry, medicine, climate

3.3 Expectations: AI and Infrastructure

- Transportation
- Commerce decision making
- Agriculture
- Engineering & architecture
- Power & conservation

3.4 Expectations: AI and the Consumers

- Evolving relationship with computation
- Sensing, reasoning & learning
- Personalized smart applications
- Products & services
- Challenges and opportunities with data & privacy

4. Applications of Artificial Intelligence

Artificial intelligence has been used in a wide range of fields including medical diagnosis, stock trading, robot control, law, remote sensing, scientific discovery and toys. However, many AI applications are not perceived as AI: "A lot of cutting edge AI has filtered into general applications, often without being called AI because once something becomes useful enough and common enough it's not labeled AI anymore," Nick Bostrom reports. "Many thousands of AI applications are deeply embedded in the infrastructure of every industry." the late 90s and early 21st century, AI technology became widely used as elements of larger systems, but the field is rarely credited for these successes. For example;

- Finance
- Hospitals and Medicines
- Heavy Industries
- Online and Telephone Customer Service
- Transportation
- Telecommunication
- Toys and Games
- Music
- Aviation
- News, Publishing & Writing

4.1 AI and Education

Artificial Intelligence research can make a valuable contribution to the education of human beings. An intellectual problem is solved, at least in many cases, by dividing it into pieces and developing a technique for each sub problem. The sub problems are the same whether it is a computer or a person trying to solve the problem. If a certain technique proves valuable for the computer, it may be helpful for a human problem solver to be aware of the computer's methods.

Some researchers in cognitive science and education have proposed the idea of intelligent CAI (computer assisted instruction), in which a computer would be programmed as a "tutor" that would observe the efforts of a student in solving a problem. The tutor would know about some of the mistaken ideas people can have about a particular class of problem and would notice a student falling into one of those traps. It could then offer advice tailored to the needs of that individual student. A second educational advantage is indirect but ultimately more important. By deliberately learning to imitate mechanical thinking, the learner becomes able to articulate what mechanical thinking is and what it is not. The exercise can lead to greater confidence about the ability to choose a cognitive style that suits the problem.

4.2 Expert Systems

The first area of AI application we explore is expert systems, which are AI programs that can make decisions which normally require human level of expertise. A program called DENDRAL, developed at the Stanford Research Institute in 1965, was the grandparent of expert systems. Much like a human chemist, it could analyze information about chemical compounds to determine their molecular structure. A later program called MYCIN was developed in the mid-1970s and was capable of helping physicians in diagnosis of bacterial infections. It is often referred to as the first true expert system.

Expert systems are perhaps the most easily implemented and most widely used AI technology. Although the effects of such systems may not be readily apparent, they have had a tremendous impact on our lives. In fact, many of the computer programs we use today can be considered expert systems. The spell-checking utility in our word processor is an expert system. It takes the role of a proofreader by reading a group of sentences, checking them against the known spelling and grammatical rules, and making suggestions of possible corrections to the writer. Expert systems, combined with robotics, brought about automation of the manufacturing process which accelerated production rate and reduced error. A typical assembly line that required hundreds of people in the 1950s now only requires ten to twenty people who supervise the expert systems that do the job. The pioneers in industrial automation are Japanese automobile manufacturers such as Toyota and Honda, with up to 80% automation of the manufacturing process.

The most advanced expert systems, like many other advanced technologies, are used extensively in military applications. An example is the next generation fighter plane of the U.S. Air Force -- the F-22 Raptor. The targeting computer onboard the Raptor takes the role of a radar controller by interpreting radar signals, identifying a target, and checking its radar signature against known enemy types stored in its database.

4.3 Neural Networks

Another area of great interest is neural networks, which implement the ability to learn into a computer program. The ability to make connections between facts and draw conclusions is central to learning. Humans rely on what we call common sense to make such connections. However, something that is common sense to us may be very difficult to implement in a computer program. One such common sense case is making a causal connection; as Charles L. Oritz Jr. wrote, "The occurrence of an event is never an isolated matter. An event owes its existence to other events which causally precede it; an event's presence is, in turn, felt by certain collections of subsequent events" (Artificial Intelligence Volume 111, p.73). Each node in a neural network must be able to take a number of inputs, process them to determine the connections that need to be made, and send outputs to the relevant nodes determined in the previous step. Each processing element in a neural network receives a number of inputs and determines to which processing elements it should send the input, and outputs

the processed data to those processing elements, much like a human neuron does.

The aforementioned "Sad Sam" program is an example of the principles of a neural network in action, though it is primitive and works with limited input. Sam is capable of drawing a conclusion from known facts, given the sentences: "Jim is John's brother" and "Jim's mother is Mary," Sad Sam was smart enough to understand that Mary must therefore be John's Mother (ai.about.com). While it is relatively easy to let a program make connections among a limited set of information, there are innumerable connections that can be made about things in the real world. The huge number of connections that can be made in the real world makes implementation of sophisticated neural networks a daunting task. A spin-off of the neural network problem is the fuzzy logic problem, which deviates from traditional yes-or-no type of Boolean logic. In fuzzy logic, values are no longer discrete and mutually exclusive; that is, a value can belong to two categories simultaneously. An example is when one talks about temperature: ninety degrees Fahrenheit is "hot" when one is talking about outdoor temperature, but for body temperature, it is abnormally "cold." Through the implementation of fuzzy logic, a neural network would be able to make that same judgment.

There are still many problems in neural network research, including creating algorithms to make the connections, to determine which sets of data should be connected, and even to abandon irrelevant data when necessary. Miscellaneous aspects of the human learning process can present challenges with the implementation of a neural network. The complexity of these problems is the reason why there remains much theoretical work to be done in the field. While a complete set of solutions lies beyond the scope of the theories and technology currently available, the principles and partial solutions of the problem have been implemented with great success. Deep Blue, the chess-playing program developed by IBM, is one of the few examples of an application of neural networking principles. It was capable of learning from previous games and predicting the possible moves of an opponent. As our understanding of the human brain and the learning process grows, so will our ability to create more effective algorithms of learning and making connections among known ideas.

4.4 AI in Robotics

Robotics is one field within artificial intelligence. It involves mechanical, usually computer-controlled, devices to perform tasks that require extreme precision or tedious or hazardous work by people. Traditional Robotics uses Artificial Intelligence planning techniques to program robot behaviors and works toward robots as technical devices that have to be developed and controlled by a human engineer. The Autonomous Robotics approach suggests that robots could develop and control themselves autonomously. These robots are able to adapt to both uncertain and incomplete information in constantly changing environments. This is possible by imitating the learning process of a single natural organism or through Evolutionary Robotics, which is to apply selective reproduction on populations of robots. It lets a simulated evolution process develop adaptive robots.

Artificial Intelligence (AI) is a general term that implies the use of a computer to model and/or replicate intelligent behavior. Research in AI focuses on the development and analysis of algorithms that learn and/or perform intelligent behavior with minimal human intervention. These techniques have been and continue to be applied to a broad range of problems that arise in robotics, e-commerce, medical diagnosis, gaming, mathematics, and military planning and logistics, to name a few.
Several research groups fall under the general umbrella of AI in the department, but are disciplines in their own right, including: robotics, natural language processing (NLP), computer vision, computational biology, and e-commerce. Specifically, research is being conducted in estimation theory, mobility mechanisms, multi-agent negotiation, natural language interfaces, machine learning, active computer vision, probabilistic language models for use in spoken language interfaces, and the modeling and integration of visual, haptic, auditory and motor information.

Robotics is the area of AI technology most attractive to the public. In fact, robotics could be the area where AI can be most beneficial to mankind. The use of industrial robots that do repetitive tasks accurately has already increased the productivity of assembly lines in manufacturing plants. The addition of artificial intelligence to these industrial robots could further boost their productivity by allowing them to do a wider variety of tasks and to do so more efficiently. In the future, nano-robots not much bigger than a will be able to enter the human body, repair damaged organs, and destroy bacterium and cancer tissues. Special-purpose robots such as bomb-defusing robots and space exploration robots can go into hostile environments and accomplish tasks deemed too dangerous for humans.

While the benefit of robots with AI is great, there are numerous technical hurdles encountered when implementing AI in a robot, many of which are being researched today. A robot must be capable of perception in order to interact with the world around it. The ability to see, hear, and touch can be implemented through cameras, infrared and ultrasound sensors, collision sensors, and other devices. While implementing these physical sensors is relatively simple, making the robot make sense of this information can be quite difficult.

A robot called SHRDLU that can see and stack boxes on a table and even answer questions about objects on the table. Such a robot was truly a breakthrough, for it not only was able to see three dimensional objects but also had a basic understanding of physics and was able to use this

knowledge to accomplish work on its own. However, one must not forget that these robots can only operate in a limited environment with a few stationery geometric objects, which the researchers called "the micro-blocks world" (ai.about.com). The real world is far more complex, as it contains far more dynamic objects.

4.5 Social Challenges

- Users need to understand the limits of their tools and agents. (Expert systems tend to be brittle)
- AI applications need to be created that help bring harmony to the world rather than which intensify battles.
- AI applications are needed which enhance the economy rather than reduce economic competition.
- AI extends the reach of automation and threatens to eliminate, if not change many white-collar jobs.
- AI raises the bar for information literacy and computer literacy.

5. Ethical and moral issues of Artificial Intelligence

We are already living in that era's future, experiencing a golden age of technology, with no end, or limit, in sight. The moral and ethical implications of artificial intelligences are obvious and there are three sides to the argument. While one party argues that there are already too many of us living in poverty without work there is little or no reason to create mechanical laborers (that can think independently). And that we certainly should not create machines that can argue with us about such issues. Another party argues that society cannot develop or take advantage of resources without the help of machines that can think for themselves at least a little. And party number three simply doesn't care about the issue at all, as is typical of human society.

Isaac Asimov, the science fiction author, well known for his robot novels (amongst the myriad others), wrote the Three Laws of Robotics early in the last century which were incorporated into the "positronic" brains of his robots in order to protect humans from a "robot revolution", and to prevent other humans abusing them. :

5.1 The Three Laws of Robotics

- A robot may not injure a human being, or, through inaction, allow a human being to come to harm.
- A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
- A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

5.2 Brainwashing

The above three principles are a good example of the difficulty in programming an artificial brain. The human brain is evolved through millions of years of survival and social behavior. We are still undergoing this process.

Looking at human civilization with its diverse cultural, religious, ethical and moral values, what exactly are we trying to create here and to what purpose?

On a more practical level we could create an artificial intelligence, in android or machine form, that would function as a neutral entity (if that is at all definable because it would have to have a set of values) and that this entity's sole purpose, for example, is to teach.

It would teach topics that do not involve any moral, ethical or religious values, such as geography or technical skills. Inevitably, certainly if there are children involved, it would get questions such as "Yes, but, why?"

If related to the topic it would answer appropriately, but inevitably it would come to a point of no return. How then would it answer such a simple question? Except for with a "Does not compute" or other similar non-committal answer. Perhaps it could say "Ask a human teacher", or "This question is not allowed." or "'Why' is not a valid question, please restate."

Not really good enough, is it? Asking why is the most fundamental question of all, isn't it? Without it we'd be animals with only instinct and reflex to guide us. We'd be automatons... So the issue of which ethical, moral and cultural values to instate on our artificially created intelligence goes on. If it can't even answer a simple "Why?" then perhaps we should make sure these machines aren't intelligent at all. Not capable of making any decision beyond mechanical, programmed movement, and certainly not capable of any deductive reasoning and not in any position where it could influence or have control over humans or human society.

6. Advantages & Disadvantages Of Artificial Intelligence

Without stepping into the boundary less terrain of technical specifications, listed below are insights into the pros and cons of artificial intelligence. Like everything else in the real world, artificial intelligence comes with its own share of advantages and disadvantages. Its advantages make its patrons swear by it, and its disadvantages help the skeptics get more vocal about their arguments.

6.1 Pros of Artificial Intelligence

Tireless performance of tasks makes for one of the biggest advantages of artificial intelligence. Believe it not, but with

the assistance of artificial intelligence, it actually is possible to get a particular job done without the harrowing need for a lunch break or a break for coffee. Unlike humans who need to take a break at the drop of a hat, a machine can get a particular job done in the blink of an eye and that's not necessarily a bad thing. Thus you see how the 'tireless factor' in its very own way has managed to add to the success of artificial intelligence as we know it.

With artificial intelligence 'copying' becomes that much easier. Copying here does not refer to a student copying from another in an exam. It in fact refers to the training of an artificial mind to perform a particular task, duplication of task-performance if you will. When compared to the training of a large workforce to perform a certain set of tasks, training an artificial mind to do the same makes for a slightly more feasible option.

Most of the time, if not all the time, when a human being makes a decision, he or she does so after taking well into consideration his/her emotions. This setback that plagues the psyche of a human being is absent when an artificial mind performs a given task. With an artificial mind it is more about making logical and feasible decisions and so much lesser about giving into emotions. Maybe this is because an artificial mind feels no real emotions to speak of.

Artificial intelligence finds applications in space exploration. Intelligent robots can be used to explore space. They are machines and hence have the ability to endure the hostile environment of the interplanetary space. They can be made to adapt in such a way that planetary atmospheres do not affect their physical state and functioning.

Intelligent robots can be programmed to reach the Earth's nadirs. They can be used to dig for fuels. They can be used for mining purposes. The intelligence of machines can be harnessed for exploring the depths of oceans. These machines serve human so well especially where human intelligence has serious limitations.

Intelligent machines can replace human beings in many areas of work. Robots can do certain laborious tasks. Painstaking activities, which have long been carried out by humans can be taken over by the robots. Owing to the intelligence programmed in them, the machines can shoulder responsibility to a certain extent. They can be made to manage themselves and their time to complete the assigned tasks.

Emotions that often intercept rational thinking of a human being are not a hindrance for artificial thinkers. Lacking the emotional side, robots can think logically and take the right decisions. Sentiments are associated with moods that affect human efficiency. This is not the case with machines with artificial intelligence.

Thus artificial intelligence can be utilized in the completion of repetitive and time-consuming tasks efficiently. Intelligent machines can be employed to do certain dangerous tasks. Machines equipped with artificial intelligence can be made to thoughtfully plan towards the fulfillment of tasks and accordingly adjust their parameters such as their speed and time. They can be made to act quickly, unaffected by anything like emotion and take the tasks towards perfection.

6.2 Cons of Artificial Intelligence

The risk of a breakdown makes for, one of the, if not the biggest disadvantage or con of artificial intelligence. It's like spending a million bucks on a car to get you from Point A to Point B and having to deal with the issue of the car breaking down one day after its purchase. Similarly, artificial intelligence is all about the effortless performance of a job, but in the event of a breakdown, the whole picture can turn dark.

Apart from the risk of a breakdown, there also always is the imminent risk of a loss of data. In certain cases, due to the malfunction of certain components, a machine can fail to keep within its memory the files that it should have. This is something that can also happen with humans. When a human being is in charge of the collection and storage of data and fails to perform his or duty, it's something that's accepted and often branded as human error. However, with a machine it is not expected and this makes all the difference, ultimately making it a disadvantage.

The first concern regarding the application of artificial intelligence is about ethics and moral values. Is it ethically correct to create replicas of human beings? Do our moral values allow us to recreate intelligence? Intelligence is after all a gift of nature. It may not be right to install it into a machine to make it work for our benefit.

Imagine robots working in hospitals. Do you picture them showing care and concern towards the patients? Imagine intelligent machines employed in creative fields. Do you think the robots will excel in such fields? Thinking machines lack a creative mind. Human beings are emotional intellectuals. They think and feel. Their feelings guide their thoughts.

If robots begin replacing humans in every field, it may lead to unemployment. People will be left with nothing to do. Empty time may result in its destructive use. Thinking machines will govern all the fields and populate all positions pre-occupied by people.

Apart from all these issues, there is a fear of robots superseding us! Ideally human beings should continue being the masters of machines. If things turn the other way round, the world will turn into chaos. Intelligent machines may prove to be smarter than us; they might enslave us and start ruling the world. Man's greedy creativity may endanger mankind!

Eventually, it is up to you whether to stand by artificial intelligence or understand the likely disaster that it may lead to. In my view, there is no ideal replacement for human beings. Artificial intelligence can help alleviate the difficulties faced by man but intelligent machines can never be 'human'.

6.3 Summary

- Efforts in artificial intelligence leading to valuable new services and applications
- Innovations in privacy will be enabling
- AI methods for learning & reasoning promises to play a key role in these innovations

7. Conclusion

The field of artificial intelligence is truly a fascinating one. Like many other new technologies, AI is changing our lives every day. It is quite possible that the near future will bring intelligent machines to make life more convenient and comfortable for all of us. Although some may argue otherwise, there is no need to fear artificial intelligence. Like all other machines, AI machines do what human programmers tell them to do. There is, however, a need to understand AI, for it is through understanding that we can make the AI technology most beneficial.

While expert systems can be extremely helpful to human beings, there are tasks that current expert systems simply cannot accomplish. To return to our past example, the spell-checking utility can check mechanics of an article. However, it cannot check all important aspects of an article such as content and logic. Thus, it is only a marginally helpful proofreader. It would be a much more competent proofreader if it could identify logical shortcomings and so on. To do so, an expert system must be able to make cognitive connections between objects. AI just finished with its period of infancy. It has ramifications that yet remain unknown to everyone. The effort and research can bring the surprising innovations. There are also results which cannot be foreseen when the computer begins to think for itself. A computer it can be used in different ways depending on the user's needs

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Author Profiles

Shubhendu S. Shukla has completed his MA (Economics) in 2005 and MBA in 2007, and M.Phil (Management) in 2010. He has done Post Graduated Diploma in Computer Applications from IGNOU and Post Graduated Diploma in International Business from Annamalai University. Author is Member of Editorial Board in Reviewer Panel of International Journal of Science and Research (IJSR) ISSN: 2319-7064 (www.ijsr.net/editorial.php), International Journal of Scientific Engineering and Research (IJSER) ISSN: 2614-7324 (www.ijser.in/members.php), International Journal of Engineering Research and Technology (IJERT) ISSN: 2278-0181, ISO 3297:2007 http://www.ijert.org/about-us/review-board?start=9). He has worked with a prominent IT Company (Wipro Technologies) as Project Manager for e-Governance that was a Central Govt. Project about e-District, during his job he was responsible for Dealing with Consultant (Wipro), dealing with Techo team i.e. Trainer and other staff, he also Co-ordinate with District Administrative staff for monitoring, reporting, and his proposals and finally developed the Study materials. Author has more than 6 years of experience in academics as he is currently working as Asst professor in SR Group of Institutions, Lucknow. With the academics author has publish 12 International Research Paper, 7 national Research Papers, attended 7 National Conferences and Seminars, 5 International Seminars. Apart from SR Group of Institutions, Lucknow, he is Guest and Visiting Faculty of Study Centers of Global Open University Nagaland, Karnataka State Open University, Sikkim Manipal University.
Author has taught variety of subjects as Marketing, Sales and Distribution, Production and Operation management, Computer Application in Management, System Analysis &

Design and Software Engineering, Database Management System, Electronic Commerce (Specialized subjects of Information Technology).

Vijay Jaiswal has completed B.Tech (Information Technology) in 2009 and perusing M.Tech. Author has worked with a prominent company (Tata Group) as a Software Engineer for more than 2 year. He has more than 2 years of experience in academics as he is currently working as Asst professor in SR Group of Institutions, Lucknow, department of Information Technology. With the academics author has publish 2 International Research Paper, 3 national Research Papers, attended 2 National Conferences and Seminars, 1 International Seminars. Apart from SR Group of Institutions, Lucknow, he is Visiting Faculty of Study Centers of Karnataka State Open University, Sikkim Manipal University. He has taught subjects as Parallel Algorithm, DBMS, Object Oriented System, Web Technology, and Operating System.