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Department of Mechanical Engineering

SHIVALIK COLLEGE OF ENGINEERING

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Director's Message

It gives me immense pleasure to write few lines for the Departmental Magazine of Mechanical Engineering Department, Shivalik College of Engineering Dehradun, Session 2022-23. This magazine presents & expresses creative talents of students and Faculties.

I firmly believe that Mechanical Engineering Department has done a very good job over a period of 13 years of its existence, in training the mind of students and nurturing their heart to become a successful engineer on the scale of excellence.

Education determines the path of progress and prosperity for which Shivalik College of Engineering, Dehradun is very much committed as it is evident from the articles and reports published in the magazine.

I wish the Head, Faculty members and students of Mechanical Engineering Department a very good luck to achieve their set goal under the able guidance of Shivalik Management to fulfill the aspiration of parents & ambition of pupils as commitment for national service.

Prof. (Dr.) Prahalad Singh
Director, SCE

HOD's Desk

Greetings from the MED-Shivalik College of Engineering. I congratulate the students of Mechanical Engineering Department (Shivalik College of Engineering) who have taken the initiative and have contributed to this edition of the "Yantra Digest" departmental magazine. It is necessary for us from time to time, to articulate our thoughts and t re-discover that the field is and what its relevance is. In some way, this magazine contributes to fulfilling this need.

During every semester, the calendar of events is prepared, which implicitly incorporates all the curricular and extra-curricular activities of the department and is followed meticulously without any deviation. Importance is given to quality teaching and learning process through faculty development programs for teachers and soft skill programmes for students. Special care is taken about the students whose performance is poor in the examinations through counseling and extra classes.

We are happy to inform that our pride rests in the Quarterly Magazine, which highlights the creative and technical skills of departmental faculties and students.

Ajay Kumar Verma
Head-MED, SCE

Message from Editorial Board

The Magazine "Yantra Digest" is a team work to bring out the official publication of Department of Mechanical Engineering. Each year, our team work extensively to bring out the technical writing skills and showcase the technological knowledge of the students and faculty. This Magazine reflects and encompasses the creative technical presentation skills inherent to the academic and upcoming areas in the field of Mechanical Engineering along with life motivational articles. The magazine's primary focus has been geared at covering articles reflecting the student's knowledge and associations with latest and leading edge-technologies. A lot of effort has gone into the making of this issue. We hope you enjoy reading the magazine.

The magazine continues to expand its reach to achieve its vision of being a truly representative student publication. I am thankful to the Management, Director, Head of Department (Mechanical Engineering), all the faculty members and students of Mechanical Engineering Department for their contributions in making of "Yantra Digest" and I hope to build on this ethos just as much during the upcoming academic years.

Dr. Abhishek Kumar Jha
Chief Editor
Assistant Professor
Mechanical Engineering Department

Content

Artificial Intelligence

Ajay Kumar Verma
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Abstract

AI is a branch of computer science concerned with the study and creation of computer systems that exhibit some form of intelligence systems that learn new concepts and tasks, systems that can reason and draw useful conclusions about the world around us, systems that can understand a natural language or perceive and comprehend a visual scene, and systems that can perform other types of feats that require human types of intelligence. An understanding of AI requires an understanding about related terms such as knowledge, intelligence, reasoning, thought, learning and a number of computer-related terms.

Artificial Intelligence

What is Artificial Intelligence?

Artificial Intelligence (**AI**) can be defined as the study of methods by which a computer can simulate aspects of human intelligence.
Artificial Intelligence (AI) is study of the nature of intelligence by building computer systems, and the application of these insights in solving real-world problems. AI can be seen both as a science and as engineering, depending on the aim of the work. AI technology is often taught as part of computing, but it has links with many other fields such as psychology, philosophy and linguistics.
The ability of a digital or computer-controlled to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience. Since the development of the digital computer in the 1940s, it has been demonstrated that computers can be programmed to carry out very complex tasks—as, for example, discovering proofs for mathematical theorems or playing chess—with great proficiency. Still, despite continuing advances in computer processing speed and memory capacity, there are as yet no programs that can match human flexibility over wider domains or in tasks requiring much everyday knowledge. On the other hand, some programs have attained the performance levels of human experts and professionals in performing certain specific tasks, so that artificial intelligence in this limited sense is found in applications as diverse as medical diagnosis, computer search engines, and voice or handwriting recognition.

The term **Artificial Intelligence (AI)** was first used by John McCarthy who considers it to be "the science and engineering of making intelligent machines". It can also refer to intelligence exhibited by a non-natural {manufactured) entity.

Schools Of Thought

AI divides roughly into two schools of thought: Conventional AI and Computational Intelligence.

Conventional AI mostly involves methods now classified as machine learning, characterized by formalism and statistical analysis. This is also known as symbolic AI, logical AI, and Good Old Fashioned Artificial Intelligence (GOFAI). Methods include:

- Expert systems: apply reasoning capabilities to reach a conclusion. An expert system can process large amounts of known information & provide conclusions based on them.
- Case based reasoning: stores a set of problems and answers in an organized data structure called cases. A Case Based Reasoning system upon being presented with a problem finds a case in its knowledge base that is most closely related to the new problem and presents its solutions as an output with suitable modifications.
- Bayesian networks
- Behavior based AI: a modular method building AI systems by hand.

Computational Intelligence involves iterative development or learning (e.g. parameter tuning e.g. in connectionist systems). Learning is based on empirical data and is associated with non-symbolic AI, scruffy AI and soft computing. Methods mainly include:

- Neural networks: systems with very strong pattern recognition capabilities.

Fuzzy systems: techniques for reasoning under uncertainty have been widely used in modern industrial and consumer product control systems.

- Evolutionary computation: applies biologically inspired concepts such as populations, mutation, and survival of the fittest to generate increasingly better solutions to the problem. These methods most notably divide into evolutionary algorithms (e.g. genetic algorithms) and swarm intelligence (ant algorithms).

With hybrid intelligent systems attempts are made to combine these two groups. Expert inference rules can be generated through neural network or production rules from statistical learning such as in ACT-R. It is thought that the human brain uses multiple techniques to both formulate and cross-check results. Thus, systems integration is seen as promising and perhaps necessary for true A

History

The field of artificial intelligence truely dawned in the 1950's, since then there have been many achievements in the History of artificial intelligence, some of the more notable moments include;

1950: Alan Turing introduces the Turing test to test of a machine's capability to perform human-like conversation.

1951: The first working AI programs were written to run on the Ferranti Mark I machine of the University of Manchester: a checkers-playing program written by Christopher Strachey and a chess-playing program written by Dietrich Prinz.

1956: John McCarthy coined the term "artificial intelligence" as the topic of the Dartmouth Conference.

1958: John McCarthy invented the Lisp programming language.
1965: Joseph Weizenbaum built ELIZA (program), an interactive program that carries on a dialogue in English language on any topic.

1968: HAL 9000 made its appearance in the science fiction movie 2001: A Space Odyssey

1972: The Prolog programming language was developed by Alain Colmerauer.

1974: Ted Shortliffe's PhD dissertation on the MYCIN program (Stanford) demonstrated the power of rule-based systems for knowledge representation and inference in the domain of medical diagnosis and therapy. Sometimes called the first expert system.
1997: The Deep Blue chess program (IBM) beats the world chess champion, Garry Kasparov.

1999: Sony introduces the AIBO, an artificially intelligent pet.
During the 1990s and 2000s AI has become very influenced by probability theory and statistics. Bayesian networks are the focus of this movement, providing links to more rigorous topics in statistics and engineering such as Markov models and Kalman filters, and bridging the divide between `neat' and `scruffy' approaches. This new school of AI is sometimes called `machine learning'. The last few years have also seen a big interest in game theory applied to AI decision making. After the September 11, 2001 attacks there has been much renewed interest and funding for threat-detection AI systems, including machine vision research and data-mining.

AI in Business

Banks use artificial intelligence systems to organize operations, invest in stocks, and manage properties. In August 2001, robots beat humans in a simulated financial trading<Stock_trader> competition (BBC News, 2001). A medical clinic can use artificial intelligence systems to organize bed schedules, make a staff rotation, and to provide medical information. Many practical applications are dependent on artificial neural networks—networks that pattern their organization in mimicry of a brain's neurons, which have been found to excel in pattern recognition. Financial institutions have long used such systems to detect charges or claims outside of the norm, flagging these for human investigation. Neural networks are also being widely deployed in homeland security, speech and text recognition, medical diagnosis (such as in Concept Processing technology in EMR software), data mining, and e-mail spam filtering.

AI in Fiction

In science fiction AI — almost always strong AI— is commonly portrayed as an upcoming power trying to overthrow human authority as in HAL 9000, Skynet, Colossus<The_Forbin_Project> and The Matrix or as service humanoids like C-3PO, Marvin <Marvin_the_Paranoid_Android>, KITT and KARR, the Bicentennial Man, the *Mechas* in A.I., Cortana from the Halo<video_game_series> series or Sonny in I, Robot.

Author Frank Herbert explored the idea of a time when mankind might ban clever machines<Strong_AI> entirely. His Dune series makes mention of a rebellion called the Butlerian Jihad in which mankind defeats the smart machines of the future & then imposes a death penalty against any who would again create thinking machines. Often quoted from the fictional Orange Catholic Bible, "Thou shalt not make a machine in the likeness of a human mind."

Video Games

A video game (or videogame) is a game that typically involves user/player interaction with a controller interface to generate visual feedback on a video screen. It also generally has some system of reward presented to the user in return for meeting certain accomplishments within the framework of a given ruleset.
The various types of electronic devices that video games are played on are known as

platforms and examples of these are personal computers and video game consoles. Video games also exist across a full range of technology ranging from large computers such as mainframes down to smaller hand-held devices.
IBM PC (PC for short) based Computer games started out with a lower availability of multiplayer options, largely due to many games being dependent on keyboard or mouse based interactions, a single gaming port (if any) available, and network options that were limited.

Friendly AI

Friendliness theory is a proposed solution to the dangers believed to stem from smarter-than-human artificial intelligence. According to the theory, the goals of future AIs will be more arbitrary and alien than commonly depicted in science fiction and earlier futurist speculation, in which AIs are often anthropomorphised and assumed to share universal human modes of thought. Oxford philosopher Nick Bostrom puts it:
"Basically we should assume that a 'superintelligence' would be able to achieve whatever goals it has. Therefore, it is extremely important that the goals we endow it with, and its entire motivation system, is 'human friendly.'"

Requirements for FAI & Effective FAI

The requirement for FAI to be effective, both internally, to protect humanity against unintended consequences of the AI in question and externally to protect against other non-FAIs arising from whatever source are:

1. Friendliness - that an AI feel sympathetic towards humanity and all life, and seek for their best interests
2. Conservation of Friendliness - that an AI must desire to pass on its value system to all of its offspring and inculcate its values into others of its kind
3. Intelligence - that an AI be smart enough to see how it might engage in altruistic behaviour to the greatest degree of equality, so that it is not kind to some but more cruel to others as a consequence, and to balance interests effectively
4. Self-improvement - that an AI feel a sense of longing and striving for improvement both of itself and of all life as part of the consideration of wealth, while respecting and sympathising with the informed choices of lesser intellects not to improve themselves
5. First mover advantage

Cognitive Science

Cognitive science is usually defined as the scientific study either of mind or of intelligence (e.g. Luger 1994). Practically every formal introduction to cognitive science stresses that it is a highly interdisciplinary research area in which psychology, neuroscience, linguistics, philosophy, computer science, anthropology, and biology are its principal specialized or applied branches. Therefore, we may distinguish cognitive studies of either human or other animal brains, mind and intelligence

Cognitive Science & AI

"... One major contribution of AI and cognitive science to psychology has been the information processing model of human thinking in which the metaphor of brain-as-computer is taken quite literally."

Artificial intelligence (AI) involves the study of cognitive phenomena in machines. One of the practical goals of AI is to implement aspects of human intelligence in computers. Computers are

also widely used as a tool with which to study cognitive phenomena. Computational modeling uses simulations to study how human intelligence may be structured.
There is some debate in the field as to whether the mind is best viewed as a huge array of small but individually feeble elements (i.e., neurons), or as a collection of higher-level structures such as symbols, schemas, plans, and rules. The former view uses connectionism to study the mind, whereas the latter emphasizes symbolic computations. One way to view the issue is whether it is possible to accurately simulate a human brain on a computer without accurately simulating the neurons that make up the human brain.

Conclusion

In futures studies, a technological singularity (often *the Singularity*) is a predicted future event believed to precede immense technological progress in an unprecedentedly brief time. Futurologists give varying predictions as to the extent of this progress, the speed at which it occurs, and the exact cause and nature of the event itself.

J. Good (1965) writes:

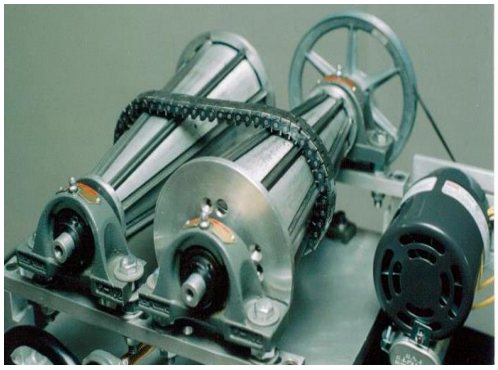
*"*Let an ultra-intelligent machine be defined as a machine that can far surpass all the intellectual activities of any man however clever. Since the design of machines is one of these intellectual activities, an ultra-intelligent machine could design even better machines; there would then unquestionably be an 'intelligence explosion,' and the intelligence of man would be left far behind. Thus, the first ultra-intelligent machine is the last invention that man need ever make*."*
Some speculate superhuman intelligences may have goals inconsistent with human survival and prosperity.
In an essay on human extinction scenarios, Oxford philosopher Nick Bostrom (2002) lists superintelligence as a possible cause:

"When we create the first super intelligent entity, we might make a mistake and give it goals that lead it to annihilate humankind, assuming its enormous intellectual advantage gives it the power to do so. For example, we could mistakenly elevate a subgoal to the status of a super goal. We tell it to solve a mathematical problem, and it complies by turning all the matter in the solar system into a giant calculating device, in the process killing the person who asked the question."

Continuously Varying Transmission

Dr. Kuldeep Panwar
Associate Professor, Mechanical Engineering, SCE

The **continuously variable transmission** (**CVT**) is a transmission in which the ratio of the rotational speeds of two shafts, as the input shaft and output shaft of a vehicle or other machine, can be varied continuously within a given range, providing an infinite number of possible ratios.



Other mechanical transmissions only allow a few different discrete gear ratios to be selected, but the continuously variable transmission essentially has an infinite number of ratios available within a finite range, so it enables the relationship between the speed of a vehicle engine and the driven speed of the wheels to be selected within a continuous range. This can provide better fuel economy than other transmissions by enabling the engine to run at its most efficient speeds within a narrow range

CVT's design advantages lie not only in its efficiency but also in its simplicity. It consists of very few components. A continuously variable transmission typically includes the following major component groups:

- A high-power/density rubber belt
- A hydraulically operated driving pulley
- A mechanical torque-sensing driving pulley
- Microprocessors and sensors

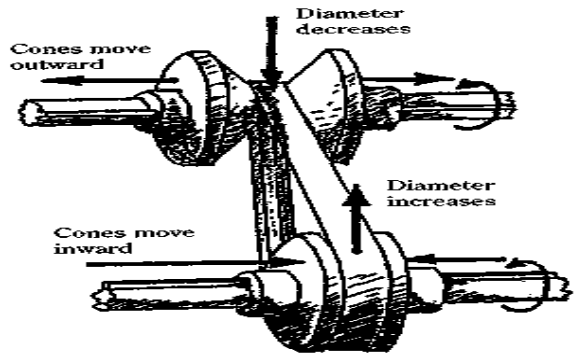
No More Gears: A Timeline of CVT Innovation

Some say you can't teach an old dog new tricks. But the continuously variable transmission (CVT), which Leonardo de Vinci conceptualized more than 500 years ago and is now replacing planetary automatic transmissions in some automobiles, is one old dog that has learned a few new tricks. Indeed, ever since the first toroidal CVT patent was filed in 1886, the technology has been refined and improved.

- 1490 - da Vinci sketches a stepless continuously variable transmission
- 1886 - first toroidal CVT patent filed
- 1935 - Adiel Dodge receives U.S. patent for toroidal CVT
- 1939 - fully automatic transmission based on planetary gear system introduced
- 1958 - Daf (of The Netherlands) produces a CVT in a car
- 1989 - Subaru Justy GL is the first U.S.-sold production automobile to offer a CVT
- 2002 - Saturn Vue with a CVT debuts; first Saturn to offer CVT technology
- 2004 - Ford begins offering a CVT

Working

Although there are different variations on the CVT theme, most passenger cars use a similar setup. Essentially, a CVT transmission operates by varying the working diameters of the two main pulleys in the transmission.



The pulleys have V-shaped grooves in which the connecting belt rides. One side of the pulley is fixed; the other side is moveable, actuated by a hydraulic cylinder. When actuated, the cylinder can increase or reduce the amount of space between the two sides of the pulley. This allows the belt to ride lower or higher along the walls of the pulley, depending on driving conditions, thereby changing the gear ratio. If you think about it, the action is similar to the way a mountain bike shifts gears, by "derailing" the chain from one sprocket to the next — except that, in the case of CVT, this action is infinitely variable, with no "steps" between.

Types

Pulley-based CVTs

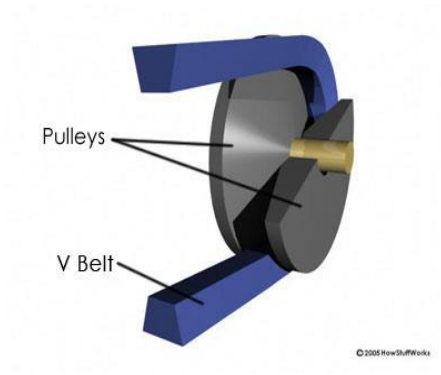
Peer into a planetary automatic transmission, and you'll see a complex world of gears, brakes, clutches and governing devices. By comparison, a continuously variable transmission is a study in simplicity. Most CVTs only have three basic components:

- A high-power metal or rubber belt
- A variable-input "driving" pulley
- An output "driven" pulley

CVTs also have various microprocessors and sensors, but the three components described above are the key elements that enable the technology to work.

The variable-diameter pulleys are the heart of a CVT. Each pulley is made of two 20-degree cones facing each other. A belt rides in the groove between the two cones. **V-belts** are preferred if the belt is made of rubber.

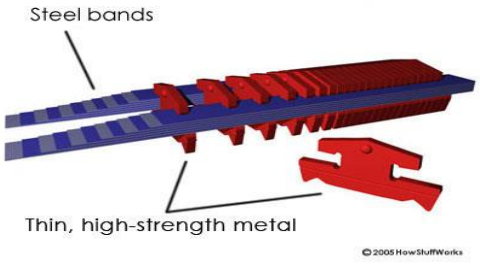
When the two cones of the pulley are far apart (when the diameter increases), the belt rides lower in the groove, and the radius of the belt loop going around the pulley gets smaller. When the cones are close together (when the diameter decreases), the belt rides higher in the groove, and the radius of the belt loop going around the pulley gets larger. CVTs may use hydraulic pressure, centrifugal force or spring tension to create the force necessary to adjust the pulley halves.



Variable-diameter pulleys must always come in pairs. One of the pulleys, known as the **drive pulley** (or **driving pulley**), is connected to the crankshaft of the engine. The driving pulley is also called the **input pulley** because it's where the energy from the engine enters the transmission. The second pulley is called the **driven pulley** because the first pulley is turning it. As an

output pulley, the driven pulley transfers energy to the driveshaft.

When one pulley increases its radius, the other decreases its radius to keep the belt tight. As the two pulleys change their radii relative to one another, they create an infinite number of gear ratios -- from low to high and everything in between. For example, when the pitch radius is small on the driving pulley and large on the driven pulley, then the rotational speed of the driven pulley decreases, resulting in a lower “gear.” When the pitch radius is large on the driving pulley and small on the driven pulley, then the rotational speed of the driven pulley increases, resulting in a higher “gear.” Thus, in theory, a CVT has an infinite number of "gears" that it can run through at any time, at any engine or vehicle speed.Metal belts don't slip and are highly **durable**, enabling CVTs to handle more engine torque. They are also **quieter** than rubber-belt-driven CVTs.

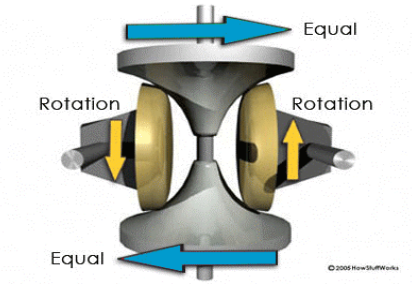


Toroidal CVTs

This version of the CVT -- the toroidal CVT system -- replaces the belts and pulleys with **discs** and **power rollers**.

Although such a system seems drastically different, all of the components are analogous to a belt-and-pulley system and lead to the same results -- a continuously variable transmission. Here's how it works:

- One disc connects to the engine. This is equivalent to the driving pulley.
- Another disc connects to the drive shaft. This is equivalent to the driven pulley.
- Rollers, or wheels, located between the discs act like the belt, transmitting power
  from one disc to the other.

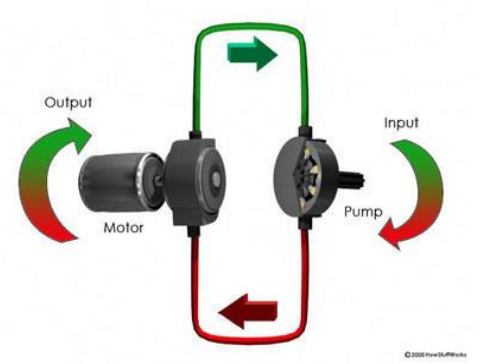


The wheels can rotate along two axes. They spin around the horizontal axis and tilt in or out around the vertical axis, which allows the wheels to touch the discs in different areas. When the wheels are in contact with the driving disc near the center, they must contact the driven disc near the rim, resulting in a reduction in speed and an increase in torque (i.e., low gear). When the wheels touch the driving disc near the rim, they must contact the driven disc near the center, resulting in an increase in speed and a decrease in torque (i.e., overdrive gear). A simple tilt of the wheels, then, incrementally changes the gear ratio, providing for smooth, nearly instantaneous ratio changes

Hydrostatic CVTs

Both the pulley-and-V-belt CVT and the toroidal CVT are examples of frictional CVTs, which work by varying the radius of the contact point between two rotating objects. There is another type of CVT, known as a hydrostatic CVT, that uses **variable-displacement pumps** to vary the fluid flow into hydrostatic motors. In this type of transmission, the rotational motion of the engine operates a hydrostatic pump on the

driving side. The pump converts rotational motion into fluid flow. Then, with a hydrostatic motor located on the driven side, the fluid flow is converted back into rotational motion.



Advantages :-

CVT has the following advantages:

- continuously changing reduction ratio, which keeps the engine work in optimum rate;
- great decreasing of fuel consumption;
- smooth and impact less transmission of power to the driving wheels;
- maximum utilization of power because there is no need of temporary decoupling of the engine and the transmission for changing from one gear to another;
- less dangerous substances in output gases and less contamination of environment.
- safe and pleasant driving as the driver is concentrated on the road conditions and does not distract his attention for shifting.

Drawbacks:-

CVT have the following disadvantages:

- transmit motion by friction, which leads to a greater wearing and a short exploitation period;
- -cannot transmit great powers;
- require great forces of pressure between the cone sheaves and the belt and between the toroid cylinders and disks, which leads to greater dimensions and a special and sophisticated hydraulic system for governing;
- have small diapason of changing of the transmission ratio and require installing of hydraulic transformer between the engine and the transmission which by itself is a sophisticated and expensive aggregate;
- require special oils and materials;
- sophisticated and expensive technologies for their production;
- sophisticated construction which can be seen by the applied figures;
- great price , which substantially greater than the price of the classical 4 or 5 stepped transmission .

Active Magnetic Bearings

Shivasheesh Kaushik
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Abstract
Wear and tear in bearings can be minimized and its service life enhanced under all types of operating conditions (including starting and stopping) of load, temperature, speed etc, with higher reliability by avoiding direct metal to metal contact by any of the design criterion. In active magnetic bearing (AMB) system, the shaft is kept suspended in a magnetic field provided by a set of four electro-magnets. Position of the shaft along and about the three axes is controlled by the energizing current and an electronic servo system comprising of sensors, power amplifier, controller etc. Presently AMB's are available in radial, axial and conical configurations. They find a wide range of application in fields like power generation (steam and gas turbines, including nuclear plants), aerospace, high speed compressors and centrifuges, etc. Various advantages offered by this system over the conventional bearings have been highlighted in the paper.

1. Introduction

Experimental studies on magnetic suspension systems have been conducted as early as mid-1800. Typically these suspension systems were passive magnetic designs that used permanent magnets or electromagnets energized by constant current. But not until early 1970s did active magnetic suspension prove to be practical in bearing application. Initially, the development of active magnetic bearing (AMB) systems was directed at aerospace projects. One of the earliest applications was a shaft support system for a flywheel in a communication satellite steering gyroscope system. Generally, the flywheel bearing system with conventional rolling element bearing limits satellite life to 5 to 7 years. An AMB system has lengthened the satellite life to more than 10 years, with an estimated reliability of more than 99%.

The non-aerospace applications of AMB system have been in turbo-vacuum pumps in mass spectrograph, electron microscopy, plasma and nuclear plants, high speed precision machine tools, compressors and centrifuges, power generating equipment like steam and gas turbines and so on.

2. General System Requirements

The design of AMB control system shall cater for the following functions and requirements:

(a) To take up radial and axial loads and provide stabilized supporting for the rotor in operation.

(b) To ensure stable working of the rotor in all operating cases (including passing the critical speeds.)

(c) To reliably operate for a long time in gas fluid under conditions of high speeds, temperatures and radiation at minimum loss of friction and power consumption.

(d) To ensure reliable control over electromagnetic bearing operation in all normal & abnormal operational modes.

3. Main System Functions

The AMB control system should have the following main functions:
(a) Control function: provide safe and reliable control in all operation modes and ensure the required lifting capacity to effectively prevent interruption of operation in case of failure of equipment's.
(b) Diagnosis function: have the capability to detailed analyze, record and diagnose the states of the elements of AMB control system in all operation modes.
(c) Communication function: exchange information between the AMB system and the
instrument and control (I&C) system.

4. System Structure, Characteristics and Working Principle

Displacement & rotation both are controlled	Only displacement is controlled

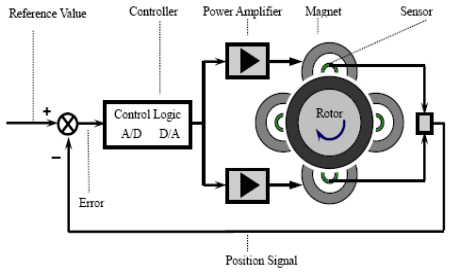

Fig 1. Typical AMB system working principle diagram

The typical AMB system diagram is illustrated in Fig.1. Besides the controller, the general control system also includes the sensor, A/D and D/A conversion and power amplifier. Rotor displacement along one of the axes is detected by the position sensors and converted into signals of standard voltage. After comparison with the set reference value, the error signal is fed to the controller. The accurate inductive position sensors improve the accuracy and reliability of AMB.
After A/D conversion, the controller processes this digital signal according to a given regulating rule (control arithmetic) and generates a signal of current setting. After D/A conversion, this current signal enters the power amplifier, whose function is to maintain the current value in the electric magnet winding at the current level set by the controller. Therefore, if the rotor leaves its center position, the control system will change the electromagnet current in order to change its attraction force and, respectively, draws the rotor back to its balance position. The power amplifiers allow the AMB to carry loads of several tons.

5. Main Parameters of a Turbo Compressor Rotor Bearing of a Nuclear Power Plant

The main parameters of radial and axial AMB of turbo compressor rotor of a nuclear power plant are shown in table1 and description of the system components is given thereafter.

TABLE 1. Main parameters of the magnetic bearings

Parameter	Value
Radial electromagnetic bearing	
Lifting capacity, N	3000
Interior / outer diameter of stator magnetic circuit, mm	150 / 300
Effective axial length, mm	100
Normal bias current, A	7.5
Mass, kg	118
Radial gap between bearing and rotor, mm	0.7
Radial gap between catcher bearing and rotor, mm	0.15
Axial electromagnetic bearing	
Lifting capacity, N	20000
Interior / outer diameter of stator magnetic circuit, mm	170 / 364
Normal bias current, A	15
Mass, kg	180
Radial gap between bearing and rotor, mm	1.0
Radial gap between catcher bearing and rotor, mm	0.3

5.1 Magnetic Bearing

AMB systems must be custom designed for each application. Also, AMB's can be adapted to existing system. Commonly, an AMB system is designed to include two

radial and one thrust bearing to control five possible degrees of displacement and rotation as shown in figure 1.

The radial and axial magnetic bearings are located in the generator and turbo compressor. In order to reduce the range of products, magnetic bearings for generator rotor and turbo compressor rotor are designed as the unified size according to the generator rotor load in

operation condition. The radial bearing radial gap is 0.15mm considering the gap of 0.4mm between the compressor stator and blades in order to protect the compressor.

5.2 Position Sensor

The rotor displacements in radial and axial are monitored by the position sensors, which are of induction type. The sensor consists of sensitive elements located on the stator and an acting element located on the rotor in front of the sensitive elements. The sensitive element is an annular magnetic circuit with 24 poles, of which each 6 poles are grouped to detect the radial displacements in X and Y directions. In such design, a kind of 2/3 redundancy working mode for sensor signals can be easily realized. The acting element is an extension made of the laminated ferromagnetic steel, which is fixed on turbomachine shaft. Windings around the stator perimeter are distributed in order to (

b) Receive the control commands from the operation computer to change some parameters of the AMB control system.

(c) Generate and release the current control signals in coil windings according to the specified algorithms and control commands.

(d) Diagnose the states of the elements of the AMB system and transmit this information to the operator computer via networks.

(e) Release signals about alarm and emergency protection.

5.4 Host Computer

average and smooth the measure value. This kind of sensor has good sensitivity of no less than 10mV/μm and resolution of at least 1μm. Its cut-off frequency is enough so high (>5k Hz) that the phase lag at operation frequency can be neglected. The voltage signal after the sensor modulator can be transferred more than 200m without obvious attenuation.

5.3 Controller

The controllers, as well as all its peripheral equipment, including A/D, D/A, network card, etc., is standard industry type, usually selected as high-speed Digital Signal Processing (DSP) computer, which has good stability and excellent hard real-time interrupt processing capability. For example, the new DSP product of TI 6713 has powerful floating-point operation of 1350 MFLOPS and can be adopted as the ideal microprocessor of the controller. The A/D converter has 10 channels with 500kS/s rate and 16bit precision, while the D/A converter has 5 channels with 1MS/s rate and 14bit precision. The controller shall have the following functions:

(a) Receive information about displacement, rotation speed and angular position of the

turbomachine rotor from the sensor converters.

The operating and monitoring computer (host) lies on the high level control channel, whose type is standard PXI industry computer and its operation system is universal MS Windows. The typical configuration of the host computer can select the NI with 2.3GHz Pentium 4 CPU. The communication between controller and host computer is based on industry network. The main functions of the host computer are listed as follows:

(a) Establish and change the control algorithms or rules of the AMB.

(b) Start up and stop the AMB control system.
(c) Receive information about the states of AMB components and display this information by different graphical means on the monitor.
(d) Diagnose controller state and make decision.
(e) Log and print information about the state of the AMB control system components.
(f) Send process information to the Instrument and Control (I&C) system of reactor plant.

5.5 Power Amplifier

The power amplifier receives the control signal in analog voltage from the controller and keeps the current in the magnet winding according to this voltage signal. Generally speaking, power amplifier is a kind of controlled constant-current source to the inductive reactance. As the power of single amplifier unit is about 4.5kVA (300V, 15A), switch amplifier is the best type considering the losses and efficiency. In order to reduce the drawback of switch amplifier of sharp oscillation impulsion at stable operation state, special method is selected to realize a relative smoothly current, such as three-state voltage level, two H-bridge connecting in series, high switch frequency of 60 kHz and so on. The phase lag is less than 3° at 200 Hz to achieve good dynamic characteristics.

6. Conclusion: To conclude the paper, various advantages offered by AMB system can be summarized as below:
1. Permits heavy loads.
2. Operation at high speeds. Rotor peripheral speed can be as high as 200 m/s.
3. Can work at wide range of temperatures varying from –150 ^{o}C to 450 ^{o}C.
4. No wear and tear due to absence of direct metal to metal contact.
5. No lubrication required; hence clean system. No sealing requirement.
6. No noise and vibrations.
7. Can work in corrosive atmosphere and also in vacuum conditions.
8. No frictional power loss except magnetic losses due to hysteresis and eddy currents.
9. Electronic control of bearing stiffness and damping characteristics: In case of rolling element, hydrodynamic and hydrostatic bearings these characteristics are constant depending upon the bearing geometry and bearing material. However, in AMB system, stiffness depends on the control equipment inherent frequency and the total suspended mass. Stiffness can be adapted and electronically controlled to suit the operating requirements by electronic circuit modification. For application requiring high positioning accuracy, the AMB system can be designed specifically for high stiffness.
10. Electronic control of rotor position.
11. Electronic control due to variation in any operating condition including any imbalance.

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2. Design and Experiments of the Active Magnetic Bearing System for the HTR-10: Lei Shi, Lei Zhao, Guojun Yang, Huidong Gu, Xingzhong Diao, Suyuan Yu; 2nd International Topical Meeting on "High Temperature Reactor Technology" Beijing, China, September 22-24, 2004 *#Paper D04*

3. Electromagnetic bearings, a reasonable element in turbomachinery? Seigwart, R

Brief Review of Finite Element Analysis

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What Is FEA??

Finite element analysis was first developed for use in the aerospace and nuclear industries where the safety of structures is critical. Today, the growth in usage of the method is directly attributable to the rapid advances in computer technology in recent years. As a result, commercial finite element packages exist that are capable of solving the most sophisticated problems, not just in structural analysis, but for a wide range of phenomena such as steady state and dynamic temperature distributions, fluid flow and manufacturing processes such as injection molding and metal forming.

FEA consists of a computer model of a material or design that is loaded and analyzed for specific results. It is used in new product design, and existing product refinement. A company is able to verify that a proposed design will be able to perform to the client's specifications prior to manufacturing or construction. Modifying an existing product or structure is utilized to qualify the product or structure for a new service condition. In case of structural failure, FEA may be used to help determine the design modifications to meet the new condition.

Mathematically, the structure to be analyzed is subdivided into a mesh of finite sized elements of simple shape. Within each element, the variation of displacement is assumed to be determined by simple polynomial shape functions and nodal displacements. Equations for the strains and stresses are developed in terms of the unknown nodal displacements. From this, the equations of equilibrium are assembled in a matrix form which can be easily be programmed and solved on a computer. After applying the appropriate boundary conditions, the nodal displacements are found by solving the matrix stiffness equation. Once the nodal displacements are known, element stresses and strains can be calculated

Within each of these modeling schemes, the programmer can insert numerous algorithms (functions) which may make the system behave linearly or non-linearly. Linear systems are far less complex and generally ignore many subtleties of model loading & behavior. Non-linear systems can account for more realistic behavior such as plastic deformation, changing loads etc. and is capable of testing a component all the way to failure. Despite the proliferation and power of commercial software packages available, it is essential to have an understanding of the technique & physical processes involved in the analysis. Only then can an appropriate & accurate analysis model be selected, correctly defined and subsequently interpreted.

History of FEM & FEA

Finite Element Analysis (FEA) was first developed in 1943 by R. Courant, who utilized the Ritz method of numerical analysis and minimization of variational calculus to obtain approximate solutions to vibration systems. Shortly thereafter, a paper published in 1956 by Turner, Clough, Martin, & Topp established a broader definition of numerical analysis. This paper centered on the "stiffness and deflection of complex structures".

By the early 70's, FEA was limited to expensive mainframe computers generally owned by the aeronautics, automotive, defense, and nuclear industries, and the scope of analyses were considerably limited. Finite Element technology was further enhanced during the 70's by such people as Zeinkiewicz & Cheung, when they applied the technology to general problems described by Laplace & Poisson's equations. Mathematicians were developing better solution algorithms, the Galerkin, Ritz & Rayleigh-Ritz methods emerged as the optimum solutions for certain categories of general type problems. Later, considerable research was carried out into the modelling & solution of non-linear problems, Hinton & Crisfield being major contributors.

While considerable strides were made in the development of the finite element method, other areas did not remain static. Very powerful mesh generation algorithms have been developed. Commercial generators have the capability of meshing all but the most difficult geometry. Superior CAE concepts have also emerged, it is not unusual to have a single CAD model for producing engineering drawings, carrying out kinematics & assembly analysis, as well as being used for finite element modeling. Due to the rapid decline in the cost of computers and the phenomenal increase in computing power, present day desktop computers are capable of producing accurate results for all kinds of parameters (standard PC's are over 10 times more powerful than the best supercomputers of the early 90's). The finite element method now has it's roots in many disciplines, the end result is a technology that is so advanced that it is almost indinguishable from magic. The vast catalog of capability that comprises FEA, will no doubt grow considerably larger in the future. CAE is here to stay, but in order to harness it's true power, the user must be familiar with many concepts, including the mechanics of the problem being modelled. All analyses require time, experience & most importantly, careful planning.

Application Areas

In essence, the finite element is a mathematical method for solving ordinary & partial differential equations. Because it is a numerical method, it has the ability to solve complex problems that can be represented in differential equation form. As these types of equations occur naturally in virtually all fields of the physical sciences, the applications of the finite element method are limitless as regards the solution of practical design problems.

Due to the high cost of computing power of years gone by, FEA has a history of being used to solve

complex & cost critical problems. Classical methods alone usually cannot provide adequate information to determine the safe working limits of a major civil engineering construction. If a tall building, a large suspension bridge or a neuclear reactor failed catastrophically, the economic & social costs would be unacceptably high.

In recent years, FEA has been used almost universally to solve structural engineering problems. One discipline that has relied heavily on the technology is the aerospace industry. Due to the extreme demands for faster, stronger, lighter & more efficient aircrafts, manufacturers have to rely on the technique to stay competitive. But more importantly, due to safety, high manufacturing costs of components & the high media coverage that the industry is exposed to, aircraft companies need to ensure that none of their components fail, that is to cease providing the service that the design intended.

FEA has been used routinely in high volume production & manufacturing industries for many years, as to get a product design wrong would be detrimental. For example, if a large manufacturer had to recall one model alone due to a piston design fault, they would end up having to replace up to 10 million pistons. Similarly, if an oil platform had to shut down due to one of the major components failing (platform frame, turrets, etc..), the cost of lost revenue is far greater than the cost of fixing or replacing the components, not to mention the huge environmental & safety costs that such an incident could incurs.

The finite element method is a very important tool for those involved in engineering design, it is now used routinely to solve problems in the following areas:

- Structural strength design
- Structural interaction with fluid flows
- Analysis of Shock (underwater & in materials)
- Acoustics
- Thermal analysis
- Vibrations
- Crash simulations
- Fluid flows
- Electrical analyses
- Mass diffusion
- Buckling problems
- Dynamic analyses
- Electromagnetic evaluations
- Metal forming
- Coupled analyses

Nowadays, even the most simple of products rely on the finite element method for design evaluation. This is because contemporary design problems usually cannot be solved as accurately & cheaply using any other method that is currently available. Physical testing was the norm in years gone by, but now it is simply too expensive.

A Typical Analysis

In the real world, no analysis is typical, as there are usually facets that cause it to differ from others. There is however a main procedure that most FE investigations take. This procedure is detailed below:

Planning the Analysis

This is arguably the most important part of any analysis, as it helps ensure the success of the simulation. Oddly enough, it is usually the one analysts leave out. The purpose of an FE analysis is to model the behaviour of a structure under a system of loads. In order to do so, all influencing factors must be considered & determined wether their effects are considerable or negligable on the final result. The degree of accuracy to which any system can be modelled is very much dependant on the level of planning that has been carried out. Answers to many questions need to be found. 'Planning an analysis' is dealt with in detail in the 'improving results' section of this site.

Pre-Processor

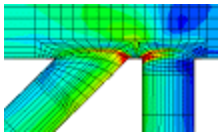
The preprocessor stage in general FE packages involves the following:

- Specifying the title, that is the name of the problem. This is optional but very useful, especially if a number of design iterations are to be completed on the same base model.

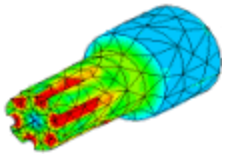
- Setting the type of analysis to be used, e.g. structural, fluid, thermal or electromagnetic, etc. (sometimes this can only be done by selecting a particular element type).

- Creating the model. The model is drawn in 1D, 2D or 3D space in the appropriate units (M, mm, in, etc..). The model may be created in the pre-processor, or it can be imported from another CAD drafting package via a neutral file format (IGES, STEP, ACIS, Parasolid, DXF, etc.). If a model is drawn in mm for example and the material properties are defined in SI units, then the results will be out of scale by factors of 10^6. The same units should be applied in all directions, otherwise results will be difficult to interpret, or in extreme cases the results will not show up mistakes made during the loading and restraining of the model.

- Defining the element type, this may be 1D, 2D or 3D, and specific to the analysis type being carried out (you need thermal elements to do thermal analyses).



- Applying a Mesh. Mesh generation is the process of dividing the analysis continuum into a number of discrete parts or finite elements. The finer the mesh, the better the result, but the longer the analysis time. Therefore, a compromise between accuracy & solution speed is usually made. The mesh may be created manually, such as the one on the right, or generated automatically like the one below. In the manually created mesh, you will notice that the elements are smaller at the joint. This is known as mesh refinement, and it enables the stresses to be captured at the geometric discontinuity (the junction).



Manual meshing is a long & tedious process for models with any degree of geometric complication, but with useful tools emerging in pre-processors, the task is becoming easier. Automatic mesh generators are very useful & popular. The mesh is created automatically by a mesh engine, the only requirement is to define the mesh density along the model's edges. Automatic meshing has limitations as regards mesh quality & solution accuracy. Automatic brick element(hex) meshers are limited in function, but are steadily improving. Any mesh is usually applied to the model by simply selecting the mesh command on the preprocessor list of the gui.

- Assigning properties. Material properties (Young's modulus, Poissons ratio, the

density, & if applicable, coefficients of expansion, friction, thermal conductivity, damping effect, specific heat etc.) will have to be defined. In addition element properties may need to be set. If 2D elements are being used, the thickness property is required. 1D beam elements require area, I_{xx}, I_{yy}, I_{xy}, J, & a direction cosine property which defines the direction of the beam axis in 3D space. Shell elements, which are 2½D in nature (2D elements in 3D space), require orientation & neutral surface offset parameters to be defined. Special elements (mass, contact, spring, gap, coupling, damper etc.) require properties (specific to the element type) to be defined for their use.

- Apply Loads. Some type of load is usually applied to the analysis model. The loading may be in the form of a point load, a pressure or a displacement in a stress (displacement) analysis, a temperature or a heat flux in a thermal analysis & a fluid pressure or velocity in a fluid analysis. The loads may be applied to a point, an edge, a surface or a even a complete body. The loads should be in the same units as the model geometry & material properties specified. In the cases of modal (vibration) & buckling analyses, a load does not have to be specified for the analysis to run.

- Applying Boundary Conditions. If you apply a load to the model, then in order to stop it accelerating infinitely through the computer's virtual ether (mathematically known as a zero pivot), at least one constraint or boundary condition must be applied. Structural boundary conditions are usually in the form of zero displacements, thermal BCs are usually specified temperatures, fluid BCs are usually specified pressures. A boundary condition may be specified to act in all directions (x,y,z), or in certain directions only. They can be placed on nodes, keypoints, areas or on lines. BC's on lines can be in the form of symmetric or anti-symmetric type boundary conditions, one allowing in plane rotations and out of plane translations, the other allowing in plane translations and out of plane rotations for a given line. The application of correct boundary conditions are a critical to the accurate solution of the design problem. At least one BC has to be applied to every model, even modal & buckling analyses with no loads applied. See the 'Advanced BCs' section for explanations on more advanced boundary condition types.

Solution

Thankfully, this part is fully automatic. The FE solver can be logically divided into three main parts, the pre-solver, the mathematical-engine & the post-solver. The pre-solver reads in the model created by the pre-processor and formulates the mathematical representation of the model. All parameters defined in the pre-processing stage are used to do this, so if you left something out, chances are the pre-solver will complain & cancel the call to the mathematical-engine. If the model is correct the solver proceeds to form the element-stiffness matrix for the problem & calls the mathematical-engine which calculates the result (displacement, temperatures, pressures, etc.). The results are returned to the solver & the post-solver is used to calculate strains, stresses, heat fluxes, velocities, etc.) for each node within the component or continuum. All these results are sent to a results file which may be read by the post-processor.

Post-Processor

Here the results of the analysis are read & interpreted. They can be presented in the form of a table, a contour plot, deformed shape of the component or the mode shapes and natural frequencies if frequency analysis is involved. Other results are available for

fluids, thermal and electrical analysis types. Most post-processors provide an animation service, which produces an animation & brings your model to life.

Contour plots are usually the most effective way of viewing results for structural type problems. Slices can be made through 3D models to facilite the viewing of internal stress patterns.

All post-processors now include the calculation of stress & strains in any of the x, y or z directions, or indeed in a direction at an angle to the coordinate axes. The principal stresses and strains may also be plotted, or if required the yield stresses and strains according to the main theories of failure (von mises, St. Venant, Tresca etc.). Other information such as the strain energy, plastic strain and creep strain may be obtained for certain types of analyses.

A Final Word

The finite element method extremely powerful. However, with comforting contour plots, one can be easily fooled into thinking that a superior result has been achieved. The quality of the result is totally dependent on the quality of the analysis model & how accurately it represents the physical problem being investigated. Remember, careful planning is the key to a successful analysis. Sometimes an analysis is not required, as some problems have analytical or imperical solutions, others may be determined using spreadsheets.

Difference between FEM & FEA.

This is a very contentious issue, one that academics love to debate over a cool long-neck of a friday evening. I am going to stick my head on the block here & try to explain the difference, happy chopping my academic friends.

The terms 'finite element method' & 'finite element analysis' seem to be used interchangeably in most documentation, so the question arises is there a difference between FEM & FEA??

The answer is yes, there is a difference, albeit a subtle one that is not important enough to lose sleep over.

The finite element method is a mathematical method for solving ordinary & elliptic partial differential equations via a piecewise polynomial interpolation scheme. Put simply, FEM evaluates a differential equation curve by using several polynomial curves to follow the shape of the underlying & more complex differential equation curve. Each polynomial in the solution can be represented by a number of points and so FEM evaluates the solution at the points only. A linear polynomial requires 2 points, while a quadratic requires 3. The points are known as node points or nodes. There are essentially three mathematical ways that FEM can evaluate the values at the nodes, there is the non-variational method (Ritz), the residual method (Galerkin) & the variational method (Rayleigh-Ritz).

FEA is an implementation of FEM to solve a certain type of problem. For example, if we were intending to solve a 2D stress problem. For the FEM mathematical solution, we would probably use the minimum potential energy principle, which is a variational solution. As part of this, we need to generate a suitable element for our analysis. We may choose a plane stress, plane strain or an axisymmetric type formulation, with linear or higher order polynomials. Using a piecewise polynomial solution to solve the underlying differential equation is FEM, while applying the specifics of element formulation is FEA, e.g., a plane strain triangular quadratic element.

Hybrid Electric Vehicles

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Abstract

The development in automobiles to realize vehicles with better fuel economy and lesser emissions has led to the Hybrid Electric vehicles. Lot of research work is being done on hybrid vehicles and the stage has nearly arrived when we can see these vehicles running on Indian roads. The main aim of this paper is to give a brief introduction and special features of Hybrid Electric Vehicles.

Introduction

Hybrid electric vehicles typically combine the internal combustion engine of a conventional vehicle with the battery and electric motor of an electric vehicle. The combination offers low emissions, with the power, range, and convenient fueling of conventional (gasoline and diesel) vehicles.

The largest factor that has perhaps instigated the research and introduction of hybrid vehicles is the concerns for increasing air pollution in our global environment. It is estimated that as much as 80 percent of the air pollution is caused from the emissions from vehicles, a phenomenon commonly observed in metropolitan cities around the world. One way of reducing air pollution, as well as emission of harmful gases is the introduction of hybrid vehicles, using dual technologies of gas and electricity. Though researches have also been made in the fuel-cell powered system of battery which make electricity as the principle source of power, yet the use of dual powers of gas and electricity have more than proved their success.

Working of Hybrid Electric Vehicles

Hybrid electric vehicles are powered by two energy sources—an energy conversion unit (such as a combustion engine or fuel cell) and an energy storage device (such as batteries or ultra capacitors). The energy conversion unit may be powered by gasoline, methanol, compressed natural gas, hydrogen, or other alternative fuels. Hybrid electric vehicles have the potential to be two to three times more fuel-efficient than conventional vehicles.

The primary engine is used for highway driving; the electric motor provides added power during hill climbs, acceleration, and other periods of high demand. The primary engine is connected to a generator that produces electricity. The electricity charges the batteries, which drive an electric motor that powers the wheels. [1]

Hybrid-Electric cars have following parts:

Internal Combustion engine: The hybrid car has an I.C. engine much like the one you will find on most cars. However, the engine on a hybrid is smaller and uses advanced technologies to reduce emissions and increase efficiency.

Fuel tank: The fuel tank in a hybrid is the energy storage device for the gasoline engine. Gasoline has a much higher energy density than batteries do. For example, it takes about 1,000 pounds of batteries to store as much energy as 1 gallon (7 pounds) of gasoline.

Electric motor: The electric motor on a hybrid car is very sophisticated. Advanced electronics allow it to act as a motor as well as a generator. For example, when it needs to, it can draw energy from the batteries to accelerate the car. But acting as a generator, it can slow the car down and return energy to the batteries.

Generator: The generator is similar to an electric motor, but it acts only to produce electrical power. It is used mostly on series hybrids.

Batteries: The batteries in a hybrid car are the energy storage device for the electric motor. Unlike the gasoline in the fuel tank, which can

only power the gasoline engine, the electric motor on a hybrid car can put energy into the batteries as well as draw energy from them.

Transmission: The transmission on a hybrid car performs the same basic function as the transmission on a conventional car. [2]

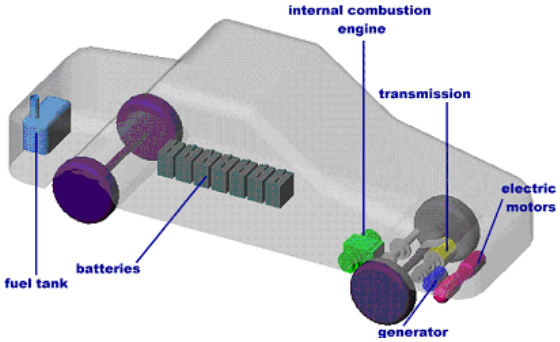

Figure 1: Structure of Hybrid Electric Vehicle

Different modes of working in the Hybrid Vehicles

An internal combustion engine runs most efficiently at highway speeds, and so it is used alone in highway driving. It is very inefficient in stop and go traffic. However, an electric motor would soon deplete its battery on a long highway drive, but can drive the vehicle efficiently through city traffic with no emissions to release into the city atmosphere. Of course, there are driving modes in between these, when both I.C.E. and electric motors work in tandem, as when the vehicle is accelerating.

Power flow through the drive mechanism depends on the arrangement of the system and several clutches which engage and disengage components from the assembly. In the following diagrams:

solenoid clutch #1	controls the connection between the I.C.E. and the generator.
solenoid clutch #2	controls the connection between the I.C.E. and the transmission.
overrunning clutch #3	controls the connection between the I.C.E. and the system.
overrunning clutches #4&5	control the connections between the electric motors and the system.

Case 1: When the HEV is started only electric motor is in operation up to a certain speed so as to minimize emissions from ICE.

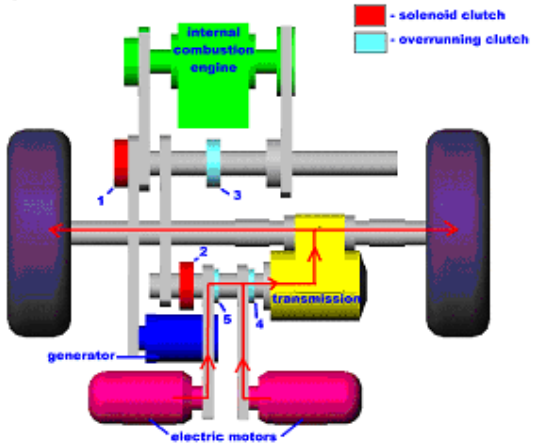

Figure 2: Battery providing driving power

Power flows from both electric motors, through the transmission, and to the drive shaft and tyres. Overrunning clutches 4 and 5 are engaged, all others are disengaged.

Case 2: When High acceleration is required both power sources provide power.

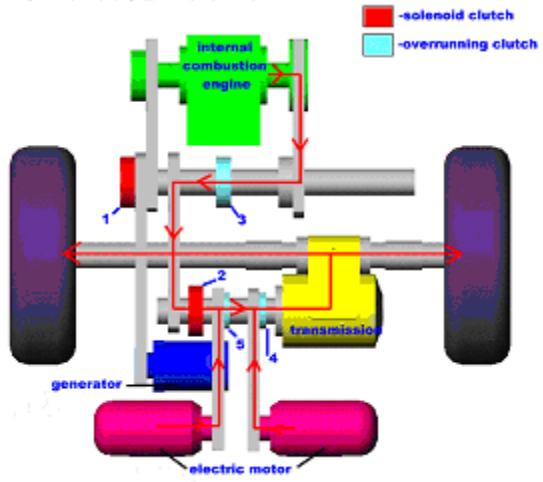

Figure 3: Both engine and battery driving vehicle

Power flows from the internal combustion engine, through the secondary drive shaft, through the transmission, and then to the primary drive shaft and then to the tires. Power also flows from both electric motors to the transmission, and then to the primary drives shaft and tyres. Overrunning clutches 3, 4, and 5 are engaged and solenoid clutch 2 is engaged. All others are disengaged.

Case 3: While Cruising engine has a lot of extra power, this power from engine is utilized in charging battery.

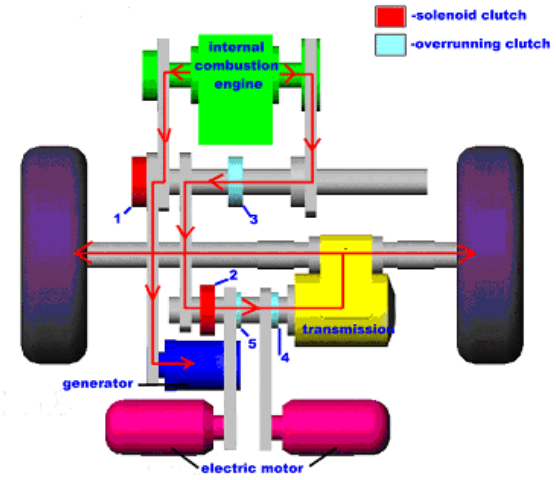

Figure 4: Engine charging battery and driving vehicle

Power flows from the internal combustion engine, through drive shaft 2, to the transmission, and then to drive shaft 1 and the tires. Power also flows from the I.C.E., through drive shaft 2, and to the generator. Overrunning clutch 3 and solenoid clutch 1 are engaged, all others are disengaged.

Case 4: The HEV's are provided with **Regenerative Braking**: The electric motor applies resistance to the drive train causing the wheels to slow down. In return, the energy from the wheels turns the motor, which functions as a generator, converting energy normally wasted during coasting and braking into electricity, which is stored in a battery until needed by the electric motor.

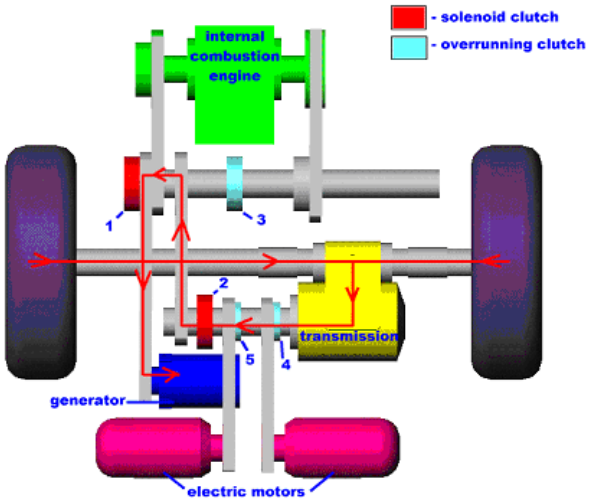

Figure 5: Battery charging by wheel motion.

Power flows from the wheels to the primary drive shaft, then through the transmission, through the secondary drive shaft, and to the generator, and finally to the batteries. This occurs during regenerative braking. Solenoid clutches 1 and 2 are engaged, all other clutches are disengaged.

Case 5: Both Electric motor and ICE provides power and ICE also charges battery

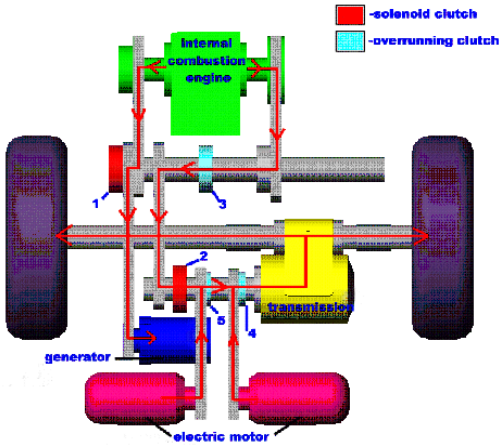

Figure 6: Power flow when both power sources are working in tandem and engine charging battery

Power flows from the internal combustion engine, through the secondary drive shaft, to the transmission, then through the primary drive shaft and the tyres. The I.C.E. also provides power to the generator, through solenoid clutch 1,

and then to the batteries. Also, the electric motors provide power to the primary drive shaft, through the transmission. All clutches are engaged. [3]

Types of Hybrid Vehicle

Hybrid vehicles make use of both an on-board rechargeable energy storage system and a fueled power source for vehicle propulsion. There are many ways to accomplish this.

1. **Types by drive train structure**

1.1 **Parallel hybrid:** Parallel hybrid systems, which are most commonly produced at present, have both an internal combustion engine and an electric motor connected to a mechanical transmission. To store power, a large battery pack is charged to a higher voltage than the normal automotive 12 volts. Accessories such as power steering and air conditioning are powered by electric motors instead of being attached to the combustion engine. This allows efficiency gains as the accessories can run at a constant speed, regardless of how fast the combustion engine is running.The electric motor turns on only when a boost is needed. Others can run with just the electric system operating.

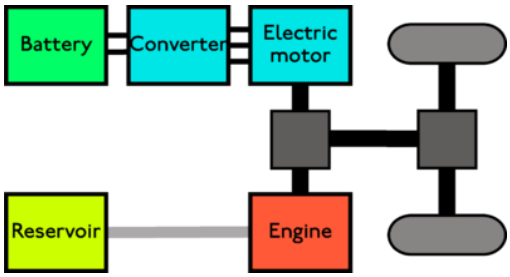

Figure 7: Structure of a parallel hybrid electric vehicle

1.2 **Series hybrid:** In a series hybrid system, the combustion engine drives an electric generator instead of directly driving the wheels. The generator both charges a battery and powers an electric motor that moves the vehicle. When large amounts of power are required, the motor draws electricity from both the batteries and the generator. A complex transmission is not needed, as electric motors are efficient over a wide speed range. The combustion engine runs at a constant and efficient rate, even as the car changes speed. During stop-and-go city driving, series hybrids are relatively the most efficient.

A weakness is that the power from the combustion engine has to run through both the generator and electric motor. During long-distance highway driving, the electrical transmission can be less efficient than a conventional transmission.

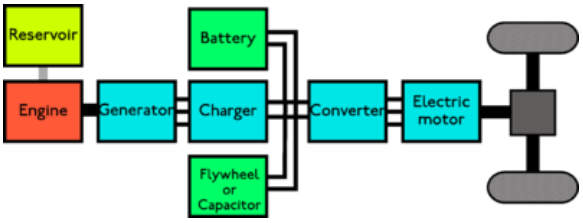

Figure 8: Structure of a series hybrid vehicle

1.3 **Combined hybrid:** Combined hybrid systems have features of both series and parallel hybrids. They incorporate power-split devices allowing for power paths from the engine to the wheels that can be either mechanical or electrical. The main principle behind this system is the decoupling of the power supplied by the engine (or other primary source) from the power demanded by the driver. These vehicles has a **power split device**. This is a clever gearbox that hooks the gasoline engine, generator and electric motor together. It allows the car to operate like a **parallel hybrid** - the electric motor can power the car by itself, the gas engine can power the car by itself or they can power the car together. The power split device also allows the car to operate like a **series hybrid** - the gasoline engine can operate independently of the vehicle speed, charging the batteries or providing power to the wheels as needed. It also acts as a **continuously variable transmission** (CVT), eliminating the need for a manual or automatic transmission. Finally, because the power split device allows the generator to start the engine, the car does not need a starter.

In a conventional vehicle, a larger engine is used to provide acceleration from still than one needed for steady speed cruising. This is because a combustion engine's torque is minimal at lower RPMs, as the engine is its own air pump. On the other hand, an electric motor exhibits maximum

torque at stall and is well suited to complement the engine's torque deficiency at low RPMs. In a combined hybrid, a smaller, less flexible, and highly efficient engine can be used. It is often a variation of the conventional Otto cycle, such as the Miller or Atkinson cycle. This contributes significantly to the higher overall efficiency of the vehicle, with regenerative braking playing a much smaller role. [4]

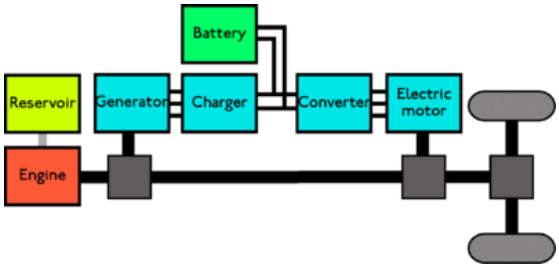

Figure 9: shows the structure of a combined hybrid electric vehicle

2. **Types by degree of hybridization**

There are degrees of hybridization such as "mild" and "full" and even different drive trains utilized depending on which hybrid you're looking at. If we approach hybrids by looking at five technology steps that separate conventional vehicles from battery electric vehicles, we can better evaluate how a particular hybrid operates. To be a true hybrid, a vehicle needs the first three steps. The fourth and fifth create the potential for hybrids with superior energy and environmental performance.

If it ...	Conventional Vehicle	Mild Hybrid	Full Hybrid	Plug-In Hybrid
Shuts off the engine at stop-lights and stop-and-go traffic	●	●	●	●
Uses regenerative braking and operates above 60 volts		●	●	●
Uses an electric motor to assist a conventional engine		●	●	●
Can drive at times using only the electric motor			●	●
Recharges batteries using clean electricity from the wall plug and has a range of at least 20 miles on electricity alone				●

Figure 10: shows level of hybridization

2.1 **Idle-Off:** Like the switch that turns off the refrigerator light bulb when the door is closed, this feature allows a vehicle to turn off its gasoline engine when stopped, saving fuel. In a well-designed system, the engine will turn back on and be ready to go in less time than it takes for you to move your foot from the brake to the gas pedal. However, while hybrids use a full function electric motor operating above 100 Volts to accomplish this, conventional vehicles accomplish this same thing by using a beefed up 12 Volt or 42 Volt starter motor (often called an integrated starter-generator). So, this ability alone does not define a hybrid even though all hybrids can do this.

2.2 **Regenerative Braking:** The energy associated with a car in motion is called kinetic energy-the faster a car moves, the more kinetic energy it has. To slow down or stop a car, you have to get rid of that energy. In a conventional car, you use the friction of your mechanical brakes to stop, turning the kinetic energy into hot brakes and thereby throwing away the energy. Regenerative braking takes over some of the stopping duties from the friction brakes and instead uses the electric motor to help stop the car. To do this, the electric motor operates as a generator, recovering some of the kinetic energy and converting it into electricity that is stored in the battery so it can be used later to help drive the vehicle down the road. In order for the system to actually improve fuel economy, however, the vehicle must have a large enough electric motor operating at a high enough voltage to efficiently capture the braking energy. Also, the vehicle requires a battery pack with enough capacity to store this energy until it is needed.

2.3 **Power Assist and Engine Downsizing:** The most basic definition of a hybrid vehicle is one that uses two methods of providing power to the wheels. As a result, the ability of an electric motor to help share the load with a gasoline engine is the technology step that, on top of the first two, truly qualifies a vehicle as a hybrid. A vehicle meets this classification only if it has a large enough motor and battery pack such that the motor can actually supplement the engine to help accelerate the vehicle while driving. This power assist ability, combined with downsizing the engine, allows the vehicle to achieve the same performance as a vehicle with a larger engine

while achieving superior fuel economy. Typically vehicles containing these first three features are categorized as a "mild" hybrid like the Insight, Civic, and Accord hybrids from Honda.

2.4 **Electric-only-drive:** This technology step allows the vehicle to drive using only the electric motor and battery pack, thus taking full advantage of electric side of the dual system. With this step, we separate out "full" hybrids such as the Toyota Prius and Ford Escape Hybrid. This is the reason why Prius owners are sometimes shocked when they start their car and don't even realize it's on—only the quiet battery system is operating the car rather than the traditional rumble of the combustion engine. The greater flexibility of full hybrids allows the vehicle to spend more time operating its engine only when it is at its most efficient. At low speeds and at launch, the electric motor and battery powers the car and at high speeds the engine takes over.

2.5 **Extended Battery-Electric Range:** The final level of hybridization extends the electric motor's capacity to drive car by recharging battery from a clean energy grid (i.e. plug in).A plug-in hybrid electric vehicle (PHEV) is a hybrid which has additional battery capacity and the ability to be recharged from an external electrical outlet. In addition, modifications are made to the vehicle's control software. The vehicle can be used for short trips of moderate speed without needing the internal combustion engine (ICE) component of the vehicle, thereby saving fuel costs. In this mode of operation the vehicle operates as a pure battery electric vehicle with a weight penalty (the ICE). The long range and additional power of the ICE power train is available when needed.

This would allow the hybrid to operate solely as a battery-electric vehicle for as much as 20-60 miles, thus improving their environmental performance if they are using clean sources of electricity. A Plug-in can operate as a typical full hybrid if it is not recharged from the power grid, so the benefits of this feature are largely dependent on how often the consumer plugs in. The biggest challenge with these hybrids is cost—they have the highest up-front costs because they require larger motors and battery packs to ensure good vehicle performance and sufficient all-electric range. To date automakers have not offered any of these hybrids for passenger vehicles, though DaimlerChrysler is currently testing a commercial van-based plug-in hybrid. [5]

Advantages of Hybrid Vehicles

1. Low Emissions and High Efficiency
2. High Fuel Economy and Low Costs
4. Energy Security

The key to a hybrid car is that the gasoline engine can be much smaller than the one in a conventional car and therefore more efficient. Most cars require a relatively big engine to produce enough power to accelerate the car quickly. In a small engine, however, the efficiency can be improved by using smaller, lighter parts, by reducing the number of cylinders and by operating the engine closer to its maximum load.

Limitations

1. Hybrid Cars accelerate at much slower speeds compared to vehicles totally powered by gasoline. This is the major disadvantage because many drivers feel unsafe in an automobile that is incapable of keeping pace with traditional vehicles.
2. Batteries last an average of 80,000 miles before replacement is necessary, which then costs an estimated $5,000 to $8,000, depending on the model.
3. Hybrid vehicles are smaller and use lightweight body materials, which make them more vulnerable to complete destruction in an automobile accident than larger, steel reinforced vehicles. HEVs are not available in all areas of the country and the few places that do have them are limited in stock.
4. To convert a normal gasoline powered engine to electric power costs an average of $7,500, excluding the cost of labor. The process also includes 17 steps and can take up to 75 hours of manual, back-breaking labor. Parts Included in the Conversion: Batteries-$1,000 to $2,000 Motor-$1,000 to $2,000 Controller-$1,000 to $2,000 Adapter Plate- $500 to $1,000. [6]

Future for Hybrid Vehicles

Today, all major automakers are working on producing HEVs and fuel cell vehicles. Auto manufacturers are looking to create various versions of hybrids. Some using diesel engines and a battery pack, others with a "mild hybrid" system where the battery pack gently assists the conventional engine, and still others where fuel cells would be integrated into the hybrid system. There are many ways to configure an HEV and many different approaches to fueling the vehicles as well.

HEVs are now at the forefront of transportation technology development. Hybrids have the potential to allow continued growth in the automotive sector, while also reducing critical resource consumption, dependence on foreign oil, air pollution, and traffic congestion. Hybrids are a hot subject today and will remain till the Fuel cell technology become useable in the vehicles.

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Logistics management

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Abstract

Logistics management concepts and tools currently have a great value for several business sectors that are searching for productivity and competitiveness improvement, providing costs reduction and better customer satisfaction. With that purpose they are trying to promote a better integration between internal and external actors who support logistics activities. Logistics management offers everything that one want in a career—job openings at all levels, excellent salaries, upward mobility, exciting responsibilities and worldwide opportunities within the function and throughout the company. The demand for logistics managers at all levels is excellent. The increasing importance of analytical, strategic, and technological activities also makes logistics an attractive career to more people. Another factor which contributes to the changing face of logistics is the value that organizations are placing on diversity today. Successful organizations realize that diversity gives them an edge in the highly competitive global marketplace. As a result they are recruiting a variety of people from all walks of life for their logistics management positions. Logistics is a discipline worthy of attracting the best and the brightest people from all walks of life. Anyone with the education, skills, and drive to succeed can build a prosperous career in logistics management.

1 A historical perspective on logistics

Logistics is as old as the world itself. The word logistics is derived from the Greek word logistics, which means to be adept or skillful in calculation. Even though the concept of the calculation of requirements for support may be connected to the meaning of the word, it does not provide us with anything more concerning the origin of the word logistics. Since the earliest times logistics has been associated with supplying masses of people with their needs. One of the first examples of a massive logistics exercise logistics is associated with a military force.

2 Definitions

The most basic definition for logistics comes from the Webster Dictionary: "The procurement, maintenance, and transportation of military material, facilities, and personnel." Another very basic definition: “The organization of supplies and services”, and as: “The art of supplying and organizing services and equipment etc.” A more recent definition is: “The aspect of military science dealing with the procurement, maintenance, and transportation of military material, facilities and personnel”.

The Council of Logistics Management (CLM) offers the following definition: "Logistics is the process of planning, implementing and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods and related information from point of origin to point of consumption for the purpose of conforming to customer requirements"

The Society of Logistics Engineers (SOLE) defines logistics as "The art of science and management, engineering, and technical activities concerned with requirements, design, and supplying and maintaining resources to support objectives, plans and operations"

Logistics work requires:

- Knowledge of agency program planning, funding, and management information

systems.

- Knowledge of the organization and functions of activities involved in providing logistical support.
- Ability to coordinate and evaluate the efforts of functional specialists to identify specific requirements and to develop and adjust plans and schedules for the actions needed to meet each requirement on time.

3 What is logistics?

Logistics is the universal thread or "pipeline" that plans and coordinates the delivery of products and services to customers all over the world (see diagram below). Logistics professionals manage and coordinate activities in this global pipeline to ensure an effective and efficient flow of materials and information from the time a need arises until it is satisfied and beyond.
The goal of these logistics activities is to satisfy the needs of the ultimate consumer—you. Simply stated, logistics managers ensure that…

***...the right** product**, in the right** quantity**, in the right** condition**, is delivered to the right** customer **at the right** place**, at the right** time**, at the right** cost.*

It involves the integration of information, transportation, inventory, warehousing, material handling, and packaging. The operating responsibility of logistics is the geographical repositioning of raw materials, work in process, and finished inventories where required at the lowest cost possible. This was mainly due to the increasing complexity of supplying one's business with materials and shipping out products in an increasingly globalized supply chain, calling for experts in the field who are called Supply Chain Logisticians. This can be defined as having the right item in the right quantity at the right time for the right price and is the science of process and incorporates all industry sectors. The goal of logistic work is to manage the fruition of project life cycles, supply chains and resultant efficiencies.

Movement=Transportation
Storage=Inventory, Warehousing

Logistics does not deal with Technology of Production, such as the design of machines and vehicles and the design of finished products.

4 Transportation:

Some of the important questions are:

a) Where resources should be moved to, and by what mode and route?
b) When should shipment be sent through terminals, and when should shipment be sent direct?
c) Which, and how many, terminals should shipments be sent through?
d) What are the best vehicle routes?
e) When should a vehicle be dispatched over a route?

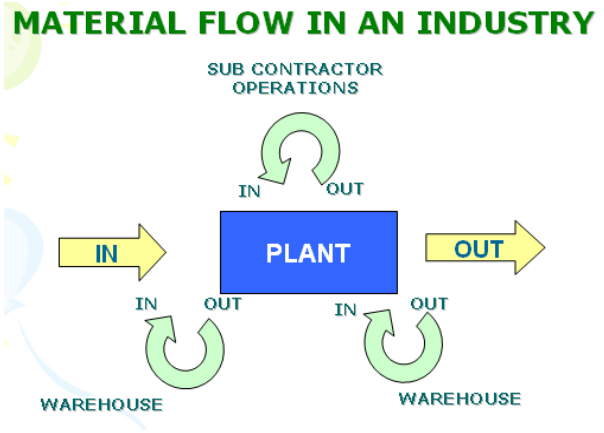


Figure 1 Ware house

5 How important is logistics?

Logistics has a huge impact on the domestic and global economy. Low-cost information is being leveraged against more expensive logistics assets such as inventory, warehousing, labor and transportation.

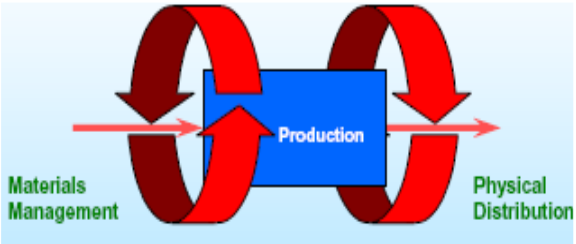


Figure 2: Importance & Information

What is the role of logistics in the organization?

Logistics is critical to the success of every organization. Logistics is now recognized as a strategic tool for creating customer value and loyalty. Companies like Wal-Mart, Coca Cola, and Nike attribute a great deal of their success to their global logistics systems.

The scope of opportunities for logistics professionals is expanding. Logistics managers are involved in boundary and organization-spanning teams, strategic planning, alliance building, and a host of other activities that directly impact the success of their organizations worldwide. Because these roles are expanding, a career in logistics management.

6 Objectives of Logistics Planning

- Cost reduction
- Capital reduction
- Service improvement

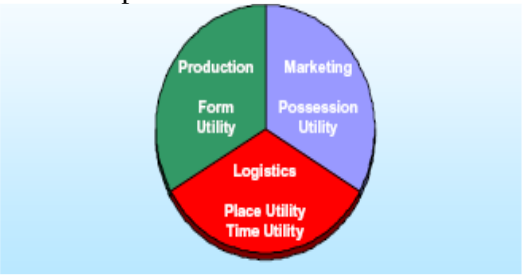


Figure 3: Value-Added Role of Logistics. (*Logistics adds time and place utility*)

What is Logistics Management?

Logistic management is the management process which integrates the flow of supplies into, through and out of an organization to achieve a level of service which ensures that the materials are available at the right place, at the right time, of the right quality, and at the right cost. Logistics management is the process of planning, preparing, implementing, and evaluating all logistics functions that support an operation or activity. Effective logistics management ensures all functions are executed in a unified manner to reduce costs, ensure appropriate support actions, and decrease delivery time.

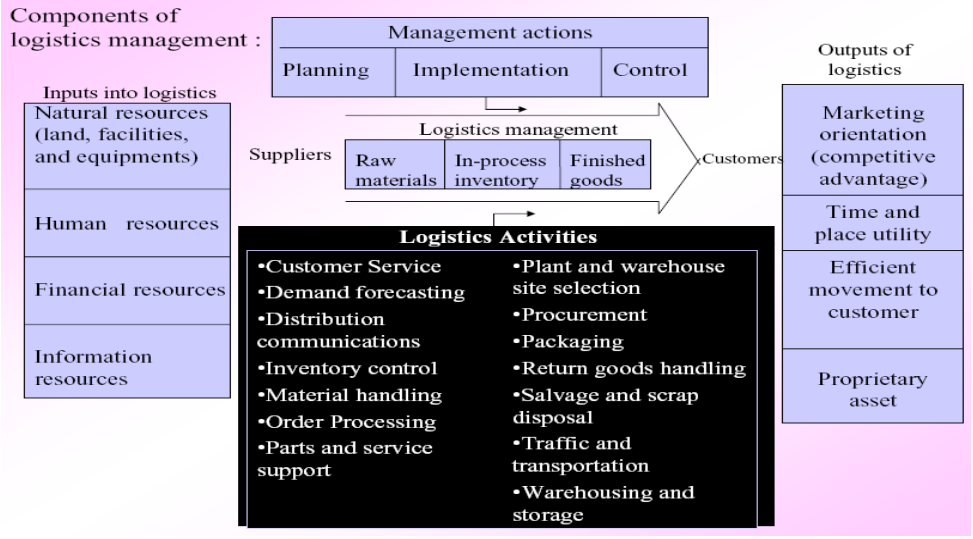


Figure4: Components of Logistics Management

6 The primary responsibilities of logistics management specialists are:

- To identify all activities that will be involved in providing needed logistical support.
- To integrate the actions required of each activity into a comprehensive logistics plan in support of or to be incorporated into overall program plans.
- To monitor progress toward meeting the logistics plan and to identify the cause and impact of delays or other problems.
- To adjust plans and schedules for all related actions as required by delays or changes to logistics requirements.
- To evaluate plans for and provision of logistical support for feasibility, efficiency, and economy, and to develop alternatives when required.

The work is performed through consultation with technical specialists in each function on specific requirements and capabilities, lead times, costs, and other matters affecting logistics planning. The logistics management specialist must understand the functional fields involved in sufficient depth to accurately understand and analyze the logistics management implications of the information obtained.

7 Distinguishing Between Logistics Management and Other Occupations

Some positions which require extensive coordination and interrelationship with numerous logistics functions may initially appear to be properly classified in the Logistics Management.

7.1 Supply Management

The supply occupations are sometimes confused with logistics management. Supply work involves furnishing all types of supplies, equipment, material, and property. Supply activities range from the initial identification of requirements to the ultimate issue of items for disposal. Supply work exists at many different levels of an agency's organizational structure. In a staff capacity, supply specialists analyze, develop, evaluate, and plan supply systems and programs with the goal of assuring that the necessary items are in the right place at the right time to meet required needs. To accomplish the duties and responsibilities associated with the provision of supplies, equipment, and material, many supply specialists have varying degrees of coordination and involvement with other logistics functions such as maintenance, procurement, transportation, fiscal management, and automated data processing.

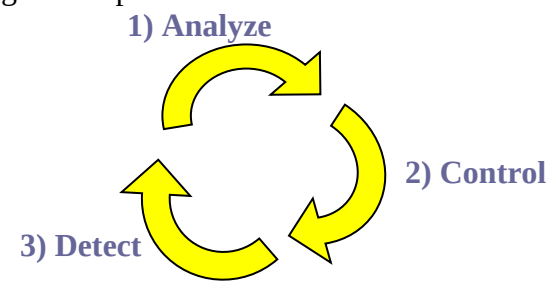
Figure 5: A scene of Ware House

Logistics management work can rarely be done without the specialist having some degree of knowledge of supply systems, procedures, and programs. In fact, most logistics management positions require the application of a broad general knowledge of supply systems, techniques, and procedures. Overriding the requirement for supply knowledge, however, is a requirement for integrating or coordinating supply activities with those of other functional specialties such as maintenance, facilities management, and transportation. This is done for the primary purpose of assuring that all support requirements are met. In carrying out this coordinative effort the logistics management specialist need not have a comprehensive indepth knowledge of supply functions to the extent required of supply specialists. When problems or issues arise requiring a highly developed expertise in supply operations, the logistics management specialist

relies upon the supply specialist to provide input and take necessary action.

7.2 Inventory Management

In some organizational settings, especially at large supply centers, inventory management may be confused with logistics management. In fact, some positions which are now properly classified may have grown out of the inventory management occupation. Inventory Logistics Management, whether at the operational level or at the staff level, is specifically and primarily oriented toward the control and positioning of material to meet identified material needs. At the operational level, inventory management is concerned with, among other things, supply items ("piece parts"), processing requisitions, reallocating or redistributing material, analyzing requirements, and recommending procurement actions. Inventory management involves developing policy; developing and evaluating material management programs, systems, procedures, and methods; and developing long-range plans. In contrast, logistics management involves activities which support the overall requirements of a material system. This work involves not only the coordination of material or supply requirements for the assigned system, but also a concern for other functions such as maintenance planning, securing adequate facilities for maintenance, managing support agreements, and reviewing performance data to determine budgetary requirements. Such work requires a general knowledge of inventory management as well as other logistics support functions in order to integrate, coordinate, and analyze total support requirements. Some inventory management work involves considerable contact with other functional activities similar to the contacts maintained by logistics management specialists.



8 Logistic Readiness

In order to maintain the highest levels of preparedness in the industries, material must be maintained at an acceptable state of readiness so that their designated missions can be carried out. The efficiency and effectiveness of the material and support has profound influence on the industry's capability to meet material needs. The work of some logistics management specialists is devoted specifically to planning for and evaluating logistic readiness.

The evaluation of the state of logistic readiness is made through the compilation and analysis of data which describes such factors as the availability and state of repair of material, long- and short-range planning for support, and the responsiveness of numerous program and logistics functions in meeting support requirements. In order to resolve requirements and to increase levels of readiness, extensive coordination is made with logistics functional specialists, planning offices, and representatives of such support functions as manpower, training, and budget. Causes for problems and deficiencies are sought and corrective actions planned and coordinated.

Figure 6: Logistics Management

Logistics Information Systems

Automated data processing systems play a major role in overall logistics program planning and execution. Logistics information systems are designed to provide data which facilitate the activities of logistics functional and program specialties.

The maintenance of logistics information systems requires the logistics management specialist to serve as an "intermediary" between the functional specialties, such as supply and maintenance, and the automated data processing function. The work involves assistance and coordination with functional specialists in the identification of operational requirements and the subsequent "translation" of these requirements for information into the language and format appropriate for computerized systems application. The work also involves the analysis of data automation policies, regulations, and procedures to determine their impact on logistics information systems and to identify changes in the maintenance and use of computerized data by functional specialists.

- Information technology
- Third-party logistics

9 Logistics Issues for the 21st Century

- An intense refocusing on the customer
- A quest for quality and productivity
- Reduced differentiation on product and price
- A trend toward fewer suppliers
- Information exchange for inventory investment
- More powerful computers and software
- Integration of the TOTAL supply chain

10 Future Challenges in Logistics

- Strategic planning and participation
- Just-in-time (JIT); Quick response (QR); &
- Efficient consumer response (ECR)
- Logistics as a competitive weapon
- Emphasis on reducing logistics costs
- Logistics as a boundary-spanning activity
- Supply chain management
- Globalization

The increasing importance of international logistics operations to corporations presents both prospects and problems for distribution professionals.

On one hand, they will gain stature in their company … on the other hand, they will face a larger number of more sophisticated logistics problems stemming from the complex nature of overseas distribution operations.

To cope with today's requirements in economy and industry an efficient management of logistics on all levels is essential. Logistic has been with mankind since the beginning of time even through its formal definition only came much later. Different phases of the interest in logistics on the man-made environment have been identified, and the effects and impact of logistics can be measured and quantified within each phase. However, some contradictory definitions exist that create confusion as to exactly what this thing logistic is. This confusion is attributed towards functionalizing logistics as opposed to taking a systems and life-cycle approach to understanding logistics.

Logistics is the latest buzzword today. Why not when acknowledged that 'Logistics alliances' are making industries more efficient and thus more competitive. Though things acknowledgement has come a bit late in the day, logistics as a function existed even earlier – albeit in a different form. Forces of Globalization, practice of outsourcing coming to age, embracing of JIT – Just-In-Time Philosophy, Shrinking products life cycles, developments in Information Technology (IT) and most importantly realization that inventory in all forms is a cost center are said to be the forces behind logistics function taking certain stage. Thus the role of logistics has been examined in this report in modern world.

Smart Materials

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Abstract
Smart Materials are presently making a move in all the spheres of technology and a lot of research is going on them. By this paper you will get a clear understanding of smart materials technology, the advantages and disadvantages it offers over traditional materials and engineering and manufacturing techniques. It also includes valuable insight into the research that is under way-how thing work and how are they progressing and what obstacles still remain to be overcome before commercialization can begin. You will also discover the prospects for smart materials in the marketplace, and pinpoint potentially lucrative opportunities to exploit these innovative technologies.

Introduction
Smart materials are the materials which respond to environmental stimuli with particular changes in some variables. For that reason they are often also called as **responsive** materials.
Depending on changes in some external conditions, smart materials change their properties (mechanical, electrical, appearance), their structure or composition, or their functions. Smart materials are materials that have one or more properties that can be significantly altered in a controlled fashion by external stimuli, such as stress, temperature, moisture, pH, electric or magnetic fields. [1]

Classification of Smart materials
1. **Piezoelectric materials**
Piezoelectric materials have the ability to produce a voltage when subjected to mechanical stress. The effect is reversible when these materials are subjected to an externally applied voltage, can change shape by a small amount, for example quartz.

Applications
1. **High-voltage sources**
Direct piezoelectricity of some substances like quartz, can generate thousands of volts (known as high-voltage differentials).
a) A similar idea is being researched by DARPA in the USA in a project called Energy Harvesting, which includes an attempt to power battlefield equipment by piezoelectric generators embedded in soldiers' boots.
b) A piezoelectric transformer is a type of AC voltage multiplier. Unlike a conventional transformer, which uses magnetic coupling between input and output, the piezoelectric transformer uses acoustic coupling. An input voltage is applied across a short length of a bar of piezo-ceramic material such as PZT, creating an alternating stress in the bar by the inverse piezoelectric effect and causing the whole bar to vibrate. The vibration frequency is chosen to be the resonant frequency of the block, typically in the 100 kilohertz to 1 megahertz range. A higher output voltage is then generated across another section of the bar by the piezoelectric effect. Step-up ratios of more than 1000:1 have been demonstrated. An extra feature of this transformer is that, by operating it above its resonant frequency, it can be made to

appear as an inductive load, which is useful in circuits that require a controlled soft start.

2. **Sensors**

a) Piezoelectric elements are used in electronic drum pads to detect the impact of the drummer's sticks.

b) Automotive engine management systems use a piezoelectric transducer to detect detonation, by sampling the vibrations of the engine block.

c) Smart sensors for side impact diagnostics in automobiles. Used for deploying air bag at different levels, in real time.

3. **Diesel engines**

High-performance common rail diesel engines use piezoelectric fuel injectors, instead of the more common solenoid valve devices.

7. **Reduction of vibrations**

The TU Darmstadt in Germany researches ways to reduce and stop vibrations by attaching piezo elements. When the material is bent by a vibration in one direction, the system observes the bend and sends electric power to the piezo element to bend in the other direction.

Such an experiment was shown at the Material Vision Fair in Frankfurt in November 2005. Several panels were hit with a rubber mallet, and the panel with the piezo element immediately stopped swinging.

8. **Coin Verification**

Automatic dispensing of goods and services relies on payment beforehand with coins and due allowance for many possible combinations to achieve the target fee must be made. Piezoelectric materials such as PZT provide a cost-effective means of verifying individual combinations offered.

A PZT plate measuring a few millimetres in length and width will provide an adequate electrical signal that can be processed electronically for validation purposes when impacted by a coin. With reference to the diagram, a coin is rolled down a guide and allowed to strike an isolated metal anvil. The PZT plate, attached to the anvil, produces an electrical signature for the unique modes of vibration of the anvil when struck by each coin type. The advantage of using a PZT sensor is that it only responds to mechanical vibrations in the anvil. Dimensions, material density, elastic coefficient and mass distribution in the coin all determine how the anvil vibrates making it very unlikely that two different coins will produce identical signatures. [2]

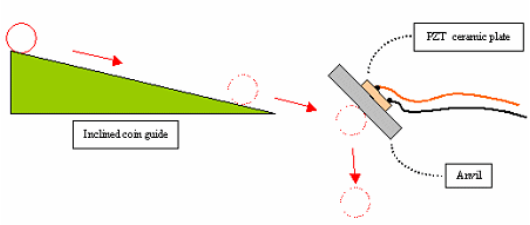

Figure 1: shows coin hitting the ceramic plate

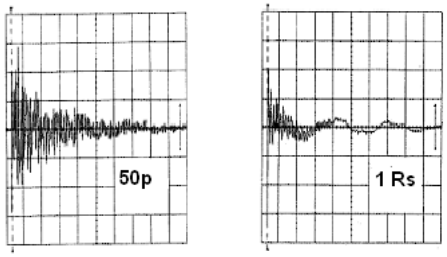

Figure 2: show oscillograms signatures for 50 paise and 1 Rs. coins from a typical experiment.

2. **Rheological materials**

Smart materials encompass not only solids but also fluids. Electro-rheostatic

(ER) and magneto-rheostatic (MR) materials are fluids which can experience a dramatic change in their viscosity. These fluids can change from a thick fluid to nearly a solid substance within the span of a millisecond when exposed to a magnetic or electric field; the effect can be completely reversed just as quickly when the field is removed.

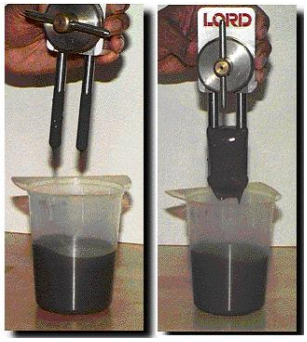

Figure 3: shows the effect of field on rheological materials

Applications of ER fluids:

a) Its use in fast acting hydraulic valves and clutches, with the separation between plates being of the order of 1 mm and the applied potential being of the order of 1 kV. In simple terms, when the electric field is applied, an ER hydraulic valve is shut or the plates of an ER clutch are locked together, when the electric field is removed the ER hydraulic valve is open or the clutch plates are disengaged.

b) Other proposed uses are in shock absorbers.

c) Use in the army's planned future force warrior project. They plan to create bulletproof vests using an ER fluid because the ability to soak the fluid into cloth creates the potential for a very light vest that can change from a normal cloth into a hard covering almost instantaneously.

Applications of MR fluids:

a) **Automobiles:** If the shock absorbers of a vehicle' suspension are filled with MR fluid instead of plain oil, and the whole device surrounded with an electromagnet, the viscosity of the fluid (and hence the amount of damping provided by the shock absorber) can be varied depending on driver preference or the weight being carried by the vehicle - or it may be dynamically varied in order to provide stability control

b) **Smart Structures**: MR fluid is used inside large dampers to stabilized buildings during earthquakes. During an earthquake, MR fluid inside the dampers will change from solid to liquid and back as tremors activate a magnetic force inside the damper. Using these dampers in buildings and on bridges will create **smart structures** that automatically react to seismic activity. This will limit the amount of damage caused by earthquakes. **Skyscrapers and long bridges** are susceptible to resonance created by high winds and seismic activity. In order to mitigate the resonance effect, it is important to build large dampers into their design to interrupt the resonant waves. If these devices are not in place, buildings and bridges can be shaken to the ground, as is witnessed anytime an earthquake happens. The sizes of the dampers depend on the size of the building and are designed to absorb the violent shocks of an earthquake.

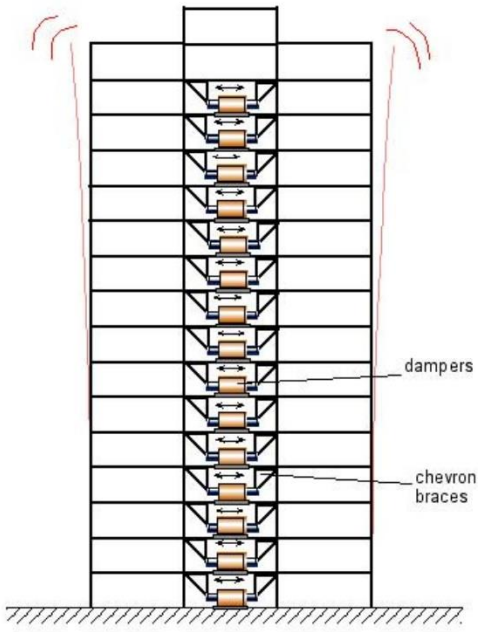

Figure 4: shows building incorporated with rheological dampers

Each damper would sit on the floor and be attached to the chevron braces that are welded into a steel cross beam. As the building begins to shake, the dampers would move back and forth to compensate for the vibration of the shock. When it's magnetized, the MR fluid increases the amount of force that the dampers can exert. [3]

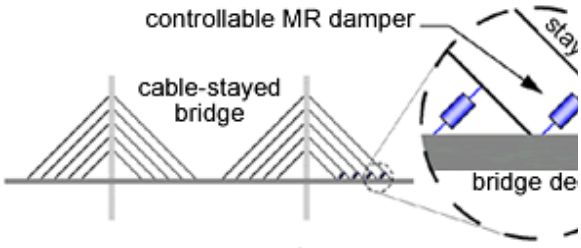

Figure 5: shows Cable-Stayed Bridges

3. **Thermo-responsive materials**

Thermo-responsive materials or Shape memory alloys, the dominant smart material, change shape in response to heat or cold. They are most commonly nickel and titanium combined.

Applications

a) **Pic-Micro controller**: It uses a muscle wire. This wire is a nickel and titanium alloy. At room temperature it can be stretched by a small force. However, when a small current is passed through the wire it returns to a much harder form and to its original length with a reasonable force. An important use of **muscle wire** and a **PIC micro-controller** circuit is seen below.

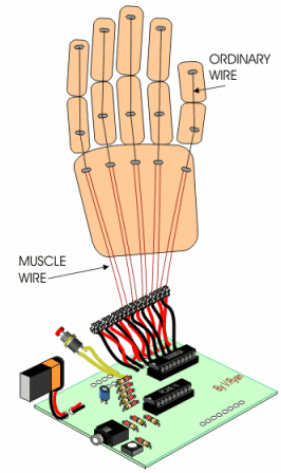

Figure 6: shows robotic hand using thermo-responsive material wire

A robotic hand has 'stretched muscle wires' attached to the base of each finger. When current is applied to the muscle wire it contracts to its 'natural' length, pulling on the ordinary wire, making the fingers look as if they are moving. A PIC micro-controller can be programmed so that outputs are switched ON or OFF. When switched ON the muscle wire contracts (shrinks) to its original length. In the example, five of the outputs have been programmed to switch on and off, making the fingers of the hand move.

b) There have been many attempts made to re-create human anatomy through mechanical means. The human body however, is so complex that it is very

difficult to duplicate even simple functions. Robotics and electronics are making great strides in this field, of particular interest are limbs such hands, arms, and legs. In order to reproduce human extremities there are a number of aspects that must be considered:

- The gripping force required to manipulate different objects (eggs, pens, tools)
- The motion capabilities of each joint of the hand
- The ability to feel or touch objects (tactile senses)
- The method of controlling movement within the limb
- Emulating real human movement (smoothness, and speed of response).

Shape memory alloys mimic human muscles and tendons very well. SMA's are strong and compact so that large groups of them can be used for robotic applications, and the motion with which they contract and expand are very smooth creating a life-like movement unavailable in other systems.

Creating human motion using SMA wires is a complex task but a simple explanation is detailed here. For example to create a single direction of movement (like the middle knuckle of your fingers) the setup shown in Figure 7 could be used. The bias spring shown in the upper portion of the finger would hold the finger straight, stretching the SMA wire, then the SMA wire on the bottom portion of the finger can be heated which will cause it to shorten bending the joint downwards (as in Figure 7). The heating takes place by running an electric current through the wire; the timing and magnitude of this current can be controlled through a computer interface used to manipulate the joint.

There are still some challenges that must be overcome before robotic hands can become more commonplace. The first is generating the computer software used to control the artificial muscle systems within the robotic limbs. The second is creating large enough movements to emulate human flexibility (i.e. being able to bend the joints as far as humans can). The third problem is reproducing the speed and accuracy of human reflexes.

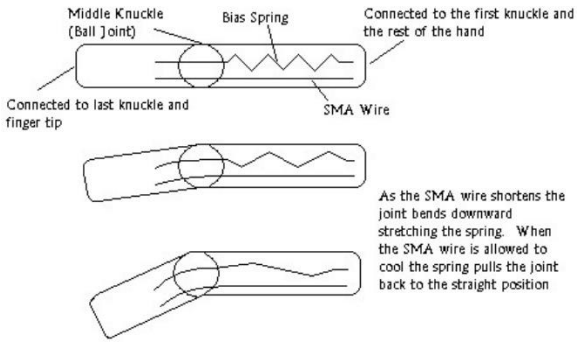

Figure 7: shows robotic finger incorporated with thermo-responsive or SMA material

SMA's can be used to model railway signal. When current is passed through the 'stretched' muscle wire it returns to its original length, lifting the signal.

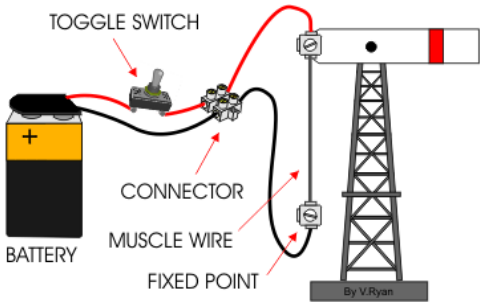

Figure 8: shows use of SMA wire in Railway Signal Modeling

b) **Window Actuators**

Smart ventilation system was developed based on a material known as 'shape memory alloy' (SMA). SMA material offers great potential and is commercially available. This material is able to return to a predetermined shape or size with high force when its temperature exceeds a certain level.

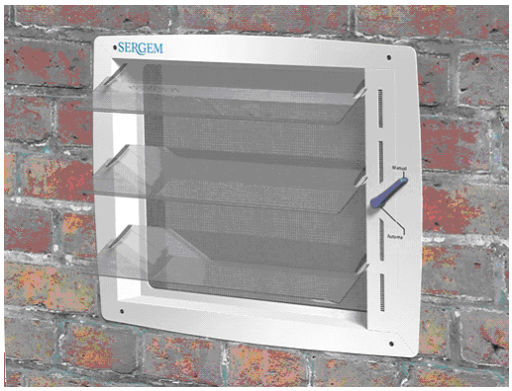

Figure 9: shows ventilation system guided by SMA

The **ventilation system** will open or close autonomously based on the inside and/or outside temperature of a building, without the need for electricity. [4]

4. **Halochromic materials**

These are the materials which have ability to change color with variation of different parameters.

a) **pH-sensitive materials:** The most interesting of these are indicators that change colors as a function of pH, and show promise in paints that change color when the metal beneath begins to corrode.

b) **Electro-chromic materials**: Electro-chromium is defined as the ability of a material to change its optical properties when a voltage is applied across it. Electrochromic is the phenomenon displayed by some chemical species of reversibly changing color when a burst of charge is applied. Example of such materials includes tungsten oxide (WO3), which is the main chemical used in the production of electrochromic windows or smart windows.

Applications

a) **Smart windows**

Electrochromic windows darken when voltage is added and are transparent when voltage is taken away. Like suspended particle devices, electrochromic windows can be adjusted to allow varying levels of visibility. Electrochromic windows center around special materials that have **electrochromic** properties. "Electrochromic" describes materials that can change color when energized by an electrical current. Essentially, electricity kicks off a chemical reaction in this sort of material. This reaction (like any chemical reaction) changes the properties of the material. In this case, the reaction changes the way the material reflects and absorbs light. In some electrochromic materials, the change is between different colors. In electrochromic windows, the material changes between colored (reflecting light of some color) and transparent (not reflecting any light).

At its most basic level, an electrochromic window needs this sort of electrochromic material and an electrode system to change its chemical state from colored to transparent and back again. There are several different ways to do this, employing different materials and electrode systems.

-Like other smart windows, electrochromic windows are made by sandwiching certain materials between two panes of glass.

In this design, the chemical reaction at work is an **oxidation reaction -** a reaction in which molecules in a compound lose an electron. Ions in the sandwiched electrochromic layer are what allow it to change from opaque to transparent. It's

these ions that allow it to absorb light. A power source is wired to the two conducting oxide layers, and a voltage drives the ions from the ion storage layer, through the ion conducting layer and into the electrochromic layer. This makes the glass opaque. By shutting off the voltage, the ions are driven out of the electrochromic layers and into the ion storage layer. When the ions leave the electrochromic layer, the window regains its transparency.

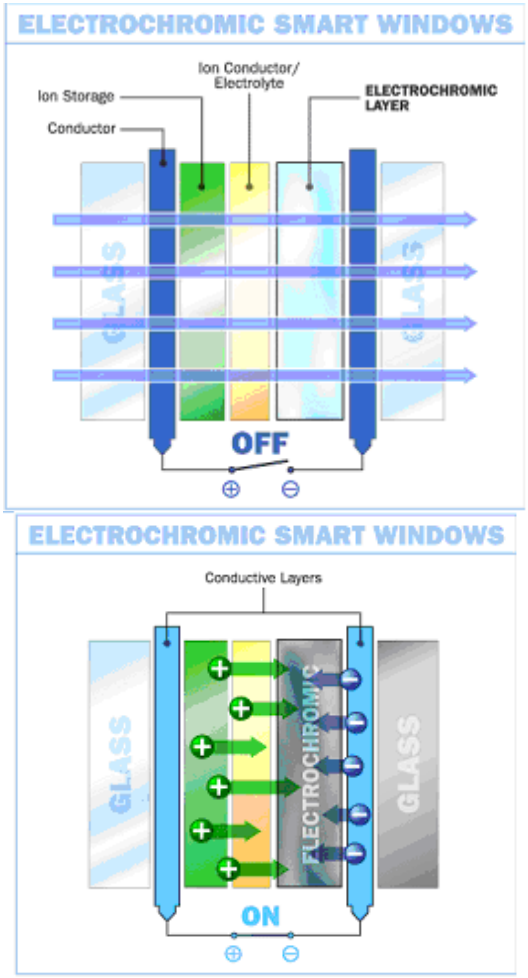

Figure 10: When switched off, an electrochromic window remains transparent. When switched on, a low volt of electricity makes the electrochromic window translucent.

With an electrochromic smart-window, it only requires electricity to make the initial change in opacity. Maintaining a particular shade does not require constant voltage. You merely need apply enough voltage to make the change, and then enough to reverse the change- making this pretty energy efficient. In fact, according to Sage Electronics, you can run a house full of electrochromic windows for about the same amount of money that it takes to power a single 75-watt light bulb.[5]

5. **Smart gels**

Smart gels are a class of materials that expand or contract when triggered by tiny changes in temperature, light, a solvent or other stimulus. The ability of the gels to undergo huge but reversible changes in volume allows unique new systems to be made that can encapsulate and release materials.

Applications

a) They could be useful in applications such as an artificial pancreas that releases insulin inside the body in response to high sugar level. They really just expanded or contracted to absorb or expel fluids

b) Using hydro gels: - Water-based, gelatin-like polymers that can be programmed to expand and contract in reaction to temperature Japanese have created a self-regulating delivery system for medicine. When fever raises the body temperature, the tiny particles of the hydrogel contract and squeeze out medication. And when fever subsides, the particles expand to hold the medication in Hydrogel devices that can be implanted to medicate an illness. Once the device has completed its task, it can be broken

down and absorbed by the body. Both the injection and the device could work for as long as a month or as short as a single day. [6]

6. **Electroactive Polymers**
When in contact with water or another fluid, electricity is passed through the material to change its crystalline structure. This voltage change results in a shape change. Muscles operate in a similar way, so it should be no surprise that some of the first research with electroactive materials had to do with creating parts of the fictional "bionic man". Thus the robotic limbs can be made up of these materials and there movement can be governed by changing the voltage**.** They need to be wet to work efficiently. [7]
Example of Electroactive Polymers isIonic Polymers

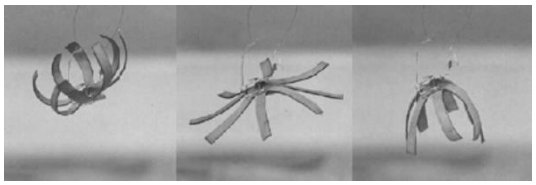

Figure 11: Ionic polymer starfish, showing different stages in response to varying electric input.

Conclusion
Current research focuses on cost, durability and uniformity. The most important aspect of smart systems is cost, not the technology behind it. Materials, technologies or individual components that go into smart systems are of little interest in the marketplace. The chosen solution will not necessarily use the best technology but will offer the best net value to the customer. Smart systems must offer added value relative to alternative non smart approaches for market acceptance and growth. Most smart ceramic systems face significant cost and complexity-of-application obstacles. All the traditional materials will face a tough competition from these materials once they become cost effective.

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ROBOTICS – *an evolution*

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Abstract
Relentless efforts by scientists and engineering community had triggered off an unceasing & swift development in the field of robotics. Robots have contributed remarkably towards the benefits and comforts of humanity, be it the field of Medical Science & of Industrial advancements in Automation, Technology & Household Assistance, Entertainment & Education. Their significant contribution has led to the betterment of Lifestyle, Security, Health, Entertainment and learning. In a period of last fifty years these machines have ousted man from almost every industrial field where parameters like speed, efficiency, accuracy, cost effectiveness are of prime importance. It will certainly not be exaggeration to say that in future robots would leave their masters (i.e. human beings) who have created them far behind in their march towards Intelligence and Supremacy.

1.Introduction

Robotics: Robotics is the study of the design, construction and use of robots

Robots: "A Reprogrammable, Multifunctional Manipulator designed to move material, parts, tools, or specialized devices through various Programmed motions for the performance of a variety of tasks."

"An automatic device that performs functions normally ascribed to humans or a machine in the form of a human."

A robot must obey 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.

Types of robots

Adaptive robots: These robots get feedback from a sensor to alter the operation of device.

The term robot derives from the Czech word robota, meaning forced work or compulsory service, or robotnik, meaning serf. "Force through intelligence."

"Where AI (Artificial Intelligence) meet the real world."

Asimov's laws of robotics (1942)

A robot may not injure a human being, or, through inaction, allow a human being to come to harm.

Non-adaptive robots: No way of sensing the environment, so do the job regardless of any environmental factors.

Stationary robots: Stationary robots remain at one place.

Mobile robots: Mobile robots are free to move around

Robots that move around on legs, tracks or wheels.

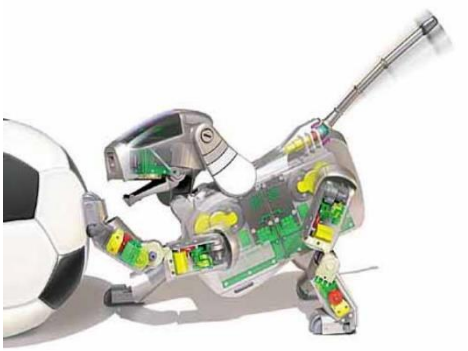
In 1979 a nuclear accident caused a

- leak of radioactive material which

was controlled by a special robot TELEOPERATOR.

1. **Educational robots:** Robotics kits are extensively used in education for e.g. ROBOLAB, LEGO, ROBOCUP SOCCER

6. **Domestic robots:** These are those robots which are designed to perform the house hold task like mowing the lawn, cleaning pools, and washing windows, and modern toys which are programmed to do things like talking, walking and dancing as well they entertain small children.



7) **Industrial robots**

a. Material handling
b. Welding
c. Inspection
d. Improving Productivity
e. Laboratory Applications

Purpose of robots

- Repetitive tasks that robots can do 24/7.
- Robots never get sick or need time off.
- Robots can do tasks considered too dangerous for humans.

- Robots can operate equipment to much higher precision than human.
- May be cheaper over the long term.
- May be able to perform task that are impossible for humans.

Robots are basically used for the following task

- Dirty Task Like painting of automobiles, garbage disposal.
- Repetitive Or Mundane Jobs Like welding, washing etc.
- Dangerous Tasks Like Bomb Diffusing
- Impossible Tasks like exploration on different planets
- Robots Assisting The Handicaps with the help of artificial robotic arms or legs.

Applications of robotics

1. **Exploration**

- Space mission
- Robots in the antarctica
- Exploring volcanoes
- Under water exploration

2. **Medical science**

- Surgical Assistant
- Artificial Robotics Arms Or Legs

3. **Industrial application**

- Automated manufacturing
- Assembly
- Painting
- Machining
- Welding

Historical developments

13th – 15th century
An automated rooster erected on top of the cathedral in Strasbourg in 1350 is a good example. It was designed to flap its wings and crow every day at noon.

18th century
In 1774 inventors Pierre and Henri-Louis Jacquet-Droz unveiled the "**Automatic Scribe**". This lifelike figure of a boy could draw and write any message up to 40 characters long. A robot woman **playing a piano** was another one of their great inventions.

19th century
Robots of the 1800s were chiefly designed to meet the growing demands of a flourishing industrial society.
A good example is this Textile Machine**.**
1890: THOMAS EDISON used a condensed version of his phonograph invention in the
design of the famous **talking doll**.
1898: NIKOLA TESLA, a famous inventor, patents the first remote controlled device. The "**teleautomaton"** which was a crewless boat was controlled from a distance without wires.

20th century
It triggered off the high end industrial application robots
1940: Westinghouse Electric Corp. creates two of the first robots that use the electric motor for entire body motion. **Elektra** could dance, count to ten and smoke, while his dog companion **sparko**, could walk, stand on its hind legs and bark.
1941: **isaac asimov** first uses the term 'ROBOTICS' to describe the technology of robots. He predicted the rise of the robot industry.

1968: sri international, formerly known as the Stanford Research Institute, builds and tests the first mobile robot with vision capability. '**shakey**' was equipped with a television camera, a range finder and sensors. Shakey was the first mobile robot that could think and respond to the world around it.
1968: The General Electric **walking truck** was the first manual controlled walking truck.
1969: Stanford University develops the first electrically powered **computer controlled robotic arm**. This becomes standard for research projects.
1974: Professor Sheinman, of Stanford Arm fame, forms Vicarm Inc. to market a version of the arm controlled by microcomputer for industrial applications. This **robotic arm**, known as the Silver Arm performs small-parts assembly using touch sensitive sensors.

First commercial robot

After the 1950's the **first commercial robot** nicknamed the **'Unimate'**, was created.
The first Unimate was installed at a General Motors plant to work with heated die-casting machines.

Present developments in robotics

1. **Bomb disposal** (mini-Andros robot) robots make a dangerous job a little less hazardous. They're designed to search for, locate and neutralize explosive devices. One of the main **advantages** of robots is their ability to operate in environments that are HAZARDOUS OR DEADLY TO HUMANS.
American scientists developed Pioneer in response to the disaster at the Chernobyl Nuclear Power Station. This robot was designed to withstand large doses of radiation and is capable of clearing debris.

Mini Andros
(Bomb Disposal Robot)

2. **Industrial robot like material handling:** A robot is required to palletize soft packages onto a pallet. Robot Palletizer for the Sugar and Flour Industry

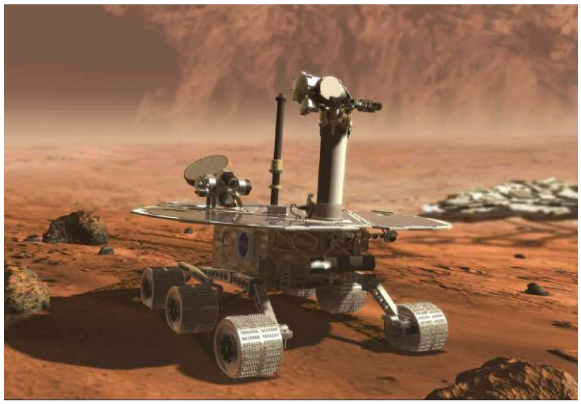
3. **Biological research** – biology inspired ("biomimetic") autonomous underwater robots based on the lobster and the lamprey (an eel-like jawless vertebrate).

4. Internet bots: Also known as web robots are automated internet applications controlled by software agents. The word "bot" in the term is a reference to the "robotic", mundane, repetitive tasks that the applications perform.[citation needed]Tactile sensors and skin are close to providing robots with a human-like sense of touch. The South Korean government has set a goal of having a robot in every South Korean home by 2015-2020.Robot News gives current news in robotic developments and Talking Robots Podcast contains interviews with robotics professionals.

5. **Research – exploring the outer space**

Canadarm - Canada's most famous robot and technological achievement - made its space debut on November 13; 1981.It was given to NASA as Canada's contribution to the Space Shuttle Program. Officially known as the Shuttle Remote Manipulator System (SRMS), Canadarm is an analogue of the human arm, with nerves of copper wiring, bones of graphite fibre and electric motors In place of muscles.

6. **Exploring other planets by nasa using rovers, landers, pathfinders**
Mars Pathfinder was originally designed as a technology demonstration of a way to deliver an instrumented lander and a free ranging robotic rover to the surface of the red planet. Pathfinder not only accomplished this goal but also returned an unprecedented amount of data and outlived its primary design life.



7. **Humanoids**
In 1997 Honda produced a robot that was more human-like than any other. Honda's aim was to produce a two-legged robot with the ability to be totally mobile in everyday environments. The P3 can walk around, climb stairs, carry things, pick things up and push things. Its camera-based 'eyes' help it to position itself accurately in its environment and stay balanced while walking or even climbing stairs. The technology used for the P3 was incorporated into Honda's dancing robot ASIMO, the latest in the range. Its ability to move has been increased and a new portable controller makes it much easier to operate.

The future of robotics

1. **Nano-technology:** Nanomedicine is a branch of nanotechnology which includes the construction, repair, monitoring and control of the human body at the molecular level. Basically this technology will be comprised of tiny nanomachines and programmable nanorobots which will be able to operate on the human body with greater precision than ever before imagined.

2. **Telesurgery:** The idea of robots performing open-heart surgery sounds like science fiction but recently this idea has become a reality. With the invention of the “Da Vinci Surgical System”, introduced in 1999 by the California Company Intuitive Surgical, surgeons can operate on patients while sitting at a computer council from across the room where they control a robot much like playing a video game.

3. **Space exploration:** Scientist think that there may be possibility that life may exist at other planets, so to pursue their

long space expeditions robots are highly helpful.

4. **Unmanned air vehicles (UAV):** It is used for military purpose for ensuring peace and security.

5. **Controlling terrorism:** With the use of bomb disposal robots, peace and harmony can be maintained thereby controlling terrorism.

6. **Military developments:** In spite of sacrificing life of defense personnel, mechanical robots are used to fight wars.

7. **Developemenmt in the field of biomedicines:** Nano-Sized robots are injected in the body of patients, which performs the treatment without stitches and cuts.

Dangers and fears

Although robots have not developed to the stage where they pose any threat or danger to society, fears and concerns about robots have been repeatedly expressed in a wide range of books. The principal theme is the robots' intelligence and ability to act could exceed that of humans, that they could develop a conscience and a motivation to take over or destroy the human race. Designing and programming robots to be intrinsically safe and to exhibit safe behavior in a human environment is one of the great challenges in robotics. Some people suggest that developing a robot with a conscience may be helpful in this regard.

Conclusion

It is the field of robotics which posses' greatest challenge to the scientists and it is this field of robotics which have constantly motivated and encouraged many aspiring young scientist to carve a name for themselves in history by significantly contributing to the field. Plenty of feats have been successfully achieved in the field but as they say the future is uncertain which hold many other peaks, which the humans still think to scale those Peaks and march forward in their pursuit to attain the unattainable and make possible the things which seems to be impossible today.

Evaluating the trend of development in the field of robotics over the last one hundred years, we come to an affirmative conclusion that the unimaginable development is going to take place in the next 30-40 years and it would be especially in the hi-tech field like Space Exploration, Nanotechnology, Medical Science, Military etc.

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Intelligent Highways

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Abstract

Traffic is getting worse everywhere, especially in the larger cities. Trip lengths are longer, increasing travel time. Traffic jams occur more frequently, as do traffic accidents causing personal injury and property damage. Traffic congestion is primarily due to an increase in the amount of traffic at a far greater rate than construction of new roads. A scary prospect is that local communities feel that road construction will never catch up with the traffic load. Financial constraints, political issues, and environmental impact studies slow down and in some cases actually prevent new road construction. In general, traffic is going to get worse before it gets better. The goal of such highways/roadways is to use technology to help increase the capacity of existing roads. While the primary objective of such program is to improve traffic flow, the system can significantly help to reduce emissions too, by reducing or nullifying stoppage time on red lights, toll-booths, etc. Such a system would be employing technologies such as GPS systems, Cell phone tracking systems, loop detectors, etc. to perform the many complex functions involved.

1. Components of an Intelligent Highway.

Recent developments in electronics, especially wireless systems, make it possible to build a practical 'Intelligent Highway'. These systems would include the application of a normal cell phones, GPS receivers, Smart Tags, etc. to enable smooth flow of traffic.

An intelligent highway, to perform efficiently, should be able to perform several basic functions like data acquisition, data transmission, control and vehicle-equipment interaction.

The data acquisition system for the intelligent highway will adopt different sensors to detect the presence and quantity of traffic and as well as weather conditions. Induction loop detectors are used at intersections to provide control to signal lights. These will remain in use, but other types of sensors will be installed at intersections and along roadways. Radar detectors have successfully been installed on overhead structures to detect traffic on multilane highways. Additionally, video cameras in a closed circuit television (CCTV) system will be employed.

2. Need for an intelligent traffic management system.

1) Such highways/roadways will help us to reduce stoppage time at red lights, toll-booths, etc. and covert these wasted minutes to fruitful work.

2) Intelligent traffic systems would help us to abridge emissions from vehicles as when a number of cars are idling in a given spot, the levels of emission are much higher and hazardous to human beings as well as to the atmosphere.

3) Newer technologies aim at fully automatic cars, which won't be requiring a driver behind the steering wheel, and thus would be driven automatically by the help of GPS, radars, sensors, etc, planted both inside the vehicle and on overhead beams.

4) An intelligent highway would enable fast and efficient tolling without stopping the vehicle. This would help to reduce a lot of time and money. This would again employ sensors to do the job. Companies like E-Zpass have already installed such electronic tolling booths and are doing a fine job. The time is gone when you had to search for change in your pocket to get a toll ticket.
5) In case of accidents, such intelligent traffic systems would automatically contact the concerned agencies.
6) Intelligent highways/roadways would enable flexible ramp metering or what we generally call as traffic lights. The timing of these lights would change automatically according to the amount of traffic on the road. These would be self adapting, efficient and strict systems which won't allow the traffic rules to be broken.
7) In the near future, theft of vehicles would be nearly impossible, as the stolen car would be traced immediately by radars, satellites. The information would be passed on to the real owner of the car via cell phone or the internet, thus creating a safe world for car owners.

3. Working of an Intelligent Highway.
All of the sensor data and video will be transmitted by wireless means to a control centre for the analysis and compilation for its ultimate use. Once the data has been collected, analyzed, and formatted, it will again be transmitted by wireless means. Traffic and road condition data can be transmitted by standard broadcast AM, FM, and TV stations, using radio data systems (RDSs), the new digital satellite radios, and finally via GPS service. The main control centre would be set up to acquire, process and communicate the collected information. The system would verify the information accuracy, reconcile conflicting data, and prepare a set of traffic-condition data for transmission. The control centre would monitor important roadways intersections with CCTV, as well as display this information. Control centers would develop wireless messages for transmission to display signs or to supply adaptive control to traffic signals. Ultimately, control centers may even transmit commands to provide remote control of individual vehicles.

3.1 Global Positioning System (GPS) – The heart of future traffic management.
A key part of the system will be a GPS (Global Positioning System) receiver. It will supply location information that can be transmitted via the cell phone. Additionally, the GPS system will be implemented in conjunction with a processor and digitized maps that will provide on-screen maps for driver navigation. Information can also be transmitted in the event of an accident. Most new telematic systems automatically dial emergency services when an airbag deploys. A standard GPS receiver will not only place you on a map at any particular location, but will also trace your path across a map as you move. If you leave your receiver on, it can stay in constant communication with GPS satellites to see how your location is changing. With this information and its

built-in clock, the receiver can give you several pieces of valuable information:

- How far you have traveled (odometer)
- How long you have been traveling
- Your current speed (speedometer)
- Your average speed
- A "bread crumb" trail showing you exactly where you have traveled on the map
- The estimated time of arrival at your destination if you maintain your current speed

Figure 1: A GPS system installed in a vehicle

In the future, sensors will monitor all types of vehicle data. In addition to location and speed, things such as engine speed, temperature, transmission gear, fuel and oil levels, and tyre pressure can be measured and transmitted or stored. Advanced systems will include sensors for longitudinal or lengthwise distance measurements with radar, laser, or Infrared (IR) detectors. This distance information can provide a warning to the driver, or in closed-loop systems it can provide automatic operation of a cruise-control or braking system to increase the gap between vehicles should spacing become too close or the closing rate between two vehicles become too great. The availability of such data will make it possible to install a 'black box' that's similar to those installed in airplanes. It will record necessary data which will help to determine the status before and after the accident.

4. Services which will be offered by Intelligent Highways.

i) Automated Traveler Information system (ATIS): The objective is to provide as much information as possible about traffic and road conditions to help drivers plan the fastest and most efficient routes.

ii) Automatic Traffic Management Systems (ATMS): This part of the infrastructure is designed to optimize traffic flow and reduce traffic congestion by sensing traffic conditions through sensors and video monitors.

iii) Automated Vehicle Control Systems (AVCS): A long term and perhaps even idealistic objective of intelligent highway technology. AVCS would allow the autonomous operation and/or remote control of the vehicle.

iv) Commercial Vehicle Operations (CVO): This facilitates inter-state trucking. CVO provides for electronic systems to deal with clearance paperwork, automated safety inspections, weighing trucks at highway speeds, and monitoring operations to improve safety, fuel efficiency, and emissions.

v) Emergency Management: The whole purpose of this segment of an intelligent transportation system is to ensure rapid notification of accidents for prompt response to wrecks, vehicle breakdowns, hazardous-material spills, and other emergencies.

vi) Electronic Payment: Becoming more common, these facilities automate payment for tolls, parking, entrance or other kind of fee. Such payments stop or slow down traffic more and more each year. Automated systems use smart tags/electronic tags to permit automated payment through subscriptions and smart cards.

vii) Safety: Most of the other systems ensure the safety of drivers. Additional safety systems primarily improve safety for pedestrians. This can be accomplished by providing systems for drivers to detect and avoid pedestrians, by controlling walk-signal duration to minimize pedestrian accidents, and by implementing systems to more efficiently deal with handicapped and elderly persons.

5. Future scenario.

5.1 Using Cell phones to track vehicles.

There are millions of cell-phone users in the entire world today. Each day, thousands more sign up. The radio signals emitted from these devices can reveal our location at anytime. This ability to locate cell-phone users will become a vital component of future traffic-management systems.

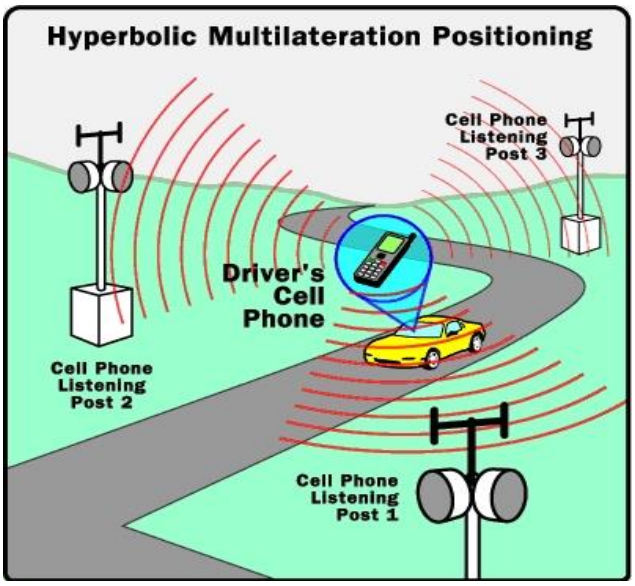
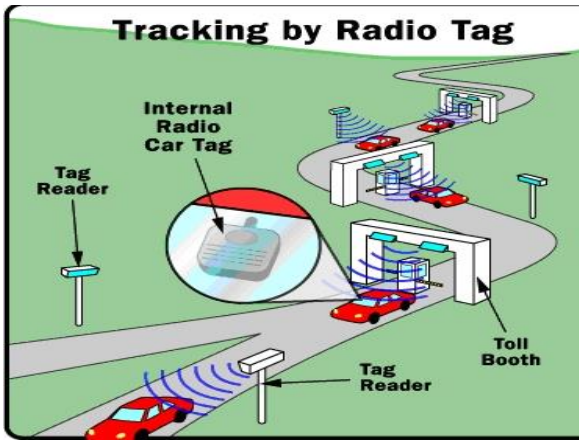


Figure 2: Using Cell phones to track vehicles

A position is determined by locating the intersection of the hyperbolas from the radio waves detected by the listening posts. By analyzing how long it takes the radio wave to reach the listening post from the cell phone, a computer can calculate almost precisely where someone is located on the highway.

5.2 Tagging or Electronic Tolling.

Transportation agencies are also installing additional electronic toll tag readers along major highways. In some cities where toll booths are common, radio-frequency tags are attached to cars. As cars pass the reader, it detects the tag and subtracts a set amount of money from a prepaid account.



Unlike with a toll booth, drivers would not have to slow down for the reading device. They would merely drive past it. By analyzing a particular car's time between two points, a computer can determine the car's location and speed.

These tags and the cell-phone tracking systems will make it almost impossible for someone to travel undetected. Companies have said that it would not sell information about motorists' locations to advertisers.

Figure 3: E-Z Pass Tolling System

Here are the basic components that make the system work:

- Transponder
- Antenna
- Lane controller - This is the computer that controls the lane equipment and tracks vehicles passing through. It is networked on a Local area network (LAN).
- Host computer system - All of the toll plaza LANs are connected to a central database via a Wide area network (WAN).

Here's how the system works:

1. As a car approaches a toll plaza, the radio-frequency (RF) field emitted from the antenna activates the transponder.
2. The transponder broadcasts a signal back to the lane antenna with some basic information.
3. That information is transferred from the lane antenna to the central database.
4. If the account is in good standing, a toll is deducted from the driver's prepaid account.
5. If the toll lane has a gate, the gate opens.
6. A green light indicates that the driver can proceed. Some lanes have text messages that inform drivers of the toll just paid and their account balance.

Steering-by-Wire

Samriddhi Vasisth
Third Year Student, Mechanical Engineering

Abstract

"The aim of steer-by-wire technology is to completely do away with as many mechanical components (steering shaft, column, gear reduction mechanism, etc.) as possible. Steering by-wire replaces the steering column with a fault-tolerant controller and motors that connect to the steering rack to control direction. This type of system is safer than mechanical steering, and improves "road feel" and gas economy".

Introduction

The steering system is the primer interface between the driver and the vehicle, through which the driver inputs his intentions to control the vehicle direction, and from which the driver receives important information about the vehicle state of motion and road condition from the steering torque / 'steering feeling'. Consequently, the steering system characteristic has a great effect on the driver's feeling, and vehicle response towards driver's input. Nevertheless, present steering system characteristics are usually designed as a compromise for various driving situations, and all aspects of drivers. In the future, Intelligent Transport Systems (ITS) and Advance Driver Assistance Systems demands the steering systems to have an adaptive functionality, whereby the steering system characteristics can be adjusted actively/appropriately according to driving situations, driver's needs and preferences, vehicle inherent characteristics, and environmental and traffic conditions, in order to minimize driver's workload, and at the same time, maintain driver's good feeling during driving. Steer-By-Wire (SBW) steering system has been developed to achieve the above requirement, by eliminating the mechanical linkage between the steering wheel and the steering gear as like in a conventional steering system. Some analysts claim that by 2010 1/3 of all new cars will have steering by-wire.

By-Wire Basics

Without the traditional mechanical steering link, developers of by-wire controls found early on that the loss of tactile feedback often results in a degradation of control via over or under steer, thus compromising safety and reducing productivity.

To overcome this problem, a controllable and proportional force feedback device is connected to the operator steering control to produce useful tactile information, often mimicking the feel of the conventional system being replaced. The controller is programmed with a tactile feedback algorithm that modulates torque feedback to the operator as a function of steering wheel rotational position, velocity, acceleration,

steered wheel position, vehicle speed, or other parameters — singly or in combination.

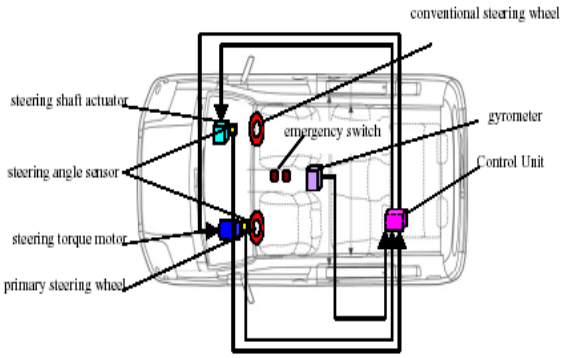


Figure 1: SBW vehicle configuration

By-wire steering is a great advantage in "man-up" vehicles where the operator is hoisted up to manually pick stock from high racks in the warehouse because it eliminates complex telescoping mechanical steering linkages. Incorporating tactile feedback with steering sensing provides the option or possibility to communicate information to the driver regarding vehicle conditions. For example, tactile pulsing (high torque to low torque) while turning the wheel may indicate a vehicle fault or increased steering effort may indicate a vehicle obstruction. Vehicle warning systems, enstops (end of travel indication), and variable friction or variable steering effort (depending on machine mode of operation) provide more precise control by minimizing the possibility of over steer / under steer and offer improved safety by providing more precise vehicle control. Furthermore, product standardization around common by-wire controls may decrease the cost associated with operator training and common vehicle interfaces can be adopted more easily.

Outline Of Sbw Vehicle

For the purpose of the above study, the authors reconstructed an existing vehicle into a vehicle equipped with SBW systems.

The vehicle has a new steering wheel which is disconnected from the front wheels. The driver's steer input to the steering wheel is detected by a steering wheel sensor, while vehicle motion states are measured by the gyrometer, comprising of yaw rate sensor and lateral acceleration sensor. In addition, another rotation angle sensor (potentiometer) detects the steering column shaft turning angle. This information are transferred to the control unit (Micro Auto Box), which uses this to calculate the output steering angle and steering torque, based on the defined control algorithm. An output steering angle signal is sent from the control unit to a motor actuator (step motor), attached to the conventional steering column shaft, which is connected to the steering rack and front tire by mechanical linkage, to control the front tire steer angle. Thus, by changing the steering column shaft rotation, in relation to driver's steer input, it is possible to change the overall steering gear ratio for the SBW vehicle. A steering torque motor (servo motor), which is attached directly behind the steering wheel, generates the steering torque to the driver. Two emergency switches that cut off power supply to the steering column shaft motor and steering torque motor are used in emergency situations to return the steering system to the conventional type, which enables the driver to take over a full control of the vehicle by using the conventional steering system.

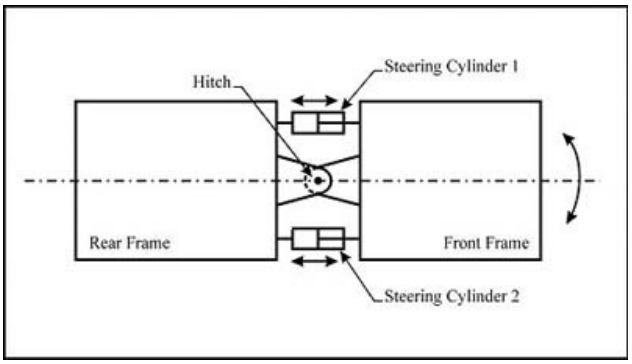
Completely replacing conventional steering system with steer-by-wire holds several advantages, such as:

- The absence of steering column simplifies the car interior design.
- The absence of steering shaft, column and gear reduction mechanism allows much better space utilization in the engine compartment.
- The steering mechanism can be designed and installed as a modular unit.
- Without mechanical connection between the steering wheel and the road wheel, it is less likely that the impact of a frontal crash will force the steering wheel to intrude into the driver's survival space.
- Steering system characteristics can easily and infinitely be adjusted to optimize the steering response and feel.

Steering By Wire in Earth Mover

Automotive industry has been developing "by-wire" system for the next generation of passenger cars which will be in the market in mass quantities by year 2010. "By-wire" systems refer to the physical connection between operator command devices and the controlled sub-system, such as the connection between the steering wheel and the steering mechanism, the connection between the brake pedal and the brake actuators, the connection between the accelerator pedal and engine controller. This project focuses on "by-wire steering system", also called "steer-by-wire" system, for articulated machines such as wheel loader type earth moving equipment.

The main different between the conventional steering systems and the "steer-by-wire" systems is at the connection between the steering wheel (or steering lever) and the steering control valve. We can view the steering system as having two main sub-systems: 1. Command input sub-system (steering wheel and/or steering lever), 2. Steering power circuit (i.e. in the case of electro-hydraulic power steering, this sub-system includes the pump, cylinder, and valves).



Block diagram of steering by-wire in earth mover

The conventional systems include different forms of mechanical & hydraulic connections between the steering wheel & the steering valve. In simplest terms, the steering wheel rotation is proportionally amplified by the steering valve to obtain a proportional articulation angle. As the 2 systems (steering wheel & steering power system) are mechanically coupled, there is a built in inherent force feedback to operator at the steering wheel proportional to the steering conditions.

A "steer-by-wire" system has only electrical signal connection between the steering wheel sub-system and the steering power sub-systems. This approach has both advantages and disadvantages compared to conventional steering systems. Steer-by-wire advantages: -

- Modular steering command input design,
- simplifies the assembly,
- Lower manufacturing cost.

Conclusion

New technologies are being developed every day. The current mechanical steering is insufficient to run the applications emerging in the market. Transition to steering-by-wire will enable to superlative standards of safety, performance, luxury, aesthetics and eco-consciousness to the delight of moving world. Much work has been done and much remains to be done. It is becoming clear that the industry consensus is not "If the transition takes place" but it is "when it will take place?"

The question of "when?" is difficult to answer, but direction for automotive industry is clear.

References

- M.Segawa, S.Kimura, T.Kada, S.Nakano, "A Study of the Relationship between Vehicle Behavior and Steering Wheel Torque on Steer By Wire Vehicles", Extensive Summaries of 18th IAVSD Symposium on Dynamics Of Vehicles on Roads and Tracks, pp67-69, 2003.

- Dr. Sabri Cetinkunt, Salem Haggag, David Alstrom, "Steer By Wire Control Systems for Earth Moving Equipment Applications Research".

EVENTS

SHIVALIK COLLEGE OF ENGINEERING, DEHRADUN

MECHANICAL ENGINEERING DEPARTMENT

DEPARTMENTAL EVENTS / ACTIVITIES

EVENT /ACTIVITY: 01

Name of Department	**Mechanical Engineering**
CategoryofEvent Organized	**Workshop**
Title of The Event	**"CNC Exturn"**
Date of Event Organized	**7-14th September, 2022**
Name of The Coordinator of Event	**Dr. Sono Bhardawaj, Mr. Subhan Ali**
Class of The Participant	**ME (B.Tech +Diploma)**
No. Of Participants	**40**
Name of The Expert	**Mr. Ajay Verma**
Contact Details of Expert/Agency	**Shivalik College of Engineering, Dehradun**
Objective of The Event	**The objective of this workshop was to guide the students about the working principle and applications of CNC machines; furthermore the students will be able to prepare CNC part programmes for machining 2-D/3-D work pieces.**
Outcome of The Event	**Students got the detailed knowledge about the latest trends going in the field of part programming, able to understand different G and M codes for producing different contours.**

Event Report

The sevendays' workshop on "CNC Exturn" was organized by Department of Mechanical Engineering at Shivalik College of Engineering, Dehradun on 7th to 14th September 2022. The workshop was attended by 40 participants. The technical part of the workshop was conducted by Mr. Ajay Verma, Head of Mechanical Engineering Department, Shivalik College of Engineering Dehradun.Event coordinators Dr. Sono Bhardawaj and Mr. Subhan Ali look after all the arrangements for the workshop.

Department teaching and non-teaching staff were acted as resource persons in workshop and taught students the basics of CNC program writing and also given hands-on demonstration on R&D center vertical milling center and CNC Lathe. Students were

found enthusiastic throughout the sessions in learning various concepts and operating high end VMC and CNC lathes.

In this workshop, advance Mechanical designing techniques were taught like bottom to top designing, assembly of different parts to make a single machine and other advance technique and a practical demonstration was given to the students.

Photographs of the event

EVENT /ACTIVITY: 02

Name of Department	**Mechanical Engineering**
CategoryofEvent Organized	**Workshop**
Title of The Event	**"ANSYS Fluent Module"**
Date of Event Organized	**14the September to 14th October, 2022**
Name of The Coordinator of Event	**Dr. Sono Bhardawaj, Dr. Abhishek Jha**
Class of The Participant	**ME (B.Tech +Diploma)**
No. Of Participants	**40**
Name of The Expert	**Mr. Shivasheesh Kaushik**
Contact Details of Expert/Agency	**Shivalik College of Engineering, Dehradun**
Objective of The Event	**The objective of this workshop was toinculcate the knowledge of Ansys Fluent software which is a general-purpose computational fluid dynamics (CFD) software used to model fluid flow, heat and mass transfer and many more.**
Outcome of The Event	**Students got the detailed knowledge about a modern, user-friendly interface that streamlines the CFD process from pre- to post-processing within a single window workflow.**

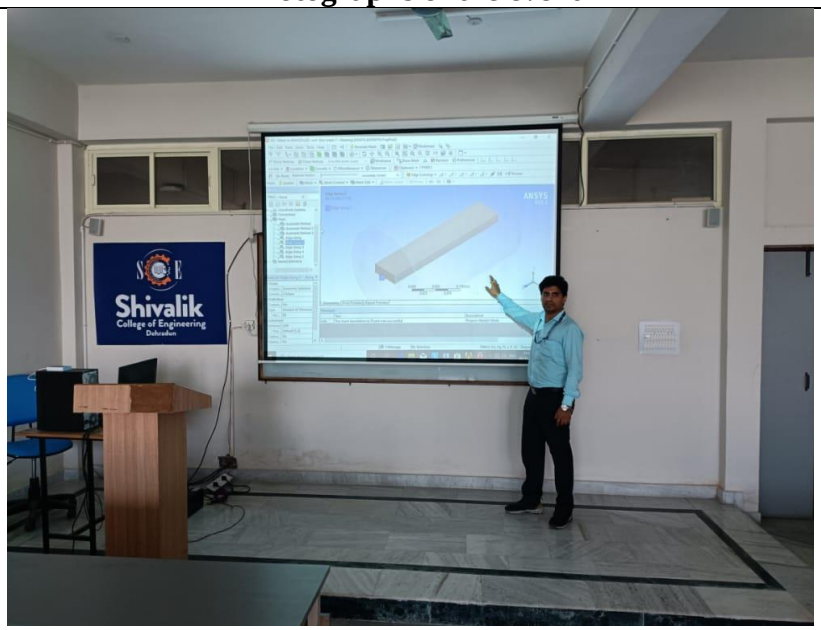
Event Report

The one month workshop on "ANSYS Fluent Module" was organized by Department of Mechanical Engineering at Shivalik College of Engineering, Dehradun from 14th September, 2022 to 14thOctober 2022. The workshop was attended by approximately 40 participants. The technical part of the workshop was conducted by Mr. Shivasheesh Kaushik, Assistant Professor, Mechanical Engineering department, Shivalik College of Engineering, Dehradun.

- **The complete workshop will be scheduled as 2 hrs/day session span for one month between 2:00 PM to 4:00 PM. The course will be a hand on session demonstrating how to work on the software. You can either work along with the course or has the freedom to design and develop an advanced system of your own choice.**
-
- **The objective is to have the students experience how to work on a software and apply the knowledge you have learned, confidently, in developing an analysis system from the scratch and make a conclusive remark. Use the**

Watertight Geometry Meshing Workflow in Ansys Fluent to create highquality CFD Simulation meshes from imported CAD geometry through a succession of intuitive guided workflow tasks.

Photographs of the event



EVENT /ACTIVITY: 03

Name of Department	**Mechanical Engineering**
CategoryofEvent Organized	**Celebration**
Title of The Event	**"Engineers Day"**
Date of Event Organized	**15-09-2022**
Name of The Coordinator of Event	**Mr. Shivasheesh Kaushik, Dr. Sneha Das**
Class of The Participant	**Engineering (B.Tech +Diploma)**
No. Of Participants	**65**
Objective of The Event	**The objective of this Quiz was to promote the Engineering Knowledge, Quality in Technical Education, Planning and Coordinated Development of Technical Education systems on the occasion of Engineer's Day.**
Outcome of The Event	**The students of B.Tech and Diploma Engineering appeared in the quiz, they tested themselves on their basic concepts and**

	fundamentals of the engineering fields. So that the students are able to presume the questions level of technical exams and other Job oriented technical exams.

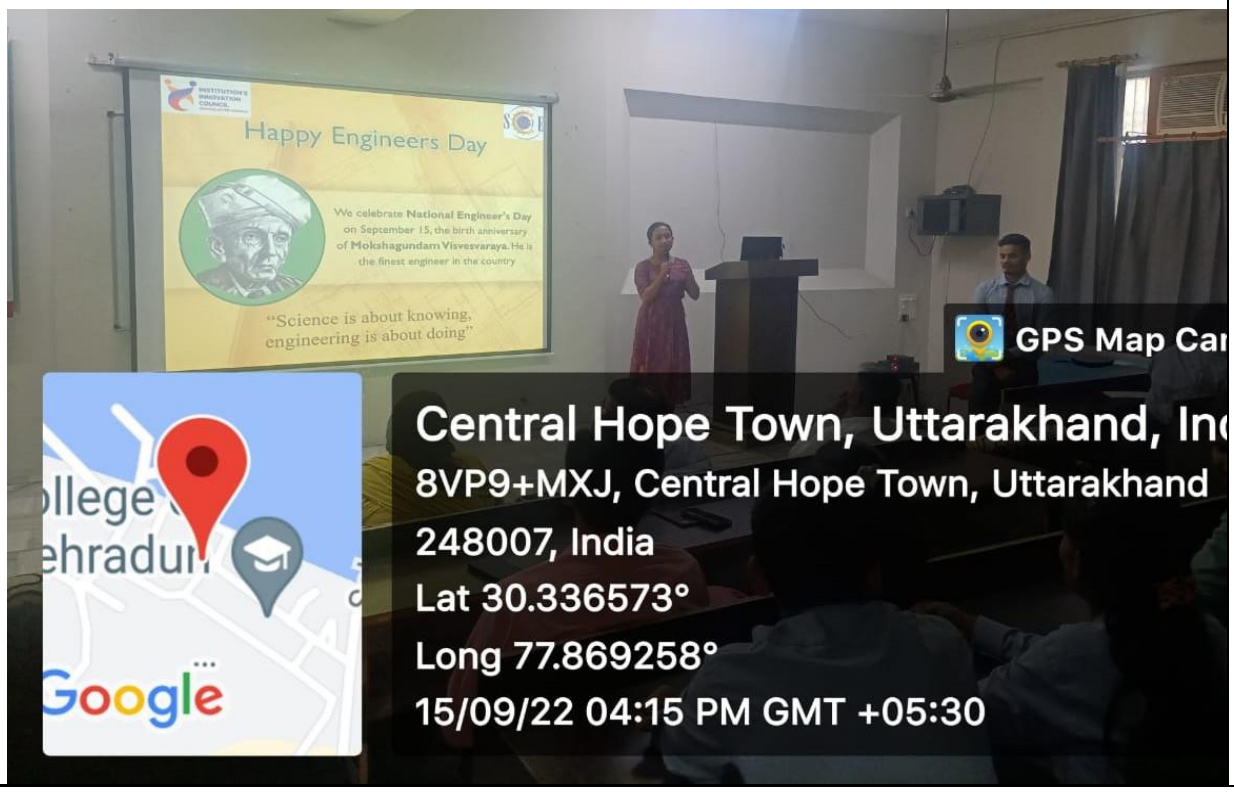
Event Report

The IIC Department has successfully organized the ABHIYANTRIKI QUIZ-2022 on the occasion of Engineer's Day on 15th September, 2022 with in the vicinity of SCE, Dehradun campus. Event coordinators Dr. Sneha Das and Mr. Shivasheesh Kaushik look after all the arrangements for the Engineers day celebration.

The event was inaugurated by Dr. Kuldeep Panwar (Dean, Quality assurance, SCE Dehradun) and Mr. Ajay Verma (Head of Mechanical Engineering Department, SCE Dehradun).Approximately 65 Students were present in the event (including Faculty Members). Total 5 presentations were done and a rapid Quiz session named Abhiyantriki Quiz 2022 was held as well in the event. Total 5 sessions were held including the inaugural and valedictory sessions. The students of B.Tech and Diploma Engineering appeared in the quiz, they tested themselves on their basic concepts and fundamentals of the engineering fields. So that the students are able to presume the questions level of technical exams and other Job oriented technical exams.

Photographs of the event


INVITATION
Happy Engineer's Day
Sir Mokshagundam Visvesvaraya
(1860-1962)
Department of Mechanical & Civil Engineering
Venue: Seminar Hall-1
Date: 15/09/2022
Time: 03:00 PM


Happy Engineers Day
We celebrate National Engineer's Day on September 15, the birth anniversary of Mokshagundam Visvesvaraya. He is the finest engineer in the country
"Science is about knowing, engineering is about doing"
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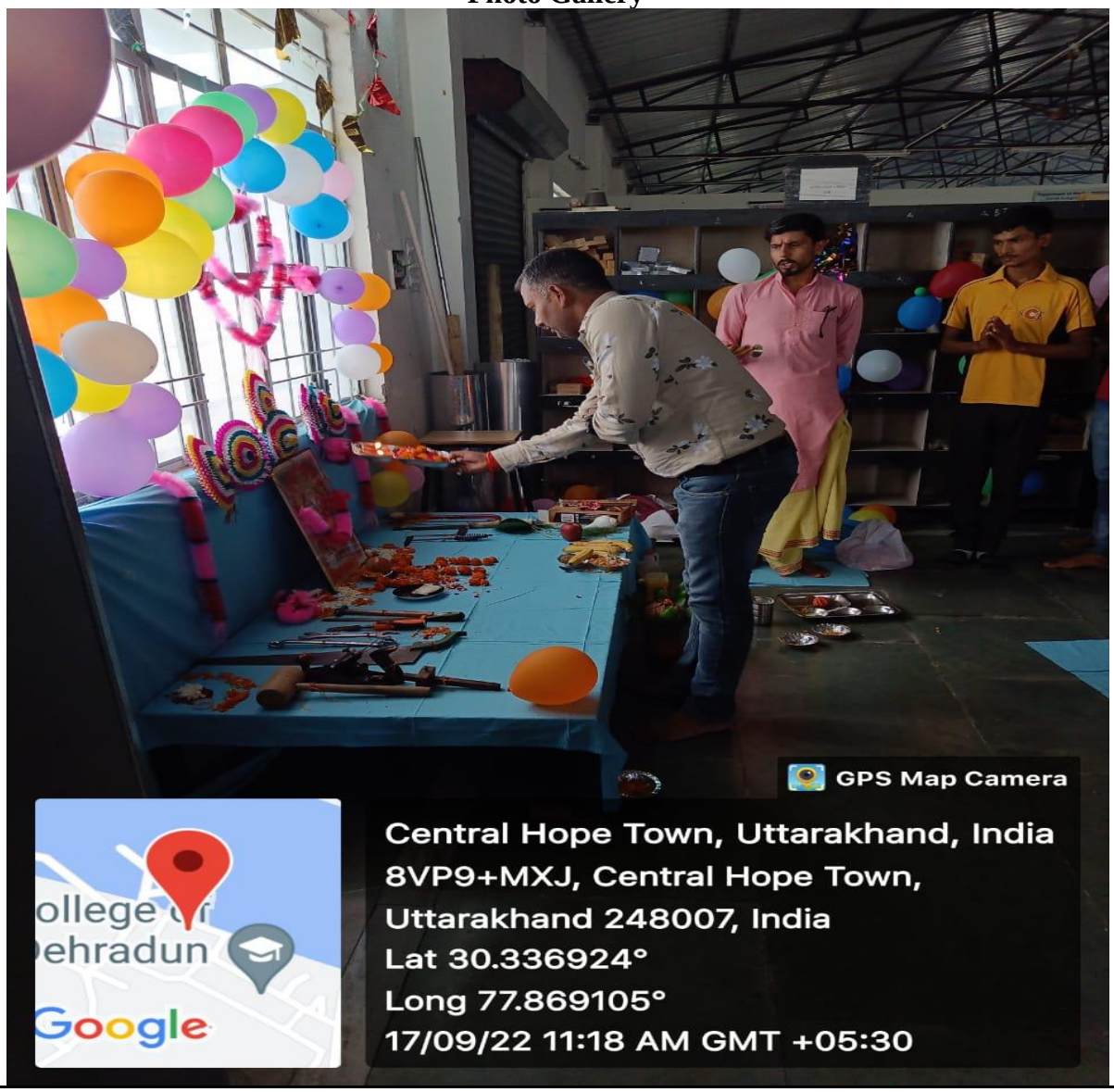
EVENT /ACTIVITY: 04

Name of Department	**ME**
Categoryof Event Organized	**Vishwakarma Pooja**
Title of The Event	**Vishwakarma Day Celebration**
Date of Event Organized	**17th September 02022**
Name of The Coordinator of Event	**Mr. Gautam K Pundir, Mr. Shivasheesh Kaushik, Mr. Subhan Ali and Mr. Rajendra Gusain / Mr. Kanchesh Sharma**
Class of The Participant	**All Students & Staff**
No. of Participants	**100 Above**
Name of The Chair Person	**Mr. Ajay Kumar (Vice Chairman)**
Contact Details of Chair Person	**9997997584**
Objective of The Event	**People worship Lord Vishwakarma to express their gratitude for the tools and machines and seek his blessings.**

Event Report

The. Vishwakarma Jayanti is a day of celebration for Vishwakarma, a Hindu god, the divine architect. The festival is observed primarily in factories and industrial areas, often on the shop floor. As a mark of reverence the day of worship is marked not only by the engineering and architectural community by craftsmen, mechanics, smiths, welders, industrial workers, factory workers and Engineering colleges. The Mechanical Department of Shivalik College of Engineering, Dehradun successfully organized a Vishwakarma Pooja on 17th September 2022. Mr. Ajay Singh, VC, SCE, Dr. Prahlad Singh, Director, SCE, Mr Ajay Verma, HOD, DME, all faculty members and Student of SCE were present in the celebration.

Photo Gallery

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EVENT /ACTIVITY: 05

Organizing Department	**Mechanical Engineering**
Title of the event	**Workshop on "Innovative Design: Ideation to Realization" at DIC, IIT Roorkee**
Date& Day of event organized	**Wednesday, 28thSeptember 2022**
Name of the coordinator of event	**Dr. SonoBhardawaj Mr. ShivasheeshKaushik**
No. of Participants	**42**
Name of the expert	**Dr. Inderdeep Singh, Dr. GauravRaheja, Dr. SaptarishiKolay, Dr. BibhutiRanjanBhattacharjya**
Contact Number of expert	
Objective of the event	**To aware the student about the new updates in Innovative Design methods and its benefit especially in this competitive era.**
Outcome of the event	**Student understood about the new ideas and processes which can convert these ideas in to physical product.**

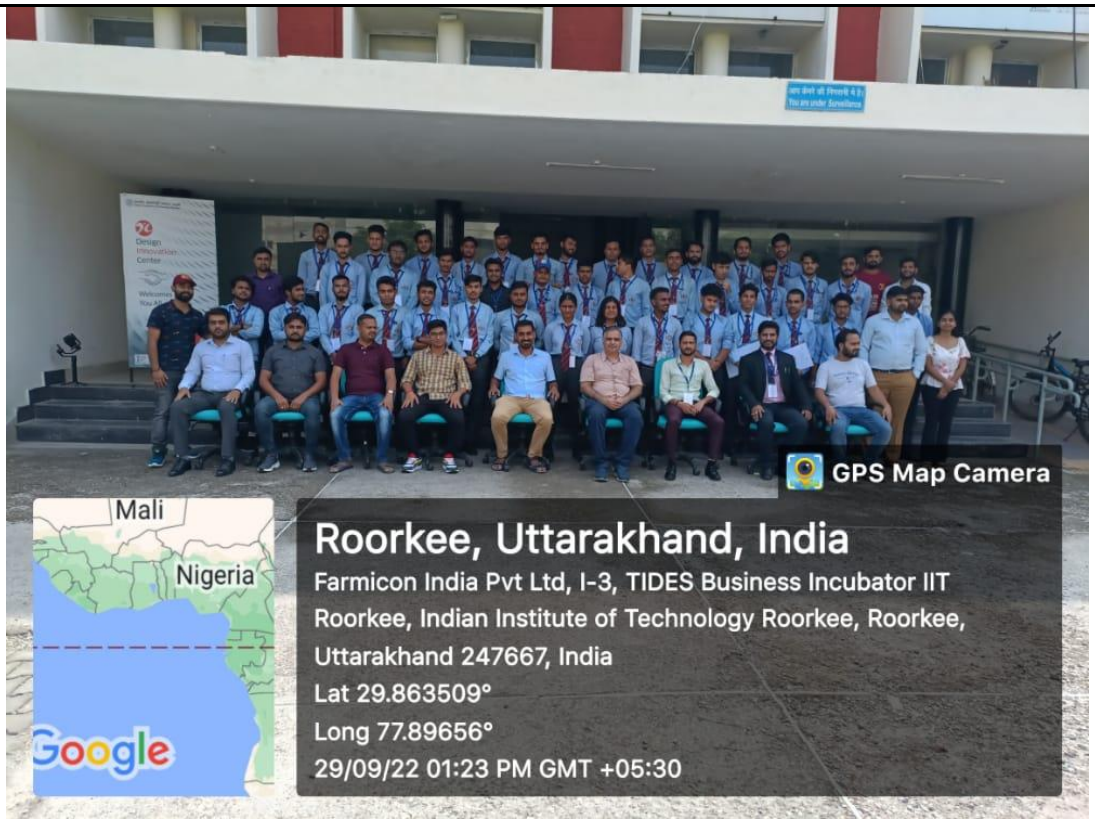
Event/Activity Report

The workshop on "Innovative Design: Ideation to Realization" has been successfully participated by all the students of B.Tech and Diploma Mechanical Engineering, Shivalik college of Engineering, Dehradun,organized by Design Innovative Center (DIC) at Indian Institute of Technology (IIT)Roorkee.

Event coordinators Dr. SonoBhardawaj and Mr. ShivasheeshKaushiklook after all the arrangements for the workshop.The event started from S.C.E. Dehradun by bus at 7:00 am. The bus reached at IIT Roorkee by 9:30. At the entry of the DIC the students have registerd and got Identity cards for the workshop. Experts from IIT Roorkeehave provided some lectures on some creative ideas and processes to convert these ideas in to reality.

These expert lectures are followed by the hands-on training to students according to their interests especially on 3D Printing Technology. They also share the schemes of IIT Roorkee for internships and live projects. They offered students to become a part of incubation center of DIC Center by proposing some good projects.

Activity Photographs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EVENT /ACTIVITY: 06	
Organizing Department	**Mechanical Engineering Department**
Title of the event	**Guest Lecture on Future Challenges facing Humanity Remedies and Requirement**
Date& Day of event organized	**19-10-2022 (Wednesday)**
Name of the coordinator of event	**Dr. SonoBhardawaj , Dr. AbhishekJha**
No. of Participants	**120**
Name of the expert	**Prof. (Dr.) Badri Narayan**
Contact Number of expert	**9381779330**
Objective of the event	**The main objective of organizing the special lecture on "Future Challenges facing Humanity Remedies and Requirement" is to aware the students about the different challenges and their possible solutions that can be very fruitful to bridge the gap between academia and community.**
Outcome of the event	**Student has learned aboutthe different challenges faced in daily life and also motivated to find out the different problem solving techniques.** **They are aware about some burning challenges like deficiency of water and soil fertility which may be the greatest problems in front of the whole world in near future.**

Event/Activity Report

The Mechanical Engineering Department has successfully organized the Guest lecture on Future Challenges facing Humanity Remedies and Requirementdelivered by Prof. (Dr.) Badri Narayan (Ph.D IIT Kharagpur, B.Tech NIT Suratkal)with in the vicinity of SCE, Dehradun campus. Prof. (Dr.) Badri Narayan has a vast experience of approximately 28 years in academia as well as in research.

Although he is from Metallurgy Engineering Department but he is always ready to face the different challenges and changes to make his contribution for the betterment of the society. Prof. (Dr.) Badri Narayan started the lecture with some Mantra from Vedas to energize the students.

Further, he told some great recent inventions in different fields like discovery of Graphene. Prof. (Dr.) Badri Narayan also explain some interesting stories of some great

personalities to motivate and to inculcate great enthusiasm for facing day-to-day challenges in the fresh mind of the students.

Activity Photographs


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EVENT /ACTIVITY: 07

Name of Department	**Mechanical Engineering**
CategoryofEvent Organized	**Workshop**
Title of The Event	**"FUSION 360"**
Date of Event Organized	**12-10-2022**
Name of The Coordinator of Event	**Dr. SonoBhardawaj**
Class of The Participant	**ME (B.Tech +Diploma)**
No. Of Participants	**35**
Name of The Expert	**Mr. AnshPuri**
Contact Details of Expert/Agency	**ELCOT Complex, 2-7 Developed Plots, Industrial Estate, Perungudi, Chennai-600096, Tamil Nadu.**
Objective of The Event	**The objective of this workshop was to ignite the creativity from the young minds in the area of design thinking, product design and advance simulation using Autodesk Fusion 360 software.**
Outcome of The Event	**Students got the detailed knowledge about the latest trends going in the field of design thinking, product design and advance simulation using Autodesk Fusion 360 software.**

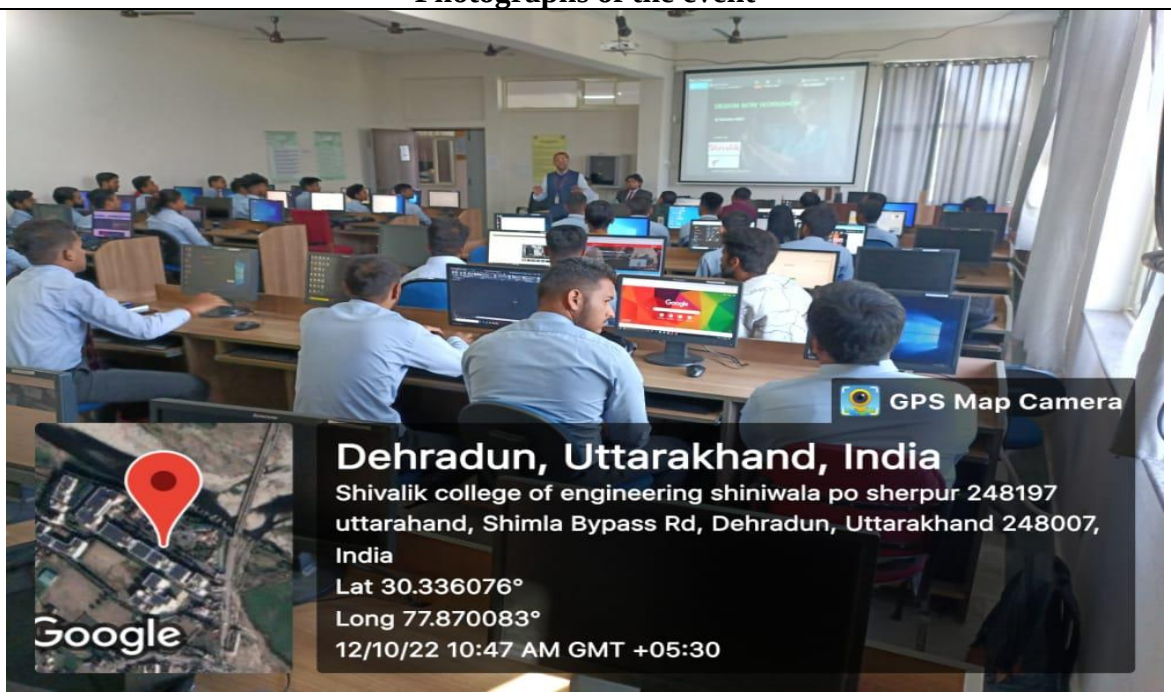
Event Report

The first day of threedays' workshop on "Fusion360" in association with ICT was organized by Department of Mechanical Engineering at ShivalikCollege of Engineering, Dehradun in association with Autodesk on 12th October 2022. The workshop was attended by more than 35 participants. The technical part of the workshop was conducted by a certified Autodesk Designer.

Fusion 360 is a cloud-based 3D CAD/CAM tool for product development that combines industrial and mechanical design, collaboration, and machining in a single package. The tools in Fusion 360 enable fast and easy exploration of design ideas with an integrated concept-to-production toolset. Fusion 360 is natively written for both Mac and PC, allowing you to use your preferred OS or both.

In this workshop, advance Mechanical designing techniques were taught like bottom to top designing, assembly of different parts to make a single machine and other advance technique and a practical demonstration was given to the students.

Photographs of the event



EVENT /ACTIVITY: 08

Name of Department	**Mechanical Engineering**
CategoryofEvent Organized	**Workshop**
Title of The Event	**"3 Days Short-Term Training Program on Solidwors" by CADD Center**
Date of Event Organized	**02-04th November, 2022**
Name of The Coordinator of Event	**Dr. Sono Bhardawaj, Dr. Abhishek Kumar Jha, Mr. Shivasheesh Kaushik**
Class of The Participant	**ME (B.Tech +Diploma)**
No. Of Participants	**35**
Name of The Expert	**Mr. AkshayKatiyar**
Contact Details of Expert/Agency	**CADD Center Training services, 2nd floor, Chhetri Plaza, Ballupur Chowk, Dehradun, Uttarakhand-248001.**
Objective of The Event	**The objective of this workshop was to ignite the creativity from the young minds in the area of design thinking, product design and advance simulation using CAD software.**
Outcome of The Event	**Students got the detailed knowledge about the latest trends going in the field of design thinking, product design and advance simulation using CAD software.**

Event Report

The 3 Days Short-Term Training Program on Solidworks in association with CADD Centre was organized by Department of Mechanical Engineering at Shivalik College of Engineering, Dehradun from 2nd November to 4thNovember 2022.

The workshop was attended by more than 30 participants. The technical part of the workshop was conducted by Mr. Akshay Katiyar, Centre Head, CADD Centre Dehradun. Event coordinators Dr. Sono Bhardawaj, Dr. Abhishek Jha and Mr.Shivasheesh Kaushik look after all the arrangements for the workshop.

The CAD/CAM tool for product development that combines industrial and mechanical design, collaboration, and machining in a single package. The tools in CAD software

enable fast and easy exploration of design ideas with an integrated concept-to-production toolset.

In this workshop, advance Mechanical designing techniques were taught like bottom to top designing, assembly of different parts to make a single machine and other advance technique and a practical demonstration was given to the students.

Photographs of the event