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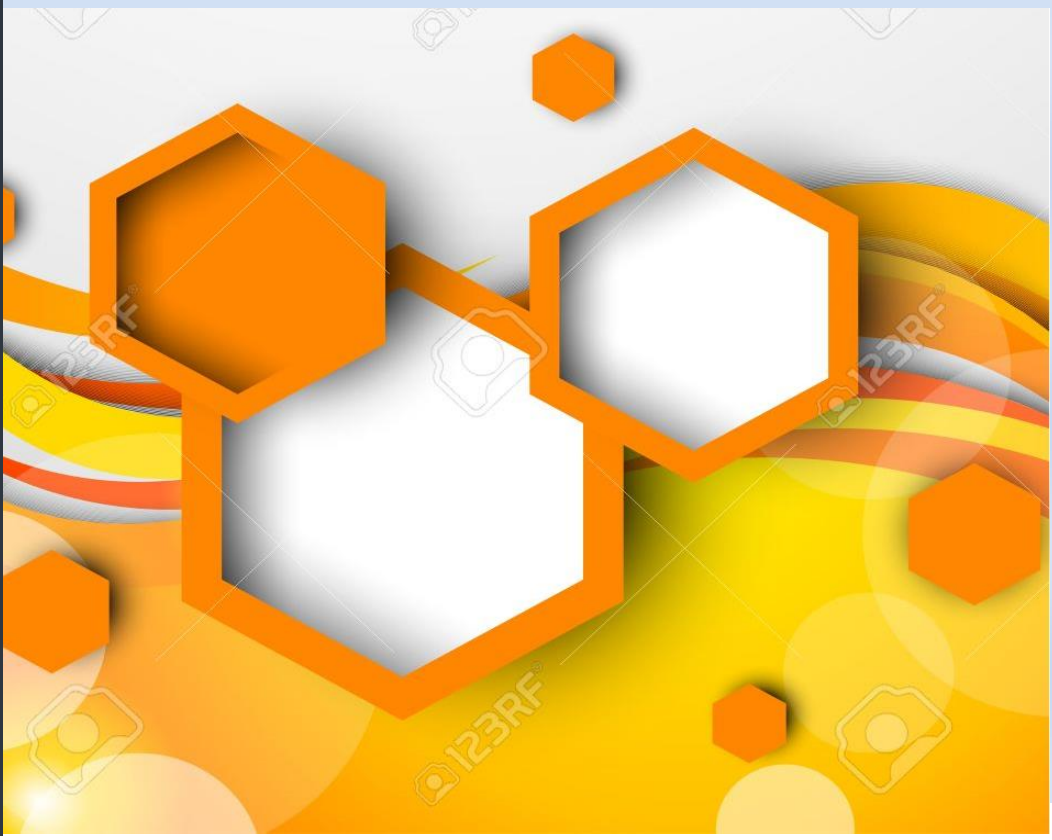


Emerging Trends in Industrial Robotics

S.Shahithahamed
DMTE – III Year

R.S.Praveenkumar
DMTE – III Year

Introduction

A Robot System used for Manufacturing. An Industrial is Automated Programmable and Capable of Movement on Two or More Axes. The typical Applications of Include Welding, Painting, Assembly, Pick and Place for Printed Circuit Boards, Labeling, etc., In Year of 2015,an Estimated 1.63 Million Industrial Robots were in Operation Worldwide According to International Federation of Robotics. An industrial robot is a robot system used for manufacturing. Industrial robots are automated, programmable and capable of movement on three or more axis. The typical applications of robots include welding, painting, assembly, pick and place for printed circuit boards, packaging and labeling, palletizing, product inspection, and testing; all accomplished with high endurance, speed, and precision. They can assist in material handling.

Types and Features

The most commonly used robot configurations are articulated robots, SCARA robots, delta robots and Cartesian coordinate robots, (gantry robots or x-y-z robots). In the context of general robotics, most types of robots would fall into the category of robotic arms

- Some robots are programmed to faithfully carry out specific actions over and over again (repetitive actions) without variation and with a high degree of accuracy. These actions are determined by programmed routines that specify the direction, acceleration, velocity, deceleration, and distance of a series of coordinated motions.
- Other robots are much more flexible as to the orientation of the object on which they are operating or even the task that has to be performed on the object itself, which the robot may even need to identify. For example, for more precise guidance, robots often contain machine vision sub-systemsacting as their visual sensors, linked to powerful computers or controllers. Artificial intelligence, or what passes for it, is becoming an increasingly important factor in the modern industrial robot.

History of Industrial Robotics

The earliest known industrial robot, conforming to the ISO definition was completed by "Bill" Griffith P. Taylor in 1937 and published in Meccano Magazine, March 1938. The crane-like device was built almost entirely using Meccano parts, and powered by a single electric motor. Five axes of movement were possible, including grab and grab rotation. Automation was achieved using punched paper tape to energise solenoids, which would facilitate the movement of the crane's control levers. The robot could stack wooden blocks in pre-programmed patterns. The number of motor revolutions required for each desired movement was first plotted on graph paper. This information was then transferred to the paper tape, which was also driven by the robot's single motor. Chris Shute built a complete replica of the robot in 1997. George Devol applied for the first robotics patents in 1954 (granted in 1961).

The first company to produce a robot was Unimation, founded by Devol and Joseph F. Engelberger in 1956. Unimation robots were also called programmable transfer machines since their main use at first was to transfer objects from one point to another, less than a dozen feet or so apart. They used hydraulic actuators and were programmed in jointcoordinates, i.e. the angles of the various joints were stored during a teaching phase and replayed in operation. They were accurate to within 1/10,000 of an inch. Unimation later licensed their technology to Kawasaki Heavy Industries and GKN, manufacturing Unimates in Japan and England respectively. For some time Unimation's only competitor was Cincinnati Milacron Inc. of Ohio. This changed radically in the late 1970s when several big Japanese conglomerates began producing similar industrial robots.

In 1969 Victor Scheinman at Stanford University invented the Stanford arm, an all-electric, 6-axis articulated robot designed to permit an arm solution. This allowed it accurately to follow arbitrary paths in space and widened the potential use of the robot to more sophisticated applications such as assembly and welding. Scheinman then designed a second arm for the MITAI Lab, called the "MIT arm." Scheinman, after receiving a fellowship from Unimation to develop his designs, sold those designs to Unimation who further developed them with support from General Motors and later marketed it as the Programmable Universal Machine for Assembly (PUMA).Industrial robotics took off quite quickly in Europe, with both ABB Robotics and KUKA Robotics bringing robots to the market in 1973. ABB Robotics (formerly ASEA) introduced IRB 6, among the world's first commercially available all electric micro-processor controlled robot.

The first two IRB 6 robots were sold to Magnusson in Sweden for grinding and polishing pipe bends and were installed in production in January 1974. Also in 1973 KUKA Robotics built its first robot, known as FAMULUS, also one of the first articulated robots to have six electromechanically driven axes.Interest in robotics increased in the late 1970s and many US companies entered the field, including large firms like General Electric, and General Motors (which formed joint venture FANUC Robotics with FANUC LTD of Japan). U.S. startup companies included Automatix and Adept Technology, Inc. At the height of the robot boom in 1984, Unimation was acquired by Westinghouse Electric Corporation for 107 million U.S. dollars.

Westinghouse sold Unimation to Stäubli Faverges SCA of France in 1988, which is still making articulated robots for general industrial and cleanroom applications and even bought the robotic division of Bosch in late 2004.Only a few non-Japanese companies ultimately managed to survive in this market, the major ones being: Adept Technology, Stäubli, the Swedish-Swiss company ABB Asea Brown Boveri, the German company KUKA Robotics and the Italian company Comau.

Why Using Industrial Robots?

Industrial Robots can Offer Many Benefits. Many Companies are Using Industrial Robots to Conserve Funds, Time, Materials and Space While at the Same Time Increasing Production and Product Quality. They are

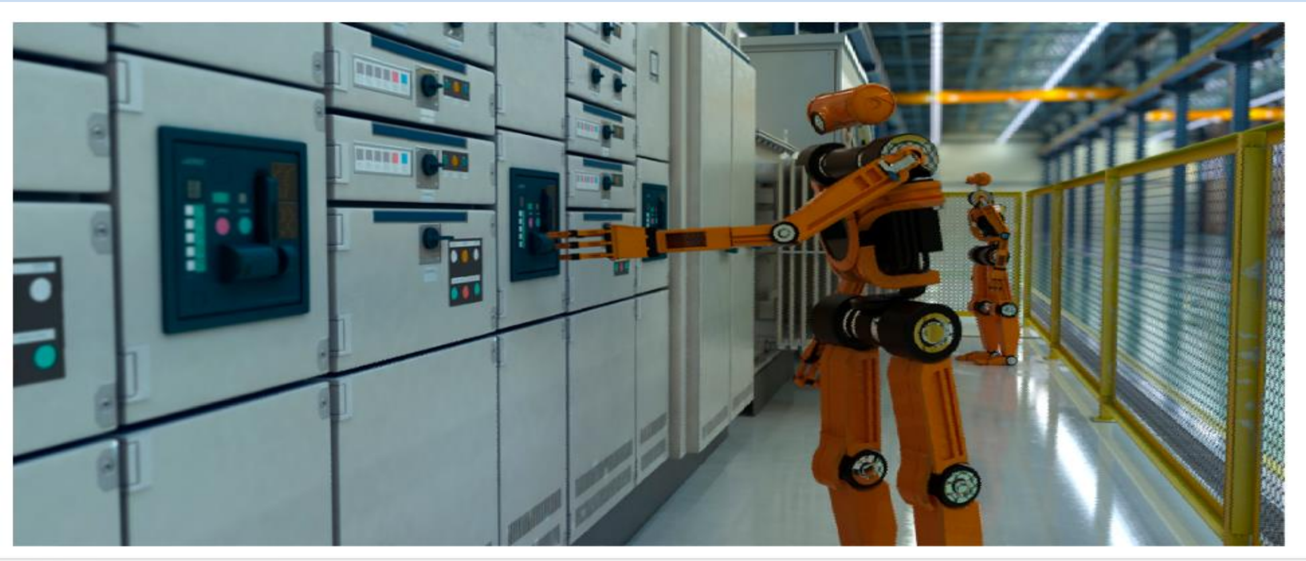
1. Top Quality
2. Financial Savings
3. Avoid Waste
4. Space-efficiency
5. Production

1.Top Quality:-

Robots Perform Applications With Consistency And Precision, Resulting in Higher Quality Products. They Provide Performance Reliability That Is Worth The Investment.

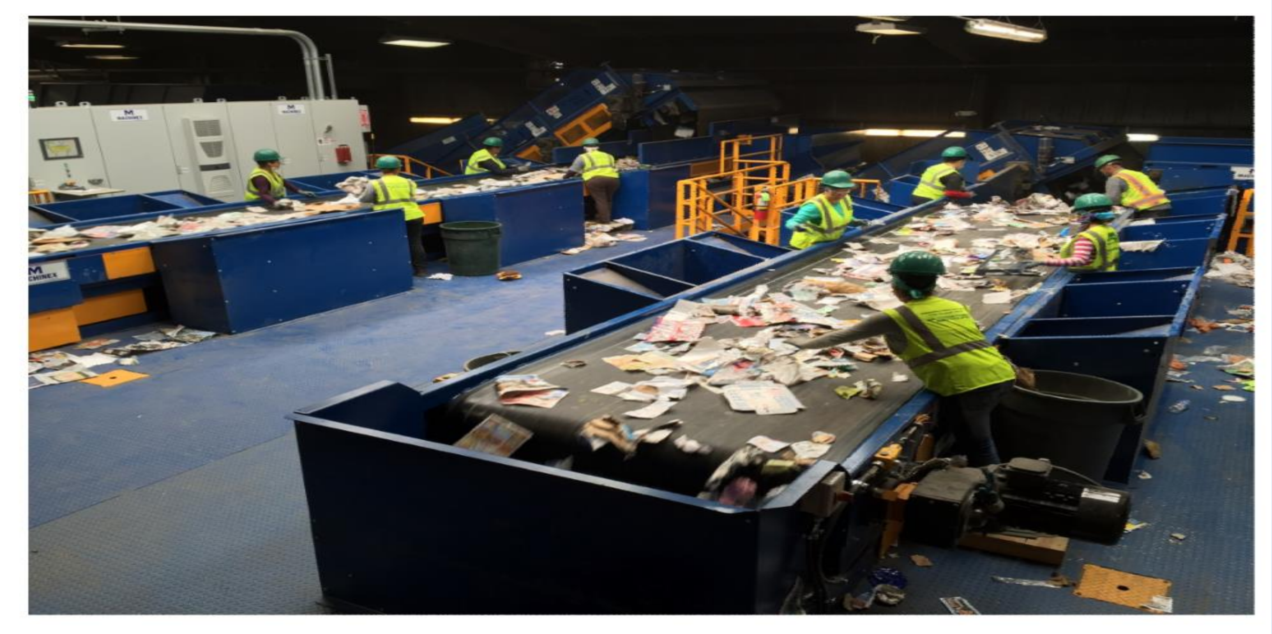
2.Financial Savings:-

A Lot Of Companies are Using Industrial Robots because they Offer a Quick ROI(Return on Investment). Robots Pay for Themselves with Consistent Efficiency. They Save Companies Money because they do not require Breaks, Vacation, or Sick Leave.



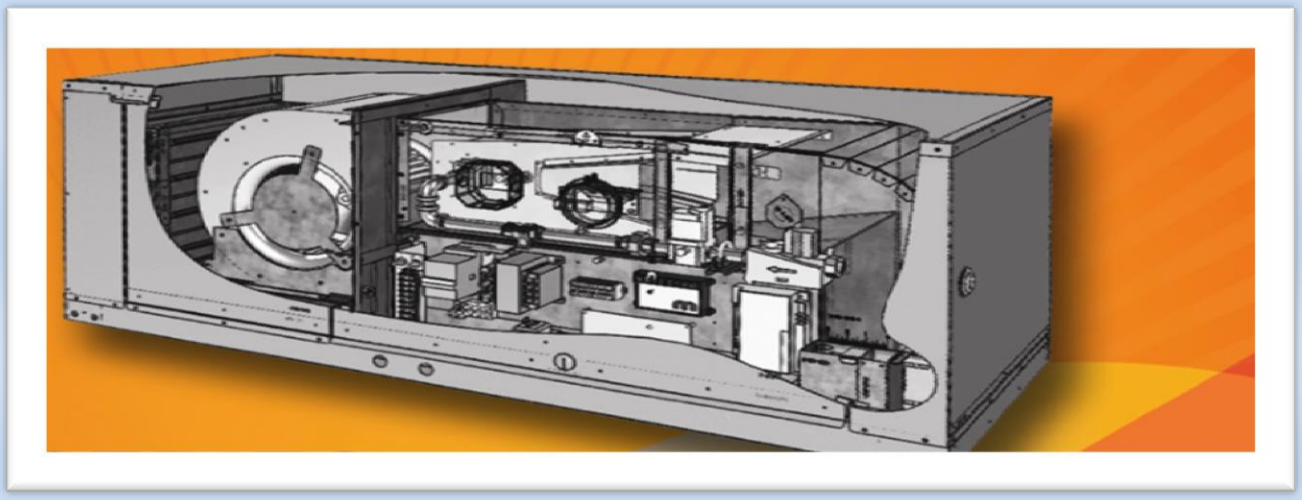
3. Avoid Waste:-

Robots Handle Application with Precision and Accuracy, Saving Valuable Material. When Companies use Industrial Robots, They can Expect Fewer Mistakes and a Safer Work Environment.



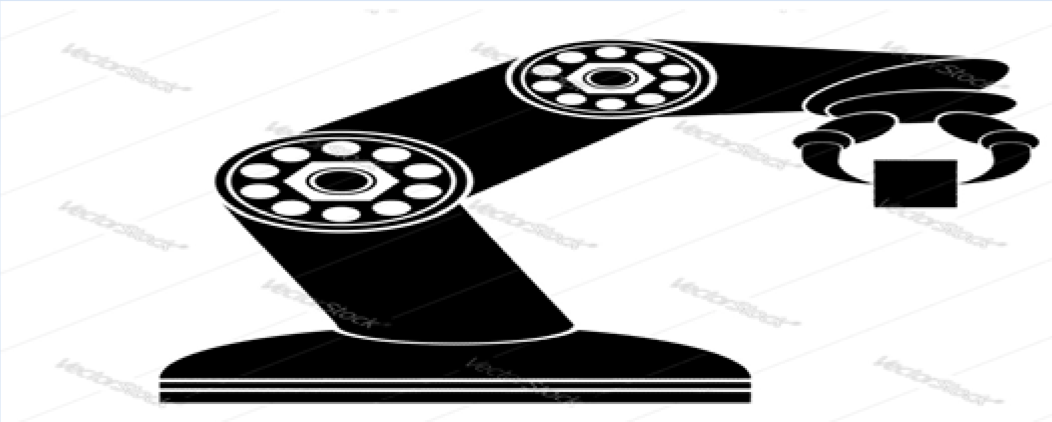
4.Space-efficincy:-

Industrial Robots have Compact Bases Built to Fit in Confined Spaces. They can be Installed on Shelves, Pedestals, Walls, Ceilings, or On Rails – Saving Valuable Floor Space.



5.Production:-

Robots Increase Profits by Reducing Production Time. Some Businesses use Industrial Robots Imply because of the Gains in Throughput. Allow more by Putting Robots.



Advantages of Industrial Robots

1. Cost -Effectiveness
2. Quality Assurance
3. Optimized Production Efficiency

1.Cost-effectiveness:-

4. Cost Effectiveness is One of the most Sound Arguments to be Made for the Case of Industrial Robots.
5. Robots will Reduce Production Costs by Eliminating Internal Costs to Compensate Human Salaries.
6. Businesses are forecasting that their Implement Robots into Production, or that They will have more Financial Mobility to Invest in New Production or Technologies.

2.Quality Assurance:-

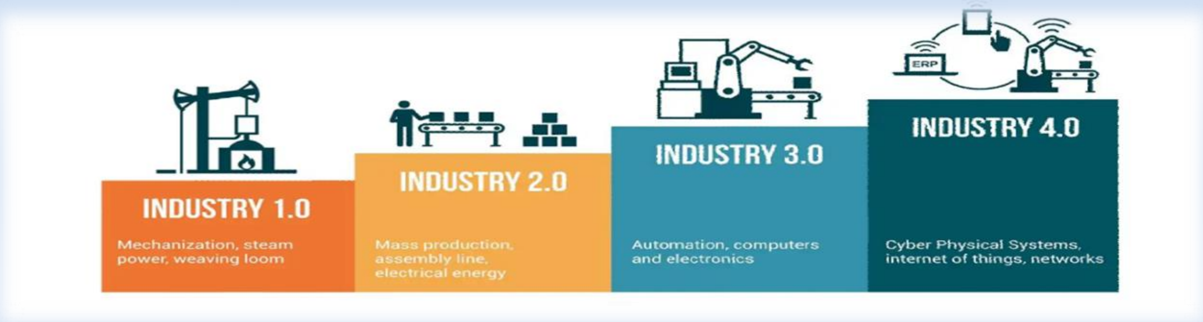
- Quality Assurance is expected with the use of Machinery in Production.
- Industrial Robots will be able to Ensure Consistency with Mass Production of Manufactured Products.
- The Possible Human Error that Assembly Line Workers Pose the Threat of will be Remove

3.Optimized Production Efficiency:-

- Optimized Production Efficiency Means that a General Manager will be able to have Set Quantity and Quality Standards.
- That will be jeopardized by Low Concentration, Break Time and Employee Injuries, among other Things.
- The Efficiency of Production Forecasts and Supply Levels will be increased with Robots, able to be Programmed to Work at The Optimal Seed for a Given Plant

Industry 4.0

Industry 4.0 is the digital transformation of industrial markets (industrial transformation) with smart manufacturing currently on the forefront. Industry 4.0 represents the so-called fourth industrial revolution in discrete and process manufacturing, logistics and supply chain (Logistics 4.0), the chemical industry, energy (Energy 4.0), transportation, utilities, oil and gas, mining and metals and other segments, including resources industries, healthcare, pharma and even smart cities. To understand Industry 4.0 it is essential to see the full value chain which includes suppliers and the origins of the materials and components needed for various forms of manufacturing, the end-to-end digital supply chain and the final destination of all manufacturing, regardless of the number of intermediary steps and players: the end customer (in his/her capacity as an entrepreneur, consumer, building occupant, retail store owner, worker, citizen, patient and so forth). This Industry 4.0 page gets regularly updated and is a continuous work in progress as in several areas evolutions happen fast. Moreover, Industry 4.0 is a vast reality, encompassing many societal, work-related, industry-specific and technological changes.



Industry 4.0 is a Name Given to the Current Trend of Automation and Data Exchange in Manufacturing Technologies. It Includes Cyber-physical System, The Internet of Things, Cloud Computing and Cognitive Computing. Industry 4.0 is Commonly Referred as the Fourth Industrial Revolution. Industry 4.0 Fosters what has be Called a Smart Factory

Conclusion:-

The design principles of Industry 4.0 such as interoperability, virtualization, decentralization, real-time capability, a service-oriented approach and modularity all play a key role in the radically changing architecture of the various Industrial solutions as we know them. Today we Find Most Robots Working for People in Industries, Factories, etc.,

Robots are Useful in Many Ways.

Therefore, Having Need to be Efficient to keep up with the Industry Competition.

- Therefore, Having Robots Helps Business Owners to be Competitive, Because Robots can Do Jobs Better and Faster than Humans Can, e.g. Robot can build assemble a Car.

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Non-Conventional Energy Sources


A Gopinath
DME, III Year

R.Gokul
DME , II Year

Abstract

Biomass energy is available at cheaper cost and it does not harm the environment .In some ways it also controls the pollution of the environment. Biomass energy can be good renewable energy source for rural areas in India. Production of Biomass energy has huge scope for innovation and its application in remote & rural areas. For that we will need efficient resources, Sustainable, renewable, non-conventional and equally essential resources of energy is needed to full fill the potential of India in the future. Biomass results in the production of biofuel which acts like treasures of renewable energy in the world.

Introduction

India concludes 17.5% of the total world population. i.e., 1210 crores of population, which makes it, second most populous country in the world

India has the second largest economy of the world. India is placing gargantuan demand on its energy resources due to its substantial and sustained economic growth over the years . To complete the demand of energy, Indian government is looking forward to generate energy from renewable energy resources (solar, wind, biomass etc.) which is available as free or low cost mode. Renewable energy source are good for country as it may lead country towards energy security.

Non-conventional sources of energy are pollution-free and eco-friendly. Energy generated by using wind, tides, solar geothermal heat and biomass including farm and animal waste as well as human excreta is known as non-conventional energy. Non-conventional sources of energy are pollution-free and eco-friendly. Energy generated by using wind, tides, solar geothermal heat and biomass including farm and animal waste as well as human excreta is known as non-conventional energy.

Importance of non-conventional sources of energy

The non-conventional sources of energy are more in nature. According to energy experts the non-conventional energy potential of India is estimated at about 95,000 MW. The Non-conventional resources of energy can be renewed with minimum effort and money. Non-conventional sources of energy are pollution-free and eco-friendly.

Bio-Energy

Bioenergy is renewable energy created from natural, biological sources. Many natural sources, such as plants, animals, and their byproducts, can be valuable resources. Modern technology even makes landfills or waste zones potential bioenergy resources. Bio energy is renewable energy made available from materials derived from biological sources. Biomass is any organic material, may include wood, wood waste, straw, manure, sugar cane and many other by products from a variety of Agricultural processes.

Bio-Mass

Biomass is organic matter produced by plants-terrestrial and aquatic and their derivatives. Biomass energy is the use of organic material to generate energy. Biomass is just organic matter – think, stuff that's made in nature – like wood pellets, grass clippings and even dung. Crops, like sugarcane and corn, can also be used to create biofuels.

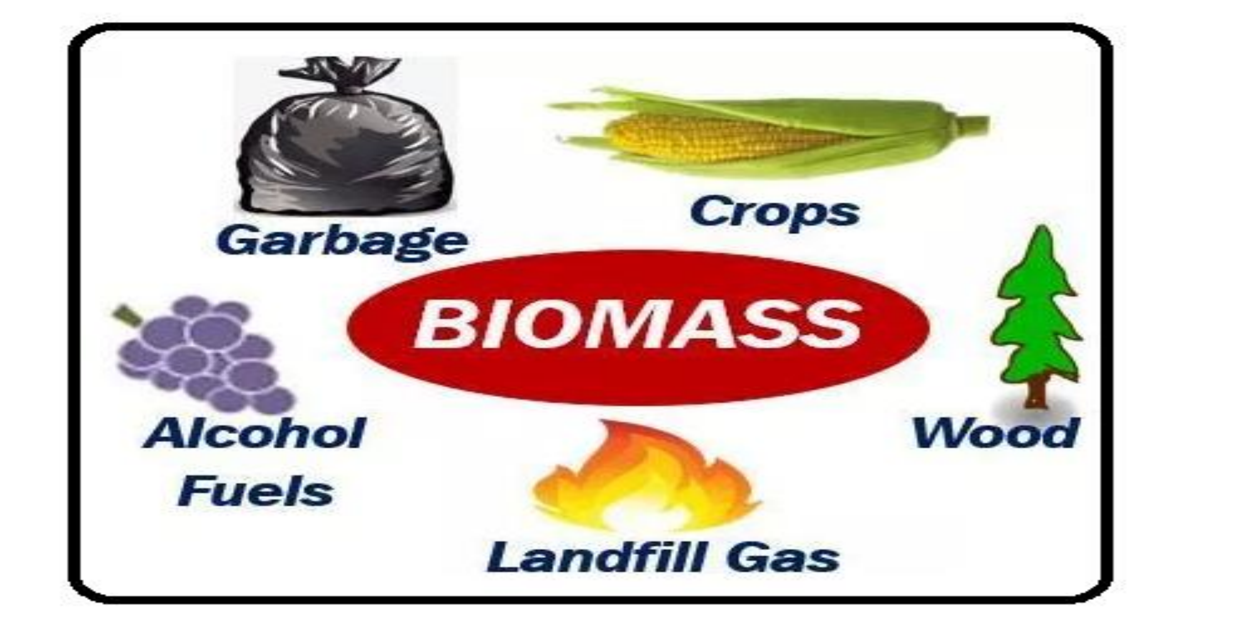
The Biomass includes

I. Forest crops and residues.

II. Crops specially grown in ‘energy farms’ for their energy content.

III. Animal manure

Biomass continues to account for an estimated 1/3rd of primary energy use, while in the poorest counties up to 90% of all energy is supplied by biomass. Biomass energy, or bio energy is the conversion of biomass (organic material originating from plants, trees, and crops and essentially the collection and storage of the sun’s energy through photosynthesis) into useful forms of energy such as heat, electricity, and liquid fuels.



Biomass Energy Conversion Technologies

- Combustion
- Gasification
- Anaerobic Digestion
- Liquid Bio fuels

Combustion

The Biomass Combustion Technologies during combustion, biomass fuel is burnt in excess air to produce heat.The main products of efficient biomass combustion are carbon dioxide and water vapor, however tars, smoke and alkaline ash particles are also emitted.

Gasification

Gasification is a process that converts organic- or fossil fuel-based carbonaceous materials into carbon monoxide, hydrogen and carbon dioxide. This is achieved by reacting the material at high temperatures (>700 °C), without combustion, with a controlled amount of oxygen and/or steam. The resulting gas mixture is called syngas (from synthesis gas) or producer gas and is itself a fuel. The power derived from gasification and combustion of the resultant gas is considered to be a source of renewable energy if the gasified compounds were obtained from biomass.

Anaerobic digestion

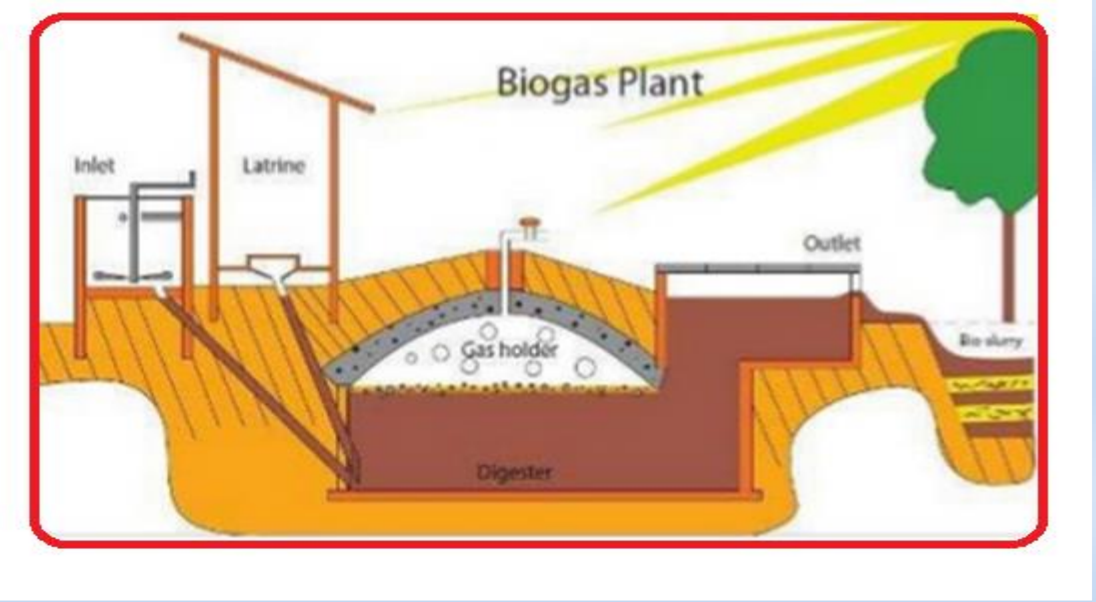
It is widely used as a source of renewable energy. The process produces a biogas, consisting of methane, carbon dioxide, and traces of other 'contaminant' gases. This biogas can be used directly as fuel, in combined heat and power gas engines or upgraded to natural gas-quality bio methane.

Liquid Bio fuels

Liquid biofuels, which include ethanol produced from crops containing sugar and starch and biodiesel from oilseeds, are referred to as first-generation biofuels. These fuels only use a portion of the energy potentially available in the biomass.

Dheenbhandhu Biogas Project Model

A domestic bio-gas unit is a digesting chamber where manure, from both cows and humans, ferments to provide biogas, through the release of methane. Biogas is seen as a clean fuel, and provides a feasible alternative to cooking gas. In colder climates like the lower regions of the Himalaya the Deenbandhu fixed model is ideal because the digestion chamber is underground providing good insulation against the cold. We have found that the critical factors for success with Bio-gas are ensuring quality during construction, and training user groups in the correct use and maintenance of their plants. Ignoring these critical issues often leads to the failure of bio-gas plants perpetuating the myth that bio-gas technology is inappropriate in the Himalaya and elsewhere in the country. We use a design optimised for a longer 55 day cycle so that the mixture gets more time for digestion. Care is also taken to choose sites that get 2-3 hours of sunlight in winter. We have found that while the production of gas does reduce by about 25% during three months in winter, the plants function very well and one cubic metre plant provides 2-3 hours of clean cooking fuel every day. For rural communities this not only provides efficient low-cost fuel but reduces the strains of overgrazing of animals on the land.



Present State of Biomass Energy in India

India has a potential of about 18 GW of energy from Biomass. Currently, about 32% of total primary energy used in India is derived from Biomass. More than 70% of the country's population depends upon biomass for its energy needs.

Advantages of Biomass Energy

Biomass is always and widely available as a renewable source of energy.

- It is carbon neutral. ...
- It reduces the overreliance of fossil fuels. ...
- Is less expensive than fossil fuels. ...
- Biomass production adds a revenue source for manufacturers. ...
- Less garbage in landfills.

Advantages of Environment

- ✓ Renewable resource
- ✓ Reduces landfills
- ✓ Protects clean water supplies
- ✓ Reduces acid rain and smog
- ✓ Reduces greenhouse gases
- ✓ Carbon dioxide
- ✓ Methane

Disadvantages of Biomass Energy

- ✓ It is dispersed and land intensive as a source.
- ✓ It is I is often of low energy density.
- ✓ The Labor intensive and the cost of collecting large quantities for commercial application is significant.

Fuel Properties of Biogas

- ✓ 60 % Methane : 22.350 to 24.22 MJ/m3.
- ✓ Without CO_2 : 33.525 to 35.390 MJ/m3.
- ✓ Octane rating without CO_2 : 130.
- ✓ Octane rating with CO_2 : 110.
- ✓ Ignition temperature : 650 ^{0}C
- ✓ Air to methane ratio for complete Combustion (by volume) : 10 to 1
- ✓ Explosive limits to air (by volume) : 5 to 15

Conclusion

A biomass industry is able to produce a lot of energy with a small amount of biomass material. Although biomass industry will be expensive it can be a very big step in protecting the resources in the world and reducing greenhouse gases that affect the environment greatly.

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Role of Mechanical Engineers in Agriculture

M.Bharanidharan,
DME – III Year

H.Mohamed Kaja Nowfal,
DME – III Year

Abstract

The quality safeties of agricultural products play an important role in national economic development and social stability.. The mechanical engineering profession has a long and honorable history of achievements in agriculture. At the present time its contributions seem to be mainly in mechanization and in environmental structures for both plants and animals. The emphasis is on production despite the fact that in the modern food system distribution accounts for the major part of energy use and overall cost. This paper identifies agricultural distribution as an important and urgent area for the commitment of the mechanical engineer. It shows how the engineering method, which lies at the heart of the profession's contributions to society, can be applied to this large and growing sector of the economy.

Introduction

In this paper agriculture field in role of mechanical engineering in agriculture field using some mechanical equipment that reduces human work and give high production and reduces working time. It helps farmers reduce work and increase production. Mechanical engineers are involved with the generation, distribution, and use of energy. This could be as a part the control and automation of manufacturing systems, the design and development of machines or the solutions to environmental problems. Among farmers to-day view is very commonly held that engineers have given agriculture something less than its due share of attention. No doubt this arise in part from the difficulties under which farming has labored during the last few years. Badly needed implemented have been and still are in short supply. Scarcity of skilled labour and material has lowered constructional standards. Above all, the war brought the commercial development of new machine virtually to a standstill just when the urge to extend agricultural mechanization was great than ever before. But when all this has been taken into account, there is still something to be answered. By and large, engineering has certainly influenced most other Industries. For example, although British farms now use something like 6,000,000 horse-power in the form of tractor alone, cultivating implement and methods have changed hardly at all. For the most part of the tractor are used as mechanical horse to pull much the same equipment as before at much the same speed. If transport had made only comparable progress, we should still be going about in ox wagons and stage coaches, even if we did pull them with slow moving engines.

Tractor hydraulic hitch

The tractor hydraulic hitch system is an important subsystem of modern agricultural tractor work unit. Its main function is to hook and control agricultural machines working position. The hydraulic hitch system is an important part of modern agricultural tractor work unit. The research on the hydraulic hitch system control method, is the basis of ensuring that the tractor work unit reach the optimal performance .This paper analyzes the tractor hitch control function, introduces the principle of electro-hydraulic control of tractor ploughing depth, and the tractor mechanical hydraulic hitch equipment as the basis, using electric hydraulic control to replace the original mechanical hydraulic control, improved design of automatic control system. The novel electro-hydraulic hitch system having multiple parameter stability comprehensive regulation performance, can replace the traditional mechanical type regulating device, to achieve depth homogeneous, stable work.

Harvesting Machine

The modern combine harvester, or simply combine, is a versatile machine designed to efficiently harvest a variety of grain crops. The name derives from its combining three separate harvesting operations—reaping, threshing, and winnowing—into a single process.

Among the crops harvested with a combine Wheat, Oats, Barely, Corn Soybeanssorghum, soybeans, flax (linseed), sunflowers and canola. The separated straw, left lying on the field, comprises the stems and any remaining leaves of the crop with limited nutrients left in it: the straw is then either chopped, spread on the field and ploughed back in or baled for bedding and limited-feed for livestock.

Share lifting harvesters

Top lifters use rubber belts to grab the green tops of the carrot plant and pull them from the soil. A share pushes under the carrot root and loosens the plant. The belt takes the carrots, with tops, in to the machine where the tops are cut off and sent along a waste path and dropped back on to the field

Conclusion

To create competitive man power in the field of Agricultural Engineering, for the analyze complex engineering problems reaching substantiated conclusions the consequent responsibilities relevant to the professional engineering.

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Electric Vehicles - Impact on Utility and Regulatory Interventions

R.Yusuf Khan
DME – III Year

C.Surendar
DME – III Year

Abstract

The total fuel efficiency during the cycle process in Alair electric vehicles (EVs) can be 15% (present stage) or 20% (projected) comparable to that of internal combustion engine vehicles (ICES) (13%). The design battery energy density is 1300 Wh/kg (present) or 2000 Wh/kg (projected).

Introduction

1/3rd of crude imports in India attributed to transportation;80% in the road transportation. The National Electric Mobility Mission Plan 2020, notified by Department of Heavy Industries puts emphasis on EVs as a key mitigation strategic-benefits of EVs include curbing air-pollution; substantive benefits ambient air quality in the urban centers. TheRecently published reports by NITI Aayog argues in favor of EVs; utilities can use EVs as mobile assets

The Forum of Regulators commissioned a study to assess

- International best practices within the EV space
- Role of regulators and distribution licensees
- Impact of EVs on the distribution networks

NEMMP vehicle stock numbers

- ✓ Low Growth scenario (2.2 lacs vehicles excluding 2-wheelers)
- ✓ High Growth scenario (4 lacs vehicles excluding 2-wheelers)

NEMMP+ vehicle stock numbers

- ✓ Low Growth scenario (4.95 lacs vehicles excluding 2-wheelers)
- ✓ High Growth scenario (8.4 lacs vehicles excluding 2-wheelers)

Investments in the charging infrastructure

NEMMP scenario

- ✓ Low growth (2,873 MUs and INR 603 Crores investment) – 547 MW additional

Load.

- ✓ High growth (5,322 MUs and INR 834 Crores investment) – 1013 MW additional load

NEMMP+ scenario

- ✓ Low growth (7,993 MUs and INR 1,142Crores investment) – 1,521 MW additional load
- ✓ High growth (25,218 MUs and INR 3,372 Crores investment) – 4,798 MW additional load

Pointers from International Best Practices

- Regulators in California and Vermont have approved the capital expenditure towards EV

Supply Equipment (EVSE) installations as a part of rate base.

- Electricity distribution companies have offered attractive time-of-day tariffs to promote off-peak charging.
- They have also played a key role in the development of public charging infrastructure.
- US, Japan and China experimenting utilization of EVs as grid assets, - demand response

Resource or ancillary services through Vehicle-to-Grid technologies.

- Governments have offered substantial direct and indirect incentives to EVs. Direct incentives include purchase subsidy for EVs and subsidy for installation of chargers while indirect benefits range from tax breaks to access to reserved lanes and parking spots,
- France offers an CO_2 emission based “feebate” system, which subsidizes electric vehicle purchase while penalizing higher-emission vehicles

Penetration of EVs – Technical Impact

- Impact of slow and fast charging on the voltage levels simulated in MATLAB on

residential and commercial distribution transformers

- Impacts need to assessed at macro (national grid) and local distribution
  - No impact on the entire grid with 5000 MW of peak loads
- Simulation results show no adverse impact on the voltage levels
  - ✓ The transformer can be safely loaded with a split of 60%-40% for residential loads and electric vehicle load respectively.
  - ✓ A baseline 50% loaded commercial feeder can safely absorb up to 20% of additional EV load from fast charging, similarly the residential feeder, can safely handle a ratio of 60%:40% from Residential load and EV load
- The peak co-incident charging scenario showed that a loading of around 20% from fast chargers should be the threshold
- Limitations – impact on each grid points – distribution networks – need to develop specific expansion plans.

Penetration of EVs – Legal Aspects

Legal questions

- ✓ Would setting up of public charging stations fall under the jurisdiction of distribution systems?
- ✓ Does it entail supply of electricity to public at large?
- ✓ Who can invest in Public charging infrastructure?

Evaluation of above questions suggests the following:

- ✓ EV charging service would fall within the ambit of electricity distribution (a licensed activity)
- ✓ EV charging service to EV users/drivers entails supply of electricity, thus needs to be regulated
- ✓ Tariff charged to the Consumers needs to be regulated and determined by respective missions.

Penetration of EVs – Possible Business Models

Distribution Licensee owned EV charging infrastructure

- ✓ Supply of electricity to EVs
- ✓ Tariff as determined by the SERC

Distribution Licensee franchised EV charging infrastructure

- ✓ Franchisee to install / operate charging stations. Franchisee can also be under PPP

Model

- ✓ Franchisee receives electricity at single point as bulk supply
  - ➢ Tariff (incl. tariff cap, if any) as determined by the SERC
  - ➢ Can also be allowed to buy power through Open Access without application of Cross Subsidy Surcharge

Privately Owned Battery Swapping Stations

- ✓ Aggregation of demand for batteries and setting up of battery swapping stations by the utility / distribution licensee / franchisee

- ✓ Sale of Battery is not sale of electricity. Third parties can set up stations to avail special category tariff as determined by the SERC
- ✓ Can also be allowed to buy power through Open Access

Penetration of EVs – Tariff
Two scenarios

- ✓ NEMMP targets and corresponding EV charging infrastructure requirements and
- ✓ An aggressive target termed the NEMMP+[1]

Both NEMMP and NEMMP+ scenarios use Low Growth and High Growth options

Tariff impact assessment was carried out in two formats –

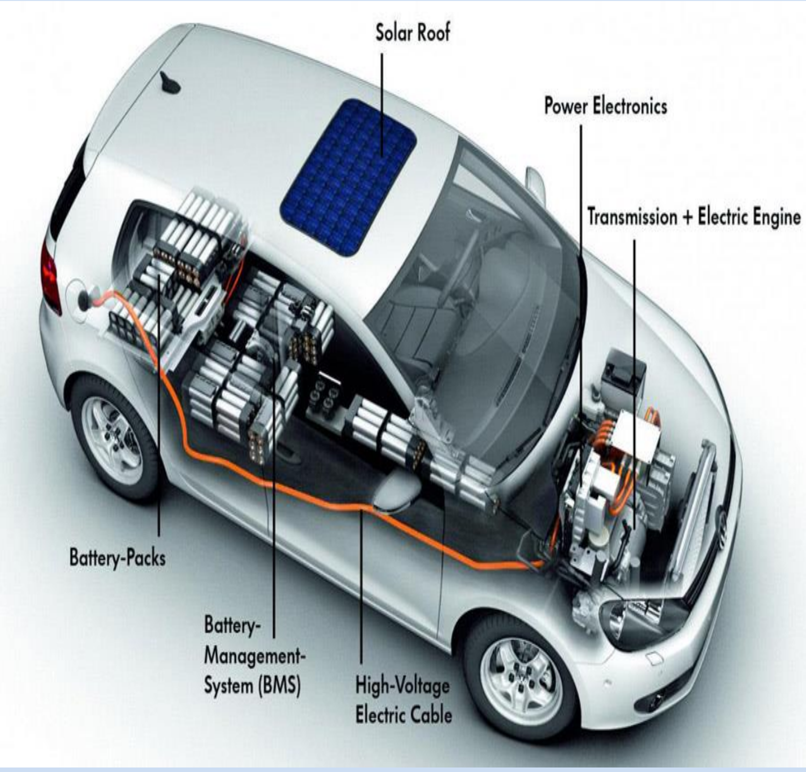
- ✓ Entire investment socialized to all the consumers of the licensee and
- ✓ Investments charged only to the EV category

Scenario	Business models	Growth options	Tariff Impact (Rs./kWh)
NEMMP	Scenario 1A: Investments socialized to all the consumers	Low Growth	0.0007
		High Growth	0.0010
	Scenario 1B: Investments charged only to EV category sales	Low Growth	0.2810
		High Growth	0.2097
NEMMP+	Scenario 2A: Investments socialized to all the consumers	Low Growth	0.0013
		High Growth	0.0040
	Scenario 2B: Investments charged only to EV category sales	Low Growth	0.1912
		High Growth	0.1790

Penetration of EVs – Suggestions for Regulatory Interventions

- Regulators to allow pass through of investments made in EV charging infrastructure bythe Distribution Licensees in tariffs

- Create simplified framework for franchisee agreements between the DLs and private sector/interested Public Sector Undertakings/associations to set-up charging infrastructure
- Appoint multiple and non-exclusive franchisees within its area of supply for setting up public charging infrastructure
- Create new tariff category for EVs by allowing recovery of incremental cost of infrastructure through wheeling charges over and above the average cost of service
- Allow special ToD structure for EV charging infrastructure accounting for use of backed-down assets in the night time
- Allow Open Access to EVs charging infrastructure aggregators without cross subsidy surcharge. Also allow banking of RE generation to promote reduced tariffs



Penetration of EVs – Enabling Framework for Roll-out

Roles and Functions of various agencies

- CERC / FoR – Regulatory framework including legal aspects, licensing requirements, tariff etc.
- Amendment to the Electricity Act, 2003 if licensing requirement for charging infrastructure / charging business is to be dispensed with.
-

Standardization – Connectivity, Safety and Product

- Connectivity with the Grid – CEA to specify standardization of connectivity parameters

i.e. power factor, load factors, harmonics, voltage etc.

- Equipment / Products – BIS to specify standards for equipment / products /components

Roll-out Plan

- Should provide for “Electric Charging” as well as “Swapping Aggregator” models

- In the long-run volumetric increase in Evs may result in reduction of cost gap between these models

Penetration of EVs – Charging Infrastructure as per NEMMP

Category	Low Growth		High growth		Sources
	Level 2	Fast DC	Level 2	Fast DC	
4 Wheelers	35,000	17,000	45,000	23,000	Exhibit # 42 to # 49 at page 112 to 115 of NEMMP 2020 document
2 Wheelers	-	-	-	-	
Buses	60	30	100	50	
3 Wheelers	2,000	1,000	4,000	2,000	
Light Commercial Vehicles	4,000	2,000	5,000	3,000	
Sub Total	**41,060**	**20,030**	**54,100**	**28,050**	
Cost per charging installation, INR (all types except buses)	36,000	2,25,000	36,000	2,25,000	Footnotes at the above referred exhibits
Cost per charging installation, INR (buses)	4,50,000	10,00,000	4,50,000	10,00,000	
Total Cost, INR Crores	**150**	**453**	**199**	**635**	
Grand total (INR Crore)	**603**		**834**		

Advantages

1) No fuel, no emissions

2) Running costs

3) Low maintenance

4) Performance

5) Popularity

Disadvantages

1) Driving range

2) Recharge time

3) Battery life

Conclusion

The progress that the electric vehicle industry has seen in recent years is not only extremely welcomed, but highly necessary in light of the increasing global greenhouse gas levels. As demonstrated within the economic, social, and environmental analysis sections of this webpage, the benefits of electric vehicles far surpass the costs. The biggest obstacle to the widespread adoption of electric-powered transportation is cost related, as gasoline and the vehicles that run on it are readily available, convenient, and less costly. As is demonstrated in our timeline, we hope that over the course of the next decade technological advancements and policy changes will help ease the transition from traditional fuel-powered vehicles. Additionally, the realization and success of this industry relies heavily on the global population, and it is our hope that through mass marketing and environmental education programs people will feel incentivized and empowered to drive an electric-powered vehicle. Each person can make a difference, so go electric and help make a difference.

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3D Printing

K.B.Kabilan, DME- II Year

Abstract

3D printing is a form of additive manufacturing technology where a three dimensional object is created by laying down successive layers of material. It is also known as rapid prototyping, is a mechanized method whereby 3D objects are quickly made on a reasonably sized machine connected to a computer containing blueprints for the object. The 3D printing concept of custom manufacturing is exciting to nearly everyone. This revolutionary method for creating 3D models with the use of inkjet technology saves time and cost by eliminating the need to design; print and glue together separate model parts. Now, you can create a complete model in a single process using 3D printing. The basic principles include materials cartridges, flexibility of output, and translation of code into a visible pattern.3D printers are machines that produce physical 3D models from digital data by printing layer by layer. It can make physical models of objects either designed with a cad program or scanned with a 3D scanner. It is used in a variety of industries including jeweler, footwear, industrial design, architecture, engineering and construction, automotive, aerospace, dental and medical industries, education and consumer products.

Introduction

General explanation of 3D printing: a method of manufacturing known as ‘additive manufacturing’, due to the fact that instead of removing material to create a part, the process adds material in successive patterns to create the desired shape.

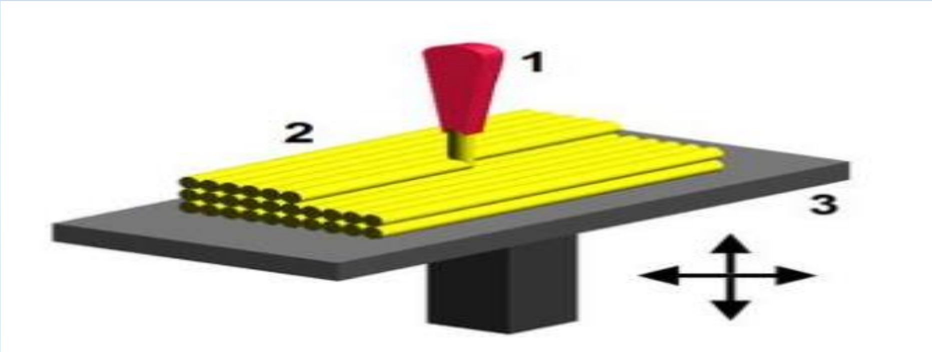
Main areas of use:

3D printing uses software that slices the 3D model into layers (0.01mm thick or less in most cases). Each layer is then traced onto the build plate by the printer, once the pattern is completed, the build plate is lowered and the next layer is added on top of the previous one. Typical manufacturing techniques are known as ‘subtractive manufacturing’ because the process is one of removing material from a preformed block. Processes such as milling and cutting are subtractive manufacturing techniques. This type of process creates a lot of waste since; the material that is cut off generally cannot be used for anything else and is simply sent out as scrap. 3D printing eliminates such waste since the material is placed in the location that it is needed only, the rest will be left out as empty space.

Different 3D printing technologies

1. Stereolithography
2. Selective laser sintering
3. Fused deposit modeling
4. Inject 3D printing

Fused Deposit Modeling

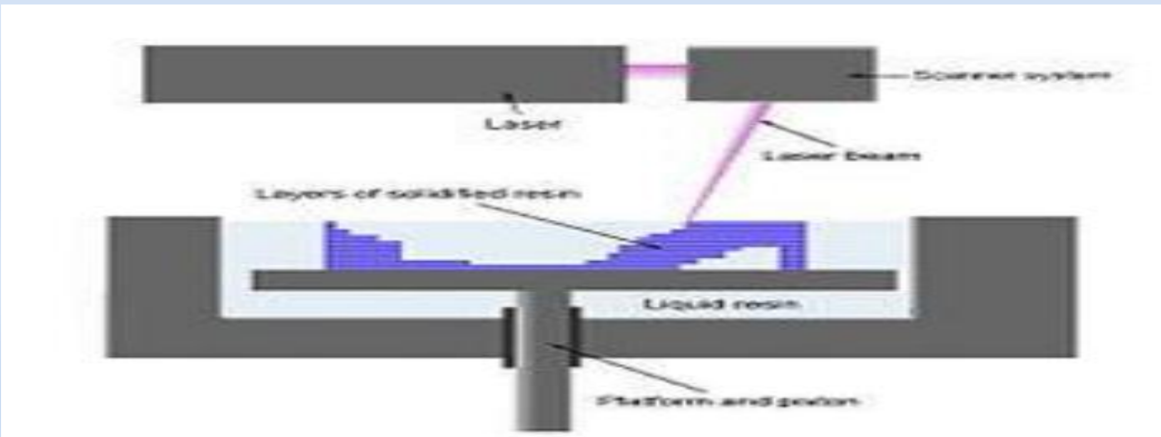


Fused deposition modeling fused deposition modeling, is an additive manufacturing technology commonly used for modeling, prototyping, and production applications. Fdm works on an "additive" principle by laying down material in layers. A plastic filament or metal wire is unwound from a coil and supplies material to an extrusion nozzle which can turn the flow on and off. The nozzle is heated to melt the material and can be moved in both horizontal and vertical directions by a numerically controlled mechanism, directly controlled by a computer-aided manufacturing (cam) software package. The model or part is produced by extruding small beads of thermoplastic material to form layers as the material hardens immediately after extrusion from the nozzle. Stepper motors or servo motors are typically employed to move the extrusion head. Fdm, a prominent form of rapid prototyping, is used for prototyping and rapid manufacturing. Rapid prototyping facilitates iterative testing, and for very short runs, rapid manufacturing can be a relatively inexpensive alternative.

Advantages: Cheaper since uses plastic, more expensive models use a different (water soluble) material to remove supports completely. Even cheap 3D printers have enough resolution for many applications.

Disadvantages: Supports leave marks that require removing and sanding. Warping, limited testing allowed due to thermo plastic material

Sla – Stereo Lithography



Stereolithography is an additive manufacturing process which employs a vat of liquid ultraviolet curable photopolymer "resin" and an ultraviolet laser to build parts' layers one at a time. For each layer, the laser beam traces a cross-section of the part pattern on the surface of the liquid resin. Exposure to the ultraviolet laser light cures and solidifies the pattern traced on the resin and joins it to the layer below. After the pattern has been traced, the sla's elevator platform descends by a distance equal to the thickness of a single layer, typically 0.05 mm to 0.15 mm (0.002" to 0.006"). Then, a resin-filled blade sweeps across the cross section of the part, re-coating it with fresh material. On this new liquid surface, the subsequent layer pattern is traced, joining the previous layer. A complete 3-d part is formed by this process. After being built, parts are immersed in a chemical bath in order to be cleaned of excess resin and are subsequently cured in an ultraviolet oven. Stereolithography requires the use of supporting structures which serve to attach the part to the elevator platform, prevent deflection due to gravity and hold the cross sections in place so that they resist lateral pressure from the re-coater blade. Supports are generated automatically during the preparation of 3D computer aided design models for use on the stereolithography machine, although they may be manipulated manually. Supports must be removed from the finished product manually, unlike in other, less costly, rapid prototyping technologies.

Advantages and disadvantages:

one of the advantages of stereolithography is its speed; functional parts can be manufactured within a day. The length of time it takes to produce one particular part depends on the size and complexity of the project and can last from a few hours to more than a day. Most stereolithography machines can produce parts with a maximum size of approximately 50×50×60 cm (20"×20"×24") and some, such as the mammoth stereolithography machine (which has a build platform of 210×70×80 cm),[7] are capable of producing single parts of more than 2m in length. Prototypes made by stereolithography are strong enough to be machined and can be used as master patterns for injection molding, thermoforming, blow molding, and various metal casting processes. Although stereolithography can produce a wide variety of shapes, it has often been expensive; the cost of photo-curable resin has long ranged from \$80 to \$210 per liter, and the cost of stereolithography machines has ranged from \$100,000 to more than \$500,000

Work flow

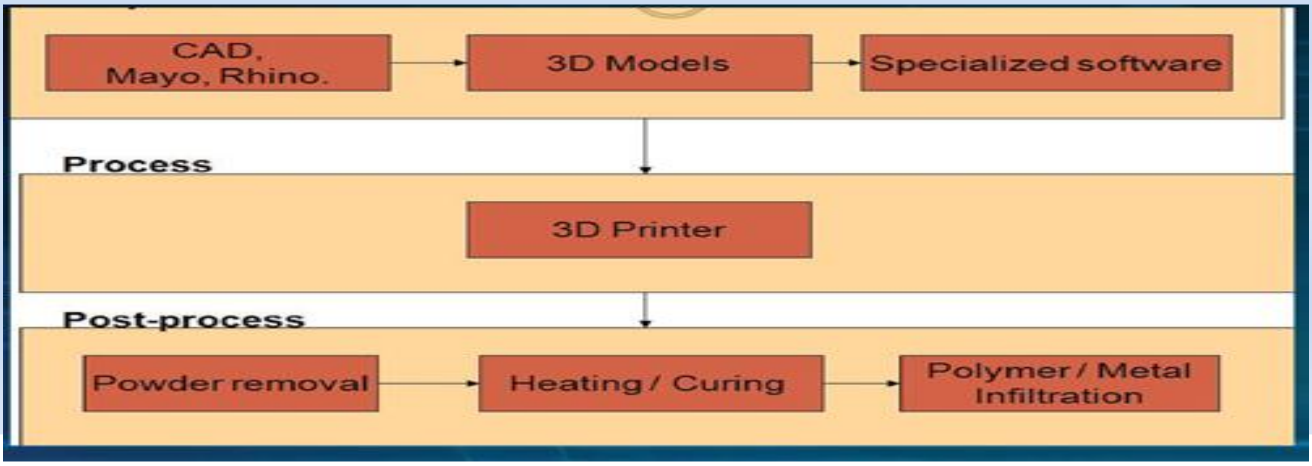


Table showing all available types of 3D Printers:

Type	Technologies	Materials
Extrusion	Fused deposition modeling (FDM)	Thermoplastics (e.g. PLA, ABS), eutectic metals, edible materials
Granular	Direct metal laser sintering (DMLS)	Almost any metal alloy
	Electron beam melting (EBM)	Titanium alloys
	Selective heat sintering (SHS)	Thermoplastic powder
	Selective laser sintering (SLS)	Thermoplastics, metal powders, ceramic powders
	Powder bed and inkjet head 3d printing, Plaster-based 3D printing (PP)	Plaster
Laminated	Laminated object manufacturing (LOM)	Paper, metal foil, plastic film
Light polymerized	Stereolithography (SLA)	photopolymer
	Digital Light Processing (DLP)	liquid resin

Current and future applications of 3D printing

Biomedical engineering

In recent years scientists and engineers have already been able to use 3D printing technology to create body parts and parts of organs. The first entire organ created through 3D printing is expected to be done in the coming years. The process of creating the organ or body part is exactly the same as if you were to create a plastic or metal part, however, instead the raw material used are biological cells created in a lab. By creating the cells specifically for a particular patient, one can be certain that the patient's body will not reject the organ. Another application of 3D printing in the biomedical field is that of creating limbs and other body parts out of metal or other materials to replace lost or damaged limbs. Prosthetic limbs are required in many parts of the world due to injuries sustained during war or by disease. Currently prosthetic limbs are very expensive and generally are not customized for the patient's needs. 3D printing is being used to design and produce custom prosthetic limbs to meet the patient's exact requirements. By scanning the patient's body and existing bone structure, designers and engineers are able to re-create the lost part of that limb.

Aerospace and automobile manufacturing

High technology companies such as aerospace and automobile manufacturers have been using 3D printing as a prototyping tool for some time now. However, in recently years, with further advancement in 3D printing technology, they have been able to create functional parts that can be used for testing. This process of design and 3D printing has allowed these companies to advance their designs faster than ever before due to the large decrease in the design cycle. From what used to take months between design and the physical prototype, now within hours the design team can have a prototype in their hands for checks and testing

Designing for 3D printing

All the parts created using a 3D printer need to be designed using some kind of cad software. This type of production depends mostly on the quality of the cad design and also the precision of the printer. There are many types of cad software available, some are free others require you to buy the software or have a subscription. Deciding what type of cad software is good for you will depend on the requirements of what you are designing. However for beginners, that simply want to learn cad and create basic shapes and features, any of the free cad software packages will do.

Conclusion

The world is forever changing with the help of 3D printing. The use of 3D printing for medicinal purposes today is beyond astonishing but what the future holds is unknown, however it is certain that additive layer manufacturing will be a large corporate in solving our problems. 3D printing really is limitless and only the surface has been scratched, there is still much more to be uncovered. As shown in throughout the web page. 3D printing bones is still new and continuously improving and adjusting but it has already enhanced the life of many patients around the world and more specifically in australia. It is evident that the more funding and research put into 3D printing, the further 3D printing will take us. 3D is forever unpredictable. “if a picture is worth a thousand words… a prototype is worth a thousand pictures.

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