BEES Magazine

August 2019

K S R Institute for Engineering and Technology

Department of Electrical and Electronics Engineering

BEES Magazine

Together We Make Difference

August 2019

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Editorial Board

Blockchain

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Introduction

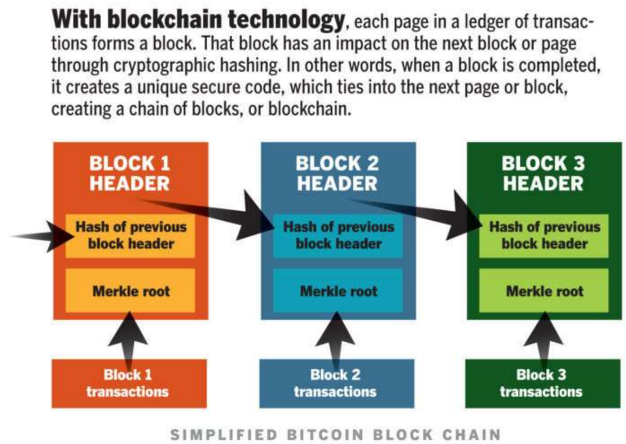
First and foremost, blockchain is a public electronic ledger built around a P2P system that can be openly shared among disparate users to create an unchangeable record of transactions, each time-stamped and linked to the previous one. Every time a set of transactions is added, that data becomes another block in the chain (hence, the name).

Blockchain can only be updated by consensus between participants in the system, and once new data is entered it can never be erased. It is a write-once, append-many technology, making it a verifiable and auditable record of each and every transaction.

While it has great potential, blockchain technology development is still early days; CIOs and their business counterparts should expect setbacks in deploying the technology, including the real possibility of serious bugs in the software used atop blockchain. And as some companies have already discovered, it's not the be-all solution to many tech problems.

Blockchain standards organizations, universities and start-ups have proposed newer consensus protocols and methods for spreading out the computational and data storage workload to enable greater transactional throughput and overall scalability – a persistent problem for blockchain. And the Linux Foundation's Hyperledger Project has created modular tools for building out blockchain collaboration networks.

While some industry groups are working toward standardizing versions of blockchain software, there are also hundreds of startups working on their own versions of the distributed ledger technology.



Each digital record or transaction in the electronic ledger is called a block. When a block is completed, it creates a unique secure code that ties it to the next block.

Why has blockchain been getting so much buzz? In a word, bitcoin – the wildly hyped cryptocurrency that allows for payment transcations over an open network using encryption and without exposing the identities of individual bitcoin owners. It was the first ever decentralized one when it was created in 2009. Other forms of cryptocurrency or virtual money, such as Ether (based on the Ethereum blockchain application platform), have also gained significant traction and opened new venues for cross-border monetary exchanges. (Ethereum was introduced in 2013 by developer Vitalik Buterin, who was 19 at the time.)

The term bitcoin was first... well, coined in 2008 when Satoshi Nakamoto (likely a pseudonym for one or more developers) wrote a paper about a "peer-to-peer version of electronic cash that would allow online payments to be sent directly from one party to another without going through a financial institution."

For more than a year, however, Bitcoin has been on a roller coaster ride, with its value dropping from a peak of nearly $20,000 to a little more than $3,500, mainly due to the fact that it has no intrinsic value; its worth is based only on high demand and limited supply. Unlike fiat currencies or stocks, there is no institution or government backing the value of bitcoin.

That may change for cryptocurrencies someday.

Governments have already made overtures toward creating stablecoins, or cryptocurrency that's backed by a stable asset such a gold or traditional fiat currency. Blockchain is also being used to digitize other assets, such as cars, real estate and even artwork.

Blockchain, or distributed ledger technology, isn't a single technology. Rather it's an architecture that allows disparate users to make transactions and then creates an unchangeable, secure record of those transactions.

Public vs. private blockchains

As a peer-to-peer network, combined with a distributed time-stamping server, public blockchain ledgers can be managed autonomously to exchange information between parties. There's no need for an administrator. In effect, the blockchain users are the administrator.

A second form of blockchain, known as private or permissioned blockchain, allows companies to create and centrally administer their own transactional networks that can be used inter- or intra-company with partners.

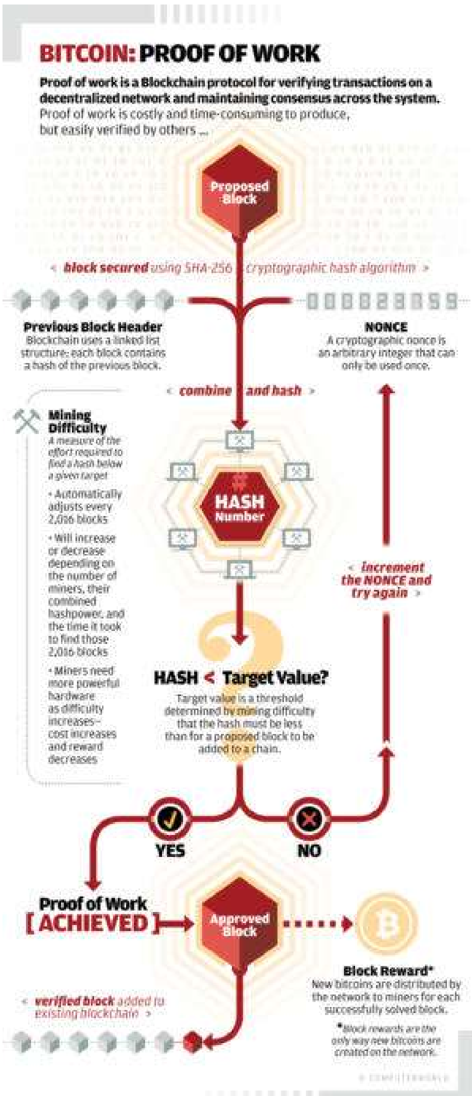
Additionally, blockchain networks can be used for "smart contracts," or scripts for business automation that execute when certain contractual conditions are met. For example, after a bad batch of lettuce resulted in customers becoming sick from e-coli, Walmart and IBM created a blockchain-based supply chain to track produce from farm to table. Walmart has asked its produce suppliers to input their data to the blockchain database by September 2019. Once on the blockchain, produce can be automatically tracked through smart contracts from point to point, removing human intervention and error.

After piloting a blockchain-based produce supply chain tracking system, Walmart and Sam's Club are telling suppliers to get their product data into the system so they can begin tracking produce from farm to store. The deadline: September 2019.

Smart contracts can also be used to approve the transfer of assets, such as real estate. Once conditions are met between buyers, sellers and their financial institutions, property sales can be confirmed on DLT. For example, New York-based ShelterZoom this year is launching a real estate mobile application that lets real estate agents and clients see all offers and acceptances in real time online. It will also allow access to property titles, mortgages, legal and home inspection documents through the Ethereum-based encrypted blockchain ledger.

How secure is blockchain

While no system is "unhackable," blockchain's simple topology is the most secure today, according to Alex Tapscott, the CEO and founder of Northwest Passage Ventures, a venture capital firm that invests in blockchain technology companies.



"In order to move anything of value over any kind of blockchain, the network [of nodes] must first agree that that transaction is valid, which means no single entity can go in and say one way or the other whether or not a transaction happened," Tapscott said. "To hack it, you wouldn't just have to hack one system like in a bank..., you'd have to hack every single computer on that network, which is fighting against you doing that.

"So again, [it's] not un-hackable, but significantly better than anything we've come up with today," he said.

Blockchain's advances rely on scalablity

One of the major issues facing blockchain involves scalability, or its ability to complete transactions in near real time, such as clearing payments via credit cards.

Scalability has already been identified as an issue with cryptocurrencies such as bitcoin and Ethereum's Ether. If a distributed ledger is to achieve adoption by financial technology (FinTech) companies and compete with payment networks hundreds of times faster, it must find a way to boost scalability and throughput and address latency problems.

In today's blockchains, each authenticating computer or node records *all* the data on the electronic ledger and is part of the consensus process. In large blockchains such as bitcoin, the majority of participating nodes must authenticate new transactions and record that information if they are to be added to the ledger; that makes completing each transaction slow and arduous.

Because of that, bitcoin, which is based on a PoW, can only process 3.3 to 7 transactions per second – and a single transaction can take 10 minutes to finalize.

Ethereum, another popular blockchain ledger and cryptocurrency, is only able to process from 12 to 30 transactions per second.

By comparison, Visa's VisaNet on average processes 1,700 transactions per second.

Nanotechnology in Energy

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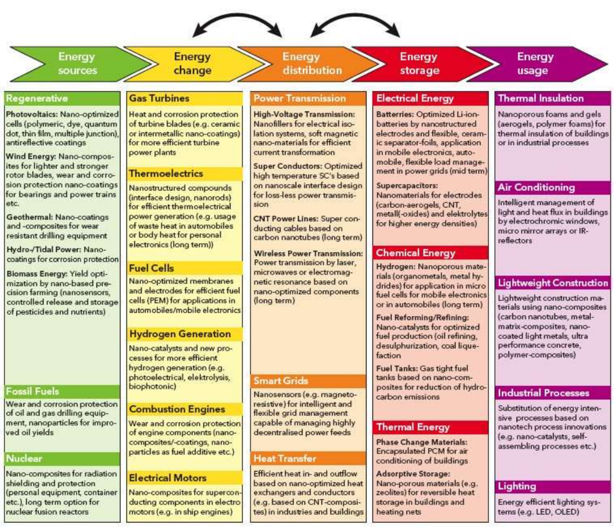
Introduction

Nanotechnologies provide the potential to enhance energy efficiency across all branches of industry and to economically leverage renewable energy production through new technological solutions and optimized production technologies. Nanotechnology innovations could impact each part of the value-added chain in the energy sector:



Energy sources

Nanotechnologies provide essential improvement potentials for the development of both conventional energy sources (fossil and nuclear fuels) and renewable energy sources like geothermal energy, sun, wind, water, tides or biomass. Nano-coated, wear resistant drill probes, for example, allow the optimization of lifespan and efficiency of systems for the development of oil and natural gas deposits or geothermal energy and thus the saving of costs. Further examples are high-duty nanomaterials for lighter and more rugged rotor blades of wind and tidepower plants as well as wear and corrosion protection layers for mechanically stressed components (bearings, gear boxes, etc.). Nanotechnologies will play a decisive role in particular in the intensified use of solar energy through photovoltaic systems. In case of conventional crystalline silicon solar cells, for instance, increases in efficiency are achievable by antireflection layers for higher light yield.

First and foremost, however, it will be the further development of alternative cell types, such as thin-layer solar cells (among others of silicon or other material systems like copper/indium/selenium), dye solar cells or polymer solar cells, which will predominantly profit from nanotechnologies. Polymer solar cells are said to have high potential especially regarding the supply of portable electronic devices, due to the reasonably-priced materials and production methods as well as the flexible design. Medium-term development targets are an efficiency of approx. 10% and a lifespan of several years. Here, for example, nanotechnologies could contribute to the optimization of the layer design and the morphology of organic semiconductor mixtures in component structures. In the long run, the utilization of nanostructures, like quantum dots and wires, could allow for solar cell efficiencies of over 60%.

Energy conversion

The conversion of primary energy sources into electricity, heat and kinetic energy requires utmost efficiency. Efficiency increases, especially in fossil-fired gas and steam power plants, could help avoid considerable amounts of carbon dioxide emissions.

Higher power plant efficiencies, however, require higher operating temperatures and thus heat-resistant turbine materials. Improvements are possible, for example, through nano-scale heat and corrosion protection layers for turbine blades in power plants or aircraft engines to enhance the efficiency through increased operating temperatures or the application of lightweight construction materials (e.g. titanium aluminides).

Nano-optimized membranes can extend the scope of possibilities for separation and climate-neutral storage of carbon dioxide for power generation in coal-fired power plants, in order to render this important method of power generation environmentally friendlier in the long run. The energy yield from the conversion of chemical energy through fuel cells can be stepped up by nano-structured electrodes, catalysts and membranes, which results in economic application possibilities in automobiles, buildings and the operation of mobile electronics.

Thermoelectric energy conversion seems to be comparably promising. Nano-structured semiconductors with optimized boundary layer design contribute to increases in efficiency that could pave the way for a broad application in the utilization of waste heat, for example in automobiles, or even of human body heat for portable electronics in textiles.

Energy distribution

Regarding the reduction of energy losses in current transmission, hope exists that the extraordinary electric conductivity of nanomaterials like carbon nanotubes can be utilized for application in electric cables and power lines. Furthermore, there are nanotechnological approaches for the optimization of superconductive materials for lossless current conduction.

In the long run, options are given for wireless energy transport, e.g. through laser, microwaves or electromagnetic resonance. Future power distribution will require power systems providing dynamic load and failure management, demand-driven energy supply with flexible price mechanisms as well as the possibility of feeding through a number of decentralized renewable energy sources.

Nanotechnologies could contribute decisively to the realization of this vision, inter alia, through nano-sensory devices and power-electronical components able to cope with the extremely complex control and monitoring of such grids.

Energy storage

The utilization of nanotechnologies for the enhancement of electrical energy stores like batteries and super-capacitors turns out to be downright promising. Due to the high cell voltage and the outstanding energy and power density, the lithium-ion technology is regarded as the most promising variant of electrical energy storage.

Nanotechnologies can improve capacity and safety of lithium-ion batteries decisively, as for example through new ceramic, heat-resistant and still flexible separators and high-performance electrode materials. The company Evonik pushes the commercialization of such systems for the application in hybrid and electric vehicles as well as for stationary energy storage.

In the long run, even hydrogen seems to be a promising energy store for environmentally-friendly energy supply. Apart from necessary nanostructure adjustments, the efficient storage of hydrogen is regarded as one of the critical factors of success on the way to a possible hydrogen management.

Current materials for chemical hydrogen storage do not meet the demands of the automotive industry, which requires a hydrogen-storage capacity of up to ten weight percent.

Various nanomaterials, inter alia based on nanoporous metal-organic compounds, provide development potentials, which seem to be economically realizable at least with regard to the operation of fuel cells in portable electronic devices.

Another important field is thermal energy storage. The energy demand in buildings, for example, may be significantly reduced by using phase change materials such as latent heat stores. Interesting, from an economic point of view, are also adsorption stores based on nanoporous materials like zeolites, which could be applied as heat stores in district heating grids or in industry. The adsorption of water in zeolite allows the reversible storage and release of heat.

Energy usage

To achieve sustainable energy supply, and parallel to the optimized development of available energy sources, it is necessary to improve the efficiency of energy use and to avoid unnecessary energy consumption. This applies to all branches of industry and private households. Nanotechnologies provide a multitude of approaches to energy saving. Examples are the reduction of fuel consumption in automobiles through lightweight construction materials on the basis of nanocomposites, the optimization in fuel combustion through wear-resistant, lighter engine components and nanoparticular fuel additives or even nanoparticles for optimized tires with low rolling resistance.

Considerable energy savings are realizable through tribological layers for mechanical components in plants and machines. Building technology also provides great potentials for energy savings, which could be tapped, for example, by nanoporous thermal insulation material suitably applicable in the energetic rehabilitation of old buildings.

In general, the control of light and heat flux by nanotechnological components, as for example switchable glasses, is a promising approach to reducing energy consumption in buildings.

Intellectual Property Rights

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Introduction

Intellectual property (IP) refers to creations of the mind, such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce.

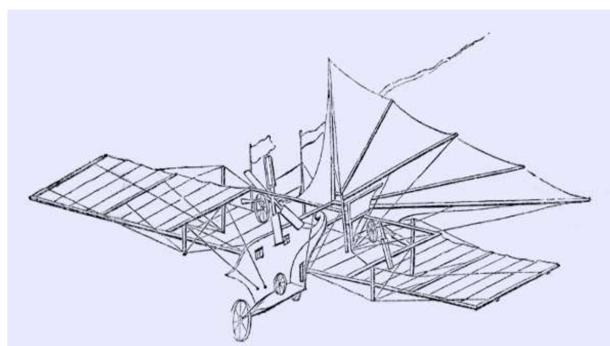
IP is protected in law by, for example, patents, copyright and trademarks, which enable people to earn recognition or financial benefit from what they invent or create. By striking the right balance between the interests of innovators and the wider public interest, the IP system aims to foster an environment in which creativity and innovation can flourish. Electronic waste or e-waste is generated when electronic and electrical equipment become unfit for their originally intended use or have crossed the expiry date. Computers, servers, mainframes, monitors, compact discs (CDs), printers, scanners, copiers, calculators, fax machines, battery cells, cellular phones, transceivers, TVs, iPods, medical apparatus, washing machines, refrigerators, and air conditioners are examples of e-waste (when unfit for use). These electronic equipments get fast replaced with newer models due to the rapid technology advancements and production of newer electronic equipment. This has led to an exponential increase in e-waste generation. People tend to switch over to the newer models and the life of products has also decreased.

Types of intellectual property

Copyright

Copyright is a legal term used to describe the rights that creators have over their literary and artistic works. Works covered by copyright range from books, music, paintings, sculpture and films, to computer programs, databases, advertisements, maps and technical drawings.

Patents

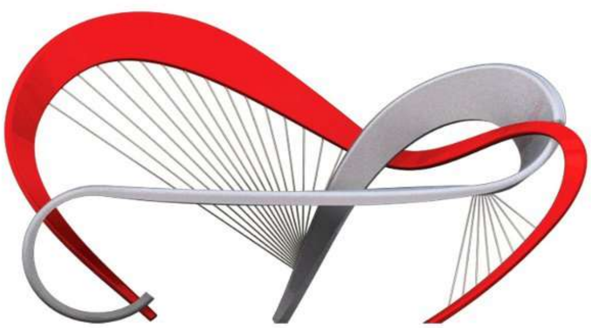


A patent is an exclusive right granted for an invention. Generally speaking, a patent provides the patent owner with the right to decide how - or whether - the invention can be used by others. In exchange for this right, the patent owner makes technical information about the invention publicly available in the published patent document.

Trademarks

A trademark is a sign capable of distinguishing the goods or services of one enterprise from those of other enterprises. Trademarks date back to ancient times when artisans used to put their signature or "mark" on their products.

Industrial designs



An industrial design constitutes the ornamental or aesthetic aspect of an article. A design may consist of three-dimensional features, such as the shape or surface of an article, or of two-dimensional features, such as patterns, lines or color.

Geographical indications

Geographical indications and appellations of origin are signs used on goods that have a specific geographical origin and possess qualities, a reputation or characteristics that are essentially attributable to that place of origin.

Most commonly, a geographical indication includes the name of the place of origin of the goods.

Trade secrets

Trade secrets are IP rights on confidential information which may be sold or licensed. The unauthorized acquisition, use or disclosure of such secret information in a manner contrary to honest commercial practices by others is regarded as an unfair practice and a violation of the trade secret protection.

IoT in Home Automation

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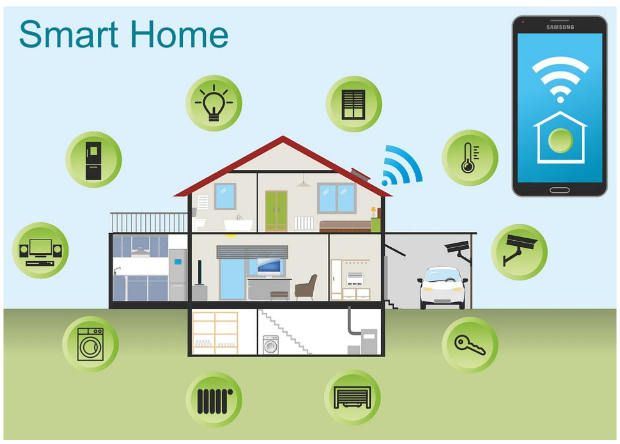
Introduction

Once a dream, iot home automation is slowly but steadily becoming a part of daily lives around the world. In fact, it is believed that the global market for smart home automation will reach $40 billion by 2020.



This shouldn't be surprising when you consider the convenience and ease that smart home devices offer. Since these IoT devices are interconnected, it becomes easier to manage multiple operations. In fact, IoT home devices also help in reducing costs and energy, not to mention time as well, says Rushabh Patel, founder and CEO, **Siddhi InfoSoft**. These days, there is a vast range of devices powered by IoT. These include thermostats, refrigerators, security systems and even dryers and kettles. With the passage of time, more devices are sure to be added and with smarter features.

Before proceeding any further, let's take a closer look at IoT. 'Internet of Things' is an umbrella term used for all technologies that enable the connection of a device to the Internet.

Such systems depend on the collection of data. The data is then used for monitoring, controlling and transferring information to other devices via the internet. This allows specific actions to be automatically activated whenever certain situations arise. In a simple example, consider a smart kettle. The kettle can be programmed to automatically turn off once it reaches a specific temperature. It might also send a notification to the user on the same.

Now apply the same concept to the entire home and all the devices present. That is a smart home powered by IoT. Instead of manually going up to the device and taking action, those actions can be taken at the press of a button. **T**hese days, most smart IoT home automation devices allow you to control them via an app or even via voice commands.

Now imagine if you did not even need to undertake such actions. In other words, the smart home will know when to take certain actions and automatically take them. This is where the future of home automation and IoT lies.

Here are some possible scenarios that we may see in future.

Lighting

These days, smart lighting is all the rage. They can be scheduled to turn on/off and change their intensity. However, in future, it is possible for this to be taken a step further. With IoT enabled across the home, the lights can respond to other actions you take.

For example, the lights can respond to your home cinema. They can turn off or dim whenever you start watching a movie. Going further, they may even react to the type of movie. For example, they can turn off completely if the lights sense that you are watching a horror movie, giving you the proper atmosphere.

Doors

In the future, doors can become smarter as well. Imagine them opening only when you enter or close. This may be made possible via a smart device or facial recognition. This can be taken to the next step by getting the rest of the house take actions in tandem with your entry.

For example, the lights can turn on as soon you as enter through the door. Alternatively, if you are leaving, they can turn off.

Windows

Windows can become smarter as well. Imagine them automatically open the shutters when the sun rises and close at sunset. You may even be able to program them to close automatically when it rains. Consider the previous example of a home movie. Your curtains can lower whenever you are watching a movie.

Thermostat

These days, you can control your home thermostat remotely via apps. In the future, you may not even need to do that. The thermostat will be able to recognise if you are nearing your home. It will then check the room and external temperature and set the right one for you. It may even recognise when you are taking certain actions and adjust accordingly such as when you are showering or exercising.

Gardens

Even your gardens can become smarter in the future with IoT. You will be able to place IoT sensors in the garden. If these sensors detect dryness in the soil, they can trigger the irrigation system. Robotic lawnmowers can be automatically deployed if the grass exceeds a certain height.

Home routines

It is already possible for much of the home to be connected with smart devices. There are smart sockets that automatically turn on/off devices. Smart alarms can play music when you wake up or even tell you the news. Voice assistants can even run entire routines where the lights, home appliances, thermostat, alarms and other devices are controlled.

Going forward, this will be extended throughout the home. Consider the morning routine. The shutters will open right before you wake up to help you get rid of that grogginess. Even before you wake up, the coffee maker will start getting your morning cup ready. The bathroom will get the water heated for your shower. Your stereo will start playing some morning tunes as you have your morning cup. Your TV will also turn on and show you your preferred news channel. Of course, the thermostat will adjust to a comfortable temperature.

Of course, all of these are not going to happen overnight. There are a few barriers to widespread adoption of IoT-enabled smart homes, the primary of which is cost. Privacy is another major concern. Then there are the current technological limitations that create difficulties in a seamless connection between multipole IoT devices.

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Thermoelectric Power Generator

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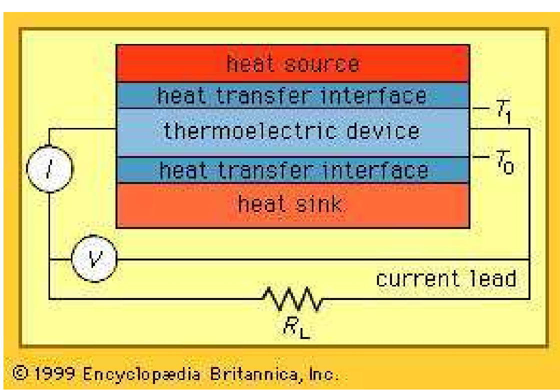
Introduction

Thermoelectric power generator, any of a class of solid-state devices that either convert heat directly into electricity or transform electrical energy into thermal power for heating or cooling. Such devices are based on thermoelectric effects involving interactions between the flow of heat and of electricity through solid bodies.

All thermoelectric power generators have the same basic configuration, as shown in the figure. A heat source provides the high temperature, and the heat flows through a thermoelectric converter to a heat sink, which is maintained at a temperature below that of the source. The temperature differential across the converter produces direct current (DC) to a load (R_L) having a terminal voltage (V) and a terminal current (I). There is no intermediate energy conversion process. For this reason, thermoelectric power generation is classified as direct power conversion. The amount of electrical power generated is given by I^2R_L, or VI.



Components of a thermoelectric generator.

A unique aspect of thermoelectric energy conversion is that the direction of energy flow is reversible. So, for instance, if the load resistor is removed and a DC power supply is substituted, the thermoelectric device shown in the figure can be used to draw heat from the "heat source" element and lower its temperature. In this configuration, the reversed energy-conversion process of thermoelectric devices is invoked, using electrical power to pump heat and produce refrigeration. This reversibility distinguishes thermoelectric energy converters from many other conversion systems, such as thermionic power converters. Electrical input power can be directly converted to pumped thermal power for heating or refrigerating, or thermal input power can be converted directly to electrical power for lighting, operating electrical equipment, and other work. Any thermoelectric device can be applied in either mode of operation, though the design of a particular device is usually optimized for its specific purpose.

Major Types Of Thermoelectric Generators

Thermoelectric power generators vary in geometry, depending on the type of heat source and heat sink, the power requirement, and the intended use. During World War II, some thermoelectric generators were used to power portable communications transmitters. Substantial improvements were made in semiconductor materials and in electrical contacts between 1955 and 1965 that expanded the practical range of application. In practice, many units require a power conditioner to convert the generator output to a usable voltage.

Fossil-fuel generators

Generators have been constructed to use natural gas, propane, butane, kerosene, jet fuels, and wood, to name but a few heat sources. Commercial units are usually in the 10- to 100-watt output power range. These are for use in remote areas in applications such as navigational aids, data collection and communications systems, and cathodic protection, which prevents electrolysis from corroding metallic pipelines and marine structures.

Solar-source generators

Solar thermoelectric generators have been used with some success to power small irrigation pumps in remote areas and underdeveloped regions of the world. An experimental system has been described in which warm surface ocean water is used as the heat source and cooler deep ocean water as the heat sink. Solar thermoelectric generators have been designed to supply electric power in orbiting spacecraft, though they have not been able to compete with silicon solar cells, which have better efficiency and lower unit weight. However, consideration has been given to systems featuring both heat pumping and power generation for thermal control of orbiting spacecraft. Utilizing solar heat from the Sun-oriented side of the spacecraft, thermoelectric devices can generate electrical power for use by other thermoelectric devices in dark areas of the spacecraft and to dissipate heat from the vehicle.

Nuclear-fueled generators

The decay products of radioactive isotopes can be used to provide a high-temperature heat source for thermoelectric generators. Because thermoelectric device materials are relatively immune to nuclear radiation and because the source can be made to last for a long period of time, such generators provide a useful source of power for many unattended and remote applications. For example, radioisotope thermoelectric generators provide electric power for isolated weather monitoring stations, for deep-ocean data collection, for various warning and communications systems, and for spacecraft. In addition, a low-power radioisotope thermoelectric generator was developed as early as 1970 and used to power cardiac pacemakers. The power range of radioisotope thermoelectric generators is generally between 10^{-6} and 100 watts.

Principles Of Operation

An introduction to the phenomena of thermoelectricity is necessary to understand the operating principles of thermoelectric devices.

Seebeck effect

In 1821 the German physicist Thomas Johann Seebeck discovered that when two strips of different electrically conducting materials were separated along their length but joined together by two “legs” at their ends, a magnetic field developed around the legs, provided that a temperature difference existed between the two junctions. He published his observations the following year, and the phenomenon came to be known as the Seebeck effect. However, Seebeck did not identify the cause of the magnetic field. This magnetic field results from equal but opposite electric currents in the two metal-strip legs. These currents are caused by an electric potential difference across the junctions induced by thermal differences between the materials. If one junction is open but the temperature differential is maintained, current no longer flows in the legs but a voltage can be measured across the open circuit. This generated voltage (V) is the Seebeck voltage and is related to the difference in temperature (ΔT) between the heated junction and the open junction by a proportionality factor (α) called the Seebeck coefficient, or $V = \alpha\Delta T$. The value for α is dependent on the types of material at the junction.

Peltier effect

In 1834 the French physicist and watchmaker Jean-Charles-Athanase Peltier observed that if a current is passed through a single junction of the type described above, the amount of measured heat generated is not consistent with what would be predicted solely from ohmic heating caused by electrical resistance. This observation is called the Peltier effect. As in Seebeck's case, Peltier failed to define the cause of the anomaly. He did not identify that heat was absorbed or evolved at the junction depending on the direction of the current. He also did not recognize the reversible nature of this thermoelectric phenomenon, nor did he associate his discovery with that of Seebeck.

Thomson effect

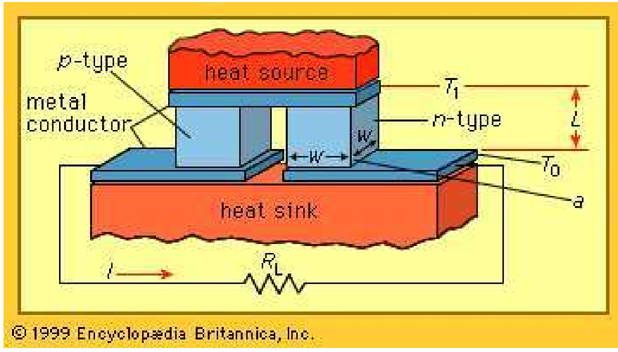
It was not until 1855 that William Thomson (later Lord Kelvin) drew the connection between the Seebeck and Peltier effects, which was the first significant contribution to the understanding of thermoelectric phenomena. He showed that the Peltier heat or power (Q_p) at a junction was proportional to the junction current (I) through the relationship $Q_p = \pi I$, where π is the Peltier coefficient. Through thermodynamic analysis, Thomson also showed the direct relation between the Seebeck and Peltier effects, namely that $\pi = \alpha T$, where T is the temperature of the junction. Furthermore, on the basis of thermodynamic considerations, he predicted what came to be known as the Thomson effect, that heat power (Q_τ) is absorbed or evolved along the length of a material rod whose ends are at different temperatures. This heat was shown to be proportional to the flow of current and to the temperature gradient along the rod. The proportionality factor τ is known as the Thomson coefficient.

Analysis of a thermoelectric device

Practically, the thermoelectric property of a device is adequately described using only one thermoelectric parameter, the Seebeck coefficient α. As was shown by Thomson, the Peltier coefficient at a junction is equal to the Seebeck coefficient multiplied by the operating junction temperature. The Thomson effect is comparatively small, and so it is generally neglected.

While there is a Seebeck effect in junctions between different metals, the effect is small. A much larger Seebeck effect is achieved by use of *p*-*n* junctions between *p*-type and *n*-type semiconductor materials, typically silicon or germanium.

The figure shows *p*-type and *n*-type semiconductor legs between a heat source and a heat sink with an electrical power load of resistance R_L connected across the low-temperature ends. A practical thermoelectric device can be made up of many *p*-type and *n*-type semiconductor legs connected electrically in series and thermally in parallel between a common heat source and a heat sink. Its behaviour can be discussed considering only one couple.



Single couple of a thermoelectric

An understanding of the thermal and electric power flows in a thermoelectric device involves two factors in addition to the Seebeck effect. First, there is the heat conduction in the two semiconductor legs between the source and the sink. The thermal flow down these two legs is given by $2\kappa(a/L)\Delta T$, where κ is their average thermal conductivity in watts per metre-kelvin, a (or w^2) is the area in square metres of the base of each leg, L is the length of each leg in metres, and ΔT is the temperature differential between source and sink in kelvins. The second factor is the ohmic heating that occurs in both of the legs because of electrical resistance. The heat power produced in each leg is given by $\rho I^2(L/a)$, where ρ is the average electrical resistivity of the semiconductor materials in ohm-metres and I is the electric current in amperes. Approximately half of the resistance-produced heat in each of the two legs flows toward the source and half toward the sink.

In a thermoelectric power generator, a temperature differential between the upper and lower surfaces of two legs of the device can result in the generation of electric power. If no electrical load is connected to the generator, the applied heat source power results in a temperature differential (ΔT) with a value dictated only by the thermal conductivity of the p- and n-type semiconductor legs and their dimensions. The same amount of heat power will be extracted at the heat sink. However, because of the Seebeck effect, a voltage $V_\alpha = \alpha\Delta T$ will be present at the output terminals. When an electrical load is attached to these terminals, current will flow through the load. The electrical power generated in the device is equal to the product of the Seebeck coefficient α, the current I, and the temperature differential ΔT. For a given temperature differential, the flow of this current causes an increase in the thermal power into the device equal to the electric power generated. Some of the electric power generated in the device is dissipated by ohmic heating in the resistances of the two legs. The remainder is the electrical power output to the load resistance R_L.

The leg geometry has a considerable effect on the operation. The thermal conduction power is dependent on the ratio of area to length, while ohmic heating is dependent on the inverse of that ratio. Thus, an increase in this ratio increases the thermal conduction power but reduces the power dissipated in the leg resistances. An optimum design normally results in relatively long and thin legs.

In choosing or developing semiconductor materials suitable for thermoelectric generators, a useful figure of merit is the square of the Seebeck coefficient (α) divided by the product of the electrical resistivity (ρ) and the thermal conductivity (κ).

Automotive Electronics

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Introduction

Role of automotive electronics in cars, the first thing that comes to our mind is different types of electronic systems used in automobiles such as; music system, safety airbags, & electronic controller. An automobile electronics mainly includes the headlight, LED brake light, etc. Every module used in an automobile is a modern electronic gadget. Previously, electronics in automobiles are mainly used for controlling the engine. But, now the latest advancements provide the most complicated driving skill to people. If you love automobiles, then it is very important to know about the electronics used in automobiles and one should update with the latest technologies used in vehicles. There are different electronic systems are used in automobiles for automobile operations like to enhance the driving act, fuel efficiency, comfort of the drivers as well as riders. There are many devices are changed from mechanical to electronics. When we notice the automobiles cars in the year 1980s, they are used for only transportation but now they have changed into auto electronic engines through computer-controlled systems. This transformation can be done by employing several electronic systems in automobile design.

An embedded system plays an essential role in automobile architecture. Because they used in the anti-lock braking system, telematics, music system, and safety airbags, radio, parking ability, etc. Additionally, it is important to know that electronic parts which are used in automobiles can be controlled digitally for most of the car operations. The electronic devices which are installed in an automobile can be categorized into engine electronics, safety device electronics, and chassis electronics, etc.

Types of Automotive Electronics

Automotive electronics are distributed systems which can be classified into different types based on different domains like Engine Electronics, Transmission Electronics, Chassis Electronics, Passive Safety, Driver Assistance, Passenger Comfort, Entertainment Systems, Electronic, and Integrated Cockpit Systems.

Engine Electronics

The ECU or engine control unit is an essential electronic part in automobiles. This unit can order one of the maximum real-time goals because the engine used in automobiles is extremely complex and fast. The electronics which are used in automobiles, the computer power of the ECU is the maximum like a 32-bit processor. In modern cars, they may have up to 100 ECUs whereas, in the commercial vehicle, it has up to 40 ECUs.

An engine control unit in automobiles can be used to control the functions like rate of fuel injection, NOx control, controlling of emission, throttle, turbocharger, cooling system, and oxidation catalytic converter

A gasoline engine can be used to control lambda, On-Board Diagnostics (OBD), ignition, cooling, lubrication system, throttle, and fuel injection. In real-time there are many parameters for the engine can be controlled and monitored

Transmission Electronics

It is used for controlling the transmission system, mostly while shifting the gears for enhanced shift comfort & to lesser torque interrupt. The operation of an automatic transmission can be done by utilizing the controls & several semi-automatic transmissions include a fully-automatic clutch. The communication between ECU & the transmission control can be done by exchanging information &control and sensor signals for their process.

Chassis Electronics

The chassis system includes **electronic subsystems in a car**, which monitors different parameters and controls actively like ABS (Anti-lock Braking System), EBD (Electronic Brake Distribution), TCS (Traction Control System), PA (Parking Assistance), and ESP (Electronic Stability Program).

Passive Safety

The passive safety system is all about learning & practicing of plan, building, apparatus & instruction to reduce the incident and result of traffic accidents of motor vehicles.

These systems are always set to operate when there is a smash in development otherwise to stop it once it detects a hazardous condition like airbags, control of hill descent, and emergency brake aid system.

Driver Assistance

The ADAS or Advanced driver-assistance system helps a driver while driving a vehicle. This is designed with a secure HMI (human-machine interface). These systems are used for increasing automobile safety road safety.

This system includes different assist systems like lane, speed, park, blind-spot detection, and control system like the adaptive cruise.

Passenger Comfort

The automotive electrons used in an automobile for passenger comfort mainly include automatic climate control, automatic wipers, adjustment of the electronic seat with memory, automatic headlamps for automatic beam adjustment, and automatic cooling for adjusting the temperature.

Entertainment Systems

The entertainments systems used in automobiles mainly include vehicle audio, a navigation system, and data access. All these can form an infotainment (entertainment & information) system. This system development method can change based on manufacturer. For both hardware & software development, various tools are utilized.

Latest Innovations in Automobile Electronics

The latest innovations of electronics which can be introduced by different organizations to use in automobile mainly include the following. The automotive electronics design fundamentals mainly include environments, customer requirements, etc.

Waymo

After several experiments in automobiles, Waymo launched the first driverless car, which provides secure and self-driven experience. The company like Alphabet is the parent company has declared that it will create driverless cars which can be accessible to the public by the year 2020.

Tesla

Tesla launched electric cars. The Tesla model cars are completely electric luxury cars that are pushed by electric motors. These are launched in the year 2012.

Honda Prius

The Toyota Prius is another hybrid electric car developed by Toyota in 1997. It is rated as one of the cleanest cars with minimum smog-forming emissions.

Nissan Leaf

In Dec 2010, the first electric car was manufactured. The packs of battery in Nissan Leaf charging capacity will be from 0 to 80% within just 30 min with the help of DC fast charging.

The usage of the **future of automotive electronics** by consumers has been increasing day by day due to better using their time within transportation to enjoy new services. Thus, a smart car has better features like more secure, comfortable, energy-efficient, etc. At present, researchers have announced that above 60% of the trends in automotive electronics will be elegant by this year-end. So the number of electronic parts in automobiles will be increased in your car. According to Business inside Intelligence, around 94 millions of smart cards will be shipped by the end of 2021. This would affect a complex annual expansion rate of almost 35% from the present 21 million associated cars.

Open Source Technology

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Introduction

Open source technology is a growing trend in GIS, but what is it? Open source software is software in which the source code used to create the program is freely available for the public to view, edit, and redistribute. The term "open source" refers to something people can modify and share because its design is publicly accessible.

The term originated in the context of software development to designate a specific approach to creating computer programs. Today, however, "open source" designates a broader set of values—what we call "the open source way." Open source projects, products, or initiatives embrace and celebrate principles of open exchange, collaborative participation, rapid prototyping, transparency, meritocracy, and community-oriented development.

Open Source software

Open source software is software with source code that anyone can inspect, modify, and enhance.

"Source code" is the part of software that most computer users don't ever see; it's the code computer programmers can manipulate to change how a piece of software—a "program" or "application"—works. Programmers who have access to a computer program's source code can improve that program by adding features to it or fixing parts that don't always work correctly.

What's the difference between open source software and other types of software?

Some software has source code that only the person, team, or organization who created it—and maintains exclusive control over it—can modify. People call this kind of software "proprietary" or "closed source" software.

Only the original authors of proprietary software can legally copy, inspect, and alter that software. And in order to use proprietary software, computer users must agree (usually by signing a license displayed the first time they run this software) that they will not do anything with the software that the software's authors have not expressly permitted. Microsoft Office and Adobe Photoshop are examples of proprietary software.

Open source software is different. Its authors make its source code available to others who would like to view that code, copy it, learn from it, alter it, or share it. LibreOffice and the GNU Image Manipulation Program are examples of open source software.

As they do with proprietary software, users must accept the terms of a license when they use open source software—but the legal terms of open source licenses differ dramatically from those of proprietary licenses.

Open source licenses affect the way people can use, study, modify, and distribute software. In general, open source licenses grant computer users permission to use open source software for any purpose they wish. Some open source licenses—

what some people call "copyleft" licenses—stipulate that anyone who releases a modified open source program must also release the source code for that program alongside it. Moreover, some open source licenses stipulate that anyone who alters and shares a program with others must also share that program's source code without charging a licensing fee for it.

By design, open source software licenses promote collaboration and sharing because they permit other people to make modifications to source code and incorporate those changes into their own projects. They encourage computer programmers to access, view, and modify open source software whenever they like, as long as they let others do the same when they share their work.

No. Open source technology and open source thinking both benefit programmers and non-programmers.

Because early inventors built much of the Internet itself on open source technologies—like the Linux operating system and the Apache Web server application—anyone using the Internet today benefits from open source software.

Every time computer users view web pages, check email, chat with friends, stream music online, or play multiplayer video games, their computers, mobile phones, or gaming consoles connect to a global network of computers using open source software to route and transmit their data to the "local" devices they have in front of them. The computers that do all this important work are typically located in faraway places that users don't actually see or can't physically access—which is why some people call these computers "remote computers."

More and more, people rely on remote computers when performing tasks they might otherwise perform on their local devices. For example, they may use online word processing, email management, and image editing software that they don't install and run on their personal computers. Instead, they simply access these programs on remote computers by using a Web browser or mobile phone application. When they do this, they're engaged in "remote computing."

Some people call remote computing "cloud computing," because it involves activities (like storing files, sharing photos, or watching videos) that incorporate not only local devices but also a global network of remote computers that form an "atmosphere" around them.

Cloud computing is an increasingly important aspect of everyday life with Internet-connected devices. Some cloud computing applications, like Google Apps, are proprietary. Others, like own Cloud and Next cloud, are open source. Cloud computing applications run "on top" of additional software that helps them operate smoothly and efficiently, so people will often say that software running "underneath" cloud computing applications acts as a "platform" for those applications. Cloud computing platforms can be open source or closed source. OpenStack is an example of an open source cloud computing platform.

Control. Many people prefer open source software because they have more control over that kind of software. They can examine the code to make sure it's not doing anything they don't want it to do, and they can change parts of it they don't like. Users who aren't programmers also benefit from open source software, because they can use this software for any purpose they wish—not merely the way someone else thinks they should.

Training. Other people like open source software because it helps them become better programmers. Because open source code is publicly accessible, students can easily study it as they learn to make better software. Students can also share their work with others, inviting comment and critique, as they develop their skills. When people discover mistakes in programs' source code, they can share those mistakes with others to help them avoid making those same mistakes themselves.

Security. Some people prefer open source software because they consider it more secure and stable than proprietary software. Because anyone can view and modify open source software, someone might spot and correct errors or omissions that a program's original authors might have missed. And because so many programmers can work on a piece of open source software without asking for permission from original authors, they can fix, update, and upgrade open source software more quickly than they can proprietary software.

Stability. Many users prefer open source software to proprietary software for important, long-term projects. Because programmers publicly distribute the source code for open source software, users relying on that software for critical tasks can be sure their tools won't disappear or fall into disrepair if their original creators stop working on them. Additionally, open source software tends to both incorporate and operate according to open standards.

Reasons to Use Open Source Software

1. Its Cost Efficient

Between the cost of the software, licensing, virus protections and ongoing upgrade expenses, the cost of proprietary systems add up quick. Additionally, the software still contains flaws and limits your abilities. With an open source system,

2. It Allows Flexibility

After you make the investment in the proprietary software that you feel best suits your business, you're then locked into a system that is concrete, rigid, constantly needs upgrades and may contain unspecified bugs. Open source programs keep an open code so you can constantly go in, rewrite the code so as your business changes and adapts, so will your software system.

3. It's More Secure

With proprietary software no one outside of the company knows how many bugs the program contains. Bugs in open source software tend to get fixed immediately. Versus a program like Microsoft, which typically takes weeks if not months to patch vulnerabilities?

4. No Problem.

With the popularity of open source software, there is plenty of support through forums, and live support chats. For businesses that want extra assurance, there are now paid support options on most open source packages at prices that still fall far below what most proprietary vendors will charge.

5. A Product You're Proud Of

Open source allows you to tweak the software to suit your needs. With its open code, it's simply a matter of modifying it to add the functionality you want. It puts you in a unique position. This customization allows you to develop the applications quickly, reliably and economically to grow with the expansion of your business..

Deep Learning

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Introduction

During recent years, deep learning has become somewhat of a buzzword in the tech community. We always seem to hear about it in news regarding AI, and yet most people don't actually know what it is! In this article, I'll be demystifying the buzzword that is deep learning, and providing an intuition of how it works.

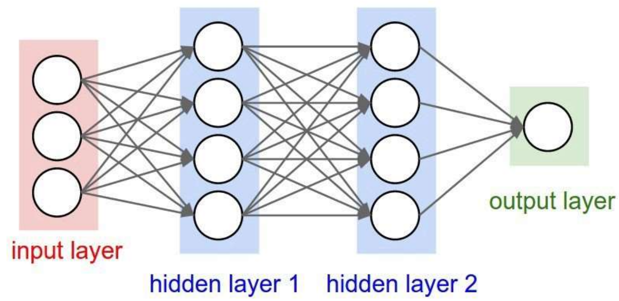
Generally speaking, deep learning is a machine learning method that takes in an input X, and uses it to predict an output of Y. As an example, given the stock prices of the past week as input, my deep learning algorithm will try to predict the stock price of the next day.

Given a large dataset of input and output pairs, a deep learning algorithm will try to minimize the difference between its prediction and expected output. By doing this, it tries to learn the association/pattern between given inputs and outputs — this in turn allows a deep learning model to generalize to inputs that it hasn't seen before.

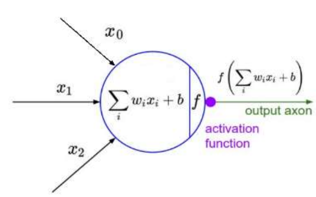
As another example, let's say that inputs are images of dogs and cats, and outputs are labels for those images (i.e. is the input picture a dog or a cat). If an input has a label of a dog, but the deep learning algorithm predicts a cat, then my deep learning algorithm will learn that the features of my given image (e.g. sharp teeth, facial features) are going to be associated with a dog.

How Do Deep Learning algorithms "learn"?

Deep Learning Algorithms use something called a neural network to find associations between a set of inputs and outputs. The basic structure is seen below:



A neural network is composed of input, hidden, and output layers — all of which are composed of "nodes". Input layers take in a numerical representation of data (e.g. images with pixel specs), output layers output predictions, while hidden layers are correlated with most of the computation.



I won't go too in depth into the math, but information is passed between network layers through the function shown above. The major points to keep note of here are the tunable weight and bias parameters — represented by w and b respectively in the function above. These are essential to the actual "learning" process of a deep learning algorithm.

After the neural network passes its inputs all the way to its outputs, the network evaluates how good its prediction was (relative to the expected output) through something called a loss function. As an example, the "Mean Squared Error" loss function is shown below.

$$\frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2$$

Y hat represents the prediction, while Y represents the expected output. A mean is used if batches of inputs and outputs are used simultaneously (n represents sample count)

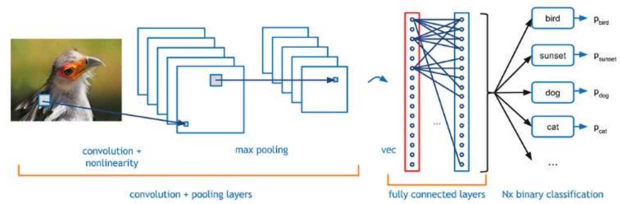
The goal of my network is ultimately to minimize this loss by adjusting the weights and biases of the network. In using something called "back propagation" through gradient descent, the network backtracks through all its layers to update the weights and biases of every node in the opposite direction of the loss function — in other words, every iteration of back propagation should result in a smaller loss function than before.

Without going into the proof, the continuous updates of the weights and biases of the network ultimately turns it into a precise function approximator — one that models the relationship between inputs and expected outputs.

So why is it called "Deep" Learning?

The "deep" part of deep learning refers to creating deep neural networks. This refers a neural network with a large amount of layers — with the addition of more weights and biases, the neural network improves its ability to approximate more complex functions.

Deep learning is ultimately an expansive field, and is far more complex than I've described it to be. Various types of neural networks exist for different tasks (e.g. Convolutional NN for computer vision, Recurrent NN for NLP), and go far and beyond the basic neural network that I've covered.



Above: A Convolutional Neural Network

Even if you don't remember everything from this article, here are a few takeaways:

Deep Learning refers to Deep Neural Networks

Deep Neural Networks find associations between a set of inputs and outputs

Back propagation is something that's used to update the parameters of a Neural Network

The implications of deep learning are insane. While I gave fairly simple application examples such as image classification and stock price prediction, there's ultimately so much more! Video synthesis, self-driving cars, human level game AI, and more all of these came from deep learning

Program Outcomes (POs)

PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, and engineering fundamentals to solve the complex electrical engineering problems.
PO2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex Electrical and Electronics Engineering problems enabling attainment of conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/Development of Solutions:** Design solutions, components or process for complex Electrical Engineering problems to meet the specified needs considering public health, safety and environmental considerations.
PO4	**Conduct Investigations of complex problems:** Exercise research knowledge and technical methodology for design, analysis and interpretation of data to converge to a suitable solution.
PO5	**Modern Tool Usage**: Use modern engineering tools, softwares and equipments to predict, analyze and model engineering problems.
PO6	**The Engineer & Society:** Apply reasoning skills to assess societal, health, safety, legal and cultural issues relevant to the professional engineering practice and take consequent responsibilities in the society
PO7	**Environment and Sustainability:** Realize the impact of the professional engineering solutions and demonstrate the knowledge for sustainable development in environmental context
PO8	**Ethics:** Apply and realize the professional ethics and responsibilities in Electrical engineering practice.
PO9	**Individual and Team Work:** Exhibit Individuality, Leadership and Team spirit in multidisciplinary settings.
PO10	**Communication:** Communicate, comprehend, write reports, design documentation and presentation effectively on complex engineering activities
PO11	**Project Management & Finance:** Demonstrate the Electrical engineering and management principles adhering to financial strategies to manage projects as a member or leader in a team
PO12	**Life Long Learning:** Inculcate independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO 1: Electrical drives and control: Graduates will Analyze, design and provide Engineering solutions in the field of Power Electronics and Drives

PSO 2: Embedded system: Graduates will Simulate, experiment and solve complex problems in Embedded System.

KSR INSTITUTE FOR ENGINEERING AND TECHNOLOGY

VISION

To become a globally recognized Institution in Engineering Education, Research and Entrepreneurship.

MISSION

- ❖ Accomplish quality education through improved teaching learning process.
- ❖ Enrich technical skills with state of the art laboratories and facilities.
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VISION

To produce world class Electrical and Electronics Technocrats and Entrepreneurs with social responsibilities.

MISSION

- ❖ Impart quality education in the field of Electrical and Electronics Engineering through state of the art learning ambience.
- ❖ Enrich interdisciplinary skills and promote research through continuous learning.
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BEES Magazine

August 2019