K S R Institute for Engineering and Technology

Department of Electrical and Electronics Engineering

BEES Magazine

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Together We Make Difference

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Editorial Board

Eye Tracking Technology

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IV year EEE

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IV year EEE

Introduction

Imagine scrolling an online news article by merely staring at the bottom of the webpage. How about reorganizing your desktop files by dragging them around with your gaze?

For years we've been using mice and keyboard (and later touch screens) as the main tools to control and send commands to our computers and devices.

But 2016 proved that things are headed for a change. With great leaps in artificial intelligence and machine learning, we saw a new array of highly efficient assistants and devices that can be controlled with voice commands.

The start of 2017 gave a hint at what the next breakthrough might be. If you're following tech publications, eye tracking has made the rounds quite a bit lately. The Facebook-owned Oculus acquired eye tracking startup Eye Tribe; Acer announced a new monitor that tracks eye movement at CES 2017; and again, at CES, Tobii announced a new line of eye tracking initiatives for the coming year.

Here are the key points if you're wondering what is eye tracking technology and what it can do.

What is Eye Tracking?

Eye tracking is about understating the state and activity of the eye. This includes tracking your point of gaze, the duration of your stare at any given point, when you blink and how your pupils react to different visual stimuli. But it's also about where you're not looking, what you're ignoring, what gets you distracted and so forth.

The information gathered by eye tracking technology can be used to facilitate a number of tasks that were previously cumbersome, and also opens up possibilities that were inconceivable before.

While the concept might sound simple, the technology behind it is quite complex and has been made possible thanks to advances in sensors technology as well as image analysis and recognition.

Eye Tracking Devices

Head-mounted eye tracking gear

Based on task requirements, eye tracking gear are usually head mounted or remote. Head mounted or mobile units, such as eye tracking glasses, are more suitable for settings where you're moving around such as task performance in real life or virtual environments. Remote devices, now reduced to the size of very small panels, offer a less intrusive experience and are convenient for when you're sitting behind your computer and gazing at the monitor.

Most common eye tracking devices usually involve two main components: an infrared or near-infrared light source and a camera. The light is directed toward the eye, and the camera picks up the reflections to calculate rotation of the eyes and direction of the gaze. Eye tracking devices also pick up other activity such as blink frequency and changes in eye pupil diameter.

The collected data is then fed to algorithms and software, which discover details in the user's eyes and reflection patterns, and interpret the image stream to calculate the user's eyes and gaze point on a device screen.

Remote eye tracking

Use Cases of Eye Tracking Technology

We use our eyes constantly for different tasks including reading magazines, gazing at posters and ads, playing games and whatnot. Virtually anything that involves a visual component can become the subject of eye tracking and the data collected by eye tracking devices can be leveraged to glean insights and understand human behavior.

Here are some of the more popular use cases.

Eye Tracking in Gaming

One of the most obvious uses of eye tracking is improving gaming experience. There are a wide range of areas where eye tracking can make it easier for users to interact with the user interface of games, as they can replace mouse navigation and scrolling.

They can also be used to analyze the eye interaction with the interface. This can help players improve their gaming by giving them insights on what details they're ignoring.

In rendering, the technology can be used to prioritize rendering for the gaze area and make more efficient use of computer resources.

The technology can also be used to improve the gaming environment, such as having the game characters react when the user is staring directly at them. Imagine an RPG where characters in a tavern will get mad if you look at their purse or an FPS where you can tip off AI allies about enemies sneaking up on them by looking in their direction.

Games will become a whole lot easier to play (though I'm not sure if it's a good thing).

Eye tracking in advertising and market research

Knowing where customers and users look—and where they don't—can be invaluable for both online, TV and print advertising. Eye trackers on monitors and kiosks can glean insights into how many users see key messages and component of ads, while mobile gear can be used to weigh customer reaction to print material, posters and product packages.

Eye tracking devices can also help store owners research customer behavior and navigation patterns in order to better understand how customers look at products on shelves, which sections of the store get more attention from customers, and how they can make better use of their store space.

Eye Tracking in UI and Environment Testing

Eye tracking can give a huge leg up to A/B testing, the method used to measure efficiency of variations to user interface.

Software and web developers can use eye tracking to better understand what's good and not so good about the user interfaces of their applications and websites. Eye tracking will let you know what areas of the screen are getting more attention and focus, and how you can reorient and restructure user interfaces to improve user engagement.

Software and game developers can better understand which features of their applications are going unnoticed. VR environments can be tested to see how much attention is directed to each of the areas.

Eye Tracking and Accessibility

Eye tracking will make it possible for users with physical difficulties in performing mouse navigation. Eye tracking can help users with disabilities move the cursor as efficiently as anyone.

Eye Tracking and Driving Safety

Distracted driving and drowsiness are two of the prominent causes of road incidents. Eye tracking technology can help track the driver's attention and state of awareness and issue warnings.

Combined with other innovative technologies such as smart sensors and image analysis software, eye tracking can help direct drivers' attention to where it most matters and prevent incidents from happening.

This is just the beginning. There are a lot of other fields where eye tracking can be useful, including medicine, education, simulation and neuroscience, and probably many more areas that we will soon find out as the technology further matures and goes mainstream.

Will there be a dark side to it? Time will tell. For the moment, we know that companies will be able to collect much more information about us, and that usually does come with some privacy tradeoffs. But it's still too early to tell whether this is a bad thing or not.

Machine Learning

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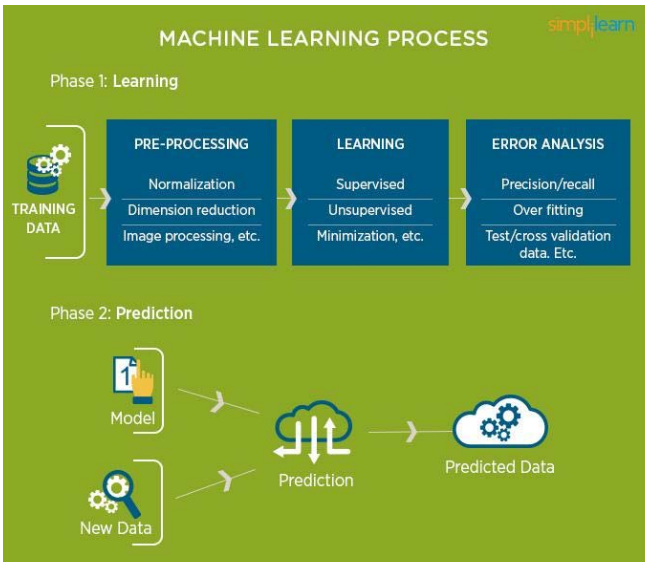
Introduction

Machine learning is a core sub-area of artificial intelligence; it enables computers to get into a mode of self-learning without being explicitly programmed. When exposed to new data, these computer programs are enabled to learn, grow, change, and develop by themselves.

While the concept of machine learning has been around for a long time, the ability to apply complex mathematical calculations to big data automatically—iteratively and quickly—has been gaining momentum over the last several years. So, put simply, the iterative aspect of machine learning is the ability to adapt to new data independently. This is possible as programs learn from previous computations and use "pattern recognition" to produce reliable results.



With the constant evolution of the field, there has been a subsequent rise in the uses, demands, and importance of machine learning. Big data has become quite a buzzword in the last few years; that's in part due to increased sophistication of machine learning, which helps analyze those big chunks of big data. Machine learning has also changed the way data extraction, and interpretation is done by involving automatic sets of generic methods that have replaced traditional statistical techniques.

Uses of Machine Learning

Earlier in this article, we mentioned some applications of machine learning. To understand the concept of machine learning better, let's consider some more examples: web search results, real-time ads on web pages and mobile devices, email spam filtering, network intrusion detection, and pattern and image recognition. All these are by-products of applying machine learning to analyze huge volumes of data.

Traditionally, data analysis was always being characterized by trial and error, an approach that becomes impossible when data sets are large and heterogeneous. Machine learning comes as the solution to all this chaos by proposing clever alternatives to analyzing huge volumes of data. By developing fast and efficient algorithms and data-driven models for real-time processing of data, machine learning is able to produce accurate results and analysis.

Terms and Types

Whether you realize it or not, machine learning is one of the most important technology trends—it underlies so many things we use today without even thinking about them. Speech recognition, Amazon and Netflix recommendations, fraud detection, and financial trading are just a few examples of machine learning commonly in use in today's data-driven world.

Data Mining, Machine Learning, and Deep Learning

Put simply, machine learning and data mining use the same algorithms and techniques as data mining, except the kinds of predictions vary. While data mining discovers previously unknown patterns and knowledge, machine learning reproduces known patterns and knowledge—and further automatically applies that information to data, decision-making, and actions.

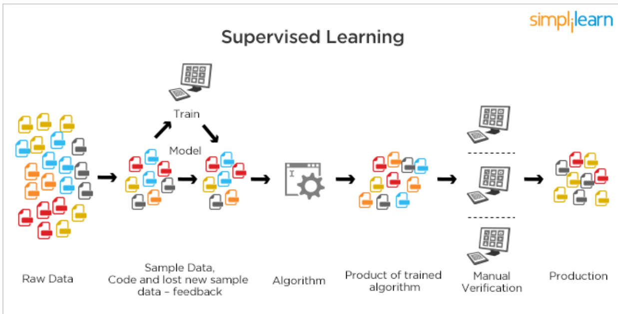
Deep learning, on the other hand, uses advanced computing power and special types of neural networks and applies them to large amounts of data to learn, understand, and identify complicated patterns. Automatic language translation and medical diagnoses are examples of deep learning.

Popular Machine Learning Methods

How exactly do machines learn? Two popular methods of machine learning are supervised learning and unsupervised learning. It is estimated that about 70 percent of machine learning is supervised learning, while unsupervised learning ranges from 10 – 20 percent.

Supervised Learning

This kind of learning is possible when inputs and the outputs are clearly identified, and algorithms are trained using labeled examples. To understand this better, let's consider the following example: an equipment could have data points labeled F (failed) or R (runs).

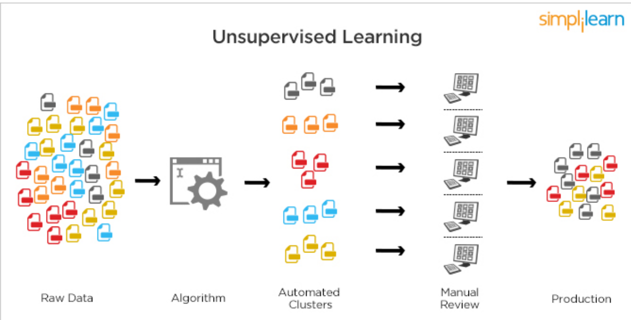


The learning algorithm using supervised learning would receive a set of inputs along with the corresponding correct output to find errors. Based on these inputs, it would further modify the model accordingly. This is a form of pattern recognition, as supervised learning happens through methods like classification, regression, prediction, and gradient boosting. Supervised learning uses patterns to predict the values of the label on additional unlabeled data.

Supervised learning is more commonly used in applications where historical data predict future events, such as fraudulent credit card transactions.

Unsupervised Learning

Unlike supervised learning, unsupervised learning is used with data sets without historical data. An unsupervised learning algorithm explores surpassed data to find the structure. This kind of learning works best for transactional data; for instance, it helps in identifying customer segments and clusters with certain attributes—this is often used in content personalization.



Popular techniques where unsupervised learning is used also include self-organizing maps, nearest neighbor mappig, singular value decomposition, and k-means clustering. Basically, online recommendations, identification of data outliers, and segment text topics are all examples of unsupervised learning.

Machine Learning Algorithms and Processes

If you're studying machine learning, you should familiarize yourself with these common machine learning algorithms and processes: neural networks, decision trees, random forests, associations and sequence discovery, gradient boosting and bagging, support vector machines, self-organizing maps, k-means clustering, Bayesian networks, Gaussian mixture models, and more.

Other tools and processes that pair up with the best algorithms to aid in deriving the most value from big data include:

- Comprehensive data quality and management
- GUIs for building models and process flows
- Interactive data exploration and visualization of model results
- Comparisons of different machine learning models to quickly identify the best one
- Automated ensemble model evaluation to identify the best performers
- Easy model deployment so you can get repeatable, reliable results quickly
- Integrated end-to-end platform for the automation of the data-to-decision process

MEMS (Microelectromechanical Systems)

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Introduction

MEMS refers to technology that allows mechanical structures to be miniaturized and thoroughly integrated with electrical circuitry, resulting in a single physical device that is actually more like a *system*, where "system" indicates that mechanical components and electrical components are working together to implement the desired functionality. Thus, it's a micro (i.e., very small) electrical and mechanical system.

Mechanical to Electrical to (Micro)mechanical

Mechanical components and systems are generally considered to be less technologically advanced than comparable solutions based primarily on electrical phenomena, but this doesn't mean that the mechanical approach is universally inferior. The mechanical relay, for example, is far older than transistor-based devices that provide similar functionality, but mechanical relays are still widely used.

Nevertheless, typical mechanical devices will always have the disadvantage of being hopelessly bulky in comparison to the electronic components found in integrated circuits. The space constraints of a given application may cause electrical components to be favored or required, even when a mechanical implementation would have resulted in a simpler or higher-performance design.

MEMS technology represents a conceptually straightforward solution to this dilemma: if we modify the mechanical devices such that they are not only very small but also fully compatible with integrated-circuit manufacturing processes, we can, to a certain extent, have the "best of both worlds."

What Makes a MEMS?

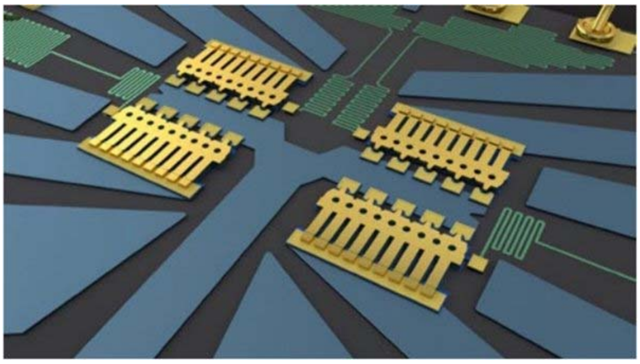
In the previous section, I stated that MEMS technology is a *conceptually* straightforward solution. As you might expect, coming up with the idea of a microscopic mechanical device is much easier than actually building it.

We use the verb "to machine" to describe the work of turning a piece of metal into a mechanical component such as a gear or a pulley. In the MEMS world, the equivalent term is "to micromachine." The tiny mechanical structures in a MEMS device are fabricated by physically modifying silicon (or another substrate material) using specialized techniques about which I know almost nothing. These silicon mechanical structures are then combined with silicon integrated circuits, and the resulting electromechanical system is enclosed in packaging and sold as a single device.

As explained in a paper on MEMS published by Loughborough University in England, MEMS devices make use of micromachined structures, sensors, and actuators. Sensors allow a MEMS to detect thermal, mechanical, magnetic, electromagnetic, or chemical changes that can be converted by electronic circuitry into usable data, and actuators create physical changes rather than simply measure them.

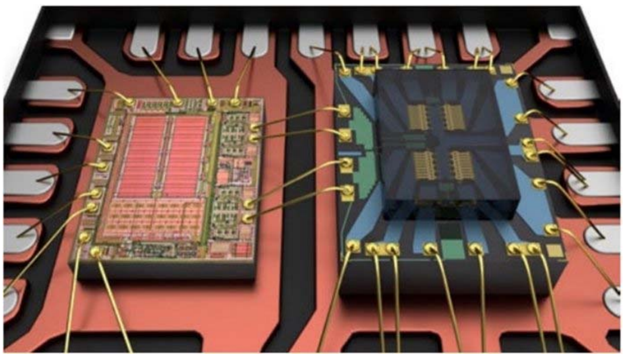
Examples of MEMS Devices

Let's look at an example of the functionality and internal structure of a MEMS device.



Micromachined cantilever switch beams.

This graphic conveys the physical structure of micromachined cantilever switch beams. There are four switch beams and each one has five contacts (the use of multiple contacts is a technique for reducing on-state resistance). The switch beams are actuated by an applied voltage.



Here we see the MEMS switch (on the right) and the associated driver circuitry (on the left), interconnected and housed in a QFN package. The driver circuitry allows a typical digital device, such as a microcontroller, to effectively control the switch because it does everything necessary to generate a ramped, high-voltage actuation signal that promotes effective and reliable switch operation.

MEMS Applications: When Are MEMS Devices Used?

MEMS technology can be incorporated into a wide variety of electronic components. The companies that make these components would presumably claim that a MEMS implementation is superior to whatever was used before the MEMS version became available. It would be difficult to verify enough of these claims to justify a generalized statement along the lines of "MEMS devices offer significantly better performance than non-MEMS devices." However, my general impression is that in many situations MEMS is indeed a significant step forward and, if performance or ease of implementation is a priority in your design, I would look at MEMS devices first.

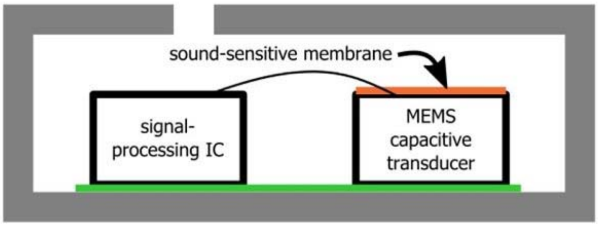
In the context of electrical engineering, MEMS technology has been incorporated into four product categories:

- Audio
- Sensors
- Switches
- Oscillators

There might be some less-common products that don't fit into one of these categories; if you're aware of something that I overlooked, feel free to let us know in the comments.

Audio

In the audio domain, we have MEMS microphones and MEMS speakers. The basic characteristics of a MEMS mic are conveyed by the following diagram.



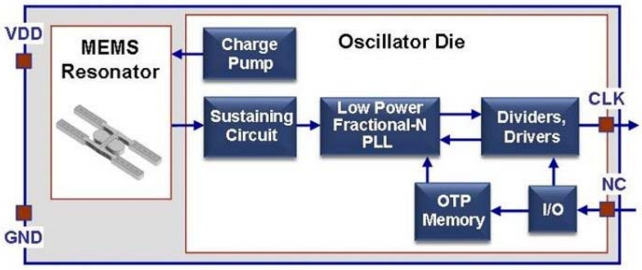
Sensors

Sensors are the dominant application of MEMS techniques; there are MEMS gyroscopes, inclinometers, accelerometers, flow sensors, gas sensors, pressure sensors, and magnetic-field sensors.

Switches

Electrically controlled switches are, in my opinion, a particularly interesting application of MEMS technology. The ADGM1004 is easy to control, works with signal frequencies from 0 Hz to over 10 GHz, has less than 1 nA of leakage current in the off state, and provides an actuation lifetime of at least one billion cycles.

Combining a micromachined resonator with excitation circuitry and sustaining circuitry results in a MEMS oscillator. If you'd like to investigate an actual MEMS component, you can check out a news article from 2017 in which I discussed the SiT2024B MEMS oscillator from SiTime.



Oscillators

MEMS oscillators, might be an excellent choice in demanding applications; in the abovementioned article on the SiT2024B, I point out that based on SiTime's information, a MEMS oscillator can seriously outperform quartz-based oscillators.

Conclusion

Many electronic devices incorporate MEMS technology, and it's likely that you'll come across a MEMS component sooner or later—if not every time you design a board. This article has provided a good overview of what MEMS is and how it is used in electronic design.

Industry 4.0

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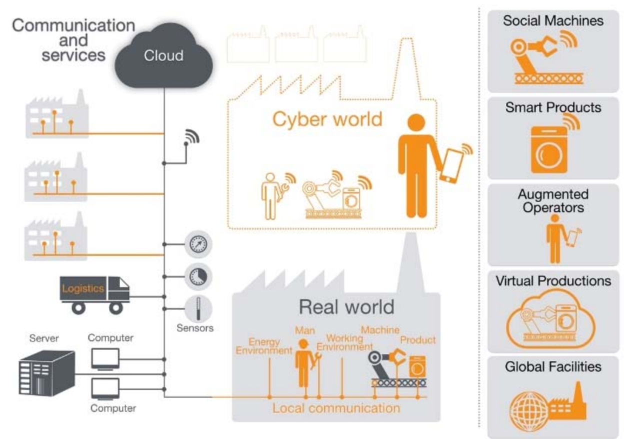
Introduction

The term "Industrie 4.0" was conceived in Germany in 2015 as part of a campaign to encourage technology development and advanced manufacturing initiatives to transform manufacturing and production. Industry 4.0, in essence, represents the next industrial revolution and, for OTTO Motors, it represents the next generation of robotics in advanced manufacturing - those that are interconnected and collaborative.

The 4th industrial revolution is the action of the physical world becoming a type of information system through sensors and actuators embedded in physical objects and linked through networks.

According to a 2015 Gartner Study, about 25 billion objects will be interconnected by 2020. Today there are 3.8 billion such objects. It's difficult to imagine the potential of having 6 times the amount of devices interconnected over the next few years, but this is exactly what we're going to see.



This new revolution and the centralization of operational data will fuse process data and physical systems into one. But this won't happen overnight. As technology evolves, we'll see further cross-functionalization of engineering teams; we're already seeing this movement in universities today with the introduction of new engineering streams such as Mechatronics Engineering. There is a universal understanding that in the very near future, it is no longer going to be enough to be an expert in one individual field such as "mechanical engineer". Rather, the factory workers will need to understand full systems in order to implement true process change. Even if we do achieve the vision of the future - the vision of the smart factory - the human workforce will need multiple skills to take on complex manufacturing roles to include implementation, support, and training of these highly advanced, cyber-physical systems.

A Step into the Future

In the factory of the future, machines will instantly recognize material that is brought to them and adjust themselves accordingly to provide accurate and efficient service. Then the system's onboard intelligence will autonomously record deviations from the standard process so it can make the determination of when the part is done. Lastly, it will call for the transport of the good to be taken to the next step in the process. Transportation will - as you may have guessed - be completely self-driven. Process and device will become inseparable. This is the direction we're heading in and it is all powered by the capabilities of Industry 4.0. Learn more about Industry 4.0 and how self-driving vehicle technology will drive change on the factory floor.

5 Key Industry 4.0 Technologies

New Industry 4.0 technologies, spanning mobile computing to cloud computing, have undergone vast development in the last decade and are now ready to be used as commercially available, interconnected systems within manufacturing – this is Industry 4.0. It holds the key to accessing real-time results and data that will catapult the industry into new levels of lean achievements.

The concept of Industry 4.0 however, is not a simple one. It envelops many technologies and is used in a variety of different contexts. There are five pieces that define Industry 4.0 at its core. Each piece is similar in nature but, when integrated together, create capability that has never before been possible. In an effort to understand Industry 4.0, the following five terms are explained as they contribute to the next industrial revolution:

1. Big Data

As per Forbes, Big Data is a collection of data from traditional and digital sources inside and outside your company that represents a source for ongoing discovery and analysis. Today data is collected everywhere, from systems and sensors to mobile devices. The challenge is that the industry is still in the process of developing methods to best interpret data. It's the evolution of Industry 4.0 that will change the way organizations and solutions within those organizations work together; teams will be able to make better, smarter decisions.

2. Smart Factory

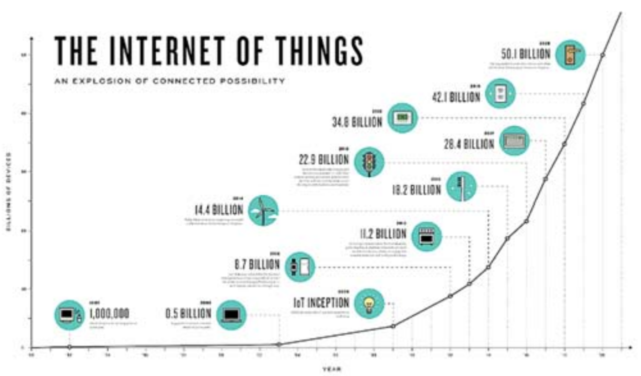
The concept of Smart Factory is the seamless connection of individual production steps, from planning stages to actuators in the field. In the near future, machinery and equipment will be able to improve processes through self-optimization; systems will autonomously adapt to the traffic profile and network environment.

Leading by example is the Siemens Electronic Works facility in Amberg, Germany. Smart machines coordinate production and global distribution or a built-to-order process involving roughly 1.6 billion components. When the Smart Factory is achieved, it will represent a pivotal shift for Industry 4.0, as the revolution will begin to roll out across multiple verticals. Various markets spanning healthcare to consumer goods will adapt Industry 4.0 technologies initially modelled in the Smart Factory.

3. Cyber Physical Systems

Cyber physical systems are integrations of computation, networking and physical processes. Computers and networks monitor and control physical processes with feedback loops; the physical system reacts, the system uses software to interpret action and tracks results. The notion centers on computers and software being embedded in devices where the first use is not computation; rather it is a loop of action and machine learning.

4. Internet of Things (IoT)



The internet of things is a simple term for a grandiose concept. IoT is the connection of all devices to the internet and each other. As Wired said, “it’s built on cloud computing and networks of data-gather sensors; it’s mobile, virtual, and instantaneous connection.” This interconnection will enable “smart factories” to take shape as equipment will use data to manufacture, move, report and learn at astounding rates, efficiently.

5. Interoperability

Interoperability is in essence what happens when we bring the above elements together. It is the connection of cyber-physical systems, humans and smart factories communicating with each other through the IoT. In doing so, manufacturing partners can effectively share information, error-free. Consider that no single company can dictate all its partners use the same software or standards for how the information is represented. Interoperability enables error-free transmission and translation.

From 3D prints to self-driving vehicles, Industry 4.0 technologies are propelling the manufacturing industry with new means of efficiency, accuracy and reliability. The level of intelligence offered today is only the beginning for what is to come.

Android Versions

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Introduction

Thanks to its version code names based on delicious desserts, a trip to android history is refreshing. What's more, with every release of its new version, Google puts up a giant statue of the delicacy associated with the code name on its campus.What better way to celebrate the arrival of those luring Android versions, equally tempting as the desserts they stand for.

Every Android version after 1.5 has been evolved with definite code names that have been chosen in an alphabetical manner. And no official explanation has ever been given for this peculiar naming convention, although it has garnered much media attention.

However, Google did not attach any high-calorie code name to its initial versions 1.0 and 1.1 of the Android Operating System.

1. Cupcake

Although not the very first version from Google after buying the company Android, Version 1.5 is considered as the first prominent version that highlighted the true power of its platform.

With this version, in fact, Google kicked off the trend of naming its versions after yummy desserts. The many novel features associated with the Cupcake version include third-party keyboard and direct upload to YouTube.

2. Donut

Released in 2009, Android Version 1.6 has been code named as "Donut," after the tasty ring-shaped delicacy. Its specialties like enhanced user experience, text-to speech support, improved video aspects and refined search integration helped Google to get itself rooted firmly in the highly competitive Smartphone market.

Larger screen-size support and turn-by-turn navigation facilities were the other sweet coatings on the donut version.

3. Eclair

Named after those oblong baked pastries with chocolate filling, Android 2.0 was released in October 2009. The bug fix version named as 2.0.1 soon followed a couple of months later in December 2009. Then in January 2010, out came Android 2.1 with added animation features.

However, the three versions are often considered as a single release. Google map navigation is its highlighted feature. Other celebrated features of Version Éclair include flash and digital zoom options for camera, live wallpapers, multi-touch support mechanism and of course, Bluetooth 2.1 support.

4. Froyo

The next one in the queue, Android 2.2 is about sheer speed and nothing else. Short for Frozen Yoghurt, Google got this version's speed technically enhanced. Yet another unique characteristic feature was its uniquely redesigned home screen. It ensured better functionality for the device, with the entire process streamlined.

5. Gingerbread

Named after the popular ginger-flavored cookies, Android version 2.3 looked new and fresh in various ways. A few of its unique features included several cameras, SIP internet calling, download manager, a few sensors like a barometer, gravimeter etc.

6. Honeycomb

Google introduced Android 3.0 in February 2011 and called it, Honeycomb. Made for tablets, versions 3.1 and 3.2 followed in rapid succession. Gingerbread was, in fact, Android's very first tablet-only update.

7. Ice Cream Sandwich

Version 4.0 was the outcome of Google's plan to get the tablet-only platform of Honeycomb synthesized with a mobile platform. Dubbed as Ice-cream Sandwich, enhanced functionality was not the only big change that it brought in. In terms of design too, there were drastic changes.

Introduction of default font was another highlight of Ice-cream Sandwich. From this version onwards, Google effectively brought all its services under the umbrella, 'Google Play'.

8. Jelly Bean

Although primarily meant to enhance functionality and improve user interface, "Google Now" was indeed the most innovative aspect of Version 4.1. Nicknamed as Jelly Bean, here was something that could correctly guess what you are up to search, before you actually go looking for it.

Apart from the predictive feature, highly interactive notifications too made Jelly Bean stand out from the rest. Version 4.1 was also noted for its unique in- built speech-to-text engine, popularly referred to as 'voice typing'. The outcome has been an overall performance enhancement that assured an absolutely buttery smooth user interface.

9. KitKat

Google officially unveiled Android version 4.4, which it named as Kitkat, in 2013. Nestle offered full support and even kicked off a special ad campaign on its release.

However, the code name that Google had initially associated with Android 4.4 was "Key Lime Pie". The name was later changed to Kitkat as they thought key lime pie was not a very popular dessert.

Google wanted a dessert name that is known by all, and hence partnered with Nestle for the code name Kitkat. Version 4.4 debuted on Nexus 5, and can effectively run on quite many devices compared to earlier Android versions.

'Google Now' feature, introduced initially in Jelly Bean was taken even ahead with the introduction of Kitkat. Earlier, you had to touch the gadget to open up the smart artificial intelligence (AI) assistant. Now with Jelly Bean, all you got to do to initiate the search is to utter the required phrase to the gadget.

Another advantage of Version 4.4 was that now the operating system could run even on devices with lower RAM. 512 MB RAM was the recommended minimum. The introduction of Emoji on Google's keyboards was yet another unique aspect of Kitkat.

10. Lollipop

With Version 5.0, popularly referred to as Lollipop, Android could simply spread across a wide range of devices from smart phones to televisions and even to smart watches.

Lollipop came out with a brand new runtime. Battery saving feature ensures excellent battery life on these various devices. It saves your phone from damage even while its battery is running low.

11. Marshmallow

Android 6.0, named Marshmallow, has been released under the code name Android M. It has ushered in a fistful of welcome changes that are sure to make a major impact. Doze mode that cuts down the power consumption drastically when the device is idle, opt-in app permission, fully supported USB C, inbuilt fingerprint sensor support system is but a few of them. It even allows the user to get a MicroSD card formatted and use it as internal storage, enjoying the same security level. Of course, all those versions that have been rolled out by Google till now have been sweet. Still sweeter ones are yet to come and steal the show. Android N, the next in line is already underway with its developer preview already released.

TFT & OELD – Advancement in Display Technology

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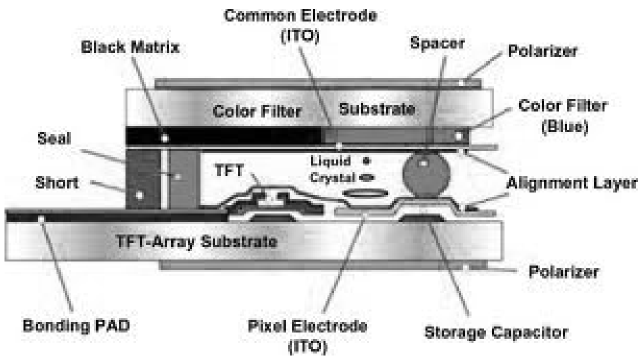
TFT Technology:

Thin Film Transistor (TFT full form) monitors are now popular in Computers, TV, Laptops, Mobile phones etc. It gives enhanced quality of images like contrast and address-ability. Unlike the LCD monitors, TFT monitors can be viewed from any angle without image distortion. TFT display is a form of Liquid Crystal Display with thin film transistors for controlling the image formation. Before going into the details of TFT technology, let us see how the LCD works.

The LCD contains Liquid crystals which is a state between liquid and solid. That is the matter can change its form from liquid to solid and viceversa. The liquid crystal flows like a liquid and it can orient to form the solid crystal. In the LCD displays, the liquid crystals used have the property of light modulation. The LCD screen do not emit light directly but it has a number of pixels filled with liquid crystals that pass light. These are arranged in front of a Back light which is the source of light. The pixels are distributed in columns and rows and the pixel behaves like a capacitor. Similar to a capacitor, the pixel has a liquid crystal sandwiched between two conductive layers. The images from The LCD may be Monochrome or colored. Each pixel is connected with a switching transistor.



When compared to the ordinary LCD, TFT monitors give very sharp and crisp text with increased response time. The TFT display has transistors made up of thin films of Amorphous silicon deposited on a glass using the PECVD technology. Inside each pixel, the transistor occupies only a small portion and the remaining space allows the passage of light. Moreover, each transistor can works off at the expense of very little charge so that the image redrawing is very fast and the screen refreshes many times in a second. In a standard TFT Monitor around 1.3 million pixels with 1.3 million thin film transistors are present. These transistors are highly sensitive to voltage fluctuations and mechanical stress and will be damaged easily leading to the formation of Dots of colors . These dots without the image are called as Dead pixels. In the Dead pixels, the transistors are damaged and cannot work properly.

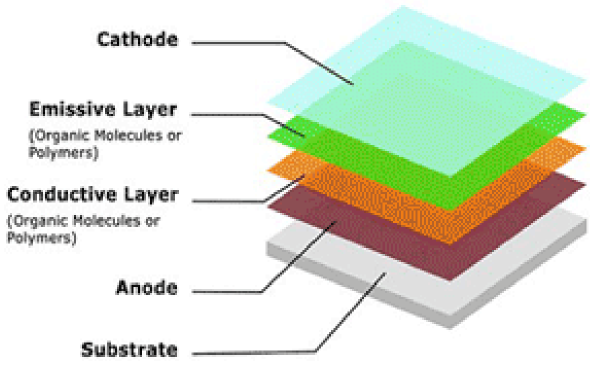
The Monitors using TFT are known as TFT-LCD monitors. The display of TFT monitor has two Glass substrates enclosing a layer of liquid crystal. The Front glass substrate has a color filter. The Back glass filter contains the thin transistors arranged in columns and rows. Behind the Back glass substrate, there is Back light unit that gives light. When the TFT display is charged, the molecules in the liquid crystal layer bend and allow the passage of light. This creates a pixel. The color filter present in the Front glass substrate gives the required color to each pixel.

There are two ITO electrodes in the display to apply voltage. The LCD is placed between these electrodes. When a varying voltage is applied through the electrodes, the liquid crystal molecules align in different patterns. This alignment produces both light and dark areas in the image. This kind of image is called as Grey scale image. In color TFT monitor, the color filter substrate present in the front glass substrate gives color to the pixels. The color or grey pixel formation depends on the voltage applied by the Data driver circuit.

The Thin film transistors play an important role in pixel formation. These are arranged in the Back glass substrate. The pixel formation depends on the On/Off of these switching transistors. The switching controls the movement of electrons into the ITO electrode region. When the millions of Pixels are formed and alighted according to the switching of the transistors, millions of liquid crystal angles are created. These LC angles generates the image in the screen.

Organic Electro Luminescent Display

Organic Electro Luminescent Display (OELD) is the recently evolved solid state semiconductor LED having a thickness of 100-500 nanometers. It is also called as Organic LED or OLED. It finds many applications including the displays in mobile phones, digital camera etc. The advantage of OELD is that it is much thinner than the LCD and consumes less power. OLED is composed of aggregates of Amorphous and Crystalline molecules which are arranged in an irregular pattern. The structure has many thin layers of organic material. When current passes through these thin layers, light will be emitted through the process of Electrophosphorescence. The display can emit colors like Red, Green, Blue, White etc.



Based on the construction, OLED can be classified into

- Transparent OLED- All layers are transparent.
- Top emitting OLED – Its Substrate layer may be either reflective or non reflective.
- White OLED – It emits only White light and makes large lighting systems.
- Foldable OLED – Ideal to make Cell phone display since it is flexible and foldable.
- Active Matrix OLED – The Anode is a transistor layer to control the pixel. All the other layers are similar to the typical OLED.
- Passive OLED – Here the external circuitry determines its pixel formation.

In function, OLED is similar to an LED but it has many active layers. Typically there are two or three organic layers and other layers. The layers are Substrate layer, Anode layer, Organic layer, Conductive layer, Emissive layer and Cathode layer. The substrate layer is a thin transparent glass or plastic layer that supports the OLED structure. Anode later is active and removes electrons. It is also a transparent layer and is made up of Indium Tin Oxide. The organic layer is composed of Organic materials.

Conductive later is an important part and it transports the holes from the Anode layer. It is made up of organic plastic and the polymer used are Light emitting Polymer (LEP), Polymer Light Emitting Diode (PLED) etc. The conductive layer is electroluminescent and uses the derivatives of p-phenylene Vinylene (Poly) and Ployfluorene. The Emissive layer transports electrons from the Anode layer. It is made up of Organic plastic. The Cathode layer is responsible for the injection of Electrons. It may be either transparent or opaque. To make Cathode layer, Aluminum and Calcium are used.

OLED gives excellent display than the LCD and the pictures can be viewed from any angle without distortion. The process of light emission in the OLED involves many steps. When a potential difference is applied between the Anode and Cathode layers, current flows through the Organic layer. During this process, the Cathode layer emits electrons into the Emissive layer. The Anode layer, then releases electrons from the conductive later and the process generates holes. At the junction between the Emissive and the conductive layers, the electrons combine with the holes. This process releases energy in the form of Photons.

Innovations in Solar PV Technology

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Introduction

When we think of solar panels, chances are we think of roofs or giant arrays of glimmering panels in the desert. However, advances in photovoltaic (PV) technologies over the last decade have made possible many more smaller-scale applications for everyday living, on a more personal level. Improvements in design and configuration, energy storage, efficiency, and battery size have created opportunities for solar energy in a variety of situations, some of which you have probably not considered—including off-grid scenarios that can help you survive emergency situations. Below are nine examples of innovative, low-cost ways solar energy is being used to enhance our daily lives.

Streetlights

More cities across the world are powering streetlights with solar energy. The sun charges the batteries during the day, which then powers light-emitting diodes (LEDs) at night to illuminate the streets. San Diego is incorporating smart sensors into streetlights that can even direct drivers to open parking spaces and help first responders during emergency situations. Combining internet-linked sensors with solar powered streetlights saves both time and money.

Vaccine Refrigerators

In developing countries, 24-hour electricity isn't guaranteed, and in many cases, there is no electrical grid. "Private companies have been manufacturing solar-powered vaccine refrigerators so healthcare workers in remote areas can administer critical medication to those who need it," states Charlie Gay, director of the Solar Energy Technologies Office for the Office of Energy Efficiency and Renewable Energy (EERE). "This technology solution has been saving lives for more than four decades."

Ovens

Solar ovens—also called solar cookers—reflects the sun's energy to cook food. Solar cookers can be parabolic or square structures lined with a reflective material that directs the rays into the box, where it heats the food evenly.

Parabolic solar cooker.

The lid on top is typically made out of glass to better focus the sun's rays. They are ideal for off-grid living and often used in developing countries, which reduces air pollution that results from burning fuel.

Cell-Phone Charger

USB cell phone chargers can charge a phone to almost full after only a few hours exposure to UV sunlight. These portable solar panels are about the size of a tablet and can also charge GPS trackers, tablets, or even laptops. They can be hooked on backpacks to collect solar energy as you walk, making them ideal for outdoor excursions.

Paint

Instead of constructing typical solar cells of silicon, "polymers dissolved in a solvent create a 'paint' or coating that can be applied to any surface – from homes to offices to cars," writes technology writer Stephanie Hicks on Hub Pages. "It's inexpensive and versatile. Unlike bulky photovoltaic solar panels, solar paint uses thin-film nanoparticles instead of silicon as solar conductors. When applied to the sides of structures that face the sun, the thin solar cells invisibly generate clean, green power."

Tents

Solar-powered tents are essentially larger versions of solar-powered backpacks.

Orange solar tents.

The tents have imbedded photovoltaic cells that store solar energy by day, which is then used to illuminate the tent at night and charge or power devices and small appliances, including heaters. The U.S. Army has a version that can generate up to 2 kilowatts of power a day.

Bike Locks

The Ellipse Skylock is the world's first solar-powered bike lock. It powered by a built-in solar panel that provides enough power for a week after just one hour of charging. The Skylock connects wirelessly to the rider's phone to provide keyless entry, theft detection, bike sharing, and crash alerts. It also sends an alert if the bike is disturbed, using its long-range Bluetooth.

Backpacks

Thin-film solar panels attached to the outside of backpacks provide up to about four watts of power—enough to charge phones, cameras, and other devices while simply walking. These exterior solar cells can also be attached to briefcases and handbags. These backpacks are ideal for students, hikers, and campers, who will always have a charged device during their travels, or when they reach their destination.

Solar Fabric

Solar fabric is an application of solar technology with a wide range of applications. Solar cells are woven into textile fibers and generate convenient solar electricity. "One version, created by FTL Solar, can literally be pitched like a tent to provide both shelter and electricity," writes Hicks. "Consider the endless possibilities: military, rescue operations, disaster relief, recreational options, medical units, and even temporary housing. Any place you need flexible convenient solar power, solar fabric is your answer."

Healthcare Technology using IOT

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Introduction

The next wave in the era of computing will be outside the realm of the traditional desktop. In the Internet of Things (IoT) paradigm, many of the objects that surround us will be on the network in one form or another. Radio Frequency IDentification (RFID) and sensor network technologies will rise to meet this new challenge, in which information and communication systems are invisibly embedded in the environment around us. This results in the generation of enormous amounts of data which have to be stored, processed and presented in a seamless, efficient, and easily interpretable form. This model will consist of services that are commodities and delivered in a manner similar to traditional commodities. Cloud computing can provide the virtual infrastructure for such utility computing which integrates monitoring devices, storage devices, analytics tools, visualization platforms and client delivery. The cost based model that Cloud computing offers will enable end-to-end service provisioning for businesses and users to access applications on demand from anywhere.

Activity trackers during cancer treatment:

The Memorial Sloan Kettering Cancer Center (MSK) and cloud research firm Medidata are testing the use of activity trackers to gather lifestyle data.

Patients will wear an activity tracker for up to a week prior to treatment and then continuously for several months over the course of multiple treatments.

The trackers will assist in logging activity level and fatigue, with appetite also being logged directly, and all data saved to Medidata’s Patient Cloud ePRO app on their personal smart phones. Using a variety of data gathered day-to-day through wearables or apps is a fairly obvious way that diagnosis and treatment can be improved for many conditions.

This is particularly the case for a disease such as cancer, for which the reaction to therapy plays an important and determinant part in prescribing the right treatment.

Pharma is following, though, and developing its own connected systems to help diabetes sufferers. In 2016, Roche acquired distribution rights to an implantable long-term continuous glucose monitoring (CGM) system which uses a 90 day sensor below the patient's skin.

The sensor communicates with a smart transmitter which then sends blood glucose levels to a sister mobile app on the patient's phone.

Medical Information Distribution

This is a most prominent innovation of IoT applications in healthcare, the distribution of accurate and current information to patients remains one of the most challenging concerns of medical care. IoT devices not only improve health in the daily lives of individuals but also facilities and professional practice.

IoT systems take healthcare out of facilities like hospitals and allow intrusive care into the office, home or social space. They empower and enable individuals to cater to their own health, and allow healthcare providers to deliver better care to patients.

Conclusion

Hence, today we learned IoT applications in the healthcare field. We covered the different healthcare applications of IoT and how IoT is beneficial for healthcare. In next tutorial, we will study IoT application in agriculture. Till, will you satisfy with the "IoT applications in healthcare", tell us in the feedback section.

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.

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

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- ❖ Enrich technical skills with state of the art laboratories and facilities.
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To produce world class Electrical and Electronics Technocrats and Entrepreneurs with social responsibilities.

MISSION

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