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CONTENTS

INTELLIGENT APPS: THE NEXT GENERATION OF APPLICATIONS

Intelligent Apps are applications that use historical and real-time data from user interactions and other sources to make predictions and suggestions, delivering personalized and adaptive user experiences. The next generation of mobile applications will be the result of multiple worlds colliding when application development meets artificial intelligence, the Internet of Things and big data analytics, intelligent apps are the outcome. Simply, these are apps that continually learn from user interactions and other data sources to become even more relevant and useful.

Features of smart apps

Chatbots, virtual assistants and recommendation engines on e-commerce sites are just some examples of intelligent applications. While it's difficult to formulate a catch-all definition of smart apps, they have a number of typical features:

Data-driven

Intelligent apps combine and process multiple data sources such as IoT sensors, beacons or user interactions and turn an enormous quantity of numbers into valuable insights.

Contextual and relevant

Intelligent apps make much smarter use of a device's features to proactively deliver highly relevant information and suggestions. Users will no longer have to go to their apps.

Continuously adapting

Machine learning and intelligent apps continuously adapt and improve their output.

Action-oriented

By anticipating user behaviors with predictive analytics, smart applications deliver personalized and actionable suggestions.

Omnichannel

Progressive Web Applications (PWAs) are increasingly blurring the lines between native apps and mobile web applications.

S.AISWARYA
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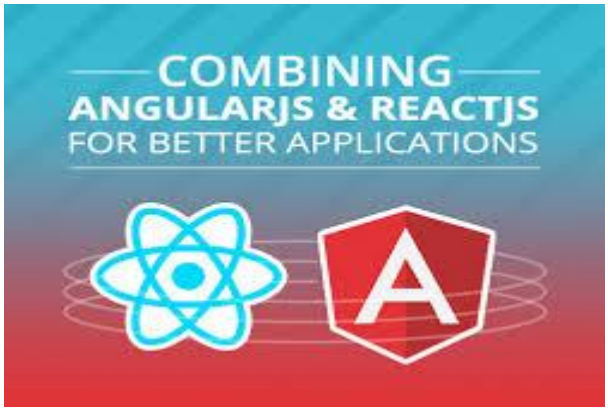
ANGULAR AND REACT- JAVASCRIPT BASED FRAMEWORKS

Angular and React are JavaScript based Frameworks for creating modern web applications. Using React and Angular one can create a highly modular web app. So user don't need to go through a lot of changes in your code base for adding a new feature. Angular and React also allows to create a native mobile application with the same JS, CSS & HTML knowledge.



What is React?

Maintained by Facebook, React. js (which we'll call React in the rest of the article) is an open-source JavaScript library for developing desktop, web, and mobile app user interfaces. Unlike most websites, those built with React don't have server-side rendering, they are rendered in the browser. This means users don't have to wait for a server response to render a new page. It's a much faster experience, which is especially important for mobile applications.

React's tool library allows developers to build components that are dropped onto a webpage. These components, which are like custom HTML elements, are what the users see on the site. Components can be reused across apps and are much easier to update than searching through lines of code. Companies that use React include Facebook (and Instagram), Uber and Netflix among others.

What is Angular?

Angular is an all-in-one open-source JavaScript framework maintained by Google, to build highly reactive single-page applications. Like React, an Angular-based website will see all site changes made in the browser. Rather than communicating with a server to load data, a browser-side experience allows the page to render quickly with a more mobile-like experience. Angular, which recently saw the release of its newest version of Angular 9 is built on Typescript, a superset of JavaScript.

Because React is a JavaScript library as opposed to the full JavaScript framework of Angular, many developers will add more libraries when using React to give it the functionality of a complete framework. Companies that use Angular include Nike, HBO and Google among others.

A.TAMILHARIHARAN
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INTELLIGENT SENSING ABILITIES IN ROBOTS

The novel system developed by computer scientists and materials engineers combines an artificial brain system with human-like electronic skin, and vision sensors to make robots smarter.

A team of computer scientists and materials engineers from the National University of Singapore (NUS) has recently demonstrated an exciting approach to make robots smarter. They developed a sensory integrated artificial brain system that mimics biological neural networks, which can run on a power-efficient neuromorphic processor, such as Intel's Loihi chip. This novel system integrates artificial skin and vision sensors, equipping robots with the ability to draw accurate conclusions about the objects they are grasping based on the data captured by the vision and touch sensors in real-time.

"The field of robotic manipulation has made great progress in recent years. However, fusing both vision and tactile information to provide a highly precise response in milliseconds remains a technology challenge. Our recent work combines our ultra-fast electronic skins and nervous systems with the latest innovations in vision sensing and AI for robots so that they can become smarter and more intuitive in physical interactions," said Assistant Professor Benjamin Tee from the NUS Department of Materials Science and Engineering. He co-leads this project with Assistant Professor Harold Soh from the Department of Computer Science at the NUS School of Computing.

Human-like sense of touch for robots

Enabling a human-like sense of touch in robotics could significantly improve current functionality, and even lead to new uses. For example, on the factory floor, robotic arms fitted with electronic skins could easily adapt to different items, using tactile sensing to identify and grip unfamiliar objects with the right amount of pressure to prevent slipping.

In the new robotic system, the NUS team applied an advanced artificial skin known as Asynchronous Coded Electronic Skin (ACES) developed by Assistant Professor Tee and his team in 2019. This novel sensor detects touches more than 1,000 times faster than the human sensory nervous system. It can also

identify the shape, texture and hardness of objects 10 times faster than the blink of an eye.

Making an ultra-fast artificial skin sensor solves about half the puzzle of making robots smarter. They also need an artificial brain that can ultimately achieve perception and learning as another critical piece in the puzzle added Assistant Professor Tee, who is also from the NUS Institute for Health Innovation & Technology.

A human-like brain for robots

To break new ground in robotic perception, the NUS team explored neuromorphic technology an area of computing that emulates the neural structure and operation of the human brain to process sensory data from the artificial skin. As Assistant Professor Tee and Assistant Professor Soh are members of the Intel Neuromorphic Research Community (INRC), it was a natural choice to use Intel's Loihi neuromorphic research chip for their new robotic system.

In their initial experiments, the researchers fitted a robotic hand with the artificial skin, and used it to read braille, passing the tactile data to Loihi via the cloud to convert the micro bumps felt by the hand into a semantic meaning. Loihi achieved over 92 per cent accuracy in classifying the Braille letters, while using 20 times less power than a normal microprocessor.

The Soh's team improved the robot's perception capabilities by combining both vision and touch data in a spiking neural network. In their experiments, the researchers tasked a robot equipped with both artificial skin and vision sensors to classify various opaque containers containing differing amounts of liquid. They also tested the system's ability to identify rotational slip, which is important for stable grasping.

In both tests, the spiking neural network that used both vision and touch data was able to classify objects and detect object slippage. The classification was 10 percent more accurate than a system that used only vision. Moreover, using a technique developed by Soh's team, the neural networks could classify the sensory data while it was being accumulated, unlike the conventional approach where data is classified after it has been fully gathered. In addition, the researchers demonstrated the efficiency of neuromorphic technology. Loihi processed the sensory data 21 per cent faster than a top performing graphics processing unit (GPU), while using more than 45 times less power.

Assistant Professor Soh shared, "We're excited by these results. They show that a neuromorphic system is a promising piece of the puzzle for combining multiple sensors to improve robot perception. It's a step towards building power-efficient and trustworthy robots that can respond quickly and appropriately in unexpected situations." "This research from the

National University of Singapore provides a compelling glimpse to the future of robotics where information is both sensed and processed in an event-driven manner combining multiple modalities. The work adds to a growing body of results showing that neuromorphic computing can deliver significant gains in latency and power consumption once the entire system is re-engineered in an event-based paradigm spanning sensors, data formats, algorithms, and hardware architecture," said Mr Mike Davies, Director of Intel's Neuromorphic Computing Lab.

P.VIJAYA SHREE
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SCIENTIFIC AND INFORMATION VISUALIZATION

Scientific and Information visualization are branches of computer graphics and user interface design that are concerned with presenting data to users, by means of images. The goal of this area is usually to improve understanding of the data being presented.

For example, scientists interpret potentially huge quantities of laboratory or simulation data or the results from sensors out in the field to aid reasoning, hypothesis building and cognition. The field of data mining offers much abstract visualization related to these visualization types.

They are active research areas, drawing on theory in information graphics, computer graphics, human-computer interaction and cognitive science. Desktop programs capable of presenting interactive models of molecules and microbiological entities are becoming relatively common (Molecular graphics).

The field of Bioinformatics and the field of Cheminformatics make a heavy use of these visualization engines for interpreting lab data and for training purposes. Medical imaging is a huge application domain for scientific visualization with an emphasis on enhancing imaging results graphically, e.g. using pseudo-coloring or overlaying of plots. Real-time visualization can serve to simultaneously image analysis results within or beside an analyzed (e.g. segmented) scan.

S.PRAKASH
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RECOGNIZING FAKE IMAGES USING FREQUENCY ANALYSIS

The deep-fake images are generated by machine learning algorithms, and humans are pretty much unable to distinguish them from real photos. Researchers at the Horst Gortz Institute for IT Security at Ruhr-Universities Bochum and the Cluster of Excellence "Cyber

Security in the Age of Large-Scale Adversaries" (Casa) have developed a new method for efficiently identifying deep-fake images. They analyse the objects in the frequency domain established signal processing technique.

Interaction of two algorithms results in new images

Deep-fake images ,a portmanteau word from deep learning for machine learning and fake are generated with the help of computer models, so-called Generative Adversarial Networks, GANs for short. Two algorithms work together in these networks: the first algorithm creates random images based on certain input data. The second algorithm needs to decide whether the image is a fake or not. If the image is found to be a fake, the second algorithm gives the first algorithm the command to revise the image until it no longer recognizes it as a fake.

In recent years, this technique has helped make deep-fake images more and more authentic. On the website www.whichfaceisreal.com, users can check if they're able to distinguish fakes from original photos. "In the era of fake news, it can be a problem if users don't have the ability to distinguish computer-generated images from originals," says Professor Thorsten Holz from the Chair for Systems Security. For their analysis, the Bochum-based researchers used the data sets that also form the basis of the above-mentioned page "Which face is real."

N.R SHARMILA
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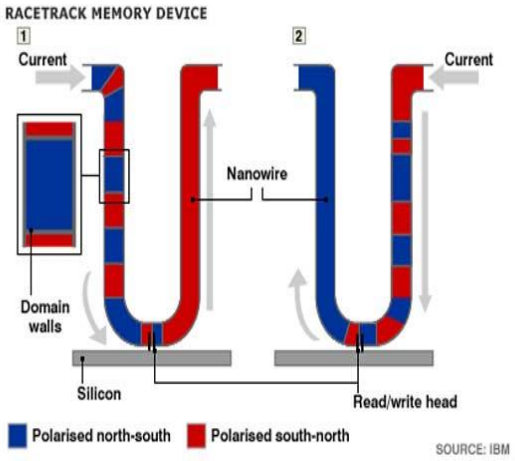
ENHANCING DATA STORAGE WITH RACETRACK MEMORY

A team of scientists has taken steps to create a new form of digital data storage, a "Racetrack Memory," which opens the possibility to both bolster computer power and lead to the creation of smaller, faster and more energy efficient computer memory technologies.



Racetrack memory which reconfigures magnetic fields in innovative ways, could supplant current methods of mass data storage such as flash memory and disk drives, due to its improved density of information storage, faster operation, and lower energy use. Today's devices, from smart phones to laptops to cloud-

based storage, rely on a remarkable and growing density of digital data storage. Because the need will only increase in the future, researchers have been seeking ways to improve storage technologies enhancing their capacities and speed while diminishing their size.

The breakthrough reported in scientific reports, which also included researchers from the University of Virginia, the University of California, San Diego, the University of Colorado and the National Institute of Standards and Technology, stemmed from a goal to develop a new format of digital memory. The team's focus was on a skyrmion racetrack memory, an undeveloped type of memory that reverses the processes of existing storage.

Many current mass data storage platforms function like an old musical cassette tape, which reads data by moving material (i.e., the tape) with a motor across a reader (i.e., in the cassette player), then decodes the information written on the material to reproduce sound. By contrast, racetrack memory does the opposite: the material stays in place and the information itself is moved across the reader without the need to move mechanical parts, such as a motor.

The information is carried by a magnetic object called a skyrmion that can be moved by applying an external stimulus, such as a current pulse. A skyrmion, a magnetic texture with a whirling spin configuration, spins as if curled up in a ball. This ball of spins represents a bit of information that can be moved quickly as well as created and erased with electrical pulses. Skyrmions can be very small and moved at high speed at a low energy cost, thus enabling faster, high-density and more energy-efficient data storage. Bochum group chose a different approach by converting the images into the frequency domain using the discrete cosine transform. The generated image is thus expressed as the sum of many different cosine functions. Natural images consist mainly of low-frequency functions.

The analysis has shown that images generated by GANs exhibit artefacts in the high-frequency range. For example, a typical grid structure emerges in the frequency representation of fake images. The experiments showed that these artefacts do not only occur in GAN generated images. They are a structural problem of all deep learning algorithms. Frequency analysis is therefore an effective way to automatically recognize computer-generated images.

B. A. AKSHAYA SHREE
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OPPORTUNISTIC ENCRYPTION

Opportunistic encryption (OE) refers to any system that, when connecting to another system, attempts to encrypt the communications channel, otherwise falling back to unencrypted communications. This method requires no pre-arrangement between the two systems.

Opportunistic encryption can be used to combat passive wiretapping.[1] (An *active* wiretapper, on the other hand, can disrupt encryption negotiation to either force an unencrypted channel or perform a man-in-the-middle attack on the encrypted link.) It does not provide a strong level of security as authentication may be difficult to establish and secure communications are not mandatory. However, it does make the encryption of most Internet traffic easy to implement, which removes a significant impediment to the mass adoption of Internet traffic security.

Opportunistic encryption on the Internet is described in RFC 4322, Opportunistic Encryption using the Internet Key Exchange (IKE), RFC 7435 Opportunistic Security, Some Protection Most of the Time and RFC 8164 Opportunistic Security for HTTP/2.

Opportunistic encryption can also be used for specific traffic like e-mail using the SMTP STARTTLS extension for relaying messages across the Internet, or the Internet Message Access Protocol (IMAP) STARTTLS extension for reading e-mail. With this implementation, it is not necessary to obtain a certificate from a certificate authority, as a self-signed certificate can be used.

- RFC 2595 Using TLS with IMAP, POP3 and ACAP
- RFC 3207 SMTP Service Extension for Secure SMTP over TLS
- STARTTLS and postfix
- STARTTLS and Exchange

Many systems employ a variant with third-party add-ons to traditional email packages by first attempting to obtain an encryption key and if unsuccessful, then sending the email in the clear. PGP, p≡p, Hushmail, and Ciphire, among others can all be set up to work in this mode.

In practice, STARTTLS in SMTP is often deployed with self-signed certificates, which represents a minimal one-time task for a system administrator, and results in most email traffic being opportunistically encrypted.

K.SURESHKUMAR
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WEB SHELL

A web shell is a web security threat, which is a web-based implementation of the shell concept. A web shell is able to be uploaded to a web server to allow remote access to the web server, such as the web server's file system.

A web shell is unique in that it enables users to access a web server by way of a web browser that acts like a command-line interface. A user can access a remote computer via the World Wide Web using a web browser on any type of system, whether it's a desktop computer or a mobile phone with a web browser, and perform tasks on the remote system. No command-line environment is required on either the host or the client. A web shell is often considered a remote access trojan.

A web shell could be programmed in any language that the target server supports. Web shells are most commonly written in PHP due to the widespread use of PHP, however, Active Server Pages, ASP.NET, Python, Perl, Ruby and Unix shell scripts are also used, although not as common because it is not very common for web servers to support these languages. Using network monitoring tools such as Wireshark, an attacker can find vulnerabilities which are exploited resulting in a web shell installation. These vulnerabilities may be present in content management system applications or the web server's software. An attacker can use a web shell to issue commands, perform privilege escalation on the web server, and the ability to upload, delete, download and execute files on the web server.

General usage

Web shells are used in attacks mostly because they are multi-purpose and are difficult to detect. Web shells are commonly used for:

- Data theft.
- Infecting website visitors (watering hole attacks).
- Website defacement by modifying files with a malicious intent.
- Launch Distributed Denial of Service (DDoS) attacks.
- To relay commands inside the network which is inaccessible over the Internet.
- To use as command and control base, for example as a bot in a botnet system or in way to compromise the security of additional external networks.

Delivery of web shells

Web shells are installed through vulnerabilities in web application or weak server security configuration including the following:

- SQL injection.
- Vulnerabilities in applications and services (e.g. web server software such as NGINX or content management

system applications such as WordPress).

- File processing and uploading vulnerabilities, which can be mitigated by e.g. limiting the file types that can be uploaded.
- Remote File Inclusion (RFI) and Local File Inclusion (LFI) vulnerabilities.
- Remote code execution.
- Exposed administration interfaces.

An attacker may also modify (spoof) the Content-Type header to be sent by the attacker in a file upload to bypass improper file validation (validation using MIME type sent by the client), which will result in a successful upload of the attacker's shell.

Examples of notable web shells

A b374k shell running on a Windows 7 Ultimate Edition server.

An example of what a fake error page might look like in a WSO web shell.

- **b374k** – A web shell written in PHP with abilities such as monitoring processes & command execution. The latest version of the b374k shell is 3.2.3.
- **C99** – A web shell capable of showing the web server's security standards and has a self-destruction option. The original version of C99Shell does not work with PHP 7 due to the usage of removed functions.
- **China Chopper** – A web shell which is only 4 kilobytes in size, which was first discovered in 2012. This web shell is commonly used by malicious Chinese actors, including Advanced Persistent Threat (APT) groups, to remotely access web servers. This web shell has two parts, the client interface (an executable file) and the receiver host file on the compromised web server. It has many commands and control features such as a password brute-force attack option.
- **R57** – The R57 web shell has tools to scan the infected web server for other web shell installations, with the option to remove or overwrite them.
- **WSO (web shell by oRb)** – Has the ability to be password protected with a login form, some variants can disguise as a fake HTTP error page.

Web shells can be as short as just one line of code. The following example PHP script is 15 bytes in size:

```
<?=`$_GET[x]`?>
```

If an attacker inserts this line of code into a malicious file with a PHP filename extension (such as `.php`) on a web server that is running PHP, the attacker can issue commands, for example reading the /etc/passwd file, through a web browser using the following Uniform Resource Locator if the web shell was located at uploads/webshell.php:

http://example.com/uploads/webshell.php?x=cat%20%2Fetc%2Fpasswd

The above request will take the value of the `x` URL parameter, decode the URL and send the following shell command:

```
cat /etc/passwd
```

If the permissions of the /etc/passwd file allow viewing the file, the web server will send the contents of /etc/passwd to the web browser and the browser will then display the contents of the /etc/passwd file or any other file the attacker wishes to view.

This attack could have been prevented if the file permissions did not allow viewing the file or if the shell functions of PHP were disabled so that arbitrary shell commands cannot be executed from PHP. Other malicious actions are able to be executed by attackers with that web shell, such as replacing the contents of a file on the web server. For example, consider the following command:

```
echo x > index.php
```

The above command could be used to replace the contents of the index.php file with the text "x", which is one way a web page could be defaced, or create the index.php file with the contents if the file does not exist. Attackers can also use the Bash command rm to delete files on the web server and mv to move files.

Prevention and mitigation

A web shell is usually installed by taking advantage of vulnerabilities present in the web server's software. That is why removal of these vulnerabilities are important to avoid the potential risk of a compromised web server. The following are security measures for preventing the installation of a web shell:

- Regularly update the applications and the host server's operating system to ensure immunity from known bugs.
- Deploying a Demilitarized Zone (DMZ) between the web facing servers and the internal networks.
- Secure configuration of the web server.
- Closing or blocking ports and services which are not used.

- Using user input data validation to limit local and remote file inclusion vulnerabilities.
- Use a reverse proxy service to restrict the administrative URL's to known legitimate ones
- Frequent vulnerability scan to detect areas of risk and conduct regular scans using web security software.
- Deploy a firewall.
- Disable directory browsing.
- Not using default passwords.

Detection

Web shells can be easily modified, so it's not easy to detect web shells and antivirus software are often not able to detect web shells. The following are common indicators that a web shell is present on a web server:

- Abnormal high web server usage (due to heavy downloading and uploading by the attacker).
- Files with an abnormal timestamp (e.g. newer than the last modification date).
- Unknown files in a web server.
- Files having dubious references, for example, cmd.exe or eval.
- Unknown connections in the logs of web server.

For example, a file generating suspicious traffic (e.g. a PNG file requesting with POST parameters). Dubious logins from DMZ servers to internal sub-nets and vice versa.

Web shells may also contain a login form, which is often disguised as an error page. Using web shells, adversaries can modify the .htaccess file (on servers running the Apache HTTP Server software) on web servers to redirect search engine requests to the web page with malware or spam. Often web shells detect the user-agent and the content presented to the search engine spider is different from that presented to the user's browser. To find a web shell a user-agent change of the crawler bot is usually required. Once the web shell is identified, it can be deleted easily.

Analyzing the web server's log could specify the exact location of the web shell. Legitimate users/visitor usually have different user-agents and referers (referrers), on the other hand, a web shell is usually only visited by the attacker, therefore have very few variants of user-agent strings.

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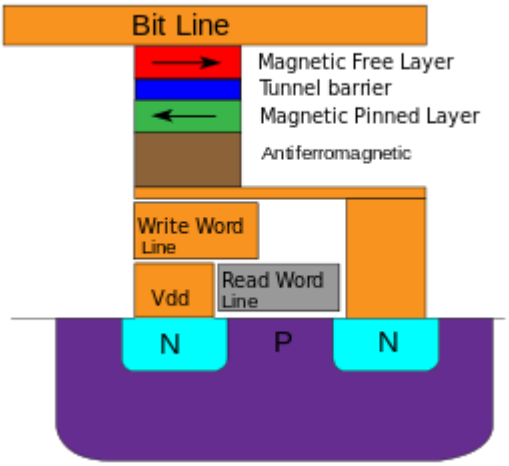
MRAM(MAGNETORESISTIVE RAM)

Magnetoresistive Random-Access Memory (MRAM) is a type of non-volatile random-access memory which stores data in magnetic domains. Magnetoresistive RAM will eventually surpass competing technologies to become a dominant or even universal memory. Currently, memory technologies in use such as

flash RAM and DRAM have practical advantages that have so far kept MRAM in a niche role in the market. MRAM is in production by Everspin Technologies, and other companies, including Global Foundries, Avalanche Technology, Sony, and Samsung Electronics, have announced production plans.

Unlike conventional RAM chip technologies, data in MRAM is not stored as electric charge or current flows, but by magnetic storage elements. The elements are formed from two ferromagnetic plates, each of which can hold a magnetization, separated by a thin insulating layer. One of the two plates is a permanent magnet set to a particular polarity, the other plate's magnetization can be changed to match that of an external field to store memory. This configuration is known as a magnetic tunnel junction and is the simplest structure for an MRAM bit. A memory device is built from a grid of such cells.



The simplest method of reading is accomplished by measuring the electrical resistance of the cell. A particular cell is (typically) selected by powering an associated transistor that switches current from a supply line through the cell to ground. Because of tunnel magnetoresistance, the electrical resistance of the cell changes with the relative orientation of the magnetization in the two plates. By measuring the resulting current, the resistance inside any particular cell can be determined, and from this the magnetization polarity of the writable plate. Typically if the two plates have the same magnetization alignment (low resistance state) this is considered to mean "1", while if the alignment is antiparallel the resistance will be higher (high resistance state) and this means "0".

Data is written to the cells using a variety of means. In the simplest "classic"

design, each cell lies between a pair of write lines arranged at right angles to each other, parallel to the cell, one above and one below the cell. When current is passed through them, an induced magnetic field is created at the junction, which the writable plate picks up. This pattern of operation is similar to magnetic-core memory, a system commonly used. This approach requires a fairly substantial current to generate the field, however, which makes it less interesting for low-power uses, one of MRAM's primary disadvantages. Additionally, as the device is scaled down in size, there comes a time when the induced field overlaps adjacent cells over a small area, leading to potential false writes. This problem, the half-select (or write disturb) problem, appears to set a fairly large minimal size for this type of cell. One experimental solution to this problem was to use circular domains written and read using the giant magnetoresistive effect, but it appears that this line of research is no longer active.

A newer technique, Spin-Transfer Torque (STT) or spin-transfer switching, uses spin-aligned ("polarized") electrons to directly torque the domains. Specifically, if the electrons flowing into a layer have to change their spin, this will develop a torque that will be transferred to the nearby layer. This lowers the amount of current needed to write the cells, making it about the same as the read process. There are concerns that the "classic" type of MRAM cell will have difficulty at high densities because of the amount of current needed during writes, a problem that STT avoids. For this reason, the STT proponents expect the technique to be used for devices of 65 nm and smaller. The downside is the need to maintain the spin coherence. Overall, the STT requires much less write current than conventional or toggle MRAM. Research in this field indicates that STT current can be reduced up to 50 times by using a new composite structure. However, higher-speed operation still requires higher current.

The potential arrangements include Thermal-Assisted Switching" (TAS-MRAM), which briefly heats up (reminiscent of phase-change memory) the magnetic tunnel junctions during the write process and keeps the MTJs stable at a lower temperature the rest of the time and "Vertical Transport MRAM" (VMRAM), which uses current through a vertical column to change magnetic orientation, a geometric arrangement that reduces the write disturb problem and so can be used at higher density.

Features of MRAM

Density

The main determinant of a memory system's cost is the density of the components used to make it up. Smaller components, and fewer of them, mean that more "cells" can be packed onto a single chip, which in turn means more can be produced at once from a single

silicon wafer. This improves yield, which is directly related to cost.

DRAM uses a small capacitor as a memory element, wires to carry current to and from it, and a transistor to control it – referred to as a "1T1C" cell. This makes DRAM the highest-density RAM currently available, and thus the least expensive, which is why it is used for the majority of RAM found in computers. MRAM is physically similar to DRAM in makeup, and often does require a transistor for the write operation (though not strictly necessary). The scaling of transistors to higher density necessarily leads to lower available current, which could limit MRAM performance at advanced nodes.

Power consumption

Since the capacitors used in DRAM lose their charge over time, memory assemblies that use DRAM must refresh all the cells in their chips 16 times a second, reading each one and re-writing its contents. As DRAM cells decrease in size it is necessary to refresh the cells more often, resulting in greater power consumption. In contrast, MRAM never requires a refresh. This means that not only does it retain its memory with the power turned off but also there is no constant power-draw. While the read process in theory requires more power than the same process in a DRAM, in practice the difference appears to be very close to zero. However, the write process requires more power to overcome the existing field stored in the junction, varying from three to eight times the power required during reading. Although the exact amount of power savings depends on the nature of the work more frequent writing will require more power in general MRAM proponents expect much lower power consumption (up to 99% less) compared to DRAM. STT-based MRAMs eliminate the difference between reading and writing, further reducing power requirements.

It is also worth comparing MRAM with another common memory system flash RAM. Like MRAM, flash does not lose its memory when power is removed, which makes it very common in applications requiring persistent storage. When used for reading, flash and MRAM are very similar in power requirements. However, flash is re-written using a large pulse of voltage (about 10 V) that is stored up over time in a charge pump, which is both power-hungry and time-consuming. In addition, the current pulse physically degrades the flash cells, which means flash can only be written to some finite number of times before it must be replaced.

In contrast, MRAM requires only slightly more power to write than read, and no change in the voltage, eliminating the need for a charge pump. This leads to much faster operation, lower power consumption, and an indefinitely long lifetime.

Data retention

MRAM is often touted as being a non-volatile memory. However, the current mainstream high-capacity MRAM, spin-transfer torque memory, provides improved retention at the cost of higher power consumption, *i.e.*, higher write current. In particular, the critical (minimum) write current is directly proportional to the thermal stability factor Δ. The retention is in turn proportional to exp(Δ). The retention, therefore, degrades exponentially with reduced write current.

Speed

Dynamic Random-Access Memory (DRAM) performance is limited by the rate at which the charge stored in the cells can be drained (for reading) or stored (for writing). MRAM operation is based on measuring voltages rather than charges or currents, so there is less settling time needed. IBM researchers have demonstrated MRAM devices with access times on the order of 2 ns, somewhat better than even the most advanced DRAMs built on much newer processes. A team at the German Physikalisch-Technische Bundesanstalt have demonstrated MRAM devices with 1 ns settling times, better than the currently accepted theoretical limits for DRAM, although the demonstration was a single cell. The differences compared to flash are far more significant, with write speeds as much as thousands of times faster. However, these speed comparisons are not for like-for-like current. High-density memory requires small transistors with reduced current, especially when built for low standby leakage. Under such conditions, write times shorter than 30 ns may not be reached so easily. In particular, to meet solder reflow stability of 260 °C over 90 seconds, 250 ns pulses have been required. This is related to the elevated thermal stability requirement driving up the write bit error rate. In order to avoid breakdown from higher current, longer pulses are needed.

For the perpendicular STT MRAM, the switching time is largely determined by the thermal stability Δ as well as the write current. A larger Δ (better for data retention) would require a larger write current or a longer pulse. A combination of high speed and adequate retention is only possible with a sufficiently high write current.

The only current memory technology that easily competes with MRAM in terms of performance at comparable density is static random-access memory (SRAM). SRAM consists of a series of transistors arranged in a flip-flop, which will hold one of two states as long as power is applied. Since the transistors have a very low power requirement, their switching time is very low. However, since an SRAM cell consists of several transistors, typically four or six, its density is much lower than DRAM. This makes it expensive, which is

why it is used only for small amounts of high-performance memory, notably the CPU cache in almost all modern central processing unit designs.

Although MRAM is not quite as fast as SRAM, it is close enough to be interesting even in this role. Given its much higher density, a CPU designer may be inclined to use MRAM to offer a much larger but somewhat slower cache, rather than a smaller but faster one. It remains to be seen how this trade-off will play out in the future.

Endurance

The endurance of MRAM is affected by write current, just like retention and speed, as well as read current. When the write current is sufficiently large for speed and retention, the probability of MTJ breakdown needs to be considered. If the read current/write current ratio is not small enough, read disturb becomes more likely, i.e., a read error occurs during one of the many switching cycles. The read disturb error rate is given by $1 - \exp(-(t_{read}/\tau)/\exp(\Delta(1-(I_{read}/I_{crit}))))$, where τ is the relaxation time (1 ns) and I_{crit} is the critical write current. Higher endurance requires a sufficiently low I_{read}/I_{crit}. However, a lower I_{read} also reduces read speed.

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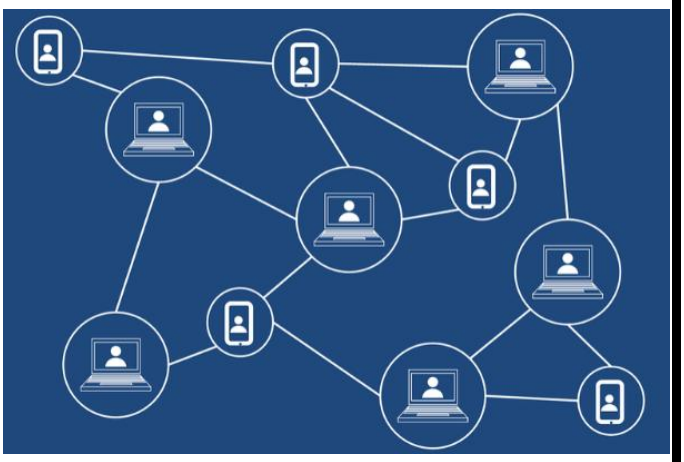
BLOCKCHAIN FOR MOBILE APP DEVELOPMENT

The promise of blockchain is realized by mobile app developers now. The blockchain can be incorporated into building mobile apps and the key considerations for doing so.



Every business niche now realises the promise of blockchain as a decentralised database. Apart from living up to its promise in securing financial transactions and preventing data breaches, blockchain is now being incorporated into all other types of applications. As mobile transactions are getting momentum for many businesses, blockchain-based mobile apps are increasingly getting popular.

The popularity is understandable with so many statistical data confirming it. By 2021, the blockchain market spending is predicted to cross $9.7 billion from just $945 million in 2017. IDC predicts that in 2018 alone spending on blockchain will be a whopping 2.1 billion. The technology will experience 42.8% growth every year until 2022. Lastly, a staggering 71%

of business leaders across niches think blockchain will be the key factor in the uplifting of technology standard.

In spite of the wide-ranging advantages, blockchain may not fit into every type of mobile app. For an app only publishing contents without any active transaction interface, blockchain may not be required at all. On the other hand, any app sporting transaction interface and payment gateways, or any app loaded with mission-critical database, needs the active support of a secure and decentralised database technology like blockchain.

In multiple ways, blockchain can be incorporated to boost the value proposition of a mobile app. It varies from so-called financial and security apps to mobile apps for manufacturing collaboration to apps for supply chain management.

Some common types of blockchain-based mobile APPs:

- An APP for exchanging cryptocurrencies can make things easier for asset traders and miners. Like stock market apps, such cryptocurrency apps allow you to have total control over your digital assets and trade with them. Cryptocurrencies that are powered by blockchain can be used for all sorts of payment and transactions through such apps.
- Electronic wallet apps that can store your digital assets and money and allow you to spend on transactions involve blockchain technology.
- There can also be digital asset tracker apps to provide you updated information about the rates, cryptocurrency trades, market dynamics and a portfolio of various cryptocurrencies.
- Retail apps allowing its customers to pay through bitcoin or other based cryptocurrencies is another type of blockchain-based app.
- Smart contract or self-executable protocols that respond automatically to some predetermined triggers is another facet of blockchain that can be used in mobile apps for driving automation.

Key technology considerations

Incorporating blockchain into mobile apps requires an in-depth understanding of the technology and the variety of constituents like the network, blockchain platforms, programming languages, various processes like back-end, front-end, and quality assurance for different mobile platforms, etc.

Key considerations to incorporate Blockchain into mobile APPs

- As for network options, you have two broad choices such as permissionless blockchain network that supports

Bitcoin, Ethereum, etc. and permissioned blockchain network supporting platforms like Multichain. The first one boasts of wider and unrestrained access, while the second one is a closed network ruled by accessibility constraints and regulations.

- There are two broader categories of blockchain-based apps, respectively as apps for cryptocurrency and apps for smart contracts.
- The mobile app developers also need to choose between 25 blockchain platforms including both open-source and public platforms, as well as private platforms.
- Apart from traditional programming languages like Java, C++, Python, etc., the developers can also opt for advanced blockchain-specific languages like Simplicity and Solidity.

Steps to implement Blockchain

When the objective of implementing blockchain for your app and respective benefits are clear, and when you are over with the key considerations mentioned above, we can proceed to the practical steps of blockchain-based mobile app development.

Choose the suitable consensus-based method

As of now, you must have known that a mutual consensus mechanism ensures the unconditional accessibility and security of blockchain. Need to choose a particular consensus method that suits your app character best. Some of the common alternatives are Proof of Work, Proof of Elapsed Time, Proof of Stake, Round Robin, etc. You need to select a method based on your app requirement.

DesignArchitecture

Need to choose a configuration for the design architecture. You can host blockchain with the cloud-based, hybrid, or in-house model. Now you have an array of options for configuration relating to the processor, operating system, disk size, and memory. The design architecture should be chosen based on the mobile OS platform you are developing the app for.

UI and Admin panel Design

Finally, need to develop the app UI and admin panel of the blockchain app. This is achieved by using a front-end programming language, an external database, and designated app servers. After soft-launching the app by using the console, you need to connect it with analytics.

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COGNITIVE COMPUTING

Cognitive computing (CC) describes technology platforms that, broadly speaking, are based on the scientific disciplines of artificial intelligence and signal processing. These platforms encompass machine learning, reasoning, natural language processing, speech recognition and vision (object recognition), human–computer interaction, dialog and narrative generation, among other technologies.

In general, the term cognitive computing has been used to refer to new hardware and/or software that mimics the functioning of the human brain and helps to improve human decision-making. Cognitive Computing is a new type of computing with the goal of more accurate models of how the human brain/mind senses, reasons, and responds to stimulus. CC applications link data analysis and adaptive page displays (AUI) to adjust content for a particular type of audience. As such, CC hardware and applications strive to be more affective and more influential by design.

Adaptive

To learn as information changes and as goals and requirements evolve. They may resolve ambiguity and tolerate unpredictability. They may be engineered to feed on dynamic data in real time or near real time.

Interactive

To interact easily with users so that those users can define their needs comfortably. They may also interact with other processors, devices, and cloud services, as well as with people.

Iterative and Stateful

To define a problem by asking questions or finding additional source input if a problem statement is ambiguous or incomplete. They may remember previous interactions in a process and return information that is suitable for the specific application at that point in time.

Contextual

To understand, identify and extract contextual elements such as meaning, syntax, time, location, appropriate domain, regulations, user's profile, process, task and goal. It may draw on multiple sources of information, including both structured and unstructured digital information, as well as sensory inputs (visual, gestural, auditory or sensor-provided).

Cognitive Analytics

Cognitive computing-branded technology platforms typically specialize in the processing and analysis of large, unstructured datasets. Word processing documents, emails, videos, images, audio files, presentations, webpages, social media and many other data formats often need to be manually tagged with metadata before they can be fed to a computer

for analysis and insight generation. The benefit of utilizing cognitive analytics over traditional big data analytics is that such datasets do not need to be pre-tagged.

Other characteristics of a cognitive analytics system include:

- Adaptability: cognitive analytics systems can use machine learning to adapt to different contexts with minimal human supervision
- Natural language interaction: cognitive analytics systems can be equipped with a chatbot or search assistant that understands queries, explains data insights and interacts with humans in natural language.

Applications

Education

Even if Cognitive Computing cannot take the place of teachers, it can still be a heavy driving force in the education of students. Cognitive Computing being used in the classroom is applied by essentially having an assistant that is personalized for each individual student. This cognitive assistant can relieve the stress that teachers face while teaching students, while also enhancing the student's learning experience overall. Teachers may not be able to pay each and every student individual attention, this being the place that cognitive computers fill the gap. Some students may need a little more help with a particular subject. For many students, Human interaction between student and teacher can cause anxiety and can be uncomfortable. With the help of Cognitive Computer tutors, students will not have to face their uneasiness and can gain the confidence to learn and do well in the classroom.. While a student is in class with their personalized assistant, this assistant can develop various techniques, like creating lesson plans, to tailor and aid the student and their needs.

Healthcare

Numerous tech companies are in the process of developing technology that involves Cognitive Computing that can be used in the medical field. The ability to classify and identify is one of the main goals of these cognitive devices. This trait can be very helpful in the study of identifying carcinogens. This cognitive system that can detect would be able to assist the examiner in interpreting countless numbers of documents in a lesser amount of time than if they did not use Cognitive Computer technology. This technology can also evaluate information about the patient, looking through every medical record in depth, searching for indications that can be the source of their problems.

Industry work

Cognitive Computing in conjunction with big data and algorithms that comprehend customer needs, can be a major advantage in

economic decision making. The powers of Cognitive Computing and AI hold the potential to affect almost every task that humans are capable of performing. It would also increase the inequality of wealth; the people at the head of the Cognitive Computing industry would grow significantly richer, while workers without ongoing, reliable employment would become less well off.

The more industries start to utilize Cognitive Computing, the more difficult it will be for humans to compete. Increased use of the technology will also increase the amount of work that AI-driven robots and machines can perform. Only extra ordinarily talented, capable and motivated humans would be able to keep up with the machines. The influence of competitive individuals in conjunction with AI/CC with has the potential to change the course of humankind.

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FUNCTIONAL PROGRAMMING

Introduction

Functional programming is a programming paradigm in which we try to bind everything in pure mathematical functions style. It is a declarative type of programming style. Its main focus is on "what to solve" in contrast to an imperative style where the main focus is "how to solve". It uses expressions instead of statements. An expression is evaluated to produce a value whereas a statement is executed to assign variables. Those functions have some special features discussed below.

Functional Programming is based on Lambda Calculus: Lambda calculus is framework developed by Alonzo Church to study computations with functions. It can be called as the smallest programming language of the world. It gives the definition of what is computable. Anything that can be computed by lambda calculus is computable. It is equivalent to Turing machine in its ability to compute. It provides a theoretical framework for describing functions and their evaluation. It forms the basis of almost all current functional programming languages. **Programming Languages that support functional programming:** Haskell, JavaScript, Scala, Erlang, Lisp, ML, Clojure, OCaml, Common Lisp, Racket.

Concepts of functional programming:

- Pure functions
- Recursion
- Referential transparency
- Functions are First-Class and can be Higher-Order
- Variables are Immutable

Pure functions

These functions have two main properties. First, they always produce the same output for same arguments irrespective of anything. Secondly, they have no side-effects i.e. they do modify any argument or global variables or output something. Later property is called immutability. The pure functions only result is the value it returns. They are deterministic. Programs done using functional programming are easy to debug because pure functions have no side effect or hidden I/O. Pure functions also make it easier to write parallel/concurrent applications. When the code is written in this style, a smart compiler can do many things it can parallelize the instructions, wait to evaluate results when need them, and memorize the results since the results never change as long as the input doesn't change. example of the pure function:

```
sum(x, y)      // sum is function taking x and y
return x + y   // returning sum of x and y
```

Recursion

There are no "for" or "while" loop in functional languages. Iteration in functional languages is implemented through recursion. Recursive functions repeatedly call themselves, until it reaches the base case. example of the recursive function:

```
fib(n)
  if (n <= 1)
    return 1;
  else
    return fib(n - 1) + fib(n - 2);
```

Referential transparency

In functional programs variables once defined do not change their value throughout the program. Functional programs do not have assignment statements. If we have to store some value, we define new variables instead. This eliminates any chances of side effects because any variable can be replaced with its actual value at any point of execution. State of any variable is constant at any instant. example:

```
x = x + 1 // this changes the value assigned to the variable x.
    // So the expression is not referentially transparent.
```

Functions are First-Class and can be Higher-Order

First-class functions are treated as first-class variable. The first class variables can be passed to functions as parameter, can be returned from functions or stored in data structures. Higher order functions are the functions that take other functions as arguments and they can also return functions. example:

```
show_output(f)
  f();          // calling passed function
```

```
print_gfg()          // declaring another function
print("hello gfg");
show_output(print_gfg)
```

Variables are Immutable

In functional programming, we can't modify a variable after it's been initialized. We can create new variables but we can't modify existing variables, and this really helps to maintain state throughout the runtime of a program. Once to create a variable and set its value, it can have full confidence knowing that the value of that variable will never change.

Advantages of Functional programming

1. Pure functions are easier to understand because they don't change any states and depend only on the input given to them. Whatever output they produce is the return value they give. Their function signature gives all the information about them i.e. their return type and their arguments.
2. The ability of functional programming languages to treat functions as values and pass them to functions as parameters make the code more readable and easily understandable.
3. Testing and debugging is easier. Since pure functions take only arguments and produce output, they don't produce any changes don't take input or produce some hidden output. They use immutable values, so it becomes easier to check some problems in programs written uses pure functions.
4. It is used to implement concurrency/parallelism because pure functions don't change variables or any other data outside of it.
5. It adopts lazy evaluation which avoids repeated evaluation because the value is evaluated and stored only when it is needed.

Disadvantages

1. Sometimes writing pure functions can reduce the readability of code.
2. Writing programs in recursive style instead of using loops can be bit intimidating.
3. Writing pure functions are easy but combining them with rest of application and I/O operations is the difficult task.
4. Immutable values and recursion can lead to decrease in performance.

Applications

- It is used in mathematical computations.
- It is needed where concurrency or parallelism is required.

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FIVE PEN PC TECHNOLOGY

5 pen technology is a recent discovery in the field of pen computing. Pen computing is a field that outlines computer like user interface that makes use of pen like devices that will be convenient to use in comparison to contemporary systems (such as laptops, desktops etc.). 5 Pen PC technology consists of 5 pen like devices which are used for providing functions of a CPU, a projector, a virtual keyboard, a camera, and communication functions of a cellular phone. P-ISM's are connected with one another through short-range wireless technology. Pen-style Personal Networking Gadget is computers in the shape of different pens each having a function of its own and when combined together give us the usage of a full-blown computer. Keyword: P-ISM, pen computing, Bluetooth, virtual keyboard, CPU pen, camera, Battery.

- P-ISM is a gadget package including five functions: a pen-style cellular phone with a handwriting data input function, virtual keyboard, a very small projector, camera scanner, and personal ID key with cashless pass function. P-ISMs are connected with one another through short-range wireless technology. Use of pen and paper to send SMSs, e-mails and surf Internet didn't seem feasible. However, the introduction of Pen-style Personal Networking Gadget i.e. P-ISM has made things easier and convenient. These are computers in the shape of different pens each where-in each has a function of its own, but when combined together, they give us the usage of a complete computer in an easy and compact manner.

COMPONENTS OF PISM

The five components of PISM:

- CPU Pen
- Communication Pen
- Virtual Keyboard
- LED Projector
- Digital Camera

CPU PEN

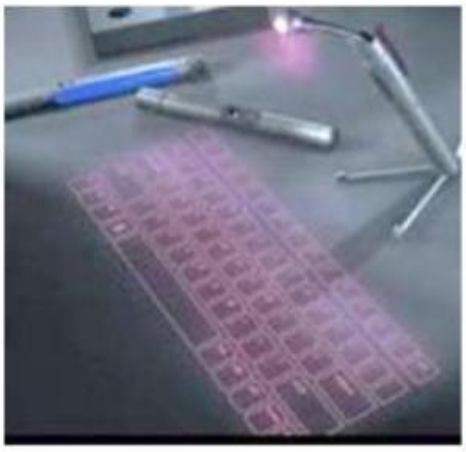
The functionality of CPU is done by one of the pens. It is also called computing engine. It consists of dual core processor embedded in it and it works with WINDOWS operation system. The central processing unit (CPU) is the portion of a computer system that carries out the instructions of a computer program, and is the primary element carrying out the computer's functions. The central processing unit carries out each instruction of the program in sequence, to perform the basic arithmetical, logical, and input/output operations of the system. OS is already preloaded in this pen and it cannot be altered. It works with Windows OS and is embedded with a dual core micro-processor chip

COMMUNICATON PEN

- Cell phone, pressure sensitive, pointer and earpiece, pointing device Communication Pen. As the name suggests this component facilitates communication between all the pens. This pen has inbuilt cellular phone function which enables it to connect. P-ISMs are connected with one another through short-range wireless technology. The whole set is also connected to the Internet through the cellular phone function. They are connected through Tri-wireless modes (Blue tooth, 802.11B/G, and Cellular) which are made small and kept in a small pen like device. It is a pointing device that will provide functions similar to a mouse. This pen will help the user to interact with information that is projected by the projector pen.

VIRTUAL KEYBOARD

Emits laser on to the desk where it looks like the keyboard having QWERTY arrangement of keys.Virtual Keyboard(VKB) Pen. This pen functions similar to the LED projector pen. The laser pen emits a laser keyboard on a flat surface which looks like the keyboard is having an arrangement of QWERTY. It generate a full-size perfectly operating laser keyboard that smoothly connects to PC and most of the handheld devices. As to type on the laser projection, it analyses what we are typing according to the co-ordinates of the location. Virtual keyboard is a software component that allows a user to enter characters. A virtual keyboard can usually be operated with multiple input devices, which may include a touch screen, an actual keyboard, a computer mouse, a head mouse and an eye mouse.



LED PROJECTOR

The role of monitor is taken by LED Projector which projects on the screen. The role of monitor is taken by LED Projector which projects on the screen. The size of the

projector is of A4 size. It has the approximate resolution capacity of 1024 X 768. Thus it gives more clarity and good picture. A video projector is a device that receives a video signal and projects the corresponding image on a projection screen using a lens system. All video projectors use a very bright light to project the image, and most modern ones can correct any curves, blurriness, and other inconsistencies through manual settings. Video projectors are widely used for conference room presentations, classroom training and home theatre.

DIGITAL CAMERA

It is useful in video recording, video conferencing, simply it is called as web cam. This terminal will enable us to know about the surrounding atmosphere and group to group communication with a round display and a central super wide angle camera. This terminal enables showing of the surrounding atmosphere and group-to-group communication with a round display and a central super-wide angle camera. Digital cameras can do things film cameras cannot displaying images on a screen immediately after they are recorded, storing thousands of images on a single small memory device, and deleting images to free storage space. The majority, including most compact cameras, can record moving video with sounds well as still photographs. Some can crop and stitch pictures and performs other elementary image editing. Some have a GPS receiver built in, and can produce Geo-tagged photographs.

BATTERY

The most important part in the portable type of computer is its battery. Usually batteries must be small in size and work for longer time. It comes with a battery life of 6+. For normal use it can be used for 2 weeks. This 'pen sort of instrument' produces both the monitor as well as the keyboard on any flat surfaces from where you can carry out functions you would normally do on your desktop computer.

Advantages

- Portable Feasible Ubiquitous
- Makes use of Wi-Fi technology
- Mobility
- Touch and feel the technology
- It supports wireless technologies

Disadvantages

- It works on wireless technologies and therefore it has limitations of range.
- It is exorbitantly expensive.

- One of the components can be easily misplaced.
- Projection surface should be flat for optimum usage.

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EVERYONE SHOULD HAVE THE OPPORTUNITY TO LEARN COMPUTER SCIENCE AT SCHOOL AND BEYOND

- SUNDAR PICHAI