



BEES Magazine

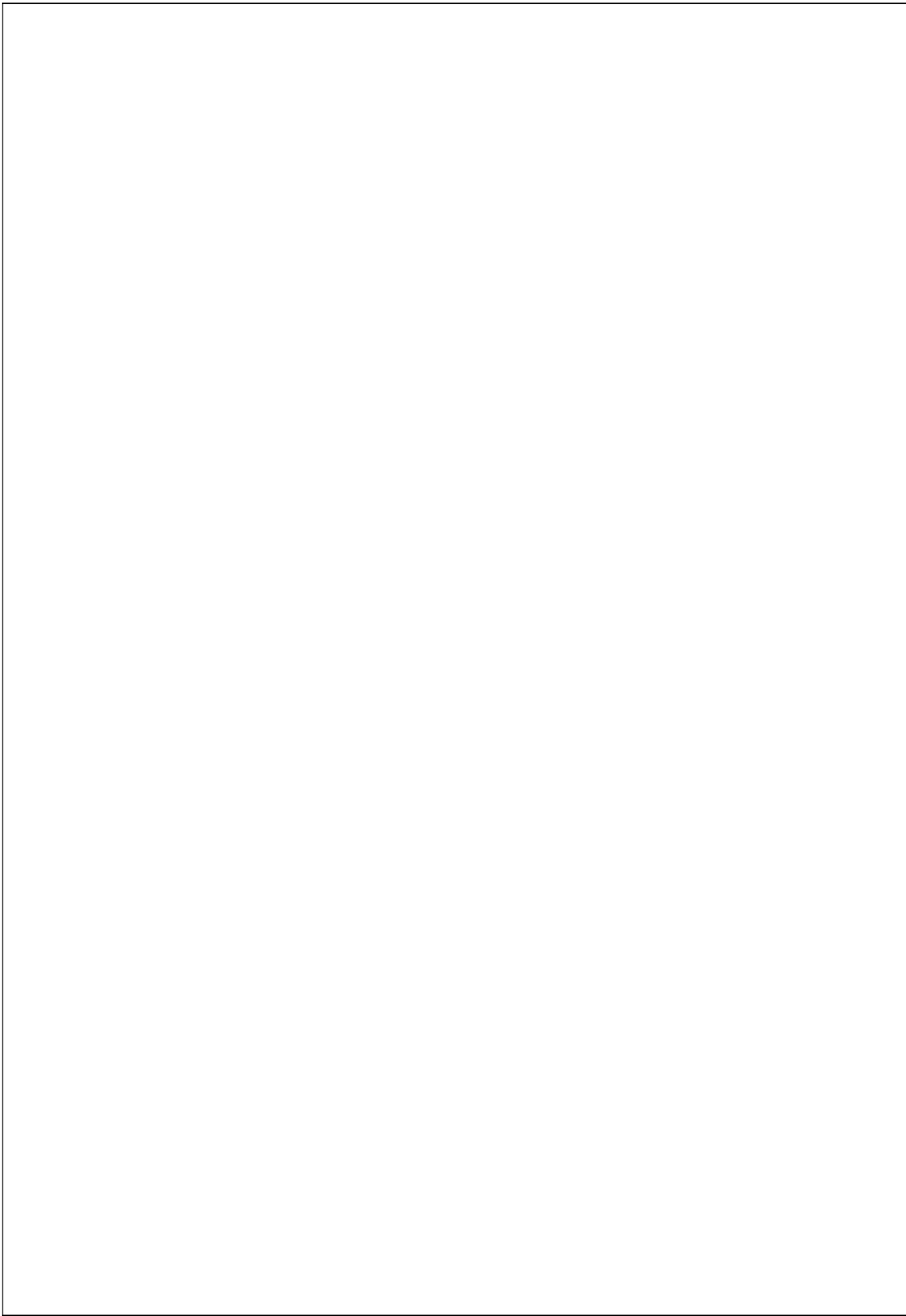
August 2017



K S R Institute for
Engineering and
Technology

Department of
Electrical and
Electronics
Engineering





BEEES Magazine

Together We Make Difference

August 2017

Contents

S. No	Topic & Author(s)	Page No
1	Wearable Technology : Protecting the Future in Electronic Developments <i>Preetha.E, Kanimozhi.V</i>	1
2	Paper Battery <i>Veerakumar B, Tharun N</i>	4
3	Fuel Cell <i>Gowrishankar S, Venkateshwaran M</i>	7
4	3G Vs. Wi-Fi <i>Hagasthiya R J, Gayathri K</i>	11
5	Gesture Recognition Technology <i>Hariharan R, Karthi K</i>	13
6	Cloud Computing <i>Vignesh P, Rajkumar G K</i>	17
7	Understanding of Arduino <i>Thiyagarajan S, Praveen Kumar M</i>	21
8	Audio Electronics: Sound, Microphones, Speakers, and Amplifiers <i>Ranjith T, Karthik T M</i>	23

Editorial Board

Student Incharges

Rokeshkumar S IV year

Arunkumar C III Year

Faculty Incharge

Mr. P.Krishnakumar

Assistant Professor / EEE

Wearable Technology

Protecting the Future in Electronic Developments

*PREETHA.E,
II year EEE*

*KANIMOZHI.V
II year EEE*

Introduction

"Wearable" – a term that was predominantly associated with the clothing industry is now trending for a whole new reason. Harnessing the electronic functions used in everyday life and incorporating them into devices and accessories that can comfortably be worn on the body, is leading us into the era of wearables,

Everyone is talking about wearable technology and with such a wide scope of applications and products the industry is expected to see another large growth in 2015. In fact, for 2014, the wearables market was forecast to be worth over £300m within the UK market; the second highest prediction in Europe after Germany. The developments are continuing at a rapid rate too, with predictions such as this one by Gartner, that by as soon as 2017, 30% of wearable devices will be completely unobtrusive to the eye.



In all types of use, the technology is designed to make us more efficient; in business, the ongoing development of smart watches for example, will allow multi-tasking, process tracking

and increased involvement during travel and when on the move. In our personal lives, devices such as health bands and fitness trackers will help us to understand our everyday activities better in order to improve our health. There are also a number of new developments taking place, showing the use of wearable technology in different industries. For example, within the fashion industry companies such as Cute Circuit are designing interactive clothing where the colour or design can be controlled via smart phone apps or twitter feeds. Utilising such technology within clothing has also expanded further into high visibility or safety accessories by companies such as Visijax.

Analysis and research are also key factors within the wearable technologies industry. In sport, there are seemingly endless possibilities to analyse and improve one's game. Whether it be via the use of Google Glass to aid performance within the sport, navigate a route and send a message during training or by the use of many other sensor based devices that can analyse technique, speed or posture for example; wearable technology provides the opportunity to develop and improve at a much faster rate. In the medical industry the ability to analyse and treat patients using wearable technology is also offering new avenues of research and is extending into ingestible devices. It is clear that the applications that can develop within this field are seemingly endless.

The technologies that such wearable devices are utilising are already common place, however and are being adapted for their use in new

applications. For example, the devices usually have to connect to a smart phone or computer in order to relay information or data. As a result, the wearable devices may have wireless or Bluetooth connectivity or as with navigation devices, may incorporate GPS. In addition, a number of applications for wearable technology may use sensors to detect a specific change (which is dependent on the nature of the sensor) and provide an output which again may be transferred to a separate receiver.



Alongside the challenge of actually designing a functioning device, the challenge that wearable technology poses is the nature in which this technology will be used and primarily, the environments that the device may be used in. For instance, a temperature sensor on a static device will have to withstand the temperatures within that environment and any thermal shock or cycling that may take place. A temperature sensor in a wearable device has the added consideration of physical interactions; the device will be moved, worn, may see impact, may be flexed and potentially exposed to a number of additional elements, such as water or chemicals, for example. It is therefore imperative that these devices are protected accordingly to ensure reliable performance when utilised in their end-use environments.

Protection can be provided in the form of encapsulation resins or conformal coatings, for example. The variety of potential applications can

also generate another challenge in selecting the most suitable protection compound. As we have already concluded, the wearable device is likely to use some form of connectivity, whether it be direct to another device or system or via a sensor to record changes in information gathered. This connection to other devices will operate via radio waves and therefore any protection compound used, must allow RF signals to be transmitted without any interference. In connection with this requirement the environmental conditions and general use of the device must be considered in order to produce a full picture of its working life.

To enable a better understanding of likely performance and simplify the selection process, it is possible to draw on experience from other industries and technologies. For instance, if we think of a wearable device that can be worn by a swimmer to monitor heart rate and general health when in the pool, it is immediately understood that this device must still work when immersed in water. Any changes in temperature will be minimal but quite rapid and the frequency and length of time the device could be immersed in water is unknown. It should therefore be assumed that the device is constantly operating when immersed in water. This application can be likened to that of a sonar buoy used in marine applications where sensors are utilised for providing vital information about the sea environment. In this case, the device will have to send an RF signal and operate when constantly immersed in salt water; a similar environment to that of the wearable health tracker worn by the swimmer.

We can also elaborate on the information we have already gained from other industries. For example, salt water is generally more corrosive than the water found in a swimming pool and therefore the application experience gained from

the sonar buoys will show the performance of a device protected with a suitable compound, such as Electrolube UR5041, in a similar but more aggressive environment. This is obviously just one example of many different considerations; the degree of flex and toughness of the device, the operating temperature range and the possibility of any chemicals coming into contact with the device are all possible factors to take into account during the selection process. Thinking about all of these properties and not forgetting the need to allow connectivity via RF signals, there are many properties such as the dielectric constant, salt mist resistance, shore hardness and elongation at break that can be used to find the optimal product for in-use testing.



Although this information may seem somewhat vague, it is clear that each application will have its own criteria in terms of performance, environment and expected use and in all cases, a reliable and accurate response is required from the wearable device. An example of application requirements is given in the “Sudden Impact” wearable device challenge being conducted by Element 14 where Electrolube are one of the

industry partners. The challenge is to develop a wearable device for athletes that provides vital health information to increase safety on the field and monitor the condition of athletes in real-time, thus reducing sports related injuries. In this case, we know that the device will have to be protected from shock, potentially water or other pollutants and allow wireless connectivity. As with all wearable devices, there is the possibility that LEDs or displays may be present and therefore the protection offered will need to be clear and maintain its clarity over time. By working through these parameters with an electro-chemical manufacturer, such as Electrolube, it is possible to quickly find the most suitable solution for the application and therefore ensure the performance of the wearable device during its working life.

Whatever the application, the wearables market is definitely a hot topic. Some say that 2015 is the year of the wearable, where others feel there is still more work to be done. A large number of devices are still in their testing phase and performance, benefits of use and long term reliability need to be confirmed. The concept and new developments in this field are what will continue in the future and with the variety of devices possible will come the vast array of requirements which will define the need for suitable protection medium. Wearable technology is designed with the intention to make everyday tasks easier and more accessible. It will encourage different methods of interaction and communication, again increasing our mobility within the electronic world and thus shall further enhance relationships and collaborations in this field.

Paper Battery

VEERAKUMAR B,
III year EEE

THARUN N
III year EEE

Introduction

Electronic devices and gadgets require a power supply (either AC or DC), this power supply can be taken directly from the mains power supply or from the electrical batteries. The battery can be defined as an electronic device comprised of (one or more) electrochemical cells. The chemical energy of the electrochemical cells can be converted into electrical energy. Based on different criteria batteries are classified into various types such that based on rechargeable condition they are classified as rechargeable batteries and non-rechargeable batteries. The advancement in technology developed environmentally friendly and more flexible batteries such as paper batteries. In this article, let us discuss about paper battery construction and working. But, primarily, we must know what a paper battery is.

Paper Battery



Paper Battery

The flexible and thin energy storage device which can be used as a battery is called as paper battery. This paper battery can also be used as a capacitor. This battery can be produced by merging the

nanotubes (made using carbon) and nano-composite paper (made using cellulose). The paper battery consists of property of a battery – high-energy storage capacity and property of super capacitor – high-energy density and thus, produces extreme power.

Paper Battery Construction

The major components used for the construction of paper battery include:

- Carbon Nanotube (CNT) used for cathode terminal
- Lithium metal (Li+) used for anode terminal
- Different types of electrolytes that include blood, urine, and sweat (which are termed as bio-electrolytes)
- Paper (Cellulose-Separator)

7-Simple Steps for the Construction of Paper Battery

Step 1: Take a cellulose-based paper and apply black carbon ink on it

Step2: Spread this ink applied on the paper

Step3: After spreading ink, laminate a thin film over the cellulose surface

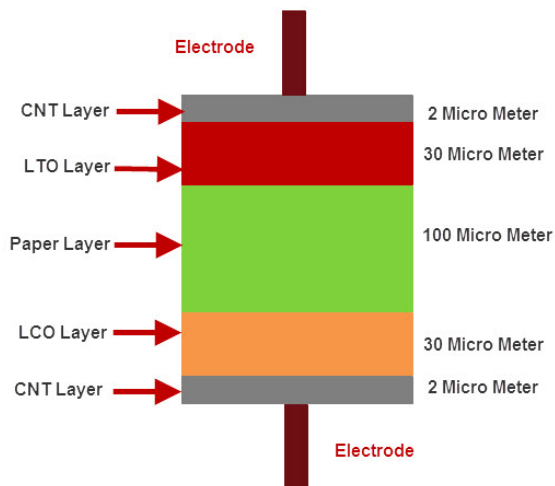
Step4: Heat the cellulose paper for 5min at 80 degrees C

Step5: Then, peel off the film from the substrate

Step6: The electrodes of paper battery are formed by film. The electrolytes LTO and LCO are connected to different films

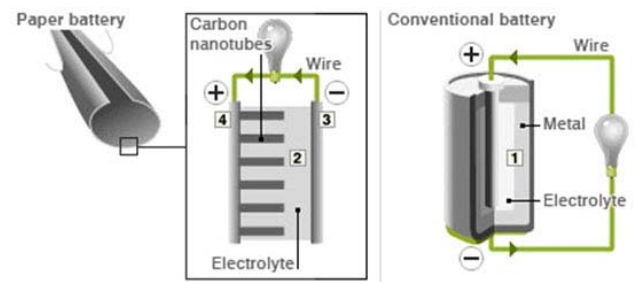
Step7: The functioning of paper battery can be checked by connecting battery terminals to the LED

Paper Battery Structure



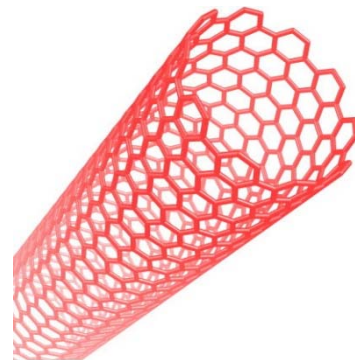
Paper Battery Working

The conventional rechargeable batteries which we use in our day-to-day life consist of various separating components which are used for producing electrons with the chemical reaction of a metal and electrolyte. If once the paper of the battery is dipped in ion-based liquid, then the battery starts working i.e., electricity is generated by the movement of electrons from cathode terminal to anode terminal. This is due to the chemical reaction between the electrodes of paper battery and liquid. Due to the quick flow of the ions within a few seconds (10sec) energy will be stored in the paper-electrode during the recharging. By stacking various paper-batteries up on each other, the output of the paper battery can be increased.



Paper Battery Working

As the paper batteries are connected each other very closely for increasing their output, there is chance of occurring short between the anode terminal and cathode terminal. If once the anode terminal contacts with cathode terminal, then there will be no flow of current in the external circuit. Thus, to avoid the short circuit between anode and cathode a barrier or separator is needed, which can be fulfilled by the paper separator.



Nanotubes used for Paper Battery

Paper Battery= Paper (Cellulose) + Carbon Nanotubes

The paper battery can be used for various applications as it facilitates advantages such as folding, twisting, molding, crumpling, shaping, and cutting without affecting on its efficiency. As the paper batteries are the combination of cellulose paper and carbon nanotubes, which facilitates advantages of long term usage, steady power, and

bursts of energy. These types of paper batteries are estimated to use for powering the next generation vehicles and medical devices.

Paper Battery Properties

The properties of paper battery can be recognized from the properties of cellulose such as excellent porosity, biodegradability, non-toxic, recyclability, high-tensile strength, good absorption capacity, and low-shear strength and also from the properties of carbon nanotubes such as low mass density, flexibility, high packing density, lightness, better electrical conductivity than silicon, thin (around 0.5 to 0.7mm), and low resistance.

Advantages of Paper Battery

- Unlike the conventional batteries, paper battery can be used by folding, cutting, and rolling.
- Paper battery functions as a battery as well as a capacitor.
- Paper battery is a modern storage device with ultra-thin in size.
- It has special properties such as more economical, biodegradable, and bio-compatible.
- Paper battery can generate electrical energy of 1.5V.
- The output voltage of paper battery can be customized based on requirement.

Disadvantages of Paper Battery

- The carbon nanotubes used in paper battery are very expensive.
- The paper battery wastage may damage lungs if it is inhaled.
- The e-wastage is generated by paper batteries.

Applications of Paper Battery



Paper Battery Applications

There are numerous applications for paper batteries in various fields. In electronics, paper battery is typically used in mobiles, laptops, calculators, cameras, mouse, keyboard, Bluetooth devices, and so on. Similarly, in medical sciences for artificial tissues, cosmetics, drug delivery systems, and so on. In automobiles and aircraft, paper batteries are used in hybrid vehicles because of their light weight.

Fuel Cell

GOWRISHANKAR S
IV year EEE

VENKATESHWARAN M
IV year EEE

Introduction

Through this website we are seeking historical materials relating to fuel cells. We have constructed the site to gather information from people already familiar with the technology—people such as inventors, researchers, manufacturers, electricians, and marketers. This Basics section presents a general overview of fuel cells for casual visitors.

What is a fuel cell?

A fuel cell is a device that generates electricity by a chemical reaction. Every fuel cell has two electrodes called, respectively, the anode and cathode. The reactions that produce electricity take place at the electrodes.

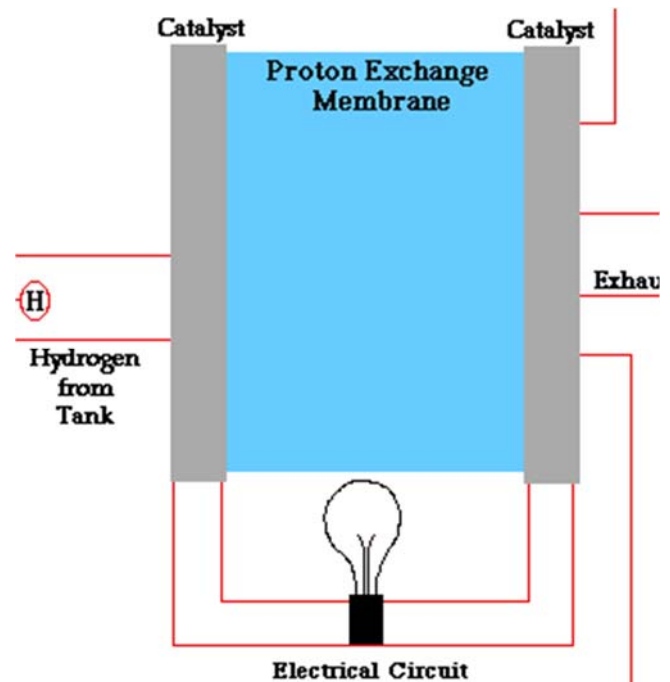
Every fuel cell also has an electrolyte, which carries electrically charged particles from one electrode to the other, and a catalyst, which speeds the reactions at the electrodes.

Hydrogen is the basic fuel, but fuel cells also require oxygen. One great appeal of fuel cells is that they generate electricity with very little pollution—much of the hydrogen and oxygen used in generating electricity ultimately combine to form a harmless byproduct, namely water.

One detail of terminology: a single fuel cell generates a tiny amount of direct current (DC) electricity. In practice, many fuel cells are usually assembled into a stack. Cell or stack, the principles are the same.

How do fuel cells work?

The purpose of a fuel cell is to produce an electrical current that can be directed outside the cell to do work, such as powering an electric motor or illuminating a light bulb or a city. Because of the way electricity behaves, this current returns to the fuel cell, completing an electrical circuit. (To learn more about electricity and electric power, visit "Throw The Switch" on the Smithsonian website Powering a Generation of Change.) The chemical reactions that produce this current are the key to how a fuel cell works.



There are several kinds of fuel cells, and each operates a bit differently. But in general terms, hydrogen atoms enter a fuel cell at the anode where a chemical reaction strips them of their electrons.

The hydrogen atoms are now "ionized," and carry a positive electrical charge. The negatively charged electrons provide the current through wires to do work. If alternating current (AC) is needed, the DC output of the fuel cell must be routed through a conversion device called an inverter.

Oxygen enters the fuel cell at the cathode and, in some cell types (like the one illustrated above), it there combines with electrons returning from the electrical circuit and hydrogen ions that have traveled through the electrolyte from the anode. In other cell types the oxygen picks up electrons and then travels through the electrolyte to the anode, where it combines with hydrogen ions. The electrolyte plays a key role. It must permit only the appropriate ions to pass between the anode and cathode. If free electrons or other substances could travel through the electrolyte, they would disrupt the chemical reaction.

Whether they combine at anode or cathode, together hydrogen and oxygen form water, which drains from the cell. As long as a fuel cell is supplied with hydrogen and oxygen, it will generate electricity.

Even better, since fuel cells create electricity chemically, rather than by combustion, they are not subject to the thermodynamic laws that limit a conventional power plant (see "Carnot Limit" in the glossary). Therefore, fuel cells are more efficient in extracting energy from a fuel. Waste heat from some cells can also be harnessed, boosting system efficiency still further.

The basic workings of a fuel cell may not be difficult to illustrate. But building inexpensive,

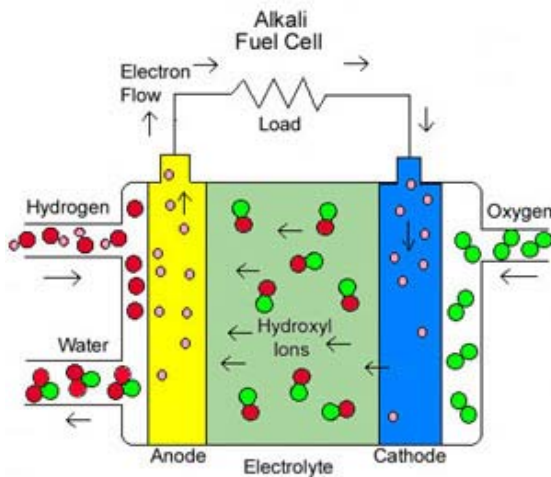
efficient, reliable fuel cells is a far more complicated business.

Scientists and inventors have designed many different types and sizes of fuel cells in the search for greater efficiency, and the technical details of each kind vary. Many of the choices facing fuel cell developers are constrained by the choice of electrolyte. The design of electrodes, for example, and the materials used to make them depend on the electrolyte. Today, the main electrolyte types are alkali, molten carbonate, phosphoric acid, proton exchange membrane (PEM) and solid oxide. The first three are liquid electrolytes; the last two are solids.

The type of fuel also depends on the electrolyte. Some cells need pure hydrogen, and therefore demand extra equipment such as a "reformer" to purify the fuel. Other cells can tolerate some impurities, but might need higher temperatures to run efficiently. Liquid electrolytes circulate in some cells, which requires pumps. The type of electrolyte also dictates a cell's operating temperature—"molten" carbonate cells run hot, just as the name implies.

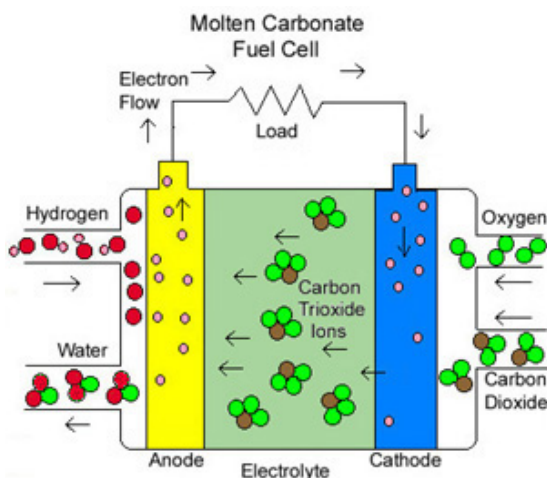
Each type of fuel cell has advantages and drawbacks compared to the others, and none is yet cheap and efficient enough to widely replace traditional ways of generating power, such coal-fired, hydroelectric, or even nuclear power plants. The following list describes the five main types of fuel cells. More detailed information can be found in those specific areas of this site.

Different types of fuel cells.



Drawing of an alkali cell.

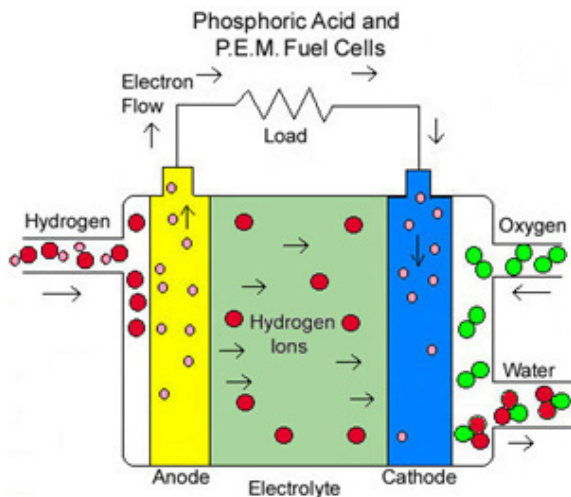
Alkali fuel cells operate on compressed hydrogen and oxygen. They generally use a solution of potassium hydroxide (chemically, KOH) in water as their electrolyte. Efficiency is about 70 percent, and operating temperature is 150 to 200 degrees C, (about 300 to 400 degrees F). Cell output ranges from 300 watts (W) to 5 kilowatts (kW). Alkali cells were used in Apollo spacecraft to provide both electricity and drinking water. They require pure hydrogen fuel, however, and their platinum electrode catalysts are expensive. And like any container filled with liquid, they can leak.



Drawing of a molten carbonate cell

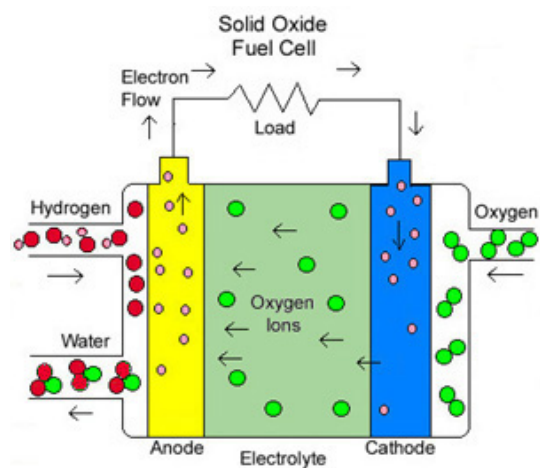
Molten Carbonate fuel cells (MCFC) use high-temperature compounds of salt (like sodium or magnesium) carbonates (chemically, CO_3) as the electrolyte. Efficiency ranges from 60 to 80 percent, and operating temperature is about 650 degrees C (1,200 degrees F). Units with output up to 2 megawatts (MW) have been constructed, and designs exist for units up to 100 MW. The high temperature limits damage from carbon monoxide "poisoning" of the cell and waste heat can be recycled to make additional electricity. Their nickel electrode-catalysts are inexpensive compared to the platinum used in other cells. But the high temperature also limits the materials and safe uses of MCFCs—they would probably be too hot for home use. Also, carbonate ions from the electrolyte are used up in the reactions, making it necessary to inject carbon dioxide to compensate.

Phosphoric Acid fuel cells (PAFC) use phosphoric acid as the electrolyte. Efficiency ranges from 40 to 80 percent, and operating temperature is between 150 to 200 degrees C (about 300 to 400 degrees F). Existing phosphoric acid cells have outputs up to 200 kW, and 11 MW units have been tested. PAFCs tolerate a carbon monoxide concentration of about 1.5 percent, which broadens the choice of fuels they can use. If gasoline is used, the sulfur must be removed. Platinum electrode-catalysts are needed, and internal parts must be able to withstand the corrosive acid.



Drawing of how both phosphoric acid and PEM fuel cells operate.

Proton Exchange Membrane (PEM) fuel cells work with a polymer electrolyte in the form of a thin, permeable sheet. Efficiency is about 40 to 50 percent, and operating temperature is about 80 degrees C (about 175 degrees F). Cell outputs generally range from 50 to 250 kW. The solid, flexible electrolyte will not leak or crack, and these cells operate at a low enough temperature to make them suitable for homes and cars. But their fuels must be purified, and a platinum catalyst is used on both sides of the membrane, raising costs.



Drawing of a solid oxide cell

Solid Oxide fuel cells (SOFC) use a hard, ceramic compound of metal (like calcium or zirconium) oxides (chemically, O_2) as electrolyte. Efficiency is about 60 percent, and operating temperatures are about 1,000 degrees C (about 1,800 degrees F). Cells output is up to 100 kW. At such high temperatures a reformer is not required to extract hydrogen from the fuel, and waste heat can be recycled to make additional electricity. However, the high temperature limits applications of SOFC units and they tend to be rather large. While solid electrolytes cannot leak, they can crack.

More detailed information about each fuel cell type, including histories and current applications, can be found on their specific parts of this site. We have also provided a glossary of technical terms—a link is provided at the top of each technology page.

3G Vs. Wi-Fi

*HAGASTHIYA R J,
III year EEE*

*GAYATHRI K
III year EEE*

Introduction

In this age of Information, various technologies are available to access the Internet, fast and uninterrupted. 3G and Wi-Fi add to this list. The write-up highlights some differentiation points between the two in detail.

Due to several advancements in Internet and telecommunication technologies, there are many modern features and facilities that are made available for laptop and mobile phone users. The use of wireless systems is on an increase for fast-paced communication, data transfer, and other online processes. Two of the primary technologies are 3G, also referred to as 3rd Generation and Wi-Fi, also known as Wireless Fidelity. Both these technologies render wireless Internet access and services to users, and can be used on devices such as laptop computers, smartphones, PDAs, and other entertainment gadgets.

What is 3G

3G i.e., Third Generation telecommunication standard for mobiles complies to the standards of IMT-2000. Its first commercial launch was in the year 2001 by NTT DoCoMo in Japan. 3G is largely used on mobile phones for purposes such as watching mobile TV, videos on demand, video calls and conferencing, etc. The activation of 3G services depends on the service provider.

What is Wi-Fi

Wi-Fi technology, also known as 802.11 standard, allows transfer of data in any form to the

other devices over the network or Internet, without any physical medium. Wi-Fi is also a wireless access standard which is used in laptop computers and smartphones with Wi-Fi facility. Wi-Fi web connection depends on the hotspots with wireless routers for Internet access within a particular range. In 1991, the technology was put to commercial use by AT&T by using it in cashier systems.

The Differences

Functioning

3G is completely provided by the service provider, whereas Wi-Fi access can be controlled by a Wi-Fi router located in a specific range from the access point. For availing Wi-Fi facility, one will have to visit a hotspot which provides a Wi-Fi zone. Today, most malls, cafes, and major streets have Wi-Fi routers for quick Internet access. For availing 3G, one needs to get in touch with one's service provider.

Signal

The 3G technology scores well over Wi-Fi with regards to signal. Since it depends on the mobile service provider, one will receive strong signals as long as one is in the network range. In case of Wi-Fi, one will be able to receive strong signals only within the range of the router situated in the hotspot.

Speed

When it comes to the speed of both these technologies, Wi-Fi is faster as compared to 3G. The maximum speed of the 'N' standard of the latest Wi-Fi technology is reported to be 600 mbps. The

data transfer speed in 3G technology differs according to the kind of device and also whether it is stationary or in motion. The maximum speed on a fixed wireless LAN is considered to be more than 2.05 mbps. However, if the reception is to be initiated on a cell phone in a moving vehicle, the speed can drop down to 128 kbps.

Cost

The cost of 3G access depends on the plan one chooses from the service provider. When it is regarding availing Wi-Fi facilities, one might have to pay the owners of the hotspots. Wi-Fi at some hotspots is free, while others may charge a certain amount. Users of the Wi-Fi facility at hotels and cafes can either pay using a credit card on a payment page hosted by appropriate authorities, or can pay in cash for getting the network access code. Some hotspots are even code free, and one can directly access the web without the access password.

Security

In terms of security, Wi-Fi is more vulnerable to fresh attacks due to its wireless nature. However, by restricting the computers that access the Wi-Fi network, one's network can be secured. On the other hand, 3G networks are more secured as they are directly linked to the service provider. They use ciphers for protection like the KASUMI block cipher.

Mobility

3G being provided by the service provider has better mobility because it can be used wherever the service provider has coverage. On the other hand, Wi-Fi mobility is limited due to its restriction to the vicinity to hotspots.

Power Consumption

3G uses more power, almost four to five times more power per byte than Wi-Fi. This makes 3G usage on the cellphones not viable when accessing large chunks of data, as one is bound to lose battery power. On the other hand, Wi-Fi has the advantage of being used indoors as well, making it the better option for accessing large chunks of data.

Bandwidth

Wi-Fi offers a larger bandwidth than 3G, making it more stable in terms of its speed. Due to its relatively smaller bandwidth, 3G speeds generally fluctuate. These fluctuations can make user experience bad.

Accessories

3G technology comes as an inbuilt feature in the PDAs or smartphones, but the case is not true with Wi-Fi. For using Wi-Fi, one has to have wireless access point (WAP) devices that allow other computers and phones to connect to the Internet via the Wi-Fi. This makes Wi-Fi enabled devices, more stationary.

Uses

3G enabled phones can be used in the same manner the ordinary phones are used, with the added advantage of video and voice content transmission. On the other hand, Wi-Fi connects faster to the Internet and also to the other computers in the network, making it faster than the Bluetooth technology.

This is some general information on 3G vs. Wi-Fi. When it comes to 3G and Wi-Fi, one needs to choose the technology according to one's needs.

Gesture Recognition Technology

HARIHARAN R
II year EEE

KARTHI K
II year EEE

INTRODUCTION

Computers have now become an integral part of our lives and hence their usage should be as trouble-free as talking to someone is. Earlier the way humans interacted with this smart machine was either through keyboard or a mouse. But now attempts are being made to make the man-machine interaction as natural as possible. Fulfilling this requirement is the popular touch screen technology which is soon expected to be replaced by the gesture recognition technology.

CLASSIFICATION OF GESTURES

Gestures can be categorized to fit into the following application domain classifications:-

Pre-emptive Gestures

A pre-emptive natural hand gesture occurs when the hand is moving towards a specific control (device/ appliance) and the detection of the hand approaching is used to pre-empt the operators intent to operate a particular control.

Function Associated Gestures

Function Associated gestures are those gestures that use the natural action of the arm/hand/other body part to associate or provide a cognitive link to the function being controlled.

Context Sensitive Gestures

Context Sensitive gestures are natural hand gestures that are used to respond to operator prompts or automatic events. Possible context sensitive gestures to indicate yes/no or accept/reject could be a thumbs-up and a thumbs-down. These could be used to answer or reject an incoming phone call, an incoming voice message or an incoming SMS text message.

Global Shortcut Gestures

Global shortcut gestures are in fact natural symbolic gestures that can be used at any time, the

term natural refers to the use of natural hand gestures that are typically used in human to human communications. It is expected that hand gestures will be selected whereby the user can easily link the gesture to the function being controlled. Possible applications could include fairly frequently used controls that present unwanted high visual workload, such as phone dial home, phone dial work.

Natural Dialogue Gestures

Natural dialogue hand gestures utilize natural gestures as used in human to human communication to initiate a gesture dialogue with the vehicle, typically this would involve two gestures being used although only one gesture at any given time.

GESTURE SENSING TECHNOLOGIES

Gesture recognition is the process by which gestures made by the user are made known to the system. It can also be explained as the mathematical interpretation of a human motion by a computing device. Various types of gesture recognition technologies in use currently are:

Contact type

It involves touch based gestures using a touch pad or a touch screen. Touch pad or touch screen based gesture recognition is achieved by sensing physical contact on a conventional touch pad or touch screen. Touch pads & touch screens are primarily used for controlling cursors on a PC or mobile phones and are gaining user acceptance for point of sale terminals, PDAs, various industrial and automotive applications as well. They are already being used for automotive applications, and PDAs. User acceptance of touch-based gesture automotive systems technologies are relatively

easier for the public to accept because they preserve a physical user interface.

Non-Contact type

Device Gesture Technologies

Device-based techniques use a glove, stylus, or other position tracker, whose movements send signals that the system uses to identify the gesture.

One of the commonly employed techniques for gesture recognition is to instrument the hand with a glove; the glove is equipped with a variety of sensors to provide information about hand position, orientation, and flex of fingers. First commercial hand tracker, Dataglove, used thin fiber optic cables running down the back of each hand, each with a small crack in it. Light is shone down the cable so when the fingers are bent light leaks out through the cracks. Measuring light loss gives an accurate reading of hand poses. Similar technique is used for wearable suits used in virtual environment applications. Though gloves provide accurate measurements of hand shape, they are cumbersome to wear, and connected through wires.

Various other kinds of systems are reported in literature for intrusive hand gesture recognition. Some uses bend sensor on the index finger, an acceleration sensor on the hand, a micro switch for activation.

Styli are interfaced with display technologies to record and interpret gestures like the writing of text.

To reduce physical restriction due to the cables, an alternate technique used is to wear an ultrasonic emitter on the index finger and the receiver capable of tracking the position of the emitter is mounted on a head mounted device (HMD).

To avoid placing sensors on the hand and fingers the "Gesture Wrist" uses capacitive sensors on a wristband to differentiate between two gestures (fist and point). Wearing a glove or suit is

clearly not a practical proposition for many applications like automotives.

Vision-based Technologies

There are two approaches to vision based gesture recognition;

Model based techniques:

They try to create a three dimensional model of the users hand and use this for recognition. Some systems track gesture movements through a set of critical positions. When a gesture moves through the same critical positions as does a stored gesture, the system recognizes it. Other systems track the body part being moved, compute the nature of the motion, and then determine the gesture. The systems generally do this by applying statistical modelling to a set of movements.

Image based methods:

Image-based techniques detect a gesture by capturing pictures of a user's motions during the course of a gesture. The system sends these images to computer-vision software, which tracks them and identifies the gesture.

These methods typically extract flesh tones from the background images to find hands and then try and extract features such as fingertips, hand edges, or gross hand geometry for use in gesture recognition.

Electrical Field Sensing

Proximity of a human body or body part can be measured by sensing electric fields; the term used to refer to a family of non- contact measurements of the human body that may be made with slowly varying electric fields. These measurements can be used to measure the distance of a human hand or other body part from an object; this facilitates a vast range of applications for a wide range of industries.

Working of Gesture Recognition Technology

Gesture technology follows a few basic states to make the machine perform in the most optimized manner. These are:

1. **Wait:** In this state, the machine is waiting for the user to perform a gesture and provide an input to it.
2. **Collect:** After the gesture is being performed, the machine gathers the information conveyed by it.
3. **Manipulate:** In this state, the system has gathered enough data from the user or has been given an input. This state is like a processing state.
4. **Execute:** In this state, the system performs the task that has been asked by the user to do so through the gesture.

Devices that work on this technology usually follow these stages but their duration might vary from machine to machine depending on its configuration and the task it is supposed to do.

A basic working of the gesture recognition system can be understood from the following figure:

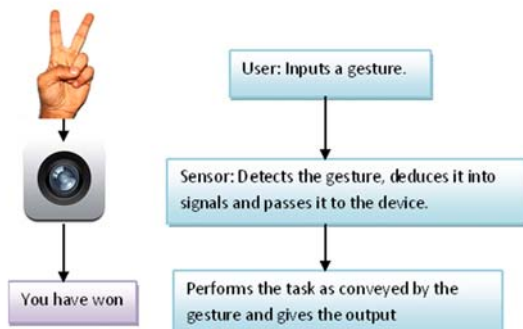


Fig. 2: A Figure Showing Working of the Gesture Recognition System

Applications of Gesture Recognition Technology

While the initial need of gesture recognition technology was only to improve the human computer interaction, it found plenty of applications as usage of computer went widespread. Currently, the following applications of gesture recognition technology are there:

- **In Video Game Controllers:** With the arrival of 6th generation video game consoles such as Microsoft X-Box with Kinect sensor, Sony PS3 with motion sensor controller, gesture recognition was widely implemented. In X-Box, often the user is the controller and has to perform all the physical movements that they desire the character in the game to do. For instance, one has to imitate kicking a football if he is playing football on any of the above listed gaming console. The Kinect sensor has a camera that catches the motions and processes it so that the character exactly does it.

In Sony PS3, users have to move the controller in such a way so that it imitates the action the user wants the character in the game to perform.



Fig. 3: A Representational Image of Application of Gesture Recognition Technology in Video Games

Aid to physically challenged:

People who are visually impaired or have some other complexity in their motor functions can take help of gesture based input devices so that there is no discomfort while they access computers. Also, these days machine wheel chairs are coming with gesture based systems. All that is required from the user in here is to lightly move hands on the panel at the arm rest of the wheel chair. The movements of the hands will act as a controller and speed as well as direction can be easily controlled.

Shown below is a typical example of gesture controlled wheel chair.



Fig. 4: A Typical Image of a Gesture Recognition Technology Controlled Wheelchair

Other Applications:

Gesture recognition technology is gaining popularity in almost every area that utilizes smart machines. In aircraft traffic controls, this technology can aid in detailing every part of location information about the airplanes near to the airport. In cranes, this can be used instead of remotes so that easy picking and shedding of load can be load at difficult locations.

Smart TVs are nowadays coming with this technology making the user carefree about the remote and allowing him to use his hands for changing the channel or volume levels. Qualcomm has recently launched smart cameras and tablet computers that are based on this technology. The camera will recognize the proximity of the object before taking the picture and will adjust itself according to the requirements. The tablet computers with this technology will ease out the task where user has to give presentations or change songs on his juke box. He can browse all the data just by waving his hands around. Various touch screen smart phones are also incorporating this technology to provide easy access. Gesture recognition technology can also be used to make

the robots understand the human gestures and make them work accordingly.

GESTURE RECOGNITION CHALLENGES

1. Latency

One of the key challenges in gesture recognition is that the image processing can be significantly slow creating unacceptable latency for video games and other similar applications.

2. Lack of Gesture Language

Since common gesture language is not there, different users make gestures differently. If users make gestures as they seem fit, gesture recognition systems would certainly have difficulty in identifying motions with the probabilistic methods currently in use.

3. Robustness

Many gesture recognition systems do not read motions accurately or optimally due to factors like insufficient background light, high background noise etc.

4. Performance

Image processing involved in gesture recognition is quite resource intensive and the applications may found difficult to run on resource constrained devices like PDA.

The rate of user acceptability of gesture recognition systems will be driven by how fast and wide spread gesture recognition becomes established and accepted in our everyday lives including other environments in which human interaction with machines takes place. These include interactions in the office, home, banking, gaming and other leisure activities.

During the next few years, Gesture recognition is most likely to be used primarily in niche applications because making mainstream applications work with the gesture recognition technology will take considerable effort than it's worth.

Cloud Computing

VIGNESH P
IV year EEE

RAJKUMAR G K
IV year EEE

Introduction:

Resource sharing in a pure plug and play model that dramatically simplifies infrastructure planning is the promise of „cloud computing“. The two key advantages of this model are ease-of-use and cost-effectiveness. Though there remain questions on aspects such as security and vendor lock-in, the benefits this model offers are many. This article explores some of the basics of cloud computing with the aim of introducing aspects such as:

- Realities and risks of the model
- Components in the model
- Characteristics and Usage of the model

The paper aims to provide a means of understanding the model and exploring options available for complementing your technology and infrastructure needs.

Cloud computing is a computing paradigm, where a large pool of systems are connected in private or public networks, to provide dynamically scalable infrastructure for application, data and file storage. With the advent of this technology, the cost of computation, application hosting, content storage and delivery is reduced significantly.

Cloud computing is a practical approach to experience direct cost benefits and it has the

potential to transform a data center from a capital-intensive set up to a variable priced environment.

The idea of cloud computing is based on a very fundamental principal of „reusability of IT capabilities'. The difference that cloud computing brings compared to traditional concepts of “grid computing”, “distributed computing”, “utility computing”, or “autonomic computing” is to broaden horizons across organizational boundaries.

Forrester defines cloud computing as:

“A pool of abstracted, highly scalable, and managed compute infrastructure capable of hosting end-customer applications and billed by consumption.”

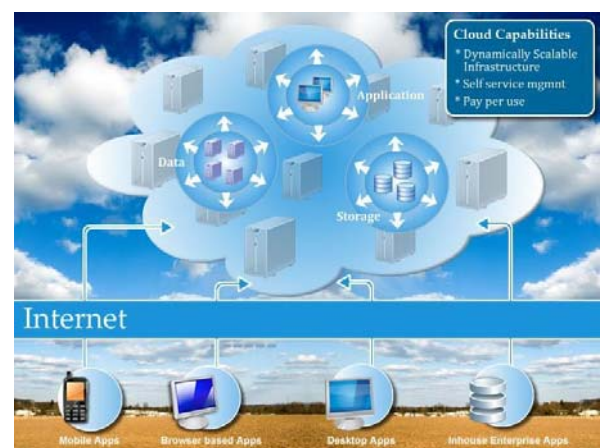


Figure 1: Conceptual view of cloud computing

Cloud Computing Models

Cloud Providers offer services that can be grouped into three categories.

Software as a Service (SaaS):

In this model, a complete application is offered to the customer, as a service on demand. A single instance of the service runs on the cloud & multiple end users are serviced. On the customers' side, there is no need for upfront investment in servers or software licenses, while for the provider, the costs are lowered, since only a single application needs to be hosted & maintained. Today SaaS is offered by companies such as Google, Salesforce, Microsoft, Zoho, etc.

Platform as a Service (Paas):

Here, a layer of software, or development environment is encapsulated & offered as a service, upon which other higher levels of service can be built. The customer has the freedom to build his own applications, which run on the provider's infrastructure. To meet manageability and scalability requirements of the applications, PaaS providers offer a predefined combination of OS and application servers, such as LAMP platform (Linux, Apache, MySQL and PHP), restricted J2EE, Ruby etc. Google's App Engine, Force.com, etc are some of the popular PaaS examples.

Infrastructure as a Service (IaaS):

IaaS provides basic storage and computing capabilities as standardized services over the network. Servers, storage systems, networking equipment, data centre space etc. are pooled and made available to handle workloads. The customer

would typically deploy his own software on the infrastructure. Some common examples are Amazon, GoGrid, 3 Tera, etc.

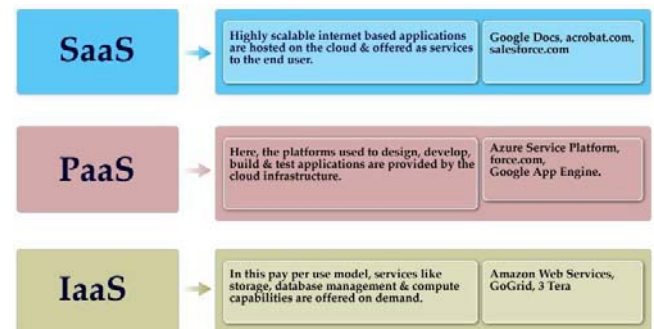


Figure 2: Cloud models

Understanding Public and Private Clouds

Enterprises can choose to deploy applications on Public, Private or Hybrid clouds. Cloud Integrators can play a vital part in determining the right cloud path for each organization.

Public Cloud

Public clouds are owned and operated by third parties; they deliver superior economies of scale to customers, as the infrastructure costs are spread among a mix of users, giving each individual client an attractive low-cost, "Pay-as-you-go" model. All customers share the same infrastructure pool with limited configuration, security protections, and availability variances. These are managed and supported by the cloud provider. One of the advantages of a Public cloud is that they may be larger than an enterprises cloud, thus providing the ability to scale seamlessly, on demand.

Private Cloud

Private clouds are built exclusively for a single enterprise. They aim to address concerns on data security and offer greater control, which is

typically lacking in a public cloud. There are two variations to a private cloud:

On-premise Private Cloud:

On-premise private clouds, also known as internal clouds are hosted within one's own data center. This model provides a more standardized process and protection, but is limited in aspects of size and scalability. IT departments would also need to incur the capital and operational costs for the physical resources. This is best suited for applications which require complete control and configurability of the infrastructure and security.

Externally hosted Private Cloud:

This type of private cloud is hosted externally with a cloud provider, where the provider facilitates an exclusive cloud environment with full guarantee of privacy. This is best suited for enterprises that don't prefer a public cloud due to sharing of physical resources.

Hybrid Cloud

Hybrid Clouds combine both public and private cloud models. With a Hybrid Cloud, service providers can utilize 3rd party Cloud Providers in a full or partial manner thus increasing the flexibility of computing. The Hybrid cloud environment is capable of providing on-demand, externally provisioned scale. The ability to augment a private cloud with the resources of a public cloud can be used to manage any unexpected surges in workload.

Cloud Computing Benefits

Enterprises would need to align their applications, so as to exploit the architecture models that Cloud Computing offers. Some of the typical benefits are listed below:

Reduced Cost

There are a number of reasons to attribute Cloud technology with lower costs. The billing model is pay as per usage; the infrastructure is not purchased thus lowering maintenance. Initial expense and recurring expenses are much lower than traditional computing.

Increased Storage

With the massive Infrastructure that is offered by Cloud providers today, storage & maintenance of large volumes of data is a reality. Sudden workload spikes are also managed effectively & efficiently, since the cloud can scale dynamically.

Flexibility

This is an extremely important characteristic. With enterprises having to adapt, even more rapidly, to changing business conditions, speed to deliver is critical. Cloud computing stresses on getting applications to market very quickly, by using the most appropriate building blocks necessary for deployment

Cloud Computing Challenges

Despite its growing influence, concerns regarding cloud computing still remain. In our opinion, the benefits outweigh the drawbacks and the model is worth exploring. Some common challenges are:

Data Protection

Data Security is a crucial element that warrants scrutiny. Enterprises are reluctant to buy an assurance of business data security from vendors. They fear losing data to competition and the data confidentiality of consumers. In many instances, the

actual storage location is not disclosed, adding onto the security concerns of enterprises. In the existing models, firewalls across data centers (owned by enterprises) protect this sensitive information. In the cloud model, Service providers are responsible for maintaining data security and enterprises would have to rely on them.

Data Recovery and Availability

All business applications have Service level agreements that are stringently followed. Operational teams play a key role in management of service level agreements and runtime governance of applications. In production environments, operational teams support

- Appropriate clustering and Fail over
- Data Replication
- System monitoring (Transactions monitoring, logs monitoring and others)
- Maintenance (Runtime Governance)
- Disaster recovery
- Capacity and performance management

If, any of the above mentioned services is under-served by a cloud provider, the damage & impact could be severe.

Management Capabilities

Despite there being multiple cloud providers, the management of platform and infrastructure is still in its infancy. Features like „Auto-scaling“ for example, are a crucial requirement for many enterprises. There is huge potential to improve on the scalability and load balancing features provided today.

Regulatory and Compliance Restrictions

In some of the European countries, Government regulations do not allow customer's personal information and other sensitive information to be physically located outside the state or country. In order to meet such requirements, cloud providers need to setup a data center or a storage site exclusively within the country to comply with regulations. Having such an infrastructure may not always be feasible and is a big challenge for cloud providers.

With cloud computing, the action moves to the interface — that is, to the interface between service suppliers and multiple groups of service consumers. Cloud services will demand expertise in distributed services, procurement, risk assessment and service negotiation — areas that many enterprises are only modestly equipped to handle.

Understanding of Arduino

THIYAGARAJAN S
IV year EEE

PRAVEEN KUMAR M
IV year EEE

Introduction

Arduino is an open source microcontroller which can be easily programmed, erased and reprogrammed at any instant of time. Introduced in 2005 the Arduino platform was designed to provide an inexpensive and easy way for hobbyists, students and professionals to create devices that interact with their environment using sensors and actuators. Based on simple microcontroller boards, it is an open source computing platform that is used for constructing and programming electronic devices. It is also capable of acting as a mini computer just like other microcontrollers by taking inputs and controlling the outputs for a variety of electronics devices.

It is also capable of receiving and sending information over the internet with the help of various Arduino shields, which are discussed in this paper. Arduino uses a hardware known as the Arduino development board and software for developing the code known as the Arduino IDE (Integrated Development Environment). Built up with the 8-bit Atmel AVR microcontroller's that are manufactured by Atmel or a 32-bit Atmel ARM, these microcontrollers can be programmed easily using the C or C++ language in the Arduino IDE.

Need For Arduino

1) Active User Community: A group of people using a similar product can hold posted message conversations and share their experiences or solve the problems of the other users in the communities with their own experiences

2) Growth of Arduino: Arduino was developed with intent to provide an economical and trouble-free way for hobbyists, students and professionals to build devices that interact with their situation using sensors and actuators. This makes it perfect for newcomers to get started quickly

3) Inexpensive Hardware: Since Arduino is an open source platform the software is not purchased and only the cost of buying the board or its parts is incurred, thus making it very cheap. The hardware designs are also available online for free from its official website

4) Arduino Board as a Programmer: To make Arduino board function easy and also making it available everywhere these boards come with a USB cable for power requirements as well as functioning as a programmer

5) Multi-platform Environment: The Arduino IDE is capable of running on a number of platforms including Microsoft, Linux and Mac OS X making the user community even larger.

Type of Arduino Boards

Arduino Type	Microcontroller	Clock Speed
Arduino Duemilanove / ATmega328	ATmega328	16 MHz with auto-reset
Arduino Nano	ATmega328	16 MHz with auto-reset
Arduino Mega 2560 or Mega ADK	ATmega2560	16 MHz with auto-reset
Arduino Leonardo	ATmega32u4	16 MHz with auto-reset
Arduino Mini w/ ATmega328	ATmega328	16 MHz with auto-reset
Arduino Ethernet	Equivalent to Arduino UNO with an Ethernet shield	
Arduino Fio.	ATmega328	8 MHz with auto-reset
Arduino BT w/ ATmega328	ATmega328	16 MHz with auto-reset
LilyPad Arduino w/ ATmega328	ATmega328	8 MHz (3.3V) with auto-reset
Arduino Pro or Pro Mini	ATmega328	16 MHz with auto-reset
Arduino NG	ATmega8	16 MHz with auto-reset

Elements of Arduino Boards

Hardware

The Arduino Development Board consists of many components that together makes it work. Here are some of those main component blocks that help in its functioning:

- **Microcontroller:** This is the heart of the development board, which works as a mini computer and can receive as well as send information or command to the peripheral devices connected to it. The microcontroller used differs from board to board; it also has its own various specifications.

- **External Power Supply:** This power supply is used to power the Arduino development board with a regulated voltage ranging from 9 – 12 volts.

- **USB plug:** This plug is a very important port in this board. It is used to upload (burn) a program to the microcontroller using a USB cable. It also has a regulated power of 5V which also powers the Arduino board in cases when the External Power Supply is absent.

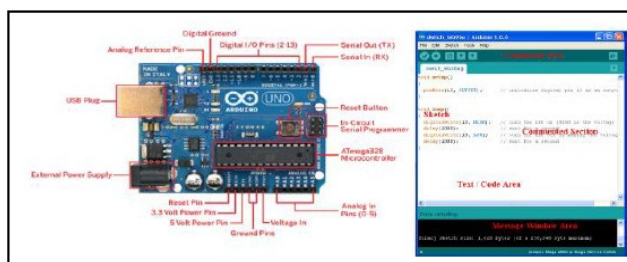
- **Internal Programmer:** The developed software code can be uploaded to the microcontroller via USB port, without an external programmer.

- **Reset button:** This button is present on the board and can be used to resets the Arduino microcontroller.

- **Analog Pins:** There are some analog input pins ranging from A0 – A7 (typical). These pins are used for the analog input / output. The no. of analog pins also varies from board to board.

- **Digital I/O Pins:** There are some digital input pins also ranging from 2 to 16 (typical). These pins are used for the digital input / output. The no. of these digital pins also varies from board to board.

- **Power and GND Pins:** There are pins on the development board that provide 3.3, 5 volts and ground through them



Software

The program code written for Arduino is known as a sketch. The software used for developing such sketches for an Arduino is commonly known as the Arduino IDE.

- **Text editor:** This is where the simplified code can be written using a simplified version of C++ programming language.

- **Message area:** It displays error and also gives a feedback on saving and exporting the code.

- **Text:** The console displays text output by the Arduino environment including complete error messages and other information

- **Console Toolbar:** This toolbar contains various buttons like Verify, Upload, New, Open, Save and Serial Monitor. On the bottom right hand corner of the window there displays the Development Board and the Serial Port in use.

Features of Arduino IDE

- The project file or the sketches for a project are saved with the file extension .ino

- Features such as cut / copy / paste are supported in this IDE.

- There also is a facility for finding a particular word and replacing it with another by pressing the Ctrl + F buttons on the keyboard

- The most basic part or the skeleton of all Arduino code will have two functions

Conclusions

In this article, we have studied the working principle of Arduino, its hardware / software features as to where it is currently being used and where all it can be used. We have also learnt how to write sketches for Arduino in its own IDE (software). Developing new ideas with Arduino is endless, with the help of this paper we have learnt to build new devices of our own to create and implement innovative things. From wearable fashion to space research, the possibilities of using an Arduino to learn and develop new ideas is infinite. Though it does have its own limitations, it is a great tool that can be used in learning.

Audio Electronics: Sound, Microphones, Speakers, and Amplifiers

Ranjith T
IV year EEE

Karthik T M
IV year EEE

Introduction

Before discussing the specific components of audio-related circuits and electronics, let's first take a crash course on the basic concepts of sound. Sound is simply a type of energy vibrating through a medium (such as air or water); this energy, within a specific range of frequencies, is interpreted by the human ear as sound.

Sound is made up of three basic elements:

- **Frequency:** how fast the vibrations are occurring
- **Intensity:** how loud the sound is
- **Timbre:** the sound's quality

The human ear can detect sound *frequencies* ranging from 20 to 20,000 Hz. However, the human ear is more sensitive to (i.e. able to discern at lowest intensity) frequencies ranging between 2,000 and 5,000 Hz. Recall that Hertz (Hz) is a unit defined as cycles per second. A sound's *intensity* corresponds to the amount of energy associated with that sound. The decibel (dB) is used for measuring the sound's energy in a way that is relevant to how humans perceive loudness.

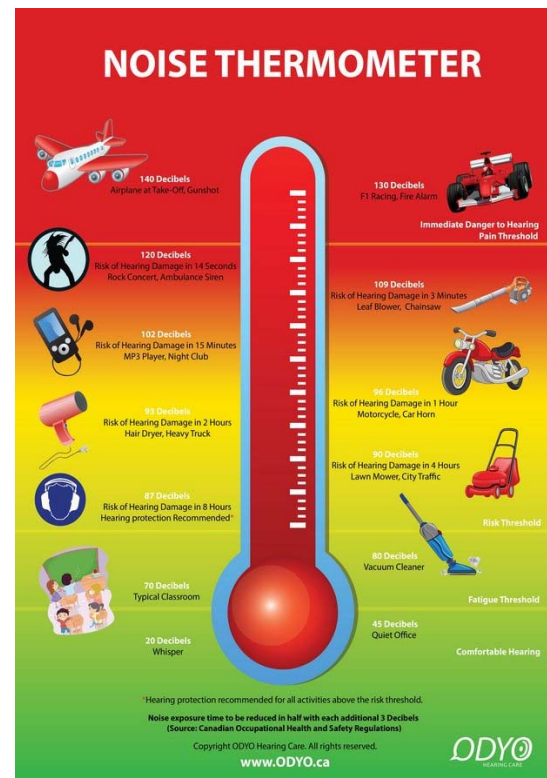
In the context of audio, the decibel is defined as follows:

$$\text{dB} = 10 \log_{10} (I/I_0)$$

where

- I = the measured intensity (W/m^2)
- $I_0 = 10^{-12} \text{ W/m}^2$, which represents the lowest sound intensity detectable by the human ear

The figure below shows a variety of sounds and their dB intensity measurement.



Examples of sounds and their intensity (in dB).

Timbre is the complex wave pattern that occurs when overtones (also referred to as harmonics) are present along with the fundamental frequency. For instance, a tuning fork is designed to produce exactly one specific frequency, called the fundamental frequency. Let's say we have a tuning fork that produces a middle C note (261.62 Hz). Since a tuning fork generates only one frequency, no other frequencies (overtones) exist. However, if you were to hear a middle C played on a violin, you would hear both the fundamental frequency (261.62 Hz) and a variety of other, albeit less intense, frequencies (overtones). The specific

intensity of each overtone is largely credited for giving an instrument (or a person's voice) its unique timbre (also called tonal quality).

Microphones:

The microphone is responsible for converting changes in sound pressure to changes in electric current. The *intensity* of the changes in sound pressure corresponds to the AC voltage *amplitude* generated by the microphone. Likewise, the *frequency* of the changes in sound pressure corresponds to the *frequency* of the AC voltage. Obviously, if any overtones are present, they too are present in the electrical signal generated by the microphone.

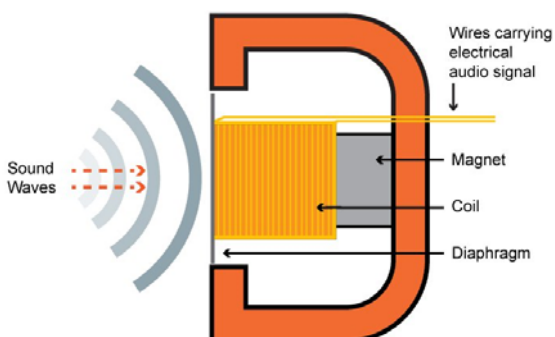
Three common types of microphones are the following:

- dynamic
- condenser
- electret

The Dynamic Microphone

The *dynamic* microphone consists of a plastic diaphragm, a voice coil, and a permanent magnet. See figure below.

Cross-Section of Dynamic Microphone



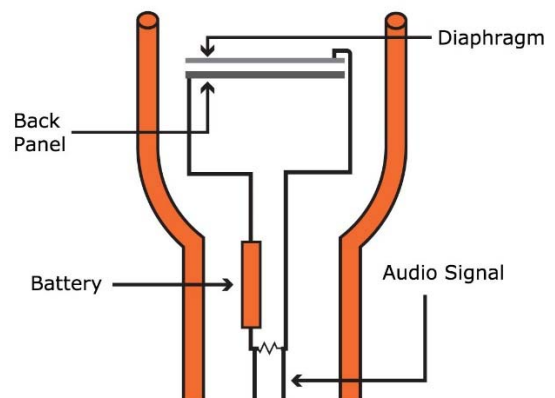
A dynamic microphone cross-section

When varying sound pressure is applied to the diaphragm, the voice coil moves back and forth through the magnet's magnetic field, resulting in a voltage across the leads of the voice coil. Hence, the sound pressure is converted to a voltage signal. Dynamic microphones are known for being very rugged, for being able to operate over a wide temperature range, for providing smooth and extended frequency response, and for not needing an external power source. They are widely used in applications such as public address and high-quality recording.

The Condenser Microphone

The *condenser* microphone (see figure below) uses a pair of charged plates that can be brought closer together or forced farther apart by changes in air pressure (i.e., sound). In doing so, the charged plates act like a sound-sensitive capacitor. This type of microphone works in conjunction with a low-noise, high-impedance amplifier.

Condenser microphones are known for providing crisp, low-noise sound and are used for producing high-quality sound recordings.

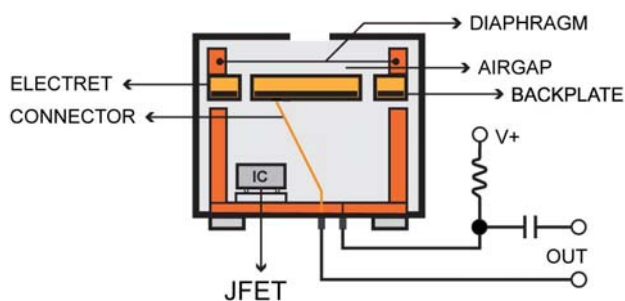


A condenser microphone's basic components.

The Electret Microphone

An *electret* microphone is actually a microphone and a JFET in a single package. The gate of the JFET provides a very high impedance and thus ensures that the charge on the electret element remains fixed. The charge must remain fixed to ensure that changes in capacitance (caused by sound waves) result in voltage changes. The JFET also converts the varying (gate) voltage into varying (drain-source) current. While the electret element itself does not require power (because its permanently charged) the overall electret microphone device requires a power supply because the integrated JFET needs bias current.

Older electret microphones were known to deliver poor performance, but modern devices can compete with condenser microphones.



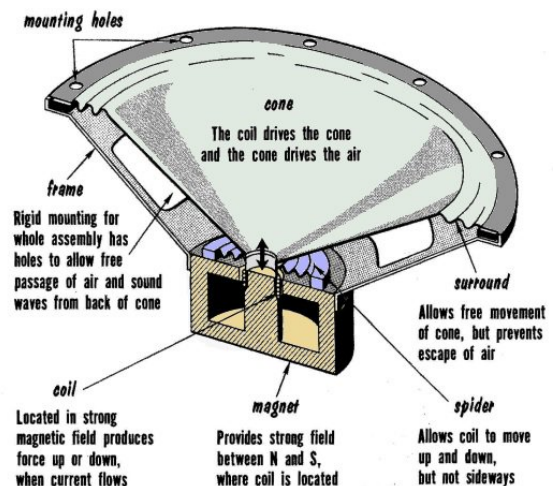
An electret microphone,

Types of Speakers

Microphones convert sound signals into electrical signals. Speakers do the exact opposite: they convert electrical signals into audible (sound) signals.

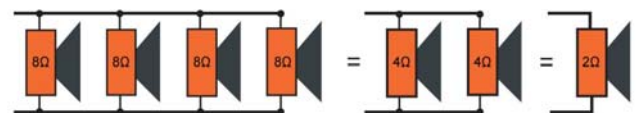
The dynamic speaker, which uses the same operating principles as the dynamic microphone, is the most popular speaker used today. When a

varying electrical signal (current) is channeled through a moveable coil (voice coil) surrounded by a magnet, the coil moves back and forth. Cones (often made of paper) attached to the moving coil then produce variations in air pressure (i.e., sound waves) that correspond to the electrical signal driven through the speaker coil.



Parts of a dynamic speaker.

Every speaker has a nominal resistance—or, more accurately, an impedance—that represents the average resistance between the speaker leads. Thus, speakers behave similarly to resistors when placed in series and in parallel. See the figure below.



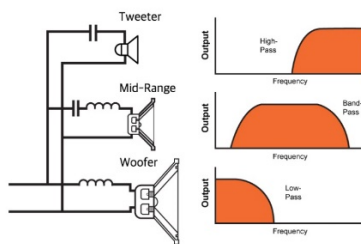
Speakers in parallel behave the same as resistors in parallel.

Frequency response, an important speaker characteristic, represents the frequency range over which a speaker can successfully propagate sound waves.

Speakers can be categorized according to the frequency range that they are designed for:

- **Woofers:** speakers designed specifically for low frequencies (less than 200 Hz)
- **Midrange:** speakers designed to accommodate frequencies ranging from 500 Hz to 3000 Hz
- **Tweeter:** a dedicated speaker type specifically designed to handle frequencies above those of midrange speakers
- **Full-range speakers:** capable of handling frequencies ranging from 100 Hz to 15,000 Hz

Such a three-way speaker system is illustrated below.



A typical three-way speaker system consisting of a tweeter, a midrange speaker, and a woofer.

Amplifiers 101

Audio amplifier have three types of classification:

- Preamplifier
- Low-power amplifier
- Power amplifier

An *audio preamplifier* (often shortened to "pre-amp") is an electronic device that amplifies a very weak signal from a microphone, as an example, into signals strong enough to manipulate. Pre-amps

are often simple, fixed-gain amplifiers designed specifically for low-noise performance.

A *low-power amplifier* is often used to manipulate signals including such aspects as volume and frequency equalization. This type of amplifier generally focuses on changing the character of the signal in desired ways while introducing as little unwanted distortion as possible and may provide little to no actual power amplification.

An *audio power amplifier* ("power amp") is used to increase the signal power so as to drive a load, such as output speakers. Similar to pre-amps, power amps are often fixed gain (in terms of signal amplitude) so that designers can focus on high-power gain and the power handling challenges that typically result. In simple audio systems where high power and high fidelity are not critical factors, a single-amplifier circuit may perform all of these functions, and, in fact, specially designed operational amplifiers, such as the LM-386 Low Voltage Audio Power Amplifier, are often used this way.

Conclusion

Audio electronics can be summarized as converting sound to electrical signals, processing the electrical signals, and turning these processed signals back into sound. This is a straightforward objective; nevertheless, this particular discipline of electrical engineering covers many areas of the EE world. In fact, many practicing engineers spend their entire careers researching, developing, and designing audio electronics and related equipment

Program Outcomes (POs)

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

Program Specific Outcomes (PSOs)

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

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

KSR INSTITUTE FOR ENGINEERING AND TECHNOLOGY

VISION

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

MISSION

- ❖ Accomplish quality education through improved teaching learning process.
- ❖ Enrich technical skills with state of the art laboratories and facilities.
- ❖ Enhance research and entrepreneurship activities to meet the industrial and societal needs.

Department of EEE

VISION

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

MISSION

- ❖ Impart quality education in the field of Electrical and Electronics Engineering through state of the art learning ambience.
 - ❖ Enrich interdisciplinary skills and promote research through continuous learning.
 - ❖ Enhance professional ethics, entrepreneurship skills and social responsibilities to serve the nation.
-

BEES Magazine

August 2017