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Gyan Ganga
Institute of Technology and Sciences

TECH ADVISOR

2020-21

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Contact Us - +91 942 53 23089, +91 982 61 18736

Location - P.O. Tilwara Ghat, Bargi Hills, Jabalpur, Madhya Pradesh Pin No. - 482003

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TECH ADVISOR 2020-21

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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ABOUT THE DEPARTMENT

Department of Electronics & Communication Engineering (EC) of GGITS, Jabalpur offers B.Tech. in Electronics & Communication Engineering with an intake of 120 students and M.Tech. in Embedded System & VLSI Design and Communication system with an intake of 18 each. The department has excellent infrastructure as well as well equipped laboratories so that the students come out with knowledge of latest cutting edge technology in both software and hardware. The department has been accredited with excellence by National Board of Accreditation (NBA). The department has well experience dedicated faculty members with different specializations.

VISION OF THE DEPARTMENT

To be center of excellence in teaching-learning and employability in various fields of Electronics and Communication Engineering to produce globally competent, innovative and socially responsible citizen.

MISSION THE DEPARTMENT

- To offer high quality graduate and post graduate programs in Electronics and Communication with strong fundamental knowledge and to prepare students for professional career or higher studies.
- To discover and disseminate knowledge through learning, teaching, sharing, training, research, engagement and creative expression.
- To foster spirit of innovation and creativity among students, faculty and staff, promote environment of growth, participation in conferences, technical and community services and lifelong learning for all.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: The graduates will have strong fundamentals in mathematics, science and engineering so that they can meet industrial and global challenges and excel in the field of Electronics and Communication Engineering and also will be motivated to excel in professional career and higher education.

PEO 2: The graduates will have good scientific and engineering breadth to analyze, design and develop systems/ components, problem-solving skills and aptitude for innovation.

PEO 3: The graduates will exhibit leadership qualities with strong communication skills, competence to function effectively in multi-disciplinary orientation teams, capability to assess and relate engineering issues to ethical, environmental and broader societal context.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Understand the fundamental and advanced concepts of Mathematics, Science & Engineering and apply it to design and develop Electronics and Communication Engineering applications in the field of communication system, signal processing, embedded systems and VLSI Design.

PSO 2: Learn and comprehend continuously the technological advancements with the usage of modern design tools to analyze and design variety of complex Electronics and Communication Engineering applications.

PSO 3: Possess/Acquire the skills to communicate in both oral and written forms with good Leadership, Managerial skill to work either independently or as a team, demonstrating the practice of professional ethics for sustainable development of society.

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MESSAGE FROM THE CHAIRMAN

I am elated at the publication of college magazine for the academic year 2020-21. I sincerely hope that the magazine proves to be an enjoyable and useful apparatus in the hands of both students and teachers of the college. I am also confident that it will serve as a source of inspiration for the teachers as well as the students to contribute articles regularly to the magazine in future. I whole-heartedly congratulate the HOD, Editors and the committee members on their successful endeavour to bring out the magazine.

MESSAGE FROM THE PRINCIPAL

It takes me great honour in congratulating the students who have contributed for the current year's Tech Advisor magazine Acknowledging the fact that the magazine is completely created and designed by the students, I really hope this would kindle a spark in the minds of the students who are yet to contribute towards the progress of the Tech Advisor initiative in the upcoming years.

MESSAGE FROM THE HOD

Tech Advisor is a communication link between faculty members and students within and outside the department. It reports about recent development and areas of thrust in the field of Electronics & Communication Engineering. Tech Advisor tries to bridge the gap between academic and actual mode of working in the industry by providing articles on various topics of industry. At the same time magazine also serve as a knowledge booster and a helping hand to our students. We also make aware our students with the general issues related to environment, ecology, economy and rest of the society. It also helps to bring together all the students and faculty members to the same platform to share numerous ideas to think upon. Students can also share their thoughts on a particular matter as well as they can also contribute any research by means of this channel. It can be easily concluded that our departmental magazine is not only information provider but also groom the overall personality of our students.

EDITOR'S DESK

The creative minds of the Electronics and Communication department of Gyan Ganga Institute of Technology and Sciences have come together to present what they have always wanted to and we congratulate every student who has given their contribution. They can't be appreciated enough and we can't explain how difficult it was to compile all their accomplishments into a single magazine. We take pride in showing you of how our very own GGITians have imaginations which spread across the horizons. We would like to thank the Management and all the staffs who have supported the 'Tech Advisor' initiative and for having trust in the Editorial board by giving us full freedom to choose the contents and design for out magazine. The magazine should serve as a pillar of motivation for every other student who is yet to emerge as an Achiever and to carry the legacy of Tech Advisor. The students who follow in the next academic years, we advise you to do the same. Go Mad, Be Productive but at the same time Be Creative!

TECH ADVISOR

2020-21

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

STUDENT'S ARTICLES

ELECTRONIC WARFARE AND JAMMING SYSTEMS

Electronic warfare (EW) and jamming have assumed a substantial role in modern warfare. EW involves the use of electromagnetic spectrum or directed energy to detect, identify, intercept, and locate hostile signals. It also uses countermeasures to radiate interfering signals to jam and disrupt enemy threats. Jamming is a form of electronic countermeasures.

Land-based EW technology provides situational awareness and combat pictures to tactical commanders, allowing them to make the right decisions on the battlespace to protect ground forces and mitigate enemy threats.

The increasing threat of drones used by adversaries and non-state actors poses a challenge for armies. It can be countered using advanced EW systems and anti-drone jammers to disrupt the uncrewed platforms.

Types Of Electronic Warfare

Electronic warfare solutions can be integrated into a range of platforms across land, air, and sea domains. The three main categories of EW are electronic attack, electronic protection, and electronic support.

Electronic attack solutions enable armed forces to disrupt, deny, degrade, destroy, or deceive enemy communications and personnel using offensive options such as electromagnetic energy, anti-radiation weapons, and directed energy against radar-equipped defence systems.

Furthermore, electronic attack technologies include countermeasures such as radio frequency (RF) weapons, signal jamming, spoofing, and lasers to neutralise enemy threats. Electronic attack solutions are also used to conduct threat analysis and response. EW solutions conceal the location of troops and provide protection to military personnel, platforms, and infrastructure against RF-equipped weapons.

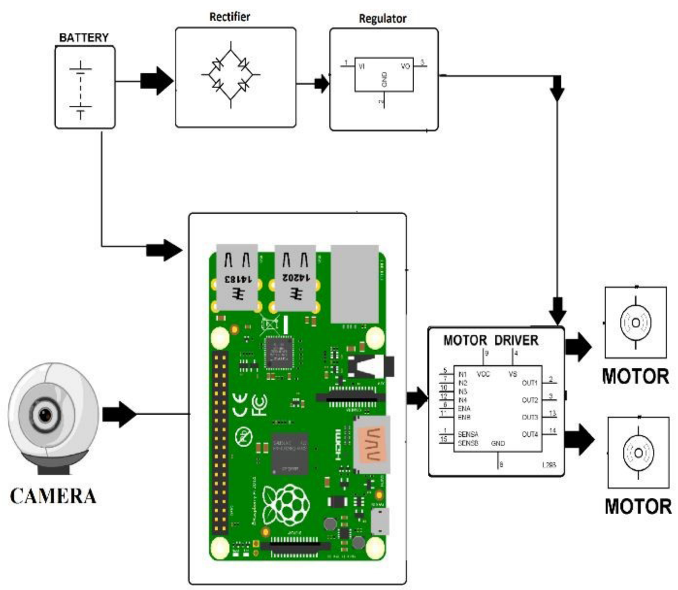
Electronic protection (EP) protects friendly forces, including personnel and assets, against the effects of electronic attacks by enemy forces. Electronic support is used to rapidly detect, intercept, identify, and track electromagnetic energy sources. It assists in the acquisition of targeting and signals intelligence data. Electronic support missions include intelligence, surveillance, and reconnaissance (ISR), and intelligence, surveillance, target acquisition, and reconnaissance (ISTAR).

ANUSHREE SINHA
0206EC171023
(B.E.-8th Sem)

OBJECT TRACKER & FOLLOWER ROBOT USING RASPBERRY PI

With advancement in robotic systems towards being autonomous surveillance robots the need for more smart thinking robots has become very essential. One of the aspect of tracking an object from its visuals has been taken up in this project Object Tracker and Follower Robot. In essence this project clubs in image processing and driving a robot autonomously with what visuals have been caught as has been in the case of Machine Vision projects. This project will be using a Raspberry Pi processor board for computational purpose and driving of the robot. The camera attached to the system captures the images of the front of the robot where it is attached. By monitoring a stream of incoming images the robot is able to autonomously decide to proceed in which direction it should go. The incoming visuals are processed using image processing techniques. By the use of image processing the coordinates of the target is recognized by the robot following which it follows a path to get to the target. In this project we have demonstrated this ability of the robot by using a yellow colored Smiley face ball. Whenever a ball is placed in front of the robot it recognizes the ball shape and color and estimates by this about what direction is it from its current location and also an approximated distance from the ball. With these calculations it proceeds towards the ball and stops at a location near the ball. This project demonstrates the capability of robots having target tracking capabilities autonomously with the help of image processing and robot driving by the results of image processing. The robot can follow the object even when the object is moving at a speed which can be tracked. In this way with the help of advanced technology the Object tracker and follower robot can achieve object tracking autonomously.

Hardware Specifications



Raspberry Pi 3, Robotic Chassis, Camera, DC Motor, LCD Display, Resistors, Capacitors, Transistors, Cables and Connectors, Diodes, PCB and Breadboards, LED, Transformer/ Adapter, Push Buttons, Switch, IC, IC Sockets.

Software Specifications

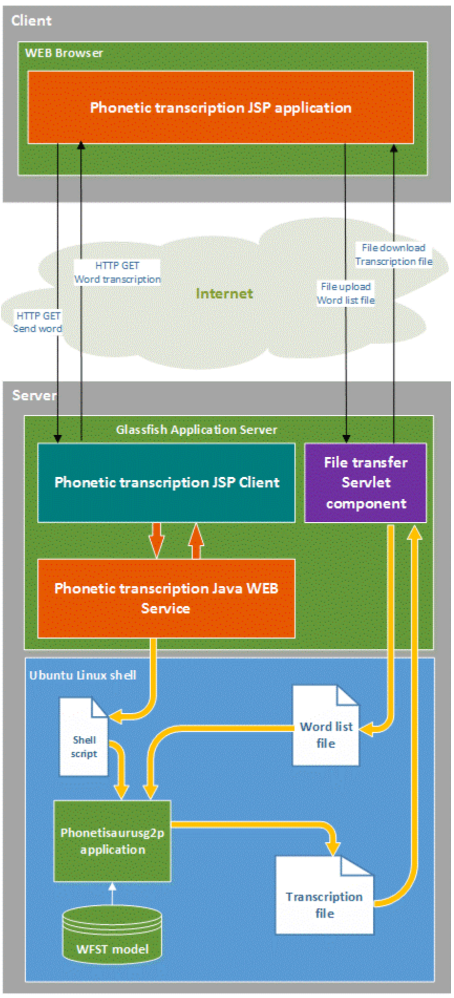
Python 3 compiler, Programming Language: Python

KU ISHITA VIJAY CHOURE
0206EC181044
(B.Tech.-6th Sem)

PHONET

Voice based web access is a rapidly developing technology. PhoNET is a solution for these and many other problems faced by the netizens. The basic idea is that using an ordinary phone to browse the web and the primary motivations are: to provide a widely available means for creating new interactive voice applications; addressing needs for mobility; and addressing issues inaccessibility. Basis of the idea are the age old IVR systems used to serve information for the dialers through a pre programmed process. Phonet is a very long journey from the IVRs; it involves the most complex technologies of the century Like Speech Recognition (SR), Text to speech (TTS) conversion and artificial intelligence (AI). This enables a user to be connected to internet as long as he has access to a phone. PhoNET uses the traditional HTML content so the web site need not be rewritten or redesigned. We present a detailed analysis in the most possible simplest way of how the technologies like SR, TTS and AI are integrated to develop a intelligent Platform (phoNET) to achieve voice based web access which involves Document processing and Document Rendering. In Document Processing we describe two approaches, telephone browsing and transcoding, focusing mostly on the former since that work is more mature. In Document Rendering we present the major problem i.e., the relevance of cognitive thought to text rendering along with its most suitable solution. In the end we examine the challenges and further developments involved in practical application of the proposed technology-The phoNET.

PhoNET technology is faster and cheaper than existing alternatives. Today, only the largest of companies are making their Web sites telephone-accessible because existing technology requires a manual, costly and time-consuming rewrite of each page. With the voice internet technologyphoNET, existing Web pages are used, allowing users to leverage their Web investment. The software dynamically converts existing pages into audio format, significantly lowering the up-front investment a business must make to allow users to hear and interact with their Web site by phone.



An audio Internet Technology that allows users to listen to email, buy on-line or surf and hear any Web site, using a simple and natural interface - an ordinary telephone. No computer is needed. Subscribers dial a toll-free number, and start accessing the Internet using voice commands. Speech recognition technology in the company's system allows users to give simple commands, such as "go to Yahoo" or "read my email" to get to the Net-based information they want, when they want it, whether they're out on an appointment, stuck in traffic, sitting in an airport, or cooking dinner. They'll be able to quickly locate information, such as late-breaking news, traffic reports, directions, or anything else they're interested in on the World Wide Web. Our product phoNET has the capability to automatically down load web contents, filter out graphics, banners and images. It then renders extracted texts into concise, meaningful and very suitable in audio format texts before using TTS to convert into speech. phoNET also converts the rendered texts into other languages in real time. It can also be easily integrated with any back end application such as CRM/SCM, ERP etc. Thus, phoNET completely eliminates the need to rewrite any content in VXML, SALT or WML. So we strongly believe that our automation based approach will be very successful. Using text-to-speech technology, an "intelligent agent" will read the requested information out loud via a computerized voice, and process the user's voice commands.

SAURABH VINODIYA
0206EC191065
(B.Tech.-4th Sem)

FACULTY'S ARTICLES

HOW IS URBAN HOUSING DESIGN CHANGING?

Urban design patterns are constantly shifting. The current style of urban homes depends on cultural shifts. Many apartment residents now look for community spaces in fancy amenities, like gyms.

Another trend is toward a more sustainable lifestyle. Some designers are even reusing old warehouses to create open and unique buildings. With all these cultural shifts, here are a few ways urban housing design is changing.

1. Revamping of Bathroom Spaces

As more people work from home, having a functional space is essential. The kitchen and bathroom are high-traffic areas. So, there is a shift toward expanding these areas. Bathrooms are now bright and welcoming spaces.
New features, such as double vanity, are growing in popularity. With a focus on wellness, the bathroom has become the place to relax. The design now incorporates more natural light and larger showers.

2. A More Communal Kitchen

Kitchens aren't tucked away in the corner anymore. Instead, there are wider spaces, often with an open layout. This allows for group cooking and a room for family and friends to gather. After spending months in isolation, the need to reconnect is essential to many homeowners.
Along with more space, there is a shift toward high-end appliances. These are often stainless steel, involve smart technology and are energy efficient.

3. The Addition of a Master Bedroom

Many homes now feature master bedrooms as the ultimate relaxation space. It gives parents a secluded area to unwind after a long work day. It also nods back to Colonial architectural styles. Within the master bedrooms, having walk-in closets is an attractive feature.

Here are a few more common decorating themes for a master bedroom:

- Using lighter colors.
- Mixing in antique pieces.
- Decorating with bold patterns.
- Designing in layers.
- Including a seating area.

4. A More Industrialized Style

The industrial style is more popular with the trend toward reusing warehouse spaces. Homeowners want rooms with brick facades, large windows and tall ceilings. A loft-style apartment is another growing theme. This provides another area to relax in or turn into a guest bedroom. It also saves space on the lower levels. One way to spruce up the loft walls is with metal artwork. It is durable and versatile in design.

Here are a few critical elements of this design trend:

- Metal and wood decor

- Exposed pipes, beams and ducts
- Metallic color palette
- Cage lighting
- Open layout

5. Reconnecting With Nature

Many residents value their health and desire a stronger connection to nature. Plus, the sunlight can boost their mood. Although, there is a demand for more private outdoor spaces. These might include balconies on apartment buildings or larger yards for homeowners. Many people add amenities, such as fire pits or outdoor kitchens, for entertaining. Other attractive features to buyers include terraces and community gardens.

Interior designers can add more windows and open entryways to increase natural light. It can also give people a panoramic view of the trees. Also, builders must keep in mind access to clean air. So, there should be high-quality-filtration systems. Homeowners should change the filters at least every three months.

6. Having More Community Spaces

Post-Pandemic, many people value community. Urban housing design is shifting toward redefining public and private spaces. These include gardens, terraces, lounge spaces and inner courtyards. Many apartments advertise these amenities, such as pools, gyms and co-working spaces.

The communal areas are places for residents to meet and connect. It also allows people from different generations and backgrounds to bond. The shift also saves architects' space by reducing the demand for private amenities.

7. Creating Flexible Spaces

Homes now use movable walls to turn an open concept apartment into dedicated spaces. The idea of flexibility and adaptability is key in future design plans. With people working and spending more time at home, they need to be able to move around items. The office space can be tucked away during the evening or when guests are over. The work area should incorporate natural elements for a more productive environment.

Some homeowners like to decorate the space with plants. A flexible layout allows for a more sustainable design and incorporation of technology. For example, there is a shift toward more energy-efficient homes. Also, there is a push to reduce our carbon footprint during construction.

8. Offering More Access to Public Transportation

With the focus on health, some people are now walking or riding bikes around the city. This also cuts down commute time and prevents them from sitting in traffic. So, access to public transportation systems is key. Plus, with the increased ride-sharing options, people have more freedom to get around.
Smart cities can also increase people's mobility. For example, traffic speed and usage data can help engineers optimize traffic flow. Using public transportation is more convenient and better for the environment. To further support the planet, more people are buying electric cars.

9. An Emphasis on Health

After the pandemic, many people are more focused on their health. So, it's essential to keep this in mind when designing buildings. Technology is helping to reduce viruses and pollutants. Quality air filters are a common feature in urban housing design.
Another trend is using naturally antibacterial material like copper or cork. Also, certain appliances may use UV light to disinfect t home products quickly. In addition, proper ventilation is critical to clean indoor air. So, using smart HVAC systems can remove toxins.

10. Including Affinity Hubs

Hybrid work seems to be the new norm for now. So, these pubs offer amenities and promote outdoor collaboration. The space aims to bring people together through shared amenities and key institutions. For example, seating areas, food options and computer stations could be available.

The hub is the perfect spot for sharing and learning new ideas. It can allow people with common interests to connect. The affinity hubs also promote diversity.

11. Using Data to Make Decisions

It's important for renters to co-manage public spaces. Builders can use data mining strategies to learn about their preferences. This helps drive design plans and ensure engineers are making the right modifications. For example, designers can use underused lots to create community and wellness spaces.

Technology can also help in the construction process. It can assist in creating blueprints and testing ideas.

Here are a few examples of devices:

- Drones
- Building information Software (BIM)
- Virtual Reality
- 3D printing
- Artificial Intelligence

12. Taking Advantage of Technology

Artificial intelligence (AI) can help understand how to make smarter spending choices. The devices can create algorithms to test urban theories. Some startups are using AI to analyze data about cities.
This allows them to gain knowledge of the area's characteristics and compositions. AI technologies have already helped to build complex structures and prefab houses.

The Shift in Urban Housing Design

Urban design has changed over time. Due to cultural shifts and the pandemic, people's needs are different. They want more open layouts to connect with nature and feel a greater sense of community.

PROF. SILKY PAREYANI
ASSISTANT PROFESSOR-EC

PIEZOELECTRIC ACCELEROMETERS WITH INTEGRATED ELECTRONICS PIEZOELECTRIC (IEPE)

Amplifiers with high input impedance are required to successfully extract the acceleration information from a piezoelectric sensing element. With some piezoelectric accelerometers, the amplifier is built into the sensor housing.

The abbreviation IEPE, short for integrated electronics piezoelectric, is used to distinguish these piezoelectric sensors from those that don't have built-in electronics. The output of an IEPE sensor is a low impedance voltage signal, whereas piezoelectric sensors that don't have built-in electronics can only produce a charge output. The amplifier employed in an IEPE sensor can be a voltage amplifier or a charge amplifier.

In this article, we'll use the term "voltage mode IEPE" to refer to an IEPE with a voltage amplifier, and the term "charge mode IEPE" for an IEPE sensor with an internal charge amplifier. We'll also use the term "charge output sensor" to refer to a piezoelectric sensor that doesn't have an internal amplifier.

Understanding Voltage Mode in an IEPE Accelerometer

To begin with, let's keep in mind a basic diagram of a voltage mode IEPE sensor, which is depicted in Figure 1.

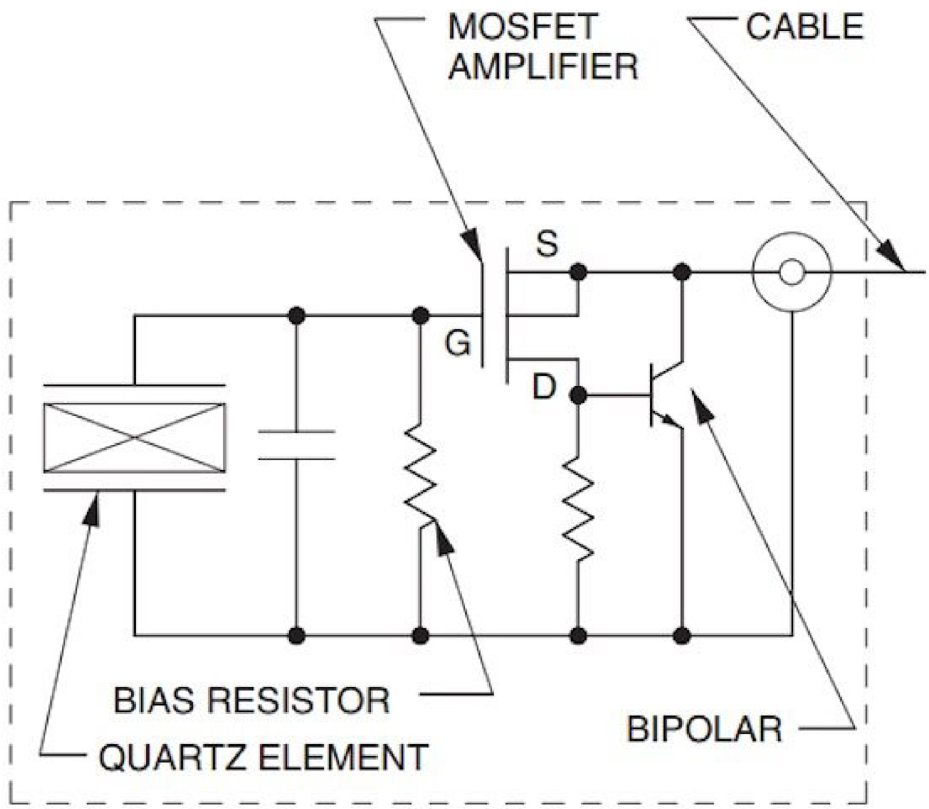


Figure 1. Example diagram of a voltage mode IEPE sensor. Image [adapted] used courtesy of Dytran

Keeping that figure in mind, let's dive into the sensing element, amplifier configuration, and discharge time constant for voltage mode IEPE.

The Sensing Element

While both quartz and piezo-ceramic crystals can be used in a voltage mode IEPE, quartz sensing elements are naturally better suited for voltage mode signal conditioning because they have lower capacitance and produce a larger voltage for a given amount of electric charge (according to V = q/C). Quartz is a natural crystal, whereas ceramics are man-made. Ceramics have both high voltage sensitivity and high charge sensitivity types. A piezo-ceramic with high voltage sensitivity can also be used in voltage mode IEPE sensors.

The Amplifier Configuration

As shown in Figure 1, the first stage of the amplifier incorporates a field-effect transistor (FET) to maximize the input resistance of the amplifier and avoid creating a leakage path for the charge produced by the sensor. At the output stage, the amplifier uses a bipolar transistor to improve line driving capability. In the above figure, the amplifier is a unity-gain source follower configuration. The source terminal of the transistor, as well as the circuit ground terminal, are brought out of the sensor housing to be connected to the power unit through a coaxial cable. The power unit of the IEPE sensors will be examined in another article.

The voltage that builds up across the sensing element (ΔV) is given by:

$$\Delta V=\Delta q/C_{total}$$

where Δq denotes the produced electric charge and Ctotal is the total capacitance "seen" at the gate of the FET transistor. The same voltage change (ΔV) riding on top of a DC voltage also appears at the output of the unity-gain amplifier. The DC value of the output without excitation is typically in the 8 V to 12 V range.

The Discharge Time Constant

The charge produced by the sensor, which appears across the capacitor, can gradually leak off through the resistance "seen" at the gate of the FET transistor. The total resistance multiplied by the total capacitance at this node determines the discharge time constant.

The discharge time constant determines the quasi-static behavior of the amplifier. Figure 2(b) shows how a limited time constant can introduce error when the input remains constant for a sufficiently long time (Figure 2(a)).

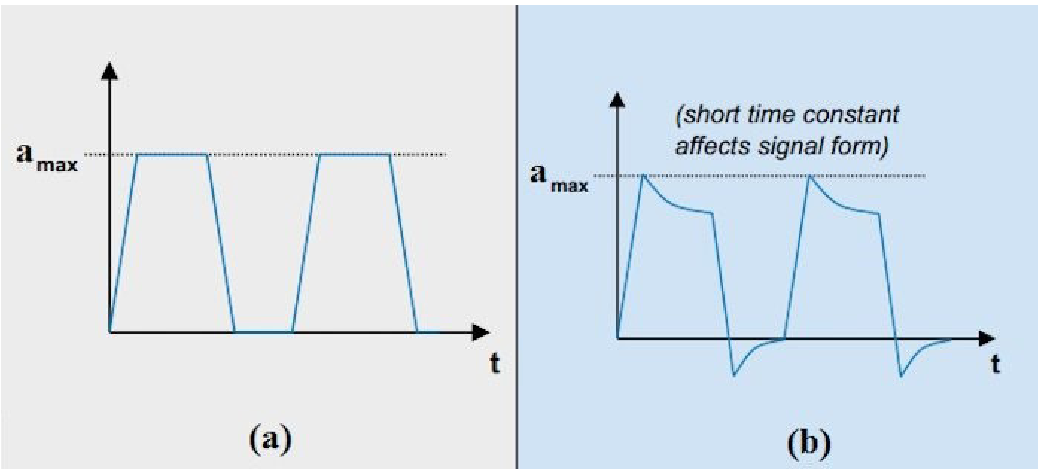


Figure 2. (a) Input acceleration waveform and (b) the output when the amplifier has a short time constant. Image (adapted) used courtesy of Kistler

Charge Mode IEPE Accelerometers

A charge mode IEPE uses an internal charge amplifier as shown in Figure 3.

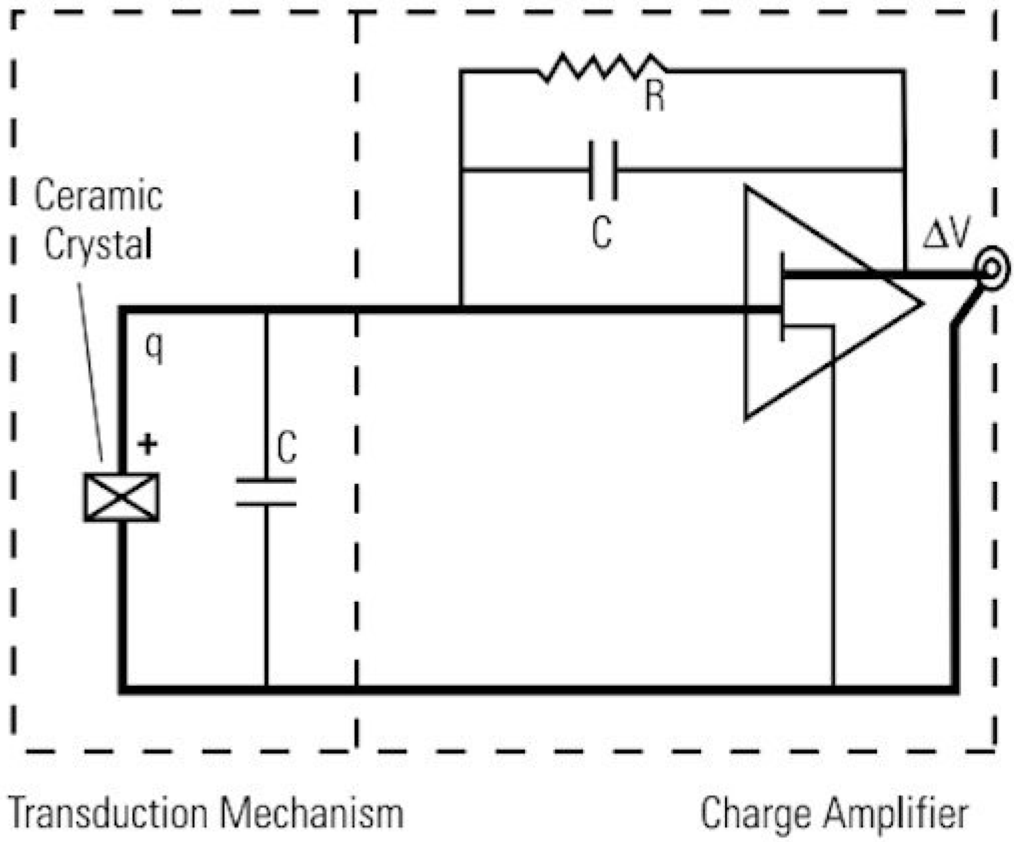


Figure 3. An example diagram of an internal amplifier in a charge mode IEPE. Image used courtesy of PCB Piezotronics

Charge mode IEPE accelerometers tend to be more common than the voltage mode type (to learn about the workings of charge amplifiers, please refer to the previous article that is linked at the beginning).

When compared to an equivalently proportioned ceramic element, quartz crystals typically have a higher voltage sensitivity and a lower charge sensitivity. The low charge sensitivity of quartz can limit its usefulness in charge mode IEPEs. This reason is why ceramic sensing elements are more commonly used in charge mode IEPEs.

Note that, just like the voltage mode IEPE, both the output signal and the supply voltage of the charge mode IEPE are brought out of the sensor through a standard coaxial or a two-conductor cable.

Dynamic Range of an IEPE Sensor

The DC value at the output of an IEPE sensor without excitation is typically in the 8 V to 12 V range. However, this DC voltage can change with temperature and the supply current provided by the power unit. The actual measured DC value of the output is reported on the calibration certificate supplied with each device. Figure 4 illustrates the dynamic range of a typical IEPE sensor.

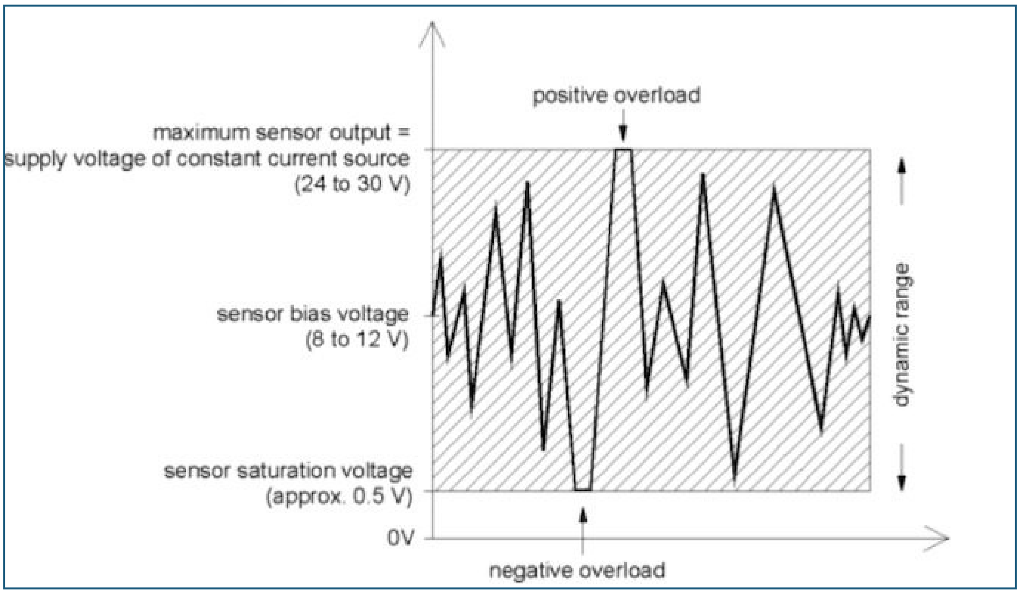


Figure 4. A graph showing the dynamic range of an IEPE sensor. Image used courtesy of MMF

The output voltage is always positive and the upper limit is determined by the supply voltage of the power unit. The lower limit, on the other hand, is determined by the amplifier parameters. Beyond this range, we'll have a clipped waveform as shown in the figure above. Keep in mind that these voltage levels may differ from manufacturer to manufacturer.

Figure 5 shows the dynamic range of an example IEPE sensor from PCB Piezotronics for two different supply voltages (Vs1 = 24 VDC and Vs2 = 18 VDC).

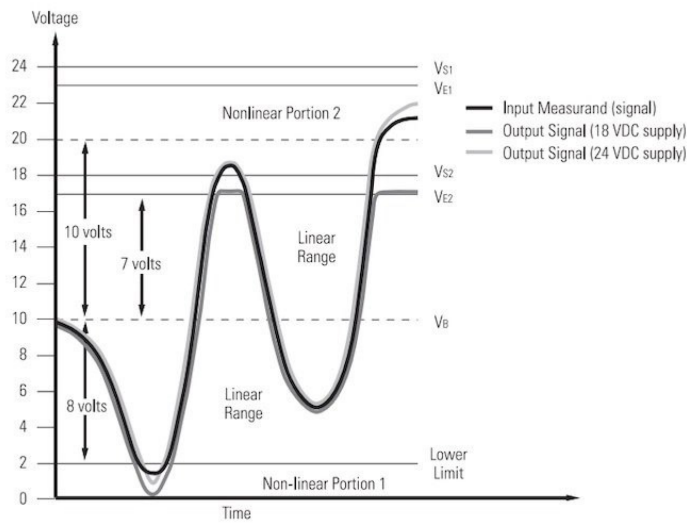


Figure 5. The dynamic ranges of an example IEPE sensor. Image used courtesy of PCB Piezotronics

In this figure, the solid curve represents the expected output, while the shaded curves represent the actual outputs for Vs1 = 24 VDC and Vs2 = 18 VDC. The DC value of the output is VB = 10 V in this example. The lower limit for this IEPE accelerometer from PCB is about 2 V. The upper limit for this sensor is 1 V lower than the employed supply voltage. This 1 V drop is required to keep the current limiting diode inside the power unit functioning correctly. The supply voltage of the PCB Piezotronics' IEPE sensors is generally within the range of 18 to 30 volts.

As shown in the figure, with a supply voltage of Vs2 = 18 V, the output is clipped at VE2 = 17 V. This can be solved by increasing the supply voltage to Vs1 = 24 V, giving an upper limit of VE1 = 23 V.

Maximum Swing Range Due to Linearity Limitations

It should be noted that the sensor might not be able to operate linearly all the way up to the positive rail. As shown in Figure 5, even with Vs1 = 24 V, the sensor deviates from the expected curve due to linearity limitations when the output gets close to the positive rail. To ensure that the sensor can produce accurate results, we need to take into account the specified maximum swing range of the device in addition to the swing limitation from the supply voltage.

An IEPE sensor typically has a maximum swing of ±3 V, ±5 V, or ±10 V. With the example shown in Figure 5, it is assumed that the sensor's maximum swing is ±10 V. That's why the region 10 V higher than the bias voltage VB = 10 V is specified as the non-linear region. With Vs2 = 18 V, the maximum swing in the positive direction is limited to 8 V due to the supply voltage limitations. Increasing the supply voltage from 18 V to 24 V allows us to take full advantage of the maximum swing of the device and achieve a maximum positive swing of 10 V. The negative swing for both supply options, however, is determined by the 2 V lower limit, giving a maximum negative swing of 8 V for this example.

In the next article, we'll look at the diagram of a typical power unit that can be used to supply power to an IEPE sensor. We'll also look at the advantages and limitations of both the IEPE type and charge output sensors.

PROF. SUNIL SHAH
ASSISTANT PROFESSOR-EC

IoT COMMUNICATION PROTOCOLS — NETWORK PROTOCOLS

One of the main pillars of IoT is its connectivity. It consists of a huge network of elements, both objects and people of different sizes and shapes, which are connected to gather and share information. In general, the information is gathered and used to automate or help make decisions. Due to the variety of data types and applications, different communication and network protocols are needed.

In this article, we will review the main characteristics of some of the main IoT protocols, as well as some of their pros and cons.

IoT Communication Parameters

Before taking the leap and deploying an IoT solution, it is critical to know the limiting factors of each technology. Communication protocols are the set of rules established between nodes to exchange information in a reliable and safe manner. Here are some of the main aspects of a communication protocol:

Speed or Data Rate: The amount of information to be transmitted within a time duration. It is usually expressed in bps (bits per second), kbps, Mbps, or Gbps.

Range: The maximum distance between two intercommunicating nodes. It mainly depends upon the transmitting power, the frequency band used, and the type of modulation. It can be also affected by the meteorological conditions or the physical placement of the nodes. In Figure 1 you can see a rough graph of the data rate versus the range of various IoT network protocols.

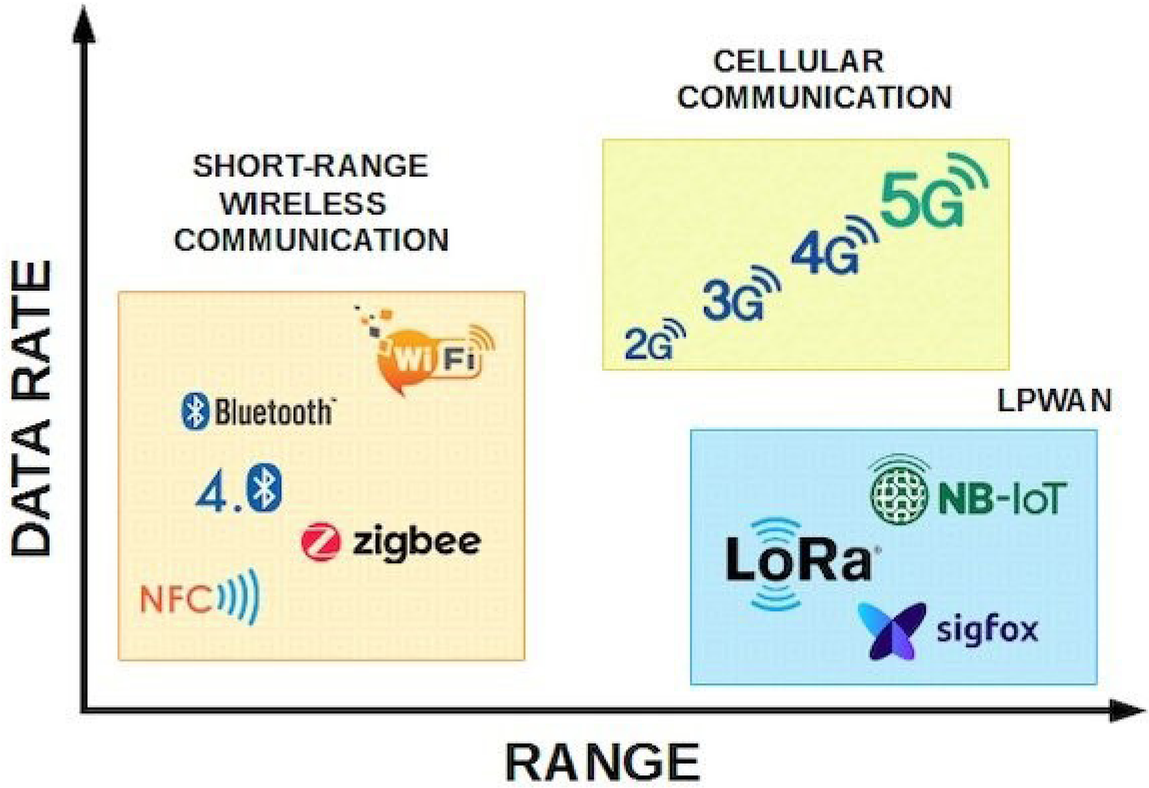


Figure 1. Data rate vs. range of various IoT network protocols. Image used courtesy of Embien

Power Consumption: The amount of energy that a node needs to work within its lifetime. This parameter defines the need for permanent power or the use of a battery. Since there are many applications using batteries, thus power consumption is a critical parameter. This means it will affect other elements such as the number of sensors or the communication power transmission. Furthermore, since batteries have a limited lifetime, the power consumption can have a direct impact on the maintenance strategy.

Interoperability: The capability to exchange information between nodes, even if they are of different types.

Scalability: The challenge of deploying a higher number of nodes, increasing the number of end-users, as well as the amount of data to store and process without the need of migrating the technology.

Cost: The price of installing and maintaining a specific technology. Power consumption, maintenance, and scalability have a big impact on the network cost.

Network Topology: The way nodes communicate with each other. Topologies can be the same as those used in traditional networks. Star, mesh, point-to-point, and point-to-multipoint are some examples of topologies, which can be seen in Figure 2.

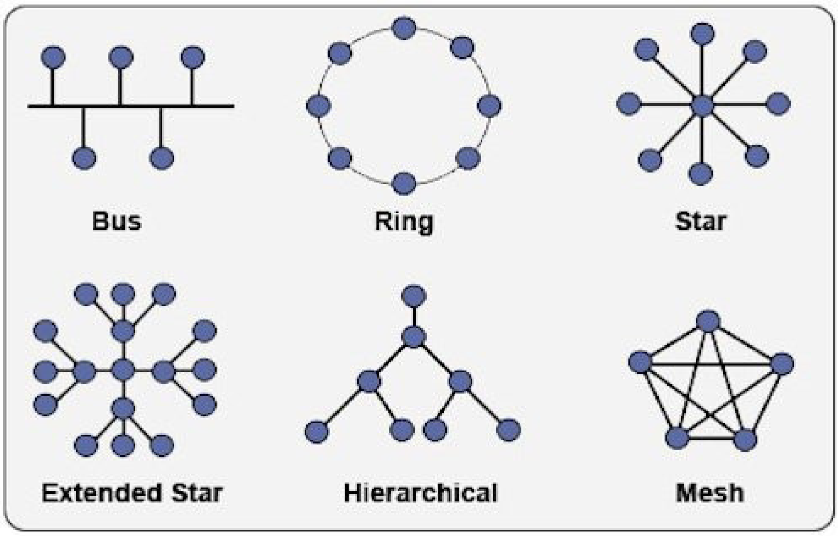


Figure 2. Examples of different network topologies. Image used courtesy of ITPRC

Security: The way to protect data being sent and received. It is necessary to ensure that the communication transmitted between nodes arrives only at the intended nodes. The IoT technologies are already ubiquitous and they can communicate sensitive information to the users; thus, the communication needs to be protected against third parties.

IoT Protocol Basics

Protocols allow nodes to have a structured way to interact between them. Since the needs and use cases of IoT devices have quickly evolved over the last few years, so have the protocols. All in all, there are mainly two types of protocols: network and data. This classification comes from the OSI (open systems interconnection) model, widely used in IT communication networks. Below you can get a general understanding of the main IoT network protocols.

Bluetooth: This protocol works within the frequency of 2.4 GHz, and can be used for short-range (<100 m) applications. One step further into Its evolution is Bluetooth Low Energy (BLE), which presents a significant reduction in the power needed for this protocol. This type can be beneficial for the transmission of small amounts of data from sensors or wearables. An example node network layout can be seen in Figure 3.

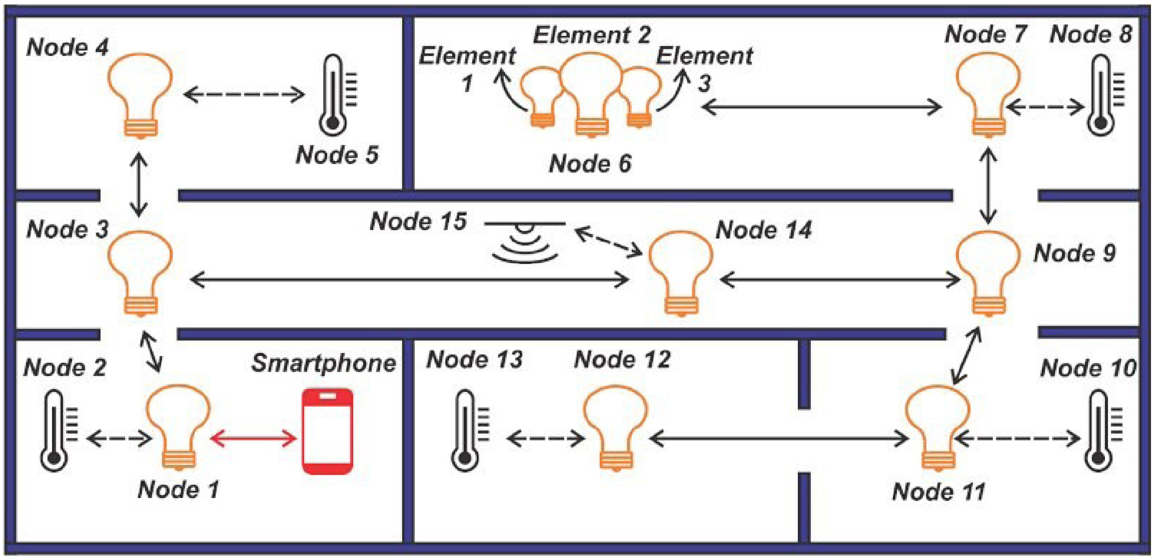


Figure 3. An example of Bluetooth IoT network nodes in a smart home.

Cellular: Current cellular infrastructure can be also used to extend the communication capabilities of IoT nodes. Depending upon the chosen band and the specific technology, it can be adequate for low power applications (e.g., 2G) as well as for high data rates applications (e.g., LTE). Additionally, there are subtypes of cellular communications, such as the LTE-M and NB-IoT, which were born to provide more data bandwidth or lower power use, respectively.

LoRaWAN: it is a low-power, wide-area (LPWA) protocol designed for battery-powered systems. It operates in the sub GHz 433/868/915 MHz and within the 2.4 GHz. LoRaWAN networks generally follow star topologies, where the elements are: end nodes, gateways, and a set of servers. The OSI reference model can be seen in Figure 4.

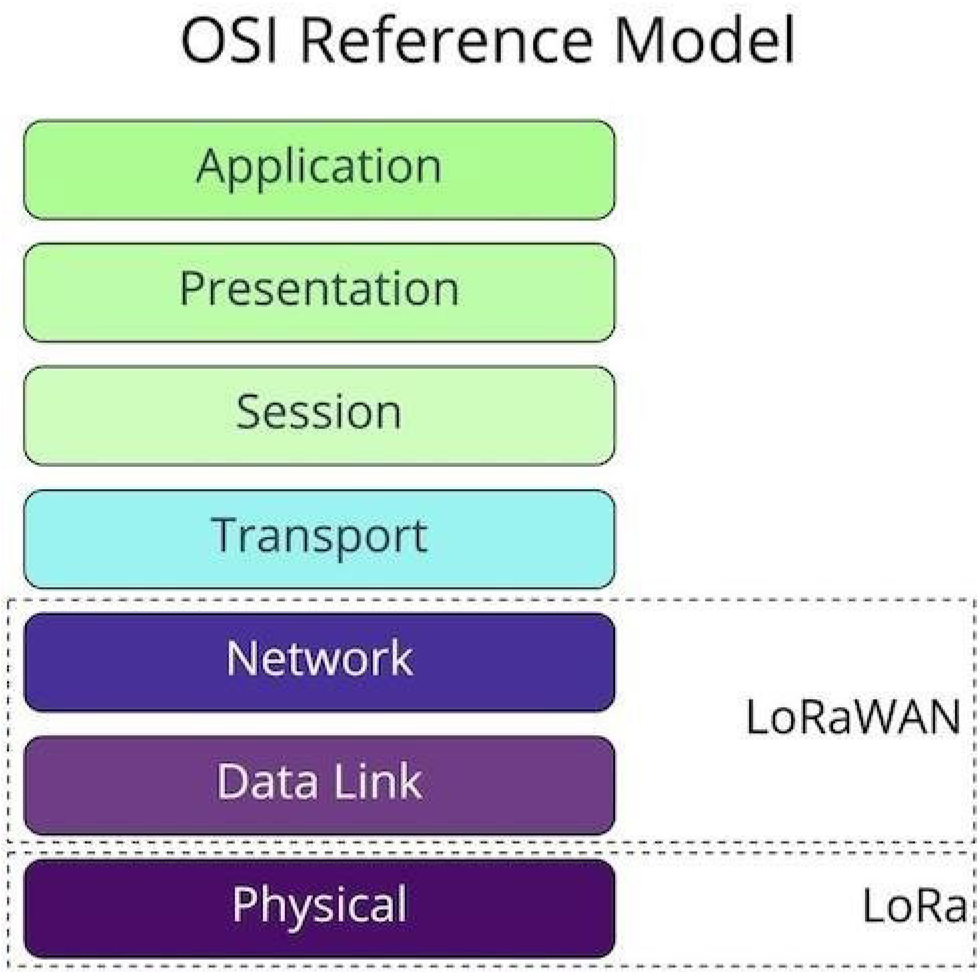


Figure 4. The OSI reference model for LoRa and LoRaWan.

Near field communications (NFC): NFC works in the frequency band of 13.56 MHz and the range is a few centimeters. This type of communication is used to extend close-contact communications. In NFC there is an active node (such as a smartphone) generating an RF field that energizes a tag. It works in the frequency band of 13.56 MHz and the range is a few centimeters.

Sigfox: Sigfox uses a technology-based ultra-narrow band (UNB) and it works in the ISM bands, requiring a dedicated infrastructure. It means that it can be globally used but a local operator is needed.

Wi-FI: Working in the frequency of 2.4 GHz and 5 GHz, Wi-Fi connectivity is widely chosen because of its pervasiveness and high data rates. Its main drawback is its high power consumption, so it is not frequently used in battery-powered applications.

Wi-Sun: Wi-Sun is a field area network (FAN) protocol created by the Wi-Sun Alliance and designed to have a low power consumption and latency. It operates in the sub GHz frequency bands as well as in the 2.4 GHz band through a mesh topology.

ZigBee: This communication protocol works in the 2.4 GHz band, for short-range (<100 m) in restricted areas. ZigBee is made for transmitting small amounts of information, namely where really low latency is needed and is widely used in the industry and consumer applications. The ZigBee RF4CE was made to replace IR remote controls (e.g., TVs and DVD systems) and remove the need of having a line of sight between the remote control and the device.

Z-wave: intended for home automation applications (Figure 5), working in ISM frequency bands and with a rate up to 100 Kbps. Its applications follow a mesh network topology performing up to 4 hopes.

Figure 5. An example application of a Z-Wave IoT network at home. Image used courtesy of Qubino

The following table (Table 1) shows the main characteristics of the listed communication protocols, ordered by range:

Table 1. Communication protocol characteristics

Protocol	Frequency	Range	Data Rates
Bluetooth	2.4 GHz	100 m	125 Kbps–Mbps
Wi-Fi	2.4 GHz, 5 GHz	50 m	150–600 Mbps
NFC	13.56 MHz	4 cm	100–420 Kbps
LoraWAN	867–869 MHz (Europe)	15 Km	0.3–50 Kbps
Cellular	902–928 MHz (North America)	30 m (Between node and base station)	21 Mbps (3G+)

Z-wave	900/1800/1900/2100 MHz	100 m	600 Mbps (4G)
Zigbee	865–926 MHz (ISM)	100 m	100 Kbps
Sigfox	2.4 GHz (ISM)	3–50 Km	20 Kbps–250 Kbps
Zigbee	900 MHz	100 m	10–1000 bps
Sigfox	900 MHz	3–50 Km	10–1000 bps

PROF. S.U. KHAPARKAR
ASSISTANT PROFESSOR-EC

LIST OF PROFESSIONAL ACTIVITIES CONDUCTED IN THE SESSION

S.No.	Name of Professional Societies/ Chapters	Event and Title	Date of event
1	IETE	Guest Lecture on Challenges And opportunities: Core Companies, Higher Education and Entrepreneurship"	21/08/2020
2	ISF	Workshop on "Labview and its applications"	09/10/2020
3	IETE	Guest Lecture on "Design and Fabrication of PCB"	27/11/2020
4	ISTE	Guest Lecture on "Microwave Integrated Circuits"	29/01/2021
5	ISTE	Guest Lecture on "Emerging Trends in Signal & Image Processing, Communication, VLSI Design and Nano Technology"	22/02/2021
6	ISF	Workshop on "SQL programming"	10/04/2021
7	ISTE	Workshop on "Dotnet"	18/05/2021

PLACEMENTS OF 2016-20 BATCH

S.NO	NAME OF THE STUDENT PLACED	ENROLLMENT NO.	NAME OF THE EMPLOYER
1	ANUSHA GUPTA	0206EC161030	HCL
2	DIPTI SINGH	0206EC161052	INFOSYS
3	ANUKRITI DUBEY	0206EC161029	ARTECH
4	PALLAVI THAKUR	0206EC161090	ARTECH
5	AKSHAY KUMAR ADVANI	0206EC161017	COLLABERA
6	SAKSHAM MAHAJAN	0206EC161129	COLLABERA
7	PRAGYA TIWARI	0206EC161097	DXC
8	SACHET PATLE	0206EC161126	DXC
9	SHUBHAM PATEL	0206EC161154	DXC
10	TARUN VISHWAKARMA	0206EC161171	DXC
11	PRIYANSHI DUBEY	0206EC161106	FIZROBOTICS
12	SUPRIYA SHUKLA	0206EC161166	FIZROBOTICS
13	PRATEEKSHA GUPTA	0206EC161099	HCL
14	AKASH SAXENA	0206EC161015	HEXAWARE
15	MAHIMA SHUKLA	0206EC161073	HEXAWARE
16	PRIYA PRASAD	0206EC161104	HEXAWARE
17	ABHA PAHWA	0206EC161004	IBM
18	ASTHA PAHWA	0206EC161039	IBM
19	PRAGYA GUPTA	0206EC161095	IBM
20	RICHA SATSANGI	0206EC161116	IBM
21	SHRISHTI BAJPAI	0206EC161148	IBM
22	SUNITI KHATRI	0206EC161165	IBM
23	NIKHIL OCHANI	0206EC161086	INFOCEPTS
24	SHRISHTI RAI	0206EC161149	INFOCEPTS
25	HIMANSHU JOSHI	0206EC161063	INFOSYS
26	PALAK SINGH	0206EC161089	INFOSYS
27	RADHIKA SAH	0206EC161110	INFOSYS
28	RISHI PANDEY	0206EX161044	INFOSYS
29	SAUMYA AGRAWAL	0206EC161137	INFOSYS
30	SAUMYA PRASAD	0206EC161138	INFOSYS
31	YASHITA JAIN	0206EC161185	INFOSYS
32	ADARSH KUMAR GOYAL	0206EC161009	KEC INTERNATIONAL

33	AYUSH MISHRA	0206EC161042	KEC INTERNATIONAL
34	AYUSHI SATSANGI	0206EC161044	KEC INTERNATIONAL
35	AISHWARYA CHOUKSEY	0206EE161003	TCS
36	ANKUR MISHRA	0206EC161024	TCS
37	ARUN NAIR	0206EC161035	TCS
38	ASHITA SAROWA	0206EC161038	TCS
39	BHAVYA SHUKLA	0206EC161048	TCS
40	JAINAM SINGHAI	0206EC161065	TCS
41	JAYSHREE PATLE	0206EC161067	TCS
42	MEGHA NORIYA	0206EC161079	TCS
43	PRAGYA TALWAR TALWAR	0206EC161096	TCS
44	RAHUL TIWARI	0206EC161111	TCS
45	RITIKA TIWARI	0206EC161121	TCS
46	SAIM OMAR KHAN	0206EC161128	TCS
47	SAKSHI PATHAK	0206 EC 161131	TCS
48	SHREYA DEO	0206EC161146	TCS
49	SHRUTI SHRIVASTAVA	0206EC161151	TCS
50	SOMYA JAIN	0206EC161159	TCS
51	SRAJAN SONI	0206EC161161	TCS
52	STUTI NEHRA	0206EC161162	TCS
53	SUHASINI CHOUDHARY	0206EC161164	TCS
54	YAMAN KUMAR KUSHWAHA	0206EC161181	TCS
55	AKSHITA ANAND SHRIVASTAVA	0206EC161018	WIPRO
56	ANKIT JAIN	0206EC161023	WIPRO
57	SARTHAK RAJ NEHRA	0206EC161134	WIPRO
58	AAKANKSHA SUNDRANI	0206EC161001	AMDOCS
59	ANUJ AGRAHARI	0206EC161028	AMDOCS
60	MANAS MUKESH LANDGE	0206EC161075	AMDOCS
61	RIYAM ROY	0206EC161123	AMDOCS
62	ROHIT KUSHWAHA	0206EC161124	AMDOCS
63	SHAILY SINGH RAJPUT	0206EC161141	AMDOCS
64	AASHI SHRIVASTAVA	0206EC161002	BRITISH TELECOM
65	AKRITI SARAOGI	0206EC161016	BRITISH TELECOM
66	ANJALI VERMAN	0206EC161021	BRITISH TELECOM
67	RIYA MISHRA	0206EC161122	BRITISH TELECOM

68	SHREYAL TIWARI	0206EC161147	BRITISH TELECOM
69	VARSHA SEN	0206EC161175	BRITISH TELECOM
70	YOGESH VISHWAKARMA	0206EC161188	BRITISH TELECOM
71	SHUBHAM SHRIVASTAVA	0206EC161155	BYJU'S
72	IQBAL SINGH BATI	0206EC161064	CAPGEMINI
73	SALONI ABRAHAM	0206EC161132	CAPGEMINI
74	SARITA BURMAN	0206EC173D01	CAPGEMINI
75	SUDHANSHU PAYASI	0206EC161163	CAPGEMINI
76	DEEPIKA RAMESH IYER	0206EC161051	CAPGEMINI
77	HARSHITA JANI	0206EC161061	CAPGEMINI
78	RISHIKA SHARMA	0206EC161120	CAPGEMINI
79	ANMOL SAHU	0206EC161026	COFORGE
80	ARPIT LANGRE	0206EC161034	COFORGE
81	BHARTI MODI	0206EC161046	COFORGE
82	MUKUL NARWARE	0206EC161082	COFORGE
83	PURNIMA GUPTA	0206EC161108	COFORGE
84	RISHAVH KUMAR MAJHWAR	0206EC161119	COFORGE
85	SHRASHTI PANDAY	0206EC161145	COFORGE
86	YASHWANT KOSHTA	0206EC161186	COFORGE
87	SHUBHAM AHUJA	0206EC161153	COFORGE
88	MAHENDRA MISHRA	0206EC161071	COGNIZANT
89	MEENAKSHI SHRIVASTAVA	0206EC161077	COGNIZANT
90	RICHA SAHU	0206EC161115	COGNIZANT
91	SNEHIL RAO	0206EC161109	COGNIZANT
92	UDITI SHARMA	0206EC161172	COGNIZANT
93	RAJA PATERIA	0206EC161112	COGNIZANT
94	PRACHI VISHWAKARMA	0206EC161093	COGNIZANT
95	NAMITA JHA	0206EC161084	COGNIZANT
96	ARYAN AGRAWAL	0206EC161036	COGNIZANT
97	ANMOL PANDE	0206EC161025	COGNIZANT
98	APURVA GUPTA	0206EC161033	DONGFANG
99	RAHUL TIWARI	0206EC161111	DONGFANG
100	SHIVAM SHARMA	0206EC161144	DONGFANG
101	PRIYANSHU DATTA	0206EC161107	ENTUPLE TECHNOLOGIES (P) LTD.
102	PRANATI REBECCA SINGH	0206EC161098	INFOSYS

103	SHRUTI TIWARI	0206EC161152	INFOSYS
104	SURBHI NEMA	0206EC16167	INFOSYS
105	SUYASH SINGH	0206EC161169	INFOSYS
106	EESHA TIWARI	0206EC161054	INFOSYS
107	SAFAL JAISWAL	0206EC161127	INFOSYS
108	HARSHIT BARMAN	0206EC161060	IRRIGATION DEPT., BALAGHAT
109	ADITYA SINGH	0206EC161012	MPHASIS
110	JUHI SINGH	0206EC161069	MPHASIS
111	NAMAN AGRAWAL	0206EC161083	MPHASIS
112	PRIYANKA RAO	0206EC161105	MPHASIS
113	HARI BHANU MISHRA	0206EC161059	MPHASIS
114	NITYA RANJAN KHUNTIA	0206EC161088	MPHASIS
115	BHAVESH SHARMA	0206EC161047	TECH. MAHINDRA
116	VANDNA CHOUDHARY KUMARI	0206EC161174	TECH. MAHINDRA
117	AKASH RAJ LARHIYA	0206EC161014	VODAFONE
118	BHAVESH SHARMA	0206EC161047	VODAFONE
119	JITESH CHOURASIA	0206EC161068	VODAFONE
120	SOUMYA PATHAK	0206EC161160	VODAFONE
121	STUTI NEHRA	0206EC161162	VODAFONE
122	VISHAL PATEL	0206EC161179	VODAFONE
123	ABHA PAHWA	0206EC161004	VODAFONE
124	DEEKSHA SHARMA	0206EC161050	VVDN
125	MITALEE SONI	0206EC161080	VVDN
126	SHABA KHAN	0206EC161139	VVDN
127	VIPUL CHOURASIA	0206EC161177	VVDN
128	UTKARSH YADAV	0206EC161173	VVDN
129	SWAPNIL DEWANI	0206EC161170	XDBS, PUNE