

METAL DETECTING ROBOT USING IOT

Submitted in partial fulfilment of the requirements for the award of

Bachelor of Engineering degree

in

Electronics and Communication Engineering

by

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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS**

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC

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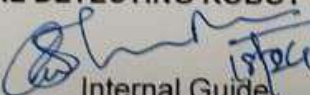
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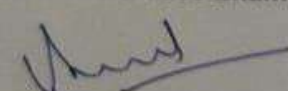
This is to certify that this Project Report is the Bonafede work of **K. KUMAR KRISHNA NIKHIL (39130245)** and **K. Satya Seshagiri Chakravarthi (39130247)** who carried out the project entitled "**METAL DETECTING ROBOT USING IOT**"

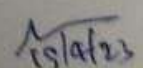

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DECLARATION

We K.Satya Seshagiri Chakaravarthi (39130247) K.Kumar Krishna Nikhil (39130245) here by declare that the Project Report entitled "**METAL DETECTING ROBOT USING IOT**" done by us under the guidance of Dr.M.S.GODWIN PREMI,M.E, Ph.D., professor, Department of Electronics and Communication Engineering is submitted in partial fulfillment of the requirements of the award of Bachelor of Engineering degree In Electronics and Communication Engineering.

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Abstract

The main objective of the system is to develop a robot to perform surveillance in domestic areas. Now plays a vital role in our daily lives robot thus reducing human labor actions and human errors. The robots it can be automatic pilot, depending on requirement. In this system, using robot that can be applied to us or laptop via mobile Internet of Things (IOT). And a robot controlled automated manual using the NodeMCU. In this system various data collected by the sensors and send it to the NodeMCU controller. It will send it to the cloud. The output obtained directly in user can see on mobile or laptop as well as the presence of any object we can easily send an alert to the higher authorities. Thus, there was an operation can be. still the same thing can be the progress of our plan of surveillance robot.

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CHAPTER 1

INTRODUCTION

Different technological terms such as Telecommunications, Internet of Things (IoT), and robotics have been considered a vital part of our daily activities. Although its advances and limitations, innovative tech can be solved fundamental issues and save lives for many people for political or financial purposes. In the electronic era, speed, flexibility, and automation are major defiance that is enabling researchers to meet the challenges of the society against the quick development of the techs. Robotics have been becoming dynamically significant for several standard applications. Applications such as military, Salvage and Urban Hunt. Due to its human reduction activities in a severe environment. Effectiveness metal and landmine detections are two vital research areas that still considered more attractive to researchers due to investing tech. According to Landmine and Cluster Munition Monitor report in 2014, more than 110 million landmines in the ground scattered in 68 countries. So, landmines and metal detector robots are the advances innovation of the crucial and most dangerous part of the humanitarian detection process. Multi-sensor robot, path planning algorithm, and vehicle-mounted sensors are different strategies that used to search and detect mines.

These applications are because they provide a safe route for the soldiers through minefields. Robotics, communication, and data analysis have been advanced with high-speed achieved in landmine detection domain [1]. Data management, analysis, and archiving for the detection, navigating, and mapping area will open the door to p
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220 more deployed possibilities for furthermore mapping and detection areas.

Automation mechanism presents easier and faster scanning process due to it provides the guarantee to more rapid the scanning processing and investigation automatically. As well, it fits more deployed capabilities based on the big data received to disclose and recognize metals and mines from other objects. Several attempts by authors have been made for research and development perspectives concern assist or automate human deminers in the humanitarian demining and scanning process to reduce efforts, time, cost, human risks and dangerous issues by proposing diverse efficient and suitable robotics landmine detection with several sensors design.

Recent robotics research involves various trends such as sensor technology, Ground-Penetrating Radar (GPR), Electromagnetic Induction (EMI), Nuclear Quadrupole Resonance (NQR) and so on to perform multi-functions such as detection, deactivating, extracting, and demining for explosive devices, cluster munitions, landmines as well avoiding obstacles; These trends can deploy in diverse soil kinds such as foliage, dry and desert soil based on Aerial and wheel techniques for landmine detection.

Proposed Marwa which is a landmine detecting robot. Marwa is supported with a robotic arm whose payload a metal detector and provided visual information to be a visual serving system to benefit researchers with limited resources to work in this area.

Also, presented a metal mine signals for detection purpose to estimate the depth of the metallic targets. The metal mine detector using robotic manipulator to take advantage of high precision scanning of the minefield; the proposed detector was fast and accurate in Humanitarian Demining; As well, its pre-build library containing data of many targets at different postures and depths. Whereas a remote robot is conducted to identify personnel landmines in diverse domains.

The detector was obtained (87.5%) accuracy from a set of 8 different materials in identifying mines. Also, the detection system can be implemented in different terrains. introduced three-way to avert the issues of using one technology by using data fusion of multi-sensor system based on developing decision level fusion to decrease false alarms. While, presented multi-sensor data-fusion approach by a high accuracy geo-referencing the field-data acquired by multiple platforms to localize and detect purposes in landmines domain. Likewise, introduced a novel landmine detection sensor that based on the principle of 2-DOF vibration absorber system.

The proposed new sensor gives the sensitivity of 1559 Hz/ (MN/m) and linearity better than (95%). Besides, in 2016, Hank and Haddad presented a mobile robot for autonomous-navigation problem based on a hybrid approach; the produced navigator subjected to perform an emergency task with shorter execution times.

As alongside, designed and fabricated an efficient wireless controlled robot to detect landmine in defense fields as well avoiding the obstacles robustly; H-Bridge module used to control the robot wheels and wireless camera added to capture and located off the robot destination. Also, proposed a low-altitude autonomous flight to detect

landmines; the system called Backstepping + DAF which is an integrated system architecture based on lightweight GPR.

As well, a hybrid platform introduced by Ghareeb et al. (2017), speed data transferring and transmission quality to improve central unit destination that is based on web server and a database server application to store data regarding the navigation field for current mapping and detection or future investigation purpose. In this research, highlights on metal detection issues. Also, the capability to detect mines, avoid obstacles. The proposing system using the concept of metal detection sensor and ultrasonic sensor, wireless communication via controlled robotics vehicle remotely for flat surfaces and dry, desert soils to design and fabricate detect metals without human harm. Also, proposed an integrated management and achieving system to control, manage and stored the navigation results with online structured query language databased registry on a server side to give high-security system. As well, conduct a comparative analysis of the proposed robot detection systems and focus on their main findings and systems features like detection, controlling, management, and archiving information in the database server for future mapping and navigation.

The rest of the article is structured as follows:

In Section 2, describes hardware and software that required to produce the controlling, management, and archiving system that includes three subsections are metal detector robot architecture, management and controlling the metal detector robot, and archiving database system.

Section 3 presents all steps and processes to implement the proposed detection system. Besides, results and discussion will be included in Section 4.

Whereas Section 5 gives a comparison of the works that have been done to detect landmine detection. Finally, Section 6 concerns with conclusions and future directions.

CHAPTER 2

Literature survey

[1] Ghareeb, M., Bazzi, A., Raad, M., & AbdulNabi, S, “Wireless robo-Pi landmine detection. In Landmine: Detection, Clearance, and Legislations (LDCL),” 2017 First International Conference on (pp. 1-5). IEEE, April 2017.

The tremendous recent involvement of technology in our life generates a lot of advantages and disadvantages. Nevertheless, and to highly augment its positive influence, at the expense of the negatives, technology must be deployed to serve humanity and society. In this article, we highlight the importance of involving robotics, communication, and data analysis in the domain of land mine detection. The main idea is to design and implement a prototype of an efficient low-cost automated mine detector that will replace the current employed human detectors in the mission of detecting and extracting mines in a suspected area of land.

This detector will wirelessly communicate with a server to transmit the detected information such as the location of the metal object and captured images of the land where does it exist. The proposed system will help in significantly reducing the risk poses to the human detectors lives while they are in a field of mines.

Besides, automation will guarantee an easier and faster scanning process that will open the door to more developed possibilities such as automatically investigating the received big sizes of data for recognizing mines from other left behind normal objects.

[2] Craig, J. J., “Introduction to robotics: mechanics and control,” Upper Saddle River, NJ, USA: Pearson/Prentice Hall, Vol. 3, pp. 48-70, 2005.

The history of industrial automation is characterized by periods of rapid change in popular methods. Either as a cause or, perhaps, an effect, such periods of change in automation techniques seem closely tied to world economics. Use of the industrial robot, which became identifiable as a unique device in the 1960s, along with computer-

aided design (CAD) systems and computer-aided manufacturing (CAM) systems, characterizes the latest trends in the automation of the manufacturing process.

These technologies are leading industrial automation through another transition, the scope of which is still unknown. In North America, there was much adoption of robotic equipment in the early 1980s, followed by a brief pull-back in the late 1980s. Since that time, the market has been growing, although it is subject to economic swings, as are all markets. Figure 1.2 shows the number of robots being installed per year in the major industrial regions of the world. Note that Japan reports numbers somewhat differently from the way that other regions do they count some machines as robots that in other parts of the world are not considered robots (rather, they would be simply considered "factory machines").

Hence, the numbers reported for Japan are somewhat inflated. A major reason for the growth in the use of industrial robots is their declining cost. Figure indicates that, through the decade of the 1990s, robot prices dropped while human labor costs increased. Also, robots are not just getting cheaper, they are becoming more effective—faster, more accurate, more flexible. If we factor these quality adjustments into the numbers, the cost of using robots is dropping even faster than their price tag is. As robots become more cost effective at their jobs, and as human labor continues to become more expensive, more and more industrial jobs become candidates for robotic automation.

This is the single most important trend propelling growth of the industrial robot market. A secondary trend is that economics aside, as robots become more capable, they become able to do more and more tasks that might be dangerous or impossible for human workers to perform.

[3] Li, Shelei, Xueyong Ding, and Tingting Yang. "Analysis of Five Typical Localization Algorithms for Wireless Sensor Networks." *Wireless Sensor Network* 7.04: 27, 2015.

In this paper, the self-localization problem is studied. It is one of the key technologies in wireless sensor networks (WSNs). And five localization algorithms: Centroid

algorithm, Amorphous algorithm, DV-hop algorithm, APIT algorithm and Bounding Box algorithm are discussed.

Simulation of those five localization algorithms is done by MATLAB. The simulation results show that the positioning error of Amorphous algorithm is the minimum. Considering economy and localization accuracy, the Amorphous algorithm can achieve the best localization performance under certain conditions.

[4] Magrabi F, Aarts J, Nohr C, et al., “A comparative review of patient safety initiatives for national Health information technology,” Int J Med Inform; 82: e139–48, 2013.

Implementation of health information technology (IT) has presented several unanticipated patient safety issues, particularly related to computerized provider order entry. Health IT vendors generally have a "hold harmless" clause that removes their liability for patient harm due to health IT failures. This review explores patient safety initiatives for health IT systems across six countries, including the United States. Significant gaps in health IT safety initiatives were identified, including inadequate regulatory oversight in the US for these medical devices. The authors conclude that greater standardization and oversight is required to ensure safety for all types of health IT systems.

An AHRQ WebM&M interview with Dr. David Bates discusses the benefits and potential risks of health IT.

[5] Pugh, J., and Martinoli, A., “Inspiring and modeling multi-robot search with particle swarm optimization,” In Swarm Intelligence Symposium, 2007. SIS 2007. IEEE (pp. 332-339). IEEE, April 2007.

Within the field of multi-robot systems, multi-robot search is one area which is currently receiving a lot of research attention. One major challenge within this area is to design effective algorithms that allow a team of robots to work together to find their targets. Techniques have been adopted for multi-robot search from the particle swarm

optimization algorithm, which uses a virtual multi-agent search to find optima in a multi-dimensional function space. We present here a multi-search algorithm inspired by particle swarm optimization. Additionally, we exploit this inspiration by modifying the particle swarm optimization algorithm to mimic the multi-robot search process, thereby allowing us to model at an abstracted level the effects of changing aspects and parameters of the system such as number of robots and communication range.

[6] Rjeib, H. D., Ali, N. S., Al Farawn, A., Al-Sadawi, B., and Alsharqi, H., “Attendance and Information System using RFID and Web-Based Application for Academic Sector,”

Recently, students' attendance has been considered as one of the crucial elements or issues that reflects the academic achievements and the performance contributed to any university compared to the traditional methods that impose time-consuming and inefficiency. Diverse automatic identification technologies have been more in vogue such as Radio Frequency Identification (RFID). Extensive research and several applications are produced to take maximum advantage of this technology and bring about some concerns. RFID is a wireless technology which uses to a purpose of identifying and tracking an object via radio waves to transfer data from an electronic tag, called RFID tag or label to send data to RFID reader.

The current study focuses on proposing an RFID based Attendance Management System (AMS) and information service system for an academic domain by using RFID technology in addition to the programmable Logic Circuit (such as Arduino), and web-based application. The proposed system aims to manage student's attendance recording and provides the capabilities of tracking student absentee as well, supporting information services include students grading marks, daily timetable, lectures time and classroom numbers, and other student-related instructions provided by faculty department staff. Based on the results, the proposed attendance and information system is time-effective, and it reduces the documentation efforts as well as, it does not have any power consumption.

Besides, students' attendance RFID based systems that have been proposed are also analyzed and criticized respect to systems functionalities and main findings. Future directions for further researchers are focused and identified.

[7] Suresh, K., Vidyasagar, K., and Basha, A. F., “Multi Directional Conductive Metal Detection Robot Control. International Journal of Computer Applications, 109(4), 2015.

As technology is growing there is a considerable demand on machine interface to the controlling system. Robotics is an era where mechanical structures are powered by interfacing personal computers with the improved software tools. Hyperlink is a standalone program to interact with the devices remotely interfaced with the personal computers. Wireless communication is also a supporting mechanism to regulate the direction and movement of the robotic machines. This paper aims to direct the conductive metal finding robot in all eight directions.

An IR sensor assembly is used to position the robot to move with defined angle. Concentric coil type metal detector is used to pinpoint the targeted metal. Offset Quadrature phase shift keyed modulation stream (OQPSK) with 2.4 G Hz is used for transmitting the information to the remote-control section of the robot. The mechanical load calculations are estimated to design the robot. The developed model is best suited on uneven surfaces.

[8] Ambruš, D., Vasić, D., and Bilas, V., “Robust estimation of metal target shape using time-domain electromagnetic induction data,” IEEE Transactions on Instrumentation and Measurement, 65(4), 795-807, 2016.

Discriminating metal parts of buried hazardous targets from ordinary metallic clutter is a very difficult and time-consuming task. For that purpose, electromagnetic induction (EMI) sensors composed of multiple transmitter/receiver coils in multi-axis arrangements are commonly used. In this way, data of high fidelity and spatial diversity are obtained so that the target can be characterized in terms of its geometric and electromagnetic properties. However, this often increases sensor size and reduces its portability, which is a problem for humanitarian demining applications, where compact, robust, and lightweight sensors are needed. If such sensors are to be used for target characterization, robust estimation algorithms are required, capable of coping with

limited spatial information content and uncertainties related to sensor positioning and its coil geometry model.

In this paper, we present a robust concept for estimating the general shape of magnetic metal targets using time-domain EMI sensors with single-axis coil geometries. We introduce the signature matrix; a parameter derived from time-dependent eigenvalues of the target's magnetic polarizability tensor and use it for shape estimation. The proposed method was evaluated both through simulations and experiments, using two different sensor platforms (laboratory-based experimental sensor platform and a commercial metal detector mounted on a mobile robot).

The obtained results clearly indicate that the target shape can be estimated from sensor data of limited spatial diversity and under the uncertainties of sensor positioning and coil geometry.

[9] Albert, F. Y. C., Mason, C. H. S., Kiing, C. K. J., Ee, K. S., and Chan, K. W., "Remotely operated solar-powered mobile metal detector robot," *Procedia computer science*, 42, 232-239, 2014.

This paper presents the development of a remotely operated solar-powered metal detector robot to assist in the humanitarian effort of landmine detection. The deployment of solar-powered metal detector robot on field sites makes the landmine detection system free of the need for refueling and electrical independence. With the incorporation of inductive sensor, video camera and ATmega32 microcontroller to detect metallic landmines surrounding the suspicious areas. The proposed robotic system was designed and implemented using radio frequency (RF) module for device communication. The robot was tested and analyzed, showing a high-precision metal-detection result, which is competent in robotics applications on landmine sites.

[10] Ali, N. S., Alyasseri, Z. A. A., and Abdulmohson, A., "Real-Time Heart Pulse Monitoring Technique Using Wireless Sensor Network and Mobile Application," *International Journal of Electrical and Computer Engineering (IJECE)*, 8(6), 2018.

Wireless Sensor Networks (WSNs) for healthcare have emerged in the recent years. Wireless technology has been developed and used widely for different medical fields. This technology provides healthcare services for patients, especially who suffer from chronic diseases. Services such as catering continuous medical monitoring and get rid of disturbance caused by the sensor of instruments.

Sensors are connected to a patient by wires and become bed-bound that less from the mobility of the patient. In this paper, proposed a real-time heart pulse monitoring system via conducted an electronic circuit architecture to measure Heart Pulse (HP) for patients and display heart pulse measuring via smartphone and computer over the network in real-time settings. In HP measuring application standpoint, using sensor technology to observe heart pulse by bringing the fingerprint to the sensor via used Arduino microcontroller with Ethernet shield to connect heart pulse circuit to the internet and send results to the web server and receive it anywhere.

The proposed system provided the usability by the user (user-friendly) by the special. Also, it offered speed and results accuracy, the highest availability with the user on an ongoing basis, and few cost.

CHAPTER 3

Existing And Proposed System

Existing System

- The robot is controlled from the pc in ZigBee communication using application software. Forward, right move, left move and backward direction commands from the application software will drive the robot in any desired direction also will run with the application software.
- Microcontroller gets command from pc and transmit the information to the robot. Receiver microcontroller receives the data and performs the necessary movement of the robot using DC motors.
- Smoke Sensor is used to detect any fire/Bomb threat and indicating to control room. Wireless camera will be connected with receiver side microcontroller.
- This camera will monitor all the process simultaneously. We can monitor those things in TV through wireless tuner.
- The given proposed is done by using NodeMCU controlled robot the project is mainly concerned on surveillance in border.
- Ultrasonic sensor is used to detect the obstacle.
- PIR sensor used to detect the human motion.
- Vibration sensor is used to identify the any accidents near the robot. Like bomb explosion.
- Smoke Sensor is used to detect any fire/Bomb threat and will indicate to control room.
- Metal detector is used to detects the any land mines, disposal items. When the robot is detects the mines send a alert SMS through mail.
- The robot platform is control by using the internet streaming. If any object is detected.
- GPS is used to monitor the real time location of a robot.

Proposed System

- The given proposed is done by using NodeMCU controlled robot the project is mainly concerned on surveillance in border.
- Ultrasonic sensor is used to detect the obstacle.
- IR sensor used to detect the Object.
- Vibration sensor is used to identify the any accidents near the robot. Like bomb explosion.
- Smoke Sensor is used to detect any fire/Bomb threat and will indicate to control room.
- Metal detector is used to detects the any land mines, disposal items. When the robot is detects the mines send an alert SMS through mail.
- The robot platform is control by using the internet streaming. If any object is detected.

Advantages

- User friendly.
- Long range transmission.
- Can be implemented in all fields.
- Less expensive.

3.1 Block diagram

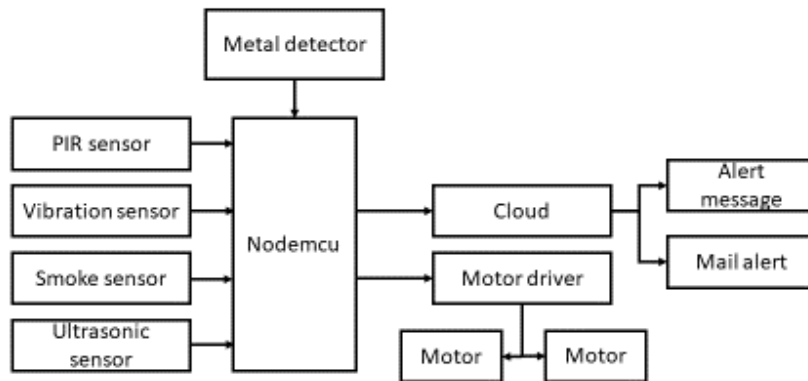


Fig 3.1.1 Block diagram

Hardware used:

- NodeMcu
- Pir sensor
- Ultrasonic sensor
- Vibration sensor
- Smoke sensor
- Metal detector
- Motor driver
- Motor

Software used:

- Arduino ide
- Embedded C

The IoT decision framework provides a structured approach to create a powerful IoT product strategy. The IoT decision framework is all about the strategic decision making. The IoT Decision Framework helps us to understand the areas where we need to make decisions and ensures consistency across all of our strategic business decision, technical and more.

The IoT decision framework is much more important as the product or services communicates over networks goes through five different layers of complexity of technology.

1. Device Hardware
2. Device Software
3. Communications
4. Cloud Platform
5. Cloud Application

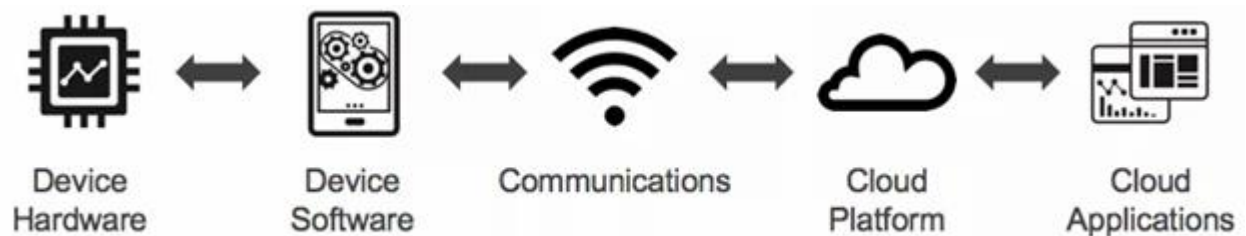


Fig 3.1.2 The IoT Technology Stack

Decision Area

The IoT decision framework pays attention to six key decision areas in any IoT product. These decision areas are:

1. User Experience (UX)
2. Data
3. Business
4. Technology
5. Security
6. Standards & Regulations

Each of these decision areas is evaluated at each of the IoT Technology Stack. The User Experience will be evaluated at Device Hardware, Device Software and so to

provide the better user experience. Then at the next step Data Decision Area, we have to explore data considerations for all the stages of IoT Technology Stack.

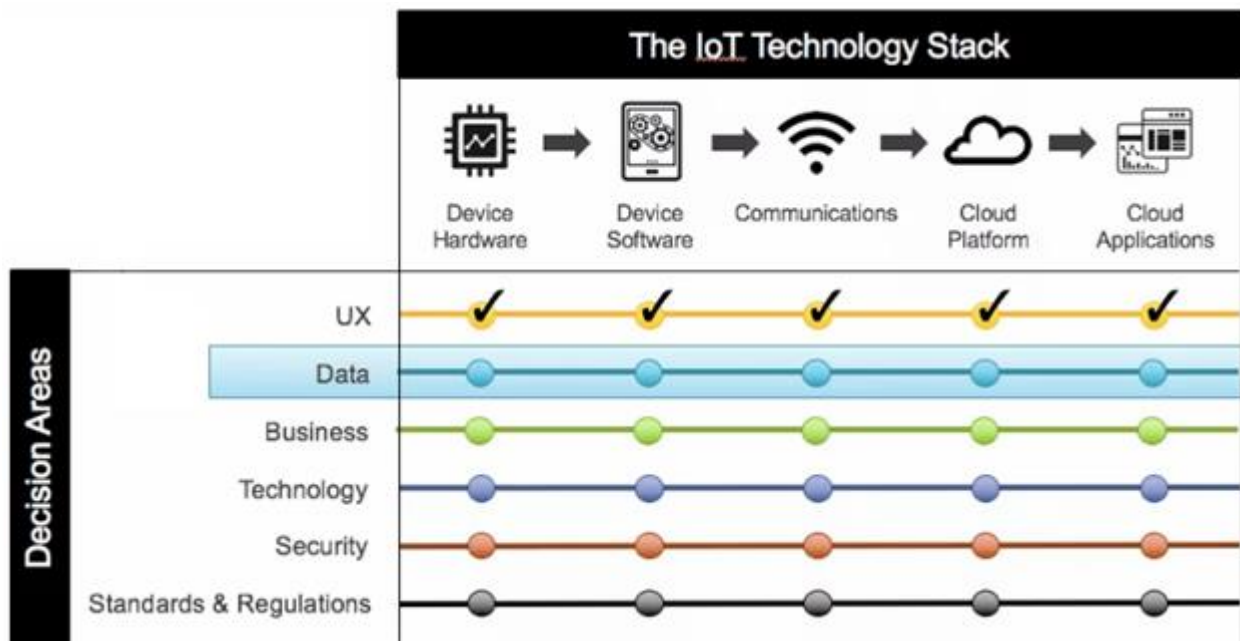


Fig 3.1.3 Decision Area of the IoT Decision Framework

Let's see each of the Decision Area of IoT Decision Framework in detail:

1. **User Experience Decision Area:** This is the area where we concentrate about who are the users, what are their requirements and how to provide a great experience at each step of IoT stack without worrying about the technical details.
2. **Data Decision Area:** In this area, we make the overall data strategy such as the data flow over the entire IoT stack to fulfill the user's requirements.
3. **Business Decision Area:** Based on the previous decisions area, we make the decision how product or services will become financial potential. At each of the IoT Stack level are monetized about the costs of providing services.
4. **Technology Decision Area:** In this area, we work with the technology for each layer to facilitate the final solution.
5. **Security Decision Area:** After going through the implementation of technology it is important to decide and provide the security at each stage of the IoT Stack.

6. **Standards & Regulations Decision Area:** At the last stage of IoT Decision Area, we identify the standards and regulations of product or services that will affect your product at each layer of the IoT Stack.

IoT Architecture

There is not such a unique or standard consensus on the Internet of Things (IoT) architecture which is universally defined. The IoT architecture differs from their functional area and their solutions. However, the IoT architecture technology mainly consists of four major components: IOT (Internet of Things):

IoT stands for Internet of Things, which means accessing and controlling daily usable equipment's and devices using Internet.

Our IoT tutorial includes all topics of IoT such as introduction, features, advantage and disadvantage, ecosystem, decision framework, architecture, and domains, biometric, security camera and door unlock system, devices, etc.

What is an Internet of Things (IoT)

Let's us look closely at our mobile device which contains GPS Tracking, Mobile Gyroscope, Adaptive brightness, Voice detection, Face detection etc. These components have their own individual features, but what about if these all communicate with each other to provide a better environment? For example, the phone brightness is adjusted based on my GPS location or my direction. Connecting everyday things embedded with electronics, software, and sensors to internet enabling to collect and exchange data without human interaction called as the Internet of Things (IoT).

The term "Things" on the Internet of Things refers to anything and everything in day-to-day life which is accessed or connected through the internet.

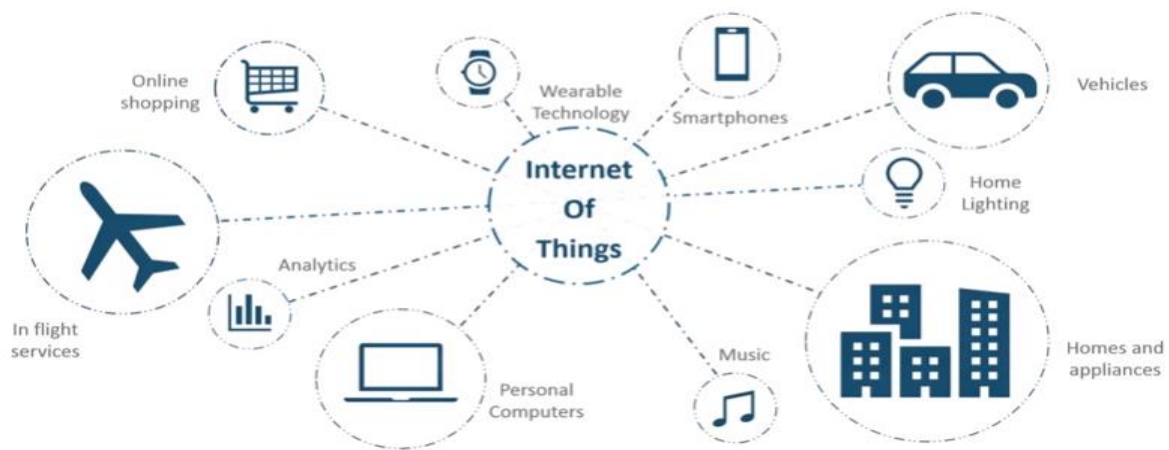


Fig 3.1.4 IoT

IoT is an advanced automation and analytics system which deals with artificial intelligence, sensor, networking, electronic, cloud messaging etc. to deliver complete systems for the product or services. The system created by IoT has greater transparency, control, and performance.

As we have a platform such as a cloud that contains all the data through which we connect all the things around us. For example, a house, where we can connect our home appliances such as air conditioner, light, etc. through each other and all these things are managed at the same platform. Since we have a platform, we can connect our car, track its fuel meter, speed level, and track the location of the car.



Fig 3.1.5 Example of IoT

If there is a common platform where all these things can connect to each other would be great because based on my preference, I can set the room temperature. For example, if I love the room temperature to be set at 25 or 26-degree Celsius when I

reach back home from my office, then according to my car location, my AC would start before 10 minutes I arrive at home. This can be done through the Internet of Things (IoT).

How does Internet of Thing (IoT) Work?

The working of IoT is different for different IoT echo system (architecture). However, the key concept of there working is similar. The entire working process of IoT starts with the device themselves, such as smartphones, digital watches, electronic appliances, which securely communicate with the IoT platform. The platforms collect and analyze the data from all multiple devices and platforms and transfer the most valuable data with applications to devices.

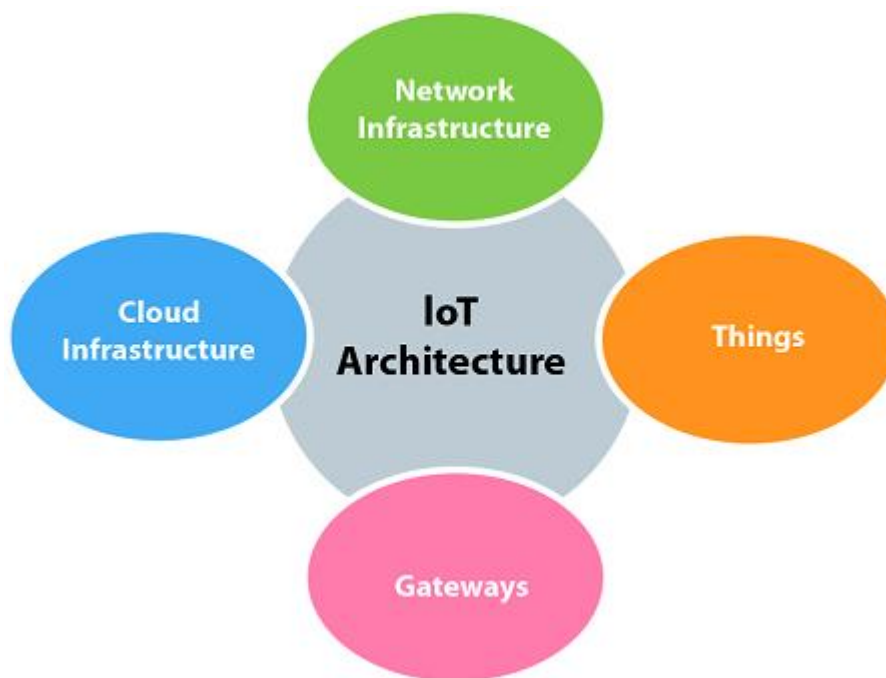


Fig 3.1.6 IoT Architecture

Features of IOT

The most important features of IoT on which it works are connectivity, analyzing, integrating, active engagement, and many more. Some of them are listed below:

Connectivity: Connectivity refers to establish a proper connection between all the things of IoT-to-IoT platform it may be server or cloud. After connecting the IoT devices, it needs a high-speed messaging between the devices and cloud to enable reliable, secure and bi-directional communication.

Analyzing: After connecting all the relevant things, it comes to real-time analyzing the data collected and use them to build effective business intelligence. If we have a good insight into data gathered from all these things, then we call our system has a smart system.

Integrating: IoT integrating the various models to improve the user experience as well.

Artificial Intelligence: IoT makes things smart and enhances life using data. For example, if we have a coffee machine whose beans have going to end, then the coffee machine itself order the coffee beans of your choice from the retailer.

Sensing: The sensor devices used in IoT technologies detect and measure any change in the environment and report on their status. IoT technology brings passive networks to active networks. Without sensors, there could not hold an effective or true IoT environment.

Active Engagement: IoT makes the connected technology, product, or services to active engagement between each other.

Endpoint Management: It is important to be the endpoint management of all the IoT system otherwise, it makes the complete failure of the system. For example, if a coffee machine itself order the coffee beans when it goes to end but what happens when it orders the beans from a retailer and we are not present at home for a few days, it leads to the failure of the IoT system. So, there must be a need for endpoint management.

Advantages and Disadvantages of (IoT)

Any technology available today has not reached to its 100 % capability. It always has a gap to go. So, we can say that **Internet of Things** has a significant technology in a world that can help other technologies to reach its accurate and complete 100 % capability as well.

Let's take a look over the major, advantages, and disadvantages of the Internet of Things.

Advantages of IoT

Internet of things facilitates the several advantages in day-to-day life in the business sector. Some of its benefits are given below:

- **Efficient resource utilization:** If we know the functionality and the way that how each device works, we definitely increase the efficient resource utilization as well as monitor natural resources.
- **Minimize human effort:** As the devices of IoT interact and communicate with each other and do lot of tasks for us, then they minimize the human effort.
- **Save time:** As it reduces the human effort then it saves out time. Time is the primary factor which can save through IoT platform.
- **Enhance Data Collection:**
- **Improve security:** Now, if we have a system that all these things are interconnected then we can make the system more secure and efficient.

Disadvantages of IoT

As the Internet of things facilitates a set of benefits, it also creates a significant set of challenges. Some of the IoT challenges are given below:

Embedded Devices (System) in (IoT)

It is essential to know about the embedded devices while learning the IoT or building the projects on IoT. The embedded devices are the objects that build the unique computing system. These systems may or may not connect to the Internet.

An embedded device system generally runs as a single application. However, these devices can connect through the internet connection, and able communicate through other network devices.

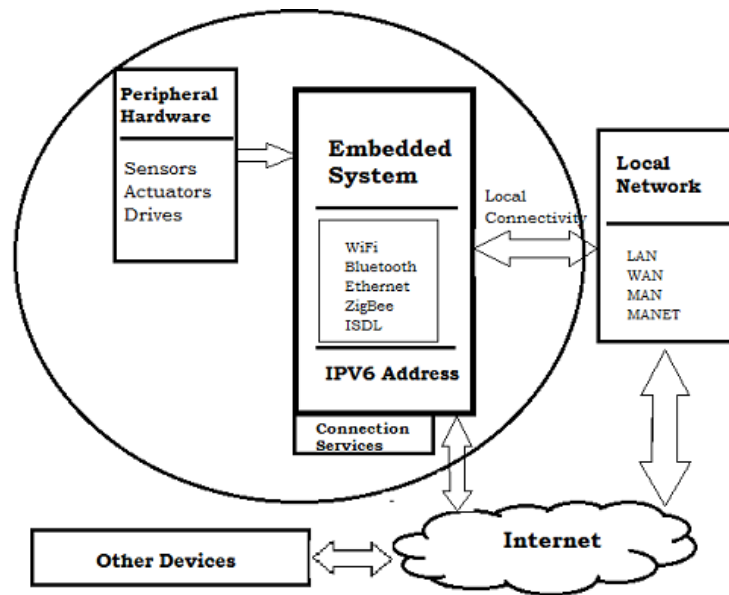


Fig 3.1.7 Embedded Devices in IoT

Embedded System Hardware

The embedded system can be of type microcontroller or type microprocessor. Both of these types contain an integrated circuit (IC).

The essential component of the embedded system is a RISC family microcontroller like Motorola 68HC11, PIC 16F84, Atmel 8051 and many more. The most important factor that differentiates these microcontrollers with the microprocessor like 8085 is their internal read and writable memory. The essential embedded device components and system architecture are specified below.

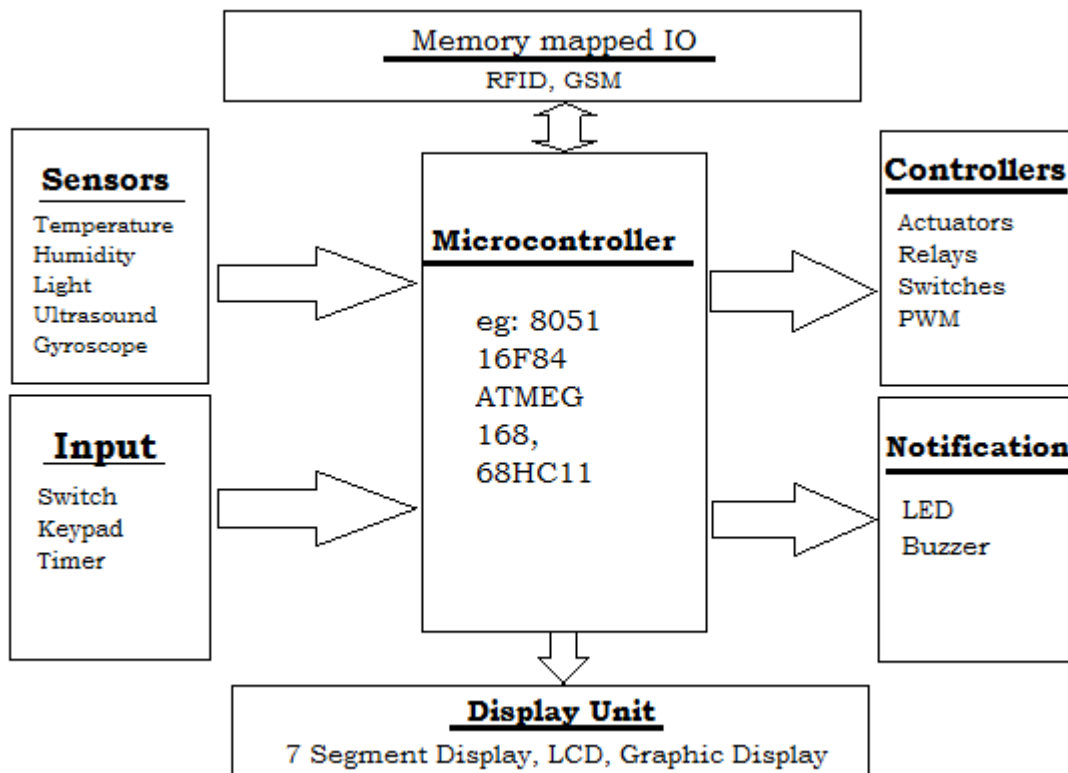


Fig 3.1.8 Basic Embedded System

Embedded System Software

The embedded system that uses the devices for the operating system is based on the language platform, mainly where the real-time operation would be performed. Manufacturers build embedded software in electronics, e.g., cars, telephones, modems, appliances, etc. The embedded system software can be as simple as lighting controls running using an 8-bit microcontroller. It can also be complicated software for missiles, process control systems, airplanes etc.

IoT Ecosystem

The IoT ecosystem is not easy to define. It is also difficult to capture its proper image due to the vastness and emerging possibility and the rapidity with which it is expanding in the entire sector. However, the IoT ecosystem is a connection of various kind of devices that sense and analyse the data and communicates with each other over the networks.

In the IoT ecosystem, the user uses smart devices such as smartphones, tablet, sensors, etc. to send the command or request to devices for information over the

networks. The device response and performs the command to send information back to the user through networks after analysed.

The typical IoT ecosystem is shown in below image, where the smarter devices send and receive data from the devices themselves in the environment that are integrate over network and Cloud Computing.

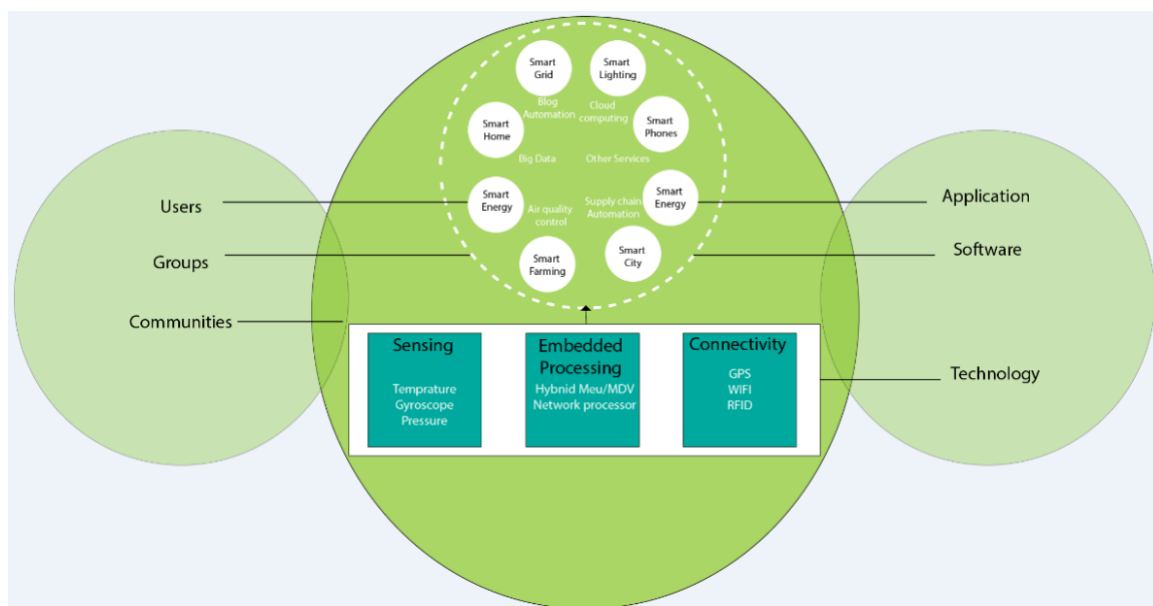


Fig 3.1.9 IoT Ecosystem

The IoT is itself an ecosystem of network devices that transfer the data. It is also well interconnected with Big Data and Cloud Computing.

- **Sensing, Embedded processing, Connectivity:** The IoT ecosystem senses its surrounding like temperature, gyroscope, pressure, etc. and make the embedded processing using devices. These devices are connected through any type of devices such as GPS, Wi-Fi, RFID, etc. over the networks.
- **Smart devices and environment, Cloud Computing, Big Data:** The data transfer or receive through smart devices and environments are communicated through Cloud Computing or other Servers and stored as Big Data.
- **Technology, Software, Application:** The IoT ecosystem uses any of different technologies, software, and application to communicate and connect with smart devices and environment.

- **Users or groups of community:** The product or services generated by the IoT ecosystem are consumed by the users or the group of communities to serve the smart life.

IoT Decision Framework

Components of IoT Architecture

- Sensors/Devices
- Gateways and Networks
- Cloud/Management Service Layer
- Application Layer

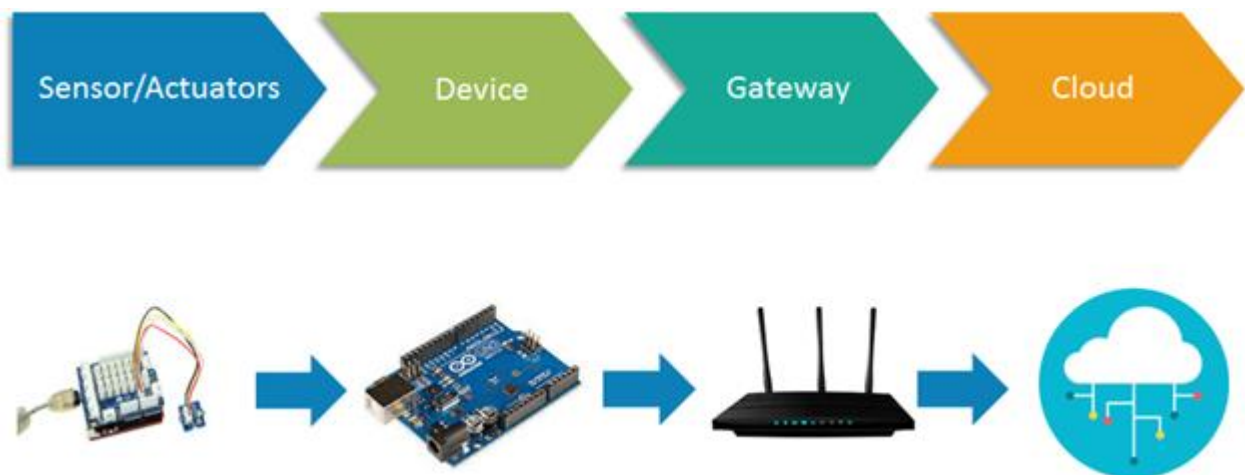


Fig 3.1.10 Stages of IoT Solutions Architecture

There are several layers of IoT built upon the capability and performance of IoT elements that provides the optimal solution to the business enterprises and end-users. The IoT architecture is a fundamental way to design the various elements of IoT, so that it can deliver services over the networks and serve the needs for the future.

Following are the primary stages (layers) of IoT that provides the solution for IoT architecture.

1. **Sensors/Actuators:** Sensors or Actuators are the devices that can emit, accept and process data over the network. These sensors or actuators may be connected either through wired or wireless. This contains GPS, Electrochemical, Gyroscope, RFID, etc. Most of the sensors need connectivity through sensors gateways. The connection of sensors or actuators can be through a Local Area Network (LAN) or Personal Area Network.
2. **Gateways and Data Acquisition:** As the large numbers of data are produced by these sensors and actuators need the high-speed Gateways and Networks to transfer the data. This network can be of type Local Area Network (LAN such as Wi-Fi, Ethernet, etc.), Wide Area Network (WAN such as GSM, 5G, etc.).
3. **Edge IT:** Edge in the IoT Architecture is the hardware and software gateways that analyze and pre-process the data before transferring it to the cloud. If the data read from the sensors and gateways are not changed from its previous reading value then it does not transfer over the cloud, this saves the data used.
4. **Data center/ Cloud:** The Data Center or Cloud comes under the Management Services which process the information through analytics, management of device and security controls. Beside this security controls and device management the cloud transfers the data to the end user's application such as Retail, Healthcare, Emergency, Environment, and Energy, etc.

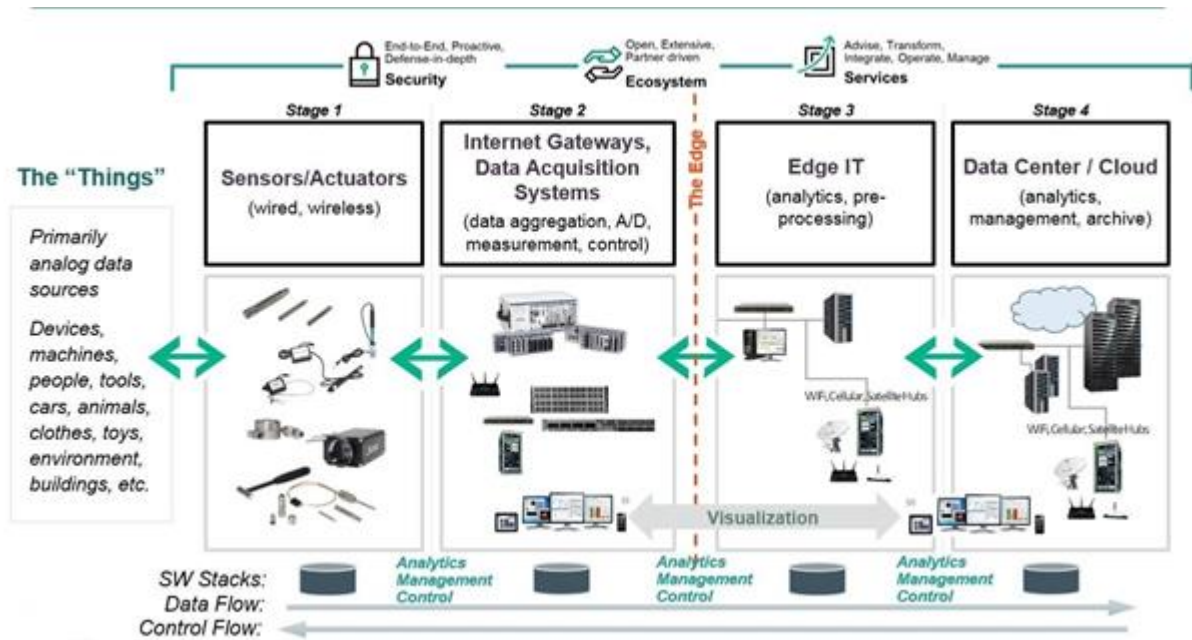


Fig 3.11 Layers of IoT

What are Smarts Objects in IoT

The concept of smart in IoT is used for physical objects that are active, digital, networked, can operate to some extent autonomously, reconfigurable and has local control of the resources. The smart objects need energy, data storage, etc.

A **smart object** is an object that enhances the interaction with other smart objects as well as with people also. The world of IoT is the network of interconnected heterogeneous objects (such as smart devices, smart objects, sensors, actuators, RFID, embedded computers, etc.) uniquely addressable and based on standard communication protocols.

In a day-to-day life, people have a lot of objects with internet or wireless or wired connection. Such as:

- Smartphone
- Tablets
- TV computer

These objects can be interconnected among them and facilitate our daily life (smart home, smart cities) no matter the situation, localization, accessibility to a sensor, size, scenario, or the risk of danger.



Fig 3.1.12 Smart Objects

Smart objects are utilized widely to transform the physical environment around us to a digital world using the Internet of things (IoT) technologies.

A smart object carries blocks of application logic that make sense for their local situation and interact with human users. A smart object sense, log, and interpret the occurrence within themselves and the environment, and intercommunicate with each other and exchange information with people.

The work of smart object has focused on technical aspects (such as software infrastructure, hardware platforms, etc.) and application scenarios. Application areas range from supply-chain management and enterprise applications (home and hospital) to healthcare and industrial workplace support. As for human interface aspects of smart-object technologies are just beginning to receive attention from the environment.

IoT Devices

Internet of Things Devices is non-standard devices that connect wirelessly to a network with each other and able to transfer the data. IoT devices are enlarging the internet connectivity beyond standard devices such as smartphones, laptops, tablets, and desktops. Embedding these devices with technology enable us to communicate and interact over the networks and they can be remotely monitored and controlled.

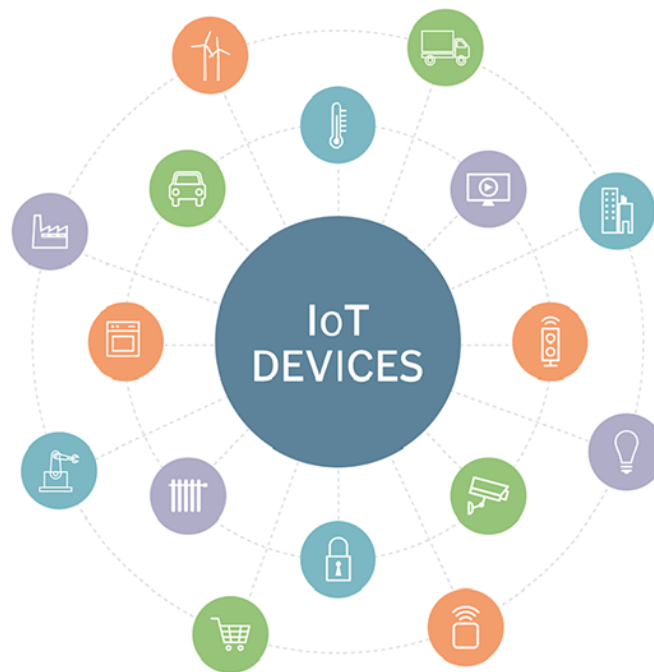


Fig 3.1.13 IoT devices

There are large varieties of IoT devices available based on IEEE 802.15.4 standard. These devices range from wireless motes, attachable sensor-boards to interface-board which are useful for researchers and developers.

IoT devices include computer devices, software, wireless sensors, and actuators. These IoT devices are connected over the internet and enabling the data transfer among objects or people automatically without human intervention.

Some of the common and popular IoT devices are given below:

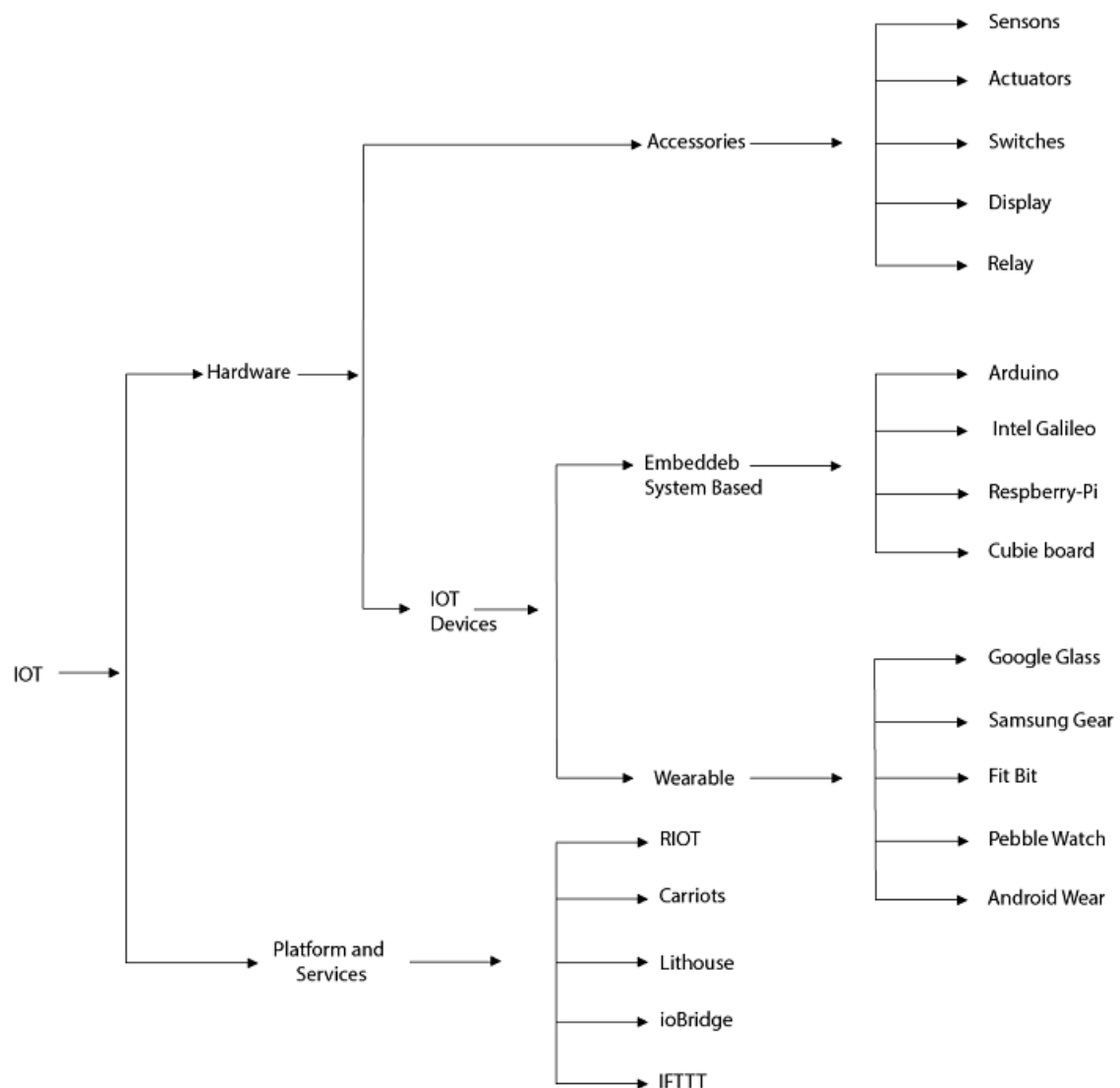


Fig 3.1.14 IoT devices

3.2: HARDWARE EXPLANTION:

3.2.1 Arduino UNO:

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing

software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs.

Arduino projects can be stand-alone, or they can communicate with software running on your computer. The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free.

The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment.

Arduino Uno:



Fig 3.2.1 ARDUINO UNO

3.3 Overview

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open source, which means hardware is reasonably priced and development software is free. This guide is for students in ME 2011, or students anywhere who are confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources.

This guide covers the Arduino Uno board (Spark fun DEV-09950, \$29.95), a good choice for students and educators. With the Arduino board, you can write programs and create interface circuits to read switches and other sensors, and to control motors and lights with very little effort. Many of the pictures and drawings in this guide were taken from the documentation on the

Arduino board looks like.



Fig 3.3.1 ARDUINO UNO

The Demilune board features an Atmel ATmega328 microcontroller operating at 5 V with 2 Kb of RAM, 32 Kb of flash memory for storing programs and 1 Kb of EEPROM for storing parameters. The clock speed is 16 MHz, which translates to about executing about 300,000 lines of C source code per second. The board has 14 digital I/O pins and 6 analog input pins. There is a USB connector for talking to the host computer and

a DC power jack for connecting an external 6-20 V power source, for example a 9 V battery, when running a program while not connected to the host computer. Headers are provided for interfacing to the I/O pins using 22 g solid wire or header connectors.

The Arduino programming language is a simplified version of C/C++. If you know C, programming the Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions.

An important feature of the Arduino is that you can create a control program on the host PC, download it to the Arduino and it will run automatically. Remove the USB cable connection to the PC, and the program will still run from the top each time you push the reset button. Remove the battery and put the Arduino board in a closet for six months. When you reconnect the battery, the last program you stored will run. This means that you connect the board to the host PC to develop and debug your program, but once that is done, you no longer need the PC to run the program.

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

3.3.1 NodeMCU:

NodeMCU Boards available in market refer [NodeMCU Development Boards](#)

NodeMCU Dev Kit has Arduino like Analog (i.e., A0) and Digital (D0-D8) pins on its board.

It supports serial communication protocols i.e., UART, SPI, I2C etc.

Using such serial protocols, we can connect it with serial devices like I2C enabled LCD display, Magnetometer HMC5883, MPU-6050 Gyro meter + Accelerometer, RTC chips, GPS modules, touch screen displays, SD cards etc.

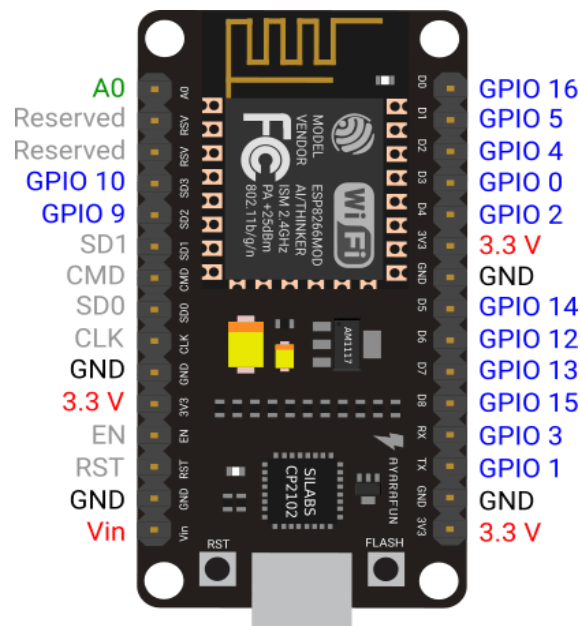


Fig 3.3.2: NodeMCU

- NodeMCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Expressive Systems, and hardware which is based on the ESP-12 module.
- The NodeMCU ESP8266 development board comes with the ESP-12E module containing ESP8266 chip having Ten silica Extensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects.

NodeMCU can be powered using Micro USB jack and VIN pin (External Supply Pin). It supports UART, SPI, and I2C interface.

Metal detector



Fig 3.3.3 Metal Detector

- A **metal detector** is an device that detects the nearby presence of metal. Metal detectors are useful for finding metal objects on the surface, underground, and under water. The unit itself, consists of a control box, and an adjustable shaft, which holds a pickup coil, which can vary in shape and size. If the pickup coil comes near a piece of metal, the control box will register its presence by a changing tone, a flashing light, and/or by a needle moving on an indicator. Usually, the device gives some indication of distance; the closer the metal is, the higher the tone in the earphone or the higher the needle goes. Another common type is stationary "walk through" metal detectors used at access points in airports and other secure areas to detect concealed weapons on a person's body.
- The simplest form of a metal detector consists of a transmitter producing an alternating current that passes through a coil producing an alternating magnetic field. If a piece of electrically conductive metal is close to the coil, an eddy current will be induced in the metal, and this produces a magnetic field of its own. If another coil is used to measure the magnetic field (acting as a receiver), the change in the magnetic field due to the metallic object can be detected.
- The first industrial metal detectors were developed in the 19th century and were used extensively for mineral prospecting and other industrial applications. Uses include detecting the presence of weapons such as knives and guns (especially in airports). Metal detectors are also used to detect foreign bodies in food, and in the medical field to detect metal in concrete and pipes and wires buried in walls and floors.

3.3.2 VIBRATION SENSOR:

With the proper sensor to supply the critical operating information, the machine operates in a safer condition for both the machine as well as the personnel operating the machine. Various machine operating conditions concerning temperature extremes, magnetic fields, vibration range, frequency range, electromagnetic compatibility (EMC) and electrostatic discharge (ESD) conditions and the required signal quality necessitate the need for a variety of sensors.



Fig 3.3.4 Vibration Sensor

There are some challenges related while measuring the vibration which includes a selection of suitable component, the configuration of the system, signal conditioning, analysis of waveform and setup. This article discusses what is a vibration sensor, working principle, types, and applications

3.3.3 Ultra-sonic sensor:

Ultrasonic sound vibrates at a frequency above the range of human hearing. ... Our ultrasonic sensors, like many others, use a single transducer to send a pulse and to receive the echo. The sensor determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse.

There are a variety of sensors based on other physical transduction principles like the optical range finding sensors and the microwave-based devices too. Then why should

one use ultrasonic transducers in the first place, given that the speed of sound is very slow than the speed of electromagnetic waves? The answer lies in the question itself. Because the EM waves-based devices are too fast. Being slower than the EM waves, the time taken by ultrasonic waves is much longer than that taken by the latter and hence its measurement can be done more easily and less expensively. Because these are based on sound waves rather than EM waves, these would work in places where the latter would not.

Distance Measurement Sensor Applications. Senix ToughSonic® Ultrasonic Sensors measure the distance of target objects or materials through the air using “non-contact” technology. They measure distance without damage and are easy to use and reliable. Whether used indoors or out, ToughSonic® sensors can take abuse.

For example, in the case of clear object detection and measurement of liquid levels or high glare environments, light-based sensors would suffer greatly because of the transmittance of the target or the translucence of the propagating media. Ultrasonic devices being based upon sound propagation would remain practically unaffected. These also function well in wet environments where optical beams may suffer from refraction from the water droplets in the environment. On account of range and accuracy, the ultrasonic sensors may lie in between two EM wave-based sensors, the Infrared rangefinders on the lower end and the LIDARs on the upper end. Not as accurate or long distance as the LIDARs, the Ultrasonic rangefinders fare better than the IR rangefinders which are highly susceptible to ambient conditions and require recalibration when environment changes. Further these devices offer advantage in medical imaging as compared to MRI or X-Ray scans due to inexpensiveness and portability. No harmful effects of ultrasonic waves at the intensity levels used have been detected in contrast to X-rays or radioactivity-based methods and is particularly suited for imaging soft tissues.

The basic principle of work:

- (1) Using IO trigger for at least 10us high level signal,
- (2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

- (3) IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.
- (4) Test distance = (high level time X velocity of sound (340M/S) / 2



Fig 3.3.5 Ultra-sonic sensor

3.3.4 MQ2 Gas sensor:



Fig 3.3.6 MQ2 Gas sensor

MQ2 is one of the commonly used gas sensors in MQ sensor series. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor also known as **Chemoreceptor's** as the detection is based upon change of resistance of the sensing material when the Gas comes in contact with the material. Using a simple voltage divider network, concentrations of gas can be detected.

MQ2 Gas sensor works on 5V DC and draws around 800mW. It can detect **LPG, Smoke, Alcohol, Propane, Hydrogen, Methane** and **Carbon Monoxide** concentrations anywhere from 200 to 10000ppm.

Internal structure of MQ2 Gas Sensor

The MQ2 is a heater-driven sensor. It is therefore covered with two layers of fine stainless-steel mesh known as an “anti-explosion network”. It ensures that the heater element inside the sensor does not cause an explosion because we are sensing flammable gasses.

When the outer mesh is removed, the sensor looks like this. The sensing element and six connecting legs that extend beyond the Bakelite base form the star-shaped structure. Two (H) of the six leads are in charge of heating the sensing element and are linked together by a Nickel-Chromium coil (a well-known conductive alloy).

The remaining four signal-carrying leads (A and B) are connected with platinum wires. These wires are connected to the body of the sensing element and convey slight variations in the current flowing through the sensing element.

IR Sensor/Infrared Sensor:

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called an INFRARED SENSOR. Usually, in the infrared spectrum, all the objects radiate some of these types of radiations are invisible to our eyes, which can be detected by an infrared sensor. The emitter is simply an IR LED (form of thermal radiation).

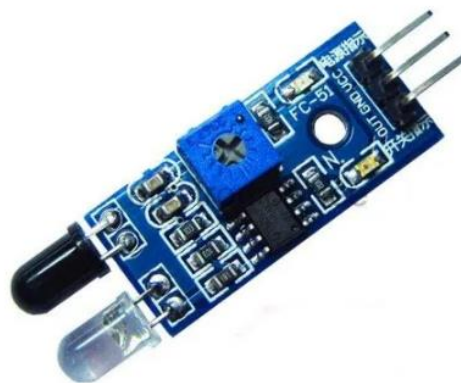


Fig 3.3.7 IR Sensor/Infrared Sensor

Infrared Sensor) and the detector is simply an IR photodiode that is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received. decided by the IR receiver depending on the intensity of the response.

IR technology is used in daily life and also in industries for different purposes. For example, TVs use an IR sensor to understand the signals which are transmitted from a remote control. The main benefits of IR sensors are low power usage, their simple design & their convenient features. IR signals are not noticeable by the human eye. The IR radiation in the electromagnetic spectrum can be found in the regions of the visible & microwave.

Usually, the wavelengths of these waves range from 0.7 μm to 1000 μm . The IR spectrum can be divided into three regions like near-infrared, mid, and far-infrared. The near IR region's wavelength ranges from 0.75 – 3 μm , the mid-infrared region's wavelength ranges from 3 to 6 μm & the far IR region's infrared radiation's wavelength is higher than 6 μm .

These types of radiations are invisible to our eyes, which can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode that is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

Types of Infrared Sensor

Infrared sensors are classified into two types like active IR sensor and passive IR sensor.

Active IR Sensor

This active infrared sensor includes both the transmitter as well as the receiver. In most of the applications, the light-emitting diode is used as a source. LED is used as a non-imaging infrared sensor whereas the laser diode is used as an imaging infrared sensor. These sensors work through energy radiation, received & detected through radiation. Further, it can be processed by using the signal processor to fetch

the necessary information. The best examples of this active infrared sensor are reflectance and break beam sensor.

These sensors work through energy radiation, received & detected through radiation. Further, it can be processed by using the signal processor to fetch the necessary information. The best examples of this active infrared sensor are reflectance and break beam sensor.

Passive IR Sensor

The passive infrared sensor includes detectors only, but they don't include a transmitter. These sensors use an object like a transmitter or IR source. This object emits energy and detects through infrared receivers. After that, a signal processor is used to understand the signal to obtain the required information.

The best examples of this sensor are pyroelectric detector, bolometer, thermocouple-thermopile, etc. These sensors are classified into two types like thermal IR sensor and quantum IR sensor. The thermal IR sensor doesn't depend on wavelength. The energy source used by these sensors is heated. Thermal detectors are slow with their response and detection time. The quantum IR sensor depends on the wavelength and these sensors include high response and detection time. These sensors need regular cooling for specific measurements

CHAPTER 4

DC MOTORS

4.1 General Information

A DC motor is used to drive a mechanical load. In this lab, a separately excited DC generator provides the load. The load on the motor is adjusted by varying the generator field current. By increasing the field current of the DC generator, the load on the DC motor increases and thus the armature current increases. In general, DC motors are characterized by their torque-speed curves as shown in Figure 9.1. Since the measuring equipment for shaft torque is not available in the lab it is necessary to use alternative means of characterizing the DC motor. One alternative is to plot shaft speed versus armature current since torque is directly proportional to the armature current with a constant field current supplied to the motor. Shaft speed is also a function) as field current is directly proportional to the direct axis flux produced in the machine.

4.2 Construction

The stator of the dc motor has poles, which are excited by dc current to produce magnetic fields. In the neutral zone, in the middle between the poles, commutating poles are placed to reduce sparking of the commutator. The commutating poles are supplied by dc current. Compensating windings are mounted on the main poles. These short-circuited windings damp rotor oscillations. The poles are mounted on an iron core that provides a closed magnetic circuit. The motor housing supports the iron core, the brushes, and the bearings. The rotor has a ring-shaped laminated iron core with slots. Coils with several turns are placed in the slots. The distance between the two legs of the coil is about 180 electric degrees.

The coils are connected in series through the commutator segments. The ends of each coil are connected to a commutator segment. The commutator consists of insulated copper segments mounted on an insulated tube. Two brushes are pressed to the commutator to permit current flow. The brushes are placed in the neutral zone, where the magnetic field is close to zero, to reduce arcing. The rotor has a ring-shaped

laminated iron core with slots. The commutator consists of insulated copper segments mounted on an insulated tube. Two brushes are pressed to the commutator to permit current flow. The brushes are placed in the neutral zone, where the magnetic field is close to zero, to reduce arcing. The commutator switches the current from one rotor coil to the adjacent coil, the switching requires the interruption of the coil current. The sudden interruption of an inductive current generates high voltages. The high voltage produces flashover and arcing between the commutator segment and the brush.

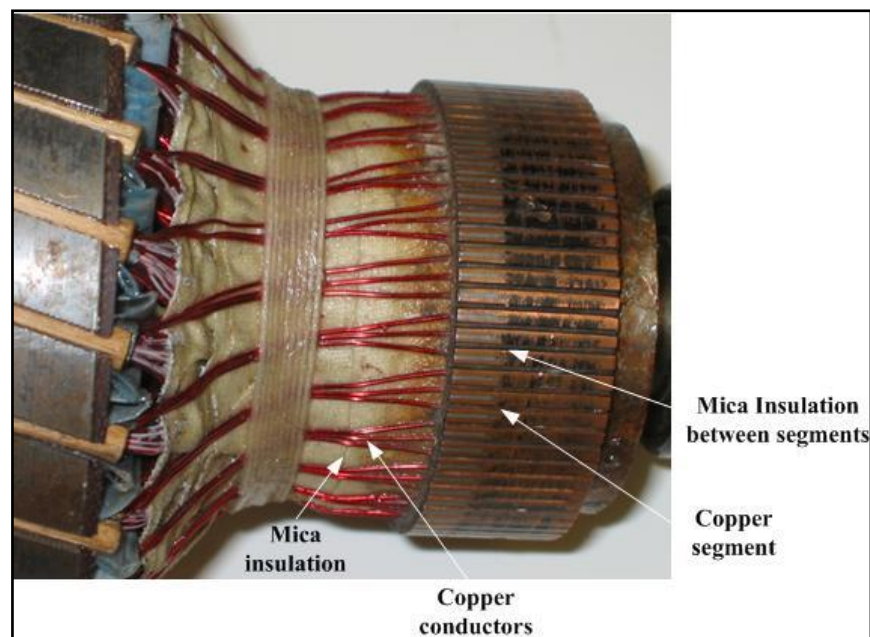


Fig 4.2.1 Construction

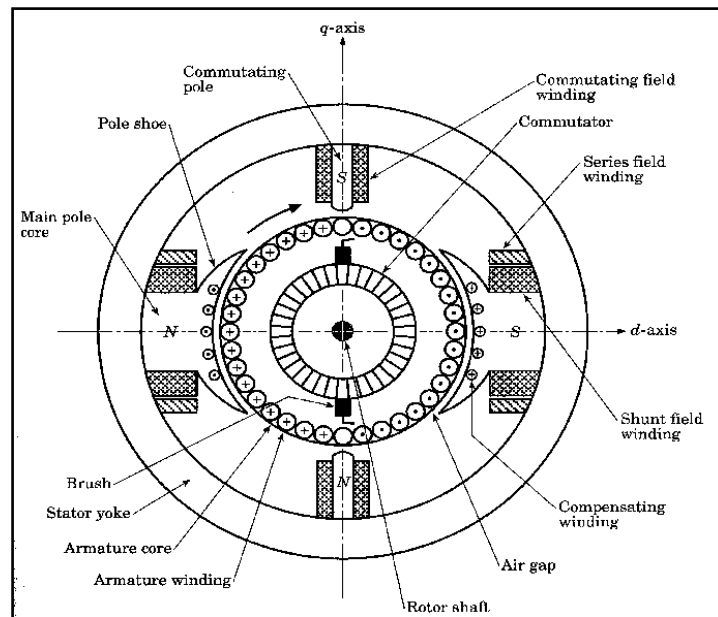


Fig 4.2.2 construction

4.3 DC Motor Operation

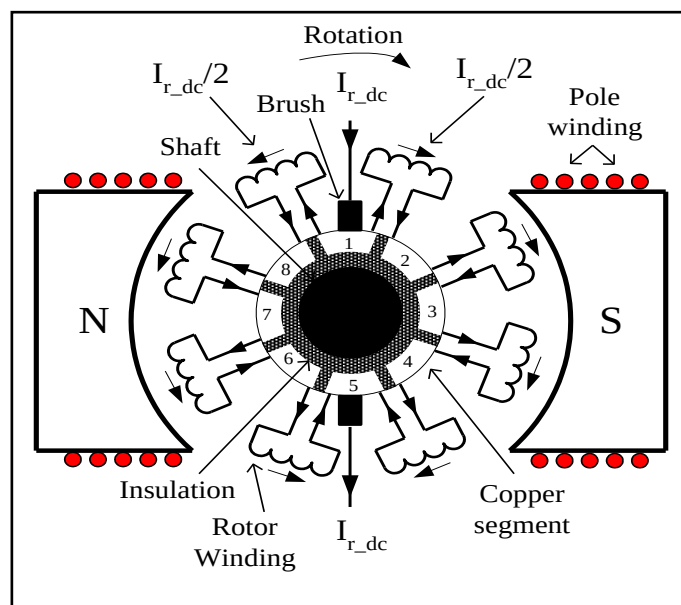


Fig 4.3.1: DC Motor Operation

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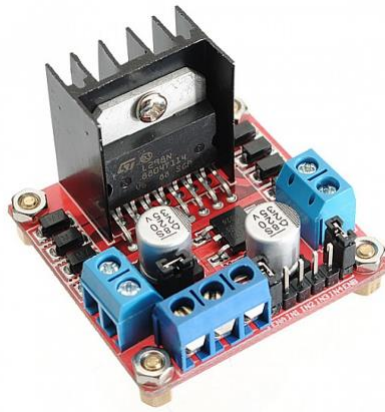


Fig 4.3.3: DC Motor Operation

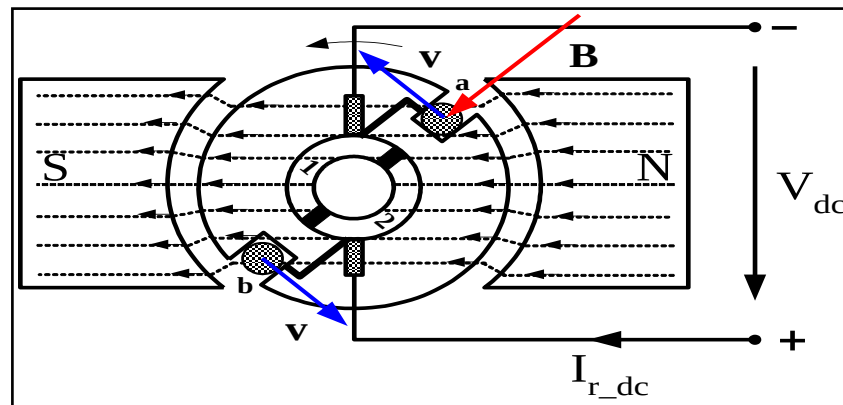


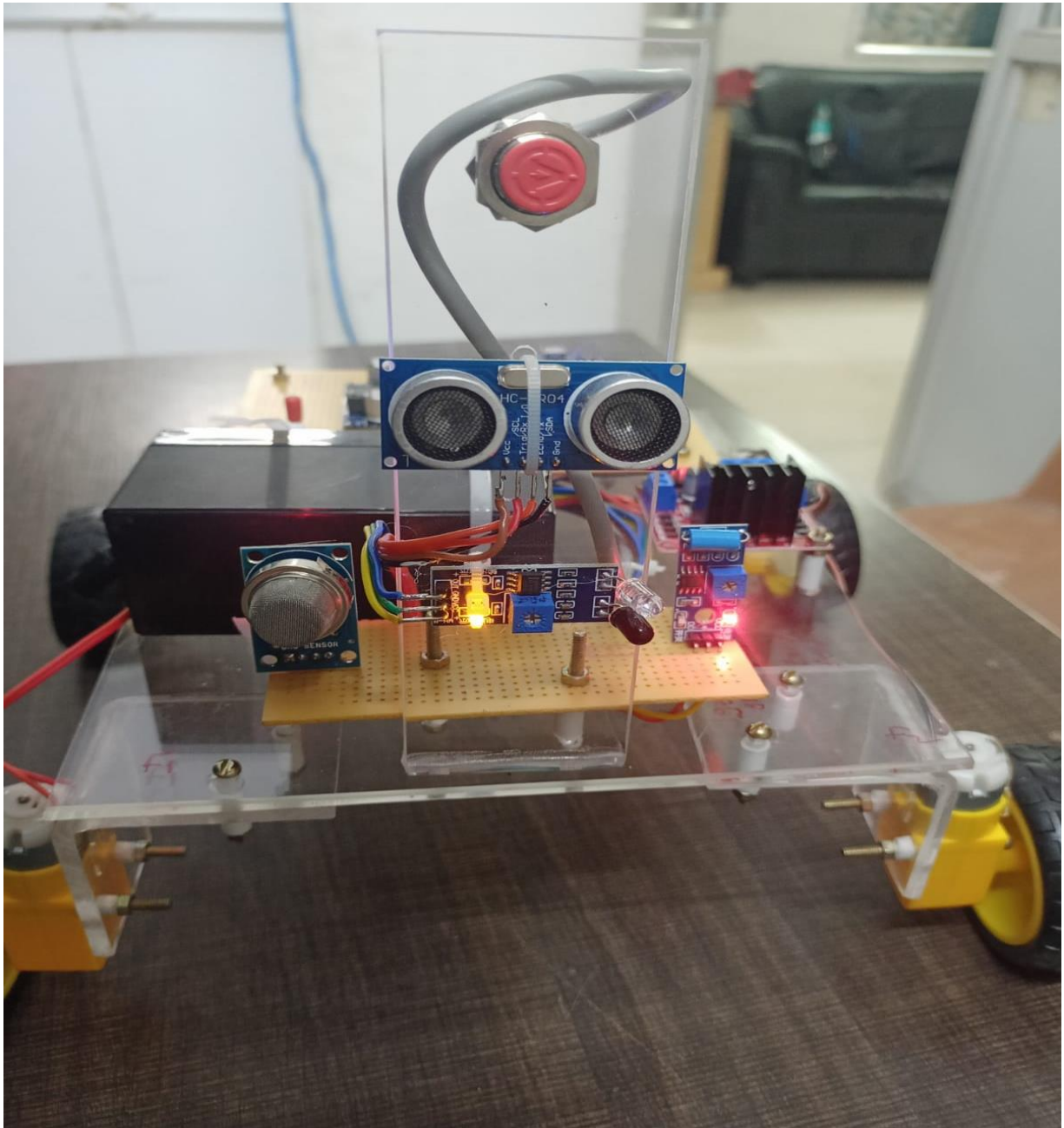
Fig 4.3.4: DC Motor Operation

CHAPTER 5

Conclusion

The main idea is to design and implement a prototype of an efficient low-cost automated mine detector that will replace the current employed human detectors in the mission of detecting and extracting mines in a suspected area of land. As well, communication and data analysis in the domain of landmine detection. The detector wirelessly communicates with a server to transmit and store the detected information such as the location of the metal object and captured images of the land where does it exist. Designing an ρ ISSN: 2088-8694 Int J Pow Elec & Drip Syst, Vol. 10, No. 1, March 2019: 219 – 229 228 integrated system which consists of a simple robot provides with a metal detector and uses Bluetooth technology to communicate with its software inside the computer. The system comprises two types of users. An admin can control the system, and a user can only control the robot. In the intelligent algorithm, the robot can discover the obstacles in the front of it, so if there is more than one way to enter the searching place, the robot can detect the best way that has the lowest obstacles. The robot will send the data to the computer, so the system displayed the received data from the robot and analyze them. All results will be exported as PDF file and upload to an online database that connected with the system to archive the results. In the future perspectives, intend to develop the proposed system to perform different perdution objects in the mapping and navigated areas based on supported data set. As well, test the system with robot mobile-based.

OUTPUT:



Metalrobot



ALCOHOL

METAL

OBSTACLE



SPEED



FORWARD



LEFT



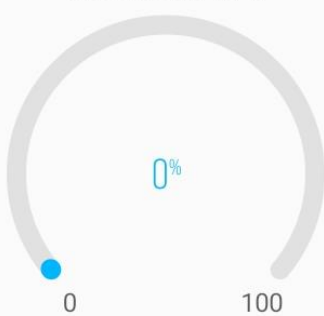
RIGHT



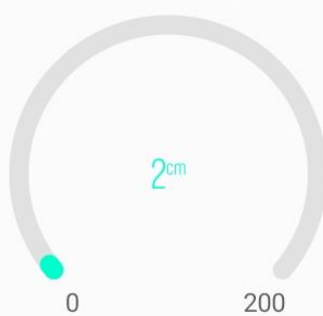
REVERSE



ALCOHOL LEVEL



DISTANCE



Metalrobot



ALCOHOL

METAL

OBSTACLE

SPEED



FORWARD



LEFT



RIGHT



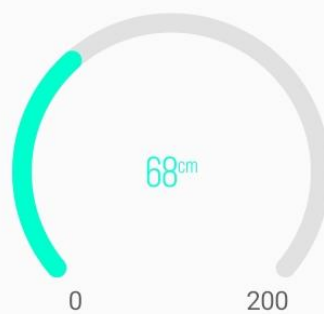
REVERSE



ALCOHOL LEVEL



DISTANCE



Metalrobot



ALCOHOL

METAL

OBSTACLE



SPEED



FORWARD



LEFT



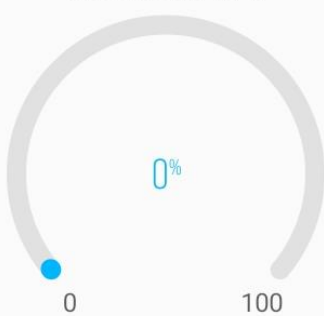
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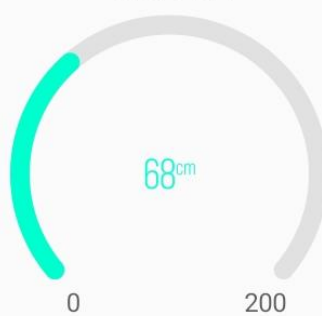
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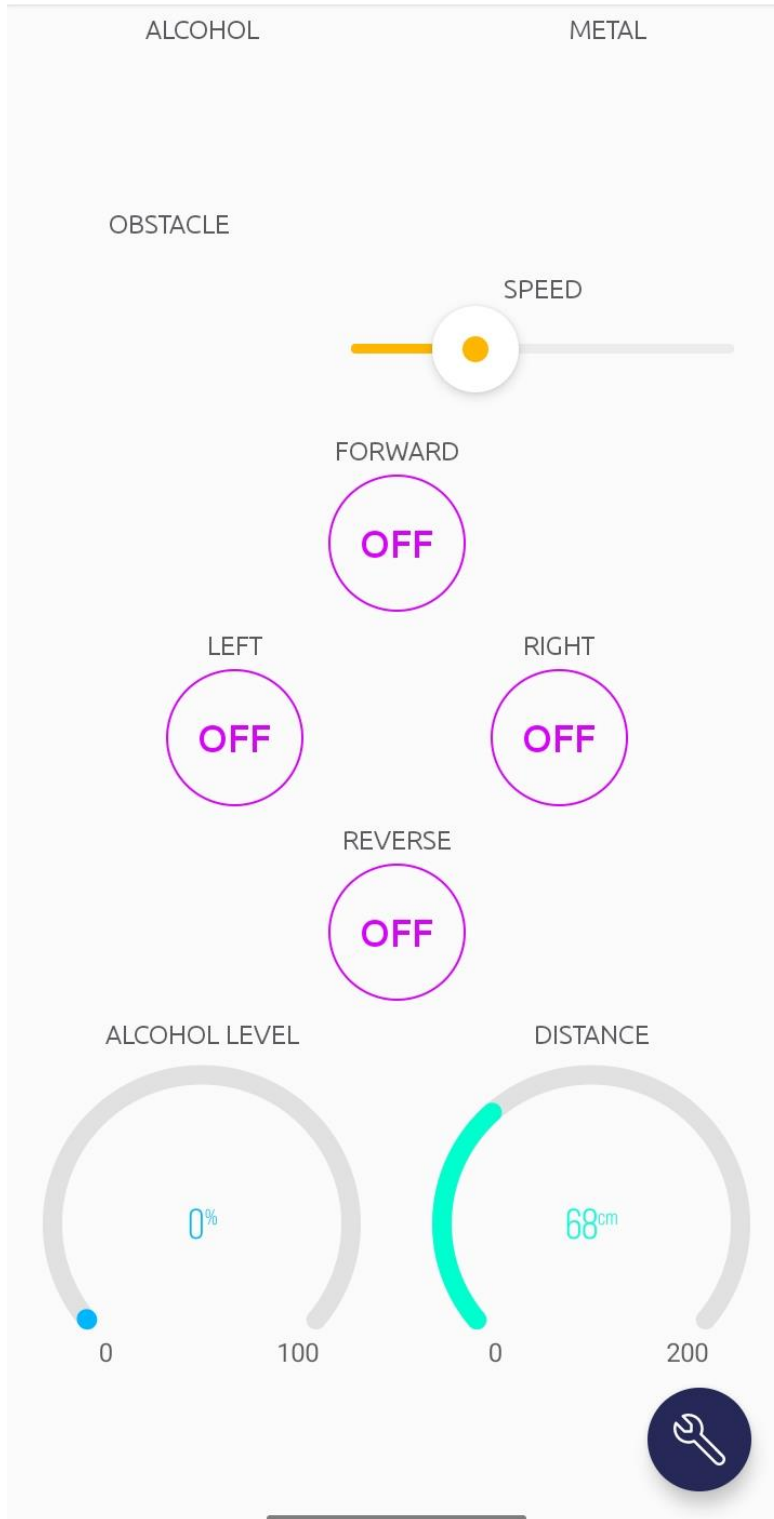
ALCOHOL LEVEL



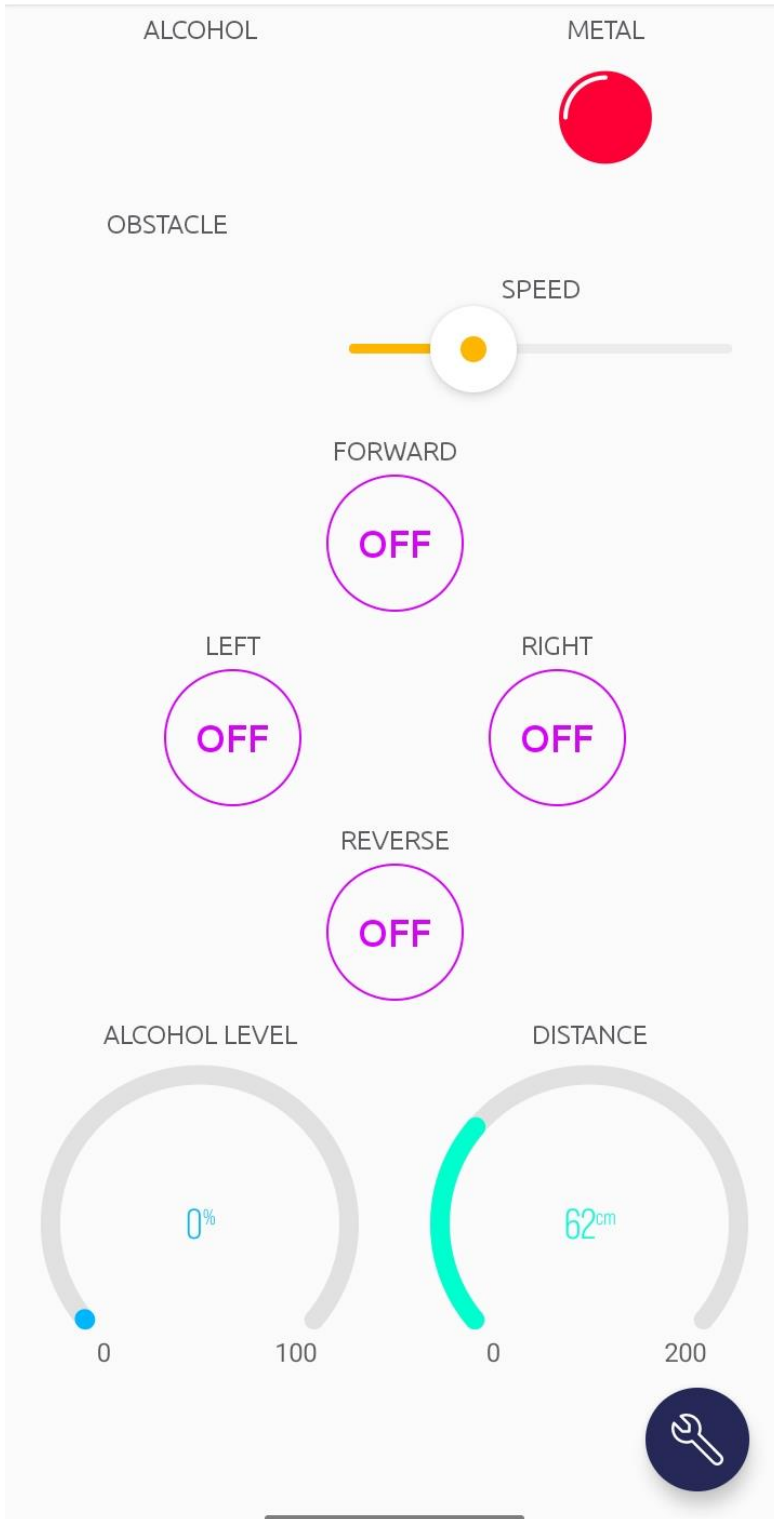
DISTANCE



Metalrobot



Metalrobot



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