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# Electrical Engineering Concepts

[Basic Electrical engineering Concepts](#)

# Creating your own iot device

[Creating your own iot device in arduino](#)

## M2M,IOT things introduction

In the ancient china, a man came to an emperor with his invention of chess, he demonstrated it to his king, and king was very impressed with his invention and asked him what he expects as a reward. The man told the king, he wants grain of rice to be placed on square doubling the grain rice on each subsequent square.

King thought it to be very humble and modest reward and asked his servant to fulfill the request, by the time the rice grains filled the first half of the chessboard, he had more than 4 billion rice grains, by the time the servant got to 64<sup>th</sup> square, the man had more than  $(18 \times 10^{18})$  or more than all the wealth of the land.

If you ask me, how much is the growth potential for IOT (Internet of Things). It is exponential, as new devices get designed, more objects become m2m more the growth potential is.

Since you are reading my eBook, I assume that you are a student who wants to learn about IOT, so I will be sharing links to the course of IOT and the material where you can purchase devices to make your IOT device, implementing the IOT concepts will enhance your understanding about IOT.

Web 1.0 allowed humans to read content from web pages, web 1.0 is the first generation of web, web2.0 is the second generation where browsers can well be client as well as server, pushing & receiving data from the client to the server, in web 1.0 browser use to connect to the server take data and then disconnect from the server, but in web 2.0 browser maintains continuous connection with the server pushing & receiving data back and forth, take example of gmail.com, facebook.com

But in web 3.0 machines can read and understand data just like humans, it is internet of things or m2m( machine to machine communication), devices have capability to sense and communicate with other things

ebook is divided into 3 parts, to build your tempo, direct explanation of technical details will bore you so iam explaining it step by step first it gives information about things which are already in market regarding iot, career opportunities and how you can benefit from it.

to build iot apps, you need to be a programmer and also electrical engineer, basic electrical knowledge will do

to actually build iot devices, you will need understanding of maths, electrical engineering and computer programming, and understanding of boards, your hardware device limitations, the process will start from the idea and then prototyping and then actual manufacturing.

if your product is good and you think it is useful that people will actually pay for it, you can get funding and mass produce in china, almost all iot devices are made in china.

Shenzhen is the iot devices manufacturing hub in china.

there is a new 3D printer coming up, "MakerArm", it can print circuit boards for you, that printer is currently available for preorder on kickstarter.

book is designed in such a way, that even non-technical person understands it and does not fall asleep while reading it.

## Benefits of IOT

A device which is not connected to the internet is a dumb device. IOT device can improve usefulness and save costs.

IOT is beneficial in Health care, Transportation, Automating tasks, understanding patterns, Tracking behavior for real-time marketing, Enhanced situational awareness, Sensor-driven decision analytics, Process optimization, Optimized resource consumption, Instantaneous control and response in complex autonomous systems

- Ubiquitous networks – personal wi-fi on your mobile phone and on every other device. Everyone (and everything) wants and needs to be connected.
- Connected computing – we want all of our devices, phones, televisions, music players, vehicles, etc. to keep track of what we are doing, viewing, reading, and listening to as we move through our day, from place to place – the handoffs from device to device are already happening.
- Ubiquitous sensors – on everything. It is already here – the Internet of Everything and the wearables revolution.
- Intelligence at the periphery of the network – Jim Gray, the visionary database guru from Microsoft, envisioned smart sensors acting as a mini-database with embedded machine learning algorithms. Here is how he said it (10 years ago): “Intelligence is moving to the periphery of the network. Each disk and each sensor will be a competent database machine.”
- Analytics-as-a-Service – the API and App economies are already vast and growing – this enables any “thing” to “do something interesting” as long as it can connect to an API or invoke an App that performs a network-based service. The “thing” is a data generator and/or collector that also learns from, makes predictions, and maybe even takes data-driven actions in response to the data that are collected (through the versatility and convenience of an App or API call).
- Marketing automation – mobile customer engagement, geolocation, Apple’s iBeacon, etc. are all creating a network of knowledge about customers’ locations, intentions, preferences, and buying patterns. Of course, this degree of location-based knowledge needs to strike the right balance between user privacy and the timely delivery of useful products and services to that user.
- Supply Chain Analytics – delivering just-in-time products at the point of need (including the use of RFID-based tracking). Essentially, everything is a customer (including machines, automobiles, manufacturing plants, ATM machines, etc.), and the IoT is monitoring, watching, and waiting for a product need to arise.

- Aging workforce! Really? – Yes! There is a huge hiring gap in manufacturing, which is pushing toward more automation, robotics, M2M (Machine-to-Machine), machine log mining, 3-D printing, predictive and prescriptive analytics in the machines that are doing that work for us. As the classic rock song “2525” predicted would happen in the year 5555: “some machine is doing that for you.”
- Transportation: We have been using GPS to track movement of delivery trucks for years. IOT eases and simplifies the entire process by introducing a monetary sensor that helps to track distance and time locations and other contributing factors.
- Inventory management: As managing fleet, inventory management and tracking is also a major task. IOT is used to tag radio frequency sensors to track the location of products in real time. It has been instrumental in tracking the level of inventory and to stock it in advance, making alerts for unforeseen stoppages, automatically placing orders, etc.
- Promotions: Many businesses use IOT to send mobile promotions to frequent shoppers. This is done by keeping track of the shoppers history and shopping interests. It utilizes location-based tracking of the physical shoppers as well as those shopping over the internet.
- Assessing web user intelligence: IOT is used by third party web data aggregators to have a better understanding of their customer by tracking them on social media networks. This is essential to identify the key customers and their preferences.
- Facilitates warranty and maintenance services: IOT enables product tracking. This in turn helps to keep a track of products that require maintenance or warranty. This also helps in crisis moments like thefts to track and place a product.
- Vending technology: IOT has played a big role in enhancing the working of vending machines by enabling them to communicate to monitor inventory levels, determine pricing, etc.

While this chapter highlights some key benefits of IOT, in the next chapter I have explained the terms like RFID and AR markers because they are important to the concept of IOT, especially RFID.

## Some of the communication protocols for iot

- Http
- Xbee
- MQTT
- BLE
- RFID

some new protocols came up, designed specifically for iot devices to be more efficient.

### Http

this is the basic protocol, where we pass data as a json via url to the cloud server or any of our web server.

### Xbee

Xbee is the wireless microcontroller made by Digi International, it uses zigbee protocol, it is basically communication between 2 wireless radios.

it consists of 3 pins and an antenna, it has 11 digital pins and 4 analog pins, iam pasting the image below, how it looks like



### MQTT

it is better than http for iot devices, mqtt is more designed for iot devices, http requires more bandwidth and much more battery power, which is inefficient for small iot devices, mqtt is much like meteor framework programming model, subscribe publish model, communication is in binary format, so less bandwidth, lightweight and consumes less battery power.

<https://mosquitto.org/>

you can download open source program for it from the website, and run it as a broker, any clients which are connected to particular topic will receive messages, if there are any new messages on that particular topic.

## Ble

it is wireless network technology based on bluetooth protocol, but it requires lot less energy, major adopters of ble technology is health and fitness devices and apps.

## RFID



For developing IOT devices, we must understand RFID (Radio Frequency Identification) as well, RFID is barcode in chip format, information on chip can be updated as well, and is capable of communicating with RFID reading enabled other devices, as the prices are getting lower and lower every day, its use is only going to increase.

RFID provides unique identification for an object, without RFID there would be no way for wireless networks to identify each other, currently it's used in many devices like mobile phones, tablets, computers, credit cards, access cards, and many other things

## What is AR Markers



Ar Markers (Augmented Reality) Marker is effectively two dimensional symbols, similar to a QR code that allows a camera to determine position and rotation relative to a surface. With this information, a camera can do many different things.

It is used in video games, when you scan AR marker with your mobile camera, an animated character will come out of it

You can check this YouTube video

[https://www.youtube.com/watch?v=PTK\\_qfh2fD8](https://www.youtube.com/watch?v=PTK_qfh2fD8)

or search in YouTube for AR Markers

You will get several demo videos



## Industrial Internet of things

Factories can automate their repeated tasks, which can both improve productivity and efficiency, a simple case study, an IOT consultant is invited to a mid-size potato chip company, to figure out the inefficiency and ways to automate things and to improve productivity and efficiency.

after the chips are baked they move along a conveyor belt where a team of workers wait to inspect them, looking for either overcooked or undercooked chips, when team spots an unacceptable chip, he will just flip the chip on the floor, and the belt will move on, later that chips which are thrown on floor are collected and included in feed for farm animals, you can easily see here a team of people watching chips moving on the conveyor belt whole day and flipping chips which are unacceptable, it is also error prone and the job is of course very boring, here the automation can take place and remove inefficiency and improve productivity.

A simple webcam over the top of the conveyor belt and special computer vision software which can detect bad chips and strategically placed air nozzles would shoot tiny puffs of air at the chips in question blowing them off the belt.

This type of solution is already implemented in many potato chips company, it also saves money and improves efficiency, and staff which is employed to flip the bad chips can now be utilized in other area, where it can bring more efficiency or sales.

If you are planning to be an IOT consultant this could be the job for you, automate the industries bring down their costs, improve efficiency and automate as much as possible to boost productivity

Machines have tendency to break down due to variety of reason, a mechanic is always present in the assembly line, just in case a problem occurs, we can free him or lessen his work, by using IOT solution to the machines,

IOT solutions can monitor the machines using webcam and detect vibrations, when vibrations exceed a certain level, that means conveyor belt or gears are slipping , or some other issue, if the vibrations has altogether stopped that means machine has halted production, now mechanics can be alerted

IOT enabled machines can detect overheating and slow down its production, IOT enabled machines can detect occurrence of problem, with this data we can better understand machines and manage accordingly, we can predict future failures and act accordingly.

## Consumer IOT

You must have heard & seen on Tv, that how a 12<sup>th</sup> pass student has made an app, which can track your motorbike location, preventing it from getting stolen, these are actually very simple IOT devices which anyone who can read and write can make, there are tutorials available for that.

I am putting list of successful IOT products

### Fitbit

Fitbit develops IOT devices to monitor your health, Fitbit is a physical activity tracker designed to help people become more active, basically help people become healthier human beings, it was introduced by its co-founder Eric Friedman & James Park in 2008, in short it's a 21<sup>st</sup> century pedometer

The product is deceptively simple, it's only 2 inches long and 1.2 inches thick, throughout the day

You can check more about it in YouTube

<https://www.youtube.com/watch?v=93s1EsgdowA>

Search in YouTube for Fitbit to understand it more

### Amazon Echo

Amazon Echo is an amazing IOT device, a round-shaped speaker, which is always connected to the internet, and whenever you say "Alexa" it gets activated and will listen to your command.

For ex. "Alexa What Time is it", it will tell your current time, it will tell time according to your current location.

It can play music for you, it can read news for you, it will answer most of your questions, and it can help kids do homework.

Amazon Echo can read Kindle Books for you, can play audible books, it can also be your alarm clock and wake you up on time you set.

Amazon Echo can be connected to your home devices, and then you can switch lights on or off

Amazon Echo can take down your shopping orders and directly shop from Amazon, It is far better than Apple Siri.

I just wanted to introduce you to Amazon Echo, you can Google about Amazon Echo, and YouTube it to get to know more about Amazon Echo

Check out more about it in YouTube

<https://www.youtube.com/watch?v=KkOCeAtKHlc>

## **Jibo**

This is similar to amazon echo, but it is lot better since it has face, this is lot better than amazon echo, but since a big company like Amazon is behind Echo it is selling more.

<https://www.youtube.com/watch?v=3N1Q8oFpX1Y>

It is also an IOT enabled speaking device (Assistant), you will never feel lonely if you have JIBO

## **Amazon Dash**

You never run low on things which are important to you, it's amazon dash button available to amazon prime members, whenever you are low on particular day to day consumer product you just need to press the dash button and it will order it for you.

There are 18 different brand buttons currently available, each button is decorated with the brand logo and you can keep it anywhere, whenever it gets low you just press the button. It's a very simple IOT device.

Check out this amazon dash video

<https://www.youtube.com/watch?v=EHMXXOB6qPA>

Amazon is bringing many new changes in consumer service, it's making new radical innovation, I think it will overtake Google, since Google is busy with DARPA, amazon will run over Google in consumer related products.

Amazon is also working on better version of "Amazon Dash", "Amazon Dash Replenishment", it will monitor and analyze your use of a particular product and will auto order it for you, so you don't fall short on the product you use the most. This will make life very easy for you, since you won't have to remember small things.

<https://www.youtube.com/watch?v=vTYcWG6BIDY>

What they are trying to do is to take humans off from ordering cycle

Amazon is simply amazing in doing day to day innovations for use of common people.

## **IFFT**

(If this then that) is a cool, IOT enabled service

If helps you connect all your apps, you can also connect your IOT Devices like fitbit, you can connect your home lights with IFFT, like IFFT can blink your home lights if someone photo tags you on facebook, there are many recipes available, you can also create your own recipes

Learn more about it

<https://ifttt.com/>

If you are very busy person, this thing can help you save time, you can automate things.

## **Philips Hue**

If it basically allows you to control your light bulbs from anywhere, it's an IOT enabled light bulbs system. You can even program with ifttt.com to blink, whenever some 1 tags you in photo. You can even make it to change light colors with your favorite music to enhance your mood, if you configure it with amazon echo or Apple Siri you can switch lights on and off with your words.

Check its YouTube video demo

<https://www.youtube.com/watch?v=h1falu7l8bg>

## Success Stories in IOT

### Intelligent waste management (Burba Project)

EU had set goals to for waste separation and recycling but it was not able to achieve it, the goal had to be viable economically and environmentally

#### *Problems with the company side*

The waste collection is routinely scheduled and cannot be adjusted when there is spike in waste  
sorting of waste difficult as citizens mix up the waste  
feed of waste reaching recycling unit is not efficient  
routine pick up of trucks is not optimized  
Best location of street garbage containers to minimize costs is difficult to estimate since lack of qualitative and quantitative data  
containers many a times displaced by by-passers for car parking or by vandals

#### *Problems with Citizen Side*

Sorting depends on the understanding of citizens, lack of appropriate directions to the citizens regarding sorting  
Citizens have no feedback about their efforts in sorting and how much waste they created

#### *Solution*

Burba project developed an innovative product to optimize waste management through the use of RFID & LBS technologies, they got it integrated into an intelligent waste container

Intelligent waste container will be able to identify the citizen through a personal RFID card which will be used to open the lid of the container and this data can be used to give feedback to the citizen, the smart container is able to identify items marked with RFID tags.

By these methods a citizen is notified how much waste he created and also whether he separated/sorted the waste accordingly, on the basis of this municipality can create incentive based recycling programs and charge citizens accordingly

In future it is expected that everything will have RFID tags, so when citizen try to dispose of item, RFID can be used to identify type of waste and can help the citizen separating the waste.

## Health

(RFID Makes Surgery Safe)

Have you ever heard, that doctor forget towel in a person's stomach after operation, I have heard this numerous times, surgical towels are used either they are placed under the organ to stop bleeding or give better exposure of that organ to the doctor so doctor can operate, sometimes doctor forgets that towel and dose the cut.

Actually towels are counted before getting into operating table, dustbin is emptied, each time towels are counted before inserting and removing, but even then can doctors forget them, it is quite a common scene with every 1/3000 to 1/5000 cases, in case of stomach operation it is 1 in 1000/1500.

this is not actually doctor's carelessness, but human error, there is such a mess during operation, this mistake is serious trouble to patients, they might develop puss in that area and severe infection and pain

Solution

IOT(Internet of Things)

is going to help here

In order to solve this problem, surgical towels should be equipped with RFID, so that each towel can be identified, and by installing RFID antennas it is possible to track all the towels and make sure that no towels are missing

Currently because of very high prices surgical towels with integrated RFID are not available in market but it is completely implemented in Munich Germany Isar River University Hospital

## **Nature Monitoring**

(Monna Connected Birds)

Monna plans to launch Europe into global leadership for monitoring nature, it combines technical development for analysis of bird migration, it is based on research and development of bird monitoring system and use that data in scientific, technological and academic field

Aguila Technologies have developed this systems, the tracker developed for Monna relies on a miniaturized high sensitive GNSS/GPS geo positioning technology. The GPS used allows to receive quality signals even when poor satellite coverage and in bad weather conditions.

The long range transmission relies on UNB (Ultra Narrow band) technology, Monna trackers use the sigfox network which allows European coverage

The embedded transmission carried by bird can send data up to 30km.

Monna Project Also Received award in 2013 from the SIAD (Salon International de l' Agriculture Durable)

## **EKONET Project**

UN estimates that more than 50% of people will live in cities, and it is estimated that it will continue to grow, only 3% space is occupied by cities but

## **City Aware Smart Service**

This is actually implemented concept in SANTANDER in Spain

Santander Team is trying to build a smart city, where IOT enabled devices are installed everywhere in the city including inside roads, city has already installed over 12000 sensors across the city to make the city real laboratory in which scientific community can investigate on which companies can develop business application and products and which help citizens in improvement in their quality of life

Key features of converting to smart city is driver knows where parking space is available, so he gets straight to it, reducing traffic on the road, saving fuel and also less emissions, they have sensors panels on the roads which monitor certain gases, CO2 levels, humidity and so on

This is already happening few of the cities are already been or getting converted into smart cities

For more info you can visit

<http://www.smartsantander.eu/>

## Careers in IOT

Like in the year 1999, when the internet was new, no one was exactly sure what to do about it, and how to make money from it. Then AdSense and affiliate programs came, and lot of people become millionaires

My career and many people like me, career just happened to us, we didn't plan anything or nothing happened like we planned, i am a commerce graduate, was not sure what to do in life, when I graduated internet was new, but nobody knew how can we benefit economically, I did a computer programming course since I was not getting a job, demand for programmers was so high, that they hired anybody who can just read and write code, then I got a job as a programmer, my salary was very high compared to other programmers because of study and practice I did, I made websites for myself when I was doing job, then got into website business and made money from AdSense and affiliate programmers, it is not like since I was a little boy, I always wanted to be an affiliate marketer or make money showing AdSense ads ☺ I have to constantly update with technologies to make money, since the landscape was changing very fast. I have to update or risk being left behind. I took opportunities as they came.

The reason we need little bit of planning to be better prepared for the challenges, some opportunities or technologies take time to learn, so by anticipating we invest our time in gaining new skills which can be beneficial to us in the future.

LOT of things started as something else but ended up something else; YouTube was started as a dating site, but end up being video channel where people share videos. Key is to get started as soon as you can and then world guides you where to go.

Technology can bring sudden disruption, your career may simply vanish, when 3d printers will be standard for production, many skilled factory workers will lose job, their career will simply vanish,

One thing I will like to tell, don't totally believe to investment/ financial advisors advice, they just predict the future on the basis of past data, which is very irrelevant, future will never be the same as past, and plus they charge you fees for their wrong advice, learn little bit of economics and stock market and invest on your own. The reason these financial advisors and investment company made money is by using a bubble, they made money without adding any value to the society, when 9/11 happened finance was easily available and at a very low lending rate, these hedge fund and investment companies borrowed those money and used it to push prices of land and everything else, since loan was available easy to anyone without even checking their ability to repay, there was sudden demand for goods which again pushed the prices of everything, that's a long big story, how hedge fund managers, bankers exploited the situation made money, fled the country, and now staying on beaches.



I dislike people who make lot of money without adding any value to the society, they just make money by manipulating the system, and riding the people's greed that money can be doubled in months

Google makes money by easing our everyday lives; Actors singers make money by entertaining us, you seen Bournville chocolate TV commercial, in order to eat that chocolate you must earn it.

Technology Careers are high in demand and well paying, it is also predicted to be so in future, long range career planning in technology is just not practical, just plan ahead for 2-3 years.

Currently companies are very busy connecting devices to each other, but we must understand what problem we are trying to solve, microwave oven connecting to refrigerator and refrigerator connecting to microwave oven is not solving any problem, money can be made in most cases only if we are trying to solve a problem or have a solution for a need.

Understand the need and then come up with a solution which can solve the need in better way

Mainly there are two types of IOT opportunity , consumer IOT or industrial IOT, you can be an industrial IOT expert and can help companies improve their efficiency, productivity, reduce or eliminate waste by automating the process.

Or you can create devices useful for general public, like that motorbike tracking app, health app and make a living out of it.

There is a website which provides online training plus practical's and also provide tools required for those practicals

<http://www.axelta.com/AxOnlineIOTBootcamps.php>

If you are very new, you can do course on axelta.com

You can also find various courses in <http://www.udemy.com> , but these courses won't come with the tools required to do practicals

So it is better to get started with axelta.com, and then once you are confident enough you can do your own stuff and buy tools from these other websites

In Spite of being a decade old technology, IOT is still at its infancy level, just like internet was at the year 1997, you can be next Google or amazon of IOT,

There are some problems in IOT in spite of being promising technology it is still not widely used, just like WebRTC, in spite of very cool technology for video and audio communication, very few are actually using it.

Problems & Challenges of IOT implementation are discussed in next chapter

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