



Internet of Things-The Next Big Leap

Publisher- Silver Touch Technologies Ltd.

Editor- Deepa Ranganathan

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Introduction

Internet of Things widely known as IoT as a concept was first introduced decades ago by the British pioneer of technology Kevin Ashton. He coined this term to describe a system wherein objects from the physical world connected & communicated over the internet with the help of sensors. This term described how Radio-Frequency Identification (RFID) tags could enhance the corporate supply chain to count/track goods with better accuracy and precision. Today, this term helps describe situations wherein internet connectivity can be, and its capabilities can be extended to a wide range of objects, devices, sensors, etc. to create a well-connected world.

The term Internet of Things is pretty new, but the concept dates back in time when computers and networks collaborated to control devices. There was a system somewhere in 1970 which monitored the meters on the electrical grid remotely using the telephone lines. These are some of the examples that describe how Internet of Things as a concept existed in the past. Advances in wireless technology have allowed growth in machine-to-machine communication and better industrial and enterprise solutions. From these small beginnings, the smart object networking of today has emerged, leading to an incredible increase in Internet of Things.

Internet of Things may be an age-old concept, but it started gaining mass momentum in today's time & age. So, what's the reason for the sudden popularity? One of the primary reasons lies in the fact that a significant number of small devices can connect & communicate over the internet in a cost effective manner with better ease and convenience.

Here are all the reasons why IoT is suddenly gaining momentum.

All devices are connected: You can experience ubiquitous, high-speed and low-cost connectivity with this technology which is available across wireless services, licensed or unlicensed.

IP-based Networking: IP is the dominant global standard for networking, which offers a defined platform that contains software & tools, which can help connect a wide range of devices in an expensive manner

Miniaturization: With the advances in manufacturing, you can devise cutting-edge computing & communication technology in small devices. This technology can help design small and inexpensive sensor devices, which can contribute to enhancing IoT applications.

Data Analytics: the combined power of advances in data storage, cloud services and computing power, can help in the analysis of vast data sets, thus allowing extraction of information.

Cloud Computing: The rise of cloud computing combined with the power of big data helps in serving with better applications with IoT

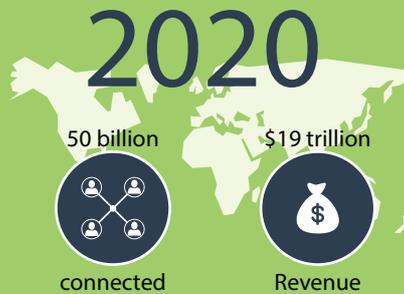
With such amazing benefits, there is no wonder that IoT is gaining momentum and meaning in the present times. Now, you are aware of IoT. Let's begin understanding its significance in current times, and how we can build enterprises with this emerging technology.

Significance of IoT

The Internet of Things is entering all aspects of your life, and gaining importance. It affects your everyday life majorly, and statistics suggests you look up to IoT in almost all applications, so as to ease your life.

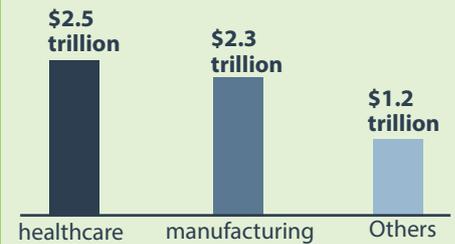
Let's have a quick scan through of the statistics for Internet of Things which will help us understand how it will affect everyday life, and why it matters to both Consumers and Enterprises.

- In 2008, the number of devices connected to the internet surpassed the number of people



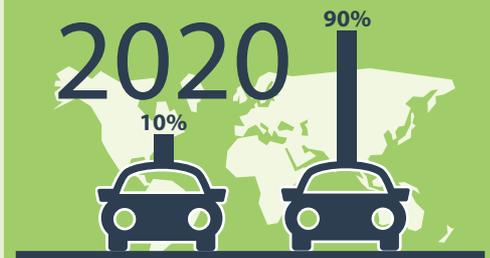
- It is expected to reach 50 Bn connected devices by 2020, and the profits earned will be \$19 Tn

- Currently, IoT is spread in factories, businesses and healthcare. It will soon reach your homes & phone. The net global worth of IoT by 2025 would equal \$6.2 Tn.



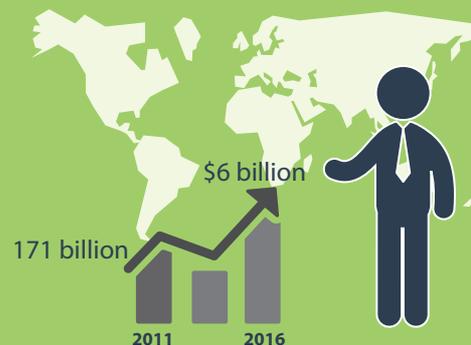
- Connected homes form a major part of the Internet of Things. The number of connected home devices by 2019 will reach 1.9 Bn, and the total revenue generated will be \$490 Bn

- The convergence of machine, analytics and data will be a \$200 Bn global industry in the next couple of years



- In 2012 only 10% of the cars were connected to the internet. This will become 90% by 2020

- The businesses that have made IoT investments have observed a 90% ROI which is highest in any segment.



- The wearable market will be a \$6 Bn industry by 2016 with over 171 Bn devices being sold across the globe

- The mass adoption of connected technology is definitely happening in the long term, but as of now close to 87% consumers have not heard of Internet of Things



These statistics give quite an idea on why Internet of Things is significant in the present times. Let's have a quick look on how IoT is redefining our lives.

- GPS systems, alarms systems, and thermostats will be sending and receiving continuous streams of data to monitor and automate all your activities in automobiles and at homes
- Lights and thermostats will operate autonomously to save on energy costs. They will be turned off automatically when everyone will leave the place or keep only those area alighted and temperature main tained where people are sitting.
- IoT will enable intelligent transport solutions, speeding up traffic flows, reducing fuel consumption and prioritizing vehicles repair schedule
- There will be smart doorbells, locks, and surveillance systems, giving you information about who's in front of the building, thus ensuring your peace of mind
- Smart electric grids will help in efficiently connecting renewable resources, improving system reliability and charging consumers based on smaller usage increments
- It will help improve customer service with personalization, accelerate process optimization, address real-time business needs, threats and opportunities and make forecasting more efficient in your business.
- IoT devices will ensure more data flow thus improving analytics for all the aspects of your business for improving the strategy and customer experience
- IoT will help in remote health care monitoring, thus providing convenient access to health care, raising its quality and reach, and saving lives
- For industrial use, machinery will be able to operate autonomously, and when your smart machine is not working properly, you will get a notification
- Sensors in homes and airports or even shoes and doors will help in improving security by sending signals when they remain unused for a certain period or, used at the wrong time
- There will be smart cars that will give drivers a better sense of real-time traffic conditions, making your business trip more efficient. With self-driving cars, accidents and travel time will reduce significantly
- Machine monitoring sensors in your factory will diagnose and predict pending maintenance issues, short-term part stock-outs, and even prioritize maintenance crew schedules for repair equipment.

If you think you are immune to the IoT fad, chances are you are not! We expect to see a massive rise in data generated by IoT applications pouring into our networks and systems. Let's have a quick look on how IoT proves to be advantageous for businesses and end consumers.

Enterprises & Industries

Companies can use IoT to drive cost-efficiency by improving asset utilization, enhancing process efficiency and increasing productivity.

- IoT applications can help increase return on R&D investments, reduce time-to-market and give new business opportunities, leading to additional sources of revenues
- IoT can assist in optimizing resource consumption, leveraging real-time control, increasing responses in complex autonomous scenarios, driving decision making and real-time tracking
- Automotive industries can benefit from an improved customer experience, decreased pollution, increased safety and added revenues

- Manufacturing industries will get real-time analytics of supply chains and will be able to enhance agility & flexibility and reduce energy consumption
- The retail industry will be able to track inventory, purchase through Smartphone's and conduct an analysis of consumer choices. They will even be able to use data from video surveillance, cameras, social media, Internet and Smartphone's usage
- IoT will enable supply chain industries to reduce working capital requirements, improve efficiencies and avoid disruptions in manufacturing
- Healthcare industry will get the benefits of improved employee productivity, optimized usage of resources, resulting in efficiency gains
- IoT will assist in working with Biometric and facial recognition locks and remote sensors, ensuring security to enterprises
- Infrastructure industries will be able to get environmental benefits and save significantly on costs by properly utilizing resources and taking preventive maintenance of critical systems
- The Oil & Gas industries will be able to reduce their operating costs and fuel consumption
- IoT will enable the Utility sector to provide more responsive and reliable services helping them cut costs for both utilities and consumers

Consumers

- IoT will help utility companies to communicate in real-time with users, shut down the operations of heavy load appliances, such as A/Cs during peak demand times resulting in lower electricity bills for consumers
- IoT can be beneficial for industrial automation, lighting control, home/building automation, security & monitoring, health & fitness, agricultural and more
- Through IoT, remote control of climate control systems can be enabled so that end users can alert their homes to make shifts in usage for higher operating efficiency. These systems also have the capability to communicate with homeowners, when required, through text messaging
- IoT makes it possible for a single application to control devices rather than requiring users to learn different User Interface (UI), for every new appliance added to the network
- In IoT devices are managed over the network, which can be controlled using certain applications
- IoT application can help to regulate traffic. Sensors prefixed on the roads can monitor traffic variables such as volume and speed. When sensors transfer this data to the computer using specialized software that takes charge of traffic-control devices, it can maximize traffic flow. Newer IoT technologies will also help to monitor the status of infrastructures like roads, bridges or highways
- IoT offers many gadgets for fitness and health. These devices connect with your smartphones through apps and help you keep track of your health
- Through Smartphone's users can control or check the status in the context of connected cars and contribute to a smart city via crowd-sourcing applications

Applications of IoT

Internet of Things is being widely used in various industries to ease the tasks. Automobile, Healthcare, Manufacturing and Home are few of the prominent industries, which have seen a substantial growth with IoT. Here, we will look at some of the applications of IoT in various industries, and how it is resourceful.

Industrial Applications

The Industrial IoT, also the fourth wave of industrial revolution, is driving the progress for the various industries like manufacturing, energy, transportation, cities and various other critical sectors. The Industrial IoT is happening here and now! It offers tangible and measurable business impact, which helps industries move ahead, and make critical decisions with ease.

This emerging technology helps companies collect, aggregate and analyze data from various sensors and devices connected to each other to maximize the efficiency and output of the operation. Some of the major applications of IoT include motion control, machine-to-machine, predictive maintenance, smart grid, etc.

Security and data privacy are major concerns for the industries when driving in Industrial IoT, and businesses, as well as governments, are working towards mitigating these concerns, and helping build fully secure enterprises. The interconnected devices for IoT will contribute to reducing the complexity related to interoperability between systems.

Here we will discuss a few practical applications of IoT realized for the particular industry. This will help us understand how IoT works, and how it benefits the different industries

Remote Inventory Management System

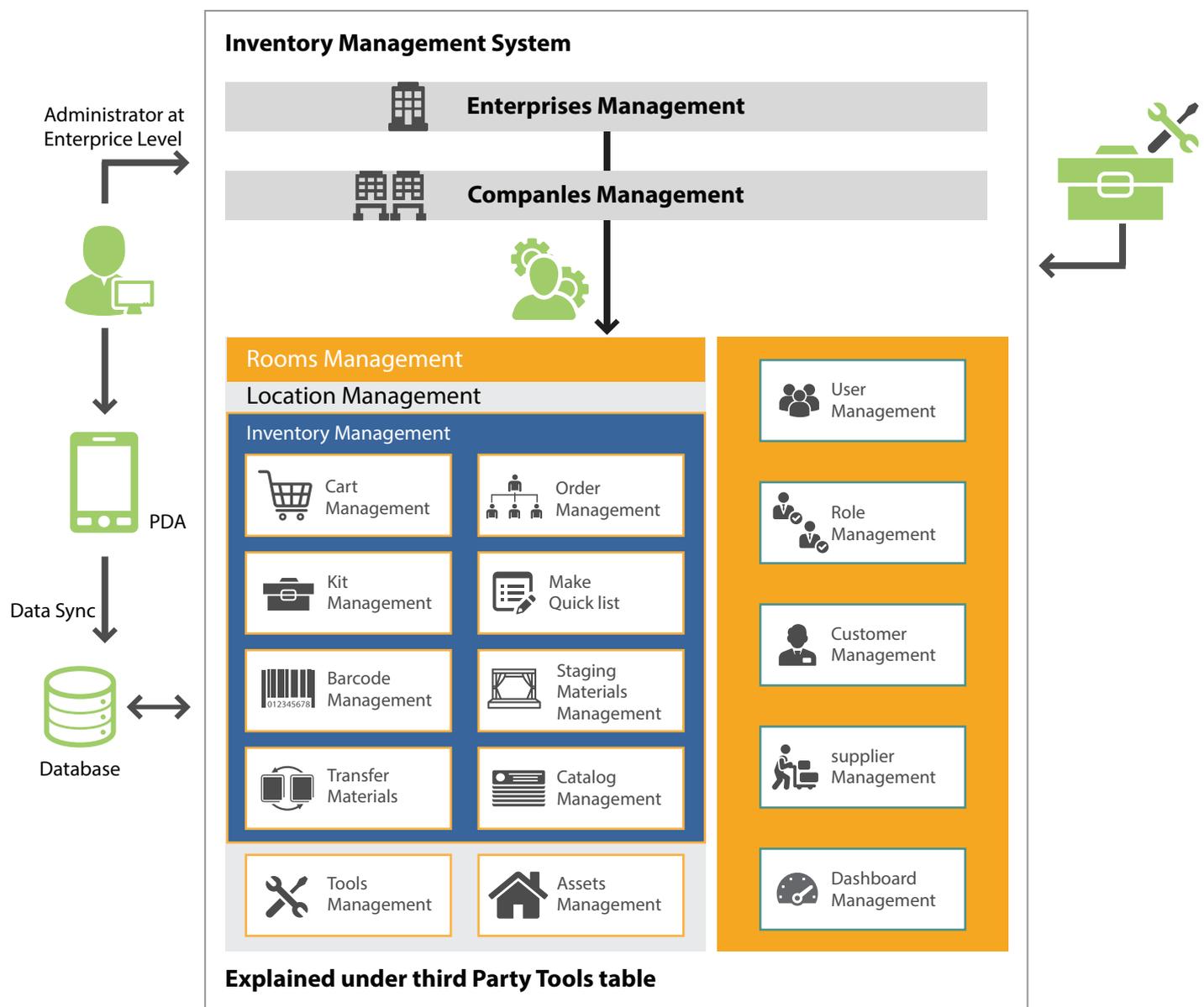
A leading inventory management company required an automated solution that would help their end users improve their sales & service levels, optimize inventory, & eliminate stockouts. They needed a cost-effective solution that would help their end users manage inventory at the point-of-use.

› Need for Automation

Stockroom management is a hassle for many businesses, and there is no connect between the stockroom and the actual point of use in a service industry. This causes discrepancies in the sales. The client catered to companies, offering them stockroom and inventory management services. They required a solution that would connect point of sales to the stockroom so as to optimize inventory and maximize service levels to achieve maximum productivity. The client would offer this system to the different clients they serve, thus building on their inventory management needs.

› The Solution

A SaaS-based stockroom management inventory system was proposed to help resolve the discrepancies and to manage the inventory at all places. This solution would help maintain and keep a stock of the entire inventory, at the point of sale as well as the stockroom.



A PDA device is used to scan the barcode of the inventory at the point of sale, which is stored in the local database in the offline mode. Data from the local database is then transferred to the central database using the web services, so that the actual point of sale data is available. The stockroom data stored in the local database is shared with the central database as and when there is a stockout. The solution included sensors and jQuery data tables. This entire setup including the PDA device helped manage the inventory, and prevent stockouts.

This example helps understand how IoT benefits supply chain and wholesale industry.

Automated Driving Test Track – eGovernance Industry

Commissioner of Transport, Government of Gujarat, India wanted to automate the driving test track, to reduce manual interference and have unbiased results. The solution offered, proved to be a perfect example for an Internet of Things application, where different devices are connected over a network to capture data and then process it to generate Driving Test results.

➤ Need for Automation

Earlier the driving test used to be a manual process with human intervention. One had to take an "8" driving test to prove your ace in driving a Two Wheeler or Four Wheeler. A single Inspector would be the judge of the capabilities of the driver, and also check the errors committed in the process.

This process needed to be automated for several reasons. A human intervention would simply hint at biased or erroneous judgment. The manual processes were not completely transparent, and the only record that was held of the process was what the Inspector logged.

The test was also simple and only a single test would be conducted- a driver had to drive the vehicle as in "8". Again, the long queues could not be avoided in the process as there was both human and infrastructure related limitation to the process.

To ensure accuracy, transparency, speed, bias and human interference in the entire process, there was need to automate the driving test track.

➤ **Automation of Driving Test Track: The Solution**

The solution offered aimed to remove the limitation that arose from the earlier manual solution, which is inaccurate readings and biased results. This solution has been categorized under internet of things because of the way the different technologies used within it aim to capture the data, and send results on a real time basis.

The Technologies that are connected

- In the "8" driving track, there are pole sensors located at equidistant points along the 8. These pole sensors are used to sense the jerks and vibrations that the vehicle experiences within the track, and report them to the central tracking software
- There are beam sensors along this track which sense the forward and reverse movement of the vehicle in the track with precision
- The cameras will capture the video recording of the motion of the car and record the data collected
- RFID tags are placed along the direction of the 8 to record the user movements, while the "Stop-go" signal helps reassert the actual situation in simulation mode
- There is a mobile application using which the driver can register for the test. Apart from the mobile app, there is another technology, a third party app, which is used for the biometric validation

➤ **How the Solution Works?**

- The driver when applying for a driving license, should register using the mobile app. Once the registration process is completed, the driver will need to go for biometric scanning, to record their fingerprint in the system
- Once this process is done, they will receive a unique identity, which they need to produce while appearing for the test
- On the day of the test, the driver will be allowed inside only after the Id and the fingerprint produce a perfect match
- The technologies mentioned above, beam and pole sensors along with the cameras and RFID tags record the data with precision
- All the data recorded, and the ID plus fingerprint match are sent to the central control software, where the data is analyzed, and the results are given out based on the pre-set criteria
- The result is then sent to the third party application, from where it is then sent to the user

The different technologies communicate over a network without the need for computer or human interaction, which is why the results presented include high levels of accuracy

In case, the candidate fails in the test, he/she can reappear in 7 days.

› Benefits of IoT in RTO

Incorporating the Internet of Things solution to the automated driving test track, has offered a range of benefits to both the driving test takers and RTO officials.

- The process of giving a driving license has become less complicated because of the automation incorporated in the whole system
- The whole process does not call for manual interference which means the data is recorded along the track error free and with complete accuracy
- The devices capture data real time, and process as easily as possible. This tends to make the whole process of driving test tracking easy and fast
- Newer and better testing standards could be incorporated without worrying about precision of results
- The system of testing became more transparent because of the Internet of Things solutions which offered automation, and quick processing
- If RTO, at any point wants to add more parameters, they can do so without disrupting the existing solution

Home & Life Applications

Shortly, you would be living in a connected universe comprising of smart cities, and smarter homes. Your refrigerator will be connected to the stores from where you buy the food as well as the truck that delivers food so that you are well-connected. As of now, you have a smart home, which is the most tangible aspect of IoT.

The smart home market is growing rapidly. According to certain forecasts, the smart home market will grow by 56% year-on-year for at least the next three years. By 2018, you will observe at least one smart home system installed in about 224 Mn homes. A classic example of home automation comes in the form of a smartphone controlled air-conditioner.

Need for Automation

The air-conditioning system in homes and offices could be controlled using the remote. This meant the person had to be in the same room as the air conditioner to operate it. Many times people required the AC to be switched on before they entered their homes or offices so that they can enter a cool environment. People, who have a habit of leaving their ACs on when leaving the premises, had to travel the whole distance back to turn off the AC.

The number of smartphone users is increasing exponentially. A smartphone-controlled device can be operated from anywhere at any time.

Smartphone Controlled AC: The Solution

The client wanted a solution wherein the AC would communicate with the smartphone over the internet via a mobile app. The app should contain all the operational functions present in the actual remote. The application should function only on IR-enabled mobile devices as these devices emit the IR signals from the IR blaster. The signals will be coded to define the particular function on the remote.

Two types of remotes should be described to control the AC:

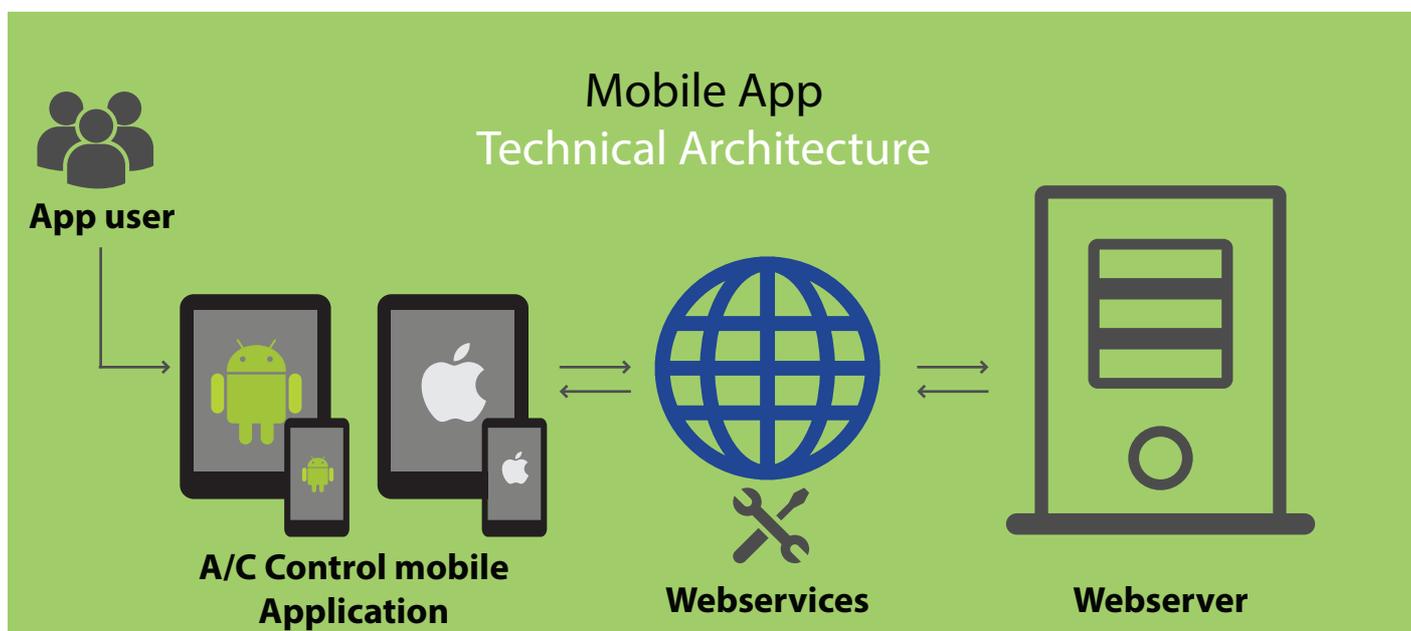
1. Quick Remote: This will include all the essential functions- On/Off, Set Temp Up, Set Temp Down, Fan Speed, Mode
2. Full Remote: This will include certain functions other than the basic ones- 4 Timers, Kaimin, Asymmetric swing, Parallel swing, H-Swing, Filter clean reset, Digilock, My Mode, ACT mode, I-See, I-Sense, My Clean, Auto Off, Smart Swing plus features of quick remote.

This client wanted this app for iPhone, iPad and Android platforms.

How the Solution Works?

A single mobile application can be used to operate and control the different ACs that operate at various locations. You will need to check the device compatibility with your mobile application to gain control. A web services API is used to communicate with the AC over different networks, which depends on the availability and your requirement. This application will communicate with the AC over six different channels- IRDA, IR Dongle, GPRS, Wi-Fi Router, Wi-Fi Direct, and Bluetooth.

When the user launches the application, the app will check for the availability of the modes mentioned above, and choose the one available to communicate and signal the AC for set functions.



IRDA: This mode is chosen if you are using a smartphone which includes the IR LED. On selection of this mode, your phone will send IR remote signals based on 38 kHz carrier frequency via the IRDA port

IR Dongle: You can activate the IR mode using the IR dongle, if you don't have an IR enabled smartphone. In this case, the IR signals will be generated via the audio jack output. The IR dongle will determine the range of the signals.

GPRS: The connection enabled via GPRS will help the application communicate with the AC via web services. This range is unlimited, and the AC is controlled from anywhere

Wi-Fi: Two different connections are observed for Wi-Fi

1. Over internet via Wi-Fi router: If you want to connect the smartphone to the AC via Wi-Fi, the application will connect and communicate via the server using web services. Here, you have unlimited control over the AC i.e. you can operate it from anywhere
2. Wi-Fi direct: This connection type is generally used for one to one communication between the app and the AC. Here the range will be limited, and the Wi-Fi range determines it.

Bluetooth: This connection type shall be used for one to one communication from Smart phone to AC

IoT for Smart Operations

Hajj, the Muslim pilgrimage to Mecca has become accessible to the pilgrims from across the world. It has become increasingly crowded in the recent past. Serious accidents such as stampede involving casualties and loss of lives have been reported each year at this pilgrimage. At such times, it becomes difficult for the Indian Consulate of Mecca to identify the Indians amongst the dead, injured & hospitalized and get them home. The situation is becoming difficult by the day for the Consulate, and they require a solution to resolve the matter.

Loss of luggage marks another pain point for the Consulate. There are times when the luggage gets mixed up with someone else's, or the luggage does not reach the right person. At such a point, identifying the luggage owner and ensuring the luggage reaches them is important.

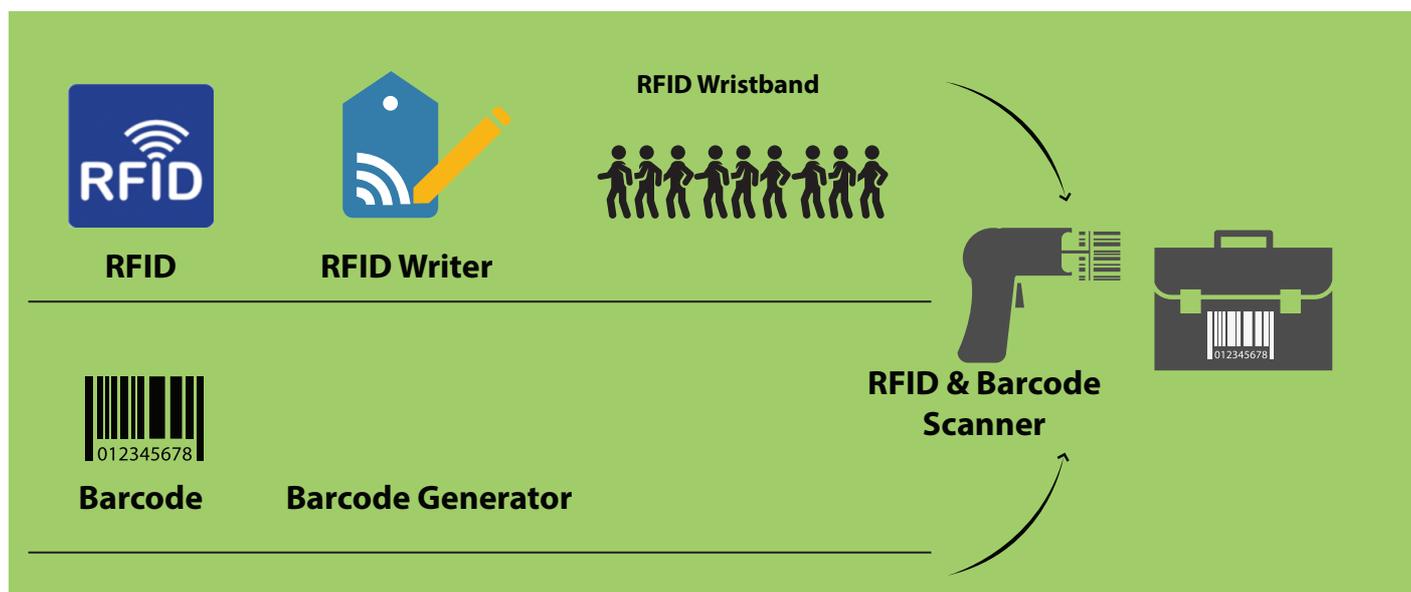
The consulate needed a system that could maintain a record of the people and their luggage. The system should resolve the pain areas that have been identified by the Consulate.

RFID Based Solution

The Haj flights operate from 21 embarkation points. At each of these embarkation points, the Haj Committee has deputed their staff, and set up camp offices which assist the Haj Pilgrims in different ways. This office is responsible for verification of the remittance as well as distribution of travel documents to these pilgrims.

A RFID solution would help address the issue of identifying the Indian Pilgrims during major accidents, and get them back to base. The Indian Pilgrims would be tagged with the RFID wrist-band at the embarkation point. Data would be written digitally onto the wrist-band using the RFID writer, before it is handed over to the Pilgrim. The data can be the passport number of the person. In case of an accident, the RFID Reader would help scan and read the data from the wrist band tied to the person's hand. This will help identify if the person is an Indian Pilgrim or not, and allow the Consulate to take immediate action.

A similar solution can be extended to the luggage, to help track the luggage in case it goes missing. When the luggage is checked-in at the airport, a Barcode sticker with a unique barcode is tagged to the luggage. This barcode is scanned, and you can identify whether or not the luggage belongs to you. The barcode once tagged is stored to the local file on the device.



Connected Technologies:

- **RFID Writer:** This device will help write the data (Passport Number) to the RFID wrist band.
- **RFID Wristband:** This will store the Yatri's information
- **RFID/Barcode Scanner:** This will scan the Passport number on the RFID wrist band as well as on the luggage tag. This data that is scanned will help access all the details for the Yatri
- **Barcode Generator:** This barcode generator will help generate the sticker containing the barcode which will then be tagged to the luggage for easy identification
- **Software Solution:** Search functionality will be included to search for the data from the local database, to display details related to the Yatri. Passport Number, Name, State Code, Family Unique Number and Accommodation details will be displayed on searching

This is a small yet well-defined RFID based IoT solution for smarter and efficient systems within the offices.

Conclusion

The Internet of Things is being implemented at a scale that is beyond imagination. The necessary advances in this regard have already been made, and manufacturers as well as agencies are implementing small scale versions to ring in this technology.

The legal, ethical, and security barriers have made the adoption of this technology slow. Obviously makers of technology are trying hard to overcome these barriers, and have been successful in many ways. This ambitious paradigm that increases the scale of connected devices is soon to take over the daily lives of enterprises as well as consumers in more ways than has been described here.

THANKS FOR READING



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To learn more, Visit us on the web at

www.silvertouch.com

Email: info@silvertouch.com