DIGITAL ASSIGNMENT 1

By
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THE REAL WORLD DEPLOYED IOT PRODUCTS

- SMART TOOTHBRUSH
- FITNESS TRACKERS
- CHILD AND PET FINDER
- INFANT MONITOR
- SMART SHELVES
- SMART GARDENING
- HEALTH MONITORING
- SMART REFRIGERATOR
- POLLUTION WARNINGS
- SMART SHOES

IOT Functionalities for fitness trackers

- Sensors are used to collect data about the number of steps or heart rate. The more sensors an activity tracker has, the more accurate the tracker. Some of the sensors used in activity trackers are:

1. Accelerometers are used in all trackers to determine the number of steps taken. Most activity trackers use advanced 3 axis accelerometers to determine the position in three dimensions for improved accuracy. Gyroscope might also be used in association with accelerometers to take orientation and angular velocity into account.

2. GPS in activity trackers helps to map the route and terrain on which the activity was performed.

3. Heart rate sensors help to measure heart rates during exercise. Optical sensor, galvanic skin response sensor or bio-impedance sensor can be used to measure heart rate in increasing order of accuracy.

- **Raw data collected by sensors is integrated and converted to a standard form so that it can be used by algorithms.**

- **Algorithms convert the data into meaningful information and statistics.**

- **Apps on a smartphone or computer display the information and statistics in a user-friendly format like charts or graphs. Apps can also prompt the user to exercise when they are going to miss their daily goal. They can also connect to social media to share the user's fitness achievements.**

Sensors in fitness tracker

1) 3 axis accelerometer

To track movement in every direction. An accelerometer sensor takes inertial measurements of velocity and position. Usually on three axes, it can sense inclination, tilt, and orientation of the body as well. Naturally this is very important for any fitness tracker as most steps taken by the individual will be actually recorded by this sensor.

2) Gyroscope

To measure orientation and rotation. A gyroscope can be used for navigation and measurement of angular velocity. A 3 axis gyroscope can be paired up with a 3 axis accelerometer to provide a '6 degree of freedom' motion tracking system. Most reliable fitness trackers use this combination to get a better grip on the 3D workout motions that an individual may perform.

3) Altimeter

Altitude measurement for mountain climbing. Pressure altimeters are actually an advanced version of the aneroid barometer. Where the barometer shows the measurement of pressure, the altimeter shows the height as there is an exact correlation between them. Most fitness trackers may not offer an altimeter unless the individual opts for one specifically designed for mountain climbing.

4) Temperature sensor

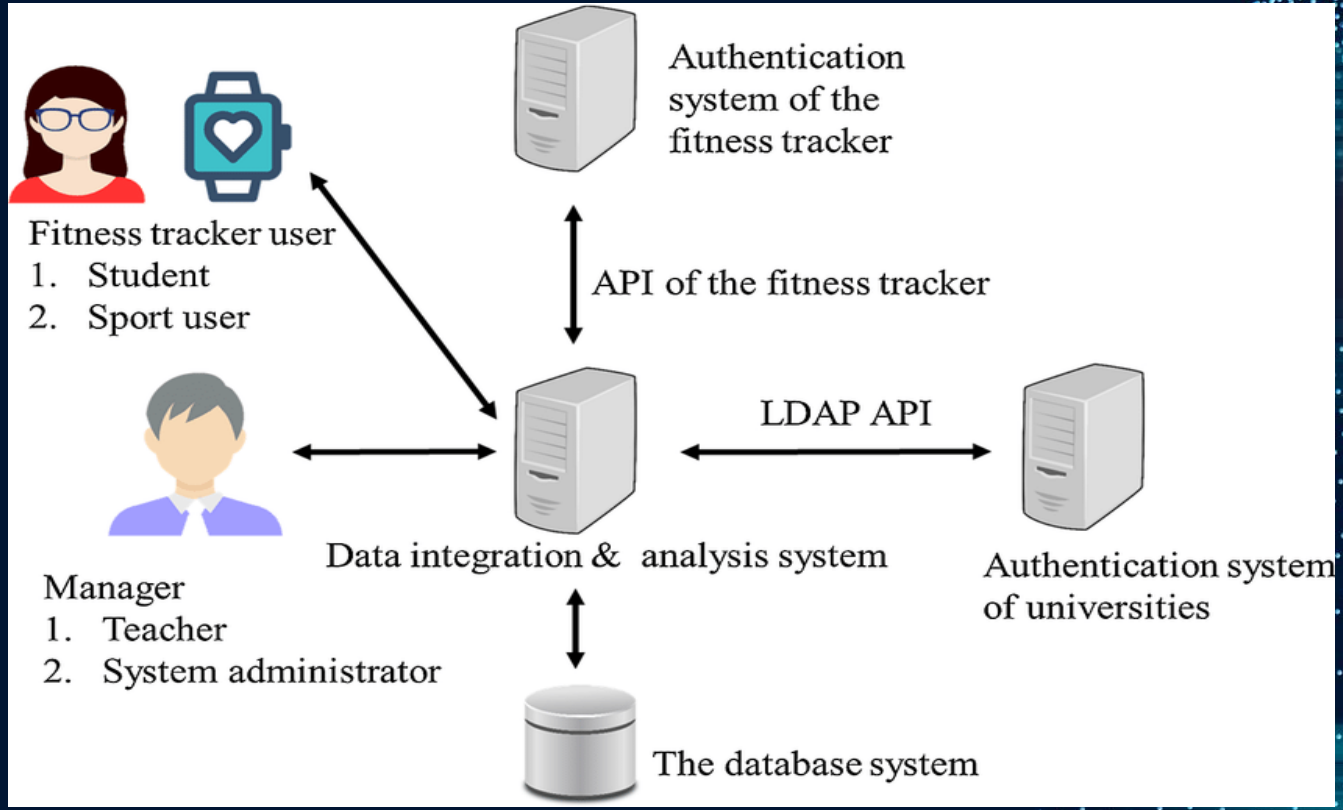
To keep track of temperature changes. While it is not exactly like a thermometer, the concept of the sensor is similar, i.e. ir provides a reading of the body temperature. The more the body heats up, the tougher the workout seems to the fitness tracker.

5) Bio-impedance sensor

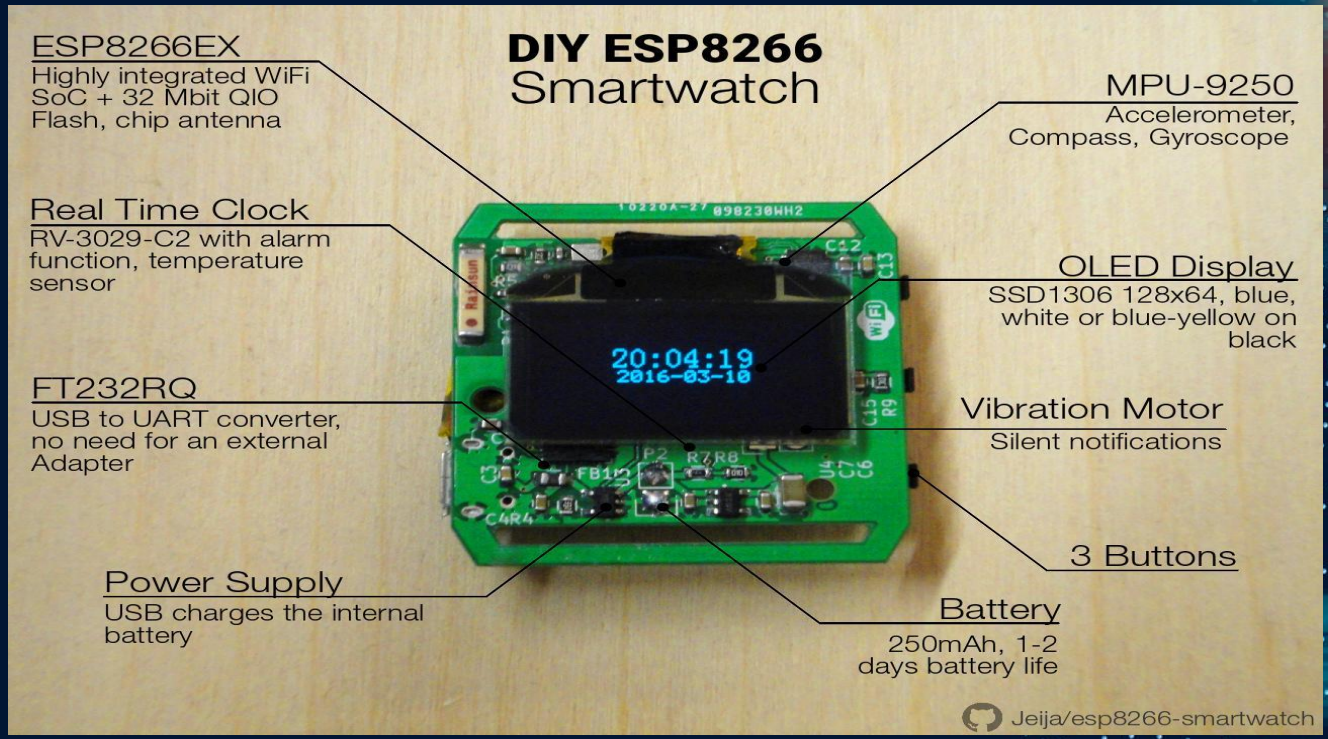
This checks the resistance of the skin to a small electric current. The galvanic skin response is a method of measuring the electrical resistance of the skin and interpreting it as a certain activity of the body. It is also known as electro-dermal response or psycho galvanic reflex. That does not mean that the fitness tracker will be giving shocks, but some of them may use this sensor to collect data for heart rate.

6) Optical sensor

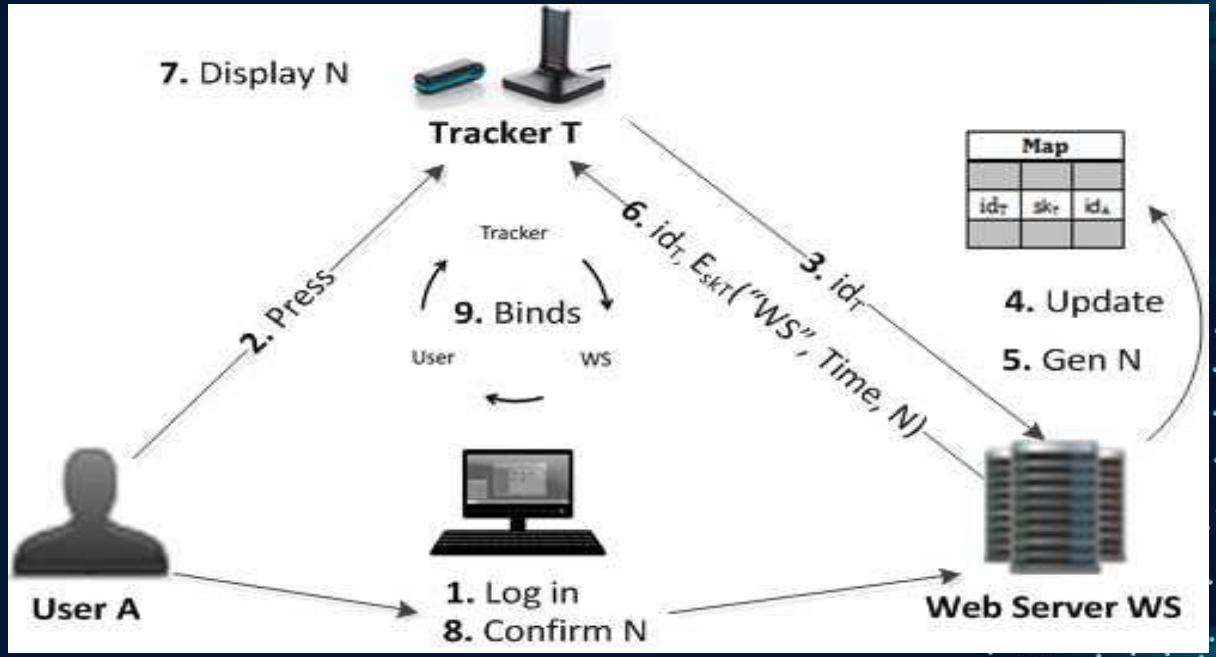
This uses light on the skin to measure the pulse. The sensors can be used to measure the rate at which blood is pumped through the capillaries, thereby measuring the heart rate. They are preferred to galvanic skin response by most manufacturers of popular fitness trackers - these are the little lights that sit flush with the skin to measure the pulse.


Authentication system of the fitness tracker
Fitness tracker user
1. Student
2. Sport user
API of the fitness tracker
LDAP API
Manager
1. Teacher
2. System administrator
Data integration & analysis system
Authentication system of universities
The database system

IoT Architecture



Computing Board



Networking Protocol

- Bluetooth is a standard wire-replacement communications protocol primarily designed for low power consumption, with a short range based on low-cost transceiver microchips in each device. Because the devices use a radio (broadcast) communications system, they do not have to be in visual line of sight of each other; however, a quasi optical wireless path must be viable. Range is power-class-dependent, but effective ranges vary in practice.

Cloud and security

- When most people think about working out, the first images that come to mind are probably some combination of darkly lit weight rooms, clanking barbells, or grunting body-builders in muscle tees slamming weights on the ground. While these archetypal images of fitness are not necessarily "wrong", they undermine the exponential digital growth the fitness and wellness industry has experienced in the last decade.

- Maintaining a healthy lifestyle has departed from the traditional association that being fit means being a gym rat or a vegan: individuals now pursue their health initiatives on varying levels thanks to the rise of digital technology.

- The impact of the technology surge in fitness has undoubtedly changed the landscape of the industry. Rather than relying on traditional methods of fitness, individuals are now granted a wide variety of options to stay healthy and fit in addition to more tools and software that can effectively gauge their effort and progress

- The main players that have helped cultivate this landscape are none other than wearable devices and cloud-based services. The technologies, though they can be used separately, typically work in tandem. Wearable devices utilize advanced sensors to collect an array of personal biometric data, giving the user real-time updates of their activity levels, as calories burned, distance traveled, or heart rate levels. User data is immediately collected and analyzed through wireless cloud-storage facilities, creating backlogs of activity data that can always be accessed from an array of the user's devices.

- Due to the widespread adoption of common fitness technology, individuals now approach fitness with a broader perspective, which has made them more conscious and motivated to pursue overall healthier lifestyles.

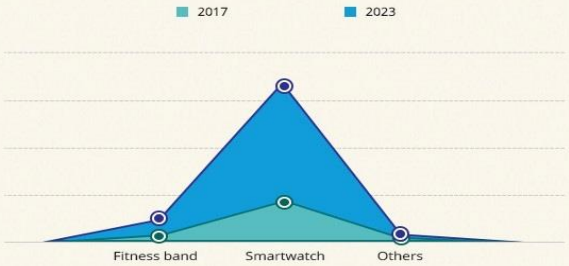
Analytics


FITNESS TRACKER MARKET
BY COMPATIBILITY
2017
2023
iOS
Android
Windows
Tizen
Others
IOS operating system holds a dominant position in 2017 and would continue to maintain the lead over the forecast period.


FITNESS TRACKER MARKET
BY SALES CHANNEL
2017
2023
Offline
Online
ONLINE sales dominate the global market in 2017 and would continue to maintain the lead over the forecast period.

FITNESS TRACKER MARKET

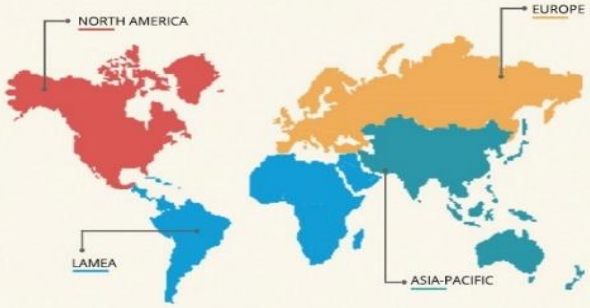
BY DEVICE TYPE



SMARTWATCH is projected as one of the fastest growing device types.

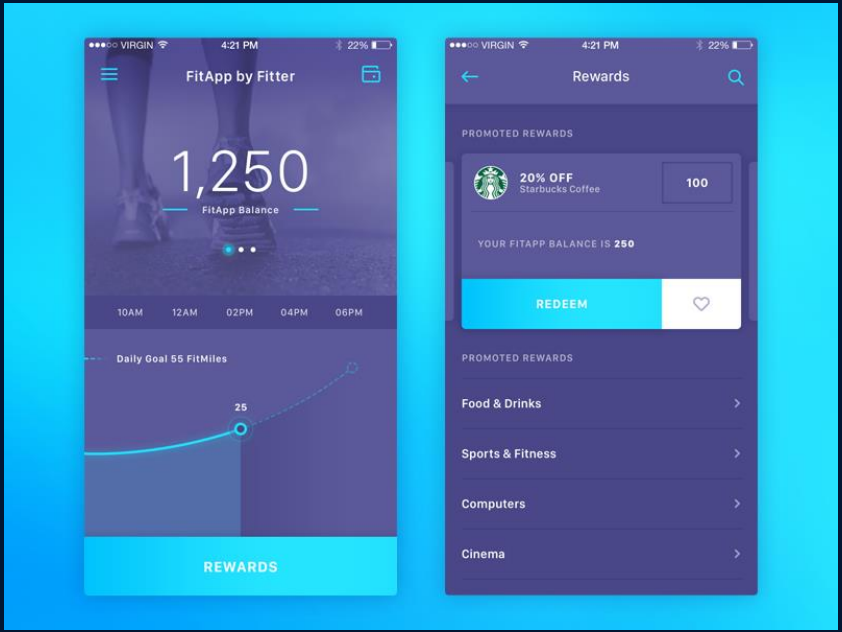
FITNESS TRACKER MARKET

BY GEOGRAPHY



Asia-Pacific would exhibit the highest **CAGR of 21.2%** during 2017-2023.

UI-DESIGN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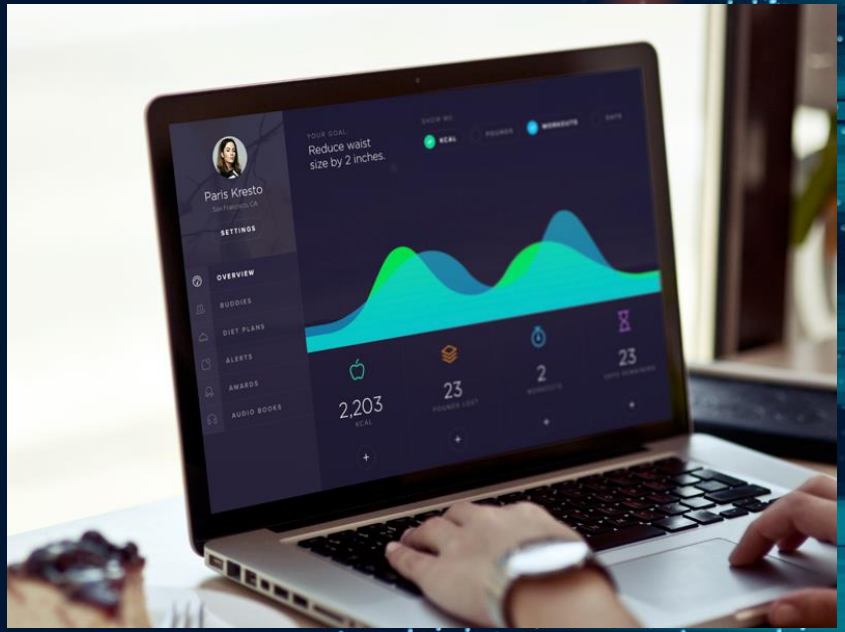
PROMOTED REWARDS
Food & Drinks
Sports & Fitness
Computers
Cinema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SETTINGS
OVERVIEW
BUDDIES
DIET PLANS
ALERTS
AWARDS
AUDIO BOOKS
Reduce waist size by 2 inches.
2,203
23
2
23


Verizon
10:17 PM
75%
82%
Completed
Steps
12538
2358
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32538
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17,3k
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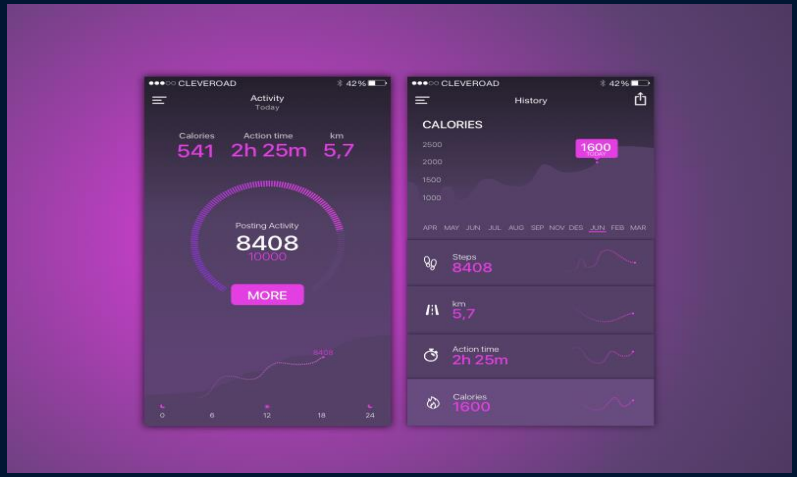
Add Activity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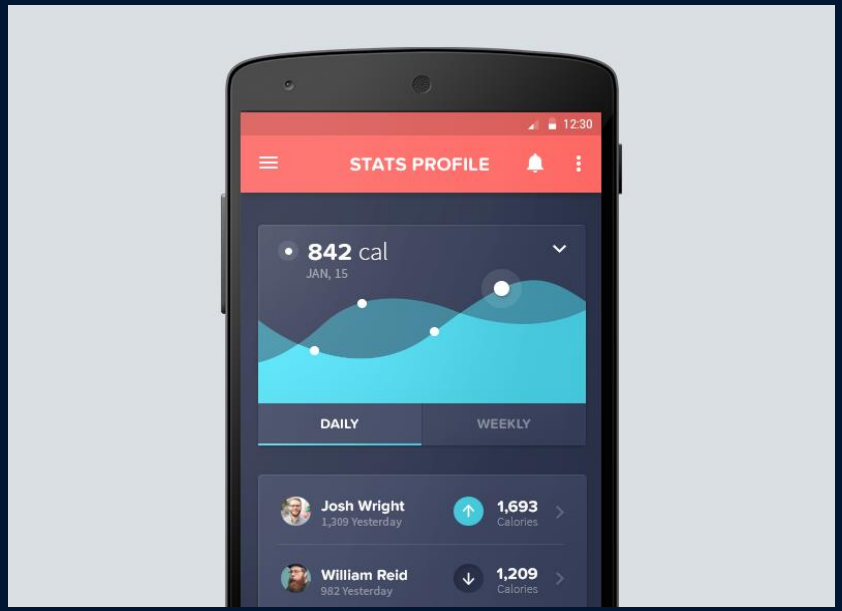
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Josh Wright
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William Reid
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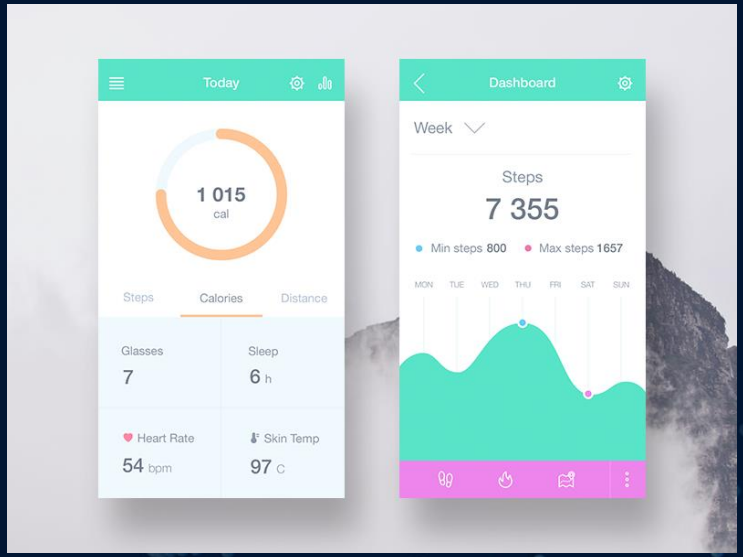
Total
1035
57%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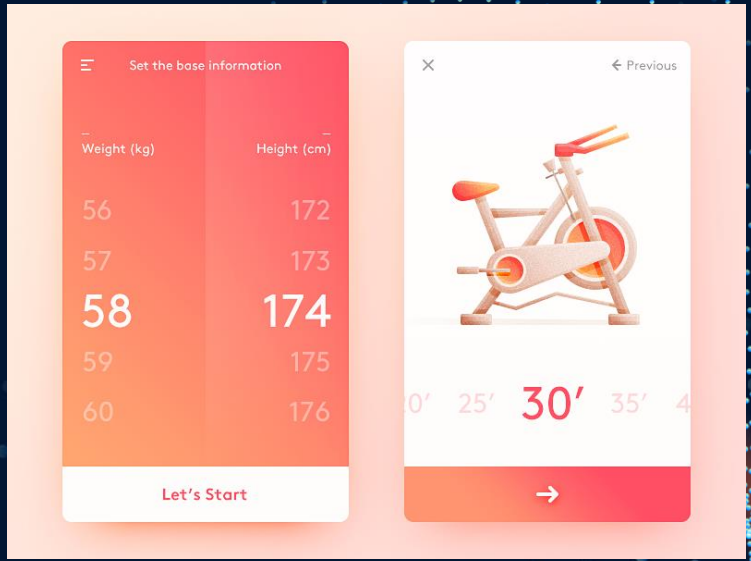
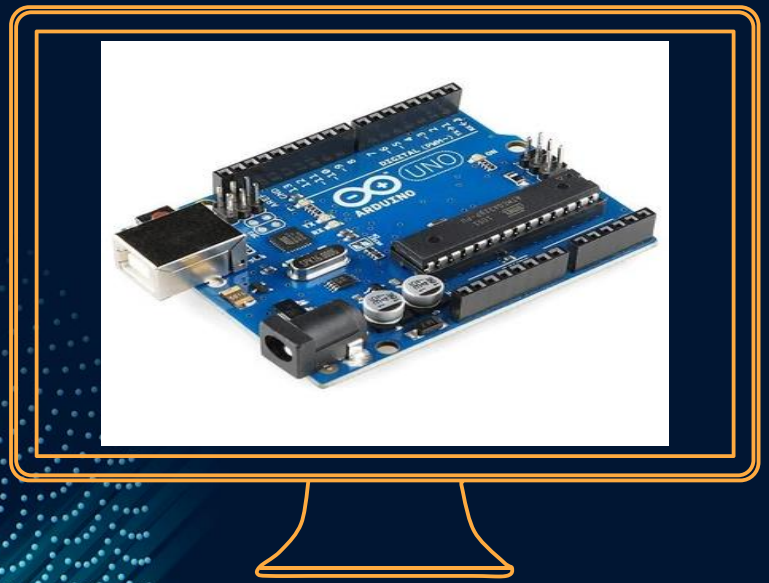

Set the base information
Weight (kg)
Height (cm)
56
57
58
59
60
172
173
174
175
176
Let's Start
Previous
25′
30′
35′

ARDUINO UNO BOARD

Arduino UNO is the most popular prototyping board. It is one of the first development boards, still, it is relevant in the new IoT scenario. Built around ATmega328 microcontroller, Arduino UNO comes with 32 Kb Flash memory, 1 Kb EEPROM, 6 Analog Input pins and 14 Digital Input / Output pins. The board can be connected to different Arduino Shields for connectivity with Ethernet, Bluetooth, Wi-Fi, Zigbee or Cellular network. It has large community support and open-source software libraries are available for interfacing of most of the sensors and implementation of several IoT protocols. It has an open-source IDE where its firmware can be easily programmed and compiled in embedded C. The Arduino can be connected to most of the IoT platforms. Arduino is preferable for IoT applications where sensor connectivity is the prime requirement and the designed 'object' has to process and communicate 'small data' after simple computing. The Arduino UNO costs merely $22 (approx). The Arduino Shields have additional cost.

ARDUINO UNO BOARD



Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), 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 a AC-to-DC adapter or battery to get started. You can tinker with your Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

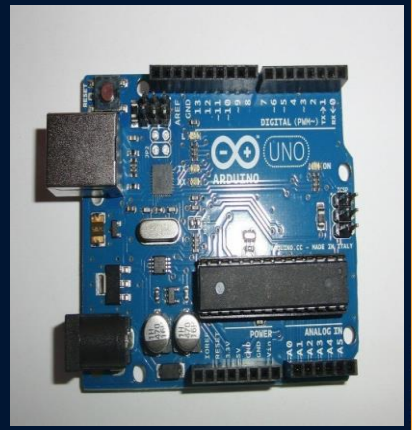
The main features are:

1.5V (operating voltage)

2.8bit

3.16MHz

It has, moreover, analog and digital pins. The interesting aspect of this board is it can be expanded using shields. A shield is another board that can be plugged into Arduino Uno that adds new features like GSM, Ethernet connection, WIFI and so on. It is very simple to use and has an official IDE to develop applications (or sketch). There are, also, free and paid IDE that offers more features respect to the official one. Recently, it is possible to add to this board Arduino Yun shield. This shield is made for IoT projects and extends the Arduino Uno board features.



OTHER VARIOUS IOT PROTOTYPING BOARD

BeagleBone Black

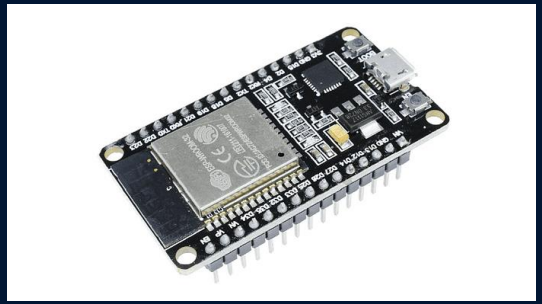
Based on AM335x 1GHz ARM® Cortex-A8 processor, Beaglebone Black comes packed with 512 MB DDR3 RAM, 4GB 8-bit eMMC on-board Flash Memory, 3d Graphics Accelerator, NEON Floating Point accelerator and 2X PRU 32-bit microcontrollers. It has on-board Ethernet, HDMI and 2 46-pin headers. It can run various Linux distributions along with Android. Beaglebone is a smart choice for IoT applications where large number of sensors need to be connected in the 'object' with on device complex computing at stationary nodes.

ESP8266

Based on L106 32-bit RISC microprocessor core, ESP8266 is a Wi-Fi Microchip with full TCP/IP stack on board. The ESP8266 is capable of either hosting an application or off loading all Wi-Fi networking functions from another application processor. The next generation ESP8266 – ESP32 has dual core CPU operating at 160 MHz, 512 Kb RAM, Bluetooth 4.2 (to serve as gateway to Bluetooth Enabled Devices Only), in-built Wi-Fi radio and MQTT protocol support. The new ESP32 board comes packed with 2 UART interfaces, 2 DAC, 16 12-bit ADC and 10 Capacitative Touch Inputs. Though ESP32 still needs external Flash memory and logic converter. The ESP8266 is best suited for wearable IoT devices that require Wi-Fi or BLE connectivity.

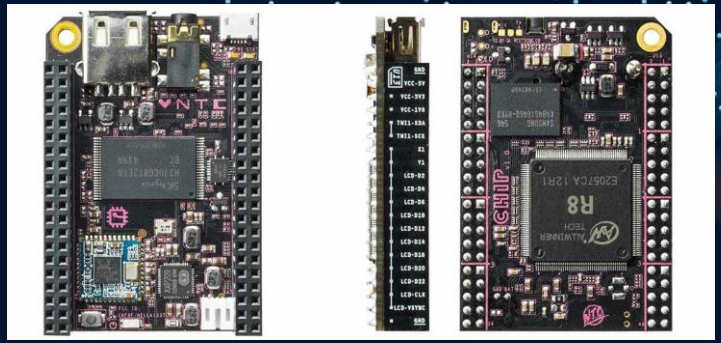
BANANA PI

Banana Pi is a line of low-cost credit card-sized single-board computers(SBC). IT is a router-based development board, which efficiently runs on various open-source operating systems including OpenWRT and Android, Lubuntu, Ubuntu, Debian, and Raspbian. Well, the hardware design of banana pi was influenced by the Raspberry Pi and it is compatible with Raspberry Pi boards.



JETSON NANO

Jetson Nano is a power-efficient and low-cost development board. Provides total performance to run modern AI workloads in a small form factor. Additionally, It has the ability for heavy workload applications like image classification, object detection, segmentation, and speech processing. It is capable to run multiple neural network apps at the same time.



C.H.I.P

Built on a 1 GHz Processor, CHIP comes with 4GB High Speed storage and 512 MB RAM. It has in-built Wi-Fi, Bluetooth 4.0 and contains composite output to connect with VGA or HDMI display. It has 8 GPIO pins and support for supports PWM, UART and I2C. It can run Linux distribution called Debian. With low cost of around $9 and small form-factor, it is suitable to start prototyping IoT products.

IoT FUNCTIONALITIES DOMAIN WISE

Wearables

Wearable technology is a hallmark of IoT applications and probably is one of the earliest industries to have deployed the IoT at its service. We happen to see Fit Bits, heart rate monitors and smartwatches everywhere these days.

One of the lesser-known wearables includes the Guardian glucose monitoring device. The device is developed to aid people suffering from diabetes. It detects glucose levels in the body, using a tiny electrode called glucose sensor placed under the skin and relays the information via Radio Frequency to a monitoring device.

Smart Home Applications

When we talk about IoT Applications, Smart Homes are probably the first thing that we think of. The best example I can think of here is *Jarvis*, the AI home automation employed by Mark Zuckerberg. There is also Allen Pan's Home Automation System where functions in the house are actuated by use of a string of musical notes.

Health Care

IoT applications can turn reactive medical-based systems into proactive wellness-based systems.

The resources that current medical research uses, lack critical real-world information. It mostly uses leftover data, controlled environments, and volunteers for medical examination. IoT opens ways to a sea of valuable data through analysis, real-time field data, and testing.

The Internet of Things also improves the current devices in power, precision, and availability. IoT focuses on creating systems rather than just equipment.

04

SMART CITIES

The Government and engineers can use IoT to analyze the often-complex factors of town planning specific to each city. The use of IoT applications can aid in areas like water management, waste control, and emergencies.

05

AGRICULTURE

A greenhouse with embedded devices not only makes it easier to be monitored but also, enables us to control the climate inside it. Sensors measure different parameters according to the plant requirement and send it to the cloud. It, then, processes the data and applies a control action.

06

INDUSTRIAL AUTOMATION

This is one of the fields where both faster developments, as well as the quality of products, are the critical factors for a higher Return on Investment. With IoT Applications, one could even re-engineer products and their packaging to deliver better performance in both cost and customer experience. IoT here can prove to be game changing with solutions for all the following domains in its arsenal.

DA-IOT

Case studies on Bluetooth, Zigbee, Wi-Fi, GPS, IP

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Case study on Bluetooth

ABSTRACT:-

Connectivity and physical mobility requirements for industrial applications have brought an exponential growth in wireless systems. In a production factory parameters like temperature, humidity level, vibration level and light etc., are to be monitored and controlled.

Every year, the *Bluetooth*® community makes major strides that drive wireless innovation, overcome challenges, and create stronger, more interoperable connections around the world. Community members work diligently with global partners to deliver comprehensive case studies that validate the reliability, flexibility, and scalability of Bluetooth technology across a wide range of platforms and infrastructures, from indoor navigation to commercial connected lighting and even COVID-19 response solutions powered by Bluetooth technology.

Building Automation: Achieving energy savings of over 90 percent with smart lighting sensors and Bluetooth mesh

Intelligent sensors are becoming increasingly important in building technology. Modern sensor technology with high-performance communication hubs can help commercial properties from office buildings to event halls operate in a sustainable and cost-saving way. Networks based on Bluetooth mesh are optimized for the control and communication

of sensors and the establishment of large-scale device networks. The latest-generation SENSOTEC sensors from STEINEL Solutions AG, can be easily integrated into existing lighting solutions thanks to their compact design. They register presence, luminous intensity and many other parameters with zonal accuracy, as the basis for building automation, plant tracking and other IoT solutions.

As an OEM partner, STEINEL Solutions offers its customers a service package including consulting, product development and industrialization from the initial idea to the finished product. The company pioneered the first sensor light and is now the technology leader for motion and presence detectors throughout Europe with our electronics experts in the fields of sensor technology, communication, low power and the development of customer-specific solutions at the Swiss development site in Einsiedeln. Thanks to the affiliation with the STEINEL Group, customers can access a Europe-wide network for series production, depending on the product life cycle and market success. In Germany, STEINEL is headquartered with a research and logistics center in Herzbrock-Clarholz, Westphalia.

Due to their small size, STEINEL's sensor solutions can be easily installed in lighting fixtures. Early on, these modules for commercial lighting were equipped with solutions to detect movement in parts of the building and to commission and parameterize the individual luminaires. However, there was an issue with these different, proprietary approaches: They were not compatible with each other. To be functional, these sensors needed additional gateways. Data exchange and central data analyses were associated with a high level of effort.

STEINEL achieves interoperability with Bluetooth mesh, developed by the Bluetooth Special Interest Group (SIG). Two criteria were particularly decisive in the selection process. "In addition to its high reliability, the great advantage of the Bluetooth standard is its widespread use and connectivity via smartphones," explains Manuel Siegrist, Sales & Product Manager SENSOTEC at STEINEL Solutions AG. "This allows us to offer a control app for our sensors that any facility manager can use without complications." This app makes STEINEL's solution not only easy to use, but also sustainable in the long term. This is because the company offers regular further developments for the control of its sensor networks via the app – very simple via firmware updates.

The advantages of Bluetooth mesh

Bluetooth mesh offers the highest reliability, scalability and interoperability for commercial building automation. All product types from STEINEL's SENSOTEC NET portfolio can be configured via Bluetooth technology to form a Bluetooth mesh network. Wireless networking also brings a major advantage in the retrofit sector: if a lighting system is to be modernized, it can be retrofitted without having to make adjustments to existing

installations. Previous wired lighting systems with their high installation costs and expenses for replacements are thus a thing of the past.

The integration of Bluetooth technology into lighting systems has also made it easier to prepare the installation offline and then commission the luminaires online on site in a short time. The initialization and configuration of the sensors takes place via the web and mobile app of the software specialist and cooperation partner SILVAIR. The app also enables free definition of luminaire groups with configurable behavior. For example, only certain required areas are illuminated. SILVAIR offers innovative IoT solutions and provides lighting control systems to reduce energy consumption in commercial buildings.

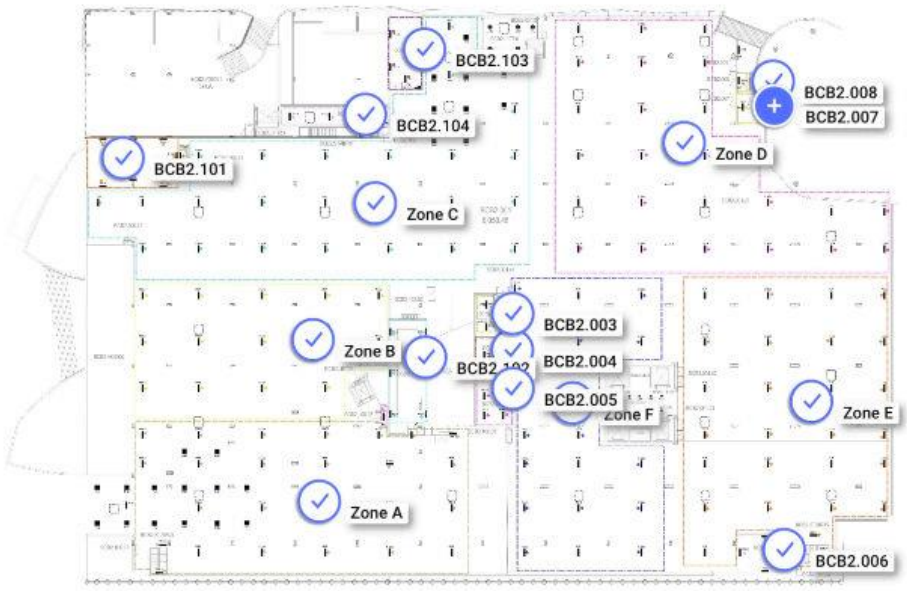


Figure 1 Floor plan in the Web and Mobile App from software specialist SILVAIR

Figure 2 Intelligent lighting solution for underground garages & parking garages

Use Case: Intelligent lighting solution for underground & parking garages

Until now, the lighting underground garages and parking garages has guaranteed one thing above all for operators: it is cost-intensive. Especially because lighting is required 24/7. Innovative and intelligent lighting systems can improve energy efficiency immensely by only switching on the lighting when it is actually needed. SENSOTEC sensors installed in linear luminaires provide a Bluetooth based intelligent modern lighting solution for underground garages and parking garages. The intelligent lighting system detects pedestrians or cars and illuminates frequented zones for a defined period of time. In the remaining time, areas without presence are illuminated with dimmed comfort light of 10-50 percent or switched off completely.

Energy savings, efficient processes, better use of space

With Bluetooth enabled sensors from STEINEL, building operators are provided with numerous smart optimization options:

- Energy-efficient facility management: energy data and consumption can be measured with pinpoint accuracy. This directly reveals unnecessary power consumption and saves costs. Some customers achieve more than 90 percent energy savings and thus operate their buildings more efficiently and in a more environmentally friendly manner.
- Optimize space utilization: Heat maps provide accurate information about the actual volume of people in commercial properties. They show where there are opportunities

to optimize space utilization. For example, data for the utilization of flexible office workstations can be collected and evaluated from the information provided by Bluetooth mesh sensor networks. This allows a reliable overview of actual demand and more efficient building utilization.

- Optimizing process flows: STEINEL customers also use data from sensor technology to redesign their processes. In a hotel, for example, cleaning staff receive information via Bluetooth mesh as to whether a guest has already left their room. Accordingly, cleaning procedures are planned automatically. The staff does not have to search for free rooms and can thus work faster and more efficiently.

Outlook: Lighting systems as IT infrastructure for smart building applications

In the future, all information potentially received by Bluetooth sensors can be centrally collected and analyzed via networked luminaires. «Our vision for the future is lighting installations as central IT backbones for a wide range of building automation requirements», says Manuel Siegrist. «With Bluetooth mesh and intelligent lighting sensor technology, a higher-level IT infrastructure is created. This then includes, for example, the control of heating, ventilation and air conditioning, shading by blinds and controls via window contacts».

Feedback from STEINEL customers who are already working with Bluetooth mesh in lighting sensor technology is extremely positive. In addition to savings that can be achieved in the short term through greater energy efficiency, the simple, reliable handling of the sensors via a smartphone app is also impressive. It also creates the basis for future wireless IoT networking and building automation.

Case study on Zigbee:

An Introduction:

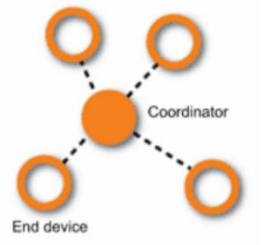
There has been tremendous growth in the field of wireless communication during the last decade. The wide acceptance of 802.11 standards for wireless local area network (WLAN) and cellular phone networks have proved that low cost wireless solutions are feasible and acceptable. There are many applications that require low cost, low data rate, low power and inexpensive solution to network within a small area thus requiring a low rate wireless personal area network (LR. WPAN).

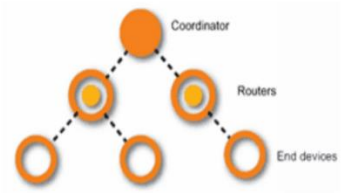
There are many proprietary solutions that address these needs, but they are expensive and incompatible between manufacturers. The IEEE 802.15.4 is a new standard for LR-WPAN viding a low cost complicated solution. The expected applications are home/office automation, industrial sensors and control, distributed sensor networks and environment monitoring. The ZigBee networking standard has slowly but surely taken up an important share of the wireless market. Vendors of ZigBee products are increasing, and more and more types are coming out.

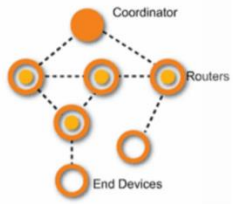
The ZigBee alliance, an association of companies working together to develop ZigBee standard based products for monitoring and control has led to the increased adoption of the IEEE 802.15.4 standard. The ZigBee standard defines upper layer that are built on the IEEE 802.15.4 standard. The aim of the ZigBee alliance is to replace every switchbox. electrical outlet and various sensors in a building by wireless nodes that communicate with each other even though manufactured by different manufacturers. This standard is being widely adopted by the industry and the numbers of products based on the standard are increasing exponentially. The ZigBee alliance a forecasting that in the next few years time, there could be 50 ZigBee devices per home and eventually as many as 150.

Network Topologies

In order to enable efficient data exchange in large-scale networks ZigBee standard utilizes topologies enabled by data IEEE 802 15.4 transfer models and extends them by specifying tree and mesh network topologies. A Zigbee network can adopt one of the three topologies: Star, Tree and Mesh. These are illustrated below.







Device types

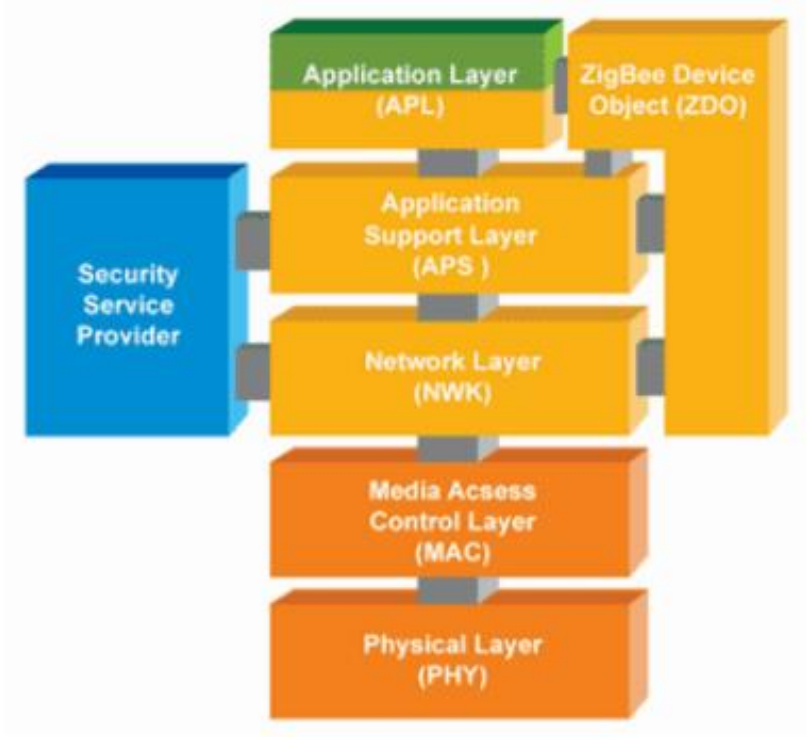
There are three different types of Zigbee devices :-

ZigBee coordinator (ZC): The most capable device, the coordinator forms the root of the network tree and might bridge to other networks. There is exactly one Zigbee coordinator in each network since it is the device that started the network originally. It is able to store information about the network including acting as the Trust Centre and repository for security keys.

ZigBee Router (ZR): As well as running an application function a router can act as an intermediate router, passing data from other devices.

ZigBee End Device (ZED): Contains at enough functionality to talk to the parent node (either the coordinator or a router) it cannot relay data from other devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. A ZED requires the least amount of memory, and therefore can be less expensive to manufacture than a ZR or ZC

ZigBee protocol stack



ZigBee Protocol Stack

Figure 2

The ZigBee specification is a standard that defines a stack protocol enabling the i interoperability of wireless devices in a low-cost, low-power consumption and low-data-rate network The ZigBee stack is founded over the IEEE 802.15.4 standard, which defines the multiply accumulate (MAC) and physical (PHY) layers of the protocol MAC and PHY layers define the RF and communications components of neighboring devices. ZigBee stack layers, on the other hand include a network layer, an application layer and a security service provider (SSP).

Devices are defined by the profiles and are implemented as application objects. Each application abject is connected to the rest of the ZigBee stack by an endpoint, which is an addressable component within a device. Communication is made from endpoins to endpoint and through data structures called clusters Clusters contain a set of attributes needed to share information between application objects. Clusters used in a specific application are defined within its profile. Each interface can receive or send data in the form of a cluster.

There are two special endpoints: 0 and 255. Endpoint 0 is used for the configuration and management of the entire Zigbee device. Through this endpoint, the application can communicate with other layers of the Zigfee

stack to initialire and configure them, attach points with data transmission, security and binding Binding is the ability to match different but compatible devices together, such as a switch and lamp. The network layer enables devices to communicate with one another. It is involved in the initialization of the device within a network routing of messages and network discovery. The application support subbyer also provides these services. The application can configure and access the parameters of the network layer through the ZDO

Application Example- A Reference Design

This reference design describes the design of light dimming devices for light bulbs. based on Freescale's MC1321x microcontroller with an 802.15.4 RF modem and controlled by the MC33794 E-Field Imaging device. The communication is based on a low power 2.4 GHz radio frequency transceiver using Simple MAC (SMAC) based on ZigBee.

Figure 3 FreeScale reference design

The system consists of two kinds of applications:

1) Intelligent switch is intended to replace a standard wall switch and provides dimming function on one phase of AC power. The control

interface is an E-field contactless touch panel with various shapes of electrodes. The intelligent switch can also control four intelligent outlets through a 2.4 GHe radio frequency transceiver using SMAC.

2) Intelligent outlets are intended to replace standard wall power outlets. The device needs the full AC power and dims the light in standard desk lamps and other portable devices. There are two versions of intelligent outlet boards, implementation in a wall outlet case and implementation in an adaptor case.

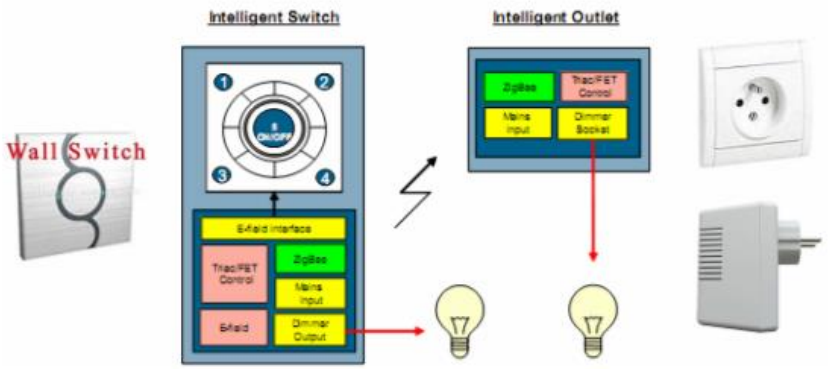


Figure 4

System block diagram

MC1321x MicroController

The MC1321x family Freescale's second-generation Zige platform incorporating a low-power 2.4 GHz radio frequency transceiver and an 8-bit microcontroller into a 9x9x1 mm 71-pin LGA package.

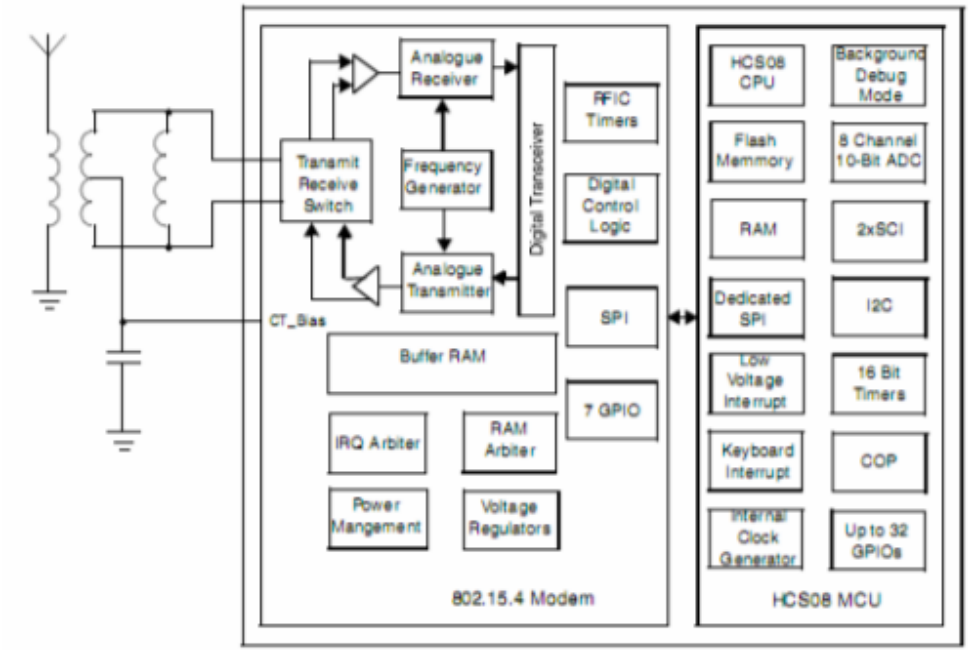


Figure 5

MC13213 block diagram

The MC1321x solution can be used for wireless applications from simple proprietary point-to-point connectivity to a completa Zigfiee mesh network The combination of radio and a microcontroller in a small footprint package allows for a cost-effective solucon. The MC132ls contains an AF transceiver, which is an IEEE 802.15.4-compliant radio operating in the 2.4 GHz SM frequency band. The transceiver includes a low-noise amplifier, ImW nominal output power, PA with internal voltage controlled oscillator (VCO), integrated transmitireceive switch, on-board power supply regulation, and full spread-spectrum encoding and decoding The MC1321x also contains a microcontroller based on the HCSOR family of microcontroller units (MCU) and can provide up to 60-Kbyte of fash memory and 4Kbyte of RAM. The onboard MCU allows the communications stack and the application to reside on the same system-in-package (SiP).

Case study on WiFi :

OVERVIEW:-

Mumbai is the capital city of the Indian state of Maharashtra. It is the most populous city in India. Along with the neighbouring regions of the Mumbai Metropolitan Region, it is second most populous metropolitan area in India, with a population of 21.3 million as of 2016. Mumbai lies on the Konkan coast on the west coast of India and has a deep natural harbour. Mumbai generates 6.16% of the total GDP of the country. It serves as an economic hub of India, contributing 10% of factory employment, 25% of industrial output, 33% of income tax collections, 60% of customs duty collections, 20% of central excise tax collections, 40% of India's foreign trade and ₹4,000 crore (US$620 million) in corporate taxes.

REQUIREMENTS:-

Mumbai became first metro in India to implement successful public WiFi hotspots, over 2000 WiFi hotspots were created around the city where Wifisoft played a pivotal role in implementing and managing the public WiFi network. The whole network was managed and monitored centrally on WiFiLAN Cloud.

Daily statistics:

• 100,000+ logins

• 50,000+ unique users

• 8 TB of data transfer

• 2000 Aps.

HOW HELP WAS PROVIDED:-

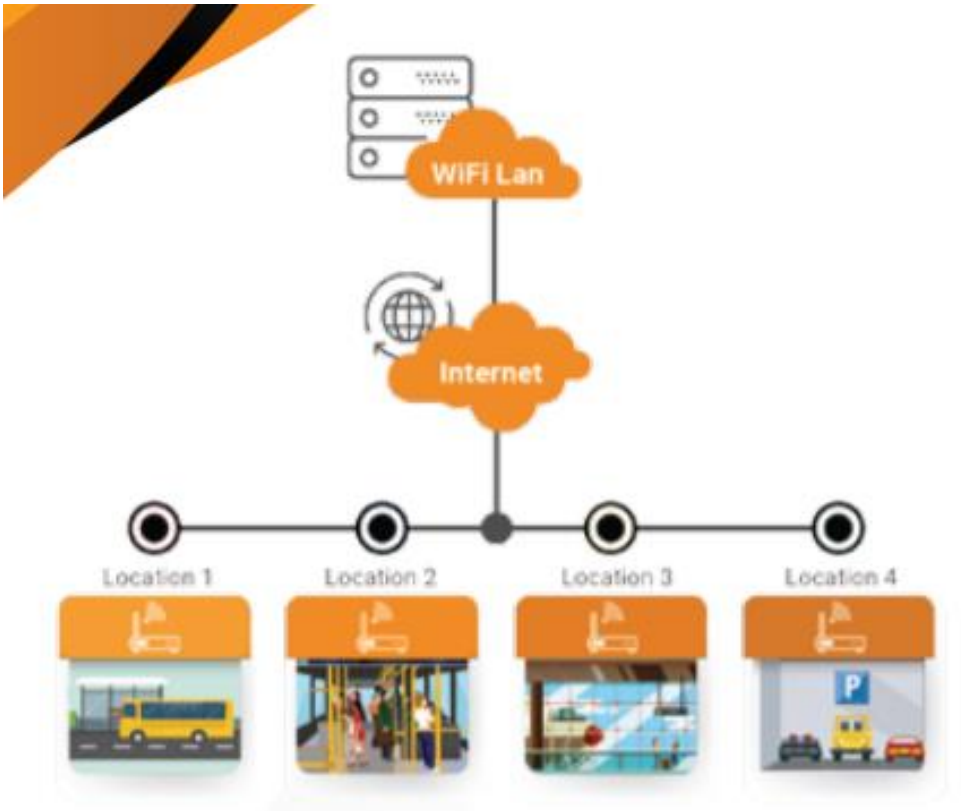
- Deployed 2000 outdoor access points that are able to accommodate 40-50 concurrent users each
- Centrally managed controller with a single dashboard to control all access points

- Customised captive portal with ad space
- Cost effective solution
- Access point Monitoring
- A reduction in network fault calls
- Ability to remotely control, monitor and troubleshoot
- Seamless and scalable WiFi
- Manage user logins and control the usage
- Discourage multiple logins by the same user
- Bandwidth management
- Policy management
- Vendor agnostic hotspot platform

MUMBAI WIFI CASE STUDY

Mumbai has deployed over 2000 hotspots throughout the city to facilitate its residents and enable ease of mobile off loading, proximity marketing and failover protocol.

Mumbai is the commercial and financial capital of India and also capital of the richest state Maharashtra. It is a thriving metropolis in Western India with an estimated population of 18.4 million. Mumbai is wealthiest city in India and is considered to be one of the top ten centers of commerce in the world. It alone contributes around 6.2% of India's GDP and around 25% of industrial output.



The Maharashtra government has promised the citizens of Mumbai that city-wide WiFi network will be installed and users will be able to get free Internet service across 2000 locations in Mumbai. The city WiFi network would facilitate the growth of commerce within the city and will provide citizens affordable Internet connectivity. It would also facilitate e-governance and other online activities thus allowing common people to avail Internet services without paying the high cost.

The government floated a tender in mid 2016 and awarded the contract of installing the WiFi network to L&T Infotech. Additionally, MTNL, the incumbent Internet service provider in the city, was awarded the contract of providing connectivity and operation of the city WiFi network.

Both MNTL and L&T had earlier installed a city-wide surveillance system of IP cameras in prominent areas in the city. It was decided to use the same surveillance network for city WiFi hotspots. Each hotspot would have an outdoor access point mounted on the pole near the surveillance camera. L&T had chosen Aruba and Fortinet access points that could be easily mounted on the poles and provided a good WiFi coverage in the area.

MTNL was responsible for provide the Internet backhaul for the WiFi project. Being one of the incumbent companies in Mumbai, MTNL had already laid out fiber across the city and was able to provide Internet connectivity to all the areas where WiFi hotspots were to be installed.

However, MTNL lacked the expertise of managing the public WiFi network and didn't have the necessary technology for providing a seamless and secure WiFi Internet experience. It is mandatory for any public WiFi hotspot in India to provide SMS/OTP-based two factor authentication process and also maintain a complete log of each users browsing session. MTNL also wanted to implement various policies and control the time and quota each user would avail in the WiFi session. Finally MTNL wanted an central interface for managing and monitoring all the remote access points with an ability to generate daily, weekly and monthly reports.

MTNL had engaged several WiFi operators for implementing the OSS/BSS and captive portal solution for this project. However, none of these companies were able to provide a robust and reliable solution that MTNL and L&T needed. Moreover, many of these companies lacked the technical skills and industry experience for implementing the project of this scale.

MTNL engaged Wifi-soft to carry out the proof-of-concept at 5 different locations within the city. This helped them evaluate the technical capabilities and industry experience of Wifi-soft team. Wifi-soft was able to deploy the complete OSS/BSS and captive portal solution that integrated with both Aruba and Fortinet access points and controllers. Given that Wifisoft had over 12 years of experience of managing public WiFi, it was able to implement the complete backend solution in less than 7 days. MTNL and L&T team went around the city to test the complete functionality of the solution.

On successful proof-of-concept, MTNL allowed Wifisoft to engage as technology partner for the project. Wifisoft not only provided the OSS/BSS technology but also helped MTNL and L&T in designing and configuring the core network. Wifisoft engineers assisted MTNL in building the right network architecture and also setting up the data center operations. They also worked with L&T in configuring, testing and commissioning the access points and controllers. Total of 1300 Aruba access points and 700 Fortinet access points were installed in 70+ circles around the city. All access points were managed by their respective wireless controllers and end users received IP addresses from the central DHCP server.

Wifisoft also designed a multi-lingual captive portal as per the design and specifications of MTNL. The captive portal implemented the SMS/OTP login method as per TRAI/DoT requirements. Each user's mobile number was validated by the system before the user was given free Internet access. The system also controlled the duration of each session and speed and bandwidth quota allocated to each user.

Wifisoft also maintain all the session history, URL logs and access logs for each individual user. Daily, weekly and monthly reports were generated automatically and delivered to the concerned authorities. Wifisoft also maintained a live dashboard that displayed the real-time statistics of the whole network on a single interface.

The project was inaugurated by the honorable chief minister of Maharashtra – Mr. Devendra Phadnavis on 8th February 2017 and thrown open to the people of Mumbai. Within a week, over 250,000 people registered for the Internet service. Each day over 75,000 people availed the free WiFi service and 8TB of data was consumed on a daily basis. The system was designed to scale for handling over 2 million logins per day.

The project was a resounding success and several media agencies carried the news about the project for several weeks. Although there were few connectivity issues at some of the locations, the L&T and MTNL team reacted quickly to resolve the issues. Within a few weeks, the system was operating normally and delivering WiFi Internet service to Mumbai residents round the clock. Mumbai became the first major city in India to deliver a free WiFi service to its residents.

Excerpts

https://en.wikipedia.org/wiki/Mumbai

Case study on GPS

Target/Walmart GPS Testing:

Objectives:

- Validate Mobile GPS as a Viable Research Methodology that is Ready Now
- Measure Methodology Response Rates to Forecast Future Project Feasibilities
- Evaluate Technology to Uncover GPS Research Pros, Cons, and Best Practices
- Gauge Participant Interactions with the Newly Minted Mobile GPS Research Technology and Methodology

SOTG Mobile GPS Research Terminology.

GeoFence- predefined set of boundaries, perimeter, or radius around a store or point location.

• Surveys On The Go tracks when users enter or exit a geo-fenced area

GeoValidate- validating a Geofenced location point from an aerial satellite view to ensure the boundaries do not limit or exceed the study location.

GeoIntensity - As users approach the targeted location, the GPS intensity increases with increased accuracy.

- GeoIntensity helps reduce battery drain
- GeoIntensity helps ensure that the users are

GeoNotification- user receives a survey push notification on the SOTG Mobile app based on entering or leaving a GeoFenced location point.

• Push notifications will take them to a survey they can complete immediately, or a sitting survey for them to complete at a later time.

Time allowed for a survey to sit in the inbox can be pre-set really at the location

- Goals: Confirm GPS capabilities, measure response rates, evaluate technology and participant interactions

- Universe: Likely to visit the 1,767 Target or 3,622 Wal-Mart GeoValidated stores within one week period and opt-in to SOTG's GeoNotification tracking system

- Methodology: Prequalify and enable background GPS. Unaware of Target/Wal-Mart as "hot spot," participants were notified after a Location Verification delay of 2 minutes in a Geofenced zone.

93% of participants said they would definitely engage in future GeoNotification projects

‣ Content/Task: Participants were asked about their current mood, items they plan to purchase at Target or Wal-Mart, and to go to the soda aisle and take a picture of a specific product display. Participants were paid $0.25 a complete and the average survey ran for 1 minute and 21 seconds.

Participant Metrics:

- 9,610 qualifying participants.
- 3,747 invitations triggered upon entering "hot spot" zone (89% "hit" rate on our GPS technology for those in the Target zone).
- 838 onsite completes (22.4% completion rate).

‣ Content/Task: Participants asked about current mood, items they plan to purchase at Target or Walmart, and to take a picture of a product display.

‣ Participants were paid $2 a complete and the average survey ran for 1 minute and 56 seconds.

Participant Metrics:

- 9,610 qualifying participants.
- 3,747 invitations triggered upon entering "hot spot" zone (89% "hit" rate on our GPS technology for those in the Target zone).
- 838 onsite completes (22.4% successful completion rate).

Output Metrics:

- Most common onsite "feelings" report: "happy" (29.9 %), "satisfied" (21.2%) and "rushed" (12.8%).
- Panelists were willing to take a photo of a prominent display - 93% effective photo submission rate.
- Panelists took the task seriously spent on average 2 minutes to complete the survey.

Results: Panelists successfully completed the task at a high rate, were fully engaged, and were willing to share their "feelings" in an interactive survey.

88% of participants said the tasks were "easy"

Content/Task: Participants were asked about their current mood, their primary reason for visiting Target/Wal-Mart.

‣ Participants reported the items they purchased and were asked to take pictures of their receipts or grocery bags.

- Participants were paid $2 a complete and the average survey ran for 2 minutes and 22 seconds.

Participant Metrics:

- 837 qualifying participants.
- Invitations triggered upon completing the In-Store survey.
- 501 completes (60% task rate)

Output Metrics:

- Most common done shopping "feelings" report: "satisfied" (44.9%) and "happy" (21.6%).
- Panelists were willing to take a photo of their receipt or grocery bags 96% effective photo submission rate.

‣ Most panelists bought or less items (64.9%) and spent $11-550 (46.5%) ‣ Panelists took the task seriously spent on average 2 ½ minutes on the survey.

‣ Clear majority of panelists found the process to be "easy" (88.6%). ‣ ALL panelists said "yes" (100 %) when asked if they would take a similar survey.

Results: Panelists successfully completed the task at a high rate, were fully engaged, were willing to share their "feelings" or items they purchased, and are very willing to take a similar survey in the future.