

Open Source Hardware for IoT: A Review

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Abstract—IoT is first to the collection of all those devices that has the ability to connect to the internet and collect and share data. Hence the name “Internet of Things”. This device collects data from its surroundings, using sensors and actuators, and sends this collected data to the internet where the processing of that data takes place. The article presents a few most popular IoT boards such as Raspberry Pi, Arduino, and Particle with their types, applications and comparison. Further, there are two most widely developed fields which are the healthcare system and business industry discussed.

Keywords—IoT, Raspberry pi, tools, IoT Hardware, IoT healthcare, Arduino, Particle, IoT business

I. INTERNET OF THINGS

The term internet in IoT refers to the wide range of applications and systems of rules built on largely interconnected computer networks whereas things refer to every object that can connect with the internet. The things are enclosed within a few sets of vital existence including human beings' sensors and transmitting devices and any other objects which can connect with each other, exist at any time, all time connectivity is the key requirement of IoT devices. To achieve this, the applications need to support and connect with a diverse set of devices and technology which includes devices to collect the data and transmit desired elements that are utilized for the analysis and interpretation of knowledge. There are several devices that can be included in this classification. For example phones, laptops, watches, DVS refrigerators, washing machines, cars, and even homes

II. BUILDING BLOCKS OF IOT

The simple building blocks of IoT consist of four major blocks which are Sensors, Processors, Gateway, and Applications.

- Sensors can be identified as things in IoT that can collect data or transfer data and they are uniquely identifiable. This layer also represents the sensors or the actuators within them.
- The processors are the processing unit of the IoT ecosystem. The processors are like micro-processing units where data is analyzed and processed before sending it to the gateway.
- Gateway is responsible for transferring or routing the process data navigating the process data to its proper location and the network connectivity for the data. Examples of the gateway are WAN, LAN, and all types of internet connections.

- Whereas, applications are the key requirement for proper utilization of the collected data. Cloud-based applications are responsible for contributing effective meaning to the data.

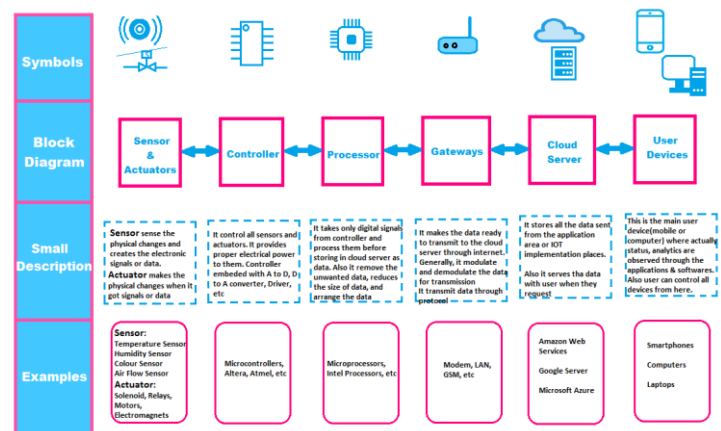


Figure 1. Block diagram of IoT
Image Source: EtechoG

III. IOT HARDWARE PLATFORM

IoT Hardware consists of a wide range of devices such as sensors, bridges, devices for routing, etc. These IoT devices bring about key tasks and functions such as security, action specifications, system activation, communication, and detection of support-specific actions and goals. In an IoT system, IoT platforms are the support software that is used to connect everything IoT platforms are the support software that connects everything in an IoT system. An IoT platform enables the device management, data flow, communication, and functionality of applications. There are many IoT hardware platforms such as Adafruit, Raspberry Pi, SparkFun, Espressif, Arduino, SODAQ, Particle, Intel Edison, Intel Galileo, BeagleBone (BeagleBoard), Banana Pi, Node MCU, Flutter and so on.

IV. RASPBERRY PI

The Raspberry Pi is a small low-cost computer that is the size of a credit card that connects to a computer screen, utilizes a conventional keyboard and a mouse. It is said to be a computer in your palm and more specifically it is easy to access hence these are a few of the main reasons why raspberry pi has become so popular with respect to IoT as well as hobby electronics people. So there are various variants of raspberry pi, some common variants are the newest raspberry pi three model b then pi two model b even the raspberry pi zero. These are the

ones most commonly being used and there are other variants but these three can be considered as the main market holders. Hence silent and energy saving, the raspberry is a fanless energy-efficient computer that works quietly and consumes significantly more electricity than traditional.

I. Types of Raspberry Pi Boards

1) Raspberry Pi Zero

The raspberry pi zero is a super cheap and extremely compact computer. The zero is smaller than a credit card measuring about 65 millimeters by 30 millimeters and is only 5 millimeters thick. It also weighs 9 grams. Also, the raspberry pi zero w is a member of the pi zero families with wireless LAN and Bluetooth capabilities. The raspberry pi zero uses the same single-core Broadcom CPU as the original raspberry pi however it has been turned to 1 gigahertz making it 40 percent faster than the original. The zero raspberry pi with 512 MB of ram is around three times faster than the original raspberry pi in terms of total performance. Raspberry pi zero has an (802.11) eight zero two points one wireless LAN. Bluetooth of four points one also has Bluetooth low energy and one gigahertz single-core CPU. Even a five-two MB of ram mini HDMI port and micro USB OTG port. The micro USB power is compatible with 40 pins header composite video and has reset headers and CSI camera connectors.

The raspberry pi zero has a single tiny HDMI port rather than the full HDMI port found on prior raspberry pi devices despite this it can still produce video at 1080p and 60 frames per second. One micro USB port provides power to the raspberry pi zero while the other serves as the USB outboard for connecting a keyboard mouse, Wi-Fi dongle, or other peripherals. There is no standard Wi-Fi or Ethernet port on the raspberry pi zero. It provides access to connect to the internet on its own but that's the kind of the purpose of this bare-bones gadget as it has an unpopulated 40-pin GPIO header and an unpopulated composite video header just as all other raspberry pi variants, it can be used to solder on its own interface components. This is where the raspberry pi's enormous potential and flexibility really shine. Another important cost-cutting technique is the lack of fixed storage on raspberry pi zero instead which needs to be provided on our own storage in the form of a MicroSD card which has to be placed into the provided slot. The raspberry pi zero like previous raspberry pi devices runs on Raspbian its lightweight operating system based on the DBN operating system open source project is free to download raspberry and also gives users access to pi shop which is essentially on an app store with hundreds of packages built particularly for the raspberry pi given the raspberry pi 0's capable hardware it can just run about any packages

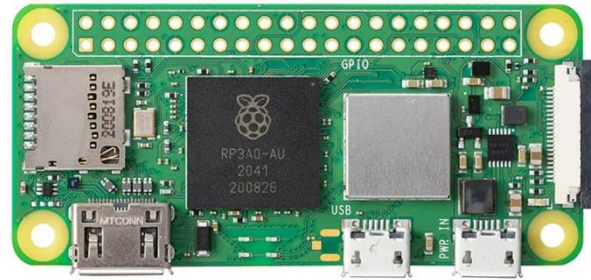


Figure 2. Raspberry Pi Zero
Image Source: Silverline Electronics

2) Raspberry Pi B

Raspberry Pi has 4 USB ports, an Ethernet port a combination of audio-visual jack camera interface for the flex cable that connects to the Pi camera, HDMI out, a micro-USB port for power 40 GPIO pins, and for mounting holes there is a display port with a flex cable and on the bottom, there's a micro SD card on the underside of the both of them. This is for storing the image of the operating system and any other files the user wants to keep on the Pi. This model has a package-on-package assembly for the main processor and this includes the RAM and the broad comm system on a chip SOC.



Figure 3. Raspberry Pi
Image Source: Wikipedia

3) Raspberry Pi 2

Raspberry Pi 2 unlike the raspberry pi b, looks about the same. In fact, in version 2, the ram has been moved to the backside and they've upgraded from 512 megabytes of ram to a full gigabyte. The Broadcom chip stays in the same place but it is no longer a package-on-package assembly owing to this to be the biggest change as the processor has been upgraded on the B+ from a Broadcom BCM 2835 to a Broadcom BCM 2836 on version 2. Additionally, the single-core processor has been upgraded to a quad-core processor which is much better for Multitasking. Finally, the version of ARM architecture is upgraded from an armed v6 to an armed v7.



Figure 4. Raspberry Pi 2
Image Source: Distrelec

4) Raspberry Pi 3

The raspberry pi 3 is a single-board computer running a Broadcom BCM which packs a cortex. This is a 64-bit quad-core ARM processor with a clock speed of 1.2 gigahertz. The GPU is a Broadcom video core 4 with a clock speed of 400 megahertz. There are a total of 40 pins in the expansion header on the top of the board, eight of them supply access to ground, two of them supply five-volt power and another two of them supply 3.3-volt power, two of the pins can be used for EEPROM communication which is typically used by expansion boards the remaining 28 pins can all be programmed to be general-purpose digital i/o but some of them have alternative special purposes whereas two of them can be used as Rx and Tx while other two of them can be used as STO and SCO for I square C. Five of them can be used for SPI and finally four of them can be used for pulse width modulation. The Pi 3 can run several different operating systems ranging from standard desktop oasis to retro gaming systems to home media sinners.

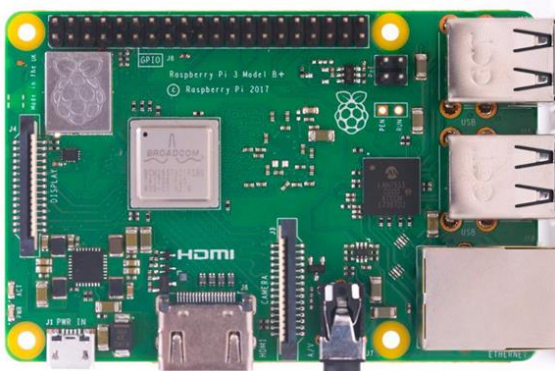


Figure 5. Raspberry Pi 3
Image Source: Element14

5) Raspberry Pi 4

The raspberry pi 4 model b is a 1.5 gigahertz, 64-bit quad-core arm cortex A72 processor which was released in June 2019. It has 1Gb, 2Gb, or 4Gb SD ram also it has 2.4 gigahertz and 5.0 gigahertz, wireless Bluetooth of 5.0 with gigabit Ethernet 2, USB 3.0 ports,

and two USB 2.0 ports. Raspberry pi 4 has standard 40 pin GPIO header, two micro HDMI ports, two LAN MIPI DSI display port, 2 LAN CSI camera port, 4 pole stereo audio and composite video port. Including a micro SD slot for loading OS and data storage of 5-volt dc also a USB C connector and 5-volt dc GPIO header and power over Ethernet is enabled and operating temperature is in the range of 0 to 50 degrees Celsius. When utilized with an adequate power supply the pi 4 can also be powered using a USB C connector allowing for power to be delivered to downstream Peripherals. Raspberry pi 4 is swifter and ameliorate than previous generations. They have created a complete desktop experience for the first time whether you are editing documents browsing the web with multiple tabs open wrangling spreadsheets or creating a presentation the experience will be smooth and familiar.



Figure 6. Raspberry Pi 4
Image Source: Hackster.io

	Raspberry Pi 1 Model A	Raspberry Pi 1 Model A+	Raspberry Pi 1 Model B	Raspberry Pi 1 Model B+	Raspberry Pi 2 Model B	Raspberry Pi 3 Model B	Raspberry Pi Zero
Release Date	2013	2014	2012	2014	2015	2016	2015
SoC	Broadcom BCM2835	Broadcom BCM2835	Broadcom BCM2835	Broadcom BCM2835	Broadcom BCM2836	Broadcom BCM2837	Broadcom BCM2835
CPU Speed	700 Mhz ARM-1176JZF-S	700 Mhz ARM-1176JZF-S	700 Mhz ARM-1176JZF-S	700 Mhz ARM-1176JZF-S	900 Mhz ARM-Cortex-A7	1.2 Ghz ARM-Cortex-A53	1 Ghz ARM1176JZF-S
Cores	1	1	1	1	4	4	1
SDRAM	256 MB	256 MB	512 MB	512 MB	1 GB	1 Gb	512 MB

Table 1. Comparison table of Raspberry Pi
Source: Core Electronics

II. User case study

Raspberry Pi in Dementia

The Hochschule Düsseldorf University of Applied Sciences is one of the largest universities in the German Federal State of North Rhine-Westphalia. In 2013-14, one of the projects they started to work on was called Nutzer Welten, which aimed to help people suffering from the early stages of dementia get the most benefits out of assisted living. They wanted to design hardware and implement a software framework that would help people with dementia and hence live their everyday lives better. That's why they called their work Nutzer Welten –

which means ‘the world of the user’ – because the main criteria of the whole project was to put the user at the centre of everything they were working on. They found that there was a clear need to use technical devices to help people with dementia, for instance, in finding a person if they were lost or in helping them to get back to their room if living in a care home environment. However, more than this, the fundamental goal of their project was to set up a complete support system for the whole home or living space, especially when a person wanted to stay on their own and not in a supervised living environment. [1]



Figure 7. Raspberry Pi in Dementia

Image Source: Computer Weekly

III. Applications of Raspberry Pi

Raspberry pi has been used for a number of projects like

- Remote control smart drone portable – used to track distance between the drone and marker.
- Home Automation - automates home appliances while allowing users to control them easily through the internet from anywhere in the world.
- Robotics Arm - detects the pre-specified objects and thus segregates them based on color.
- Arcade Devices –allows users to develop gaming consoles and retro gaming machines.

IV. ARDUINO

The Arduino is an electronics tool for making astounding things like atomic clocks, quadcopters, pet feeders, art projects, 3d printers, or even electron microscopes and the list goes on. Arduino mostly acts as the brain behind all those computations. The Arduino board is just a printed circuit board with an integrated circuit that is used. On the outside, it has pin headers that allow connecting the integrated circuit and then can be easily connected to the computer with a USB cable. Second part is the software. For the software, Arduino has its entire software programming environment that is very streamlined for somebody who's just getting started with programming to make it easier than ever to program an Arduino board.

I. Types of Arduino Boards

1) Arduino Uno

The Uno is one of the most popular boards in the Arduino family and a great choice for beginners. The major components of the Arduino UNO board are a USB connector, power ports, microcontroller, analog input pins, digital pins, reset switch, crystal oscillator, USB interface chip, and Tx/Rx LEDs. The important component is the microcontroller, it is the most prominently visible black rectangular chip with 28 pins, and it acts as the brain of the board. Atmega328p by Atmel is the microcontroller used on the Uno. Atmega328p has a flash memory of 32 kb and a ram of 2 Kb. The Arduino ide loaded program is stored here. There are six analog input pins labelled Analog 0 to 5. These pins read the signal from an analog sensor such as a temperature sensor and convert it into a digital value. They just measure voltage and not the current because they have very high internal resistance hence only a small amount of current flows through these pins. Although these pins are labelled analog and are analog inputs by default, these pins can also be used for digital input or output. Digital pins are labelled digital 0 to 13. These pins can be used as either input or output pins. When used as output these pins act as a power supply source for the components and when used as input pins they read the signals from the component connected to them. When digital pins are used as output pins they supply 40 milliamps of current at five volts which is more than enough to light an LED.

Some of the digital pins are labelled with the tilde symbol next to the pin numbers. Pin numbers 3, 5, 6, 9, 10, and 11, and these pins act as normal digital pins but can also be used for pulse width modulation PWM which simulates analog output such as fading and LED in and out. Next is the reset switch, when this switch is pressed it sends a logical pulse to the reset pin of the microcontroller and hence runs the program again from the start. This can be very useful for testing the code multiple times. There is also a crystal oscillator, which is a quartz crystal oscillator that takes 16 million times a second on each tick. The microcontroller performs one operation for example subtraction, addition, etc. The USB interface chip acts as a signal translator, it converts signals at that USB level to a level that the Arduino UNO board understands. The last one is the Tx/Rx indicator Tx stands for transmit and Rx for receive. These are indicator LEDs that blink when the UNO board is transmitting or receiving data.

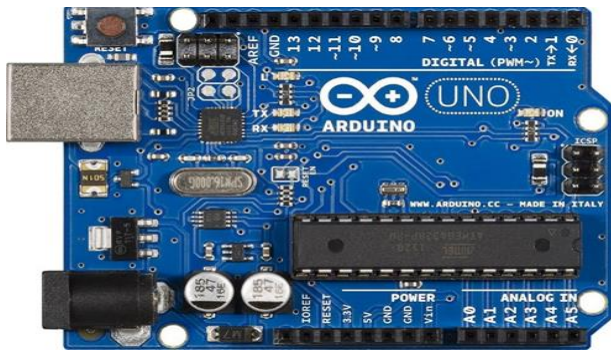


Figure 8. Arduino
Image Source: sparkfun

2) Arduino Lilypad

Arduino Lilypad is a wearable and e-textile device. It was cleverly constructed with large connection pads and a flat back to sew conductive thread into garments. In addition, to the daily pad features, it has its own set input-output power and sensor boards designed exclusively for e-text styles and can even be washed. The main board is based on the ATmega328V or the ATmega168V. LilyPad Arduino is different from the usual Arduino boards because it needs a USB to Serial interface to be programmed. The Arduino USB 2 Serial interface is the one recommended by the official website of Arduino, but any standard FTDI-compatible interface is also suitable for the same. The USB 2 Serial interface acts as an Arduino UNO and shares the same drivers.

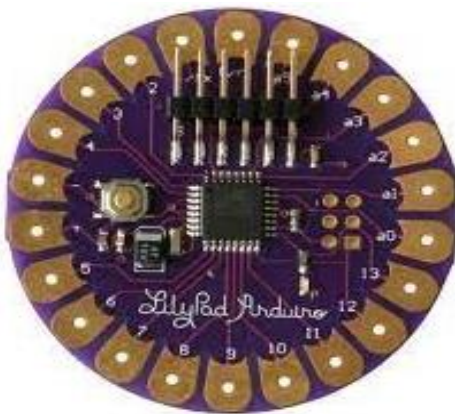


Figure 9. Arduino Lilypad
Source: Hobbify

3) Arduino Mega

The Arduino mega is known as the larger brother of Arduino UNO. It consists of several digital input-output pins. It has a total of 54 digital input-output pins and 16 analog inputs, a USB connection, a power jack, and a reset button. The Mega 2560 is an updated version of Arduino Mega, which it replaces. The Mega 2560 board is well-suited with most shields designed for the UNO and the former boards Duemilanove or Diecimila.

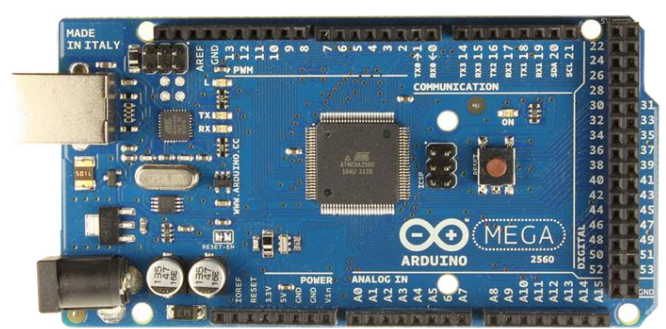


Figure 10. Arduino Mega
Image Source: Distrelec

4) Arduino RedBoard

The RedBoard is an Arduino-compatible development platform that enables swift and hassle-free project prototyping. This microcontroller or small computer can interact with real-world sensors and display information perform calculations and more. The RedBoard serves as an excellent easy-to-use physical learning platform designed to empower anyone to create unique projects. The RedBoard is a clone. This means that it behaves identically to the popular Arduino Uno. All the inputs and outputs have the same function, the inputs and outputs behave electrically the same and it is programmed in the same way. The Arduino ide can program the red board over the use of a mini connector it runs on windows 8 without requiring changes to the security settings because of the USB chip. The only prevailing difference is when installing drivers Arduino Uno uses an ATmega16U2 which is loaded with custom firmware to convert between serial and USB whereas RedBoard uses FTDI FT231X as each driver requires a different driver file.

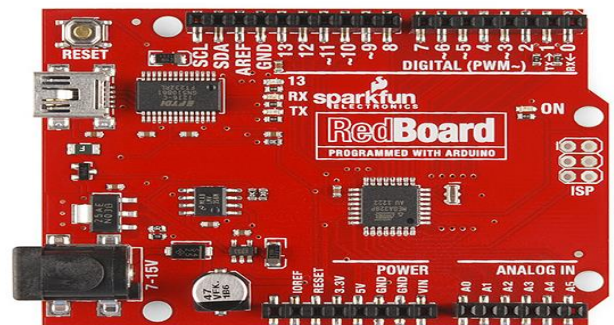


Figure 11. Arduino RedBoard
Image Source: Robu.in

5) Arduino Leonardo

The Leonardo is Arduino's initial development board with a single microcontroller and USB port as a result, it is less expensive and easier to use. Additionally, because the board handles USB directly so that it can operate as an actual USB device. The Leonardo can appear to a computer as a hid or a human interface device such as a mouse or a keyboard. The board libraries are available that allow the board to imitate a computer, keyboard, mouse, and other components. It consists of 20 digital input/output pins out of which 7 can be used as PWM outputs and 12 as analog inputs, a 16 MHz crystal oscillator, a micro

USB connection, an ICSP header, reset button, and a power jack .

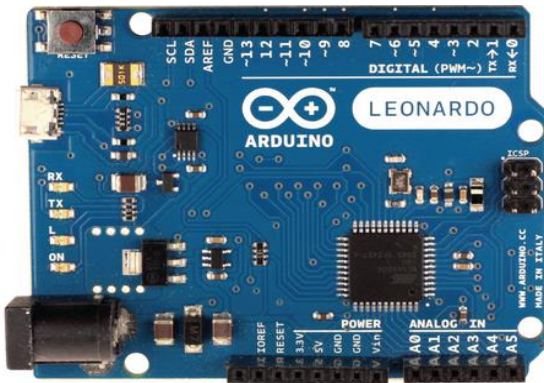


Figure 12. Arduino Leonardo
Source: Robu.in

II. Applications of Arduino Board

Arduino Uno is been widely used in many projects and real-life applications.

- For Social Distancing Reminder – Helps maintain distance between another person to the determined length.
- Pulse Oximeter – Detect the oxygen level of the patient.
- Home Automation – Controls the home fans and lights with the use of mobile phones. Parking lot counter – Assists in maintaining the cars at their spots
- Robotics – Used in a varied number of robotics and automation projects

Boards	Microcontroller	Operating Voltage (V)	Digital I/O Pins	PWM Pins	Analog I/O Pins	DC pin (V)	Flash Memory (KB)	SRAM (KB)	EEPROM (KB)	Clock (MHz)	Length (mm)	Width (mm)	Cable	Native Network
Uno	ATmega328	5	14	6	6	20	32	2	1	16	68.6	53.4	USB A-B	None
Leonardo	ATmega32u4	5	20	7	12	40	32	2.5	1	16	68.6	53.3	micro-USB	None
Micro	ATmega32u4	5	20	7	12	40	32	2.5	1	16	48	18	micro-USB	None
Nano	ATmega328	5	22	6	8	40	32	2	0.51	16	45	18	mini-B USB	None
Mini	ATmega328	5	14		6	20	32	2	1	16	30	18	USB-Serial	None
Due	Atmel SAM3X8E ARM Cortex-M3 CPU	3.3	54	12	12	800	512	96	X	84	102	53.3	micro-USB	None
Mega	ATmega2560	5	54	15	16	20	256	8	4	16	102	53.3	USB A-B	None
M0	Atmel SAMD21	3.3	20	12	6	7	256	32	X	48	68.6	53.3	micro-USB	None
Yun Mini	ATmega32u4	3.3	20	7	12	40	32	2.5	1	400	71.3	23	micro-USB	Ethernet/V
Uno Ethernet	ATmega328p	5	20	4	6	20	32	2	1	16	68.6	53.4	Ethernet	Ethernet
Tian	Atmel SAMD21	5	20	12	0	7	16000	64000	X	560	68.5	53	micro-USB	Ethernet/V
Mega ADK	ATmega2560	5	54	15	16	40	256	8	4	16	102	53.3	USB A-B	None
M0 Pro	Atmel SAMD21	3.3	20	12	6	7	256	32	X	48	68.6	53.3	micro-USB	None
Industrial 101	ATmega32u4	5	7	2	4	40	16000	64000	1	400	51	42	micro-USB	Ethernet/V
Uno Wifi	ATmega328	5	20	6	6	20	32	2	1	16	68.6	53.4	USB A-B	Wifi
Leonardo Ethernet	ATmega32u4	5	20	7	12	40	32	2.5	1	16	68.6	53.3	USB A-B	Ethernet
MKR1000	Atmel SAMD21	3.3	8	12	7	7	256	32	X	48	64.6	25	micro-USB	Wifi

Table 2. Comparison table of Arduino Board
Source: Core Electronics

V. PARTICLE

Particle is a developer-trusted IoT platform that helps users “gain insights into operations, accelerate productivity, and build new revenue streams.” Particle provides visibility to users for all of their IoT devices, allowing them to remotely monitor these devices and other business-critical assets with a complete asset-tracking platform. In addition, Particle’s data pipeline bridges the gap between the physical and digital worlds by allowing users to send commands and check device variables

through its RESTful API. Particle comes with a number of features to help manage IoT functions. With the nature of IoT, users tend to have a substantial quantity of devices that need to be registered, organized and managed, and Particle does just that. Not only that Particle’s tracking capabilities work not only for stationary devices but also for devices on the move and can track critical data including real-time location, historical location, motion, temperature, and sound.

I. Types of Particle

1) Particle Photon

The photon particle is an internet of things Wi-Fi connected board . It is supposedly the smallest board ever It has a powerful processor of 120Mhz ARM Cortex M3 microcontroller with a Broadcom Wi-Fi chip that is as tiny as a thumbnail-sized module. Additionally, the particle photon has a megabyte flash that is of 128 kilobytes of RAM with 18 mixed-signal GPIO and advanced peripherals with a single band of 2.4 gigahertz OEE 802.1 BG hence supporting wireless data rates up to 65 megabits and operates in a real-time system. Particle also provides access to a free cloud service of the particle cloud. The Particle Cloud has some amazing features used for building connected projects, including over-the-air firmware updates, an easy-to-use REST API, and firmware development supported by Web and local IDEs.

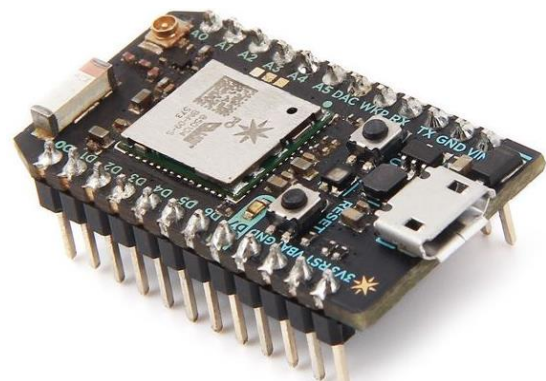


Figure 12. Particle Photon
Image Source: Robu.in

2) Particle Electron

Particle Electron is a tiny Cellular (2G/3G) based development kit that is used for creating connected projects and applications. Particle photon allows users to easily put together Wi-Fi-enabled web devices using very simple development tools and a fully IoT-optimized platform. The particle electron does the same thing for 3G cellular service that the photon did for Wi-Fi so now projects can even have a greater range and better connectivity to help quickly get started with particle electron. Particle has put together the particle electron 3G kit which includes not only the module itself but also a LIPO battery to power the module as well as a cellular antenna. It also comes with a particle SIM card which allows the device to access particles data plan which is designed for very lightweight data light applications for these low bandwidth IoT devices.



Figure 13. Particle Electron
Image Source: Hackster.io

II. Applications of Particle

Many projects have been developed with Particle such as

- a. Wi-Fi Strength Meter - Trying to determine the Wi-Fi strength of a particular area.
- b. Flip Dot Clock- Electromechanically flip-dot displays which controls them with the use of a Particle Photon and an RS-485 module that allows the two to communicate. They are usually found in bus and train stations.
- c. Smart Home Thermostat – Records the temperature of your home.
- d. Tiny message board – Use for communication through texts.

VI. NEW TECHNOLOGIES IN IOT

I. IoT in healthcare

IoT impacts health care in several ways firstly in medical research where the drug has been improved and the accuracy of clinical trials has increased. There are several real-time examples such as simultaneous reporting and monitoring in case of a medical emergency real-time monitoring via connected devices can save lives this occurs by monitoring the smartphone of the patient. This gives a firm opinion about a patient's condition irrespective of the place or time which enables treatment effectively even in remote medical assistance mobility solutions which enable medics to check on patients and identify elements. There are so many innovations in IoT in healthcare and some of which are very important one among them is tracking the real-time location of medical devices and equipment used for treatment that are connected to sensors and the doctors track the devices that are attached to sensors in order to provide treatment using real-time location services, they are also used to monitor the environment.

The next one is to monitor high hygiene this detects the cleanliness degree of the healthcare stuff and gives information to the staff. The other is remote health monitoring which helps health providers to get notifications regarding a change in the health status of a patient through sensors attached to the devices this is a boon to those in remote areas. IoT is also used to enhance the patient experience, the patients control the temperature and lighting of their room with the help of devices connected to IoT applications. This also, helps them to communicate with

their family and friends and also with the healthcare provider and medical staff. IoT is also used to enhance the management of drugs so in order to ensure an accurate dose of drug delivery, there are microscopic grain-size sensors that send signals to external devices there are also handy smartphone apps that help to track personal performance to help with chronic disease treatment. There are devices like Fitbit that help to monitor certain parameters of the body. Thus the combination of variable technology, mobile connectivity and next-generation analytics are used in treatments.

II. IoT in business

Nowadays, businesses are evolving with technological advancements so does the retail industry for example beacon-based contextual marketing platforms are giving tough fights for an e-commerce business. Smart retail solutions simplify the path to new efficiencies such as cost-saving, inventory accuracy, smarter marketing, and better customer experiences. In fact, there are now IOT-centric systems that are helping retailers increase the efficiency of their operations. The use of RFID tags by retailers to upsurge the efficiency of their supply chains is one of the most well-known examples of early IoT adoption. Another example is IOT based inventory management system with the help of sensors beacons and RFID tags. The data is collected on the cloud for analysis and delivered to the supervisors/administrators, this enables staff to be aware of what is available on the shelf and what is available in the stockroom and take further decisions. When it comes to the effective information identification and traceability of products and supply chains, IoT has played a large role this is really important for the industries like pharmaceuticals and food which involve constant monitoring of temperature, humidity, and other environmental variables. IoT systems can also help retailers cut down on employee theft and shoplifting by giving retailers the power to rise accountability at all operational levels with the availability of smart shelves source tags cubes and video surveillance equipment keeping an accurate count of everything has never been so easy for all businesses.

VII. CONCLUSION

Over the past years, IoT has become one of the most imperative technologies of the 21st century. IoT made it possible to connect to everyday objects such as kitchen appliances, cars, thermostats, baby monitors—to the internet via embedded devices, seamless communication is possible between people, processes, and things. By means of low-cost computing, analytics, the cloud, big data, and mobile technologies, physical things can share and collect data with minimal human intervention. In this hyper coupled world, digital systems can monitor, record, and adjust each interaction between connected things. IoT has helped people live and work smarter, as well as gain complete control over their lives and made it quiet easy. Due to the improved effectiveness, the company that uses IoT solutions is able to offer a wider range of products or services, thus increase their quality in comparison with its competitors, but at the same price. IoT automates workflow of patient care by using healthcare mobility solutions. Machine-to-machine communication, data movement, and interoperability have made healthcare sectors

more productive. IoT technology can be used in sectors like Agriculture, Manufacturing, Transportation, Media/Advertising, Retail, Power Distribution, Water and Waste Management, etc.

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