

# Ada Fruit and Spark Fun IOT Hardware Tools

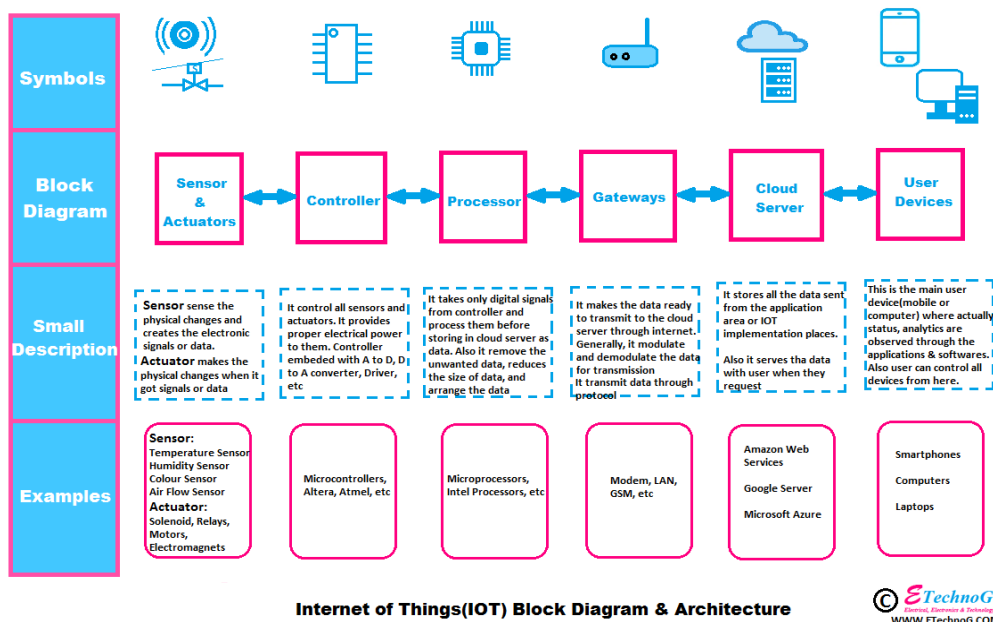
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**Abstract:-** IoT (Internet Of Things) is an integrated ecosystem which consists of many interlinked web-enabled smart devices which use embedded systems like processors, sensors and communication hardware, to gather, receive as well as work on data they acquire from their environments [1]. IoT Hardware consists a broad range of devices which are used for routing, bridges, sensors etc. These IoT devices help in managing key tasks and functions like activation of systems, security, action specifications, communication, and detection of support-specific goals [2]. Main Contribution of this work lies in understanding the importance of IOT and its different hardware devices like Raspberry Pi, Arduino, Spark Fun, Adafruit etc. However in this review paper we will see two of the important hardware tools which have been used in today's products. viz. Ada Fruit and Spark Fun. This study helps to compare both the tools and know the importance of each tool.

**Keywords:-** IoT, Ada Fruit, Spark Fun, tools, IoT Hardware.

## I. INTRODUCTION

Today the whole world depends upon the “Internet” not only to gain knowledge about the world but also to connect to each other across different countries or even continents. Internet has played a major role in development of all the major technological domains like Artificial Intelligence, Big Data, Blockchain and the most important “Internet Of Things” or IoT which we call today. IoT acts as bridge between different hardware as well as software devices like sensors, microcontrollers, cloud servers, gateways etc.[3]. IoT helps to link these different devices which can help us in creating various products like Temperature sensors, Web services and connect to user devices like computers, laptops, mobile phones etc. When it comes to IoT hardware devices we see a broad range of hardware boards like Raspberry Pi, Arduino, Spark Fun, Adafruit which have been developed to make products cost efficient as well as effective in terms of processing and giving the correct output. Every board has its own advantages and applications which makes it unique in its own way.



Internet of Things(IOT) Block Diagram & Architecture



Fig. 1: IoT Block Diagram [13]

The Spark Fun Red Board has the ability to combine UNO's Optiboot bootloader(which is used in Pro series) along with FTDI stability as well as the latest Arduino UNO R3 shield compatibility. Using Arduino IDE, the Red Board can be integrated with a USB Mini-B cable [5]. This Red Board consists of all of the hardware components like 14 Digital I/O pins with 6 PWM pins, 6 Analog Inputs, UART, SPI and external interrupts. Using a barrel jack to power the RedBoard makes its regulator to handle power from 7 to 15 VDC.

Adafruit Industries is one of the major Open Source hardware companies founded by Limor Fried in 2005. The company not only manufactures number of electronic products, tools and accessories but also produces live and recorded videos related to electronics, technology and programming [6]. In 2016, Ada Fruit Industries launched its first Circuit Playground named “ATmega32u4” followed in 2017 by a stronger Atmel SAMD21 based Circuit Playground Express. The circuit being circular in shape has become helpful in education and wearable electronics.[5]

## II. TYPES OF SPARK FUN RED BOARDS

### A. RedBoard Plus

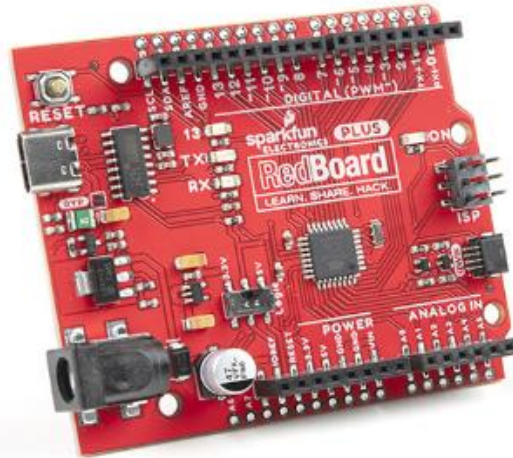


Fig. 2: Red Board Plus[14]

It is Arduino-compatible development board which all the components of an Arduino Uno along with USB-C, Qwiic and more. As it utilizes handy Qwiic Connect System, it does not require soldering or shields to connect to the rest of the system. It consists of many hardware components like 22x Digital I/O pins with 6x PWM pins, 8x analog pins, UART, I2C, SPI, and external interrupts which makes it compatible with future shields [8]. RedBoard plus has an optimized power portion as it uses AP2112 3.3V

voltage regulator to provide up to 600mA to daisy chain multiple Qwiic boards and sensors it also consists of full thermal and reverse circuit protection with an increased PTC from 500mA to 2A. It also includes 3.3v voltage translation and a Qwiic connector for quick and seamless connection [9]. There is a “Red Squirrel” switch for more advanced users as well as solder pads on the bottom for USB data pins which helps to embed Red Board Plus into a project and run an external USB connection.

### B. Red Board Qwiic



Fig. 3: Red Board Qwiic [15]

Similar to RedBoard Plus, RedBoard Qwiic also uses handy Qwiic Connect System which enables it to connect to rest to the system without soldering or shields. Redboard Qwiic has new additions like improved AP2112 regulator as well as a 3.3V regulator which provides more power. The boards and sensors get a power source upto 600mA of

current. It consists of CH340C serial-USB convertor which eliminates the need to manually install drivers[5]. It consists of all the many components like 20 Digital I/O pins with 6 PWM pins, UART, SPI and external interrupts which makes it compatible with future shields. Qwiic also uses barrel jack to power its board.

C. Red Board Turbo - SAMD21 Development Board

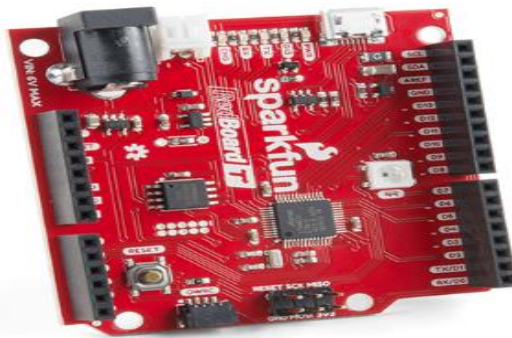


Fig. 4: Red Board Turbo[16]

Red Board Turbo consists a variety of components like USB interface for programming and power along with an RTC crystal, WS2812-based addressable RGB LED, 600mA 3.3V regulator.If in case you are not near a USB port, you

can charge the Red Board using LiPo battery connector[8]. Just like removable flash drive, Red Board turbo can also be flashed over Mass storage class.

D. RedBoard Artemis



Fig. 5: Red Board Artemis[17]

Among all the Spark Fun Red Boards, Artemis has the most improved power conditioning as well as USB-C connector which makes programming easy. It also consists of Qwiic connector which makes I2C easy and is also

compatible with Spark Fun’s Arduino core. To experiment with on-voice commands, it uses a digital MEMS microphone. It also consists of 1MB flash and 384k RAM space.

Red Board	Red Board plus	Red Board Qwiic	Red Board Turbo	Red Board Artemis
MCU	AT-MEGA 328P	AT-MEGA 328	ATSAMd21G1832-BIT	ARM Cortex M4F Apollo 3 chip
Boot Loader	Optiboot(UNO) bootloader	Optiboot(UNO) bootloader	UF2	Ambiq factory secure bootloader
Input Voltage	7V-15V	7V-15V	4.2V-6.0V	48mhz-98mhz
Clock Speed	16mhz	16mhz	16mhz	48mhz
PWM	6x	6x	10x	21x
Analog Inputs	8	6	6	6
I2C	1x Qwiic Connector	1x Qwiic Connector	1x Qwiic Connector	6x Qwiic Connector

Table 1: Red Board Spark Fun Comparison Table

III. USER CASE STUDY

A. Earthquake Data Logger

In September 2010, New Zealand faced an earthquake which had a magnitude of almost 7.1 and had caused significant damage on property and land in Christchurch. Even after the earthquake, New Zealand experienced many aftershocks which continued for weeks and months and by the time it was mid-November, they had experienced almost 3000 aftershocks. Founders of Spark Fun decided to create

an accelerometer which could detect some of these aftershocks. When it came to choosing the hardware for the accelerometer, Spark Fun chose an analog device called ADXL335 because it was easier to hook up and get started with. ADXL335 uses SPI or I2C digital signals to communicate as it is a 3.3V device[5]. Spark Fun also chose Arduino as a microcontroller platform. For power they used a standard nine volt wall wart power supply.



Fig. 6: Complete System

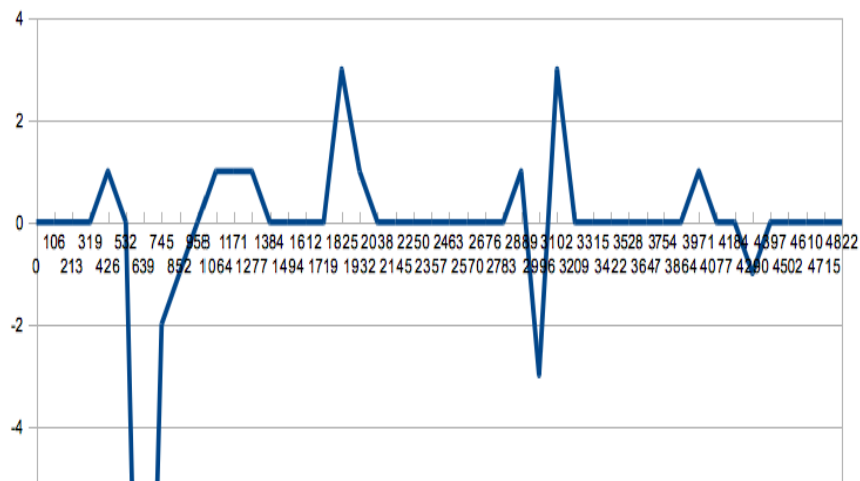


Fig. 7: Plot of relative ADC value for z axis over ~5s time

The device showed excellent results in plotting the graph of the magnitude of the device. SparkFun will try to get an accelerometer with a narrower range which could give a higher resolution within that range. This means that even smaller movements could be detected. Resolution could also be improved by restricting the values of the Arduino from 0 to 3.3V[5].

#### IV. APPLICATIONS OF SPARK FUN RED BOARDS

Spark Fun Red Boards have been used for a number of projects like

- Wireless Timing Project – helps to evaluate an athletes performance
- Wireless Sensor Project – helps to know the temperature, humidity, pressure
- Clock Project – An FPGA project that consists 24 clocks which all together create a bigger clock.
- Qwiic GPS clock – This project uses GPS satellite to tell the current date.
- *HAB Launch - S1*

#### V. FUTURE OF SPARK FUN BOARDS

In the up coming years, demand for electric vehicles is going to increase globally and this is going to increase the need to create batteries to a greater levels. Autonomy will only increase in terms of complexity with respect to cars, cameras, sensors etc. Cell phones will reach even smaller levels of components and integration of sensors. With the development of science, the technologies will march towards Integratedcircuits with more sensing and processing capabilities and in such case Spark Fun Red Boards will be very useful because of its streamlined interface.

## VI. TYPES OF ADAFRUIT BOARDS

### A. Adafruit Metro 328 Starter Pack.



Fig. 8: AdaFruit Metro 328 starter pack[19]

Metro 328 starter pack is a code compatible easy to use and hacker friendly development board. It is perfect for beginners to learn how Adafruit metro functions. It consists of 4 rubber feet headers as well as a Micro USB cable to connect Metro to computer. Integrated with a tiny Breadboard which is easy to use. We can power the metro

from any wall using a 9V DC regulated wall adapter. It also consists of other components like 10K potentiometer, 1K potentiometer, 2 small pushbuttons, 5 red diffused bright LEDs, one each of red, green and blue ultra-bright LED, 5 100 ohm resistors, 5 1K resistors, 5 10K resistors[4].

### B. Adafruit METRO 328 - Arduino Compatible - with Headers.



Fig. 9: AdaFruit Metro 328 starter pack-Arduino Compatible[20]

This version of metro has much lower voltage drops across the motor in order to get more torque out of the batteries as well as it has built in flyback diodes as well. It uses TB6612 MOSFET drivers instead of L293D Darlington driver which give 1.2A per channel current. There is a PWM driver chip which looks after all the motor and speed

controls over I2C[9]. Its features include 2 connections for 5V 'hobby' servos, 4 bi-directional DC motors and 2 stepper motors along with Arduino reset button on top. Compatibility with other boards like Arduino UNO, Leonardo, ADK/Mega R3, Due etc.[10]

### C. Adafruit "Music Maker" MP3 Shield for Arduino w/3W Stereo Amp - v1.0

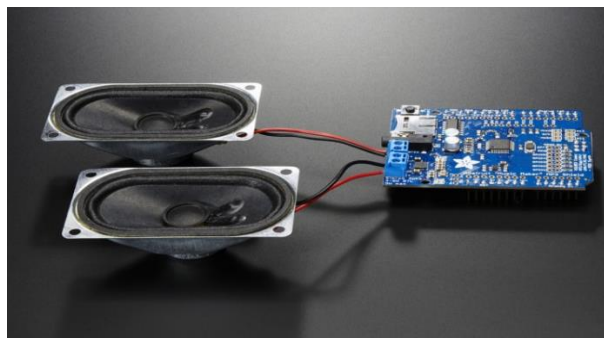


Fig. 10: Adafruit "Music Maker" MP3 Shield[21]

This music maker can help in bending all the audio files with a powerful shield feature i.e VS1053, which has the capability of decoding wide variety of audio formats like MP3, AAC, OggVorbis, WMA, MIDI[4]. It not helps in sorting audios but also helps in adjusting bass, treble and

volume digitally. Ada Fruit Music maker has audio filter caps which can help in connecting directly to headphones[9]. It also consists of MicroSD card socket, for any FAT16/FAT32 formatted SD card.

D. Adafruit Metro ESP32-S2.

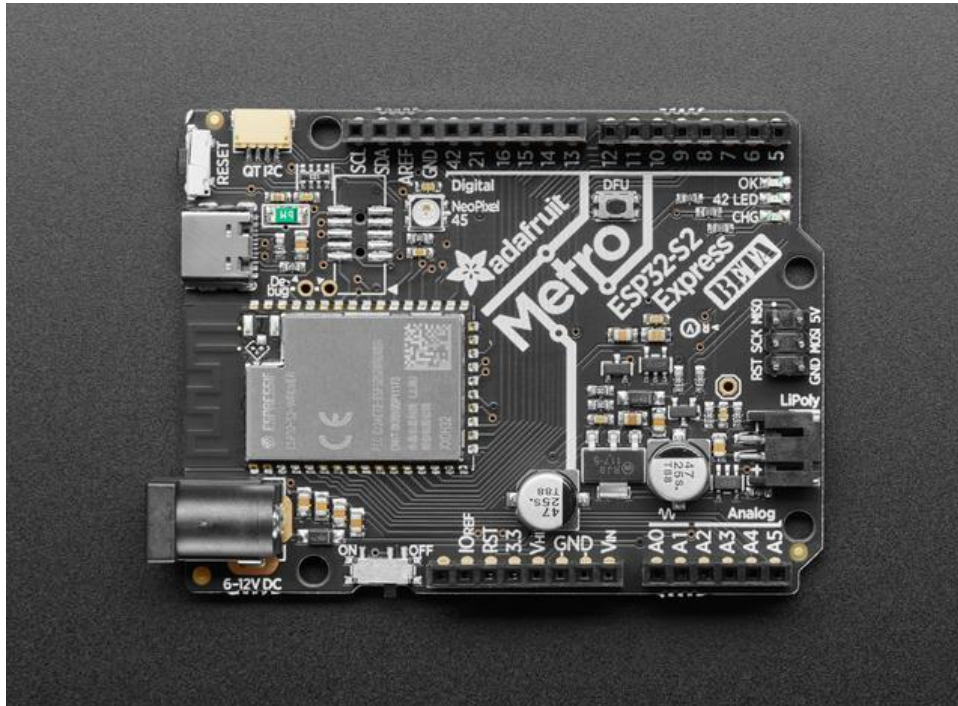


Fig. 11: Ada Fruit Metro ESP32-S2[22]

<i>The new Metro ESP32-S2 comes with a wifi module as well as a STEMMA QT connector for I2C devices. Having a native USB and load PSRAM, this board adds low cost WiFi while maintaining shield-compatibility[9]. This hardware comes with FCC/CE certification and a 4 Mbyte of Flash and 2 Mbyte of PSRAM. It also consists of 6-12 VDC barrel jack which enables built-in battery charging when powered over DC. It also has JTAG pads for advanced debugging access. Adafruit Metro 328 Starter Pack.</i>	Adafruit METRO 328 – Arduino	Adafruit "Music Maker" MP3 Shield	Adafruit Metro ESP32-S2.
4 rubber feet	2 connections for 5V 'hobby'	VS1053B codec chip	240MHz Tensilica processor
MicroUSB Cable	4 H-Bridges	audio filter caps	WROVER module
Protoshield Kit	Up to 4 bi-directional DC	4.2V-6.0V for charger - otherwise 3.5V-6.0V	Built-in battery charging
Tiny Breadboard	Up to 2 stepper motors	7 extra GPIO's	Reset and DFU
9V DC regulated wall adapter	Big terminal block connectors	MicroSD card socket	JTAG pads
9V Battery case with switch	reset button	Full 3.3/5V level shifting	21 On/Charge/User LEDs
65 flexible breadboard wires	protected 2-pin terminal block	Built in MIDI synth/drum machine	STEMMA QT

Table 2: Ada Fruit Hardware devices Comparison Table

### VII. USER CASE STUDY

Using circuit Python to create a humidity and temperature sensor.

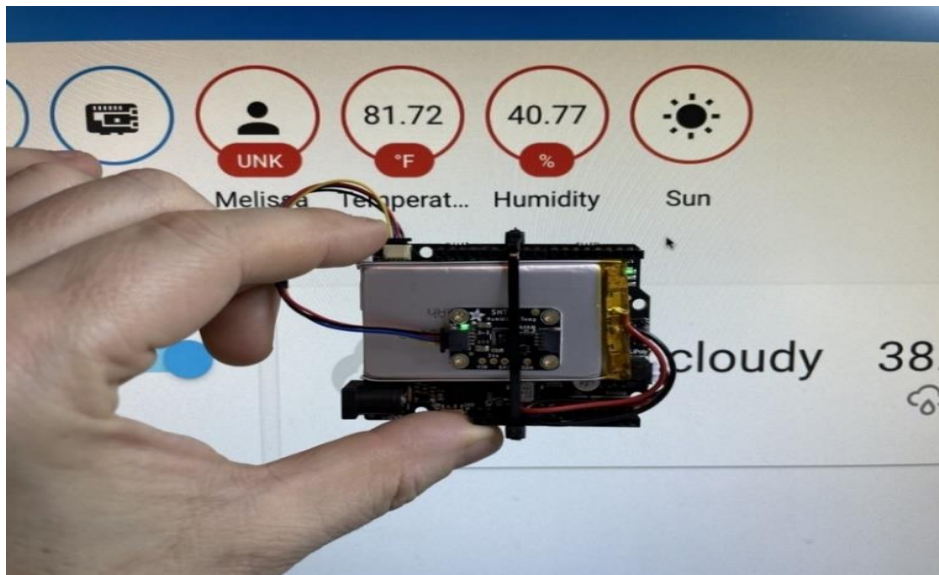


Fig. 12: Temperature Sensor[23]

This Project is one of the important projects made using MQTT and Circuit Python. It uses Adafruit made Metro ESP32-S2's STEMMA QT port. No soldering is required for the project. It consists of SHTC3 Humidity

and Temperature sensor as it has a wide range of temperatures, excellent accuracy and low power consumption[11]. ESP32-S2 has a great combination of WiFi and StemmaQT.



Fig. 13: Metro ESP32-S2

You have to simply plug in the sensor and you are ready to make customizable projects with sensing and Home Assistant. This sensor is widely used in medical devices that help patients having trouble breathing by keeping the temperature at optimum level[11]. They are also used in greenhouses where humidity values are checked constantly. Museums benefit using these sensors for keeping the artifact at certain conditions.

#### A. Applications of Ada Fruit Boards

- Adafruit Io has a number of various applications like
- Real-Time data Display
  - Integrating components like Control motors, Gather and send sensor data

- Linking various projects to internet services like Twitter, RSS feeds etc.
- Connect your project to other internet-enabled devices
- The best part? All of the above is do-able for free with AdafruitIO

#### B. Projects with Adafruit

- Real-time Smoke Detection With Ai-based Sensor Fusion
- Pi Cam - A Remote Raspberry Pi Desktop/camera/server
- Controlling Objects in Unity with a 9 DoF Sensor
- Agricultural Sensor

### VIII. CONCLUSION

Through this paper we saw how Adafruit and Spark Fun has its own advantages and disadvantages and how they can be used to for various applications which can be used in manufacturing, industrial, transportation, education etc. We also explored some of the real life applications of both Ada Fruit and Spark Fun boards and its scope in the future.

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