Comparative study of Arduino Types and Raspberry Pi with Programming Languages

Shajan Mohammed Mahdi[1], Mohanad Ali Meteab Al-Obaidi[2], Reyadh Hazim Mahdi[2]

[1]*Department of Information Technology, AL-ESRAA University College, Baghdad, Iraq*

[2]*Department of Computer Science, College of Science, Mustansiriya University, Baghdad, Iraq*

*Corresponding Author: Shajan Mohammed Mahdi
Email: shajan@esraa.edu.iq

Abstract

The world is developing at an amazing speed through modern technologies to control things and microcontrollers have become a preoccupation of most developers of remote and proximity control devices in various industrial, household, and educational sectors, so it is necessary to study them in-depth and know the differences between Arduino and Raspberry in terms of hardware and software so that the developer is aware of what they can use it to build his project. Both Arduino and Raspberry are microcontrollers, but the first works without the need to connect to a computer, and works through an open source program as it is a single board and deals with a simple program every time and can connect to the Internet, while Raspberry connects to a computer via USB It deals with the language of Linux and Ruby and can perform mathematical and arithmetic operations and encrypt Bitcoin currencies, for these reasons, all these concepts will be explained in this paper, and that any technician or programmer can choose the best electronic parts Arduino or Raspberry in order to get the project done better.

Introduction

From Arduino started in 2005 as a project for students at the Italy (Rajan et al., 2015; Ismailov & Jo'Rayev, 2022). Arduino is an open source Louis, (2016); Hussien et al. (2021) programmable electronic board that anyone can build, manufacture, sell and programmable electronic board (Costa et al., 2018). There are boards under the name "Freeduino" and "Netduino" Kim et al. (2020) that perform the work of Arduino since it is cloned from Arduino.

Certainly the Arduino is not the only electronic microcontroller on the market, but there are many "Micro-Controllers" available in the market such as "Parallax", "Basic Stamp", and the strongest competitor "Raspberry Pi" as microprocessor (Ghael et al., 2021), all of which have strong capabilities to work complete projects, of course according to the needs of the planned work and there are several reasons for using Arduino perhaps the most notably it's an open source hardware and software Arduino is mainly made of ATMEGA8 and ATMEGA168 microcontrollers, and all of their schematics are published under the creative commons license (Isizoh et al., 2022) and this is the most important feature offered to electronic circuit designers. Because it facilitates the operation of electronic controls. The other reason is the simplicity since Arduino boards are designed to suit the needs of engineers, designers, professors, students and hobbyists around the world. And not forget the other reason for the price and cost, the Arduino board is less expensive than any competitor of the same type (Arduino Team, 2021).

The self-assembly it is easy to handle and easy to connect electronic circuits to, and it is an easy solution to the problem of the microcontroller and its complex connections (Aneneet et al., n.d) for this reason, Arduino can be considered as a multi- platform system which cane divided into two platforms hardware and software , the Arduino program has the ability to work with all different operating systems from windows, Mac and Linux Langbridge (2015) while most other boards work on windows only the last reason is simple and easy programming environment, the programming environment is designed to be easy for beginners and powerful for professionals and its programming language "Arduino C" is easy to learn.

After we briefly reviewed the most important characteristics of the Arduino, so it is necessary to detail the most important types that belong to the Arduino, and then we will take the raspberry in some detail.

Type of Arduino

It includes many types, and as shown below, it was developed based on technological need:

Arduino Leonardo Board

It is considered the first development to the Arduino board with a single microcontroller, so this board is cheap and works very simple and is connected directly to a single input) ONE USP) (Verma, 2017). based on the ATmega32u4, with 20 digital input/output pins.

Figure 1. Arduino Leonardo Board

Lilypad Arduino Board

It is specially manufactured to fabric textile production plants and works through microcontrulator (ATmega168 or ATmega328) and is programmed and then tied to accomplish a certain process (Buechley, et al., 2008). Its importance lies in the low energy consumption, and is used for small-sized devices where reducing the area and size of the board is important.
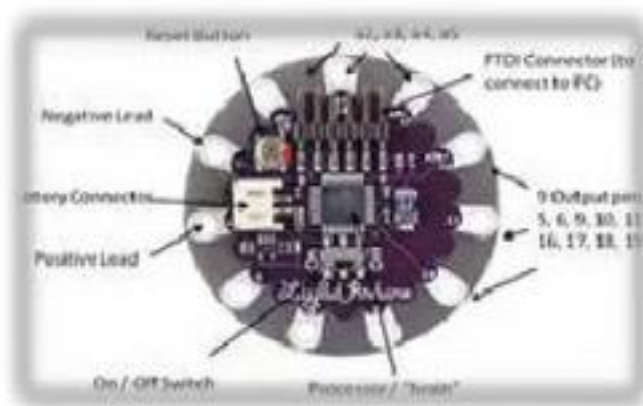

Figure 2. Lily Pad Arduino Board (Verma, 2017)

Arduino UNO (R3)

Arduino UNO is one of the most popular and widely used models with 14 digital input and output ports. It has a reset button in addition to a power port with a USB port for the purpose of sending data via the calculator or via wireless. It can also be programmed to perform multiple operations, but it does not have a microprocessor (Louis, 2016; Kaswan et al., 2020).

Figure 3. Arduino UNO R3 (Rajan et al., 2015).

Arduino Mega 2560(R3)

It is a microcontroller board depend on the ATmega2560 with 54 digital input/output pins connection, USP connected by PC with AC-DC adapter, and a reset switch. So The Mega is compatible board (Ashwini., 2016). These electronic boards provide a flexible working memory space and are the largest power and processing that allows to work with different types of sensors without delay and are used in complex projects such as temperature sensing, 3D printers, IOT applications, and radon detectors.

Figure 4. Arduino Mega 2560(R3) (Ashwini, 2016).

Applications

Arduino has a variety of applications that cannot be counted, and the most famous of them are indicated in the following table.

Table 1. Arduino applications

No.	Covering area	Applications
1	Smart homes	air conditioners, lighting, refrigerator, television, surveillance cameras, etc.
2	Transportations	airplane control, train control, driving vehicles, etc.
4	Road and bridges	control of road crossings, traffic lights, street lighting, road monitors, train tracks, etc.
5	Health aspect	monitoring vital signs for patients with cancer, diabetes, dangerous communicable diseases, ECG / EEG / EMG, etc.

6	Medical laboratories	eye tracking, pathological analyzes, remote surgeries, etc.

Raspberry PI

It is also a relatively small electronic board, rather low in cost and can be considered a nano-computer (Jolles, 2021). It has the ability to process the data that is fed with it, and is involved in the formation of things that need smarter chips Johnston & Cox (2017) such as smart homes, robots and was developed at the University of Cambridge. In terms of programming language, it depends on the use of several programming languages such as Java, Python, C/C++, Ruby (Anderson., 2019). It uses a larger processor up to 1.2GHz which enables more accurate data processing.

Figure 5. Raspberry Pi. (Jolles, 2021)

The table below shows the most important differences between these two Microcontroller:

Table 2. The difference between Arduino and Raspberry

No	Arduino	Raspberry
1	A microcontroller board	is a microprocessor as single board
2	Clock speed 16 MHz	Clock speed 1.8 MHz
3	Single task	Multiple tasks
4	Contains: CPU, RAM, ROM.	Contains: CPU, RAM, Storage, Connectors, GPIO Pins, graphics driver
5	One USB	Two USB
6	Low cost	High cost
7	Programming Languages: C or C++	Programming Languages: Python, Scratch, Ruby, C, C++
8	Need source code	Need operating sys.
9	A power failure does not affect the hardware damage	A power outage may damage hardware, software, or applications.
10	Using Shields, you can add motor drives, Wi-Fi devices, card readers, cameras, touchscreens, etc.....	GPS and touchscreens can be added through additional Raspberry or HAT devices
11	It is exposed to more attacks by electronic hacking of its connection through the network	It is not exposed to hacking attacks because it is connected to the sense via USB

Conclusion

Microcontroller have become the topic of the times and are very important in various industrial and scientific applications and the construction of graduation projects. Therefore, it is necessary to know the differences between these board to avoid material cost and speed, and they made the decision. The Raspberry Pi is a microprocessor that can also be controlled like Arduino, but it is superior to it in processing huge data and dealing with graphics that need a high amount of processing, and it can also access the web simply and easily if it is a mini-computer. As for the Arduino, it is a microcontroller not as powerful as the Raspberry Pi, but as a component of a computer system. It is a wonderful piece for electronic projects, as it does not need any operating system or software applications. So we need it to write some lines of code to use it, and there are many Arduino development boards: Arduino Uno, Arduino Pro, Arduino Mega, Arduino Duo, and others.

Acknowledgment

References

Anderson S., (2019). 3 popular programming languages you can learn with Raspberry Pi", 2019, available at https://opensource.com/article/19/3/programming-languages-raspberry-pi

Anene, E. C., Ibrahim, A. M., & Abdulhameed, M. (n.d) Microcontroller Prototyping Platform with expanded and flexible hardwired I/O resources. www.questjournals.org.

Arduino Team. (2021). One board to rule them all: History of the Arduino UNO", 2021, Available at https://blog.arduino.cc/2021/12/09/one-board-to-rule-them-all-history-of-the-arduino-uno/.

Ashwini., M. U.(2016). Implementation of Ac Power Stand By Switch-Off Outlets Using Arduino Mega2560", International Journal of Scientific & Engineering Research, Volume 7, Issue 5, May-2016, ISSN 2229-5518.

Buechley, L., Eisenberg, M., Catchen, J., & Crockett, A. (2008, April). The LilyPad Arduino: using computational textiles to investigate engagement, aesthetics, and diversity in computer science education. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 423-432).

Costa, D. G., & Duran-Faundez, C. (2018). Open-source electronics platforms as enabling technologies for smart cities: Recent developments and perspectives. *Electronics*, *7*(12), 404.

Ghael, H. D., Solanki, L., & Sahu, G. (2021). A Review Paper on Raspberry Pi and its Applications. *Int. J. Adv. Eng. Manag*, *2*(12), 225-227.

Hussien, N. M., Al-Obaidi, M. A. M., Abtan, R. A., Al-Saleh, A. H., & Al-Zuky, A. A. D. (2021). Smart System for Detecting the Entry of Authority People in the Security Facilities Based IoT using SURF Recognition and Viola-Jones Algorithms. In *Journal of Physics: Conference Series* (Vol. 1963, No. 1, p. 012075). IOP Publishing.

Isizoh, A. N., Ejimofor, I. A., Alagbu, E. E., Obianyo, O. R., & Ebih, U. J. (2022). Design and Construction of Arduino-Based Experimental Training Kit. *Journal homepage: www. ijrpr. com ISSN*, *2582*, 7421.

Ismailov, A. S., & Jo'Rayev, Z. B. (2022). Study of arduino microcontroller board. *Science and Education*, *3*(3), 172-179.

Johnston, S. J., & Cox, S. J. (2017). The raspberry Pi: A technology disrupter, and the enabler of dreams. *Electronics*, *6*(3), 51.

Jolles, J. W. (2021). Broad-scale applications of the Raspberry Pi: A review and guide for biologists. *Methods in Ecology and Evolution*, *12*(9), 1562-1579.

Kaswan, K. S., Singh, S. P., & Sagar, S. (2020). Role of Arduino in real world applications. *Int. J. Sci. Technol. Res*, *9*(1), 1113-1116.

Kim, S. M., Choi, Y., & Suh, J. (2020). Applications of the open-source hardware Arduino platform in the mining industry: A review. *Applied Sciences*, *10*(14), 5018.

Langbridge, J. A. (2015). *Arduino sketches: tools and techniques for programming wizardry*. John Wiley & Sons.

Louis, L. (2016). working principle of Arduino and u sing it. *International Journal of Control, Automation, Communication and Systems (IJCACS)*, *1*(2), 21-29.

Louis, L. (2016). working principle of Arduino and u sing it. *International Journal of Control, Automation, Communication and Systems (IJCACS)*, *1*(2), 21-29.

Rajan, C., Megala, B., Nandhini, A., & Priya, C. R. (2015). A Review: Comparative Analysis of Arduino Micro Controllers in Robotic Car. *International Journal of Mechanical and Materials Engineering*, *9*(2), 371-380.

Verma, M. (2017). Working, operation and types of arduino microcontroller. *International Journal of Engineering Sciences & Research Technology*, *6*(6), 155-158.