Developers Should Know About Raspberry Pi

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Moore (1965), the co-founder of Intel Corporation observed the number of transistors in the integrated circuits doubles every two years, which is Moore's Law. Since processors can get faster when their contained transistors get more, Moore's Law means, in other terms, processors can get smaller and more capable every year, and it makes the CPU and memory chip more useful and cheaper. From experience, the price of 2 GigaBytes USB was about $10 10 years ago, but now 32 GigaBytes USB which has the same physical size is sold at about $8. Indeed, this kind of hardware development led to the 4th industrial revolution such as in AI and IoT. Artificial Intelligence which includes the concepts of machine learning and deep learning has been delayed to be developed because processing units were not efficient enough to work with the software algorithm before. IoT, Internet of Things, also requires a small processor and a small memory chip technology that make it possible to stick with any Things and communicate with other devices. In conclusion, there is no way to access new technologies except for the development of hardware, and that is why computer developers should know about the hardware.

There is one tool to learn hardware systems more interestingly: Raspberry Pi. Raspberry Pi is a kind of single-board computer, figure speaking, which looks like a miniature of the green electronic circuit that comes out when opened the computer desktop. According to the Raspberry Pi official website, it is originally invented by the Raspberry Pi Foundation, one of the non-profit charity organizations in the United Kingdom, to help students in developing countries to study basic computer science("About us", n.d.). Despite its aims for education, due to its low-cost and high-quality feature, it has been used for the wide field of research and projects until now. Therefore, this essay will introduce the three aspects of Raspberry Pi and the researches studied by using it.

Three Aspects of Raspberry Pi

Firstly, Raspberry Pi is so similar to a normal personal desktop that anyone can handle it easily. It supports a plug and plays function which simply means that any device can play right after it is put through cable ports. According to the article, "Raspberry Pi 4 specs and benchmarks", Zwetsloot (2019) mentions the latest version of Raspberry Pi has various ports including two micro HDMI 2.0, an analog audio jack, two USB 2.0, two USB 3.0, Gigabits Ethernet, Camera Serial Interface, and Display Serial Interface. Such ports enable to connect with devices just like a normal computer, but its acceptable devices include not only user-friendly ones such as a mouse, a keyboard, and a monitor, but also primitive sensors called modules or sensors such as humidity and degree sensor, a gyroscope, and infrared light sensors. The fact gives advantages to the developers that they can handle complicated sensors more easily as if on a normal computer. In addition to that, Raspberry Pi supports a wireless network. Wi-Fi and BlueTooth modules are included on the board to make the internet network possible. Thanks to that, developers do not need to directly connect it through a cable every single time they need to transfer the code just written or give commands to a controller, but they can access it remotely.

Secondly, the open-source platform is currently open widely for Raspberry Pi developers. The developers can choose an Operating System to use among various kinds of support. Primarily, it has worked only in Rasbian, the initial Operating System based on Linux, but many Operating Systems based on Linux has begun to release a new version for Raspberry Pi. According to the article, "Windows 10 on the Raspberry Pi: What you need to know", Heath (2015) stated that even Windows, one of the OSs which are not based on Linux, had released a new version for Raspberry Pi. Besides, Raspberry Pi gives them freedom of programming

language choice, which means they can write a programming code in their preferred language, the easiest language for them. In the article, "Top Programming Languages 2020", Cass (2020) mentioned Python was picked up for the most comfortable language in 2020, in default ranking weighted toward the interests of an IEEE, Institute of Electrical and Electronics Engineers member. Thus, developers can write their codes in the most comfortable language, Python. In addition to OS and languages, many open-source code libraries completed by many developers, are currently available and can be found in developers' communities like Github. In conclusion, many options in open sources for Raspberry Pi including Operating systems, programming language, and library codes enable more productive work.

Lastly, Raspberry Pi is small and cheap due to its minimal architecture. It has pocket card size, and in an article, it is written that every version of Raspberry Pi is about $35 or less, with the cheapest model, Pi Zero, which is $5 ("What is a Raspberry Pi?", n.d). This tiny and inexpensive model can be made as a result of its minimal hardware architecture, all the necessary parts fill in a single electronic board. The facts provide developers with the greatest advantages that they can try to design the IoT system anywhere a network exists and at a low cost. One of the most typical examples is a Remote Control car with Raspberry Pi and Arduino. Raspberry Pi allows it to move freely everywhere, fixed on the tires of the car, maintaining its network connection. Another example is AI speakers, which can be designed at a low cost. According to an article, it is introduced how to make a smart speaker using Raspberry Pi and google assistant SDK(Software Development Kit) ("Make a Smart Speaker With Raspberry Pi for Daily Use", 2019). Compared with the price of google assistant AI speaker in sales announced in the article, "The cheapest Google Home prices for January 2021: the best Home Mini, Hub and Max deals"

that its cheapest one is $49, the fact that Raspberry version is just $35 or less will be a chance for the poor country.

Review of Research Studies

Until now, this essay has introduced three benefits of Raspberry Pi: its convenience to handle, provided open-source, and good value for money. Then, two research will be introduced to prove Raspberry Pi is one of the helpful tools in education. Still, many researchers agree that Raspberry Pi has benefits in learning computer engineering. According to research, "Raspberry Pi for Image Processing Education", Marot and Bourennane (2017) claim Raspberry Pi will be a new method to explain new trends on micro-computers and digital signal processing. Likewise, Jamieson and Herdtner (2015) write in their research, "More Missing the Boat - Arduino, Raspberry Pi, and Small Prototyping Boards and Engineering. Education Needs Them." that "when they teach students using prototyping boards in their course, students have done their projects well without any formal instructions provided". In conclusion, Raspberry Pi is one of the most useful tools for students majoring in Computer Engineering or Electronic Engineering.

Conclusion

In conclusion, the leading factor of the 4th industrial revolution is not software, but hardware development. The steady increase in the proportion of transistors has allowed a processor to calculate faster and reduce its body size more than before. Therefore, the developers should understand the hardware architecture, and there is a tiny and good tool, Raspberry Pi. Raspberry Pi has an easiness to handle, a wide-open source community, small size, and cheap

price due to its minimal architecture so that beginners can learn it more quickly. Besides, even though it just looks like a toy for young children, many researchers verified its power in education through their study. In my opinion, it has a great possibility to be used to make appropriate technologies for the poor and developing country, so I want to know more if a standard of appropriate technology already exists. Similarly for education, I believe Raspberry Pi will be used for high school education courses because according to the research, "Raspberry Pi for Image Processing Education", Marot and Bourennane (2013) observed middle and high schools are incorporating IT into their curriculum. More and more countries including Korea, an IT powerhouse will get interested in electronics principles. Therefore, the time has come for you to begin playing with this tiny and powerful toy.

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