

Construction of an Internet of Thing Product Built on a Processor Development Kit: A Research Review

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Abstract—This paper is a general research review based on several literatures related to a project which will design and construct an IoT (Internet of things) product using a processor and microcontroller development kit. The main idea of this product is shown in the first part and the application of this product determined the basic function needed of a processor and microcontroller development kit. The comparison of several different kind of kit are written in the PART II. And the conclusion will summarize the main concepts of the project.

Index Terms— Electronics, IoT, Processor & Microcontroller development Kit, Raspberry Pi, Photon

I. INTRODUCTION

THIS article serve as a research review of the project which will design and construct an IoT product built on an electronic board which should has a processor and microcontroller on it. The definition of an IoT product is important for this project so that an overview of the IoT are shown in the following part. Besides, the primary choose of the function of the product is also demonstrated in that part.

II. OVERVIEW OF THE INTERNET OF THINGS

A. Concept of the IoT

As the reference [1] said “The internet of things can be viewed as a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based one existing and evolving interoperable information and communication technologies”.

As shown above, the ‘things’ in this concept have a special meaning. Reference [1] also defines things in IoT are objects of the physical world (physical things) or the information world (virtual world). So, what is the characteristic of the things in physical world and information world?

The things in the physical world can be sensed, actuated and connected by each other and by human such as the electrical

or electronic devices, the environment surrounding us and even the smart phones.

The things in the information world are defined by reference [1] as the virtual things which can be stored, processed and accessed. For example, the APPs in our smart phones, a string of data stored in the hardware and an operation system stored in the SD card.

B. Purpose of the IoT

As said by O. Vermesan and P. Friess [2], today, the internet should have a revolution and it must be IoT. And they [2] also concluded that the IoT has a more and more important role in nowadays’ information and communication technologies and the development of society. The main purpose of the IoT is to enable things to be connected anytime, anyplace, with anything and anyone ideally using any path/network and any service. This is also the tendency of the future communication and information society. However, it still need the efforts of engineers and researchers to unleash the full potential and federat systems and actor [2].

C. Technology Overview of the IoT

The most important technology is mapping physical things in the physical world with the virtual things in the information world. This topology can be demonstrated by Figure 1 [1].

As mentioned before, physical things can be sensed, actuated and connected. So, the device shown in Figure 1 [1] should have the abilities of sensing, actuation, data capture, data storage and data processing. Besides, on the left hand side of the Figure, the devices also used to collect different kinds of information and send it to the information and communication networks for the next stage processing.

As shown in Figure 1 [1], the communication between the devices will be in three ways. The first path (a) is a communication based on a gateway to the communication networks. The second path (b) a way directly from one device to another device without walk through a gateway but the communication network. So, the final possible way is directly communicate without through a gateway or a network. Besides, the reference 1 also mentioned some possible

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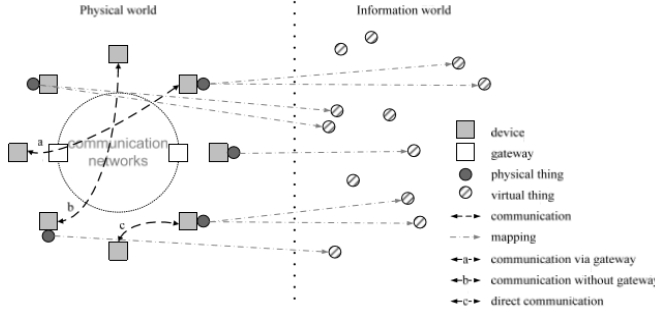


Fig. 1. Topology of the physical things represented by the virtual things communication paths may combine two of the above path to a new method of communication. This example shows that it firstly making communication directly to an ad-hoc network which giving local communication between devices and a gateway. Then, it communicating by the first path (a) through this communication network via a local network gateway. This final important thesis should be said is that, the virtual things in Figure 1 seems have no activities between each other. However, from the point of mapping, the transactions also exists in the information world.

D. Application Overview of IoT

With the development of IoT in the past decade, there are various kinds of applications were devised by engineers and researchers. According to some literatures, some of the applications are already developed to a complete mature stage. Reference [3] shows a smart grid which construct the information interaction between human and devices. The consumers could using this system easily control their infrastructure in a low power energy consumption way. For example, the system can manage the devices regulate operating at an off-peak energy hours. Reference [4] proposed an idea of an intelligent transportation systems based on the topology of IoT. The wireless sensor networks are introduced in these kind of systems to exchange of information between transports to solve the parking problems in a crowded cities. However, according to these different kinds of applications. They have a significant footholds which are summarized by reference [1] as “The applications can be based on proprietary application platforms, but can also be built upon common application support platforms providing generic enabling capabilities, such as authentication, device management, charging and accounting.”

So, the next step is the determination of the characteristic of devices. Figure 2 [1] shows some important relationships between devices and physical things.

Generally, the devices can be divided into four main kinds of devices of different functions.

- 1) Sensing and actuating device: devices used for collecting data from the physical environment and transfer them into digital electronic signals. According to reference [1], these kind of devices should have the wireless communication technologies for local networks communication through gateways.

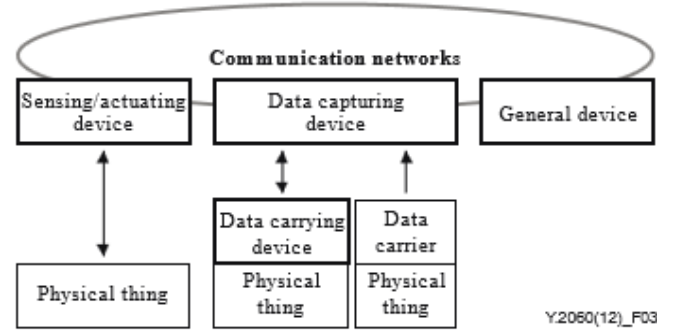


Fig. 2. Types of devices and their relationship with physical things

- 2) General device: The embedded processing ability is the main function of this kind of device. Besides, it also need the wireless communication technologies for network communication as the sensing and actuating device.
- 3) Data carrying device: Sometimes, a physical thing may need a data-carrying device for communication.
- 4) Data capturing device: the simple concept of this device could be defined as reading and wiring the physical thing data based on the data carrying device indirectly. Another way is reading and wiring directly from the data carrier which attached with a physical thing.

III. PROCESSOR & MICROCONTROLLER DEVELOPMENT KITS

A. Overview of embedded processor kits

The processor and microcontroller development kits are platforms or boards or also could be called as signal board microcontroller which basically contains microprocessor, I/O circuits, clock generator, RAM and memory. This kind of integrated circuit are useful in a lot of electrical and electronic field. In the recent five years, these board are even improved as an alternative of computer with much smaller size and weight. Besides, the much lower price is also a good choice for an IoT product from the respective of industry production. Besides, most of these kits are compatible with some open source operation system such as Linux. Then, the construction of a specific application will be much easier than other systems. This part will discuss two famous single board microcontroller on the market today.

B. Raspberry Pi

Some of the technical specification listed below are extracted from the reference [5] which is the datasheet of raspberry Pi 3 model B.

- Broadcom BCM2837 64bit ARMv7 Quad Core Processor powered Single Board Computer running at 1.2GHz 1GB RAM
- BCM43143 WiFi on board and Bluetooth Low Energy (BLE) on board
- Full size HDMI & 4 x USB 2 ports
- Micro SD port for loading your operating system and storing data
- Upgraded switched Micro USB power source (now

- supports up to 2.4 Amps)
- 1GB LPDDR2 memory
- Dimensions: 85 x 56 x 17mm
- Power: Micro USB socket 5.1 V, 2.5 A

As the reference [6] said that the raspberry is already could be seen as a PC which contains all of the personal computers' necessary components. Besides, this book [6] also showed the sensors applied by the kit. It also shows the possible problem is choosing the model of raspberry pi. For general use, model B is much better than Model A which have a twice as much memory.

However, the price of a raspberry pi 3 model B on the RS components (online supplier) is £30. And model A will save several pounds. From the perspective of cost, some projects using the raspberry pi as a simple purpose for example the small occupation of memory project could use model A for a lower cost.

C. Arduino M0 Pro

Arduino M0 Pro Development Board is an alternative of raspberry Pi which has a lower price of £23 on RS components. And it is great for IoT projects because of it used a powerful core ARM Cortex® M0+. Besides, this board has several benefits to be used in IoT project according to the datasheet provided by the manufacturer [7]. Following are the summary of product specifications:

- The board is powered by Atmel's SAMD21 MCU, featuring a 32-bit ARM Cortex® M0 + core
- Operating Voltage is 3.3V
- Digital I/O Pins: 14, with 12 PWM and UART
- Analog Input Pins: 6, 12-bit ADC channels
- Analog Output Pins 1, 10-bit DAC
- Flash Memory 256 KB

The memory is a program memory with 4 KB used for the bootloader. A dedicated ROM memory will be used for the IoT project. However, the Arduino M0 Pro should be programmed with the Arduino software so that a computer is still needed for this board. The communication of the board and the computer is very easy by using the native USB port. And the software is only supported on by Linux OS.

Generally speaking, this kit may not very suitable for a project which need a portable capabilities. This system have to connect to a large and heavy computer to make it work. However, the raspberry which support the SD port OS self-install function only need an small and portable monitor and keyboard to command the operation. From the perspective of business, the cost of raspberry pi in the external devices will be much smaller than Arduino M0 Pro.

IV. CONCLUSION

Internet of things is a concept of using technologies to serve the communication and information society which basically developed on the interconnecting of physical things in the

physical world and virtual things in the information world. The physical things can be represented by the virtual things by paths or called as mapping. And the technology used in the physical world is using some devices attach with the physical things and others for interaction with the communication network and other devices. There are three main path of communication. Besides, the devices also could divided into four main kinds which also help the engineers to determine the platform used for design and construct an IoT product. Finally, according to the necessary function provided by Dr. Klaus-Peter Zauner, the raspberry Pi is selected for this project which has a high-class wireless system and Linux accepted capability than the Arduino board.

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