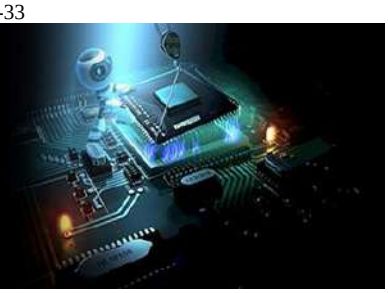
International Journal of Engineering in Computer Science



E-ISSN: 2663-3590
P-ISSN: 2663-3582
IJECS 2020; 2(2): 30-33
Received: 22-05-2020
Accepted: 24-06-2020

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An efficient solution of technological thrust for IoT in COVID-19 era

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DOI: https://doi.org/10.33545/26633582.2020.v2.i2a.38

Abstract
The stringent connectedness between the digital and physical world is referred to as IoT (Internet of Things). In the COVID-19 era, technology is being implemented in a rigorous manner to handle and balance the situation. Internet of Things (IoT) technology is playing a great role in all the aspects. In this research paper researcher compare four hardware platforms and concluded the best suitability of the hardware platform. Researchers provide the solution to the technological thrust for the IoT in terms of the hardware platform.

Keywords: internet of things, COVID-19, technological thrust, hardware platforms

Introduction

The term "Internet of Things" is used as a keyword to cover various aspects related to Internet and Web expansion in the physical space, through the widespread deployment of distributed geographical devices with integrated use of Internet-Things that foresees the future where digital and physical objects can be linked, through relevant knowledge and communication technologies, enabling a whole new category of applications and services [1].
The Internet of Things (IoT) is one of the most promising research topics in engineering and business. It is believed that the IoT will revolutionize the way people live in the near future by connecting ordinary things with each other remotely and establishing channels of communication between them. Because of this, not only as much information available about many objects and processes that were not available before the same release but also carefully designed systems would interact with these objects and information automatically acquired [3]. This results in unprecedented automation that can make industrial operations better and everyday life much easier. In addition, many applications would happen that were previously obsolete, such as smart homes, smart cities, and devices that could be installed on the human body. According to Cisco's Internet of Things Group (IOTG), the number of connected devices is expected to reach 50 million by 2020 [9, 10].
There are various hardware and open source software available using which it is possible to programmatically control many devices in a way that own solutions meet user needs in IoT. Also, providing various techniques to end user and the possibility to shape products according to their need makes it beneficial for both the user and the developer who develops the product. In this research paper the researcher emphasis on four hardware platforms which includes Arduino Uno, Raspberry pi B+, Beagle bone and Intel Galileo Gen 2 [4].

Related works

In this paper Jain and *et al*. proposed four steps cluster formation, cluster head (CH) selection, coverage hole detection, and recovery and routing. Clusters are formed by the K-means algorithm. CH is elected by Determined Weight (DW) [11].
In this paper chauhan and *et al*. proposed a new approach to compress the IPv6 header of the packet, in context of IPv6 tunnels, which would improve the efficiency of IPv6 tunneling mechanism. Doing this we have compressed the 40 bytes of IPv6 header up to 6 bytes [12].
In this paper Jain and *et al*. proposed Wireless Sensor Networks (WSNs) is a key enabling technology for Internet of Things (IoT). In recent past decades, we have observed many technological issues including energy efficiency, security, privacy, data processing, adaptability, deployment and maintenance. However, the major concern in WSN and IoT are energy efficiency, and security [13].

Hardware platform overview

Arduino

The Arduino board is a freely available open source microcontroller that can handle various communications policies that will be used on any type of IoT device. This board is cheap and has a rich feature with the availability of various daughter boards that have the amazing feature of stacking on the main motherboard. The availability of Wi-Fi and Ethernet shield and the low power of the BLE-4 Arduino make it ideal for close knit and system friendly. Easy-to-use programs and many of the examples in the Arduino IDE make it easy for the user to quickly start the process of making the IoT device work seamlessly across all types of locations. The figure 1 is showing the Arduino Uno [3, 4, 7].

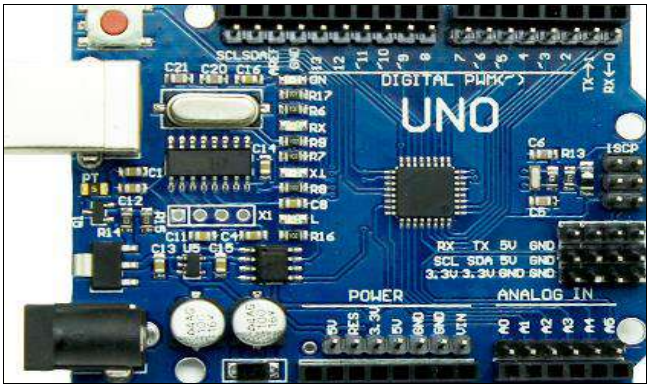

Fig 1: Arduino Uno

Raspberry Pi

The Raspberry pi board is smaller in size with the Broadcom BCM 2835 SoC based ARM11 energy minicomputer for development. The raspberry pi can be easily linked to recruitment because of its built-in GPU and audio viewing capabilities. It also uses a standard mouse and keyboard. This can be easily programmed into powerful languages like C, python etc., giving it the ability to store and analyze information. Built in Wi-Fi, BLE, storage capacity of this board and available RAM are huge compared to other boards making it useful as an IoT server in many IoT network configurations. Figure 2 is showing Raspberry Pi B+ [5].

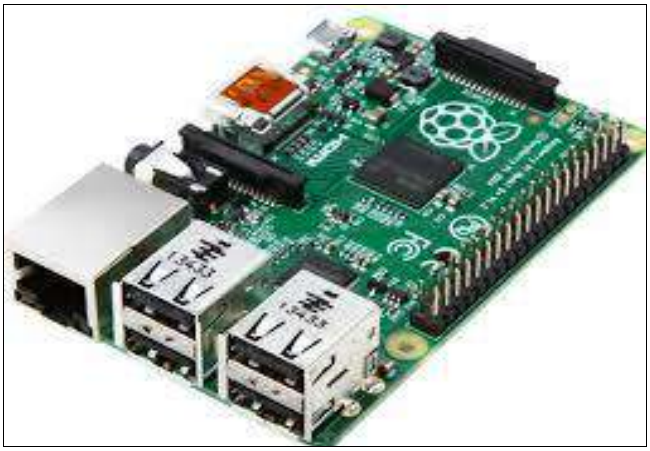

Fig 2: Raspberry Pi B+

Intel Galileo

Intel Galileo is a hardware development board, having an electronic circuit board that is designed to develop interactive objects by reading information from the physical world, and then taking action in the physical world after processing the information. When connected to a network, it can communicate with other devices such as the web server. Galileo is an Arduino compatible board, which means it can be programmed with an Arduino IDE using Arduino programming languages. Figure 3 is showing Intel Galileo Gen 2 [6].

Fig 3: Intel Galileo Gen 2

Beaglebone

Digi-key coined the term Beagle and designed by Texas Instruments along with Network Element 14. It was first fully functional low power single board open source computer launched on 28th July 2008. Community of open source developers and forums give the terrific response to Beagle board for utilizing it towards open source project developments. BeagleBoard-X15, Beaglebone Black, Beaglebone, Beaglebone-xM, BeagleBoard flavours of boards has been launched till date. Figure 4 is showing Beaglebone Black [2].

Fig 4: Beaglebone Black

Comparison

In this section comparison between Arduino Uno, Intel Galileo 2, Raspberry pi B+ and Beaglebone Black, the four hardware platform has been done by the researchers which will be helpful to find the solution for Technological Thrust for IoT in COVID-19 Era. Here researcher compare the hardware platform on the basis of the eleven parameters namely Processor, Required Voltage to Operate, Clock speed, Bus width (bits), System memory, Flash memory, Communication supported, Development environments, Programming language, I/O Connectivity, Arduino shield support respectively [7, 8].

Table 1: Hardware platforms comparison

Hardware Platforms Parameters	Arduino Uno	Intel Galileo Gen 2	Raspberry Pi B+	Beagle Bone Black
Processor	ATMega328P	Intel QuarkTM SoC X1000	Broadcom BCM2835 SoC based ARM11 76JZF	Sitara AM3358BZCZ100
Required Voltage to Operate	5V	5V	5V	3.3 V
Clock speed	16 MHz	400 MHz	700 MHz	1 GHz
Bus width (bits)	8	32	32	32
System memory	2KB	256 MB	512 MB	512 MB
Flash memory	32 KB	8MB	4 GB	4 GB
Communication supported	IEEE 802.11 b/g/n, IEEE 802.15.4, 433RF, BLE 4.0, Ethernet, Serial	IEEE 802.11 b/g/n, IEEE 802.15.4, 433RF, BLE 4.0, Ethernet, Serial	IEEE 802.11 b/g/n, IEEE 802.15.4, 433RF, BLE 4.0, Ethernet	IEEE 802.11 b/g/n, 433RF, IEEE 802.15.4, BLE 4.0, Ethernet, Serial
Development environments	Arduino IDE	Arduino IDE	NOOBS	Debian, Android, Ubuntu, Cloud IDE
Programming language	Wiring	Wiring, Wyliodrin	Python, C, C++, Java, Scratch, Ruby	C, C++, Python, Perl, Ruby, Java, Node.js
I/O Connectivity	SPI, I2C, UART, GPIO	SPI, I2C, UART, GPIO	SPI, DSI, UART, SDIO, CSI, GPIO	SPI, UART, I2C, McASP, GPIO
Arduino shield support	Yes	Yes	No	No

The table 1 shows the difference between four hardware platform namely Arduino Uno, Intel Galileo Gen 2, Raspberry Pi B+, and Beagle Bone Black. The difference on the basis of eleven parameters namely Processor, Required Voltage to Operate, Clock speed, Bus width (bits), System memory, Flash memory, communication, Development environments supported, Programming language, I/O Connectivity, Arduino shield support. The first parameter is Processor in which Arduino Uno ATMega328P, Intel Galileo Gen 2 uses Intel_ QuarkTM SoC X1000 Raspberry Pi B+ uses Broadcom BCM2835 SoC based ARM11 76JZF, and Beagle Bone Black Sitara AM3358BZCZ100. The second parameter is Required Voltage to Operate where all the hardware platform works on 5V except Beagle Bone Black which runs on the 3.3 V. The third parameter is the Clock speed which is 16 MHz in Arduino Uno, 400 MHz in Intel Galileo Gen 2, 700 MHz in Raspberry Pi B+, and 1 GHz Beagle Bone Black. The fourth parameter is Bus width (bits) which is 8 bits in Arduino Uno, 32 bit in Intel Galileo Gen 2, 32 bit in the Raspberry Pi B+, and 32 bit in Beagle Bone Black. The first parameter is the System Memory which is 2KB, 256 MB, 512 MB, and 512 MB in Arduino Uno, Intel Galileo Gen 2, Raspberry Pi B+, and Beagle Bone Black respectively. Flash memory is the next parameter which is 32 KB, 8MB, 4 GB, and 4 GB in Arduino Uno, Intel Galileo Gen 2, Raspberry Pi B+, and Beagle Bone Black respectively. The next parameter is the communication supported by the hardware platform is are IEEE 802.11 b/g/n, IEEE 802.15.4,433RF, BLE 4.0, Ethernet, Serial by Arduino Uno, IEEE 802.11 b/g/n, IEEE 802.15.4, 433RF, BLE 4.0, Ethernet, Serial by Intel Galileo Gen 2, IEEE 802.11 b/g/n, IEEE 802.15.4, 433RF, BLE 4.0, Ethernet by Raspberry Pi B+, and IEEE 802.11 b/g/n, 433RF, IEEE 802.15.4, BLE 4.0, Ethernet, Serial by Beagle Bone Black. The next parameter is a Development environment which is Arduino IDE for Arduino Uno, Arduino IDE for Intel Galileo Gen 2, NOOBS for Raspberry Pi B+, and Debian, Android, Ubuntu, Cloud IDE for Beagle Bone Black. Next parameter is Programming language is Wiring in Arduino Uno, Wiring, Wyliodrin in Intel Galileo Gen 2, Python, C, C ++, Java, Scratch, Ruby in Raspberry Pi B+, and C, C++, Python, Perl, Ruby, Java, Node.js in Beagle Bone Black. I/O Connectivity is the next parameter which includes SPI, I2C, UART, GPIO in Arduino Uno, SPI, I2C, UART, GPIO in Intel Galileo Gen 2, SPI, DSI, UART, SDIO, CSI, GPIO in Raspberry Pi B+, and SPI, UART, I2C, McASP, GPIO in Beagle Bone Black. The last parameter is Arduino Shield Support table shows that which hardware platform support the Arduino shield here the first two namely Arduino Uno, Intel Galileo Gen 2 supports this parameter while rest two namely Raspberry Pi B+, and Beagle Bone Black does not support this parameter [14].

Conclusion

Researcher compares four hardware platforms namely Arduino Uno, Intel Galileo Gen 2, Raspberry Pi B+, and Beagle Bone Black. In term of operating voltage and clock speed the Beagle Bone Black is superior then the rest hardware platform. In term of flash memory the Beagle Bone Black and Raspberry Pi B+ both the hardware platform have same the rest hardware platform. Processor used in the hardware platform has own importance for each platform. Every hardware platform has own supported communication and I/O connectivity. Arduino Uno and Intel Galileo Gen 2 have same development environment. Arduino Uno and Intel Galileo Gen 2, both the hardware platforms are supportive towards the Arduino shield while rest hardware platform namely Raspberry Pi B+ and Beagle Bone Black are not supportive. Every hardware platform has own merits and demerits as describe by the researcher. Selecting of the hardware platform depends upon the nature of requirement. The product nature, development environment, and developer interest area plays an important role in the selection of the hardware platform.

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