IT Technologies 1: small computing devices (Raspberry Pi, Arduino, ESP-32)

What does it do.

Small single-board devices like a Raspberry Pi, an Arduino or an ESP-32 are generally used in many applications. You will find them in appliances, factories, home-automation, network security, healthcare, robotics, education, hardware/invention prototyping and IoT applications. They can be used as regular computers but more often as controllers for electrical devices (everything from light bulbs, factory robotics, fridges to large commercial hot water systems). Generally, the use of one of these pieces of hardware would be to run a small script or program on the micro-computer, with its GPIO pins connected to whatever device and/or devices you would wish to control.

What these computing devices do is allow someone to use them as a computer to control the electrical signals sent to the GPIO pins. They have inputs/outputs to connect to sensors and information receive/send functions. The driving technological force behind these single-board computers has been the constant technological advancements in manufacture of smaller, more efficient, less costly computer parts. Specifically, smaller storage, CPU and ram.

An example of what a micro- computer would do in a home automation setup would be having a Raspberry Pi with a movement detector. The detector (or an ultrasonic distance detector) could see if someone or something is moving in view of the sensor. If movement is detected, a camera installed on the Pi can automatically begin recording. The video can be stored locally or remotely on a cloud server. A setup like this would not be expensive compared to the previous generation of commercial security camera setups. They required expensive DVR equipment and a central server to store video data.

Another example is to use micro-computer to report productivity in a factory. the ESP-32 micro-computer could be connected to a PLC control-board operating a conveyer belt. The ESP-32 could be programmed to send instructions to the PLC board using the ‘Modbus’ computer language through an open source software such as Node-Red. This ESP-32 could then be setup to create and send weekly reports of conveyor belt speeds to a server. The reports would give a rough assessment of productivity during the week.

An appliance example is use with a hot water system. An Arduino could be attached to a temperature sensor within the tank. The Arduino sends the sensor’s internal tank temperature records to a cloud server. The head company then accumulates statistics on how well their hot water systems are performing in the field. Using this kind of technology, a company would be able to detect trends over time and to a degree of accuracy that has not previously be achievable. Previously they would have sent an electrician/plumber to check numbers every time a tank is serviced, which is an additional labour cost avoided.

A final example is to improve network security by using a raspberry Pi as a remote VPN. Maybe you are a journalist/government employee/high corporate going to a foreign country where internet access is heavily restricted, and you need to send or view sensitive information over the internet. Before you leave, you could setup a Raspberry Pi at a secure location in your own country with an Open-VPN server, which you could then connect to remotely with an Open-VPN client when you have landed at your new location. This would allow you to have cheap access to a secure stable line that could not be viewed by a third party, such as a commercial VPN provider.

What these devices do is up to the person who is using it, as there are so many different uses and applications and the list is only growing as the technology matures.

What is the likely impact?

I believe the likely impact of small single-board computers will be the computerization of many products that were previously not computerised or networked. The price point for single-board computers has been dropping considerably, especially over the last decade. This makes it more accessible for people to use single-board computers in their product designs/tech solutions.

The impact will especially be felt in the IoT sector, which is growing at incredible rates. The IoT market is fuelled by the rise of single-board computers such as the Raspberry Pi and Arduino and is expected to reach $1,102.6 billion US dollars by the end of 2026 (Fortunebusinessinsights.com, 2020). Due to the huge growth in this sector, we can expect to see this whole new industry around small single-board computers become a much bigger deal in the future as well as providing many new jobs, challenges, solutions and problems. The single-board computer market itself is expected to reach $1 billion US dollars by the end of 2025 (Global Market Insights, 2020).

Another impact will be especially felt in developing countries where small single-board computers have been at the heart of robotics development in Kenya, Africa. This has spurred a huge education drive towards programming, robotics and computers and will be one of the big driving factors of helping to develop these countries by providing jobs, industry and education to areas that were previously not able to access and work with high cutting-edge technology (The Star, 2020), (Fast Company, 2020).

With these developments in small single-board computing technology, even the future of national security may be impacted. In April 2018, America’s space agency NASA was attacked and comprised via the use of a $35 Raspberry Pi. As people's homes, workplaces and governments are increasingly connected and equipped with small single-board computers the risk of hacking and cyber-attacks may increase and cause many potential problems in the future (Forbes.com, 2020) , (CYBERSECURITY MANAGEMENT AND OVERSIGHT AT THE JET PROPULSION LABORATORY, 2019).

How will this affect you

In daily life, I believe the affect it will have on me and others will be substantial. The idea of a computer being a large, bulky and expensive device is no longer a reality for the home consumer. If you want to watch movies, browse the internet or listen to music you can simply purchase a cheap single-board computer and plug it into any TV to do the trick. The rise of this cheap computing revolution will no doubt bring people who were previously not interested in tech into the fold as it becomes a part of daily life.

Privacy concerns will also arise. Small computer devices are all being networked and presumably connected to the cloud. People's homes will be more susceptible to attack through this gateway (WashingtonPost.com, 2020). This could affect myself directly, or indirectly (via my breach) my friends or family. With small computer devices, the need to stay diligent regarding cyber-security will be a necessity of everyday life. The need for everyday people to understand the basics of network security increases as these new technologies get implemented.

For us here studying IT at RMIT, the field of micro-computers is going to have a great effect on our careers. As people who are studying IT, or strive to work in an IT field, we should take an interest in the growing industry of IoT and single-board computers.

Electronics has been left on the wayside of IT skills for a long time now. But with the rise of single-board computers, there will also rise the IT specialists with the electronics skills to build and service them. A new specialty (or the re-emergence of an old one). Since the use of single-board computers generally requires a broad knowledge of IT, combing all aspects of previously separated fields such as hardware/networking/programming and electronics, this will be especially demanding of a broad knowledge base.

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