A Study on the Inner Workings and Use Cases of Raspberry Pis

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Introduction

This study explores Raspberry Pi's journey from a basic concept aimed at reviving practical computer science skills among students to its current status as a versatile tool for a wide array of projects, including temperature sensing. Despite facing several limitations, the Raspberry Pi's design caters to a broad spectrum of users and projects. With its affordable price, adaptability, and supportive community, the Raspberry Pi stands as a testament to innovation and accessibility in computing, embodying a bridge between learning and practical application in the digital age.

Literature Review

The Raspberry Pi in its current form is the result of continuous revisions that have been made to the concept dating back to the original attempts at making a microcomputer in 2006 at the University of Cambridge [1]. The original members who worked on the project included Eben Upton, Rob Mullins, Jack Lang, and Alan Mycroft [1]. The device was designed with education and promoting the computer science field in mind after the team observed how students were being taught increasingly how to use computers instead of how they work [source]. The first commercial release was in 2012 [1], and the Raspberry Pi team has continued improving their microcomputers ever since.

In relation to temperature sensors, heartbeat and body temperature measurements have been taken using a raspberry Pi in a prior study done by Tan Suryani Sollu, Alamsyah, Muhammad Bachtiar and Benyamin Bontong [2]. The tests found that body temperature readings with their Raspberry Pi setup had a success rate of 99.73%, instilling confidence in their use for alternative temperature-related applications.

Raspberry Pis come with their own specific set of drawbacks due to their smaller form factor's impact on their design. Raspberry Pis do not have any form of internal storage and they lack a cooling system. These limitations can cause issues in relation to Raspberry Pis' reliability. Other limitations include Raspberry Pis' low processing power and memory which limits how much intensive work they can handle. It also does not have the same reliability as other, more mainstream machines which were built to handle more intense temperatures and environments than Raspberry Pis. While these issues are worth noting, they should not interfere with most projects in practice so long as the Raspberry Pi is not pushed beyond its limits.

Memory

Memory is an important part of planning a Raspberry Pi project, as attempting to use any device for work more intensive than it can handle is going to cause problems. The Raspberry Pi 4 Model B has RAM which comes in multiple different sizes. The sizes available range from one to eight gigabytes of memory [3]. Our model has LPDDR4 (low-power double data rate) memory, a form of synchronous dynamic random-access memory commonly used in portable computers such as the Raspberry Pi. For our Raspberry Pi, we chose to go with two gigabytes of RAM. According to the product listing, the speed of the RAM for this model can transfer memory up to 3200Mb/s [4]. This choice will be the best fit for what we are trying to accomplish during the project regarding temperature sensing. The eight-gigabyte memory would most likely be overkill for our needs, and the one-gigabyte memory would be insufficient if we ever need to do an important task on the machine. While four gigabytes would be plenty to work with, it is not particularly necessary due to not really needing to access a desktop environment or any other demanding software a typical computer would have. This makes two gigabytes a good, sweet spot for our purposes.

Operating System

Raspberry Pis can run many different operating systems with different pros and cons for each of them. The consensus is that Raspberry Pi OS is the best operating system for most purposes which one would use a Raspberry Pi, but it is not the best operating system for all scenarios.

Raspberry Pi OS was originally created as Raspbian for use with Raspberry Pis by Mike Tompson and Peter Green. It was based on Debian, a Linux-based operating system developed in 1993 [5] and was released in 2012 [6]. It can be installed onto a Raspberry Pi by loading the operating system onto an SD card and using it to image the device. Some Raspberry Pis also come with the operating system preloaded onto the card [6]. Raspberry Pi OS is considered very user-friendly and the community surrounding it is still very active [6]. As such, there are plenty of readily available guides and other forms of guidance for how to work with the operating system.

Another Debian-based operating system compatible with Raspberry Pis is Kali Linux, an open-source operating system developed by Mati Ahoni and Devon Kearns while they were working under Offensive Security with the operating system initially being released in 2013 [6].

Kali Linux is most useful in security and penetration testing for computers and networks alike and comes with various tools built-in for such a purpose [6]. This operating system has a large community, but it requires a high amount of RAM and is not user-friendly for beginners to the Linux ecosystem. As such it may not be the best option outside of security-focused projects.

Starting in 2015, Microsoft has made available an IoT core version of Windows 10 capable of running on devices such as a Raspberry Pi. This operating system utilizes the free version of Visual Studio, and the operating system will be easier to transition to for most developers unfamiliar with Linux. However, while this operating system is continuously supported by Microsoft with special Raspberry Pi support built into it, Microsoft has not shared the source code which largely prevents users from modifying the operating system. Users also need access to a modern Windows operating system on their computer to download the initial files needed to install the operating system on the card, making it inaccessible for some users [6].

Overall, while Raspberry Pis support various operating systems, the Raspberry Pi OS is often the best choice, especially for lower-level projects. This is due to its ease of access, and it being made specifically for Raspberry Pis as well as it being free to use.

Communication

Raspberry Pis offer a variety of options for communicating between it and other devices, but their usefulness and ease of use vary. Communication with other devices is important for Raspberry Pis, as though Raspberry pies can operate without a computer itself, using another computer helps facilitate communication and makes using one more user-friendly. In terms of communication methods that are built in, Raspberry pies have multiple ways to transmit data including direct USB connections, Ethernet connections and Wi-Fi [7]. Raspberry Pis also come with a micro-SD card slot which can store data transmitted to it while also for new data to be written to the SD card before inserting it. A direct USB connection is often considered one of the easiest methods for relaying data, and as such, it would make for a perfect fit for our project. We will use a USB connection to transmit the data we find using the sensors connected to our Raspberry Pi.

Conclusion

In conclusion, the Raspberry Pi has evolved significantly since its inception at the University of Cambridge in 2006. Its journey from a simple microcomputer concept to a widely used device in various applications underscores its versatility and impact. Despite its limitations, the Raspberry Pi's design caters to a broad range of projects without compromising on reliability for standard applications. The Raspberry Pi OS, with its user-friendly interface and robust community support, remains the preferred operating system, facilitating ease of use and accessibility. Furthermore, the device's communication capabilities, enhance its utility in projects requiring data transmission. Overall, the Raspberry Pi's continuous development, affordability, and adaptability make it an invaluable tool for a multitude of different purposes and projects both as a teaching tool as well as for practical applications.

References

Literature Review: Study on use of temp sensors for body temp with raspberry pi.

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