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A FRAMEWORK ON SYSTEM ARCHITECTURE OF HORRORCLOUD FOR STORAGE AND ACCESSING DATA ON A SECURE OPENSTACK PRIVATE CLOUD ENVIRONMENT USING RASPBERRY PI

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ABSTRACT

A trend towards cloud computing is going on for several years now. Along with this trend, several issues and concerns with respect to protection and security developed. This report begins by quickly clarifying the present difficulties of conventional figuring, together with the relating cloud arrangements that additionally clarify this rising pattern. Predominantly, the act of 'distributed computing' is obviously characterized and clarified, together with an assortment of client choices. One specific choice is taken a gander at top to bottom: setting up a private cloud utilizing a Raspberry Pi. This arrangement is moderate adaptation when contrasted and other well-known business cloud administrations. The Raspberry Pi is a very powerful, small computer having the dimensions of credit card which is invented with the hope of inspiring generation of learners to be creative. This computer uses ARM (Advanced RISC Machines) processor, the processor at the heart of the Raspberry Pi system is a Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC at 1.5GHz speed. OpenStack is a set of software tools for building and managing cloud computing platforms for public and private clouds. Backed by some of the biggest companies in software development and hosting, as well as thousands of individual community members, many think that OpenStack is the future of cloud computing.

INTRODUCTION

Cloud computing consists of three distinct types of computing services delivered remotely to clients via the internet. Clients typically pay a monthly or annual service fee to providers, to gain access to systems that deliver software as a service, platforms as a service and infrastructure as a service to subscribers. Clients who subscribe to cloud computing services can reap a variety of benefits, depending on their particular business needs at a given point in time.

Each OpenStack deployment embraces a wide variety of technologies, spanning Linux distributions, database systems, messaging queues, OpenStack components themselves, access control policies, logging services, security monitoring tools, and much more. While on the other hand The Raspberry Pi 4 Model B is the latest version of the low-cost Raspberry Pi computer.

The purpose behind HorrorCloud.com is to prove that the cloud storage environment can be made with minimal investment over a massive remote accessibility. The fusion of Open Stack and Raspberry Pi version 4, a never made feat before made the dream go live. The web interaction our Team has made is as ease and comfort as the top reputed Cloud Service Provider companies can come up with Internet of Things (IOT)

The current scenario of making a Private Cloud for a personal or a commercial wellbeing is mostly based on ownCloud and nextCloud or any third-party based software implementations. A typical cloud has three possible service models: Infrastructure as a Service, Platform as a Service and Software as a Service, and they must be interconnected satisfy both compatibility with all the desired services and performance requirements in a large environment data. In particular, the software to be deployed in the cloud or consumed must be compatible with the systems and the most widely used operating devices; it must be user friendly and stable. The tools in the middle ware platform and must be designed to have the best performance when receiving and storing large amounts of data. The infrastructure must also be stable, easy to maintain, and through with future implementations in mind. Last, but not least, safety is an important issue for all three service models of cloud. The on-net storage is extremely beneficial because besides providing access to different geographical regions through the internet it also provides access to multiple clients at the same time and to the same files. Before the evolution of such storage devices, enterprises a huge amount of discrete file servers typically a hundred or even had to be separately configured and maintained.

Multi-hop wireless networks can be further classified into three categories, Mobile and hoc networks (MANETs) .Wireless Mesh Networks (WMN's),Wireless Sensor Networks (WSN's).For the efficient multi-hop wireless networks design, namely: (a) network protocols and (b) network operations and management (O&M).The designs include both in a cross-layer design paradigm to ensure the notion of service quality, such as quality of service (QoS) in wireless mesh networks (WMNs) and Quality of Information (QoI) in wireless sensor networks (WSNs). The Raspberry Pi is a computer, very like the computers with which already familiar. the overall system architecture of an environmental monitoring sensor network system that we are about to develop. The system includes the raspberry pi as intermediate between a number of distributed nodes sensor and our cloud system. OpenStack lets users deploy virtual machines and other instances which handle different tasks for managing a cloud environment on the fly. It makes horizontal scaling easy, which means that tasks which benefit from running concurrently can easily serve more or less users on the fly by just spinning up more instances. Tools like Nimbits is a data processing service you can use to record and share sensor data on the cloud. It is a free, social and open source platform for the Internet of Things.

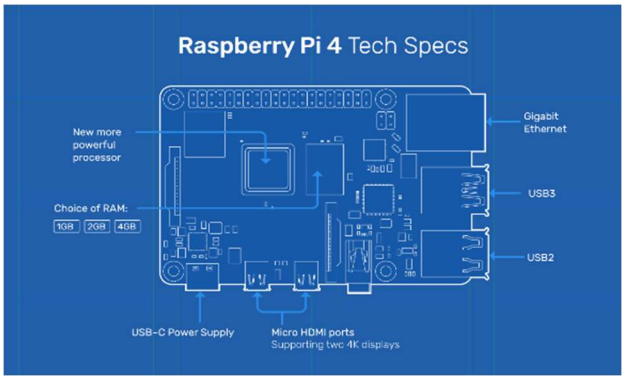
Advantages of this implementation:

Cost saving is the biggest benefit of cloud computing. It helps you to save substantial capital cost as it does not need any physical hardware investments. Also, you do not need trained personnel to maintain the hardware. The buying and managing of equipment are done by the cloud service provider.

Cloud computing offers a competitive edge over your competitors. It helps one to access the latest and applications any time without spending your time and money on installations.
Once the data is stored in a Cloud, it is easier to get the back-up and recovery of that, which is otherwise very time taking process on-premise.
Reliability is one of the biggest pluses of cloud computing. You can always get instantly updated about the changes.
The cloud computing platform helps employees who are located in different geographies to collaborate in a highly convenient and secure manner.
Cloud computing gives you the advantage of rapid deployment. So, when you decide to use the cloud, your entire system can be fully functional in very few minutes. Although, the amount of time taken depends on what kind of technologies are used in your business.

SYSTEM ARCHITECTURE

The Raspberry Pi is a low cost, **credit-card sized computer** that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.
Fig1.1



Raspberry Pi 4 Specifications

Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
1GB, 2GB or 4GB LPDDR4-3200 SDRAM (depending on model)
2.4 GHz and 5.0 GHz IEEE 802.11ac wireless, Bluetooth 5.0, BLE
Gigabit Ethernet
2 USB 3.0 ports; 2 USB 2.0 ports.
Raspberry Pi standard 40 pin GPIO header (fully backwards compatible with previous boards)
2 × micro-HDMI ports (up to 4kp60 supported)
2-lane MIPI DSI display port
2-lane MIPI CSI camera port
4-pole stereo audio and composite video port
H.265 (4kp60 decode), H264 (1080p60 decode, 1080p30 encode)
OpenGL ES 3.0 graphics

Micro-SD card slot for loading operating system and data storage
5V DC via USB-C connector (minimum 3A*)
5V DC via GPIO header (minimum 3A*)
Power over Ethernet (PoE) enabled (requires separate PoE HAT)
Operating temperature: 0 – 50 degrees C ambient
Note: A good quality 2.5A power supply can be used if downstream USB peripherals consume less than 500mA in total.

Technical Procedure

Leveraging the Cloud

Growth in cloud resources requires a consistently fast connection to keep users focused and productive. The longer the response time from an outside resource, like a hosted CRM (Customer Relationship Management) program, the more users lose focus and waste time. Since applications hosted by cloud providers have jumped a hundredfold in the last five years, companies need to upgrade their Internet connections to maintain quick response times to remain productive.

Introducing VoIP

VoIP (Voice over Internet Protocol) has become the dominant player as new technology phones replace older landline systems. There are many great reasons to switch to VoIP, but our focus here is Internet speed. Each VoIP conversation takes about 100k of bandwidth per second. If your company has only a handful of employees, this might not be a problem. But if you have 30 employees, and 20 are on the phone at one time, you have more than maxed out your upstream speeds on most business Internet plans. Without the right speed connection, call quality and data traffic will both suffer.

Streaming over cloud increases productivity while lowering cost

Since images require more bandwidth than text, you can be sure that streaming video demands plenty of Internet bandwidth. Slow Internet providers mean bad meetings, but high speed Internet service means better meetings and increased productivity.

Protecting your valuable files

Companies now realize that backing up data sets offsite simplifies business continuity and disaster recovery planning, beyond basic file backup. The amount of data backed up is constantly growing. If you're like most companies, backing up their data using a slow Internet connection creates lots of problems, even if they schedule the backup to run overnight. High-speed Internet connections make full backups possible, protecting your critical data and ensuring your business can continue even if you suffer a data loss due to equipment failure, disaster, or theft.

The TP link dual band router used for ethernet connection to Raspberry Pi is shown in the Figure a-1.

Fig1.2

Rapid Storage isolation

Cloud storage is a term that refers to online space that you can use to store your data. As well as keeping a backup of your files on physical storage devices such as external hard drives or USB flash drives, cloud storage provides a secure way to remotely store your important data. Online storage solutions are usually provided using a large network of virtual servers that come with tools for managing files and organizing your virtual storage space.

Storage isolation procedure

The isolation of Storage includes the flashing of Operating System into the SD card in a bootable format for the Raspberry Pi 4.

This procedure includes following steps using Raspberry Pi imager application:

Turn on the Raspberry Pi imager application and select Operating System as shown in Figure b-1.

Fig 1.3

Now select the Operating System as **Ubuntu Server 20.04** from the given list and connect the SD card reader that has the SD card as shown in the Fig 1.3

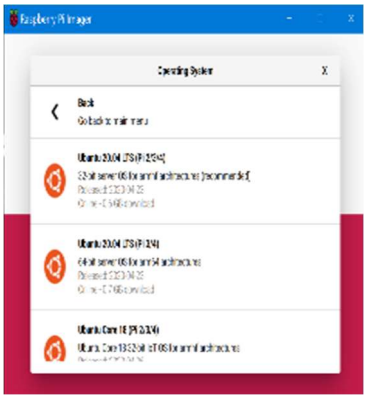
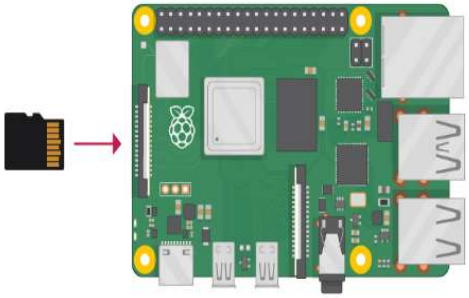


Fig 1.4

Insert the SD card into Raspberry Pi SD card slot located below the mother board as shown in the Figure 1.5.

Figure 1.5



Note: The SD card should be formatted before writing an Operating System using Raspberry Pi imager. The Ubuntu Live server 20.04 LTS iso image file can also be added in Raspberry Pi imager to get the work done.

The SD card is now isolated to boot the Pi with latest Ubuntu Server.

Ubuntu Live Server Installation

Procedure include the following set up to be done for successful installation:

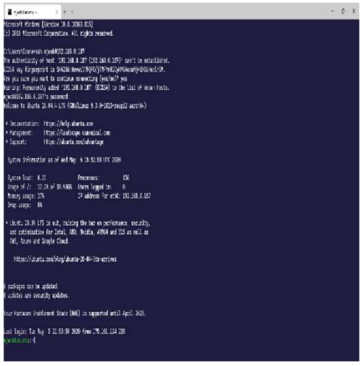


Figure 1.6

Raspberry Pi physical Heatsink & physical security

The necessary of Heatsink

The Raspberry Pi 4 may be the size of a smartphone, but it couldn't be more different, and that includes how heat is handled. The Raspberry Pi won't slow to a crawl when it gets throttled because it was designed for use in the open air or a roomy enclosure.

With the Raspberry Pi, the same software-based throttling is used but you won't hit the wall as soon and you'll recover faster because there is more airflow. As long as you're using things as intended, that is.

If you're running a custom version of the operating system or an alternative operating system, or you're pushing things to the limit by overclocking, you might see some performance loss as things aren't tuned to work together unless you do it yourself. The best way to prevent or minimize this is by using a set of heatsinks. A small investment can make a big difference, and by placing a heatsink over the chips that tend to get the hottest you'll mitigate much of the throttling performance drop. Luckily there's one specifically sold for the Raspberry Pi 4.

Surface mounted Passive Heatsink installation

A heatsink is a passive heat exchanger that transfers heat. The heatsink is typically a metallic part which can be attached to a device releasing energy in the form of heat, with the aim of dissipating that heat to a surrounding fluid in order to prevent the device overheating.

In many applications, the device is an electronic component (e.g. CPU, GPU, ASIC, FET etc.) and the surrounding fluid is air. The device transfers heat to the heatsink by conduction. The primary mechanism of heat transfers from the heatsink is convection, although radiation also has a minor influence.

Heatsinks are designed to significantly increase the contact surface area between solid and fluid, thereby increasing the opportunity for heat transfer. A typical ASIC may have a surface area in contact with air of only 1600mm^2. The surface area of a typical heatsink used to cool that device may be 10 or 20 times that value.

Refer Figure c-2 for the original HorrorCloud Pi 4 with heatsink installed.

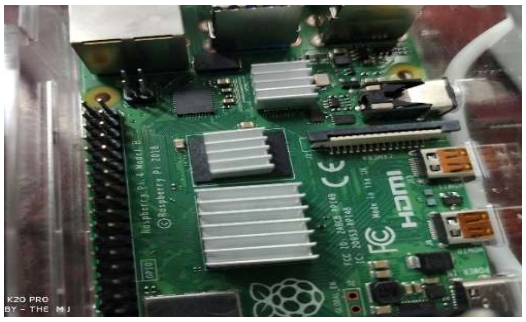


Figure 1.7

SOC start temperature: 44°C. In perhaps the most basic form of cooling available, I stuck a small 15mm x 15mm heat sink on the board's main SOC. The results were about what you would expect: things improved, but not dramatically which demands an active cooling

system implementation. Temperatures noted after Heatsink on idle turned on Pi 4 in Figure 1.7.

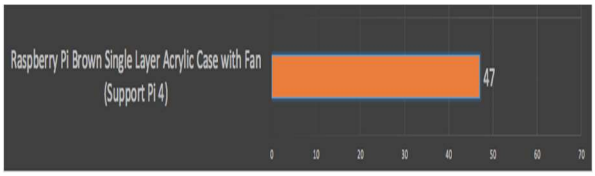


Figure 1.7

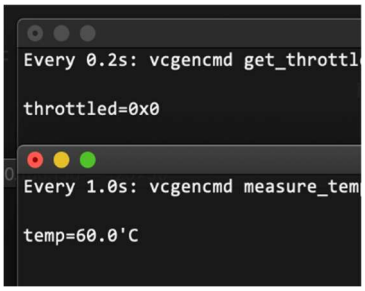
Fan based Active Heatsink installation

The Raspberry Pi Foundation's Pi 4 announcement blog post touted the Pi 4 as providing "PC-like level of performance for most users". The Foundation even offers a Raspberry Pi 4 Desktop Kit. The desktop kit includes the official Raspberry Pi 4 case, which is an enclosed plastic box with nothing in the way of ventilation.

Finally, this image was taken at idle, but if you have any activity on the USB ports, the USB controller chip on the right (that small red spot before you get to the far right of the image) lights up bright white and gets to be 60-70°C as well. A firmware update for the Pi 4 may help keep that chip a little cooler, but it will still get hot under load.

. This amount of load is enough to cause the CPU to throttle in less than 10 minutes, in my testing.

Figure 1.8



Temperatures after installing a fan

After installing the fan, booted the Pi and ran stress --cpu 4 and let it go for an hour. The entire time, the CPU's temperature stayed at or under 60°C (140°F), a full 20°C lower than the throttling point in figure 1.8.

The Pi-Fan that I am using produces 50 dB of sound at a distance of one foot (30 cm), so it's not silent, but it's actually a bit quieter than the little fans on the PoE HAT. When it's running, the fan also draws 80 mA of power, continuously, so if you're counting milliamps when supplying power to the Pi (e.g. when running off solar or battery), keep that in mind!

The Pi 4 needs a fan

A heatsink installed inside the Pi 4's official case will do precious little to avoid throttling the CPU (and likely other components, as they all get very hot). The Pi 3 B+ was the first model I used a fan with for intensive computing (e.g. running a Kubernetes cluster), but it could be used for light

computing fan less. The Pi 4 pretty much demands a fan, and I'm amazed that the Pi 4 case doesn't even include holes for better natural heat convection.

Fan is changed to turbo mode which gives twice the speed of its default oscillation using the following command:

sudo nano /usr/sbin/fancontrol (Ubuntu 20.04 LTS default path)

Code:

Interval=2

Mintemp=35

Maxtemp=50

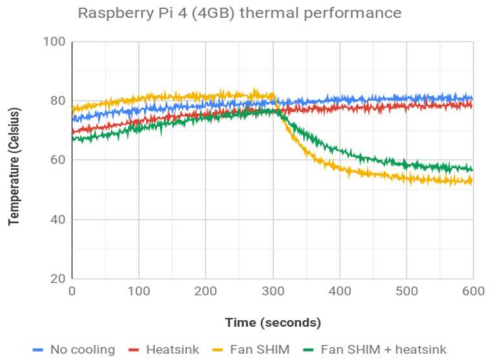
MaxPWM=255

MinPWM=0

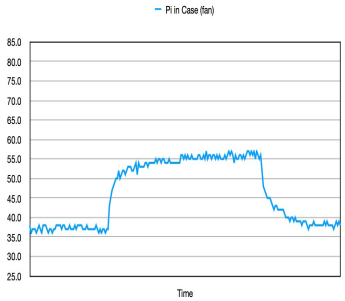
The Results

Fan gives dramatic active cooling, while the reasonably large heatsink does very little during extended high-load on the CPU.

Here's the chart of the results:



Both the "No cooling" and "Fan" tests run at around 80°C, climbing a little through the test, potentially as a result of the script running. **The average temperature through the "No cooling" test was 78.8°C.**



Once the fan kicked in during the "Fan" test, **Fan cooled the CPU by a whopping 26.7°C** (by the end of the ten-minute test) compared to the average temperature through the "No cooling" test, while **the greatest temperature difference between the tests was 30.2°C**!

Fan cooled the CPU to approximately 52°C after five minutes running, versus 80°C with no cooling at all.

Without any cooling, the CPU will reach temperatures around 80°C. Given that the Raspberry Pi's CPU throttles at just above 80°C to lower its temperature, if you're pushing the CPU hard then it's likely it will throttle.

Raspberry Pi 4 CPU overclocking

Boosting of processor ARM (Advanced RISC Machines) cortex A72 can be done up to 2.1Ghz and we succeeded in doing.

The commands shown in terminal of figure e-1 is the code written for boosting the frequency. Open the configure file using command steps as follows:

sudo nano /boot/config.txt

The file is saved with CTRL+O & exited from nano editor by CTRL+X

Command cpufreq-info –c 0 is used to check the processor speed.

Post entering the source code for the processor. Reboot the system using sudo reboot.

Here the “Hardware limit” shows in the figure 1.9 default speeds of processor inclines from “600Mhz to 1.50Ghz”.

The overclocking results

The graph below depicts the incline in CPU speeds Raspberry Pi 4 from the base 1.5Ghz to 2Ghz and additional 0.15Ghz boost from the swap.

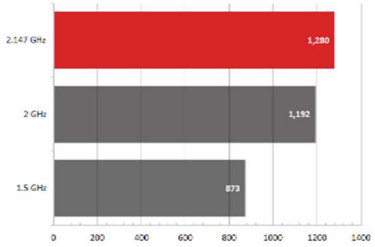


Figure 1.9

Account information of HorrorCloud.com with admin as a First name for our support mail address to reach out 24x7. Refer 1.9 for username and other details.

Testing multiple user access loads on Server

It is important to know the maximum load to be equipped on the Web Server that eventually leads to piling up of memory to zero.

Raspberry Pi 4 can only have a maximum RAM of 4GB, so we have tested different models of cluster loads on the server which include:

10 parallel simultaneous login requests for Open Stack, 5 web page visitors. This resulted in 65% RAM occupancy as shown in the figure 1.11.

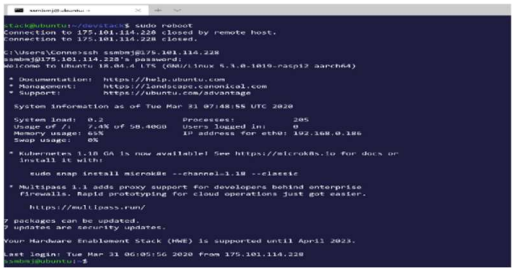


Figure 1.11

5 parallel simultaneous Open Stack login requests and 10 web page visitors. This resulted in 58% RAM occupancy as shown in the figure 1.12.

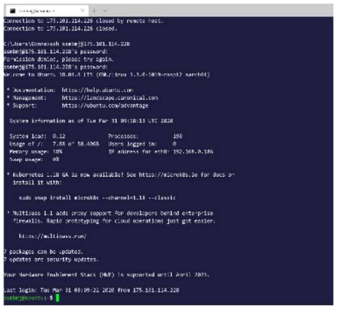


Figure 1.12

3 parallel simultaneous Open Stack login requests and 10 web page visitors. This resulted in 29% RAM occupancy as shown in the figure 1.13. Which gives room for all the operations to perform simultaneously best in their role. This is the most recommended level of user entries into the server. This also helps the 3 Open Stack users to utilize the file accessing up to 1GB/user.

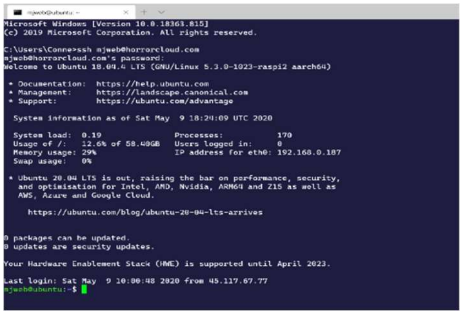


Figure 1.13

Test Cases with Result

Operating System errors

For test cases we have tried implementing the Ubuntu 19.10 implementation which led to several errors ranging from fatal to negotiable.

Fatal errors of Ubuntu Server 19.10

This error made the stack quitting from installation and is caused due to sudo permissions falsified in web server. Refer Figure 1.14.

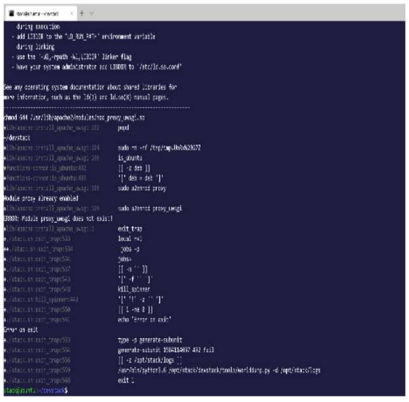


Figure 1.14

Ubuntu server 18.04 LTS results in Keystone error. This can be fixed by manually adding the domain path in the web server configuration of Keystone. Refer figure 1.15 for error and refer 1.16 for the successful installation upon fixing the error.

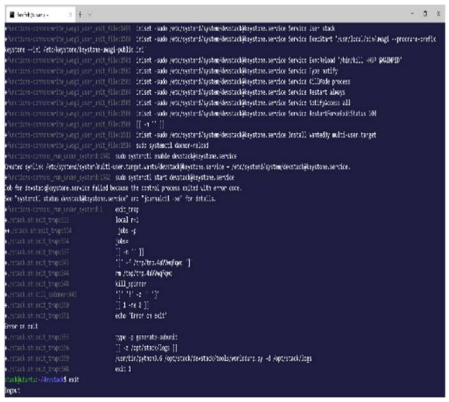


Figure 1.1-5

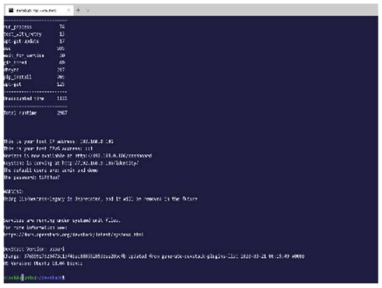


Figure 1.16

CONCLUSION

HorrorCloud.com concluded with a end note of its benefits using the Raspberry Pi 4 for implementing Open Stack.

OPEN STACK based Cloud Object File Storage

HorrorCloud.com provides the world class cloud community maker the Open Stack based cloud environment to make the users experience a enlightening usage.

I O T using RASPBERRY PI v4

IOT (Internet Of Things) is now the new tech leader in the field of IT. Raspberry Pi which is known for it's tiny architecture and also a minimal financial investment for its good and handy hardware. Now we at Horrorcloud.com implements a great blend of Raspberry Pi version 4 which is their most advanced machine till date with Open Stack in it.

FUSION OF OPENSTACK + RASPBERRY PI

HorrorCloud.com creates a FUSION of OPENSTACK & RASPBERRY PI in aim of providing the storage services over the cloud and its rapid data deployment.

LIGHT AS A FEATHER

HorrorCloud.com brings the impossible to life with most light weighted of Open Stack with depleting it to Storage in order to acquire highest performance from the Miniature host Raspberry Pi. Thanks to our developers in making this come true.

PRIVACY & SECURITY PRESERVED

The true focus of HorrorCloud.com spot lights on bringing the Private Cloud to an organization or a person to make their own cloud instead of third parties which are a contempt of doubt in the modern vulnerable era of technology. The built-in tools of Open Stack preserves the session security from Login to exit for a user. The secure protocols of our web server make it a fortress in saving the data from data with SSL certified web interaction.

PURELY PERSONAL

Data in HorrorCloud.com has been designed in a way to attain 100% user only accessible. In specific even the administration of HorrorCloud.com has no access to any of the user's data.

WE GOT IT COVERED FOR YOU

We have optimized the usage Guide for you. Check out our New User & Existing User Guidenow to help yourself in rejoicing the Horror Cloud Experience. With all these key features HorrorCloud.com is an open recommendation for developers to make their own Cloud using Open Stack for Cloud storage secure data accessing which reduces the economics of implementation by multiplied times and facilitates haleness.

OPEN STACK based Cloud Object File Storage:HorrorCloud.com provides the world class cloud community maker the Open Stack based cloud environment to make the users experience a enlightening usage. I O T using RASPBERRY PI v4:IOT (Internet Of Things) is now the new tech leader in the field of IT. Raspberry Pi which is known for it's tiny architecture and also a minimal financial investment for its good and handy hardware. Now we at Horrorcloud.com implements a great blend of Raspberry Pi version 4 which is their most advanced machine till date with Open Stack in it.

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