Raspberry pi based secured cloud data

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Abstract. In the growing digital world, Cloud Storage plays a major role. Cloud Storage is preferred for storing enormous amounts of data that our system cannot hold. But the cost of using private Cloud Storage services will be costly and our data is under the control of others. The main objective of our idea is that our data will be within ourselves rather than sending the data to unknown Cloud Storage providers and which is also cost effective. We are using the hard disks as our own Cloud Storage which will be controlled by raspberry pi and it can be accessed from anywhere. It is also more secure of using the material cloud with ourselves rather than depending on a private Cloud Storage service which may or may not be secure but here our data is only with ourselves as we will implement our suitable security measures. The design of our project is also much compact and portable as it gives a major advantage, we can carry it anywhere. The main motto of our project is to give a user personal Cloud Storage of his own in a cost-efficient manner which will be much more reliable than any other material cloud services.

1. Introduction

Nowadays, Cloud Storage plays a vital role in the digital world especially in the information technology fields where the storage of information plays an important role and also every data is important in those fields. Most of the IT fields follow the motto of “INFORMATION IS WEALTH” as their wealth depends mainly on the data/information. So, in those fields Cloud Storage plays an important role as it provides as an opportunity to store our data and work in a more secure and easily accessible platform and it is also extremely helpful if the data is lost it can be retrieved using disaster data recovery [1]. And most of the Cloud Storage services use large infrastructures which are located in several geographical locations by which all the users can be able to access the information easily in a fast way at any location. But the Cloud Storage services are more costly to obtain, and data privacy is also a major issue where there is no security of our data to be lost and being misused by someone else as we do not know where the data is being stored and whether it is properly secured or not, so it leads to lack of data security such that the service provider has the permission to access our data. Our project is to provide a private Cloud Storage for every individual user such that data privacy is being maintained and most important thing is that our data is only with ourselves and no one has the permission to access our data and we can easily backup our data if it is lost and retrieved easily where it is necessary and it is separately stored in the material cloud so it will not add up our internal storage and we can also be able to extend the storage size if needed and can store the data from any location.
Cloud storage is a model of computer storage that can store digital data in logical groups. Physical storage spans multiple servers (sometimes in multiple locations), and the physical environment is usually owned and operated by a hosting company [2]. These cloud storage providers are responsible for ensuring the availability and availability of data and the protection and functionality of the physical environment. Individuals and organizations buy or lease storage capacity from vendors to store user, organization, or application data. Managed cloud services, Web service application programming interfaces (APIs) or applications that use API, such as: Desktop cloud storage, cloud storage gateways or web-based content management systems. Joseph Carl Robnett Licklider worked on ARPANET in the 1960s, connecting people and data anytime, anywhere.

In 1983, CompuServe offered its purchaser customers a small quantity of disk area that would be used to save any documents they selected to upload. In 1994, AT&T released Personal Link Services, an on-line platform for private and enterprise verbal exchange and entrepreneurship. The garage changed into one of the first to be all web-primarily based totally, and referenced their classified ads as, "you may consider our digital assembly location because of the cloud"[3]. Amazon Web Services delivered their cloud garage provider AWS S3 in 2006, and has won sizable reputation and adoption because the garage provider has famous offerings together with SmugMug, Dropbox, and Pinterest. In 2005, Box introduced a web document sharing and private cloud content material control provider for businesses. Cloud garage is primarily based totally on enormously virtualized infrastructure and is like broader cloud computing in phrases of on hand interfaces, near-instant elasticity and scalability, multi-tenancy, and metered resources. Cloud garage offerings may be applied from an off-premises provider (Amazon S3) or deployed on-premises (ViON Capacity Services). Cloud garage normally refers to a hosted item garage provider, however the time period has broadened to encompass different styles of data garage which can be now to be had as a provider, like block garage. Object garage offerings like Amazon S3, Oracle Cloud Storage and Microsoft Azure Storage, item garage software program like Openstack Swift, item garage structures like EMC Atmos, EMC ECS and Hitachi Content Platform, and dispensed garage research tasks like OceanStore and VISION Cloud are all examples of garage that can be hosted and deployed with cloud garage characteristics.

Cloud garage is:

1. Made up of many dispensed resources, however nevertheless acts as one, both in a federated or cooperative garage cloud architecture.
2. Highly fault tolerant via redundancy and distribution of Data.
3. Highly long lasting via the introduction of versioned copies.
4. Typically subsequently regular in regards to records replicas.

Companies require higher salaries for the garages they use, with an average use of one month. This no longer means that cloud garages are cheaper, but require labor costs in the form of capital costs. Using cloud garages can reduce energy consumption by as much as 70%, which makes it an inexperienced company. Companies can choose between internal and external cloud garage options. Depending on the applicable selection criteria, attributes or a combination of the two options can increase the potential financial savings in initial direct costs. For example, continuity of operations (COOP), disaster recovery (DR), security (PII, HIPAA, SARBOX, IA/CND) and laws, regulations and guidelines for storing statistical data. By relying on applications, you can eliminate other technologies, intent, and the value of usability and security. The task of renewing the warehouse, including the purchase of additional space in the garage, is the responsibility of the transportation company [4]. Cloud Garage provides customers with instant access to various resources and programs hosted on another company's infrastructure through the Internet operator interface. Cloud Garage can be used to copy digital device snapshots from the cloud to the local, or import digital photo devices from the local to the cloud photo library. In addition, Cloud Garage can be used to transfer digital device snapshots between consumer accounts or between information centers. Cloud Garage can be used as an emergency backup because there are usually two to three unique backup servers in unique locations around the world. Using the WebDAV protocol, a cloudy garage can be regarded as an environment. It can be used as an important report server for multi-site teams [5].

Outsourcing records to the garage will increase the assault floor location. When records have been disbursed it’s miles saved at greater places growing the chance of unauthorized bodily get right of entry to the records. For example, in cloud primarily based on total architecture, records are replicated and moved often so the
chance of unauthorized records recovery will increase dramatically. Such as withinside the case of disposal of antique equipment, reuse of drives, reallocation of garage space. The way that records are replicated depends on the provider degree a consumer chooses and at the provider provided. When encryption is in vicinity it is able to ensure confidentiality. Crypto-shredding may be used whilst casting off records (on a disk). The quantity of human beings with right of entry to the records who can be compromised (e.g., bribed, or coerced) will increase dramatically. A unmarried organization may have a small group of administrators, community engineers, and technicians, however a cloud garage organization may have many clients and hundreds of servers, consequently a far large group of technical team of workers with bodily and digital get right of entry to to nearly all the records on the whole facility or possibly the whole organization [6]. Encryption keys which are stored via way of means of the provider user, as antagonistic to the provider issuer, restrict the get right of entry to to records via way of means of provider issuer employees. As for sharing more than one records withinside the cloud with more than one customers, a huge quantity of keys needs to be disbursed to customers through stable channels for decryption, additionally it needs to be securely saved and controlled via way of means of the customers of their devices. Storing those keys calls for an alternatively highly-priced stable garage. To conquer that, key-aggregate cryptosystems may be used. It will increase the quantity of networks over which the records travel. Instead of only a nearby location community (LAN) or garage location community (SAN), records saved on a cloud calls for a WAN (extensive location community) to attach them both. By sharing garage and networks with many different customers/clients it's miles viable for different clients to get right of entry to your records. Sometimes due to erroneous actions, defective equipment, a computer virus and occasionally due to crook intent. This change applies to all forms of garage and now no longer the best cloud garage. The chance of having records examined all through transmission may be mitigated thru encryption technology. Encryption in transit protects records as it's miles being transmitted to and from the cloud provider. Encryption at relaxation protects records that are saved on the provider issuer. Encrypting records in an on-premises cloud provider on-ramp device can offer both styles of encryption protection.

Enterprises are not permanent, and the services and products they provide may change. Moving your data warehouse to another company requires careful study, and there is nothing special. When the company ceases to exist or the situation changes, the deadlocked contract may become unusable.

- Bankrupt.
- Expand and change your focus.
- Purchased by other larger companies.

Purchased by a company headquartered in or relocated to a certain country. The company refuses to comply with export restrictions and therefore needs to relocate. Experience an irreversible disaster.

When sensitive data is stored with a cloud storage provider, the security of the stored data and the data in transit may become an issue. Users who have special requirements for recording, such as B. Government agencies that require the retention of electronic records by law may find it difficult to use cloud computing. For example, the US Department of Defense has contracted with the Defense Information Systems Agency (DISA) to maintain a list of records management products that meet all record retention, personal data (PII) and information assurance (IA) requirements. It is a rich resource for hackers and national security agencies. Because the cloud contains data from many different users and organizations, hackers see it as a very valuable target. File sharing For example, the Codex Cloud e-book storage site has been subject to lawsuits from every intelligence expert who uploaded and published, as well as the Groove Shark and YouTube site owners who compared it. When documents are stored domestically (especially internationally), the legal issue of legal compliance is an issue.

Nowadays, Cloud Storage plays a vital role in the digital world especially in the information technology fields where the storage of information plays an important role and also every data is important in those fields. Most of the IT fields follow the motto of “INFORMATION IS WEALTH” as their wealth depends mainly on the data/information. So, in those fields cloud storage plays an important role as it provides an opportunity to store our data and work in a more secure and easily accessible platform and it is also very helpful if the data is lost it can be retrieved using disaster data recovery. And most of the cloud storage services use large infrastructures which are located in several geographical locations by which all the users are able to access the information easily in a fast way at any location. But the cloud storage services are
more costly to obtain and data privacy is also a major issue where there is no assurance of our data to be lost and being misused by someone else as we do not know where the data is being stored and whether it is properly secured or not so it leads to lack of data security such that the service provider has the permission to access our data.

Our project is to provide a private cloud storage for every individual user such that data privacy is being maintained and most important thing is that our data is only with ourselves and no one has the permission to access our data and we can easily backup our data if it is lost and retrieved easily where it is necessary and it is separately stored in the cloud so it will not add up our internal storage and we can also be able to extend the storage size if needed and can store the data from any location.

2. Literature survey

Blockchain-based fair payment smart contract for public cloud storage auditing - Hao Wang, Hong Qin, Minghao Zhao, Xiaochao Wei, Willy Susilo, Hua Shen, 2020

Inference: Cloud storage plays an important role in today's cloud ecosystem. More and more customers tend to transfer their data to the cloud. Despite its many advantages, integrity has always been a major concern. Monitoring methods are usually used to ensure the integrity of cloud solutions. However, traditional examination systems require an external inspector (TPA), which is not always the case in the real world. The above scenario also assumes that your payment is limited.

The customer must pay for the service in advance. In this article, we want to solve the above shortcomings by using blockchain instead of TPA and developing a blockchain-based smart payment contract to pay for public cloud storage audits fairly. Our system, data owner and cloud service provider (CSP) will sign a blockchain-based smart contract. The contract ensures that the CSP must provide evidence of data ownership on a regular basis. CSP is only paid after verification. Otherwise, you will not be rewarded, but you will have to pay a fine. In order to reduce the number of interactions during contract execution, we introduced the concept of non-interactive public display of data ownership, and developed a blockchain-based smart contract for public review. Cloud storage based on this basic element.

Secure and economical multi-cloud storage policy with NSGA-II-C, lie Yang, Haibin Zhu, Tieqiao Liu, 2019

Inference: Multi-cloud computing is an attractive technology for a variety of reasons, including the security of user data. This paper proposes a solution to the problem of multi-cloud storage (MCS), which is to allocate part of the data among different cloud service providers on the basis of multi-purpose optimization with high security and performance and minimum storage cost. The undeveloped type II genetic algorithm is solved using a special combination method (NSGA-II-C). Compared with MOEA/D and SPEA2, it has better performance in terms of distance and generation diversity when solving the problems raised on the basis of statistical analysis based on experimental results. This method is compared with similar research MCS and storage in a single cloud. The results show that the final best solution is superior to similar studies in terms of safety, cost and performance. It also analyzes the relationship between the Pareto frontier targets in detail.

An integrity verification scheme of cloud storage for internet-of-things mobile terminal devices, Xiuqing Lu, Zhenkuan Pan, Hequn Xian, 2019

Inference: Since mobile cloud computing has many advantages, such as mass storage, low cost, and scalability, most data owners store their data on cloud servers to share with other users. However, the data shared on remote servers in the cloud is not under the control of the data owner. It exposes you to many security issues, such as data integrity. So far, more and more test programs have been proposed to verify the integrity of the data. However, most of them store blocks in clear text and filter the confidentiality of the data. The data owner is responsible for creating block tags, which will undoubtedly increase the computational burden of the data owner. In this document, we first propose a safe and lightweight health check solution for mobile Internet of Things (IoT) devices. A data exchange method that allows data owners to exchange data in the cloud with authorized users. Finally, we redesigned the Merkle hash tree, which can keep the block node information up-to-date and improve security when checking data integrity. Cloud data exchange makes it easy for data owners to operate.
Secure distributed adaptive bin packing algorithm for cloud storage Irfan Mohiuddin, Ahmad Almogren, Mohammed Al Qurishi, Mohammad Mehedi Hassan, Giancarlo Fortino, Iehab Al Rassan 2018

**Inference:** Cloud computing provides highly scalable and flexible computing and storage resources through a pay-as-you-go strategy. Cloud computing and storage services are becoming more and more popular, and many companies are now moving their data from internal data centers to cloud storage providers. However, the ever-growing user base and storage space for remote data management will bring problems such as low resource efficiency and internal threats to static data in cloud storage. Consolidating virtual machines to minimize the number of active servers is a promising solution to save energy but requires effective resource management strategies. In addition, encryption strategies and external auditors to maintain data integrity are still under development, and idle mode is still a problem for users. In this document, we have designed a distributed storage allocation architecture to use storage resources fairly, and we have also developed an end-to-end integrated architecture, which is a powerful security framework for data stored in the cloud. Eliminate insider threats.

Preventing Pollution Attacks in Cloud Storages, Aswin Viswas V, Philip Samuel, 2018

**Inference:** Cloud capacity could be a cloud-computing show in which information is put away on remote servers gotten to from the web. It has altogether changed the way clients and directors oversee and get to their information. Utilizing farther stockpiles to store information has numerous points of interest in terms of accessibility and operational costs, but the security of such information is still one of the major concerns for the clients. Contamination assault, where an enemy alters a few of the put away information is one of the numerous strong dangers that influence the cloud information. In this paper, we appear how sad contamination assault can be in coding based square level cloud stockpiles, and how our calculation utilizing LRC, a form of Raptor codes, can recognize an assault indeed some time recently interpreting all of the gotten packets. Considering the other existing Cloud Capacity administrations, all the administrations store their information in their favored area not the user preferred area and the information security isn’t accurately guaranteed such that the client does not know where.

3. **Methodology**

In the proposed system, the hard disk is used for the Cloud Storage which is connected to the Raspberry pi with Open media vault operating system installed in it. The open media vault is configured and various features have been enabled. With the help of an open media vault, Network Attached Storage (NAS) has been created, which can be accessed by the device which is connected within the network. Some drivers such as Apache 2, MySQL, PHP are also installed which are used for creating a new web page for the access of the Cloud Storage. Through the concept of port forwarding in the routers the website which was created can be accessed by the device outside the network. By implementing this, we can provide a secure and mobile Cloud Storage. The extension of storage is also possible in a much cost-effective way (in figure 1).

![Figure 1. Block diagram](image-url)
The Raspberry pi will act as a central processor and controls all the activities for the Cloud Storage. The power supply is given to the Raspberry pi using micro USB which is connected to the power adapter [5V-2A]. The hard disks were connected to Raspberry pi using sata to usb cable. At the initial bootup of the open media vault (OMV) operating system, the raspberry pi should be connected to the internet and hence ethernet is used to provide the internet access to the Raspberry pi. The Open media vault is configured and enables the SSH communication. The putty is now accessed through the SSH communication and the necessary drivers and the software are installed.

From this above block diagram we can see that the block diagram has only precise components and also compact and portable. Raspberry pi is used as a central processor. In this project raspberry pi 3b model is used. We can also change the specification of the processor such that if we are using this processor for the hospital or huge organisations we can use higher level processor and if we use processor for schools or small level organisations we can use lower level processor as just the efficiency of the processor varies. The normal power usage of the power adapter is around 5V/2A but if we use more storage space by adding three or more harddisks this power is not sufficient to run the cloud so the power range varies a little amount of 5V/3A in order to run the cloud in a more efficient manner. Here in our project we are using two internal harddisks of around 1TB and 100 GB which will be sufficient to run using 5V/2A and if we need to increase the storage it is possible to add additional internal harddisk just the power range varies to 5V/3A but it can also be possible in such a way that if we use only one internal harddisk of higher storage it will be more compact and more efficient to run using 5V/2A and it is a life time investment and we can easily add or remove the additional storage at the user convenient. We have connected the ethernet cable to the raspberry pi because the cloud storage will only be active only if we supply endless amount of fast internet though the raspberry pi has inbuilt wifi it is not that much sufficient to provide fast internet so we have connected the raspberry pi to the ethernet cable for much more efficiency. Next we can see about port forwarding concept. Here port forwarding concept is either software or hardware. We can also use without the router enabling port forwarding concept but we can access the device only within the network but in order to access the device outside the network the port forwarding concept in the router should be enabled and we can be able to access the cloud anywhere across the world.

Next the webpage is being created and it is created to make the interface more user friendly and the raspberry pi is configured by using the open media vault operating system and then these features are being enabled. Creating a good webpage keeps the user to easily connect to the interface so it is more important to create a good web page. The webpage has the normal user login with the password authentication and incase if we forgot our password also it can be easily recovered using other verification or authentication schemes. An user can act as a host user and provide access to various users who are able to access the webpage and the host user only has the ability to revoke the access from the users who he thinks to take back the access and the host user can allocate memory space for the individual users who are able to access their data in their separate storage space. It makes the interface more eco-friendly and more ease to access (figure 2).

Figure 2. Raspberry pi 3b

A new web page for Cloud Storage is created by using Apache 2, MySQL, MariaDB and PH. Now, this web page can be used to access Cloud Storage using the device within the network. Port forwarding is used to...
make the web page accessible to all the users outside the network. The domain name is created by duckdns. Now by typing this webpage name in the browser the user can get access to the Cloud Storage and enjoy a secure and unlimited storage.

4. Experimental results and analysis

In the proposed system, the hard disk is used for the cloud storage which is connected to the Raspberry pi with Open media vault operating system installed in it. The open media vault is configured, and various features have been enabled. With the help of an open media vault, Network Attached Storage (NAS) has been created, which can be accessed by the device which is connected within the network. Some drivers such as Apache 2, MySQL, PHP are also installed which are used for creating a new web page for the access of the cloud storage. Through the concept of port forwarding in the routers the website which was created can be accessed by the device outside the network.

The outer case for the cloud storage is designed using the Creality slicer software. The outer case is designed in such a way that it accommodates two hard disks and raspberry pi. This outer case makes the cloud storage to be in more compact form and also portable.

The PLA material is used for designing the outer case. After designing the outer case the g code file is copied into the SD card and inserted into the ender 3 printer device. The appropriate file is selected, and the printing process starts, and it took approximately 10 hours for the outer case to be completed. The outer case design in the Creality slicer software image is shown below figure 3.

![Figure 3: 3d printing of outer case](image)

The cloud storage is created using the raspberry pi with the open media vault (operating system) installed in it. The open media vault is specially designed for the network attached storage (NAS). And the user interface of the open media vault is very simple and easy to carry out. The NAS is created by configuring the OMV with the provided hard disks.

After creating the NAS, the storage should be converted into the cloud storage. This is done by using the software and languages such as apache, PHP, MySQL etc. The website is created for the user interface and linked to the NAS. The cloud storage is now ready but can only be accessed within the network. To make it accessible outside the network the port forwarding in the router is done. In the login page enter the username and the password that was created login into the cloud account. It can have more no of users and the storage can also be limited depending upon the required of the admin (in figure 4).
The above image is the user account after login from this we can see that we have all the documents and photos being stored here. There are also some inbuilt folders such as next cloud, videos and next cloud community and next cloud manual which are existing already while creating the web page using php and mysql. We can also add our personal files such as movies, games and any other folders at ease. The webpage already has many inbuilt features in it such that if we want to open any image or video it does not require any additional viewer software to open it the webpage already contains inbuilt software to view it which makes the interface much more convenient. Our interface has also other additional features such that we can easily download a huge amount of files at higher speed rate and also has the feature to share the files with low consumption of power and time. It also tells us the time of the file which is being modified so that it is much easier to locate the file when it is uploaded. Now the cloud storage is ready for the use with full security and ease to access (in figure 5).

Here, in the comparative analysis we characterise different parameters and compare it with an already existing cloud and our developed cloud. And the analysis has been represented in the form of percent for better understanding. The blue colour represents the existing cloud, and the orange colour represents our developed cloud. First, we compare the cost of both, we analyse that our cloud is half the rate of the existing cloud and it is much cost efficient, and the most important fact is that our cloud is a lifetime investment, but the existing cloud will be of only limited space and the price can also be gradually increase after few periods of time. And the next one is the storage space, considering the storage space of the existing cloud it is limited to an extend and if we to add more storage the cost also gradually increases but, in our cloud, we can easily add up storage just by add additional internal hard disk and limit the storage according to our use and it is a
one time investment. And next if we consider the power management our cloud consumes a very low amount as of 5V/2A unlike the existing cloud consumes a very large amount of power. Then comparing the size of the cloud our developed cloud is very much compact then the existing cloud as our cloud will store only our data, but the existing cloud will store very large amount of data from various users, so it needs several acres of server farm to maintain it as it is comparatively very large and difficult to maintain. Next we compare the security issues, the major drawback of the existing cloud is the security issues and the integrity issues, we cannot rely cent percent that our data is secure and only we can access our data because the data can also be breached without our knowledge someone can steal our data or modify our data or even the cloud storage service provider will also have the access our data so the integrity of our data becomes the major issue. In order to solve that our main objective of our project is to create an individual cloud storage such that the data will be within ourselves and no one has the permission to access the data other than us only we can provide access or modify the data and there is no security breach happening such that the data will be within us. And the last one is the ease to access such that our cloud is really easy to access and with a simple design and it is completely portable and much reliable, but the existing cloud infrastructure is very large with more complex design and any problem occurs it becomes a major issue, and it is very difficult to maintain. By the comparative analysis we ensure that our own cloud is far much better than the existing cloud.

Future work
This cloud storage can be further enhanced by accessing it and making it on or off from any location. This can be done by creating an app on the mobile and connecting it to the Arduino which in turn makes the cloud storage ON by using the relay. These further reduce the power consumption and increase the security.

Conclusion
According to the survey, the current generation is moving towards the digital world where data security becomes the major issue. Hence this Cloud Storage provides a security of the data. The users can store the data in a much more convenient way. Then the fact is very much preserved that our data is only with ourselves and is not necessary to depend on any other private material cloud services where data privacy will be a major issue and that issue has been overcome by this work.

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