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Security Issues On Cloud Computing

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***Abstract*— Cloud computing is basically up gradation to grid computing. It is very amazing technology because we can store data remotely on the cloud server it means it is location independent and service avail on rental basis also. According to NIST [1] Cloud computing is a model for convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. Rather than lots of features it is also having security issues. Sometimes the data kept on cloud can be misused or stolen. So in this review paper we basically discuss about the issues develops due to security and the solution given by different researchers. Security is one of the most vis-à-vis issue of Information technology Issue. To keep structural or user data is primary concern. If organization's data is not safe on cloud then there is no use of ever-changing from old technology to cloud technology. There are lot of Non-Profit Organization (NPO) which are helping and creating responsiveness about security issues of cloud computing. One of such organization is CSA (Cloud Security Alliance) that issue a report in each year regarding most popular security issues in cloud computing. CSA reports they identified nine infamous security threats to cloud which can harm user's individual data without knowing them. Here we discuss these types of issues in this paper.**

Keywords— Cloud Computing, Security, Encryption, Decryption

I. INTRODUCTION

1.1 Review of some cloud services:

Let's review some cloud services to comprehend cloud computing, its welfares, security issues and challenges. There are lot of cloud service provider in market, each have some unique and some similar features, choosing cloud service provider is also serious decision.

Popular cloud services available in market:

1. Windows Azure
2. Google Apps
3. Microsoft Office 365
4. Locus Technology
5. Zoho Office Studio

1.1.1 Window Azure

Microsoft Azure is a cloud computing platform and infrastructure created by Microsoft for building, deploying, and managing applications and services through a global network of Microsoft-managed data centres.[2]

It provides both PaaS and IaaS services and supports many different programming languages, tools and structures, including both Microsoft-specific and third-party software and systems.

Azure was announced in October 2008 and released on 1 February 2010 as **Windows Azure**, before being renamed to Microsoft Azure on 25 March 2014. Along with Amazon Web Services, Azure is considered a leader in the IaaS field.[3]

1.1.2 Google Apps

Google Apps is one of the best instances of freely available cloud services. Here we can get a lot of web based applications that have functions alike to Office Suites, Google groups, Google calendar, Google docs and Gmail. Google Marketplace is also product of Google apps in which handler can create their application using Google application. It is available free of charge with lot of limitation and paid services of Google are also available.

Google App Engine:

Google app engine is like platform as a service which provides platform for users to create their application and run on Google infrastructure.[4]

Some features of Google app engine are:

- Supports all kind of web service
- Provide tools to develop application
- Easy application development
- Almost no maintenance
- Easy scalability in Google app engine.

Even users can have domain name of their choice on Google server. It supports various programming language like PHP, JAVA, PYTHON.[5]

1.1.3 Microsoft office 365

Office 365 is the brand name used by Microsoft for a group of software plus services a subscription that provides throughput software and related services to its subscribers. For consumers, the service allows the use of Microsoft Office apps on Windows and OS X, affords storage space on Microsoft's cloud storage service OneDrive, and grants 60 Skype minutes per month. For professional and enterprise users, Office 365 offers plans including e-mail and social networking amenities through hosted versions of Exchange Server, Skype for Business Server, SharePoint and Office Online, integration with Yammer, as well as admittance to the Office software.

After a beta test that instigated in October 2010, Office 365 was launched on June 28, 2011, as a successor to Microsoft Business Productivity Online Suite (MSBPOS), originally aimed at commercial users. With the release of Microsoft Office 2013, Office 365 was expanded to comprise new plans aimed at different types of businesses, along with new plans aimed at general consumers inadequate to use the Office desktop software on a subscription basis—with an emphasis on the rolling release model.[6]

1.1.4 Locus Technology

In 1998, while employed with researchers at the Jackson Laboratory in Bar Harbor, Maine, we discovered an urgent need for systemized data management. At the time, there was very little applicable software presented given the importance of accurately tracking vital breeding and laboratory animal data. And thus Locus Technology was inborn.

With the extensive help of researchers at JAX and other research institutes, we considered and developed **Colony**, our original data management program. Colony focused on colony management and became an substitute to paper ledgers and spreadsheets.

Since then, we have sustained to develop our software in an attempt to satisfy the necessities of facility managers and researchers in both academic and commercial organizations worldwide. After Colony came **Facility**, our combined facility management system. We also developed "PHARM," a software solution that complies with the severest regulatory requirements (such as 21 CFR Part 11), mainly for large animal management.

Our newest product, **Lab Tracks**, offers high-level security for the storing of various types of research data such as animal records, images, and laboratory samples. The conformation and customization options for this package are virtually limitless.

All of our software programs provide enlarged security, a wide range of customizable features, and a reduction of time and effort spent by contributors in the research process in key areas such as report generation and data analysis. We provide adaptable, powerful solutions to beforehand unmet animal research needs.

For fourteen years, we've developed data management for organizations oscillating from single investigators to multi-national pharmacological companies in dozens of countries. Our goal is the same as it has been since our commencement: to be stable, yet go-ahead, serving and sustained by the research community. We are small enough to be flexible, and dedicated enough to provide personal attention to our many customers. [7]

1.1.5 Zoho Web based Office Suit:

It is web based submission which provides features like word processing, database and spreadsheet etc. It is based on web word processor. It is good instance of Software as a Service (SaaS). Its services are very similar to Microsoft office at personal computer.

To use its features user just necessity to create account on it.

Advantages:

- Customizable menus
- Document format converter is available.
- Various leaflets format is supported
- Freely available services.

Disadvantages:

- No extra support.
- API design is not cool.

Zoho Writer Services Review:

- As a whole it is good compendium of business needed documents services.
- Supports virtually all the available documents format.
- API is not so cool.
- Some buttons produces confused about their use.
- Customizable button is good option.

1.2 CLOUD COMPUTING PROVIDERS

- On the market there are countless small and large cloud providers like: IBM, Google, Amazon, Drop Box, NetSuite etc. but in this paper will concentration my attention on three of the most important cloud providers that exist on the market and the applicable products offered.
- **Google Enterprise**
  Google is a search engine that is offers all kind of information that is available and useful for the users. Google is offering numerous requests to his customers, applications that are helping them to reduce the ingesting of the energy and carbon emission. Cloud computing can support an unlimited number of applications and Google Enterprise is offering some of them to their clienteles.

The services offered by Google Enterprise are accessible below:

- **Google Apps**- the service includes applications as e-mail, calendar, spreadsheets, and documents.
- **Vault service**- this service agreements solution for mail security, archiving and encryption;
- Enterprise search;
- **Earth and Maps**- this services is offering tools to visualize information and track about different places;
- **Chromebooks**- the service is used for bring the power of the web.
- Google Cloud Platform characterizes all the products of cloud computing offered by Google , that are using the same organisation as the one that Google is by means of for products presented to end-users, like: Google Search , YouTube.
- Google Cloud Platform is composed from many products, where each of it has his own boundary, command-line tool and Rest API.
- Google App Engine is a SaaS for web applications;
- Google Compute Engine is a IaaS that allows to users to enable the virtual apparatus when needed;
- Google Cloud Storage allows to users to store files online;

- Google Cloud Data Store offers storage for non-relational data that has a REST API;
- Google Cloud SQL is a MySQL database that exists on Google Cloud arrangement;
- Google Big Query is used to analyse data and is using SQL-like queries for dealing with bog data in seconds;
- Google Cloud Endpoints it is used for emerging services within App Engine that can be access from IOS, Android and JavaScript clients;
- Google Cloud DNS represents a DNS service that can be found in the infrastructure of Google Cloud.[8]

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- Google Cloud Endpoints it is used for developing services within App Engine that can be admittance from IOS, Android and JavaScript clients;
- Google Cloud DNS represents a DNS service that can be found in the infrastructure of Google Cloud.[9]
- Google Apps has more than one service: Google groups, Picassa, Notebook, and Gmail, iGoogle, Docs, Reader, Page creator and Blogger. All this suggestions are intended for helping the procurer, to make his/her job easier. Because companies start using Google Apps, the resources are shared in Google Data centres. Because of this the corporation is using fewer servers, and this means that the energy and pollution is squat.

Amazon

Amazon is an internet-based corporation that has the headquarter in Seattle , U.S.A. when they first look as if on the market they were vending books, but now they are selling all kind of products from DVD's, Cd's to software, video games, furniture, etc. They are also contribution to the customer their own microelectronic products like: Amazon Kindle e-reader, fire phone, Kindle Fire tablets, Fire TV and it is one of the main breadwinners of cloud computing.

Amazon Web Services (AWS) is offering IT resources through the internet at squat costs and they have pay-as-you-go pricing. Because they are a big company that is submission different services they can offer goods at low prices, and they are giving entree to the costumer to platforms without any extra costs.[10]

Amazon Web Services is offering a large set of global compute, storage, database, analytics, application and deployment facilities that are helping the organizations to increase their development, it is serving to lower the IT costs and scale applications. All the services presented are having the trust of big enterprises, since they are using them in web and mobile applications, data meting out and warehousing, archive.

- **Websites:**
  AWS is offering cloud website hosting solutions that are helping the administrations to deliver their websites and web applications at low cost. The benefits of using this service is that the purchaser can use the website server and the software that he wants; they have to pay only for what they are using; they are allowing the customer to generate his website according to his demands; and he has access to global resources directly.
- **Backup and recovery**
  AWS is offering the possibility of stowage information in the cloud, so that the customer can avoid the managing of the hardware. This can be additional to the organisation that already exists and the security and toughness of the data will increase in the same time. The benefits of using this service are: data is stored in manifold copies; the customer has to pay only for what he is using; data is encrypted for security reasons and there can be use the substructure that already exists.
- **Archiving**
  Storage is offered at low prices. The price for one GB is of 0.01$ per month; there are numerous copies of the data; data is kept save because it is encrypted and it is integrating with the archiving software that previously exists.
- **Disaster recovery:**
  AWS has different tools that it is helping the customer to recover data from critical IT scheme that is keeping data save for when the customer doesn't need it and it is existing when he does. The benefits of this amenity are: data is secured offsite; multiple copies are done mechanically; the files are back-up and restore.
- **Development and test:**
  It is created for customers that need to progress applications and also to test them. The customer that is using this service will have instant access to new resources, the machine used can be configured for the customer's needs and the customer is paying only what he is using.[11]

IBM

The International Business Machines Corporation (IBM) is one of the major hardware and software manufacture in the world, which is offering infrastructure, hosting and referring in area like mainframe computers and nanotechnology. The headquarter of the company is located in New York , U.S.A.

IBM cloud computing characterizes various services that are provided by the IT Corporation IBM. All this products can be found under the name of IBM Smart Cloud, which has: IaaS, SaaS, PaaS provided finished private, public and hybrid cloud delivery models. Which are standing under the names: SmarCloud Foundation, SmartCloud Facilities and SmartCloud Solutions.

SmartCloud Foundation has infrastructure, hardware, management, integration and sanctuary that act as a bases for private and hybrid cloud. SmartCloud Services is designed from the foundational components, PaaS, IaaS and back-up services. SmartCloud Solution runs on the dais and infrastructure of the cloud and is comprehended from various collaborations, analytics and marketing SaaS

applications. IBM is also offering services to patrons that do not use SmartCloud Platform. The IBM SmartCloud Platform is composed only from Hardware, software, services and practices. [12]

Companies are taking to use cloud so they can supply business with responsive IT facilities and cloud is also used to modernize the way the employees are working. IBM is offering a various quantity of cloud services that are helping the customer to use his resources at maximum.

SaaS business application is providing to those that want to develop their business, regarding the field that they are from: market, garage sale, it.

Silver pop engage is a cloud based publicizing automation platform that is providing to the customer email marketing and organisation solutions. This application is collecting all the information from a specific customer and it is using this information to provide in real time communications special created for them.

- Easy file sharing for business- because IBM is using his applications to pleat people in such a manner that they will share their information, expertise, ideas; and this users are known as knowledge workforces. For this IBM has IBM Navigator on cloud that was industrialized by industry leaders in Enterprise Content Management (ECM) and is giving interaction authorization between acquaintance workers that are creating, supervision reusing the data that will lead them to innovation and the outcomes of the business will be positive.
- IBM Connections is used by businesses because they are providing to the companies the tools needed so they can be more agile, collaboration among them and the partners will be at maximum efficiency; employees will have the possibility to share their knowledge and ideas with others that are not in the same headquarter or company.[13]
- IaaS infrastructure services are offered for those companies that decide that they necessity choices of open cloud infrastructure for IT operations. Regarding the needs of the business IBM Cloud offered the opportunity for companies to have public, private and hybrid clouds.
- PaaS developer platform- IBM is offering applications that are now developed for helping customers to create the applications desired much faster and better. The customers do not need to modify the infrastructure that they already use.[14]

1.3 Security related work review:

One can consider cloud as RSS (remote storage system) that seems to be own appliance. By taking this approach we can apply same hazard model which already had applied on remote storage system according to Myagmar and Hasan. They described two security hazard models. One of the models categorizes the threats according to integrity, availability, confidentiality, approval. Second model is based on effect of threat on data during lifecycle.

Purpose of Hasan and Myagmar research work is to create threat model so that intimidations and vulnerability can be categorize, so that Cloud service provider can understands security issues and can solve them effortlessly.

They described malicious users in to three categories that create threats:

- **Insider:**
  These are workforces or ex-employees of cloud service providers (CSP). They are those employees who were complete knowledge of Cloud boundary and their service and complete architecture of cloud. For them it is very easy to get in and they are the persons who have unswervingly access to user's data.
- **Outsider:**
  These malicious user are not part of system, but they always looks for defenselessness in system so that they can get accessed to system.
- **Natural:**
  Some threats are not persuaded by insider or outsider, they may be induced by some misconfiguration in system for instance in few years back when Google Corporation changes some configuration of Google Doc that leads to change in sharing setting of individuals data.

1.3.1 Cloud Assets:

Hasan et.al [15] describes some assets of cloud that may be attacked by hackers.

Those assets are as follows:

- Data Integrity
- Communication channel
- Data Management Software
- Service Availability
- Virtual Image secrecy
- Storage Media
- Virtual Image Integrity
- Data consistency
- Virtual Image Consistency

1.3.2 Data Life Cycle in cloud computing

Followings are steps to cloud computing:

Stage 1: Data Transmission/Creation: In first step users creates on cloud or if on remote mechanism than transfer that data to cloud.

Stage 2: Data Receiving: Data is imprisonment by cloud before actual storage and actives are logged.

Stage 3: Work on Data: In this step meting out over data is done.

Stage 4: Data download or share: In this data is communal or download by users.

Stage 5: Data replica: for future concern and safety of data from damages data copies are created.

Stage 6: Data Deletion: If user wants than he/she can obliterate data from cloud.

In RSS model there is single storing media but in cloud there are several storage media, some are on virtual machines and some replicas of data, some are on dissimilar storage of cloud. Data retrieval and creation is based on users demand from cloud. By making some variations to existing threat model we can overcome security issues.

They create new cloud menace model. Updated model add one stage:

Stage 7: Data migration -> Data is transferred from one cloud stowage to another for scalability and availability purposes.

Using this updated model CSP can identify various areas where hackers can spell.

1.3.3 User centric model:

In this cloud is defined as two tier architecture. First is user side (tier 1) and second is server side (tier 2). In this model according to user view cloud is treated as single entity in which he/she sends data in and recover data from it. All other internal working of cloud is not known to a user. Users don't know about data immigration among different cloud nodes. By using this model CSP can tries to abstract a lot of technology from users so that they can diminish security threats.

1.4 Review Of Security Issues, Vulnerabilities And Challenges:

Transferring our data to additional organization is not secure, as there is a lot of risk from insider of company or as well as outsider of company though for this comprehensive understanding of security issues need to be understood and Cloud Service provider must resolve those issues.

- Kuyoro S. O. et.al [16] describes security challenges and issues and presents a report on investigation on these security issues. According to IDC survey they concluded that if we centralized all the disseminated data than we can provide more security attentive resources. They concluded that users can't trust on Cloud Service Provider completed, so they should keep their data on cloud in Encrypted form. From their research work they decided that cloud computing is rapidly growing technology though there security hazard is also changing time by time to keep yourself safe from security threat you must be aware about its security problems and challenges time to time and choose those cloud service provider which gadget latest safety measures from cloud security threats.
- **Mr.Tejas P.Bhatt et.al. [17]** Also describes a security model for cloud computing. In their research paper, they describe about all foremost security issues and then came up with a solution. Bestowing to their solution if we encrypt all data on cloud than we can save consumers data. As if someone breaches to consumers data than also he/she will not be able to appreciate about data. For this he developed a service on the top of and virtual machines. SaaS that encrypt each and every file saved on cloud storage on the foundation of secure key given by consumer. And every time a file is forced to open needs the secure key to decrypt the file.
- **Shucheng Yu et.al** [18] present their research that provide secure fine grained user data admittance control in cloud computing. Usually data are kept in encrypted form to provide security against entrusted cloud, but this solution provides an overhead of swapping key to share data between users. Shucheng Yu in their research paper analysis this issue and gave a solution that diminish overhead of key exchange. For accomplish this, they connotation proxy re-encryption, feature based encryption and lazy-re-encryption techniques. Along with this technique their projected model also contains features like user authentication secret key and admittance control techniques.
- **Dongyang Xu et.al [19] presents** a model for protected sharing of data in un-trusted clouds. According to his research work, users do not belief on cloud completely and simply encryption data techniques creates problem in public or shared cloud. Though they deliver attribute based encryption scheme than will be used for encryption of data in cloud. It is similar one to many encryption techniques in which data is encrypted by its owner and can be decrypted by many according to data admittance attributes. In previous work done by many researchers authorized users and digital content are given equal advantaged. But in their paper they present a new approach that produce sanctuary keys of different classes by using hierarchical cryptographic key management and attribute based encryption.
- **Rehnan [20] describes** effect of cloud technology in originalities in terms of security and cost. As in business every organization likes to have cheap resources. For them cloud technology is good option. He described various economical as well as efficiency factor of cloud which is attracting enterprises to adopt Cloud technology. In his research work he described many downsides and benefits of cloud computing that an enterprise can have if they approve cloud computing. In his research paper he decided that cloud computing is better for small industries than large industry in terms of security and cost.
- **Jan de Muijnck-Hughes[21]** describes cloud security method. When data is send to cloud its fortification is no more under control of users. His research paper describes PBE (Predicate Based Encryption) that helps to provide security on un-trusted cloud. In PBE, decryption of data is based on set of features which satisfied the certain predicate which deliver coarse grained controller over user's data. To encrypt user's data is not enough for security. Users must be known that how his/her data will be kept and used. Who can access his data and with whom his/her data can be shares must be known to users and it must be done with the authorization of users.

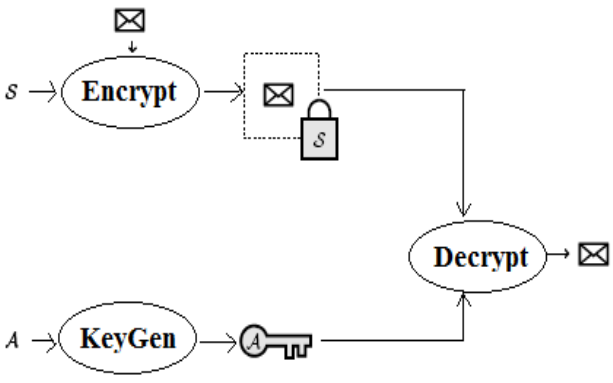

Figure 1: Predicate Based Encryption(PBE) Security Model

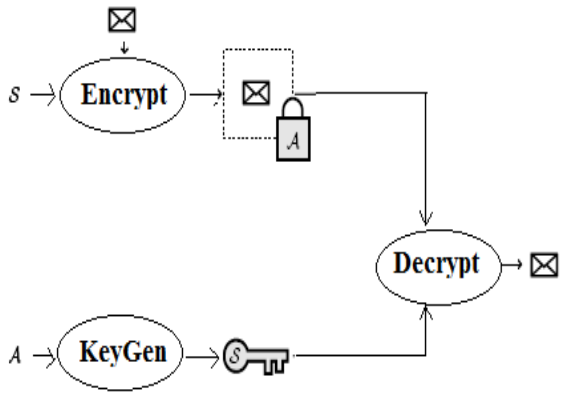

Figure 2 : Predicate Based Decryption(PBD) Security Model

- ***Wentao Liu[22]*** presented a paper on cloud security problem and approach. According to his research, he said only traditional method for as long as security to user's data is not enough for cloud computing. There is need to develop new security methods to provide cloud security. He also inferred that using both outmoded and new security methods may help to increase security on cloud. Assumption of his research is cloud is emergent technology and has excessive potential, but security plays imperative roles for its further development. According to his research security measures for cloud are needs to be updated time to time. Else new threats can make cloud service worst.
- **Yaga Reddemma et.al.[23]** In their research paper they said if data and security mechanism(encryption and decryption) by CSP than its generate problem as administrator can look at users data and may use users important data for its individual use. To solve this problem, they present a model according to which storing and security mechanism (encryption/decryption) should be done on different server. They also propose SLA between different parties involved in this mechanism.

Conclusion: Their research paper tries to carry the message that never saves encrypted data and its process and security keys together. Doing this is a great risk to your data.

Literature Reference 9
Problem discussed: Post investigation and data forensics in cloud computing.
Technique Used: Bilinear Pairing Method
Model/Tool/purposed: Yes
Rongxing et.al in his paper delivers a security model for post examination and data forensics in cloud computing. His security model includes five components: KGen, AuthAccess, Setup, AnonyAuth and ProveTrack. Due to large no of security practices in his scheme they said it is good for cloud security but there is one restraint is that it is very complex due to its mathematical model which is too complex to understand.

Literature Reference 10
Problem discussed: Security Assurance and security risk to cloud users
Technique Used: Trusted Cloud Computing Platform (TCCP)
Model/Tool/proposed: Yes
In his paper he discuss about cloud admittance and security mechanisms. Their research work and model is based on case study of small enterprise cloud. For providing security over cloud they identified the material drift between users and servers and critical points where security is needed. They said their work can be implement very easily in any kind of cloud computing and provide manipulator end to end security.

Literature Reference 11
Problem discussed: VLANs verifiable integrity and SSH tunnels and end to end service isolation through VPN.
Technique Used: Virtual Computing Laboratory (VCL) Technology, open Source.
Model/Tool/purposed: NO
In their study they discussed various matters related to cloud along with Cyber infrastructure, Virtualization and SOA (Service Oriented Architecture). They considered security, implementation and research issues in aspect and hierarchical security issues as top most regarding issue. Their study focuses on present architecture for security and concluded that present security situation is not enough for cloud security. Only Drawback of their study is that their work was not practical, it's totally theoretical.

Literature Reference 12
Problem discussed: Secure Query and forensic query correctness processing and data distribution system analysis
Technique Used: DS 2 Platform
Model/tool/purposed: Yes
In their research work they have taken data centric view of cloud security. They scholarships the security issues related to data sharing among applications hosted on clouds. They discussed various management issues in Forensic and system analysis, distributed query processing and query correction assurance. For this they provide their own model based on Distributed System. They called it Declarative Secure DS 2. Their proposed system is based on user's data security centric view.

Literature Reference 13
Problem discussed: Cloud Security attacks and security vulnerabilities
Technique Used: Transparent cloud protection system (TCPS)
Model/tool/purposed: Yes
In their research work they investigation security models at present. And they found that most of the security threats are because of cloud provision provider as sometimes they design weak API of applications or sometimes they don't take all security concerns. They used TCPS system to detect various security issues and susceptibility in various cloud service provider's systems. Their works helps CSP to identify vulnerabilities in their system and to steadfastness them.

Literature Reference 14

Problem discussed: Visibility Risk, End user belief and insider access, client side protection, server-side protection, identity management and access control

Technique Used: Theoretical Research

Model/tool/purposed: No

Their research work largely focuses on public cloud and its security measures and privacy policies. Some of the security issues measured in this paper is Insider Access, User Trust, Server Side Protection, Client Side Protection, Risk Management, Identity Organization and Access Control. Drawback of their research is that they didn't provide any practical work over their research.

Literature Reference 15

Problem discussed: Vulnerability audits of Amazon Security Graphs and Security Clusters.

Technique Used: Amazon Cloud Elastic Compute (EC2)

Model/tool/purposed: Yes

Literature Reference 16

Problem discussed: Managing Security Risks in image repository and virtual appliance images securely.

Technique Used: Image Management System that uses access control filters, scanners and framework.

Model/tool/purposed: Yes

In their research work they analysed threat from IRS (Image Repository Side). They purposed an Image management system to recognize the associated risks. Their model finds malicious stuff in step first and in step second it removes confidential material like PIN.

Literature Reference 17

Problem discussed: Privacy, Security and User concerns.

Technique Used: Privacy and Security Management tools to address user level security matters.

Model/tool/purposed: Yes

Their research work focuses on cloud security issues in term of sensible data and user's privacy policy. To deal with this issue they purposed a tool christened as privacy manager tool(PMT).

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