Online ISSN: 2581-8880

MIRJ-GTU

MULTIDISCIPLINARY INTERNATIONAL RESEARCH JOURNAL OF GUJARAT TECHNOLOGICAL UNIVERSITY

Volume 2 Issue 1, January - 2020

Gujarat Technological University
www.gtu.ac.in
ESTD - 2007

Multidisciplinary International Research Journal of Gujarat Technological University

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MISSION

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From the Desk of Editor-in-Chief

MESSAGE

I feel pride in publishing the third issue of 'Multidisciplinary International Research Journal of Gujarat Technological University'.

This issue concentrates on Engineering and Management disciplines in which articles are written in different areas such as Artificial robotic arm, 5S model implementation in industry, IP camera hacking and mitigation, Traffic analysis and relay finding, Growth management system and Markowitz model.

I hope all these articles will be useful for their range of applications and will also open up new directions for further research.

I take this opportunity to thank the GTU editorial board members & international editorial board members for their efforts in upgrading the articles in this issue.

Dr. Pankajray Patel
Director
Graduate School of Management Studies
Gujarat Technological University

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DEVELOPMENT OF ARTIFICIAL ROBOTIC ARM BASED ON NEURAL CONTROL INTERFACE

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ABSTRACT

The goal of our project is to design and develop the Artificial Robotic Arm Based on Neural Control Interface. The neural control interface (NCI) is also refers as Brain Computer Interface (BCI) or Brain-Machine Interface or Mind-Machine Interface. Basically, we are developing a robotic arm that can control by the brain signals of user. Brain Computer Interface (BCI), is a direct link to communication between brain and an external device. BCI acquires electronic signal from the brain and decode them to facilitate individuals communicating with the external world. As our project we are developing 2 degree of freedom upper limb prosthesis. For that we are using Electroencephalography (EEG) method to record, analyze and signal processing for getting an output that moves the upper limb prosthetic. In this report we are presenting the basic idea and search to get brain-waves from the brain and decode them from micro-volt signal into require form to proceed them further for implementing our ultimate goal of movement of artificial robotic arm. The system is capable of acquiring signals from brain and differentiating between two different movements of brain signals. The developed prosthesis will be capable of providing adaptive gripping on individual fingers.

Keywords: Electroencephalography, EEG, Arduino, Wave parsing, DC motors, Micro-controllers.

1 .INTRODUCTION

There are billions of neurons interlinked in human brain. Human thoughts and their emotional states influence the interactions across these neurons. Every interaction across these neurons generates an electric discharge, which can't be recorded using today's technology. Although, the activity generated by millions of concurrent electric discharges collected into waves which can recorded. The sequence of interactions between these neurons is a result of different brain states. These patterns of inter-action create wave of non-identical amplitudes and frequencies. These wave patterns can be used to form emotional state of the brain. The goal of this project is to record electric influences in the brain due to firing of these neurons, parse wave to get attention and meditation level of brain and use it to move a robot. There are various techniques available to detect electric activity in brain. One technique is named as Electroencephalography (EEG). EEG records the voltage fluctuation across the scalp that results from the inter-action across the neurons in the human mind. These voltage fluctuations are

processed and output to a micro-controller by EEG sensor. The data achieved from EEG sensor are saved in micro-controller. The micro-controller uses different methods to process and parse the data. The attention and meditation levels are obtained from processed data. These levels are used to control the direction and motion of the arm. [1]

2. WORKING MECHANISM

2.1 Signal Acquisition

First of all, Signal acquisition is the process of capturing brain signals that measures physical conditions. The brain signals could be recorded from the neural activity, surface of the brain, or from the scalp. These signals are stored in EEG sensor and then transfer those signals to filter device by using blue-tooth. The strength of this captured signals are usually low, that is why they need to be amplified. So, to be used by computer applications, they need to be digitized. EEG sensor has numbers of channels like: 8, 12, 16, 20, and 36 channels. [2]

2.2 A/d Conversation

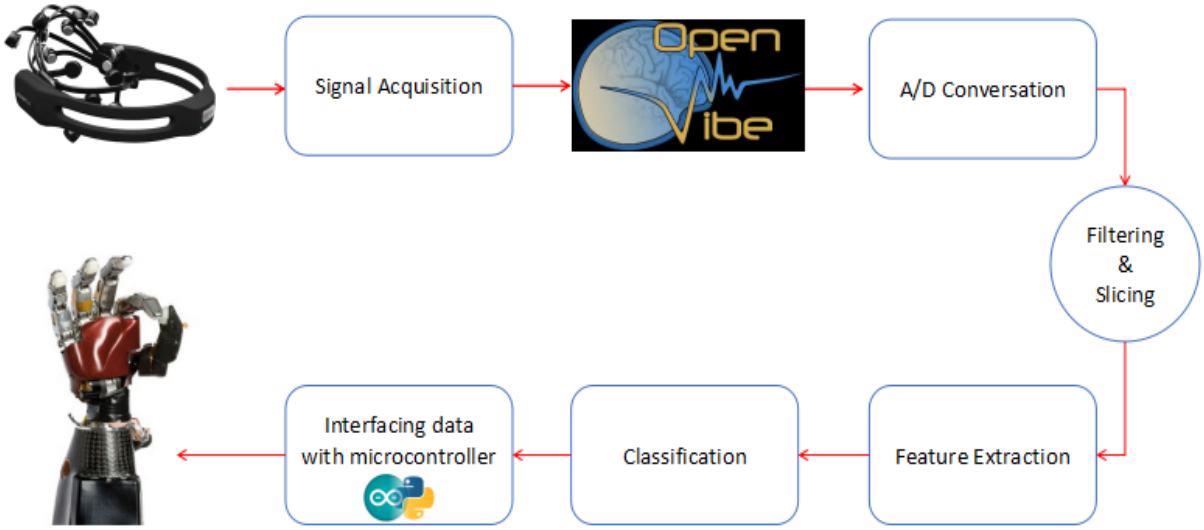
Next step is A/d conversation by which Analog signals are converted into digital signals. These Analog signals has been passed through monitoring, acquiring, analysing and processing data from sensors, which aren't be done with digital computers and processors. Therefore, this system needs an intermediate device to convert the Analog signal data into digital signal data in order to communicate with the digital processors like micro-controllers and microprocessors. These signals are in micro-volts and frequency ranges is between 0.3Hz to 43Hz. [3]

2.3 Filtering & Slicing of signal

After signal acquisition, the process of filtering and slicing is carried out to remove unwanted features, noise and components from the signal. [4]

2.4 Feature Extraction

Data analysis software provides the important packages like feature extraction. However, MATLAB and other software are also support feature extraction. Feature extraction means extracting specific signal features.Moreover, EEG recordings not only contain electrical signals from the brain, but also have several unwanted signals. Those unwanted brain signals might make the wrong analysis of the EEG data and may lead to error in conclusions. Therefore, the digitized signals must be subjected to feature extraction procedures. [5]



(Fig.1)

2.5 Classification of signal □

There are mainly five types of brain signals like DELTA, THETA, ALPHA, BETA, and GAMMA. For which real time data is very complex and varies with lots of factors responsible for classification. Brainwaves classification has able to give good results for some kinds of data signal. [6]

2.6 Interfacing Data with Micro-controller □

At the end, perfectly extracted data is transferred to micro-control by the mean of external parallel device. [7]

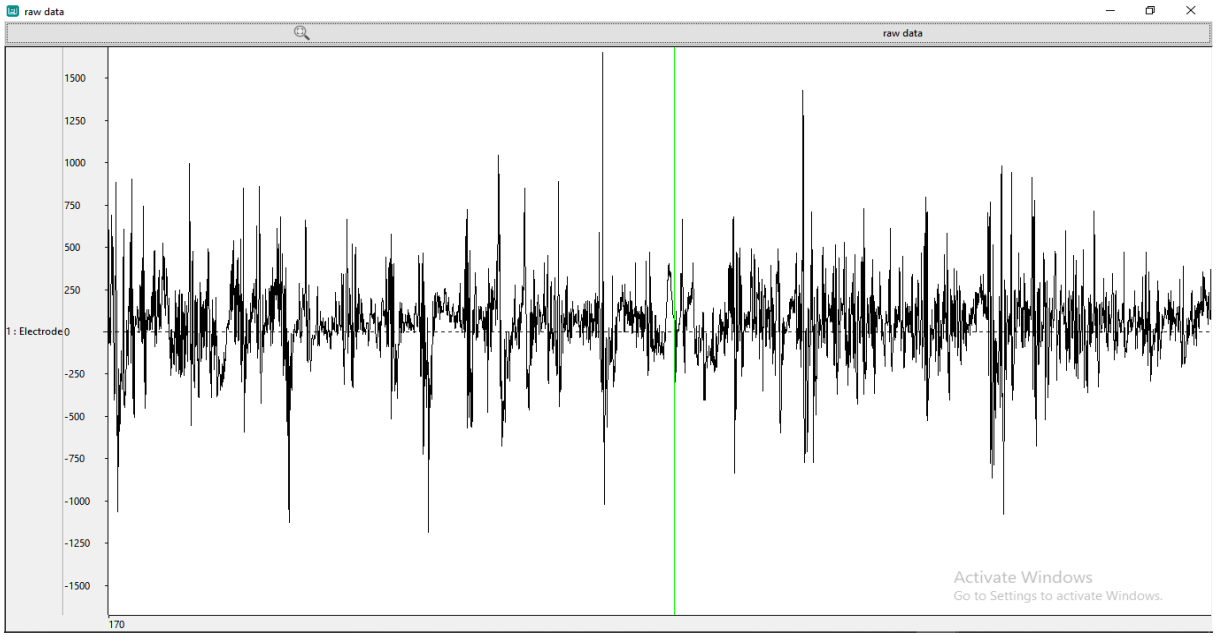
3. PROCEDURE

First of all, user wears the sensor, on pre-position location over the head and tries to touch all the electrodes to scalp. Then EEG sensor records the data and transmits it to software for signal processing in real time. After that programmed sequence executed and generates required form of filtered signal, by the software. For that we are using Open-vibe open source software. [8] Which is linked with Python script and further with Arduino IDE. Then it is transferred to the IDE and program of Arduino differ the values of signals according to the intense thinking of user. And also generate command from that to actuate motor to perform willing motion of arm. (Fig.1)

4. RESULT

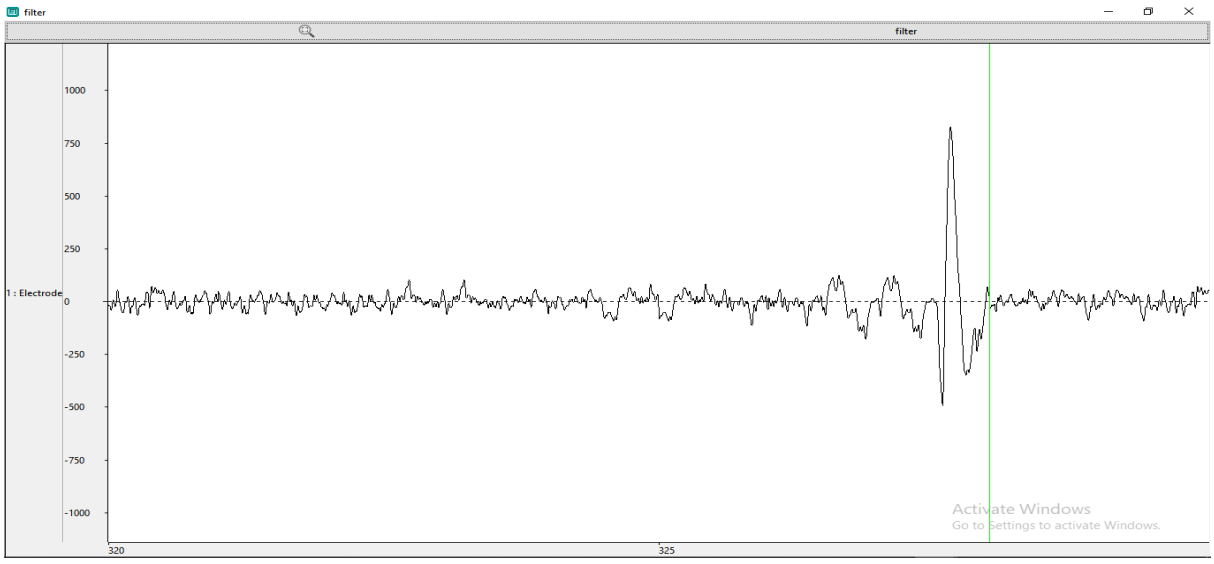
In this phase, first we generate the open-vibe program, which is able to do signal processing by using its various functions for getting required form of brain signals that can eventually able to determine the state of brain either it is Alpha wave (8-13Hz) or Beta wave (14-40Hz). For that the NeuroSky mind wave mobile sensor is used, which is based on EEG (electroencephalogram) technology. [9]

By connecting this sensor to the open-vibe software through its signal acquisition client by blue-tooth configuration, the raw data that comes from brain before signal processing is shown in fig.2.



(Fig.2)

The raw data received from brain by this method is from 0.3Hz to 100Hz. So, for getting only alpha and beta waves for BCI purpose, the signal processing (filtering) is required. Which can be implemented using open-vibe's various box tools. (Fig.3)



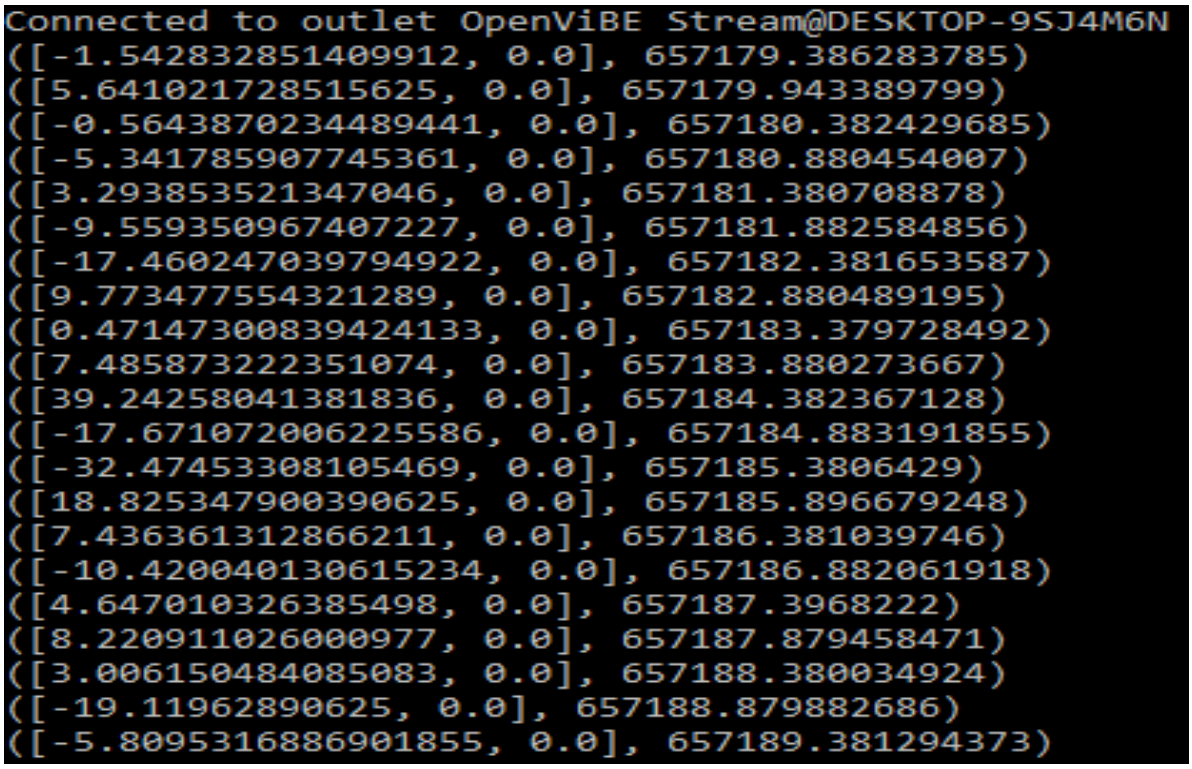
(Fig.3)

4.1 PYTHON DATA

After getting required frequency range of brain-waves, the data needs to be transferred to the micro-controller for further classification of signals to operate the arm in 2 degree of freedom. The processed data can be transferred by various tools provided by open-vibe such as VRPN, TCP and LSL EXPORT (Gipsa). [10]

Here, we use the LSL EXPORT box feature of this software that sends the data on stream through the serial port of computer and it can be catch by the serial communication on the micro-controller.

For that purpose the python scripting is used, which is able to direct the data from open-vibe to Arduino (micro-controller) .So, it is used as a mediator. (Fig.4)



(Fig.4)

4.2 ARDUINO

The serial port of computer is directly connected to the Arduino hardware, which enables the serial communication between both and with the help of python, the data of filtered brain-signals, can be read on the serial monitor. [11]

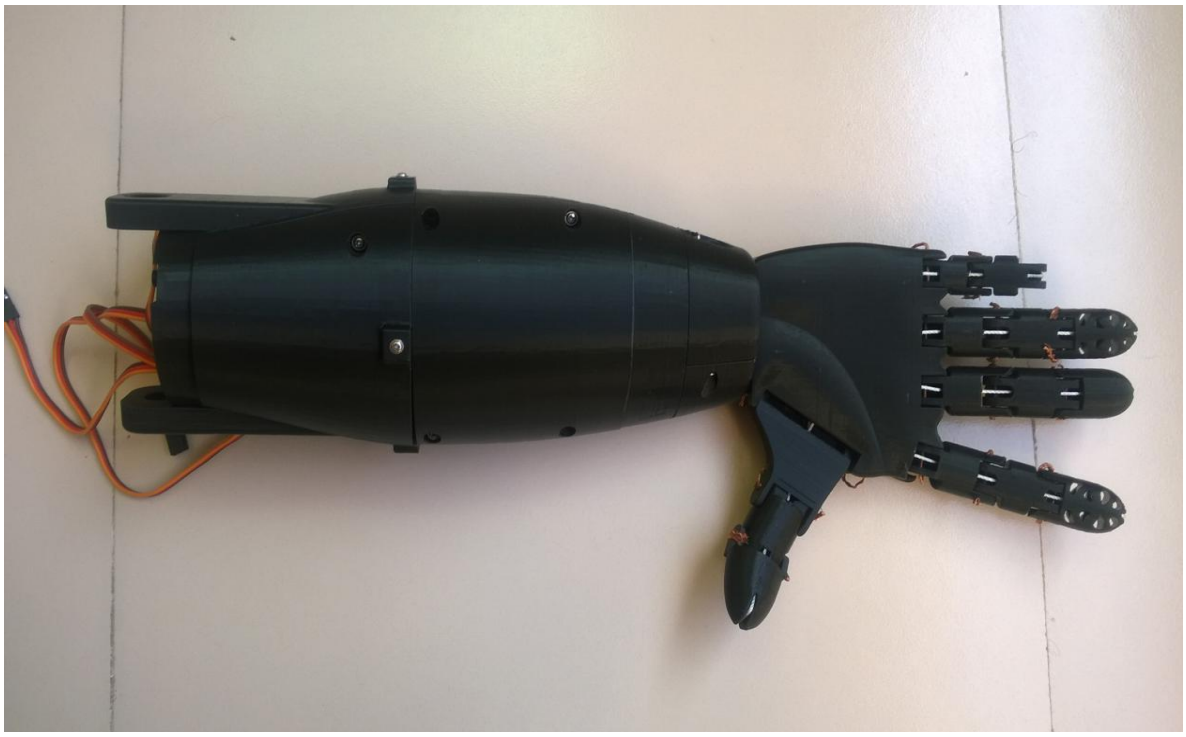
The Arduino program further classifies the different frequency range of signals and gives the command as per it programmed task to the servo motors of the prosthetic arm.

4.3 3D PRINTED ARM

The prosthetic arm is 3d printed arm, made of PLA material with the layer thickness of 0.02mm.And overall weight is about 300gm (without motors fitted in it).It basically upper-arm consists forearm, wrist, palm, fingers.

The design of this arm is adopted from existing design on internet. [16]

The complete printed and motor fitted arm is as shown in Fig.5.



(Fig.5)

5. CONCLUSION

Neural Computer Interface has become a great help to such physically disabled persons to communicate and control their environment using their thoughts. The present work has proved that without any movement of actual hand, changes in brain activity in the sensory motor area can be made by humans just by the thinking of such movements. The mental practice is needed to get control on sensory motor rhythms. As the BCI allows people to communicate and control appliances with just the use of brain signals it opens many gates for disabled people. There are various possible future applications. Even though this field of science has growing vastly in last few years, yet we are away from the scene where people drive brain-operated wheelchairs on the roads. New technologies need to be developed and other brain imaging techniques, such as MEG and MRI [12], need to be exploring to develop the future BCI. As time passes BCI might be a part of our everyday lives.

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IMPLEMENTATION OF 5S IN INDUSTRY: A REVIEW

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ABSTRACT:

The paper has several literatures on 5S methodology and Just in Time, which represents a systematic review of the literature. The paper exhibits that how different industries implemented 5S and increased the productivity of their work. Also, the review paper will help those, who want to implement such methodologies in their respective fields. Furthermore, it presents the idea of reducing the accidents and enhances the working efficiency in any industry. The paper also reveals the crucial problems in 5S, starting from maintenance techniques, layouts of 5S and the relationship of 5S with the barriers and success factors in 5S implementation. This study will be helpful to industrialists and researchers both who want to know about 5S.

Keywords: 5S methodology, 5S system, Continuous improvement.

1. INTRODUCTION

The 5s stands for "Sort", "Set in order","Shine", "Sustain" and "Standardized". The 5S is the expanded study of the Toyota Production System, which was developed by Japanese industrial engineers, Taiichi Ohno and Eiji Toyoda in 1995 [24]. Following that, 5S was developed by Sakichi Toyoda (Father of the Japanese industrial revolution) and his son Kiichiro with Taiichi Ohno [42]. In the 16th century, Venice shipbuilders used similar type of concept. In the assembly process of ship making they used quality process production to construct the ship. They completed the process in hours rather than completing in days. Eventually, the concept was transformed into the methodology. By the time, the 5S System has expanded and can be found within Total Productive Maintenance (TPM), the Just-In-Time (JIT) process, and the lean manufacturing [41]. In Later, there were two frameworks given for applying 5s methodology. The former one was given by Osada, and eventual one was introduced by Hiroyuki Hirano. Osada suggested that, keeping discipline in the training and education helps to

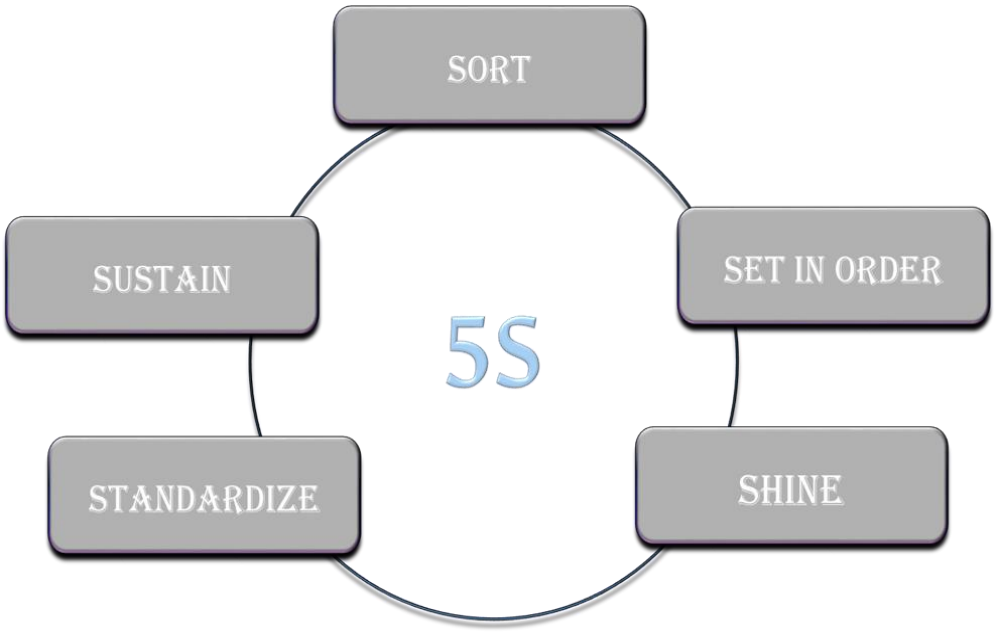
enhance the quality of work as well as work standards. Hiroyuki Hirano allocated a structure to enhance the programs with some steps. Hirano's approach was having only "4s", in which Set in order and Shine were considered as a single aspect.

1.1. **Sort (Seiri):** The phenomenon SORT defines the proper arrangement of the materials as well as tools [18]. The things are sorted according to their needs. For instance, for the things, when it is needed and if needed, then how long it is needed. The main aim of sorting is to organize the work environment and get rid of the junk. Another objective is to discard the items, which are not needed on the shop floor.

1.2. **Set in order (Seiton):** Set in order is the method by which the tools and materials are arranged in appropriate order of machine assembled. The arrangements are done in such manner, that the necessary tools are arranged by the order of their use. It helps to reduce the travelling distance as the searching time of things gets reduced. Also, the labels, tapes, floor markings and signs are used to execute SET IN ORDER [18].

1.3. **Shine (Seiso):** The literal meaning of SHINE is to do systematical cleaning. The main purpose of SHINE is not to show beautifulness but to serve a purpose [18]. Cleanliness helps to make the environment healthy and the better visibility results the higher quality work. The other purpose of SHINE is to identify the areas of dirt and unclean and to clean it.

Figure 1 Structure of 5S Methodology



1.4. Standardize (Seiketsu): To create the guidelines for Sort, set in order, and Shine is called STANDARDIZE [18]. The main purpose of it is to create best practices and to use the best practices by the workers and members. By not having the clear standards, there is no path to keep eye on the improvements. The standards are easy to get and communicable.

1.5. Sustain (Shitsuke): The prime aim of SUSTAIN is to make the habit of it to the industrial people [18]. Also, other objective is to sustain the activities like sorting and shining every day. Sustain improves the better inter human relationships. Sustain teaches the discipline and keeps the 5S process running.

2. LITERATURE SURVEY

Mr. Y.R. Chavall (2017) and team implemented 5S methodology in the college workshop of SGMCOE, Mahagaon college. The main aim behind this was to spread awareness of 5S in the college. The major issue was the teaching staff as well as students had no knowledge regarding this methodology. They arranged the informative seminar to light up the information of 5S. They divided the workshop into three zones for the ease of implementation of methodology [1]. To apply the sorting process, they made various zones in the workshops and allocated the supervisors, instructors and also the volunteers. All unnecessary materials were groped at the red tag zones; also waste is differentiated according to their material properties. After implementing the 1S in various zones, an audit was conducted by the management team. Audit team examined all the alterations in all the zones. Additionally, they took appropriate actions on the queries raised during the audit. After audit conclusion made, SEIRI was successfully implemented in the college workshop and consequently it could be seen that the systematic sorting was taken place.

Nita Sukdeo (2017) did the study of an ink manufacturing organization has been selected for the implementation of the 6S methodology. The organization was facing the issued regarding the products being returned because of incorrect labelling and packaging. Another concern was that employees were wasting their time searching for tools which resulted in downtime. The main purpose of the study was to enhance the overall rate of productivity and efficiency by solving such obstacles of the organization. A method called Organizational photography was applied to represent the situations of before and after effects of the 6S implementation [2]. In this method of direct photo analysis, the researcher captures the photo and does the analysis of it. Also, an audit was done to validate the objectives to application of the 6S methodology. There were an 8 weeks' observation done and the scores were given between 30 and 120. As a consequence of the audit, it was exhibited that 6S is the main foundation for the waste reduction, reduction of non-value adding activities and cleaner and safer working environment. The Upper management has said that they have gotten

excellent understanding of the 6S methodology and this will lead to a sustained working environment, which has a declination of hazards and risks.

The study carried out in one of the leading company in M.I.D.C (Ambernath Maharashtra) by Saad Shaikh et al (2015) showed that implementation of an effective tool named 5S helps to manage materials which can improve housekeeping, environmental conditions, health and safety standards and increase productivity and quality [3]. Also sorting eliminates unused, unwanted material from the storage room. It is observed that, how setting the things in order allocates space for components, and due to this , it gives more space for storing more material and tools and results in reduction in searching time. As 5S reduces the searching time, it improves the production and quality of the products and disciplined environment is developed amongst employees and organization. It was observed that by applying the methodology, the effectiveness enormously surged from 55% to 75%.

Shreya Chavan et al. (2017) studied the implementation of 5S in Prabha Engineering manufacturing industry in Rabale (Navi Mumbai). 5S system implemented in the manufacturing unit which is found to be appropriate due to the many merits such as the wastes, scraps and losses were minimized, and production were controlled with flexible workstations[4]. The main problems were ineffective inventory management, lack of quality improvements, quality control and lack of employee participation. After sorting the raw materials, labeling the tools and areas, removing dust and oils from the floor, creating the guidelines for above three and by keeping the discipline the desired results were gained.

R5 Food & Beverage Ltd is a private company faced few challenges to run its operation because of various issues in machines and availabilities of space, labour productivities, cleanliness of the floor etc. After a few observations done by Riad Bin Ashraf (2017), it was observed that due to absence of systematic procedures and knowledge these problems were occurring. Due to such obstacles, they applied 5S in the company as each S of the system was implemented. After implementation, about 310.1 square feet space was saved. Additionally, the new layout resulted in a declined flow distance, which was 1686.8 feet from 2450.65 feet per day [5]. Eventually some good results were achieved such as cost reduction, appropriate usage of workplace, prevention of the tools, surging efficiency, less time required for finding required things, improved working conditions and decreased machine maintenance cost.

Study for relation of 5S principles and ergonomics conducted at Tabriz-IDEM, Iran by Mohammad Rasouli Dizaji et al (2011). For collecting the needed data they used the three various types of questionnaires. The questionnaires constructed based on 5S, ergonomics and TPM. To determine the

sample volume data, author used Krejcie and Morgan's tables [6]. They used numerous types of tests for result purpose. T-test between 5S and ergonomics, Pearson correction tests between 5S and TPM and ergonomics and TPM. Eventually, 5S principle, ergonomics and TPM is interconnected modes of technique, which are used to enhance plant efficiency as well as productivity of organization.

A study was conducted at Sunmill industry Pvt. Ltd. MIDC by R.A.Pasale et. al. (2013) to improve the organization standard in terms of manufacturing. The major problem was the time taken to setup the machine was more than actual machining cycle time by the workers. This occurred due to misplaced tools, fixtures and improper material. To decrease the finding time of the tool, author introduced the sorting concept of 5S. In this, they differentiate various tools according to the machining sequence processes [7]. They introduced numerous "bins" to solve the lost material issues. They set the order of material of operation and jig fixtures according to the operation held. After the implementation, they observed the time taken for setting up the fixtures was shockingly differed from the initial one. The average time taken to set up the fixtures was 98 minutes before implementation. However, after implementation the time was drastically declined to 76 minutes.

P. M. Rojasra et al (2013) described the development of key areas, which could be used to adopt and implement the lean manufacturing practice and also presented some of the techniques to evaluate and reduce the resources needed on projects resulting in enhanced production efficiency [8]. The prime aim of this study was to implement 5S methodology and measure the performance improvement in Krishna Plastic Company, which is a small-scale industry situated at Amreli, Gujarat. It shows that a small manufacture can rapidly increase output and reduce quality threats by 80%. Also, it presents methodology for determining the real problem connected with industries in implementation of lean. Author also presented selection of required lean tools in the light of company's long-term vision.

The study was done by effort consultancy in Plastic Pipes Manufacturing Company [9] recommends implementing 5S and give suggestions to make the 5S practices more influential. There was lack of haphazard inventory and also the walk way and hazardous areas were not existed. It results over mass of material at the storage. To tackle these issues the labeling and colour coding on the respective places were introduced. Moreover, Gemba Board was used to give the daily tasks and activities to the workers. And the 5S observation sheets were prepared for analysis of data. Also, they got extremely good results by creating the proper area for every item in the industry. For instance, the mouse as well as the monitor has also their defined places, from where they cannot be moved.

S.R. Dulange (2013) runs the field experiment at the Solapur Textile Sector. The objective behind the experiment was to improve the textile market in the country, by using modern management

techniques in power looms. They made audit team for the data collection. They analyzed the lack of production tools, improper management lack of inventory stores and also the place for material was not decided. In order to resolve the problems, they introduced the colour coding method in organization for sorting the materials [10]. Also they used different tags in power looms too. They set the proper order of the material flow by using the various bins. After implementation of this modern system, they analyzed the data for next 30 weeks. Studies reported the results that the better productivity was achieved. Hence, the Solapur Textile Sector grew in terms of management and productivity.

Authors Oleghe Omogbaia et al (2017) used Dynamic approach to implement the lean tool 5S methodology. They observed problems like out of order manufacturing, demand fluctuations, plant is small and tidy, and product manufactured is seasonal product. The SD model was built on various variables such as order entry rate, lead time, short time, manufacturing cycling time etc. [11]. This dynamic model is able to access the advance improvement in lean manufacturing. The analysis result shows that total time spent on searching the items is reduced from 0.6 to 0.2 work hours per day which exhibits 67% improvement. The company's managers need to adopt the methodology to improve the aspects of lean using an SD modeling technique.

R.T. Salunkhe *et al* conducted study to reduce the time being wasted for searching of the spare parts for maintenance work industry. The study was done at the ABC industry .They used lean manufacturing tools like Kaizen and 5S methodology for solve the problems. In Kaizen, they differentiated the place of pipe and hoses in different racks. The bins did not having proper items as any items were kept at any bins. After implementation of 5S methodology there was tremendous change in searching time as the bins were segregated by colour codes [12] .The searching time gets reduced to 6-8 minutes from 13-15 minutes. After implementation, they achieved control over the inventory by maintaining minimum level of self-life items.

A Study was conducted at "Sandvik Asia Pvt. Ltd, Mehsana, Gujarat" bh Mayank Dev Singh et al (2015) with objectives of reducing the abnormality. Also they faced the problem of improper materials handling and waste of time and motion [13]. There is no visual glass by which one can see the fluid which can flow in the pipe. To solve the issues, they used 5S methodology, and they used manual sorting of material and provided the stopper at fallen down area. They allocated the tray in which the clothes and materials can be put. Additionally, a specific place was introduced for air gun. After Implementing lean manufacturing and 5S the searching time is reducing to 5-6 minute from 14-16 minutes. They saved 640+ pages per year by providing updated preventive maintenance system.

By providing standardize operation strategy, it is possible to reduce human movements in the shop floor.

Sagar et al. (2017) analyzed and implemented the 5S methodology in Harsh Polymers. The main problem faced by them was the utilization of raw materials and time wasting for finding the tools. [14] Also the place management was improper and the labors were unaware of modern innovative techniques. The research suggested that the most essential thing is to implement the rules. In order to solve the issues, they provided the bins for raw materials and tools. They created the racks in which they managed the tools according to the series of operation. Consequently, 25% to 30% of time was saved of worker by implementing this. Also the audit sheet was provided to maintain the above 3S and that is the main aim of 4^{th} S. By the cooperation among the staff and workers, all the aspects of 5S were achieved.

Deepak Dhounchak et. Al. (2017) conducted implementation study on the industry of the manufacturing. The main problem in the industry was lack of management and improper working place. Author examined there were lots of problems in the industry like improper manner of production, lack of safety towards worker, dirty workplace, and disarrangement of tools. In order to resolve these problems they introduced the concept of 6S in the organization [15]. They made red tags to identify the unwanted items to maintain proper tools arrangement. They made specific tools space to put the all the tools as per their designations. To improve the cleanliness on the shop floor they provided several techniques of cleaning. Also, they introduced the worksheets to keep the standardizations of the organization appropriate. They allocated the safety kits to the workers and gave the knowledge about that kit by arranging safety awareness programs. After implementing 6^{th} S the organization became very well arranged and enhanced safety of workers.

The study of Abhay R. kobarne, et al. (2016) describes the most considerable issue in the company and which was the poor training as well as lack of awareness methodology like 5S. They observed that lack of communication, the wide gap between the upper level management and the ground employees and less knowledge of some methodologies were the primary issues in the industry. Therefore some critical decisions of 5S activities, containing time and budget were approved by management [16]. Thus, more cooperation from all level of people is suggested during implementation period. It was seen that the checklists which were made earlier, were not as satisfied as they should be. However, after implementation, the results started to come satisfactory. Also, it was also observed that continuous training is the prime element to change the organization's environment. Moreover regular assessment should focus on improvement and development about all inputs in the industry. Along with these aspects an additional aspect which is safety was also increased. Eventually,

the 5S improved overall performance and reduced the wastes in manufacturing and also promoted neatness in storage and reduced the inventory.

A faculty named György Czifra (2107) did the study in the DS SMITH company, which is a leading European company which offers packaging solutions tailored to the requirements of a specific customer with emphasis on the modern trends in best packaging designs. They combined theoretical knowledge and practical experience to construct a system corresponding to the rules of the 5S system. They made the Gantt diagram for the implementation process, containing the assignment of resources, end time limits, and targets. Also the survey was conducted by obtaining photographic documentation. The critical places and incorrect solutions were illustrated in the photos [17]. Moreover with the same photos, they attached the particular solutions for respective issues. While the auditing process, they identified only a few small differences, which were observed in a short correction proposal. Approved solutions were applied in the rest of the workplaces and on the old production lines as well. The most crucial aspect for completing the tasks was to change the staff's mentality, which was achieved by well-timed lectures using some examples.

Kaushik Kumar et al (2012) described the steps to be followed during the implementation of the 5S methodology in any industry. Authors clearly mentioned that, if any industry implements this lean tool, then it will be very beneficial for the organization. They mentioned that what is 5S and how and when it is used [18]. Research gives the brief idea about the Sort, Set In order, Shine, Standardize and Sustain. They also stated the various benefits of the system according to industry so it can be known exactly how and when to apply this methodology.

The Review by Amardeep Singh (2015) of 5S gives a brief idea about the 5S implementations accepted by various manufacturing industry also reflects that the 5S initiatives approaches to improving performance of the industry [19]. Study shows that the 5S is not a short-term program, which is completed over the night. It is the long process. Also, this is a tactic which is used to improve the productivity in any field as the study suggests. The main aim of the 5S is to make the workplace orderly to improve safety and efficiency, to reduce the product defect rate and other possible wastes.

A research conducted by Vivekananda S. Gogi et al (2014) to identify and improve the plant layout of pulley’s factory to eliminate obstructions in material flow and thus obtain maximum productivity. The research exhibits that the efficiency of a plant layout can be increased by redesigning the plant layout using string diagram and proper planning of layout. These fundamental guidelines should be considered and followed. The issue was improper material flow on the shop floor and hence, the transportation time increased. The paper also explains about the material flow and layout design using

the string diagram [20]. To examine the material flow, they used Outline Process Chart and Flow Process Chart. By following DGCA specified path, the efficiency was improved by 17.21%.

The authors Mr. Khan Zaidahmed Zaferullah, Dr. Sanjay Kumar (2013) focuses on the application of JIT in Nigeria. [21] The survey conducted by him had revealed that JIT is just as workable in Nigeria. The current scenario of globalization, Just in Time manufacturing system is coming as boosting for attaining manufacturing excellence in the industries. The various merits receiving from the implementation of JIT practices are Quality Benefits, Time-based Benefits, Employee Flexibility and Production process simplification. Implementation of JIT practices in a firm leads to contribution towards the economic growth of the country.

Priyanka Rai (2016) highlighted that 5S is required to be followed in HRM for the organization to reach the pinnacle of glory and at the same time care should be taken [22]. The research showed that after implementation of 5S practice, its benefits for industrial organizations are more. The reliability has been carried out for the data analysis. The data was coded in terms of Likert scaled questioner form. Total 450 employees took part from diverse field of operations in this. The results showed that the technique is very useful, applicable and beneficial. But it also shows that some organizations are implementing 5S in some proportion, not as whole policy because of the employees .They show less interest towards their role in 5S implementation. But overall it can be said that 5S is a required quality management tool which causes to improve performance of employees in any organization without any limitation on different kinds of products or services and organizations need to consider it as a part of their organization strategy.

In this Malaysian research organization paper Arash Ghodrati etal. (2011) examine the performance characteristics of the 5s implementation the industrial organization. The selected industries for study are from various diverse fields of work and providing various services. This study has been performed in different companies with different kind of products and services. The study has followed descriptive research based on survey method. In this methodology they collected the data by distributing the questionnaire five industries which had implemented 5s before that. Individual analyses of five organizations successfully showed that 5S implementation has an effective impact on performance of organization. The results are obtained by comparing different parameter of the 5s in different industry. They used SPSS and excel software to ease of the process [23]. The results clarify that the 5S is an effective tool for improvement of organizational performance. It does not dependent In order to continue improvement for achieving higher performance of plant the 5s methodology support every time in any situations. In the last we can say that by the using of 5s, efficiency of

organization is increased and 5s has huge positive impact of the overall organization interims of productivity and performance.

There was a sixth S added in the existing methodology. "SAFETY" was the next S after sort, set in order, standardizes, shine and sustain. It was introduced by Mayank Vivekananda S Gautam, et al. (2014) [26]. They provided various methods for cleaning and working environment. Also, they mentioned the various safety equipments which are necessary during working on shop floor. Other than that, they also provided useful visual evidences to obtain more firm results.

The research done in a concrete panel industry, gives a glance of Lean and Six Sigma in the construction industry, which was done by Celep Oguz et al. [27]. The study is presented to investigate the applicability of Lean Six Sigma methodology and the implementation in the construction industry. Both Six Sigma and Lean are best production management tools and the combination helps each other. Lean in principle eliminates anything that doesn't add value to the customer. On the other hand, Six Sigma aims to control the process by understanding the root cause. Overall, the combination of both tools can lead to a very useful methodology to improve any process.

Ajay Anantrao Joshi (2015) emphasized about the 7^{th} as in the methodology in the paper. The 7^{th} exhibits "spirit" (team spirit). The spirit stands for the formation of the team which has motivational leader and cooperative members. Targeted outcomes after the implementation of spirit are better communication among the employees of the organizations [28]. Workers feel the self-motivated at every time and they work with full of energy and with extreme high confidence. Spirit reduced the boredom approach of the employees toward their jobs. After all, the employees got better understanding of the problems and solve the issues with some appropriate approaches; hence, the healthy environment can be created. "Sphoorti Machine Tools" has improved productivity by successful implementation of 5S methodology. This study's main aim is to improve the bottom-line production without the need for capital investment which was conducted by Soumya R. Purohit et al (2015). Also, they have found increase in productivity and hence profit levels too. The other merit behind this methodology implementation was higher enthusiasm and punctuality among the workers and safer working situations [29]. Also, the 5S concept is evolving into a 7S Methodology as there are two new aspects to add as 'Safety' and 'Security'. Therefore, they described that this methodology is still evolving and a lot of innovations to implement this methodology are also coming up in future.

Just-in time production system is one of the initiatives that focus on reduction in wastage by eliminating non-value-added activities. A study conducted by A. S. Aradhye, S. P. Kallurkar (2014) at the temple of the Dakshin Kashi, which is located near the BhimaRiver showed that, the pilgrims'

normal waiting time in queue for darshan was 8 hours. The waiting period for pilgrims' queue of darshan is reduced by implementing software-based JIT system, which system is improving continuously. As they have used this software as a test for some limited slots for the darshan for the pilgrims. They got more than 10% of response after this first attempt. Eventually, the pilgrims' normal waiting time in queue for darshan was reduced to 30 minutes [30].

A study done in a Malaysian Automotive Parts Manufacturing by Nadirah Roslin et al (2012) describes the progress in its early stages of lean manufacturing implementation [31]. The observation of lean success determinants is limited to this case, and care should be taken while generalizing the results of this case study to other Malaysian manufacturing organizations. The literature suggests that there are few critical success factors such as availabilities of resources, organizational culture, and information technology proficiency which impress each dimension of lean manufacturing. Thus, future studies of multiple case studies can be conducted to get the influence of a variety of success factors for different lean manufacturing tools.

The study of AR.Abdul et al. (2014) on 5S is conducted at the "Seremban Specialist Hospital", Malaysia. They used lean tool and 5S strategy for workplace organization and improve the efficiency of the hospital. The survey was conducted on several categories such as cleanliness, efficiency of work process etc. to get the results. After implementation of that, they successfully generated the level of understanding amount in the staff. Result also shows the immediate change is accepted after applying 5S. For analysis in various filed they used the various pie charts as well as bar graphs [32]. Before implementing all the results obtained were poor to good, but after applying 5S result were drastically changed from good to batter and then best.

The research carried out at the Hari Bio-Mass Processing Unit by K Ramesh and team (2014) conducted the study for reducing the waste and removing un-wanted activity in the biomass plant. In order to solve the transparent process flow, they diagnosed the current work flow of the organization. In order to minimize the waste, they trained the labors and line supervisors. Document analysis and result reported that after implementation of 5S, the industry achieved the clean work space. Also they washed the walls to enhance the working environment. As a result, the unwanted activities were reduced, floor layout became neat and clean and approximate 700 kgs of excessive scrap got reduced [33].

The study performed at piston and piston ring manufacturing company named B. Shankra Sales Organization(Agra), described, the production line is at underutilization [34]. The main problem of the inefficiency of the workers was the overload or idle time. One of the strongest tools for improving

productivity is that of Line Balancing. The activity carried out by Priyanka Yadav, Suman Sharma (2016) simplified the method of operation to decrease the unnecessary or excessive work. It has been shown that proper line balancing and plant layout reduces the power consumption of the machine. As a result, the cycle efficiency was increased from 76.61 to 80.95% and the rate of rejection of the piston in a slot is decreased.

Gheorghe Dulhai conducted a study at the manufacturing unit of the autocar exhaust. The aim of the study was to improve manufacturing of the auto car exhaust by various methods like 5S and continuous improvement. They used the questionnaires in order to examine the tasks. After implementation of this 5S strategy, the accidents get reduced. The maximum days they maintained safety [35] till 56 days. Reduction of physical efforts, fewer accidents during the production process were obtained. The results got appear in short time around 1-2 weeks.

Dilek Acar Gürel (2013) did the conceptual evaluation of 5S model in the hotel. The conventional approach in hotel management is focused on performance results like more profit, productivity and satisfaction. They described that an effective management system should be in hotels, in order to fulfill the expectations of the customers. According to Kandampully (2006), the main aim of the hotel management is to manage the service quality in the hotels [36]. The main merits of 5S for hotels are the clean, organized and safe work environments, where failures and losses are reduced. Therefore, the adoption of this business methodology focuses on value and quality in the entire organization. In this study, 5S model is utilized as one of the processes which satisfy the quality and some management requirements of the hotels instead of the conventional practices. However, it is observed that the implementation of 5S in hotels is limited while the various fields' implementations are encountered. This study described 5S as an effective business model for the hotels and its prime purpose is to play a role to fill the conceptual gap. The hotels already have experienced on the quality of organization, sequence, neat and clean environment, and discipline too. The study is anticipated to enhance an awareness of the quality components in a business model for hotels, looking for more profit.

The study by Mohd Nizam Ab Rahman et al. (2010) was done with doing the comparison between the two companies which were described as company A and company B. Company A's prime goal was to achieve customer satisfaction via quality products and excellent services by well experienced employees. Company B's motive was to become a number one ASEAN company for quality assurance, cost and delivery. Consequently, in company two fields were observed to be out of the excellent condition. In company B, both of the administration and manufacturing site showed the least value with compare to other parts. It can be eventually said that company a secured upper position in

the excellence level in comparison to company B. Therefore, company B illustrated weaknesses in numerous aspects. This is because of the overall proportion of company B where it only acquired 72.35% as compared to company A that gained an excellent level of 90.48% [37]. The variation in this percentage happens probably due to the size, company background as well as the positions of both companies in Malaysia.

3. LIMITATIONS OF 5S

- Some of workers think that they are already too busy in their work; they have no time to clean and organize the workplace. [38]
- In organization if the cooperation between the department is poor then sustainability of 5s not implemented properly.[39]
- Absence of appropriate record keeping mechanisms, and auditing mechanisms for evaluating and sustaining the progress 5S program in the organization.[40]
- 5s system fail even when poor leadership performed by the leader of the team. [25]

4. CONCLUSION

The literature study proves that the 5S methodology is one of the most appropriate as well as beneficial one for any industry who wants the improvements in their existing system. In addition to this, it also gives the proof that 5S helps to enhance the work productivity along with time efficiency in less time. The appropriate implementation of 5S leads to minimization of the cost and the standards of the company go towards upside. Moreover, due to fewer accidents the safety automatically rises. Overall, it can be understood that 5S methodology gives extremely outstanding results if it is applied in best manner.

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SURVEY ON IP CAMERA HACKING AND MITIGATION

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ABSTRACT

IP based cameras have been replacing the CCTV cameras as CCTV cameras cannot be used for monitoring and surveillance over the network. IP cameras can be used for monitoring and surveillance purpose over the network as they are connected with the network cable and can send their feeds to centralized server or monitoring system. Thus, the IP cameras are having security features implemented. IP cameras are not much secured as the manufacturers and the deployment organizations do not concern about the security of IP cameras and it surveillance system.

Survey conducted on various major vulnerabilities and mitigation to the particular vulnerabilities found in the IP cameras and surveillance systems. Studied existing vulnerabilities in IP cameras and surveillance systems and provided mitigation to the particular vulnerability. Hopefully findings of vulnerabilities and mitigations will be valuable to organization working with the IP cameras and surveillance systems and society as well.

Keywords: Hacking, IP camera, Network Video Recorder, Surveillance System, Mitigation

1. INTRODUCTION

The first ever CCTV Camera was used in 1942 to monitor V-2 rockets. This technology was designed by the engineer Walter Bruch. In 1949, his technology which was later launched on a commercial level. CCTV technology has been burgeoning briskly and has gotten better with time. Now cameras come equipped with high megapixels, stronger durability, weather resistant, infrared light with nigh vision equipped to it and even radio for voice transmission. This technology has been a major help for the authorities in crime prevention and monitoring [8]. IP cameras and surveillance systems consists of cameras, Digital Video Recorder (DVR)/Network Video Recorder (NVR), servers and network are becoming very common all around the world. Nowadays, IP cameras based surveillance systems are basic fundamental for most of the life areas of the modern society. Their use is immensely moving over wide areas such as law enforcement and crime prevention, to transport safety and traffic monitoring, and control of retail, to unauthorized, illegal and even criminal use.

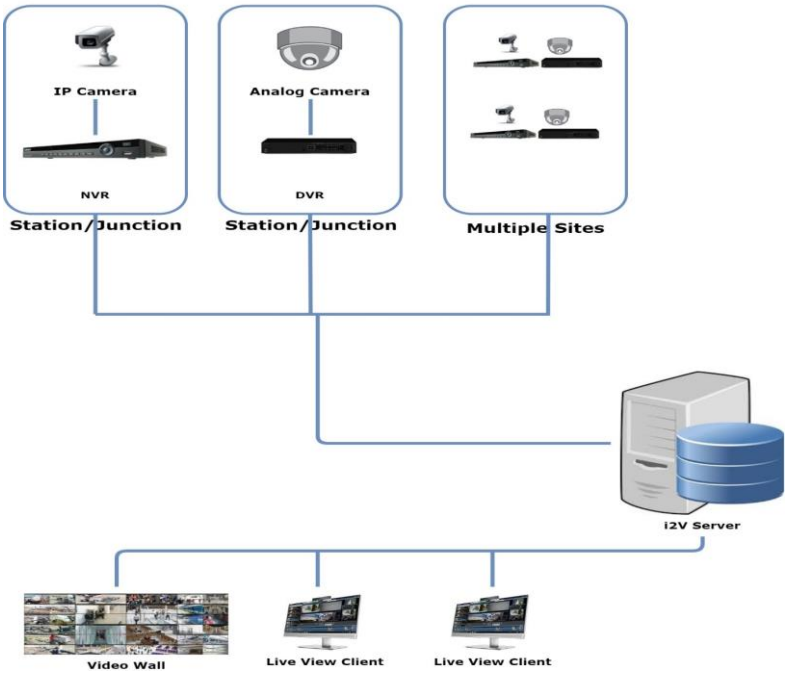
Usually, most of worries about IP camera and surveillance systems are related to privacy issues for obvious reason. The privacy impact of IP camera and surveillance system is notably important vital in the light of revelations about global IP camera surveillance programs. As progressively embedded devices are being analyzed at large scale for vulnerabilities, it is no amaze that IP camera and surveillance systems have recently boosted a dramatic increase of attention from security researchers. Those and similar studies led to more than a few vulnerabilities with large impact in real life. The assortment of vulnerabilities in those studies precisely implies the unhealthy state of cyber security of IP cameras and surveillance systems.

In this paper, conducted an organized review of the existing threats and vulnerabilities in IP cameras and surveillance systems based on found in research papers which are publically available. Additionally, we survey main risk and attack for IP cameras and surveillance systems. We also serve some remediation and mitigation that can benefit to enhance the security and privacy levels.

Main contributions are:

- Present the various types of vulnerabilities and various types of attacks found in and against the IP cameras and surveillance systems.
- Discuss in-depth novel and specific vulnerabilities and attacks on IP cameras and surveillance systems.

Fig 1: IP camera and surveillance system



2. RELATED WORK

At one side researchers approached the security and threat modelling of different parts of IP camera and surveillance system. Haitao Xu, Fengyuan Xuy, and Bo Chenz [7] have observed and investigated IP cameras with no password protection on the online directory of IP cameras. They have found large number of IP cameras without password protection and also gathered information about IP cameras such as open ports and web servers. Where some researchers had developed the infrastructure for testing the wireless IP cameras on their own and found some vulnerabilities in the wireless IP cameras [6]. Jungho Kang, Jaekyung Han and Jong Hyuk Park [5] have designed the access control protocol for IP cameras using hierarchical group key.

On the other side some researchers tried to find the vulnerabilities based on the taxonomies. Thomas Doughty, Nauman Israr and Usman Adeel have found the different vulnerabilities in IP cameras and surveillance system using ARP poisoning method; they have found vulnerabilities such as DDOS attack, MITM attack, and ARP poisoning attack vulnerabilities. They have also done brute force attack and packet sniffing as well on their own developed environment of IP cameras and surveillance system [1]. Brian Cusack and Zhuang Tian have setup the system of IP camera and surveillance

system and performed pilot test to find out the vulnerabilities on the IP cameras and surveillance system. They evaluated vulnerabilities of IP cameras [2].

Based on above related work, survey what are the common vulnerabilities found in the IP cameras and surveillance systems and what is the mitigation have been provided for the particular vulnerability.

3. REVIEW OF VULNERABILITIES, ATTACKS AND MITIGATIONS

Determined the common vulnerabilities found in the IP cameras and surveillance system by surveying. On the basis of particular vulnerability determined attacks that can be happened using specific vulnerability. At last noticed some of the mitigation provided by the researchers to mitigate some of the vulnerabilities in IP cameras and surveillance systems. Commonly found vulnerabilities are weak passwords, poorly protected credentials, insecure configuration management, and more [9].

In below sub sections presented the vulnerabilities and mitigation that were determined from the different white papers in which the researchers have found those vulnerabilities and possible attacks and provided mitigation for that particular vulnerability.

3.1 Discussion on specific vulnerability and attacks

3.1.1 Denial of Service

Denial of Service is a prime goal for the attacker, as this can set back the raising of the alarm, and deny the gathering of evidence after the incident has been detected [1].

In this kind of attack, attacker tries to gain access of the DVR/NVR of the IP camera and surveillance system and tries to get down IP camera or the whole surveillance system by sending large number of requests to the DVR/NVR or to the IP cameras. Sending large number of requests to the system causes shut down or hanging problem of the system due to the unable to handle the large number of requests.

Attacker can shut down the whole surveillance system by performing this attack on the system. These systems are very much vulnerable for this attack as IP cameras and surveillance system are open to access and their servers are not able to handle the huge amount of traffic at the same time.

3.1.2 Man in the Middle

Man in the Middle attack is very dangerous attack for the IP cameras and surveillance systems. Attacker sits between client and server of the surveillance system using ARP poisoning method and tries to capture the traffic between client and server and attacker can also alter the data packets and can change the data in between client and server.

Performing this attack on the IP cameras and surveillance systems is very easy for attackers as there are not much security measures concerned by the manufacturers and the client who implement these systems. As the No/weak encryption algorithms are used to transfer the data and feed of the IP cameras to the DVR/NVR and to the server as well, therefore all the data packets are going unencrypted and anyone can view and alter the data or feed from the data packets.

This is one of the major vulnerability found in the IP cameras and surveillance system which can cause the whole system and can impact will affect the common people of society.

3.1.3 Weak Authentication or Authorization

Weak authentication or authorization of the IP cameras and surveillance system is the major problem till date. Login portals are still using weak authentication mechanism and the clients are not aware of changing or removing default password to access IP cameras and surveillance systems.

Authentication mechanism provided by manufacturers is weak in terms of accessing the system. Clients or the users are still using the default user names and password to access the IP cameras and surveillance systems. As the weak authentication has been provided by the manufacturers, attackers can easily get into the system by brute forcing on login portals and can easily get access the IP cameras and the surveillance systems. Attacker can do anything by getting into the system and can damage the whole system.

Weak authentication or authorization is very basic and crucial vulnerability in the IP cameras and surveillance systems. Manufacturers need to make the login portals strong for authentication and users also need to be aware of to remove or disable default user name and password.

3.1.4 Remote Code Execution

Remote Code execution vulnerability is also found in the IP cameras and surveillance systems. This vulnerability allows attacker to remotely access the system and to execute the arbitrary code on IP cameras and surveillance system.

This vulnerability causes due to the non-updated firmware and using old versions of software/firmware in the IP cameras and surveillance system. Using this vulnerability attacker can get the access of the whole system along with the DVR/NVR and the servers and by exploiting this vulnerability attacker will cause damage to the whole system performing arbitrary codes on the system or servers.

Remote Code Execution is also one of the dangerous vulnerability found in the IP cameras and surveillance systems.

4. MITIGATIONS PROVIDED

In this part, stated some mitigations provided by the researchers for the various vulnerabilities of the IP cameras and surveillance systems.

One of the mitigation provided by the researchers is strong user authentication using steganography. Researchers have developed a protocol named as “User Authentication Protocol” to block the malicious users [3]. Design of IP camera access control protocol utilizing hierarchical group key is also mitigation provided by researchers [5].

Above provided both the mitigations are for access control or user authentication utilizing which we can secure IP cameras and surveillance systems from unauthenticated user and attackers.

MITM vulnerability mitigations provided are to make the communications secure between client and servers by using the encryption algorithm for safe and secure communication. So the attackers not able to get the clear texted data.

5. RECOMMENDATIONS

Apart from the mitigations provided by the researchers in this part we will try to give some solutions in brief to the above stated vulnerabilities.

Below we summarize a set of recommendations that we hope can help enhance the security of the firmware and network communication of IP cameras and video surveillance systems. With enhanced security, we hope that a safer operation and an increased privacy of the entire IP camera and surveillance system could be achieved.

• Users of the IP camera and surveillance system have to change the default user ID and passwords or remove it from system.

• Another way is to regularly update firmware of the IP camera and system.

• Use the strong passwords for login.

• Use encryption algorithms for communication over network.

• Properly configure the IP camera network and surveillance system.

6. CONCLUSION

This paper provides a systematic review of security of IP camera and surveillance systems by describing in detail vulnerabilities, attacks, and mitigations. Based on publicly available data and existing classifications and taxonomies, the review presented in this paper provides comprehensive information on how video surveillance systems can be attacked and protected. This knowledge can then be used to better understand and identify the security and privacy risks combine with the development, deployment and use of these systems. Moreover, this paper presented a set of recommendations that can enhance the security and privacy aspects of IP cameras and surveillance systems.

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TRAFFIC ANALYSIS AND RELAY FINDING IN TOR SURVEY

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Abstract

The main motto of this research is if any adversary or criminal uses the Tor browser for doing an illicit activity which causes govt. and people, as most of the techies and Tor users know that finding illicit communication in a Tor network is quite difficult because there is no direct or indirect mechanism to capture the encrypted traffic and decode it, and most importantly it's hard to find the relay location. So, we need a mechanism to trace them and identify the real criminals, this research is helpful in achieving this goal. The researcher creates a malicious payload and uses it to penetrate the Tor network with the help of traffic analysis. Here researcher also analyzes the tor middle relay in order to understand the network profound and generate statistics which creates a certain results; here the main focus is not only Tor. To check the workability of the payload, the researcher performs an experiment on the normal network in order to check the feasibility of payload and its working towards Tor. This research is helpful for those who want to study and get deep knowledge about Tor and also for those who are deucedly to penetrate Tor.

Keywords: Traffic analysis, relay finding, Tor Traffic analysis and network attacks, relay attack, Tor network attacks, finding relay location.

1 INTRODUCTION

The word cyber comes from the word cybernetics; in late 1940s cybernetics is used to describe the communication between two machines or people, now a day's a word cyber or cyberspace relates to the internet or computers and communication between them using a medium. Cyber security is an essential part of current technologies because as fast as technologies and digital security evolve day by day the hacking world grew faster so, safeguarding the network and vital information of organization and users is crucial. Cyber security involves cyber-attacks and cyber defenses where Cyber security or computer network security mainly deals with unauthorized access, protection against data breaches and digital damage to the network or computer-related systems and finds how to secure and protect them. Cyber security is more likely a process and practice of finding the vulnerability and fixing those vulnerabilities of a network or relates to electronic devices. The current era is of technology and communication where Cyber security is involved and covers every network, computer or electronic device which communicates using the internet. The vital part of safeguarding information which relies upon the internet like smart devices and smart technologies that can be affected by breach or security needs Cyber security protection.

The onion routing also known as Tor is a well-known low latency based anonymity network that is very popular among users of Dark & Deep Web, cyber criminal's favorite toy for doing any cyber-criminal activities. Tor is developed by U.S. Naval Research Lab in the 1990s for providing security and protecting their data privacy online. Their mathematician Paul Syverson and scientist Michael G. Reed and David

Goldschlag introduce Onion Routing protocol to provide strong protection against network surveillance. Tor is used for licit and illicit communication and utilization of Tor becomes very popular day by day as information and data are playing a vital role in cyberspace and mostly the data are unindexed on the internet so to access crucial data cyberpunk uses Tor, mostly data used for illicit communication like accessing govt. confidential data, unauthorized news leaks of sensitive information (ex. WikiLeaks), buying, selling, smuggling drugs and weapons, stolen credit card numbers, money laundering, bank and credit card fraud, Gain access to censored information, distribution of illegal sexual content, exchange of counterfeit currency, etc. every coin has two sides Tor have issues regarding research i.e. Tor uses onion routing technique so it's difficult to trace illicit activities online, Remembering the onion address is quite headache for Tor users and the big issues is Tor slower than normal network and uses high bandwidth for network usage and network is anonymous so difficult to identify criminal activities.

To achieve the goal of the research, the researcher divided the process flow into two phases one is a simulation-bed environment and the other is the emulation-bed environment. In a simulated-bed environment researcher establishes Tor non-exit relay and analyzes the Tor network and according to the statistic of results researcher creates a payload to penetrate the normal network and exploit router so, by penetrating it each router pingback routing table to the adversary. Here penetrating the half of the network router adversary (researcher) get full idea of the how many router in a network and list of ip-address of each router. In an emulated-bed setup, the researcher works with the actual Tor network and uses a payload to penetrate the Tor network and trace the location of the relays and also statistics and analysis of middle relay will helpful for penetration.

2 OBJECTIVES

The main objectives for this research are –

- To know about number of relays used for illicit communication.
- To observe and analyze Tor network in order to identify illicit traffic.

3 LITERATURE REVIEW

In the past decades there is a lot of work done against on traffic analysis of Tor network, previous researchers had done traffic analysis on either entry node or on exit node and in some case both S. Chakravarty, M. V. Barbera et al. [5] worked on effectiveness of active traffic analysis attack against Tor network using a statistical correlation method and Cisco NetFlow data to reveal a source of anonymous traffic which done in two phases and they monitor both enter and exit node relay data. [9] S. Chakravarty, G. Portokalidis et al. shows using two decoy servers they inject traffic pattern that exposes bait credentials for decoy services and deployed prototype implantation into the Tor network. Much research on traffic analysis happens on entry or exit points but this [6] R. Jansen, M. Juarez, et al. research conducted solely with middle relays and also worked on website fingerprinting to detect onion service usage. [8] Y. Gilad and A. Herzberg give methods to identify clients without eavesdrop on the communication to the server and also without relying on the traffic pattern using different network attacks and side channels attack based on two scenarios. P. Mittal et al. [7] showed that Tor (anonymity system) provide efficient service to its users by using full use of forwarding capacity and also this facility sometime leaks information about Tor relays in the circuit so, they present stealthy attacks based on throughput information can reduce uncertainty about bottleneck relay of any circuit whose throughput is observed to identify guard

relays and whether 2 concurrent TCP connection belong to the same user. Tor is always vulnerable against traffic analysis attack S. J. Murdoch and G. Danezis [10] present new traffic analysis technique shows which nodes are being used by Tor having a partial view of the network, this research gives a very good and brief idea about how to reduce the anonymity provided by Tor.

The actual creator of Tor P. Syverson et al. [1] talks about second-generation onion router (Tor) and gives a brief idea about how Tor network work and motto behind creating this extraordinary low latency, popularly used anonymous network and also talk about limitation in original design with improvements. Hidden server now a days known as onion servers are very crucial part of the Tor network because it allows clients(users) to interact with onion services L. Øverlier and P. Syverson [2] shows attacks on these hidden servers which reveals the location, there are the first actual intersection attacks on any anonymous deployed network. [4] P. Winter, A. Edmundson et al. studied and conduct an online survey of 517 users and 17 semi-structured interviews of Tor users on how they use onion services, network communication of Tor, problems regarding onion addresses and improvements needed in Tor and onion service. [3] Remembering onion service address is difficult so, J. Victors et al. introduce Onion Name System (OnionNS) which allows Tor users to reference any onion service by a meaningful globally unique verifiable name by the administrator. The researcher also get idea about ad-hoc network so [13] papers talk about cluster routing in traditional ad-hoc network.

4 RESEARCH METHODOLOGY

4.1 Architectural Diagram

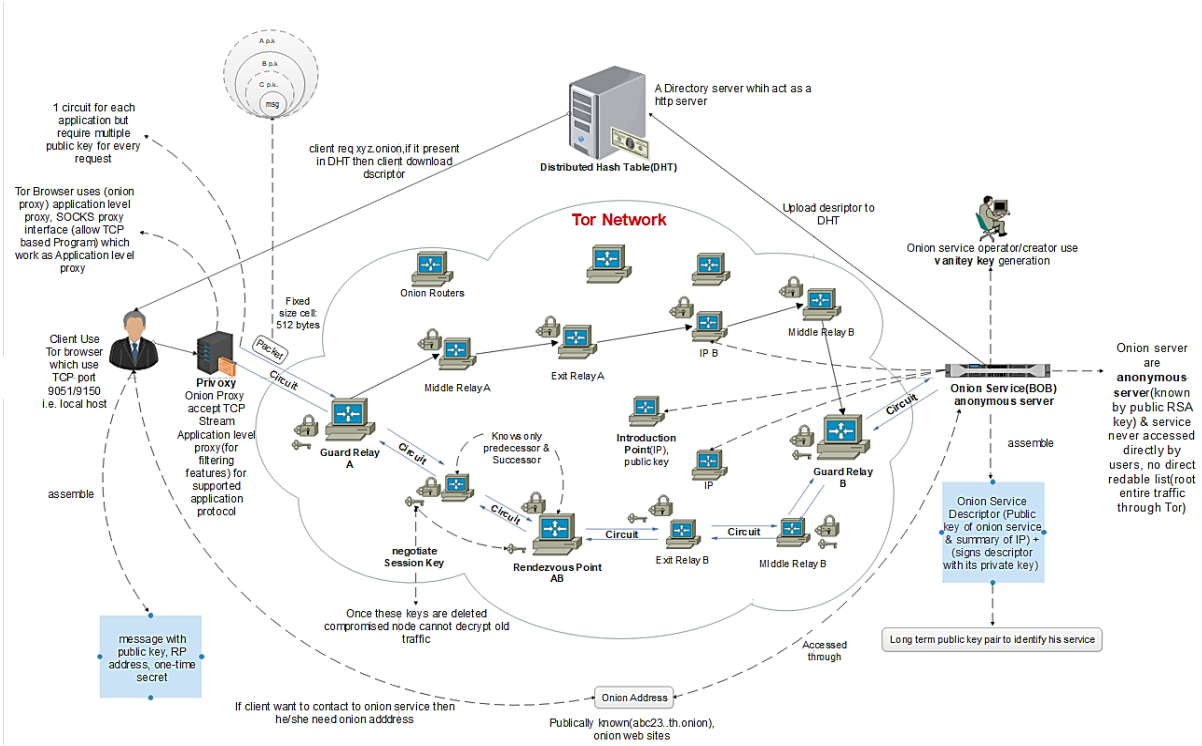


Fig. 4.1. Tor Architectural diagram

Onion routing protocol (Tor) is out-turn of a P. Syverson, M. G. Reed and D. Goldschlag which is created for protecting the user's anonymity while using the internet. Tor network is different from the traditional network, the backbone of Tor is onion servers and volunteer relays. Working of Tor is very stiff because first it needs onion servers which provide different onion services (OS) to Tor users; onion service creates a public key to advertise its existence inside Tor because a public key worked as an onion address through which users interact with different onion sites. OS creates an OS descriptor and uploads it to the Distributed Hash Table (DHT), now client/user download the DHT and knows about 16 characters long onion service address which is derived from services public key, after knowing onion address now client request to the DHT and ask services for connection. If the onion service exist and free to receive connection then client learns about onion service public key (onion service address) and IP-address, meanwhile client picks a random relay to build a circuit and assemble an introduction message (which contain one-time secret, address of Rendezvous Point) encrypt it with public key of OS and send it back to an OS till now 1st half is completed. 2nd half involves actual communication, OS receives the message and decrypts it with its own private key and learns about RP, OS creates a circuit through RP and further communication done through that circuit, here RP tells the client that connection established. Here the important part is RP doesn't know the OS and also the client, it only worked as a tunnel between client and OS, and 6 hopes are used in entire communication.

This research is about finding relays location using traffic analysis of Tor, the main agenda for this research is criminal uses dark web and deep web for accessing govt. confidential data, gain access to censored information, and other illegal online activities in which the black market utilizes the Tor infrastructure. The expected outcome of this research is to find relay location inside the Tor network with the help of traffic analysis to identify cyber-criminal illicit activities and malicious payload which gives how many numbers of relays used for illicit communication, and their location. As discussed Tor is very popular among those cyber buddies who hire hackers or criminals to do illicit activities which scathe govt. or other legitimate organizations, it directly affects the black market because it revels the relay location inside the Tor network so, for govt. defense department it becomes easy to trace them. To achieve the goal of the research, the researcher divided the process flow into two different phases, phase-1 and phase-2. Both uses in the analysis of tor network phase-1 are about simulation setup of tor middle relay and gathering logs, analyze it and payload injection in normal network second phase directly deals with actual tor network and traffic analysis of Tor, network attacks, payload injection and result analysis.

4.2 Detailed Operational Plan

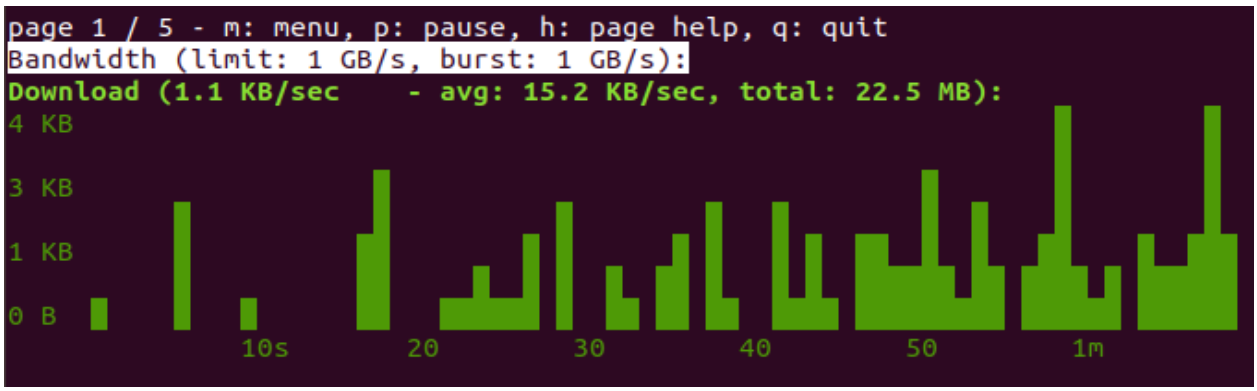
Whole research is work in two phases both phases covers the analysis of Tor network, the first phase is a simulated test bed environment in which tor middle relay is set up in two different Operating System (OS), Kali GNU/Linux kali-rolling version 2019.4, Ubuntu Bionic-Beaver version 18.04.3 LTS and to monitor relay utilization in Tor NYX version 2.1.0 is installed which gives very good idea about relay working in a graph format it also gives inbound and outbound connections details because NYX is a very useful tool to check relay utilization and if user want to modified then they can, by this setup researcher get good idea about behaviour of middle relay and analyse logs which gather data regarding the inbound and outbound connection. This setup is to run day and night for gathering good and truthful information which generate results and saves and maintain logs, this results use in analyzing tor network for finding crucial

information, here payload is vital part of the research and test-bed setup because payload helpful in locate the relay location, its written in python language, first researcher test the payload in normal network to gather router location (ip-address) to check whether it successfully penetrate the normal network or not, according to the researcher speculation if the payload failed to penetrate the normal network then it won't be able to penetrate complex and strong Tor network. To get the ip-address of router which are connected in peer-to-peer network researcher perform ethical attack here researcher make an assumption to check whether payload is able to bypass the firewall of network and router without revealing itself, if successfully worked and give list of routers ip-address in the whole network then this payload is mounted in Tor network, here payload is injected with https/http request to perform ethical attack, using those statistic researchers generate result which is helpful in phase two.

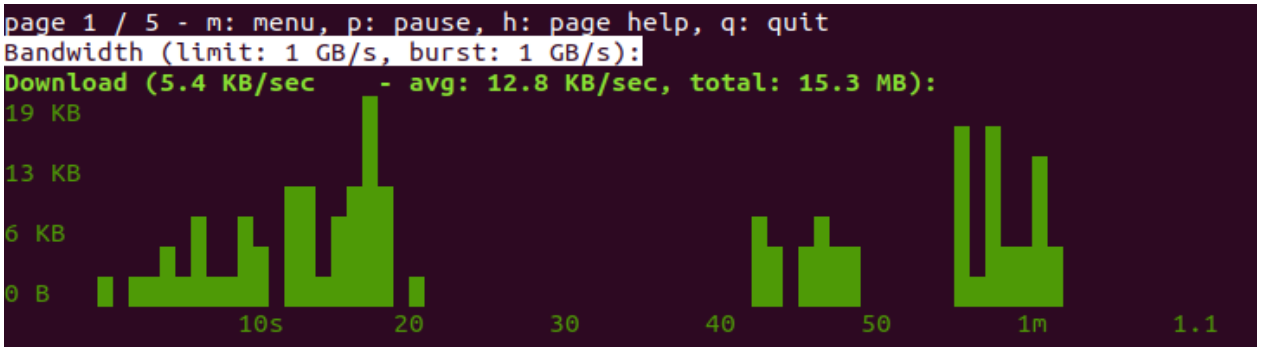
Phase two is an actual emulated bed setup in which researcher performs the real task on live Tor network, here phase-1 statistic and results are guiding researcher in performing the attacks on Tor network, phase two describes the live Tor network in which middle relay is also needed to observe and capture traffic for analysis purpose. According to the statistic of each relay, the researcher generates the results and using it, graph is generated to describe the process. Here payload plays the vital role in process because payload is used for generating an attack on Tor network and furthermore it's also used in monitoring the behavior of itself, here researcher assumes that payload is strong enough to penetrate the Tor network and give at least 1st relay location i.e. first middle relay location place after guard relay. Here main agenda of this is researcher first check the possibility of the payload whether it's powerful enough to give location of relay then researcher attaches the payload with http/https request and send it to the live Tor network. Here payload is programmed in such a way that it revert back ip-address of the particular relay and spreading automatically inside the Tor network. The payload design in such a way that it creates a persistence connection between two relay and create a circuit and each relay in a circuit ping back its own ip address to the adversary. If tor mechanism won't allow the payload to enter in network then researcher also have a solution i.e. it ping back its last location from where it is discarded. This gives idea where payload needs to be upgraded in order to enter the network.

5. ANALYSIS AND FINDINGS

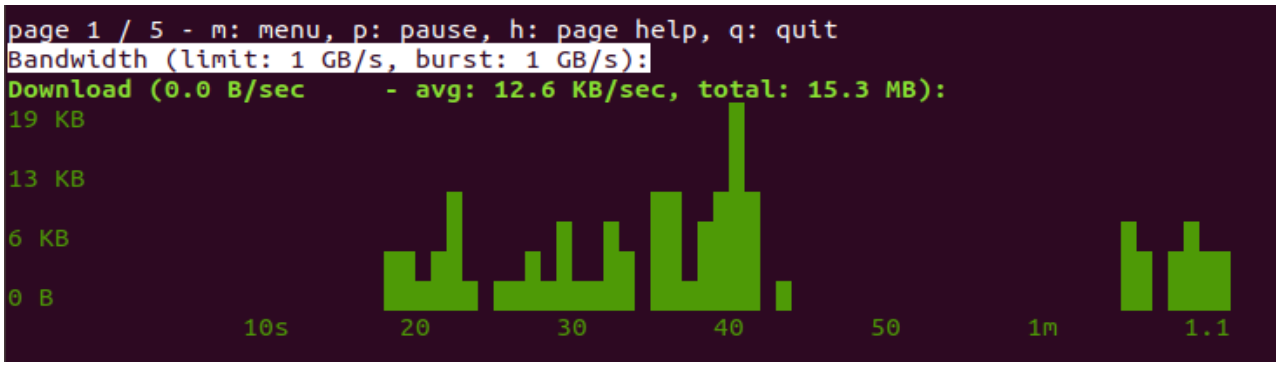
Graph 1 Download speed of In-bound connection



Graph 2 Download speed of In-bound connection



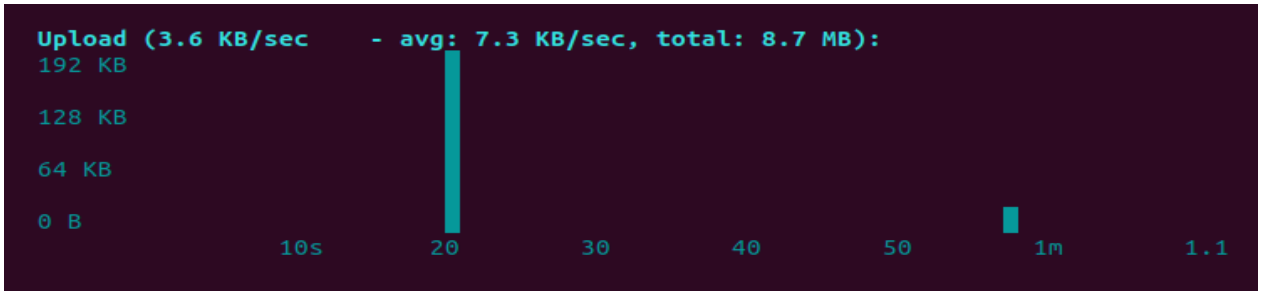
Graph 3 Download speed of In-bound connection



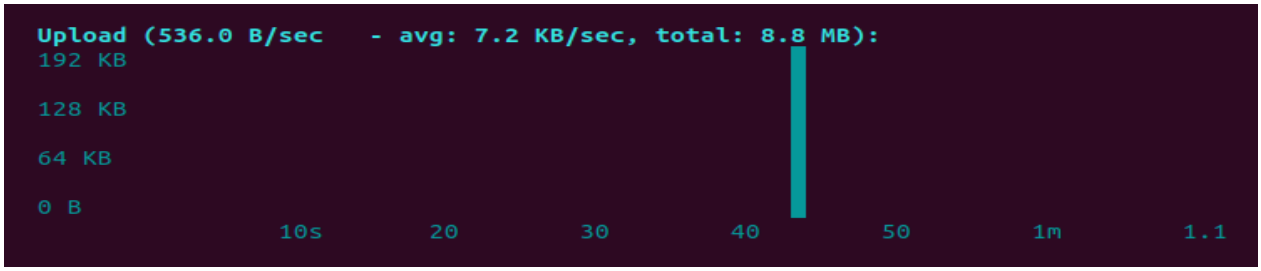
This above graph 1, 2 and 3 represents the in-bound connections download speed. Left side of the graph represents the speed in kilo bytes (kb) and below horizontal line represents time in seconds. This graph describes how many kbps of data is connected to tor middle relay. This is the graphical representation of the connection is made to tor middle relay (non-exit relay). This graph is continuously fluctuating with internet speed.

Graph 4 Upload speed of Out-bound connection

Graph 5 Upload speed of Out-bound connection



Graph 6 Upload speed of Out-bound connection



Graph 4, 5 and 6 represents the outbound connection of Tor middle relay same as in in-bound, vertical line represents the speed in kb and horizontal line represents the speed in seconds. This graph represents the rate of out-bound connection w.r.t connection established and leaving the tor non-exit relay.

Graph 1 and graph 2 is a graphical representation of the connection movements in tor network. To represents this graphical form of connection researcher use nyx tool.

NOTE: The graph 1, 2, 3, 4, 5 and 6 all are tested in Ubuntu OS.

Table: 1 Comparison between Browsers

Search string	Duckduckgo	Tor Browser	Google Browser
		Time format MM:SS:MS	
List of onion sites (general search)	00:03:83, 00:03:85, 00:00:53, 00:00:61	00:13:20	00:00:41 (4 times same result)
PROPUBLICA www.propub3r6espa33w.onion		00:55:50, 00:03:45, 00:01:31, 00:01:25	
thedarkweblinks.com	00:03:69, 00:02:86, 00:02:66, 00:02:58	00:06:78, 00:02:57, 00:02:63, 00:02:43	00:02:11, 00:01:90, 00:01:91, 00:01:90, 00:00:67, 00:01:61, 00:00:60
Facebook facebookcorewwwi.onion		00:03:45, 00:01:04, 00:00:99, 00:00:97	
Facebook (.com site)	00:01:06, 00:01:08, 00:00:70, 00:00:74	00:01:30, 00:01:10, 00:00:98, 00:00:89	00:01:40, 00:01:10, 00:01:02, 00:00:93, 00:00:92, 00:00:73, 00:00:64
sci-hub.tw/#about	00:01:33, 00:00:77, 00:00:74, 00:00:70	00:03:70, 00:00:99, 00:00:98, 00:00:86	00:03:51, 00:02:31, 00:01:93, 00:01:46, 00:01:32, 00:00:90, 00:00:79
Types of server (general search)	00:02:12, 00:00:89, 00:00:53, 00:00:63	00:02:55	00:00:63, 00:00:50, 00:00:46, 00:00:44, 00:00:48, 00:00:43 (4 times same result)
Dark web links (general search)	00:01:38, 00:01:92, 00:01:14, 00:00:75	00:09:33	00:00:40 (4 times same result)
thedarkweblinks.com	00:03:84, 00:03:13, 00:03:14, 00:02:76	00:05:20, 00:04:10, 00:04:12, 00:07:02	00:02:75, 00:01:92, 00:01:86, 00:01:78, 00:01:82
Drugs dark web link www.thedarkweblinks.com/page/7/	00:03:70, 00:03:44, 00:03:60, 00:02:40	00:02:99, 00:04:22, 00:03:01, 00:02:53	00:02:15, 00:03:22, 00:01:83, 00:02:40, 00:02:04
Drug website: Global Dreams www.zvz4ruc5b5q5yqz5.onion		03:01:99, 03:01:61 (connection timeout)	

Analysis of Tor browser w.r.t other browser is showing up here. Each column represents different information with different values and also each column colour represents different information. Here Yellow box represents that .onion site is not able to open in normal browsers, and Red box represents connection time out. Green colour represents search string and Orange, Grey; Blue colour represents a different search engine. Here some test uses college internet and some test uses home internet (GTPL network).

NOTE: There are some conditions which were considered while performing the practical

The researcher did not use any VPN (Virtual Private Network) while performing the task, there are other factors which also have to be considered in this practice like human error, Internet speed, Website responding time, well-known sites take less time than less known sites.

Table: 2 Attack Observation

Research Paper	*Traffic Analysis Attacks*	*Network Attacks*	*Injection of Traffic*	*Traffic Pattern Analysis*	*End-to-end Encryption Attack*	*Cryptography Attacks*	*Side-channel Attack*	*Decoy traffic injection*	*Payload injection*
[1]	NO	NO	NO	NO	NO	NO	NO	NO	NO
[2]	NO	YES	NO	YES	NO	NO	NO	NO	NO
[3]	NO	YES	NO	NO	NO	YES	NO	NO	NO
[4]	NO	NO	NO	NO	NO	NO	NO	NO	NO
[5]	YES	YES	NO	YES	YES	YES	NO	NO	NO
[6]	YES	YES	NO	NO	YES	YES	NO	NO	NO
[7]	YES	YES	NO	NO	YES	YES	NO	NO	NO
[8]	YES	YES	NO	YES	YES	YES	YES	NO	NO
[9]	YES	YES	YES	YES	YES	YES	YES	YES	NO
[10]	YES	YES	NO	YES	YES	YES	NO	NO	NO
[11]	YES	YES	NO	YES	YES	YES	NO	NO	NO
[12]	NO	NO	NO	NO	NO	NO	NO	NO	NO

The researcher study Tor network and on the basis of some research paper researcher make a list of common attacks which can be used to analyze or penetrate the Tor network. The observation table is the analysis of the researcher's work.

6. CONCLUSION

This research paper gives a good idea about working of the Tor network, how the client/user connects to the Tor network and actual communication happen inside Tor which helps and guides readers to further analysis of Tor and future work. The researcher talks about how payload helpful in the entire research. This research is based on identifying relay location with the help of payload by binding it with the http/https request and sends it to the Tor network and analyzes the behaviour payload and also getting ip-address of a relay in a circuit. Here traffic analysis of a Tor plays a vital part to understand the Tor network in order to perform network attacks.

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GROWTH MANAGEMENT SYSTEM OF BAYER VAPI PVT. LTD.

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ABSTRACT

Growth Management System is being introduced in Bayer Vapi Pvt. Ltd. in the year 2018 which helps in evaluating and rating the performance of blue collar employees on the basis of key performance parameters set with indicators. This system gives clarity on the expectations from these employees and focuses on their positive efforts, and those employed with the organization for three months and above will be a part of this system, but will not include those who are leaving this organization or serving their notice of leave. This paper presents the overall study of Growth Management System as a tool of performance measurement by adopting the Performance Management System as a strong foundation for the study. This study objectively aims to get a real glimpse of this system with the help of views or perceptions of both the managerial level and senior technical level employees of this company which comprises of Functional Heads, Plant Managers and Plant Engineers, and Shift In charge employees of the company. The methodology used for this study is a mix of primary and secondary research tools. This study concludes on the note of capturing the positive feedback with respect to the implementation of this system and serving the purpose of employee development, thus being resulting into the increased motivation and satisfaction.

Keywords: Growth Management System, performance measurement, employee development

1. ABOUT THE COMPANY

In 1990, Mitsu Industries Ltd. was established for manufacturing intermediates and agrochemicals in GIDC, Vapi and manufacturing started with the help of two plants and a small team. With in-house research and development, it produced some of the most complex molecules of crop protection chemicals. In the year 1991, the Bilakhia brothers stepped ahead with the vision to emerge as a market leader in agro chemical industry and started to manufacture Permethrin. Within a span of 8 years the company ranked among the top three producers in the world and became much strong in the chemical sector and was equipped with the best manufacturing facilities of the world. In 1999, Mitsu entered into a joint venture with Hoechst Schering AgrEvo and Bilag Industries Pvt. Ltd. was formed with two shareholders, viz. Hoechst Schering AgrEvo GmbH and the Bilakhia Group. In 2000, Hoechst Schering AgrEvo GmbH underwent a merger with Rhone Poulenc (inception of Aventis Crop Science) and Bilag, which was a part of Aventis Crop Science SA. In 2002, Aventis Crop Science was acquired by Bayer, and Bilag became a part of Bayer and thereafter in 2013, Bilag was renamed as Bayer Vapi Private Limited. Bayer Vapi Pvt. Ltd. is the single largest manufacturer of Synthetic Pyrethroids in the industry today. It manufactures Imidacloprid and Ethofumesate (Herbicide) and also various pyrethroids as insecticides for agriculture and environmental science. Products are manufactured by Bayer Vapi Pvt. Ltd. across two categories: Active Ingredients and Intermediates for which it has 11 manufacturing plants. The company covers all main elements of the charter with their QHSE (Quality, Health, Safety & Environmental Protection) management systems and activities.

2. ABOUT THE TOPIC

Growth Management System is the system which has been introduced at Bayer Vapi Pvt. Ltd. in the year 2018 and it has been designed by the Bangalore based software company JS Malhan (JSM). In 2018, it was for the very first time that the performance of blue collar employees was evaluated and rated with the help of this system and also various performance parameters with some important indicators were defined and set.

The objectives of Growth Management System (GMS) are as follows:-

- Establish a performance oriented culture.
- Acts as a performance assessment system.
- A feedback system focusing on the development processes.
- Gives directions to the employees on how to achieve the meaningful goals.
- Closely monitor the performance and progress of individuals.
- Reward and motivate the high performers.

2.1 Overall GMS process

GMS process is divided into the following stages:-

1. Communication of goals:

First of all, the goals to be achieved are communicated by the Plant/Function Heads to the blue collar employees or workmen. These goals are communicated to the employees by head/manager of a particular department for around two months.

2. Goal setting process:

Following are the main sequential steps for Goal setting process:-

a) Human Resource (HR) department finalizes the timelines and send communication for the commencement of Goal setting process.

b) Group Goals are set by the Plant Manager/Function Head for the workmen and displayed on the notice board.

c) The workman will provide his sign on the sheet as acknowledgement and this signed sheet of workman will be sent by the immediate supervisor to HR department.

d) HR department will review the status of goal setting exercise and generate the status report for the management on compliance with the timelines.

3. Interim Review (Mid-year Review):

Following are the main sequential steps for Interim Review:-

a) HR department initiate the mid-year review process and send the communication to the immediate supervisor.

b) One-to-one discussions take place between the workman and immediate supervisor along with the performance feedback during the half year and course correction also takes place if needed.

c) The immediate supervisor then enters the feedback for mid-year review in this system or tool.

4. Annual Review (Year-end Review):

Following are the main sequential steps for Annual Review:-

a) HR department initiate the year-end review and send communication along with the relevant data like attendance, warning letters, etc. to the immediate supervisors.
b) One-to-one discussions take place along with the performance feedback between immediate supervisor and workman during the year (year-end).
c) The immediate supervisor assigns the rating against each element in goal sheet and takes the average of all Ratings to determine the final Performance Rating.
d) The plant manager/functional head review the Ratings of workmen in their own plant/function and send to the HR department.
e) The immediate supervisor communicates the individual final performance rating to the reporting workmen; as a result, the workmen receive the final performance rating.
f) The workman can raise and address the appeal if he is dissatisfied with the given Rating and he can refer to the grievance redressal process. He then provides the sign-off on the assigned rating.
g) Finally, the immediate supervisor enters the year-end review in this system or tool along with the Employee Development Needs.

2.2 *Table 1: Performance Parameters with Indicators*

KRA	KPIs
Business Objectives	
1. Safety	Loss Time Reportable Injuries (LTRI), Loss Of Primary Containment (LOPC), Accidents, Near Miss Reporting
2. Process Adherence	Standard Operating Procedure (SOP) + Yield + Quantity
3. Housekeeping	Ensures clean workplace area
4. Behavior	Interpersonal relations, discipline, HR actions

Source: Bayer Vapi Pvt. Ltd.

2.3 Performance Rating Scale

1. Outstanding (Unique): An employee whose performance is excellent and he is a role model for his behavior and work.
2. Strong: An employee who is very good in his performance and he is very much consistent and he knows what he is doing.
3. Developing: An employee who is good in his performance and is still improving and working upon increasing his efficiency.
4. Lacking: An employee who is not so efficient in his performance and needs to be constantly monitored and requires the major improvements on certain areas.

3. LITERATURE REVIEW

(Civil Service Rules, 1997) The aim of this study is to understand that the performance management system is intended to:

a) "Relate *performance objectives to the goals and objectives of an organization"* so that all employees should understand how their jobs are important contribute to the overall success of the organization.

b) "Provide *planning and evaluation"* for the performance expectations and developmental needs of the employees as they are related to the overall organizational effectiveness.

c) "Foster *accountability"* to assure that the responsibilities of employees with respect to their jobs is well defined and is met.

d) "Foster *employee-supervisor discussions"* about organizational goals and objectives, continuous improvements in methods of doing the work, individual job expectations, job performance, and employee development needs.

(Simeka Management Consulting, 2004:12) This study examines that a Performance Management System (PMS) is an authoritative framework for managing the performance of an employee which includes a policy framework and also a framework being related to all aspects and elements in the performance cycle including performance planning and agreement, performance monitoring, review and control, performance appraisal and moderating, and managing the outcome of performance appraisals. *(Amos et al., 2008: 286)* In this paper, the author tries to examine that to be precise, a PMS gives guidelines on how everything should be done in the performance management, right from the goal setting and deciding on how to measure the achievements till the process of providing the regular assessment. A PMS is also a process that begins by translating the overall objectives of an organization into clear individual objectives which will be set as targets for the employees on a quarterly or on an annual basis.

(Helm et al., 2007) This paper aims that the Performance Management System (PMS) is very important for the performance of an organization because of the following reasons:

a) It enables the organization to achieve its goals and vision and accomplish its objectives properly.

b) It is very much essential to develop a performance oriented culture within the organization.

c) It aligns the goals of performance of the employees with the strategic goals of an organization.

d) It ensures that each employee is having the clarity regarding the performance expectations set by an organization.

e) It improves the performance of each employee and identifies the talented people for promotion and it also emphasizes to link the salary and performance.

4. PROBLEM STATEMENT

Earlier, for measuring the individual performance during the entire year the company was not having any mechanism. As a result, the good performers were also rewarded the same as the average or poor performers. Hence a systematic process to evaluate the individual performance was required and thus the company introduced the Growth Management System. Therefore, the study has been undertaken to understand about the implementation of the Growth Management System (GMS) by using the Performance Management System as a concrete base for the research objectives.

5. OBJECTIVES

- To study the mechanism of the Growth Management System as a tool of performance measurement.
- To identify the various components of Growth Management System that help in the improvement of employees' performance.
- To measure the agreement of the employees towards the outcomes achieved through Growth Management System.

6. HYPOTHESIS

1. H0:- Leadership and interpersonal skills doesn't get strengthened due to improvement of manager-employee relationship.

   H1:- Leadership and interpersonal skills does get strengthened due to improvement of manager-employee relationship.

2. H0:- Positive or negative behavior does not get captured due to the open and complete communication.

   H1:- Positive or negative behavior does get captured due to the open and complete communication.

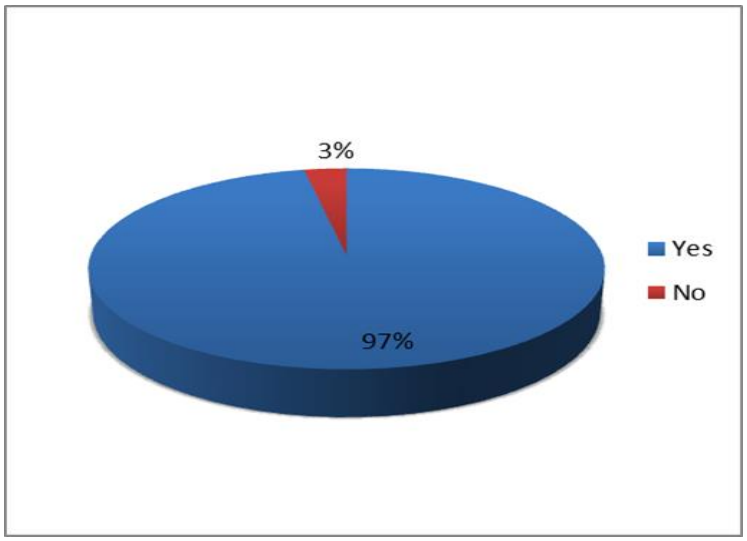
7. RESEARCH METHODOLOGY

Particulars	**Description**
Research Design	Descriptive research
Data Collection Method	Primary Data and Secondary Data
Primary Data	Online Structured Questionnaire (Microsoft Word Form)
Secondary Data	Organizational website, articles, internet, books and other references.
Sampling method	Non-random sampling:- Convenience sampling
Sampling Frame	Functional Heads, Plant Managers and Plant Engineers, and Shift In charge employees of the company
Sample size	80
Tools used for analysis	Charts and graphs, Chi-Square Tests, Cross tabulation

8. DATA ANALYSIS AND INTERPRETATION

8.1 Charts and graphs

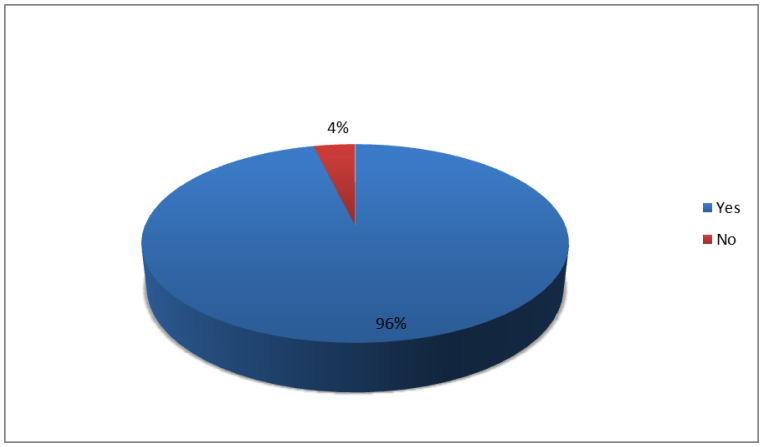
Chart 1. Fair Performance Ratings as based on the facts



This chart represents that about 97% of the respondents agree that the Performance Ratings awarded through this system are fair as based on the facts as these ratings help in monitoring the individual's performance and progress in the organization while 3% of the respondents disagree on the same.

Source: Calculation from collected Primary Data

Chart 2. Supporting the respondents to gain more insights into their strengths and areas of development

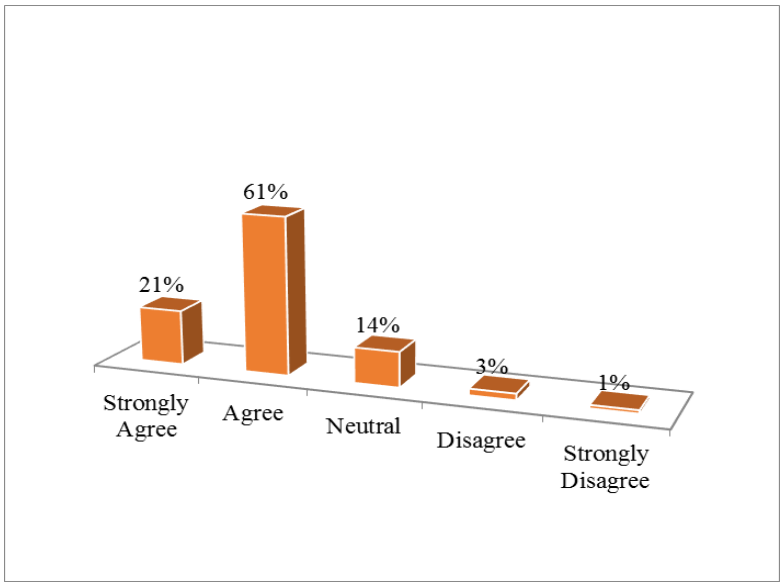


This chart illustrates that about 96% of respondents agree that this system supports the employees to gain more insights into their strengths and areas of development because it provides feedback on an ongoing basis and also the feedback is being provided on the areas of development while 4% of respondents completely disagree on this angle of the system.

3. Creating a participative environment

Source: Calculation from collected Primary Data

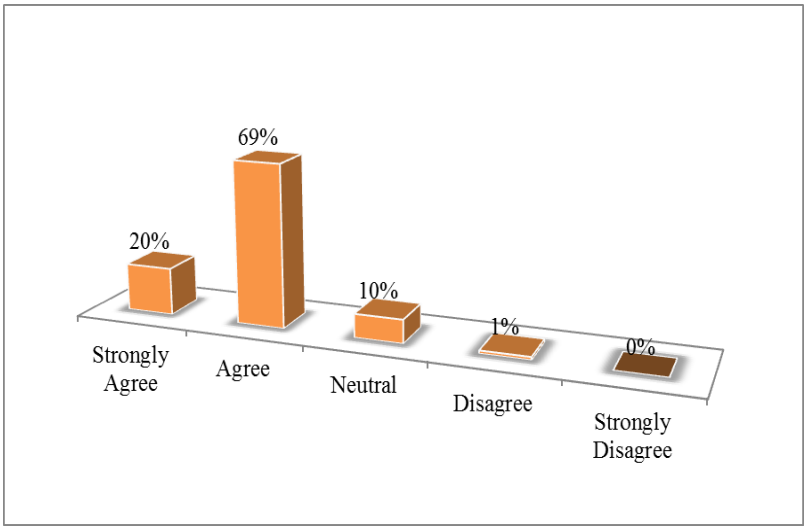
Chart 3. Creating a participative environment



Source: Calculation from collected Primary Data

This chart shows that about 21% of respondents strongly agree that the implementation of this system in the company create a participative environment with which it focuses on positive achievements and efforts and building a strong base for participation of each individual while 61% agree for the same, 14% are of the neutral opinion, 3% of them disagree on it and only 1% of respondents strongly disagree on the same.

Chart 4. Identifying the training needs



Source: Calculation from collected Primary Data

This chart represents that about 20% of respondents strongly agree that this system identifies the training needs of employees as this system undertakes the annual review along with the Employee Development Needs for this purpose and also the communication of performance rating can be linked to training and development, 69% of respondents agree for the same, 10% are of the neutral opinion, only 1% of them disagree on it and no respondent strongly disagree on the same.

8.2 Hypothesis Testing

For the hypotheses which are stated in **HYPOTHESIS** part**,** both the "variable" and "outcome" for the respective hypothesis have been framed which can be referred to in this part and statistical tests have been applied.

1. Variable: Improvement of manager-employee relationship
   Outcome: Strengthening of leadership and interpersonal skills

Table 2: Cross tabulation

		Improvement of manager-employee relationship		
		YES	NO	Total
Strengthening of leadership and interpersonal skills	YES	74	2	76
	NO	3	1	4
	Total	77	3	80

Source: Calculation from SPSS Software

Interpretation: Out of 80 respondents, 76 have agreed that leadership and interpersonal skills gets strengthened due to improvement of manager-employee relationship.

Table 3: Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.268[a]	1	.022		
Continuity Correction	.893	1	.345		
Likelihood Ratio	2.591	1	.107		
Fisher's Exact Test				.144	.144
Linear-by-Linear Association	5.202	1	.023		
N of Valid Cases	80				

Source: Calculation from SPSS Software

Interpretation: As the sig-value is more than 0.05 statistically we fail to reject null hypothesis, which means that the leadership and interpersonal skills doesn't get strengthen due to improvement of manager-employee relationship.

2. Variable: Open and complete communication.
Outcome: Capturing the positive or negative behavior.

Table 4: Cross tabulation

		Open and complete communication			
		Neutral	Agree	Strongly Agree	Total
Capturing of the positive or negative behavior	YES	6	53	19	78
	NO	1	1	0	2
	Total	7	54	19	80

Source: Calculation from SPSS Software

Interpretation: Out of 80 respondents, 78 have agreed that positive or negative behavior gets captured due to the open and complete communication.

Table 5: Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.569[a]	2	.102
Likelihood Ratio	3.004	2	.223
Linear-by-Linear Association	2.829	1	.093
N of Valid Cases	80		

Source: Calculation from SPSS Software

Interpretation: As the sig-value is more than 0.05 statistically we fail to reject the null hypothesis, which means that the positive or negative behavior does not get captured due to the open and complete communication.

9. FINDINGS

❖ About 95% of the respondents believe that Growth Management System helps in strengthening the leadership and interpersonal skills of employees at their best level as it serves as a feedback system focusing on the development processes.

❖ About 92% of respondents agree that this system helps in creating a healthy competition in the particular department and it continuously focuses on establishing the performance oriented culture.

❖ About 55% of respondents agree that Growth Management System has focused on the increased communication as this system concentrates on proper communication of goals and performance rating and also maintaining the communication balance while 35% of respondents agree that this system has focused on behavior as behavior reflects the discipline and inter-personal relations and 10% believe that suggestions is the focus point of this system as suggestions are an important part of the participative environment in the company.

❖ About 68% of respondents believe that this system being introduced as a new process of performance evaluation on the shop floor has been accepted by the blue collar employees because this system has been developed as such that it can judge the individual performance with the help of performance parameters and can provide the rewards and recognition to these employees.

❖ About 96% of respondents believe that this system aims at strengthening the manager-employee relationship through mutuality, confidence and trust as this system continuously support and encourage the employee inputs on areas of improvement.

❖ About 97% of respondents believe that this system provides them the opportunity to capture the positive/adverse act or behavior on regular course of time.

❖ About 54% of respondents believe that performance review discussions is the most challenging side of this system as it involves one-to-one discussions with performance feedback, while 10% believe about the communication of goals being the most challenging side of this system. 25% of them believe that high expectations is the most challenging side as this system recognizes and motivates the high performers, 11% of respondents are of the opinion about the contribution statements being the most challenging side of this system.

❖ About 67% of respondents agree that this system encourages the open and complete communication between manager and employee through performance review discussions as in both the interim review and annual review the managers and employees are conducting one-to-one discussions with feedback regarding the performance while 24% of respondents strongly agree for the same, 9% are of the neutral opinion and no respondent either disagree or strongly disagree on the same.

❖ About 97% of respondents agree that Growth Management System is in line with the company's vision 2023 as it mainly focuses on the future development of employees.

10. CONCLUSION

Growth Management System (GMS) implemented by Bayer Vapi Pvt. Ltd. is designed in such a way that the management level employees which consists of both the managerial level and senior technical level shall be able to evaluate the performance of blue collar employees and analyze their contribution to the organization periodically so, the performance appraisals are being used as a significant tool. Because of the implementation of this system, the blue collar employees who once might have found that they have no or little growth in the organization can now be more motivated and boosted by their management level

employees, thus it serves the purpose of employee development. This study was undertaken to understand about the overall viewpoint with respect to the implementation of the Growth Management System which has reflected the positive feedback from both the organizational and employees' perspective as its implementation has resulted into the increased satisfaction of the employees and its readily acceptance as a new process of the performance evaluation.

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APPLICATION OF MARKOWITZ MODEL IN INDIAN STOCK MARKET - REFERENCE TO BOMBAY STOCK EXCHANGE

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ABSTRACT:
This Research has been carried out to test whether the Markowitz Framework of Construction of Portfolio offers the improved Investment alternative to Investors of Indian Stock Market. This research has applied Markowitz Model on 30 Listed Securities of Bombay Stock Exchange. It can be found that this model provides better insights to the investors for investment purpose. To evaluate the performance of Portfolio Sharpe and Treynor's measure has been used.

Key words: Portfolio Selection, Portfolio Evaluation, Markowitz Model. Bombay Stock Exchange

1. THEORETICAL FRAMEWORK:

1.1 Tradition Portfolio Theory:
According to traditional portfolio theory return is appreciation in price or dividend declared by a firm over a period of time. But it is must for the forecaster or an investor to approximate future return of an enterprise to predict future return of a stock.

The analyst is likely to think about risk as the possible down side price expectation. Each shareholder assumes a roughly channel return and risk on their funds. That does not mean that the decade old traditional portfolio theory is not successful. It is just not useful or in terms of its main purpose of earning higher returns.

1.2 Modern Portfolio Theory
Harry Markowitz, Developed Modern Portfolio theory in the year of 1952. He received Nobel Prize for this invention. According to him any investors who invest in stock market or anywhere else, want to minimize the risk and maximize. It is nothing but an optimization of Risk Return ratio to Stock Investors.

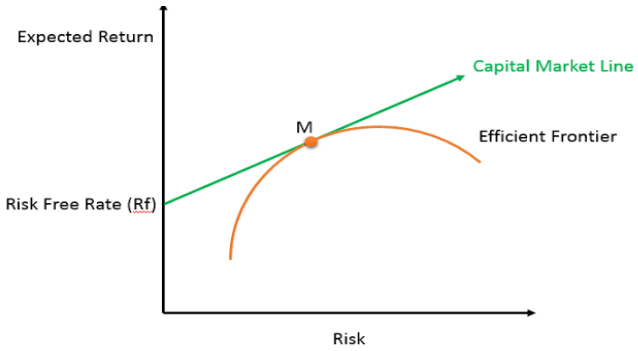

Figure 1 Efficient Frontier

Modern Portfolio Theory specifies that it is not enough to look at individual security for its market risk and company specific risk. An investor can take advantage of diversification by investing in different security by that minimizing risk of a investing in single security and can reduce volatility of portfolio (Markowitz-1952)[1].

1.3 Introduction to Indian Stock Market:

The Bombay Stock Exchange is considered Asia's Oldest Stock Exchange. Its head quarter is in Mumbai India. It was established in a year 1875. Initially it was a broker's association known as Native shares and Stock Brokers Association. Before that all the share brokers were used to gather under banyan tree to carry on transactions.

BSE Ltd, the first ever stock exchange in Asia established in 1875 and the first in the country to be granted permanent recognition under the Securities Contract Regulation Act, 1956, has had an interesting rise to prominence over the past 143 years.

The Bombay Stock Exchange deals with trading in derivatives, equity and other debt instruments, the Bombay Stock Exchange introduces the first Exchange Traded Index Derivative Contract in 2000. The Index Options started to be traded from 2001 whereas the single stock futures were traded from 2002. The weekly options were introduced in 2004[2]

2. LITERATURE REVIEW:

Rita Ambrozaite, undertook study on," Danish Mortgage Bond Portfolio Optimization Using the Mean-Variance Approach'. Objective of this portfolio was to construct portfolio with highest possible return in Danish Mortgage Market. In other word how to maximize Sharpe Ratio? To achieve an objective Markowitz mean variance methods has been applied to data available from Danish mortgage bond Market. Author proved that the sensitivity of the value of the optimal portfolio to market interest rate fluctuations was not markedly different.

Ioana Coralia Zavera in his paper titled, "Application of Markowitz Model on Romanian Stock Market", tested application of Markowitz model in Romanian market by creating a portfolio comprised of three securities. Author calculated efficient frontier and Minimum Variance Portfolio for the stock in Romanian Market.

M. Ivanova and L. Dospatliev conducted research titled, "Application of Markowitz portfolio optimization on Bulgarian stock market from 2013 to 2016". This paper was conducted with object to offer realistic study and application of Markowitz model on the Bulgarian Stock market for the period three years period. Author created efficient frontier by simulating various weight option and created Minimum Variance Portfolio.

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Another researcher Raghavendra S Bendigeri[3] wrote research paper titled," Optimal Portfolio Construction Using N – Assets Mean –Variance Portfolio Model: Study of Four Etfs of BSE" with objective of to create an optimum portfolio comprised of exchange traded fund using N – Asset Mean variance Portfolio model. A Variance – covariance matrix and Correlation matrix has been calculated to further employ the model. Researcher used GRG – Non Linear Optimization Method to calculate optimum weight for portfolio.

3. RESEARCH METHODOLOGY

The process used to collect information and data for the purpose of making business decisions. The methodology may include publication research, interviews, surveys and other research techniques, and could include both present and historical information.

Research Objectives:

1. To Understand Markowitz Model and Its Applicability in Bombay Stock Exchange
2. To Know Markowitz Framework of Construction of Portfolio offers the improved Investment alternative to Investors of Indian Stock Market
3. To Identify the efficient Portfolio with the help of Efficient Frontier

Sample Size and Sample Selection:

Below mentioned stocks have been selected on following criteria-

- Only those stocks has been selected which gave return more than RFR
- The research period is from the year January 2008 to December 2016. Hence only that Stock selected which has been listed on BSE since last ten years.

This study is based on risk and return data of 75 selected stocks listed on Bombay Stock exchange has been shown in Annexure. Refer Annexure 1 for the same. The List has been given below:

Table 1 List of Selected Security

ACC	BOMBAY BUMRAH	EICHER
ADANI	BOSCH	FINOLEX
AIA ENGINEERING	BPCL	GLAXO PHARMA
AMBUJA	BRITANNIA	GLAXO CONSUMER
ASHOK LAYLAND	BUTTERFLY	HEVELLS
AUROBINDO	CADILA	HAWKINS
AXIS	CIPLA	HDFC
BAJAJ FIN.	CUMMINS	HERO MOTO
BIOCON	DIVIS	HIND ZINC
BLUE STAR	DR REDDY	HINDALCO
HITACHI	LEEL	NESTLE
IFB	LUPIN	ORACLE
INDIABULLS REALESTATE	M & M	PETRONET

[3] Raghavendra S Bendigeri, Optimal Portfolio Construction Using N – Assets Mean – Variance Portfolio Model: Study of Four Etfs of BSE, IOSR Journal of Business and Management (IOSR-JBM), e-ISSN: 2278-487X, p-ISSN: 2319-7668,PP 24-29

INDRAPRASTAH	MARUTI	PIRAMAL
INDUSIND	MIND TREE	RAIN
ITI	MOTHERSON SUMI	RAMCO
JSW	MPHASIS	SHREE
KAJARIA	MRF	SOBHA
KOTAK MAHINDRA	MRPL	STERLITE
KRBL	NCC	SIMPHONY
TATA COMM	THERMAX	UNITED SPIRIT
TATA STEEL	TORRENT	VEKARANGEE
TATA	TTK PRESTIGE	VEDANTA
TCS	ULTRATECH	WELSPUN
TECH MAHINDRA	UNITED BEVE	WHIRLPOOL

The data for the study have been collected from the publications and website of BSE. After collection of data following procedure have been applied to create a two stock portfolio based on Markowitz Model

1. Mean Return, Standard Deviation and Beta of each stock has been calculated for the period of 10 Years that is From January 2008 to December 2017.
2. Total two Thousand eight hundred and Fifty - Two stock portfolio can be formulated and correlation of this portfolio Correlation of these thirty stocks has been calculated.
3. Out of these 2850 pair of Portfolio 50 Portfolio has been selected which has the least Correlation as per Markowitz.
4. After that Minimizing Weight, Portfolio Return and Portfolio Risk have been calculated for this 50 Portfolio based on the Monthly return of last ten years available.
5. After than an Efficient Frontier of each Portfolio has been developed on the basis of Mean Return and Risk of the portfolio which is derived by researcher.
6. To check the Portfolio Performance and Evaluation of Portfolio Sharpe's Measure and Taynors Measure calculated on the portfolio and then Ranking has been given to these portfolios.

4. ANALYSIS AND DISCUSSION:

4.1 Risk and Return of individual Security:

If we look at the mean return and SD data of Sample Company, Every company is providing Return more than 0.62% which is RFR.

Ambuja Cement has registered mean return of Monthly average is 0.86%. The highest return earned by Symphony 5.28% monthly return followed by Eicher (4.38%) and Butterfly (4.31%) The lowest return earned Tata Communication that is 0.68% Followed by Divis Lab that is 0.

The highest Risk confront by stock Nestle that is -5.93% followed by Glaxo Pharma (-7.17%) and Cipla (-7.18%). The stock of Butterfly and Bombay Bumrah Registered the Lowest risk that is -0.1883 and -0.19677 respectively.

4.2 Selection of Stocks for Two-Stock Portfolio:

Table 3: Least Correlation Portfolios:

As per Markowitz a portfolio constructed from the Group of those securities which is negatively Correlated should be selected to reduce risk. This argument is very valid as negatively correlated security will move in opposite to each other and in any case of Boom or bull of stock market one will go up and another will reduce and balance will be maintained between these two securities.

From 75 selected sample total 2850 Pair of Two stock portfolio can be Created out of these 2850 portfolios total 50 Portfolio selected which has correlation Coefficient less than 0.01. The portfolios total summary of correlation has been given in following table.

Table: 2 - Summary of Least Correlated Portfolio Set

Less than 0.1	180
0.100 to 0.199	474
0.200 to 0.399	669
0.400 to 0.599	655
0.600 to 0.699	484
0.700 to 0.799	237
0.800 to 0.899	62
0.900 to 0.999	14
Greater than or equals to 1	75

4.3 Calculation of Weight, Expected Return and risk of 50 Portfolio:

Appling Markowitz Model Minimum weight of each 50 portfolio obtained and risk and return of the each portfolio Calculated. When calculated, Minimum Weight, Its Expected Return and Expected risk for these 50 Portfolios. Following results were obtained.

The Total 50 pair of portfolios has been compared here and the maximum expected profit earned by Portfolio no 31 that is VEKARANGEE and TCS pair which is followed by Portfolio no. 23 which is comprised of VEKARNGEE and BRITANNIA this portfolio earned return of 2.45% Monthly return with 0.05 of Risk. The return of the portfolio ranges between 2.45% monthly to 0.05%. The Pair no. 31 earned the highest return and pair no. 4 earned the least return of 0.02% which is comprised of TTK PRESTIGE and BRITANNIA.

4.4 Identification of Efficient set:

An Efficient Frontier has been developed using Return and Risk data of given Portfolios. The best pair of 5 Portfolio has been identified from the given Efficient Frontier.

Fig. 2 below shows the Return and risk Pattern of fifty two stocks Portfolio. In the figure the lowest point has been shown denoting the lowest return earning portfolio but it is not providing lowest Risk and hence not considered in Minimum variance Portfolio. The line here shown in orange is an Efficient Frontier.

According to Markowitz the Portfolio Makes this line are efficient Portfolios. This portfolio provides Minimum risk among all the portfolios with maximum Return.

The five portfolios have been identified as Efficient Portfolio in this Research all those portfolio Shown in Table Below.

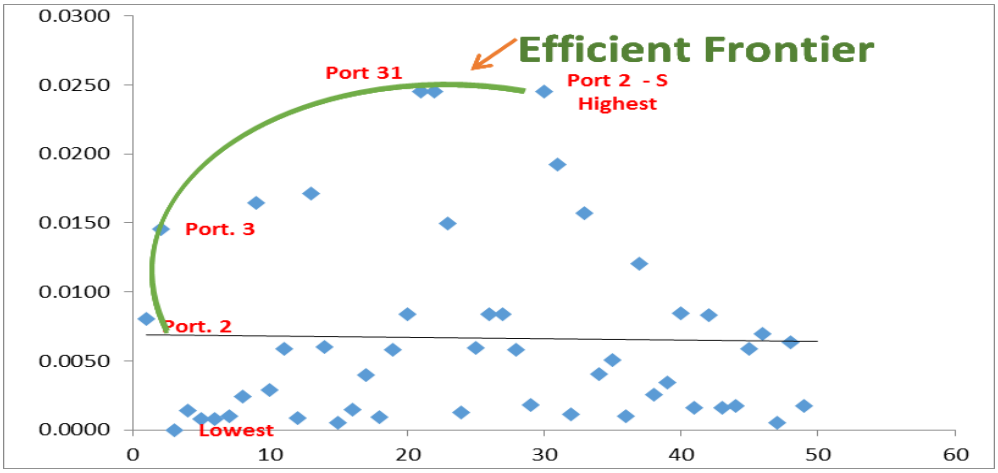

Figure: 2 Efficient Frontiers and Set of Efficient Portfolio

Table: 3 - Set of Efficient Portfolio

Port No.	Security 1	Security 2	Return R(p)
2	MINDTREE	IGL	0.0081
21	MINDTREE	BPCL	0.0084
3	KRBL	BRITANNIA	0.0146
31	VAKRANGEE	TCS	0.0245
22	VAKRANGEE	NESTLEIND	0.0245

Portfolio set no. 2, 21, 3, 31, and 22 are identified as an Efficient Portfolio according to Markowitz Efficient Frontier. Now to check the performance Evaluation of a Portfolio Shape and Taynors Ratio has been calculated.

Applying the Markowitz to twos asset portfolio, It can be found that five portfolio are efficient portfolio out of all the 50 Portfolios. Even though, it is necessary to found the better portfolio from the given portfolio. For this purpose Sharpe and Treynor gave two different methods to rank the performance of the portfolio.

Sharpe ratio is the quantifying of risk-adjusted return of a portfolio. A portfolio with a higher Sharpe ratio is considered better relative to other portfolio with lower Sharpe ratio. . The measure was named after William F Sharpe, a Nobel laureate and professor of finance.

Table: 4 - Ranking of Efficient Portfolio as per Sharpe's ranking

Sr. No.	Sharpe = Rp-Rf/ SDp	RANK
PORT22	0.58	1
PORT3	0.13	2

PORT2	0.13	3
PORT31	0.07	4
PORT21	0.06	5

As stated in above table if you calculate Sharpe the ranking of Sharpe is given the best portfolio is Portfolio 22 as it has the highest Sharpe ranking whereas the same result can be shown from Treynor's ranking as well.

Treynor Ratio gauges how efficiently the fund manager achieves the balance between return and risk of the portfolio. Unlike Sharpe Ratio, it makes use of beta in the denominator.

Table: - 5 Ranking of Efficient Portfolio as per Treynor Ranking

Sr. No.	Treynor's Ratio	RANK
PORT22	0.86%	1
PORT3	0.86%	2
PORT2	0.83%	3
PORT31	0.48%	4
PORT21	-0.34%	5

5. CONCLUSION:

Here, it can be found that from the Markowitz Selection of Portfolio criteria the best portfolio can be selected. These calculations show that an investor in Indian stock market can reduce risk for Indian Investors. Here limitation of secondary data should be considered investment by applying simple models of portfolio selection developed some five decades ago. Moreover this technique here is used only for 50 Portfolios. The result can be different if applied to Different number of portfolio.

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Annexure 1 Risk return profile of Sample Company

Sr. No.	Security	Mean Return (%)	Standard Deviation (%)	CV	Beta
1	ACC	0.84%	-8.31%	-9.90%	0.84
2	ADANI	0.75%	-14.16%	-18.86%	1.12
3	AIA Engineering	1.53%	-13.18%	-8.63%	1.40
4	AMBUJA	0.86%	-8.83%	-10.24%	0.90
5	ASHOK LEYLAND	2.28%	-14.37%	-6.29%	1.45
6	Aurobindo	2.71%	-17.65%	-6.52%	1.65
7	Axis	0.76%	-13.91%	-18.31%	1.51
8	BAJAJ FIN.	3.31%	-15.66%	-4.73%	1.49
9	BIOCON	1.53%	-13.40%	-8.78%	1.06
10	BLUE STAR	1.08%	-12.31%	-11.44%	1.35
11	BOMBAY BUMRAH	2.91%	-19.68%	-6.76%	1.68
12	BOSCH	1.58%	-7.47%	-4.72%	0.63
13	BPCL	0.95%	-12.75%	-13.39%	0.80
14	BRITANNIA	1.99%	-10.48%	-5.27%	0.23
15	BUTTERFLY	4.31%	-18.83%	-4.37%	0.96
16	CADILA	1.43%	-11.35%	-7.96%	0.45
17	CIPLA	1.16%	-7.18%	-6.19%	0.34
18	CUMMINS	1.15%	-9.88%	-8.58%	0.96
19	DIVIS	0.69%	-11.77%	-17.00%	0.44
20	DR REDDY	1.41%	-8.23%	-5.84%	0.47
21	EICHER	4.38%	-10.47%	-2.39%	0.82
22	FINOLEX	2.36%	-12.88%	-5.46%	1.42
23	GLAXO PHARMA	1.13%	-7.17%	-6.37%	0.23
24	GLAXO CONSUMER	2.13%	-7.78%	-3.65%	0.45
25	HEVELLS	1.50%	-15.73%	-10.49%	1.48
26	HAWKINS	2.93%	-12.22%	-4.16%	0.70
27	HDFC	1.15%	-10.54%	-9.16%	1.08
28	HERO MOTO	1.68%	-8.02%	-4.77%	0.68
29	HIND ZINC	1.00%	-13.02%	-12.96%	0.81
30	HINDALCO	1.20%	-13.69%	-11.38%	1.52
31	HITACHI	3.68%	-16.13%	-4.38%	1.58
32	IFB	4.01%	-16.99%	-4.23%	1.40
33	INDIABULLS REAL ESTATE	0.78%	-19.52%	-25.12%	2.19
34	INDRAPRASTAH	1.59%	-11.17%	-7.03%	0.46
35	INDUSIND	3.09%	-12.22%	-3.95%	1.57
36	ITI	2.31%	-19.89%	-8.62%	1.89
37	JSW	1.10%	-16.53%	-14.96%	1.61
38	KAJARIA	3.29%	-11.89%	-3.62%	0.84
39	KOTAK MAHINDRA	1.06%	-13.25%	-12.45%	1.43
40	KRBL	3.15%	-17.55%	-5.57%	1.39

41	LEEL	1.74%	-17.48%	-10.03%	1.75
42	LUPIN	1.26%	-11.08%	-8.81%	0.38
43	M & M	0.88%	-11.02%	-12.59%	0.93
44	MARUTI	2.39%	-10.18%	-4.25%	0.98
45	MIND TREE	1.80%	-13.14%	-7.31%	0.70
46	MOTHERSON SUMI	1.79%	-11.65%	-6.50%	0.77
47	MPHASIS	1.78%	-10.92%	-6.12%	0.97
48	MRF	2.89%	-11.86%	-4.10%	1.20
49	MRPL	0.99%	-12.57%	-12.72%	1.36
50	NCC	1.31%	-21.10%	-16.12%	2.17
51	NESTLE	1.73%	-5.93%	-3.43%	0.38
52	ORACLE	1.73%	-10.52%	-6.08%	0.86
53	PETRONET	1.51%	-10.91%	-7.23%	0.85
54	PIRAMAL	2.10%	-9.04%	-4.31%	0.62
55	RAIN	2.06%	-18.45%	-8.94%	1.29
56	RAMCO	1.25%	-13.42%	-10.74%	1.32
57	SHREE	2.63%	-10.94%	-4.16%	1.12
58	SOBHA	0.87%	-15.65%	-18.03%	1.93
59	STERLITE	2.49%	-19.41%	-7.80%	2.04
60	SIMPHONY	5.29%	-17.94%	-3.39%	1.16
61	TATA COMM	0.68%	-10.26%	-15.00%	0.48
62	TATA STEEL	0.91%	-14.91%	-16.43%	1.74
63	TATA	0.99%	-15.67%	-15.87%	1.72
64	TCS	1.54%	-9.06%	-5.87%	0.66
65	TECH MAHINDRA	1.29%	-14.06%	-10.89%	1.21
66	THERMAX	1.16%	-11.42%	-9.85%	1.25
67	TORRENT	2.21%	-9.36%	-4.24%	0.61
68	TTK PRESTIGE	3.79%	-12.97%	-3.42%	0.83
69	ULTRATECH	1.76%	-10.09%	-5.72%	1.01
70	UNITED BEVE	1.85%	-12.91%	-6.99%	1.13
71	UNITED SPIRIT	1.37%	-13.52%	-9.84%	1.05
72	VEKARANGEE	3.02%	-22.46%	-7.45%	1.53
73	VEDANTA	0.77%	-17.02%	-21.97%	1.40
74	WELSPUN	0.77%	-18.96%	-24.56%	1.79
75	WHIRLPOOL	4.00%	-14.38%	-3.59%	1.35
					0.99

Annexure 2 – Selected 50 least correlated Portfolio

Port. No.	S1	S2	corel	SD1	SD2	E(r) 1	E(r) 2	P12	W1	W2	Rp
1	TCS	HAWKINCOOK	-0.1547	0.1222	0.0906	0.0293	0.0154	-0.1534	0.8314	0.1686	0.0069
2	MINDTREE	IGL	-0.1115	0.1314	0.1117	0.0180	0.0159	-0.1106	0.7747	0.2253	0.0081
3	KRBL	BRITANNIA	-0.1020	0.1755	0.1048	0.0315	0.0199	-0.1011	0.5848	0.4152	0.0146
4	TTKPRESTIGE	BRITANNIA	-0.0936	0.1297	0.1048	0.0379	0.0199	-0.0928	0.7825	0.2175	-0.0002
5	KOTAKBANK	GLAXO	-0.0883	0.1325	0.0717	0.0106	0.0113	-0.0876	0.0000	1.0000	0.0014
6	TAT COMM	GLAXO	-0.0841	0.1026	0.0717	0.0068	0.0113	-0.0834	0.0000	1.0000	0.0008
7	TAT COMM	OFSS	-0.0799	0.1026	0.1052	0.0068	0.0173	-0.0793	0.9790	0.0210	0.0008
8	IGL	GSKCONS	-0.0778	0.1117	0.0778	0.0159	0.0213	-0.0771	0.0000	1.0000	0.0010
9	GLAXO	ADANIENT	-0.0501	0.0717	0.1416	0.0113	0.0075	-0.0497	1.0000	0.0000	0.0024
10	RAIN	GLAXO	-0.0423	0.1845	0.0717	0.0206	0.0113	-0.0420	0.5480	0.4520	0.0164
11	GSKCONS	DIVISLAB	-0.0337	0.0778	0.1177	0.0213	0.0069	-0.0334	1.0000	0.0000	0.0029
12	LUPIN	BPCL	-0.0298	0.1108	0.1275	0.0126	0.0095	-0.0296	0.9077	0.0923	0.0059
13	TAT COMM	BUTTERFLY	-0.0253	0.1026	0.1883	0.0068	0.0431	-0.0251	0.0000	1.0000	0.0008
14	BUTTERFLY	BRITANNIA	-0.0238	0.1883	0.1048	0.0431	0.0199	-0.0236	0.5361	0.4639	0.0171
15	IGL	DIVISLAB	-0.0197	0.1117	0.1177	0.0159	0.0069	-0.0195	0.9000	0.1000	0.0060
16	GLAXO	BRITANNIA	-0.0174	0.0717	0.1048	0.0113	0.0199	0.0461	0.0000	1.0000	0.0005
17	MINDTREE	MARUTI	-0.0159	0.1314	0.1018	0.0180	0.0239	-0.0157	0.0000	1.0000	0.0015
18	TCS	TAT COMM	-0.0134	0.0906	0.1026	0.0154	0.0068	-0.0133	1.0000	0.0000	0.0040
19	TAT COMM	MINDTREE	-0.0132	0.1026	0.1314	0.0068	0.0180	-0.0131	0.0000	1.0000	0.0009
20	PETRONET	GLAXO	-0.0095	0.1091	0.0717	0.0151	0.0113	-0.0094	0.9202	0.0798	0.0058
21	MINDTREE	BPCL	-0.0060	0.1314	0.1275	0.0180	0.0095	-0.0060	0.7647	0.2353	0.0084
22	VAKRANGEE	NESTLEIND	-0.0055	0.2246	0.0593	0.0302	0.0173	-0.0055	0.4474	0.5526	0.0245
23	VAKRANGEE	BRITANNIA	-0.0018	0.2246	0.1048	0.0302	0.0199	-0.0018	0.4473	0.5527	0.0245
24	KRBL	CADILAHC	-0.0017	0.1755	0.1135	0.0315	0.0143	-0.0017	0.5723	0.4277	0.0150
25	DIVISLAB	ACC	0.0007	0.1177	0.0831	0.0069	0.0084	0.0007	0.0000	1.0000	0.0012
26	M&M	DIVISLAB	0.0016	0.1102	0.1177	0.0088	0.0069	0.0016	0.9109	0.0891	0.0059
27	MINDTREE	ACC	0.0034	0.1314	0.0831	0.0180	0.0084	0.0034	0.7638	0.2362	0.0084
28	MINDTREE	AMBUJACEM	0.0035	0.1314	0.0883	0.0180	0.0086	0.0035	0.7637	0.2363	0.0084
29	SHREECEM	DIVISLAB	0.0040	0.1094	0.1177	0.0263	0.0069	0.0040	0.9176	0.0824	0.0058
30	TECHM	BRITANNIA	0.0054	0.1406	0.1048	0.0129	0.0199	0.0054	0.0000	1.0000	0.0018
31	VAKRANGEE	TCS	0.0065	0.2246	0.0906	0.0302	0.0154	0.0064	0.4463	0.5537	0.0245
32	ITI	GLAXO	0.0077	0.1989	0.0717	0.0231	0.0113	0.0076	0.5041	0.4959	0.0192
33	IGL	BUTTERFLY	0.0096	0.1117	0.1883	0.0159	0.0431	0.0095	0.0000	1.0000	0.0012
34	SYMPHONY	BRITANNIA	0.0111	0.1794	0.1048	0.0529	0.0199	0.0110	0.0530	0.9470	0.0157
35	TCS	DIVISLAB	0.0116	0.0906	0.1177	0.0154	0.0069	0.0115	0.1043	0.8957	0.0040
36	MARUTI	DIVISLAB	0.0125	0.1018	0.1177	0.0239	0.0069	0.0124	0.9860	0.0140	0.0051
37	TAT COMM	CIPLA	0.0129	0.1026	0.0718	0.0068	0.0116	0.0128	0.0000	1.0000	0.0010
38	HAVELLS	GLAXO	0.0136	0.1573	0.0717	0.0150	0.0113	0.0135	0.6371	0.3629	0.0121
39	GLAXO	DIVISLAB	0.0145	0.0717	0.1177	0.0113	0.0069	0.0144	1.0000	0.0000	0.0025
40	IBREALEST	GLAXO	0.0170	0.1952	0.0717	0.0078	0.0113	0.0168	0.0000	1.0000	0.0035

41	MINDTREE	BOSCHLTD	0.0170	0.1314	0.0747	0.0180	0.0158	0.0169	0.0000	1.0000	0.0084
42	KOTAKBANK	CIPLA	0.0176	0.1325	0.0718	0.0106	0.0116	0.0174	0.0000	1.0000	0.0016
43	HINDZINC	DIVISLAB	0.0182	0.1302	0.1177	0.0100	0.0069	0.0180	0.0000	1.0000	0.0083
44	HINDZINC	CADILAHC	0.0221	0.1302	0.1135	0.0100	0.0143	0.0219	0.0000	1.0000	0.0016
45	NESTLEIND	DIVISLAB	0.0230	0.0593	0.1177	0.0173	0.0069	0.0228	0.0000	1.0000	0.0017
46	SHREECEM	MINDTREE	0.0239	0.1094	0.1314	0.0263	0.0180	0.0237	0.0000	1.0000	0.0059
47	KAJARIACR	CADILAHC	0.0243	0.1189	0.1135	0.0329	0.0143	0.0241	0.8425	0.1575	0.0069
48	GLAXO	FINCABLES	0.0244	0.0717	0.1288	0.0113	0.0236	0.0242	0.0000	1.0000	0.0005
49	CADILAHC	BPCL	0.0271	0.1135	0.1275	0.0143	0.0095	0.0269	0.8826	0.1174	0.0063
50	NESTLEIND	IGL	0.0279	0.0593	0.1117	0.0173	0.0159	0.0277	1.0000	0.0000	0.0018

Annexure 3 – Correlation among Securities

1.
0

0. 1.
3 0

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3 4 0

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8 4 4 0

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5 4 5 5 0

0. 0. 0. 0. 0. 1.
4 4 6 4 5 0

0. 0. 0. 0. 0. 0. 1.
5 4 5 5 6 5 0

0. 0. 0. 0. 0. 0. 0. 1.
4 2 4 5 5 4 5 0

0. 0. 0. 0. 0. 0. 0. 0. 1.
3 2 5 3 2 4 3 3 0

0. 0. 0. 0. 0. 0. 0. 0. 0. 1.
5 4 5 5 6 5 5 5 4 0

0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1.
3 4 5 4 4 3 3 3 2 5 0

0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1.
5 3 4 5 6 3 5 4 2 5 4 0

0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1.
4 2 3 3 3 3 3 1 1 2 2 3 0

0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1.
1 5 1 2 2 2 1 1 1 1 3 2 1 0

0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1.
2 2 3 1 3 2 2 2 2 2 2 1 1 0 0

0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1.
2 2 3 2 2 3 2 1 1 2 2 2 0 1 1 0

0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1.
2 0 2 2 2 3 1 2 3 2 1 2 1 1 2 1 0

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4 4 6 4 5 5 5 4 4 6 5 5 4 1 2 3 2 0

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0 2 3 0 2 3 2 2 3 2 2 1 1 1 1 1 2 3 0

0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1.
1 1 4 2 2 4 2 2 4 3 3 2 1 1 2 3 4 3 3 0

0.3	0.3	0.4	0.3	0.4	0.5	0.3	0.4	0.3	0.5	0.3	0.5	0.3	0.3	0.1	0.2	0.2	0.4	0.2	0.3	1.0									
0.5	0.4	0.6	0.5	0.5	0.6	0.4	0.5	0.4	0.6	0.4	0.5	0.3	0.2	0.3	0.1	0.1	0.5	0.2	0.2	0.5	1.0								
0.1	-0.1	0.3	0.1	0.2	0.2	0.1	0.2	0.1	0.1	0.2	0.3	0.2	0.0	0.1	0.2	0.3	0.1	0.0	0.3	0.2	0.0	1.0							
0.3	0.2	0.2	0.3	0.3	0.2	0.2	0.3	0.2	0.3	0.1	0.3	0.0	0.2	0.3	0.1	0.1	0.2	0.0	0.3	0.3	0.2	0.3	1.0						
0.4	0.4	0.4	0.5	0.5	0.4	0.4	0.4	0.4	0.5	0.4	0.3	0.2	0.2	0.3	0.1	0.0	0.4	0.2	0.2	0.4	0.6	0.0	0.2	1.0					
0.2	0.2	0.4	0.2	0.2	0.4	0.3	0.3	0.3	0.3	0.3	0.2	0.1	0.0	0.4	0.1	0.3	0.3	0.2	0.3	0.3	0.2	0.2	0.4	0.2	1.0				
0.4	0.4	0.4	0.4	0.4	0.3	0.5	0.4	0.2	0.5	0.3	0.3	0.2	0.1	0.1	0.2	0.2	0.5	0.2	0.1	0.3	0.4	0.1	0.3	0.4	0.2	1.0			
0.4	0.3	0.3	0.5	0.3	0.3	0.3	0.2	0.2	0.4	0.3	0.4	0.4	0.2	0.1	0.2	0.3	0.3	0.1	0.2	0.3	0.3	0.3	0.2	0.3	0.2	0.4	1.0		
0.2	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.1	0.1	0.2	0.0	0.2	0.3	0.0	0.2	0.1	0.3	0.1	0.1	0.2	0.3	0.2	0.3	1.0	
0.5	0.4	0.5	0.5	0.5	0.5	0.4	0.5	0.5	0.6	0.4	0.4	0.3	0.1	0.2	0.1	0.2	0.5	0.2	0.3	0.4	0.7	0.1	0.2	0.6	0.2	0.4	0.5	0.5	1

Annexure 4 Least correlated Portfolio pair – 50 Portfolios

Sr. No.	Weight 1	Weight 2	Correlation
PORT1	TCS	HAWKINCOOK	-0.155
PORT2	MINDTREE	IGL	-0.111
PORT3	KRBL	BRITANNIA	-0.102
PORT4	TTKPRESTIGE	BRITANNIA	-0.094
PORT5	KOTAKBANK	GLAXO	-0.088
PORT6	TAT COMM	GLAXO	-0.084
PORT7	TAT COMM	OFSS	-0.080
PORT8	IGL	GSKCONS	-0.078
PORT9	GLAXO	ADANIENT	-0.050
PORT10	RAIN	GLAXO	-0.042
PORT11	GSKCONS	DIVISLAB	-0.034
PORT12	LUPIN	BPCL	-0.030
PORT13	TAT COMM	BUTTERFLY	-0.025
PORT14	BUTTERFLY	BRITANNIA	-0.024
PORT15	IGL	DIVISLAB	-0.020
PORT16	GLAXO	BRITANNIA	-0.017
PORT17	MINDTREE	MARUTI	-0.016

PORT18	TCS	TAT COMM	-0.013
PORT19	TAT COMM	MINDTREE	-0.013
PORT20	PETRONET	GLAXO	-0.009
PORT21	MINDTREE	BPCL	-0.006
PORT22	VAKRANGEE	NESTLEIND	-0.006
PORT23	VAKRANGEE	BRITANNIA	-0.002
PORT24	KRBL	CADILAHC	-0.002
PORT25	DIVISLAB	ACC	0.001
PORT26	M&M	DIVISLAB	0.002
PORT27	MINDTREE	ACC	0.003
PORT28	MINDTREE	AMBUJACEM	0.004
PORT29	SHREECEM	DIVISLAB	0.004
PORT30	TECHM	BRITANNIA	0.005
PORT31	VAKRANGEE	TCS	0.006
PORT32	ITI	GLAXO	0.008
PORT33	IGL	BUTTERFLY	0.010
PORT34	SYMPHONY	BRITANNIA	0.011
PORT35	TCS	DIVISLAB	0.012
PORT36	MARUTI	DIVISLAB	0.013
PORT37	TAT COMM	CIPLA	0.013
PORT38	HAVELLS	GLAXO	0.014
PORT39	GLAXO	DIVISLAB	0.015
PORT40	IBREALEST	GLAXO	0.017
PORT41	MINDTREE	BOSCHLTD	0.017
PORT42	KOTAKBANK	CIPLA	0.018
PORT43	HINDZINC	DIVISLAB	0.018
PORT44	HINDZINC	CADILAHC	0.022
PORT45	NESTLEIND	DIVISLAB	0.023
PORT46	SHREECEM	MINDTREE	0.024
PORT47	KAJARIACR	CADILAHC	0.024
PORT48	GLAXO	FINCABLES	0.024
PORT49	CADILAHC	BPCL	0.027
PORT50	NESTLEIND	IGL	0.028

Annexure 5 - Calculation of Sharpe and Treynor's Ratio

Sr. No.	CO 1	Co 2	Correl ation	VARp	SDp	Rp	Rf	Rp-Rf	Sharpe = Rp-Rf/ SDp	RANK
PORT22	GLAXO	FINCABLES	0.024	0.051%	2.249%	1.99%	0.68%	1.31%	0.58	1
PORT3	BRITANNIA	ACC	0.085	0.0055	7.410%	1.64%	0.68%	0.96%	0.13	2
PORT2	BRITANNIA	AXISBANK	0.081	0.00558	7.471%	1.62%	0.68%	0.94%	0.13	3
PORT31	HAVELLS	CIPLA	0.036	1.212%	11.007%	1.40%	0.68%	0.72%	0.07	4
PORT21	GLAXO	DIVISLAB	0.015	0.253%	5.025%	1.00%	0.68%	0.32%	0.06	5
Sr. No.	CO 1	Co 2	Correl ation	VARp	SDp	Rp	Rf	Bp	Treynor Ratio	RANK
PORT22	GLAXO	FINCABLES	0.024	0.051%	2.249%	1.99%	0.68%	0.59	0.86%	1
PORT3	BRITANNIA	ACC	0.085	0.0055	7.410%	1.64%	0.68%	0.87	0.86%	2
PORT2	BRITANNIA	AXISBANK	0.081	0.00558	7.471%	1.62%	0.68%	0.86	0.83%	3
PORT31	HAVELLS	CIPLA	0.036	1.212%	11.007%	1.40%	0.68%	0.74	0.48%	4
PORT21	GLAXO	DIVISLAB	0.015	0.253%	5.025%	1.00%	0.6	0.5	-0.34%	5

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ESTD - 2007

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Published by

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Nr. Vishwakarma Government Engineering College,
Nr. Visat - Gandhinagar Highway,
Chandkheda, Ahmedabad - 382424, Gujarat (India)

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