AGENT BASED NETWORK MANAGEMENT SYSTEMS

by

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3008

Dissertation submitted in partial fulfillment
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CERTIFICATION OF APPROVAL

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Approved by,

_____

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TRONOH, PERAK
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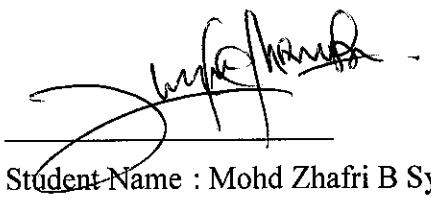
CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



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ABSTRACT

Recent years have witnessed rapid growth rates in computer network traffic. Network administrators scramble to keep pace with increasing demands by continually adding capacity. Still, network users are often dissatisfied with the performance of the network. The growth in popularity of new resources in multimedia applications promises to enhance this condition. It is a new idea about a less than a year ago to have a design – An Agent-Based Network Management System to monitor a certain network architecture via agents that has been sent in order to detect various faultiness of host. These faults include PC's that has been infected with viruses, propagated worms or even a conflicted host. However, these faults are going to be narrowed down. Fundamentally, this project is implemented to solve the problem of managing the network to its full capacity, thus eliminating problematic occurrence on the network and onto other users. The methodology applied for this project is the Systems Development Life Cycle (SDLC) which has about 5 phases. By the end of this project, a few limitations and recommendations might be made with the purpose of enhancing some of the project functions.

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INTRODUCTION

1.1 Background of Study

Network management means different things to different people. In some cases, network management involves a distributed database, auto-polling of network devices, and high-end workstations generating real-time graphical views of network topology changes and traffic. In other cases, it involves a solitary network consultant monitoring network activity with a certain tools. Generally, network management is a service that employs variety of tools, applications, and devices to assist human network managers in monitoring and maintaining networks.

It is also a term that describes a computer-based software application suite dedicated to the management of networks. Typically, the network management system provides abstractions (such as signaling links and virtual connections) appropriate to the overall running of a network.

Basically, this project is about an integration technology between an agent which is created and sent from the NMS (network management systems) to the networks in order to identify certain configurations that do not comply with the system. If so happens that a faulty occurs, a network manager is able to identify and pinpoint on specific hosts to be corrected.

In this project, many various programming languages can be used to develop and create the agents such as Java, Visual Basic, XML and many others. However, in this project, Visual Basic might be used as it is a common language that is being used extensively in developing agents. After creating the agents, a certain LAN (Local Area Network) is intertwined together with the system so that the agents can be sent and spread through

many hosts (PC's). These PC's are connected to the network and have their individual and specific Internet Protocols (IP). So, the goal here is so that, the agents that is sent and monitors the network is able to capture and identify faults or corrupts that could jeopardize the whole network. When errors are identified, network managers can act accordingly and solve the problem. With this, the efficiency of the agents is tested thus; make the network system safe and error-free.

As networks grow larger and complicated, their management also becomes more difficult, especially when there is no central authority to coordinate management. In many cases, management efforts have imposed a great deal of traffic on the network, causing noticeable delays by network users. The realistic scalability of these systems is also a problem in most management applications. When the management tasks change, every node running the management application must be updated. Several research efforts are underway in the area of proactive network problem avoidance which often relies on large amount of current and historical network data to build models of network traffic. This paper describes a distributed object, agent based framework for facilitating management of large networks as a foundation for supporting proactive network problem avoidance. The framework serves a middleware between collections of independent network management agents and network nodes.

1.2 Problem Statement

This section will cover the 'Why' and 'How' questions for this project. It briefly clarify and tells story behind the project such as problems identification and significant of the project.

1.2.1 Problem Identification

Network and Systems Management services empower us with capabilities to improve the efficiency of our IT operations staff and increase service responsiveness. By assessing

potential improvements in speed and accuracy of network and system-related problem identification and root cause analysis, these services can identify approaches to minimize troubleshooting time and achieve rapid diagnosis and resolution for issues.

Nowadays, most network management systems are organized according to the centralized paradigm, where the intelligence and control are placed in one centralized network management station, or the platform-centric paradigm, where network management applications are built on a single management platform. With this implementation of agent based network management system, the intelligence and control are based on the agent that is being created in order for it to sense and detect whether there is anything wrong in the system.

Besides the paradigm issue of the network management system, there is also the issue of commercialism whereby in the world today, there aren't many efficient network management systems that could monitor the network every single minute with effective functions. There aren't many systems which could detect faults and anything possible that could disturb the network environment thus jeopardizes the network system and also its users.

In short, the problem issue would be on the question "How can corrupted hosts because of massive interventions from viruses, worms and conflicted IP's be determined and solved". As a solution for that problem, this project may help and settle down any difficulties.

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1.2.2 Significant of the Project

Network management places complex requirements on the physical location of the network data. Three major factors are performance, availability and bandwidth usage. Performance, in this case, has to do with client queries and agent updates. For clients and agents, their repository must be 'nearby' in the sense of the physical layout of the network. This would imply the repository resides on the same subnet or is at most a few hops away from the routers that are assigned to it. However, it is unrealistic to expect a repository to reside in every subnet. One repository per some small set of physically close subnets should be sufficient. For performance reasons, the optimal location of the repository would be the network region for which it is holding data. However, data for a network region should be available during periods when that region is unreachable. Therefore, the repository should be somewhere nearby without actually residing in the region.

1.3 Objective and Scope of Study

Objective and scope of study is a key direction of this project. It contains goals to be achieved at the end of this project; scope will be covered as well as expected time of project development. The system should at least able to fulfill three (3) of objectives that will be briefly explained throughout this chapter.

1.3.1 Objectives

Specifically, the objective of this project is to relieve network managers to receive input and warnings from agents that has been developed. This can be done by executing and action once the current network is being triggered by the agents.

In term of general objective, this project is to make network management system using agents a new breakthrough in the networking world and also to see the effectiveness as it could be enhanced worldwide.

Besides, the technology used in detecting errors and conflicts on a certain network using agents is a much-aligned knowledge for future network managers and a solution for companies that needs it network to be monitored around the clock with proper functions (in this case – the agents).

1.3.2 Feasibility of the Project within Time and Scope

This project can be deemed as technically feasible as the scope of the project is limited to the solving common congestion problems that occur. There is no relative cost related to the project as the expert system can be developed using open source applications that are available in the Internet. There are also adequate resources available to support the project, such as books, online resources, lecturers and staffs. The time frame given to complete the project is also sufficient.

CHAPTER 2

LITERATURE REVIEW / THEORY

2.1 What is an Agent

The term 'agent' describes a software abstraction, an idea, or a concept. The concept of an agent provides a convenient and powerful way to describe a complex software entity that is capable of acting with a certain degree of autonomy in order to accomplish tasks on behalf of its users.

The agent concept is most useful as a tool to analyze systems, not as a prescription. The concepts mentioned often relate well to the way we naturally think about complete tasks and thus agents can be useful to model such tasks. The four key notions that distinguish agents from arbitrary programs are reaction to the environment, autonomy, goal – orientation and persistence (Fanklin & Graesser, 1996).

The design of intelligent agents (or intelligent software agents) is a branch of artificial intelligence research. Capabilities of intelligent agents include (Hewitt & Inman, 1991):

- ability to adapt – adaptation implies on the sensing of environment and reconfiguring in response. This can be achieved through the choice of alternative problem-solving rules or algorithms, or through the discovery of problem solving strategies. Adaptation may also include other aspects of an agent's internal construction.
- ability to learn – learning may proceed through trial-and-error, then it implies a capability of introspection and analysis of behavior and success. Alternatively, learning may proceed by example and generalization, and then it implies a capacity to abstract and generalize.

The development of agent-based systems includes (Hyacinth S. & Divine, 1997):

- how tasks are scheduled and how synchronization of tasks is achieved.
- how tasks are prioritized by agents.
- how agents can collaborate, or recruit resources.
- how agents can be re-instantiated in different environments, and how their internal state can be stored.
- how the environment will be probed and how a change environment leads to behavioral changes of the agents.
- how messaging and communication can be achieved.
- what hierarchies of agents are useful (e.g. task execution agents, scheduling agents and providers).

There no consistent definition of an agent. For our purposes, an agent is a software entity that represents its originator to achieve a predefined goal. Agents can be either mobile (capable of migration from host to host) or stationary, and may or may not incorporate artificial intelligence (AI) techniques. Open Systems Interconnection (OSI) network management agents, for example, are stationary agents that represent a managed object, permitting control operations to be performed by a managing application [Black95]. A mobile agent, on the other hand, is able to migrate to multiple hosts in a predetermined sequence. Furthermore, a mobile agent can perform different sets of control operations for each host it visits, asynchronously from its originator.

Contemporary network management systems as represented by Simple Network Management Protocol (SNMP) are based on the client-server centralized paradigm which may lead to inefficiency when the managed networks are large in scale (Huawen L, 2002). In those systems, management data are stored in a standard structure maintained on the elements to be managed, such as Management Information Base (MIB) Objects Tree in SNMP.

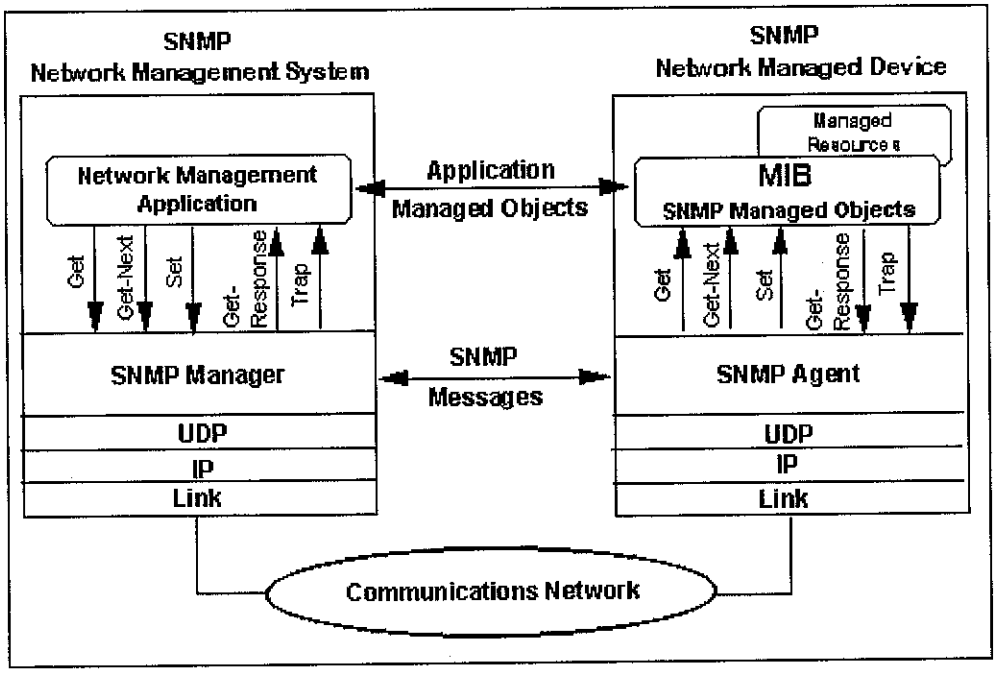

Figure 1: SNMP Network Management System

Network management system based on Client/Server paradigm normally requires transferring large amount of management data between the manager and agents. The large amount of data not only requires considerable bandwidth, but also can cause a processing bottleneck at the manager. As current networks grow larger and more complicated, the problem becomes more severe.

Jennings (1999) defines agents succinctly as 'situated problem solves' and such are ideal for application to the complex situations that arise in telecommunications network management; allowing network management software to be autonomous and adaptive reduces the need for human intervention, and given the high network speeds, can reduce downtime, loss of service and consequently revenue.

2.2 Quality of Service (QoS) in the Networks

When the Internet was first being created, there was no perceived need for a QoS application. So in fact the entire internet ran on a "best effort" system. There were four "type of service" bits and three "precedence" bits provided in each message, but they were largely unused. There are many things that can happen to packets as they travel from origin to destination and they result in the following problems, as seen from the point of view of the sender and receiver:

1. Dropped packets - the routers might fail to deliver (drop) some packets if they arrive when their buffers are already full. Some, none, or all of the packets might be dropped, depending on the state of the network, and it is impossible to determine what happened in advance. The receiving application must ask for this information to be retransmitted, possibly causing severe delays in the overall transmission.
2. Delay - it might take a long time for a packet to reach its destination, because it gets held up in long queues, or takes a less direct route to avoid congestion. Alternatively, it might follow a fast, direct route. Thus delay is very unpredictable.
3. Out-of-order delivery - when a collection of related packets are routed through the Internet, different packets may take different routes, each resulting in a different delay. The result is that the packets arrive in a different order to the one with which they were sent. This problem necessitates special additional protocols responsible for rearranging out-of-order packets once they reach their destination.
4. Error - sometimes packets are misdirected, or combined together, or corrupted, while en route. The receiver has to detect this and, just as if the packet was dropped, ask the sender to repeat it.

During the last years, the use of Peer-to-peer (P2P) applications for file exchange has increasingly gained fame. P2P traffic component of the global Internet traffic has been growing. P2P file sharing applications build up a virtual network of hosts (peers) able to

communicate with each other without following the classical client-server architecture. Instead, each peer has the same functionalities as the other peers so that the traffic load is distributed among the connected users. In some P2P networks, a special role is assigned to a set of hosts (super peers) which coordinate the operation.

P2P file sharing applications generate an intensive amount of traffic as they tend to exploit all available link capacity in the underlying network. Traffic is generated both in downstream and upstream direction. This can have a significant impact on the increasing of network congestion and reducing the capacity available for other applications, such as interactive web and other multimedia applications. As a result, interactive application are adversely affected as the high network congestion may significantly increase the network delay and hence the application response time. Therefore, it will increase the network problem that the users will be facing.

CHAPTER 3

METHODOLOGY / PROJECT WORK

3.1 Method Used

System Development Life Cycle (SDLC) is an approach to systems development that includes a method of development as well as software tools. Basically, SDLC is a better and proper method used because it should result in a high quality system that meets or exceeds users expectations within time and cost estimates, works effectively and efficiently in the current and planned information technology infrastructure. It is also cheap to maintain and cost-effective to enhance. SDLC is a systems approach to problem solving and is made up of several phases, each comprised of multiple steps which include:

- the software concept – identifies and defines a new need for the new system.
- a requirement analysis – analyzes the information needs of the end users.
- the architectural design – creates a blueprint for the design with the necessary specifications for the hardware, software, people and data resources.
- coding and debugging – creates and programs the final system.
- system testing – evaluates the system's actual functionality in relation to expected or intended functionality.

Below are the official phases in the SDLC approach that is being complacent with this project:

3.1.1 Preliminary Investigation Phase

The first phase of the systems development life cycle is the preliminary investigation phase. Due to limited resources, an organization can undertake only those projects that are critical to its mission, goals and objectives. Therefore, the goal of preliminary investigation is simply to identify and select a project for development from among all the projects that are under consideration.

The preliminary investigation phase sets the stage for gathering information about the current problem and the existing information systems. This information is then used in studying the feasibility of possible information systems solutions.

So, in this phase, investigations had been done in determining what's best for the project and to be implemented under what kind of circumstances. However, after gathering all these information's, the next step to implement or design the system is not yet essential. The next step would be the requirements definition.

3.1.2 Requirements Definition Phase

This phase is an in-depth analysis of the stakeholders' information needs. This leads to defining the requirements of the computer information systems. These requirements are then incorporated into the next phase which is the design phase. Many of the activities performed in the requirements definition phase are an extension of those used in the preliminary investigation phase. The main goal is to identify what should be done, and not how to do it.

3.1.3 System Design Phase

A system can be defined in several ways, including (1) a set of interrelated parts that function as a whole to achieve a common purpose; (2) a piece of software that operates to manage a related collection of tasks; or (3) a design for an organization that perceives sets of processes as a related collection of tasks.

In designing this system, it must be based on certain network management architecture. Most architecture uses the same basic structure and set of relationships.

The ISO network management model has contributed a great deal to network standardization. Its network management model is the primary means for understanding the major functions of network management systems. This model consists of five conceptual areas. They include:

- performance management
- configuration management
- accounting management
- fault management
- security management

The goal of the performance management is to measure and make available various aspects of network performance so that inter-network performance can be maintained at an acceptable level. For configuration management, it is to monitor network and system configuration information so that the effects on the network operation of various versions of hardware and software elements can be tracked and managed. The goal of accounting management is to measure the network utilization parameters so that individual or group uses on the network can be regulated appropriately. For the fault management on the other hand, its primary goal is to detect, log, notify users of, and automatically fix network problems to keep the

network running properly. Lastly, for the security management, it is to control access to network resources according to local guidelines so that the network cannot be sabotaged and so that sensitive information cannot be accessed by those without appropriate authorizations.

A generally typical network management architecture is depicted below:

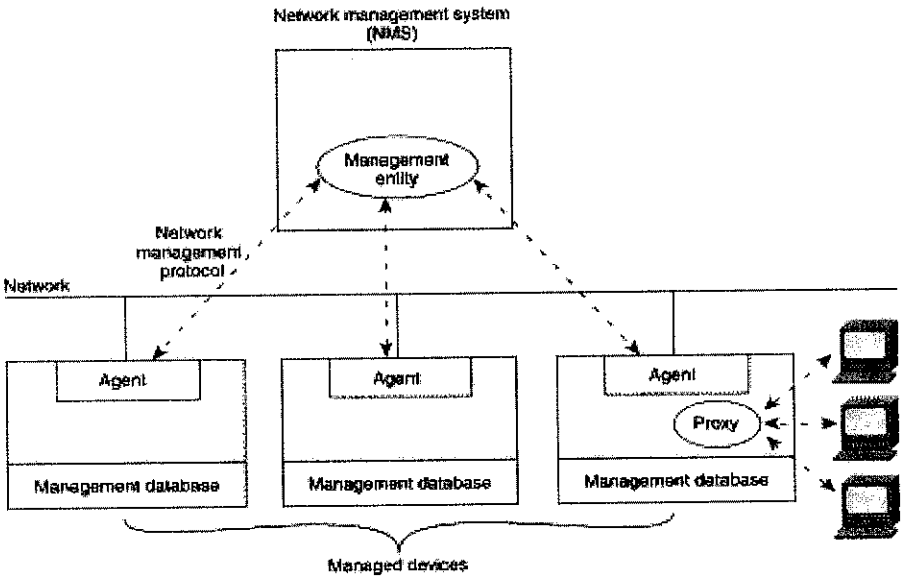

Figure 2: A Typical Network Management Architecture

3.1.4 System Implementation Phase

Implementation of a new system design must include training employees to understand the new system and their role in achieving the goals the company has for it. Implementation times can vary depending upon the complexity of the system being implemented.

Computer systems have been developed to help organizations conduct, control, and document related tasks more efficiently. In this case, the design and development requires a study of the system to be modeled or controlled by the computer.

Software and hardware are then acquired or developed to effectively handle the tasks. Implementation requires a verification stage that tests the computer system prior to actual use to verify that the system operates as envisioned. Modifications to fit the needs of the corporation are usually made over time as problems are identified with use.

These systems tend to be expensive and development often requires significant effort to correctly handle the complexities of each individual company. Some computer systems can be purchased off the shelf that handles such typical tasks as accounting, inventory control, or transportation. Some of these are even developed for a particular industry. However, most off-the-shelf products still require technical modification to fit the needs of the individual company. It should be apparent that computer systems closely parallel the organizational systems.

3.1.5 System Monitoring & Maintenance

After all the phases have been completed and the system is being implemented and made to full usage, it needs to be monitored and maintained accordingly. A network manager must ensure that the system is monitored around the clock with its agents performing its tasks in hand. On the other hand, maintaining the system is also essential after the system is being used for quite some time. This is to make sure that all the components of the system is being updated and modified in case there are faults that could lead to network errors in the current system.

With this agent based network management system, the agents are a vulnerable component, thus extra maintenance and testing should be done so that it will perform to its full level (detecting viruses, worms and other conflicting errors in a specific LAN).

3.2 Tools Used

3.2.1 Software

- Microsoft Visual Basic 6.0
- Network Manager

3.2.2 Hardware

- Operating System : Microsoft Windows XP Professional Edition Pack 2 Version 2003
- Processor : Intel Pentium 4, 2.70 GHz
- Memory : 512 Mb of RAM
- Display Mode : 1280 X 1024
- Network : Internet TCP/IP Connection
- Input : Mouse and Keyboard
- Hard Disk Requirement : 60 Mb

3.3 Administrator Representation

As for the network administrator, user(s) must first login into the system so that they can view the result and the network log. And with the access level, they can also try to locate the users in the network by using the Geographical Information System (GIS) application. After that, they view the replies and network conditions and then locate the users or hosts via intranet (LAN). If they current process failed, then the process of locating is done again. After successfully locating the user, actions can be taken and agents are sent to do its tasks. Results from the process are then sent back for the administrator to be viewed.

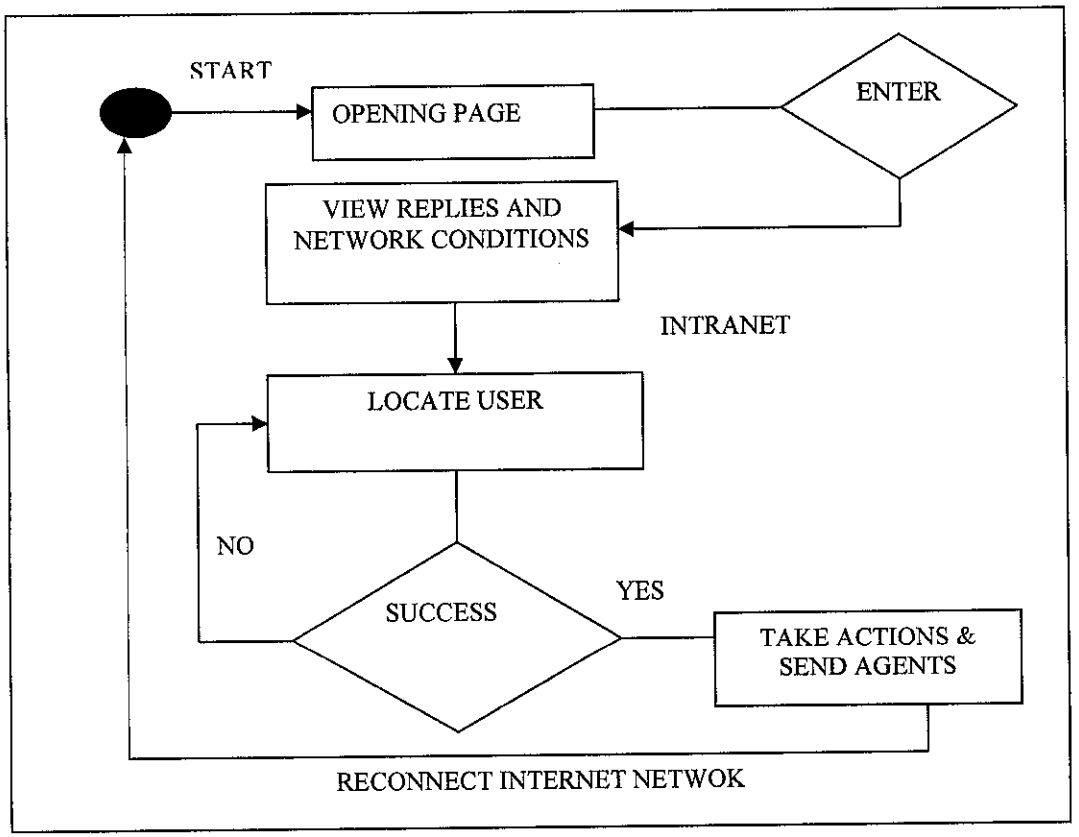

Figure 3: Flow of Process for Administrators

CHAPTER 4

RESULT AND DISCUSSION

4.1 Findings

Basically, the integration between research and objectives along with the problems occurred is the key determination on either success or failure of this project. If there is no difficulty while doing it, which means that the project is successfully, developed and thus can be used widely, vice versa.

Some problems have been faced during the requirements planning phase and user design phase. One of them is lack of understanding on technique used currently and a deep research analysis has to be done in order to make this project has clear concept. Moreover, there is a difficulty to come out with the proposed architecture design since this is the important part towards delivering the project in general way.

All in all, for project achievements, it is hoped that this project is relevant with its objectives and every function can performs correctly according to their own roles. Besides, to be expected that this project will be able to have a proper network flow and connection as well as to detect and acknowledge if any relationship has been made between agents within the network area. After completing the project, it is really hoped that this can be a user-friendly network application for users.

Throughout the development and implementation of this project, observation and analysis have been done mainly after the first (1) beta version released. At first, it is hard to identify the scope of project because the name itself is very big as well as the understanding of network administration might be differed. Therefore, the author had decided to narrow down the scope to only managing user particularly in troubleshooting of connectivity problems at users' side.

Therefore, the second (2) versions will be released to encounter problems that may arise. This version had been modified in terms of scope and also information mainly about troubleshooting of network hardware. From the observations during the testing and validation of the systems, some of the problems unable to solve mainly because of the following factors:

1. Network itself currently under maintenance.
2. Unknown problems from students' computer.
3. Viruses might be detected lead to ban of IP accessing the network.
4. The network unable to assign an IP to the computer.

These problems however are only the assumptions made based on information and study during the validation and testing phase.

Currently, the first version is released within 4 months due mainly of rapid changes has been made; from the system up to the redefined scope of the project. The system then re-tested and re-validated before being presented and commented by the lecturers during internal exhibition (pre-edx). This version was undergone testing similar like cognitive walkthrough approach that aims to evaluate its usability. In this case, this testing was done to not only evaluate its usability but also its usefulness.

4.2 Result and Discussion

In this part, the results of the project has not been updated yet as it will be completed in 2-3 weeks time prior to this dateline.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

It is important to have a better understanding on this project by having some research or preliminary study. From this, the arising problem of monitoring the network can be solved with the correct way. Besides, a good application can be developed and may reduce time of correcting errors occurred, while the specific objective and scope of study can be achieved successfully.

Directly, some advantages can be generated once the project is functioning properly without any problems and thus, solve the problems encountered. From these effects, that means it has proved that agents based on an NMS can manage a network system. Finally, it is hoped that this project can be accomplished by the time given and to be said as a successful project.

5.2 Recommendations

There are some recommendations that need to be made towards the project. It is suggested that to enhance the usability of agents on the network. In this project, a single agent or more than one agent is being used to show its functions. However, in future, maybe accumulating more agents might be essential in order to manage a far bigger network to be monitored. And it is recommended to make this project as unique as it can in determining connection.

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APPENDIX A

SCREEN SHOTS

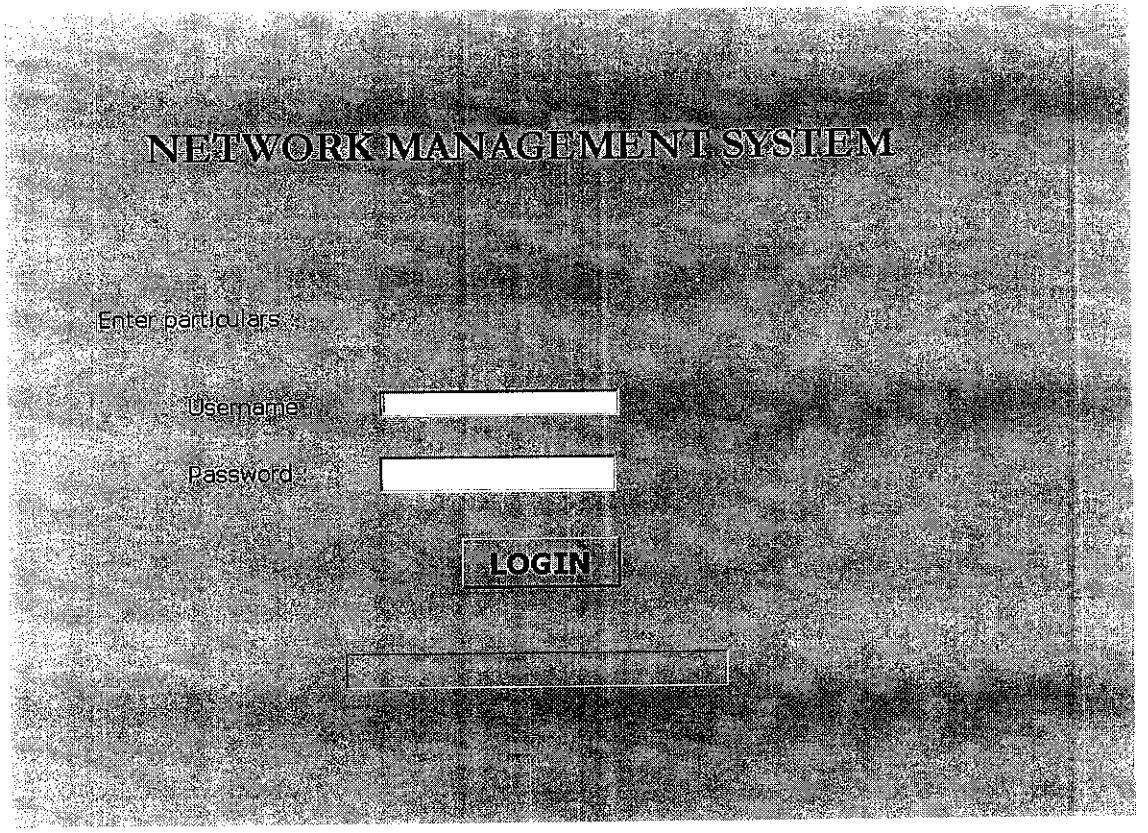

Figure 4: Main Page of System

This shows the main page of the system, whereby when a network administrator begins its work. Firstly, as it is shown above in Figure 3, the particular network administrator enters its username with a unique password to login into the network management system. Only specific network administrators are enabled to login onto this system whereas clients are not eligible to access it.

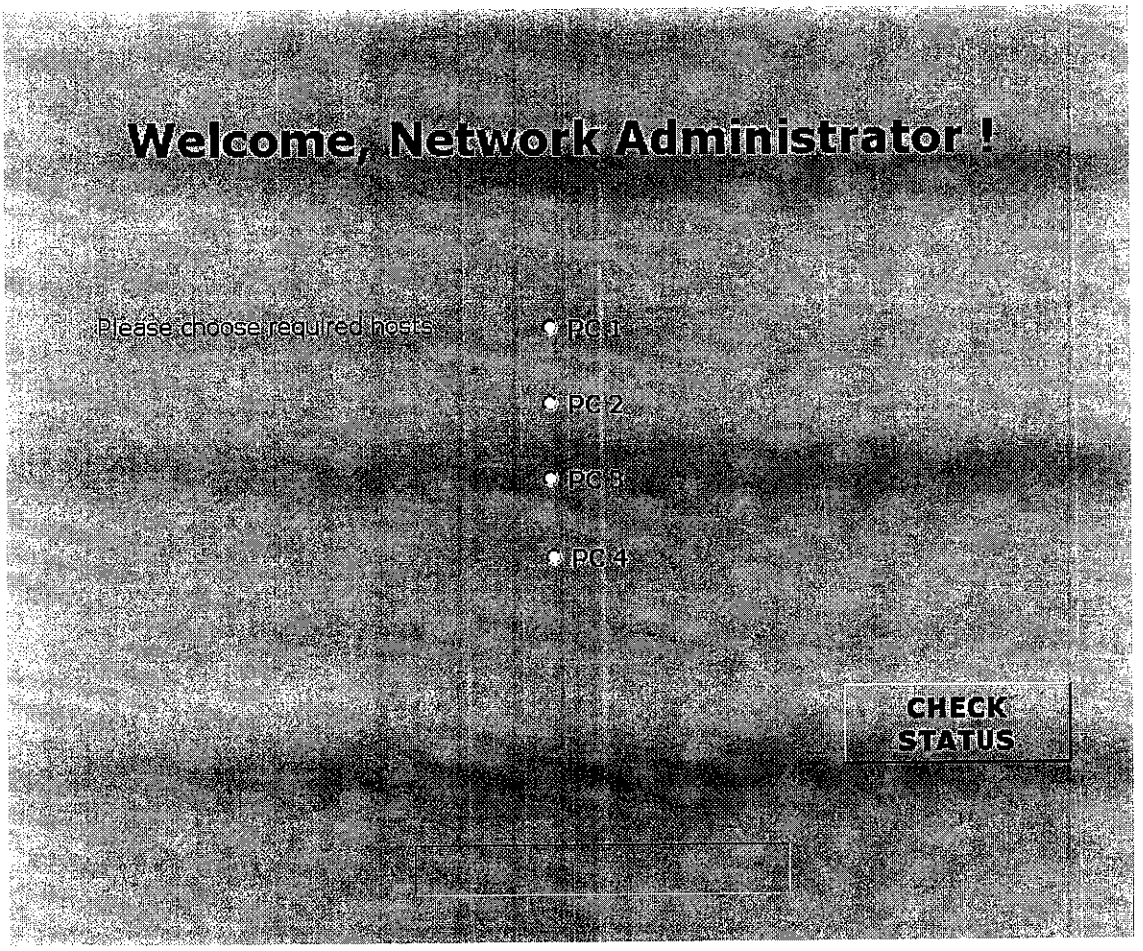

Figure 5: Welcome Page for Network Administrators

Next, once the network administrator enters their respective details to login onto the system, it brings them to the next page which is the welcome page as shown above in Figure 4. It is to be known that once they are logged in, the clients or hosts computers are connected as well. With this, the network administrator has to choose which hosts that they require to go ahead with the next step. Sometimes, there are more than 4 hosts listed in this page (hosts that appear depends on the collectable amounts of hosts connected once the network administrator logs in the system). From this, the administrator will choose one host and click the 'Check Status' button at the bottom right to go to the next page.

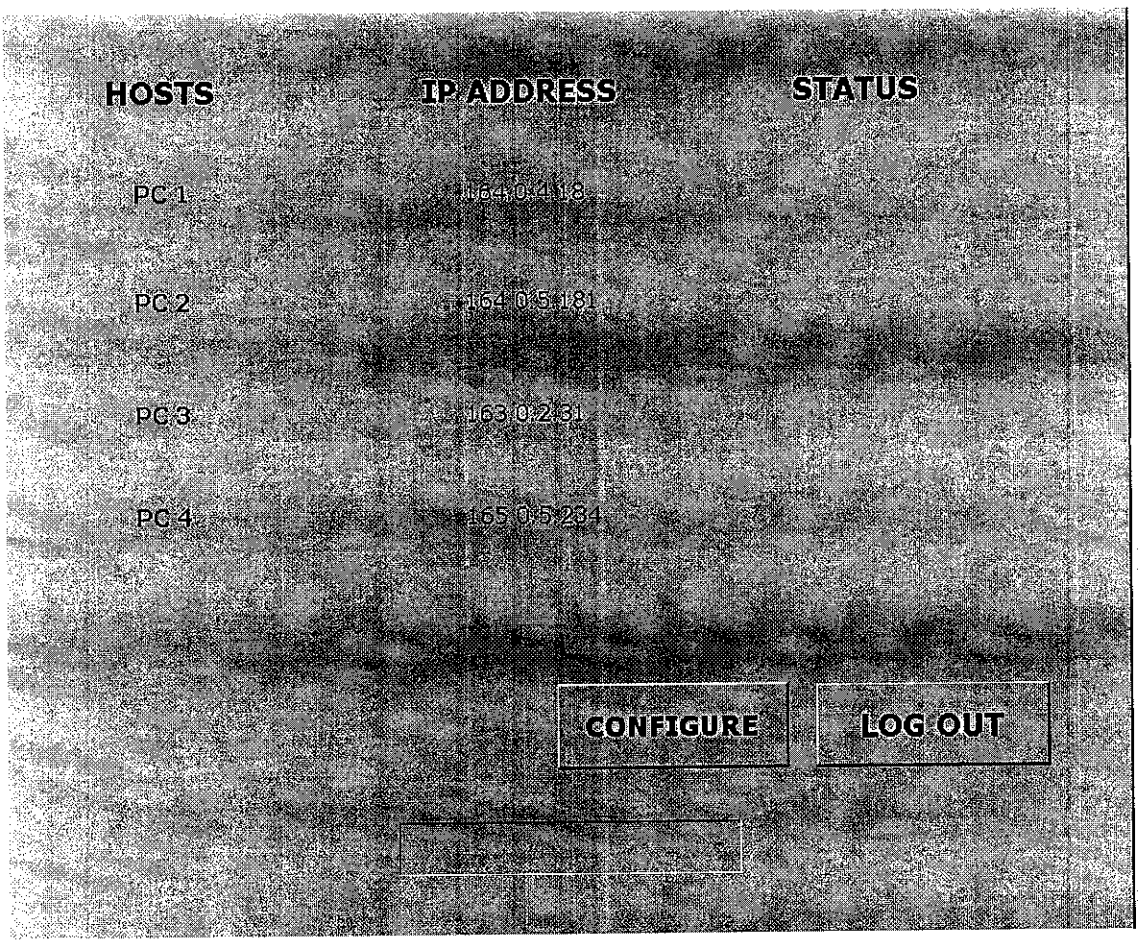

Figure 6: Status Page for Different Hosts

From those two pages directed to the administrator, finally it comes to the status page of different hosts enabled. As shown in Figure 5, if the administrator chooses to view all statuses of the available hosts then all of them show its status in this page. Besides showing the IP addresses of each host and which server they belong, a network administrator can know the status of each hosts such as if the hosts are corrupted with viruses or worms, have an IP conflict with more than one hosts or others. These problems will be shown in the status frame. After viewing this status, if the administrator wishes to log out, there is a log out button at the bottom left of the page, whereas if he/she intends to configure the hosts, the 'Configure' button is there.

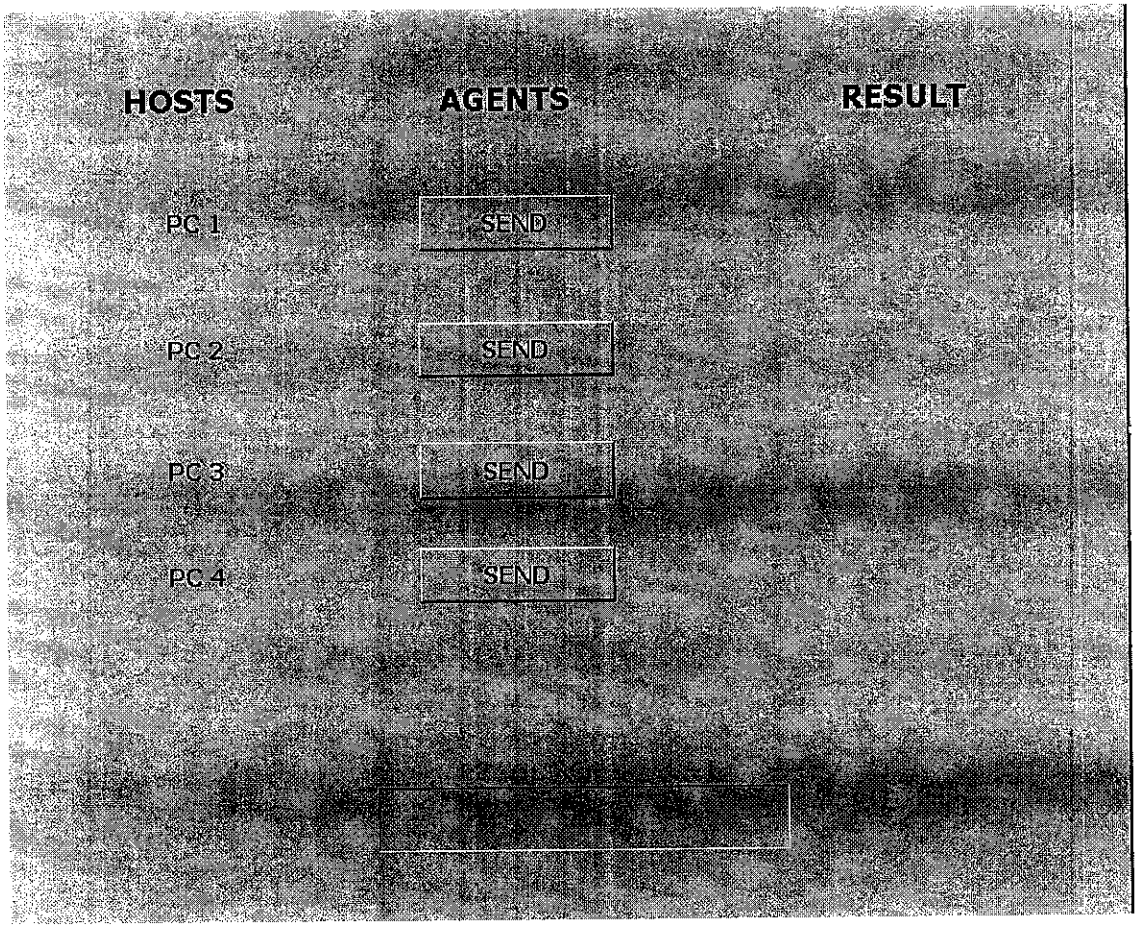

Figure 7: Configuration Page for Agents

After obtaining the statuses of the required hosts, the network administrator is being directed to another page whereby the configuration of agents may take place. Corrupted hosts or computers that requires repairing or maintenance can be done when the network administrator click on the 'Send' button in order for the agents to be sent to the respective hosts or computers. After the agents finish its tasks, the result of the task is being sent back to this particular page for the administrator to view

APPENDIX B

SAMPLE OF QUESTIONNAIRES

Personal Information:

Name:

Year:

Program:

Please tick (X) for answering the questions.

1. *Using a LAN network, what type of problems always occurs?*

NO	PROBLEMS	YES
1.	Cannot access the internet because network bottleneck	
2.	Cannot access the internet but network is ok	
3.	Network instable – IP suddenly disappears	
4.	Suddenly loss connection to the net	
5.	Do not have network connectivity at all	

If not as listed above or any additional common problems, please state at the space given:

A._____

B._____

2. *Occurrence of connectivity problems*

NO	NUMBER OF OCCURENCE	YES
1.	Once a week	
2.	Once a month	
3.	Once a semester	

If not as listed above, please state at the space given:

A_____

B._____

3. *Would you like to know about other things?*

NO	KNOWLEDGE	YES
1.	Network management system	
2.	NMS software's	
3.	Small Networking	

If not as listed above, please state at the space given:

A. _____

B._____