Server Monitoring Using Android Devices

Negar Shakeribehbahani, Nor Azlina Abd Rahman, Kamalanathan Shanmugam, Payam Nami
Asia Pacific University of Technology and Innovation
Kuala Lumpur, Malaysia
negarshakeri@gmail.com ; nor_azlina@apu.edu.my ; kamalanathan@apu.edu.my ; paynam@gmail.com

Abstract— Server Monitoring Using Android Devices is an application which Using Android operating system devices to monitor Windows servers. This software allows network administrators to monitor resources and the status of the servers, such as CPU utilization, RAM usage, Hard Drive I/O activity, storage space and running services and processes remotely and easily through an Android phone or tablet by even a poor internet connection.

Keywords-component; Server Monitoring; Windows Server Monitoring; Android Application; Andoroid Devices; SOAP Technology

I. INTRODUCTION

Nowadays, World Wide Web (WWW) through the Internet has been changed the aspects of human life, like communication ways, knowledge and cultures. In additional, business owners and investors have appreciated the importance of Internet. Among them, Internet and technologies have been grown excessively. So, that the communication ways are much easier to use. Today, there are lots of server machines which provide the network services such as web servers, file servers, database servers and more. In order to ensure the servers function properly and provide high quality of services, they need to be monitored by network administrators all the time. Besides, most people are using smart phones and tablets with a variety of applications and mobile internet connections, thus server monitoring application via Android would be a useful solution especially for whose positions related to networking. By using this application, network administrators are able to monitor multiple servers anytime and anywhere, and meanwhile, they can spend their time on doing other tasks far from the servers.

A. Rationale

Nowadays remote access to computers via the mobile devices has become more popular. The reasons are that it is more convenient to carry a cell phone rather than computer, and also, employees need to have access to their documents remotely. Accordingly, a server administrator needs to access the server to monitor its resources and status to make an appropriate action in the event that the server is suffering a problem or crash.

In order to minimize the current payments for server monitoring, a solution which makes the server administrators able to monitor the servers (In this case Windows servers) remotely, quickly and easily and consequently, minimizing the number of employees who monitor the server on the company's premises may help. "Server Monitoring Using Android Devices" is software which allows a server administrator to monitor the server and its resource status, such as remaining storage space, memory usage, CPU usage, and hardware device temperatures remotely.

B. Problem Statement

In order to ensure customers' satisfaction and avoiding business losses, servers need to be monitored continuously to minimize the downtimes and maintain the performance. However, hiring persons to monitor the company's servers needs a large amount of budget in the aspect of human resource. Indeed, the company is paying for the employees who have nothing to do in most of the times.

On the other hand, monitoring CPU temperature aids, to avoid damage, low response time and short lifespan of the system. Moreover, monitoring usage of RAM helps avoid low response time. Furthermore, monitoring status of Hard Drive helps to monitor activity and availability of the Hard Drive in order to avoid high activity and low disk space which can be due to decrease the performance of the server, even make it unresponsive. Additionally, monitoring Bandwidth Usage prevents bandwidth bottlenecks and increase the response time of the server.

C. Aim

Server Monitoring Android Application consists of designing and implementing a system to allow network administrators to monitor the server and its resources status such as temperature and utilization of CPU, status of RAM, status of Hard Drive I/O activity, status of bandwidth usage of network devices, server storage and running services and processes remotely. Besides that, the network administrators are able to view the history of the servers as well. This application is able to connect to the server automatically in desired intervals to retrieve and record server information. The application allows the network administrators to monitor:

- Temperature of CPU remotely.
- Utilization of CPU remotely.
- Status of RAM remotely.
- Status of Hard Drive I/O activity remotely.

- Status of bandwidth usage of network devices remotely.
- Server storage remotely.
- Running services and processes remotely.

II. METHODS

This project consists of two major steps: research and development.

A. Research

The Stage of the research is collecting knowledge and information from journals, conference papers, books and other valid academic resources. Also, questionnaires via internet or hard copy user surveys are used to collect information. Based on the distributed questionnaire to target respondents who were 25 persons including network administrators, network managers and IT managers, all the preliminary requirements have been gathered and analysis of questionnaire aids collected information to be meaningful. Analysis answers were useful to find the requirements for this proposed system. Through questionnaire analysis some items such as popularity of Android and Windows operating system in network industry, reasons of server monitoring, important metrics which application should support, and finally the willingness of network administrators are clarified.

B. Evaluating a Popular Monitoring System

OpManager network monitoring which is web-bases software is introduced. OpManager monitor network in several aspects which covers fault, Configuration, Accounting, Performance, Security (FCAPS) including performance of network and server monitoring, fault management, security management, configuration management and accounting management. OpManager monitors the Active Directories on the Windows Servers and shows the statistics of them about the number of users, computers, inactive users, active users domain based and aggregately up on monitor request. It is also capable to collect the information from Unix-based operating systems and their accounting status. OpManager monitors the event logs of the servers constantly. By monitoring this logs, especially the security logs of the servers, it alerts the monitors in the case that a suspicious activity detected. Moreover, it monitors the firewalls including hardware and software, and also antivirus software all over the network. For example, it alerts the monitors if antivirus software is out of date on a specific computer or a firewall is not configured properly. Furthermore, it is capable to monitor specific files or folders on any server or computer for security reasons. It alerts the monitors in the case of suspicious activities.

OpManager will be installed on a Windows server as a Windows service. It enjoys a web-based graphical user interface by bundled web server by the software installer. The TCP/IP port used to serve the GUI is selectable by the system administrator during installation. The main advantage of a web-based GUI is that the OpManager interface will be accessible across the network by the monitor employees. Furthermore, OpManager may have more than one user [1].

C. Comparison of OpManager and Server Monitoring Using Android Devices

Table 1 shows the comparison of OpManager and Server Monitoring Using Android Devices.

Table 1. Comparison of OpManager and Server Monitoring Using Android Devices

Software Specification	OpManager	Android Application
Platform	Windows, Linux	Android
UI	Web	Android application
Installation	Needs server	Does not need server
Portability	Medium	High
Protocol	SNMP	SOAP
Devices	Router, Server, Switch	Server
Cost	Minimum 1995 $	About 10 $

As the table 1 shows these two systems are quite different from each other. They have the same goal which is monitoring, but their performances are different. The platform used for OpManager is Windows or Linux and it needs to be a dedicated server while in this system is Android and it does not need specified server. Also, user interface in OpManager is Web, and it uses SNMP protocol, but in this system would be Android application and the protocol is SOAP. Moreover, OpManager is able to monitor routers, servers, and switches while this proposed system can monitor only servers. On the other hand, the portability of OpManger is medium contrast this system is high. Finally, the price of OpManager compares to this system is much higher. Therefore, even though OpManager offers more features, this system is designed to be personal, simple, easy to use and portable. Also, in the aspect of prerequisites, the proposed system does not require high cost hardware and can be installed and used by anyone with a low networking knowledge.

D. Prototype Development

Server monitoring using Android device prototype is distributed software which consists of client-side application known as android application, and server side application which is a web application.

Server side application provides the information regarding the status of a server such as CPU usage, memory usage, network load etc. for android application installed on network

administrator's smart device. The technology used for interoperability is Simple Object Access protocol (SOAP).

Figure 1 illustrates the Use Case diagram for Android application prototype. This prototype is designed specifically for the network administrators to monitor the servers remotely using Android devices. This application enable the network administrators to handle their tasks effectively and more convenient as monitoring and decision making can be done at anytime and anywhere.

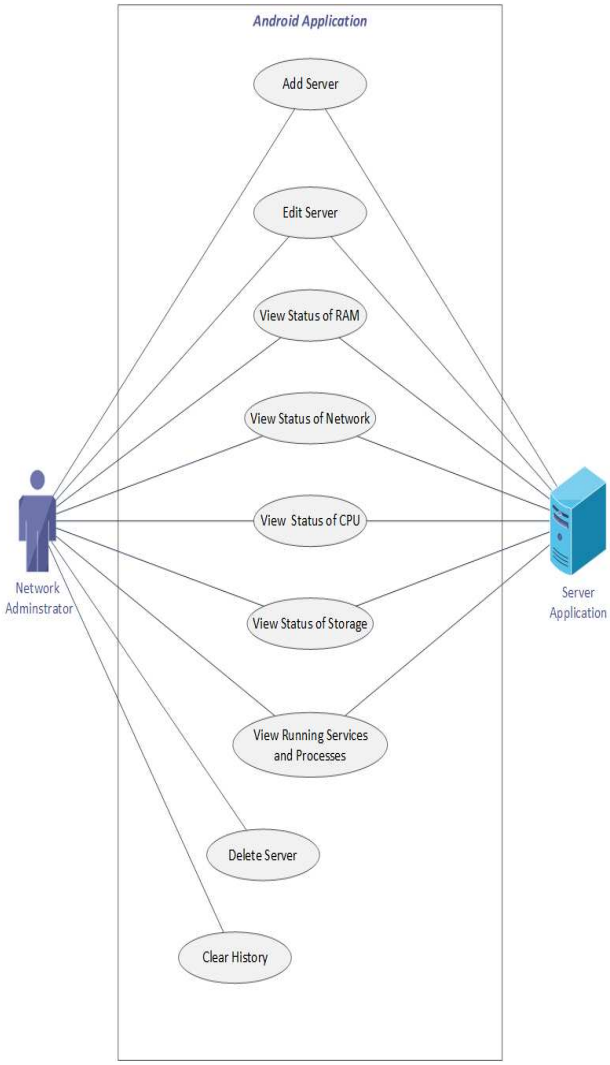

Figure 1. Use Case for Android Application

Figure 2 illustrates the Use Case diagram for server application of this project.

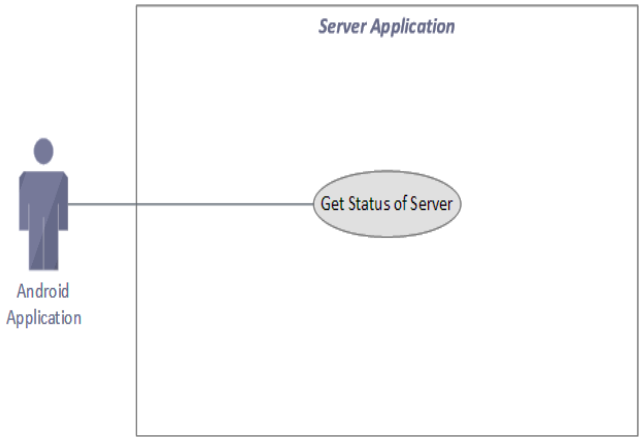

Figure 2 - Use Case for Server Application

III. TECHNOLOGIES USED FOR PROTOTYPE DEVELOPMENT

The prototype developed using several integration of technologies as discuss in this section.

A. Programming language

Server Monitoring Android App project requires two sides of programing; the first part is a Server Side Application and the second part is Client Side (Android) Application. So, each of them requires a different type of programming language. For Server Side Application C# to develop a web service and For Client Side Application Java would be suitable programming languages to an Android application.

B. Android Development

Android is a new open source platform for mobile devices which produced by Google company. Android is designed to be a complete software stack. It includes an operating system, middleware, and core applications. It is designed to facilitate the development process. Security developers can easily work with and rely on flexible security controls. Also, it is a very intuitive operating system, and users are able to understand easily how applications work and control applications.

C. Java Programming Language

All Android applications are natively developed by using Java programing language. Java has powerful libraries which they are created to help developer to build applications easier. Java enjoys several advantages. Firstly, it is object oriented. Secondly, it is easy to learn, understand and use. Moreover, it is developed and designed to be an independent platform, and to be secure and use a virtual machine to run on multi-platform. Finally, it has special strength in the servers and middleware. Typically, Android applications are developed by using Java and benefit these advantages. For example Android SDK has a large number of standard Java libraries such as networking libraries, graphics libraries, data structure libraries and more. So, it helps developers to build awesome Android applications [2].

D. Using Android Virtual Device for Android Development

AVD (Android Virtual Device) is a device configuration and allow the developers to model actual device by recognizing hardware and software. They are able to emulate by Android Emulator. Moreover, AVDs able to be configured and run on any version of Android. Therefore, AVD let developer to create several configurations to test many hardware and Android platforms. When the application is running on the emulator, it will able to use the services of Android platform such as play audio and video, store and retrieve data, access the network and create themes. Also, developer can use a variety of commands and options to control and change the performance of the application [3].

E. C# Programming Language

C# (pronounces as "C sharp") is one of the most powerful programming languages, recent nine years created by Microsoft for the major part of its .NET initiative. C# developers created it with inspiration from Java and C++ programming languages. It is multi paradigm, object oriented programming language and suitable for deployment in a distributed environment. Also, it helps developer to create portable applications. It can support the principles of software engineering such as array bounds checking, strong types and automatic garbage collection. C# is able to use XML (Extensible Markup Language) and SOAP (Simple Object Access Protocol) to allow access to programming object, so the programmer does not need to write extra code. Using C# programming language makes the process of developing faster and less expensive [4].

F. Web Services In .Net

Web services are methods for communication between devices. Web services help developer to create distributed application much easier to design and develop. In fact, web services enable a remote consumer to run it based on the given parameters and get the result over HTTP protocols. It can be considered as a set of remote functions for a developer. [5] The advantage of web services is that they are not relative to specific technology because they use XML or other global common independent languages for communication. On the other hand, developer can use it in most of the development scenario. [6] .NET uses the web services as the main protocol to establish communication between applications [7].

G. SOAP Web Services

SOAP is a lightweight protocol for transmitting information in a decentralized, distributed environment. SOAP is an Extensible Markup Language (XML) based protocol which contains three parts: an envelope that defines a framework for describing what is in a message and how to process it, a set of encoding rules for expressing instances of application-defined data types, and a convention for representing remote procedure calls and responses [8].

In aspect of security, SOAP benefits a high level of security. Authentication and authorization in sending messages can be applied to SOAP web services. Furthermore, encryption can be applied to the messages between the source and destination to secure the message, for example using the SOAP over the HTTPS protocol instead of HTTP can encrypt the message to ensure that the message cannot be modified and read the middle of the way. [9]

Figure 7. SOAP Web Services

H. Advantages of SOAP over DCOM

There are different protocols proposed for communication among software components of the distributed software. Distributed Component Object Model (DCOM) and Simple Object Access Protocol (SOAP) are popular protocols which are mainly developed by Microsoft. One popular protocol is DCOM. DCOM is a major methodology in distributed computing on the Windows platform. Although it makes developers' work less difficult by hiding many complexities of client-server application development, DCOM has two major disadvantages. Firstly, it is only mature on Windows and is not suitable for cross platform communications. Second, implementing DCOM applications in a corporate environment are difficult where communication needs to be performed across firewalls. In contrast, another technology which is SOAP is based on two protocols: XML and HyperText Transfer Protocol (HTTP), a variety of platforms, such as Windows and Android are compatible with these protocols [10].

In summarize, SOAP is compatible with all platforms and it functions on the HTTP protocol, it is a more appropriate option for interoperability.

I. SQLite Database Management System

SQLite database does not need a setup procedure or administration of the database in Android. Android is able to support SQLite database completely. After defining the SQL statement to create and update the database, the Android platform will manage database automatically. The database will be saved in the application data directory by default, if an application creates a new database. It is an open source database and able to support relative database features such as, SQL syntax, transaction and prepared statements. SQLite does not require amount of large memory at runtime, so it's a good choice for embedded database. SQLite provides type of data like, TEXT, INTEGER and REAL which they are comparable to STRING, LONG and DOUBLE in Java.

IV. PROTOTYPE

This section demonstrates the prototype of the servers monitoring android application and describes the feature implemented visually.

Add button is to enable the network administrators to add one or more servers in the list of server of application. Network administrators are able to monitor one or several numbers of servers at the same time. After the connection is successful, the application will retrieve all information that needed such as the name of the server, detail of devices, current status of RAM, CPU and CPU temperature and more. Figure 3 and Figure 4 shows add server screenshot of the prototype.

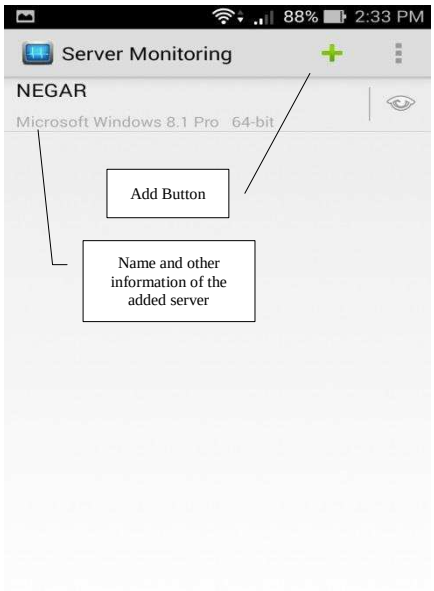

Figure 3. Add Server

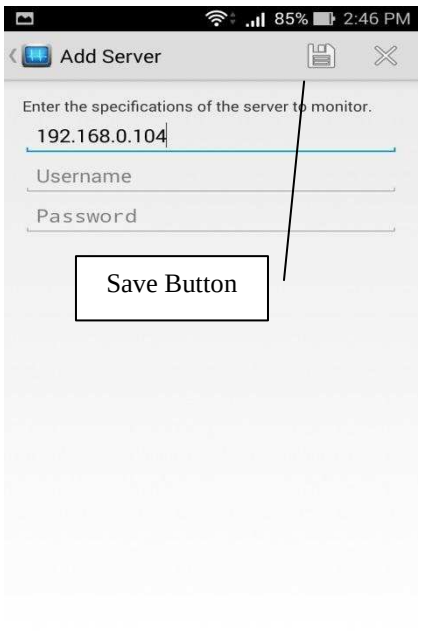

Figure 4. Add Server

This prototype enables network administrator to update the previous added information of the servers. The edit button is used to edit the information such as IP address, Username and password. Figure 5 shows the edit server screenshot of the application.

Figure 5. Edit Server

The prototype able to retrieve current status of RAM and virtual memory of the server and displays this information in chart and graph form to make the monitoring process become easier and clearer. Moreover, this application is capable to show date, time and history of RAM in graph form. It can illustrate the last hundred screenshots of RAM information.

Refresh button used to refresh current page and view the real time status of the servers' information retrieved. Furthermore, this prototype cans automatically connecting to the server in desired intervals to update the information. If the Internet has a problem and network administrator could not connect to server to get current situation of the server, the information of the servers can be retrieved from the servers' history. Figure 6 shows the screenshot to view the current status of RAM and the history of the servers.

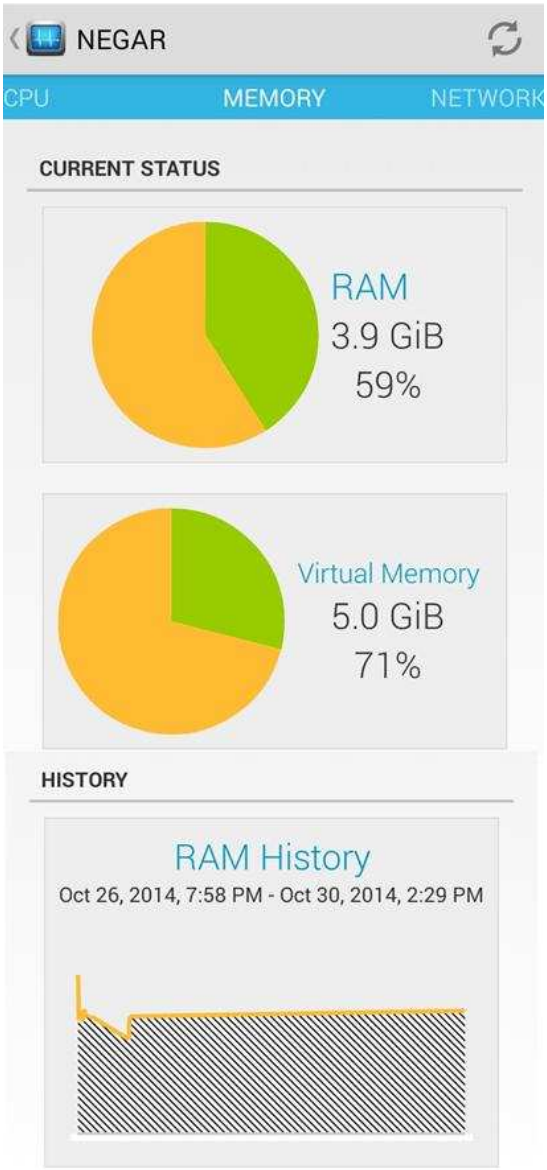

Figure 6. View Current Status of RAM and History

Another functionality of this prototype is to retrieve current status of bandwidth usage of network devices such as Ethernet upload and download, and Wi-Fi upload and download of the server and specific speed number (Mbps) and displays the information in a diagram form to the network administrator. Figure 7 and Figure 8 show the screenshots to view the current status of network and the history of the Ethernet.

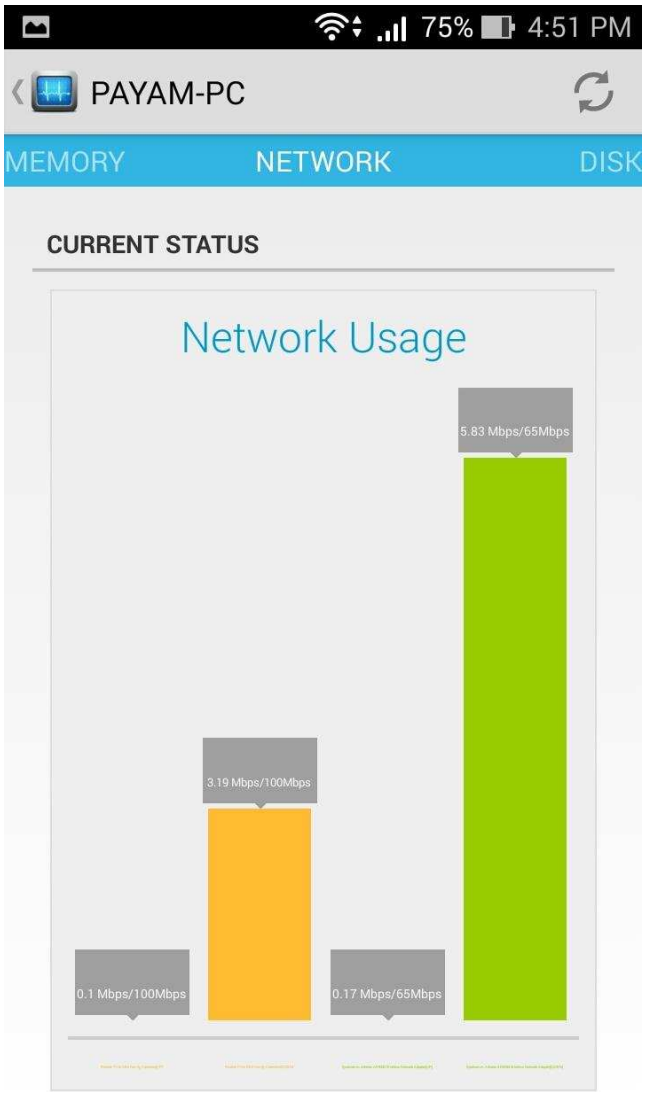

Figure 7. View Current Status of Network and History (Ethernet)

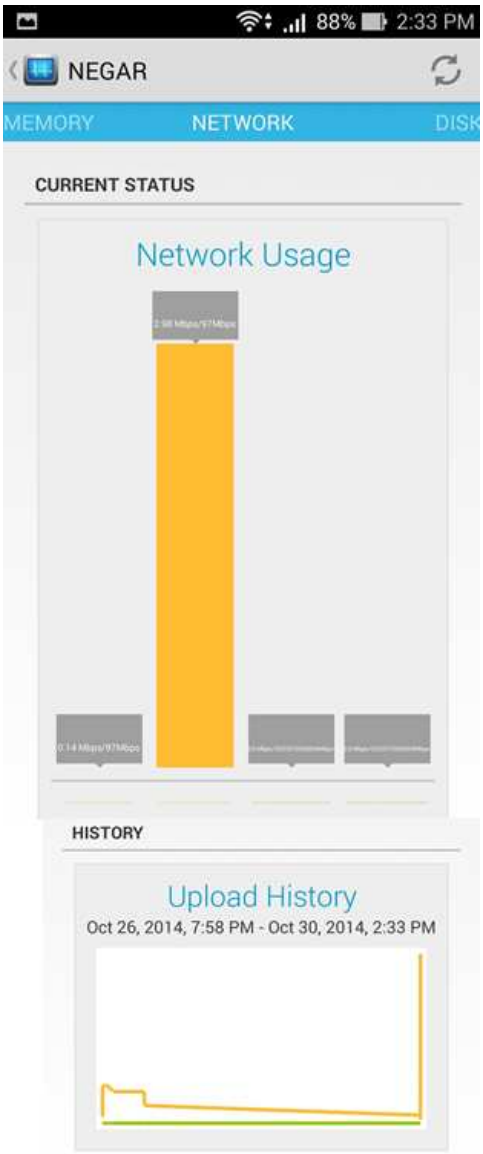

Figure 8. View Current Status of Network and History (Wi-Fi)

Next functionality of the prototype is to retrieve current usage of CPU and CPU temperature of the server and displays the information to network administrator. Figure 9 shows a screenshot to view the current status of CPU and the history.

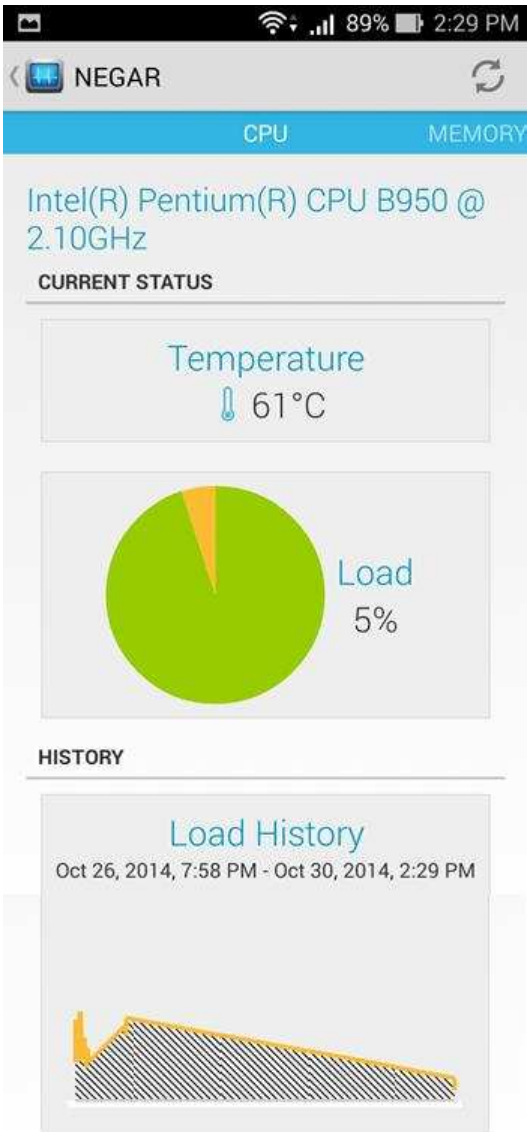

Figure 9. View Current Status of CPU and History

Current usage of storage and hard drive I/O activity of the server can be retrieved using this prototype. Figure 10 shows a screenshot to view the current status of storage and the history.

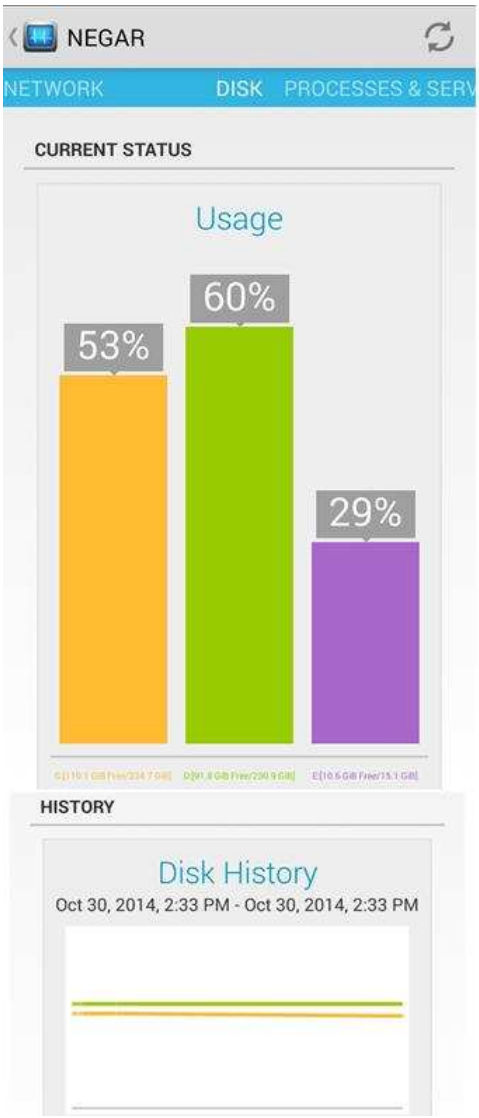

Figure 10. Views Current Status of Storage and History

Figure 11 shows a screenshot to view current status of running services and processes of the servers. This is one of the functionalities of this prototype that enable to retrieve current status of running services and processes of the server and displays the information to the system administrator, so that any action can be taken if there is any inappropriate information showed.

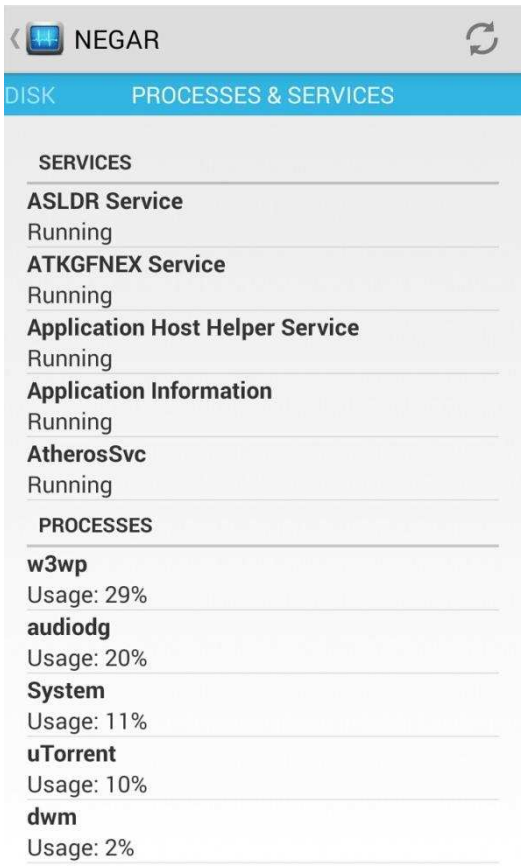

Figure 11. View Current Status of Running Services and Processes and History

This prototype also provides functionality that enables the network administrator to delete the previous added server from the list of servers. To delete the server user should select the delete button and system will delete the chosen server with all the information from the list of servers. Figure 12 shows the menu for delete, edit and clear history screenshot of the prototype.

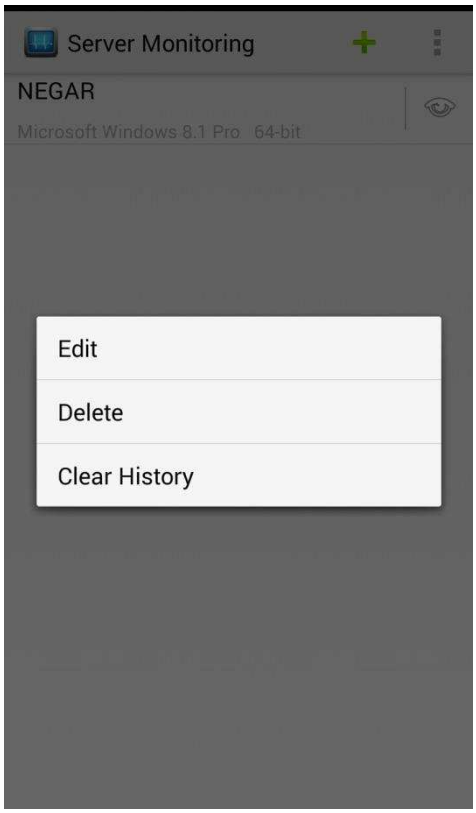

Figure 12 - Edit, Delete and Clear History

Figure 13 shows that server has been deleted from the list of severs.

Figure 13 - Delete Server

Clear the history of the server is another functionality of the prototype. Clear history button is used to clear the history of the servers that consist of all information about CPU, RAM, network, storage, running services and processes of the chosen server. Figure 14 shows that history of the chosen server has been cleared.

Figure 14 - Clear History

This prototype is able to show all the needed information of the servers to network administrators but it is requires establish the communication between server side application and client side application. As mentioned before developer used SOAP to create connection between server and client to get the information from the server and then displays the information to network administrators. Figure 15 shows application is trying to connect to the server to retrieve the information of the servers connected

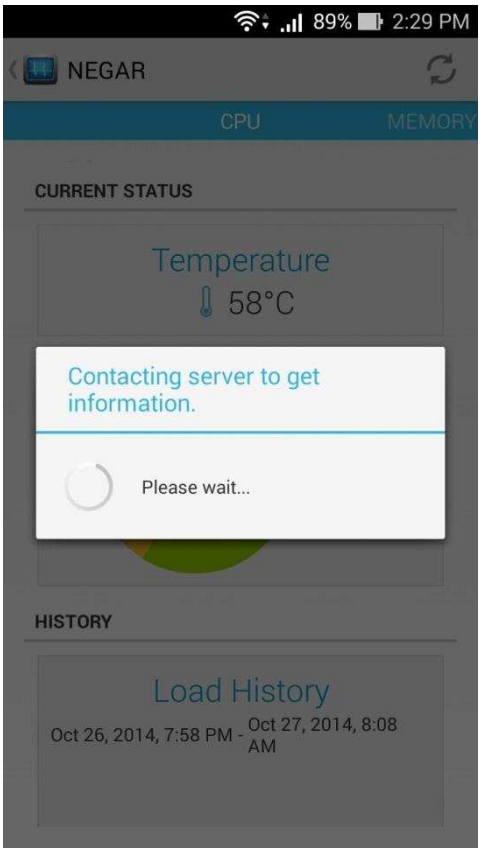

Figure 15 - Server and Client Interoperability

The auto update service feature enables the application to collect the status information of registered servers in the application as a background task. In other words, this service collects the server information while even the application is not running in settable intervals. It helps to have an updated data of servers to illustrate the more meaningful history for the servers.

All the functionalities of this prototype as shown in figure 5, figure 6, figure 7, figure 8, figure 9, figure 10 and figure 11 enable the network administrator to monitor the status of the server and display their history in graph form. In fact, the graphs can illustrate the last hundred screenshots of the server status. Besides that, all the server specifications are also provided with a Refresh button to retrieve the latest status of the server and view the real time status of the servers' information retrieved. Furthermore, this software application can automatically connect to the server in desired intervals to update the information. If the Internet has a problem and network administrator could not connect to server to get current situation of the server, the information of the servers can be retrieved from the servers' history.

V. FURTHER FEATURES

Considering of this prototype improvement, several features such as Sending smart alerts, through SMS or E-mail by recognizing potential failures and support SMTP protocol beside SOAP are recommended.

VI. CONCLUSION

The main idea behind this system is monitored devices on Windows servers via Android application. This prototype permits network administrators to monitor resources and the status of the servers, such as CPU utilization, RAM usage, Hard Drive I/O activity, storage space and running services and processes remotely and easily through an Android devices. This system would be a beneficial application for those who are working in the networking field. They are able to monitor multiple servers anytime and anywhere, and meanwhile, they can spend their time on doing other tasks far from the servers. Moreover, it helps to reduce the downtime of servers and network, and it can be due to increasing level of customers' and employees' satisfaction.

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