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Designing of Efficient Technique Blocking Abnormal Packets through Correlation Analysis in the Healthcare Environment

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Abstract

Background/Objectives: The development of IT medical technology has formed the environment where the effective management and analysis of medical information. **Methods/Statistical Analysis:** We must explore the ways to secure the security measures because the leak of personal medical information will cause a great risk of leading to the exposure of personal information. In this paper, as a way to defend against malicious attacks in the smart medical environment where the electronic medical devices and wired and wireless networks are combine. **Findings:** It is aimed to design an abnormal packet screening techniques through correlation analysis of abnormal conducts in the medical security gateway so that it can be safe from server attacks, medical information interception, any counterfeit and falsification thereof. **Application/ Improvements:** It is expected to be utilized in a wide variety of platforms and infrastructure as an essential function enable to respond to threats in future medical security gateway.

Keywords: Correlation Analysis, HealthCare, HER, Health Security Gateway, Packet Filtering

1. Introduction

The IT technology development influenced the many areas of daily living. In recent years, a smart medical environment of healthcare was derived as it was applied to the healthcare environment[1]. Healthcare refers to healthcare services which is available for patients anytime, anywhere, on the basis of the information in the medical environment. Thus, the healthcare provides the environment where the exchange of EMR (Electronic Medical Record) the medical information to be shared among patients, physicians and hospitals, is possible. The main reason why the healthcare is attracting the attention is because it ensures you to take advantage of the convenience of three kinds and it can be utilized in the academic side as well.

Various medical aspects combined enables accurate diagnosis through the big data analysis based on medical findings of various fields rather than by an individual doctor depending on each medical information[2,3]. In convenience side, it provides the convenience to the patient who is not required each time to go to the hospital facing the doctor by only transmitting their health information. Also in academic aspects, it serves as the basis for the technical development for diseases treatment through enabling you to collect and analyze the medical information of numerous patients. However, despite these advantages, it has demerit that there may occur a security threat, for instance, the medical systems can be disturbed by malicious attackers [4,5].

The leak of personal health information of the patients will cause a very high degree of damage when it occurs. This is because it concerns not only personal assets but also can be directly connected to the issue of life. In fact, an experiment oft adjusting the amount of insulin was feasible through hacking demonstration. Thus without effective prevention of the relevant problem, the health-

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care will not be widely available due to these kinds of disturbances.

Therefore, this paper aims to design the technique to block abnormal packet through the correlation analysis of unusual acts. It conducts detection in three dimensions and prevents malicious attacks. It aims to prevent leakage or hacking of personal information in medical data through performing analysis of correlation of unusual acts in the gateway where the medical data gather.

2. Related Works

2.1 EHR

EHR is the three generation medical systems of the past second generations health care system to expand the scope of medical data sharing between hospitals, if only in a limited medical information on individual hospitals to receive medical visits advantage of the EHR6.

A feature in the model presented at the IOM and HL7[7]. First, the main feature of the EHR presented by IOM is providing immediate access to the collection of personal health information and user authentication. Second, support the safety of the treatment, and care and effective decision support, and support efficient procedures.

HL7 EHR functional model is presented as support the provision of effective health services, enhance patient safety, and facilitate chronic disease management, privacy and confidentiality guaranteed. Also suggests the functionality of EHR systems in three different areas of the direct call function and the call feature support, the infrastructure information as shown in Figure 1. The direct medical practice management features, clinical decision support, operational management and communication, and to support clinical support, measurement, analysis, research, reporting, administrative and financial functions. Finally, the Information Infrastructure has information and records relating to security management, unique identifier · Register · directory services, support for the standard of health care terminology, interoperability, business rules management, and workflow.

2.2 HealthCare

As it is shown in Figure 2, the Healthcare is the fusion of IT industry and the medical industry. According to the report released by IDC, the size of the market for IoT healthcare worldwide was estimated to grow at a CAGR

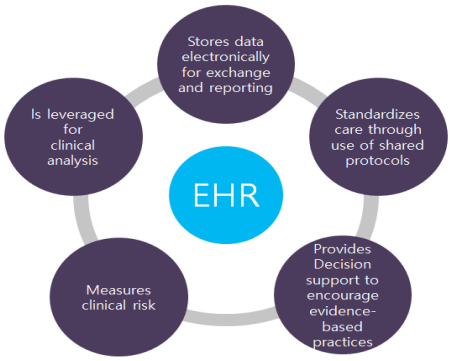

Figure 1. EHR

of 10.2% from $ 8.2 billion in 2014 to $ 12.4 billion by 2018. In addition, as the field of the highest added value, it is expected to grow to create an industry of nearly $ 285 billion by 2020. The health care systems are changing with the increase of human health-related needs and the development of ICT skills.

Healthcare environments are comprised of information and communications, computer, electronic measurement systems, medical engineering, clinical statistics, sensors, new medical equipment. With the smart phone and Internet of Things device, the users can check and send to the server their medical information in real time. Medical data are monitored by the server and supports the medical prescription appropriate for the user. Without visiting the hospital every time, the user can be provided of an accurate diagnosis through remote medical service and clinical analysis owing to the corresponding technique[8].

Smart Healthcare has been noted by the use of a variety of products such as home health care, wearable healthcare, bio-transplant health care. In the case of home health care, it is a system installed at home, that helps manage health in conjunction with individual users and smartphones. For wearable health care, while wearing always on human body, it is providing personalized service through the measurement, the transmitting and analyzing the bio-signal of the user's body in real time. Bio-implantable healthcare products such as combined contact lenses used for the treatment of glaucoma and the smart patch for the bio-signal analysis, are attached or implanted in the body. Major global IT companies are competing in presenting the preview of new healthcare platforms and devices, etc.[9]. As the healthcare equipment combined with a variety of IoT devices are being released, the platforms and technologies safe enough to defend against the threat of medical data hacking are needed.

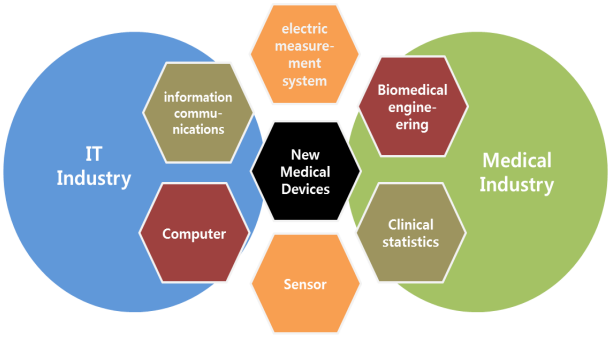

Figure 2. HealthCare Environments.

2.3 Correlation Analysis

The correlation analysis is a statistical analysis method to study the linear association between the variables. It utilizes the observed value with the data (xi, yi) pair. The Pearson correlation coefficient was used to obtain the relationship between two variables in a representative way, as table 1.

The degree r = x and y vary together/the degree x and y vary separately. In addition, in the Scatter Plot r value makes + 1 when the x and y completely matched, when mismatched 0, and -1 if completely matched in the opposite direction

The correlation coefficient is obtained in the same manner as in (1).

$$\mathbf{r} = r_{x,y} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})\,(y_i - y)}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}} \quad (1)$$

Table 1. Correlation Coefficient Analysis

Range of r	Linear Correlation
-1.0 < r <-0.7	Strong negative linear relationship
-0.7 < r < -0.3	Distinct negative linear relationship
-0.3 < r < -0.1	Weak negative linear relationship
-0.1 < r < +0.1	Almost be ignored negative linear relationship
+0.1 < r < +0.3	Weak positive linear relationship
+0.3 < r < +0.7	Distinct positive linear relationship
+0.7 < r < +1.0	Strong positive linear relationship

The relationship is identified through the analysis and assessment by the found factor. That is, correlation analysis is proceeded in four steps such as sequentially Scatter Plotting, calculation of sample correlation coefficient, the calculation of the correlation coefficient by correlation table and final step where a comprehensive test of the correlation on the basis of each step results, is conducted10,11. Scatter Plotting is the two-dimensional graph which is a representation of the functional relationship of the two variables x,y. With this graph, the linear relationship is determined. The correlation coefficients are three kinds. First, the Pearson correlation coefficient described above, Spearman rank correlation coefficient and Kendall Tau rank correlation coefficient. The assessment of the correlation is performed by the correlation coefficient worked out of the following method.

It is examined whether the correlation of two measured variables is significant or not and whether any of the correlation coefficient is the same or not. The last comprehensive test can determine the degree of statistical association between the variables[12]. The detection is then performed on the action strong of linear association. Therefore it may determine the malicious packets through correlation analysis of the unusual actions and the detected abnormal packet can be blocked.

3. Proposal

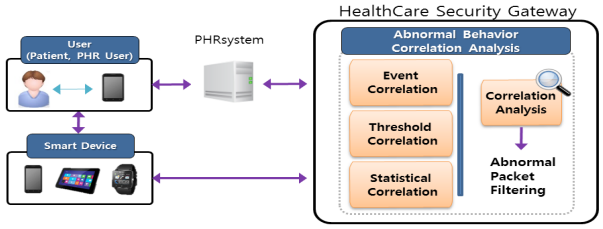

Figure 3. A Propsed Abnormal Packet Filtering Technology.

In the healthcare environment, the medical data measured from various smart devices and medical equipment are transferred to the medical security gateways, as Figure 3. PHR system (Payroll & Human Resources) in the figure is a personal health record system. That is, it takes a form that personal health record server and the gateway device are connected each other. The medical data measured at the different devices or locations are processed in the healthcare security gateway. Through correlation analysis, it is to determine the unusual act due to a strong linear correlation. In addition, because all medical information is gathered to healthcare security, a correlation analysis is

performed at the gateway to detect the unusual acts most efficiently.

In this step, it is to detect abnormal packet and block through correlation analysis of unusual actions. The correlation analysis is performed by Event Correlation, Threshold Correlation and Statistical Correlation depending on the characteristics of each type of judgment.

Each procedure of correlation analysis of unusual action due to behavior type is as follows. First, for Event Correlation, it analyzes the event information that is generated. Using the keywords found from the collected log such as IP and user data files, it extract the related information from all the data collected and processes packets by determining whether it exceeds the normal range of the correlation coefficient through a correlation analysis process. Next, Threshold Correlation analyzes the traffic threshold. For the information collected by the criteria such as the maximum amount of traffic due to the times, data-specific maximum amount of traffic, the number of · internal systems involved with external communication due to working time and the non-business time, the correlation analysis process is executed. Finally, Statistical Correlation is a statistical analysis method and executes the correlation analysis process to the average index of the repeated value, the detection of the events which have never previously occurred, the mean value of the traffic or a non-normal levels.

Therefore, at the security gateway, the correlation analysis of unusual actions according to the three types of abnormalities and they can be detected efficiently and the abnormal packets can be blocked according to the test results.

4. Conclusions

Health care is expected to contribute to the spread and development of the relevant environment, by providing the patient, the doctor and hospital with the ease in medical practice and the advantages in academic aspect. The global IT companies are introducing new platforms and devices but primarily the efficient measures to resolve the problems that can occur while malicious attackers are to send false packet, are required. This issue is of very great importance because this problem can threaten the life of the patient.

In this paper, we designed an abnormal packet screening techniques through conducting correlation analysis of unusual acts. The design executes a correlation analysis on the medical security gateway. This enables you to detect and block the possible attack targeted on the entire medical information because it is executed at the gateway where all health information is gathered. The design determines and blocks the attack to the servers, eavesdropping of medical information and counterfeiting or falsification thereof by the malicious attackers. Because it is to determine them by a numerical accuracy through the linear analysis, it is possible to detect the abnormalities with a very high accuracy. This can prevent the threats against the individual's life, which could occur due to an emergency medical service error caused by paralysis of the server or falsified medical information.

Therefore, it is possible to provide a safe and reliable health care service that prevents attacker's malicious packets. Healthcare environment will provide the medical benefit combined by the IT and medical for the users. Therefore, the design is expected to be utilized for a variety of platforms and infrastructure as an integral function in response to the threat at the medical security gateway in the future.

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