An Integrated Secure EPRP System using Choatic Functions

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Abstract- *Managing large amount of data and massive capital expenditure for IT infrastructure plays an important role. It is required to store, modify or print data reports and transfer to various levels with efficiently and at minimum cost. This paper presents an approach for privacy preservation of Enterprise Patient Resource Planning system using chaotic function which is purely integrated solution in order to improve services and profit with security feature. Apart of providing EPRP system, also discussed linear regression model of time series analysis on the clinical data in order to predict or forecast the future requirements. By this analysis health care and other social service departments can be prepared to increase their services by increasing their machinery, inventory and human resources needed to serve the clients in future.*

Keywords- EPRP System, Clinical Data, chaotic function, Linear Regression

I. INTRODUCTION

For any entEPRPrise maintaining of resources is a very difficult task especially the industries like hospitals where business and services are rendered to the people. Then integrated EPRP system plays a very vital role. It optimizes the process and transactions in a corporation. The proposed system is a secure cloud based integrated EPRP system where all the health care departments like pharmacy, finance, human resources, appointments and case sheet management has maintained. This EPRP system can applicable at any corporations. In this work we considered clinical data to implement and to monitor the efficiency of the proposed system. The main metrics of the proposed system are based on implementation of secure EPRP, optimization of EPRP, Management through EPRP. To implement secure EPRP uses Rule Based strategic security metrics with Chaotic Security Function (CSF) security algorithm. Choatic Security Function is used to provide protection to the sensitive data like authentication ID which required to access clinical data.. For optimizing EPRP system here uses Cloud based computation which optimizes the cost as number of employees recruited to maintain the departmental data. Due to on Demand software as a service (SAAS) model clinical data satisfies the factors like flexibility, scalability and cost-effectiveness. It has been increasingly adopted for distributing many relevant software systems [7].

One of the drawbacks of traditional EPRP systems is high upfront investment to maintain the database, security [5]. As all the organizational departments data should be maintained, the database management becomes a risk factor for the organization. To overcome this issues many of the enterprises are looking towards Cloud based EPRP systems [4], where the service provider hosts the application in the cloud so it can be accessed by multiple organizations. In cloud based EPRP system the data maintenance and data security is handled by the cloud service provider itself. By this cloud based EPRP system, organizations have a control over their data that flows from various departments and provides integrated solution to their customers as a single database is used by all the departments of the organization. Apart of developing secure EPRP system also going to implement time series analysis on the clinical data by using linear regression function [8] in order to forecast the number of patients that are going to admit into the hospitals due to a particular disease based on the past data.

In secure EPRP system, database is also maintained in a cloud only so that the upfront investment gets reduced. Though cloud based EPRP has many benefits in the issues of deployment, security and network performance [5]. Figure 1 shows that the architecture of proposed cloud based system. All the important and sensitive data is maintained in the cloud itself especially in clinical environment. So, security plays a very prominent role here can achieve this using chaotic function [1].

The main objectives of this work is as follows

- To develop a secure cloud based EPRP system in order to aggregate and organize the data that is spread across various independent departments like health care, inventory, finance, pharmacy and human resources etc.
- To provide integrated EPRP system development where each and every department of the organization

is integrated to each other which gives easy access to the others.

- To forecast the future in order to enhance the profitability and services rendered to the clients

II. RELATED WORK

Research on EPRP system using clinical data has been recently started and has gradually increased in recent years. Molnár, B., & Máriás, Z.[9] proposed EPRP in health care which gives a clear view of EPRP in health care field. And also illustrates various advantages and disadvantages of implementing EPRP software. And also specifies on how EPRP systems have been used in healthcare organizations and how they could be used to improve efficiency.

Pansotra, E. A., & Singh, E. S. [15] analyzed the relationship between language use and aging by collecting data from a large number of previous studies. They used LI (Linguistic enquiry) for analysis. They found that with increasing age, people tend to use more positive and fewer negative affect words, more future-tense and less past-tense, and fewer self-references

Software development plays a very prominent role in EPRP system, Sunner,D [12] states and explains the difference between traditional software development methods and agile software development methods, and introduces the characteristics of all the popular agile methods.

Ramchoun [12] proposed Multilayer perceptron: Architecture Optimization and training gives a clear view on working of multilayer perceptron and back propagation, learning of MLP and its implementation. There are several advantages of MLP when compared to other forecasting methods which are as follows:

- Directional accuracy is very high for MLP when compared to Linear regression, SM Oreg and Gaussian processes.
- Mean absolute error which indicates the difference between exact value and predicted value.

Time series forecasting has many methods to be implemented in order to forecast the future, Gupta,S [7] proposed a regression modeling technique on data mining in order to predict the future. This paper contains of formulation, testing data and implementation of linear regression on the given data. But there several limitations for linear regression which are like 1. Linear regression is meant only for linear relationships between variables 2.It is not accurate to find the relationship between variables if data is nonlinear. 3. Accuracy of the results of linear regression is very low.

In our work we are going to use linear regression function in time series analysis to forecast the number of patients to be reported for a disease in the next year based on the previous year's data. Here we are using weka tool for analyzing the data by installing the time series forecasting package and using linear regression function to predict the future. Basically a linear regression models are used to show or predict the relationship between two variables or factors. The factor that is being predicted is called the dependent variable. The factors that are used to predict the value of the dependent variable are called the independent variables. For any business to sustain and increase profitability of the organization one should forecast the future in order to analyze the previous data and predict the number of patients to be admitted in the succeeding year.

III. EXPERIMENTAL SETUP

In traditional EPRP system all the modules are not integrated but in the proposed EPRP each and every module is integrated [13] no need of human intervention. The proposed system tests and analyzes on the clinical data by considering various modules like appointments, inventory, human resources and finance. This EPRP system development contains a single database to be maintained by all the departments of the organization [12] in a cloud. As we are using cloud to host the software which will be accessed by many numbers of clients, security plays a very prominent role and cloud can uses many security algorithms [11]. Global feature based linear regression model has been used to analyse the metrics of clinical data [6].In this proposed system Chaotic Security Function (CSF) Algorithm is used to provide security to the sensitive data while it's maintenance. The proposed system shows a lot of impact on the organization control, deep and comprehensive usage of information system [13]. The main procedure of maintenance of an organizational data at cloud is as follows

Algorithm 1: EPRP system maintenance procedure

1. Information Gathering: Reconnoiance the clinical data periodically to analyze.
2. Preprocess the data: Test whether collected data is authorized and relevant or not by considering security metrics base on strategies or algorithm such as CSF to protect the sensitive data.
3. Time series forecasting: It comprises methods for analyzing data in order to extract meaningful statistics based on global feature model characteristics of the data.

Time series forecasting is the model to predict future values based on previous observed data.

4. Attribute selection: Linear regression function uses to select the attribute by data metrics for forecasting.
5. Time Stamp and Periodicity: Report generation based on this factor. Before start the processing of data needs to setup the time stamp and periodicity like monthly, weekly, daily and hourly.
6. Evaluation of Results: The results are evaluated by running the periodical data under the metrics that shows the performance of forecasted results. The results will be used to forecast the future of changes in the organizational data.

a. Reconnoinace Clinical Data Collection

As the health care center is adopting cloud based EPRP system, data retrieval is done from the cloud [9]. As cloud access is restricted only to the authorized users, data is collected only from health care centres. After the collection of data, need to perform some calculations on it in order to retrieve number of patients admitted due to a particular disease in the previous years.

Table 1. Clinical data obtained from health care centres

S.No	Year	Malaria	Dengue	Flu
1	2010	250	650	750
2	2011	410	450	468
3	2012	524	120	125
4	2013	530	820	460
5	2014	640	750	840
6	2015	850	640	654
7	2016	120	450	250
8	2017	450	320	480

b. Linear Regression

Given an input vector $x \in R^m$, where x1, . . , xm represent features (also called independent variables or predictors), we find a prediction $\hat{y} \in R$ for the age of a person $y \in R$ using a linear regression model [14]:

$$\hat{y} = \beta 0 + x^T \beta \qquad (1)$$

where β0 and β are the parameters to estimate.

Usually, the parameters are learned by minimizing the sum of squared errors. In order to strive for a model with high explanatory value, we use a linear regression model with Lasso (also called L1). This minimizes the sum of squared errors, but in addition adds a penalty term i.e

$$\lambda \sum^{m}_{j=1} |\beta j| . \qquad (2)$$

λ is a constant and can be found by optimizing over the development data. We evaluate the models by reporting the correlation and mean absolute error (MAE), Relative absolute error and Root mean squared error. It is measure prediction accuracy of forecasting method in statistics like trend estimation.

$$MAE = \frac{1}{n} \sum_{t=1}^{n} |e_t| \qquad (3)$$

c. Chaotic Security Function (CSF)

Chaotic Function satisfies the self-similar property that is whole shape has the exactly or approximately similar shape to a part of itself [2]. Chaotic function also referred as fractals. It is formatted in the following way. A fractal corner is labeling by pt1, pt2 and pt3 and chooses a random point v1. Set $v_{n+1} = ½ (v_n + pt_{rn})$, where r_n is a random number 1, 2 or 3. Draw the points from v1 to v∞. If the first point v1 was a point on the fractal, then all the points are v_n lie on the fractal as shown in Fig 1. If the first point v1 to lie within the perimeter of the gasket is not a point on the fractal, none of the points v_n will lie on the fractal, however they will converge on the sieve. If v1 is outside the gasket, the only way v_n will land on the actual gasket, is if v_n is on what would be part of the gasket, if the gasket was infinitely large [4]. This format yields the result in the form of cipher text.

The Sensitive attribute of the clinical data like client ID that is present at the middle of a triangle is the secret key. The data which is encircling the middle traingle is the original text. The plain text and the key are placed in a selected order such as middle, top, right and left. Based on the keys, the transformation of the plain text is passed out to achieve the cipher text. Both the sender and receiver share the same key as this is a symmetric encryption and is normally called as fractal symmetric encryption. First of all the inner triangles are filled with secret keys, then the outer triangles are filled with plain text as shown in Figure 1 and Figure 2 [2, 4] .

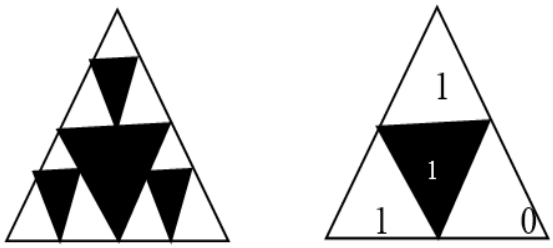

Figure 1.

Algorithm 2: CSF Algorithm

1. Divide the plain text into fixed size blocks of multiples of '3' each.
2. Insert the secret key in the middle triangles in some order, Say MTRL.
3. Insert the plain text around the middle triangle in some order, say TRL.
4. Recursively shift the sub triangles based on the middle bit. If the middle bit is 0, do right circular shift i.e., T ← L, R ← T and L ← R. Otherwise do left circular shift i.e. T ← R, R ← L and L ← T.
5. For each triangle do the following. If key k = 0, do left circular shift i.e. T. ← R, R ← L and L ← T. Otherwise do right circular shift i.e. T ← L, R ←T and L ← R.

This system maintains all the activities in the organization in order to increase the profitability and enhance the services in secure manner using CSF. It is essential thing to forecast the future for any business. So, this system can uses to predict the number of patients to be admitted due to a particular disease in upcoming year based on the previous year data by time series forecasting[15] using linear regression function. By this forecasting health care departments can improve their services for the patients by increasing the resources in various departments. Let us consider the following departments which can be able to maintain at Cloud based EPRP system.

Case 1: Human resources management

All the employees' individual details are maintained in the system cloud, when a new employee is added automatically an account will be created to that particular employee and all the appointment requests by the patients are automatically placed in employee account.

Case 2 : Appointment management

When a patient arrives to the hospital for an appointment, after booking an appointment an instant message will be sent to the patient mobile that contains of username and password to access his/her own account. And a random unique customer ID will be generated.

Case 3: Automatic Token generation:

When the doctor has approved or postponed the appointment a message will be generated to the patient's mobile that contains of the token number.

Case 4: Case sheet management:

When patients get treated by the doctor, the case sheets written by the doctor through his/her account get automatically uploaded to the patients account.

Case 5: Inventory management:

All the details of inventory has been maintained. And when the patient purchases medicines in the hospital there will be automatic updating in inventory without any human intervention.

Case 6: Finance management:

Hospitals get income through many sources like OP amount, pharmacy and lab test's paid by the patient's and there is automatic updating of income. Hospital management can check the daily and monthly income.

IV. RESULTS AND ANALYSIS

Table 2 illustrates the metrics like mean absolute error, root relative squared error, relative absolute error, mean absolute percentage error, root mean squared error and mean squared error by using linear regression [14] on various diseases clinical data. It shows that variations in the metrics by measuring the count on clinical raw data. By using linear regression analysis approach analyzed the relationship between scalar dependent variable and explanatory variable.

Table 2. Clinical data analysis by different Metrics

Features/ Disease	Dengue	Malaria	Flu
Mean absolute percentage error	32.17	33.2	35.6
Root Mean Squared error	166.95	152.1	132.7
Root relative squared error	96.700	95.6	97.7

Relative absolute error	91.86	86.5	76.3

Figure 2 shows that linear regression analysis results which represent future effect by the Dengue. By considering this forecasting report can easily take the precautions to reduce the victims from Dengue.

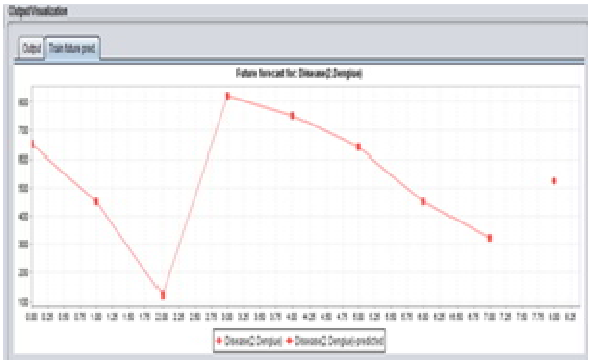

Figure 2. Analysis Report on Dengue disease in succeeding year.

V. CONCLUSION

Thus secure Integrated EPRP system development for clinical data provides a very flexible application in order to integrate various departments of the hospitals as there is a flow between each and every department. This application not only enhances the profits of the organization but also improves the services provided by the hospitals to their clients. As any business needs to predict the future any enterprise should be careful in predicting the future to increase the profits and render more services. And using time series forecasting in order to predict the future also improves the profitability to find number of patients to be admitted by a disease in the succeeding year based on the previous year data. By predicting the future hospitals can arrange their resources in order to serve the patients. By this work we can state that the integrated EPRP system can integrate the data flow of all the departments which makes the system more flexible to maintain and easy retrieval of data.

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