Health Care Management System Using Time Series Analysis

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***Abstract*—The paper proposes a technique for risk prediction with graph-based proofs so as to observe and monitor the progress of a developing situation in the field of health.**

Making an automated system which will help to predict various health parameters of a host remotely is our primary objective. Providing a way to predict the future body temperature, pulse rate, haemoglobin, systolic and diastolic pressure with the help of an existing data set record, in an optimized manner is our primary concern using which we can forecast the health of a patient.

Using the collected data with the help of a built-in framework to detect future health hazards is our main objective. Forecasting the health condition is being done by using Time series algorithm to predict body temperature, pulse rate, haemoglobin, systolic and diastolic pressure of the host patient, in an efficient manner. The errors generated for the forecast values are compared using various error evaluation techniques.

Keywords: time series, univariate time series, smoothing techniques, simple weighted moving average, Welles Wilder moving average.

I. Introduction

Health Management System is an integration of healthcare, institute administration and data gathering system. A perfectly built healthcare conveyance system holds a high percentage of accountability; healthcare service provider must ensure a high-end outcome, budgetary influence and standard practice.

In order to achieve this desired outcome, health management system executives accumulate and examine data. They combine unorthodox management techniques and then employ new-aged and enhanced technologies to reinvent healthcare. Health management system experts are the sole originators, discoverers, and entrepreneurs for the continuous revolution of the health care industry.

Integration of healthcare, entrepreneurship, and information systems are the key ingredients of an accountable and responsible healthcare management system. Healthcare suppliers and entities should establish quality outcomes, fiscal responsibility, efficiency, competency, and effective practices, as the healthcare delivery system holds to a greater obligation in today's world. In order to achieve this, health management systems professionals collect and analyze data, place along with innovative management techniques, and utilize new technologies to re-engineer healthcare. Health management systems professionals are inventors, innovators, and entrepreneurs that have been responsible for the constant evolution of the healthcare delivery system.

Understanding the patient's perspective is very essential. Health sciences provide communication for patients in the field of medicine via the help of medical professionals. A range of aid settings like hospitals, medical practices and long run care facilities are needed to be managed by the healthcare professionals and additionally, they have to even manage information and data. Information systems square measure to gather, manage and transmit knowledge to assist within the delivery of price effective tending services. Facilitation of the professionals to fulfill the long-term aid challenges can be strongly dealt with the combined efforts of health sciences, business management, entrepreneurial development and information gathering systems. The current study, describe how to analyze data and provide insight into the forecasting of the results.

Quality of service in healthcare has always been under constant criticism in the modern era; assistance is a very touchy subject. Health care management, especially for elderly people, is a topic of concern, as most people in modern times are job holders, and have very much hectic life. It is difficult to manage a constant watch on an elderly person in a house and keeping a nurse or housekeeper is also a very costly issue nowadays. In this situation, a remote health care monitoring system can provide a solution to this problem.

Healthcare has been secluded from this insurgency for long as its range and heterogeneity. Health monitoring of old is one of the most critical subjects in modern era health care. General health examination has been an indiscernible part of health evaluation in several countries. Predicting whether the participant's health is at risk or not is necessary for a before time warning and precautionary intervention. There is no ground truth for forecasting the health parameters of a patient. In this paper, we have a tendency to propose a graph-based Time series algorithm, referred to as Welles Wilder Smoothing Technique for smoothing the noise related to forecast values.

An economical unvaried formula is intended, and also the proof for the efficiency of the method proposed is given. Extensive experiments based-on both real health examination data sets and synthetic data sets are performed to show the effectiveness and efficiency of our methodology.

The paper is divided into eight parts. Section 1 comprises of introduction part of forecasting. Section 2 discusses various time series models and their evolution. Section 3 discusses various smoothing and error evaluation techniques. Section 4 shows the graph of the proposed forecasting model. Section 5 evaluates a comparison of errors among various smoothing techniques. Sections 6 and 7 have conclusion and future scope respectively. Section 8 has a list of references.

II. LITERATURE SURVEY

1) In the study on Trend Analysis of Time Series Data using Data Mining Techniques by Arpit Baheti and Durga Toshniwal [1], a framework has been suggested in order to study the time series data. The authors composed chunk of analogous time series, with the help of agglomerated hierarchical clustering technique because a large amount of data-sets in time series were taken into consideration during the study. There were a lot of series present in each cluster, even after clustering and in case if their study was done on a one-to-one basis, it would consume a lot of time and resources. Therefore, a nearby depiction for each cluster in a time series model for the supplementary study was done by the authors. An algorithm for time series, which merges time series that are present in the same cluster, has been introduced by the authors in order to achieve this goal. The authors have used a non-parametric Modified Mann-Kendall (MK) test at 95% acceptation grade, in order to assess the existence of a progression in definite portions of a time series. Sens median slope estimation technique has been used in order to analyze the constructive implication of progression.
2) In the study of Using time series analysis to forecast emergency patient arrivals in CT department by Li Luo and Yabing Feng [2], the paper studies the occupational data of CT department which is based on the extensive data accumulated by CT department in West China Hospital of Sichuan University. Using two approaches, the data is being collected: on an hourly basis, and on a daily basis, and a forecast of the quantity in the immediate prospect which sets as a model is depicted in this paper. The design collected in this paper can be used for hospital managers to manage the allotment of patients and make acceptable allotment of medical resources efficiently because of the authenticity of the data and time series analysis of S.A.S. software is extensively implemented.
3) In the study of Recursive and Rolling Windows for Medical Time Series Forecasting: a Comparative Study by Lamia Ben Amor, Imene Lahyani, Mohamed Jmaiel [3], the relevance of various numerical approach in designing and forecasting the variance volatility of medical data has been addressed by the authors. Doing this, the typical auto-regressive design as criteria for forecasting purpose and two efficient blueprints namely the rolling and the recursive windows have been referred by the authors. The forecasting competence for medical time series regarding forecasting errors and the Theil Inequality Coefficient has been computed by the authors. The rolling window concept seems to be an effective method for predicting medical series with fluctuating variances is shown in the development of this paper. On the other hand, the effectiveness of the recursive window is better when predicting medical time series with steady variances.
4) In the study of Application of Uni-variate Forecasting Models of Tuberculosis Cases in Kelantan by Sarimah Abdullah, Napisah Sapii, Sharina Dir and Tg Mardhiah Tg Jalal [4] the best time series model of TB cases from 2003 to 2010 in Kelantan and to anticipate the count of Tuberculosis incidents for the following 2 years, the analysis is devised to ascertain the pattern. An inspection using catalogued incidents which was briefed to the Kelantan Department of Health was conducted. All the examination and incorporation in the series data as monthly data were catalogued for Tuberculosis cases from 2003 to 2010. In order to figure out the perfect forecasting design for the data series uni-variate modelling (Naive Technique, Average Forecast, Exponential Smoothing Method, and Box-Jenkins Technique) has been practised to the data series. Conclusion: Growth in trend pattern was noted based on 72 monthly data series of Tuberculosis incidents; also an increase in progression pattern was documented. The best time series model was found to be Double Exponential Smoothing technique when compared to Single Exponential Smoothing, Holts Technique, ARRES, and Holt Winters Trend and Seasonality for both multiplicative and additive hypothesis.
5) In the research of Optimization the Parameter of Forecasting Algorithm by Using the Genetics's Algorithm Toward the Information Systems of Geography for Predicting the Patient of Dengue Fever in District of Sragen, Indonesia [5] by Ryan Putranda Kristianto and Ema Utami, in the latest 3 years from 2013 to 2015, there was a major rise in count of the victims of Dengue Fever in district of Sragen, Indonesia. All the people of all ages in addition to teenagers under 15 years old were affected. Due to the lack of an organization that could anticipate the growing count of Dengue Fever patients, there was an absence of anticipation from Health Department of District Sragen. Feasible analysis to anticipate the patients of Dengue Fever in that community especially for the year 2016 and future years have been done in order to fix the issues, by the authors by applying the merger of Genetic Algorithm (GA) and Triple Exponential Smoothing (TES). The analyst used the data of Dengue Fevers patient from 2013 to 2016 at the beginning of the quarter year. In framing the factors α, β, and γ GA were used that constructed the performance of forecasting, to hide the flaw section of T.E.S. Also, there was a correlation in data amidst GA-T.E.S. and T.E.S. and also the estimation of the rising accuracy after using GA in the advancement

of this study. The computation of efficiency is due to the technique of Mean Absolute Percentage Error (MAPE). The mean of increasing of the merger of GA-TES algorithm which was eight percent as compared to TES algorithm was what the data of trial result showed up. This study has made advancement in the method of reformation in economic sciences forecasting using optimization algorithm.

III. PROPOSED WORKS

A. Time Series Algorithm

Time series analysis [6] [7] [8] has just one variable that is time. Data mining already has lots of algorithms present, and thus originates the obvious question of why to use one more algorithm called time series analysis. Let's take the example of supervised learning. Under supervised learning we have regression or logistics, so there we have an independent variable, and we have a dependent variable. There we use a mapping function of how one variable is related to another, and then we can go ahead with the analysis part but time series algorithm has only one variable called time. E.g. - There is a coffee shop which is quite a successful coffee shop in town. So, we try to see the amount of coffee sold every month. For that, the addition of all the sales of the coffee is done on a monthly basis (assume). Now, we want to know the sales of the coffee next month or next year. So, we have just one variable that is time and prediction is to be made in accordance with time. For that, we need time series study and analysis.

Set of observations taken at specific instances of time usually at equal intervals are known as time series. The anticipation of future values based on the beforehand observed values is the usage of time series analysis. Business prediction involves time series analysis. A lot of traders can be seen investing in the Sensex who are trying to predict the future of the market the forthcoming day. A number of retailers try to see the number of goods they are going to sell the next day. All of it can be achieved with time series analysis. Time series is not only limited to only retail and finance, but it is applicable everywhere. In this way, we can analyze when the market just went up or has a dip, which can help to analyze the past data, and predict future data.

Making the same analogy to a healthy person suffering from increased body temperature during a certain fixed time interval, we can forecast the future as well as analyze the past using this algorithm.

1) Limitations of time series: -

i. Cases where values are constant, time series cannot be applied.

ii. Values in the form of functions e.g. sin x, cos x, where values can be predicted by simply substituting different values of x in the mathematical function. So, there is no point of applying time series analysis, where values can be calculated just by using a function.

Most of the models work on the stationarity theory of time series. If the time series has a particular behaviour over time, then there is a very high probability that it will follow the same in the future.

Stationarity has very strict criteria

1. The mean should be constant according to the time.
2. Variance should be equal at different time intervals.
3. Auto-covariance that does not depend upon time.

When all the above three conditions are met then only we can say that the model is stationary, and then we can apply time series analysis over it.

Time Series Data- A collection of observations on the values that a variable takes at totally different times can be outlined as time series data. This kind of information can also be recorded at regular time intervals, like on a monthly basis (e.g. sales), on a weekly basis (e.g. cash supply), on a quarterly basis (e.g. GDP), or on a yearly basis (e.g. Government Budget). Economic sciences, mathematical finances, statistics, seismographic predictions, weather forecasting, and lots of other alternative applications are the various fields where time series analysis is being actively used.

Cross-sectional Data- This type of data is collected by observing several subjects (such as population, associations, countries, or localities) at an equivalent point of time or throughout an equivalent time period. Example: Suppose an analyst wants to know the number of cars a household has bought in the past year. To do so, he collects data on a sample of, say, five hundred families from the population and notes the information on what percentage of cars they have bought within the past year. This cross-sectional sample provides a glimpse of the population for that duration.

In this paper implementation for the time series algorithm is being used by "Univariate Time Series". Single observations that are recorded over regular instances of time intervals are referred to as univariate time series. E.g. - monthly returns of a stock.

Various patterns can be observed in the data set based on the interval of the recorded data set (hour, day, week, month, quarter, annual, etc) which forms the modeled component. Also, increasing or decreasing values plotted on the X-axis over the time variable plotted on the Y-axis with a constant slope will be observed occasionally in time series. The varying slope may also contain patterns around them.In the implementation of our time series analysis, we may get to observe certain patterns as well such as mentioned in Table I.

TABLE I. VARIOUS PATTERNS RELATED TO TIME SERIES ANALYSIS

Trend [9]	If a relatively smooth pattern exists regularly for more than one year, then it is called a trend. A person may have a smooth pattern of health records which may be termed as trending.
Seasonal	A seasonal pattern is the one in which similar pattern can be observed regularly within one year or even shorter time interval. A person may show symptoms of frequent illness for certain health parameters then it is termed as seasonal.
Cyclic	The recurrent pattern that appears in exceedingly time-series analysis, however, beyond a frequency of one year is known as cyclic. It is a wavelike pattern about a long-term trend that is apparent over a number of years. Cycles are barely consistent and appear in combination with other components. A person may show cyclic health disorders in the case of a severe health condition.

Idea Behind Uni-variate Time Series Modeling [9]:

The need to use uni-variate modeling arises in situations where:
a) Appropriate economic theory to the relationship between series may not be available and hence one considers only the statistical relationship of the given series with its past values.
b) Sometimes even when the set of explanatory variables may be known it may not be possible to obtain the entire set of such variables required to estimate a regression model, and one would then have to use solely one series of the dependent variable to forecast the subsequent values.

Applications of Uni-variate Time Series in Terms of Forecasting:
a) Forecasting [9] inflation rates, unemployment rates or the net inflow of foreign funds in the near future could be of interest to the government.
b) Homes may be interested in the demand for the product (e.g. two-wheeler, soft drinks bottles, or soaps, etc) or the market share of the product.
c) Housing Finance Companies may want to forecast both the mortgage interest rate and the demand for housing loans.
d) Forecasting gold or silver prices by the jewel merchant.

Stationarity of a Time Series:
A time series will be said strictly stationary only if the marginal distribution of Z at time n [p (Z_n)] does not vary at any other point in time. Therefore, p (Z_n) = p (Z_{n+i}) and p (Z_n, Z_{n+i}) does not depend on n. (Here, $n \geq 1$ and i is an integer). This implies that the mean, variance and covariance of the series Z_n are time invariant. However, a series is said to be weakly stationary or co-variance stationary if the following conditions are met:
a) $E(Z_1) = E(Z_2) = E(Z_3) = \ldots = E(Z_n) = \mu$ (a constant)
b) $Var(z_1) = Var(z_2) = Var(z_3) = \ldots = Var(z_n) = \gamma_0$ (a constant)
c) $Cov(Z_1, Z_{1+i}) = Cov(Z_2, Z_{2+i}) = Cov(Z_3, Z_{3+i}) = \gamma_i$, is determined by lag i.

The necessity of the assumption of stationarity:
(i) Derivation under the assumption that variables of concern are stationary are the results of the classical economic sciences theory.
(ii) Wherever the data is non-stationary standard techniques, for the most part, are invalid.
(iii) Since the time series is non-stationary, sometimes, auto-correlation may result.
(iv) Spurious regressions may also be the result of non-stationary time series regressions, i.e. cases when the regression equation shows a significant relationship between two variables when actually there should not be any such relation.

IV. METHODOLOGY

Various approaches under time series forecasting to predict the future are as follows-
1. Past Average [10] - Historical data organized in sequential order as the dependent variable and time as an independent variable is referred to as past average. Past average is best for cyclic variation. Forecast for the later period is equal to the mean or average for the previous periods is used in this methodology.
2. Moving Average [11] - Using the historical data and calculating the mean or average for a regular period as a sliding window is a technique used in moving average method. At the end of each period, new average is calculated by adding the demand for the latest period and removing the data of the previous period. It is called moving average because the data in this method changes from period to period. Following is the way in which this smoothing technique predicts y_{t+a} using the time series y_1, y_2, y_3, ..., y_t:

$$S_t = Average(y_{t-a+1}, y_{t-a+2} \ldots . y_t), \tag{1}$$

t = a, a+1, a+2, ... N
where the smoothing constant is a.
3. Weighted Moving Average [12] - The weighted moving average allows unequal weights to be placed on each data such that the sum of all weights is equal to 1.
Following is the way in which this smoothing technique predicts y_{t+k}:

$$S_t = w_{t-1} * y_{t-1} + w_{t-2} * y_{t-2} + \ldots . + w_{t-n} * y_{t-n} \tag{2}$$

where,w_{t-1}, w_{t-2}, w_{t-3},....$w_{t-n}$are the smoothing constants such that $w_{t-1} + w_{t-2} + w_{t-3} + \ldots . + w_{t-n} = 1$.
n = number of intervals.
Y_{t-1} = Actual values in interval t-1.
The weights can be given random values to get the result, but it will not give the correct the result. In order to forecast the correct result the following method is used: Sum of digit method to calculate n-interval:
1) Sum of n natural numbers = $\frac{n(n+1)}{2}$= Σn.

2) $\frac{n}{\Sigma n}$, $\frac{(n-1)}{\Sigma n}$, $\frac{(n-2)}{\Sigma n}$,....... For n=4 Σn = $\frac{4(5)}{2}$=10

Hence $W_1=\frac{4}{10}$ $W_2=\frac{3}{10}$ $W_3=\frac{2}{10}$ $W_4=\frac{1}{10}$.

4. Exponential Smoothing Method [13] - This method requires only the current data values and the forecast data values for the current period. It is distinguished by the fact that it assigns weights to all the historical data, and the pattern of weights assigned are of exponential form. The newest data is given more weight, and the weights assigned to older periods decrease exponentially.
The Exponential Smoothing tool uses the following formulas:

$$\left.\begin{array}{l} T_0 = y_0 \\ T_t = \alpha y_{t-1} + (1-\alpha) T_{t-1}, t{>}0 \end{array}\right\} \tag{3}$$

where
primary observations are denoted by $\{y_t\}$ starting at t = 0
α is called the smoothing factor valued between 0 and 1.
If α = 0 then $T_t = (1-\alpha)\ T_{t-1}$ which is purely dynamic.
If α = 1 then $T_t = \alpha\ y_{t-1}$ which is purely static.

Measurement of Errors in Forecasting -
The process of forecasting most of the times happens to contain errors. Forecasting errors can be classified into two types:
1) Biased errors- Biased errors occur when there is a consistent mistake, i.e., the forecast values are always too high or too low. These errors are often due to the result of inaccurately estimating the components to be forecasted such as trend, seasonal influence, or cyclical movements. When

these are inaccurately estimated, then biased errors occur.
For example, if the age of a person is increasing and due to which the health of the patient is continuously deteriorating. However, if the assumptions for the previous years when the patient was in a healthy condition are taken as forecast values for the current year then the forecast values will always be showing different values than the actual values for the current year because trend was not taken into consideration.
2) Unbiased Errors- This type of error is caused by unpredictable factors because of which the forecast deviates from the actual values. An example is an accident of a patient.
In order to reduce the errors, there is a need to measure the errors. Following are the ways to measure the forecasting errors:
1) Forecasting Error or Deviation-

$$E_t = O_t - F_t \tag{4}$$

where
E_t = Deviation or forecast error for interval 't'
O_t = Original value for interval 't'
F_t = Forecast for interval 't'
2) Running Sum of Forecast Errors (RSFE) - It is the sum of the forecast error for all the intervals.

$$RSFE = \sum_{t=1}^{n} E_t \tag{5}$$

where E_t = Deviation or forecast error for period 't'.
When we calculate the sum of forecast errors the large positive errors will be offset by the large negative errors. If the sum of deviation is taken all along, only for positive or negative errors the cumulative RSFE will keep on increasing. This increasingly large error indicates systematic deficiency in the approach.
3) Mean Square Error (MSE) [14] - It is similar to calculating the variance of the data.

$$MSE = \frac{\sum_{t=1}^{n}(O_t - F_t)^2}{n} \tag{6}$$

where
O_t = Original value for time interval 't'
F_t = Forecast value for time interval 't'
n = number of intervals in the forecast
4) Standard Deviation (σ) -
$\sigma = \sqrt{MSE}$,i.e.

$$\sigma = \sqrt{\frac{\sum_{t=1}^{n}(A_t - F_t)^2}{n}} \tag{7}$$

5) Mean Absolute Deviation (MAD) -

$$MAD = \frac{\sum_{t=1}^{n}|A_t - F_t|}{n} = \frac{\sum_{t=1}^{n}|E_t|}{n} \tag{8}$$

MSE, Standard deviation and MAD measure the dispersion or the spread of the forecast errors. If the value of these errors is small then the forecast is typically close to the actual demand but if the value is very large then it indicates for the possibility of large forecasting errors.

V. Experimental Setup

The new smoothing technique used in this paper is Welles Wilder Moving Average. The strength of WWMA is its ability to filter out noise, therefore, allowing trend analysis. This technique was developed by J. Welles Wilder and was for the first time mentioned in his book, New Concepts in Technical Trading Systems." The Welles Wilder method of calculating moving averages and Simple Moving Average method for calculating moving averages are very similar to one another. Both the techniques end up in getting similar results. The formula was designed by Welles that it could be easily computed by hand or with the help of a simple calculator. The formula of WWMA is as follows:

$$WWMA = \frac{(WWMA[-1] * (n-1) + CurrentValue)}{n} \tag{9}$$

Data Set- The data set used for health predictions are based upon five parameters namely body temperature, pulse rate, haemoglobin levels, systolic and diastolic pressure. The data set is recorded on a daily basis for a time period of 3 months dated 1st January 2019 to 31st March 2019.
The range of temperature for a normal human body lies between 93°F to 106°F as shown in Figure 1.
The range of pulse rate for a normal human body lies between 50 per minute to 140 per minute as shown in Figure 2.
The range of haemoglobin for a normal human body lies between 7 (g/dl) to 20 (g/dl) as shown in Figure 3.
The range of systolic pressure for a normal human body lies between 60 mmHg to 100 mmHg as shown in Figure 4.
The range of diastolic pressure for a normal human body lies between 110 mmHg to 180 mmHg as shown in Figure 5.

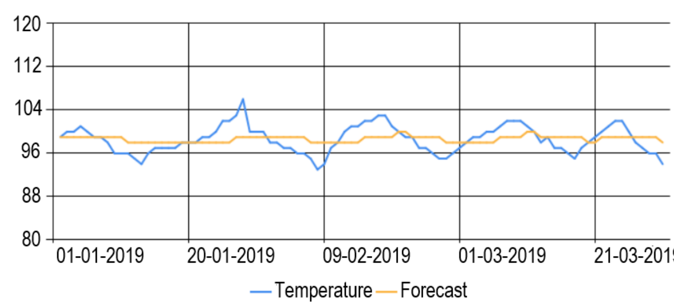

Fig. 1. Graph of actual and forecast body temperature for the time period of 3 months using Welles Wilder Moving Average.

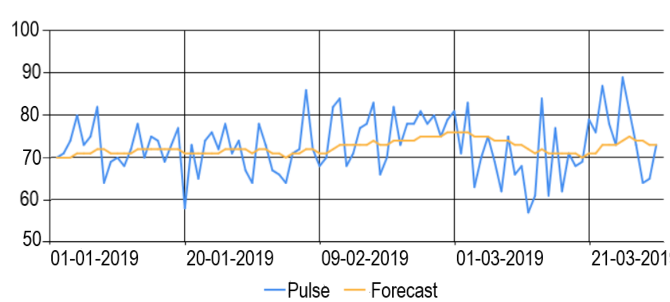

Fig. 2. Graph of actual and forecast pulse rate for the time period of 3 months using Welles Wilder Moving Average.

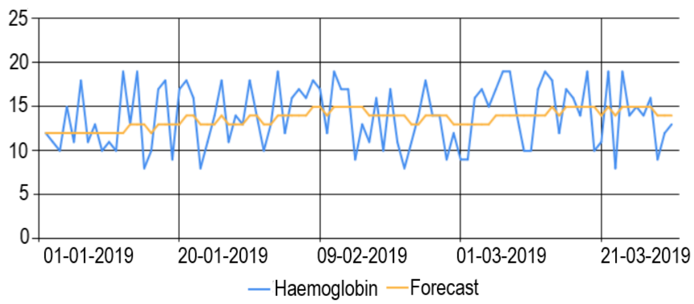

Fig. 3. Graph of actual and forecast haemoglobin levels for the time period of 3 months using Welles Wilder Moving Average.

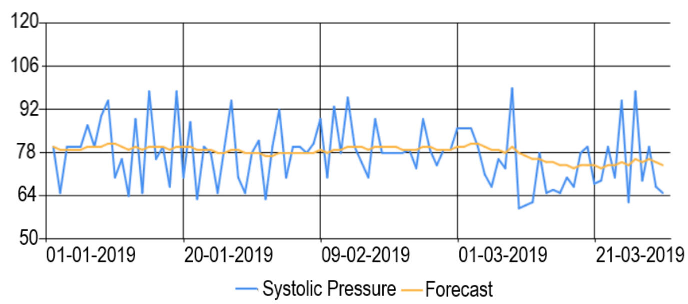

Fig. 4. Graph of actual and forecast systolic pressure for the time period of 3 months using Welles Wilder Moving Average.

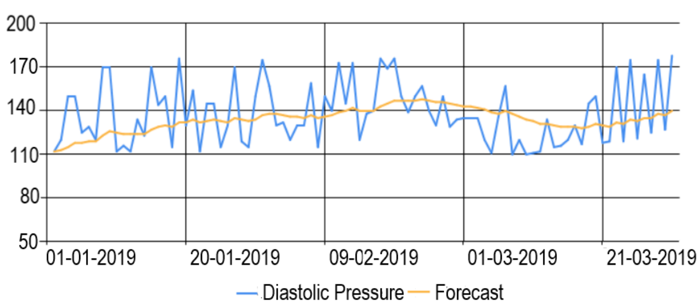

Fig. 5. Graph of actual and forecast diastolic pressure for the time period of 3 months using Welles Wilder Moving Average.

VI. RESULTS

By applying various time series approaches the values for all the parameters are forecasted. Table II shows the sample for the temperature of a single patient for the duration of five days dated from 01-01-2019 to 05-01-2019. Here WWMA is Welles Wilder Moving Average.
SWMA is Simple Weighted Moving Average.

TABLE II. SAMPLE TEMPERATURE FORECASTS FOR VARIOUS METHODS

Temperature	Date	WWMA	SWMA	NAIVE
98.85	01-01-2019	98.85	98.85	98.85
99.61	02-01-2019	98.90	99.61	98.85
100.34	03-01-2019	99.01	100.34	99.61
100.53	04-01-2019	99.12	99.0385	100.34
99.66	05-01-2019	99.15	99.7655	100.53

After the values are forecast the errors for the all the above methods are calculated in Table III.

TABLE III. ERRORS FOR EVALUATION OF VARIOUS FORECAST VALUES

Date	Error(WWMA)	Error(SWMA)	Error(NAIVE)
01-01-2019	0.00	0	0
02-01-2019	0.71	0	0.76
03-01-2019	1.33	0	0.73
04-01-2019	1.41	1.4915	0.19
05-01-2019	0.51	-0.1055	-0.87

When this approach is applied for the entire dataset for the parameter ”Temperature” we get following error results:
RSFE (WWMA) = 3.26
RSFE (SWMA) = -7.33565
RSFE (NAIVE) = -1.693
where RSFE is Running Sum of Forecast Errors.

MSE (WWMA) = 11.52681401
MSE (SWMA) = 20.9658
MSE (NAIVE) = 24.35754
where MSE is Mean Square Error.

σ(WWMA) = 3.395116199
σ(SWMA) = 4.578842
σ(NAIVE) = 4.935336
where σ is the Standard Deviation.

MAD (WWMA) = 2.895254524
MAD (SWMA) = 3.680538611
MAD (NAIVE) = 3.86767
where MAD is the Mean Absolute Deviation.

VII. CONCLUSION

The main objective in this research was to successfully forecast the various health parameters such as body temperature, pulse rate, haemoglobin, systolic and diastolic pressure of the host. There was a need to make a mark in the field of health sector using data mining as a tool. With the rise of data mining, an era of technology is moving towards a far superior dimension. The paper can definitely make a way for betterment in the field of health sciences. The research has been tested and implemented for a multiple number of times. The paper can be further extended with the help of superior software modules and new integration. Full and large scale implementation of the research can only help in realizing the full potential of the work.

VIII. FUTURE SCOPE

The future scope of the research proposed is as follows:

1) The research can be considered as a platform for collecting the health record of patients which has been constrained to mainly body temperature, pulse rate, haemoglobin levels, systolic and diastolic pressure and can be further extended to various other health parameters like body weight, body mass index, pain, oxygen saturation, blood glucose level, blood platelets count etc.

2) The research can be extended as an IOT project to develop an automated system which will help to monitor the host remotely.
3) The research can be used in disease prediction, disease classification and life expectancy prediction based upon classification techniques of data mining.
4) The research can be used in army services in an active situation.
5) It can provide a huge database for doctors to diagnose patients.

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