HOME PATIENT MONITORING SYSTEM USING IOT AND RAS

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***ABSTRACT*:** Many researches in the past ignore the need to encrypt the data for security perspective. However in recent years, researchers have given top priority for data security for smooth transmission of data over network by incorporating many encryption strategies along with actual data. In the field of modern healthcare environment, automation has emerged to be more necessary to route and stock the facts about employers (Doctors), Employees (Staffs) and customer (Patients). Hence Doctor in need of such a stored voluminous information's about a particular person, whom which the condition has to be diagnosed. In this paper, we discuss a new algorithm OEJS which is need to secure the data for Patient Monitoring which is best suit for inbound data security for healthcare application. The proposed work is based on the OEJS (Odd Even Jumbled Algorithm) which is modified form of Blowfish Algorithm. OEJS algorithm is implemented over a Blowfish Algorithm. Patient Monitoring is becoming more common across the healthcare industry around the world and particularly in the United States with various medical conditions tracked when Patients are away from the hospital. Therefore, we proposed a new OEJS algorithm for security which provides high encryption in order to solve these security vulnerabilities.

***KEYWORDS*: Internet of Things (IOT), Wireless Network, Blowfish Algorithm, Health Monitoring Wearable Medical Devices, RAS, SCADA.**

I. INTRODUCTION

Patient Monitoring System is the term for all devices that are used to supervise Patient. It refers to technology used to continually assess a person's health status [2]. The purpose is to monitor the Patient's vital factors--Blood Pressure, Body Temperature reading them at specified frequencies from analog devices and store readings in a Database [1]. If readings fall outside the range specified for Patient or device fails an alarm must be sent to a nurse. The System also provides reports. IOT is a medical Application that is changing the environment of health care industry today [9]. The IOT is slowly allowing for the health care industry to reduce its dependency on humans and steadily improving health care and providing early Diagnosis and treatment of serious issues [16]. Some advance features had added in IOT by which Patient's health is tracking 24*7 hours.

II. RELATED WORK

In today's world, many people who survive past 65 years and above have chronic or life-limiting medical conditions that require a high level of healthcare. In most cases aged parents are living alone and their offspring keep away parents due to their social working conditions [9]. Moreover they are not well aware of their medications that are available today. Besides their health condition, they always to like to stay in home than Care Centre. The Patients who stay away from medical center need ceaseless observation and advice from the health care takers (Doctors and medical practitioners). To cater a service with hassle free environment, IOT and RAS provide a framework for healthcare that integrates medical center and Patient space. By this technology Patient data record can keep secure by unauthorized access. Thus the concrete solution is required to secure the Patient data in the integrated platform of IOT and RAS [13]. Moreover the data to be monitored for second by second is under risk and requires a solution using OEJS (odd even jumbled string) encryption algorithm.

III. SYSTEM ANALYSIS

A. *Purposed System feature:*

The proposed System is a home Patient Monitoring System, consists of server, sensors. Server monitors the various sensors values, and can be easily configured to handle more hardware interface module (sensors) [6]. The Arduino Uno 3 which is a type of microcontroller is placed between Patient sensor and RS232 port. A local pc1 is used in which data is uploaded. Through a wireless connection this data is transferred in a client PC2 (Doctor).

B. *Proposed Home Patient Monitoring System Functions:*
The proposed Home Patient Monitoring System has the capabilities to monitor the following components

- Body Temperature
- Heart Rate
- Oxygen Saturation
- Store Data in Database
- Data is shown by Analogue Graph.

The proposed Home Patient Monitoring System can alert the Doctor in the following Critical Situation:

- 34.5 <Body Temperature >36 [18]
- 69 <Heart Rate >76 [19]
- 92 <Oxygen Saturation [17]

IV. **SYSTEM DESIGN AND IMPLEMENTATION**

A. *Proposed Home Patient Monitoring System:*
The proposed model of the Home Patient Monitoring System is as shown in the figure1. The model consists of different sensors like Body Temperature, Oxygen Saturation and Heart Rate. These Sensor Parameter is attached to Patient Initially a microcontroller which is a Arduino uno3 is placed between Sensor Parameter and RS 232.These Sensor Parameter are attached to Arduino, by running a simulation tool it will start to take reading of Sensor Parameter.

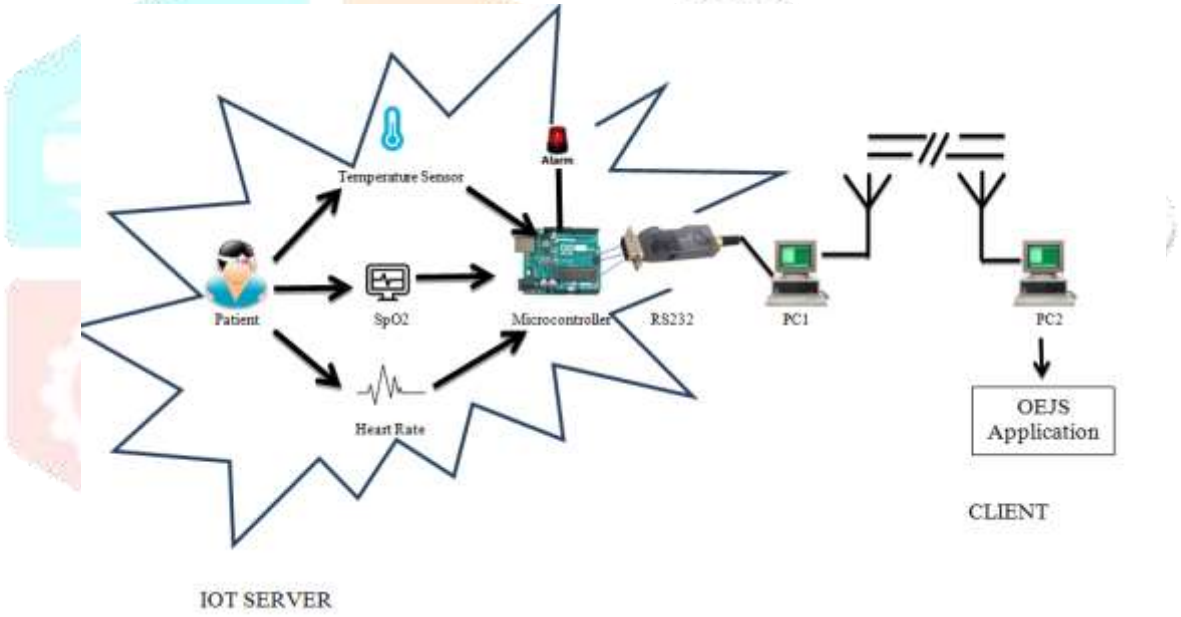

Fig.1: Proposed Home Patient Monitoring System

These Sensor values is uploaded to a local computer through a RS232 port which is communication port. It is attached to an Arduino and PC1.when the data is uploaded to pc1 these data is transfer in a client pc. This transfer of data is done through a wireless connection. These parameter values in a fix range. If parameter value is cross this fix range means if above and below value there is an alarm buzzer which alert Doctor as an indication of critical situation of Patient. This alarm is attached to simulation tool Arduino. This data is stored in Doctor's Database file, Where it is updated according to Data receive.

B. *Enabling Technology:*

(a) *IOT:*
'Things' are active participants in business, information and social processes where they are enabled to interact and communicate among themselves and with the environment by exchanging data and information sensed about the environment, while reacting autonomously to the real/physical world even stand influencing it by running processes that trigger actions and create services with or without direct human interaction. [16] IOT provides us with lots of sensor data. But the data by themselves do not provide value unless we can turn them into actionable, contextualized information. Real time sensor data analysis and decision making is often done manually but to make it scalable, it is preferably automated. Artificial intelligence provides us the framework and tools to go beyond trivial real-time decision and automation use cases of IOT.

(b) *PMS:*

Patient Monitoring System is the term for all devices that are used to supervise Patient. It refers to technology used to continually assess a person's health status. A Patient Monitoring System (PMS) is required to monitor critical physiological signs of Patients [2]. The purpose is to monitor the Patients' vital factors--blood, pressure, temperature, reading them at specified frequencies from analog devices and storing readings in a Database. If readings fall outside the range specified for Patient or device fails an alarm must be sent to a nurse.

(c) *Arduino:*

it is a circuit board which can be programmed around the actual microcontroller with many electronic parts and Arduino IDE (Integrated Development Environment), ready-made software which is used to write and upload the computer code to the physical board. Some of them are for example: Ultrasonic sensors, stepper, Switches, LED's, temperature sensors, displays etc.

(d) E*mbedded System:*

An Embedded System is designed to perform a specific task. This System as a Microcontroller-Based, Software-Driven, Reliable, Real-Time Control System. This System can be thought of as a computer hardware System having software embedded in it so it gains a name as Embedded System. An Embedded System can be either a part of a large System or an independent System [15].

(e) *Proteus:*

Proteus is one of the most famous design software and simulator tool. It can be used to simulate almost every circuit on electrical field. Proteus ISIS Professional software is a PCB design software integrated with the simulation of the circuit you design. It is integrated with real time simulation of the electronic circuit and test whether your designed circuit is working properly or not. In this software you can test your test code by loading the hex file in the circuit and test the circuit proper functioning.

(f) *RAS:*

RAS has become a major part of network solutions, using the telephone lines as the physical medium to transfer the data. RAS is a service that allows remote clients to connect to the server over a modem using a RAS-based protocol [13].

(g) *RS232:*

The most powerful standard communication developed by the Electronic Industry Association and the telecommunication industry (EIA/TIA) for the data exchange between the electronic devices was the RS-232. The RS-232 standard generally specifies the common signal & voltage levels, common pin wire configuration and minimum, amount of control signals in order to provide the synchronous transfer of the data between the computer & its peripheral devices [14].

(h) *VB6.0:*

VB is a high-level programming language. Visual Basic is a visual Programming Language because programming is done in a graphical environment. In VB 6.0, we just need to drag and drop any graphical object anywhere on the form and click on the object to enter the code window and start programming. We need to write code that performs some tasks in response to certain events so Visual Basic 6.0 is an Event-Driven [12].

(i) *Winsock:*

Winsock is the term that integrates two words: Win stands for windows & Sock stand for socket, thus it's simply a sobriquet provided to the Windows Sockets API (WSA) & is thus used to communicate between two machines having windows operating System as a platform. It can thus be used to transfer the data among these devices through a medium called socket. Winsock provides a platform how one should access network services.

C. *Flowchart for Data Encryption Algorithm:*

Figure [2] illustrates the sequence of activities in the PMS. When the connection is established it will start reading the Parameters of sensors accordingly index value. Then an active key encryption is done by using Blowfish Algorithm to increase the security.[4]We enhance this algorithm by implement own algorithm name is Odd Even Jumbled String(OEJS). We implement this algorithm for getting better result in security during data encryption and decryption. In this procedure both Blowfish and OEJS algorithm are

performed. Firstly data are encrypted according to Blowfish Algorithm. The obtained result is then processed according to OEJS algorithm for obtaining more security in Encryption and Decryption. The procedure of step by step working is shown by the flowchart.

Encryption Procedure:

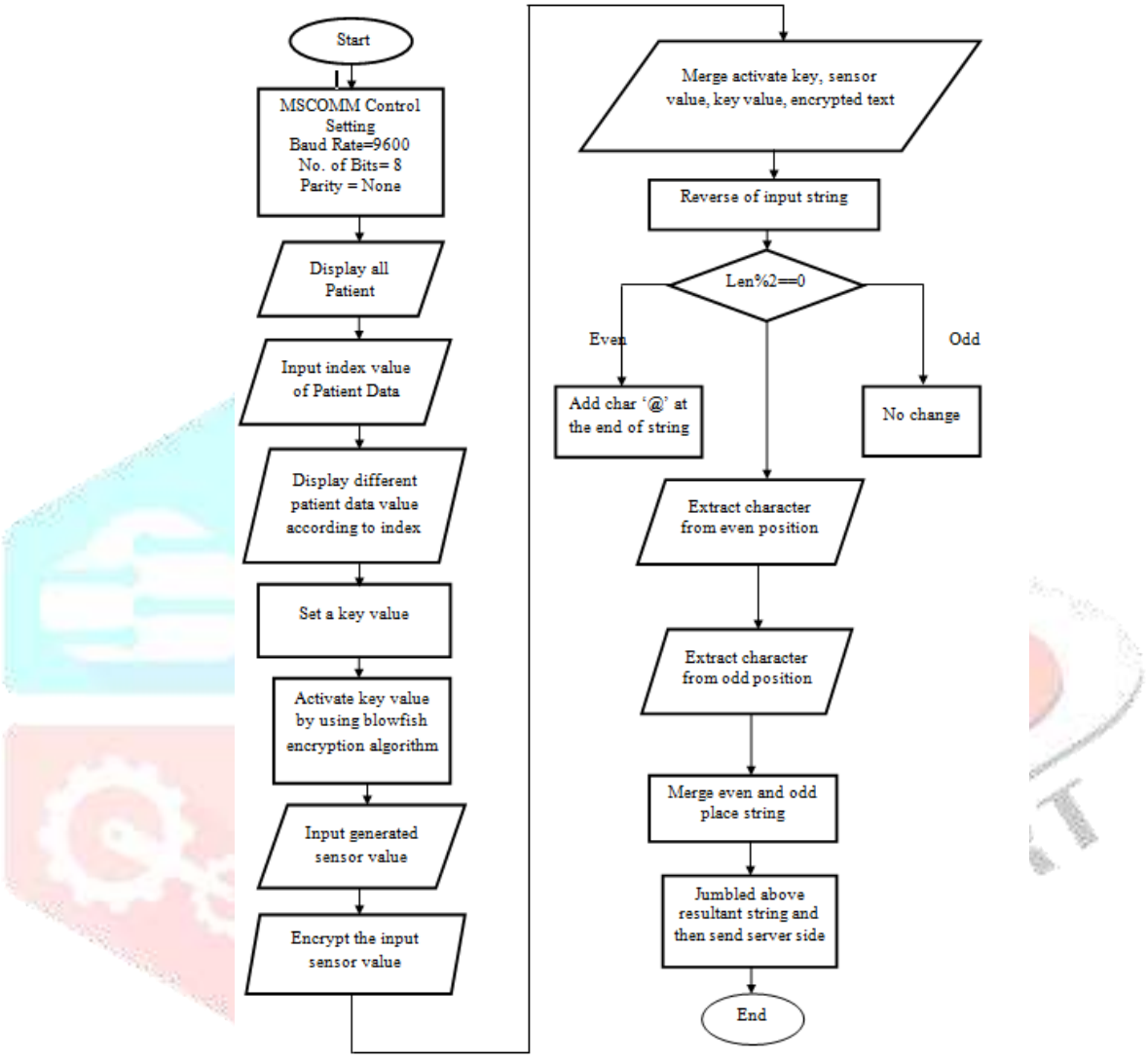

Fig.2: Encryption Procedure of Odd Even Jumbled String

In the Decryption procedure when the data is inwards in the database Alarm is triggered when Body parameter exceeds the threshold.

Critical Situation Condition:

- 34.5 <Body Temperature >36 : If the parameter in this condition there is an Alarm Buzzer which is indicated through a red light otherwise in green light [18].
- 69<Heart Rate >76 : If the parameter in this condition there is an Alarm Buzzer which is indicated through a red light otherwise in green light [19].
- 92<Oxygen saturation> : If the parameter in this condition there is an Alarm Buzzer which is indicated through a red light otherwise in green light [17].

Decryption Procedure:

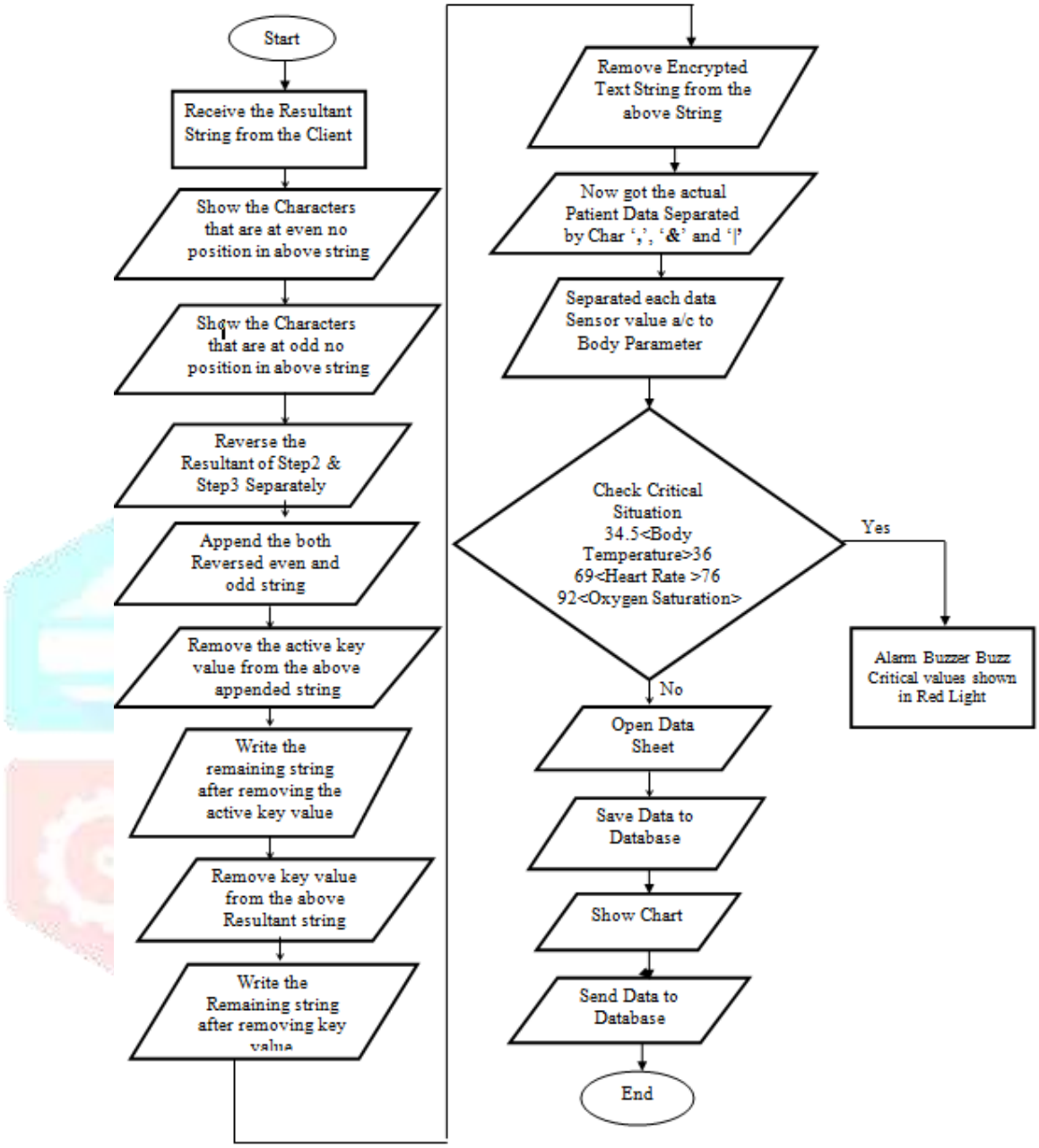

Fig.2: Decryption Procedure of Odd Even Jumbled String

D. *Mathematical Representation of OEJS Algorithm:*

Encrypted equation= Enc $\{f(Str_{14})\}$

Where 'f(Str14)' is the final step of Encryption Procedure.

Decrypted equation = Dec $\{f(str_{42})\}$

Where $'f(str_{42})$' is the final step of Decryption Procedure

E. *Parameters Value in Database:*

All the data are stored in the Database. As the Data received at the Doctor's PC it is save in the Doctor's Database file. The stored data can be analyzed at anytime and anywhere. The above figure shows the Body Temperature, Oxygen Saturation and Heart Rate at different given index value.

Table 1: Parameters Value in Database

Body Temperature (°C)	Oxygen Saturation (%)	Heart Rate (BPM)
33.12	89.37	69.42
33.14	89.35	69.44
33.13	89.4	69.48
33.11	89.38	69.41
33.17	89.45	69.47
33.16	89.47	69.5
33.20	89.49	69.52
33.25	89.55	69.49
33.18	89.53	69.51
33.15	89.58	69.43
33.22	89.56	69.46
33.28	89.51	69.5
33.13	89.48	69.53
33.19	89.44	69.56
33.23	89.43	69.51
33.27	89.41	69.52
33.21	89.46	69.55
33.17	89.52	69.57
33.22	89.56	69.56
33.12	89.37	69.42

F. *Graphical Representation of Parameters Value:*

There are three graphs shown for three Body Parameter.

- Body Temperature chart analysis the Body Temperature at different time and threshold value of temperature.
- Oxygen Saturation chart analysis the Saturation value in percentage.
- Heart Rate chart analysis heartbeat per minute.

By seeing the graph we can come to know the change in the Temperature. And at what time the Temperature was low/ high. We can also know that was Temperature was above the threshold level or not, if was above then at what time.

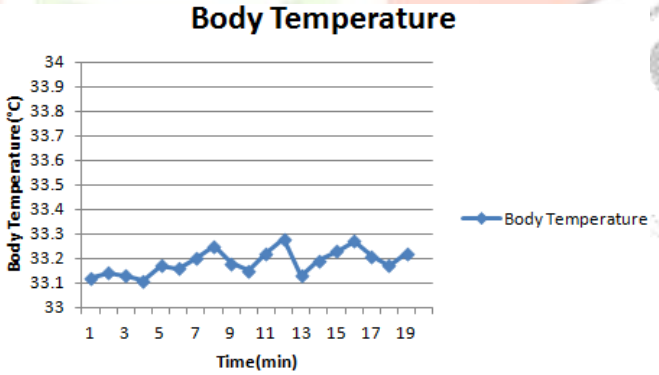

Fig.3: Graphical Representation Body Temperature Parameter

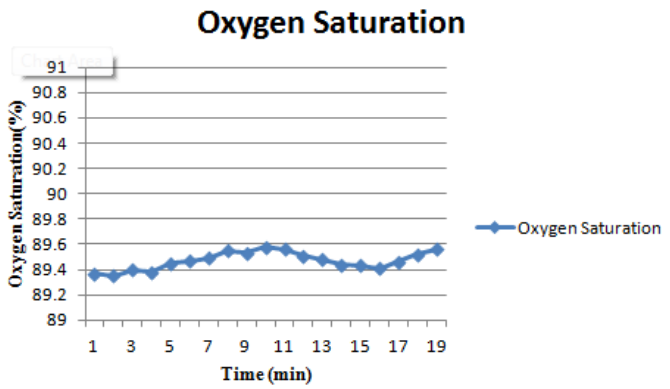

Fig.4: Graphical Representation Oxygen Saturation Parameter

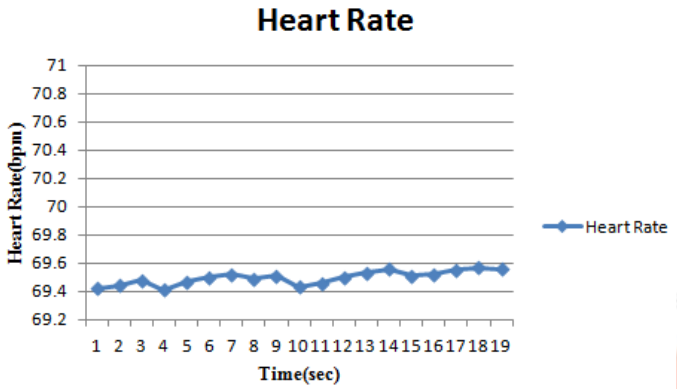

Fig.5: Graphical Representation Heart Rate Parameter

V. **RESULT**

After the successful connection to the server, the data of sensor are sent to the web server for Monitoring of the System. Figure [6] shows the algorithm decryption procedure and show the actual data sensor value. These sensor values are categorized in a Body Temperature, Oxygen Saturation and Heart Rate. When there is sensor data in a critical situation an Alarm Buzzer Buzz in a red light to alert the Doctor. Then parameters values stores in the Database. Parameter data can be analysis through the individual parameter chart. So this page shows the successfully Monitoring of Patient sensor data.

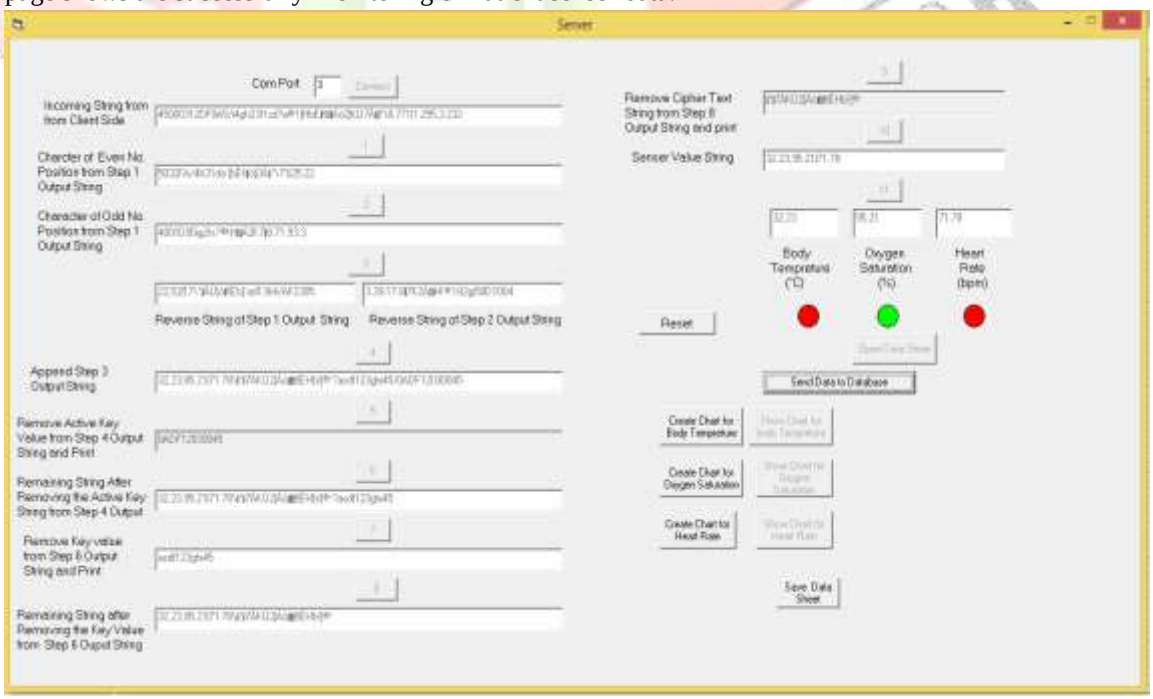

Fig.6: Decryption Procedure of Proposed System

VI. CONCLUSION & FUTURE SCOPE

There are various algorithms that could work properly in an Embedded System with limited computation capabilities and small memory unit. Compared to all other algorithms the Blowfish Algorithm has made its mark in the cryptographic field. Similarly blowfish has a long key length and ensures safety and maintains lower memory usage than other algorithms. Thus the supreme strength of the encryption algorithm is mainly rest on the key length and moreover Key Aggregation helps the user to share their data over IOT. By enhancing Blowfish Algorithm a new algorithm is made i.e. OEJS to increase the security over the IOT which helps user to store their medical records over IOT and shared with preferred user. By using blowfish with OEJS when data is transferred from transmitter to receiver side if there is any critical situation arise like human Body Parameter not in decided ratio there is an Alarm Buzzer(Red Light) which indicate that Patient in critical condition. This data is store in a database which is representing by an analogue graph. Then Doctor take an appropriate action for the recovery of Patient. So we conclude that Blowfish with OEJS can be the most appropriate algorithm for the healthcare System.

A portable medical device can be designed by using Arduino. Home Patient Monitoring System using Arduino can be implemented in hardware using more than three sensors to detect the health conditions of the Patients. This can be done over more than one Patient at a time.

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