Erection of Comprehensive Wellness Programme for Global Healthcare Monitoring System using AODV Protocol with Data Clustering Schema

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Abstract

Background/Objectives: This contribution of a comprehensive wellness programme aims at developing a Global Health care monitoring system using wireless communication between the mandatory patients, physicians and hospitals in an on-demand manner. **Methods/Statistical Analysis**: Body Area Networks are proposed to collect data from the patients with unique id. The patient will be connected to doctor according to vital parameter variations. Doctors are connected to other doctors and hospitals are connected to other hospitals with specialization of the field adopting dictionary of doctors and specification of hospitals. Nearly 18,600 diseases have been identified with five vital parameter variations and the simulation is done in LABVIEW. **Findings:** An Expertise System for hospitals is developed in detecting disease and to reduce the treatment time of patients in an efficient manner. Using AODV protocol, vital parameters of the human measured by WBAN are sent on demand. The AODV Protocol is modified according to the condition of the patient: When there is an emergency for immediate healthcare, Modified Event Driven AODV (MED-AODV) is proposed. The availability of the doctor in that situation, the-Sub AODV Protocol (S-AODV) is proposed to be initiated to go for the next immediate action to safeguard the life of the patient. When there is a situation, where the doctors are in need of the help of specialists, clustered AODV (C-AODV) protocol is initialised. When there is a need for expertise physician, irrespective of the location of the physician, the medical advice will be given by the specialist by driving Clustered AODV. This method provides a quick solution for patients regardless of their location to get medical diagnosis globally from any expertise. **Application/Improvements:** When doctors and hospital information is shared among countries, without time delay, every patient in the world can be serviced by any Doctor across the boundaries in emergency situations.

Keywords: AODV, Comprehensive Wellness, Data Clustering, Global Health Care, Schema

1. Introduction

This research proposes a solution that addresses the challenges of gathering and transferring the patient's data for remote diagnosis. There is a Virtual Group Enabler (VGE) [1], which allows virtual collaborative groups to be formed between patients, nurses, and doctors (and possibly environmental sensors). These groups allow data from WBANs to be analysed remotely by doctors and nurses; the virtual groups can be modified and changed depending on the patient's condition or requirements from the medical officers. The change in virtual group configuration can be easily adjusted through high-level policies. The envisioned scenario is an environment that is densely populated with sensors, where these sensors are networked and can allow WBAN and virtual groups to interact. To accommodate such interaction the underlying wireless technology not only has to provide a fast and reliable connection, but also needs to be energy and cost efficient due to the necessity to accommodate large number of patients. Also, the proposed system requires a certain degree of adaptability in order to be easily coupled with a policy management system, where the policy management system can handle high-level changes that

might be required by the medical officers[2]. As standard approaches fail to satisfy these requirements, our solution uses Modified Event Driven AODV Protocol-1 (MED-AODV), which is a stage 1, followed by stage 2 consisting of the Sub-AODV Protocol 2 (S-AODV), and final stage 3 consisting Clustered-AODV Protocol 3 (C-AODV) that will be presented in the proposed architecture, this are all described in Figure 1. The optimization of such a technology requires complicated fine-grained tuning, which usual medical practitioners are not familiar with. Through high-level policies, medical officers can adjust the performance of the system in the event that the quality of sensor readings is poor due to high losses.

The develop an Expertise System for rural Hospitals[3], by learning lessons from the inadequate knowledge, inefficiency in detecting the diagnosis of disease, from causation of deaths or accidents, thereby reducing the treatment time of patients consumed, in a fast, safe and efficient manner. This will help to design a system for global healthcare applications that monitor vital parameters such as ECG, SpO2, Glucose, Temperature, Heart rate, Blood pressure, etc. The transfer of biomedical data is done by using AODV (Ad hoc On Demand Distance Vector protocol) for personal area networks divided into 3 Stages: Stage-1-**Protocol-1**-Modified Event Driven AODV (MED-AODV)[4], Stage-2-**Protocol-2** -Sub AODV Protocol (S-AODV) and Stage-3-**Protocol-3**-Clustered AODV (C-AODV)[5]. The PAN nodes provide simulated feedback of patients' data (in NS2 simulator) to the doctors present for analysis of the received biomedical data within a hospital and this data is finally shared with other Specialists/Doctors present across the Globe using Wide Area Network. K-Means/clustering is used to cluster the

information of every doctor, patients and hospitals; the data is encrypted and stored in a cloud database using Eucalyptus v3.4. The ultimate aim is to implement this proposed expertise system in all hospitals across the globe and create a large comprehensive biomedical database which will act as a guide to doctors in providing efficient treatment to their patients. In this research, an effective and the flexible storage scheme of cloud data using Eucalyptus v3.4 with explicit dynamic data support to ensure the correctness, privacy, security, integrity, validity and availability of patients' data in the cloud at any given point of time.

The organization of the paper is as follows: Chapter 2 describes the methods and cluster organization in hospitals. Chapter 3 focusses on wireless body area network. Chapter 4 deals with the case study and its salient features before conclusion at chapter 5.

2. Methods

2.1 Cluster Organization in Hospitals

The above diagram indicates the four stages of the algorithm which was developed for exhibiting the concept. AODV protocol mechanism used to communicating one network medium to another network medium[6]. Stage 1 indicates the modified event driven protocol which connects the patient and the doctor based on the disease spectrum in the hospital. Stage 2 presents the sub AODV protocol based on the event mechanism. Stage 3 declares the doctor to doctor connectivity based on the intelligence or knowledge required to go for further analysis about the disease. Stage 4 ensures the patient data stored in the cloud database with high security and privacy enforcement imposed by the patient-doctor relationship.

2.2 Process Flow for Proposed Architecture

Proposed method process flow architecture shown in the Figure 2 and the process are:

1. The first step is the registration of the patient in the hospital, given a Unique ID till the time of treatment.
2. Then is the attachment of the body sensors to the patient's body, acting as a Body Area Network for the Tier-1 Inter Architecture.
3. Then is the formation of groups of a Patient and Doctor Profiles formed under the Group Policy, i.e. Patient-Doctor Profile and Doctor-Doctor Profile.
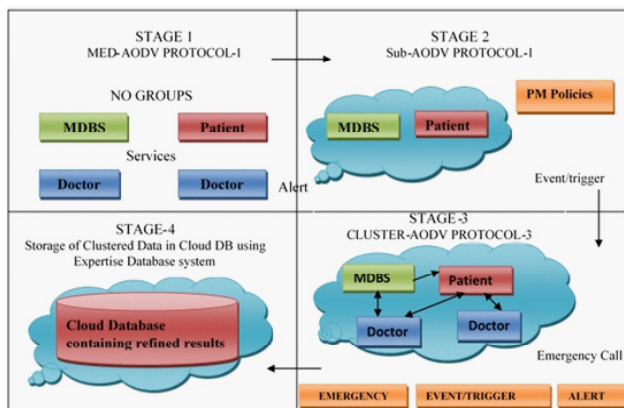

Figure 1.   Stages of Cluster Organization in Hospitals.
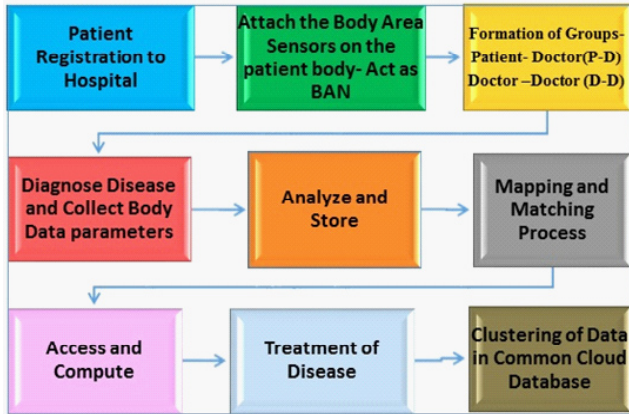
Figure 2. Process Flow Diagram for Architecture.

4. Diagnose the disease and collect the body data parameters collected by Body sensors, routing the information in an environment, say within a small area in hospital.[7] This works under Tier-2 Intra Architecture.

5. **Analyze and Storage** - The data collected will then be sent to Doctors PC. Disease signature specific to patient analyzed by the doctor and accordingly gives prescriptions. This works in Tier-3 External Architecture.

6. **Mapping and Matching** - Disease is mapped to a predefined treatment Database given by the Expertise system, to determine the targeted drug therapy, i.e. acting as a guide and reference for the doctors to give prescriptions.

7. **Access and Compute** - The results are then saved to the cloud in an encrypted form for the privacy of patient profile and so doctors can quickly and safely access patient information. The encryption of data is done using the Box Cryptor v2.0.403 and storage is done using Cloud Computing Eucalyptus v3.0 or simply stored in Doctors Database Personal Computer or Hard disk.

8. The treatment of disease is administered by the doctor's prescriptions.

9. The clustering of the data is done using K-means algorithm or Software known as Rapid Miner v5.0 and stored in the common cloud database build by Eucalyptus v3.0 for future access and refinement. The database contains details containing information about Patient profile, Doctor Profile, Expertise System-having Prescriptions for diseases by age group and different Body Parameters such as ECG, EEG, BP, Sugar, Dental, Temperature; List of Hospitals and Area of Specialization.

10. Finally the Expertise System is incorporated in the local hospitals for faster treatment of disease as the results are refined and rebuilt.

2.3 Proposed Architecture

The system proposes the modified AODV Protocol works in 3 stages stated (Figure 3.) as follows:

1. The first the formation of group profiles is done on the basis of Patient-Doctor and Doctor-Doctor under Group Policies, then comes the **Stage-1-Protocol-1- Modified Event Driven AODV** protocol where on the basis of certain threshold values of parameters, if exceeds the normal value say, 100, then certain 'Alarm' and 'Hyper Alarm' events are generated, thereby warning the patient to undergo for treatment to doctor. Reports are finally generated by the treated disease.

2. But if the Doctors are unavailable or are unable to treat the disease, then we move to the next **Stage-2- Protocol-2-Sub AODV Protocol (S-AODV)**, where the consultation for diagnosis and treatment is done with the help of doctors within the hospital or nearby hospitals. This is a Self-Automation Mechanism.
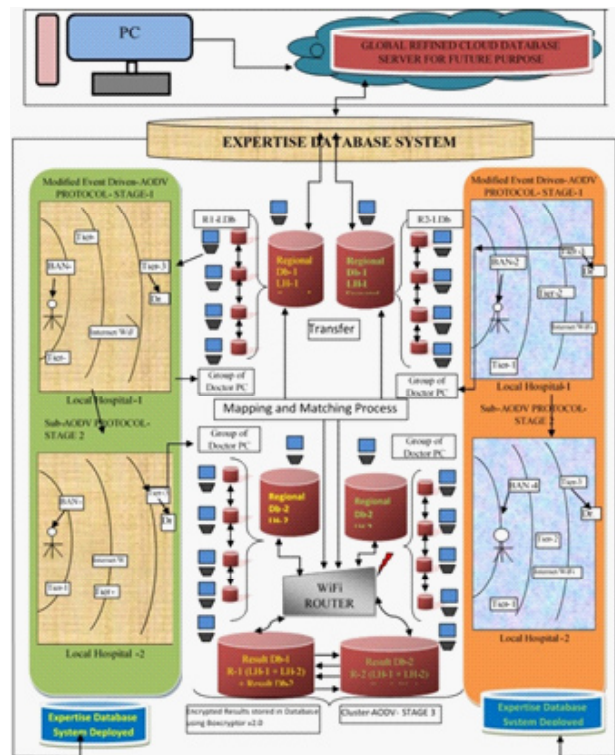

Figure 3. Architecture of Global Healthcare Monitoring System.

3. Still, even if the Doctors are unavailable or unable to find the diagnosis or unable to treat the patient then we move on to the next **Stage 3-Protocol 3-Clustered AODV (C-AODV)** protocol where all the data is clustered containing information of patient profile, doctor's prescription for the disease, etc., which is then finally sent to either Doctors sitting across the globe for consultation or referred by the Expertise System directly using Backbone Network Connection.

4. The final aim is to learn lessons from the inadequate knowledge, inefficiency in detecting the diagnosis of disease, from causation of deaths or accidents and to finally prepare an **Expertise System** which is to be directly incorporated and deployed in the local hospitals to save the time for disease treatment.

2.4 Process Flow for Protocols

2.5 The Landscape for Global Healthcare Monitoring System Implementation to be Deployed in Organizations in Future

The prototype of body area network with wireless sensors is considered for the deployment of the protocols. Sensor nodes are used to sense vital human parameters such as Electrocardiogram (ECG), blood pressure, Oxygen level, heart rate, and body temperature[8-11]. The authors Ren-Guey Lee, et al. in their paper, "A Mobile Care System with Alert Mechanism", suggested that Hypertension and
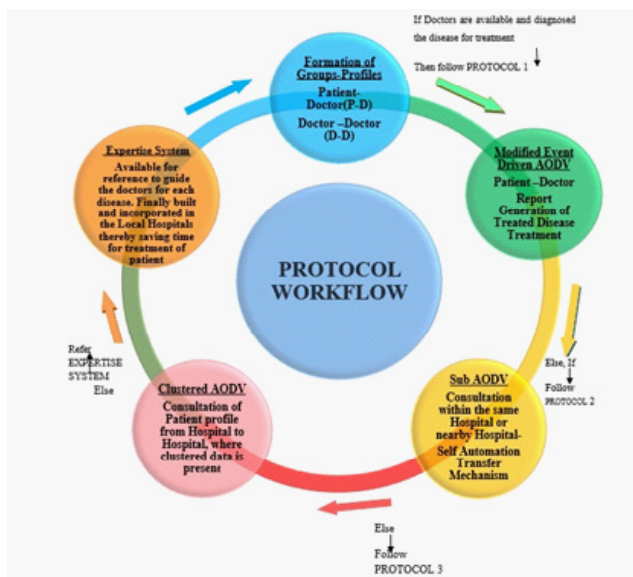

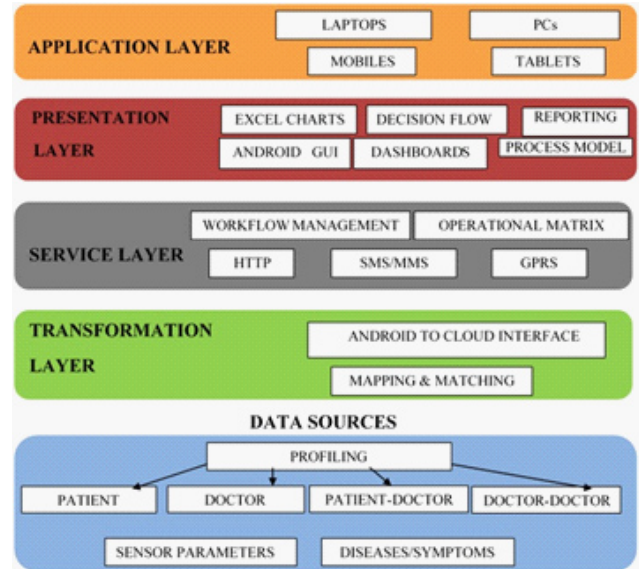**Figure 4.** Process Flow Diagram for Protocols.

Figure 5. Global Healthcare Monitoring System Layer Structure.

arrhythmia can be effectively prevented and controlled if the physiological parameters of the patient are continuously monitored. Therefore a role-based intelligent mobile care system with alert mechanism was proposed and implemented by them[12]. The paper on "Alerts in mobile healthcare applications: requirements and pilot study presents an efficient routing and monitoring of alert messages to quality cost-effective healthcare services"[13]. The authors in their paper on, "Assistive Technology for Elders: Wireless Intelligent Healthcare Gadget" suggested a compact device which has various wearable sensors with a flow controller module and a communication control module to send alert messages to their care takers[14].

Keeping the normal human body parameters as median values, variations in the human body parameter values of different patients are recorded for further analysis. A stochastic model has been developed with the threshold of normal human values against the variation of parameters with both maximum and minimum levels set that a human can withstand for life. An algorithm is developed to identify the abnormalities in the human values which lead to disease and medicine diagnosis[15]. The obtained values are converted into the specific data packet format, and sent wirelessly to a hospital server for doctoral assessment. If the parameters exceeded the threshold value[16–18] it is proposed to set an alert message to the care person assigned to the patient with all communication encrypted with Feistel Cipher Structure. Javad

Aramideh, Hamed Jelodar proposed a solution in their paper on, Application of Fuzzy Logic for Presentation of an Expert Fuzzy System to Diagnose Anemia. It presents an expert system based on fuzzy system, only to diagnose amnesia and the other body parameters are not considered [19]. Telehealth measures are also on the move in the near future [20].

3. Wireless Body Sensor Network

The Wireless body Sensor Network (WBSN), or Wireless Body Area Network (WBAN) or a Body Sensor Network (BSN) is a wearable computing wireless network device (Figure 6). In specific, the network made up by several tiny size Body Sensor Units (BSUs) are together with a single Body Central Unit (BCU). This network field is a collaborative area which could allow reasonable and unbroken health monitoring with real-time updates of medical records through the back bone Network, can be used for early detection of patients with medical conditions. Figure 6 describes the vital parameters which can be monitored are being sent to the smart phone for early diagnosis.

3.1 Body Sensor Unit

Wireless body sensors are freely sensing the human health condition vital parameters such as ECG, Blood Pressure, SpO2, Heart Rate, Respiration Rate, and temperature.
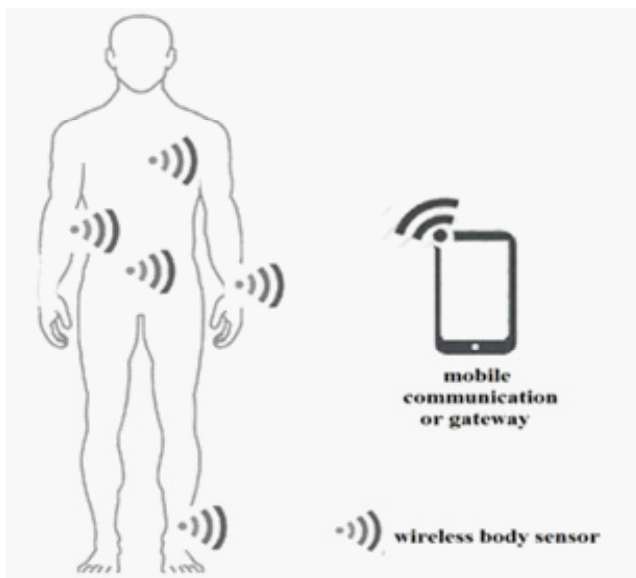
These sensors are working with low energy mode (battery) with highly reliable communication and low delay which is shown in Figure 7. These sensors are communicated to gateway through Electromagnetic (Radio Wave) technology.

These vital parameter values are converted into a binary bit format and these values are compared against normal human parameters. If the values exceed the critical threshold value, then an alert message will be sent to the medical person along with the collected data to the Medical Server Unit (MSU) for experts' analysis. In the normal condition Mobile Node [MN] sends the collected data's to MSU without alert message. In both the cases, the received data is stored in the server database as in Figure 8.

3.2 Stochastic Modelling

Stochastic modelling deals with the use of probability to model real-world situations in which uncertainty is present. Since uncertainty is pervasive, the tools can potentially prove their quality of measure in almost all facets of medical diagnosis system. Figure 9 describes the general stochastic model. Table 1–5 contains the threshold values for different parameters and the vital parameters with normalized variation values. Figure 10, describes the Combination of Parameters using Combinatorial Logic, for diseases identification process
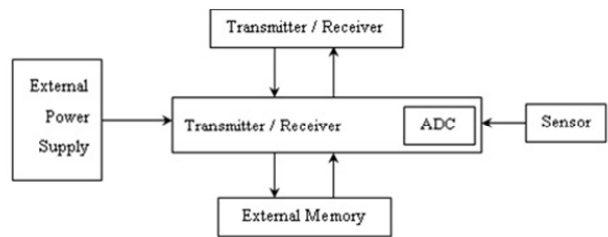

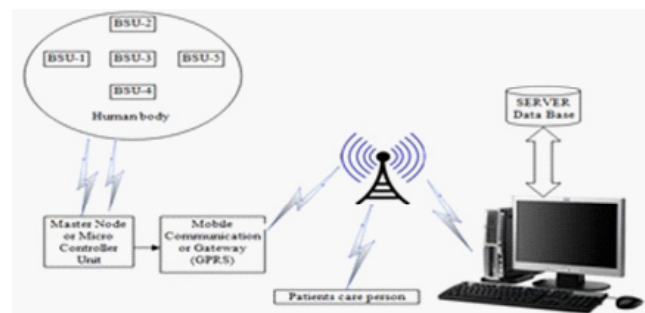**Figure 7.** Body Sensor Unit Architecture – General Diagram.
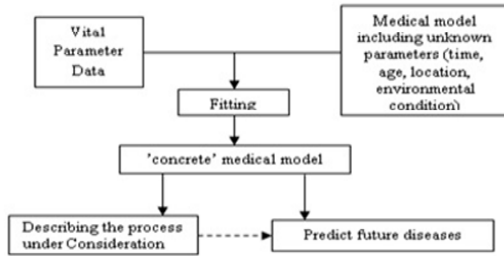

Figure 8. System Architecture Model.

Figure 6. Wireless Body Sensor Network.

Figure 9. General Model –Block Diagram.

Table 1. Temperature (°C) Threshold Values

Range	temp(°C)	Effects
−1	24	death
−0.9	25	death due to irregular heart beat
−0.8	26	respiratory arrest
−0.7	28	disturbed heart rhythm
−0.6	31	rarely conscious/shallow breathing
−0.5	32	hallucinations/sleepiness
−0.4	33	depressed reflexes/confusions
−0.3	34	severe shivering/blueness
−0.2	35	intense shivering/numbness
−0.1	36	mild to moderate shivering
0	36.12	normal body temperature
0.1	37	high normal
0.2	38	sweating/slight hunger
0.3	39	severe sweating/fast heart rate
0.4	40	fainting/dehydration/vomiting
0.5	41	dizziness/delinium/palpitation
0.6	42	become comatose/severe delinium/very fast heart rate
0.7	43	severe brain damage
0.8	44	almost death
0.9	44	Death
1	44	death

Table 2. Pulse Rate (Bpm) Threshold Values

Range	Pulse	Effects	Variation
−0.4	29	death	29 or less
−0.3	37	high risk	(+ or −) 7
−0.2	46	risk	(+ or −) 3
−0.1	54	deviant	(+ or −) 5
0	80	normal	(+ or −) 20
0.1	110	deviant	(+ or −) 10
0.2	150	risk	(+ or −) 30
0.3	215	high risk	(+ or −) 35
0.4	250	death	250 or more

Table 3. Spo2 (%) Threshold Values

Range	SpO2	Effects	Variation
−0.5	64	death	64≥
−0.4	72	high risk	(+ or −) 8
−0.3	86	risk	(+ or −) 5
−0.2	93	deviant	(+ or −) 1
0	97	normal	(+ or −) 3
0.1	101	error	≥100

//Output Parameters

OPC1: Category 1→Diseases $_{D1… D18900}$

OPC2: Category 2→TP$_{D1… D15}$, SP$_{D1…D5}$, EC$_{D1…D3}$, BP$_{D1…D15}$, PR$_{D1… D7}$

1. for each IP ∈ SD do
   a) for each OPC1 ∈ SD do
      sim[y] ← Simulation (IP, OPC1)
   b) for each OPC2 ∈ SD do
      sim[y] ← Simulation (IP, OPC2)
2. a) OPC1$_{max}$ ← some OPC1 ∈ SD with maximal sim[OPC1]
   b) OPC2$_{max}$ ← some OPC2 ∈ SD with maximal sim[OPC2]
3. a) if class[IP]=class[OPC1]
      then
         classification ← Disease from Database
      else
         classification ←Unpredictable
   b) if class[IP]=class[OPC2]
      then
         classification ← Disease from Database
      else
         classification ← Unpredictable.

flow and the disease classification algorithm explained in section 3.2.1. The Medical diagnosis system is used to measure the following vital parameters via Blood Pressure, ECG, heart Rate, SpO2 and temperature.

3.2.1 Disease Classification [DC] Algorithm

The DC Algorithm (SD: Symptom Description)
//Input Parameters
IP: TP, SP, EC, BP, PR

Table 1. Contains the normalized human body temperature in its normalization Range and actual

Table 4. Blood Pressure (Mm Hg) Threshold Values

Range	Systolic	Diastolic	Effects
−1	45	25	death
−0.9	55	35	coma
−0.8	65	40	dizzing/fainting
−0.7	75	45	tired
−0.6	85	50	weak/exhausted
−0.5	90	60	normal(children and athletics)
−0.4	95	65	normal(children and athletics)
−0.3	100	70	normal(children and athletics)
−0.2	110	75	after strenuous exercise
−0.1	115	75	after strenuous exercise
0	120	80	normal(children and athletics)
0.1	135	85	Evening BP/before salty, fatty food
0.2	140	90	BORDER LINE
0.3	150	90	morning BP/after salty, fatty food
0.4	165	95	morning BP/after salty, fatty food
0.5	175	100	leading to heart attack and stokes
0.6	185	105	leading to heart attack and stokes
0.7	200	110	leading to heart attack and stokes
0.8	215	120	leading to heart attack and stokes
0.9	225	125	bloated/sedentary/heart attack/stoke
1	240	135	death

Table 5. Ecg Threshold Values

Range	PR-Interval (sec)	QRS-Interval (sec)	QT-Interval (sec)	Net Deflection (Sec)	Status
−0.1	<0.12	<0.05		<1	Abnormal
0	0.12–0.20	<=0.12	<0.42	1	Normal
0.1	>0.20	>0.12	0.42<	1<	Abnormal

Figure 10. Parameters Combination using Combinatorial Logic for Diseases Identification.

from −1 minimum to +1 maximum pulse rate and range 0 is considered as normal pulse rate.

Table 3. Contains the normalized human SPO2 oxygen content in its normalization Range and actual oxygen rate and the variations in values which causes the tuples starting from −1 minimum to +1 maximum spo2 and range 0 are considered as normal spo2 rate.

Table 4. Describes the normalized human blood pressure normalization Range, actual systolic and diastolic values, and these values deviations are from ± 2 to ± 10 which causes the tuples starting from -1 minimum to +1 maximum blood pressure values and range 0 is considered as normal blood pressure.

Table 5. Contains the normalized human ECG value, the range, its P-R interval, QRS complex, QT interval,

temperature values which causes the tuples starting from −1 minimum to +1 maximum temperature values and range 0 is considered as normal temperature value.

Table 2. Contains the normalized human body pulse rate in its normalization Range and actual pulse rate and the variations in values which causes the tuples starting
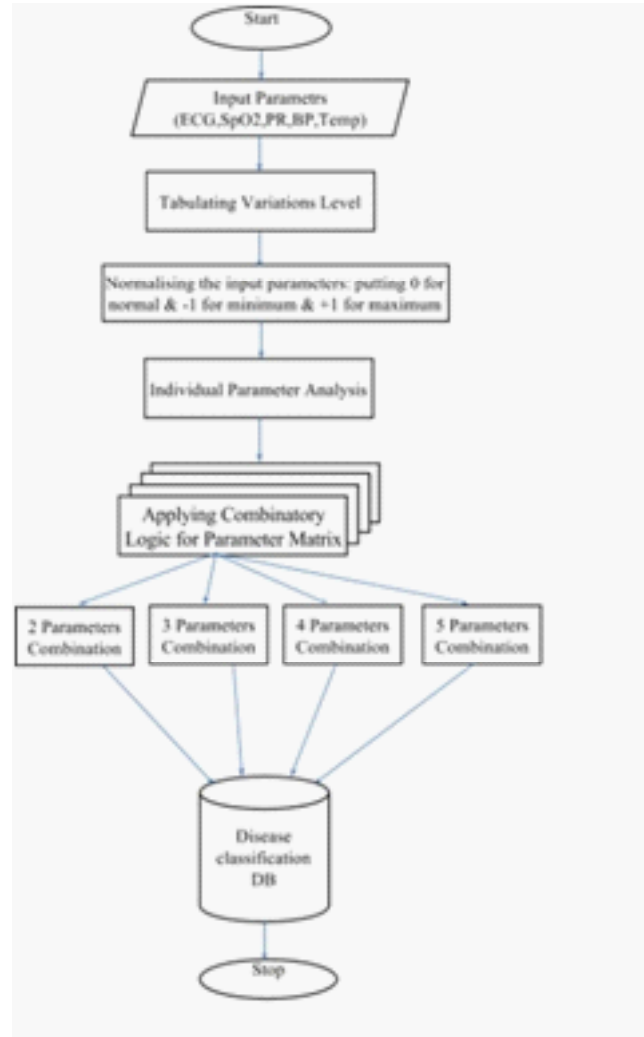
Net Deflection and the status. In its normalized Range he tuples starting from -1 minimum to +1 maximum ECG rate with life and death equations in both the extremes.

3.2.2 Quick Diagnosis of Diseases

Creating dashboards for constant monitoring, mapping, matching, tracking and performance evaluation of different body parameters and diseases for quick diagnosis of diseases by comparing with expertise system.

In the Disease diagnosis process identifying human emergency according to his/her body parameters values, Figure 11–14 is used to explain the blood pressure values
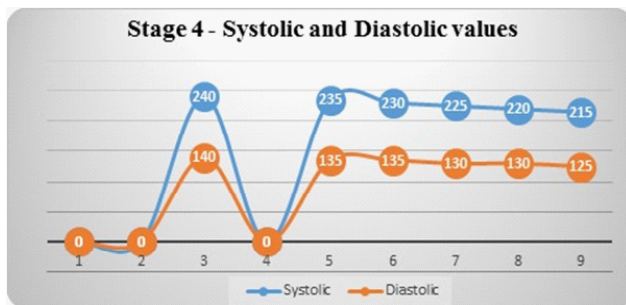

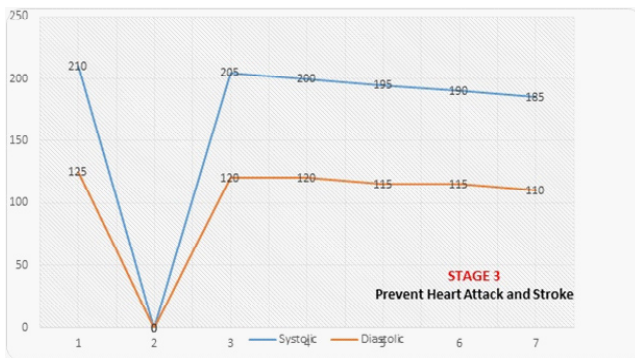**Figure 11.** Stage 4 Systolic and Diastolic Pulse levels.

Figure 12. Stage 3 Systolic and Diastolic Pulse levels.
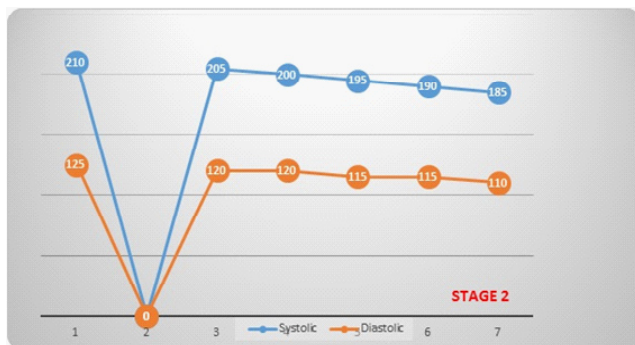

Figure 13. Stage 2 Systolic and Diastolic Pulse levels.
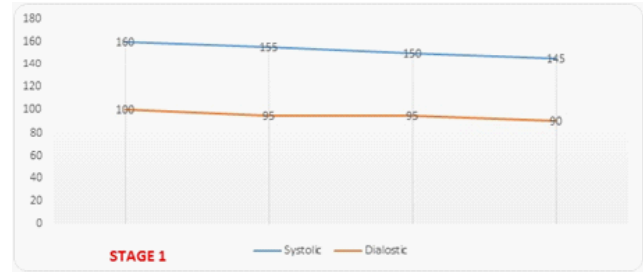

Figure 14. Stage 1 Systolic and Diastolic Pulse levels.

and related emergency importance and the blood pressure changes and the situations considered in the disease diagnosis process [21, 22]. Accordingly emergency needs are divided into four stages to analyse the emergency situation level. If the blood pressure of systolic and diastolic values reaches the extreme level, immediately the human needs the doctor's help to avoid life threat, (Figure 11).

In the Quick Disease diagnosis process, initially identifying the normal human body parameters values according to the human is considered age-wise. Different age group of human's Normal heart rate variations are shown in the Figure 15.

In the Quick Disease diagnosis process, oxygen saturation values are also considered to identify the human's requirement of immediate medical diagnosis, Figure16 represents the Oxygen Saturation level.

Categorization of disease with percentage of active classes and prevalence of disease are described in Figure 17 and Figure 18.

3.2.3 Encipher and Decipher Process

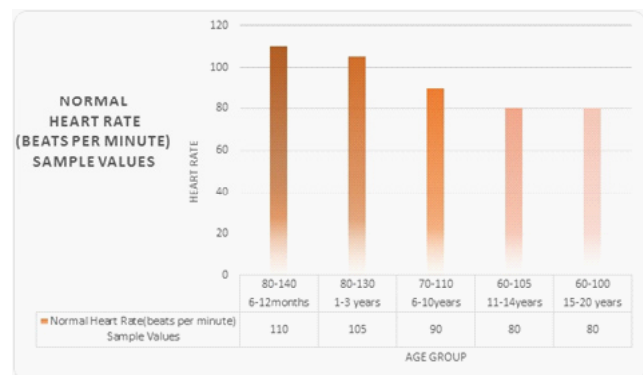The vital parameter signal output is converted in to bit size format, per sample, is described in Table 6. This

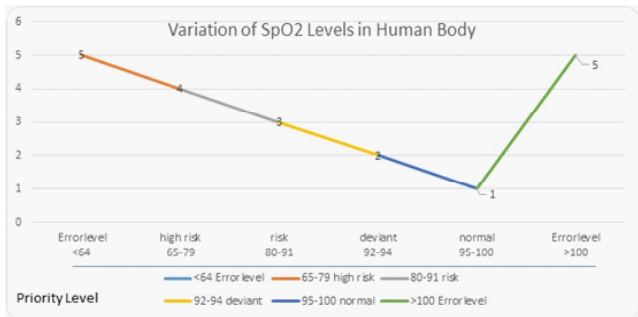**Figure 15.** Histogram for Heart Rate Ranging from Infant to Adults.

Figure 16. Graph Representation for Measuring and Prioritizing the SpO2 Levels.
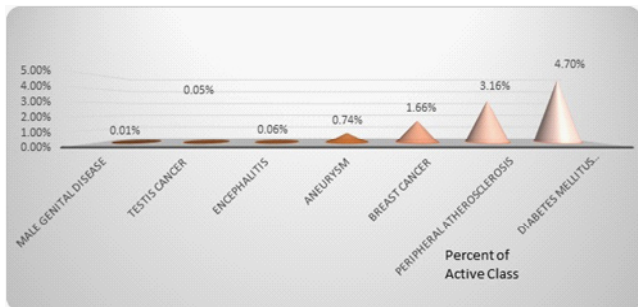

Figure 17. Graph Representation for Categorizing Diseases with percentage of Active Classes.
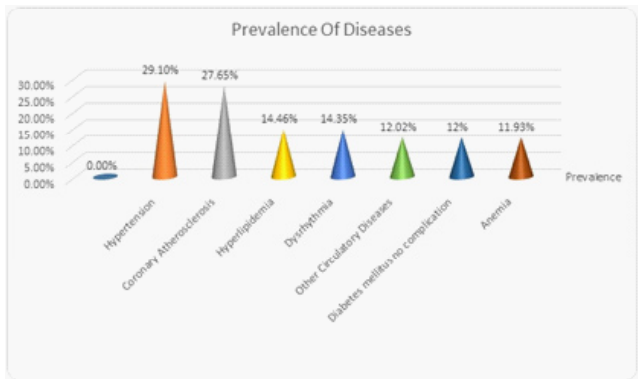

Figure 18. Graph Representation of Prevalence of Different Diseases.

Table 6. Vital Parameters Bit Size Representation

Vital Sensors	Data Size
Temperature sensor	12bits
Heart Rate	10bits
ECG	10bits/sample
Blood pressure	8bits (systolic) + 8bits (diastolic)
SPo2	8bits
Patient details	8bits

combined 64bits, is encrypted with customized Feistel cipher structure to protect the data from intruders during wireless communication. Again a random 256-bit encryption text is created. This 256 bit is divided into eight 32 bits, for eight round Encipher and decipher process, instead of 16 round process. 64-bit data is divided into two 32-bit parts. Figure 19 illustrates the encryption and decryption process.

3.2.3.1 Encryption

Split the plaintext block into two equal pieces, (L1, R1) for each round i = 1, 2, 3… 8. Compute the equation (1) for left block encipher (LE$_i$) process and equation (2) for right block encipher (RE$_i$) process.

$$LE_i = RE_i - 1 \qquad (1)$$

$$RE_i = L_i - 1X\, ORF\,(RE_{i-1}, Ki) \qquad (2)$$

Then the cipher text is (RE8, LE8).

3.2.3.2 Decryption

Decryption of a cipher text (R2, L2) is accomplished by computing for i = 1, 2, 3, 8. Compute the equation (3) for left block Decipher (LD$_i$) process and equation (4) for right block Decipher (RD$_i$) process.
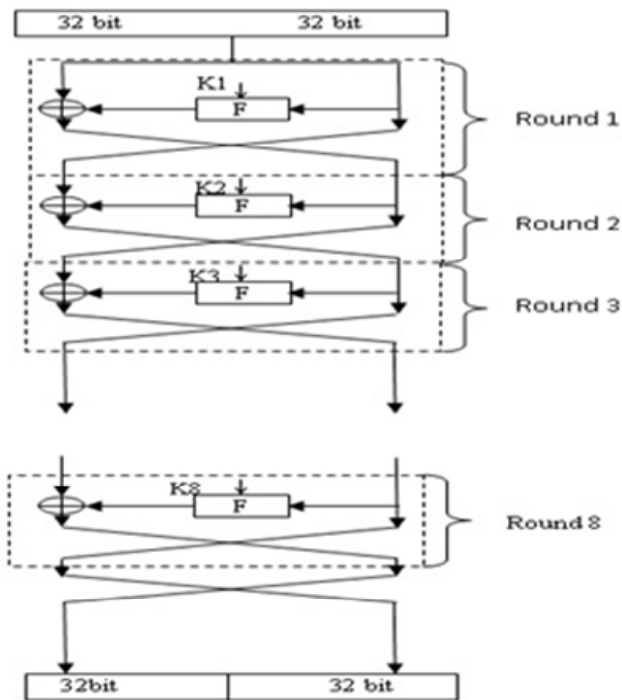

Figure 19. Customized Feistel Cipher Structure.

$$LD_i = RD_{i-1} \qquad (3)$$

$$RD_i = LD_{i-1} XORF (RD_{i-1}, K_{4-i+1}) \qquad (4)$$

Then (LD8, RD8) is the plaintext again.

Note: L1, R1- plaintext block into cipher text

R2, L2 - Decryption of a cipher text in to plain text

3.2.4 Packetization

Encrypted FCS 64 bit is packed into a single packet to transmit the medical data through mobile communication. Each packet contains four parts as it is shown in Figure 20.

- SEQ NO: sequence no (2 bytes).
- Source id and Destination id.
- Payload.
- Length.

Packet header contains the source id and destination address and size of packet, and sequence for orderly received and transmission process. The payload contains the fixed size 64 bit encrypted format of raw data.

3.2.5 System Activity

The entire prototype system data flow activities is illustrated in Figure 21.

- Collected wearable wireless sensor data send to Master Node (MN) from all slave node, if so called sensor units.
- MN identifies the critical situation using the existing historical patient report and transfer the data to the gateway to inform the patient's emergency status.
- Normal health condition, via gateway, the MN sends the patient's health record to medical server for future analysis and maintain the patient's health history records.
- In case of any critical situation, MN sends the alert message to patient's caretaker to avoid criticality.
- In both the cases, collected vital parameters are stored in a database for further analysis by a specialist medical person.
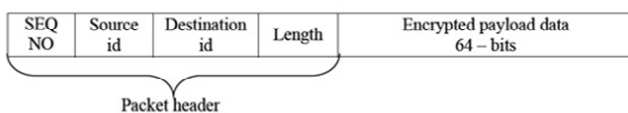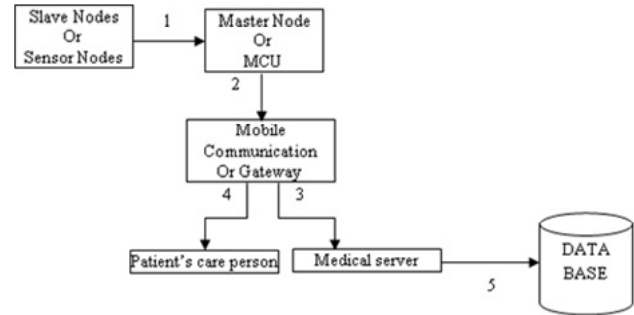

Figure 20. Sample Packet Format.

Figure 21. Data Flow Activities.

3.2.6 Mobile Communication

The SIM900 GSM/GPRS module is used for the data transmission process from MCU to Medical Server in case of AODV protocol is not working[23]. It is working at 3V/1.8V power supply and "AT" commands are used in the entire communication process (synchronization, packet transfer, retransmission, acknowledgement, end other processes). It is integrated with the AMR926EJ-S core single-chip processor and transmits data at different frequencies (Quad-Band 850/900/1800/1900 MHz). The SIM900 transfers the data to the medical server unit via GPRS communication method, and sends the alert MSG to the patient's caretaker via GSM module.

3.2.7 Medical Server Unit

The vital parameter data is received through the medical web server from mobile communication device (Figure 22.) and this setup helps to monitor multiple patients at a time from a remote location[24]. After receiving the data, it is decrypted by customized Feistel decryption algorithm using equations (3) and (4). Finally, the data is stored in the prescribed web page. Depending upon the emergency alert message, it can be sent to the specialist and also stored in the database for further analysis.

In MSU, the data is stored in the database using MSSQL SERVER2005. In the Patient details, the data base contains the patient's hospital information along with the patient details (e.g. name, age, address) as shown in Table 7. Table 8 contains the patients' medical reports such as ECG, blood pressure, heart rate, SpO2, and temperature measurement details. Table 9 contains the doctor's name, specialist, and other required details. The patient details along with the particulars of the doctor who attends.
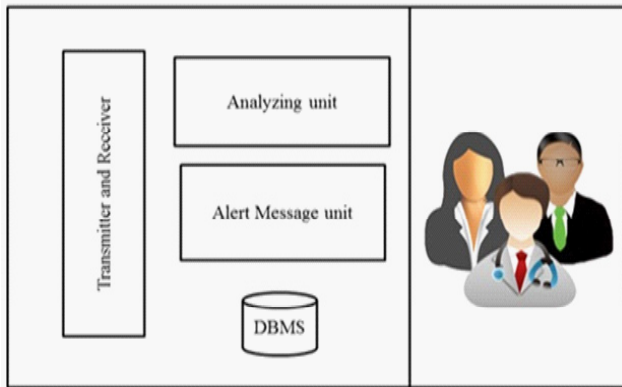
Figure 22. Medical Server Unit.

Table 7. Sample Patients Details

SI.No.	Patient_id	Patient_ name	Patient_age	Patient_ address
1	123	Mani	24	Chennai

Table 8. Sample Patients Medical Reports

NO	Patient_ id	Patient_ Temp	Patient_ BP	Patient_ HR	Patient_ ECG	Patient_ SpO2	Patient_ date
1	123	104	125 140	94	Yyy	80	09/03/2013

Table 9. Sample Doctors Details

Doctor_ id	Doctor_ name	Doctor_ specialist	Doctor_ details	Doctor_ patient_ id
D123	Pooja	Cardiologist	23 year Ex	123

Figure 23. Different Parameter's Combinations and Obtained Diseases.

4. Case Study - A Comparison Normalization of Body Parameters to Predict the Diseases

The Figure 23 describes different parameter combinations which lead to identify some diseases to prevent the life threat. In the process, temperature, Blood pressure, SpO2, Pulse rate are the only four parameters used for quick diagnosis.

4.1 Results and Analysis

Depending on the human body parameter (generated from LABVIEW visual Programming) which is shown in the Figure 24, the web server shows the patient's current situation and the disease details (Figure 25). The combination of parameters are stated as (-1.0ECG) + (-1.0TEMP) + (-1.0PULSE) + (-1.0BP) + (-1.0SpO2). This condition is based on the web server monitoring system displaying the
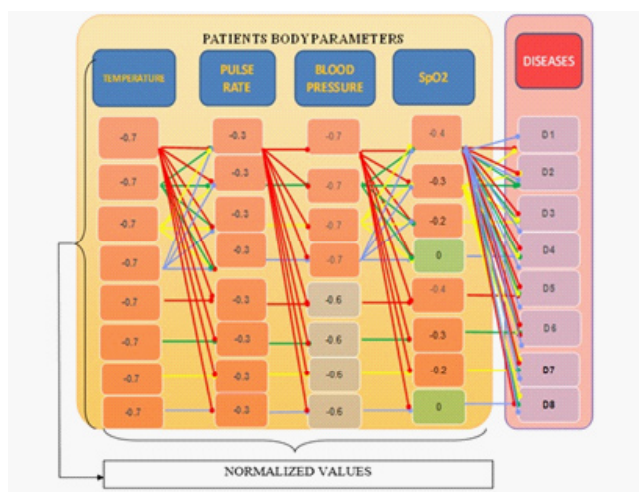

Figure 24. LabVIEW Simulation.

Figure 25. Web Page Result.

patient's live or dead situation which is shown in Figure 25. The individual effects of each parameter are combined as a combinatorial vector which leads to the parameters to analyse the disease spectrum.

{(ECG, Temp, Pulse, BP, and SpO2) = (10, 24, 29, 45, and 64)}

$\Longrightarrow$

{(-1ECG, -1TEMP, -1PR, -1BP, -1SpO2) = (Death, Death, Death, Death, Death)}

The normalized values of the above mentioned parameters are exhibited in the left hand side and the corresponding causes are represented in the right hand side of the table.

4.2 Salient Features

- Expertise System is used as a reference, to guide the doctors for each disease. It can be built and incorporated in the Local Hospitals thereby saving time for treatment of patients.
- Secure data forwarding in cloud storage system, i.e., Message can be forwarded directly between end-users via cloud environment.
- Patient Data confidentiality, Robustness, Functionality will be improved to a greater extent.
- Prevention of Accidents/Death rates can be decreased due to implementation of Proposed Model/Architecture.
- Global Healthcare Monitoring Systems are developed for future refinement of treatment of diseases in a time and cost efficient manner.
- Extensive security and performance analysis will show that the proposed scheme is highly efficient and resilient against security threats, malicious data modification attack due to the use of Encryption using BoxCryptor v2.0 and Cloud database storage using Eucalyptus v3.4.
- High Availability for cloud components with the power of computing, analyze and storage.
- Powerful Identity Management.
- User identity management is supported within Eucalyptus with capabilities to control virtual resource pools using fine-grained Role-Based Access Control mechanisms for each resource pool.

5. Conclusion

The combinatorial analytics for the mentioned parameters had been analysed with a total of nearly 18,600 diseases. The number of parameters which can be added more will fetch more parametric combinations with different kinds of diseases which leads to the development of a medical expert system. The single parameter variation from the minimum level of maximum level a person can withstand, provides a set of diseases. Adding number of parameters one by one with different permutations and combinations is to be built as a Medical Expert System. A layman can also understand for the different human parametric combinations, what kind of disease will affect him rather than a medical specialist can refer for a quick analysis. An algorithm for successfully diagnosing the abnormalities of the body parameter signals was developed which will be measured from remote patients and transfer it to the hospital server using wireless transmission with security. Using the existing AODV Protocol in a modified manner as per the explanations given in paper without any time delay, every patient in the world can be serviced by any Doctor across the boundaries. This system is a conceptual model which also comprises an Architecture, and layered protocol design using Cloud Database. If a common disease dictionary is created with different body parameters of a human, based on Age, Gender, Race and Medical History, it will help connect the doctors in the disease's perspective. Like Doctors, the Hospital information should also be shared among countries, so that 'Anything, Anywhere, Anyhow' will become a reality[25]. If countries come forward to standardize the rules for physicians to serve for any patient anywhere in the world, then this conceptual work will become a reality show in the near future. As new devices like surface blood level devices are in the medical field, measuring and sending the parameters as quick as possible is not at all a constraint[26].

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