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Modeling Intelligent Health Care Using Multi-Agent System

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Abstract

Health monitoring can be automated through the help of multiple agents by data collection, coordination and storage. In this paper, we plan to organize our multi-agent architecture in two units. First one is the source unit, which contains smart wireless sensors and collection agent. The sensors read the vital signs from the patient's body and they transfer the data to collection agent. The collection agent checks the received data whether it is redundant or not. The valuable medical data are then compressed and sent to updation agent in the destination unit. The updation agent updates the medical data into the database and physician. The physician gives the exact prescriptions for the received medical data with the help of medical history obtained from the database. The prescriptions are transferred to the database and transfer agent. The transfer agent transfers the prescriptions to corresponding collection agent after the compression process. The collection agent conveys the prescriptions to the patient after the decompression. Finally, the experimentation was made and we saved 1:5 of data by our proposed MAS system. Our implementation is done using JADE.

Keywords: *Multi-agent system, Huffman compression, redundant data, wireless sensor network, body area network*

1. Introduction

By a high degree of distributed, labour-intensive works, mobility, time-critical, and access from different kinds of tools, E-health care is differentiated. Incessant pervasive monitoring in e-health care has the possibility to enhance the quality of life of many persons (for example, those who suffer from heart arrhythmias or pregnant women foetal monitoring) [1]. Pervasive computing has made the interaction between humans and computational tools natural and user can get the necessary cleansed data. The recently introduced tools like mobiles, laptops, PDAs, etc have made ever-present computing probable [2] i.e. they are accessible anywhere at any time. In hospitals, emergency and critical situations, industry, education, or the hostile battlefield, pervasive computing is applied [3].

Body Area Network (BAN) or Body sensor network (BSN) consists of huge number of sensors are employed to collect, communicate physiological changes at repeated intervals.

The suitability of the agents for the development of sensor network based applications is made possible by these characteristics. Their ability to change according to the nature of the surrounding is the main advantage of these agents. Thus, this agent-based approach trims down the need for the existence of the healthcare system in every PC. In health monitoring, the quantity of data collected is also enormous. A technique of data reduction is included in the proposed system and consequently the amount of data that has to be stored is minimized [5]. Direct analysis of individual physiological data and personalized patient feedback in real time using alarms and reminders are possible in Mobile ubiquitous monitoring systems in the field of e-health. Patients can be ubiquitously and remotely assessed, diagnosed and treated.

In this paper, we arrange our suggested multi-agent system, which is applied for reducing the size of data transfer. Our suggested architecture is divided into two units, the first one is named as source unit and the second one is destination unit, which are joined by the global internet for the circuit process. The source unit encloses the parts such as smart sensors, which damaged in the patient's body and the collection agent. At first, the vital signs of the patient data's are monitored by the smart wireless sensors. The monitored data's are transmitted to the collection agent via smart wireless sensor network. It validates the received data weather the received data is superfluous or not once the collection agent received the data with the assist of earlier data received from the patient. If the collection agent finishes that, the received data is redundant next it will not employ that redundant data for more processing it just ignore the redundant data. In the case of received data is not redundant next the collection agent condenses the non-redundant data and move to the updation agent in the destination unit for additional process. In the database, the updation agent decompresses the compressed data and adds the decompressed medical data in to related patient record file. In addition, the updation agent transfers the decompressed medical data to the physician for examining purpose. The physician examines the presently received data with the medical record history of the patient and returns the prescriptions to the transfer agent and database. Through global network, the transfer agent compresses the medical prescription data and it transmits the compressed data to related collection agent. Once the collection agent received the compressed prescription data consequently, it communicates the information to patient after the decompression process. The remaining part of the paper is organized as follows.

Section-2 describes the related work by researchers, Section-3 explains the proposed model and the experimental result is depicted in Section-4, Section-5 provides the concluding remark.

2. Literature Review

Sergio PajaresFerrando et. al. [13] have offered Context-Aware Multi-Agent Planning (CAMAP), which is an approach for multi-agent planning that employs argumentation mechanisms to decide the most suitable course of action according to the situation information distributed between the agents. CAMAP is used in real-world application of AmI, in the field of health-care. Dante ALZ-MAS, an Ambient Intelligence based multi-agent system has been offered by I. Tapia and Juan M [18], which aimed at improving the help and health care for Alzheimer patients. The system included numerous context-aware technologies that permitted it to automatically get information from the users and the environment in an evenly distributed way, spotlighting on the features of ubiq-

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uity, awareness, intelligence, mobility, etc., all of which are ideas defined by ambient intelligence.

Chuan-Jun Su et. al [1] have executed highly distributed information infrastructure—MADIP by applying Intelligent Agent paradigm, which was capable to inform the liable care-provider of abnormality, the present distance medical advice and executes incessant health monitoring for those who require it, automatically. To tackle the issues of interoperability, scalability, and openness in heterogeneous e-health environments, a FIPA2000 standard compliant agent development platform—JADE (Java Agent Development Framework) was implemented for the design and execution of the suggested intelligent multi-agent based MADIP system.

Jian Wu et. al [14] have introduced a multi-agent design technique and system evaluation for wireless sensor network based structural health monitoring to authenticate the competence of the multi-agent technology. The distributed wireless sensor network can routinely assign SHM tasks through the cooperation of six dissimilar agents of SHM applications, self-organize the sensor network and collect different sensor information. The strain gauge and PZT sensors are applied to observe strain distribution change and joint failure of an experimental aluminum plate structure in the evaluation work. A dedicated sensor network platform that includes the wireless strain node, wireless PZT node and wireless USB station is planned for the assessment system. The multi-agents software architecture is defined based on the hardware platform. The multi-agent monitoring principle and execution for two typical types of structure states are offered in the validation work. This document explains the competence of the multi-agent technology for WSN based SHM applications on the large aircraft structures.

David Isern et. al [15] have offered The K4Care platform, which suggested an agent-based three-layered architecture aimed at solving these two issues and assist the provision of these services. In order to assist the automation of the modelling and execution of the multi-agent system, the development of the platform was sustained by a methodology. The intelligent agents of the platform, which represent the Home Care domain actors, have the capacity to direct the implementation of administrative and medical processes. They drive the flux of knowledge and have power over all the involved professionals, making simpler their interactions and capturing novel medical knowledge emerging from physicians. To improve personalized treatments, the platform also offer devices that permit medical practitioners acclimatized to the clinical and social circumstances of each patient and based on the standard international recommendations, for the most repeated Home Care pathologies. The paper explains the architecture of the system, how the personalized treatments are created and how they are performed through the co-ordinated work of agents. An assessment of the actual state of the work and a comparison with other related guideline execution systems are also offered.

For developing patient-centric health applications and monitoring systems, ShirinGhorbani et al [16] have offered Personal Health Service Framework (PHSF), which is an open architecture. PHSF has employed advancements of service-oriented architecture to offer a baseline for developing health-related systems. PHSF services were applied to make self-monitoring and isolated monitoring possible and to link healthcare providers and patients. PHSF was executed as a mixture of web services presented in seven components in four layers. In that article, a heart monitoring application build on PHSF was explained.

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A multi-agent web service framework based on service-oriented architecture for the optimization of medical data quality in the e-healthcare information system was proposed by Ching-Seh Wu et. al [17]. An evolutionary algorithm (EA) based on the design of the multi-agent web service framework, meant for the dynamic optimization of the medical data quality was offered. Two main components are present in the framework. First, an EA was made use of to dynamically maximize the composition of medical processes into optimal task sequence, according to particular quality of characters. Second, a multi-agent framework is presented to find out, monitor and report any infidelity between the maximized task progression and the actual medical records. Experimental results for a breast cancer case study are taken for the demonstration of their framework. Moreover, they have shown exceptional performance of their algorithm and in addition, they have also presented a comparison with other works in the literature review.

3.Proposed Model

In this paper, our MAS consists of three agents namely collection agent, updation agent, transfer agent, which are used in two units such as source unit and destination unit. The source unit consists of patient, smart sensor and collection agent. In the destination unit, two agents are available. One is updation agent and the other one is transfer agent. Moreover the destination area consists of database to store all events about the patient's medical data. The source and destination areas are connected through global internet. The following diagram represents the overall architecture of the proposed algorithm.

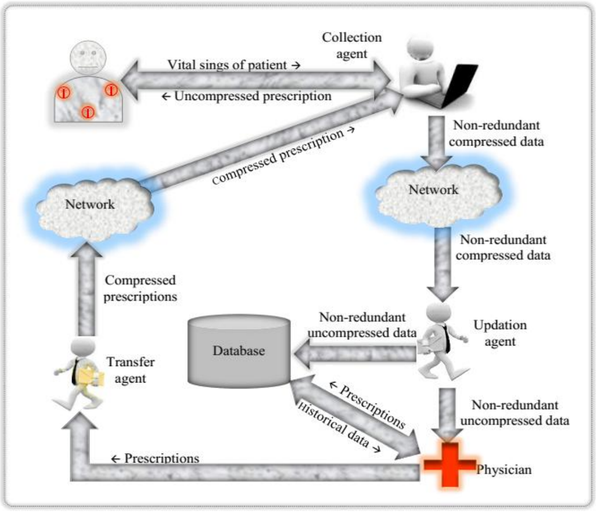

Figure1: Architecture of the proposed approach

Figure 1 indicates the overall architecture of the proposed health care monitory system of the elder people. The overall architecture can be divided into two units, namely, the source unit and the destination unit, which are connected by the global internet for the circuit process. The source unit contains the parts such as smart sensors, which are worn in the patient's body, and the collection agent. Initially, the vital signs of the patient data's are observed by the smart wireless sensors. The observed data are transmitted to the collection agent through smart wireless sensor network. Once the collection agent received the data, it verifies the redundancy of received data with the help of previous data received from the patient. If the collection agent concludes that the received data is redundant, then it will not use that redundant data for further processing and it will neglect the redundant data. If the received data is not redundant, then the collection agent compresses the non-redundant data and transfers to the updation agent in the destination unit for further process. The updation agent decompresses the compressed data and adds the decompressed medical data in the corresponding patient record file in the database. Moreover, the updation agent transfers the decompressed medical data to the

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physician for analysing purpose. The physician analyses the currently received data with the historical medical record of the patient and returns the prescriptions to the transfer agent and database. The transfer agent compresses the medical prescription data and it transmits the compressed data to corresponding collection agent through global network. Once the collection agent received the compressed prescription data, it conveys the information to patient after the decompression process.

3.1 Source unit

The main aim of the source area is collecting and evaluating the vital signs from the patient's body and to suggest processed prescription to the patient, obtained from the destination area. The processing procedure of each of them is described in below.

3.1.1 Collection of vital signs

The smart sensors are worn in the patient's body at significant places to collect vital signs such as *body temperature, blood pressure, pulse rate and respiratory rate* at frequent interval, which is done by collection agent. Consequently, on the off chance that we have to store the assembled information for investigation, over a period, the information will be enormous. Out of this colossal information, just some would be required for later reference. In this way, it is a waste of memory to store all the accumulated qualities. Subsequently, there is a requirement for information reduction in such health monitoring systems. In order to solve this problem, in this paper, we removed the unnecessary data by avoiding the collected redundant information through proposed *redundant measure*. At each time, when the collection agent receives the data from the patient's body, it will evaluate the data through redundant measure. If the collection agent confirms that the collected data is redundant, then it will not be considered for further processing. In case, if the collection agent confirms that the collected data is not a redundant data, then the collection agent compresses the collected data and transfers the compressed data to the destination area.

3.1.2 Calculation of redundancy measure

The redundancy measure is used to evaluate the similarity of the sensed data with the previous sensed data. In order to design the exact method in this paper, we utilize genetic algorithm through crossover and mutation process.

The patient medical data consist of values of body temperature, blood pressure, pulse rate and respiratory rate, which are acquired from various patients. Hence, four attributes are associated with the considered medical data and a sample medical data is given in Table 1. Initially, we take some medical data of patient as the training data D_{train}

Table 1: Represents the sample training data D_{train}

D_{train}	Temperature (a_1)	Pressure (a_2)	Pulse (a_3)	Respiratory (a_4)
d_1	97.5	150	70	15
d_2	98.6	140	79	16
d_3	98	160	82	18
d_4	97.8	190	68	17
d_5	99	175	92	16

With the help of the training data, we generate combinations of medical records for further process. Here, we separate the combinations in two ways. The first one is named as redundant combinations C_R , i.e. the data in the combinations are similar with each other and the other

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one is non-redundant combinations C_{NR}, i.e. the data in the combinations are different. The sample combinations of training data is given in Table 2.

Table 2: Represents the combinations of training data

Redundant combinations C_R	Non-Redundant combinations C_{NR}	
(d_1, d_1)	(d_1, d_2)	(d_2, d_4)
(d_2, d_2)	(d_1, d_3)	(d_2, d_5)
(d_3, d_3)	(d_1, d_4)	(d_3, d_4)
(d_4, d_4)	(d_1, d_5)	(d_3, d_5)
(d_5, d_5)	(d_2, d_3)	(d_4, d_5)

Subsequently, we calculate the distance of each attribute in each combination. The calculation of distance of each attribute of the combination is made by the following equation (1).

$$a_i^{x,y} = \left\| d_x(a_i) - d_y(a_i) \right\| \quad (1)$$

In Equation 1, value of x and y represents the ID of medical data in the combination and the 'i' indicates the attribute, which varies from one to four. Similarly, we calculate the distance for each attribute for every combination. Equation 2 represents calculating the distance value for attribute 'a_1' for the combination (d_1, d_2).

$$a_1^{12} = \left\| 97.5 - 98.6 \right\| \quad (2)$$

The next step is to generate the solutions, which is displayed in table 3, for the genetic algorithm [21] with binary operators. These solutions are generated randomly. Processing these solutions using genetic algorithm can produce the best solution with high fitness value, which is considered as redundancy measure.

Table 3: Solution table

solutions	c	a_{12_3}	a_{123_4}
s_1	+	/	*
s_2	-	*	+
s_3	+	*	-

With the intention of calculating the fitness value of each solution, initially we apply the distance value of every attribute of each combination into each solution. From Table 3, where a_{1_2} represents the binary operator applied between the distance value of a_1 and a_2. The value of a_1, a_2, a_3 and a_4 are obtained by the distance calculation function (equation (1)). The symbol a_{12_3} from the above table 3 indicates that the binary operator is applied between the resultant value a_{12_3} and a_3 and the symbol a_{123_4} indicates that the binary operator is applied between the resultant value a_{12_3} and a_4. Each solution has three numbers of attributes, which are displayed Table 4.

Table 4: Represents the result value of each solutions

Redundant combinations C_R				**Non-Redundant combinations C_{NR}**							
	a_{1_2}	a_{12_3}	a_{123_4}		a_{1_2}	a_{12_3}	a_{123_4}		a_{1_2}	a_{12_3}	a_{123_4}
S^{11}	s_1^{11}	s_2^{11}	s_3^{11}	S^{12}	s_1^{12}	s_2^{12}	s_3^{12}	S^{24}	s_1^{24}	s_2^{24}	s_3^{24}
S^{22}	s_1^{22}	s_2^{22}	s_3^{22}	S^{13}	s_1^{13}	s_2^{13}	s_3^{13}	S^{25}	s_1^{25}	s_2^{25}	s_3^{25}
S^{33}	s_1^{33}	s_2^{33}	s_3^{33}	S^{14}	s_1^{14}	s_2^{14}	s_3^{15}	S^{34}	s_1^{34}	s_2^{34}	s_3^{34}
S^{44}	s_1^{44}	s_2^{44}	s_3^{44}	S^{15}	s_1^{15}	s_2^{15}	s_3^{15}	S^{35}	s_1^{35}	s_2^{35}	s_3^{35}
S^{55}	s_1^{55}	s_2^{55}	s_3^{55}	S^{23}	s_1^{23}	s_2^{23}	s_3^{23}	S^{45}	s_1^{45}	s_2^{45}	s_3^{45}

In Table 4, S^{11} indicates the obtained score value, when the solution s_1 is applied in the distance values of redundant combination of d_1. Symbol S^{12} depicts the obtained score value when the solution s_1 is applied in the distance values of redundant combination of d_1 and d_2.

(i) Calculation of fitness function

Once the calculation of score value of each solution with respect to every combination gets finished, the next step is to convert those score values into binary values based on the user-defined threshold. Converting score values into binary values is done using the following equations 3.

$$S^{x,y} \le t_h \rightarrow 0 \quad S^{x,y} > t_h \rightarrow 1$$

(3)

Once the binary conversion gets finished, the next step is to calculate the fitness function, which can be calculated using equation (4), where $cnt\,(0)_{C_R}$ represents the number of binary symbols '0' appeared in the solution s_i for redundant combination C_R and $cnt\,(1)_{C_{NR}}$ represents the number of binary symbols '1' appeared in the solution s_i of redundant combination C_{NR}. Finally, $cnt\left(C_R + C_{NR}\right)$ represents the total number of combinations generated from the training data.

$$F\left(s_i\right) = \frac{cnt\,(0)_{C_R} + cnt\,(1)c_{NR}}{cnt\left(c_R + c_{NR}\right)}$$

(4)

Once the fitness values are calculated, the next step is to find the solutions that are subjected to genetic operators such as crossover and mutation.

(ii) Crossover

The crossover operator in genetic algorithm is exploited to covert the chromosome or chromosomes from one generation to another. Crossover generates child solution by means of one or more parent solutions.

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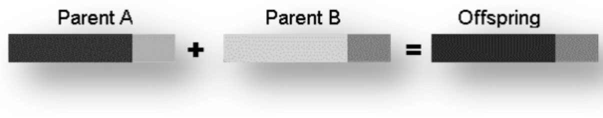

Figure 2: Represents the cross over operation

Table 5: Solutions before crossover

Solution	Chromosome		
S_1	+	-	*
S_2	/	+	-

Table 6: Solutions after crossover

Solution	New Chromosome		
S_1	+	-	-
S_2	/	+	*

(iii) Mutation

Mutation is a genetic operator used to keep up genetic diversity qualities from one era of a populace of genetic algorithm chromosomes to the succeeding. It is comparable to biological mutation. Mutation modifies one or more gene values in a chromosome from its primary stage. In mutation, the resultant may change completely from the past result. Consequently, GA can offer an optimum result by employing mutation. Mutation happens amid development as per client determinable mutation likelihood. This likelihood ought to be fixed minimum. On the off chance that is situated excessively high, the search will transform into a primitive arbitrary search. The traditional illustration of a mutation operator includes likelihood that a self-assertive bit in a hereditary grouping will be transformed from its unique state. A typical technique for executing the mutation operator includes producing an arbitrary variable for every bit in an arrangement. This irregular variable expresses whether a specific bit will be altered. This mutation method, created on the biological point mutation, is called single point mutation. Different categories are inversion and floating point mutation. At the point when the gene encoding is prohibitive as in change issues, mutations are swaps, inversions and scrambles.

The reason for mutation in GAs is protecting and presenting assorted qualities. Mutation ought to permit the calculation to dodge nearby minima by keeping the number of population in chromosomes, which are halting convergence. This thinking additionally clarifies the way that most GA frameworks evade just taking the fittest of the populace in creating the following but instead an irregular (or semi-arbitrary) determination with a weighting to those that are appropriate.

Bit inversion - selected bits are inverted

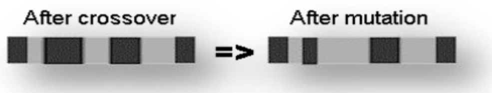

Figure 3: Represents the mutation operation

Table 7: Mutation after crossover

Solution	New Chromosome		
S_1	+	-	-
S_2	/	+	*

Once the crossover and mutation processes get over, the next step is to find the fitness value of the newly generated solutions from which we select the best three among them for further process. This process is repeated until the fitness of best solutions is almost similar.

Once the genetic algorithm is completed, it produces the best set of results from which we selects the best one, which has the high fitness value. Once the selection of best solution gets finished, the next step is to use that solution to

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evaluate the redundancy nature of upcoming data.

For each patient, the collection agents store the previous medical data. When the new data arrives to the collection agent, it calculates the distance between the previous medical data with currently received data through the selected solution obtained from the genetic algorithm. If the result value obtained from the solution is greater than the user-defined redundant threshold, then collection agents allow the received medical data for further processing and it stores that data as previous data of the patients. In case, if the result value obtained from the solution is lesser than the user-defined redundant threshold, then collection agent just neglects the received data.

3.1.3 Huffman coding

Assume that the body sensors transfer the sensed data at every time interval (t) to the collection agent, but the collection agent transfers the data to updation agent at the time interval of (t+T) where t>T. In this case, the collection agent received more sensed data over a period of time T. Hence Huffman compression algorithm is utilized for reducing the size of the received sensed data, which helps to reduce the computation cost as well as energy. If the value of T is small, the size of the received data is also less; in this case, the Huffman compression algorithm is not required.

Huffman encoding [20] is a manifestation of factual coding, which endeavours to lessen the measure of bits needed to speak to a series of symbols. The strategy finishes its objectives by permitting symbols to differ in their extent. The shorter codes are allotted to the most frequent symbols, and more codes to the symbols, which seem less recurrently in the string. Currently, Huffman-encoding algorithm executes to build the minimum redundancy codes for every information. Information expects the distinctive probability $P(x_i)$ values for discovering the code word. After that, aggregate number of image (0's or 1's) is decreased by one. Hence, two symbols are joined together every instant of time. The code is planned by combining the least plausible symbols and this methodology is rehashed until just two probabilities of two compound symbols are left and accordingly a code tree is produced and Huffman codes are acquired from marking of the code tree. Huffman code technique is focused around the two perceptions:

- Frequent symbols will have shorter code words than symbols that ensue rarely.
- The two symbols that occur least regularly will consume the same length.

3.2 Destination unit data processing

The destination agent processes the received medical data and it returns the solution to the source unit. For processing the medical data, destination unit of our proposed MAS (Multi Agent System) consists of updation agent, transfer agent, medical database and physician. Each of which has its unique method for processing the medical data which is described below.

3.2.1 Updation agent

The updation agent receives the compressed medical data of the patient from the source unit. Subsequently, the updation agent decompresses the medical data and sends it to the physician and to the corresponding patient record file in the database.

3.2.2 Database

The database is used to store the medical history of the patient such as patient ID, patient personal records and its time, prescriptions given by the physician.

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3.2.3 Physician

The physician analyzes the received medical data of the patient with the existing history of the patient. Then, the physician gives the exact prescriptions for the received medical data to the transfer agent for further process.

3.2.4 Transfer agent

The transfer agent compresses the received medical record and selects the corresponding collection agent to send the compressed prescriptions.

4. Experimental results

In this section, we described the experimental results of the proposed architecture for monitoring the patients using intelligent agent-based system in wireless sensor network.

4.1 Experimental environment

The proposed approach for monitoring the patients using intelligent agent-based system in wireless sensor network is programmed using Java (jdk 1.6) in JADE. The experimentation has been carried out by a number of patient's medical data that transfer through packets, using core 2-duo processor PC machine with 2 GB main memory running a 32-bit version of Windows 7.

In this paper, we evaluate our proposed approach based on the number of redundant data and the size of data that have been saved while transferring the medical data by avoidance of redundant data and compression method. The evaluation procedure is based on the various values of number of data packets sent from the patient side and the redundant threshold value.

4.2 Evaluation of number of redundant data

Our main aim of the proposed method is avoiding the transfer of unnecessary redundant medical data and so, to reduce the computational cost. Here, we evaluate the number of redundant data for various values of number of packets sent from the patient side. The number of redundant data is defined through calculating the difference between the number of data transfer from the patient side and number of data received in the database. The following figures 4 and 5 represent the evaluations of number of redundant data for various values of number of data packet sent from the patient and user defined redundant threshold, respectively.

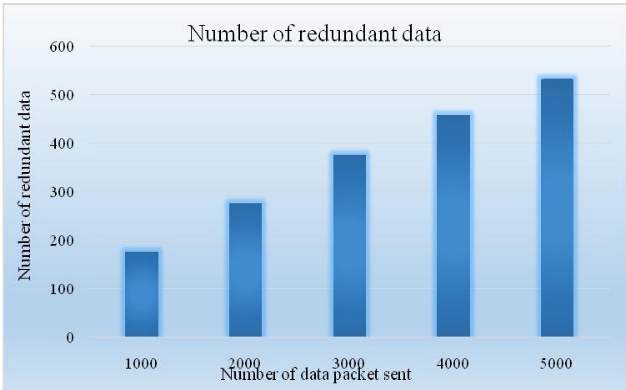

Figure 4: Number of redundant medical data by varying the number of data packet sent

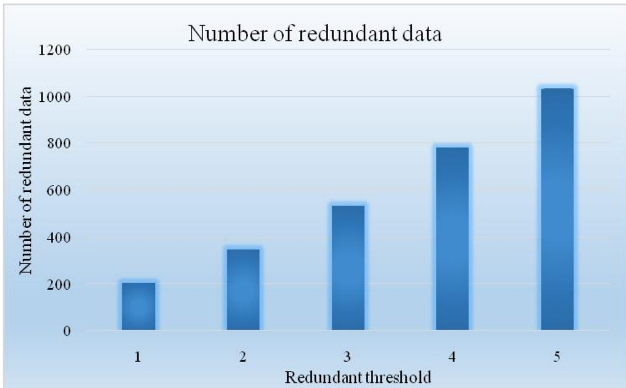

Figure 5: Number of redundant data for various values of redundant threshold

From the above figure 4, we evaluate number of redundant medical data by varying the number of data packet sent from the patient side. At the same time, we set the user-defined threshold value as constant as three. By analysing figure 4, number of redundant data is increased, when we increase the value of number of data

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packet sent from the patient side. From figure 5, we evaluate number of redundant medical data by varying the values of user-defined redundant threshold. Meanwhile, we set the number of data packet sent from the patient side as constant as 5000. By analysing figure 5, number of redundant data is increased, when we increase the value of user-defined threshold. The maximum number of redundant data is 1032 when the user-defined threshold value as five and the number of data packet sent from the patient side is 5000. The minimum number of redundant data is 176 when the user-defined threshold value as one and the number of data packet sent from the patient side is 1000.

4.3 Evaluation of size of redundant data

Once the collection agent confirmed that the received medical data is redundant data, then the collection agent does not allow that medical data for further process. Then, the size of the redundant data is saved from the transfer process by the collection agent. Likewise, the collection agent avoids redundant data. The size of those redundant data represented data for various values of number of data packet sent from the patient and user defined redundant threshold, respectively in the figures 6 and 7.

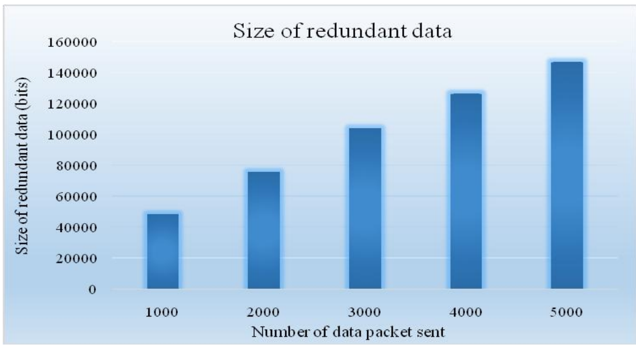

Figure 6: Size of redundant medical data by varying the number of data packet sent

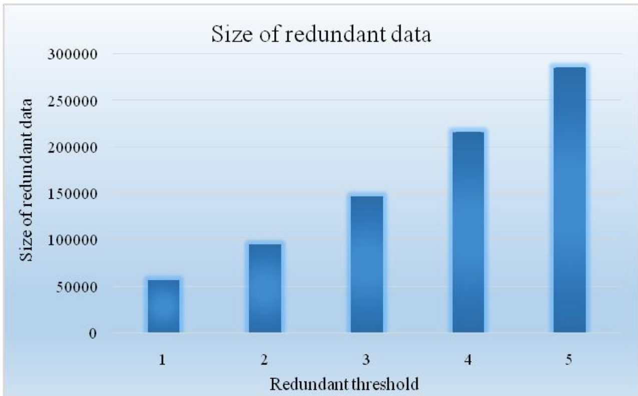

Figure 7: Size of redundant data for various values of redundant threshold

From the above figure 6, we evaluate size of redundant medical data by varying the number of data packet sent from the patient side. At the same time, we set the user-defined threshold value as constant as three. By analyzing the figure 6, size of redundant data is increased when we increase the value of number of data packet sent from the patient side. From the above figure 7, we evaluate size of redundant medical data by varying the values of user-defined redundant threshold. Meanwhile, we set the number of data packets sent from the patient side as constant as 5000. By analyzing the figure 7, the number of redundant data is increased when we increase the value of user-defined threshold. The maximum size of data saved by avoiding the redundant data is 285184 bits when the user-defined threshold value is five and the number of data packets sent from the patient side is 5000. The minimum number of redundant data is 48576 when the user-defined threshold value is set as one and the number of data packets sent from the patient side is 1000.

4.4 Evaluation of the size of saved data by compression

Once the collection agent is confirmed that the received medical data is not a redundant data, the collection agent uses a compression process to further reduce the valuable medical data.

Likewise, every non-redundant medical data are subjected to compression algorithm by the collection agent. The size of the compressed and the non-compressed data are evaluated for various values of the number of data packets send from the patient and user defined redundant threshold and they are shown in figure 8 and figure 9 respectively.

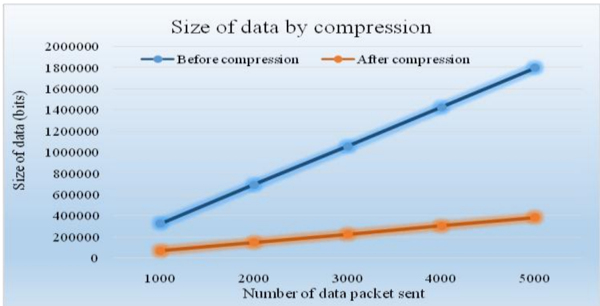

Figure 8: Evaluation of size of data saved by compression method for various values of number of data packets sent.

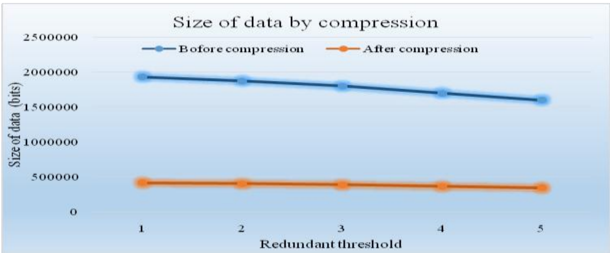

Figure 9: Evaluation of size of data saved by compression method for various values of redundant threshold.

5. Conclusion

In this paper, we have presented a multi-agent architecture for health care monitoring system that was organized in to two units. The first one was the source unit, which contains the smart wireless sensors and the collection agent. The sensors read the vital signs from the patient's body and transfer the data to the collection agent. The collection agent verifies whether the received data is redundant or not. The non-redundant medical data is then compressed and sent to the updation agent in the destination unit by the collection agent. The updation agent updates the medical data in the database and aids the physician to produce the exact prescriptions based on the received medical data and with the help of medical history obtained from the database. Then, the prescriptions are transferred to the database and the transfer agent. The transfer agent transfers the prescriptions to the corresponding collection agent after the compression process. The collection agent conveys the prescription to the patient after completing the decompression process. Finally, the experimentation was made and 1:5 data has been saved by our method. The implementation is done using JADE.

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