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A Design and Implement Contexts-Aware Case based u-Health System

Mi-Rim Song, Jin-Young Moon and Sang-Hyun Bae*

Dept. Of Computer Science & Statistics, Chosun University, Korea
Sangsong15@hanmail.net, pinkwant@nate.com, shbae@chosun.ac.kr
**Corresponding author*

Abstract

It is necessary to implementation of system contain intelligent decision making algorithm considering individual characteristics because existing u-Health system is simply monitoring obtained data from sensor network. In this paper, we designed inference system using case based reasoning method and implemented knowledge base that case for fire and damage of biological. We used K-Nearest Neighbor algorithm for recommend best similar case and input 3.000 EA by case for fire and damage context case base. As a result, we obtained about 86.6% average accuracy for damage of biological case and about 83.9% average accuracy for fire case. We implemented u-Health monitoring system using inference result.

Keywords: *Case Based Reasoning; Expert System; USN; Digital Marine Vessel; Context aware*

1. Introduction

Interest in improving the quality of life and survival of recently is increasing, in the aging of the world's population advance to minimize the possibility of the occurrence of the disease than the side to treat human diseases it is a factor important to the health of the aging society and life extension of health care [1]. As a result, medical services are promoting the development of telemedicine services such as health care mobile phone of home treatment of the concept of ubiquitous, the development of wireless sensor network technology is accelerating the development of mobile health care system. Wireless sensor network is that a collection depends on the sensor and the information gathered can be processed depends on the processor, and it can be transferred with a small equipment what is provided with a transceiver device, that is, means a network of sensor nodes, unlike existing network, it is intend to not means of communication but information gathering about the environment that is intended [2]. In particular, the combination of medical information systems and ubiquitous computing environment, a variety of application services related to prevention and health diagnosis is required.

For this support, communications infrastructure and hardware configured by the sensor should be constructed for the middleware technology for integrating communications infrastructure and extraneous hardware is required. Further, the user interface module, analysis and collect health information based on this, application various services to deal with emergencies is required.

However, existing system proceeded actively research that it is point of hardware infra with sensor, equipment and etc. Information systems that are built for U-Health system application services, doctors in most hospitals in the study of existing research with an emphasis on hardware infrastructure, devices, or other sensor has been actively a situation's is

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built emphasis on pathological management of patients and enhance operational and nurse, existing systems, since the stopped to monitor simply intelligent considering the characteristics of the individual implementation of the system with a decision algorithm is required. For decision support, expert systems, neural networks, artificial intelligence techniques such as case-based reasoning is utilized, the conventional method is difficult to consider the tracking process by the expertise of the model building process there is a tendency that if required by many methods using case-based reasoning which can be seen the effect of past experience has been studied. Case-based reasoning is suitable in the field to solve similar problems through past experience that occur continuously, even complex problem, as long as they have the same experience cases obtained in the past, and to infer any special is efficient to issue that requires a lot of time it is possible to get a solution without, using the similarity function to determine a solution for retrieval examples of most similar [3] [4].

In this paper, we use the (K-Nearest Neighbor) algorithm KNN who refer to the case of k-nearest to the current case. Algorithm KNN is classification of the method stored in the memory in the form of a training set of objects already known, by selecting such object, depending on the value of the selected object, to predict the value of the new object KNN algorithm (classification) algorithm. You can use the KNN algorithm to measure the (similarity) similarity between objects, it is recommended the most appropriate way. In this paper, we have designed a system to build a knowledge-based bio-risk cases, the fire by using the method of case-based reasoning, and inference. Data entered will implement the u-Health monitoring system based on the result is stored in the case database when a new problem occurs to me with reference to examples in the past that was most similar case base, and was diagnosed to.

In this paper, it is configured as follows. In Section 2, the trends of related research, In Section 3, shows how to enter, build case-based and measurement of data, In Section 4, the results of implementing system, In Section 5, we describe the performance evaluation by examine. In Chapter 6, I present the direction of future research and conclusion.

2. Related Work

2.1. Case-Based Reasoning

In order to solve new problems that were obtained on the basis of experience of being used to solve some problems in the past, case-based reasoning can be applied effectively to both prediction problem and classification. The case-based reasoning is that similar problems that they have the solution similar problems occurring once due to the fact that there is likely to occur frequently. Therefore, if you know the past, similar problems currently exist and how they solve it, it is possible, based on past experience, inferring a solution to the problem of the current. How to solve the problem of case-based reasoning, so is similar to the problem-solving human way, the benefits easier to understand the results, even just to save just a new problem, learning that takes place without additional work with.

The case-based reasoning solve a new problem as shown in Figure 1 to pass through a stage of search cases, re-use of the case, change case, maintenance of case [5].

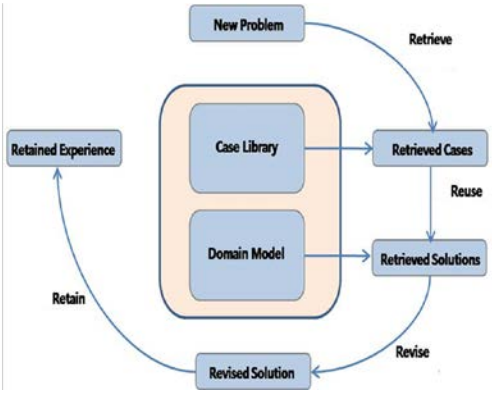

Figure 1. Case Based Reasoning Process

In stage of Retrieve, to extract past cases closest to the new problems to be solved, at the stage of Reuse, and the current problems, the solution of similar cases that were found in the search it is intended to be used to resolve. At the stage of Revise, to evaluate the solution derived, to recalibrate the case based on the evaluation result. And the stage of retain, new that have occurred through the previous three steps stored in a case base of conventional problems. Because it can be learned without modeling the target system can be applied even if there is no prior information about the field of application, if the output class is continuous or discrete, case-based reasoning, able to handle all there is an advantage that can be. Thus, how Case Based Reasoning Model use of case-based reasoning models in various fields has been increased demand for the improved performance has increased more and more, or extracts quickly cases that were most similar Let me be the key performance indicators, the. Therefore, in order to improve its performance and determine whether to perform that case retrieving and case indexing are an element of the main algorithm for both case-based reasoning in any way be is very important.

If you look at the previous studies of case-based reasoning system, Limam *et al.*, was proposed a use case-based reasoning techniques for re-design of new business processes [6]. Bartlmae & Riemenschneider was suggested knowledge management framework based on case-based reasoning methods and approaches operating system experience for managing knowledge experience obtained when running the project knowledge discovery from the database. Case-based reasoning, which is often used as a tool for learning and problem solving in recent years in fact, case-based reasoning system that was successful in various fields have been developed.

2.2. KNN Algorithm for the Measurement of Similarity

The search exemplary method for measuring the similarity of case-based is recursive search and nearest neighbor search. Recursive search is to search the attributes of separating best case, search for similar cases by using this property. Recursive search uses the structure in the form of a decision tree for configure and locate case. After that for a similar case retrieval of the current problem, we measured the degree of similarity between all cases of case-based and represents the current problem, contact adjacent search recently, the case of a certain number of high similarity it is a way to search, find similar case. Method most commonly used in nearest neighbor search is a KNN algorithm to find examples of k pieces closest to the current case.

In this paper, in order to find a similar case with the KNN algorithm. The KNN algorithm, instead of relying only on example of the closest on classifying a new problem, to predict, for

using the method of taking a vote from the case of the closest K pieces, that the accuracy of prediction increases made. In addition, we evaluate a similarity to all cases from the input data, and then select the method with the highest similarity. Figure 2 shows the course of the KNN algorithm. If you look at the previous studies of the KNN algorithm, the first Har and Cover were proposed independently KNN algorithm, [7] Thereafter, the KNN algorithm showed the validity logically by Smith and Medin, *etc*., but was in a state model for the actual algorithm has not been developed [8]. After Aha, kibler and Albert developed some of the instance based learning algorithm[9]. KNN algorithm has been applied in many field, it is one of machine learning methods that validates its performance.

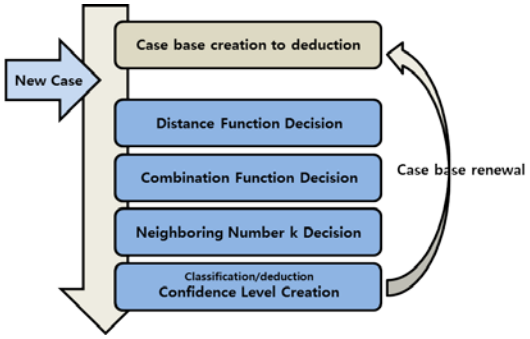

Figure 2. KNN Algorithm Execute Process

3. Construction of both Input Example Measurement and Case-based

3.1. Use case-based Data

The data used in this study as sensor data input through experimentation consists Temperature each day according to the experimental location, illumination, humidity data, pulse daily according to the user, diastolic blood pressure, systolic blood pressure, and blood glucose level data. To construct the case base, to simulate the fire situation in accordance with the environmental conditions and biological risks, were run as input data 5000 to the situation for each. Case data is formed with a large state table dangerous biological, two tables such as fire situation table has the structure of a relational database. Figure 3 shows the relationship diagram - object of data. Looking at the configuration of the table, the user table is composed of general information of the user what is user's ID, password, name, age *etc*. to confirm the personal information. Biological hazards table consists of data input time and pulse rate, diastolic blood pressure, Fire situation table consists of data input time and temperature, illumination, humidity.

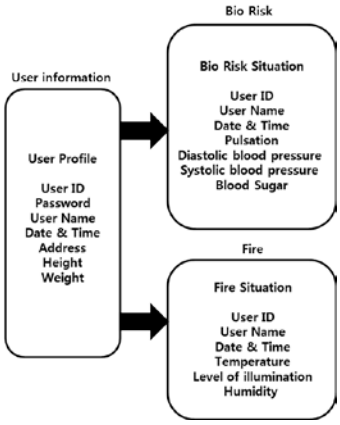

Figure 3. Data Entity Relationship Diagram

3.2. Measurement of the Input Data of a Dangerous Situation Biological

Wireless network technology in the u-Health system duplicate check to easily measure the health status of the patient such as remote medical care by reducing post-mortem, at the same time as the reduction of cost, service delivery personal of one person patient, it is an important technology necessary to sophisticated services. In this paper, we implemented a ZigBee wireless sensor network systems for measuring the risk of physical user. IEEE802.15.4 Zigbee is a short-range wireless communication technology that focuses on applications that require low-speed, low cost, and low power consumption. In this paper, we implemented a ZigBee wireless sensor network system of the 2.4GHz Zigbee for detecting a biological signal, and case detection of the content, to infer. Figure 4 shows the screen of the wireless communication experiment using Zigbee.

Figure 4. Experience of Bio Data

(Number of 2 hours after the pulse, systolic blood pressure, diastolic blood pressure, blood glucose level (fasting value), blood glucose level) input data of five from the sensor is sent.

7E 00 0A 7D 10 00 00 02 00 00 00 01 00 02 00 EE D3 FF FF 55 00

1	2	3	4	5	6	7	8	9	10	11
7E 00	0A	7D	10	00 00	02 00	00 00	01 00	02 00	EE D3 FF FF	55 00

1.Address 2:MSG Type 3:GroupID 4:Data Length 5:Source address 6:Orgin address 7:Sequence number 8:Hop Count 9:address 10:timestamp 11:reading

Figure 5. Sensed Data Structure

In Figure 5 MSG Type let me know the type of biometric data is whether the which type pulse, systolic blood pressure, diastolic blood pressure, blood glucose levels and GreupID tells us the information of the sensor. In other words, one for each sensor has a GroupID. Timestamp is the time of measurement data from the sensor. Reading is expressed in hexadecimal 2bype the value of the data that enters fact.

3.3. Fire Situation, Measurement of the Input Data

In order to obtain a fire situation data, using the sensor module with built-in temperature, humidity, illuminance sensors, processor board was used Telos platform sequence, it was measured using the CC2420 Radio Chip MCU and the MSP430. When fire situation occurs, if it is created in one packet each temperature, humidity and illuminance values, the energy consumption associated with the data transfer and the generation of additional traffic occur, the database together in a single packet I has been sent to. Figure 6 shows fire situation, a structure of packet data. The total length of the packet is 34 bytes, the fixed header is 10 bytes, the sensor node ID and channel is composed of 6 bytes, in the part of the 20-byte buffer. The order of humidity, temperature and illumination, the buffers are designed detected actual values so that they are in hex value by 2 bytes each six bytes.

Header(10)	Sensor node ID & Channel(6)	Humidity(2)	Temperature(2)	Illumination(2)	(12)

Figure 6. Packet Configuration

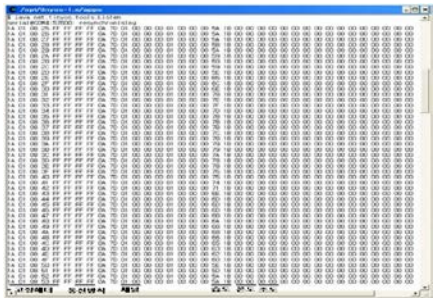

Figure 7. Structure of Data

Figure 7 shows the packet reception status of a lab environment. Each bundle represents a single byte, the value of 7, 8 second from the left fills in on the communication system, 15 and 16, each set will tell you the channel. Because it is "FF FF", is a wireless communication, the communication mode in the figure below, can know that the channel is one. Shows humidity, temperature, the illuminance value 17 to 22.

The input data is output through more calculation process of one step, called split, Figure 8 shows the conversion formula of the actual value temperature and humidity.

```
* Actual Temperature = Actual Sensing Value * 0.01 - 40
* Humidity = (t_c - 25) * (0.01 + 0.00008 * (double) raw_humi dity) + rh_lin,
rh_lin = -0.000028 * (double)raw_humidity * (double)raw_humidity + 0.0405 *
(double)raw_humidity - 4;
```

Figure 8. Conversion Formula of Temperature and Humidity

3.4. Measurement of Similarity

How to calculate the similarity between the cases for calculating the similarity to all instances from the input data, to select the method with the highest similarity is as follows. The total of similarity $S(N, O)$ between new input case N and the cases in case base O such as equation (1) obtains the attributes i as much similarity score $f(N_i, O_i)$, the weight of each attribute is calculated by multiplying the sum of it.

$$S(N, O) = \frac{\sum_{i=1}^{n} f(N_i, O_i) \times W_i}{\sum_{i=1}^{n} W_i} \quad (1)$$

In this case, n is number of attributes, $f(N_i, O_i)$ means the similarity score between the case N and i attributes of, O, W_i refers to the weight of the i property. The similarity between cases is represented by a real number between 0 and 1 by the equation (1), it means that the similarity of the two cases as low as close to 0, have high affinities closer to 1 I mean that. In other words, it is recommended the example closest to the one similarity when you get the case. The similarity score $f(N_i, O_i)$ of between attributes depends (numeric, categorical) to the type of the attribute, because, in this paper, since the input data is all numeric type, the similarity score calculated to as in equation (2).

$$f(N_i, O_i) = 1 - \frac{a_i - b_i}{\max_i} \quad (2)$$

Here, a_i is the value of N_i, b_i is, O_i, $\max_i$ means the maximum value of the attribute value in O_i basis. In general, performance of case-based reasoning system will be subject to many influences from the attribute weights used for similarity calculation and the number k of nearest neighbors that is referenced to generate an answer [10]. In this paper, it is desired to optimize the system by performing the experiment while increasing the number k of nearest neighbor. In addition, even though such should be the weighting for the attribute that most influences the case, in this experiment, as the numeric data type, the attributes of each attribute of each data, impact on the status of the fire situation and dangerous biological If you are similar to the weight of attribute is given by '1' the same. For all cases of case-based, calculate the total similarity, total similarity is sorted in descending order from the largest case, to be sent to the monitoring system by priority.

4. Implementation Results of the System

In this paper, we constructed case of dangerous situations organism, the situation case base of fire for using the case-based reasoning, to diagnose the degree of biological risk of the user, the status of the fire. In order to deduce the status of biological risk, utilize the data pulse of the user, diastolic blood pressure, systolic blood pressure, blood sugar, to deduce the fire situation, use temperature, illumination, humidity data. The input data is processed by receiving an input from a sensor that is installed by the experimental environment. The reasoning of the case past the closest case-based built, diagnose, diagnostic result, data that has been sensing, is sent to the monitoring system. Figure 9 is a block diagram of the proposed system.

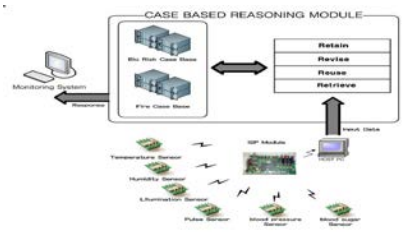

Figure 9. System Block Diagram

In this paper, we implement the monitoring system using Delphi, Table 1 shows the implementation of the system.

Table 1. System Implement Environment

	Article	Classification
Software	OS	Windows XP
	Language	Delphi
	DBMS	MSSQL
Hardware	DB Server	Sqlserver 2000
	Server	Pentium(R) P.core2 Duo 1.6

U-Health monitoring system is implemented may be monitored determination result of each date and different situations, numeric data, and graphs. The numbers on the counter, if there is data to verify that the new data has been added to every minute database, the newly detected it is checked at every minute to be able to determine on the system. Further, it is possible to adjust the number of cases k pieces similar and to check the search results. Figure 10 is a result of the implementation monitoring system.

Figure 10. Result of Monitoring System Implementation

5. Performance Evaluation

In this paper, an experiment was conducted by placing the six radio sensors to measure the input data and the construction of case-based, to recognize the status of u-Health. To simulate a fire situation and dangerous situations biological to build a case base, were run as input data 3000 to the situation for each. Experimental results, it was subjected to 10-Fold cross validation in order to minimize the influence of the learning data, to ensure reliability. The experimental data are divided into verification data and case-based construction for data, I was used in a ratio of 7:3 respectively. As a numeric data type, attributes of each, impact on

the status of the fire situation and dangerous living body are similar, grant to '1 'in the same weight of attributes, the attributes of each data, create a case-based We have optimized the system as Leave-One-Out after. Table 2 (unit:%) is the result that accuracy of the case-by-case basis for verification data obtained in the experiment. Average accuracy of the fire case and biological risk case became each 86.6% and 83.9%.

Table 2. Performance Evaluation of Data

Fold NO	Biological Risk Case	Fire Case
1	85.1	86.3
2	82.7	85.6
3	84.3	81.2
4	84.1	78.9
5	90.5	83.1
6	92.3	81.5
7	87.8	88.2
8	89.1	86.2
9	86.5	85.7
10	83.9	83.1

We also performed experiments while adjusting the number of similarity classification k to build an optimal case-based reasoning system, Table 3 shows the experimental results mean accuracy of the number of k (%). The experimental results, when number of k is either very high or very low, it can be seen that the accuracy is relatively reduced.

Table 3. Accuracy by Number of k

Number of k	Biological Risk Case	Fire Case
1	84.9	81.3
3	85.1	85.4
5	87.8	86.3
7	88.2	87.9
9	83.8	81.1

Figure 11 shows the change in the accuracy of the number k, it can be seen that the highest accuracy when the k number is 7.

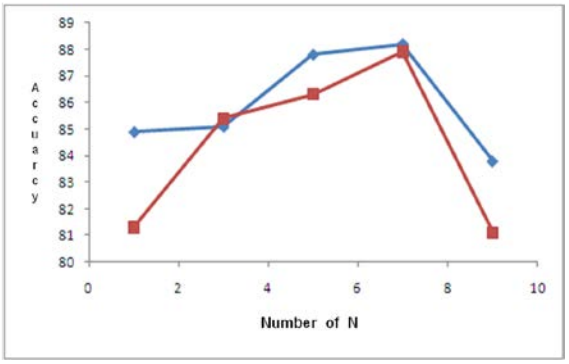

Figure 11. Accuracy Change by Number of k

As a result of having learned neural network in case-based reasoning technique, easy to implement compared to the situational awareness system of rule-based traditional exhibits high accuracy appears in this paper by and decision making support of u-Health system, it is possible to respond effectively to a dangerous situation.

6. Conclusion

A reality u-Health-related existing system has been built with an emphasis on pathological management of patients and improvement of the business of doctors and nurses of the hospital and it is simply to monitor, implementation of the system with the decision-making intelligent algorithm that takes into account the characteristics of the individual are required. In this paper, we designed a system that utilizes the method of case-based reasoning, to build knowledge base as a biological risk and the case of fire of u-Health system. In order to construct the case base, a result of performing to 10-Fold cross validation receives the data 3000 to the situation for each average precision for each case showed 82.5%, 80.1%. As a result of experiments were performed while adjusting the number of similarity classification k to build an optimal case-based reasoning system, it was found that the accuracy decreases if number of k is either very high or very low. By decision-making support according to user characteristics, is capable of respond effectively to dangerous situations, u-Health system of case base, may develop into a personal health care system throughout the experiment. In the future, it is intended to study how to be able to diagnose the location u-Health Systems high-risk patients, for various situations and many more.

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Authors

Mi-Rim Song
2006, Korea. Chosun Univ. Dep of Computer Science & Statistics, (Bachelor of Science)
2013-Currently, Korea. Chosun Univ. Dep of Computer Science & Statistics, (The master's course)
Significant area of Interest: Robot simulation, U-health System, Artificial Neural Networks System.

Jin-Young Moon
2007, Korea. Chosun Univ. Dep of Computer Science & Statistics, (Bachelor of Science)
2012-Currently, Korea. Chosun Univ. Dep of Computer Science & Statistics, (The master's course)
Significant area of Interest: Robot control, U-health System, Artificial Neural Networks System. Big-data Processing Technology.

Sang-Hyun Bae
1982, Korea. Chosun Univ. Dep of Electrical Engineering (Bachelor of Engineering)
1988, Japan. Tokyo Provincial College. Dep of Electricity and Information Engineering (Doctor of Engineering)
1984, Japan. Tokyo Provincial College Researcher.
1996, Japan Advanced Institute of Science and Technology. (visiting Professor)
2003, Univ. of Alberta. (visiting Professor)
1988-Currently, Korea. Chosun Univ. Dep of Computer Science & Statistics. (Professor)
2009-2011, National Research Foundation of Korea. (Non-executive Director)
2012-Currently, Korea Technology Commercialization Association. (president of Kwang-ju chapter)
Significant area of Interest : Digital Contents, Artificial Neural Networks, Big Scale Knowledge Base. U-health System