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A Study on Emergency Monitoring Robot System by Back-Propagation Algorithm

Sowol Yoo, Miae Kim, Kwangok Lee, and Sanghyun Bae†

Abstract

This study aims to implement the emergency monitoring robot system which predicts the current state of the patients without visiting the medical institutions by measuring the basic health status of the user's blood pressure, heartbeat, and basic health status of body temperature in the disaster emergency situation based on the Smart Grid. By arranging a large number of sensor(blood pressure, heartbeat, body temperature sensor) and measuring the bio signs, so the attached wireless XBee sensor can be stored in DB of robot, and it aims to draw the current state of the patients by analysis of stored bio data. Among 300 data obtained from the sensor, 1st data to 100th data were used for learning, and from 101st data to 300th data were used for assessment. 12 results were different among the total 300 assessment data, so it shows about 96% accuracy.

Key words: Smart Grid, u-Health, XBee, Back-Propagation Algorithm

1. Introduction

The new industry, u-Health as the available health management and medical service in anywhere and anyplace by connecting the traditional public health medical to Smart Grid was created. The u-Health is receiving attention with measure to advance the medical system by suppressing the increase of the medical expense following the increased interest about the entered the aging society, increase in chronic diseases, prevention[1].

The current medical service is depended on the test using the large equipment of a few large hospitals. These symptoms add the patients' economic burden, the medical diagnosis is the doctor or expert´s domain, so it takes a lot of times for the feedback process. But in the emergency situation like disaster, waiting for the doctor to check the patient's condition should be conducted promptly.

The emergency monitoring robot system applying the bio-technology to provide the rapid diagnosis and individual personalized diagnosis by analysis on the input the bio sensor in order to solve this problem is the essential core technology.

This study aims to implement the emergency monitoring robot system which predicts the current state of the patients without visiting the medical institutions by measuring the basic health status of the user's blood pressure, heartbeat, and basic health status of body temperature in the disaster emergency situation based on the Smart Grid. By arranging a large number of sensor (blood pressure, heartbeat, body temperature sensor) and measuring the bio signs, so the attached wireless XBee sensor can be stored in DB of robot, and it aims to draw the current state of the patients by analysis of stored bio data.

This study was configured as follows. In Chapter 2, the configuration and design of system was shown, Chapter 3 showed the assessment of implementation and performance, and Chapter 4 suggested the conclusion and future direction of research.

2. Configuration and Design of System

This study used the blood pressure, heartbeat, body temperature sensor for the measurement, and it was connected to the integrated module, and it was connected to PC as the XBee wireless communication, and the system to confirm the patient's condition by using

Department of Chemistry, Chosun University, Gwangju 501-759, Korea
†Corresponding author : hsohn@chosun.ac.kr
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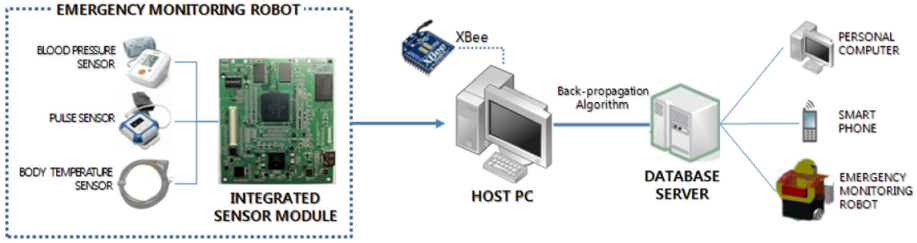

Fig. 1. System configuration.

the disaster emergency monitoring robot, PC, smartphone by storing the measured bio data in DB was configured.

Fig. 1 shows the whole configuration of the suggested system.

2.1. Bio Sensor Integrated Module

The biometrics-based disaster emergency monitoring robot system uses the each measurement sensor in order to secure the stream data (contraction period blood pressure, relaxation period blood pressure, heartbeat, body temperature).

The data which is used for the analysis is in the same environment, so it was transported by combining as one packet. If it is transported in each packet, the additional traffic and energy consumption may be occurred, so it was transported by combining as one packet for the energy efficiency after question process.

2.2. XBee Wireless Communication

For the XBee module, the XBee PRO DigiMesh Type which takes the broadcasting roles of other nodes with its value by forming network, and the communication configuration between XBee modules are configured as Fig. 2[2].

XBee Pro DigiMesh module provides two to three times transmission distance more than the existing ZigBee module. In addition, the wireless communication using ZigBee has difficulty to implement the Sleep Mode or Multi-Hop, but the multiple functions can be set easy through the firmware program which sets the XBee communication environment, and only the operating part of program should be design in software, so the system implementation is more easy[3].

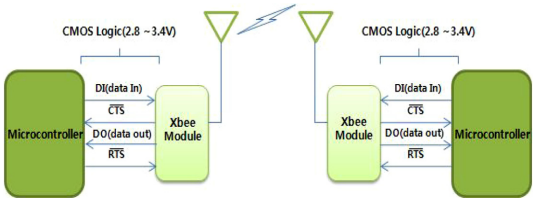

Fig. 2. XBee module communication configuration.

2.3. Back-Propagation Algorithm

The back-propagation algorithm can be classified with two stages largely, and the first stage is for calculating the error of the input value and output value, and the second stage forms the mapping relations between the input value and output value by adjusting the connection strength between the neurons using the delta rule for reducing the error. This adjusting the error by detecting during transmitting from the low layer to the top layer, and based on this, it adjusts its connection strength by back-propagation from the top layer(Goal value) to the low layer(input value)[4,5].

2.4. Decision Algorithm Using Back-Propagation Algorithm

Number of data for learning : N
Three i (1iN) learning data : I_i
I_{i1}: Number of blood pressure of contraction period
I_{i2}: Number of blood pressure of relaxation period
I_{i3}: heart rate
I_{i4}: body temperature

4 stage neural network configurations using given 4 input data is as follows.

① The number of node of input layer should be 4 which is number of each data item.

② The output layer is the degree of risk so it has 4 nodes. If the 1st node is selected by the learned weight through the input data, it is relevant to 1st stage good status showing the normal numerical value.

③ The number of node of hidden layer should be 1

or more. If the hidden layer counts increase, the time of learning will be increased, so it is important to set the affordable hidden layer count.

④ In the input data, it should be standardized by calculating the maximum value and minimum value.

3. Assessment of Implement and Performance

3.1. Robot System

Fig. 3 shows the Biometrics based disaster emergency monitoring robot which was suggested in this study.

3.2. Monitoring Control Module

The data measured by loading the module which can monitoring the initial body condition frequently on the robot can be transported to Internet, and it is the measurement module to output the information to the screen of robot or PC, cell phone. The primary care type module experiment includes the blood pressure, heartbeat, body temperature, and it was developed by the measurement basis. The Table 1 is based on the blood pressure, heartbeat, body temperature measurement, Fig. 4 is the screen to connect the wireless XBee communication to the control module.

Fig. 3. Biometrics-based Emergency Monitoring Robot System.

Table 1. Benchmarks measure

Blood pressure measurement	30 ~ 280mmHg, error range ±3 mmHg
Heartbeat measurement	70 cycles per minute
Body temperature measurement	10 degree ~ 40 degree, measurement unit 1.0 degree, measurement error ±0.2 degree based on the outside temperature

Fig. 4. XBee connected to the control module.

3.3. Bio-Monitoring System

The measured data(body temperature, blood pressure, heartbeat) can be stored in DB by the XBee wireless communication, and it can be confirmed instantly by the developed monitoring system. Fig. 5 shows the bio monitoring system screen.

The interface can be divided with the item for monitoring the numerical value data hourly and the graph item of the blood pressure of contraction period, blood pressure of relaxation period, heart rate, and body temperature change in the data classification results.

Following Fig. 6 shows the PC screen implementation results screen of the interface developed as HTML5.

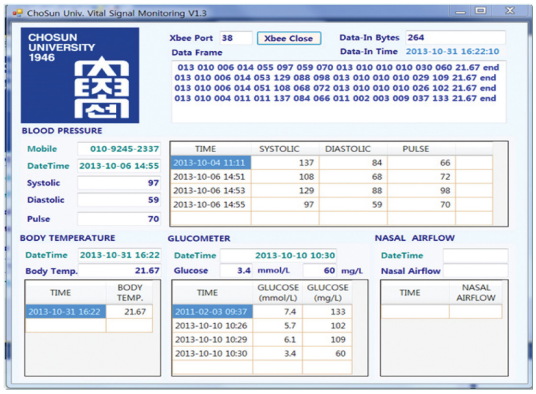

Fig. 5. Bio-monitoring system.

Fig. 6. Implementation of the results PC.

Fig. 7. Implementation of the results smartphone.

Fig. 8. Implementation of the results robot.

Following Fig. 7 shows the smartphone screen of the interface developed as HTML5.

Following Fig. 8 shows the robot screen of the interface developed as HTML5.

3.4. Performance Assessment of System

The 300 blood pressure of contraction period, blood pressure of relaxation period, heart rate, body temperature bio signs which were obtained from the sensor were used for the performance assessment of the system designed in this study. In addition, each data can be classified with four types of status of good, unsound, serious, emergency situation by the expert's diagnosis.

Among 300 data, from 1st data to 100th data were used for learning, and from 101st data to 300th data were used for assessment in the risk analysis. 100 data which were used for learning learned weight and input the 101st data to 300th data by standardizing it as value.

Table 2. The status of each user's bio signs

Physical condition		Blood pressure (mmHg)		Heart rate (times)	Body temperature (°)
		Contraction period	Relaxation period		
1	Good	100-130	60-80	60-90	35.8-38.0
2	Unsound	131-149	80-90	91-140	38.1-39.0
3	Serious	150-180	90-100	141-180	39.1-39.9
4	Emergency situation	Over 200	Over 100	Over 180	Over 40

Table 3. System monitoring results

No.	Blood pressure of contraction period (mmHg)	Blood pressure of relaxation period (mmHg)	Heart rate (times)	Body temperature (°)	Doctor's diagnosis results	System monitoring results
107	167	93	128	36.0	3(serious)	4(*)
145	122	79	80	36.8	2(unsound)	3(*)
151	133	89	89	35.9	1(good)	2(*)
156	161	93	110	34.9	3(serious)	4(*)
169	122	79	75	38.3	2(unsound)	3(*)
172	103	71	56	35.1	1(good)	2(*)
180	121	77	89	33.4	1(good)	2(*)
184	130	80	100	36.0	2(unsound)	3(*)
207	138	88	102	36.8	2(unsound)	3(*)
237	150	110	81	36.9	3(serious)	4(*)
245	121	79	78	36.6	1(good)	2(*)
262	121	77	81	37.5	1(good)	2(*)

4. Conclusion

As the health became a centric value of society, the personalized medical services such as the medical service specialization and diversification etc. are demanded, and the development of u-Health system is accelerated.

In the emergency situation like disaster, waiting for the doctor to check the patient's condition should be conducted promptly, so this study aims to implement the system to check the patient's condition through the emergency monitoring in real time through the immediate monitoring by transporting measured data as server by measuring the bio information (blood pressure, heartbeat, body temperature) in the bio sensor.

Among 300 data obtained from the sensor for assessment of the performance of the developed system, 4 types of bio signs such as the blood pressure of contraction period, blood pressure of relaxation period, heart rate, and body temperature were used. Among 300 data obtained from the sensor, 1st data to 100th data were used for learning, and from 101st data to 300th data were used for assessment. 12 results were different among the total 300 assessment data, so it shows about 96% accuracy. It may be cause of big problem, in other words, there was no lower case than the expert´s diagnosis results in the system.

In the future, the bio signs measurement sensor for the user cannot feel the discomfort in daily life and patients grasping location features, the home network system using wireless sensor implementation, the history tracking using statistical algorithm will be added, so it will bring more enhanced system.

Acknowledgment

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