

ADVANCED HEALTH CARE MONITORING SYSTEM USING NAÏVE BAYES CLASSIFIER

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ABSTRACT

At remote locations like in rural areas, mountain areas, it is biggest challenge to provide urgent health care and hospital service for needed one. Even it is well known that any patient after an operation or long medical treatment, usually go through the recovery or rehabilitation process where patient require to follow a strict routine prescribed by doctor or health care agencies. It needs nurse, doctor or healthcare to monitor these patients closely and it is really tedious for the patients who live at said remote places. In existing system, the solution for this remote patient health monitoring is available based on Wireless Sensor Network technology with use of multiple network hardware components. In existing system, to avoid use of individual health related parameters and requirement of extensive processing of these details to monitor patient health, new approach is explored here. In this paper, the proposed system is represented using novel approach for monitoring patient health at remote location which makes use of Naïve Bayes Classifier algorithm at central processing center to integrate all individual patient health related parameters. The performance of proposed system will be definitely effective in emergency condition based on results produced by Naïve Bayes Classifier approach.

INTRODUCTION

The healthcare system can be used in many fields such as medical, military, and commercial field .System can be extremely useful in providing accurate and reliable information on peoples'' activities and behavior and also for giving or providing treatment immediately .It provides the safety.

Introduction of health monitoring system

As shown in fig 1.1 the existed system has the different component. System consist of different part such as wearable sensors, cluster head, servers (local & remote) , WSN(Wireless Sensor Network) and database.

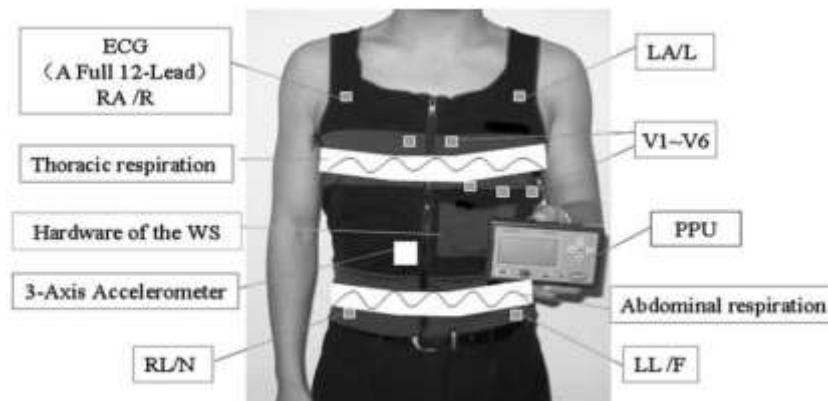


Fig.1.1 basic diagram of monitoring wearable sensors

In system wearable sensors are in the form of panic buttons in emergency case. It sense data continuously 24/7. Wearable sensors should be light in weight so it is comfortable to wear 24/7. In the medical field, it is possible to monitor patients or persons body temperature, heart rate, brain activity, muscle motions & other critical data [1]. It is important to have very light sensors that could be worn on the body to perform standard medical monitoring. It is possible to measure blood pressure using pulse transmit time [2] and volume oscillometric technique [1]. Skin temperature measured by using digital temperature sensor. The use of system has made it possible to have necessary treatment immediately or as soon as possible as compare to traditional treatment for heart attack persons & others serious disease persons. It is also possible to have the necessary treatment at home for patients after an attack of diseases such as heart attack, sleep apnea, Parkinson dieses. Patients after operations usually go through activities of the patients are possible to monitor by system [1].

In military field also we can use this system. By using this system we can identify situation of military man whether he is died or live .If it is live then identify its location & provide the service on his situation. Elder care- there is a need to perform unobtrusive monitoring of elder people at home or in nursing homes [3].

Patients after an operation usually go through the recovery/rehabilitation process where they follow a strict routine. It needs nurse, doctor or healthcare to monitor those persons. It helpful in rehabilitation process [4]

LITERATURE REVIEW

Current implementations were investigated in order to identify limitations and possible areas for improvement, specifically work done by V. Jones ET along the comparison between two types of health monitoring systems. The comparison was done in order to design a more generic open solution capable of enhanced flexibility and adaptive health monitoring in the future [2].

The European developed device known as the MobiHealth was designed with the intent to focus on remote monitoring and treatment services while the Australian developed device, the Personal Health Monitor (PHM) was primarily focused on local (on the device) personal health monitoring. As shown in fig 2.1.1 MobiHealth remote monitoring system works. Remote monitoring allows for a reduction in device processing costs, however, delay or waiting periods for data transmission could cause other complications for real time monitoring [2].

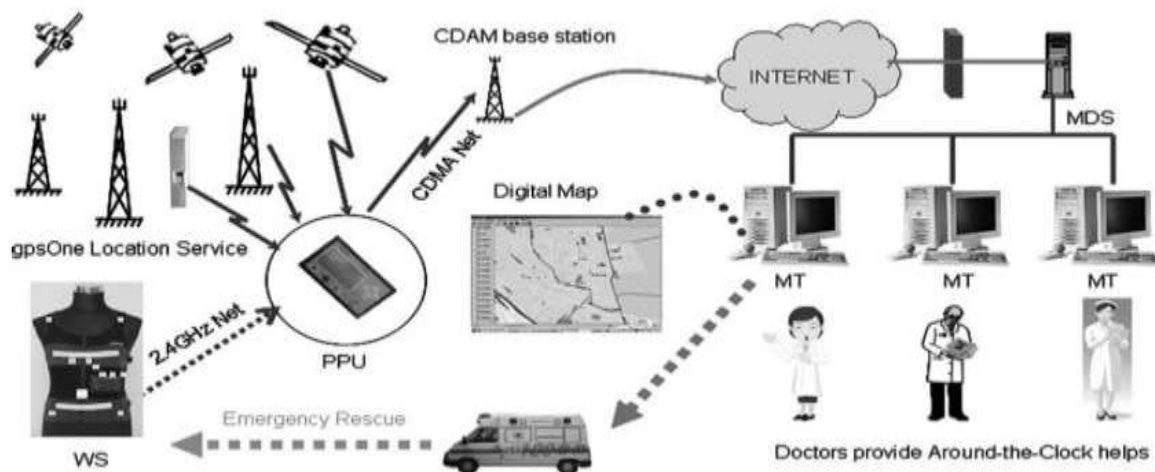


Fig 2.1 Overview of MobiHealth Monitoring System

Local monitoring systems which allow for real time monitoring are more complex and expensive, but still provide a doctor at a remote location with biofeedback. Each of the systems have their advantages depending on the chosen desired outcome, however, it is certain that in both cases it will allow mobility of patients as well as location independent monitoring. The proposed solution would thus be a device that is suitable for measuring and processing the measured vitals locally. Once this step is completed it sends the data wirelessly to a handheld device such as a PDA or Smartphone for monitoring, as well as allowing the data to be routed to a server through either the cellular network or a Wi-Fi network. The storage of data on a remote server will allow for trend analysis and data mining to hopefully improve medical feedback and the prediction/prevention of possible medical events. The handheld device will allow the patient to observe his/her current vital signs and warn the patient when a medical emergency is taking place [6]. Studies show that when a patient with a medical condition, in need of a lifestyle change is able to observe his/her vital signs, the device can aid and motivate a patient to achieve these lifestyle changes. Patients also tend to feel more relaxed when knowing the status of their own vitals. The device should be developed with the long-term focus on allowing patients who are discharged from hospital to be monitored remotely as well as to allow the monitoring of the elderly.

The measured medical parameters and medical record of a user are meant to be kept confidential. Since information will be transferred between wireless nodes and across the internet; certain steps should be taken to ensure that sensitive information remains secure. Wireless sensor nodes connected to the internet can be built on novel ideas such as the IoT (internet of Things) to transfer data from patients to a database.

The medical information stored on the database should have limited access, thus user authentication and some form of access control should be implemented to ensure that only the relevant parties have access to user medical records [1].

The data may or may not be completely processed at the sensing end but most of the data are stored, processed in the computer Fig. 2.2

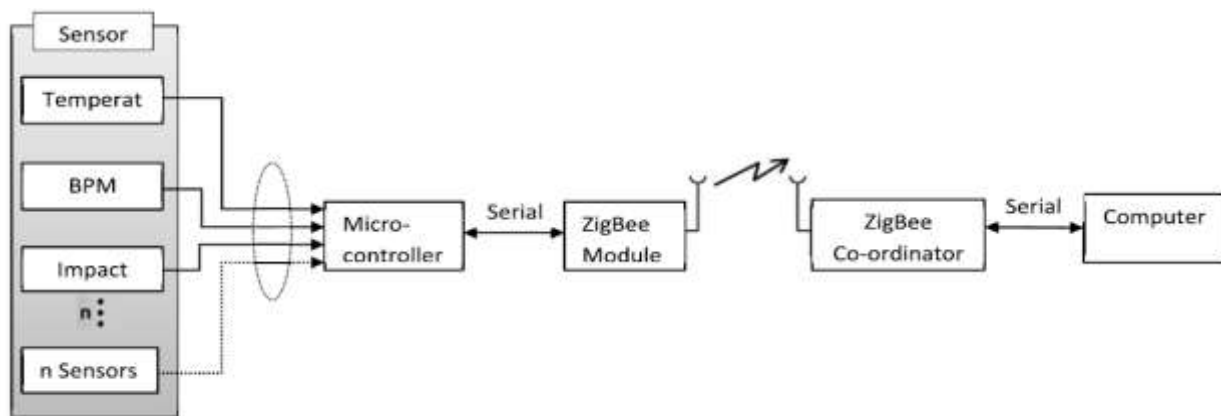


Fig 2.2 Block diagram representation of the human activity monitoring system

Picture of the developed wearable physiological parameters monitoring system and extensive display is possible either in a graphical format and/or as a numerical value. Depending on the complexity, the results may be available through an access of a website from a remote place. The block diagram representation of a developed physiological monitoring system is shown in figure 2.2. The monitoring system may consists of many sensors to measure physiological parameters such as body temperature, heart-rate etc.

PROPOSED SYSTEM

As shown in figure 3.3, proposed system consists of Human body with wearable sensors. Wearable sensors capture different body parameters and send it to central processing Centre. At Central Processing Centre; we are not going to predict human health condition by using individual parameter sensed by wearable sensors. In proposed system, we have introduced use of Naïve Bayes classifier [7] to predict human health condition. In Naïve Bayes [7] classifier, we are going to predict human health condition by using different parameters sensed by wearable sensors. The detail working of Naïve Bayes classifier is given below in selected algorithm for health prediction. Based on result of Naïve Bayes classifier, it predicts whether emergency service is required or not. If emergency service is required then it will forward patient data to Local Server. The Local Server will find nearby hospitals to that patient by using RFID and forward message to nearby hospitals for emergency services. If emergency service is not required then data will forwarded to central server and it will forward to concerned doctor for regular health monitoring.

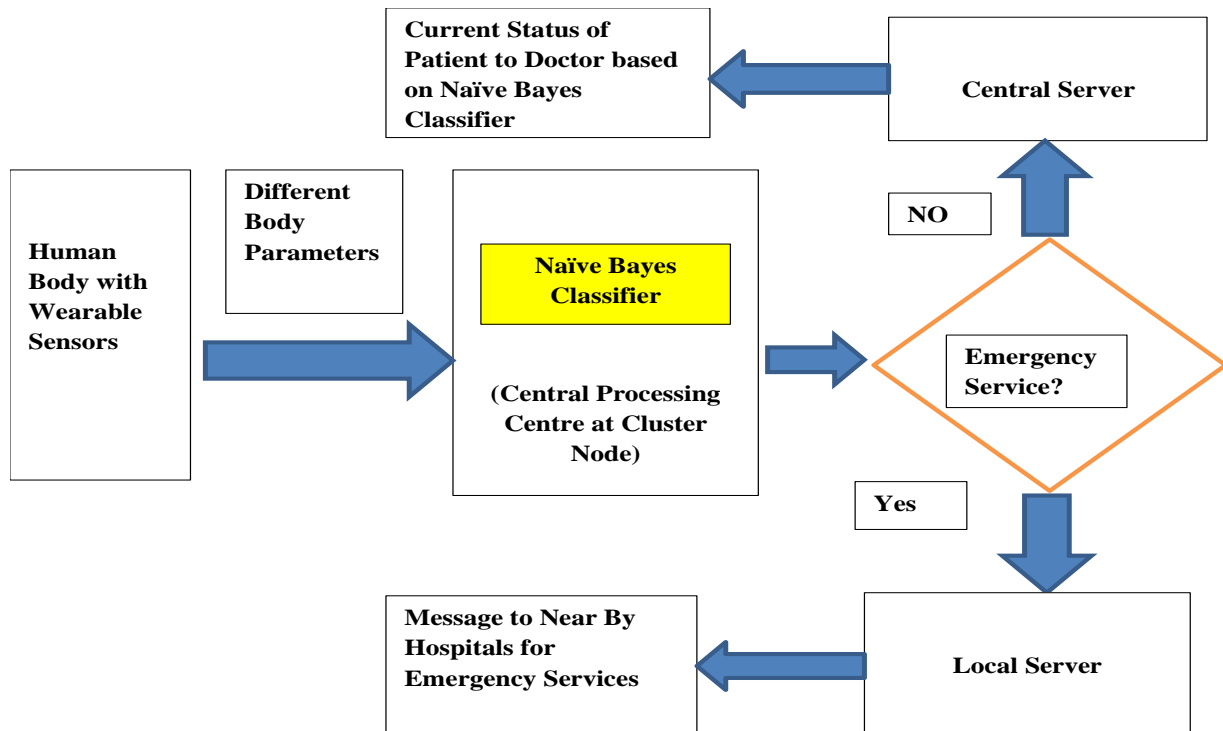


Figure 3.1 Proposed System Architecture

Selected Algorithm

The Naïve Bayes classifier [7] is used as follows:

The Bayes Naive classifier selects the most likely classification V_{nb} given the attribute values a_1, a_2, \dots, a_n . This results in:

$$V_{nb} = \operatorname{argmax}_{v_j \in V} P(v_j) \prod P(a_i | v_j)$$

We generally estimate $P(a_i | v_j)$ using m-estimates:

$$P(a_i | v_j) = \frac{n_c + mp}{n + m}$$

Where:

- n = the number of training patients for which $v = v_j$,
- n_c = number of patients for which $v = v_j$ and $a = a_i$,
- p = a priori estimate for $P(a_i | v_j)$,
- m = the equivalent sample size.

Steps:

- Step 1: Find value of n i.e. number of patients in existed database.
- Step 2: Find n_c i.e. number of patients probability is YES/NO
- Step 3: Find P
- Step 4: Find m i.e. number of disease parameter
- Step 5: Find N i.e. result of considered parameter
- Step 6: Calculate probability of different parameter such as blood pressure, body temperature, and heart rate (For Yes and No).



Step 7: Multiply all probability having emergency service (For Yes).

Step 8: Multiply all probability which not has emergency service (For No).

Step 9: If probability of provide emergency service is greater than provide service immediately else not need to provide service immediately

Case Study:

Following table 3.1.1 shows our trained dataset for Naïve Bayes classifier based on previous patient history.

Patients	Blood Pressure	Heart Rate	Body Temperature	Result
1	140	90	110	YES
2	80	75	80	NO
3	120	50	100	YES
4	90	80	70	NO
5	85	70	50	NO

Table 3.1.1 Training Dataset of patient

Now we want to decide situation when Blood Pressure is 140, Heart Rate is 75 and Body temperature is 50 which is not available into our trained dataset.

By using above Naïve Bayes classifier formula, now we will calculate probabilities, P(140|Yes), P(75|Yes), P(50|Yes) , P(140|No) , P(75|No), and P(50|No)

Yes: **No:**
140(BP): **140(BP):**
n = 1 n = 1
n_c = 1 n_c = 0
p = .2 p = .2
m = 2 m = 2

75(HR): **75(HR):**
n = 1 n = 1
n_c = 0 n_c = 1
p = .2 p = .2
m = 2 m = 2

50(BT): **50(BT):**
n = 1 n = 1
n_c = 0 n_c = 1
p = .2 p = .2
m = 2 m = 2

We are assuming no other information so, $p = 1 / (\text{number-of-attribute-values}) = 0.5$ for all of our attributes. Our m value is arbitrary, (We will use $m = 2$) but consistent for all attributes. Now we simply apply Naïve Bayes formula, using n , nc, p, and m.

$$P(140 | Y es) = (1 + 2 * 0.2) / (1+2) = 0.46$$

$$P(140 | No) = (0 + 2 * 0.2) / (1+2) = 0.13$$

$$P(75 | Y es) = (1 + 2 * 0.2) / (1+2) = 0.13$$

$$P(75 | No) = (1 + 2 * 0.2) / (1+2) = 0.46$$



$$P(50 | \text{Yes}) = (3 + 2 * 0.2) / (1+2) = 0.13$$

$$P(50 | \text{No}) = (1 + 2 * 0.2) / (1+2) = 0.46$$

We have $P(\text{Yes}) = 0.4$ and $P(\text{No}) = 0.6$, total probability of Yes will be calculated as follows,

$$P(\text{Yes}) * P(140 | \text{Yes}) * P(75 | \text{Yes}) * P(50 | \text{Yes})$$

$$= 0.4 * 0.46 * 0.13 * 0.13 = 0.003106$$

Same as total probability of No will be calculated as follows,

$$P(\text{No}) * P(140 | \text{No}) * P(75 | \text{No}) * P(50 | \text{No})$$

$$= 0.6 * 0.13 * 0.46 * 0.46 = 0.0165048$$

Since $0.0165048 > 0.003106$, our example gets classified as 'NO' emergency service.

Mathematical Model

Mathematical model represents overall system in terms of mathematical notation. Mathematical modeling is represented as in the terms of Set Theory.

Proposed system is represented as follows,

$$S = \{I, P, R, O\}$$

Where, S= represent the proposed system,

$$I = \{I1, I2, \dots, In\}$$

Where, I = inputs,

I1= input give as body temperature to wearable sensor.

I2= input give as heart rate to wearable sensor.

I3=input given as blood pressure to wearable sensor.

$$P = \{P1, P2, \dots, Pn\}$$

Where, P=Processes,

P1=check whether data send local server or remote server,

P2= local server send information to hospital or healthcare center,

P3=store data at database,

$$R = \{R1, R2, \dots, Rn\}$$

Where, R= rules,

R1= must collect data appropriate,

R2=send information reliable,

$$O = \{O1, O2, \dots, On\}$$

Where, O = output,

O1= required emergency service (Yes)

O2=. Not required emergency service (No).

Venn diagram:

Figure 3.2 shows veen diagram of proposed system.

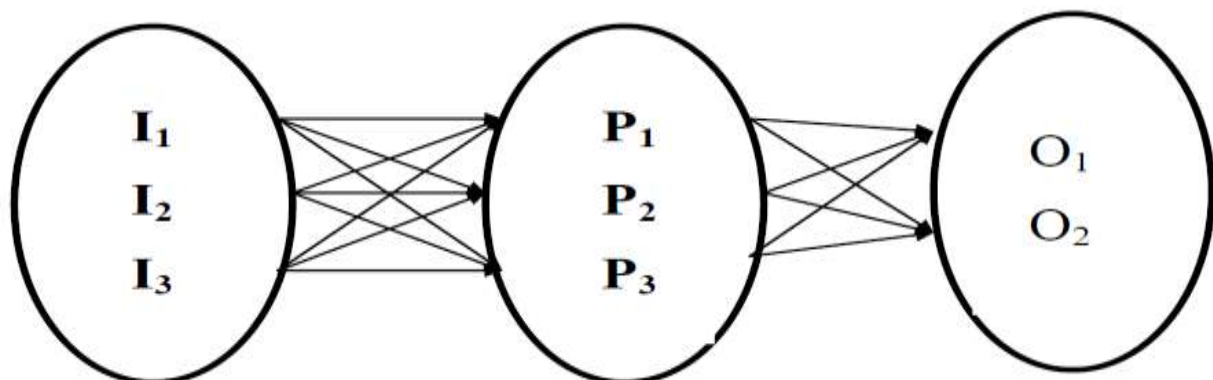


Figure 3.2 Venn diagram of Proposed System

CONCLUSION

Here proposed system monitor the human health activities by using wearable sensor. Here proposed system having less weight, high reliable sensor which monitors the human activity. Wearable sensors sense the different parameter from human body and send it either local server or remote server. Based on parameter it provides the service. Literature review is helpful for understanding existed system and to know already used algorithm. Based on naïve Bayes classifier it identifies the emergency data and normal data. System useful for providing treatment immediately. The proposed systems store all the measured data in database. The information in database can be helpful in future.

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