

A MORE SECURE AND RELIABLE PROTOCOL FOR WIRELESS PATIENT MONITORING SYSTEM

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Abstract

Hacking of Wireless network leading to insecure data is the main issue that needs to be attended. To achieve the goal of data security, there is need of the new protocol development especially for medical applications using wireless communication. The conventional system usually uses broadcast or multicast communication mode to increase the signal reliability; however, these modes lead to network traffic and signal transmission delay. The proposed system includes a reliable protocol which is based on anycast communication mode for wireless patient monitoring system and Rivest Cipher 4 (RC4) security algorithms to ensure data security. On the basis of a reliable scheme, the proposed work is to design and implement this novel system using ZigBee device for patient monitoring, which integrates fall detection, temperature, pulse rate monitoring. The result of reliable protocol implementation assures the communication without fail mechanism, minimizes network traffic and transmission delay.

Keywords—Anycast, Rivest Cipher 4, Reliable Protocol, Zigbee.

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1. INTRODUCTION

In today's world, medicine field has technologically updated to a large extent to provide the excellent medical services at less cost to the patients all over the world. But still there are many limitations in the existing automated medical services and systems. Main problem is security of data regarding personal and bio signal information. There is possibility of being abused and the personal information may be put to a bad use. Therefore, it will be necessary to apply security technology through which only the server and client point user can read data correctly in the monitoring system also There are many state of the art patient monitoring tools and sensors which give precious information about the patient's health, the communication between patient and doctor, are still in its primitive stages. Today in many hospitals the doctors have to go for physical rounds for checking the patient data which is highly uncomfortable for serious patients, besides the time consumption and inefficiency. There is need of a reliable and efficient wireless network topology in which the doctor can access the patient's data.

Therefore to satisfy limitations of existing system, in proposed system, implementation of security system with the help of RC4 and reliable protocol which contain co-operative communication introduced.

2. LITERATURE SURVEY

Currently, a number of research works is going on with the patient monitoring systems. Let us now briefly overview some research of patient monitoring systems.

In 2000 Istepanian and Petrosian presented an method for data compression, which helps to reach a maximum compression ratio for a mobile telecardiology model [1]. In 2002 Jovanov et al. presented wireless distributed system for data acquisition to acquire collected data from monitors and synchronizes recorded data with existing records [2]. In 2005 Varshney and Sneha presented protocols for power management with varying user densities, power levels, and multihop to support device diversity. Their system provides a reliable message delivery with reasonable transmitted power [3].

In 2006 Varshney et al. proposed a framework of patient monitoring systems, framework in this system uses communication modes as multicast, reliable multicast, broadcast, and reliable broadcast [4]. Cypher et al. studied previous work which is based on wireless communications of healthcare networks. The researcher considers the case of one-hop transmission method which results in an accumulated delay [5]. In 2007 Wan-Young Chung et al. presented a Cell Phone Based Health Monitoring System using Wireless Sensor Network Technology in which to monitor the patient's physiological signs from a wireless sensor they uses wireless CDMA-based platform for hospital environment but again network traffic increases which leads to degradation in the

transmission of data signal[6]. F. W. Chong et al. works on An Integrated Wrist-worn Routine Monitoring System using BSN in which monitoring of ECG, BP etc. taking place for that they uses WBAN technologies[7]. In 2009 Dusit Niyato et al. provided eHealth service, which is used to collect and transfer bio signal data from the patients to the eHealth service provider with the help of Wi-Fi technology which provides large transmission capacity in a small coverage area but it is not suitable for multi hopping [8]. Cheng Ding et al. presented Wireless Monitoring System for Patients using ZigBee but they do not consider scheme which automatically selects the closest data receiver [9]. In 2011 Liam Marnane et al. described Monitoring vital signs and location of patients by using ZigBee. They propose a WWBAN (Wearable Wireless Body Area Network) technology for patients. Again they do not consider anycast communication mode which is having advantages of nearest or best server selection, Service identification, improving system reliability [10]. In 2012 Shyr-Kuen Chen et al. presented reliable transmission protocol for patient monitoring system but, there is necessary to apply security technology through which only the server and client point user can read data correctly in the monitoring system [11].

It is summarized that previous work tends to use broadcast or multicast communication mode to achieve reliable message delivery in a multihop wireless network. However, the traffic network cost is also significantly increases. Therefore, proposed system combines anycast communication mode with a reliable signal transmission which improves transmission efficiency.

3. PROPOSED SYSTEM OVERVIEW

Wireless Patient monitoring system consists of two modules viz. security algorithm and reliable protocol. Security algorithm uses RC 4. Reliable protocol uses co-operative communication which is based on anycast communication mode all the real time health information for multiple patients efficiently displayed so healthcare personnel could handle multiple patients at the same time. Also it contains patient units with ZigBee device. Fig.1. shows network connection between master and patient units which indicate wireless communication via Zigbee takes place. Also it shows communication between patient units when anyone is not in the range of master so they cooperate to each other with the help of reliable protocol.

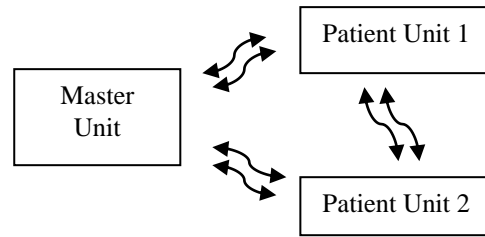
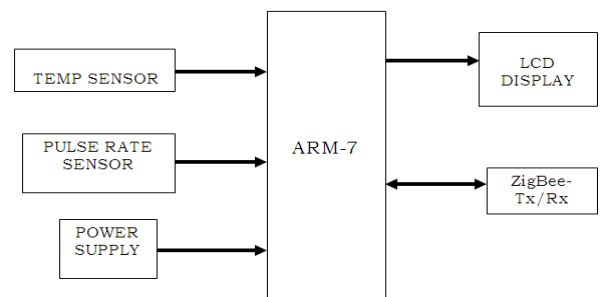
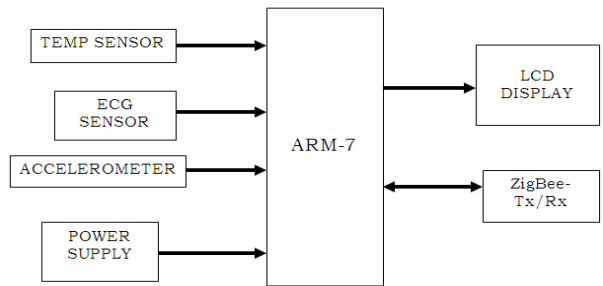


Fig.1 Network connection between Master and patient units.

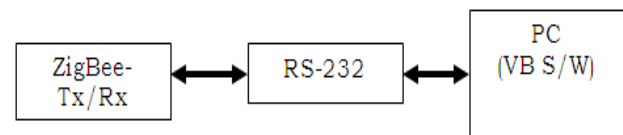
Fig.2. shows block diagram of patient monitoring system. System consists of Zigbee network, sensors, server and patient unit combination. The temperature, pulse rate sensors are connected to one unit and ECG, temperature and accelerometer sensor are connected to another unit. Each unit consists of sensors, ZigBee Transceiver, ARM 7 and LCD.



(a) Patient Unit 1



(b) Patient Unit 2



(c) Master Unit

Fig.2. Block Diagram of Patient Monitoring System

A main Server displays patient data and also monitors the status of all the patients which covers the whole area.

3.1 Security System

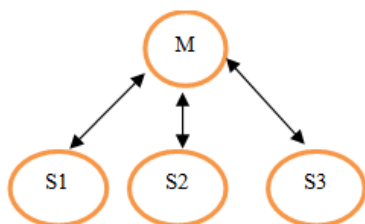
A Patient monitoring system monitors biomedical information; this information is being transmitted through remote healthcare server through wireless network this information can be relatively easy to be accessed due to the wireless communication. This is susceptible to hacking. Therefore, it will be necessary to apply security through which only the server and end user can read data correctly in the system. In the monitoring system uses RC4 which generates pseudorandom bits, stream cipher symmetric key. RC4 uses two array state and key. State table having size of 256 byte and capability of using keys between 1 and 2048 bits. Security algorithm contains two phases viz. Key setup and Ciphering. Ciphering process comprises swapping of state and Xoring method. Overall security algorithms contain Key scheduling algorithm (KSA) and pseudo-random generation algorithm (PRGA).

3.2 Co-operative Communication Protocol

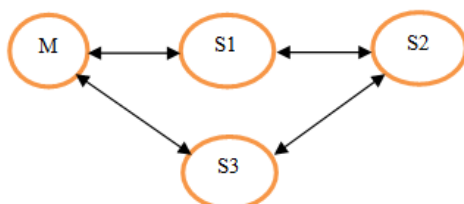
Cooperative communication protocol consists of master (Server) and Patient units (slaves) communication. This concept gives the idea about shortest path selection which also shorten the delay for the system communication and two or more patient units transfer the vital information of the patient with the help of cooperative mechanism therefore system work without fail type of mechanism.

4. DESIGN OF PROPOSED SYSTEM

In the design process of patient unit (slave) and master unit communication with Zigbee which follows reliable protocol display flow chart for cooperative communication in Fig.4.



(a) Direct Communications



(b) Cooperative communication

Fig 3 Communications between master and slave

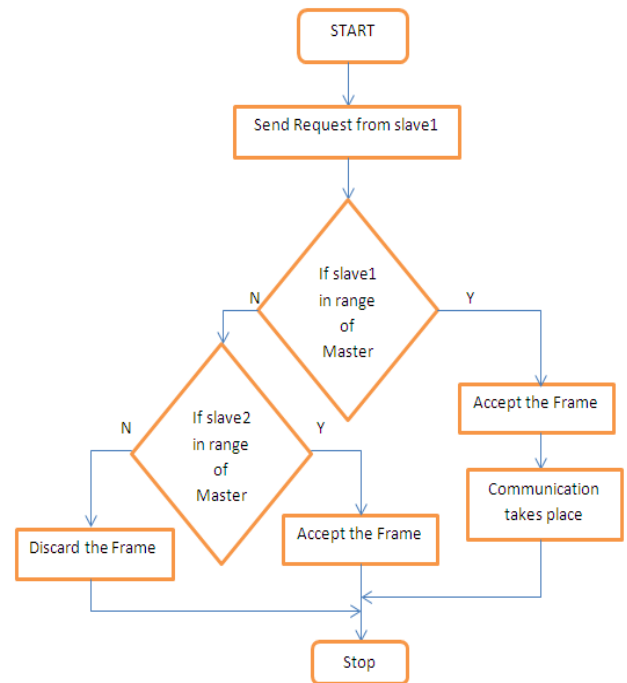


Fig 4 Flow chart for cooperative communication

Case 1: As shown in Fig. 3. If master is placed in the range of patient unit 1 (S1), patient unit 2 (S2) and patient unit 3 (S3) then direct communications takes place.

Case 2: If master is placed in the range of patient unit 1 (S1) but not in the range of Patient unit 2 (S2), S1 and S2 both are within the range of frame. In that case communication will take place with the help of S1 because S1 cooperate to S2 then data of S2 transfer via S1 to the master unit. Same case is for the S3. All this communication follows anycast communication mode.

4.1 Algorithm for the Cooperative Communication Protocol

- Slave 1 sends the request to master
- Slave 1 ID check whether it is in the range of master
- If Slave 1 ID matches with master ID then it accept the frame ID and Direct communication takes place between master and slave1.
- If Slave 1 ID not match with master ID then it will check for Slave 2 ID with Master ID if both are matches then it accept the frame ID and cooperative communication takes place between slave 2 and master via slave1.
- If both slaves ID not matches then discard the frame.

4.2 Hardware Requirements

ARM7 TDMI , Pulse rate sensor , ECG ,Body Temperature sensors, accelerometer.

4.3 Software Requirements

Programming Tool: Visual Basic 6.0 and Keil3 compiler,
Operating System: Windows NT 4.0/2000/XP.

5. RESULTS AND DISCUSSIONS

Patient monitoring system for Doctor (Master) and Patient (Slave) communication is display the result presented below in Fig. 5. This shows patient monitoring system with

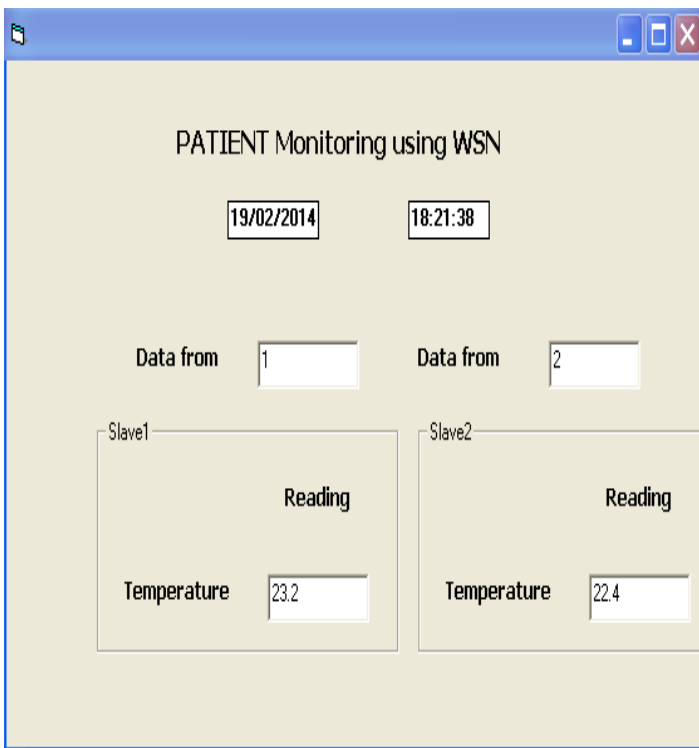


Fig 5 Patient Monitoring System with Direct communication protocol

Direct communication therefore it represent master and both slaves in the range. Fig. 6. Displays the result for cooperative communication in which slave 2 is not in the range of master but slave 1 within the range of master so as to communicate with each other. Therefore data of slave 2 is being transmitted via Zigbee to slave 1 in that way slave 1 cooperates to slave 2 and successfully data of anyone slave is received to master who's not in the range of it.

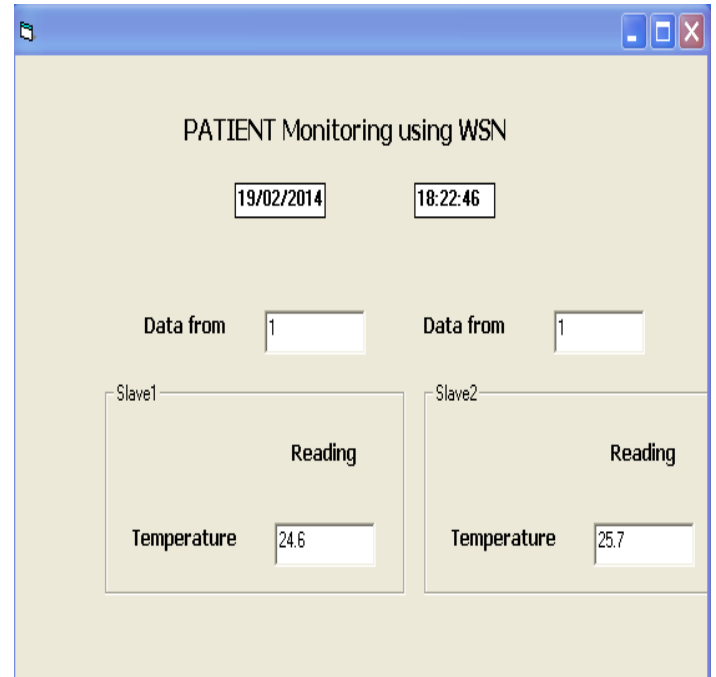


Fig 6 Patient Monitoring System with Cooperative communication protocol

6. CONCLUSIONS

It has been observed from the result that reliable protocol used in the proposed system uses shortest path which also represents nearest neighbor protocol scheme based on anycast communication mode. Therefore, reliability of system increases for patient monitoring system application which minimizes the delay and system works without fail mechanism. Implementation of security algorithm is in progress which secures the biomedical information for military medical services. Still there is scope of making the system more reliable for patient monitoring system application in the urgency level.

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