Healthcare security monitoring schemes for detection of node replication attack in wireless sensor networks

Abstract

Due to the increased growth of elderly people in recent years, healthcare systems face many challenges on the money spent for those people. Both quality and affordability has to be provided by the new technology which is the today's need. When applying WSN technologies, the advantages such as continuous monitoring with alert mechanisms and relative information are to be satisfied. Among the other challenges, due to the deployed environment, security is a key challenge. As gateway connects to the wireless networks, it is the target area for many adversaries to launch various attacks. Initially, attacker launches node compromise attack which leads to node replication attack. The introduced security methods for intelligent healthcare monitoring system effectively detect replication attack and provide protection to the system. The potential application of proposed methods namely Exponential Moving Average based Replica Detection (EMABRD), Secured Ant Colony Optimization (SACOP) and Fingerprint based Zero-Knowledge Authentication (FZKA) is applied to a real time environment. While comparing three algorithms, SACOP has a higher detection probability of malicious nodes at the expense of increased storage and communication overheads over EMABRD and FZKA.

Merits of Healthcare Monitoring System

The following are the merits of the Healthcare Monitoring System applied as static WSN.

- Monitoring remotely
- Identification in real-time and its actions
- Identification based on context

The static WSN are used in various healthcare applications due to above-mentioned advantages.

It include,

- Day-to-day activity monitoring
- Fall and movement detection
- Location tracking
- Medication intake monitoring

To detect acceleration and position of the body relative to freefall in three axes, a device named Accelerometer built based on MEMS technology is used. In order to measure orientation and speed, single and multi-axes devices are used.

Gyroscope
A type of sensor which measure or maintain the orientation is gyroscope. This rotor sensor work on the principle of conservation of angular momentum. For operating with various gyroscopes such as MEMS, optic fiber, solid state ring lasers and the extremely sensitive quantum gyroscope, other principles also exist. Also, to maintain direction in tunnel mining, gyroscopes are used.

Electrocardiogram (ECG)
While heart contracts, Electrocardiogram receive and record the electrical stimulation. The appearance of an electrical and mechanical activity is determined by electrical stimulation of a muscle cell. signal, Heart Rate (HR), Respiration Rate (RR) and Heart Rate Variability (HRV) are measured using this sensor.

Pulse oximeter
A medical device which is used for monitoring the oxygen saturation of a patient's blood by absorbing the infrared light at the measuring site is called pulse oximeter.

Blood pressure
The principal vital sign in the body is known through the measurement of blood pressure in the arteries. It increases and decreases more rapidly along the arterioles and small arteries and when the blood moves through the capillaries and back to the heart through veins respectively.

Photoplethysmogram (PPG)
To determine the arterial oxygen saturation (SpO2) level, PPG signal is used. By measuring and controlling the intensity of transmitted light at two wavelengths, SpO2 is calibrated from the PPG signal. PPG can also determine respiration rate, pulse and heart rates.

Galvanic Skin Response (GSR)
Change in skin conductivity due to sweating is detected by GSR. It is used for the assessment of an individual's health condition.

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Introduction

Recent advances in the technologies of WSN have gained attention towards various fields like healthcare, entertainment, industry, retail and travel and emergency management in order to improve the quality of life [1], [2]. During recent years, healthcare monitoring system has been paid more attention because of tremendous growth in technology in spite of its security challenge. The performance of WSNs is affected by challenges, potential threats and vulnerabilities of healthcare monitoring system.

Due to the increased growth of elderly people in recent years, healthcare systems face many challenges on the money spent for those people. Both quality and affordability have to be provided by the new technology which is the today's need [3]. When applying WSN technologies, the advantages such as continuous monitoring with alert mechanisms and relative information are to be satisfied. In terms of quality and cost, WSN is one among the possible technologies providing a viable solution.

Challenges and threats in healthcare monitoring system

Architecture and components of healthcare monitoring system
Consider a healthcare monitoring environment consisting of a central Body Area Network (BAN) through which different types of sensors inserted in the body senses and transmits data to the home gateway. Likewise, many central BANs are connected together to send the details sensed by different sensors inserted in the body to the doctor as shown in fig.