ENERGY EFFICIENCY ACQUIRED USING STRESS DETECTION ALGORITHM WSN

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ABSTRACT

With recent technological growth in the field of Wireless Sensor Network (WSN), its subset, Wireless Body Area Network (WBAN) has emerged tremendously and transformed the paradigm of medical sector by offering simple, more affordable healthcare services and swapping out pricey wired technology with sophisticated wireless alternatives. WBAN uses tiny sensor nodes that may be positioned inside, outside, or on a patient's body to monitor a variety of health metrics. These sensor nodes are powered by small sized batteries. Small size results in hardware constrains which further limits the lifetime of sensors. Usually, recharging or replacing battery is not feasible due to different deployment and execution scenarios. Therefore, energy efficiency which is capable of extending lifetime of sensor nodes and network becomes one of the major concerns for WBANs. Along with energy efficiency, reliability is also a challenging issue for WBANs as any nonreliable information about the health of the subject can mislead further diagnosis or treatment. For an effective WBAN, energy usage and dependability are therefore important considerations. The possibility for significant improvement of the administration and management of health care. WBANs comprise a variety of biological sensors that are heterogeneous. The sensors are positioned within the body in various places and are wearable, or placed beneath the skin of the person. Each has distinct specifications and are used to perform diverse purposes. The devices are employed to monitor the changes that occur in patients' vital indicators and also for determining emotions or states of human beings like stress, fear or happiness. They are connected to a specific coordinator node that tends to be less constrained in energy and also has greater processing capacities.

1. INTRODUCTION

The notion of the Wireless Sensor Network (WSN) has arisen as a key subject for research during the past decades as a result of blossoming growth in the field of wireless communication and networking. Agricultural field monitoring, health monitoring, environmental monitoring, smart home monitoring, and defense monitoring are just a few of the applications for WSN[1]. WSN's primary function is to collect data from the surrounding environment and send it for further processing. WSN has a large number of tiny sensor nodes to do this task, each having limited network bandwidth, energy and transmission power, energy resources, and compute power. The WBAN approach was established by taking into account the notion of WSN for monitoring the health of immobile elderly individuals patients[2]. The traditional medical care system is currently beset by a slew of concerns and obstacles as a result of the large expansion of the elderly population. In most nations, elderly people do not live with their children and are instead placed under the care of a care facility[3].

The advancements in wireless technology that use low power intelligent integrated circuits, smart wireless technologies and small-sized sensors at a low cost have led to the development of a brand new which can continuously monitor vital physiological signals that track human body's activities. WBANs are a viable option to ease social and financial obligations to satisfy the growing demands in real-time, continuous healthcare and fitness monitoring. They are affordable and easy to use. capabilities of WBANs will significantly enhance the efficacy of healthcare. In addition to healthcare they can also support numerous intriguing and exciting applications, like entertainment, sports military-related applications[4].

The recent developments in the field of semiconductor devices and wireless communication technologies have empowered the Wireless Body Area Network (WBAN), a promising platform for medical and nonmedical applications. With the advanced small-sized and low-powered bio-sensors, WBAN has found to be suitable for smart health care systems. Health care systems are the most challenging applications of WBANs. WBAN consists of a number of small invasive or non-invasive body sensors implanted on the human body based on the type of application[5].

Expanding utilization of remote networks and consistent scaling down of electrical gadgets has enabled the advancement of Fog based Wireless Body Area Networks (Fog - WBANs). The sensors of a Fog-WBAN measure the heartbeat, the internal heat level or record a drawn-out electrocardiogram. The use of fog based WBAN ensures an increase in actual portability of the patient, and they are not required to remain in the medical clinic. With fog based WBANs worn on the body and no need to relocate private information, security is also expected to monitor their state. This works on the nature of patient consideration and the effectiveness of medical clinic abilities. WBANs have acquired a ton of examination consideration lately since they offer huge advantages for distant wellbeing checking and persistent, ongoing patient consideration[6].

2. Litreature Survey

The researchers study the connection between frequency of the signal and the individual's physical attributes. The study is conducted on 2360 MHz. This is the medical band that is currently is undergoing FCC approval. Our findings show that path loss of women is lower than in men, and the degree of fading is generally more prominent in males than females. The results also reveal that voluntary breathing and movements cause minor-scale loss of color that is linked to that of the Rice distribution[7].

The authors employ an opportunistic scheduler to enhance the effectiveness of the wireless body model. The model used previously was not particularly focused on the wireless body size. The algorithm chooses the most efficient method to send the data. Thus, the rate of data transmission is reached at the highest. This increases the speed reduces transmission time .It yields positive outcomes when applying the algorithm to wireless body-area networks through the addition of simulation into the setup setup. The result is superior to the previous study result. The algorithm could also be applied to other areas of wireless communications[8].

The authors have the concept of implementing the cognitive radio (CR) technology. This is which is a exciting technology from new wireless research. the body area network. This system will be discussed and a the demonstration of how it can improve the performance of the WBAN systems will be demonstrated by way of simulation. Comparing the performance of the CR technology built on a specific WBAN protocol indicates that it can be a significant factor in the advancement in the performance of BAN system[9].

The harm that could be done to emergency personnel or equipment may lead to communication link issues and loss of sensitive information and other security threats that can cause a variety of critical problems, including the inability to access data, delays in information external and internal attacks. Safety of emergency personnel their equipment for communications is crucial to ensure the service is fully functional. The author proposes an architecture based on sensors in the body to safeguard the assets (emergency staff, the equipment information in the system) from attacks and damage to take the appropriate steps to minimize risk[10].

Author suggested an integrated security framework using biometrics for wireless body-area networks, that takes advantage of the biometric capabilities shared by sensors on the body that are located at different places on the body of an individual. The data communication between the sensors is secured by the authentication scheme and select encryption methods that require minimal computational power and fewer resources (e.g. batteries, a battery, and bandwidth). In particular, employed by taking into account the non-Gaussian characteristics of ECG signals to ensure that the authentication is accurate. Furthermore, biometric data, including ECG parameters are used as the biometric keys for security of the framework. Our experiments have demonstrated that this approach is able to provide more precise authentication without the additional requirements of keys or strict time sync[11].

Body Area Networks (BANs) have only just recently becoming a major factor in e-healthcare, providing monitoring of different patients easy and accessible to both patients and physicians. The research conducted in the past on BANs has concentrated on the design of biosensors in signal processing, the efficiency of power, wireless protocols. Yet, several challenges hinder the process of development and application until today. One of them is reliability, which is the combination of security, reliability and accessibility - both from an extra-BAN and intra-BAN communications viewpoint. By using a broad, divided systems model (intra-BAN extraBAN) and identifying potential points of failure. This paper outlines and categorizes the various schemes and issues suggested to enhance the dependability. In addition, the upcoming issues and the new direction of research that will improve the reliability of BANs are discussed[12].

3 Methodology

Stress is how the body responds to different demands caused by psychological and physical circumstances. It is almost a term that has been used by all of us at some point in time. The prospect of human beings can be prognosticated by careful tracking and identification of stress. MarounKousaffi et al., describes Wireless Body Sensor Network(WBSN) can monitor stress, and nodes that can transmit through radio wave signals. The signals from human beings were used to assess the levels of stress on which different views have been voiced. Neural Network (NN) is the method that requires to be guided to find the tenacity of stress in the input. Another issue faced is uninterrupted data transmission that leads to energy consumption in WBSNs and thus leads to curtailing of the lifespan of sensors. Therefore, a system has to be suggested for Data transmission.

Here, analyze and affirm the dissimilarities in the primary WSN and the WBASN. The outstanding dissimilarity in WBASN sensors are minimal than those of tradition WSNs comparatively. The sensor is fitted with reduced energy source because of which WBASN atmosphere may previously have discussed effectual energy routing protocols. The nodes develop clusters when a sensor network is put to work and chooses a cluster as cluster head from each node. These cluster head nodes are accountable for data reception from rest of the nodes in a cluster, they collect or combine obtained data and send it to data base. The three-level multifariousness readings for the standard, advanced, and super nodes' energy are, E0, ,,EAdv and ESuper according to. Nodes that have a population percentage are considered to be advanced nodes. They have all n nodes. These are equipped with a factor of energy higher than m times normal value. Super nodes are composed of a factor that increases energy as m0, that has percentage population factor ,,a0 in relation to the total number of nodes.

The clustering of several profile nodes is projecting the structure topology as multiple clusters. Transmission of each node varies in each cluster. Virtual network of similar type is developed which institutes transmission of event data updating. Here, nodes containing better node degree and minimal distance are chosen to be CH. But this CH could be in the proximity generating unwanted energy profligacy leading to severe instability and declination in lifespan. The most innovative strategy for the energy efficient hybrid routing protocol that is driven by events to disperse massive traffic evenly in the clustered networks by offering a cluster of different sizes setting. A superior node degree is rendered by the adopted CH that leads to a finer coherent energy.

In comparison to an average size cluster in the mid of a network the cluster close to the sink is generally smaller in size. The existing energy on the routing path forms the basis for the choosing of the CH and hence on a given path, the node that has a greater energy is chosen for the function of CH. This strategy boosts the capacity of energy increasing the lifetime but it cannot guarantee for the chosen node in the network site. The scheme of multi-hop communication is to be observed for transfer of information. The CH selection is made by analyzing the residual energy and mass of nodes the distance between sink and node. The most possible node for CH for additional activity of the network can be evaluated by fuzzy logic. For the most probable node selection 27 different combinations have been calculated and yet again there are increased control heads for network managements and increased energy consumption for CH evaluation. The possibility function value varies in every repetition and forces overload on network energy.

Algorithm - LRNN MODEL

Step 1: Load input data and target/output data;
Step 2: Define the LRNN architecture;
Step 3: Define the range for number of neurons in HL, feedback delay;
Step 4: Define Size of the input;
Step 5: Define the number of epochs;
Step 6: Set training algorithm = { LM, SCG , BR }
Step 7: Set Activation function= { tansig, purlin, logsig, radbasn, elliotsig }
Step 8: Initialize the LRNN topology;
Step 9: Train the LRNN model;
Step 10: Simulate the LRNN model for prediction;
Step 11: Calculate Error = target response – predicted response;
Step 12: Calculate the root mean square error (RMSE) and MSE;

Detecting missing values

Suppose whenever Sensor Nodes (SN) sends captured data to the Base Station (BS), the SN must wait until an acknowledgment is received from BS. If the SN does not receive an acknowledgment, it will keep on transmitting the captured data to BS with timestamp value. This scheme confirms that both the BS and the SN consumed more energy for their communication concurrently. Also, the assigned serial number (seq_no) is sent to BS for each sensor data. If BS detects missing in seqno, it flags missing sensor data alert, allowing the algorithm to recreate them using the LRNN based prediction model. At the beginning of each slot, an SN must send the actual perceived data value to BS. If BS does not receive any data, it will consider that the SN has died or crashed, and it stored "NAN" value in the memory to denote missed value.

Algorithm : Detection of missing sensor data

Procedure:
1. START
2. Initialize (seqno,= 1)
3. BS will perform the following:
4. If BS received xt with a sequence number (seqno) then Send an acknowledgement (ack)
    Else
        Xt = " NAN"
    End if
5. If (Seqno is missing) then
    xt = " NAN"
    End If

End

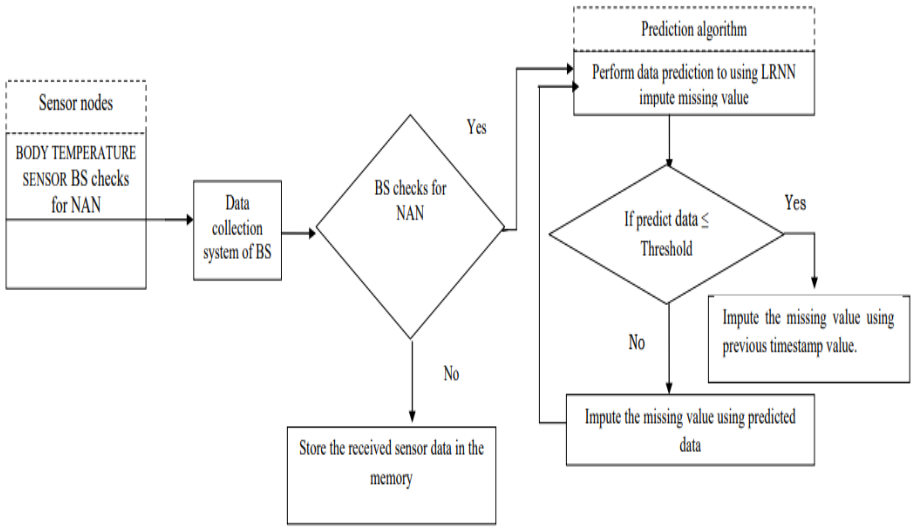

Fig 1: Data transmission reduction model using LRNN.

4 Results and performance evaluation

Computational Setup for the Proposed Work
• Experimentation platform: i7-CPU running 64-bits OS of MS Windows 10
• Simulation and Computational Software: MATLAB Toolbox 2019b.
• Initial run: Default parameters values for WSN design and development and customized network parameters' value are given in Table 1

Table 1: Parameters of the network

Parameter	Symbols	Value
BSInitial energy	EO	300 J
SNInitial energy	Es	100J

Acceptable Predictionerror	e	0.5
Numberofsensornode	N	2
Networkfieldlength	L	500m
Controldatapacket	-	2bytes
SensorDatapacket	-	10bytes
Transmissionenergy	ETX	150
Receivedenergy	ERX	50

Table 2: Pulse rate sensor utilizing LRNN Tansig-WBAN Model saves energy

No.ofTransaction	No.ofMissedTransaction	EnergySavedforBase Station	EnergysavedforSensorNode	TotalEnergySaved
T1	3	9.96	16.47	26.76
T2	5	26.56	78.30	43.89
T3	7	49.90	113.34	69.70
T4	10	83.90	167.89	87.38
T5	12	123.54	226.87	108.90

The S-WBAN and LRNN-Tansig-WBAN models' performance in relation to the base station's energy savings during communication with the pulse rate sensor node is shown in Table 2. BS has discovered three missing transactions for the T1 transactions' pulse rate sensor. The sensor node receives the request from the standard WBAN model in order to retrieve these lost pulse rate sensor readings, using a total energy consumption of 25.32 micro joules. The prediction-based WBAN model, which used 9.96 microjoules of energy to estimate these values by BS, predicts these missing sensor values using LRNNTansig-WBAN prediction models without seeking data from the pulse rate sensor node.

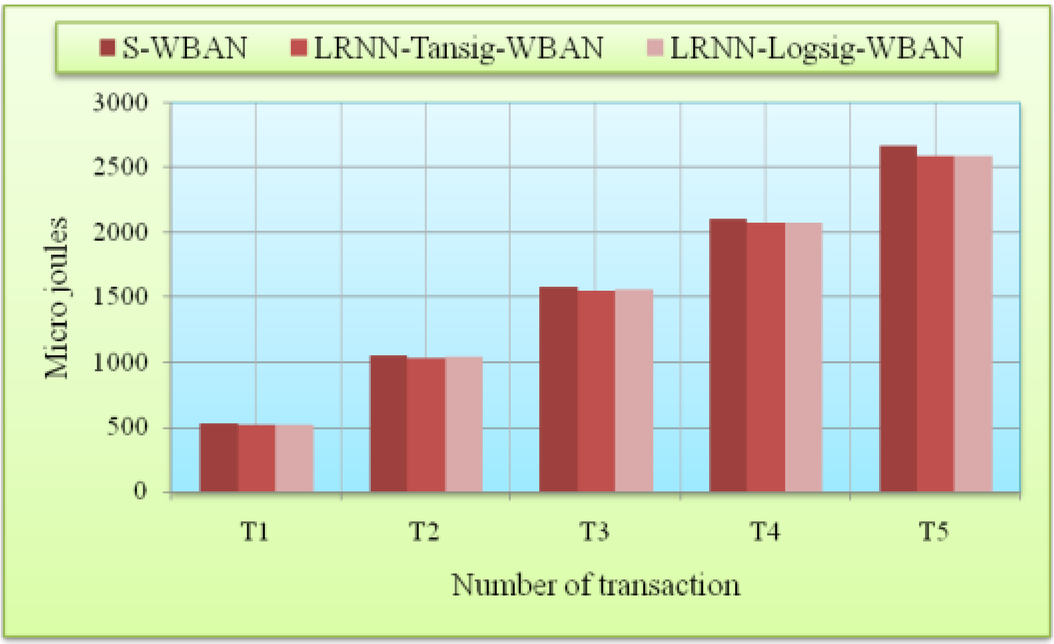

Fig 2: Comparison of all pulse rate sensor types' total energy usage.

The comparison of the pulse rate sensor's overall energy usage utilizing the S-WBAN, LRNN-Tansig-WBAN, and LRNNLogsig-WBAN models is shown in Figure 2. Given that the LRNN-Tansig-WBAN model used less energy for these transactions than the S-WBAN and LRNN-Logsig-WBAN models, it is evident that the model worked well for all of the transactions, including T1, T2, T3, T4, and T5.

5 CONCLUSIONS:

In the perspective of a WBAN, an energy-saving approach for WBAN based on the LRNN prediction model has been developed. The suggested LRNN-based WBAN provides an efficient method for transmitting data using less energy. In contrast to standard WBAN, this technique was developed specifically for WBAN by taking into consideration their unique properties. A WBAN based on LRNN prediction" for data transmission is tested on simulated datasets proved to be successful and broadly applicable. The main limitation of the model proposed in this chapter is that the prediction model will be updated each time to calculate the missing values. This will take some time. To overcome this problem, a data transmission approach will be proposed in the next chapter using two different inputs, such as past sensor values and values of interrelated sensors, for better predictive accuracy without frequent prediction model updating.

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