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REAL TIME WIRELESS SENSOR NETWORKS

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I. INTRODUCTION

Wireless sensor networks (WSN) are composed of a finite set of sensor devices geographically distributed in a given indoor or outdoor environment. Each node in a sensor network is typically equipped with a radio transceiver or other wireless communications device, a small microcontroller, and an energy source, usually a battery. The cost of sensor nodes is similarly variable, ranging from hundreds of dollars to a few pennies, depending on the size of the sensor network and the complexity required of individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and bandwidth [1].

Development of wireless sensor networks was motivated by military applications such as battlefield surveillance and now currently used in many industrial and civilian application areas. Real-time applications of wireless sensor network deployment in a practical scenario such as the real-time intelligent monitoring of temperature, surveillance on traffic monitoring, vehicular behavior on roads, water level and pressure, and remote monitoring of patients [2].

WSN has unique characteristics:

- Limited power they can harvest or store
- Ability to withstand harsh environmental conditions
- Ability to cope with node failures
- Mobility of nodes

II. REAL TIME APPLICATIONS OF WSN

The real time application of WSN is like a hot cake. It has been successfully implemented in diverse fields such as military, habitual, business, health, and industry applications. Some of the applications have been delineated below.

Wireless Body Area Network (WBAN)

Special wireless devices for healthcare systems are called Wireless Body Area Networks (WBANs). WBANs introduced a dynamic arena of development and research into today's life. In spite of these physiological parameters, they also monitor and analyze the routine of exercise and the requirement of the human body. Figure 1, shows the overview of WBAN architecture.

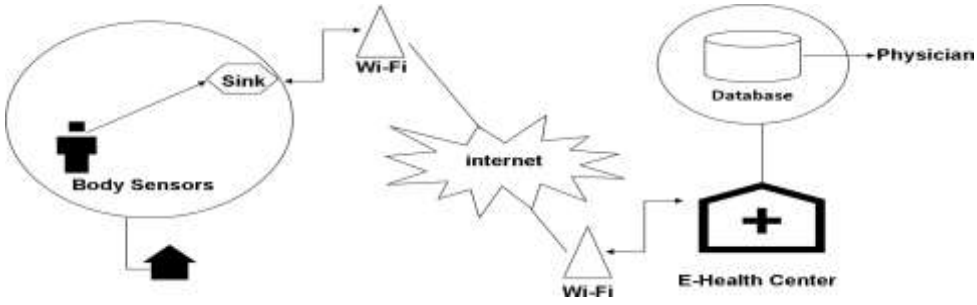

Figure 1: Wireless Body Area Network (WBAN) Architecture.

ISSN No: 2350-1278
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In this world, where the population is growing vastly but the resources are not sufficient, there should be some systems that satisfy imminent health care demands. All WBAN applications are based on three-tier architecture. All three tiers or levels are based on some devices, and these devices help WBANs to get and monitor data obtained from the human body and these levels are defined as follows [3,4].

- Level 1: First level of WBAN architecture is called the body sensor units that is based on one or more body sensor units and are placed outside or inside of the human body. This sensor gets required data from the human body and sends it wirelessly to the next layer.
- Level 2: Second layer is called the body central unit. The body central unit contains personal servers, and these servers get data from sensors which calculate and manipulate this data, generating the required results. This layer can be based on a wireless computer system, an Android mobile phone, or any GPS supported system that can manipulate received data.
- Level 3: Third layer based on end user's machines where end users are medical assistance or physicians and their machines can be a computer or mobile phones. These machines gather the required information from layer two, and ask end users to provide a response for a patient's fitness. If there are some emergency results, then the machine sends an alarm to the end user and makes it possible to generate a quick response so that patients can get proper treatment.

Lv et al., 2010 studied a health monitoring system. They developed iCare for the senior citizen person. The real-time sensor caters for the daily needs of the elderly persons through reminders, alarms, and medical comprehensive guides, etc. Furthermore, it helps to monitor health in a very comprehensive and convenient way [5].

Kannan et al., 2011 studied the application of real-time sensors for elderly persons and their well being. They developed wearable gloves via which the sensor nodes work, and during an emergency situation, they generate an alarm, short messaging system, and voice call. The sensors measure the heart rate, oxygen content, body temperature, and pressure. This was not developed before; the authors have attempted to make a user-friendly device which can prevent life-threatening conditions [6].

Baek et al., 2013 investigated real-time sensor applications on body posture in offices, restrooms, homes, etc. It was observed that wrong posture or positioning of the body led to vulnerable outcomes for elderly persons. The authors extensively studied posture and positioning of the body movement via a real-time sensor application. They proposed a device which can be worn as a necklace which includes the sensor nodes and the movement is detected by the sensors. Furthermore, they obtained more than an 80% sensitive result with 100% specificity [7].

Kantoch et al., 2014 investigated the application of sensors in the health motoring system. They developed a Bluetooth module with wearable sensors. This device monitors the ECG pattern, skin humidity, and body temperature. They calculated the error and it was shown to be around 5% compared to a certified commercial medical device already available in the market [8].

Rasyid et al., 2015 investigated the body temperature, heartbeat, and oxygen saturation in blood via real-time sensors. The ubiquitous application of the real time sensor provides a new avenue for the diagnostics industry. The results are in the form of graphs and tables for

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comprehension. They can be accessed in a specific area network such as from 10 m to 50 m via ZigBee without using the wire, which is more appropriate for the WBAN [9].

Rasyid et al., 2016 investigated a non invasive approach for the detection of the blood glucose level. Of late, the authors have developed a non-invasive approach and quiet reproducible technique via the application of real-time sensors and it plays a pivotal role in the Healthcare industry. The authors have developed glucose sensor monitoring via a Glucometer sensor with an Arduino Uno board and ZigBee module system. Furthermore, in this approach, the patient does not need to be present physically for the routine examination; they can perform the test via a web-based application via the usage of mobile phones [10].

Wu et al., 2017 investigated the application of sensors based on solar influx gathering. The authors placed an emphasis on evaluating the body temperature distribution, heartbeat, and shelf life of the instrument via web-based smart-phone applications. Additionally, they enhanced the lifetime of the device via several changes in the influx of the solar power. The authors put forward the strategies for resolving the aforementioned tasks [11].

WSN and Health

In health, WSN uses an advanced medical sensor to improve health applications. WSN is used to monitor diseases like Alzheimer's and heart attacks [12].

Hii et al., 2011 investigated and incorporated the real-time sensors on smart phones and made them more user friendly in the health care system.. The mechanism they delineated is the only comprehensive for the Electrocardiogram (ECG) and for the future scope of work they have suggested that the monitoring of the blood glucose level, blood pressure, and several kinds of diagnostics could be possible via the application of real-time sensors [13].

Kakria et al., 2015 investigated real-time sensors for the diagnosis of cardiac patients. The authors selected the age group 18–66 years, and among this age group, they selected some individuals. The authors introduced this application to cater for severe cardiac patients who are unable to attend a routine checkup. One of the main reasons behind this technology is to commercialize it for the benefit of those patients who are not financially sound. They have deployed these sensors under the supervision of experts. Furthermore, the system is developed in such a manner that any kind of crisis phase will be generated in terms of messages that will be automatically sent to the doctor [14].

WSN and VANET

A Vehicular Ad-Hoc Network or VANET may be a variety of the Mobile Ad-Hoc Network or MANET that offers communication between vehicles and roadside base stations. A vehicle in VANET is measured to be an associate intelligent mobile node capable of communication with its neighbors and different vehicles within the network. The internet of Vehicles (IoV) consists of vehicles that communicate with each other and also with public networks via V2V (vehicle-to-vehicle), V2I (vehicle-to-infrastructure), and V2P (vehicle-to-pedestrian) interactions, which permits the gathering and that is why there is a period of time sharing of critical information regarding the condition of the road network [15].

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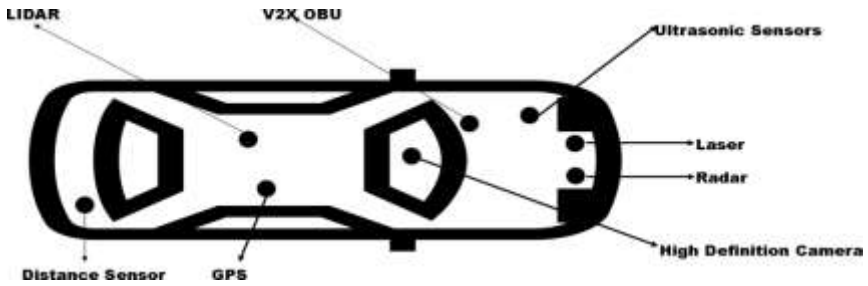

Figure 2: Vehicular Ad Hoc Network (VANET) Smart Vehicle

Chatrapathi et al., 2015 investigated the application of sensors in the road traffic system. The authors have extensively worked on Internet of Things (IoT) and VANET. The combinatorial approach of the aforementioned framework has been employed to detect accidents, avoid secondary accidents, and contact the ambulance in a timely manner. Additionally, the sensor will communicate with the ambulances and hospital for further correspondence regarding the incident. The authors inferred that their approach reduces the time for contacting the aforesaid, which might lead to a chance of saving a life [16].

Tai el al., 2017 developed a novel traffic monitoring system for VANET-based applications. Their proposed model is able to generate and analyze traffic condition reports, including the current time and location of the traffic with the help of image processing techniques. This approach exhibited around 85% accuracy in maintaining the authenticity of the data, 84.093m/s for the implementation time, and a 0.011% increase in computation overhead applying for the confidentiality scheme [17].

Industrial and Business Uses

This is very helpful in an industrial application. These sensors are also used for monitoring, controlling, and processing the data, such as pressure, vibration, temperature, and viscosity. Sensors collect the data or information sent to the control system management. They also play a pivotal role in establishing the business process. The WSN uses the building decision support systems, avoiding various problems in the real world.

Ni et al., 2009 investigated the gas meter sensor system. They developed a network hierarchy, such as receiving, transmitting, auto-reconfiguration, scheduling, and deep sleeping strict requirement of energy utilization [18].

Chen et al., 2011 studied the reduction of air conditioning energy utilization. They gave an insight into the mechanism of how to reduce the utilization by predicting a mean vote and computational fluid dynamics approach [19].

Valverde et al., 2012 investigated a coffee factory in Madrid, Spain. They installed the sensors in the industry and it is a very daunting task to deploy sensors. They installed them everywhere in the production unit from raw coffee to the final product. They installed the hardware system along with the software for better sensing the pollutants in the industry [20].

SWOT (Strength, Weakness, Opportunities, and Threat) Analysis of WSNs

The acronym of SWOT is Strength, Weakness, Opportunities, and Threat. SWOT is applied in this study to diagnose the merits and demerits of the real time application of the WSN. A WSN is ubiquitously applied in every aspect of daily life for its convenience in terms of intelligence and wireless networking such as smart and improved transportation systems. An

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attempt has been made in this paper to recognize the SWOT analysis for the real time application of the WSN.

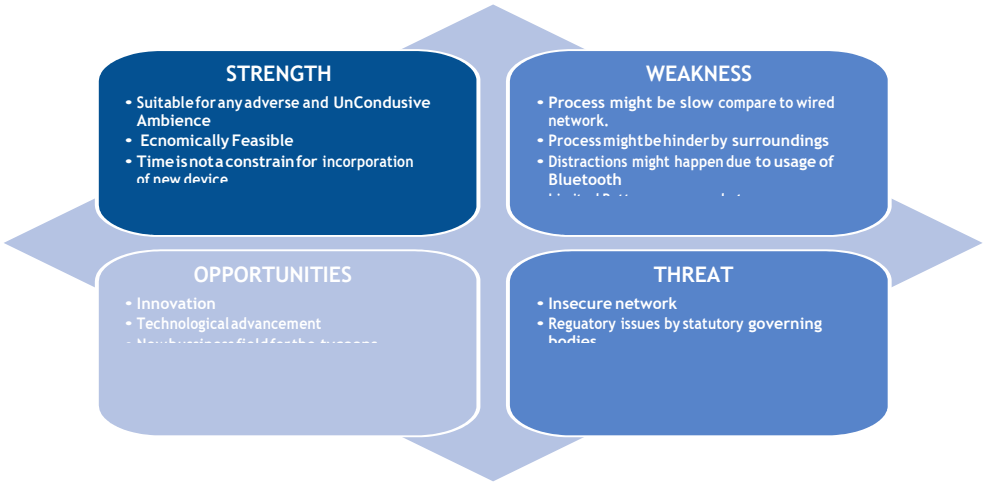

Figure 3: SWOT (Strength, Weakness, Opportunities, and Threat) Analysis of WSNs.

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