Review Paper on Application of Cognitive Radio Wireless Sensor Network

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Abstract: A cognitive radio wireless sensor network is one of the vital areas where cognitive techniques can be used for opportunistic spectrum access. Research in this area is still in its infancy, but it is progressing quickly. The aim of this study is to classify the existing literature of this fast emerging application area of cognitive radio wireless sensor networks, highlighting the key research that has already been undertaken. This paper describes the advantages of cognitive radio wireless sensor networks, the difference between cognitive radio networks, wireless sensor networks, and cognitive radio wireless sensor networks, potential application areas of cognitive radio wireless sensor networks.

Keywords: Sensor networks, Cognitive sensors, Cognitive wireless sensor networks.

Introduction

Wireless Sensor Networks

Communications in wireless sensor networks (WSNs) are made up of responsible for monitoring different environmental conditions like temperature wireless sensor. In a dense network environment, wireless sensor nodes deployed in the similar area capacity try to access a channel whenever an event occurs. Wireless sensors are normally deployed in inaccessible area.. WSNs consist of hundreds and thousands nodes, each node is connected to several nodes of sensors. Distance of the wireless sensor is few meters. Base station is collecting the data from the WS nodes.WS node is work as the single or multiple-hop manner. The sink node is send the data and also save the data using the gateway, often using the internet or any other communication channel. Current WSNs operate in the ISM band, which is shared by the many other band and communication technologies. Research has shown that this coexistence in the ISM band can humiliate the performance of the WSNs. The wide deployments, large transmit power, and big coverage range of IEEE 802.11 devices and other proprietary devices can humiliate the performance of WSNs significantly when it is operating in overlapping frequency bands. The wireless personal area networks and the other wireless devices operating in an unlicensed frequency band . The coexistence interference can be avoided by the intelligent use of three types of diversity, frequency, time and space.. Some solutions are also suggested in references. Researchers and industry are working to improve the performance of WSNs in terms of price, energy utilization, data rate, strength, networks throughput, QoS and security, etc .Recently years to improve the network performance change the hardware and software of the system . According to the network performance logical techniques have been employed. such as power aware MAC, cross-layer design technique, efficient sensing technique, and significant enhancement in hardware design, but these techniques have their own limitations Wsn is used in the industrial application for the machine control and the monitoring the environment. In the hospital monitor the patient health. Recently University of the California research the wireless sensor network software architectures. The network is interface with gateway to determine the surface condition in the area cooperative algorithm is used and increasing the network capacity. Clusters are used in the network if the gateway are failed cluster deal with fault and restored the network. Sensor nodes are communicate with the radio signals.

Cognitive Radio Network

Cognitive radio is the form of the wireless communication the transceiver can intelligently detect the channel which are used or not directly move in the channel available channel.CR is a hybrid technology involving software defined radio (SDR) as useful to spread spectrum communications .function of the cognitive radio is the sense the neighboring wireless devices in the operation. Encrypt or decrypt signals, and adjust output power and modulation characteristics. There are two types of

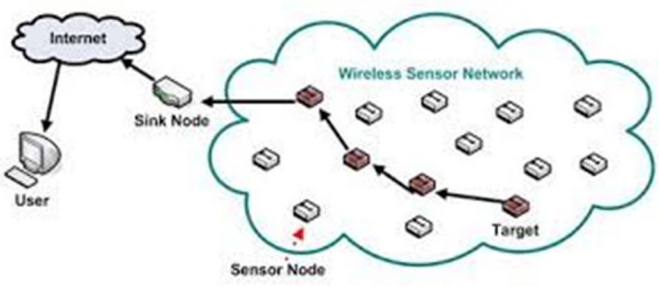

Figure 1 (wireless sensor network)

cognitive radio, full cognitive radio and spectrum-sensing cognitive radio. Full cognitive radio is aware the wireless node or network spectrum-sensing cognitive radio is used in the radio frequency spectrum and to detect channels .Cognitive Method in WSN Cognitive techniques have been used in wireless networks to circumvent the limitations compulsory by conventional WSNs. Cognitive radio (CR) is a applicant for the next generation of wireless communications system. The cognitive technique is the process of planning, performing, and continuously updating and upgrading learning. but cognitive radio can be included with wireless sensors, it can overcome the various challenges in the Wireless sensor network. Cognitive radio has the ability to know the unutilized spectrum in a license and unlicensed spectrum band, and operate the unused spectrum opportunistically. The incumbents or primary users (PU) have the exact to use the spectrum anytime, whereas secondary users (SU) can operate the spectrum only when the PU is not using it. Cognitive Radio allow unlicensed users to access multiple licensed channels opportunistically. This nature of CR gives potential compensation to WSNs by increasing the communication consistency and improving the energy efficiency. When wireless sensor nodes with cognitive capabilities are introduced the entire network, it gives new opportunities to researchers and engineering to develop algorithms, hardware and software that can overcome the limitation of wireless sensor design techniques. Taking advantage of the current example in the spectrum employment rule by FCC and technical advancement in sensor technology, wireless sensors with CR can affect the current issue of spectrum inefficiency and increase the network efficiency.

Cognitive Radio Wireless Sensor Networks (CR-WSN)

CR-wireless sensor networks (CR-WSNs) are a specific adhoc network of distributed wireless sensors that are organized with cognitive radio capabilities. CR-WSN is different in some aspects with a conventional WSN and conventional distributed cognitive radio networks (CRNs). CR-WSNs normally occupy a large number of spatially spread energy-constrained, self configuring, self-aware WS nodes with cognitive capabilities. They need cognition capacity for a high degree of cooperation and adaptation to execute the desired coordinated responsibilities. They have not only to transfer data packets, but also to protect present license users. When the structure that employs most of the capabilities vital for a CR system, as defined by International Telecommunication Union (ITU) and also for WSNs According to Akan et al, a CR-WSN is defined as a distributed network of wireless sensor (CRWS) nodes, which sense the signal and collaboratively communicate their readings dynamically more the available spectrum bands in a multi hop manner, finally to satisfy the application specific requirements. In CR-WSNs, a wireless sensor node selects the most suitable channel once an inoperative channel is identified and vacates the channel when the advent of a licensed user on the channel is detected. The cognitive radio technique is probably one of the most capable techniques for improving the efficiency of the WSNs. CR-WSNs increase spectrum utilization, and fulfills the end-to-end goal, increase network competence and expand the lifetime of WSNs. Many areas CR is the using the same spectrum without any interference. wireless sensor network is the operated in the unlicensed band. These bands are overcrowded. To solve the problem dynamic spectrum allocation.CR technology aims at making use of the network resources currently used in wireless communication system more efficiently. CR allows opportunistic use of the licensed spectrum band by an unlicensed user with minimum allowable interference to the licensed user, and without compromising on the desired quality of service required by the unlicensed user. Cognitive radios support the increased need for networked communications and situational awareness. Their capability to sense, learn, analyze and adapt autonomously will enable significantly more efficient use of the spectrum, both in time and in space. Awareness of other users and their requirements opens the possibility to use un- or under-utilized portions of the spectrum without disrupting existing military, government or civilian services.

Advantages of Using CR in WSNs

CR-WSN network area that utilize the spectrum resource efficiently for bursty traffic. The system has the capacity of packet loss reduction, power waste reduction, high degree of buffer management, and has better communication quality.

Advantages of using cognitive radio in WSNs

Capable for the Spectrum Utilization

The electromagnetic spectrum is a valuable gift of Nature. The amount of available spectrum bands cannot be increased but they can be used more capably. With the exception of industrial, scientific and medical radio bands, requires a license from the government of the individual country to utilize the radio bands. Due to the high cost related with spectrum licensing, many researchers and hardware manufacturers have planned on developing devices for ISM bands. Therefore, ISM bands are congested limiting the development of new technologies. On the other hand, many licensed spectrum bands are either utilized or unutilized . Cognitive radio wireless sensors can use the unutilized spectrum, called white spaces, without disturbing the license users. Unlicensed users can use those bands every user can used or no cost, so that more technologies can be developed for these bands.

Multiple for Channels Utilization

Most conventional WSNs use a single channel for communication. In WSNs, upon the detection of an result sensor nodes generate the traffic of packet bursts. At the same time, in compactly deployed WSNs, a large number of wireless sensor nodes within the event area effort to acquire the same channel at the same time. This increases the probability of collisions, and decreases the generally communication reliability due to packet losses, leading to excessive power consumption and packet delay. CR-WSNs access multiple channels opportunistically to ease this potential challenge. The applications of cognitive networking in wireless networks is the problem of dynamic channel. To solve this problem, the cognitive controller needs to gather past and current traffic diagonally multiple channels and forecast future traffic loads on each of the channels for decide best channel for the access point (AP) to operate on for serving wireless clients. Sensing channels for traffic information collection is very challenging in multi-channel wireless networks. The 802.11b based wireless networks and it is operated on ISM band and they transmission overload channel. Yet orthogonal channels are used for configuring Access Points (APs), in some cases (e. g .such as Bluetooth, microwave ovens, and other noise sources) other channels are used in the configuration by APs. In some scenario APs belong to different wireless LANs co-exist on the same channel and the cognitive wireless networking system should have the capability of monitoring all wireless channels in a spatiotemporal fashion. we suggested packet sampling with single wireless interface which rotates its channel in a round robin fashion for traffic monitoring in multi-channel wireless networks.

Power Efficiency

In WSNs, there is a large amount of power waste for packet and retransmission due to packet losses. CR wireless sensors may be able to change their operating parameters to adjust to channel conditions. Therefore, energy utilization due to a packet collision and retransmission can be affect. In wireless network macrocell and the femtocell are used both are the cognitive capability. We analyzed the energy-efficient resource allocation problem A gradient based iteration algorithm is used to attain the Stackelberg equilibrium key to the energy-efficient resource allocation problem. Recent proposed a pricing-based spectrum let framework between one PU and multiple SUs.

Universal Operability

Each country has own spectrum regulation rules. A certain band available in one country might not be available in another country. Traditional wireless sensors with a preset working frequency might not work in cases where the manufactured wireless sensors are distributed in different regions. On the other hand, if nodes are prepared with cognitive radio capability, they can overcome the spectrum incompatibility problem by changing their communication frequency band. Therefore, CR wireless sensor is operated at the anywhere anyplace in the world.

Application of CR-WSN

CR-WSNs may have a wide range of application . certainly, CR-WSN can be deployed anywhere in place of WSNs. various examples of prospective areas where CR-WSNs can be deployed are as follows: facility organization, machine surveillance and protective maintenance, precision agriculture, medicine and health, logistics, object tracking, telemetries, intelligent roadside, security, actuation and protection of complex systems, monitor of indoor and outdoor environment

For Military Applications

Predictable WSNs are used in many military and public security applications, such as: (a) chemical biological radiological and nuclear (CBRN) attack detection and investigation; (b) control authority; (c) collect the information of battle damage evaluation; (d) battlefield surveillance; (e) intelligence subordinate (f) targeting, etc. In the battlefield or in uncertain regions, an opposition may send jamming signals to disturb radio communication channels . In such situations, because Cognitive Radio-WSNs can handoff frequencies over a wide range, CR-WSNs can use different frequency bands, and also avoid the unwanted frequency band with a jammed signal. In addition, some military applications require a large bandwidth, minimum

channel right to use and communication delays. For such applications, CR-WSNs can be a better choice.WSN is used for the sensor measuring(light,signal,sound). The main consideration for using cognitive radios is in a networked environment. In this case, there are potentially many CRs searching for available spectrum at the same time, and some method must be devised to ensure that as high a proportion as possible are able to access spectrum for their respective needs.The cooperative, in which the nodes share their requirements and come to a common decision about the spectrum access, transmit power, etc

For Health Care

In a health care system, such as telemedicine, wearable body sensors are being used progressively more. Numerous wireless sensor nodes are positioned on patients and obtain critical data for remote monitoring by health care providers. The IEEE 802.15 Task Group 6 (BAN) approved a draft of a standard for body area network (BAN) technology. Wireless BAN-assisted health care systems have previously been in practice such developing countries. Wireless BAN for healthcare systems is suitable for areas, where the number of health specialists is comparatively low. Medical data is critical, delay and fault.Therefore, the limitation of traditional WSN, as discussed in the previous section confines the potentiality of telemedicine. The Quality of Service may not be achieved at a adequate level if the operating spectrum band is crowded in convenient 'telemedicine with BAN'. The use of 'CR wearable body wireless sensors' can mitigate these troubles due to bandwidth, jamming and global operability, hence improve reliability. presents a model for wireless BAN with CR wireless sensors.wireless communication support the electronics health application to transfer the medical data and patient information.

Home Application

Dynamic spectrum allocation is used in the home application. Usual WSNs is used for the reliable communication because ISM bands in indoor areas are particularly packed. Some examples of the indoor applications of WSNs are for the intelligent buildings, home monitoring systems, factory automation, personal entertainment, etc. CR-WSNs can moderate the challenges faced by conventional indoor WSNs applications.

Bandwidth Applications

Cognitive Radio is the improve the bandwidth efficiency through the secondary user.Multimedia applications, such as on-demand or live video streaming, audio, and still images over resource constrained WSNs, are extremely challenging because of their massive bandwidth requirements . Other WSN applications, such as WSNs in a hospital environment, vehicular WSNs, tracking, surveillance, etc., have vast spatial and lay variations in data density correlated with the node density. These applications are bandwidth-hungry, delay impossible and bursty in nature. Because in CR-WSN, SUs can access multiple channels whenever available and necessary.

Real-Time observation Applications

Real-time observation applications, such as traffic monitoring, biodiversity mapping, monitoring, environmental monitoring, environmental conditions monitoring that affect crops and irrigation WSN, underwater WSNs, vehicle tracking, inventory tracking, disaster relief operations, bridges or tunnel monitoring, require minimum channel access and communication delay. Some real-time observation applications are highly delay-sensitive and require high reliability of the network. Due to delay multi hop is used. WSNs if the channel state is not good. On the other hand, WS nodes hop to another channel if they find another idle channel with a better condition in CR-WSNs. Channel aggregation and the use of multiple channels at the same time are possible in CR-WSNs to increase the channel bandwidth.

Transportation and Vehicular Networks

The IEEE 1609.4 standard proposes multi-channel operations in wireless contact for vehicular environments (WAVE). The WAVE system operates on the 75 MHz spectrum in the 5.9 GHz band with one control channel and 6 service channels. All vehicular users will have to assert for channel access and use it to transmit the information in the 5.9 GHz band. However, it still suffers from spectrum absence problems. This spectrum scarcity issue and the requirements of cognitive radio in WAVE have been studied .Some preliminary works in Cognitive Radio-enabled vehicular communications have already been done. Vehicular wireless sensor networks are rising as a new network standard for proactively gathering monitoring information in urban environments. CR-WSNs are likely to be more applicable in this field.

Diverse Purpose Sensing

The use of wireless sensors in the similar area for different objectives coexists. In a conventional WSN, those wireless sensors effort to contact the channel in non-cooperative manners. Through the help of an capable medium access control (MAC) protocol, CR-WSN might select different channels for different applications considering load balancing and equality. A CR wireless sensor network is a kind of wireless sensor network that comprises spatially-distributed independent CR equipped wireless sensors to monitor the physical or environmental conditions cooperatively. This paper discusses the

development of CR-WSNs, opportunities, technical issues.. CR wireless sensor networks are still in their early life. Several areas remain to be explored and improved. For the success of CR-WSNs, considerable research is required in several aspects. considerable developments in hardware, software and algorithms are needed to make smart CR wireless sensors.

Conclusions

A CR wireless sensor network is a form of wireless sensor network that comprise spatially-distributed cognitive radio independent CR equipped wireless sensors to monitor the physical or environmental conditions politely. This paper discusses the evolution of CR-WSNs, opportunities, technical issues.. CR wireless sensor networks are still in their infancy. Several areas remain to be explored and improved. For the success of CR-WSNs, considerable research is required in several aspects. Substantial developments in hardware, software and algorithms are needed to make smart CR wireless sensors.

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