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Deployment of Wireless Sensor Technology in Multi-Environment Critical Event Detection:

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ABSTRACT *The growth of wireless sensor network technology has enabled us to develop advanced system for real time security monitoring. An effective use of WSN is being exercised to overcome the security issues in market, schools, organizations and various other public places. Some issues discussed concerns with how information technology contributes to the wide sphere of security. A simple system has been devised to secure such places by monitoring the critical and suspicious events. This paper describes the applications of WSN for monitoring the market places using Alarm system and broadcasting the same to entire monitoring team. As & when any critical event occurs an alarm message will be sent to the entire monitoring team along with the location of event. This will enable us to utilize the power of highly secure and unmanned system using WSN technology.*

KEYWORDS : Alarm System, Market Place, Unmanned Security, WSN.

1. Introduction

Wireless sensor network (WSNs) are being used in a wide variety of critical applications such as military and healthcare application, agriculture and industrial process monitoring. WSN is private network made by large number of sensor nodes which do a specific function. WSN has several advantages including easy installation, cost effectiveness, small size and low power consumption, which is essential for our security agencies. WSN provides continuously monitors information and broadcasts to the monitoring team with an alarm message for every critical event at public places including market, school, organization and other public places. This facility makes the monitoring team (security agencies) to focus on an larger area from a single seat, thereby enhances the precision and avoids the life risk of the cops. By providing the wireless technology for security purpose is the best effort for diverting the new generation towards the smart security system. When a critical event occurs in the monitoring area i.e. market or any other public place and is detected by a sensor node, an alarm needs to be broadcast to the other nodes as soon as possible. Then, sensor nodes can warn users nearby to flee or take some response to the event. As sensor nodes for event monitoring are expected to work for a long time without recharging their batteries, sleep scheduling method is always used during the monitoring process. Obviously, sleep scheduling could cause transmission delay because sender nodes should wait until receiver nodes are active and ready to receive the message. The delay could be significant as the network scale increases. Therefore, a delay-efficient sleep scheduling method needs to be designed to ensure low broadcasting delay from any node in the WSN. Critical condition in the places like: Markets, Schools, Business Complexes, Bus Stations, Railway Stations, Airports, Crowds etc. should be properly covered and detected for security monitoring along with the proper point address. Each and every node is marked using simple Alpha-Numeric codes. So that event detected at any particular place shall be located without delay and be broadcasted to other nodes for information. This would enable the top monitoring team to overcome the issue rapidly. To minimize the broadcasting delay, it is needed to minimize the time wasted for waiting during the broadcasting. As the alarm message may be originated by any possible node. When a node detects a critical event, it originates an alarm message and quickly transmits it to a center node along a predetermined path. Then, the center node broadcasts the alarm message to the other nodes along another path.

In the critical event monitoring, only a small number of packets need to be transmitted during most of the time. When a critical event is detected, the alarm packet should be broadcast to the entire network as soon as possible. Therefore, broadcasting delay is an important issue for the application of the critical event monitoring. A centralized gateway node collects all transmission requirements during a contention period and then schedules the distributions according to the reservation path. An energy-adaptive MAC protocol, Gateway MAC (G-MAC) implements a new cluster-centric paradigm to effectively distribute cluster energy resources and extend network lifetime. Concentrating the transmissions into a smaller active period reduces idle listening, but it also increases the probability of collisions. Receiving and discarding messages intended for other nodes, or message overhearing, is commonly employed in non-energy constrained networks to increase throughput and high delay [6]. Continuous monitoring applications are an important class of wireless sensor application. These applications require periodic refreshed data information at the sink nodes [2]. The need of the sensor node was to transmit continuously in periodic fashion to the sink nodes it leads to excessive energy consumption. DMAC protocol specifically design for the wireless sensor network, where the communication pattern is restricted to an established unidirectional data gathering tree. Here, all nodes having a periodic receive– transmit sleep cycle with level-by-level offset schedule ,which means that all nodes wake up when the source node have just gotten a data packets, and go to the sleep as soon as they transmit packets to the destination nodes. The level-by-level offset schedule in DMAC can achieve much lower transmission delay in one traffic direction; it is not efficient in bidirectional delay guarantee [8]. The authors presented several sleep scheduling patterns that adhere to the bidirectional end-to-end delay constraints, such as shifted even and odd pattern, ladder pattern, two ladder pattern and crossed-ladders pattern. However, the patterns are not suitable to alarm broadcasting in the WSN, because the traffic discussed is just a single flow. If the sink node broadcasts packets according to the patterns, there will be serious collision in the network [9]. In this query based sensor network a node cannot voluntary send data packets that they sensed to the sink node, unless the sink node sends them queries, these queries are very complex. Hence the sink node needs to predict the data arrival time for each destination nodes. Collecting information from the environment by keeping all the nodes active and transmitting to the sink is energy expensive. Therefore, the scheme is not suitable to alarm broadcasting in the WSN for critical event detection [10]. ADB is based on asynchronous wake-up. It exploits some information contained in data packets and ACK, so to arrange the transmission among nodes. When sensor nodes take prior knowledge of all the link quality, packet broadcasting in ADB actually follows a determined broadcasting tree in the network. Furthermore, as sensor nodes with ADB wake up asynchronously, collision can almost be avoided. In this technique, to compare the proposed scheduling scheme with ADB [11] and DW-MAC [12].

2. Alarm Signaling and Event Detection

Alarm signal travels from event detecting node to the central node. The central node broadcasts the signal to the entire network. Once a node detects any critical event, other nodes auto coordinate and become cautious of the other possible events to be detected. With wireless sensor networks, objects can be tracked by simply tagging them with a small sensor node. The sensor node will be tracked as it moves through a field of sensor nodes that are deployed in the environment at known locations. Instead of sensing environmental data, these nodes will be deployed to sense the RF messages of the nodes attached to various objects. The nodes can be used as active tags that announce the presence of an object or event. A database can be used to record the location of tracked objects relative to the set of nodes at known locations. With this system, it becomes possible to ask where an object is currently, not simply where it was last scanned. Unlike sensing or security networks, node tracking applications will continually have topology changes as nodes move through the network. While the connectivity between the nodes at fixed locations will remain relatively stable, the connectivity to mobile nodes will be continually changing. Additionally the set of nodes being tracked will continually change as objects enter and leave the system. It is essential that the network be able to efficiently detect the presence of new nodes that enter the network. The critical event monitoring in a WSN, sensor nodes are usually set with passive event detection capability and it allow a node to detect an event even when its wireless communication module is in sleep mode. Upon the detection of an event by the sensor, the radio part of the sensor node is immediately woken up and is ready to send an alarm message. The time is partition into different time slots. The length of each slot concerning the minimum time is needed by sensor nodes to transmit or receive a packet. Time of sensor nodes is assumed to be locally synchronous, which can be implemented and maintained with periodical beacon broadcasting from the center node. The scheduling method will be of three phases:

1. Any node in the network which detects a critical event sends an alarm packet to the center node along a predetermined path according to level-by-level offset schedule.
2. The center node broadcasts the alarm packet to the entire network also according to level-by-level offset schedule.
3. Center node sends the alarm packet to the gateway through which it will be delivered to the base. The proposed method defines the traffic paths from nodes to the center node as uplink and defines the traffic path from the center node to other nodes as downlink.

3. Architecture and IP Security Surveillance

A number of devices are used in this system in a proper coordinated manner to avoid any kind of lapse or fall. A number of special IP Cameras along with a control panel connected to server via a router. A router can have two or three cameras connected along with the control panel.

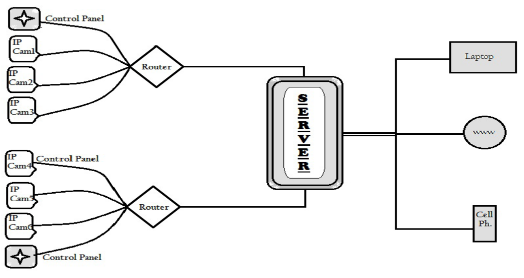

Fig 1. Basic Connectivity Diagram used in Event Detection

There are such many routers that can be designed to connect with the server. The server would receive all the data as input from IP cameras via routers. On the other hand laptops or other display devices are connected to the server for obtaining the information as output processed by the server. The event data captured can be now broadcasted to the base station or to the internet. The base station users or the monitoring team could access the entire network using particular access user ID's and passwords. Router assigns an IP address to each camera and other network attached device using the dynamic host configuration protocol when the device is connected to the local area network (LAN). These routers and cameras are located in the homes of users. A web interface is used as a control panel to control the camera(s) and other devices via home surveillance/monitor application that is deployed on the router; therefore, users can control and of the functions of monitoring system in their home via any web browser. This is expected to be very convenient for users, but this assumes that the home router is connected to the Internet (or intranet) and that suitable security mechanisms are used so that only authorized users can access any of the devices inside the home.

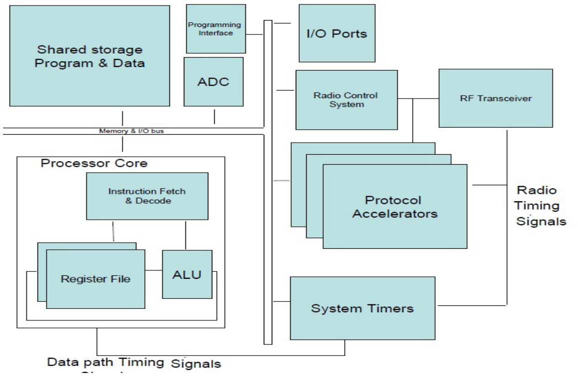

Fig. 2: System Architecture used in WSN Event Monitoring.

We assume that the user will use a web browser running on some terminal to access the system's web interface via the Internet. Additionally, the application can send specific data to remote servers (for example, to enable a remote alarm monitoring service). The reason for deploying this software on the router is that most homes now have some sort of home router and this router is powered on at all time, whereas the homeowner's personal computer might be turned off when not being used.

4. Implementation Area:

On implementation of this project in the City Market- High Street (Lane-II) Srinagar J&K, very best results were achieved. Street map of the market and sensor nodes is shown in figure 3. In this deployment 28 Sensor nodes were deployed in the entire market covering about 3.5 Sq. KM's. It includes Mega Fruit Market having daily loading capacity of 500 trucks and their supply to the several city and rural markets. A Shopping Mall with over 114 showrooms of different companies and products like Honda Motors, Suzuki, Airtel, BSNL, Chinar Spices, IT Centre, Boutique, Carpet Showrooms etc. having daily visits of more than 10000 customers. In the same market various other essential organizations were under surveillance including Banks, Fire Service, Parking Areas, City Central Bus Stand etc. besides the round the clock movement of traffic on surrounding this market. Sensors nodes worked in coordination to each other and relayed the entire information to the base station at the distance of 5 kilometers via multiple-hops. The battery backup was enough to last for weeks.

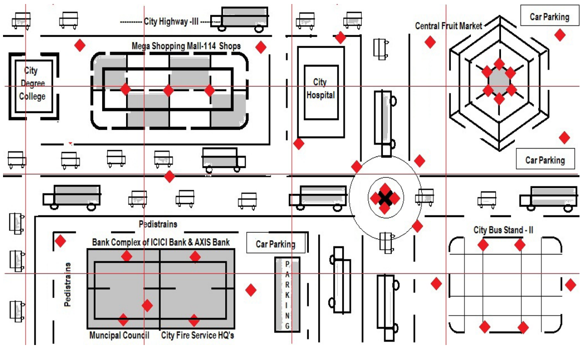

Fig. 3: Deployment of Sensor Nodes in the Mega Public Market.

Every node was assigned with a unique ID in relation with its particular location in the market starting from N1 to N18. The nodes (shown in red) were placed using multi topology system. Every node had an immediate access to its neighboring nodes and to the central node. All nodes broadcasted the alarm signal to the base station via central node having node ID CN0. Besides node to central node communication, the sensor nodes would find the shortest path to broadcast the alarm to central node. Central node would directly communicate with the base station monitoring team with live broadcasting of the information. The same technology is used in various other large agricultural fields, oil fields, mining, defense systems, line of control, dams, power projects and play fields etc.

5. Conclusion

Wireless Sensor Technology has several advantages including easy installation, cost effectiveness, small size and low power consumption, which is essential for deployment of this technology in large agricultural fields, oil fields, mining, defense systems etc. WSN provides continuously monitoring broadcasts along with an alarm or message for every critical event that may occur in the monitoring area. This facility makes the monitoring team to focus on larger area from a single seat, thereby enhances the precision and creates an unmanned monitoring and security zone itself. By providing the wireless technology for security purpose is the best effort for diverting the new generation towards the smart security system. The sensor nodes can warn users nearby to flee or take some response to the event.

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