EMAS: Environment Monitoring and Smart Alert System for Internet of Things (IoT)

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Abstract—The recent advancements open up many significant energy optimization techniques in Internet of Things. The smart systems can now achieve paramount level of control of user comfort while reducing use of energy. Our main purpose is to construct smart environment monitoring and surveillance system using wireless sensor network (WSN) mainly focus on plantation, bridge monitoring and industrial products. The system periodically measures temperature, light and humidity levels of the atmosphere. When a critical change in the environmental variables is detected, the network administrator or the employee of that building will be notified via a text message on their cell phone. Thus, they will be able to act to critical changes as quickly as possible and it may be able to intercept effects of the critical change. Results are obtained in the field tests reasonably ensure that the WSN possess excellent package delivery high power efficiency.

Keywords—Environmental monitoring, wireless sensor network, monitoring applications, Active Node, Cluster based routing.

I. INTRODUCTION

The recent trends and modern technological development broaden the vision of Internet of Things (IoT). These advancements prevail viable smart solutions in terms of innovative applications. The distributed wireless communication networks increase the scope of surveillance by deploying cheap, low power consuming and multi-dimensional sensors that are tiny in size capable of transferring short range information [1][2]. The region of the environmental monitoring scheme exists in the bigger classes of distributed control implementation. Technological advances in microelectronic mechanical systems (MEMS) and wireless communication technologies have accelerated the growth of minute, low-cost, low-power and multi-purpose intelligent sensor nodes in a wireless sensor network (WSN). Installed in an open region, these smart nodes are linked via internet wireless connections [3], as shown in Fig 1.

Fig 1. Wireless Sensor Network

The data information is transferred through the networks of nodes of the system in which node perform complex task such as statistical system. The advantage of implementing computing and networking capabilities is that, it allows sensor networks to be re programmed and re-tasked. An essential aspect of WSN application is environmental monitoring. It has grown extensively along with the latest technological development. Environmental monitoring system generally monitors and examine environmental parameters such as temperature, humidity, light [2][4][5]. The technology used for sensing controlling is combination of electric magnetic fields sensors, radio wave frequency sensors, optical electro-optics sensors, infrared sensors. Sensors work on multi hopped, short distance, energy efficient wireless links. Multi-hop routing introduced an important way for topology management and medium access control [6]. WSNs are capable of operating unattended in harsh climate where human-in-the-loop surveillance systems are unsafe ineffective [7]. The environment monitoring and smart alert system (EMAS) system is designed on a sensor network through which analyzing, monitoring and vigilance of environment sampling, aggregation of information and health of monitoring and vigilance of environment conditions can possibly be done by sensor nodes. The data obtained through this is transferred to base station (BS) in a multi hope process thereby uploading the data to the server to obtain desired objectives as shown in figure 2.
The rest of the paper is organized as follows: section II contains literature survey, section III explains the methodology, section IV discusses issues and section V concludes the paper.

II. LITERATURE SURVEY

The advancements in wireless communication technologies and the development in IT are all set to open the gateways for the generation of cheap sensors. A lot of work is done on WSN in past making it more advance and applicable on a larger scale. Some of the work is described in this section. Wireless sensor networks are the fundamental building block of the environmental monitoring system [2]. Nodes show up their full strength when deployed in a network [8]. In severe circumstances, automation of the surveillance method can be useful. With WSN short-range transmission, agro climate in the Amazon was tracked. More remote nodes were discovered to bear a loss of performance, while nodes close the sink retained their level of performance [9]. By combining sensor technology IoT [10], the networks of environmental sensors will become a study instrument of future earth and environmental science systems [11]. The use of wireless sensing instruments was tested to monitor residential circumstances. It was discovered that setting up a sensor networks was simple, but complicated programming was needed to make it work [12]. A web-based environmental surveillance system was created to program wireless devices to send signals. The signals are then transmitted to the database in a code written in java. A web-based system is intended to enable the user to access information such as data type and sensor place [13]. We have designed a web and application based environmental monitoring and alert system which works on the principle of IoT with wireless sensors deployed to gather the certain data for the user. A user can monitor the conditions of the area, where sensors are deployed, on the mobile application and on the web.

III. METHODOLOGY

A. Preliminaries

The environmental monitoring and alert system consist of the capacities of both hardware and software. System hardware comprises of one or more processing and control units linked to the control unit, a set of peripheral devices. The control unit operates on the peripheral data provided or on the system’s pre-defined guidelines. Commands are sent by ethernet cable, telephone lines, and fiber-optic cables to the peripherals from the central unit. Software plays an important role in running the hardware and logically linking all the units. It enables the control unit to control the peripheral device activities. The architecture used in EMAS is ‘tiered architecture’, with gateways, controllers’ repeaters. A peer-to-peer (P2P) architecture surfaced. In P2P architecture, the devices failure doesn’t affect the whole architecture but only one device. The sensor network architect for HVAC application can be tiered or flat. Sensor data originates at the lowest sensor peripherals or sensor nodes. HVAC energy usage depends on external environmental conditions [14]. The nodes are basically used for sensing purposes but they can perform general purpose computing networking. Nodes on the field are deployed in clusters, Traditional routing protocols for WSN are usually not optimal when it comes to energy consumption. Clustering is effective in saving the energy during the use of WSN [3]. A sensor node sends its data through the cluster in a multi hop style to the cluster head. Multi hop routing is an important service required for WSN [15]. A cluster is a subset of vertices linked to the graph [16]. The head of the cluster transmits the sensor information.

B. Implementation

Integrating wireless sensors into EMAS is quite a complicated and sensitive process. To integrate the sensors into EMAS, the nodes have to follow the architecture that can readily be assimilated into mainstream architectures. Wireless motes are programmed in such a way that it produces useful results. Figure 3 shows the methodology of implementation as 1) Data acquisition 2) Data collection 3) Data Retrieval. The application is designed to help the user to monitor the situation where the EMAS is installed. Application monitors the data, collect it, sends to the database the application then alerts the user about the changes happening in the environment.

1) Data acquisition: We have used UC Berkley / Crossbow IRIS XM2110 motes with MTS420 purchase boards mounting on it in our implementation. Atmel Atmega128 microcontroller running at 7, 3728 MHz with a significant amount of permanent storage fine (512 KB). The system uses normal battery cells as power source. A “MIB520 USB Interface Board” is used as sensor peripheral for the sensor node. There are six nodes deployed in the system. The sensor panel has the following components: light picture resistor (Clairex CL9P4L), thermistor (YSI 44006), sensor of humidity or temperature, barometric pressure or sensor of temperature, light sensor, twoaxis accelerometer, global positioning system (GPS). MDA 100 is the actuation node that has been deployed. The actuation node receives messages from the CU and consequently affects the operation of the HVAC. It is then necessary to pass the messages sent by the temperature sensor to one of the heating/cooling controlling
HVAC control modules. All sensor motes run TinyOS, a sensor network-specific operating system. It has a programming model based on components, supplied by the language of nesC [17][18]. TinyOS produces information packets and then places them on the network using the TinySDN component programming interface [19]. It allows the setting of low-level hardware features to achieve low-power circumstances of sleep. TinyOS summarizes all hardware resources as parts [20].

2) Data Collection: The radio has a highly delicate receiver that can be interfered with from another IRIS node by an adjoining local oscillator. Each sensor operates in a single-hop broadcast network as a transmit-only device. The node uses the temperature sensor to sample the temperature data on the sensor board periodically, create a set of entries and schedule a transmission if required numbers are available. The data that processes the data and transmits it to EMAS is acquired at the control unit. As processing process, the control system can decide to affect an actuation for which it sends a signal to the actuation node. In the data collection process, after converting it to engineering units from raw values, Java was used to send all the data received from nodes in real time to online database. With the dense deployment of sensor nodes, high spatial resolution for the physical phenomenon can be achieved. MS-SQL was used to create the database. MS-SQL [21] is a relational database management system developed by Microsoft. It stores the data that is collected from nodes.

3) Data Retrieval: Once the data is stored in the database, any time, from any device, it can be accessed from anywhere. Users can communicate in two distinct ways with the scheme. Remote users can access the information as it appears in the HVAC control system’s database. Control system administrators can set up permissions on what remote users can change. Users on the site can have more direct control and greater access rights. The user can view various information, such as humidity and temperature, stored in the database. The node sent data is stored in the respective nodeID, showing the readings of humidity, temperature, pressure, and accelerometer.

IV. CHALLENGES

- Power management: This is vital to long term operation, especially when monitoring remote and hostile environments are required. Harvesting schemes, cross layer protocols, and new power storage devices are identified as possible solutions to improve the lifespan of the sensors.
- Scalability: A network of wireless sensors can cater for thousands of nodes. Current environment WSN sets out to use tens to hundreds of nodes. Therefore, it is necessary to prove that the theoretical solutions available are suitable for a large real WSN.
- Remote management: Systems installed at isolated locations cannot be accessed frequently, therefore a common remote access protocol is required to run, control, reprogram and configure the WSN, regardless of the manufacturer.
- Standardization: IEEE 802.15.4 provides a millstone in attempts to standardize. Though in practice, compatibility between off the shelf modules is very low. In order to reduce costs and increase the options available, it is necessary to define standard interfaces to allow interoperability between different vendor modules.
- Mesh routing support: The topologies of mesh Networks can provide both multi-hop and variety of routes. A routing protocol to support multi-hop mesh networks is therefore crucial, taking into account the network’s very limited features. Power management: This is vital to long term operation, especially when monitoring remote and hostile environments is required. Harvesting schemes, cross layer protocols, and new power storage devices are identified as possible solutions to improve the lifespan of the sensors.
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V. CONCLUSIONS

The Internet of Things is a promising progress and is currently being used in a range of applications requiring minimum human intervention. We have shown how wireless sensors and actuators can be incorporated into the current EMAS structure. An embedded architecture can be coupled with legacy systems to enable future systems to be deployed, provided energy can be scavenged for perimeter sensor nodes or battery life expanded over several years, which means that the networks will have to be energy saving rigorously. Wireless sensor networks are used in this study job and their techniques and norms were performed. Some of the most recent environmental monitoring projects were analyzed with real deployments and the conclusions were used to identify the challenges to be addressed. One thing is for sure that deployment becomes simpler than ever, and it would be as easy as plug-n-play in future moments when technology progresses to detect any physical characteristic.

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