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Smart Emergency Response System Using Voice Command and MEMS Technology



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Abstract

In wireless sensor network, the critical issue is to operate successfully, to provide sufficient sensing coverage. The smart sensing environment as a sensing system with the capability to sense the environment and respond properly in an automated manner. The proposed protocol targets an automated smart monitoring network. Two centralized algorithms are included in the protocol: enhanced virtual forces algorithm with boundary forces and sensor self-organizing algorithm. The EVFA-B protocol applies weighted attractive and repulsive forces on each sensor based on predefined distance thresholds. Resultant forces then guide the sensors to their suitable positions with the objective of enhancing the sensing coverage. Furthermore, in the presence of sensor energy depletions and unexpected failures, our SSOA algorithm is activated to perform local repair by repositioning sensors around the sensing void. This capability of local recovery is advantageous regarding, saving the communication and moving energies.

Key words: ***Wireless sensor, deployment, Coverage problem, Smart sensing environment and Sensor automation***

INTRODUCTION

The advance of micro-electromechanical system (MEMS), sensing technology and wireless communication have significantly encouraged the development of WSNs in the past decades. In habitat and environmental surveillance, medical application, agriculture assistance and military problems the WSN were being widely used. The sufficient sensing coverage provide successful surveillance, Manual placement of static sensors involves labor effort (reaching the ceiling to perform the planned deployment) and lacks network self-healing competence (when faulty sensors [1] occur). For motion facilities, a smart sensors are considered with mobility capability to accomplish self-deployment once an initial random placement of sensors [2] are done. Furthermore, since sensing devices are prone to errors due to energy depletions or unexpected failures, faulty sensors may occur over time, leaving monitoring voids (uncovered sensing holes).

In movement ability, the sensors [3] are repositioned with themselves instead of replacing faulty sensors with new ones for restoring the sensing coverage as shown in Fig. 1b. According to the above descriptions, two deployment- related issues need to be addressed.

First, a coverage aware sensor deployment scheme can be developed to ensure sufficient sensing coverage. A sensor self-organizing mechanism developed for efficient recover of sensing void and for restoring required sensing coverage.

Local repairs generally consumes less moving energy and communication overhead than a global

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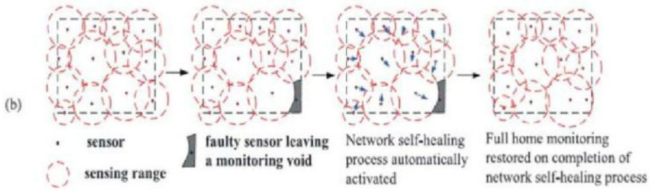
redeployment. The sensor self-organizing mechanism limits the network recovery/repairing locally to reduce unnecessary moving energy consumption. In the proposed work, it not intend to study about energy-conserving sensor communication behavior though moving energy os reduced by keeping sensors from moving far away when performing self-deployment, none of the issue of required amount of sensors achieves a certain degree of sensing coverage. Rather, with any number of sensors, [4] it is investigated the deployment-related problems and propose a coverage-aware sensor automation (CASA, which means" home" in Spanish) protocol including the aforementioned two deployment related designs, with the objective of providing/maintaining high sensing coverage. Our ultimate goal is to realize an automated monitoring network so that detection applications of various emergency events are implemented practically.



The remaining section of this paper is organized as follow. Section 2, review several prior research effort.Section3, we introduce the System Architecture and Data Flow of the paper. Section 4, the proposed CASA protocol and provide the modules related to its implementation. Section 4, Conclusion and Future Work.

Prior Work: For large-scale WSNs, several works have been proposed to address the energy conservation issue. Sufficient number of sensors randomly deployed over the monitoring field for confirming a certain degree of redundancy in sensing coverage. The proposals design node of working schedules rotates between an active and sleep modes. The objective of those proposed working schedules is to achieve energy conservation while preserving reasonable sensing coverage and network connectivity.

The movement-assisted sensor deployment techniques by utilizing mobile sensors to enhance the sensing coverage after a random initial placement of sensors. With the motion facilities equipped with the sensing devices [5], sensors can move around to deploy themselves. Given any number of randomly placed sensors, a centralized force-guided algorithm, inspired by the disk packing theory and virtual force field concept from robotics, to establish motion paths for sensors.

The proposed algorithm evaluates all attractive and repulsive forces by obtaining the resultant force exerted on each sensor. The computed resultant force are directs the sensor to move to the desired position. Also utilizing mobile sensors, a distributed sensor [6] self-deployment scheme.

Initially the sensing voids are identified based on Voronoi diagram and three algorithms are provided to guide sensor movements toward the detected holes. Accurate Voronoi polygon constructions are not achieved to unevenly distributed sensors with limited communication distances. Hence some optimization heuristic [7] prevents sensors from moving too far and kept a reasonable number of total movements in it. The termination condition for the Voronoi-based deployment strategy is coverage for a monitoring environment with sensor number much larger than necessary, unbalanced sensor distribution is likely to occur.

As a result, a scan-based movement-assisted sensor deployment (SMART) method to address the unbalanced problem. SMART focused on sensor load balancing by using 2D scanning and exchanging dimensions to achieve a balanced network state.

The SMART operates on top of existing sensor deployment schemes and produces good performance especially for unevenly distributed WSNs. The aforementioned movement-assisted sensor deployment techniques all consider homogeneous sensors (with equal sensing/detection radius).

A VorLag algorithm, takes heterogeneous mobile sensors into the deployment considerations and the solution enhances traditional Voronoi-based approach by incorporating Laguerre geometry to accommodate diversity in the sensing range/radius.

A CASA protocol suite is proposed for addressing the global sensor deployment scheme (EVFA- B) and sensing coverage recovery in the presence of sensor failures (SSOA). First, the enhanced virtual forces algorithm are developed with boundary forces (EVFAB) based on the concept of potential field [8] and disk packing theory. Second, the SSOA is devised to provide the network self -healing (automated fault recovery) capability, which most previous sensor deployment protocols do not handle.

Architecture and Dataflow Diagram Overview

System Architecture: In the Fig. 3.1 shown below, consists of a sensing system, mobile, computer system and users, where data are sensed and sent to the network by sensors. These data's which are delivered from the sensors are collected by the different systems which request for the data. For the monitoring environments where planned sensor deployment is possible, various static deployment strategies have been introduced to enhance the surveillance coverage [9].

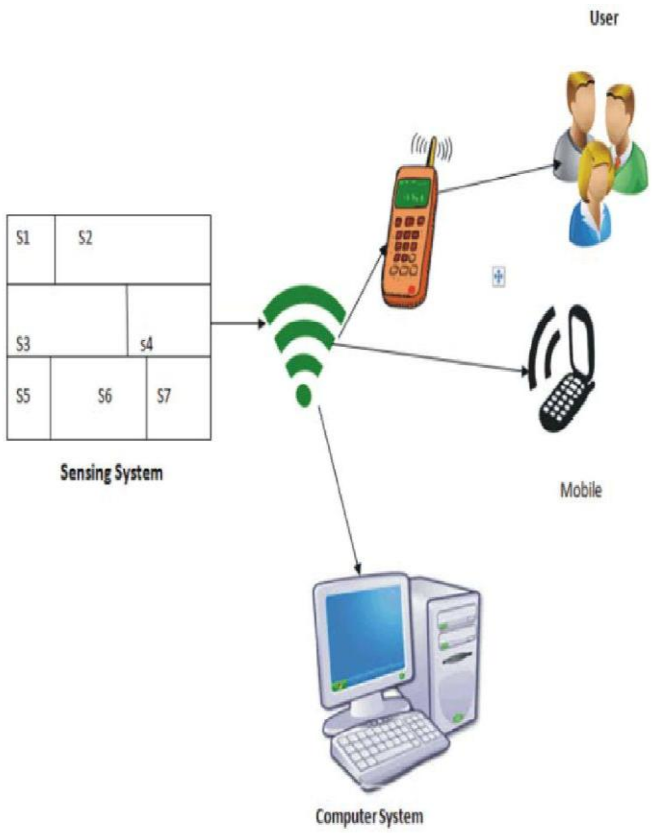


Fig. 3.1: System Architecture

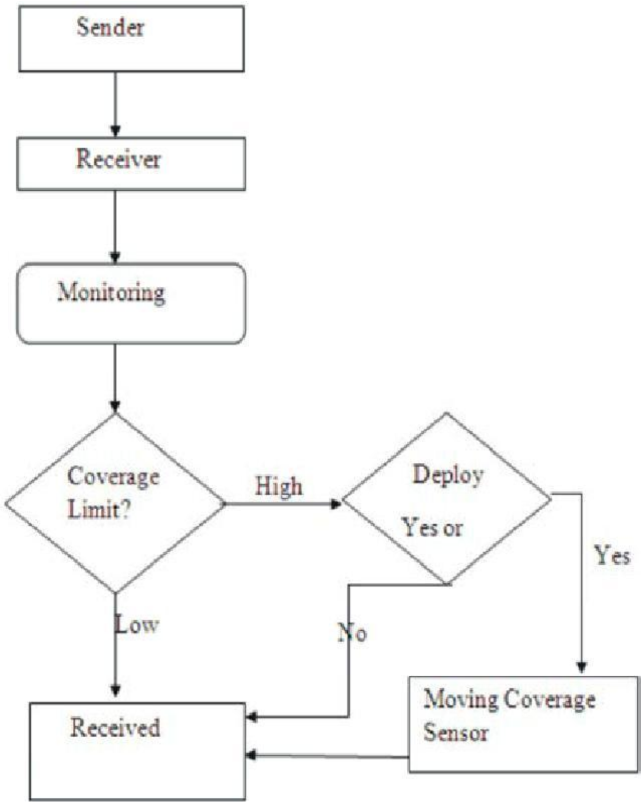


Fig. 3.2: Dataflow Diagram

In this system, one commonly considered metric is to minimize the number of sensors required to achieve a certain sensing coverage. Due to different sensor capabilities and manufacturing expenses, this metric is sometimestransformed into minimizing/optimizing the required total device cost for those deployed sensors, making this research subject more interesting yet the challenging.

Static deployment involves a manual sensor placement/installation [10], which is unable to repair sensing voids dynamically in the presence of unexpected sensor failures.

Dataflow Diagram: In this Fig. 3.2, sender sending the data which is to be received by the receiver is being monitored by a monitoring system. If the coverage area of the sender doesn't reach the coverage limit of the receiver, then a moving sensor is deployed to increase the coverage, helping to reach the destination. If it is within the limit it is the received by receiver from the sender without asking for moving sensors deployment.

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Module Description:

The objective of proposed system is to operate successfully, to provide sufficient sensing coverage. The smart sensing environment as a sensing system with the capability to sense the environment and respond in an automated manner. In this proposed work, the smart sensing environment with heterogeneous sensor equipped with actuation facility is targeted. The coverage aware sensor automation (CASA) protocol is proposed to realize an automated smart sensing environment.

Two centralized algorithms are included:

Enhanced Virtual Force Algorithm with Boundary forces (EVFA-B) and Sensor Self-Organizing Algorithm (SSOA).The EVFA-B protocol produce weighted attractive and repulsive forces which produce a resultant force which guides the sensor to the suitable position with the objective of enhanced sensing coverage. In the presence of energy depletion and unexpected failures SSOA algorithm performs local recovery. The Algorithm 1 and Algorithm2 provides the pseudo code for EVFA-B operation and SSOA operation respectively are written below.

Algorithm 1: Enhanced Virtual Forces Algorithm withBoundary Forces (EVFA-B).

```
1: set loops= 0;
2: set cnow= cinit; // initial coverage ratio
3: while (loops <Maxloops) && (cnow<cth) do
4: for each sensor si _ {s1; s2; . . . ; sk} do
5: compute F=? Fij+Fib
6: end for
7: perform virtual movements; // all sensors virtually move
to their next positions
8: update coverage ratio cnow;
9: set loops=loops+1;10: end while
```

Algorithm 2: Sensor Self-Organizing Algorithm

```
1:while (sdeaddetected) do
2:evaluatecnow;
3:if (cnow<cth) then
4:perform EVFA-B to redeploy the entire WSN;
5:else
6:obtain the overlapping degree Wi of each Si _ Ndead;
7:construct graph Gr;
8:apply MWC-FS approach to determine the maximum-
weight clique set in [11] Gr;
9:rescue sensors set Rdead is selected as the determined
clique set;
10:for each sr = Rdead do
11:perform the first- tier physical movement;
12:for each affected neighbor sr _ Nr do
13:perform the second-tier physical movement;
14:end for

15:end for
16:end if
17:end while
```

Modules: The modules of my work are listed below:

- Server network establishment space allocation Network tomography
- Monitoring report generation
- File uploading and add-on moving coverage management

Module Description

Server Network Establishment Space Allocation:

In this module, space allocation for each sensor node in the wireless sensor network is done. A file server provides a central location on the network where it can store and share files with users across the network. When users require an important file like a project plan, they access the file on the file server instead of having to pass the file between their separate computers. If the network users need access to the same files and network-accessible applications, configure this computer as a file server.

Network Tomography:

In this module, the background details about the end point are obtained. The study of a network's internal characteristics using information derived from end point data is called as Network tomography. The word

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tomography is used to link the field, in concept, to other processes that infer the internal characteristics of an object from external observation, as is done in magnetic resonance imaging or positron emission tomography (even though the term tomography strictly refers to imaging by slicing). Network tomography believers maps the data path that takes through the Internet by examining information from "edge nodes, " the computers in which the data are originated and from which they are requested. The field is useful for engineers attempting to develop more efficient computer networks. Data derived from network tomography studies can be used to increase the quality of service by limiting link packet loss and increasing routing optimization [12].

Monitoring Report Generation:

In this module, the report is generated depending on the sending sensor coverage limit. Fundamentally wireless sensors are unreliable. With unexpected failures or sensor energy depletions there is a decrease in sensing coverage which declines the event detection capability of a WSN.

In Small-scale monitoring zones, where sensor deployment mechanism is feasible and beneficial. For large-scale WSNs, several works have been proposed to address the energy conservation. There exists a powerful cluster head responsible for performing centralized computations. All sensors communicate with the cluster head through a single-hop or multi-hop wireless transmissions. A2 sensors have the isotropic sensing shape and the binary sensing /detection behavior, in which an event is detected, by a sensor with complete certainty if this event occurs inside its sensing radius. Both the homogeneous and heterogeneous5 sensors are allowed in our model. Information on respective sensing ranges is provided.

File Uploading and Add-On Moving Coverage Management: In this module, it deals with the coverage management by increasing the sensing area by creating moving sensor deployment. As pointed out in that real time focus models do not sufficiently capture the radio and sensor irregularity in a real world environment, a proof-of-concept implementation is thus needed to demonstrate the feasibility of our proposed CASA protocol. Many works are proposed for large-scale WSNs for addressing energy conservation. Suppose a sufficient number of sensors are given which are randomly deployed over the monitoring field which ensures the certain degree of redundancy in sensing coverage. These proposed the schedules of design node in which the sensors rotate between active and sleep modes. The energy conservation is to be achieved while reasonable sensing coverage and network connectivity are preserved.

Working:

In this project we are developing rescue dog suit which detects living human body. Here we are using PIR to detect living human body. Once the dog reaches near to the human body, the sensor present in the suit check for human alive. It also include basics like wireless cameras, toxic gas detector/ LPG detector, smoke detector and MEMS accelerometer in the system. We can control the dog from remote location using voice command and also we can know the surrounding things using wireless camera. Here we use Bluetooth for communicating between user and the dog.

Software Libraries Used:

- Bluetooth Module: AUBTM20 via UART protocol.
- WTV-SR Voice Recorder / Play Back Module via SPI.

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- PIC18F Device Driver Library.
- Sensors: ADC device drivers.
- MEMS accelerometer Via I2C protocol

Software Tools Used:

- Programming Language : Embedded C
- Development Tool:MPLAB IDE 8.56v
- Compiler : C18

Embedded Protocols Used:

- I2C- (Inter integrated circuit) Serial communication Protocol
- SPI- (Serial peripheral interface).
- UART- (Universal synchronous asynchronous receiver transmitter)

Hardware used:

- Microcontroller :PIC 18f45j11.
- Audio Out : Speaker.
- Wireless : Bluetooth.
- Gas sensor : MQ2.
- Human Detector : PIR sensor.
- Slope : MEMS accelerometer.
- Voice Recorder : WTV-SR

CONCLUSION

The critical issue of sensor sensing coverage is overcome by using CASA protocol.The main objective is to provide effective surveillance coverage for smart sensing environments. Two centralized algorithms which are included in the CASA protocol suite, namely Enhanced Virtual Force Algorithm with Boundary Force (EVFA-B) and Sensor Self-Organizing Algorithm (SSOA), to separately handle the global sensor self-deployment and local sensor self-organization in the presence of node failures. This capability of local recovery is advantageous regarding saving the communication and moving energies. By using these protocols, the coverage area of the sensor node is increased and thereby helping to improve the reliability.

Future Work: The availability of the global sensor deployment for coverage is limited in the proposed system. So, as the future enhancement, an idea of limitless virtual coverage is considered.

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