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Energy Efficient Protocols for Wireless Sensors Network

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Abstract:- In wireless sensors networks (WSN), huge number of nodes are deployed randomly in area for analysing the environment conditions at that time like temperature, light, earthquake, humidity, sound etc. & transmit their sensed or measured data to sink nodes by means of multi hopping data transmission process. The sensor nodes relay on limited battery life where as sink nodes are always rich power because they are connected at back end network. During the data transmission, the sensor nodes which are closer to sink nodes use up their energy earlier than the nodes which are away because they relay more data packets. It means some sensor nodes are burn out and some are alive. This cause to energy imbalance in between the sensor nodes, and leads to connectivity holes and coverage holes, and finally there is whole network failure.

Keywords: - Wireless sensor networks, Clustering, Simulation for WSN.

I. INTRODUCTION

A wireless sensor network (WSN) consist of spatially distributed autonomous sensors to monitor physical or environmental condition, such as temperature, light, earthquake, humidity, sound etc and cooperatively pass their data through a network to a main location. The modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance. Today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring and so on. The wireless sensor network consists of large no of resource constrained wireless sensor nodes which are able to take various environmental measurement i.e. light sound, humidity etc. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communication bandwidth.

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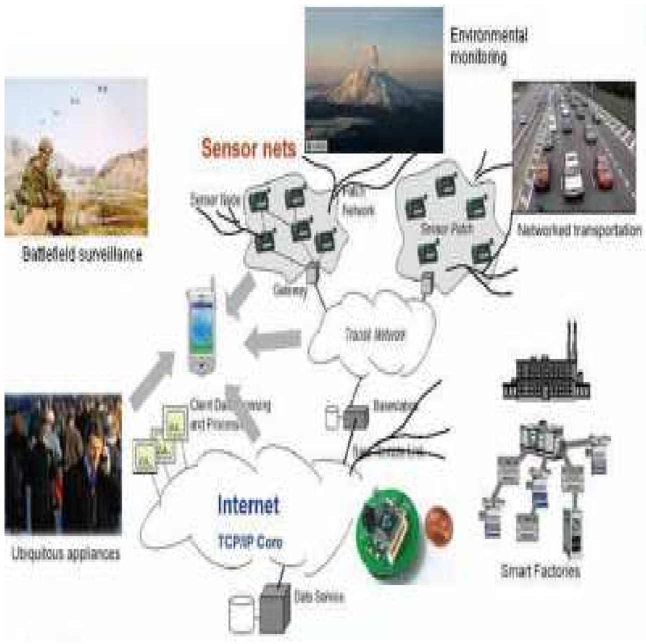

Fig. 1.1 Architecture of WSN

A. Characteristics of WSN

The main characteristics of a WSN include:

- Power consumption constrains for nodes using batteries or energy harvesting
- Ability to cope with node failure
- Mobility of nodes
- Communication failures
- Heterogeneity of nodes
- Scalability to large scale of development
- Ability to with stand harsh environmental condition
- Ease of use
- Self- organizing capabilities
- Short-range broadcast communication and multi hop routing
- Dense development and corporative effort of sensor nodes
- Frequently changing topology due to fading and node failures.
- Limitations in energy transmit power, memory and computing power.

B. Applications in WSN

WSNs use in the number of real world application. Some of the typical applications are as follows:

Area Monitoring: Area monitoring is a common application of WSNs. In area monitoring, the WSN is deployed over a region where some phenomenon is to be monitored. A military example is the use of sensors detects enemy intrusion; a civilian example is the geo-fencing of gas or oil pipelines.

Environment/Earth Monitoring: The tem environment sensor Networks has evolved to cover many applications of

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WNSs to earth science research. This includes sensing volcanoes, oceans, glaciers, forests etc. Some of the major areas are listed below.

Air Quality Monitoring: The degree of pollution in the air has to be measured frequently in order to safeguard people and the environment from any kind of damages due to air pollution. In dangerous surrounding, real time monitoring of harmful gases is a concerning process because the weather can change with severe consequences in an immediate manner. Fortunately, wireless sensor networks have been launched to produce specific solutions for people.

- Interior monitoring

Observing the gas levels at vulnerable areas needs the usages of high-end, sophisticated equipment, capable to satisfy industrial regulations. Wireless internal monitoring solutions facilitate keep on large areas as well as ensure the precise gas concentration degree.

- Exterior monitoring

External air quality monitoring need the use of precise wireless sensors, rain and wind resistant solution as well as energy reaping method to assure extensive liberty to machine that will likely have tough access.

II. RELETED WORK

A novel computational model for self-organization was first proposed by Turing as Turing's reaction-diffusion model. This model was mathematically supported and experimental. Later, cellular automata-(CA-) based model for self-organization was developed by Gutowitz. The CA-based model was further modified by Leach and Taffoli for incorporating nonlinearity. In fact, the DHM for self-organization has been proposed as a potential mechanism for development and differentiation in artificial life systems. Swarm robotics is a very active research area and has proposed many approaches. It showed that a set of autonomous agents can use pheromone to form interesting and complex global behaviors and exhibit swarming behaviors. The concept of biological hormones proposed one of the earliest attempts to build systems that are robust, flexible, and have the capability to self-organize. The ADS (autonomous decentralized systems) technology has been applied to industrial problems and has the properties of on-line expansion, on-line maintenance, and fault tolerance. This attracted researchers to build ADS. Hormone-inspired DHM (digital hormone model) extends Turning's reaction-diffusion model by considering not only the interplay between reactions and diffusions, but also the network topological structure around each robot, the local sensory and actuator states, and the movements of individual robots. Ant colony, schooling fish, and nectar source selection by honey bees are examples of biological self-organization systems. A simulation of task allocation in the multirobot system using DHM for optimizing the cost of robot system is proposed by Li et al. Conservation and effective prolong lifetime of WSN are established by hormone-based distributed clustering algorithm. Inspired from bioendocrine systems, a tracking strategy is devised for Hormone messages are used in sensor networks to coordinate sensor nodes for mobile target tracking in a self-adaptive way.

III. IMPLEMENTATION

Extended Digital Hormone Model (EDHM)

Sensor networks have been used for a variety of applications one such being spatio-temporal sampling of an environment. It has been previously brought out that such kind of sampling is analogous to foraging activities of bees. Taking that analogy further, we present a tailored, extended digital hormone model (EDHM) that succinctly captures the rules required for spatio-temporal sampling, in a theoretical framework. This model defines the rules for collaboration among mobile nodes for sampling a region in space and time, in an energy efficient manner. We further look at the conditions under which our model will serve its purpose of being energy efficient and also see how a spatio-temporal signal can be reconstructed using this method.

A. Foraging Activities of Honey Bee

Honey bees have been found to focus their foraging activities around more profitable nectar sources. A collaborative effort of several bees maintains a steady flow of food supply in the bee hive. It has been verified that the foraging activities emergent at the colony level occur without any central leadership or a global rule. The overall nectar source election process can be understood with respect to the behavior of individual bees. The following steps are used for the collaboration of honey bees.(1)Honey bees are divided into employed and unemployed forager.(2)The employed forager will communicate by performing a waggle dance to share the knowledge (quality, distance, and route) about the food source with other bees.(3)Unemployed forager observing the dance has an opportunity to become well informed about the various food sources exploited by their colony.(4)Based on the observed dance, the unemployed forager decides whether to start foraging that particular source or to wait for other dances. It has been deduced that the decision to forage is based on the information received during a small time frame and as such does not involve an accumulation of knowledge over successive dances by different bees. To implement the above steps in mobile robots, for sensing signal in a collaborative fashion, we considered the following assumptions and framed rules based on these assumptions.

B. Assumptions

(A1)The state of mobile robots is classified as Probe, Listen, and Move. The state information of nodes is represented by a variable . In the probe state the node takes samples of environmental data through its sensors and conditionally transmits hormones. In the Listen state, a node turns off its sensors and listens to its neighbors for possible hormone transmissions. The Move state captures the locomotion of the node from an initial coordinate to a final one.(A2) refers to both the set of sensor readings , from sensor of node at sampling instance and the remaining battery batt, where(A3)All robots have short range wireless communication facility (either RF or infrared) and can talk to robots that are in proximity.(A4) denotes the hormone that is transmitted from a probing node to a listening node. Each is a three tuple containing the coordinates of the transmitting node as well as the sensor reading. (A5)We assume that a node remains in the Probe or Listen states for a time , before executing . The node can be in the Move state as long as it does not reach its target location.(A6)It is also assumed that each node knows its location in a global co-ordinate system, and that this information is transmitted along with the sensor reading whenever a hormone is propagated. The model does not require any global node

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identifiers.(A7)The value of can fall in three regions as shown in Figure 1. falls in the region if , if in between , and and if , where and are lower threshold and upper threshold values set for .

IV. PRACTICALS ISSUES

While implementing the model, we faced several issues that need to be understood for improving the performance of the model in an actual deployment. These are summarized below. (i) Radio Conflict. As has been previously bought out, localization uses RF (along with ultrasound) which is also required for transmitting and receiving hormones. This not only leads to a time duration where no useful work is being done (model execution is paused) which can cause missed events and hormones resulting in loss of performance, but also increases channel contention. Having a second radio for communication is feasible if the cost of hardware is not of concern. Another solution can be to synchronize the transmission schedules using protocols such as S-MAC. (ii) Localization Time. Since the localization code is multiplexed with the model on the same processor, the model is paused from executing. Only the possible approach is to either have a separate node running the localization code (on a different frequency) or use another localization system such as GPS (which dose not work indoors). (iii) Braking. Since the BeeBot does not have an instantaneous brake and due to the time required for knowing the coordinates, often the bot overshoots the target region leading to oscillatory behavior. This leads to an increase in the converging time for the navigation algorithm. The problem can be solved by making the localization hardware separate and also by providing an effective braking mechanism. (iv) Orientation. Knowing the orientation is another challenging task. The methods discussed in the last chapter are only partly successful as they are either susceptible to errors or require more number of nodes. The best way to get the orientation shall be to use a digital compass as it will provide instantaneous readings with comparatively less hardware cost and power consumption. (v)Beacon Coverage. Since we have only used three beacons, accurate localization can only be done where the ultrasound pulses from all three beacons reach (Figure 1). More accuracy and wider coverage are possible by using a greater number of beacons.

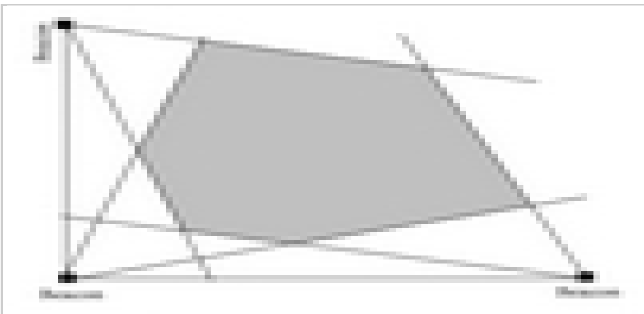

Fig. 1.2 Effective Localization Area

V. CONCLUSION

We have seen that EDHM helps to attain balance between the extent to which battery saving is required and the tolerance in reconstruction error. The simulation results exhibit how larger the number of nodes share the task, improving on both the fronts of efficiency and sampling. We shall, however, like to comment that our model is slightly biased towards saving energy than accurately sampling the region. Nevertheless, the utility is above one for most of the cases, except when the number of nodes is too less to effectively collaborate. Our experiments also reinforce the view that for a self-organizing system to succeed, the number of individual units should be considerably large. It can be also seen from the above discussion that simulations are a good instrument for verifying the validity of theoretical proposal, but the actual implementation might require tackling issues that are totally unrepresented (in the theoretical model). Such issues, nevertheless, must be resolved for the implementation to perform as expected.

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