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Survey on reusable protocols of WSN

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Abstract- Use of wireless sensor network (WSN) has resulted in many revolutionary changes in human life. But research community has not been able to create a common platform which will enable the implementation of different range of applications easy using that platform. "SWiFiNet" is task distributed reusable system architecture. In this architecture complex functionality has been transfer to the second tire devices of the system. This survey paper aims to analyze various reusable wireless sensor networks and concept related to "SWiFiNet".

Index Terms- SWiFiNet, Reusable architecture.

I. INTRODUCTION

Use of wireless network is increasing in every field, day by day. WSN is extensively use where wired network cannot be deployed or is expensive to deploy. WSN opens many ways for research community to further enhance wireless communication efficiency and productivity. Many protocols and algorithms has been developed to addressed many kind of issues related to WSN. But most of these protocols and algorithms concentrate on routing, energy efficiency, reliability and congestion control.

No more research is done on creating some integrated network architecture that will make the implementation of any WSN application easy. It means to make the components of the WSN system reusable. The main focus of WSN is on creating more and more efficient wireless interfaces. The wireless sensor network generally developed for specific work. These work include climate reporting, military applications, fuel level indicator and many more. While creating such system one has to start from the scratch and it becomes burdensome.

So, for all these difficulties, one solution is to create reusable WSN framework. This kind of framework is developed in "SWiFiNet". It is a task distributed System Architecture for WSN.

This paper provides overview of "SWiFiNet" and reusable architecture for WSN. In first section provided introduction about WSN and "SWiFiNet". Second section provides related work regarding task distributed network architecture. Third section provides design goals of reusable architecture. Fourth section provides WSN architecture along with "SWiFiNet" architecture comparison. Fifth and last part concludes the paper

II. RELATED WORK

There has been attempts to make task distributed reusable wireless sensor network architecture. The different applications related to reusable WSN architecture is as follows:-

The ReWINS research initiative is an attempt to develop such an end-to-end solution with support for incremental deployment through a transparent lower layer implementation and control architecture and a user-friendly application interface.

Wireless Integrated Network Sensors or the WINS project and NIMS project at University of California, Los Angeles is about ad-hoc wireless sensor network research dealing mainly with building micro-electronic mechanical sensors (MEMS), efficient circuit design, and design of self-organizing wireless network architecture. Though these projects have been successful in demonstrating a network of self-organized sensor wireless nodes, they seem to have a bias towards environmental and military applications. Also they use proprietary RF communication technology and hence the solutions are restrictive for wide scale deployments in industries.

Motes and Smart Dust project at University of California, Berkeley involved creating extremely low-cost micro-sensors, which can be suspended in air, buoyed by currents. Crossbow Inc. has commercialized the outcome of this project. Here again the solution is restrictive, as proprietary communication technologies have been used to achieve inter-device communication. Further, the focus has been on development of sensors and their interaction rather than how the sensors will be integrated to form systems (simple or complex). This is generally termed as the "bottom-up" approach, which may not be suitable for building complex systems.

Pico-Radio – A group headed by Jan Rabaey at University of California, Berkeley is trying to build a unified wireless application interface called Sensor Network Service Platform. An attempt is to develop an interface that will abstract the sensor network and make it transparent to the application layer. A preliminary draft describing the application interface has been recently released [4]. They

believe in a "top down approach" (from control to sensor nodes) for building sensor networks which is probably more suitable for building complex systems.

Recently, there have been several initiatives like TinyDB , Cornell's Cougar etc. to develop a declarative SQL-like language to query sensors and define certain standard query services. Here the implementation is sensor-interface specific and not a generic or abstracted sensor networking platform. These query services can be implemented with ease on top of our (developed) wireless interface and sensor networking platform and can be made generic by extending them for other sensors. Other research initiatives in this field include MIT's μAMPS , Columbia University's INSIGNIA , Rice University's Monarch. Though there have been a lot of research efforts in developing ad-hoc wireless networks, the focus has been on developing smart wireless sensor interfaces and not much attention has been paid to the actual application integration. Typical approach has been to develop powerful smart wireless interfaces, which supports the important features/requirements for a particular class of applications (like military, environment sensing or more focused applications like fuel-level control in automobiles). The result is a number of wireless interfaces appropriate for a certain class of application; but almost no interoperability between them. We believe that the deployment of wireless infrastructure in industries will occur in incremental stages and thus interoperability (between different sensor-networks) and extendibility (according to application needs) will form the basic requirements of any prospective solution. A prospective good solution would be an end-to-end solution, which is modular and extendable.

All of the above applications were the forward steps towards the making of reusable network architecture.

Sr. No	Application/Project	Purpose of Application/Project	Limitation
1	ReWins	To develop such an end-to-end solution	The main focus is given on industrial scenarios.
2	Wireless Integrated Network Sensor	Building efficient circuit design, and design of self-organizing wireless network architecture	These project seems to have bias towards environmental and military application
3	Motes and smart dust project	Creating low cost micro sensor which can suspended in air	The focus is on sensors rather how they will be integrated
4	Pico-Radio	To make sensor network transparent to application layer	Suitable for building complex systems only
5	TinyDB	To develop declarative SQL-like language to query sensor	Not a generic or abstracted sensor networking platform

III. Guideline Principles of Reusable architecture for WSN

In "SWiFiNet" the complicated functionality is deployed on the second tire devices of the hierarchical Network. The end nodes leave with the simple functionality of sensing and forwarding the data.

The guideline principles of reusable architecture for WSN are as follows:

1. Network Architecture: -

As mention earlier "SWiFiNet" provides hierarchical network architecture, which is one of the required guiding principle for reusable WSN architecture. There are mainly two types of network architecture. First is flat network architecture. In flat Network architecture all nodes will have same functionality. While in hierarchical network architecture, functionality is divided into number of tiers. Each tire will have different set of nodes having different functionality. By doing this we can build more efficient networking system and also can forms clusters, which are useful for handling complicated network.

2. Network Dynamics:-

The network can have different types of nodes like static, Dynamics or scattered. As the application demand changes, Network dynamics changes. One of the desirable feature of reusable WSN framework is, it should be easy to add node or to delete node form the network weather it is static, dynamic or scattered. In "SWiFiNet" the more functionality is provided on second tire of network.

3. Node centric system architecture:-

Nodes are the most important part of any wireless sensor network. There are different types of sensor nodes available in the market. Nodes are basically lightweight, less processing power, less memory, small size and less cost device. The main function of these sensor devices is to sense the background and forward data to the sink node. In "SWiFiNet" the functionality of sensor node has been limited to sense data and forward it to parent node. They need not do any additional work.

4. Network Lifetime

The life of the network is last valuable message send by node to its desired destination. Network lifetime is very important and that's why communication overhead must be made minimum in reusable network framework. The sleep wake up cycle should be adjusted so that it will provide optimum result for the network. Network lifetime will change according to the application.

5. Data transmission Model:

There are three types of data transmission models available. First one is periodic data transfer, in which data that is sensed by the node and will be send periodically to the sink node. The second model is event driven model. In this model when any activity crossed threshold, nodes get activated and send data to the sink node. The third data transmission model is queried data transmission model in which sink node will raise the query to the end node, which in response will provide relevant data to sink node. These models can be use according to the need of application.

6. As given earlier, in network architecture hierarchical network is desirable feature of reusable network architecture. In this hierarchical network model, two tire devises are provided more resources. So an overlay infrastructure is created which will act as message catching layer for the data packets. Most of the complex functionality should be deployed on this layer.

IV. Distributed System Architecture

"SWiFiNet" follows bottom up approach. It means first the end nodes will be design and then the rest of the system will be develop according to the requirements. In "SWiFiNet" the focus is on distributed system architecture and reusability of the components. "SWiFiNet" follows hierarchical architecture having master node, router node and sink node. Detail functionality of these components are as follows:-

Sensor node: The task of sensor node is restricted to sensing background and connecting the neighboring nodes or the master node. When the packet is handed over to any parent node, then it is the responsibility of the parent node to transfer the packet to the master node. In this node's layer architecture, the network layer will have the addresses of the parent devices. It will be stored in the table. Two types of addresses are present in the table. First one is primary parent address and the other is secondary parent address. If primary address parent is not available then secondary parent address will be try by the node.

If network layer don't contain any table then a 'Hello' packet request is broadcast into the network. Then the neighboring device will issue the join request. The join request will be accepted if the device meets LQI threshold criteria.

Router Node: - The main functionality of the router node is to provide a connection between end node and the sink node. In "SWiFiNet" distributed architecture the functionality of the router node has increased remarkably. The complex implementation of any application or protocol will be deployed on the router nodes. The router node network layer also maintains the table containing entries of the parent devices to the router node. It can be router node again or router will send the information directly to the master node.

Master Node:- The complete topology information of the network is maintain by the master node. When there is queried transmission model, master node will generate query and send it in the network. Whenever the routing tables are updated in end nodes or router nodes will send the information to the master node.

SWiFiNet Architecture: - The architecture of the "SWiFiNet" is having similarities to the model explained above. But it is having some major difference compare to the general system architecture. The main difference is distributed system architecture is based on 802.11a while "SWiFiNet" is based on 802.15.4 which is short range communication protocol. It also require less bandwidth compare to 802.11a. It simplifies the functionality of the mac/physical layer. Sleep wakeup call is application dependent. Due to this the life of the nodes can be determine and they can be use efficiently. As sleep wakeup call is predefined the message communication reduce and also the complexity of network. By using this architecture we can easily implement application with different functionality background. By reconfiguring some of the parameters we can have desired system. So we no longer need to start from the scratch. Again the main functionality of the network is deployed on the second tire devices of the network.

Conclusion:-

The survey paper provides a detailed comparison and description of the well-known projects and applications which are developed from reusable architecture point of view. “SWiFiNet” is basically a task distributed generic reusable architecture for WSN. The functionality of sensor node is reduced and has been transferred to the second tire devices like router node. By doing so sensor nodes are restricted to gather information and connecting to neighboring nodes. As time synchronization overhead is not present the lifetime of the network increase.

This reusable architecture can be used for various range of applications and can be configured accordingly.

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