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# Design and Analysis of Virtualized Wireless Sensor Network in Internet Of Thing (IOT).

***Elby K Eldhose[1] and Jisha G[2].**

1. Department of Information Technology, Rajagiri School Of Engineering and Technology,Kakkand.
2. Department of Information Technology, Rajagiri School Of Engineering and Technology,Kakkand.

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## *Abstract*

Wireless Sensor Network gained more influence and are used in broad range application areas including health, agriculture and gaming. Also Internet Of Thing (IOT) is a another emerging scenario with the capability of self configuring and interoperable communication protocol where each object have identities. In the emerging Internet of things (IOT) model, Wireless Sensor Networks are the key components. But still WSN is task-oriented and deployed to support specific domain applications. Researching is ongoing, how to make the sharing of existing WSN infrastructure by multiple independent applications. Virtualization is a technique that solves this issue. Virtualization is a method of sharing resource /infrastructure with multiple applications. This paper makes a study about Wireless sensor Network, Virtualized Wireless Sensor Network and their applications.



## Introduction:-

Internet of Things is the next emerging technology, which involves the communication and exchange of data in heterogeneous environment. WSN are the basic communication medium that helps the users to interact with the real World (I. F. Akyildiz et al.,2002).WSN contains set of nodes with specific task assigned during deployment. Main drawback of existing WSN is they are task oriented, dedicated to a particular application with no chance of reusing them for another application. With the introduction of IoT, deployed WSN will have to support multiple application in order to satisfy the envision of IoT.

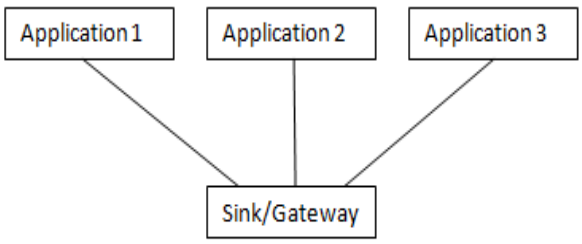


Fig. 1. Sink node collects all the information

In figure 1 Data can be shared, sink/gateway collect all information and it is accessed by multiple independent application , WSNs are merged into the cloud by sending observed sensor data to outside world with the help of host

manger. The host manager simply collects the sensor data, profiles/aggregates it, and then allows multiple applications to use it for their own purposes.

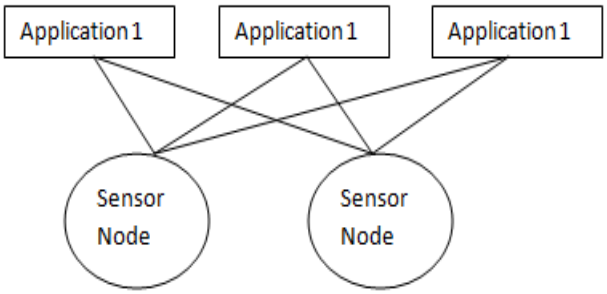


Fig. 2. single node process all the application

Another approach is to use the capability of each sensor nodes to run concurrent application by grouping them according to the requirement.

This paper introduce a critical overview about the wireless sensor network and virtualization wireless sensor network , the state of the art.

## Overview Of Wireless Sensor Network:-

Wireless sensor Network is the deployment of nodes in a particular area to form a network for observing particular event . It acts as glue between the real and physical worlds. The communication architecture contains sink nodes and a base station. Sink node collects particular event information and propagates through the intermediate nodes to reach the base station .Each node has the capability of sense, process and communicate (I. F. Akyildiz et al.,2002). One of the major issues is, they are domain specific. Ones it is deployed for a particular application cannot be used by anther task. There are mainly two types of sensor networks homogenous WSN and Heterogeneous WSN. In homogenous network all the deployed node has identical hardware and complexity. Heterogeneous network contains different type of nodes with different functionality and battery energy (R. Chu, L. Gu.,2013**)**. All of the above structures are limited to a specific assigned task and there is no effective utilization of resources. As a solution for this limitation we propose a virtualized concept in wireless sensor network.

*Applications of WSN*

- Disaster relief operations: Sensor nodes are deployed from aircraft to the wildfire in order to monitor the temperature. It delivers a temperature map. It also helps to the monitoring of environment before a fire occurred .
- Biodiversity mapping: In this application also sensors are used to monitor the wildlife. It is actually the repeated observation of biological diversity in order to get the status and trends .
- Intelligent buildings: Mainly focused on reduced energy wastage by the proper humidity, ventilation, air conditioning etc. Also need the monitoring of proper air flow, room occupancy. Intelligent monitoring is also applicable for the bridges, monitoring the mechanical strength, monitoring the crack and strains .
- Precision agriculture: It is also known as satellite farming or site specific crop management, is a farm monitoring concept of monitoring, observing and responding in variability of crops. The variability includes climate, crop, soils, weeds etc. Aim is for full farm monitoring with the goal of maximum output while preserving the resources. Precision agriculture achieved by the help of GPS and GNSS .
- Medicine and health care : It includes the Postoperative or intensive care. Monitoring of long term illness or condition of a patient .

## Role Virtualized Wireless Sensor Network in IOT:-

In general virtualization refers to the act of developing something virtual (not real) by dividing the mainframe resources for different application. But it is not limited to a virtual hardware frames. Virtualization got fast attention in networking and computing because of the benefits such as resource utilization, low cost, flexibility, manageability

and scalability (Imran Khan et al.,2015). Above mentioned benefits, makes the concept of virtualization perfect for Internet of Things. So this advantage can be adopted in WSN.

*Advantage:*

- Sharing of Physical Network
- Brings flexibility and scalability
- Simplified architecture
- Network Heterogeneity
- Scalability
- Programmability

*Architecture of VWSN*

Sensor network virtualization mainly focused in the region of node level virtualization and network level virtualization. WSN node level virtualization, each node run multiple applications concurrently shown in figure 3.

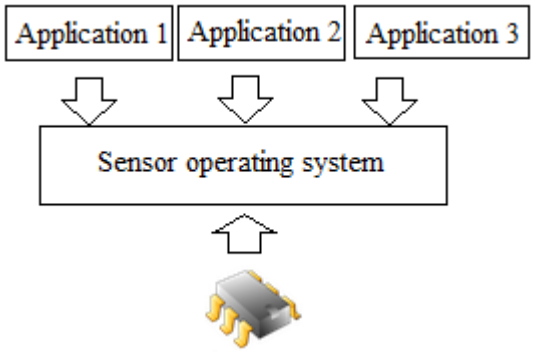


Fig. 3. Sink node collects all the information

In WSN network level virtualization, particular subset of node from the deployed WSN forms a group and performs the dedicated application. It can be achieved in two ways, in the method different VSN can be formed from the deployed WSN. Second method tries to from a single VSN over multiple WSNs in different administrative domains shown in figure 4.

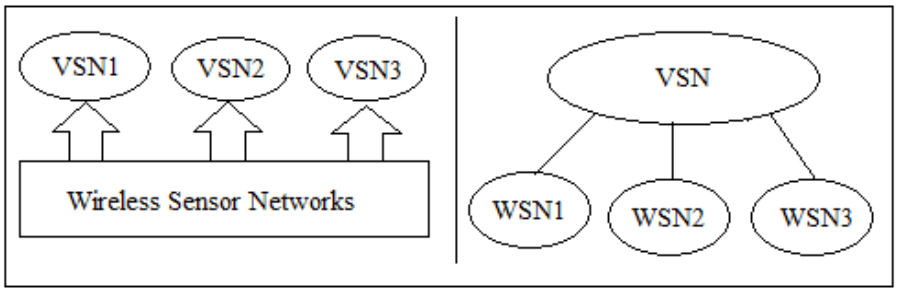


Fig. 4. Network level virtualization

Figure 5 shows the layered virtualized WSN architecture

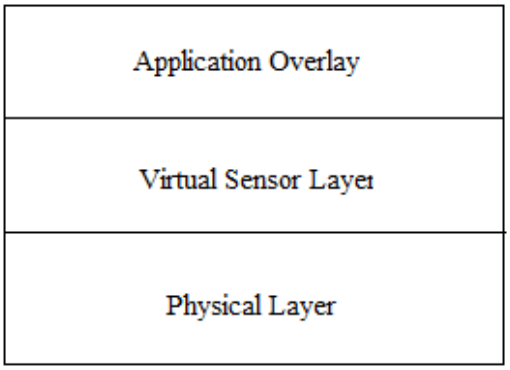


Fig. 5. Multi-layer architecture

In the architecture there are mainly three layers physical, virtual sensor layer and application overlay, two paths data path[Di] and control path[Ci]. At the physical layer we deploy independent sensor node that has the capability of multi sensing functionality. Also contains specialized nodes called gates-to-application (GTA) node. The functionality of GTA nodes to help the sensor nodes to link with the application overlay. The virtual sensor layer is a logical representation of each node on the physical layer that processes multiple applications concurrently. The application overlay contains different functional tasks. The application overlay takes data from the physical sensor node according through there requirement. So by using the concept of virtualization we can make the sensor network independent over domain specific and task oriented. Then it will be very easy to connect the wireless sensor network to the Internet of Things.

**Proposed VWSN Model:-**

The proposed VWSN model contains two section first section contains, components that used for implementing the scenario.Next section includes architecture part.

**Components Used:-**

- Sensor Nodes: Sensor nodes are the key components in a WSN network. Usually sensor nodes are used for sensing particular event. Each node has the capability of performing some processing and transmission to the neighbor nodes. The communication can be either single-hop or multi-hop. In the implementation part we used DHT 11 Temperature sensor. It has the capability of sensing both Temperature and Humidity.
- Sink Node: Ultimate decision is taken by the sink node. It aggregate all the informations gathered from the end sensor nodes. Here we used an arduino UNO module, which act as the sink node.
- Gateway: Gateway is another aggregation point in Wireless Sensor Networks. Due to the limited communication range, we used gateways to transmit long range. In our scenario we used Raspberry Pi as gateway. Raspberry Pi a low cost, credit-card sized computer. All the coding part is done in python.
- End User application: The functionality each end user application, to access the information. In the illustration we used three applications. Two of them act as a user interface for accessing the sensor data by all the users via the gateway. And the third one is a mobile application which is used for accessing the data directly from sink node.

Using these components we implemented the sharing of WSN infrastructure.

**Architecture:-**
Figure 6 shows the Virtualized Wireless Sensor Network implementation architecture.

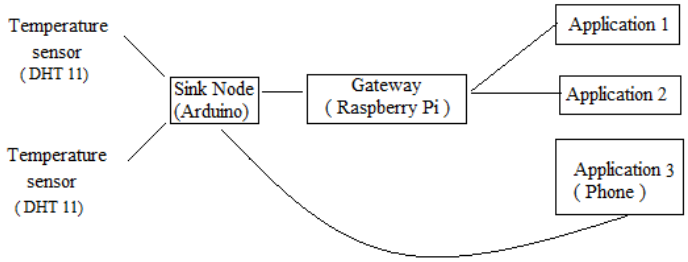


Fig. 6. VWSN Architecture (Implemented)

Here we used three different end user application one to access the temperature value greater than 50, another application retrieves temperature value as well humidity value. Third is a mobile application, to get the sensed information to the end users mobile phone. Ardino directly send the data to mobile application with the help of bluetooth module. Other two application accessed through gateway(Raspberry Pi). All the three application share the same WSN infrastructure, so we implemented the VWSN. Processed data can be further send to a cloud system or can be updated continuously through a websites which is accessed by end user.

The architecture specified in figure 6 has been implemented in real time as shown in figure 7.

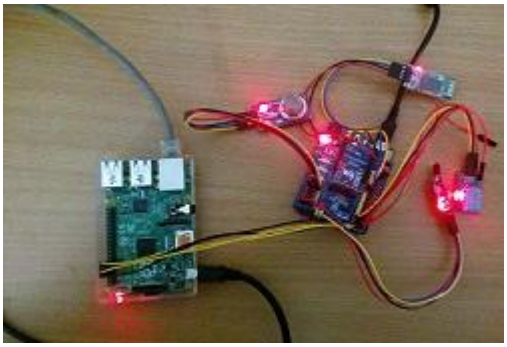

Fig. 7. Real time implementation using arduino and Raspberry Pi

Figure 8 shows the application3, that is the end user get the information regarding the temperature and humidity directly from the arduino.

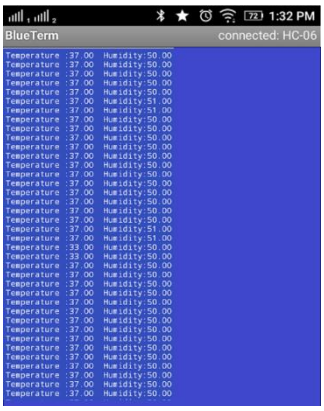


Figure 8 shows the application3

## Conclusion:-

Internet of Things (IoT) is a emerging technology to address all the objects uniquely. So in order to cover all the application areas, WSN plays a vital role in the event detection. It was a huge problem when we connect it to IoT. This paper proposes virtualization on existing WSN in order to overcome the difficulties faced in interconnecting WSN with IoT. This Paper provides a detailed overview about the wireless sensor network and its applications. Also gives a multi-layered architecture for VWSN. Finally, illustration of accessing the sensor node information by three different end users.

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