

# Survey on Robotics and Wireless Sensor Network Integration

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**Abstract:** Researcher have done lots of investigation in the area of robotics and wireless sensor network(WSN) independently, but if integrate this two areas then it would support to lots of application such as underwater, disaster management, nuclear power station, space exploration, military, healthcare etc. In this paper we start with review of WSN, robotics and how we could use robot in WSN. We can use robot to solve number of problems of wireless sensor network just like a localizing of nodes, and also robot can used as a data mules for aggregating data from different sensor nodes. We can also build a wireless sensor network using autonomous mobile robots instead of sensor node; the use of mobile robots gives accurate positioning. Received signal strength is used to get accurate position of mobile robots.

**Keywords:** Data mule, Localization, Mobile robot, Wireless Sensor Networks.

## I. INTRODUCTION

Now days there has been lots of research takes place in wireless sensor network and it has various applications. In the robotics area, instead of single robot researcher moved to multiple robots and try to synchronize them using multiple algorithms such as a genetic algorithm and particle swarm optimization. In this paper firstly we describe what is mean by wireless sensor network. WSNs are networks of hundred to thousand sensor nodes; each sensor node is an embedded device which required very less power and that sensor nodes connected wirelessly by using different wireless protocol such as zigbee, Wi-Fi (Wireless-Fidelity) etc. These sensor nodes are distributed over a large area for monitoring environmental or physical conditions. Each node in the WSN has different functions according to the network topology. Few nodes are used sensing the environmental conditions; few nodes are used for routing i.e. for data aggregation. Data from all sensor nodes is collected at one particular node is termed as a 'sink node' [1]. Collected data by sensor node is aggregated wirelessly at sink node and then it sends to user through internet. Basic architecture of WSN is as shown in fig.1. Wireless sensor network can be

classified into two types Unstructured WSN and Structured WSN.

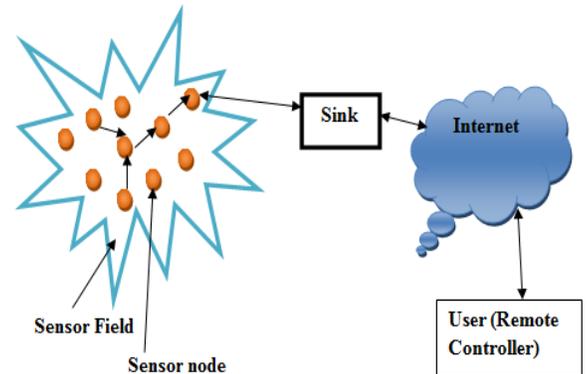


Fig. 1 Architecture of wireless sensor network

In unstructured WSN nodes are deployed randomly in ad-hoc manner over a large area. In structured mode nodes placement are preplanned; at the time maintenance structured mode is easy as compare to unstructured mode [2] [3].

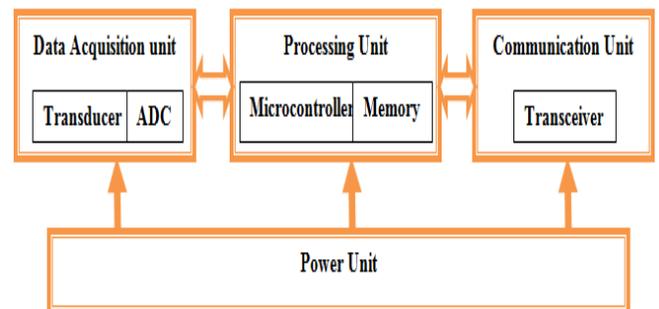


Fig.2 Wireless sensor node

Figure 2 shows basic structure of sensor node. Generally sensor node contains data acquisition module for collecting the physical data, Processor, Communication module and power module for giving power to this entire module. Transducer is present in

data acquisition module which is used for convert the physical signal into its equivalent analog signal; then Analog to Digital Converter (ADC) is used for obtaining digital signal which is needed for processor module. Stored data in memory unit is processed by microcontroller and send control signal to communication module for further communication in between sensor nodes. Power unit may be solar cell or batteries. Power unit is used to determine the size of the mote. We can add different component in sensor node structure depending upon the requirement of applications. For example if we need location information then adds Global Positioning System (GPS) module in node structure [4] [5].

In WSN there are several issues such as a network topology selection, path selection for data transmission from one sensor node to another node, for wireless transmission which protocol is beneficial? Is that protocol is energy efficient or not. What is data transmission rate? Selection of sink node and if the nodes in WSN are static then at the time of data aggregation several issues occurred. Autonomous robot help the WSN in multiple ways, it enhance the capabilities of WSN. It helps for deploying the node, aggregating data, localizing node, it can act as a sensor node.

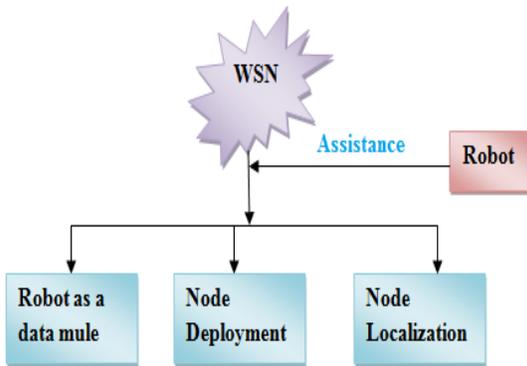


Fig. 3 WSN assisted by mobile robot

### II. Robot as a Data Mules

In WSN there are two types of sensor nodes i.e. static sensor node and mobile sensor node. Mobile sensor node based WSN has more advantages over the static sensor node based WSN but its cost is more; so depend upon applications we have to choose sensor nodes. If we go to static sensor nodes then there are issues occur at the time data aggregation. For these issues Giuseppe Anastasi et.al used mobile robot to collect data from various static sensor node and it is termed as 'Data mule'. Mobile robot visits the various sensor nodes after certain time for pick up the data and

sends it to Access Point (AP). Most of the time sensor node is sleeping mode for energy conservation and at that instant if mobile robot arrives to pick up the data from sensor node then it miss the mobile robot passage; so sensor node has to wait until the next iteration of mobile robot. In this scenario energy conservation is pointless [6].

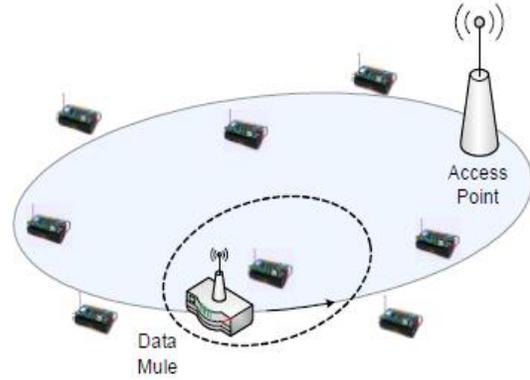


Fig.3 Data mule architecture [6]

### III. Localization Nodes Using Robot in a WSN

In some dangerous area such as nuclear power station, military manual sensor node placement is not possible; so HAI Dan et.al proposed method in that a robot fitted with GPS (Global Positioning System) module is used to place the node. Received Signal Strength Indication (RSSI) is used to estimate the distance between neighboring sensor nodes and also RSSI used estimate the distance between mobile robot and each sensor node; this would help to localize the node[6]. This method is illustrated in Fig.4.

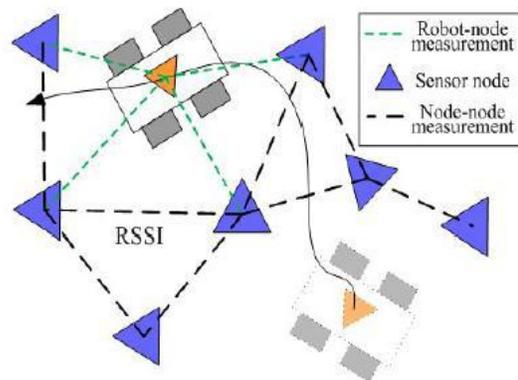


Fig. 4 Localization Scenario [5]

#### IV. WSN Based on Multi-Mobile Robot

Mobile robots perform the task in the dangerous area where human cannot work such as disaster management, drainage system, Coal mine etc. We can use mobile robot to perform some boring and repetitive task. In WSN instead of sensor node if we use Mobile robots to monitor environmental condition and for collecting a real world data then it would be beneficial. Robots mainly consist of microcontrollers, sensors, actuators and motors. Robots navigate through the area for collecting and routing the data packets. In multi-robot system coordination between these robots is one of the main issues. To solve this issue use master slave architecture, where one of the robots is master and all others are slave. Master robot takes the decision and all others follow it[7][8]. Every slave robot receives command from master robot and performs actions accordingly. In multi-robot architecture few one collects data, few robots is used for routing the data packet [9].

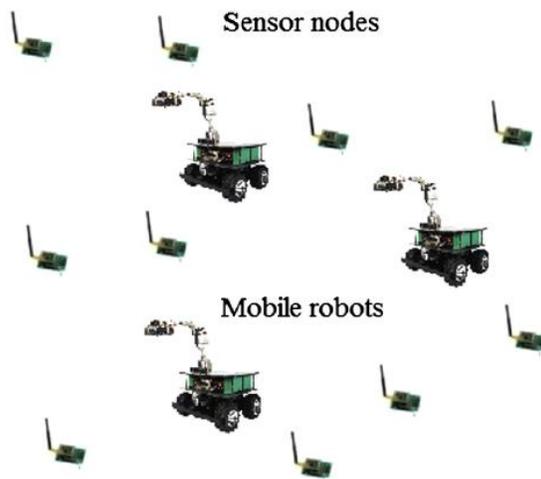


Fig. 5 WSN based on multi-mobile robot [10]

#### V. CONCLUSION

In this paper we make the survey of how can we use mobile robot in WSN; and also we discussed issues. If we integrate WSN and robotics then there is a huge application many more problems get solve. Merging of these two fields may replace the human presence in dangerous area. By using mobile robot data collection

might be improved; but it is challenging to maintain the co-ordination between multiple mobile robots.

#### VI. REFERENCES

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