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WIRELESS SENSOR NETWORK FOR REAL TIME MONITORING OF HARMFUL EMISSIONS AND THUS PROVIDING SAFETY TO WORKERS AT CONSTRCTION SITES

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ABSTRACT

Inrecentyears, Wireless sensors has been increasingly used for the monitoring of construction sites for the protection of workers and monitoring dust emissions.In this paper using sensor nodes various parameters such as dust, noise and vibrations are detected and the resultant data is then sent to data sink. In this paper in addition to safety of worker's localization principle has also been used for the tracking building materials and construction instruments.

Keywords: Angulation,Data Sink, Localization, Lateration, RSSI,Sensor Nodes,Zigbeeetc.

I. INTRODUCTION

In Various environmentalpurposes Wireless Sensors have found applications and has been extensively used such as water quality maintenance, water and air pollution regulation etc**.** While Constructing any building various machinery and materials such as cement, bricks are used which ultimately leads to emission of dust, noise and vibrations**.** These factors not only disturbs and deteriorate the health of the workers inside site but also the harms the surrounding and nearby residents**.** The entire idea of this paper is to develop and install aframework which monitors and visualizes the gas emission, noise from the construction sites successfully in real-time environment and safeguards workers employed in the site**.**A mobile wireless sensor networkis introduced in the paper for the worker**'**s protection**.**Standard Committee and Public authorities takes the decision to limit the noise, dust emission, Vibrations and other harmful agents based on the previous examinations**.** When the emission of these exceeds the limit set by the authority, the mobile sensor nodes collects and sends these information to the remote operator which then reacts upon this information and takes the action quickly**.** The workers within the site are being tracked using ZigBee based WSN network and RSSI methods**.**The following localization principles- Angle of Arrival, RSSI, Time of Arrival, Time Difference of Arrival is analysed and then tracking of resources within and outdoor of construction site is performed**.** After analysing these localization principles,wireless positioning is performed and assessment of technologies such as ZigBee, Ultra-Wideband, Bluetooth is done**.**Feasibility of these technologies and methodologies are evaluated for tracking of workers at the Construction sites**.** For finding the location of workers and construction resources two different methods are used at the construction site for determining node positioning-

1**)** finding distance between the node i**.**e**.** lateration

2**)**finding angle between the nodesi**.**e**.** angulation

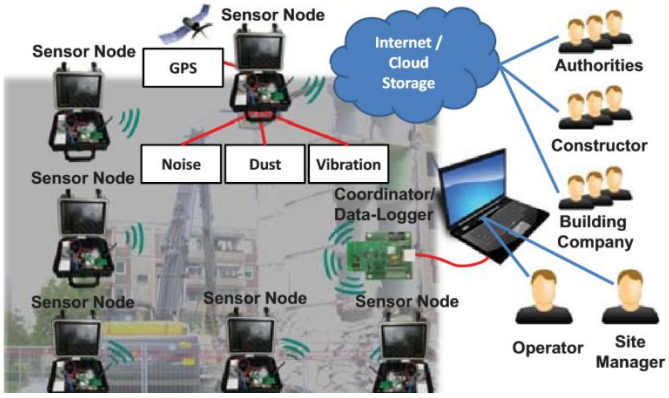

Figure 1: **Monitoring harmful emissions at the construction site.**

II. HARDWARE ARCHITECTURE

Many mobile Sensor nodes are placed at the construction site**.** Fixed nodes are installed at the site using metal rod and screws**.** Inside the construction ground some nodes are installed for the measurement of vibration**.** The nodes present on-site are installed in two ways, above the ground for monitoring dust and noise emission and within the ground mounted on rod called acceleration sensor for monitoring vibrations caused by tools used while constructing anybuilding**.**

Figure-2: Installation of Sensor nodes on-site using metal rods and screws.

For the safety of workers within the construction site, mobile nodes are installed inside thewearable garments which will accompany them the entire day. Activities inside the sites are detected by the sensors installed which then process it and then send it to Data sink. These Senor nodes present in worker's garments working indoor environment are connected via ZigBee. Large environment utilises ad-hoc network.The data associated with workers from all the sensors are received by Gateway which then transmitted to a remote unit via standard Internet connection such as 3G, Wi-Fi etc.

III. SENSOR NODE

Wireless Sensor Nodes have wide applications in various Physical and Environmental applications.

The main components of sensor nodes are:

i)Sensors which detects the physical activities

ii) Antenna

iii)Microcontroller

iv)External memory

v)Power source

vi)Energy harvester

IV. ZigBee FOR RESOURCE TRACKING

In Wireless Network, ZigBee is a standard technology which is recognized globally for its use. It can also be used for its control applications,access the remote unit and also monitors it.

The technologies provided by ZigBee are cheaper than any other wireless Networks such as Bluetooth, Wi-Fi etc. Since consumption of power of ZigBee is very less and therefore it is used in construction sites as it gives the sensor a very long battery life.

For resource tracking and monitoring at construction sites, ZigBee based Wireless sensor network are applied with Ultrasound and TOA for localization purpose.

ZigBee based wireless network when used on-site divides its nodes in to two parts-static nodes and mobile nodes.

Static nodes are scattered at the site and creates a adhoc network for monitoring of dust emitted, noise and vibrations generated at the site. Mobile nodes are attached to resources to track labour, tools etc.

V. RECEIVED SIGNAL STRENGHT INDICATOR (RSSI)

The localizationprinciples such as TOA, TDOA etc.are used at the construction sites but the correctnessof these principles suffer or deteriorate because of shadowing or blockage caused due to surrounding settings or construction materials, equipment at the site. This is overcome by using RSSI principle at the construction sites. RSSI with the help of signal propagation modelsthe distance between the two ZigBee nodes is estimated. It then determines the range in relation to three different nodes in order to calculate the location of tracking resource by use of triangulation algorithm.

VI. PHYSICAL SENSORS

Exact measurement of dust is almost impossible as it keeps on changing at the construction sites and depends on factors such as rain, wind, humidity, Temperatureetc. Dust Sensor gives the indication of dust concentration at the construction site and hence useful for improving air quality and thus providing protection to worker’s health. Vibration sensors such as accelerometer are used at the construction sites. They are installed within the ground with the help of metal rods and screws.

VII. SENSOR POWER SOURCE

Sensor Nodes are not auto rechargeable and therefore all the components in WSN are selected such that they consume less power.

Butwhen used continuously the battery discharges and also it becomes very difficult to provide power supply for recharging the batteries of sensors at construction sites.as a result Energy harvester is used in the WSN that converts energy which is available from the environment such as solar light from sun, wind Energy, Acoustic Noise, thermal energy etc. in to electrical energy. This Electrical energy converted by harvester is then used by battery for its recharging thus making Wireless Sensor network more reliable and avoids nodes failure.

VIII. CONCLUSION AND FUTURE WORK

This Paper suggests designing of Wireless Sensor Network for continuous monitoring and controlling of harmful emissions of dust, noise at the construction sites thus providing safety to the workers and nearby residents. It gives the detailed overview of hardware architecture of Wireless Network used at construction site.

For the future implementation a limit can be set for the emission of dust, noise, vibrations at the site based on the previous experiences and accordingly a series of experiments on real construction and destruction sites can be performed. If the emission exceeds the set limit, check and analyse the working of WSN, Sensor Nodes and the action taken by authorities.

With the development and improvement of ZigBee based wireless sensor network and localization principle, the proposed system can be used to track the resources such as labour, material, tools at the construction sites and the exact position of node of interests

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