WIRELESS SENSOR NETWORKS FOR MONITORING AND REDUCTION OF NOISE HAZARDS

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Outline

• Introduction to wireless sensor networks

• Applications of wireless sensor networks

• The use of renewable energy sources to power wireless sensor networks

• Conclusions
Introduction to wireless sensor networks
Wireless Sensor Network (WSN)

Wireless Sensor and Actuator Network (WSAN)

A group of specialized sensors and actuators with infrastructure for wireless communication, designed to monitor and control the state of physical systems or the environment in various locations, forming a network through which data and control commands are transmitted.
Internet of Things (IoT)

Kevin Ashton, 1999, Procter & Gamble

# Standards of wireless communication

<table>
<thead>
<tr>
<th>Standard</th>
<th>Bluetooth</th>
<th>Bluetooth LE</th>
<th>Wi-Fi</th>
<th>ZigBee</th>
<th>Z-Wave</th>
<th>Thread / 6LoWPAN</th>
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<tbody>
<tr>
<td>Network</td>
<td>PAN</td>
<td>PAN / BAN</td>
<td>LAN</td>
<td>PAN / LAN</td>
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<td>Topology</td>
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<td>Star</td>
<td>Star</td>
<td>Mesh</td>
<td>Mesh Star</td>
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<tr>
<td>Power consumption</td>
<td>Low</td>
<td>Very low</td>
<td>Low to high</td>
<td>Very low</td>
<td>Very low</td>
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<tr>
<td>Bandwidth</td>
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<td>1 Mb/s</td>
<td>11 – 100 Mb/s</td>
<td>250 Kb/s</td>
<td>40 Kb/s</td>
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<td>Range [m]</td>
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<td>5 – 10</td>
<td>4 – 20</td>
<td>10 – 300</td>
<td>30</td>
<td>800</td>
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WSNs applications

- industrial automation
- smart homes / buildings / cites
- health care / health monitoring
- weather monitoring
- construction monitoring
- agriculture and forestry
- environmental monitoring
Examples of WSN applications for noise monitoring
WSN applications for noise monitoring

WSN applications for noise monitoring

WSN applications for noise monitoring

WSNs applications for monitoring and reduction of noise hazards - CIOP-PIB research works
Wireless monitoring system supporting correct use of earmuffs
Earmuffs with electronic circuits
Structure of the system

The system consists of:

• earmuffs, including measuring devices integrated with a radio module for wireless data transmission,
• a wireless data transmission network (ZigBee),
• a main unit of the system processing noise data.
Construction of the earmuffs with measuring devices
Measurement examples
The system for monitoring the working environment and warning employees about hazards
Structure of the system
Location assessment methods - triangulation

\[ P_{RX} = P_{TX} \cdot G_{TX} \cdot G_{RX} \left( \frac{\lambda}{4\pi d} \right)^2 \text{ [W]} \]

\[ RSSI = 10 \cdot \log \frac{P_{RX}}{P_{Ref}} \text{ [dBm]} \]
Structure of the system

### RSSI measurements

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<td>-60,38</td>
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Noise measuring device - communication module
Noise measuring devices
Noise measuring devices
Bluetooth beacons
Wearable device
Warning system against approaching vehicles for workers using hearing protectors
The structure and operation of the system

- An employee warned about an approaching vehicle
- Coverage of the warning zone
- Safe worker

[Graph showing RSL vs Distance]
WSNs supply with the use of renewable energy sources
The concept of system
Electric generators
Thermoelectric generators
Thermoelectric generators
Model of the system
Coclusions

Wireless sensor networks, including those using the Internet of Things, can be an excellent tool to monitor the work environment and warning employees about hazards. Such monitoring will enable immediate reaction to emerging new hazards or changes in the already existing intensity. Data on hazards present in the workplace, collected at many of its points and in longer periods of time, will also enable appropriate design of work processes or preventive activities, limiting the exposure of employees to harmful agents in the work environment.
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Thank You for Your attention!

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