Respiratory monitoring using piezoresistive sensors based on graphene nanoplatelets: experiments during daily activities

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Sense Risc Project
Sviluppo di abiti intelligENti Sensorizzati per prevenzione e mitigazione di RIschi per la SiCurezza dei lavoratori
Wearable Systems
# Wearable Systems

## Types of Sensors for Human Activities and Vital Signs Monitoring

### Strain/Bending Sensors
- Textile-based Sensors
- Optical Sensor

### Magnetic and Inertial Measurements Units (M-IMU)
- Accelerometers
- Gyroscopes
- Magnetometers

### ECG Sensors

<table>
<thead>
<tr>
<th>ECG Sensors</th>
<th>Temperature Sensors</th>
<th>PPG Sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Human Activities
- Joint kinematics
- Muscle activity
- Motion pattern
- Heart rate
- Respiratory rate
- Body temperature
- Blood pressure

## Physiological Vital Signs
- Heart rate
- Body temperature
- Blood pressure
Wearable Systems

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ECG Sensors
Temperature Sensors
GSR Sensors
PPG Sensors

Respiratory rate

Human Activities
Physiological Vital Signs
Respiratory Rate monitoring

### Contact-based Techniques

<table>
<thead>
<tr>
<th>Respiratory airflow</th>
<th>Gas Temperature</th>
<th>Gas Humidity</th>
<th>Gas components</th>
<th>Chest wall movements</th>
<th>Modulation cardiac activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow measurements</td>
<td>Temperature measurements</td>
<td>Humidity measurements</td>
<td>CO₂ measurements</td>
<td>Strain measurements</td>
<td>Biopotential measurements</td>
</tr>
<tr>
<td>Pneumotachograph</td>
<td>Thermocouples</td>
<td>Capacitive sensors</td>
<td>Infrared sensors</td>
<td>Resistive sensors</td>
<td>ECG sensors</td>
</tr>
<tr>
<td>Fiber optic sensors</td>
<td>Thermistor</td>
<td>Capacitive sensors</td>
<td>Fiber optic sensors</td>
<td>Inductive sensors</td>
<td>Light intensity measurements</td>
</tr>
<tr>
<td>Tracheal sound measurements</td>
<td>Pyroelectric sensors</td>
<td>Nanotubes</td>
<td>Fiber optic sensors</td>
<td>Capacitive sensors</td>
<td>PPG sensors</td>
</tr>
<tr>
<td>Microphone</td>
<td>Fiber optic sensors</td>
<td></td>
<td></td>
<td>Movement measurements</td>
<td></td>
</tr>
</tbody>
</table>

Respiratory Rate monitoring

Contact-based Techniques

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  - Microphone

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  - Thermocouples
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  - Capacitive sensors
  - Fiber optic sensors

- Modulation cardiac activity
  - Biopotential measurements
  - ECG sensors
  - Light intensity measurements
  - PPG sensors

Impedance measurements
- Transthoracic impedance sensors

Movement measurements
- Gyroscopes
- Magnetometers
- Accelerometers

Chest Wall Movements
Strain Measurements
Fiber-optic Sensors
Fiber-optic Sensors
Fiber-optic Sensors
Fiber-optic Sensors

Error <5%
Resistive Sensors

1. GNP + Solvent
2. Sonication & Evaporation
3. Ink
4. Mixing
5. GNP
6. Oven
Resistive Sensors
Resistive Sensors
Resistive Sensors
Resistive Sensors
Resistive Sensors
Resistive Sensors vs. FBG sensors

- **Resistive**
  - Adequate Accuracy
  - Short response time
  - Robust
  - cheap
  - BLE communication
  - Noise
  - Zero/sensitivity drift

- **FBG sensors**
  - High Accuracy
  - Short response time
  - High Sensitivity
  - Multi-point measurements
  - Interrogator
  - Expensive
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