System Overview

Opo is a wearable sensor system which provides detailed face-to-face interaction distance and duration in a wearable, easy to deploy manner. Previous systems provide either detailed interaction data, or wearability and easy deployability. Opo accomplishes both by using UL wakeups instead of wireless discovery protocols.

Wearable

1.6 cm

Small form factor

Accurate

Detailed

Ranging Accuracy Test

Two Person Interaction

Comparison to Other Systems

<table>
<thead>
<tr>
<th>System</th>
<th>Ranging Method</th>
<th>Ranging Accuracy</th>
<th>Infrastructure</th>
<th>Time Resolution</th>
<th>Size (cm²)</th>
<th>Battery Size (mAh)</th>
<th>Battery Life (hr)</th>
<th>Tested on People</th>
</tr>
</thead>
<tbody>
<tr>
<td>WREN [31]</td>
<td>RF Scan</td>
<td>208</td>
<td>No</td>
<td>20 s</td>
<td>13 cm²</td>
<td>190 mAh</td>
<td>16 hr</td>
<td>Yes</td>
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<tr>
<td>TelodR [1, 50]</td>
<td>RSSI Sensing</td>
<td>208</td>
<td>No</td>
<td>20 s</td>
<td>20 cm²</td>
<td>4000 mAh</td>
<td>16 hr</td>
<td>Yes</td>
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<tr>
<td>Social fMRI [9]</td>
<td>Bluetooth Scan</td>
<td>500</td>
<td>No</td>
<td>300 s</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Yes</td>
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<tr>
<td>WASP [32]</td>
<td>RF ToF</td>
<td>50</td>
<td>Yes</td>
<td>.04 s</td>
<td>N/A</td>
<td>6.5 Ah</td>
<td>10 hr</td>
<td>Yes²</td>
</tr>
<tr>
<td>Cricket [46]</td>
<td>UL/RF TDoA</td>
<td>10</td>
<td>Yes</td>
<td>1 s</td>
<td>40 cm²</td>
<td>4000 mAh</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>iBadge [40]</td>
<td>UL/RF TDoA</td>
<td>10</td>
<td>Yes</td>
<td>30.5 cm²</td>
<td>N/A</td>
<td>5 hr</td>
<td>N/A</td>
<td>Yes</td>
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<tr>
<td>RADAR [11]</td>
<td>RF Fingerprinting</td>
<td>2500</td>
<td>Pseudo²</td>
<td>N/A</td>
<td>38.5 cm²</td>
<td>N/A</td>
<td>5 hr</td>
<td>Yes</td>
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<td>Dolphin [36]</td>
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<td>13 s</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>No</td>
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<tr>
<td>Future UL [45]</td>
<td>UL Ass:A ToA</td>
<td>sub-cm</td>
<td>Yes</td>
<td>1 s</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>No</td>
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<tr>
<td>Opo</td>
<td>UL/RF TDoA</td>
<td>5</td>
<td>No</td>
<td>2 s</td>
<td>14 cm²</td>
<td>40 mAh</td>
<td>93 hr</td>
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</tr>
</tbody>
</table>

Wearable 1.6 cm

Accurate

Detailed

Ranging Accuracy Test

Two Person Interaction

Comparison to Other Systems

Tested on People

A Week as a PhD Student

2 People Partying all Night

Limitations

- Duration sensing suffers in hyper dense scenarios
- Tradeoff between group interaction performance and false wakeups, which drain power
- Tradeoff between ensuring people are facing each other (reducing false positives), and ensuring that every interaction is sensed

Future Work

Integration with smartphones

- Provide BLE data backbone to the cloud
- Provide contextual data, such as GPS location

Data Analysis

- Crowd and cluster detection
- Cross-validation and filtering
- Large-scale network interactions

Mezuri

All materials, software, and hardware, developed for this work are freely available and released to the public domain at http://lab11.eecs.umich.edu and http://github.com/lab11

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