AIDE: Augmented Onboarding of IoT Devices at Ease

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Research Background & Goals

Legacy Manual Procedure
- Onboard each device one by one
- Verify

Shortcomings
- Tedious and error-prone
- Does not scale with number of devices
- Hard to verify visually for some devices

Naive: At each location, select the strongest RSS as the target device

Greedy: Iteratively select the strongest RSS at all locations

AIDE: Voting-based algorithm considering likelihood of devices at all locations

Measuring Procedure & Algorithm

We measure RSS at fixed positions closest to each target device. At each measurement location, we move our phone in a circular way when collecting RSS.

\[
D = \begin{bmatrix}
  d_{11} & d_{12} & \ldots & d_{1N} \\
  d_{21} & d_{22} & \ldots & d_{2N} \\
  \vdots & \vdots & \ddots & \vdots \\
  d_{M1} & d_{M2} & \ldots & d_{MN}
\end{bmatrix}
\]

(a) RSS matrix

\[
V = \begin{bmatrix}
  \sum_{i=1}^{N} (d_{1i} - d_{1j}) \\
  \sum_{i=1}^{N} (d_{2i} - d_{2j}) \\
  \vdots \\
  \sum_{i=1}^{N} (d_{Mi} - d_{Mj})
\end{bmatrix}
\]

(b) Vote matrix

- M: number of devices (including target and non-target devices)
- N: number of measurement locations

Traversing every combination of N devices out of M devices, and for those N devices we traverse every combination of N measurement locations. The result is given by the combination that has the largest summation

Phone App Illustration

1. Open AIDE, focusing phone camera to the target light bulbs. Then, click Capture button to fix a picture of target light bulbs.

2. Click light bulbs on screen one by one, a button is added for each light bulb.

3. Click BLE button to select the BLE devices, including the target devices and non-target devices, then click Close button.

4. Click each location to measure RSS. After measuring all locations, click Confirm button, which runs AIDE algorithm to associate each measurement label with a BLE.

5. The light bulbs can be controlled by selecting the label, and then click the toggle button to change the color of that light bulb.

Results

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Topology: Line</th>
<th>Topology: Grid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naive</td>
<td>53.8%</td>
<td>62.2%</td>
</tr>
<tr>
<td>Greedy</td>
<td>76.5%</td>
<td>64.4%</td>
</tr>
<tr>
<td>AIDE</td>
<td>87.9%</td>
<td>84.4%</td>
</tr>
</tbody>
</table>

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