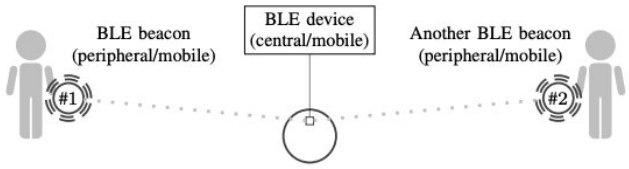
A simple technique allows robots to recognize touch and proximity

29 April 2019, by Ingrid Fadelli



This figure depicts the overall experimental setup. A central BLE device is used to passively scan for advertisements of peripheral BLE devices. People may be equipped with one or more advertising BLE devices. The central device computes packages with RSS data and the ID of received advertisements. These packages are provided via a wired connection to another system on the robot's board or wireless via Bluetooth connection to another machine. As the researchers do not have access to the robot's board, they used the bluetooth connection yielding additional latency. Credit: Scheunemann et al.

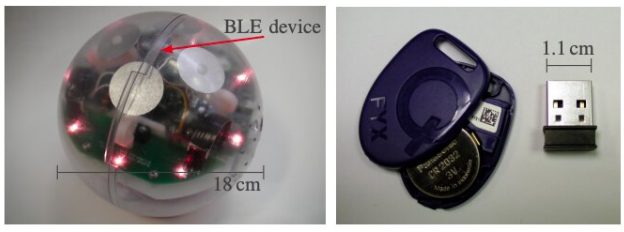
Researchers at the University of Hertfordshire have recently proposed an easy and configurable technique that enhances a robot's ability to perceive and interact with people in its surroundings. Their technique, presented in a paper pre-published on arXiv, utilizes affordable Bluetooth low energy (BLE) devices. Among its many possible applications, it could enhance therapy for children with autism spectrum disorder (ASD), allowing robots to act as mediators and monitor children in their surroundings.

"I am interested in robots that can interact fully autonomously without external control and without an external computer," Marcus M. Scheunemann, one of the researchers who carried out the study, told TechXplore. "I started my work at the University of Hertfordshire to develop robots that can be mediators during therapy for children with autism."

Developing robots that can accurately recognize the proximity to and between children is a considerably challenging task. This is because children are generally quite spontaneous in their decision-making processes, hence, they might move a lot and continuously change their interaction styles. This makes it harder for robots to track children using traditional methods such as cameras or sensors, particularly if a robot is mobile and has little computational power.

Most external tracking devices that feed proximity information to robots need at least three markers in order to be placed on children. In addition, to operate correctly they need to be externally worn and permanently visible at all times.

While the information provided by many existing tracking devices is typically accurate, these devices can be difficult to apply to children and typically restrict their movements to a single equipped room. To overcome the limitations of existing methods, Scheunemann and his colleagues developed a new technique that allows robots to recognize touch and proximity to other humans using BLE devices.



(a) The robot platform (b) BLE components

(a) The mobile robot platform QueBall can move back-forth and tilt left/right. It can also emit sound and colors and detects touch. The researchers did not develop this robot; they merely used it as an example. (b) A self-powered and configurable advertising beacon that is meant to be attached to people (left) and a central Bluetooth device, or BLE scanner, that is equips the robot to scan its surroundings for the strength of

peripheral signals (right). Credit: Scheunemann et al.

"Utilizing BLE is an affordable way to circumvent the issues of existing tracking techniques," Scheunemann said. "When a child wears at least one BLE beacon, a robot can measure the signal strength and infer knowledge about which child is interacting at a given time or when it gets touched. The beacons can be the size of a coin-cell battery and can be placed in clothes or caps, without being visible from the outside, contrarily to external tracking devices."

The technique devised by Scheunemann and his colleagues does not require a camera and can compute all information quickly on-board. In addition, unlike other tracking devices, the BLE devices used by the researchers are cheap and can be purchased easily off-the-shelf.

To test their technique, the researchers carried out three proof-of-concept experiments in a noisy laboratory setting using a mobile spherical robot called QueBall. First, they used their technique to enhance the robot's ability to infer information related to the proximity of individuals in its surrounding environment.

In a second experiment, Scheunemann and his colleagues used the BLE devices as touch sensors, allowing QueBall to recognize when it was being touched. Finally, they used their technique to enable the robot to distinguish between different interacting individuals.

"The technique proposed by us makes it simple to have a robot as a mediator for autistic children's therapy," Scheunemann said. "Using our method, a robot can infer proximity information about a given child, without the need to calibrate a camera to the environment or for environmental changes. This technology can also be scaled for other human-robot interaction scenarios where proximity information to a human is needed."

In their evaluations, Scheunemann and his colleagues found that observing the raw received signal strength (RSS) between different BLE devices significantly enhanced a robot's interactions with humans. In the future, their technique could foster more adaptive behavior in robots that operate in a variety of settings. For instance, it could facilitate the employment of robots as therapy mediators for children with ASD.

"In our future work, we plan to use this technology to equip robots with BLE scanners, so that they can easily infer information related to the proximity to and between interacting humans."

More information: Utilizing Bluetooth low energy to recognize proximity, touch and humans. arXiv:1904.03475 [cs.RO]. arxiv.org/abs/1904.03475

mms.ai/BLE4HRI/

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