

Lab 4: Make the Robot See

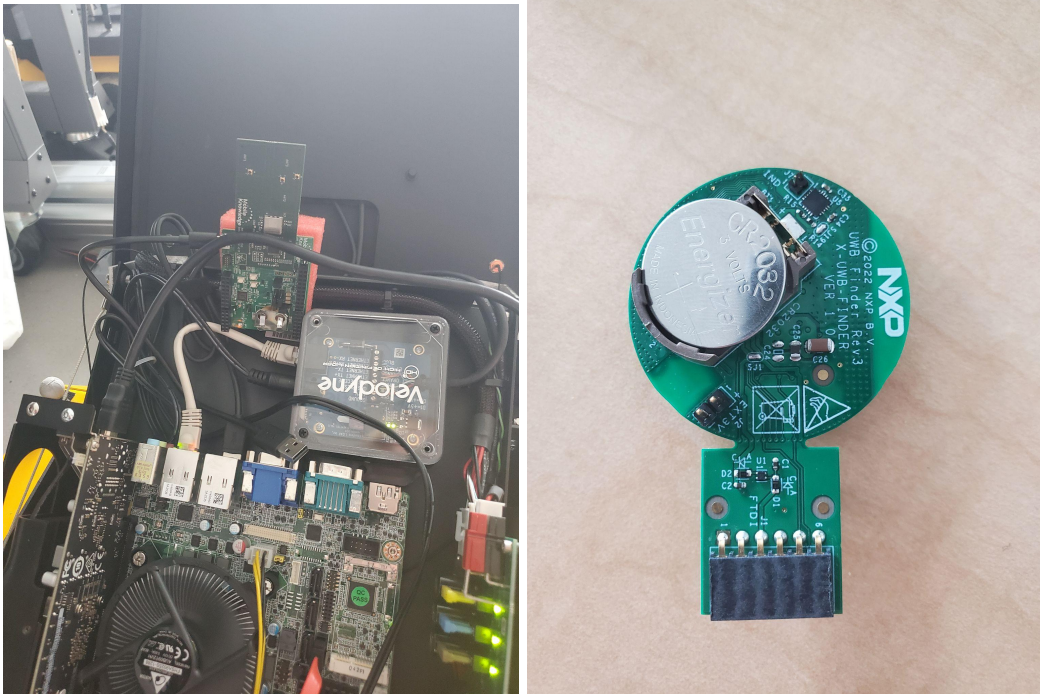
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Technical details

1. For my research, we are trying to make a fully autonomous HRI experiment where the robot guides the user out of a burning building. Because we want full autonomy, we need a more precise way to track humans than standard computer vision algorithms.
2. We've decided to use the MobileKnowledge UWB kit, a bluetooth-esque piece of hardware that can identify 6D relative pose between an anchor and a tag.



Left: The UWB anchor. It connects to the robot via USB. Right: The UWB tag. The anchor can find its relative position.

3. I have gotten this publishing data to ROS. The distance data is good ($\pm 1\text{m}$ or so), but the angular data has several issues. For one, it is noisy— $\pm 30\text{deg}$ or so. Most concerning is that it does not differentiate between forward and backward— both map to zero degrees. I am scheduling a call with their customer support to fix this.

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[2023-05-02 14:22:30] 00:60:37:6B:FF:CD MK-FFCD 183 cm 31°
[2023-05-02 14:22:30] 00:60:37:6B:FF:CD MK-FFCD 197 cm 32°
[2023-05-02 14:22:31] 00:60:37:6B:FF:CD MK-FFCD 200 cm 31°
[2023-05-02 14:22:31] 00:60:37:6B:FF:CD MK-FFCD 207 cm 32°
[2023-05-02 14:22:32] 00:60:37:6B:FF:CD MK-FFCD 206 cm 32°
[2023-05-02 14:22:32] 00:60:37:6B:FF:CD MK-FFCD 208 cm 32°
[2023-05-02 14:22:33] 00:60:37:6B:FF:CD MK-FFCD 209 cm 31°
[2023-05-02 14:22:33] 00:60:37:6B:FF:CD MK-FFCD 204 cm 29°
[2023-05-02 14:22:34] 00:60:37:6B:FF:CD MK-FFCD 209 cm 31°
[2023-05-02 14:22:34] 00:60:37:6B:FF:CD MK-FFCD 205 cm 28°
[2023-05-02 14:22:35] 00:60:37:6B:FF:CD MK-FFCD 204 cm 27°
```

Example data, reported in the form of range and angle of arrival. This chunk is atypically good.

Reflection

1. Knowing where the user is helps us follow the user as they grab items, and make sure that the user is following the robot on the way to the exit.
2. If the relative localization is not accurate, then the robot can behave erratically. The angular error is especially concerning– it could cause the robot to move in completely the wrong direction.
3. Temperature is not an issue with UWB. The speed of relative location estimates is about 1Hz, which may require us to limit the robot speed to 0.5m/s to avoid collisions. The connection is stable & low-bandwidth because all computation is handled onboard.
4. The UWB is able to find the tag in all directions, so it should be able to find the user in our use case. We will need supplemental video feeds (either externally like CCTV or on the robot itself) to prevent collisions.