

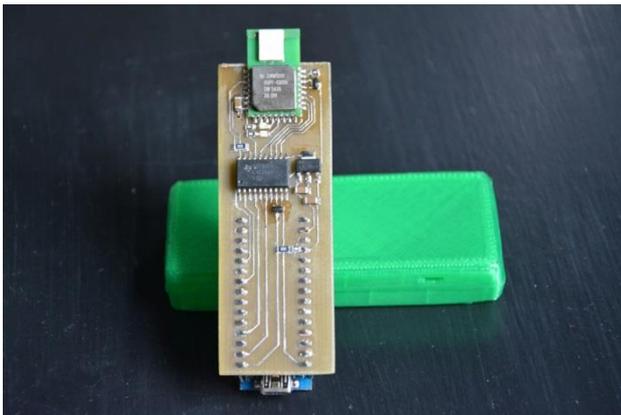
TOPOrtIs TPM UWB wireless system technical description

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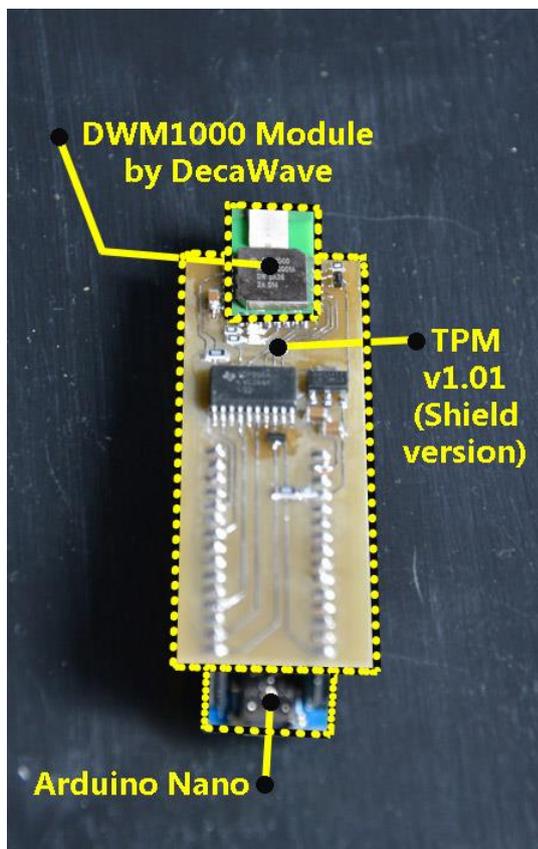
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TPM is a three dimensional (can be used as 2D as well) positioning equipment based on DWM1000 UWB module by DecaWave.

TPM works on anchor\tag basis. Anchors have to be installed and initiated prior a measurement. Each anchor exact location has to be used for tag position calculation, although self-positioning option is available for easier and not as accurate measurements. Tag position calculation is done with ToA(time of arrival) analytics method. Overall experimental update rate can

be increased to up to 100 Hz per tag, so for this specific competition, we will be filtering tag position to archive better results. Same hardware can be used as tag or anchor, although minor software adjustments has to be done prior that.



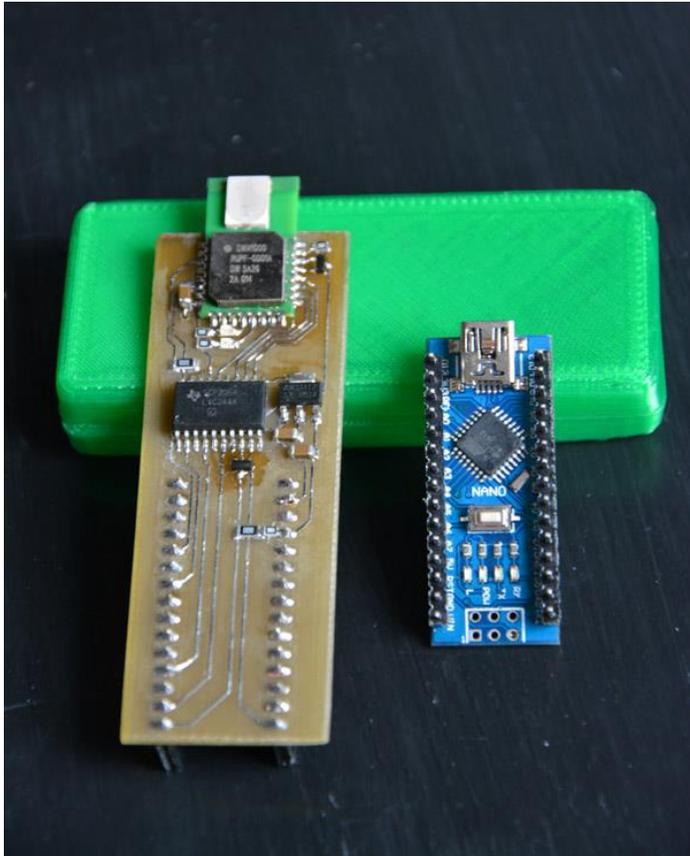
TPM system uses cables to connect all the anchors but can be used without cables in order to improve mobility. There is one downside of using wireless system - setup cuts system update rate approximately in half.

Tag position is calculated by multilateration method. System requires at least 3 anchors to operate. Every addition anchor used improves it, but lowers an update rate, since system allows a tag to talk to only one of the anchors at the time.

TPM hardware is based on Arduino Nano board with integrated DWM1000 module by DecaWave. TPM size(with cover) is 95x30x21mm.

ToA(Time of Arrival) calculation is based on time that light needs to travel between two DWM1000 modules. Distance is calculated by multiplying speed of light by time it takes to travel. Extremely high speed of flight makes it hard to archive high positioning, hence allowing UWB system to work within 10 cm accuracy. Each addition anchor and higher update rate increases accuracy.

TPM ToA communication is based on 3 message system. Each tag sends pool message to an anchor to start distance measurement. After receiving pool message, anchor sends back respond message including data it calculated from first message. Final message from tag to anchor finalize communication. All calculations are done on computer attached by wires to all anchors(can be done wirelessly). Positioning data is optionally transmitted to tag in next response message by master anchor.



UWB system works with LOS(line of sight) or without it. In second option, accuracy drops proportionally to size of an object in between of a tag and each anchor. All objects located nearby the tag/anchor also create interferences. In order to archive the best performance, all anchors should be installed one meter away from walls/objects. If high accuracy is not a primarily goal, all anchors can be deployed at any place where measurements has to be taken.

Additional:

At TOPOrtIs we came up with combination of different technologies for better accuracy and built up a product that uses ultrasound to position objects that are nearby. System uses ultrasound when object is close to the anchors and UWB once distance becomes further. Overall ultrasound covers 30m experimental zone and UWB covers 60m experimental distance.