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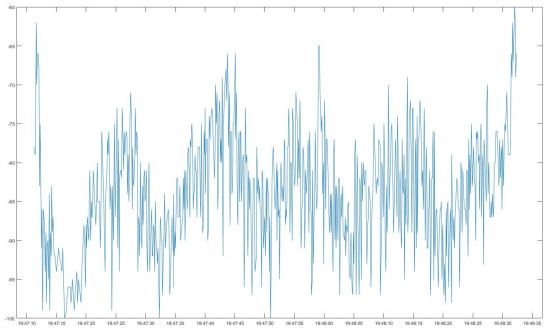
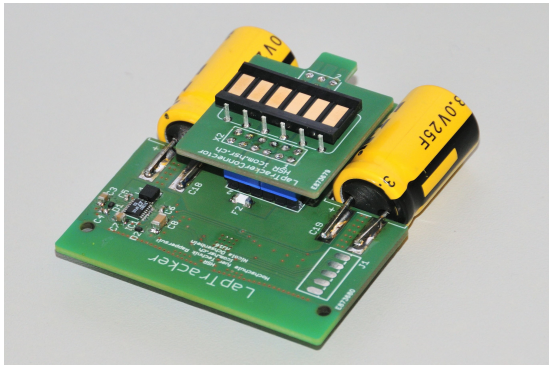
Topic	Sensor, Actuator and Communication Systems

Lap detection of ice skaters

Development of a system for lap detection of ice skaters



Received unfiltered signal strength of a test run in a small gym. Nevertheless, the 5 laps run are distinguishable.



Hardware of the tag. Well visible are the yellow supercapacitors, the charge connector in between and the voltage regulator at the bottom left.

Charging case with 2 of 6 fully mounted charger stations. Tag half way inserted into charging station.

Introduction: To provide a good infrastructure many clubs in the field of sports organize sponsoring events. Popular are lap-based performance activities like running where sponsors pay for the amount of rounds completed by the athlete. The SCRJ Lakers Nachwuchs annually organizes a skateathon where the athletes skate laps within 6 minutes. Around 900 athletes skate at this event. Up to 30 people skate at the same time and their laps have to be counted. The current solution to count the laps is based on UHF RFID, where the athletes wear passive powered tags. This system needs a high installation effort to set up the receiver antennas. A new system is desired to reduce the installation effort. It should not use more than a flash drive sized receiver but may use active powered tags.

Approach/Technologies: These days numerous systems to count laps can be found. However, all of these require high installation effort. Bluetooth solutions are investigated in a parallel project and are therefore not of interest to this thesis. Moreover, a Bluetooth solution might prove to be too slow. The communication design of the HSRvotes can be used to develop the new system. HSRvote operates in the 2.4GHz ISM band. The HSRvotes transmit their IDs asynchronously and unacknowledged. Even though there are transmission collisions and nulls, which result in message loss, there are still enough successful transmissions to detect the laps. The strength of the signal at the receiver increases the closer the tag gets and vice versa. Using a Kalman filter to condition the received signal, it is possible to count the laps with a peak detector.

Solution: The developed solution consists of tags, charger station and the computer software to count the laps. The tag is powered by supercapacitors. This allows fast charging in less than a minute. Fully charged, the tag holds for more than 24 hours. When the empty tag is charged for 15 seconds, it is powered for 6 hours. The computer software is written in C# because the existing counting software is also implemented in C#. This allows easy porting. The software can be used standalone to analyze the received signal, filter the signal, count the laps, and save the recorded data.