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Master's thesis Remote control of mechanical rat traps based on vibration and audio sensors

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How to use audio from a microphone and vibrations from an accelerometer to detect activated rat traps

Rat problems in a quiet environment? Look no further. There's no need for complex algorithms. All that is required is an embedded system and a simple algorithm to detect events corresponding to activated rat traps.

The aim of our thesis was mainly to study the possibilities of detecting events where a rat trap has been activated by analyzing audio streams from a MEMS microphone or movement patterns from a MEMS accelerometer. An algorithm was implemented and optimized for a quiet environment. We managed to get good results by just using an algorithm based on amplitude thresholds. The results presented in our thesis shows that using an accelerometer in an embedded system instead of a microphone is more reliable and more accurate in finding the event of interest (corresponding to a rat trap activation). The advantage with the accelerometer is that we can analyze and make comparisons between three different axes whereas the microphone only has one signal to analyze. Even though both the accelerometer and the microphone are able to detect the response of a rat trap activation by themselves we still recommend using the microphone together with the accelerometer. This is because both sensors output signals that can vary a lot from one activation to the other which makes the detection of events more difficult. Therefore, it is always a good thing if you have multiple sources to check and compare in order to decide if the detection is correct or not. Another advantage that comes from using both sensors together is that you measure two different things, sound with the microphone and vibrations with the accelerometer.

Another aim was to see if any characterization of the events could be found in order to find out which rat trap was activated and whether it was an empty rat trap or if the rat trap caught something. Our results show that it is hard to characterize but also that there are possibilities to do so. A reason to why it is hard to characterize events where a rat trap has been activated is because the time of an activation is so short and happens so fast that the sensors do not keep up and therefore can not give a consistent response. Another reason is the manual activation of the rat trap because each activation is different from the other. It's not possible to activate a rat trap in the same way at every given time, which leads to different amplitude and duration as seen in Fig. 1.

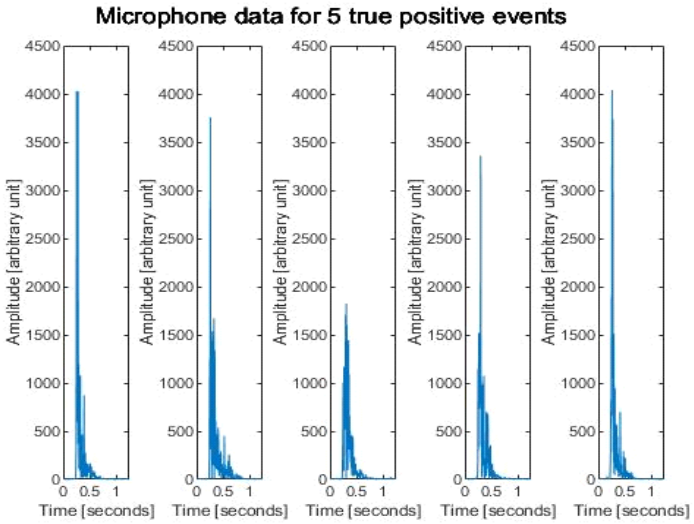

Figure 1. Events corresponding to activated rat traps.

The technological development has improved our lives, in both positive and negative ways. The arguments that can be stated for our project or for monitoring of the rat traps is that it can help to avoid or minimize the rats infectious diseases, or avoid data damage, which will have major consequences in some cases, e.g. when rats gnaw on cables. However, we can mention one important ethical issue raised against monitoring of the rat traps using our prototype. That is whether it will be possible to keep the integrity of the individual, when using a microphone. For instance, if two people are talking about confidential things could the data recorded with the microphone be misused in any way to cause harm towards the involved individuals?