Intelligent Surveillance with Autonomous Underwater Vehicles

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INTRODUCTION
Monitoring fish stocks and other sea-related tasks can be done with small autonomous underwater vehicles (AUV), instead of big ships, which are cheaper to employ and use less fuel. We consider designing a software framework for an AUV, which makes it easy to deploy.

Monitoring of fish stocks and oxygen levels
Currently monitoring such parameters requires larger manned ships by sailing back and forth over the area. This can take several weeks which makes the result somewhat outdated when they are done. By replacing the ship with several AUVs we save fuel, money and can cover a larger area in shorter time by having them swim in a coordinated fashion. It also leaves the researchers available for analysis of the data. We believe automated coordination is useful in other cases as well and that we can generalize the methods for achieving such.

Tracking movement of sea nutrition
When placing windmills it is important to avoid putting the foundation at sources of sea nutrition which are vital to the local biological life. An AUV can track the nutrition from specific sources to see how important the source is. For various reasons, tracking with divers and ships is very difficult.

METHODS
In this project we solve these tasks at a high level using logical planning instead of the traditional guidance, navigation and control (GNC). The existing AUVs have systems that are able to use GNC for simple movement between points in space and our method simplifies the input for such systems. Rather than specialize an AUV from scratch for each task, we introduce methods for specifying any task at a high level of abstraction. This simplifies the employment of a system of AUVs.

REALISATION
As our project is only concerned with the software of the AUV, the necessary materials are the same as the existing AUVs. They are expensive to produce but can be equipped with tools to make the it clearly visible, in case something goes wrong. This way the AUVs do not have to be replaced and they do not accumulate as trash on the sea floor. It is an open task to decrease the production cost on each physical unit and implement the lower level GNC.

RELATED WORK
AUVs are often discussed in the international magazines Hydro International and Sea Technology. The Kongsberg Hugin is widely popular but to our knowledge there is limited research in the automated coordinated movement between multiple AUVs.

NoiseMap

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INTRODUCTION
Noise pollution is becoming a problem, especially in large cities. Studies show that in daily life, 70% of people are exposed to average noise levels during a day that can cause long-term hearing damage (Flamme et. al., 2012). Many local, national and international organizations have strong interests in gathering data on noise exposure. NoiseMap is a personal informatics system for Android mobile phones that measures the level of ambient noise, and allows the user to reflect on how much noise he is exposed to.

RESULTS
A working prototype for NoiseMap was developed as part of the course “02827 Mobile Application Prototype Development”. The main target audience of NoiseMap are:
- private citizens that want to monitor and introduce their exposure to noise
- local, national and international organizations that need to perform noise pollution measurement in cities and buildings

NoiseMap collects audio data from the microphone and location data from the GPS. This data is processed to provide different types of feedback to the user:
- Immediate noise exposure: the application displays the current ambient noise level in dB, a visual indication (a colored bar), a description of the level of risk (e.g. noisy area), and a suggested action (e.g. move away)
- Noise map: the noise level measurements are coupled with location data to create a map of noise intensities. This noise map is overlaid on a Google Maps
- History: the audio levels trends are showed as a graph over time
- Statistics: the data is grouped by time and dB levels and displayed using different graphs

A particular effort has been made to ensure that the phone microphone provides measurements with the highest accuracy possible.

CONCLUSION
Extensive testing of the application has been performed both by the authors and by external users. The application is able to provide valuable information regarding noise exposure and can be used to reflect on a number of elements:
- what are the areas with most noise pollution
- which times of the day or week is the noise exposure highest
- when does the immediate or cumulated noise exceeds healthy levels

Further work includes more precise measurements, additional visualizations and the possibility to submit the measurements to a shared noise map.