

# Thesis / Project

## « Sensor Based Location Awareness with LSTM-Networks »

### Background

Machine learning (ML) techniques can be used to imitate basic cognitive skills of animals. An example is the sense of location awareness. It enables all higher animals to remember a discrete number of locations, to recognize where it is, and to remember how to get from one location to another. The ability to recognize its own location in a set of known locations can be replicated using ML, e.g., with artificial neural networks, in a sensor module with multiple sensors. This can be used for transport boxes with integrated battery-powered sensor modules that are repeatedly transported through a factory along almost the same paths. Three student theses have already shown that this is possible with decision trees or feed-forward artificial neural networks. However, also artificial neural networks of type LSTM are an obvious choice for that purpose, as these are able to process time series of sensor data.

### Goals of the project

The goal of the proposed student project is to investigate if and how LSTM networks can be used to implement a sense of location awareness for transport boxes in factories. The resulting location process must be analyzed for its accuracy of detecting locations and robustness after false detections. Reasons for lack of accuracy and robustness are to be analyzed and understood by means of examples. It shall be analyzed if sensor data can be used directly as features (inputs of the LSTM network) or need to be preprocessed. LSTM networks should be trained and tested by using training data that is available in the institute. The training data contains sensor data recorded for three paths in the TUHH including the real locations of the transport box. It should be analyzed, if and how synthetic training data should be generated from the recorded training data to improve the training of the LSTM network. Practical experiments shall be performed with software written in Python based on Keras / TensorFlow.

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