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Mobility in IT & Artificial Intelligence

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The two panels on IT (chair: Günter Koch) and on Artificial Intelligence (chair: Michael Vogelsang) were run in parallel. Both sessions concentrated on technological and informatics-methodological aspects. The Panel on IT was characterized by a variety of topics, whereas in the complementary Panel on Artificial Intelligence (AI) a first time attempt within the MIGW series was made to localize and specify which of the diverse aspects today defining AI are of special interest to mobility in a globalised world.

The IT track started with a highly informatics-technical discussion if and how Open Source technology is to be used in order to "configure" the control of the automobile of the future. In an impressive survey Robert Höttger concentrates on the central architectural element of a car as controlled by electronics, which is the Electronic Control Unit (ECU) made up by sophisticated software assembly interconnected via a heterogeneous network that consists of a huge amount of sensors, actuators, processing units, interfaces, gateways and more. However, the author does not just only concentrate on this technological core piece of a future autonomous and – at the same time – interconnected vehicle, he also embeds this unit in a wider ecosystem, which follows the standards as set on software level by "Eclipse Kuksa Platforms" being his choice for implementation. (Eclipse offering a mature software development and integration environment is well known and applied since long i.e. stable and trustworthy). The paper gives an impression of the complexity of the overall software system configured through different platforms used for offering to be "populated" with software from different origins, i.e. for configurations with open source software. Such complexity naturally leads into a sophisticated discussion how heterogeneous systems need to be designed when choosing "standards from the shelf" as offered for the integration of open software (and, in combination, also with hardware interface) components.

A special subject neighbored to the article on open software is addressed by the team of Henrik Detjen, Maurizio Salini and Martin Wozniak. Their focus is to study head-up display designs as an integral part of a manoeuvre-based vehicle control systems assisting the driver of an automobile of the pre-autonomous generation. The thrill in their research work is that they aim to find out what the best user interface (UI) is for a driver, i.e. human perception of the driving scenario plays an important role. Different visualization sketches for regulating the typical driving parameters as are speed, distance to next car and lane position are studied. Their conclusion is that two user interface design approaches, namely static versus adaptive need to be foreseen. Given that there is enough space for a head-up display (HUD), they recommend to offer two types of user interfaces, depending on two separate phases of driver experience: In the learner-phase, the “Static UI” version is the likey better choice, whereas in the following expert phase the driver may change to a “Dynamic UI with fixed layout” assuming that the driver has enough own intuitive knowledge to make judgements on the traffic situation around him/her.

A topic addressing orientation in three dimensional navigation, namely in sea / water based ship transport is the subject of the article of Gert Büttgenbach. As a former captain of commercial ships, in his second life phase as a computer expert and entrepreneur becoming a designer of sea navigation software based on electronic maps, his concern is how maps having been so far authorized through public institutes and/or regulations from public authorities can be made more precise and updated in time as is needed today. Facing ever growing dimensions of ships, especially “container giants” and thereby the value of these and in consequence the need for both precise steering and preciseness of information on the environment, i.e. the “water routes” as given by sea maps, he identfies the conflict between regulative information provision and the interest of the shipping company to have much better and up-to-date navigation data at hand. The article ends in offering a business model how to overcome this conflict by de-regulating and opening the generation of up-to-date sea maps by combining several concepts:

- To open electronic map design for private providers,

- Establish a rating mechanism for finding the current best map and associated data,

- For such purpose offer a blockchain infrastructure,

- Establish cooperation with insurance companies,

- Implement a so called bathymetric database permanently updated with data on shallow waters. Input providers feeding the database using the blockchain channel will be awarded with cryptocurrency compensation.

The beauty of this paper is that it not only describes the technical challenges of sea navigation it also provides ideas on business-conceptional solutions for hard economic problem in sea transport.

The last paper of the IT Panel was devoted to the question, if robots can replace or at least support nursing services in care. The authors, Ivonne and Wilfried Hoenekamp, concentrate on the question, if such “artifical bodies” would be accepted by persons targetted at.

The paper starts in giving an introduction on the state of the art, first hand giving a report on experience already made in different places and with different types of robots, first hand in Japan, known as a pioneer country in applying robots in care.

The objective of the research work of the authors, however, was to investigate the acceptance of care robots in their cultural environment which is in Germany and more specific in a hospital in Hamburg. In order to perform their emprical research, they worked out two hypothesises:

1. (H1) There is little or no acceptance of the use of care robots in the hospital by the residents of a residential community aged 60 or above.
2. (H2) The acceptance of care robots in the hospital by the residents of a residential community aged 60 years and above is different for different uses or activities that the care robot performs.

To investigate on these two hypothesises a questionaire was developed and applied to a community of 120 appropriate persons living in a condominium, from whom 99 responses were eligible for evaluation.

The questionnaire used was compiled by the authors based on a so called Technology Usage Inventory (TUI) which itself is founded on an Technology Acceptance Model (TAM). The quality criteria for the TUI were calculated after a previous study and rated as good, gender- and age-specific reference values available. Reliability was assessed by internal consistency and validity by factor analysis.

The responses given in verifying hypothesis H2 reflect a negative attitude towards care robots at 53 %, accordingly 47 % of the respondents accept care robots in hospitals. The hypothesis H1 thereby has also been verified, as the value is less than 50 %. These results, however, are much less clear than was expected when the project started. The conclusion of the authors is, that much more work has to be invested, e.g. in explaining the function and scope of easing nursing through robots and on different types and tasks of robot in care. I.e. the research on acceptance looks to be in its early phase and needs further investigations.

The main objective of the Panel on “Artificial Intelligence” (AI) was to gain an insight about applications of AI technologies in mobility. In his introduction the chairman of the session, Michael Vogelsang, emphasized the multi-purpose use of the term Artificial Intelligence.

Having this in mind, the team of Richard Meyes, Hasan Tercan and Tobias Meisen presented three impressive use cases to show the efficiency of machine learning algorithms in the automotive production processes.

In the first case a combination of classifier and regression LSTM models were used to forecast the sensory signals to predict the occurrence of process failures.

In the second case different prediction models such as Artificial Neural Networks (ANN), a Bayesian polynomial regression, a random forest and gradient boosted regression tree were compared to find the best AI based control of the forming process of windshields. The best performing model, a neural network that consists of one hidden layer with 50 neurons, obtains a R^2-Score of 0.932. Thus, the authors conclude that the prediction of (future) geometry deviations of windshields based on the process data is possible and a machine learning algorithm is able to complement the manual quality control at the end of the production line.

The third case explored the idea to replace hardware sensors in prototype vehicles by soft sensors in series production vehicles. The extreme gradient boosting algorithm was used to reconstruct an external signal from 79 internal control units. The authors showed that the overall trend and most of the different frequency components of the original signal can be reconstructed reliably, although some minor features are not properly fit by the learning model.

The authors summarize that trust in the benefits of the new technologies rather than fear should prevail.

Changing the perspective from production to logistics the authors Can Sentürk and Hans-Günter Lindner studied how parcel logistics can be planned by applying neural networks, so that tour plans are calcultated after criteria of fairness for the drivers. In essence they evaluate a system called eBrahim which is an Artificial neural network with deep learning characteristics for building clusters of logic and geographic segments forming the basis for tour plans (in the concrete case for Luxembourg). The system supports the planning of parcel delivery by calculating the necessary effort per parcel as well as the number of delivery stops.

The objective is to find an optimal dispatch per day, under the conditions of fairness. Three issues fairness are indentified by a Fuzzy Cognitive Map:

- "The more distance you drive, the fewer stops you can achieve."
- "The more stops you have, the shorter the distance you can drive."
- "The more time you have on the road, the more distance and/or more stops you can perform."

In practice, the authors used an artificial neural network (ANN) with the three layers. The dataset for training this ANN required the geo position of the stop (delivery point), the time between that single stops, and the information if the delivery was successful or not.

The question to be solved in this approach was, if the eBrahim system should be made by one ANN for all regions or by a cluster of several ANNs. In the latter case, the cluster times need to be aggregated. After some test runs, the authors found out that a cluster of ANNs needs less records for calculating valid and accurate results. In the end it was decided that eBrahim for a given region (which is Luxembourg) works well with 405 ANNs that each represent one cluster.

In summary, both panels explored the most recent developments of IT and AI in the context of mobility. Finding AI based solutions means experimenting with available tools finding the best fit between input and output data. In a way the classical IT problem solving as presented in the case of Open Source configuration and AI problem solutions are similar: In both cases the method is to find the best or at least the optimal fit between a specified challenge and the pieces or methods to create a solution.