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A Low cost forecasting framework for air pollution

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Abstract

The analysis of air quality and the continuous monitoring of air pollution levels are important subjects of the environmental science and research. This problem actually has real impact in the human health and quality of life. The determination of the conditions which favor high concentration of pollutants and most of all the timely forecast of such cases is really crucial, as it facilitates the imposition of specific protection and prevention actions by civil protection.

In this research effort we used machine learning algorithms, in order to study and monitor air quality and the hazardous trace gases that are produced by human activities, in the city of Athens, capital of Greece. Initially, we identified the conditions under which extreme pollution occurs, by using unsupervised machine learning techniques. Furthermore, the merging of supervised and unsupervised algorithms helped us to predict future extreme pollutant values, without inserting in our models any other pollutant as input.

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Machine Learning based Methods in Robotic Vison System for Assistive Feeding Scenario

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Abstract

Assistive robots and devices enable people with severe motor impairments to perform different activities of daily living (ADLs), such as dressing, picking up objects, and self-feeding (drink and food intake). Surveys on the potential users have shown that self-feeding is one of the most expected ADLs. Our BMBF (the German Federal Ministry of Education and Research) supported project MobIle (Physical Human-Robot-Interaction for Independent Living) aims at the research and realization of basic skills such as meal feeding and liquid drinking with and without direct physical contact between robot and human.

This proposed work presents part of our first results in the project MobILe, and mainly focuses on the machine learning based methods used in the vision based system which is being developed for recognition and localization of the face of the end-user and detection of the needed facial information (such as mouth open/closed state).

An ensemble regression tree based method [1] is implemented to detect the facial landmarks on human face, based on which the 3D location of the human face and facial parts (e.g. mouth) is found by utilization of RGB-D camera [2]. Furthermore, the CNN (convolutional neural network) based object recognition algorithm is used for detection of the mouth open/closed state which represent the readiness of the user for intake when food or drink is closer to the human mouth.

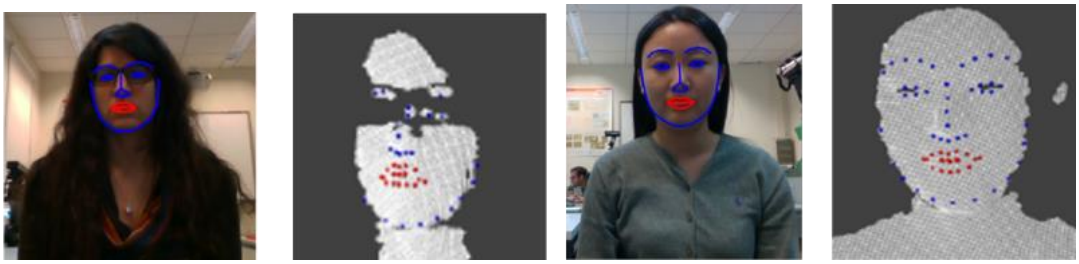

Figure 1 2D-3D Facial landmarks localization

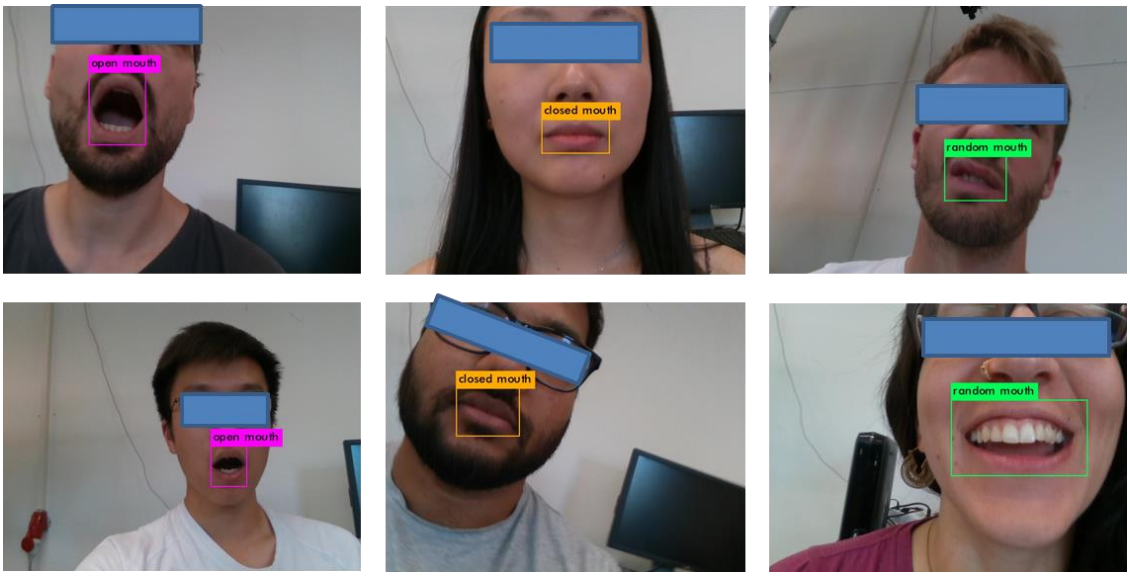

Figure 2 Mouth open/closed state recognition

REFERENCE

[1] Kazemi, Vahid, and Josephine Sullivan. "One millisecond face alignment with an ensemble of regression trees." *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*. 2014.

[2] Fang, Qinyuan, et al. "RGB-D Camera based 3D Human Mouth Detection and Tracking Towards Robotic Feeding Assistance." *Proceedings of the 11th PErvasive Technologies Related to Assistive Environments Conference*. ACM, 2018.

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Analysis of ozone changes in the tropical middle stratosphere by means of multivariate linear regression

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Abstract

Machine learning techniques i.e. regression, clustering etc. are nowadays developing very fast. Therefore they have applications in numerous fields of study, in particular in environmental science, i.e. improvement of weather and climate predictions, improvement the representation of clouds in climate models (*e.g. Gentine et al., 2018*), analysis of long-term changes in the composition of the atmosphere (*e.g. Galytska et al., 2018*). In the current research we developed Multivariate Linear Regression (MLR) to analyze ozone changes in the tropical middle stratosphere.

Stratospheric ozone is one of the most important components of the atmosphere as it absorbs harmful UV solar radiation. However, recent studies have shown that in the area of its formation in the tropical middle stratosphere there is significant decrease of ozone. In our research we applied data from SCIAMACHY satellite measurements during 2004-2012 and compared those measurements with results of Chemistry-Transport Model (CTM) TOMCAT. To reveal major causes of ozone changes we applied MLR based on Ordinary Least Squares technique with prescribed proxies. We found that the seasonal changes in transport indirectly affect chemical processes that cause ozone decline.

Reference

Galytska, E., Rozanov, A., Chipperfield, M. P., Dhomse, S. S., Weber, M., Arosio, C., Feng, W., and Burrows, J. P.: Dynamically controlled ozone decline in the tropical mid-stratosphere observed by SCIAMACHY, Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-746, in review, 2018.

Gentine, P., Pritchard, M., Rasp, S., Reinaudi, G., & Yacalis, G. (2018). Could machine learning break the convection parameterization deadlock? *Geophysical Research Letters*, 45, 5742–5751. https://doi.org/10.1029/2018GL078202

Poster Contribution for Summer School on Machine Learning at University of Bremen 24.–28.09.2018

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Evaluation of Facial Analysis for Intention Recognition Using Deep Learning

Introduction Controlling complex computational or robotic systems can be very challenging for a human. The research in human-computer interaction tries to build such systems in a way it is very intuitively to the human and mostly works by an implicit control commands. With the contribution of machine intelligence these systems are able to "read the human" and execute based on these, different functions.

But what's still missing, is an implicit and intuitively feedback channel the system can use to determine if the executed function was desired, respectively expected, by the user. A way of detecting these can be reading the emotional state of the user. In this research we investigate different methods and algorithms to detect the intention of an user from e. g. facial expressions to determine whether an error or an wrong behavior of the system occurred.

Related Work In recent years algorithms to detect faces and therewith emotions of a person have been evolving. For example Kahou *et al.* [1] use deep neural networks to detect facial expressions while Ozkan *et al.* [2] use concatenated Hidden Markov Model. Emotions can be detected optically using images or a video of faces or gestures. They can also be detected using electrooculography signals as the work from Paul *et al.* [3] shows.

Methodology In our experimental scenario a users interacts with a semi-autonomous robotic arm to perform different certain tasks. In this context semi-autonomous means execution of full tasks, triggered by the user. The user has to intervene, if the robotic system doesn't perform like expected.

Based on the results of the related work we will modify the used algorithms to detect emotional states as a feedback channel in the mentioned scenario. Therefore we cluster the emotional states in the two categories agreement and not-agreement and try to detect a switch between this two states.

Future work Furthermore the algorithm which is most suitable will be chosen. The method will be implemented in the existing setup and will be evaluated. With the results of this research it is also possible to empower people who are not used to control that kind of systems or who are not able to interact with them because of missing input modalities like tetraplegics.

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Object Recognition for Robotic Manipulation

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Abstract

Object recognition is part of the Computer Vision research field that aims at helping robots better understand their environment. A computer can achieve simple vision tasks; however, it still fails to interpret a scene the way humans do because it is a complex problem with many variables. In the presented work, an object recognition framework was developed for the MeRoSy project which is funded by the German Federal Ministry of Education and Research.

In detail, the dual-arm MeRoSy robot will cooperate with an able-bodied person in an industrial setting. To reach this goal, an algorithm to recognize objects and retrieve their 3D positions is implemented. The main input source for the algorithm is a Kinect v2 sensor which can capture color and depth information of the scene. The first part of the algorithm uses a Deep Learning Convolutional Neural Network method with color images captured by the Kinect to recognize of objects in the scene. In the second part, a feature matching pipeline with point clouds is used to recognize and retrieve the 3D positions of the same objects. Finally, sensor fusion is applied on both sets of information to provide a concrete decision regarding the recognition and position of objects in the scene and transforms the results to a new coordinate system.

The Deep Learning method gives accurate recognition results, but lack 3D localization of objects. On the other hand, the feature matching method produces acceptable recognition and localization results. The overall output of the algorithm is very accurate when it comes to the recognition.