reviewed paper

EmoCyclingConcept – Smart and Safe Mobility – Workshop

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1 ABSTRACT

Safety is one of the most important goods we have these days. When it comes to traffic in our cities and the interactions between the different traffic participants it is especially the everyday cyclist whose need for safety is crucial. How can you measure a good feeling or perceived safety? One possibility is to do a survey for some specific routes through the cities. To get more detailed results you invert the idea of safety. You measure unsafety by collecting negative emotional experiences while cycling. But how is this done?

The Department of Computer Aided Design in Urban Planning and Architecture (CPE) from the University of Kaiserslautern has dealt with this method for more than 5 years. Meanwhile we collected data in the context of accessibility of pedestrians (Bergner, et al. 2011) as well as cyclists (Buschlinger, et al. 2013) in different countries and with a variety of cooperations. Within the latest DFG-project "Urban Emotions", over 75 cyclists have been measured. For this method, three different instruments are used:

The main instrument is the "Smartband" (www.bodymonitor.de). It measures the galvanic skin response as well as the skin temperature to analyse the body signals. There is a special relation between psychological arousal and physiological reactions like the skin conductance and the temperature (Kreibig 2010). If you recognize this unique pattern, in which the level of skin conductance rises and the skin temperature decreases 3 seconds later, it can be interpreted as a "negative arousal" (Bergner et al. 2011). The body data is located with a GPS-tracker. For further analysis a GoPro records the trip. With the help of this setup, it is possible to identify severe problems (Rittel 1973), on which urban planners should react by trying to eliminate them.

The project should be understood as a work for progressing research, dealing with the optimization of the method by testing in use cases.

2 STATE OF RESEARCH

The EmoCyclingConcept can be assigned to spatial sensing. We try to figure out how citizens respond to the environment. Therefore we use sensors and the people themselves also act as sensors. Spatial sensing therefore becomes human sensing. Similar experiments have already been done by Michael Goodchild with his "Citizens as Sensors" (Goodchild 2007) or Nolds' EmotionalCartography (Nold 2009). Compared to technical sensors the human being has some advantages. With the five senses of awareness (visual, aurally, olfactory, gustatory, haptic) and the context-intelligence, which enables to filter spatial phenomenons, makes the human being an optimal sensor for the environment (Zeile 2010; Exner 2013, 67 acc. to Sheth 2009, 89). Because of the focus on geo-located arousal or emotion we call it "EmoMapping". Measuring emotions with sensor devices, like it is done in the Urban Emotions approach (Zeile et al 2015, Resch et al. 2015, Dörrzapf et al. 2015) focuses on the following four basic emotions: anger, fear, sadness and joy. According to psychophysiological researchers and a review of different methods of detecting stress (Kreibig 2010), the EmoCyclingConcept focuses on "negative stress", which is described as a combination of anger and fear (Kreibig 2010).

Based on the experiences of former projects like "Ein emotionales Kiezportrait", "Emomap Mannheim" (Zeile 2010), "EmBaGIS" (Bergner 2010) or "EmoCycling" (Buschlinger, et al. 2013), the "EmoCyclingConcept" (Groß 2015) measured a higher amount of participants to get more reliable results. Furthermore it tried to represent the average society by recruiting people between the age of 15 and 85. In this latest work of research 75 cyclists were measured on a 2.4 km track. The circuit was predetermined and fixed. There was no opportunity of a free-ride, because all the test riders should be measured in comparable traffic situations. For this, different scenarios were developed: A variety of intersections (with or without traffic lights), roundabouts and cycling paths were chosen. This should build a database so that first statements could be deduced on how far environmental factors act together and lead to stress or how far the subjective safety coincide to objective safety.

Before measuring, the track was analysed for expectable critical spots and their possible reasons. In addition to that, every participant had to mark his own expected stress scenes before his ride. Everybody attended the track wearing the three instruments (cf. section "Workshop Setup"). Afterwards they had to repeat the survey, in regard to where they thought or felt that they were stressed. The results were three different evaluations of every cyclist:

- the subjective expectation
- the subjective awareness
- the measurement by instruments

These three steps enable the opportunity to gain some knowledge about the subjectively perceived safety and the objective safety. Further every single scenario with a measured arousal was analysed with the help of the videos.

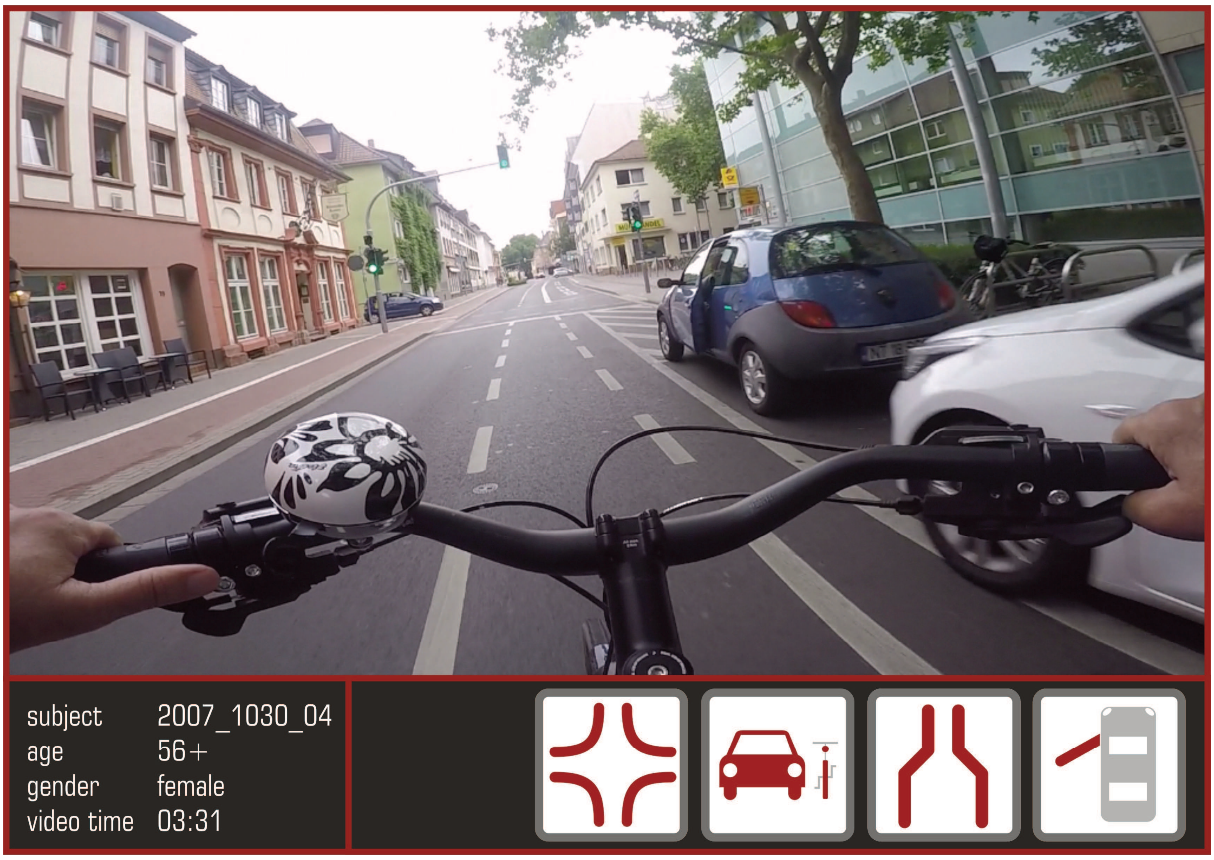

Fig. 1: Complex of triggers in a dooring-scene

This introduces the second aspect of this project. The planners have to understand the reasons of the citizens' emotions. Only when they know why people are afraid in specific situations, they can handle it with adequate measures. To get first hints of neuralgic points a first quantitative analysis is useful. For specific scenes a qualitative analysis is necessary. Therefore every spot, where the sensors showed an arousal was analysed with video (Fig. 1). The reasons were categorized based on the effects of stress. You can distinguish between three main categories with 13 triggers:

Horizontal effects (Fig. 2) occur in level. These triggers include intersections, threading, curves, surface (nature), obstacles and constrictions.

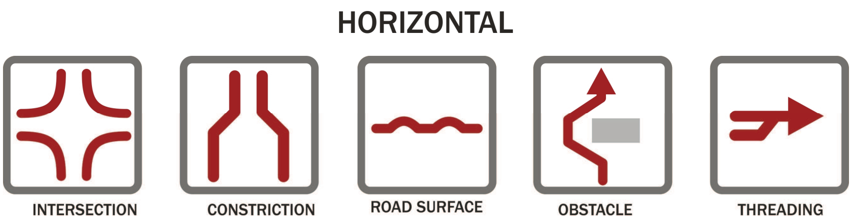

Fig. 2: Horizontal effects

Vertical effects (Fig. 3) describe all triggers which appear in the third dimension. These are negative or positive gradient as well as curb side.

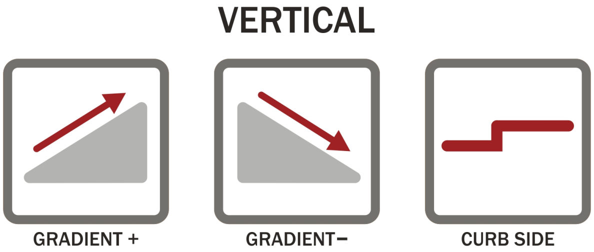

Fig. 3: Vertical effects

Anthropogenic effects (Fig. 4) do not have any three-dimensional aspect but anthropogenic causes like oncoming traffic, dooring, pedestrians or overtaking.

Fig. 4: Anthropogenic effects

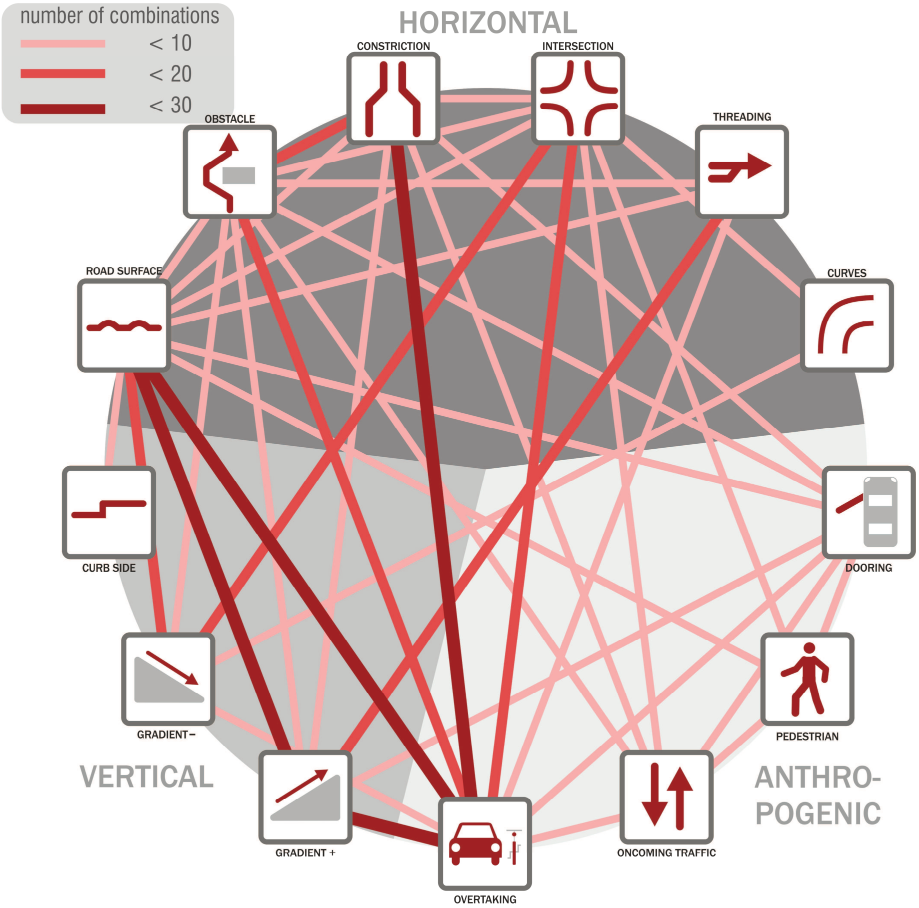

Fig. 5: Complexes of effects (dataset of Usecase "Worms")

Especially the EmoCyclingConcept has to be understood as a part of new cycling concepts for cities. The analysis of the triggers builds the base of measures. The following graphic (Fig. 5) shows how often the triggers are connected to each other. They never appear alone. Only several trigger in combination lead to arousal. In the Usecase the following three were the most occurring triggers: positive gradient, bad road surface and overtaking traffic. Every third moment of stress contained at least one of these three triggers. There are some simple reasons why. A positive gradient and bad surface lead to a lower speed, which is a

ISBN 978-3-9504173-0-2 (CD), 978-3-9504173-1-9 (print)
Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

reason for instability and unsafety. Overtaking cars are too close in many cases, because other vehicles do not keep the prescribed distance of 1.50m. From those three triggers you can derive essential measures. When it comes to planning cycle-friendly routes, planners should avoid distinctive topography if possible. Bad road surfaces, especially at the edge of the roadway should be repaired. The number of close overtaking can be avoided by wider bike lanes or a reduction of the speed limit.

Beyond this some further hypotheses could be formulated:

- Participants under the age of 40 have less moments of stress than those over 40 years.
- There is no significant difference between male or female cyclists.
- The expectation of negative emotional happenings is higher than the real amount of experienced moments.
- The method identifies 95% of experienced moments.
- Even not experienced scenes can be identified with the help of video analysis.

The Usecase has shown that even without video analysis the quantitative analysis enables an adequate localisation of critical points (Fig. 6). By verifying with the help of the video and the qualitative analysis the triggers become clearly recognizable. Linked to the spatial context specific patterns appear. Due to the survey of expectation and experience compared to the measured results it could be proven in the approach that the subjective awareness can be recorded with physiological parameters like skin conductance and temperature.

3 WORKSHOP DESCRIPTION

In this workshop, participants will have the opportunity to measure their own stress while cycling through the streets of Hamburg with the equipment. The ride lasts about 20 minutes. After collecting the data on the first day, the datasets will be evaluated directly so that the results can be visualised (Fig. 6) and discussed the following days in a larger group of people. Each set will take about thirty minutes if everything goes as planned. If you are interested in how the datasets are analysed, we will explain it to you as well. Due to the manual effort to analyse the datasets the workshop is limited to 10 participants. Rental bikes are provided by the city of Hamburg.

Fig. 6: Density of stress from 48 bicyclists showing critical spots (Heatmap)

4 WORKSHOP SETUP

Every test person will wear the three mentioned instruments (Fig. 7), which are explained more detailed in the following:

The first one is the "Smartband" which is worn around the left wrist. The connection to the skin is guaranteed by two electrodes. Via skin the galvanic skin response and the temperature is measured. These two key parameters enable the later analysis of the psycho-physiological context. After knowing if there was stress for the bicyclist, it is important to know where it happened.

To be able to locate retrospectively where the stress occurred, everyone is equipped with a GPS-tracker. Therefore the person wears the "i Blue 747" by "Transsystems". The device records coordinates, acceleration and three-axial-movement every second.

As third instrument, a camera is fixed to the chest, helmet or bicycle. The videos can help in the following analysis to identify the trigger of stress. These occur in multiple ways and can be found in overtaking cars, doors being opened as well as a bad road surface or intersections.

Fig. 7: Used devices 1. GoPro, 2. i Blue 747, 3. Smartband

5 ESTIMATED RESULTS

This workshop should generate further knowledge of the emotional experience of people which are not familiar with the local situation. Because of the small sample statistical reliable results cannot be developed. It is a test run, to discover if the presented set-up is already suitable for an on-site experiment with a fast generated result. The downside of the presented approach in former times was the fact that the analysis of the collected data took too much time due to the need of manually post processing procedures. The results of the workshop, pictures and inside experiences from the experiment and also from the discussion during our live experience / experiment will be published on our Urban Emotion Blog under http://urban-emotions.ru.uni-kl.de/ .

We hope to get some results of the process. Not only of pathfinding in an unknown city, but also how the process of renting a bike with rental systems effects the choice in transportation system and we also hope to gain some insights of the test area, where potential danger spots could be located, areas of not feeling safe or, in a more positive view: where are the nice spots for a bike ride in Hamburg?

6 DISCUSSION

As already mentioned in former chapters the method of emotional mapping itself works. The main problems are technical aspects. For an autonomous use by citizens the processing and evaluation of data has to be optimized. At this state it is too time-consuming when it comes to the synchronization of the devices as well as the manual processing and correcting. The used GPS-trackers do not record with a reliable accuracy which leads to temporal deviations up to 50 meters. This also has to be corrected manually. The handling of the different devices is complicated and needs an admission to the test persons.

The handling can be optimized by merging the two devices: the Smartband and the GPS-tracker. An application which creates a single file collected i.e. by smartphone (GPS) and fitness-tracker (body data) would be another possibility. Furthermore algorithms should be able to correct occurring artefacts automatically. The accuracy of GPS-signals can be increased by methods of signal-filtering.

Beside the method of measuring the galvanic skin response for psycho-physiological reactions there is another method which is rather common in medical research. The cardio-vascular measuring can be an addition or verification. But both methods have to be researched.

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7 OUTLOOK

On the long run the "EmoCyclingConcept" should not just stay a temporal instrument for cycling concepts. It should be established as a subversive instrument for citizens in modern urban planning (Streich 2014). With new technologies like smartphones as well as fitness trackers people will be able to track their data autonomously. It offers the possibility to detect infrastructural grievance by bottom up process. The concept can raise awareness towards local politicians and planners concerning the importance of an adequate bike infrastructure. The more cyclists use this concept the larger the network of measured streets becomes to a coverage mapping at all times. The role of the planner will be to analyse the critical spots according to the contexts of environmental effects.

Latest projects are dealing with the automation of evaluation aiming for real time results. Technical developments of our modern society which make self-tracking possible and easier can support the progress of this method.

8 ACKNOWLEDGEMENT

Great thanks to the participants of the usecase and the support of the whole team of CPE. The authors would like to express their gratitude to the German Research Foundation (DFG – Deutsche Forschungsgemeinschaft) for supporting the project Urban Emotions, reference number ZE 1018/1-1 and RE 3612/1-1.

9 REFERENCES

BERGNER, B., P. ZEILE, G. PAPASTEFANOU, UND W. RESCH.: „Emotionales Barriere-GIS als neues Instrument zur Identifikation und Optimierung stadträumlicher Barrieren.“ In Angewandte Geoinformatik, von J. Strobl, T. Blaschke und G. Griesebner, 430-49. Berlin/ Offenbach, 2011.

BUSCHLINGER, S., ET AL.: EmoCycling - Bachelorprojekt TU-Kaiserslautern,. Kaiserslautern, 2013.

DÖRRZAPF, L., ZEILE, P., SAGL, G., SUDMANNS, M., SUMMA, A., & RESCH, B.: Urban Emotions - Eine interdisziplinäre Schnittstelle zwischen Geoinformatik und räumlicher Planung. GIS.Science(1), 11–19. 2015.

EXNER, J.-P.: Smarte Planung - Ansätze zur Qualifizierung eines neuen Instrumenten- und Methodenrepertoires. 2013.

GOODCHILD, MICHAEL F.: Citizens as sensors: the world of volunteered geography. GeoJournal, 2007: 69 (4), 211-221.

GROß, D.: EmoCyclingConcept – Potentiale der emotionalen Stadtkartierung für Radverkehrskonzepte am Usecase Worms, Kaiserslautern. 2015.

KREIBIG, S.D.: „Autonomic nervous system activity in emotion: A review.“ In: Biological Psychology, von B.V. Elsevier, 394-421. Genf, 2010.

NOLD, C.: EmotionalCartography. London: C.Nold, 2009.

RESCH, B., SUMMA, A., SAGL, G., ZEILE, P., & EXNER, J. P.: Urban Emotions-Geo-semantic emotion extraction from technical Sensors, human sensors and crowdsourced data. In G. Gartner & H. Huang (Eds.), Progress in Location-Based Services 2014 (pp. 199-212, Lecture Notes in Geoinformation and Cartography). Berlin: Springer International Publishing. 2015.

RITTEL, H. W. J.: Dilemmas in a General Theory of Planning. Policy Sciences, 4(2), 155–169. 1973.

SHETH, A.: Citizen sensing, social signals, and enriching human experience. In Internet Computing, 87-92. New York: IEEE, 2009.

STREICH, BERND.: Subversive Stadtplanung. Wiesbaden: Springer VS, 2014.

ZEILE, P.: Echtzeitplanung - Die Fortentwicklung der Simulations- und Visualisierungsmethoden für die städtebauliche Gesamtplanung. Kaiserslautern, 2010.

ZEILE, P., RESCH, B., EXNER, J.-P., & SAGL, G.: Urban Emotions: Benefits and risks in using human sensory assessment for the extraction of contextual emotion nformation in urban planning. In S. Geertman, J. Ferreira, R. Goodspeed, & J. Stillwell (Eds.), Planning Support Systems & Smart Cities (pp. 209-225): Springer. 2015.