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Augmented Reality as a Communication Tool in Urban Design Processes

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1 ABSTRACT

One of the main parts in planning is the communication of planninginformation. Not only the decision maker, but also the inhabitants have to be informed on the planned actions, no matter if they are affected directly or indirectly by the planning . The classical two-dimensional visualizations do not offer the required range to present the contents of the planned changes, and lay people do not have the same base knowledge to understand the three-dimensional extent to what is shown in the plan.

3D models are one possible solution to this problem, based on the fact, that e.g. a new planned building or area can be viewed from different angles and also allow a direct judgement.The down side of these models is the creation. It is complicated and expensive to create the three-dimensional surroundings. What if the virtual model could be combined with the existing reality? Would that make things easier?

With the use of Augmented Reality various techniques are available which have to be tested.

Using these methods real-world situations can be overlayed with digital content which allows an extension of information of reality. Based on practical examples, these new methods and techniques are explained in detail.

2 INTRODUCTION

Urban planning is an extremely complex subject that is often difficult to understand for lay people. Especially if the individual is affected by the planning process, the possibility must be given to express his dismay in the participation process. But how can citizens express their opinion if their basic knowledge is not the same? What can help these people to understand the three-dimensional effect of a plan based on the classical two-dimensional visualization. How can this be made more transparent and understandable?

Regardless to the chosen (visualization) method, factors of the communication theory must also be taken into account. The general view on the continuous communication between planners and the addressee in the whole planning process, shows that the analytical categories of communication theory can be applied (Fürst & Scholles 2008:198).

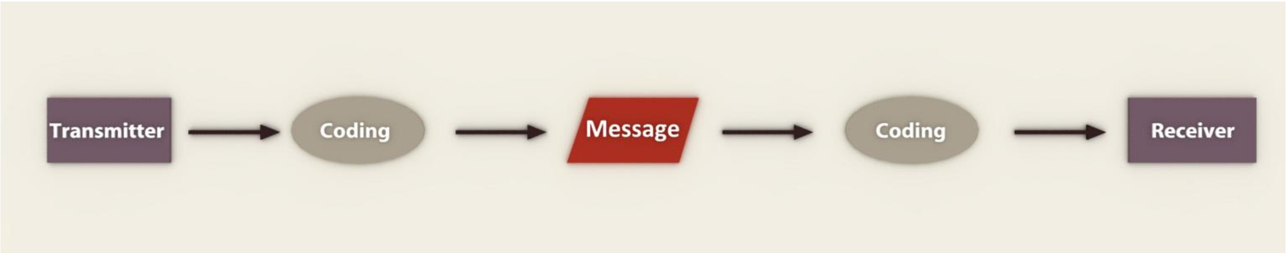

Fig. 1: Communication in planning processes, based on transmitter-receiver model (Zeile 2010, according to Fürst & Scholles 2008:198)

The vocabulary that planners use to define a problem in planning is very fixed and defined by law. They encode their core message, which then must be decoded by the receiver. This can result in transmission errors, since the receiving side remains within its own interpretation range. It attempts to translate the information to his language. Here emotions, such as a distrust of the stakeholders, or a defensive position due to personal fears, or the own idea of a "good" plan, can falsify the actual statement. (Fürst & Scholles 2008:198).

In this content Smartphones or tablets with Augmented Reality Browsers offer a possible solution for a better exchange of information as they are more understandable and transparent. Augmented Reality is conciderd to be “the extension of reality with additional content”. Two different methods can be differentiated: On the one hand the use of Augmented Reality in situ, meaning that in the case of a planning project, fotos or 3D models can be blended in to the built reality. On the other hand, a printed 2D plan can be extended with additional

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information or models, with the use of Augmented Reality markers. These methods can be seen as a type of translation, as it enables a lay person to understand the previously complex two-dimensional presentation.

In the follwing current methods and techniques are to be discussed.

3 STATE OF RESEARCH

3D-city models have gained more and more popularity in the last years. This is especially based on the continously simplified development. If the new design of a building or situation is integrated in a city model, it can be viewed from all perspectives and alternatives can be discussed and rated.

On the other hand it is criticized that the effort and the costs to create the surroundings is too high. Can the new design be combined with the built reality (Zeile 2012) ?

3.1 Augmented Reality

This question constitutes the approach of the technology of augmented reality. Instead of using a virtual environment to show the content, it is projected into the reality. To achieve this 4 elements are needed: a computer with the required software, which serves as rendering unit, overlaying real pictures with virtual pictures, a tracking system, which locates the position of the user, a recording device in form of a camera and also a display.

If all these requirements are fulfilled, 4 different methods of Augmendet Reality can be differentiated (Höhl 2008):

- The Projective Augmented Reality (PAR) uses a projector to show digital information on a real object.
- With the method of Video See-Through (VST) enclosed projection glasses are used.
- The Optical See-Through (OST)-method works with an optical unit to combine the signals, a semi-transparent mirror, which allows the perception of the environment.
- The Monitor Augmented Reality (MAR) displays digital contents on a Monitor. This technique is concidered the easiest solution.

A few years ago this method was only possible from a stationary computer, or the User hat to transport about 20 kilos of equipment. Today the same technical effort can be given to the User as a handheld device in form of a smartphone (Zeile 2011). The Augmented Reality technique implemented in smartphones shows a whole new form of Augmented Reality. It is basically an advanced form of the Monitor Augmented Reality, only that the User is not fixed to one spot, but can move freely in reality. This makes it possible to use the system nearly everywhere, as long as a mobile internet connection is assured and the required App (a so called Augmented Reality-Browser) is installed. The tracking system to determine the perspective is included in practically all newer smartphones in form of a GPS-module and also a compass (Allbach et al. 2011).

3.2 Geolocalisation or Marker Based Technics

With the current MAR-techniques two procedures are differentiated: On the one hand, using the integrated GPS-module, the geolocalisation techniques and on the other hand the so called marker-based techniques. In the case of the geolocalisation the content, which is to be displayed is linked to the geoposition, allowing the user to view it at the point of interest. This method is restricted though because the GPS-localisation is not always as exact. If there is a high density of buildings or trees, the GPS-signal and the deposited AR-content starts to “jump”.

A new approach to solve this problem is found in the marker-based tracking systems, which do not need a GPS-signal. The setting, in which the content is supposed to be overlayed is found on a server as a marker. All that is needed is a foto of the setting. Originally set up for print media, this application can be extended to the built reality with simple tricks: disturbing elements that complicate the recognition, such as reflecting windows or weather-related changes in the sky, have to be cut out with image editing programs, e.g. Adobe Photoshop. Distinctive structural elements in the face of the building are adequate to recognise the according setting to then overlay the content (Zeile 2012). The technical restrictions to create such an Augmented Reality projection are reduced to a minimum. Years ago it was limited to people with the needed know-how to set up such a server and deposit certain contents, whereas now there are platforms that offer a graphical user interface and drag&drop functions. Therefore Hoppala augmentations (Gadeya 2013) or the RADAR-platform of the DFKI Kaiserslautern (Memmel 2013) can be used for the accomplishment of geolocalized AR-visualizations. This development is continued by the new platform "LayAR-Creator" (Layar 2012) relating to the current AR-application LayAR. Centre of attention is the user-friendliness.

4 METHODS FOR AUGMENTED VISUALISATION OF URBAN PLANNING

In the presented projects three different methods, meaning also three different applications were used: LayAR (Layer 2009) as a representative of the location based service as well as LayAR Vision (Layar 2012) and AR Media (Inglobe Technologies 2011) as marker-based techniques. LayAR is concidered to be the most common Augmented Reality-Browser on smartphones. The georeferenced contents can be stored on a server for a later presentation when a GPS-localisation is possible and the smartphone only has to be aligned on-site to show the contents on the display. This allows an import of pictures, 3D-objects, audio- and video data in to reality.

LayAR Vision is the marker-based version of LayAR. Both versions are combined in the same App. Since the introduction of LayAR Vision the App LayAR directly starts in a "Scan"-mode. If a photo is taken in this mode the App compares this situation with all the markers filed on the server. If it finds this situation on the server it leads the user to the according info-layer within the App.

Manual navigating to the LayAR-channel, which is still necessary with geo-referring layers is not applied in this option. With LayAR Vision it is not yet possible to visualize three-dimensional contents.

A marker based AR-technique to present three-dimensional information is AR Media. This application can be used as a plugin for any current softwareprogramm for three-dimensional modelling (SketchUp, Vectorworks, 3D Max,…). The program is then extended with the AR-function. With the help of this, 3D models can be placed on such a marker, which resembles to the famous QR-codes. This marker can be printed out at home by everyone, the matching 3D-model can be downloaded as well as the free AR Media Viewer (Inglobe Technologies 2011). By adjusting the webcam to the marker an AR visualization can be generated on the monitor. For Apple's iOS systems there is the so called AR Media Viewer, a free App which enables a visualization with a smartphone or a tablet.

AR Media shows tremendous functions, such as the scaling of the 3D-model, the ability to show different versions and different angles by turning the marker or by using the common form of wiping over the touchscreen. A high level of detail can be displayed, as the model is saved locally on the device and does not have to be streamed over the internet. Therefore the only restrictions result in the hardware of the used smartphone or tablet.

5 USE CASES AUGMENTED REALITY

The presented methods were tested within cooperation projects with cities and communities, adjusted to their objectives and presented in the following.

5.1 Smartwalk Saarbrücken „Stadtmitte am Fluss"

In the summer of 2012 the research team of the department CPE worked with the mentioned visualization methods on the example of the major project "Stadtmitte am Fluss" in Saarbrücken. This major project dealt with the revaluation and creation of a better quality of ambience along the river Saar, which runs directly through the city.

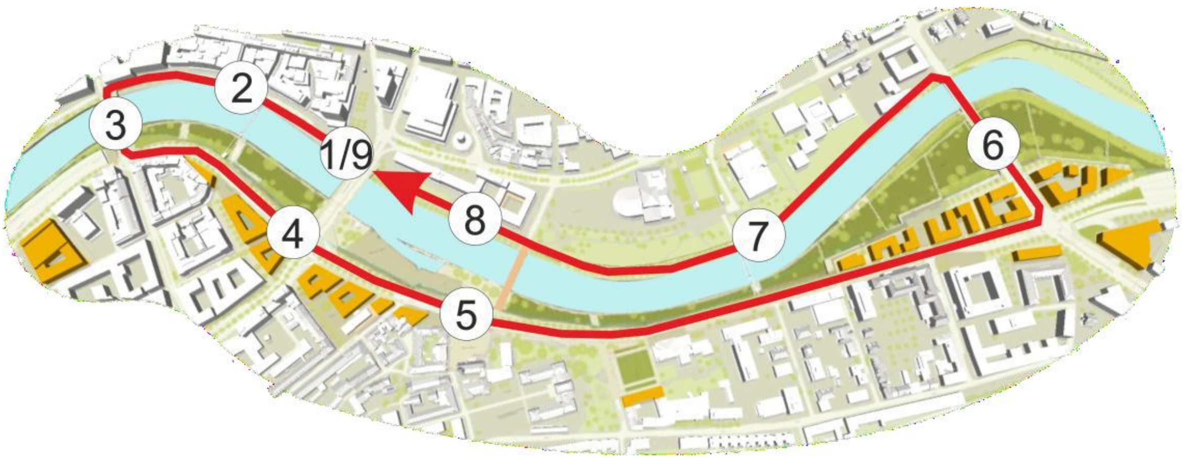

Fig. 2: Track oft he smartwalk through the area „Stadtmitte am Fluss“ in Saarbrücken (Research group CPE, based on the master plan of Saarbrücken)

Especially building projects to reduce the traffic pollution, such as noise and emissions were intended. A focal point of this planning was the tunnelling of the urban motorway which runs alongside of the Saar.The emerging free space on the top of the tunnel is supposed to be used by the people as an attractive park and recreation space. Also the boulevard on opposite side of the river is to be upgraded and integrated in the urban pattern. Key aspect of the research was on the one hand to communicate with the inhabitants on the planning, on the other hand to reach and fascinate young adults with the help of innovative visualization methods. The second aspect should work by the principle of the "Homo ludens" (Streich 2011) with a "playful contact" of the subject of planning and town developments.

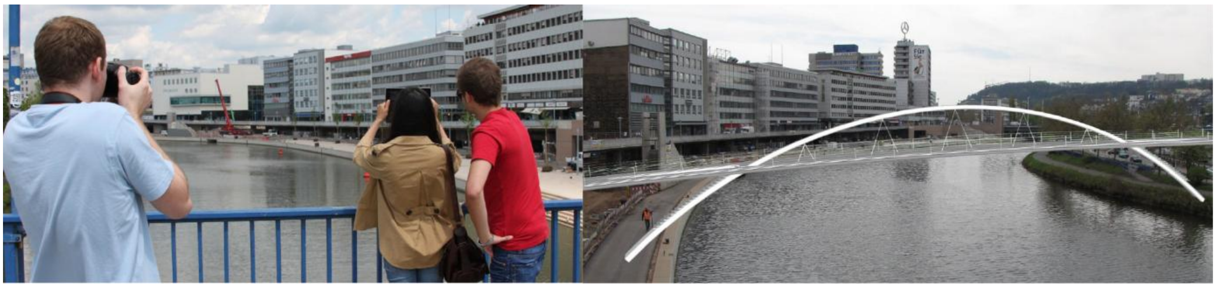

Fig. 3: Use of Augmented Reality to overlay the new virtual design of a pedestrian bridge over the real picture- (Research Group CPE)

The main focus was set on the development of the so called "Smartwalk", a kind of virtual tour through nine stations without a fixed order. The walk extends to the planning area of the project "Stadtmitte am Fluss" and uses various digital contents configurated for smartphones or tablet pcs.

If the observer is for instance at a station where he can see an empty site the new planning can be experienced with a video fitted to the gap. At a different station the new planned pedestrian bridge is blended in as a 3D-model and at yet another station viewers can get a brief overview of the whole area with some basic textual information as well as information on the project.

At a different spot a 3D-model of the entire area including noise pollution and flooding simulations can be viewed. To offer a better understanding of the new planning the presentation was not only made for future planning but also shows a comparison to the historical development and the current situation.

The associated information of the project can be accessed at every station, either through a mobile website or in form of an available audio-stream. To reach as many people as possible a simplified version of the walk is offered based on QR-codes and mobile websites. The purpose of the Smartwalk is not only to inform, but the city of Saarbrücken is hoping to get feedback of the viewers. To allow this, every station offers the possibilty of a rating- and commenting system (Becker et al. 2012).

Fig. 4: Visualization if a new design in AR Media, (left) Visualization over Webcam and Notebook, (right) iPad (Research Group CPE)

AR Media was also used so that citizens had the opportunity to look at the new planning from home, by using the augmented 3D-models. In the end not everyone interested in the project has the chance to take a tour of the area to get more information.

5.2 Conversion area Trier Bobinet

Often the area affected by building projects is spread over such a large range that the whole extent of the project can not be taken in by the viewer straight away. The use of AR Media opens further potential since a 3D model does not have to be placed on one single marker. Shown in the example of the conversion area Trier Bobinet the 3D-model of the entire planning area was set on various markers arranged in a grid. AR Media supports a maximum spreading of 7x7 markers. This way the display of the 3D-model in the Augmented Reality view can be increased. Depending on which marker the webcam (or the camera of the iOS-device) is directed the matching section of the 3D-model is shown. The transition from one marker to another is smooth which allows a scan of the entire area (Noll 2012).

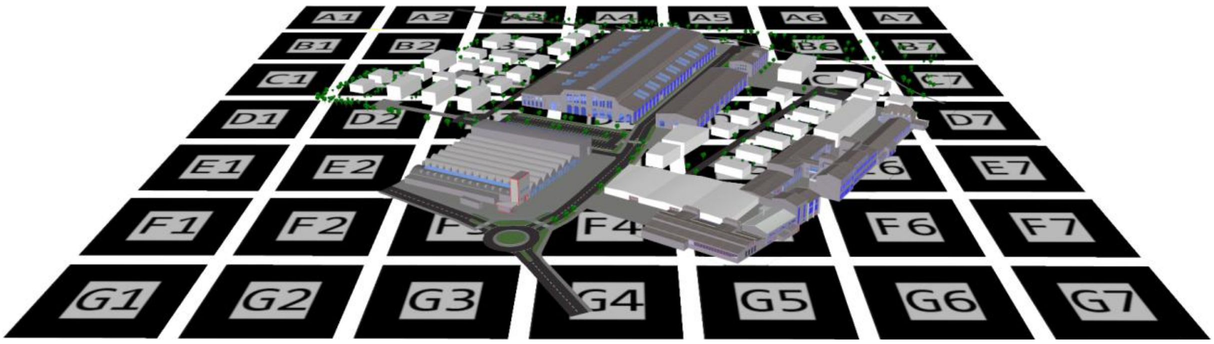

Fig. 5: Placement of a new design with the help over several markers in AR Media (Noll 2012)

5.3 Added value for urban planning

After selecting technical capabilities for the use of AR-presentations in planning, it has to be figured out if the new repertoire of methods can help a lay person to judge the planning project and form an opinion. To fathom out the question the new methods were compared in another final paper and the value for the interested citizen was determined based on a questionnaire. This was applied in the example of the Landesgartenschau in Schwäbisch Gmünd. Here Henn architects are planning a research centre and a trainee center, that is going to be a combination of 35 ship containers. By stacking containers of different sizes an abstract construction is created (Henn 2012).

Fig. 6: Evaluation at the construction site in Schwäbisch Gmünd (Dübner 2012)

To find out if the people passing by the planning area can imagine how it will look the evaluation takes place at this point, devided in different stations. The first evaluation took place after looking at the two-dimensional plan. In the following steps the various AR-methods were added, repeating the evaluation after every method. The interested people viewed the building project as a marker-based visualization in AR Media, as a two-dimensional overlay with LayAR and finally as a three-dimensional model over a LayAR-geo-channel. Regardless to their age or previous experience with smartphones and Augmented Reality every person could handle the techniques. The presented AR-methods were consistently seen positive and helped the test person to imagine the building (Dübner 2012).

5.4 Augmented Reality as a communication instrument for landuse planning

Besides the pure presentation of the planned construction of a building project, the legal regulations of a development plan also have a spatial impact. Therefore, also the classical two-dimensional plans require a translation. Can the presented mobile Augmented Reality methods enable this translation for citizens? Since not every citizen has the same spatial perception the question arises, if the complex contents of a development plan can be shown in a three-dimensional visualization, including the extent the planning will have on the area. Within another research project, the contents of the development plan were created as a three-dimensional alternative. After an existing development plan was recreated on a three-dimensional level and presented in Google Earth, the next step was to find out how Augmented Reality methods can offer a higher value for citizens. In the first possibility, the models were transformed and located on a geo-channel in LayAR. This allowed an inspection of the development plan "in situ". Particular regulations, which are in their selves complicated enough, were extended with additional textual information. This offers a combination of the visualization of the set regulations with the translation for the interested layperson. The handling of this method though, turned out to be difficult, as the restriction of the exact location was set because of an insufficient GPS-signal. In addition, the level of detail that influences the data volume of the model was limited through the quality of the mobile internet connection (Broschart 2011).

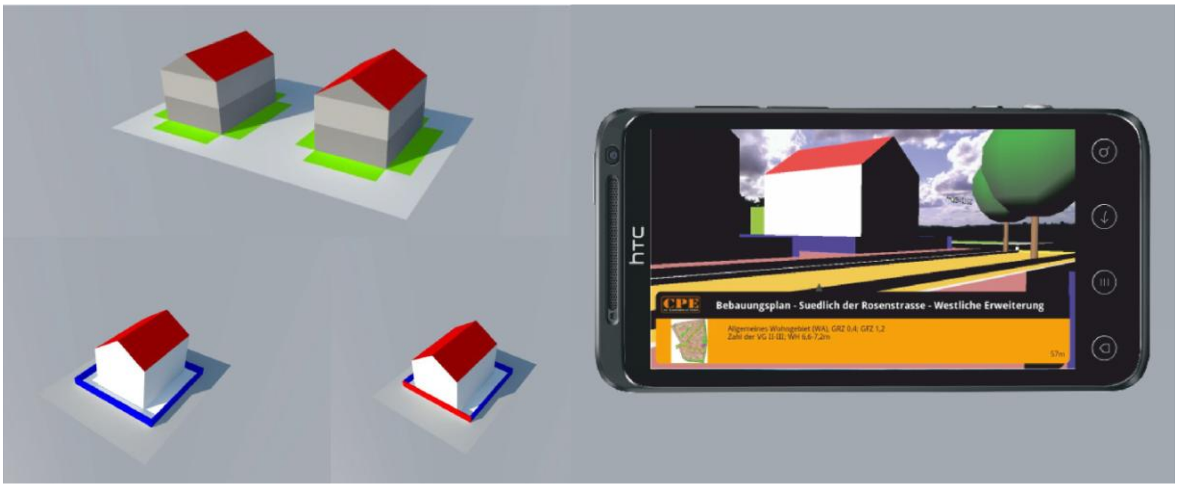

Fig. 7: Threedimensional examples of the content of building codes (above: open design; below: perimeter and fixing building limiting line) Augmented Reality Visualization of a development plan (Broschart 2011)

In the second version, the attempt was started to explain the contents of the development plan with the help of mobile Augmented Reality methods directly on the plan. Again, LayAR Vision was used for this approach. The actual development plan is then set as the marker and additional contents can be "placed" on this surface. On the other hand, LayAR Vision does not offer the presentation of three-dimensional contents, so the explanations to the single regulations are pictorial. The contents with various degrees of information are basically supposed to be decoded through the smartphone to enable the understanding of the different regulations. With this technique, the legally valid development plan can be used as the base without changing the plan. This means that the smartphone would function as an informal translation device for the formal plan, which could be used for the mandatory presentation (Zeile 2011).

Fig. 8: Marker-based AR-Visualization of a developement plan with buliding codes (Zeile 2011)

6 CONCLUSION

The presented Augmented-Reality methods can already be used in various parts of planning. The methods repertoire of a planner is being extended in its function of "translating" for lay people who are interested in planning. First evaluation results turned out positive: For inhabitants an additional benefit is assured, as they are assisted in their spatial perception, but also there is the possibility of making planning activities more attractive with the playful and interactive handling.

Currently there are certain restrictions to these techniques, such as an insufficient mobile internet connection or the vague GPS-signals which are needed for the geolocalizing AR-techniques like LayAR.

The newly provided LayAR Vision, a marker-based technique can compensate these problems, nevertheless the assistance for 3-dimensional contents is (still) missing. However it is expected to proceed in a continuous development, which will enable further possibilities for the supply of information.

Also in the area of the handling there is some potential, possibly Google's Glasses Project shows the next step to make Augmented Reality more intuitive.

The shown Augmented-Reality methods do offer an enrichment, but their use must me considered, as it should only be seen as an extention to the already existing methods of participation. Non of the forms of information processing should be used on it's own. The Augmented-Reality methods can only show their full effect if they are used as an addition to the participation process.

All in all it can be said that planning is based on the communication between all people involved and this works best in the direct conversation. "Online does not work without offline!"

7 ACKNOWLEDGEMENT

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