Augmented Reality in vehicle – Technical realisation of a contact analogue Head-up Display under automotive capable aspects; usefulness exemplified through Night Vision Systems.

Driver assisted systems have primarily one aim, to enhance comfort and driving safety. However the increasing number and complexity of existing proprietary systems and the inevitable increased operational time and effort pose a danger not to be underestimated. This is based on the fact, that the desired advantage was offset by the insufficient human machine interfaces (HMI) because of increased distraction from the primary driving task. To counteract this dangerous trend, researchers worldwide are looking intensively for a uniform operating display concept for the car of the future. At that point Augmented Reality plays a considerable and important role. Implementing this intuitive display technology could possibly reduce the decoding complexity for nearly most driver assistance information system to a minimum. Visionary operational scenarios during real visibility are three dimensional visualisations of partially autonomous vehicle conditions, accepting requests from navigation points merging with reality or immediate marking of pedestrians, animals or other safety criteria during bad weather conditions (Figure 1).

Previous AR-Systems which achieved spatial impressions primarily through stereoscopy cannot pass automotive criteria. The main problem is, that so far technical solutions are head-based, needing a head-tracking-system and last but not least causing an enormous increase in costs. To compensate for these problems, practices were developed at the Chair of Ergonomics, which provide the driver with a three-dimensional deep spatial impression from 10m – 300m with the same components of a conventional head-up display, partially utilising depth perception. The engineered system was verified and tested by means of a static mode experiment and put into practice in an experimental vehicle (7 Series BMW) using a modular contact analogue head-up display for night vision application, including automated pedestrian detection (Figure 2).

An object outside the field of vision can therefore be marked with a virtual warning symbol which is then perceived by the driver at the exact position of the real object. Until the point of danger is passed this virtual marker moves precisely along with the object. This type of representation provides the driver, compared to conventional HMI-solutions, with additional information concerning direction, distance and approaching speed, which is essential to judge and assess the imminent danger. Furthermore the decoding effort for the driver is immensely reduced compared to conventional night vision HMI solutions.

Next generation night vision systems will also possess active object recognition capabilities. However these HMI-solutions will be limited to known display modes (Central Information Display, Head-up Display …). All mentioned advantages in respect of contact analogue HUD’s for Night Vision Systems were endorsed during extensive practical vehicle based investigations and trials. With the help of 27 test persons four variants were evaluated concerning effectiveness, efficiency, deviation and satisfaction. For this purpose subjective data was collected by means of questionnaires as well as objective data taken from sight recognition systems.

Subjectively as well as objectively the advantage achieved using contact-analogue Head-up Display cannot be repudiated.

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Figure 1: Augmented reality application in vehicle

Figure 2: Contact analogue HUD in the experimental vehicle