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# DRIVER ASSISTANCE SYSTEM USING AUGMENTED REALITY HEADSET

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## ABSTRACT

Recently, advanced image processing algorithms have been employed to analyses the environment while driving and provide the driver with useful information. Driver assistance systems can detect pedestrians, recognize road signs and provide navigation instructions. On the other hand, the means of presenting these information are rather crude and typically include a small display. Therefore, the driver needs to divide attention between the display and the real world. This issue can be addressed by employing Augmented Reality (AR). In this paper we propose a system in which important information for the driver are displayed on semi-transparent glasses included in an AR-headset and therefore are mixed with the real-world view. Environment analysis is performed on a smartphone which communicates with the headset, which in turn is responsible for detecting their relative position and aligning views. Proof-of concept scenario includes pedestrian detection as well as falling asleep detection, with use of a built-in accelerometer.

## 1. INTRODUCTION

Cars are currently one of the most commonly used mode of transportation worldwide. Despite the advances in the automotive industry, the safety of car transportation is still an issue. Number of traffic deaths in the US in 2013 was over 34 thousands [1]. Despite numerous electronic safety mechanisms, the driver of the vehicle remains the key factor. Recently, advances in sensors, computer vision and machine learning have enabled development of sophisticated driver assistance systems which provide a number of useful information in real-time. Pedestrian accidents can be limited with the use of pedestrian detection systems, that can detect sudden crossings [2]. Efficient recognition of pedestrians is possible also during the night-time by employing infrared sensors [3]. Lane detection systems can alert the driver to unintentional lane departure [4]. Recent methods are able to deal with both straight and curved lanes, under different weather conditions and in the presence of shadows and obstacles [5]. Robust traffic sign detection and recognition has been proposed with the use of Convolutional Neural Networks [6]. Detection of other vehicles on the road is also important in terms of safety and can be addressed with deep learning methods [7]. While systems for analysing the vehicle environment are numerous and advanced, the means of presenting information to the driver are rather crude. Typically, a smartphone or a small dedicated display is employed. While providing important information, such setups create also a distraction for the driver, who needs to constantly switch between looking at the road and at the display. Therefore, a new manner of conveying information to the driver is needed. Automotive companies work on presenting information directly on the vehicle's windscreen in a semi-transparent manner [8]. This technology, however, is rather still immature, as it allows to display graphical contents, but lacks the ability to create a mixed view of real world and virtually added information. With the use of Augmented Reality (AR) such mixed views are possible by displaying generated information on a semitransparent display and therefore augmenting the view of the real world rather than creating a separate, distracting view. Possible applications are numerous - highlighting pedestrians and road signs, displaying distance to other vehicles or providing precise navigation, by overlaying the planned route directly on the view of the road.

## 2. AUGMENTED REALITY

Study conducted in [9] showed that AR positively impacts allocation of visual attention in drivers. Authors of [10] conducted an experiment with a simulator on 26 drivers and concluded that AR systems improve situational awareness. While AR simulators are often employed [11], there are few implementations of actual AR systems for driving. In [12] an AR system is presented, which detects vehicles in front and augments the view by displaying on the windscreen a color-coded information about the distance to the vehicle, by aligning the graphics with the seen vehicle.

In this paper we propose a driver assistance system using an AR-headset, that includes semi-transparent glasses (see Fig. 1) and allows to create mixed view of real world and virtually added information. The AR-headset is used only to convey information to the driver, while analysis of the environment is performed by other sensors, which communicate with the headset. Using an AR-headset rather than displaying information on the windscreen is beneficial for two reasons. Firstly, it can provide information about an object or event even when the driver is not directly looking at it. For instance, when looking in the left mirror the driver may be quickly informed of a pedestrian on the right side of the road. Secondly, a headset can be used in any car, without the need to install additional systems. In this work we present a concept of ARheadset based driver assistance system and verify it with an implementation. Since the headset can display information from any sensor, we focus primarily on aligning the virtual and the real world view, according to the movements of the driver's head. Additionally, our system includes falling asleep detection module based on a built-in accelerometer.

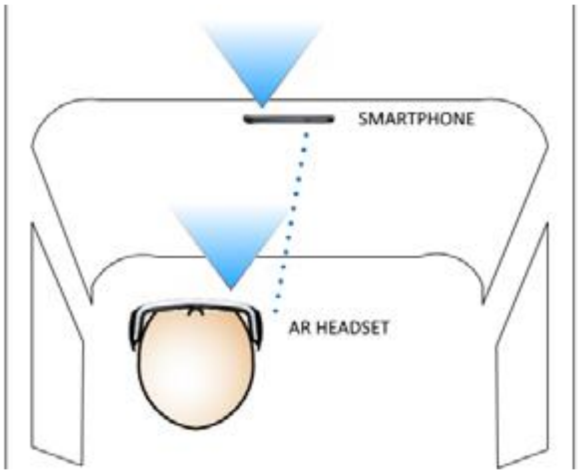
## 3. EXISTING SYSTEM

- Through a systematical approach, the state of the art of AR as a useful technology in the automotive industry. There are more applications and systems in this field and this effort tries to address some research questions in order to provide useful findings for future research and to complement previous AR review studies.

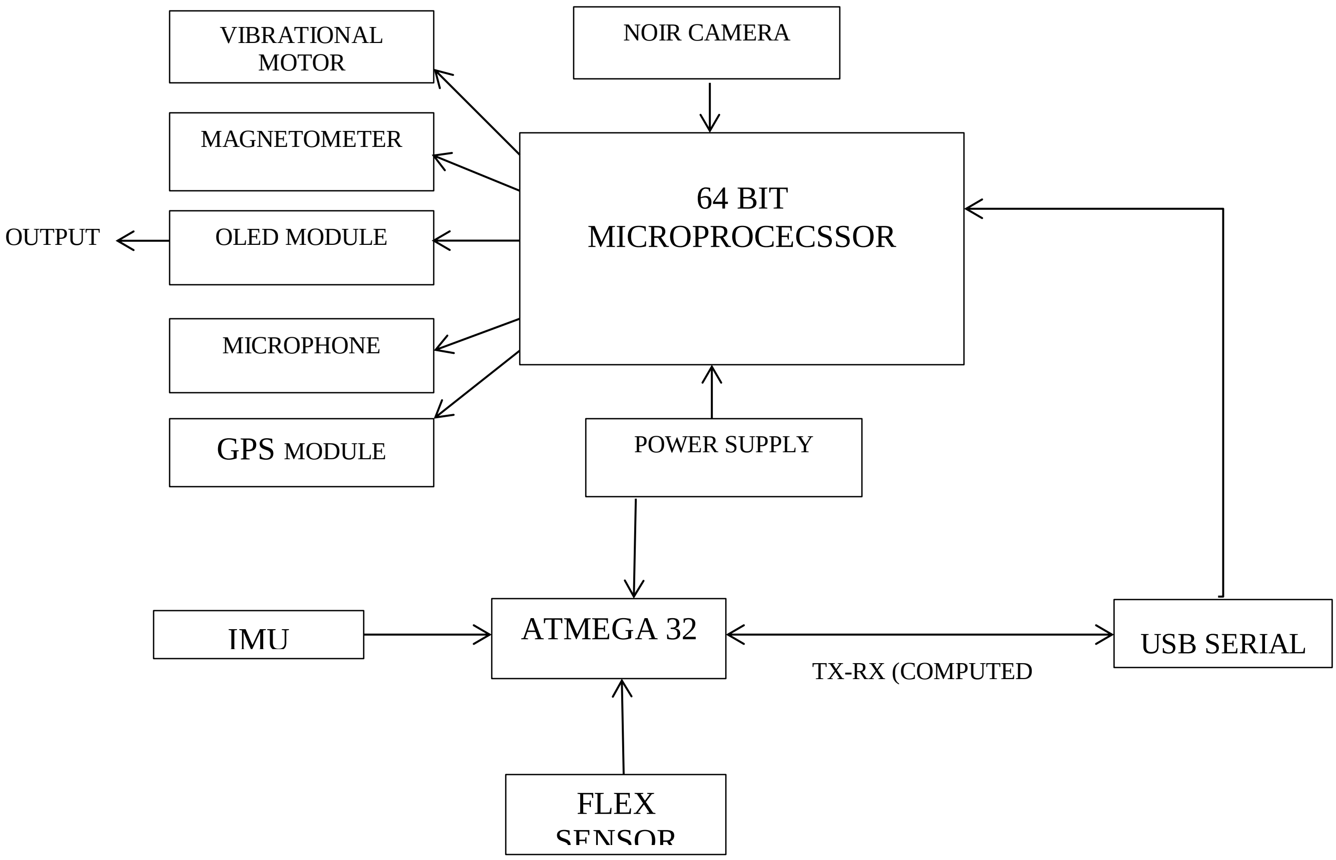
- Without claiming to offer an exhaustive study, this article seeks to systematize research papers related to the automotive industry and to present the general characteristics of AR systems developed for this field, as well as the existing benefits and challenges.
- In the future, we intend to explore more deeply the individual application fields in the automotive industry. In this regard, we should try to identify the trends that are emerging in terms of AR implementation as this technology goes to the highest level of maturation.

## 4. PROPOSED SYSTEM

- In this work we proposed a system which employs an AR-headset for providing a driver with important information via a mixed view of real-world and virtually generated data.
- Our implementation proved the viability of such system. As we presented only a proof-of-concept system, there is still plenty of room for development in this area. Smartphone could be detected based on depth maps, if depth sensor were available in the AR-headset, which is the case with some AR devices, for instance Microsoft HoloLens .
- Creation of models for view alignment could be automated by employing keypoint detection and matching algorithms such as SURF. More relevant information could be delivered to the driver by employing advanced sensors and image processing algorithms.
- To conclude, we believe that AR systems may be the future of driver assistance systems and an important part of the automotive industry in the upcoming years.



# 5. BLOCK DIAGRAM




# 6. HARDWARE REQUIREMENTS

- Vibrational Motor
- Magnetometer
- OLED MODULE
- Microphone
- GPS Module
- Noir Camera
- Microprocessor
- Power supply
- ATMEGA 32
- Flex sensor

- IMU

## 7. VIBRATION MOTOR

**Vibration motor** is a compact size coreless DC **motor** used to informs the users of receiving the signal by **vibrating**, no sound. **Vibration motors** are widely used in a variety of applications including cell phones, handsets, pagers, and so on. ... Based on those features, the performance of the **motor** is highly reliable.

**Figure 1** Vibration motor

## 8. MAGNETOMETER

A **magnetometer** is a device that measures magnetic field or magnetic dipole moment. Some **magnetometers** measure the direction, strength, or relative change of a magnetic field at a particular location

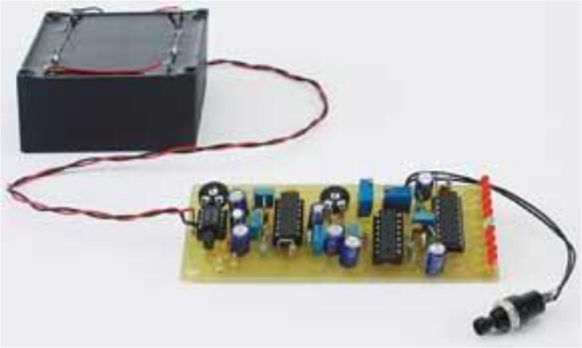


**Figure 2** Magnetometer

## 9. OLED MODULE

This is a 0.96 inch blue **OLED display module**. ... **OLED** (Organic Light-Emitting Diode) is a self light-emitting technology composed of a thin, multi-layered organic film placed between an anode and cathode. In contrast to LCD technology, **OLED** does not require a backlight.


**Figure 3** OLED MODULE

## 10.MICROPHONE

A **microphone** is a device that translates sound vibrations in the air into electronic signals or scribes them to a recording medium. Microphones enable many types of audio recording devices for purposes including communications of many kinds, as well as music and speech recording.

**Figure 4** Microphone

### 11. GPS

The Global Positioning System (**GPS**) tells you where you are on Earth. ... One way to track them would be to have a **GPS** receiver installed in the car! The **GPS**, or Global Positioning System, is one of the hottest technologies around, and no wonder

**Figure 5** GPS

## 12.NOIR CAMERA

The Raspberry Pi **NoIR Camera** v2 is the official “night vision” **camera** board released by the Raspberry Pi Foundation. ... The **NoIR Camera** has No InfraRed (**NoIR**) filter on the lens which makes it perfect for doing Infrared photography and taking pictures in low light (twilight) environments.

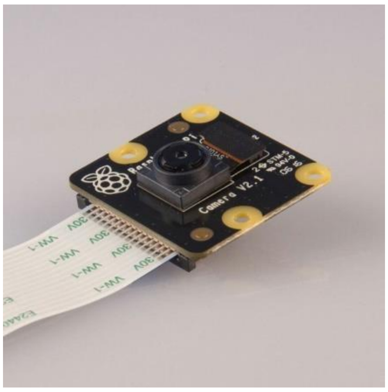


**Figure 6** NOIR Camera

## 13.MICROPROCESSOR

A **microprocessor** is an electronic component that is used by a computer to do its work. It is a central processing unit on a single integrated circuit chip containing millions of very small components including transistors, resistors, and diodes that work together.


**Figure 7** Microprocessor

## 14.POWER SUPPLY

Landscape lighting, however, is typically supplied in lower voltage (12 Volts) spread out through several different lights. A **transformer** can convert the 120v electrical currently supplied from your house down to the **12v** needed for each low voltage landscape lighting fixtures in your lawn!

**Figure 8** Power supply

## 15. ATMEGA32

The **ATmega328 is** a single-chip microcontroller created by **Atmel** in the megaAVR family (later Microchip Technology acquired **Atmel** in 2016). It has a modified Harvard architecture 8-bit RISC processor core.


**Figure 9** ATMEGA 32

## 16. FLEX SENSOR

A **flex sensor** or **bend sensor** is a **sensor** that measures the amount of deflection or bending. Usually, the **sensor** is stuck to the surface, and resistance of **sensor** element is varied by bending the surface.

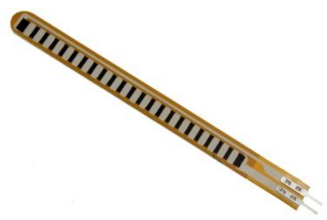


**Figure 10** Flex Sensor

## 17. IMU SENSOR

The **IMU sensor** is an electronic device **used** to calculate and reports an exact force of body, angular rate as well as the direction of the body, which can be achieved by using a blend of 3 **sensors** like Gyroscope, Magnetometer, and Accelerometer.


**Figure 11** IMU sensor

## 18. CONCLUSION

In this work we proposed a system which employs an AR-headset for providing a driver with important information via a mixed view of real-world and virtually generated data. Our implementation proved the viability of such system. As we presented only a proof-of-concept system, there is still plenty of room for development in this area. Smartphone could be detected based on depth maps, if depth sensor were available in the AR-headset, which is the case with some AR devices, for instance Microsoft HoloLens [15]. Creation of models for view alignment could be automated by employing keypoint detection and matching algorithms such as SURF [16]. More relevant information could be delivered to the driver by employing advanced sensors and image processing algorithms. To conclude, we believe that AR systems may be the future of driver assistance systems and an important part of the automotive industry in the upcoming years.

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