eMobility

Using the eyes of the vehicle for positioning

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The increasing electrification of vehicles calls for research and development of new and innovative charging paradigms. In comparison to wired charging, inductive or wireless charging is a convenient alternative. The efficiency of wireless or inductive charging technology is dependent on many factors, but the significant one being the position of the automobile over the inductive charging pad. ServiceXpert Gesellschaft für Service-Informationssysteme mbH uses technology currently present in automobiles and applies them for future-oriented developments.

In today's contemporary automotive industry, most vehicles are equipped with one or more cameras that perform various tasks pertaining to advanced driver assistance systems (ADAS). The future of e-mobility is to solve complex problems by aiding in the design and development of innovative solutions, like simplifying the charging process. The engineers at ServiceXpert use current concepts and existing technologies to develop them further in order to create future-proof electromobility. The concept of charging without cables and without a physical registration or organizational process on a charging station is charming and would significantly increase the comfort of drivers of electric vehicles. Inductive charging technology is a new breakthrough in the field of charging methods for electric vehicles. Since inductive charging is completely wireless, there is no need to use long and heavy charging cables, hence, making inductive charging by far the most convenient method to charge an automobile.

This charging technology is based on the principle of electromagnetic induction, an electromagnetic field is induced between two pads containing magnetic coils. In this way the energy is transferred from a magnetic coil present in the ground pad, which is located, for example, at parking spot reserved for electric vehicles, to the corresponding magnetic coil present at the base of an electric automobile.

The position and placement of the coils with respect to each other conforms to the standards specified in the standard IEC 61980. The standards prescribe a positioning window in relation to the coil center in which inductive charging is allowed. A positioning system not only helps to increase efficiency, but also ensures that the prescribed standards for positioning are met. An auxiliary system is therefore indispensable, if automobiles are to be charged inductively within the standardized frame conditions.

In order to precisely determine the position of the vehicle, the detection and calculation

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of the position of the ground pad is crucial. Many companies that already offer inductive charging systems are looking for cost-effective and reliable positioning systems. One obvious solution in this context is to use the cameras already available for other advanced driver assistance systems, in order to determine the position of the vehicle relative to the ground pad. The engineers at ServiceXpert, with years of automotive experience along with in-depth knowledge of camera-based systems and embedded software development (especially AUTOSAR), have been able to develop an efficient, and a cost-effective prototype of a positioning system.

The following lines depict a simple scenario while positioning an automobile for inductive charging: As the automobile approaches the charging pad which is placed on the ground, the positioning system guides the driver to follow a straight line in the direction of the charging pad. At a certain point, the charging pad is not visible from the automobile and hence, the driver needs support from a positioning system that aids him to park the vehicle exactly above the charging pad. Today, such systems do exist, these systems use various sensors and signals to aid in positioning the automobile. However, current positioning systems have problems with range and interoperability with the different charging systems which in turn are affected by the characteristics of the vehicle and charging coil.

In order to solve these challenges for the optimal positioning of the vehicle, the engineers at ServiceXpert have developed a unique, but simple solution that incorporates a stereo camera. A stereo camera functions like the eyes of a vehicle. With the camera's aid, the vehicle's system can see the vehicle's surroundings, recognize objects and calculate the distance between these objects. It is also used to compute the position of the vehicle relative to the charging pad.

In order to aid the process of positioning, the ground pad is provided with an optical positioning feature, which ensures easy recognition by a standard camera. The camera then can provide information indispensable for the positioning process. As soon as the optical marker present on the ground pad is captured by the camera, the distance of the vehicle and the angle relative to the optical marker is calculated for each individual image generated by the camera. As soon as the ground pad is not in the field of view of the camera, an algorithm tracks the movement of the vehicle in relative to the last position. The information required to support the driver is shown on a display inside the vehicle. The driver receives a message to stop the vehicle as soon as the vehicle is within a predefined optimal range and a predetermined orientation. For this system, the cameras of existing driver assistance systems only must be installed on the vehicle in such a way that they recognize the ground pad at least once and thus the corresponding positioning algorithm can be "fed" with image data.

Most of the inductive charging stations with higher charging power will have a wall base station in the future, a so-called "wall box" that controls and supplies the inductive ground pad. Communication between the two parties starts when the vehicle is within range of the wall box. As soon as the vehicle reaches the correct position above the ground pad, the vehicle sends the request for energy transfer in order to initiate the charging process. The wall box takes over the vehicle authentication, processes and online payment and then displays the necessary information, such as the total energy units consumed.

The prototype implemented by ServiceXpert was presented for the first time as part of the „Inductive Charging" Technology Day by Zollner Elektronik AG on October 17, 2019. Among the participants were representatives from well-known automotive OEMs. The system presented met with great interest among those present and proved to be very attractive, as there are no additional costs for installing new hardware in the vehicle. Visitors to the Technology Day were able to experience the positioning system for themselves by parking the automobile above the ground pad with the help of an external display present on the center console of the automobile.

For future development of the prototype developed by ServiceXpert, the connection to other sensors already available in the vehicle along with existing vehicle operating data will be used in order to ensure more precise and stable tracking of the movement. Also, the data calculated for a positioning system can also be used to support the driver support when parking and / or autonomous parking.

Mr. Thomas Eiber, project manager for „Inductive Charging" at Zollner Elektronik AG in Zandt, who works closely with ServiceXpert on the project: „The agile way of working, the well-founded AUTOSAR know-how's and the eye for cost-effective, practical solutions is what ServiceXpert is about and very much appreciated in development projects at Zollner."

The team at ServiceXpert always uses the current state of the art technology in the development and provision of intelligent solutions for complex mobility requirements and continuously builds up competencies and know-how in the context of technological change in the automotive industry. The use of a stereo camera for vehicle positioning during inductive charging offers a cost-effective, convenient solution in the area of electromobility. ■

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