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RESEARCH NEWS

Robotic lawn mowers with highly advanced sensors

Increased safety for children around lawn mowers

Robotic lawn mowers are great for cutting the grass, but they do pose a risk of injury to children playing nearby. Highly advanced sensors developed by Fraunhofer researchers ensure that the lawn mower shuts down when children are in close proximity. The system, which is based on LiDAR technology, uses a single pulse of light to capture the entire surroundings, covering a range of up to two-hundred meters.

Levels of digitalization and automation are increasing not only in industrial environments but also in our everyday lives. More and more people today are using robotic devices to vacuum the floors or mow the lawn, for instance. In the same way autonomous vehicles negotiate traffic on the roads, the robotic devices have to precisely monitor their surroundings at all times to avoid causing material damage or injury. A recent test conducted by German consumer safety group Stiftung Warentest, however, indicates that not all robotic lawn mowers perform this task to full satisfaction. The test reveals, for example, that when crawling children are nearby, some of the lawn mowers studied did not stop in time and left serious cuts on the test dummies. None of the devices stopped when a replica of a child's hand was placed in front of them. Some of the robotic lawn mowers tested rely exclusively on shock sensors, which only detect and initiate a response to obstacles on impact. Given that these sensors are located a certain distance from the ground, the device's rotating blades can come into contact with children's extremities before it identifies them as hands, arms or legs.

Three-dimensional monitoring of the surroundings

The Fraunhofer Institute for Microelectronic Circuits and Systems IMS in Duisburg is developing highly advanced optic sensors that measure the surrounding area in 3D. They incorporate LiDAR (Light Detection and Ranging) technology, which measures the distance to the object based on the time taken for a light pulse emitted to return. The pulsed laser light is reflected by the surface of objects with which it comes into contact. Using time-of-flight imaging cameras, the LiDAR device then captures the reflected signals. The distance and position of objects as well as the speed at which they are moving is calculated based on the time it takes for the light to reach the object and return.

The sensors use state-of-the-art image processing technology to generate three-dimensional representations of the surroundings in real time, thus making it possible to

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distinguish between people and other objects. This prevents the robots from getting close to children playing nearby in the first place, and if a child does happen to approach it, the device shuts down immediately. In addition to developing photodiodes, which convert the incident light into an electric current, the researchers are exploring methods to reduce the adverse effects of sunlight. The sensors will therefore also be able to reliably detect objects and prevent impending collisions in bright sunshine.

Made up of several special photodiodes – known as single-photon avalanche diodes (SPADs) – developed at Fraunhofer IMS, these new generation sensors capture an image of the entire surrounding area with a single pulse of light. SPADs are a hundred times more sensitive than the photodiodes found in smartphones, for example. Now, the research team is aiming to use SPADs to cover distances of up to 200 meters, with the first systems set to go into production in late 2019.

Sensor and analysis electronics combined on a chip to save space

Thanks to CMOS technology, the photodiodes are integrated with the requisite analysis electronics on a single chip. This gives the sensors a compact design and means they can be produced economically. As a result, they can be used in products suitable for the mass market, such as robotic lawn mowers, without driving their costs up. In collaboration with leading sensor and camera manufacturers, Fraunhofer IMS also offers three-dimensional monitoring and imaging solutions tailored to customer specifications.

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LiDAR OWL – the time-of-flight imaging camera, that could be used with the robotic lawn mowers.
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