TECHNICAL INSIGHTS

SENSOR

TECHNOLOGY ALERT

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1. MONITORING GLAUCOMA WITH PRESSURE SENSOR

Glaucoma is a disease caused by damage to the optic nerve. According to the Glaucoma Research Foundation, glaucoma is the second leading cause of blindness in the world, afflicting more than two billion Americans. Glaucoma is caused by high blood pressure, which damages the optic nerve and results in vision loss. It is extremely vital for patients at risk of glaucoma to check eye pressure a few times a year. At present, eye pressure can typically be checked only by an ophthalmologist. Patients cannot monitor eye pressure themselves. There is a need for a cost efficient, reliable, and user friendly device, which can monitor eye pressure regularly and help prevent the risk of glaucoma.

To address the above challenge, researchers from the University of Washington have developed a low-power sensor chip to measure changes in eye pressure. This low-power sensor is basically used to monitor glaucoma by changes in eye pressure. The chip comprises a radio frequency (RF) chip and a pressure sensor.

To track the iris, the researchers have employed an RF chip. The iris is the diaphragm that controls the size of the pupil, thus controlling the amount of light entering the eye. The RF chip comprises an antenna and transceiver. The antenna deployed by the researchers is thin and circular in shape so that it can be easily mounted inside the eye. The RF chip is used to sense the surrounding field for wireless power and data transfer; it draws power from the radio waves reaching the antenna. These radio waves are created by the surrounding magnetic field. Changes in eye pressure are monitored by pressure sensor monitors and they record information on the chip. Using RF, the chip transfers the recorded information about the eye pressure to the nearby receiver. In the future, the researchers plan to use smart phones as receivers. Thus, the eye pressure sensor can avoid the risk of glaucoma by continuously monitoring eye pressure.

The low-power sensor chip, once developed, will be used in medical applications, such as in cataract surgery to replace the natural lens with the artificial lens embedded with the low-power sensor chip. In the future, sensors will also be used to detect changes in temperature. The researchers are planning to modify the chip to track the changes in the eye's acidity level.

This project was funded by Coulter Foundation, USA, and the University of Washington. The researchers are planning to reduce the size of the device to make it compatible with the artificial lens. This device is expected to be commercialized in around five years. The final product will be cost efficient, reliable and easy to use for doctors performing surgery; besides. It will provide data with high efficiency. Once the product is fully developed, it is expected to have opportunities to be widely adopted by ophthalmologists.

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2. SAFE AND EFFICIENT ELECTRONIC DRIVER

According to a 2009 report by the United States Census Bureau, about 40,000 Americans die every year in and 2.9 million get injured in road accidents. Most road accidents are caused by human error and drunken driving. Chances of driver distraction are high when they are tired or sleepy. Accidents can also occur if the driver is talking on the cell phone or to passengers in the car or if they are emotionally disturbed. There is a need to lower these accident rates and devise a mechanism which takes control over the car if there is an emergency or if a driver is not fit to drive a car.

To address the above challenge, researchers from Carnegie Mellon University have designed innovative software with sensors to drive an autonomous vehicle. The researchers from the university have called it a 'car with a brain' and named it 'Boss'. This vehicle is capable of routing on highways and roads without any human intervention. This software relies on inputs from infrared cameras, light detection and ranging (LIDAR) and radar.

LIDAR has been deployed in driverless cars. It measures speed, distance, and rotation. LIDAR sends out laser pulses from the transmitter. These laser pulses are reflected from the obstacles back to the vehicle. This information helps the software to take action such as applying brakes. Infrared cameras are employed in cars to provide clear night vision. Radar is used in cars (for example, for adaptive cruise control). A radar detector sends out high-frequency radar waves. These waves bounce back from the nearest objects and return to the sensor. The sensor calculates the total time required for transmitting and receiving signals. Software designed by the researchers takes data from these sensors and calculates the information with respect to safety belts inside the car, speed of the car, objects in front of the car, outside weather, traffic lights, total distance and a correct route to travel, applying brakes in emergencies, shifting lanes and changing the speed of the vehicle. With a specially designed program and mathematical calculation based on the data from sensors, software on the computer controls the vehicle without human intervention. The computer with software is tucked under the floor. Thus, autonomous vehicles work safely without a driver.

Once fully developed, Boss is expected to be used by car manufacturers. In the future, the concept can also be utilized for helicopters and airplanes. It can be deployed in agriculture to drive a tractor without a driver. It can also be used in a majority of stadiums to make the ground even by driving an automatic vehicle to cut the grass. It may have further applications in the defense sector to drive a tank or a submarine without a driver.

This project was supported by the National Science Foundation (NSF), General Motors, Defense Advanced Research Projects Agency (DARPA) and the US Department of Transportation. The researchers are working on the policy and technology fronts to make the driverless experience easy. This project is expected to be commercialized by 2020. Once the driverless technology is fully developed, and costs are limited, it can have potential to be well received by car manufacturers.

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3. AGRICULTURAL ROBOT WITH SENSORS FOR MONITORING YIELD

Sudden climate change and other environment issues have an adverse effect on crop growth. At the time of harvesting, farmers get updates on the quality of their vegetation. A decade old cycle is being followed by farmers, from planting crops to harvesting. In terms of crop quality and maintaining a yield, they are lacking updates. There is a need for an inexpensive, efficient, and reliable device which can monitor crops and update farmers about the steps to be taken in adverse weather conditions, during plantation, development of plantation and while harvesting. This device should perform an autonomous survey in terms of mapping the yield.

To address the above challenge, researchers from the University of Sydney have developed a ground robot with intelligent software called Ladybird. Ladybird is capable to classify, detect and map variety of different vegetables with the help of sensors. Ladybird is comprised of a solar panel and an array of sensors such as lasers, cameras, and software.

The researchers have deployed solar panels on the top of ladybird. To charge the robot with the help of solar power, solar panels are deployed. The laser sensor used in Ladybird is used to sense the height of vegetables or the vegetation from the ground. This data helps to guide crop development. Hyperspectral cameras are employed for spectral imaging across many wavelength bands in agricultural farms. This camera gives detailed information by dividing the light into small bands. This camera can efficiently monitor the health of crops and provides information such as nutrients and water requirement for the particular crop. The robot also helps sprinkle chemicals on the particular crop. Information from the array of sensors is sent to the software. Researchers have derived a mathematical calculation with the help of a program. This program guides the user to perform tasks, such as sprinkling chemicals on crops. Thus, Ladybird helps farmers to survey, map, classify and detect a variety of vegetables.

Ladybird, once fully developed, the robot can be used in all kinds of farming above the ground for instance, for orange and apple farming and under the ground, for potato, onion and beetroot farming. The researchers are also planning to employ several different sensors to monitor the growth of crops. With the same technology, the researchers have developed a robotic arm to remove weeds during harvesting.

This project was funded by the University of Sydney. The researchers are working on embedding a robotic manipulator arm under the Ladybird for spot sensing and automatic harvesting of the developed crops. Ladybird is expected to be commercialized in a years' time. Once the Ladybird is fully developed, it is expected to be widely adopted by farmers.

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4. RECENT PATENTS IN THE FIELD OF PHOTOELECTRIC SENSING

Photoelectric sensors are often used to sense the absence, presence and the distance of the object by transmitting light. Such sensors can also provide color or contrast recognition. Photoelectric sensors sense the change in light intensity. A photoelectric sensor is built by using components, such as a transmitter, amplifier, converter and receiver. Photoelectric sensors often use an infrared light emitting diode (LED) as the light source and a photo transistor as a receiver. Photo transistors are employed to analyze incoming light from infrared LED and triggers appropriate output.

Photoelectric sensors are widely used in applications such as material handling (for example, bottle detecting), food processing, and transportation. It can also be used for safely closing and opening garage doors or opening doors in grocery stores, automatically controlling elevators, detecting chip components, and many more.

Thru-beam, retro-reflective and diffused methods are used by photoelectric sensors for target/object detection. Thru-beam mode sensors provide the longest sensing range for photoelectric sensors. The system has two components: a transmitter and receiver. This mode is used in two different housings, one for the receiver and other for the transmitter. In the other two modes, the transmitter and receiver are placed in the same housing. Diffuse reflection sensors may be less accurate than through-beam or reflective types.

A recent patent in photoelectric sensing (EO 2581760) allows for removal of the noise signal by extracting, from a received light signal, a signal in the vicinity of a carrier frequency.

PATENT TITLE	PUBLICATION DATE / NUMBER	ASSIGNEE	INVENTORS	ABSTRACT
Photoelectric Sensor	18.06.2014; EP 2581760 B1	Kato Taichirou, Kajita Tetsuya, Hatanaka Hiroshi, Takamiya Tomohiro, Sato Nagayuki	Azbil Corp	A receiver 20 has a reference voltage generating circuit 27 for generating a reference voltage. A BPF circuit 24, by setting this reference voltage to the center value of the extracted signal, removes a noise signal by extracting, from a received-light signal, a signal in the vicinity of a carrier frequency. The absolute value circuit 25 performs full-wave rectification on the output signal of the BPS circuit 24 using that reference voltage, to use, as a detection waveform, the signal component for from a transmitter 10. The LPF circuit 26 removes the high-frequency component from the output signal of the absolute value circuit 25.
Wireless Optical Patient Monitoring Apparatus	17.06.2009; EP 1005287 B1	Datex Ohmeda Inc	Malinouskas Donald, Hojaiban George	A wireless optical patient monitoring apparatus, comprising: a transducer (470, 482) adapted to detect a physiological function, said transducer (470, 482) providing an output signal indicative of said physiological function; a modulator (462, 486) adapted to modulate a carrier by said output signal;an optical source (17; 19; 464, 488) associated with said modulator (462, 486) adapted to emit an optical signal which corresponds to said modulated carrier; a photodetector (6, 7, 8; 472)
Scanner With Prepress Mode	17.12.2002; US 6496274 B1	Heidelberger Druckmasch Ag	Telle Lawrence B	A scanning device includes an automatic document handler for stream feeding in serial fashion hard copy original pages to a platen or scanning station to be automatically read by the image scanner into electrical signals or data. The raw image data is stored in a memory buffer. An operator may use the data in this buffer to manipulate the image electronically before using the image for further processing, such as printing or publishing.

Scanner With Prepress Scaling Mode	22.10.2002; US 6469801 B1	Heidelberger Druckmasch Ag	Telle Lawrence B	A scanning device includes an automatic document handler for stream feeding in serial fashion hard copy original pages to a platen or scanning station to be automatically read by the image scanner into electrical signals or data. The raw image data is stored in a memory buffer. An operator may use the data in this buffer to scale the image electronically before using the image for further processing, such as printing or publishing.
Scanner With Prepress Scaling Mode	22.11.2001; WO 2001/087041 A2	Heidelberg Digital Llc	Telle Lawrence B	A scanning device includes an automatic document handler for stream feeding in serial fashion hard copy original pages to a platen or scanning station to be automatically read by the image scanner into electrical signals or data. The raw image data is stored in a memory buffer. An operator may use the data in this buffer to scale the image electronically before using the image for further processing, such as printing or publishing.
Scanner With Prepress Mode	22.11.2001; WO 2001/088841 A1	Heidelberg Digital Llc	Telle Lawrence B	A scanning device includes an automatic document handler (32) for stream feeding in serial fashion hard copy original pages to a platen or scanning station (38) to be automatically read by the image scanner into electrical signals or data. The raw image data is stored in a memory buffer (54). An operator may use the data in this buffer to manipulate the image electronically before using the image for further processing, such as printing or publishing.

Optical Scanner Which Reduces The Effects Of External Electrical Noise And Disturbing Light	09.11.1999; US 5981944 A	Brother Kabushiki Kaisha	Ito Koji	An optical scanner reduces the effects of external electrical noise and disturbing light that leaks therein during an image read operation. Light beams emitted by a plurality of light sources are synthesized so as to travel along a common optical path, the synthesized light beams are deflected by a polygonal rotating mirror and condensed. The condensed light beams fall on a beam splitting device. One of the light beams is projected on the image forming surface of a photosensitive member for image recording, another light beam scans the image surface of a document, and light scattered by the light reflecting from the image surface of the document is detected by photoelectric devices. The light beam projected on the document is modulated by a modulator in accordance with a fixed frequency, and signals provided by the photoelectric devices are demodulated by a demodulator.

Exhibit 1 lists some of the patents related to photoelectric sensing.

Picture Credit: USPTO/Frost & Sullivan

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