TECHNICAL INSIGHTS

SENSOR

TECHNOLOGY ALERT

14th November 2014

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1. SMART CARD WITH ONBOARD CONTROL

According to the European Central Bank, total false transactions using payment cards have reached to €1.33 billion (about US $1.66 billion at the current exchange rate). According to UK's passport office, more than 290,000 passports are lost or stolen each year, and are misused. Biometric recognition systems are being used by the banks, offices, airports and many more establishments to identity scams; however, because of errors caused by human operators or machines, these scams are undetected. With an increase in the number of scams, it is very critical for various organizations, such as, banks, to implement a process or device that will be compatible with the customers of banks and provide a supreme level of security without sharing personal data or information, such as, fingerprints.

To address the above-mentioned challenge, researchers from a firm based in Italy, Card Tech Srl, have developed a smart card. Card Tech has used the IDEX's bendable SmartFinger sensor to develop a thin and bendable card. The IDEX SmartFinger sensor assists Card Tech to offer supreme biometric performance. This smart card is compatible with the existing infrastructure of payment card reader.

The smart card comprises advanced polymer capacitive biometric sensor, an algorithm, and a low power microcontroller. The total system is integrated on board the smart card. The smart card is 0.76 mm thick and complaint with the international standard of payment cards. The microcontroller is deployed to perform real-time scanning of the fingerprint and compare it with the user's registered fingerprint. The authentication of the user data is executed inside the card, which eliminates the need of any external database giving maximum

security and privacy to the user. Thus, the smart card from Card Tech and IDEX will be able to perform safe and secure transactions both in the real or virtual world.

The smart card will be commercialized with the payment card reader. The technology behind the smart card has potential applications in various fields such as in online banking services, government ID, airport security, credit and debit cards, portable storage, mobile phones, health systems, physical and logical access, and many more. The smart card by Card Tech is being awarded with the ISO 7810ID-1 standard. This recognition will further attract key industry participants from various industries. The market for smart cards and biometrics is expected to grow rapidly and the impact will be seen by 2017.

The project was supported by IDEX. Researchers at IDEX and Card Tech are identifying ways of deploying the technology in mobile devices. The project was partially funded by IDEX and Card Tech. IDEX has been granted 14 patents, and three are still pending. Both the companies are looking forward to scaling the product for mass production.

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2. STRAIN MEASUREMENT USING SENSOR

Composites have a tendency to wear and degrade, which can have cataclysmic economic consequences and impact the safety of personnel and public. There is need for a device or method to test the condition of composite structures and assess the extent of strain that the structure can handle. In addition, the device should be easy to use, accurate, and cost efficient.

Toward fulfilling the above-mentioned need, several researchers from the SmartFiber project have developed a fiber Bragg grating sensor. The sensor is developed to test the condition of materials in composite structures such as wind turbines.

The fiber Bragg grating sensor system comprises a photonics integrated circuit, read out integrated circuit, photodiode, wireless interface, and optical fiber sensor. The signal is transmitted by the photonics integrated circuit; the circuit is fabricated with the help of silicon. The light transmitted through the photonics integrated circuit is further combined with the fiber of fiber grating

sensor. The narrow spectrum of the light is reflected back while the light that cannot be reflected is further propagated with the help of fiber. The amount of light that is reflected back is detected with the help of photo detector. The resulting electrical signal is further processed and it is used to calculate the maximum amount of strain a structure could withstand. The light that propagates further through the fiber results in the modulation of refractive index. This resulting change in the Bragg wavelength is directly proportional to the applied strain; the respective strain will be used to measure the condition of the composite structure.

Once the project is fully developed, the device will be employed to investigate the composite structures of wind turbines. Wind turbines can be too heavy to run on full capacity. This system will help to test the strength of the structure and determine the maximum capacity at which the wind turbine can rotate. In future, this system will be employed in carbon fiber based and glass fiber based composites. It will also be used in the aerospace industry, civil construction industry, and in ship propellers, tidal blades, and many more applications. To ensure the reliability of the structure, a fully embedded monitoring system that is self-sustaining would be beneficial.

The system was developed under the SmartFiber project. The partners for the SmartFiber project are Airborne group, FBGS Technologies, Optocap Ltd., Xenics, Imec Research Institute, Fraunhofer IIS, and Ghent University. The project was funded by Seventh Framework Programme of the European Commission. The researchers are currently testing the system with various composite materials and acquiring data about the particular material at lower frequencies.

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3. TURRETED SURVEILLANCE USING HIGH-DEFINITION INFRARED SENSOR

Unmanned aerial vehicles are capable of garnering a large amount of intelligence without putting human life in danger. This has been the strongest motivation for the rapid development of aerial vehicles. However, the conventional systems being used may not able to effectively engage and track

multiple targets. Such systems have a short range of viewing and require transporting of the system to offsite locations, which incurs a separate maintenance cost. These systems cannot be upgraded according to the mission requirements. There is a need for an easy-to-maintain modular system that can be upgraded according to the mission requirements. It should be able to track and engage multiple targets over a long range. In addition, the system should be easy to use and cost effective.

To address the above-mentioned challenges, researchers from US-based company Lockheed Martin have developed a high-definition electro-optical and infrared (IR) targeting system called INFIRNO. The system includes a visible and IR light imaging sensor, short wave IR imaging sensor, thermal imaging sensor, and lasers for range finding and target designation. Lockheed Martin has developed the sensor system for helping jets in air warfare.

The high-definition infrared sensor helps to provide advanced image processing, and track and engage multiple targets. The INFIRNO system is a 15 inch sensor system and weighs approximately 61.2 kg. The INFIRNO system consists of a line replaceable unit, which helps the user to customize the system according to the mission requirement. The INFIRNO system will be basically used for turreted surveillance in military operations. The system will be first deployed in Lockheed F-35, Bell Helicopter AH-1Z, and Boeing AH-64.

Once the project is fully developed and passes the qualification test, it will be used in the defense sector for intelligent surveillance and investigation missions. The INFIRNO system will be used for ground, aerial and surface water vehicles. It will help the user to identify and track the targets over a long range. The INFIRNO system, deployed in the aircrafts or vehicles, will be quite easy to maintain. The user can easily upgrade the system according to requirements. INFIRNO diminishes the life cycle and maintenance costs, and benefits the user with its easy-to-use operational functions.

The project was funded through the internal investment of Lockheed Martin. Researchers from Lockheed Martin are planning to put the product through a series of qualification tests. The tests will demonstrate different platforms in which the product will be applicable. The project is expected to be commercialized by the end of year 2015. The competitors of Lockheed Martin in the target market area would be FLIR systems and L-3 Communications. The INFIRNO is expected to receive a good response from defense sector because of

its reduced life cycle cost and ease of maintenance, as there will be no further need to detach this sensor system from the body of the aircraft.

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4. PATENTS IN THE FIELD OF MOTION SENSORS IN UNMANNED VEHICLES

Unmanned vehicles are vehicles, which have the capability to maneuver autonomously on their own. An unmanned vehicle can also be guided from a remote location using a remote control. Unmanned autonomous vehicles are capable of sensing their environment and responding on their own. Unmanned vehicles can be classified as unmanned ground vehicles, unmanned aerial vehicles, and unmanned water surface vehicles. The unmanned water surface vehicles can further be classified as unmanned surface vehicles and unmanned underwater vehicles.

Sensors play a key role in advancement of unmanned vehicles. Different types of sensors--such as motion sensors, camera and image sensors, bio sensors, and tactile sensor systems--are deployed in unmanned vehicles to perform operations without human intervention. Sensor fusion derives data from disparate sources such that the resulting information is in some sense better than the data obtained from these sources if they were used individually.

A recent patent in motion sensing that uses multi-model distributed filtration (CN103697889) is assigned to Beihang University, which has been classified under self-navigation and positioning method.

From 1969 to 2014, approximately 1937 patents have been registered under unmanned vehicles. From 1965 to 2014, approximately 1930 patents have been registered under motion sensors. From 1994 to April 2014, approximately 18 patents have been registered under unmanned vehicles and motion sensors.

Motion sensor will be one of the factors, which will help to achieve fully autonomous vehicle without driver intervention. Motion sensors will be deployed in unmanned ground, surface, and aerial vehicles.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Unmanned aerial vehicle self-navigation and positioning method based on multi-model distributed filtration	02.04.2014; CN103697889	Beihang University	Zhao Long	The invention discloses an unmanned aerial vehicle self-navigation and positioning method based on multi-model distributed filtration and aims to reduce the calculation complexity of the unmanned aerial vehicle self-navigation and positioning method, meet a requirement of an embedded processor on real-time processing, guarantee stable control on an unmanned aerial vehicle and also ensure self-navigation and positioning of the unmanned aerial vehicle under a condition that a satellite navigation positioning system is unavailable within short time or long time. By the virtue of the unmanned aerial vehicle self-navigation and positioning method, measured values of motion of the unmanned aerial vehicle are obtained through different measurement systems and different sensors by constructing different orders of system state equations for estimating multi-mode distributed filtration states; a distributed filtration method is adopted to estimate and compensate an error of a low-cost inertial navigation system, so that continuous and reliable navigation and positioning information can be supplied to the unmanned aerial vehicle. The unmanned aerial vehicle self-navigation and positioning method disclosed by the invention can continuously and stably supply precise navigation and positioning information to an unmanned aerial vehicle control system for a long time.
Unmanned undersea vehicle hardware in the loop simulation (HILS) system for improving dynamic control performance and a dynamic control characteristics verifying method using the same	26.07.2013; KR101290083	Ortiz Albert	Choi, Byung	PURPOSE: An unmanned undersea vehicle HILS system and a dynamic control characteristics verifying method using the same are provided to reduce development expenses by integrally verifying hardware and software of an unmanned undersea vehicle through actual marine environment modeling and sensor simulation on land. CONSTITUTION: An input unit (110) receives a route on a predetermined virtual map and a search region of the route from a user. A communication unit (120) transmits a 3D optimal route and a dynamic control signal with regard to the received route and the search region of the route to an unmanned undersea vehicle and receives actual sensor data from the unmanned undersea vehicle. A control unit (130) generates the 3D optimal route and the dynamic control signal reflecting the inputted route and the inputted search region through motion simulation of the unmanned undersea vehicle and transmits the 3D optimal route and the dynamic control signal to the unmanned undersea vehicle. The control unit generates virtual sensor data by the motion simulation and verifies the dynamic control characteristics of the unmanned undersea vehicle by comparing the generated virtual sensor data and the received actual sensor data. COPYRIGHT KIPO 2013 null [Reference numerals] (100) Unmanned undersea vehicle HILS system; (110) Input unit; (120) Communication unit; (130) Control unit; (200) Unmanned undersea vehicle; (AA) Dynamic control signal; (BB) Actual sensor data
Method of generating digital-analogue control signal for onboard angular motion control systems of unmanned aerial vehicles and device for realising said method	20.01.2013; RU0002473107		Cheeses Anatoly Sergeyevich (RU)	FIELD: information technology. SUBSTANCE: device for generating a digital-analogue control signal for onboard angular motion control systems of unmanned aerial vehicles has a digital control signal setting device, a comparing element, a first amplifier, a digital angle sensor, an angular velocity sensor, a second amplifier, a first adder, a digital-to-analogue converter, a digital differentiating section, a third amplifier and a second adder. EFFECT: high dynamic accuracy of control and eliminating lack of control. 1 dwg

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Systems and methods for inertially controlling a hovering unmanned aerial vehicles	08.12.2011; US20110301783	Honeywell International Inc.	Goossen Emray R.	Systems and methods for inertially controlling a hovering unmanned aerial vehicle (HUAV) are provided. One inertial controller includes a frame and a sensor for detecting a change in an orientation and/or motion of the frame with respect to a predetermined neutral position. The inertial controller also includes a processor for generating commands to the HUAV to modify its current orientation and/or motion in accordance with the change. A system includes the above inertial controller and a sensor for determining a second change for an orientation and/or motion for the HUAV based on the change, and a processor for generating a signal commanding an HUAV control system to orient and/or move the HUAV in accordance with the second change. One method includes detecting a change in an orientation and/or motion of an inertial controller frame and commanding the HUAV to modify its current orientation and/or motion in accordance with the change.
Miniature electric ducted propeller type intelligent unmanned aerial vehicle	05.01.2011; CN101934858	Wang Zefeng	Wang Zefeng	The invention relates to a miniature electric ducted propeller type intelligent unmanned aerial vehicle, which consists of a ducted casing, a bracket, a coaxial counter propeller, a fairing, a battery, a motor, a driving control circuit and a microcontroller. The machine body has a dish-shaped appearance; and the ducted casing is arranged outside a rotor wing to eliminate flight safety threat caused by the traditional structure of the exposed rotor wing and improve the working efficiency of the propeller. The aerial vehicle adopts a design of the coaxial counter double-rotor wing, cancels the inertial rotation of the machine body without a tail rotor wing, saves materials and expands the operating space. The propeller is driven by the motor; the motor is under the servo control of the driving control circuit; and the horizontal motion of the aerial vehicle in the air is implemented by a deflectable guide plate below the propeller in a matching mode. In addition, a multi-azimuth convenient slot is formed inside the ducted casing of the aerial vehicle for mounting and detaching various sensors at any time; and the microcontroller comprehensively processes information fed back by each sensor and performs autonomous flight control according to a task.

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Method and apparatus for the hookup of unmanned/manned ("HUM") multi purpose air vehicles with each other	23.11.2010; US7837151	Sargent Fletcher Inc.	Garcia, Jr. Frank	A system for the hookup of either a manned or unmanned air vehicle with a refueling air vehicle. A probe extending from an air vehicle being refueled is joined to a drogue at the end of a boom on a refueling air vehicle. In bringing the probe into the drogue an optical sensor on one of the vehicles is employed in conjunction with optical beacons on the other vehicle with the sensor measuring the relative motion between the probe and the drogue and generating a control signal for controlling motion of the probe relative to the drogue. The positioning of the probe relative to the drogue is accurately controlled during the fueling operation by a rigid actuator mechanism formed by a rod sidably fitted within a sleeve, the rod being driven by a tensioned reel in response to control signals. One end of the actuator is connected to the drogue while the other end is connected to the refueling aircraft to form a triangular configuration, allowing only small interaction forces thereby restraining relative motion between the probe and the drogue.
Braking device of unmanned vehicle	11.08.2010; CN101797917	China PLA Artillery College	Chen Gang	The invention relates to a braking device of an unmanned vehicle. The device comprises a motor, a reducer, a coder and a sensing mechanism, wherein the reducer is a worm gear reducer, the input end of the reducer is connected with the motor, and an output shaft at the back end of the motor is connected with the coder; one end of the output shaft of the reducer is connected with the contacts of sensors, the other end of the output shaft of the reducer is connected with a torque sensor, and the other end of the torque sensor is connected with a wire wheel wound with steel wires; and both sides of the upper part of a sensor fixing mount connected with the shell of the reducer are respectively provided with a zero-position sensor and a pole-position sensor, and the contacts of the two sensors are respectively positioned at the inner side of the circular motion trajectory of sensor contacts. In the invention, the worm gear mechanism can effectively keep a vehicle in the braking state; the spacing sensor and the torque limiter realize the effective braking and ensure the safety of the vehicle; and the steel wires avoid the interaction between the unmanned driving mode and the manual driving mode. The invention has the advantages of simple and compact structure, low cost and strong universality, and does not destruct the structure of the original vehicle.

Exhibit 1 lists a few patents related to motion sensors in unmanned vehicles.

Picture Credit: Frost & Sullivan

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