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Infrared camera enables reliable facial recognition

**A research team at the Bonn-Rhein-Sieg University of Applied Sciences has developed a skin detection process which supports biometric systems in securely identifying faces. For measurements in the infrared range, the scientists rely on the Goldeye G-032 SWIR camera.**

Stadtroda, 25.11.2015 - For security in public places or in buildings such as airports, or in security-related areas such as data centers, biometric systems are being used more and more. The greater the proliferation of such systems, the more possibilities are developed for circumventing or outwitting them, all of which requires the development of even more reliable security systems. Conventional imaging systems can be deceived with the aid of masks or other facial reproductions. The camera can't tell the difference between the falsified image and the reference image. How then can a security system recognize whether an actual face is being scanned or not? A project team at the Bonn-Rhein-Sieg University of Applied Sciences, under the direction of Professor Norbert Jung, found an answer. The solution consists of multispectral signatures and infrared cameras.

**Security Leak: face or masquerade?**
In order to find the right answer, the reasons for existing security leaks first must be analyzed. Currently, conventional imaging systems used for biometric facial verification possess one great weakness: they merely compare images with each other, failing to provide 100% security. The camera records an image of a person, and the software compares the biometric characteristics with a template such as a passport photo or a mug shot. If the person being photographed is wearing a mask, or holding a photograph of another individual in front of his or her own face, the camera records that mask or image and compares it to the reference image. It cannot recognize whether it is recording a human face or something else. A reliable security system must therefore be able to differentiate between human skin and other materials while concurrently checking biometric characteristics.

Within the visible light spectrum (approximately 380 nm to 780 nm), skin is not identifiable based upon color, primarily due to different skin types which encompass color tones of myriad nuances.  Moreover, poor lighting conditions, by which the camera cannot definitively distinguish colors, have a negative impact on analysis results.

Even a surface's albedo, or reflection coefficient, cannot be relied upon to clearly recognize skin. Different materials reflect incoming light at different levels of intensity. Other parts of the light are either absorbed or dispersed in the illuminated material. Albedo represents the relationship between reflected and incoming light. Every material possesses a specific value that helps to differentiate it from other materials. Still, the values of different skin types vary widely. Additionally, other materials such as meat, leather or wood, can produce very similar albedos. Thus, albedo in the visual range cannot be considered for use in skin detection.

**Skin's spectral signature**
Yet if one moves away from the visible and into the short-wave infrared wavelength range (780 to 1400 nm), an entirely different situation presents itself. Due to its high water content and albedo in the short-wave infrared range, skin can clearly be differentiated from other materials. Skin type, age, gender, and similar criteria no longer play a role.
On the basis of these findings, scientists at the Bonn-Rhein-Sieg University of Applied Sciences developed the “spectral signature” method within the framework of their research project on fake detection using face biometrics. In this method, the albedo of skin in a wavelength range between 900 and 1500 nm was analyzed and a skin-specific value range was determined. At approximately 1450 nm, the characteristic absorption characteristics of skin, independent of skin type, are particularly large. Above 900 nm, skin pigments have no relevant influence on albedo, thus absorption by the water contained in the skin increasingly gains in influence.

The investigation was implemented with an active camera system in which an infrared camera is mounted in the middle of a ring of LEDs. Three rows of LEDs transmit light in different wavelengths within the defined range onto the face to be analyzed, whereby the measurement becomes even more reliable. The camera records the reflected short-wave infrared light. The data are made available on the connected computer using the Vimba Software Development Kit from Allied Vision.

Software written by the University in C++ then takes over the analysis. For many imaging tasks, the OpenCV Library is used.  As a result, the skin — irrespective of type or color — is displayed as brown on a screen. Other materials appear, each according to its consistency, in black or white, and can be explicitly differentiated from skin.

**More security using skin detection**
When facial recognition systems are equipped with these camera systems, they only authenticate users if facial characteristics are correct and recognized as skin.  In so doing, the security of the results is substantially increased. Use of LEDs allows the system to be used largely independently of environmental lighting. Since infrared light is invisible for the user, he/she notices nothing of the scan. The spectral signature thus enables rapid and reliable security surveillance with no discomfort.

A further research project at Bonn-Rhein-Sieg University of Applied Sciences deals with the use of skin detection methods in workplaces with a high level of work process automation. Often, machines and robots are in use. Safeguards are absolutely necessary to avoid accidents. Here, person recognition based on image capture can serve to differentiate between objects and skin, to identify materials, and to determine danger zones. When a human penetrates the danger zone with his/her hands, the robot or machine will be decelerated or halted.

**Goldeye G-032 SWIR enables monitoring in the infrared range**
The Bonn-Rhein-Sieg University of Applied Sciences used the short-wave infrared Goldeye G-032 SWIR camera from Allied Vision, equipped with a GigE-Vision interface with Power over Ethernet, for the research and development of both projects. So equipped, it is the best suited camera for the wavelength range in which the spectral signature is measured. Specifically in security technology, the camera is commonly not directly connect to a computer or processing unit. Image data must cover a long distance. The Goldeye camera is optimally equipped in this regard as well. With a single cable, it can transmit data up to 100 meters and supply the camera with power at the same time. One further advantage for use of Allied Vision's camera in surveillance technology is its compact form, including its versatile attachment/mounting/connection options.
Still, not only its technical qualities quickly convinced the project leadership that the correct camera had been selected.

 From the outset, the research team experienced a great deal of support from Allied Vision colleagues. Allied Vision made the Goldeye available on a loan basis right from the start of the research project, allowing the camera's possibilities to be extensively tested in advance. Based upon those positive findings, corresponding project contracts were then generated and funds were allotted.  Because of the camera's comparatively economical price, relative to other suppliers' models, both RBS U projects ended up being carried out using cameras from Allied Vision.  During the course of the project, the research team could continually count on support from Allied Vision as well. Whether for questions about camera connection, control and calibration, or about use of the Vimba SDK, AV stood at the researchers' side as a reliable partner.

Both of these research projects demonstrate how the use of infrared technology can decisively advance the reliability of security systems, both in protection from crime as well as in accident avoidance. All that is needed now is to implement these technologies in everyday use.

(see also Journal of Sensors Article ID 456368: Design of an Active Multispectral SWIR Camera System for Skin Detection and Face Verification; Holger Steiner et al. ; March 2015; <http://www.hindawi.com/journals/js/aa/456368/>)

**Profile of Allied Vision**

For over 25 years, Allied Vision has been helping people to see the bigger picture. Allied Vision supplies camera technology and image capture solutions for industrial inspection, science, medicine, traffic monitoring and many more application areas in digital imaging. With a deep understanding of customers’ needs, Allied Vision finds individual solutions for every application, a practice which has made Allied Vision one of the leading camera manufacturers worldwide in the machine vision market. The company has eight locations in Germany, Canada, the United States, Singapore and China and is represented by a network of sales partners in over 30 countries. [www.alliedvision.com](http://www.alliedvision.com)

**Contact (Company Headquarters):**Allied Vision Technologies GmbH | Taschenweg 2a | 07646 Stadtroda, Germany
Tel.: +49 36428/677-0 | Fax: +49 36428/677-24 | info@alliedvision.com | [www.alliedvision.com](http://www.alliedvision.com)

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| **Media Contact:** |  |  |
| Nathalie TöbbenAllied Vision Technologies GmbHKlaus-Groth-Str. 122926 Ahrensburg GermanyTel.: +49 4102/6688-194Fax: +49 4102/6688-10nathalie.toebben@alliedvision.com  |  |  |