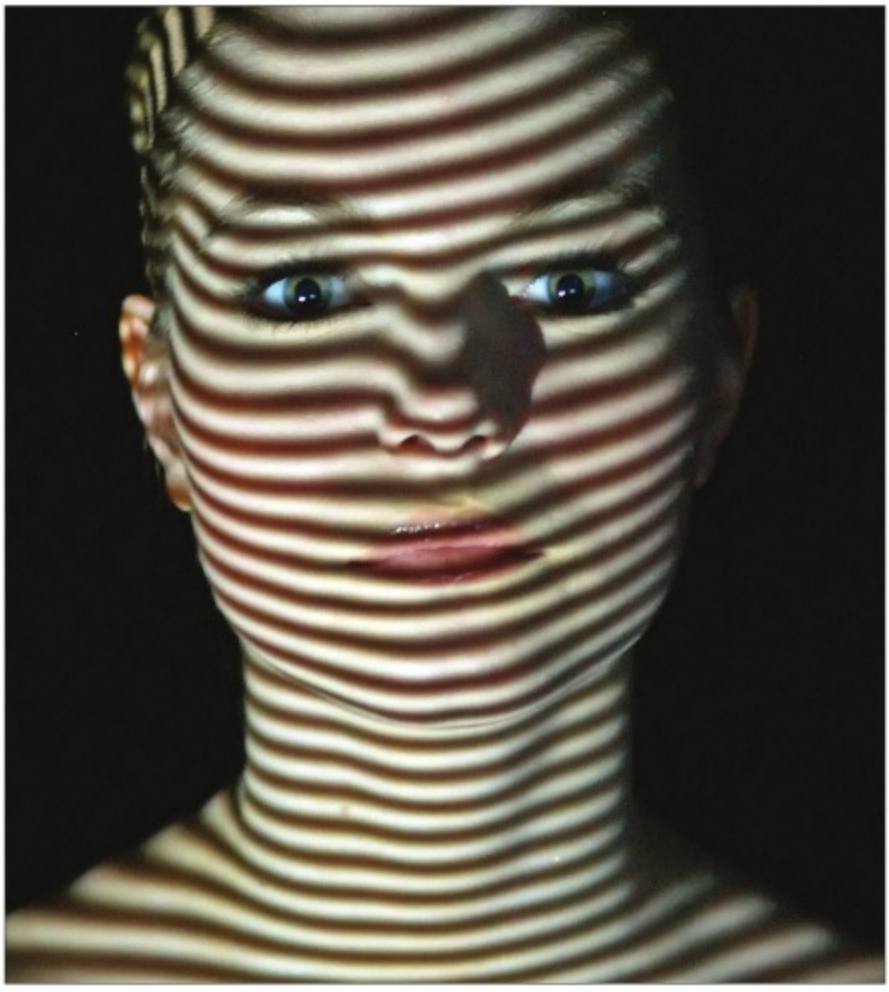


Fringe pattern projection for face capture
Picture source: GFMesstechnik GmbH

Looking good

Non-contact 3D measuring technology for medical and cosmetic applications. Intelligent camera permits fast and highly precise image processing.

By Sabrina Pschorn, VRmagic

Reliable and objective analysis of the skin surface is essential for evaluation of cosmetic products and assessment of moles or healing processes for scar tissue and wounds. Using an intelligent camera from VRmagic, the company GFMesstechnik GmbH has developed a 3D scanner (3D vision sensor) that is ideal for this digital image processing task.

Common measuring techniques use a probe to scan the skin surface or involve measuring skin impressions. Tissue contact is unavoidable with both these methods, and the resultant mechanical pressure distorts the measurement parameters. In addition, a non-contact measuring method without direct skin contact is particularly advantageous when examining wounds. However, a lack of accuracy and long measuring times restricted the possibilities of optical measuring methods in the past.

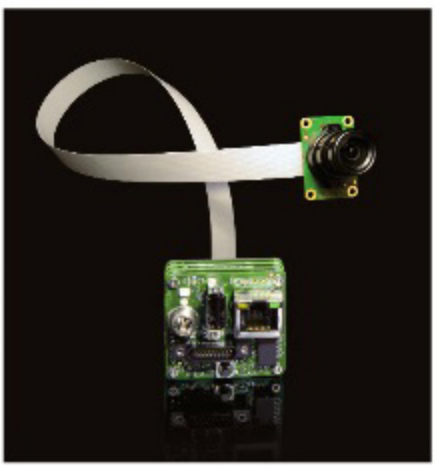
PRIMOS (phaseshift rapid in-vivo measurement of skin) is a non-contact, computer-controlled in-vivo measuring method that detects tiny irregularities in the skin precisely to within a thousandth of a millimetre within milliseconds. The measuring principle is based on the method of phase-measuring digital fringe projection. Using DLP technol-

Hand-guided 3D sensor PRIMOSlite Picture source: GFMesstechnik GmbH

ogy from Texas Instruments, the 3D measuring instruments from GFM project a fringe pattern onto the skin area under examination. The fringe pattern is parallel if the surface of the skin is flat. The fringe pattern is distorted if the projected light encounters skin irregularities. This results in exact height values for each individual pixel.

3D data calculation by autonomous sensor

An intelligent camera from VRmagic is responsible for controlling the DLP projector, image capturing and data calculation. This programmable Linux-based camera features a DaVinci dual-core chip from Texas Instruments with 300 MHz ARM9 and 600 MHz DSP core with 4800 MIPs. The embedded platform has 256 MB RAM and 512 MB flash memory. Communication between ARM and DSP is realized with the TI Codec Engine. The camera is equipped with a remote CMOS MT9V022 sensor from Aptina with global shutter technology and a resolution of 0.36 megapixels. Image capturing and calculation of the 3D data take place directly in the camera, which makes the system an autonomous sensor (3D vision sensor). The calculated 3D data is transmitted as a dot cloud to a computer by an Ethernet connection. The computer then performs evaluation and interpretation.

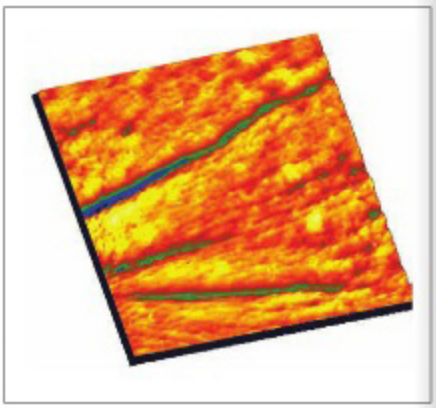


The intelligent VRmagic camera performs image capture and calculation of the 3D data; Picture source: VRmagic GmbH

VRmagic has adapted the intelligent camera specifically to the requirements of GFM, thereby allowing realization of an integrated design with connection of the DLP projector to processor and camera. As a result, handling of the 3D scanner is both simple and compact. The DLP projector from Texas Instruments and the camera are fully synchronized with a frequency of 60 Hz. Projection and image capture therefore take place at exactly the same time, guaranteeing very short measuring times. This means that even hand-guided measurements are possible. The guaranteed measuring accuracy is in the submicrometre to millimetre range, depending on measuring field. The surface colour also does not have any influence on measuring accuracy.

Objective evaluation by software

A particular challenge when assessing differences in the skin structure is always finding the same skin location for measurement. This is the only way of ensuring an objective before-and-after comparison. GFM has developed the software "PRIMOS" specifically to permit such exact and reproducible skin measurement. This makes it possible to easily determine the efficacy of cosmetic and medical treatments. The software features an overlay function to assist the user in positioning the proband. To ensure exact alignment of the sensor, a previous image of the same skin location is superposed on the live image. A projected cross is also displayed to permit selection of the correct focus. The matching function also offers a highly-precise algorithm, which exactly aligns and superposes the measured data.



Right: Colour-coded 3D representation of periorbital wrinkles (crow's feet) Picture source: GFMesstechnik GmbH

PRIMOS also includes functions for determination of skin roughness and for measurement of distances, radii, angles and volumes. The functional scope is completed by a database in which up to 2000 datasets can be processed automatically.

www.gfm3d.com
www.vrmagic.com