

Short Report

3D Body Scanners Based on White Light Projection Technology

The second technology used extensively for human body measurement is based on the projection of light patterns. Like laser scanning systems, white light projection systems are based on the triangulation approach, however, instead of moving the scanner unit, a light pattern (usually in form of black and white stripes) is projected onto the human body (Figure 1 top left). A light sensor (e.g. a digital camera) acquires the scene. The scanning device is composed usually of a pattern projector and a light sensor (Figure 1 top center). More complex systems employ multiple light sensors and/or multiple projectors. The measurement process is similar to laser scanning, whereas, instead of measuring a single moving laser stripe, the projected black and white stripes are measured in a single step by mean of triangulation. Usually, binary coding systems (Figure 1 top right) are used to determine the origin of the single stripes; for the increment of the resolution, the projected stripes are additionally shifted. Different patterns are employed by the different manufactures. Figure 1 (bottom) give some examples of possible variations of the classic binary code.



Fig. 1. Top: White light projection method. Left: projection of light pattern as stripes. Center: scanning device Capturor of InSpeck. Right: projected sequence of binary coded stripes pattern. Bottom: Examples of projected light pattern. From left to right: vertical stripes by 3D-Shape, horizontal lines by Wicks and Wilson, color coding by Sanyo Electric, squared pattern by Eyetronics, dot pattern by VX Technologies.

Since the acquisition units are composed by projectors and cameras, the additional acquisition of a color image is usually performed, allowing at the end the generation of fully colored 3D surface models. The major difference to laser scanning is that the acquisition happens in a very short time and that it results in the digitization of entire surface parts. Everything happens in short time period (mostly under one second), so that human bodies can be digitized without problems: the uncontrolled movements of the person are not a problem. However, the field of measurement of such scanning devices is limited, e.g. *Capturor* of InSpeck (Figure 1 top center) can measure surfaces with maximal size of half part of the human body (e.g. upper torso).

To measure the entire human body multiple scanning devices are required. Different configurations are possible for the measurement of the entire body. The minimal number of employed acquisition units is two (from the front and from the back). However, for a complete coverage of the human body, the ideal number of units is six, as for example the full body scanner of InSpeck (Figure 2): the scanner is composed of three pillars, each having two units, each composed of a camera and a projector. This procedure has the disadvantage, that multiple units cannot be used simultaneously since they interfere with each other's light patterns projections. Practically, this means, that multiple equipments have to be used serially. This implies again an extension of the acquisition time.



Fig. 2. Full body scanner of InSpeck. From left to right: configuration with six units; column with two acquisition units; unit composed of one camera and one projector; coded light projection, resulted 3D surface model.

When applied to the human face, the only differences resides in the setups and positioning of the sensors and/or acquisition units. White light projection technology appears to be more suited for face measurements than laser scanner. The shorter acquisition time plays the essential role. Also in this case, the only difference to full body scanning system based on the same technology, is the number and setup of the employed acquisition units. The figure 3 shows two examples. The first one (Breuckmann) employs two synchronized acquisition units placed in front of a person. The simple units are composed of a camera and a projector. The result of the scanning process is a 3D model of the frontal part (ear-to-ear) of the head. In order to acquire also the back of the head, a second scan had to be performed or four acquisition units may be used.

The second example (IVB-Jena) regards a more complex face scanning systems composed of five cameras, one projector and a special motorized mirror system.

The results of face scanning by white light projection and by laser scanning are very similar in term of accuracy and resolution. The main advantage of white light projection methods is the shorter acquisition time, resulting in less noise. Additionally, hairs and facial hair are acquired better then by laser scanning. Moreover, the costs of these solutions are usually less expensive than laser scanners.

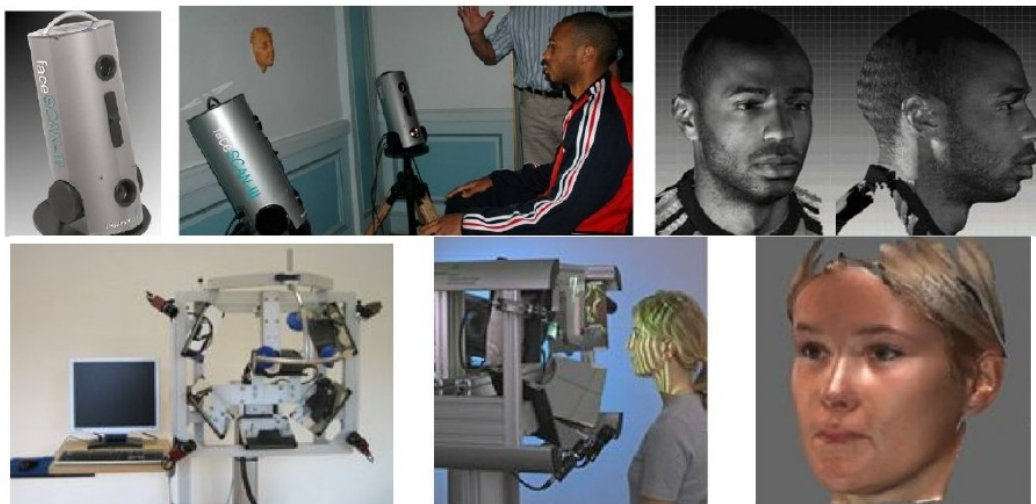


Fig. 3. Top: Breuckmann face scanner faceSCAN-III; a single unit, two synchronized units and obtained 3D model. Bottom: IVB-Jena face scanner gscan, measuring a human face and sample data.

For more detail about white light scanning technology:

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