

Short Report

3D Laser Scanning Systems

Laser scanning technology consists of using lasers to project onto the human body one or more thin and sharp stripes. Simultaneously, light sensors acquire the scene and by applying simple geometrical rules (called triangulation, see Figure 1 center) the surface of the human body is measured. To assure the inoffensiveness of the light beam, only eye-safe lasers are used. Special optical systems and mirrors are used for the generation of stripes from a single laser light beam. The laser scanner unit, which is composed of the laser, the optical system and the light sensor, is moved across the human body to digitize its surface.

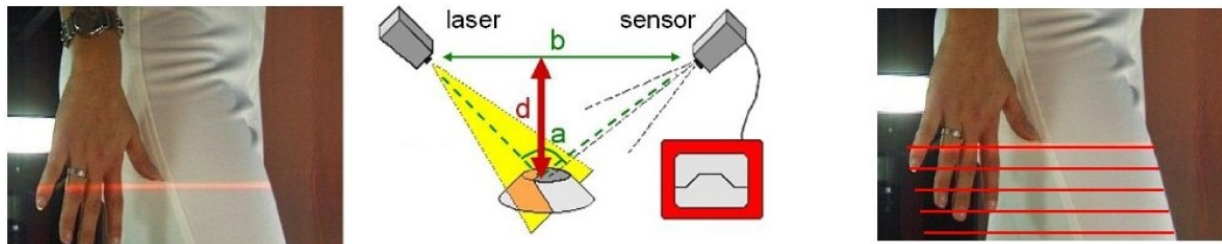


Fig. 1. Laser scanning. Left: laser stripe on the human body. Center: triangulation method, different object heights d result in different triangulation angles a that can be measured by the light sensor. Right: the scanner unit is moved across the human body to scan its surface.

The type of movement, the number of employed units and their disposition can vary depending on the system. For example, the full body scanner displayed in Figure 2 consists of three scanner units that move vertically synchronously along three pillars and directed toward the center where the person stand. The result of the scanning process is in this case a complete 3D surface model of the person.

More sophisticated laser scanning solutions are also able to acquire texture and/or color information, thus resulting in a true-looking colored 3D surface model of the person.

The high costs for production of hardware components for the laser scanning technology have to be considered as disadvantage. Additionally to the laser, the light sensor and the optical system, also precise electric motors have to be used for the displacement of the scanner units. Moreover, the complete scanning system has to be calibrated so that the geometrical disposition of all the elements can be determined exactly. A second disadvantage of this method is the time required for the digitization of large surfaces. There is no problem for the measurement of extremities as feet and hands, since these body parts can be kept immobile for some seconds. However, in the case of the measurements or full body, it is practical impossible to stay immobile for several seconds. Uncontrolled movements as breathing or muscle contraction can therefore generate errors.

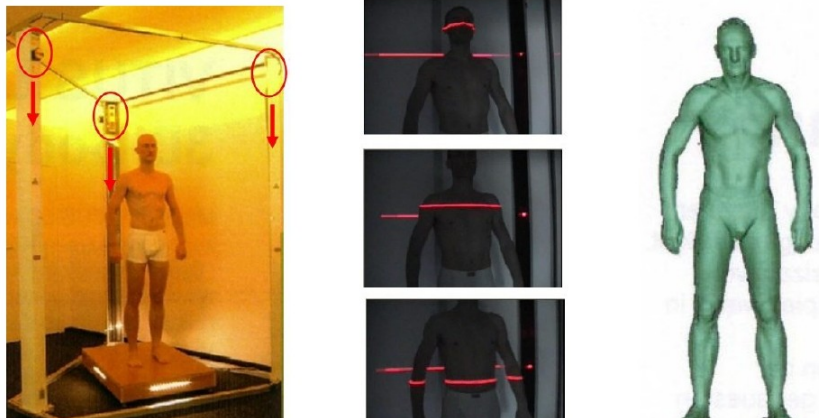


Fig. 2. 3D full body scanner VITUS LC with three scanning units. Center: the laser stripe moves vertically down. Right: the result is a 3D surface model of the person.

When applied to the human face, the only differences resides in the setups and positioning of the sensors and/or acquisition units. Figure 3 shows two examples of 3D face scanner based on laser scanning technology. In the first case (Cyberware), the scanner is composed of four laser scanning heads that rotates around the persons head. The result is a complete 3D model of the entire head. The scanner of the second example (Vitronic) is composed of four scanning heads moving vertically down and arranged in four columns around the person. The result is also in this case a 3D model of the entire head.

As in the case of full body scanner, also for face scanner, a long acquisition time may pose problems in the accuracy of the results. The smaller scale and the more complex details of the human face makes the judgment of the results more severe.

Very important for the generation of a reality like 3D model of the human face are the colors, i.e. the texture. Only 3D face scanning system capable of acquiring texture should therefore be considered.

An additional issue that may pose problems in the scanning process is caused by hairs, facial hairs, eye brows and eyelashes. Their shape is in fact difficult to be acquired by 3D scanners and the results are noisy surfaces in their area. This problem can be solved uniquely by applying smooth filters or by manual editing this specific features.

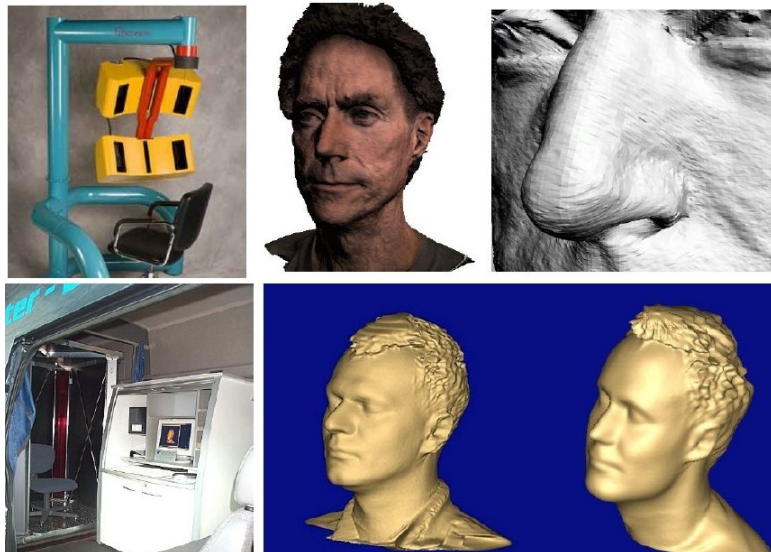


Fig. 3. Top: Cyberware Head & Face Color 3D Scanner - Model PX, dual head configuration with sample data. Bottom: Vitronic VITUS^{ahead} scanner and sample data.

For more detail about 3D laser scanning technology:

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