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Sommario	<p>Scuola di Dottorato "Pitagora" in Scienze Ingegneristiche, Dottorato di Ricerca in Ingegneria Meccanica XXI Ciclo a.a. 2007-2008 This thesis describes the development of a 3D scanning system based on an active vision technique that uses structured light to obtain the impression of the dental arch. Currently to realize a dental prosthesis a special doughy sticky material is adopted to impress the patient's dental arch. This imprinting may be scanned and then analyzed and modified by C.A.D. software. All this process is sometimes too long, and it may take several weeks to obtain the final prosthesis. At that moment, there are only few works that use techniques to shorten the processing times and produce a three dimensional model of a dental arch, but often they don't allow to obtain optimal results due to a low resolution and a slow acquisition rate. Among all the studies described on literature, it results that the structured light is a relatively simple technique that allows for a relative high resolution. In the last years, the development of all these systems, has draw the attention to those devices able to obtain a structure of patient's dental arch as a C.A.D. model. The device developed and described in this thesis is a novel kind of optical scanner that allows for a total elaboration time, for the realization of a three dimensional model,</p>

which is lower than those of the systems described in literature. The new optical scanner consists of four digital camera, a multimedia DLP mini-projector and a software to manage the hardware and process the images. It is actuated by step motors on an 2D guide, which is held rigidly fixed to the denture of the patient by a self balanced kinematic chain, that allows for small motions of the patient's head. This system designed allows the relief and automatic reconstruction through the use of structured light with a particular Gray-Code method. This work is mainly divided in two main parts: 1. The study of the optical system calibration 2. The study of the reconstruction of dental arch The technique used relies on a new version of Gray-Code method; which allows to solve the so called "correspondences problems". The structured light is produced by a mini-projector, which has to undertake a calibration phase as well as the camera used for image acquisition. The second part of this study is related to the analysis and merge of the acquired images. This problem involves the alignment of the cloud of points obtained from the automatic scanning process by each camera. In this phase, all the errors involved in the whole procedure are also investigated.

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