Editorial

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Interdisciplinary Researches in Iran IV: The Road Map of Ocular Image Analysis Research Group

Nowadays, the world is faced with diverse, challenging issues which lead to the development of communities to discuss the matter and provide solutions for them. Academic research groups are then established to puzzle out the raised questions with reliance on expert opinions and studies in response to the current prevailing needs.

Islamic Republic of Iran blessed with knowledgeable academic resources, is currently growing fast in research.[1] A great number of centers are already dedicated to research, commonly with the focus on a specific area. However, the real maturity in research groups demands an accurate and precise definition of the goals and solidarity to approach the target. Such a mature center can be expected to deliver valuable products in a predetermined time. It is expected that designing a roadmap would be helpful in achieving such a maturity.

A roadmap is a visually inspectable plan that matches short- and long-term goals with specific technology solutions to help meet those goals.[2] It is a plan that applies to a new product or process, or to an emerging technology.[3]

The roadmapping process is well-known for technologies and constitutes three main phases:[4]

- Phase 1: Preliminary phase
- Phase 2: Development phase
- Phase 3: Follow-up activity phase.

In the first phase, the key decision makers must identify that they have a problem and that technology roadmapping can help them in solving the problem. In the second phase, the product that will be the focus of the roadmap should be identified, and technology areas and alternatives must be recognized along with their time lined. In the final phase, the roadmap must be critiqued, validated, and accepted by the group. Next, there must be a periodical review and update point because the needs from the participants and the technologies are evolving.[3]

By contrast, roadmap of a research center is not essentially identical with roadmaps for technologies. It usually covers the goals and categorizes these goals with no particular timeline requisites. Samples of such roadmaps are described in this paper. The planes are developed for Ocular Image Analysis Research Group, School of Advanced Technologies in Medicine, Isfahan University of Medical Sciences. This center is established in 2009, suggested by Dr Hossein Rabbani.[5] Weekly meetings of the group are almost held during the past years, and the desired outcome of these sessions was the guidance of the students working in this area, resolving the problems in current projects, and collecting ideas from ophthalmologists, faculty, and postgraduate students for new projects.

The main goals of this research center can be summarized into five main goals: Modeling, preprocessing, segmentation, feature extraction, and classification. The mentioned topics are ordered from most principal subjects (modeling) to more practical areas (classification). The roadmap of this center is designed in two different models. The simple version depicted in Figure 1 is a bar format which provides a simple and easy-to-trace plan. A more complicated format demonstrated in Figure 2 is a spiral form which is capable of presenting more interconnection among the subjects. The topics in mentioned roadmaps are more elaborated in following paragraphs.

Medical imaging is a powerful source for physiologic and anatomic information, and nowadays it is an inseparable part of diagnosis and treatment of diseases. However, this great amount of data is difficult to be interpreted by simple observation. Therefore, automatic analysis of medical images is inevitable to help the physicians and modeling of images can be known as the core of such processes. Indeed, a concerned model for an image defines the required process such as coding, compression, contrast enhancement, denoising, feature extraction, classification.

As soon as we determine a reliable model for ocular images, the rest of the topics may be explored more correctly. Preprocessing, as the main step in most of the processing algorithms, can be divided into three main applications: Denoising, registration, and alignment. Denoising methods may be studied in raw

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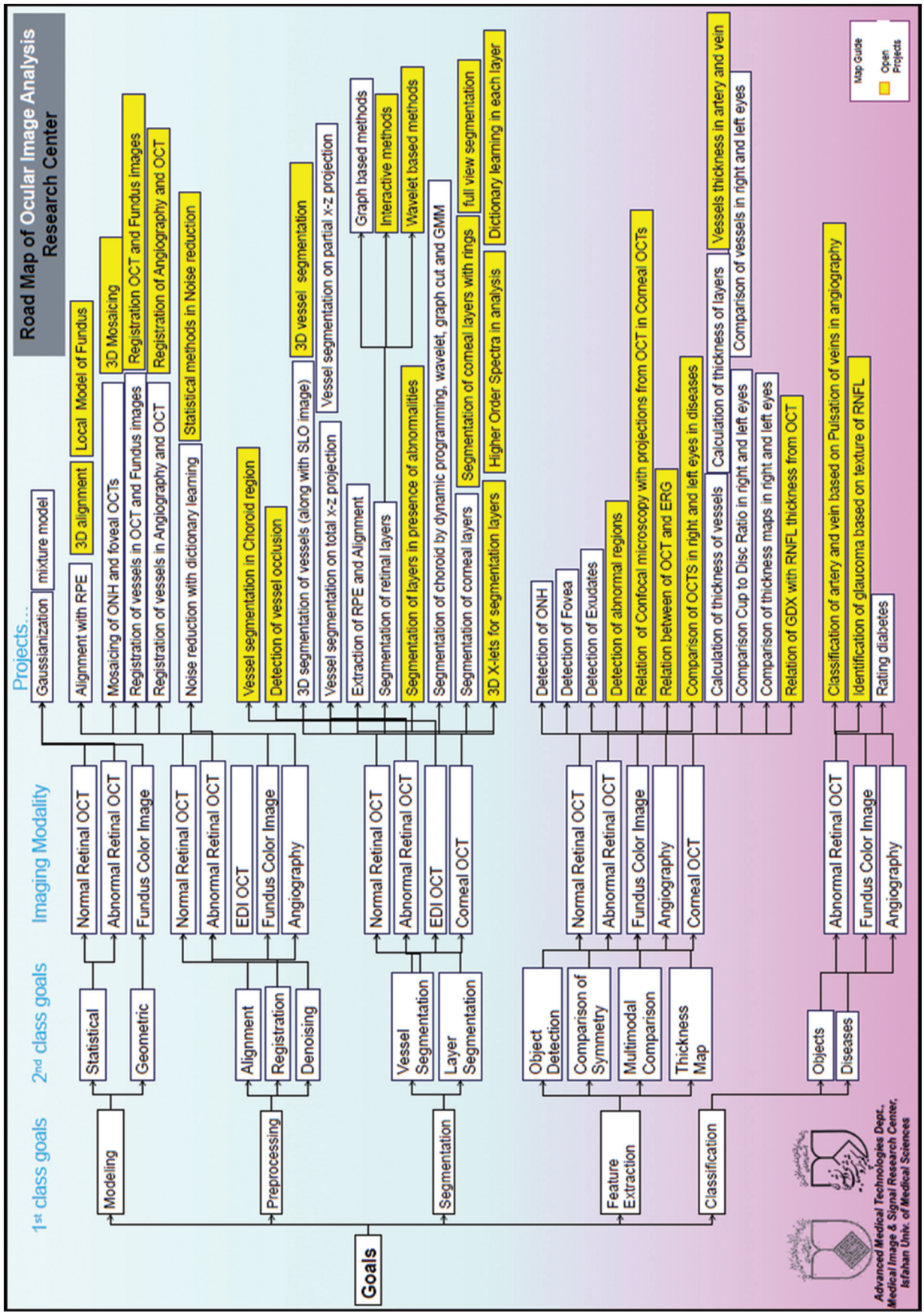

Figure 1: Roadmap of ocular image processing (Bar format)

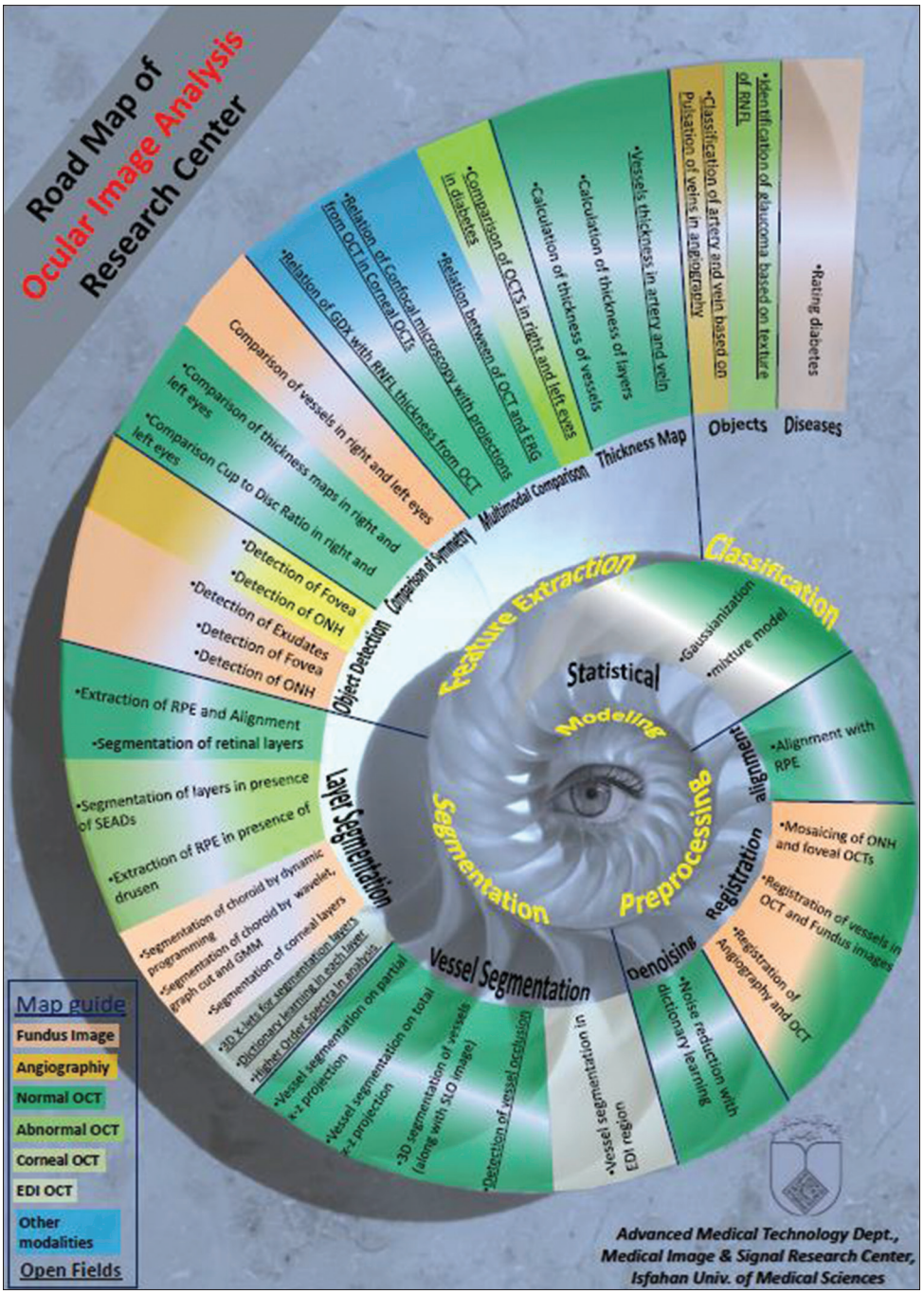

Figure 2: Roadmap of ocular image processing (Spiral fromat)

image domain and sparse representations. The latter may also be subcategorized into parametric and nonparametric methods. Registration may also be classified in preprocessing techniques and may cover aspects from mosaicing of different optical coherence tomography (OCTs) to registration of vessels in OCT and fundus images. As the last subclass of the preprocessing step, alignment based on graph theory and A-scan analysis may also be considered.

One may consider segmentation as the core mission of automatic analysis methods on ocular images. Segmentation of layers (in OCT) and vessels (in OCT and fundus) may be studied in different classes. For layer segmentation, five main categories of A- and B-scan, Active contours, Artificial intelligence, and 3D graph-based methods may summarize the prevalent methods. Vessel segmentation may also be surveyed in 3D segmentation of vessels, methods for detection of vessel occlusion, and vessel segmentation in EDI region.

As we move toward more application-based strategies in OCT image analysis, feature extraction is not ignorable.

Object detection, extraction of features by comparing symmetry of two eyes, multimodal features, and information from thickness map are the main subclasses of this category. In object detection, any abnormality such as foci, drusen, exudates, and hemorrhage may be of interest.

The final goal of an automatic image analysis method on ocular datasets is classification. If an analysis would be able to correctly differentiate between normal cases from a patient suffering from problems such as glaucoma, macular edema, or any other problem, the method can be considered a reliable aid for diagnosis.

The long-term goal of this center is design of a monolith and comprehensive software for analysis of ocular images (OCT of retina, cornea, and choroid, fundus images, and angiographic datasets) in normal people and diseases. To achieve this long-term target, it is expected that current projects such as statistical modeling of retinal layers and segmentation of abnormalities would successfully finish as a short-term goal and at least four open topics of Figures 1 and 2 would be started in the next year.

At the end, it should also be mentioned that the roadmap designed for research centers on its original shape is proper for showing the vision and mission of the group and if any of the projects is aimed for implementation, a technology roadmap (as described above) should be designed to indicate the aim, process, and the timeline of the project.

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