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CENG 407

SOFTWARE REQUIREMENTS SPECIFICATION (SRS)

DETECTION OF OBSTRUCTIONS IN THE VESSELS IN FUNDUS IMAGES

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1. INTRODUCTION

This document provides detailed information about the requirements of obstructions detection system software. It will explain the purpose and features of the proposed method, the working principles of this method and the general information about the difference of the proposed method from previous studies. This document is intended for both stakeholders and developers who are working on such work.

1.1 Purpose

This project's main purpose is to find congestions inside vessels in eye angiographic images therefore, primary objective is to reduce the effort spent by the doctor to detect eye diseases.

The main motivation for the ophthalmologist to use this software is to allow the software to interpret the image much more quickly with immense accuracy and precision to reduce the time spent on a single patient so that the doctor can deal with more patients in the same time.

1.2 Scope of the Project

This software system will be an Obstruction Detection System for an ophthalmologist. This system will be designed to maximize the ophthalmologist's productivity by providing tools to assist in automating the congestion detection process inside retinal vessels, which would otherwise have to be performed manually. By maximizing the ophthalmologist's work efficiency and production the system will meet the ophthalmologist's needs while remaining easy to understand and use. More specifically, the system is designed to automatically identify obstructions however, in case of any possible error, the ophthalmologist is also asked to provide a feedback about the congestion spots that system has already found.

1.2.1 Benefits

Thanks to this software, the ophthalmologist can diagnose multiple patients in the time needed to diagnose a single patient. In addition, early and more accurate diagnosis will prevent the disease to advance any further thus, it may even save some from going blind.

1.3 Glossary

Term	Definition
Fundus Image	Fundus photographs are visual records which document the current ophthalmoscopic appearance of a patient's retina [2].
Ophthalmologist	Doctor who specialized in eye and sight care.
Fluorescein	Chemical used for enhancing the brightness of the vessels.
SRS	Software requirements specification.
Obstruction	Congestion resulting eye strokes.

Stakeholder	People with any interest in project's outcome.
Diagnose	Identify the nature of the medical condition.

Table 1.3.1 Glossary of SRS

1.4 References

[1] IEEE. "*IEEE Std 830-1998 IEEE Recommended Practice for Software Requirements Specifications".* IEEE Computer Society. October 20, 1998.

1.5 Overview of the Document

The rest of this paper is organized as follows:

Section 2 describes the definition, specification of the project and properties of the method and its application for users who use the system and read the document. The constraints and risks of this method are mentioned. Section 3 is mainly written for developers of this system and describes in technical terms the details of the requirements of this system. Section 4 describes the specifications of actors and stakeholders and their interactions with the developed method are presented. The functions used by the user in order to use the project software and the tasks of these functions are described.

2. OVERALL DESCRIPTION

2.1 Product Perspective

The software described in this SRS allows the doctor mark congestions inside the veins by a specified geometrical shape and color in order to see them easily. After the software done its marking process, doctor can choose between two diagnosis option which are diagnose the disease himself/herself or letting the software to interpret the situation. Software will have pre-prepared results for certain values. Those result outputs are diagnostics collected from doctors prior to the development phase of the software. By selecting automatic diagnosis option, doctor can either accept the result or make changes on it. Either way, he/she accelerates the process of diagnosis.

2.2 User Characteristics

Expectation from the users who read the document should have knowledge about the concepts related to image processing and in the eye area in medical science.

Expectation from the users who use the system should have knowledge about the topics and concepts related to medical science. That is, the user is expected to be an ophthalmologist.

2.3 Constraints

Type of the image to be processed is a constraint for this software. Image needs to be in DICOM standards as most of the medical images share this standard.

This software is also constrained by the capacity of the storage of computer the software is running on as the software allows ophthalmologist to save results.

2.4 Risks

While transferring the fundus image into the software, image quality may be reduced or can pick unwanted noise. Both will cause software to interpret the fundus image with poor accuracy. Software may mark spots without any congestion occurring or miss spots where the congestion actually exists.

2.5 Assumptions

The accuracy and precision percentage of the software finding the congestion spots in the veins in fundus images will be in direct proportion to the quality of the photograph and also automatic diagnosis computed by this software will be generating outputs as similar as ones that the doctor himself/herself does.

3. REQUIREMENTS

3.1 Specific Requirements

3.1.1 User Interfaces

The only UI shown in this project is the main form divided into sub parts which are:

- Upper horizontal menu including file operations (upload/save).
- Division where the pre or post processed image is shown.
- Result division for output and diagnosis to be shown.
- Toolbar to allow user to select marking shape and color of the congestion.
- Checkbox to indicate whether diagnose operation will be automatic or manual.

3.1.2 Hardware Interfaces

No hardware interfaces needed to run this software however, fundus camera is recommended and required for gathering retinal images with maximum quality thence software will run on its maximum efficiency.

3.1.3 Software Interfaces

Software presented in this SRS does not need any other software interface than the operating system itself.

3.1.4 Communications Interfaces

No internet connection is required to run this software thus there will not be any communication interfaces.

3.2 Functional Requirements

- User shall be able to upload fundus images to the software.
- User shall be able to change color and geometrical shape of the marks.
- User shall be able to save processed image to specific location with specified name along with the results formatted in a .txt file.

3.3 Software System Attributes

3.3.1 Performance

- Congestion marking process shall take no more than a minute.
- Accuracy percentage of the output image shall be higher than 85%.

3.3.2 Availability

Users can use the system on computer environment. To be able to use the system on computer environment, the system is clicked and started by user.

3.3.3 Security

Because there is no critical information to be kept, there are no security constraints.

3.3.4 Portability

Because the system will be developed on computer environment, it can work only on computer.

3.3.5 Usability

- Software shall accept image formats of .jpg, .png and .tif
- Software shall be able to maintain images with any size bigger than 565x565 but reject and display a warning message if smaller.

3.3.6 Scalability

There is no scalability requirement because the system has only one user.

3.3.7 Ease of Use

Since the developed system is a medical oriented project, it must be a doctor-friendly user interface and this interface should be simple and easy to use.

4. UML ANALYSIS MODEL

4.1 Use Cases

4.1.1 Actor(s)

User: User is a person who uploads the images in the form necessary for system developed for obstruction detection in vessel after vessel segmentation. User can perform any necessary operations according to the function of the button by selecting any of the accessible features or buttons in the system, such as detecting obstruction in vessels in the image or showing results obtained and recording these results.

4.1.2 Stakeholder(s)

Project Advisor: The project advisor is responsible for delivering the project on time and on a given budget. They usually work together and guide the team that develops the project so that the goals in the project can be fulfilled correctly.

The Project Manager's goals are;

- To follow the project and check if it is done as requested.
- To ensure that the risks and problems are properly handled.
- Working with the group to motivate them and give the necessary support.

Project Development Team: It is a team of people who design the project given by the project advisor according to the desired characteristics and who play an active role in the project by working together within the project.

The Project Development Team's goals are;

- To make the project timely and correctly.
- To be able to complete the project in accordance with the quality and rules as much as possible.
- To obtain high accuracy and low computational time.

Doctor: Doctor is the person who wants the project and will use it after the project is done. It is the person who guides to the project development team with project advisor about the necessary progresses of the project and how the project should be.

The Doctor’s goals are;

- To use provided method and software for more accuracy and faster disease diagnosis.

4.1.3 Use Case Diagram

Figure 4.1.1 presents a use case diagram for the subject obstruction system. The system shows the operations that end users can perform.

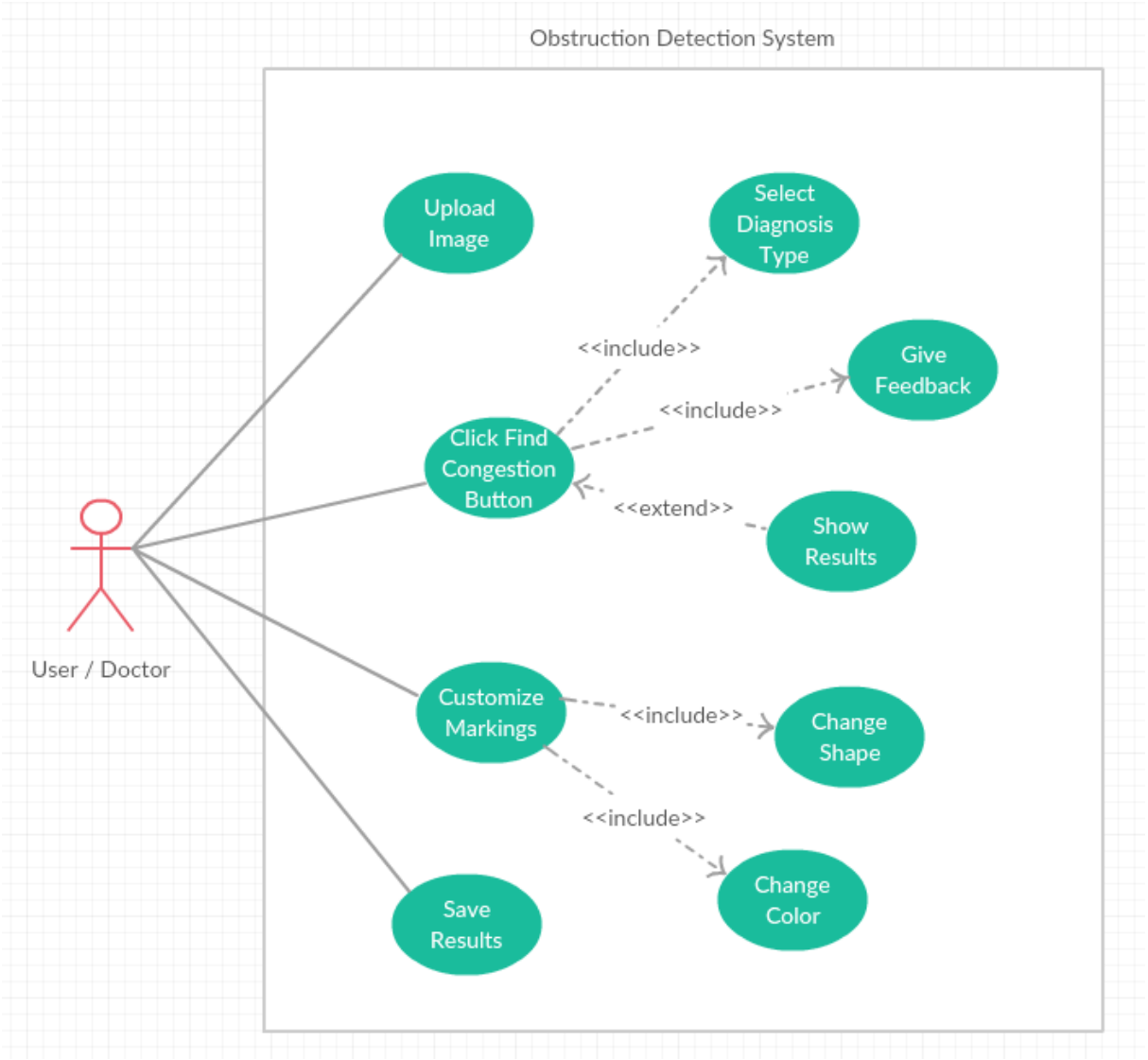

Figure 4.1.1 Obstruction Detection System Use Case Diagram

4.1.3.1 Brief Description of Use Case Diagram

After getting the software running, process simply begins with the "Upload Photo" use case. This use case allows user to upload a fundus image to be processed if its format is appropriate.

In the "Click Find Congestion Button" use case, user wants to see if there is any congestion occurring inside patient's retinal vascular system. After the software marks all of the congestions, the all congestions marked by the system will be shown on the screen and these points must be confirmed by the doctor / user as there is congestion or not. After the doctor / user gives feedback to these points, doctor / user can now select between two diagnosis types, automatic or manual on the confirmed points. Automatic diagnosis is basically replaces the software with the doctor. Doctor shall now decide if suggested diagnosis is useful or not and select manual diagnosis if he/she thinks diagnose result is not useful or not correct. Either way, software will show number of congestions and possible risks.

In the "Customize Markings" use case, user is allowed to determine the shape and color of the marks in order to maximize visibility.

After all of the process has done, user is given ability to save processed image along with its results as a package at wherever he/she wants. Package is simply a folder composed of an image and a .txt file which keeps the results.

4.1.4 Use Case Descriptions

Table 4.1.1 presents the Upload Image use case description to show the interaction between a user/doctor and a computer environment when uploading an image.

Use Case	Upload Image
Primary Actor	User
Goal In Context	Loading the image into the software to be processed.
Preconditions	None
Trigger	None
Scenario	User selects a fundus image that belongs to a patient and loads it into the software to be processed.
Exceptions	Wrong format or image with inappropriate size is selected to load.

Table 4.1.1 Upload Image Use Case Description

Table 4.1.2 presents the Click Find Congestion Button use case description to show the interaction between a user/doctor and a computer environment when finding congestion in vessels.

Use Case	Click Find Congestion Button
Primary Actor	User
Goal In Context	Starting the marking process and view results.
Preconditions	A fundus image shall be loaded into the software.
Trigger	User clicking the "Find Congestion" button.
Scenario	User wants to see whether patient has congestion in his/her retinal vascular system or not.
Exceptions	Process failure because of poor quality image.

Table 4.1.2 Click Find Congestion Button Use Case Description

Table 4.1.3 presents the Customize Markings use case description to show the interaction between a user/doctor and a computer environment when customizing and changing features.

Use Case	Customize Markings
Primary Actor	User
Goal In Context	Enhancing visuality of the congestion spots.
Preconditions	None
Trigger	User clicking either one of the "Change Shape" or "Change Color" buttons.
Scenario	User wants to change color or the shape of the mark.
Exceptions	None.

Table 4.1.3 Customize Markings Use Case Description

Table 4.1.4 presents the Save Results use case description to show the interaction between a user/doctor and a computer environment when saving results obtained as a result of all operations.

Use Case	Save Results
Primary Actor	User
Goal In Context	Saving the output image and results.
Preconditions	Success of the marking process.
Trigger	User clicking the "Save Results" button.
Scenario	User wants to save output image to diagnose later or for any achieving purpose.
Exceptions	Low memory to save output folder on host computer.

Table 4.1.4 Save Results Use Case Description

4.2 State Chart Diagram

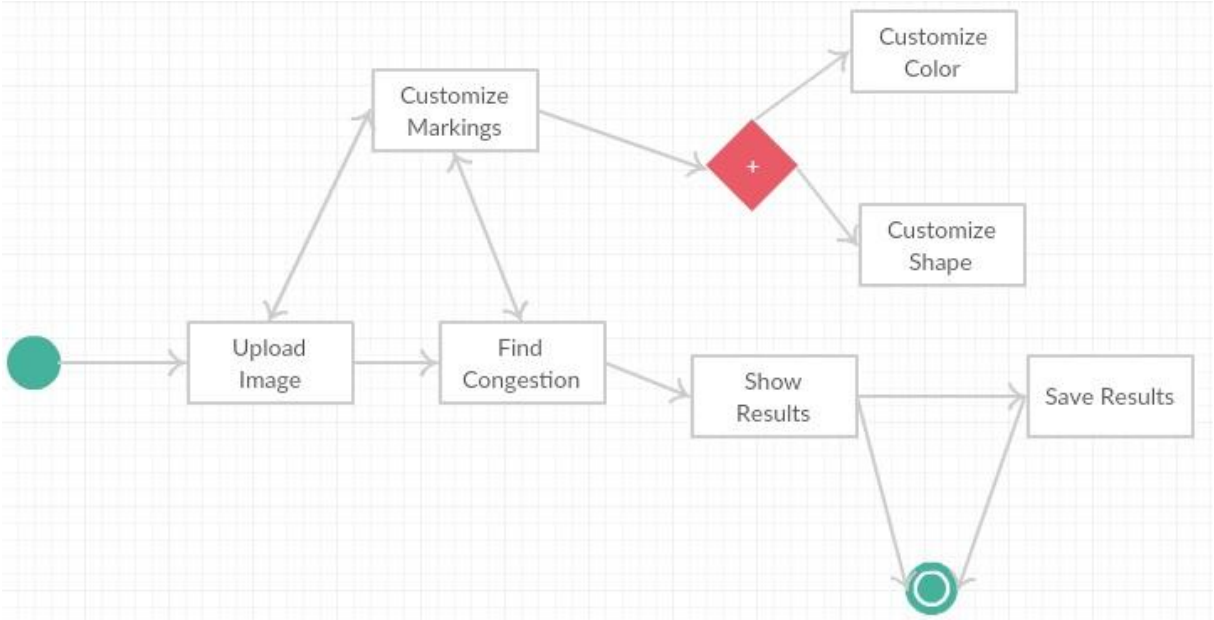

Figure 4.2.1 Obstruction Detection System State Chart Diagram

5. REFERENCES

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