



# SLIIT

COMPUTING

|

BUSINESS

|

ENGINEERING

**Smart Dentassist;**  
An Interactive System for Dental Support and  
Patient Management

(SRS Document)

**Project ID : 15-085**

**IT 12062034 - K. G. L. Bogahawatte**

## Declaration

“We declare that the project would involve material prepared by the Group members and that it would not fully or partially incorporate any material prepared by other persons for a fee or free of charge or that it would include material previously submitted by a candidate for a Degree or Diploma in any other University or Institute of Higher Learning and that, to the best of our knowledge and belief, it would not incorporate any material previously published or written by another person in relation to another project except with prior written approval from the supervisor and/or the coordinator of such project and that such unauthorized reproductions will constitute offences punishable under the SLIIT Regulations.

We are aware, that if we are found guilty for the above mentioned offences or any project related plagiarism, the SLIIT has right to suspend the project at any time and or to suspend us from the examination and or from the Institution for minimum period of one year”.

.....  
IT 12062034 - K. G. L. Bogahawatte

# Table of Contents

Declaration.....	i
List of Figures .....	iv
1. Introduction.....	1
1.1 Purpose .....	1
1.2 Scope .....	1
1.2.1 Patient Management System.....	2
1.3 Definitions, Acronyms, and Abbreviations .....	3
1.4 References .....	3
1.5 Overview .....	4
2. User Requirements.....	6
2.1 Product Perspective .....	6
2.1.1 System Interfaces .....	7
2.1.2 User interfaces .....	7
2.1.3 Hardware Interfaces .....	13
2.1.4 Software Interfaces .....	13
2.1.5 Communication Interfaces .....	13
2.1.6 Memory Constraint .....	14
2.1.7 Operations .....	14
2.1.8 Site Adaptation Requirements .....	14
2.2 Product Functions.....	15
Patient Management System :.....	15
2.3 User Characteristics.....	19
2.4 Constraints.....	19

2.5	Assumptions and Dependencies.....	20
2.6	Apportioning of Requirements.....	20
3.	System Requirements.....	21
3.1	External Interface Requirements.....	21
3.1.1	User Interfaces .....	21
3.1.2	Hardware Interfaces .....	31
3.1.3	Software Interfaces .....	32
3.1.4	Communication Interfaces .....	33
3.2	Classes / Objects.....	33
3.3	Performance Requirements .....	36
3.4	Design Constraints .....	37
3.5	Software System Attributes.....	37

## List of Figures

Figure 1 : Flowchart of the system .....	6
Figure 2 : System diagram .....	4
Figure 3 : Smart Dentassist Homepage.....	7
Figure 4 : Patient Registration - Personal Information .....	8
Figure 5 : Patient Registration - Contact Information .....	8
Figure 6 : Patient Registration - Health Information .....	9
Figure 7 : Dental History - Health History .....	10
Figure 8 : Dental History - Women's Health .....	10
Figure 9 : Dental History - Past Treatments .....	11
Figure 10 : Dental History - Treatments .....	11
Figure 11 : Dental History - Treatments .....	12
Figure 12 : Patient Management Use Case Diagram .....	15
Figure 16 : Smart Dentassist homepage UI .....	22
Figure 17 : Patient Registration - Personal Information UI.....	23
Figure 18 : Patient Registration - Contact Information UI .....	24
Figure 19 : Patient Registration – Patient Details UI.....	25
Figure 20 : Dental History : Health History UI .....	26
Figure 21 : Dental History - Women's Health UI .....	27
Figure 22 : Dental History - Past Treatments UI .....	28
Figure 23 : Dental History - Treatments UI.....	29
Figure 24 : Dental History - Dental Examination UI.....	30
Figure 25 : Class diagram of system - Patient Perspective .....	34
Figure 26 : Class diagram of system - Nurse Perspective .....	35
Figure 27 : Class diagram of system - Dentist Perspective .....	35

## List of tables

Table 1 : Use case - register patient .....	16
Table 2 : Use case - Check in patient.....	16
Table 3 : Use case - Schedule appointments.....	16
Table 4 : Use case - view waiting list .....	17
Table 5 : Use case - Record medical history.....	17
Table 6 : Use case - Record diagnosis .....	17
Table 7 : Use case - record observations .....	18
Table 8 : Use case - View patient details & past treatments.....	18
Table 9 : Use case - Receive reminders on appointments .....	19

# **1. Introduction**

## **1.1 Purpose**

This document provides a detailed description of the “Smart Dentassist; An Interactive System for Dental Support and Patient Management”. It will explain the purpose and features of the system, the interfaces of the system, what the system will do, the constraints under which it must operate and how the system will react to external stimuli. All parts are intended primarily for stakeholders of the application, but will also be of interest to software engineers building or maintaining the software. The intended audience of this document includes project supervisors, designers, developers, end users of the system and any other person interested in “Smart Dentassist”.

## **1.2 Scope**

“Smart Dentassist; An Interactive System for Dental Support and Patient Management” will be a web based system developed using *Java, php HTML, MySQL*. This system will be used by dentists to manage patients and appointments, communicate (live stream videos and images) with other dentists, receive support to diagnose conditions, to make decisions, to decide on treatments, to simulate outcomes of a treatment, and maintain a knowledge base. The main objective of designing this system is to enhance oral health and maximize the dental care provided by dentists by assisting the dentist and educating the patient.

This system consists of 4 main components ;

1. Patient Management System
2. Teleconferencing System
3. Diagnosing, treating and simulating outcome
4. Dental Information Knowledge Base

### **1.2.1 Patient Management System**

The system will register new patients by taking the essential details such as name, date of birth, gender, address, telephone numbers, email address, allergies and generate a unique barcode for each patient. When the barcode is scanned, the patient's details will be displayed. Images captured from intra oral cameras, medical history and all other relevant data will be stored in patient folder. The system will generate a virtual waiting list for the dentist. When patients arrive at the dental clinic, they will be entered into the system at the reception. The dentist will be able to view the patient being treated as well as the list of patients who are waiting for their turns. The system will maintain an independent timer for each person to track appointments and to send reminders.

This component will benefit the dentist as follows :

- Enhanced patient database.
- Better means of communication with patient through reminders

This component will benefit the patient as follows :

- Being reminded of upcoming appointments and treatments.
- Enhanced dental care.

The main objectives of this components are ;

- To provide a better dental health care service to patients, irrespective of where they live.
- To take measures to prevent oral diseases
- To encourage the common man to take preventative measures
- To improve the technology of the dental medicine field



### 1.3 Definitions, Acronyms, and Abbreviations

SRS	Software Requirements Specification
Stakeholder	Any person with an interest in the project who is not a developer.
PC	Personal Computer
Knowledge Base	A store of information or data that is available to draw on.

### 1.4 References (place this at the end of the document)

- [1] “Media Centre”, *World Health Organization* , available:  
<http://www.who.int/mediacentre/factsheets/fs318/en/> , [accessed : 28.01.2015]
- [2] “What problems could my dental health cause”, *British Dental Foundation*, available:  
<http://www.dentalhealth.org/blog/blogdetails/104> [accessed : 28.01.2015]
- [3] “Oral Health”, *National Institute of Dental and Craniofacial Research*, available:  
<http://www.nidcr.nih.gov/oralhealth/>, [accessed : 28.01.2015]
- [4] *Sri Lanka Annual Health Bulletin 2012*, Sri Lanka : [accessed: 06.02.2015]
- [5] “A Healthy Mouth”, *Sri Lanka Dental Association*, available:  
<http://www.slda.lk/public/your-oral-health/> [accessed: 02.02.2015]
- [6] *Oral Health Worldwide : A report by FDI World Dental Federation*, Switzerland :  
FDI World Dental Federation
- [7] “Department of Health Services”, *Ministry of Healthcare and Nutrition, Sri Lanka*,  
available: <http://www.health.gov.lk/>, [accessed: 02.02.2015]

## 1.5 Overview

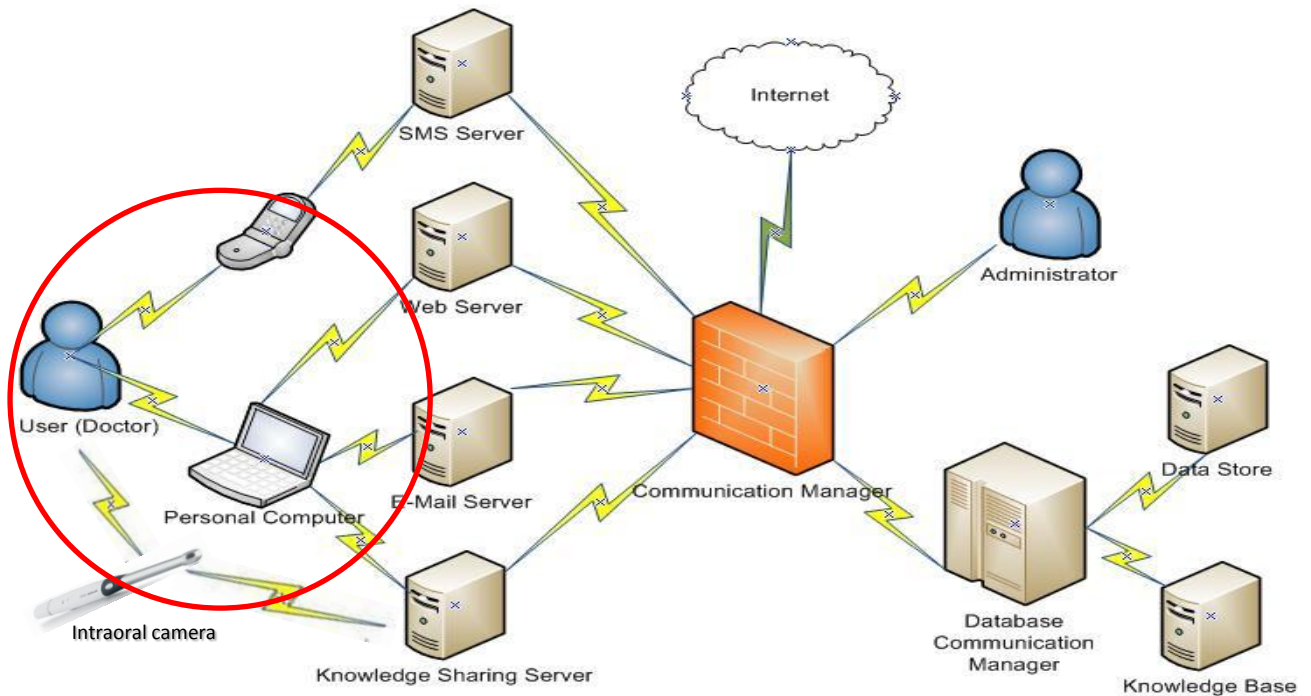


Figure 1 : System diagram

The main goals of this research project are as follows,

- To provide a better dental health care service to patients, irrespective of where they live.
- To educate patients clearly on their dental conditions with the visual output of intra oral cameras.
- To educate children as well as adults on how to prevent oral diseases.
- To provide patients with a better understanding of the outcomes of treatments carried out.
- To educate children and adults the best practices of maintaining good oral health.
- To improve the technology of the dental medicine field
- For “knowledge balancing” among dentists
- To provide better communication facilities for dentists with specialists and consultants
- To create a “Knowledge Base” for dentists which helps in decision making.

The main tasks of the system are

- Providing a patient management system for dentists which could send updates and reminders to their patients.
- Providing a decision support system to the dentists.
- Emphasizing the need for bi-annual dental check-ups.
- Providing better education to patients on their dental conditions.
- Educating the common citizen about causes of oral diseases, impact of oral health on the human body.
- Educating children especially, as well as adults about the oral diseases can be prevented.
- Providing better means of communication to dentists with their consultants, as the geographic distribution and availability of dental personnel is low.

The next chapter, the Overall Description section, of this document gives an overview of the functionality of the component. It describes the informal requirements and is used to establish a context for the technical requirements specification in the next chapter. This section is intended for the **customer**.

The third chapter, the Specific Requirements section, of this document is written primarily for the **developers** and describes in technical terms the details of the functionality of the component.

Both sections of the document describe the same software product component “Patient Management System” in its entirety, but are intended for different audiences and thus use different language.

## 2. User Requirements

### 2.1 Product Perspective

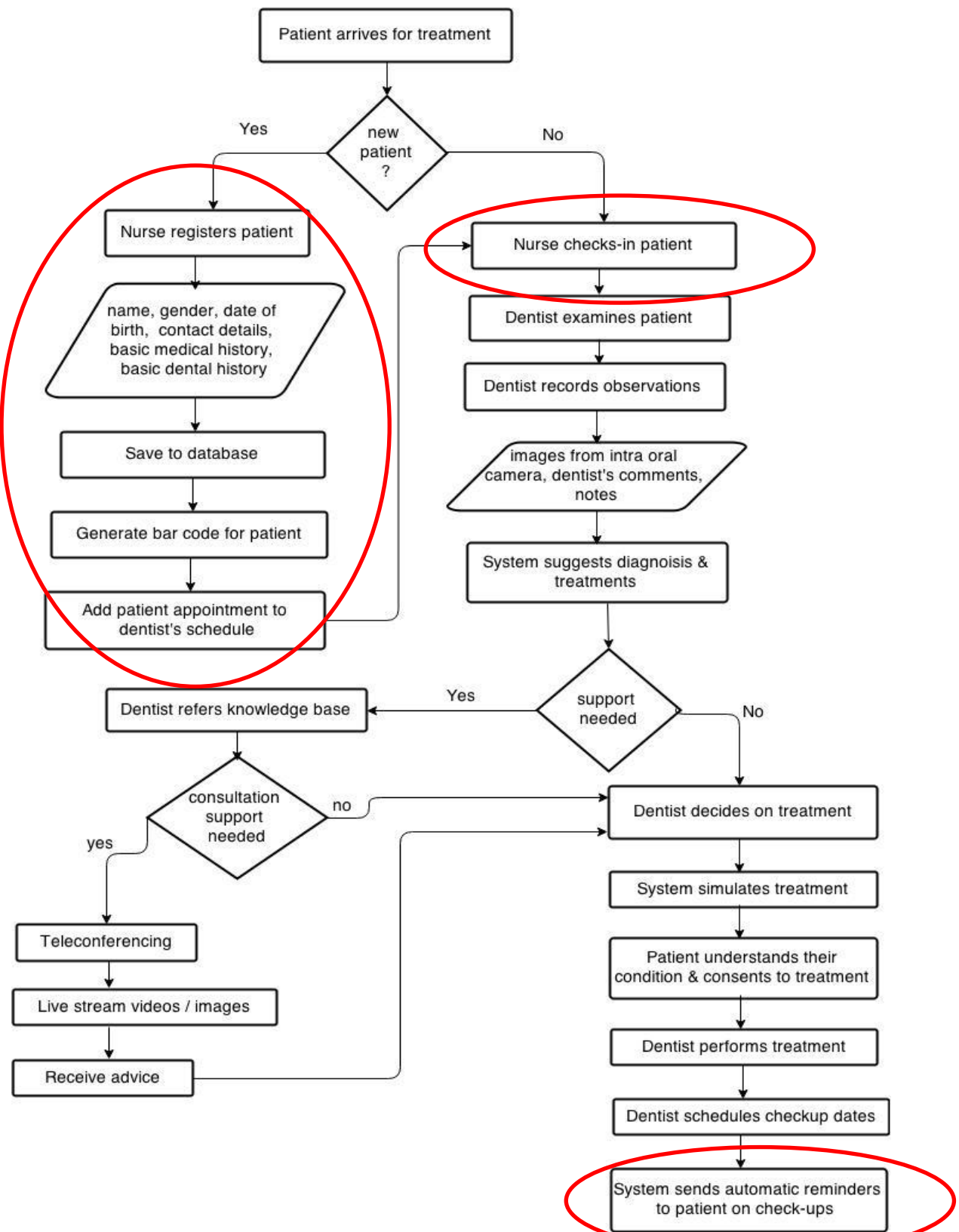


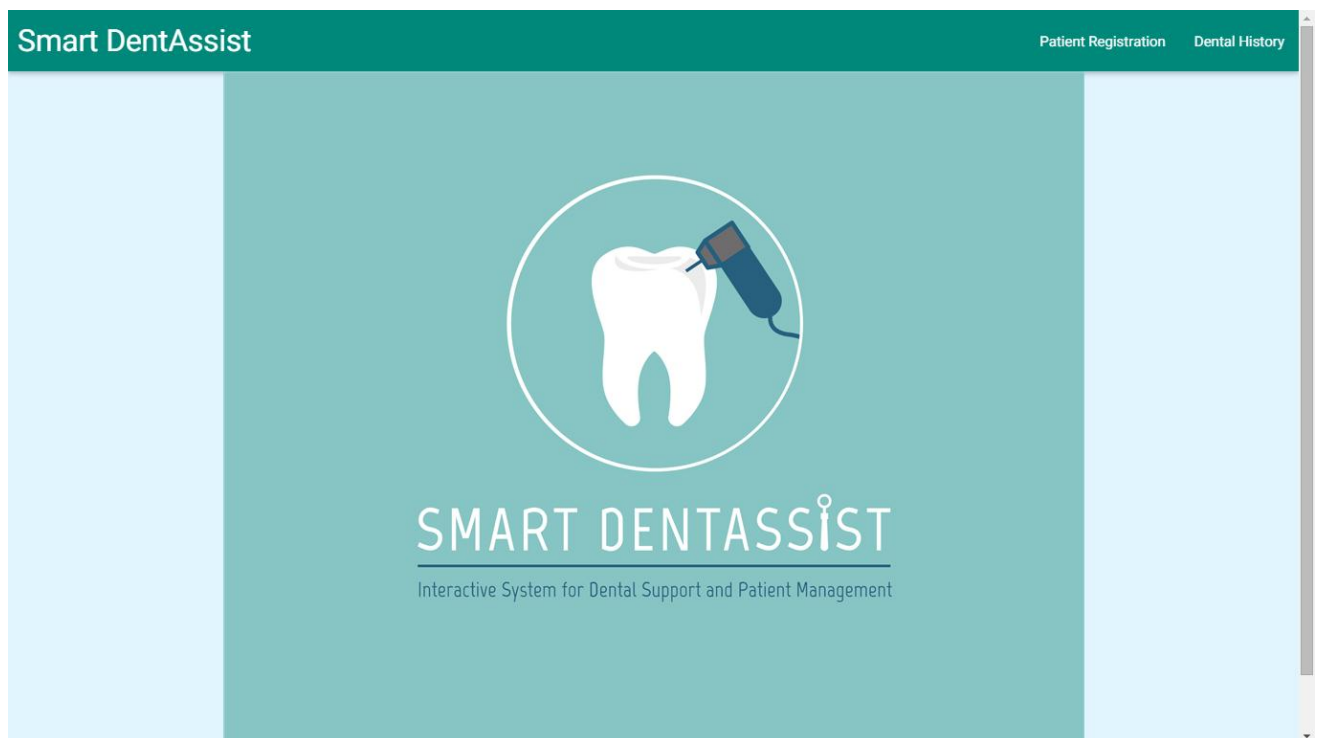
Figure 2 : Flowchart of the system

### 2.1.1 System Interfaces

- Web interfaces
- SMS gateway
- Teleconferencing interface
- Image capturing, processing and simulating interface

### 2.1.2 User interfaces

**Figure 3 : Smart Dentassist Homepage**



The home page of the Smart Dentassist system is displayed above. This will be displayed first to its users. Depending on the task the user needs to perform, they could select whether to navigate to “Patient Registration” section or “Dental History” section.

Users of the two sections Patient Registration and Dental Health could vary. Patient Registration section is intended for the use of the dentist’s assistant / nurse / receptionist. Dental health section is intended for the use of the dentist.

**Figure 4 : Patient Registration - Personal Information**

The screenshot shows the 'Smart DentAssist' application interface. The top navigation bar is green with the text 'Smart DentAssist' on the left and 'Patient Registration' and 'Dental History' on the right. Below the navigation bar, there are three tabs: 'PERSONAL INFORMATION' (active), 'CONTACT INFORMATION', and 'PATIENT DETAILS'. The 'PERSONAL INFORMATION' tab contains the following fields: 'First Name' (with a person icon), 'Surname' (with a person icon), 'Gender' (with a person icon and radio buttons for 'Male' and 'Female'), and 'Known Allergies' (with a speech bubble icon). At the bottom right of the form, there are three buttons: 'RESET' (with a circular arrow icon), 'REGISTER' (with a document icon), and 'CANCEL' (with an 'X' icon). The footer of the form contains the text '© 2015 Smart DentAssist - Final Year Project'.

New patients who arrive for treatments must be registered in the system. The “*Personal Information*” tab of *Patient Registration* section is designed for the user to enter patients’ basic personal information to the system.

**Figure 5 : Patient Registration - Contact Information**

The screenshot shows the 'Smart DentAssist' application interface. The top navigation bar is green with the text 'Smart DentAssist' on the left and 'Patient Registration' and 'Dental History' on the right. Below the navigation bar, there are three tabs: 'PERSONAL INFORMATION', 'CONTACT INFORMATION' (active), and 'PATIENT DETAILS'. The 'CONTACT INFORMATION' tab contains the following fields: 'Home' (with a telephone icon), 'Mobile' (with a telephone icon), 'Work' (with a telephone icon), 'Email' (with an envelope icon), 'Postal No' (with a location pin icon), 'Address 1' (with a location pin icon), 'Address 2' (with a location pin icon), and 'City' (with a location pin icon). At the bottom right of the form, there are three buttons: 'RESET' (with a circular arrow icon), 'REGISTER' (with a document icon), and 'CANCEL' (with an 'X' icon). The footer of the form contains the text '© 2015 Smart DentAssist - Final Year Project'.

The “*Contact Information*” tab of *Patient Registration* section is designed for the user to enter the patients’ contact information to the system.

**Figure 6 : Patient Registration - Health Information**

The screenshot displays the 'Smart DentAssist' web application interface for patient registration. The top navigation bar is green with 'Smart DentAssist' on the left and 'Patient Registration' and 'Dental History' on the right. Below the navigation bar, the form is divided into three main sections: 'PERSONAL INFORMATION', 'CONTACT INFORMATION', and 'PATIENT DETAILS'. The 'PATIENT DETAILS' section is currently active and contains a text input field for 'Main reason for today's visit', a 'Medical Health History' section with a list of checkboxes for various conditions, and another text input field for 'Other'. The 'Medical Health History' section is organized into three columns. The first column lists: Diabetes, High cholesterol, High blood pressure, Low blood pressure, Heartburn(reflux), Anemia/blood problems, Swollen ankles, Depression/Anxiety, and Thyroid problems. The second column lists: Shortness of breath, Tonsillitis, Asthma, Stroke, Sinus problems, Arthritis, Cancer, Ulcers/colitis, and Gastric irritation. The third column lists: Heart disease/Murmur/Angina, Kidney/Bladder problems, Lung problems/cough, Liver problems/Hepatitis, Headaches/Migraines, Neurological problems, Eye disorder/Glaucoma, Ear problems, and Seasonal allergies. At the bottom of the form, there are three buttons: 'RESET', 'REGISTER', and 'CANCEL'. A URL bar at the very bottom shows 'shamalmahesh.net78.net/index.php/patient\_registration'.

PERSONAL INFORMATION	CONTACT INFORMATION	PATIENT DETAILS
<input type="text" value="Main reason for today's visit"/>		
<b>Medical Health History</b>		
<input type="checkbox"/> Diabetes	<input type="checkbox"/> Shortness of breath	<input type="checkbox"/> Heart disease/Murmur/Angina
<input type="checkbox"/> High cholesterol	<input type="checkbox"/> Tonsillitis	<input type="checkbox"/> Kidney/Bladder problems
<input type="checkbox"/> High blood pressure	<input type="checkbox"/> Asthma	<input type="checkbox"/> Lung problems/cough
<input type="checkbox"/> Low blood pressure	<input type="checkbox"/> Stroke	<input type="checkbox"/> Liver problems/Hepatitis
<input type="checkbox"/> Heartburn(reflux)	<input type="checkbox"/> Sinus problems	<input type="checkbox"/> Headaches/Migraines
<input type="checkbox"/> Anemia/blood problems	<input type="checkbox"/> Arthritis	<input type="checkbox"/> Neurological problems
<input type="checkbox"/> Swollen ankles	<input type="checkbox"/> Cancer	<input type="checkbox"/> Eye disorder/Glaucoma
<input type="checkbox"/> Depression/Anxiety	<input type="checkbox"/> Ulcers/colitis	<input type="checkbox"/> Ear problems
<input type="checkbox"/> Thyroid problems	<input type="checkbox"/> Gastric irritation	<input type="checkbox"/> Seasonal allergies
<input type="text" value="Other"/>		
<div>shamalmahesh.net78.net/index.php/patient_registration</div> <div>RESET REGISTER CANCEL</div>		

The “*Patient Details*” tab of *Patient Registration* section is designed for the user to enter patients’ general health conditions to the system.

**Figure 7 : Dental History - Health History**

The screenshot shows the 'Smart DentAssist' application with the 'Dental History' tab selected. The 'HEALTH HISTORY' sub-tab is active. The form contains several sections of questions:

- Dental Health History:** A list of 10 checkboxes asking about chewing difficulties, mouth pain, brushing habits, gum bleeding, gum swelling, tooth sensitivity, pain when chewing/opening wide, slow-healing sores, jaw trauma, and facial/joint/throat/temple pain.
- Are you a habitual:** Checkboxes for Gum chewer, Pipe smoker, Betel chewer, and Cigarette smoker.
- Do you feel twinges of pain when your teeth come in contact with:** Checkboxes for Hot foods or liquids, Sours, Cold foods or liquids, and Sweets.
- Other:** A text input field for additional information.

At the bottom right, there are three buttons: 'RESET', 'SAVE', and 'CANCEL'.

The section *Dental History* will be used mainly by the dentist to enter patient’s medical history in detail when a new patient arrives for treatment. “*Health History*” tab is designed to store signs and symptoms as well as habits and practices related to dental issues.

**Figure 8 : Dental History - Women's Health**

The screenshot shows the 'Smart DentAssist' application with the 'Dental History' tab selected. The 'WOMEN'S HEALTH' sub-tab is active. The form contains several input fields:

- Are you pregnant?** A checkbox.
- Number of weeks:** A text input field.
- Total number of pregnancies:** A text input field.
- Number of births:** A text input field.
- Nursing?** A checkbox.
- Date of last menstrual period if you are still menstruating:** A date input field.
- Age at beginning of periods (menstruation):** A text input field.
- Age at end of periods (menopause):** A text input field.

At the bottom right, there are three buttons: 'RESET', 'SAVE', and 'CANCEL'.

© 2015 Smart DentAssist - Final Year Project



“*Women’s Health*” tab (displayed above) is designed to store important health details of women that may have an impact on treatments.

**Figure 9 : Dental History - Past Treatments**

The screenshot shows the 'Smart DentAssist' web application interface. The top navigation bar is green with 'Smart DentAssist' on the left and 'Patient Registration' and 'Dental History' on the right. Below the navigation bar, there are five tabs: 'HEALTH HISTORY', 'WOMEN'S HEALTH', 'PAST TREATMENTS' (which is selected and underlined), 'TREATMENTS', and 'DENTAL EXAMINATION'. The 'PAST TREATMENTS' tab contains a list of dental procedures, each with a checkbox: Removal, Wound treatment, Fillings, Sealants, Retainers, Braces, Cleaning, Polishing, Bridges, Dentures, and Implants. At the bottom right of the form, there are three buttons: 'RESET', 'SAVE', and 'CANCEL'. The footer of the page is light blue and contains the text '© 2015 Smart DentAssist - Final Year Project'.

The “*Past Treatments*” tab (displayed above) of *Dental History* section is designed for the dentist to enter previously carried out dental treatments of the new patient, into the system.

**Figure 10 : Dental History - Treatments**

The screenshot shows the 'Smart DentAssist' web application interface. The top navigation bar is green with 'Smart DentAssist' on the left and 'Patient Registration' and 'Dental History' on the right. Below the navigation bar, there are five tabs: 'HEALTH HISTORY', 'WOMEN'S HEALTH', 'PAST TREATMENTS', 'TREATMENTS' (which is selected and underlined), and 'DENTAL EXAMINATION'. The 'TREATMENTS' tab contains two sections: 'Treatment Needed' with radio buttons for Urgent Treatment, Restorative Care, Preventive Care, and Other; and 'Drugs Prescribed' with checkboxes for Antibiotic, Sedative, Anti-inflammatory, and Other. At the bottom right of the form, there are three buttons: 'RESET', 'SAVE', and 'CANCEL'. The footer of the page is light blue and contains the text '© 2015 Smart DentAssist - Final Year Project'.

The “*Treatments*” tab (displayed above) of *Dental History* section is designed for the dentist to enter treatments required for the patients and the priority of the treatment into the system.

**Figure 11 : Dental History - Treatments**

**Smart DentAssist** Patient Registration Dental History

**HEALTH HISTORY**

- ☐ Caries
- ☐ Initial
- ☐ Dentine
- ☐ Pulp exposed
- ☐ Fluorosis
- ☐ Missing Teeth
- ☐ Dry Mouth
- ☐ Extra Oral
- ☐ Facial issues
- ☐ Swellings
- ☐ Other

**WOMEN'S HEALTH**

- ☐ Periodontal diseases
- ☐ Gingivitis
- ☐ Periodontitis

**PAST TREATMENTS**

- ☐ Lesions
- ☐ Premalignant
- ☐ Cancerous
- ☐ Non Cancerous

**TREATMENTS**

- ☐ Sensitivity
- ☐ Tooth decay
- ☐ Fractured teeth
- ☐ Worn fillings
- ☐ Gum disease
- ☐ Worn tooth enamel
- ☐ Exposed tooth root

**DENTAL EXAMINATION**

- ☐ Malocclusion
- ☐ Class 2 Division 1
- ☐ Class 2 Division 2
- ☐ Class 3
- ☐ Oropharyngeal Cancer
- ☐ Sores that bleed easily or do not heal
- ☐ Thick or hard spot or lump
- ☐ Roughened or crusted area
- ☐ Numbness, pain or tenderness
- ☐ Change in the way your teeth fit together when you bite down

**Comments**

shamalmahesh.net78.net/index.php/dental\_history

RESET SAVE CANCEL

The “*Dental Examination*” tab (displayed above) of *Dental History* section is designed for the dentist to enter results and observations acquired after examining the patient, into the system.

### 2.1.3 Hardware Interfaces

The hardware needed for this research project will be ;

- Laptop computer
- Intraoral camera
- Tablet PC
- Bar code reader

The **laptop computer** which will be used by the dentist, will contain the proposed software system and will perform the necessary processing activities.

The **intraoral camera** will capture images of the patient's oral cavity and transmit them to the laptop computer, where the processing will take place.

The **tablet PC** will serve as the education tool for the patient, on which images captured by the intra oral camera will be displayed and simulations of the treatments and outcomes will be displayed.

The **bar code reader** serves as a tool for patient management, where a unique bar code will be generated for each patient, and once the bar code is scanned patient profile will be displayed on computer.

### 2.1.4 Software Interfaces

- The system will be developed using Java version 1.7
- The webpages will be developed using HTML, CSS, JavaScript and jQuery.
- The database will be created using MySQL version 5.5

### 2.1.5 Communication Interfaces

- Intra oral camera software will provide wireless access to the laptop and tablet PC. Images and videos captured by the intra oral camera will be transmitted to the laptop and tablet PC to be viewed by dentist and patient.
- A Modem or a dongle will provide access to Internet when necessary Internet access will be required for Teleconferencing and live streaming videos and images captured by the intra oral camera.

### **2.1.6 Memory Constraint**

“Smart Dentassist” is expected to use no more than 4 GB of Ram and 250 GB of external storage.

### **2.1.7 Operations**

- Dentist’s assistant / Nurse is able to register new patients to the system, by entering patients’ personal information and basic medical history.
- Dentist’s assistant / Nurse is able to enter to the system patient’s reason for the visit, signs and symptoms faced by the patient and other oral health related information.
- Dentist is able to save observations and conclusions of examining the patient.
- Dentist and patient are able to view the video and images captured by the intraoral camera on the laptop / tablet PC
- The system models the patients teeth graphically
- The system makes suggestions of possible treatments and displays similar previously treated cases
- The system simulates graphically the outcomes of treatments selected by the dentist
- The system automatically reminds patients of their upcoming appointments
- Dentists is able to teleconference with colleagues or consultants and live stream the images / videos captured by the intraoral camera

### **2.1.8 Site Adaptation Requirements**

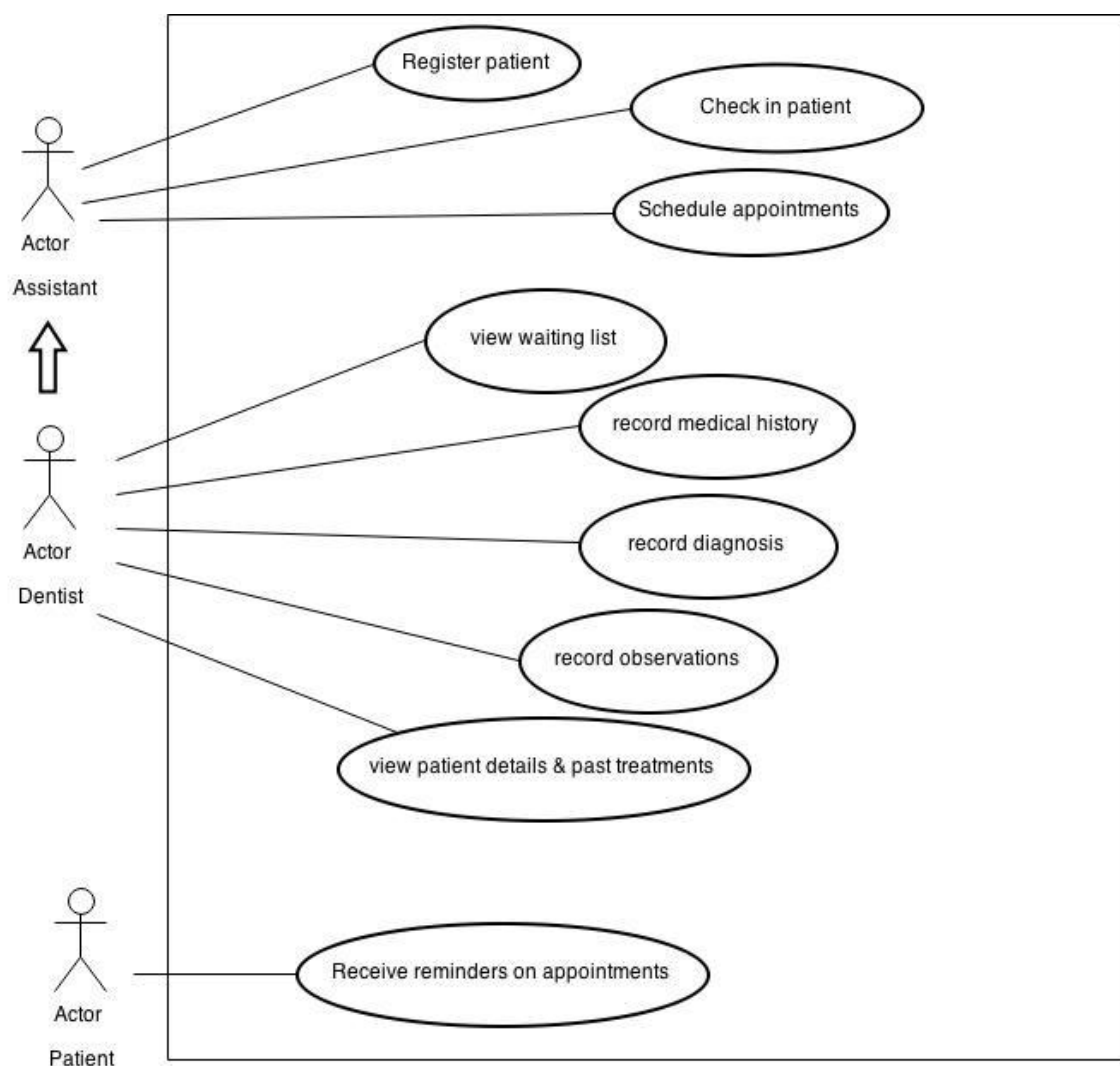
The system will be compatible with mobiles, tablet, desktop and laptop computers.

## 2.2 Product Functions

### Patient Management System :

The system must register new patients by taking the essential details such as name, date of birth, gender, address, telephone numbers, email address, allergies and generate a unique barcode for each patient. When the barcode is scanned, the patient's details will be displayed. Images captured from intra oral cameras, medical history and all other relevant data will be stored in patient folder. The system will generate a virtual waiting list for the dentist. When patients arrive at the dental clinic, they will be entered into the system at the reception. The dentist will be able to view the patient being treated as well as the list of patients who are waiting for their turns. The system will maintain an independent timer for each person to track appointments and to send reminders.

Figure 12 : Patient Management Use Case Diagram



**Table 1 : Use case - register patient**

<b>Use case</b>	Register Patient
<b>Pre-condition</b>	1. Application is up and running 2. Database connection is active
<b>Actor</b>	Assistant / Nurse
<b>Main Success Scenarios</b>	1. Enter patient basic personal information 2. Enter patient contact details information 3. Enter patients' general medical history
<b>Extension</b>	

**Table 2 : Use case - Check in patient**

<b>Use case</b>	Check in Patient
<b>Pre-condition</b>	1. Application is up and running 2. Database connection is active 3. Patient must be already registered
<b>Actor</b>	Assistant / Nurse
<b>Main Success Scenarios</b>	1. Go to check in interface 2. Scan patient barcode with bar code reader 3. Doctor's waiting list & schedule are automatically updated
<b>Extension</b>	

**Table 3 : Use case - Schedule appointments**

<b>Use case</b>	Schedule appointment
<b>Pre-condition</b>	1. Application is up and running 2. Database connection is active 3. Patient must be already registered
<b>Actor</b>	Assistant / Nurse
<b>Main Success Scenarios</b>	1. Scan patient barcode / search patient 2. Select time and date 3. Enter reason for appointment / patient complaint 4. Add appointment

<b>Extension</b>	
------------------	--

**Table 4 : Use case - view waiting list**

<b>Use case</b>	View waiting list
<b>Pre-condition</b>	1. Application is up and running 2. Database connection is active
<b>Actor</b>	Dentist
<b>Main Success Scenarios</b>	1. Open daily schedule 2. View list of upcoming appointments
<b>Extension</b>	

**Table 5 : Use case - Record medical history**

<b>Use case</b>	Record medical history
<b>Pre-condition</b>	1. Application is up and running 2. Database connection is active 3. Patient is already registered
<b>Actor</b>	Dentist
<b>Main Success Scenarios</b>	1. Scan patient barcode / search patient 2. Open dental health history interface 3. Check/tick options and make comments if necessary 4. Save to the system
<b>Extension</b>	

**Table 6 : Use case - Record diagnosis**

<b>Use case</b>	Record diagnosis
<b>Pre-condition</b>	1. Application is up and running 2. Database connection is active 3. Patient is already registered 4. Patient history is saved
<b>Actor</b>	Dentist
<b>Main Success Scenarios</b>	1. Scan patient barcode / search patient

	<ol style="list-style-type: none"> <li>2. Open treatment interface</li> <li>3. Check/tick treatment types, drugs and treatment priority</li> <li>4. Add comments</li> <li>5. Save to the system</li> </ol>
<b>Extension</b>	3a. if there are any other details to be stored, the dentist can store them as comments.

**Table 7 : Use case - record observations**

<b>Use case</b>	Record observations
<b>Pre-condition</b>	<ol style="list-style-type: none"> <li>1. Application is up and running</li> <li>2. Database connection is active</li> <li>3. Patient is already registered</li> <li>4. Patient history is saved</li> </ol>
<b>Actor</b>	Dentist
<b>Main Success Scenarios</b>	<ol style="list-style-type: none"> <li>1. Scan patient barcode / search patient</li> <li>2. Open observations interface</li> <li>3. Check/tick observations, signs, symptoms</li> <li>4. Add comments</li> <li>5. Save to the system</li> </ol>
<b>Extension</b>	

**Table 8 : Use case - View patient details & past treatments**

<b>Use case</b>	View patient details & past treatments
<b>Pre-condition</b>	<ol style="list-style-type: none"> <li>1. Application is up and running</li> <li>2. Database connection is active</li> <li>3. Patient is already registered</li> <li>4. Patient history is saved</li> <li>5. Patient diagnosis &amp; observations are saved</li> </ol>
<b>Actor</b>	Dentist
<b>Main Success Scenarios</b>	<ol style="list-style-type: none"> <li>1. Scan patient barcode / search patient</li> <li>2. Open patient profile interface</li> <li>3. View past treatments, methods, drugs used, outcome</li> </ol>



<b>Extension</b>	3a. If the patient is new, only the registration details will be displayed
------------------	--

**Table 9 : Use case - Receive reminders on appointments**

<b>Use case</b>	Receive reminders on appointments
<b>Pre-condition</b>	<ol style="list-style-type: none"> <li>1. Application is up and running</li> <li>2. Database connection is active</li> <li>3. Patient is registered in the system</li> </ol>
<b>Actor</b>	Patient
<b>Main Success Scenarios</b>	<ol style="list-style-type: none"> <li>1. Receive text message / mail reminders of upcoming appointments</li> </ol>
<b>Extension</b>	

## 2.3 User Characteristics

Users of this system are ;

- Dentist
- Dentists assistant / nurse / receptionist

The dentist has full access to the system, while the assistant / nurse / receptionist has access only to the patient registration component.

Therefore, this component will be used by the **assistant / nurse / receptionist**

## 2.4 Constraints

- Java will be the implementation language
- MySQL will be used to create the database
- A storage devise of 100 GB the least will be required to store images
- A daily backup will be required to free storage space on the device

## **2.5 Assumptions and Dependencies**

- Future versions will use cloud technology for the knowledge base.

## **2.6 Apportioning of Requirements**

The requirements described in sections 1 and 2 of this document are referred to as primary specifications; those in section 3 are referred to as requirements (or functional) specifications. The two levels of requirements are intended to be consistent. Inconsistencies are to be logged as defects. In the event that a requirement is stated within both primary and functional specifications, the application will be built from functional specification since it is more detailed.

## **3. System Requirements**

### **3.1 External Interface Requirements**

#### **3.1.1 User Interfaces**

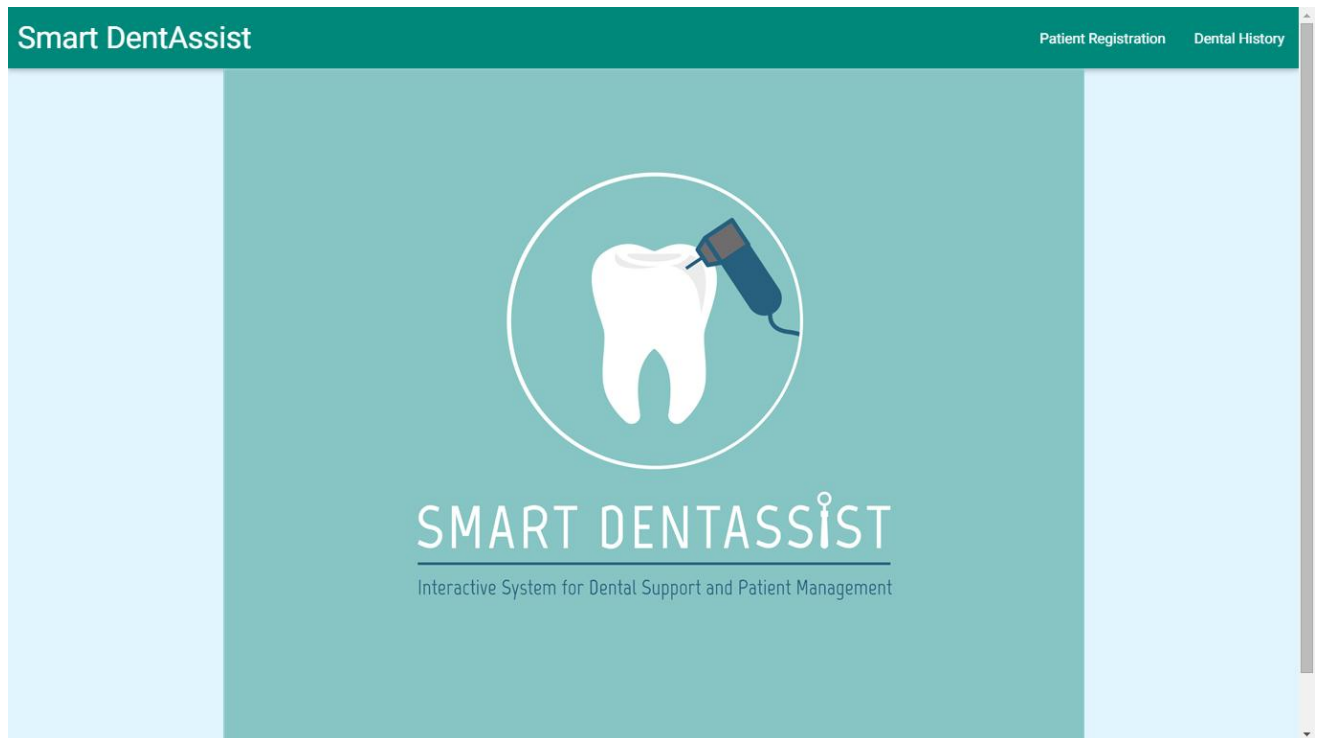
Users of this system will not be experts, hence user friendliness will be crucial. Users of this system will be the dentist and the dentist's assistant / nurse.

User interfaces will be simple, clear and easy to use. Font on these interfaces must be greater than 12 pt.

System interfaces will be designed to ensure highest usability and efficiency. Text fields will be used only where necessary. The interfaces will be designed to contain check boxes and radio buttons predominantly, to ensure the data entry process easy and efficient.

The system is expected to be used at least 8 hours a day. Hence its interfaces will have suitable colours to avoid inconvenience and discomfort to its user.

**Figure 13 : Smart Dentassist homepage UI**



The home page of the Smart Dentassist system is displayed above. This will be displayed first to its users. Depending on the task the user needs to perform, they could select whether to navigate to “Patient Registration” section or “Dental History” section.

Users of the two sections Patient Registration and Dental Health could vary. Patient Registration section is intended for the use of the dentist’s assistant / nurse / receptionist. Dental health section is intended for the use of the dentist.

**Figure 14 : Patient Registration - Personal Information UI**

Smart DentAssist

Patient Registration Dental History

PERSONAL INFORMATION CONTACT INFORMATION PATIENT DETAILS

First Name Surname

Gender Occupation

Male Female

Known Allergies

RESET REGISTER CANCEL

© 2015 Smart DentAssist - Final Year Project

The “*Personal Information*” tab of *Patient Registration* section is designed for the user to enter patients’ basic personal information to the system as new patients who arrive for treatments must be registered in the system. The user of this interface will be the nurse / dentists’ assistant.

*First name, Surname, Occupation* and *Known Allergies* will be text fields for the user to type in necessary details. *Male* or *Female* options will be radio buttons for the user to simply click and select.

*Reset* button will clear the details in the text fields and selected radio button. *Register* button will save the data into the database. *Cancel* button will terminate the registration.

**Figure 15 : Patient Registration - Contact Information UI**

Smart DentAssist

Patient Registration Dental History

PERSONAL INFORMATION CONTACT INFORMATION PATIENT DETAILS

Home Postal No

Mobile Address 1

Work Address 2

Email City

RESET REGISTER CANCEL

© 2015 Smart DentAssist - Final Year Project

The “*Contact Information*” tab of *Patient Registration* section is designed for the user to enter the patients’ contact information to the system. The user of this interface will be the nurse / dentists’ assistant.

*Home, Mobile, Work, Email, Postal No., Address 1 , Addresss 2, City* will be text fields for the user to type in necessary details. The fields *Home, Mobile, Work* will be validated for 10 digit numbers, while *Email* too will be validated for its correctness.

*Reset* button will clear the details in the text fields. *Register* button will save the data into the database. *Cancel* button will terminate the registration.

**Figure 16 : Patient Registration – Patient Details UI**

Smart DentAssist

Patient Registration Dental History

PERSONAL INFORMATION CONTACT INFORMATION PATIENT DETAILS

Main reason for today's visit

Medical Health History

- ☐ Diabetes
- ☐ High cholesterol
- ☐ High blood pressure
- ☐ Low blood pressure
- ☐ Heartburn(reflux)
- ☐ Anemia/blood problems
- ☐ Swollen ankles
- ☐ Depression/Anxiety
- ☐ Thyroid problems
- ☐ Shortness of breath
- ☐ Tonsillitis
- ☐ Asthma
- ☐ Stroke
- ☐ Sinus problems
- ☐ Arthritis
- ☐ Cancer
- ☐ Ulcers/colitis
- ☐ Gastric irritation
- ☐ Heart disease/Murmur/Angina
- ☐ Kidney/Bladder problems
- ☐ Lung problems/cough
- ☐ Liver problems/Hepatitis
- ☐ Headaches/Migraines
- ☐ Neurological problems
- ☐ Eye disorder/Glaucoma
- ☐ Ear problems
- ☐ Seasonal allergies

Other

RESET REGISTER CANCEL

shamalmahesh.net78.net/index.php/patient\_registration

The “*Patient Details*” tab of *Patient Registration* section is designed for the user to enter patients’ general health conditions to the system. The user of this interface will be the nurse / dentists’ assistant.

*Main reason for today’s visit* , *Other* will be text fields for the user to type in necessary details. *Medical Health History* section will consist of a list of common diseases and conditions along with check boxes, so the user only needs to click on diseases to save the patient’s health conditions to the system.

*Reset* button will clear the details in the text fields, and the checked check boxes. *Register* button will save the data into the database. *Cancel* button will terminate the registration.

**Figure 17 : Dental History : Health History UI**

Smart DentAssist

Patient Registration Dental History

HEALTH HISTORY WOMEN'S HEALTH PAST TREATMENTS TREATMENTS DENTAL EXAMINATION

Dental Health History

☐ Do you have difficulty in chewing your food?

☐ Do you chew on only one side of your mouth?

☐ Do you avoid brushing any part of your mouth because of pain?

☐ Do your gums bleed when you floss?

☐ Do your gums feel swollen or tender?

☐ Are your teeth sensitive?

☐ Does it hurt when you chew or open wide to take a bite?

☐ Have you ever noticed slow-healing sores in or about your mouth?

☐ Have you had a blow to the jaw (trauma)?

☐ Do you have pain in the face, cheeks, jaws, joints, throat, or temples?

Are you a habitual

☐ Gum chewer? ☐ Pipe smoker? ☐ Betel chewer? ☐ Cigarette smoker?

Do you feel twinges of pain when your teeth come in contact with

☐ Hot foods or liquids? ☐ Sours? ☐ Cold foods or liquids? ☐ Sweets?

Other

RESET SAVE CANCEL

The section *Dental History* will be used mainly by the dentist to enter patient's medical history in detail when a new patient arrives for treatment. "*Health History*" tab is designed to store signs and symptoms as well as habits and practices related to dental issues. The user of this interface will be the dentist.

This interface will consist of lists the questions the dentist will ask the patient. Each question will have a check box, for the user to mark questions for which the patient gives positive answers. The text field *Other* will be used when any comments are needed to be made or details other than the given list items must be saved.

*Reset* button will clear the details in the text fields, and the checked check boxes. *Register* button will save the data into the database. *Cancel* button will terminate the registration.



**Figure 18 : Dental History - Women's Health UI**

Smart DentAssist

Patient Registration Dental History

HEALTH HISTORY WOMEN'S HEALTH PAST TREATMENTS TREATMENTS DENTAL EXAMINATION

☐ Are you pregnant?

☐ Nursing?

Number of weeks

Date of last menstrual period if you are still menstruating

Total number of pregnancies

Age at beginning of periods (menstruation)

Number of births

Age at end of periods (menopause)

RESET SAVE CANCEL

© 2015 Smart DentAssist - Final Year Project

“*Women’s Health*” tab (displayed above) is designed to store important health details of women that may have an impact on treatments. The user of this interface will be the dentist.

This interface will consist of two subheadings with check boxes. Once a particular check box is checked, the text fields below it will be enabled for data entry.

*Reset* button will clear the details in the text fields, and the checked check boxes. *Register* button will save the data into the database. *Cancel* button will terminate the registration.

**Figure 19 : Dental History - Past Treatments UI**

Smart DentAssist

Patient Registration Dental History

HEALTH HISTORY WOMEN'S HEALTH PAST TREATMENTS TREATMENTS DENTAL EXAMINATION

☐ Removal  
☐ Wound treatment

☐ Fillings  
☐ Sealants  
☐ Retainers  
☐ Braces

☐ Cleaning  
☐ Polishing  
☐ Bridges  
☐ Dentures  
☐ Implants

RESET SAVE CANCEL

© 2015 Smart DentAssist - Final Year Project

The “*Past Treatments*” tab (displayed above) of *Dental History* section is designed for the dentist to enter previously carried out dental treatments of the new patient, into the system. The user of this interface will be the dentist

This interface will consist of a list of dental treatments, each list item with a check box. The dentist will check the check boxes corresponding to the treatments the patient has undergone previously.

*Reset* button will undo the checked check boxes. *Register* button will save the data into the database. *Cancel* button will terminate the registration.

**Figure 20 : Dental History - Treatments UI**

Smart DentAssist

Patient Registration Dental History

HEALTH HISTORY WOMEN'S HEALTH PAST TREATMENTS TREATMENTS DENTAL EXAMINATION

☐ Treatment Needed

☐ Urgent Treatment

☐ Restorative Care

☐ Preventive Care

☐ Other

☐ Drugs Prescribed

☐ Antibiotic

☐ Sedative

☐ Anti-inflammatory

☐ Other

RESET SAVE CANCEL

© 2015 Smart DentAssist - Final Year Project

The “*Treatments*” tab (displayed above) of *Dental History* section is designed for the dentist to enter treatments required for the patients and the priority of the treatment into the system. The user of this interface will be the dentist

This interface will contain mainly 2 sections. One section contains a list with radio buttons to save the type of treatment needed. The other section contains a list with check boxes to save the types of drugs needed. In both cases the dentist will only need to click on the required list items to save data into the system.

*Reset* button will undo the checked check boxes. *Register* button will save the data into the database. *Cancel* button will terminate the registration.

**Figure 21 : Dental History - Dental Examination UI**

The screenshot displays the 'Dental Examination' tab within the 'Dental History' section of the 'Smart DentAssist' application. The interface is organized into five columns, each representing a different category of dental history: HEALTH HISTORY, WOMEN'S HEALTH, PAST TREATMENTS, TREATMENTS, and DENTAL EXAMINATION. The 'DENTAL EXAMINATION' column is currently selected and highlighted. It contains a list of checkboxes for various dental conditions and observations, including Malocclusion, Class 2 Division 1, Class 2 Division 2, Class 3, Oropharyngeal Cancer, Sores that bleed easily or do not heal, Thick or hard spot or lump, Roughened or crusted area, Numbness, pain or tenderness, and Change in the way your teeth fit together when you bite down. Other categories like HEALTH HISTORY and WOMEN'S HEALTH also have checkboxes for conditions like Caries, Initial, Dentine, Pulp exposed, Fluorosis, Missing Teeth, Dry Mouth, Extra Oral, Facial issues, Swellings, Other, Periodontal diseases, Gingivitis, Periodontitis, Sensitivity, Tooth decay, Fractured teeth, Worn fillings, Gum disease, Worn tooth enamel, and Exposed tooth root. At the bottom of the interface, there is a 'Comments' text field and three buttons: 'RESET', 'SAVE', and 'CANCEL'.

The “*Dental Examination*” tab (displayed above) of *Dental History* section is designed for the dentist to enter results and observations acquired after examining the patient, into the system. The user of this interface will be the dentist

This interface will consist of list of possible observations and conclusions of the dental examination carried out. The dentist will only need to click on the required list items to save data into the system. The text field *Comments* is designed to store additional remarks, comments, or information to the database.

*Reset* button will undo the checked check boxes and clear text fields. *Register* button will save the data into the database. *Cancel* button will terminate the registration.

### 3.1.2 Hardware Interfaces

The hardware needed for this research project will be ;

- Laptop computer
- Intraoral camera
- Tablet PC
- Bar code reader

The **laptop computer** which will be used by the dentist, will contain the proposed software system and will perform the necessary processing activities.

The **bar code reader** serves as a tool for patient management, where a unique bar code will be generated for each patient, and once the bar code is scanned patient profile will be displayed on computer.

#### **The intraoral camera**

The intraoral camera will capture images of the patient's oral cavity and transmit them to the laptop computer, where the processing will take place. Device specifications are listed below.

Pixels : 1MP

6 LED Lights (5600K)

Bright Adjustment: 4 Levels of different brightness

Focus Range: 10 to 50mm

Field Angel: 105 Degrees Celsius

Magnification: 5 xs

Connection: Wi-Fi

Terminal Connection: 4 Terminals (At the same time)

Available Distance: Up to 30 Meters

Battery: 3.7V 2100 mAh

Charging Time: About 1 Hour

Usage Time: 3 Hours

Smartphone Compatibility: iOS ,Android, Windows System

Button: Photo/ Video button, Brightness Adjusting button, On/Off button

Micro USB port

Toothpick socket

Main Product Dimensions: 233x34x36 mm (L x W x D)

### **The bar code reader**

The bar code reader serves as a tool for patient management, where a unique bar code will be generated for each patient, and once the bar code is scanned patient profile will be displayed on computer. Device specifications are listed below

Interfaces Supported: USB

Scanning Type :Automatic scanning or manual

Depth of Field : 15-800mm PCS0.9

Scan Rate: 85 scans per second

Reading Preciseness : 0.40-0.825mm

Reading Distanc : 10-520mm

Print Contrast : 30% minimum reflective difference

Scanning Angle : Inclination angle 45°, Elevation angle 60°

Operating Temperature : 0°C - 50°C / 32°F to 122°F

Storage Temperature : -40°C - 70°C / -40°F to 158°F

Operating Humidity : 5% - 95% (non condensing)

Storage Humidity: 5% - 95% (non condensing)

Power Voltage ;5V

Static Current : 36mA

Ambient Light Immunity : Immune to direct exposure of normal office and factory lighting conditions, as well as direct exposure to sunlight

Electrostatic Discharge: Conforms to  $\pm 15$ KV air discharge and  $\pm 8$ KV of contact discharge

EMI/EMS : En50081, par1 criteria

### **3.1.3 Software Interfaces**

- The system will be developed using Java version 1.7
- The webpages will be developed using HTML, CSS, JavaScript and jQuery.
- The database will be created using MySQL version 5.5

### **3.1.4 Communication Interfaces**

- Intra oral camera software will provide wireless access to the laptop and tablet PC. Images and videos captured by the intra oral camera will be transmitted to the laptop and tablet PC to be viewed by dentist and patient.
- A Modem or a dongle will provide access to Internet when necessary Internet access will be required for Teleconferencing and live streaming videos and images captured by the intra oral camera.

## **3.2 Classes / Objects**

Classes required by the system are shown below in class diagrams.

The class diagrams below represent the system in different perspectives.

**Figure 22 : Class diagram of system - Patient Perspective**

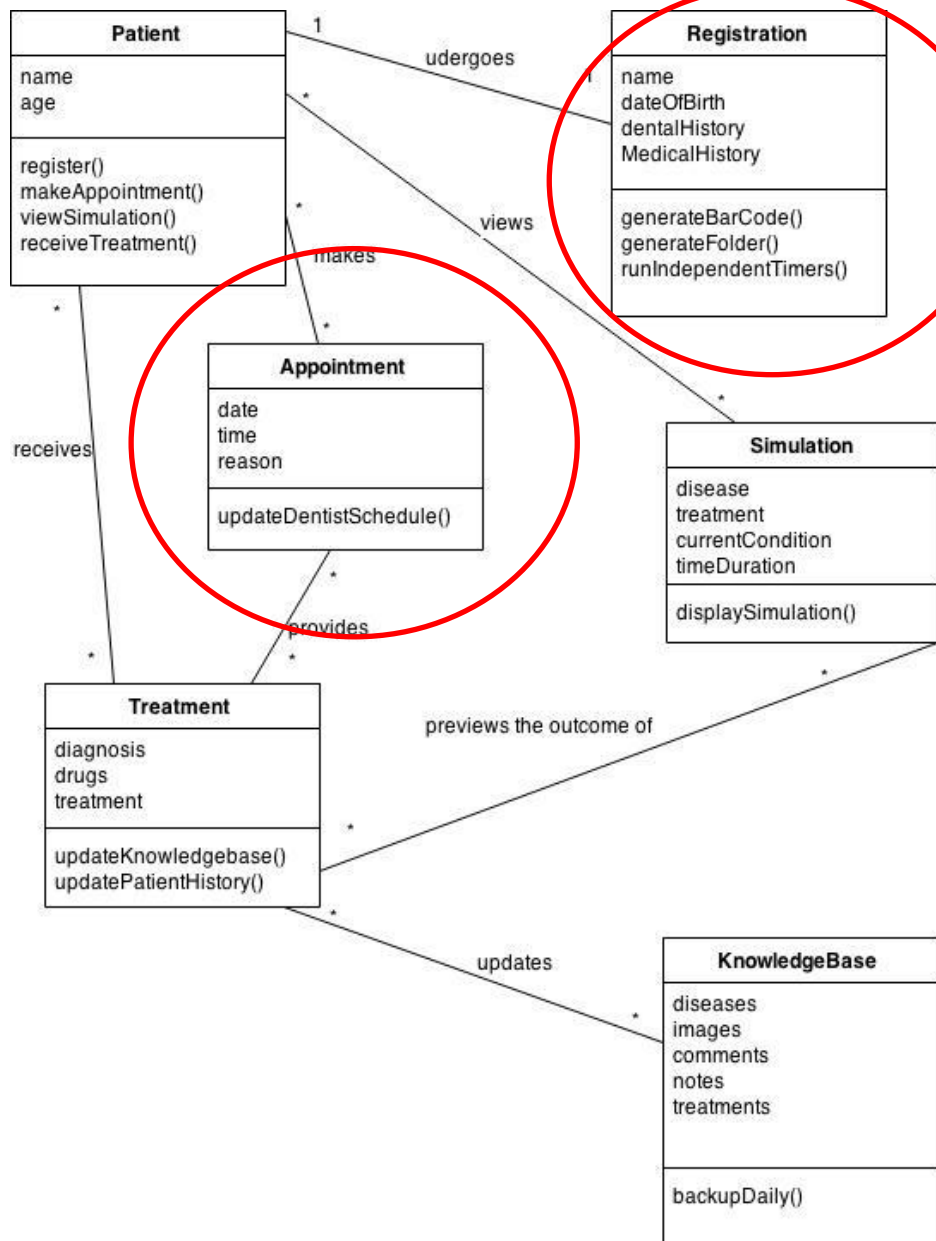




Figure 23 : Class diagram of system - Nurse Perspective

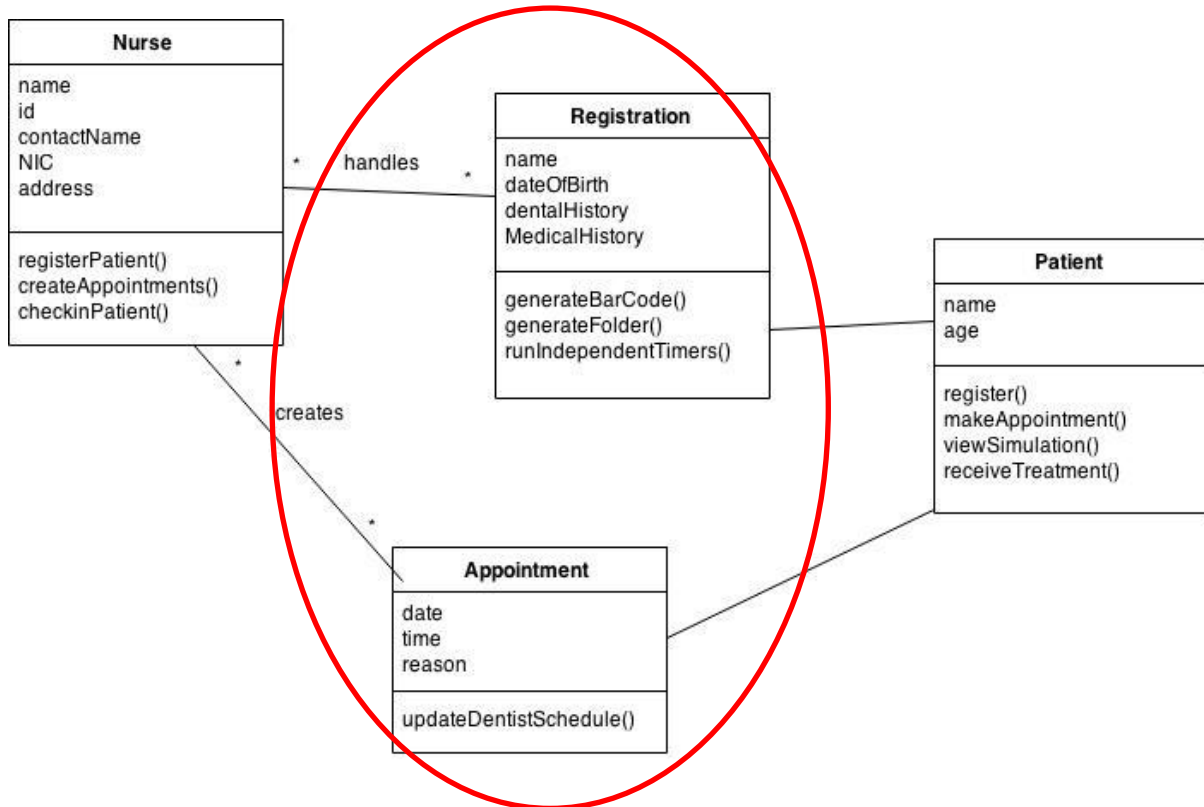
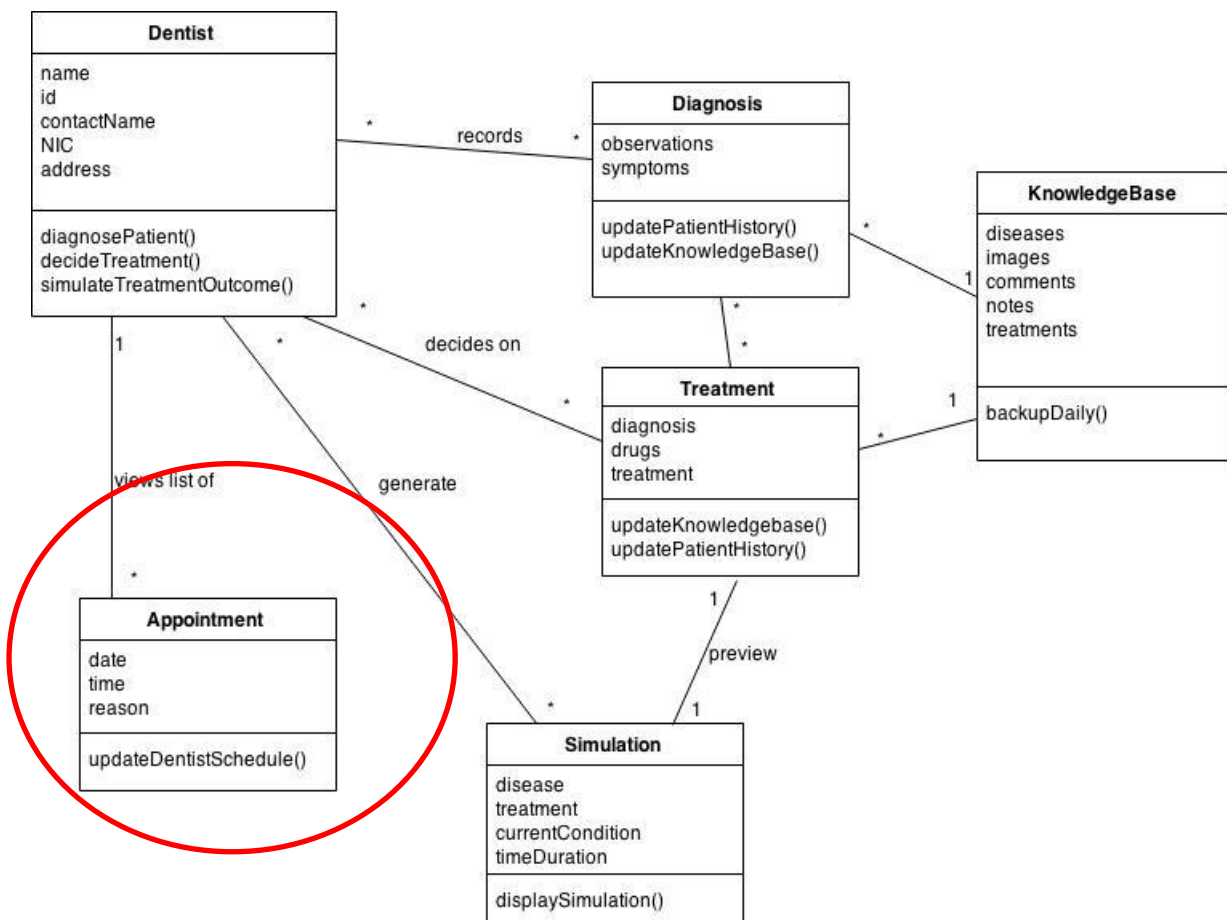


Figure 24 : Class diagram of system - Dentist Perspective



### **3.3 Performance Requirements**

The laptop used for this system must be no less than the following

- Core i5 CPU
- 4 GB RAM
- 250 HD

### 3.4 Design Constraints

Since the web application is used by doctors and nurses who are fairly computer illiterate, the GUIs will be designed as very simple and self-evident interfaces. Light colours, mind relaxing images will be used in designing the GUIs.

### 3.5 Software System Attributes

- **Correctness** - The correctness of the details which is in data base should be 100% correct when taking the assumptions and the constraints together.
- **Availability** - The administrative officer can access any data in the database at any time.
- **Confidentiality** – Information must be kept private from the outside world.
- **User friendly** – The system's user interfaces must be kept simple and easy to handle.
- **Safety** - Database backup is required in case of a database crash or an operating system failure. A backup shall consist of a complete reproduction of every file on the server.
- **Security** - The system shall implement authentication via a secure login scheme.

## References

- [1] “Media Centre”, *World Health Organization* , available:  
<http://www.who.int/mediacentre/factsheets/fs318/en/> , [accessed : 28.01.2015]
- [2] “What problems could my dental health cause”, *British Dental Foundation*, available:  
<http://www.dentalhealth.org/blog/blogdetails/104> [accessed : 28.01.2015]
- [3] “Oral Health”, *National Institute of Dental and Craniofacial Research*, available:  
<http://www.nidcr.nih.gov/oralhealth/>, [accessed : 28.01.2015]
- [4] *Sri Lanka Annual Health Bulletin 2012*, Sri Lanka : [accessed: 06.02.2015]
- [5] “A Healthy Mouth”, *Sri Lanka Dental Association*, available:  
<http://www.slada.lk/public/your-oral-health/> [accessed: 02.02.2015]
- [6] *Oral Health Worldwide : A report by FDI World Dental Federation*, Switzerland :  
FDI World Dental Federation
- [7] “Department of Health Services”, *Ministry of Healthcare and Nutrition, Sri Lanka*,  
available: <http://www.health.gov.lk/>, [accessed: 02.02.2015]