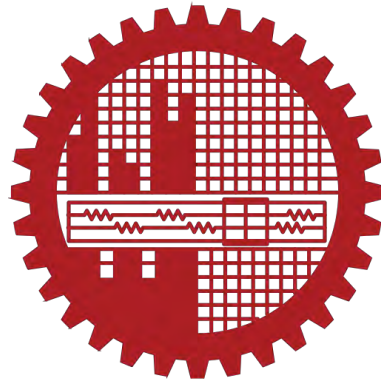# DELIVERING HEALTH CARE IN RURAL COMMUNITIES THROUGH TELEMEDICINE

By

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ID: 0413311020

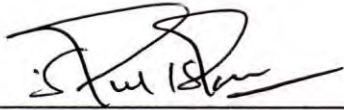**POST GRADUATE DIPLOMA IN INFORMATION AND COMMUNICATION TECHNOLOGY (PG Dip. in ICT)**

Institute of Information and Communication Technology (IICT)
BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

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The project report titled "DELIVERING HEALTH CARE IN RURAL COMMUNITIES THROUGH TELEMEDICINE" submitted by SANGITA RANI PODDAR, Student ID: 0413311020, Session: April, 2013 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Post Graduate Diploma (ICT) held on 28 March, 2018.

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CANDIDATE'S DECLARATION

It is hereby declared that this project report or any part of it has not been submitted elsewhere for the award of any degree or diploma.

Sangita

_____

SANGITA RANI PODDAR

Dedicated

To

My parents for whom I am here on earth

Table of Contents

List of Figures

Acknowledgement

I would like to thank my supervisor, Prof. Dr. Md. Saiful Islam, Director, Institute of Information and Communication Technology, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh for his kind, constant, and inspiring guidance and encouragement valuable advice and suggestions at all stages for preparing this report.

In completing this project, I have been fortunate to have help, support and encouragement from many of my friends. I would like to acknowledge them for their cooperation.

I would like to thank my family, specially my parents for their continuous support and inspiration throughout the whole period of this undertaking.

Abstract

Telemedicine is a means of improving care quality and access in rural areas, but limited evidence is available on how telemedicine affects the hospital-community relationship. Telemedicine is a rapidly growing new mode of healthcare practice. It is particularly used and needed in remote areas. There are many reasons to develop telemedicine clinics for assessment and management of diseases. Time constraints, location, and poor weather conditions can all impact on the ability of patients and providers to attend rural clinics. The utility of telemedicine in the diagnosis and subsequent follow-up appears promising in the literature, as it provides a viable means of assessing cognition in patients in remote areas with limited access to medical specialists.

In this project work, a web application has been developed; where various types of users like medical staff, doctor, and patient can login. Medical staff can setup appointments, create or update prescriptions. The web application has full support of video conference among doctor and patient. Millions of people in rural area can use this system with only internet connection. By using this system they can take advantage of its technological capacity and geographically communication problem. This system is extendable.

Chapter 1

Introduction

1.1 Introduction

Telemedicine is the integration of electronic information and medical technology. It delivers information in the form of voice, data, video and imagery. It transfers the medical information connected by telephone, Internet or other networks and carrying out the necessary outputs, which is benefited to the rural, and urban area people. The rural area has lack of communication to health community directly. Telemedicine communication will be transferred from base hospital to the vision centers or community center by connecting one computer to another computer. A vision center provides comprehensive quality eye care to the rural peoples. The broadcast of telemedicine may be one-on-one, one-on many and many- too many [1].

Since the emergence of telegraph and telephone technologies in the 19th Century, doctors have been communicating and consulting with each other over long distances. In 1970 Telemedicine, as distance healing was first highlighted, when Thomas Bird wrote about patient care in which physicians were able to examine their patients by using telecommunication technologies. Telemedicine can simply involve two health professionals discussing a case over the telephone, or be as sophisticated as using the satellite technology to broadcast a consultation between providers at facilities in two countries, using video conferencing equipment in short.

Telemedicine technology has the potential to reduce differences in the lives of people, especially those living in rural areas, away from hospitals and thus deprived of quality and timely medical care with health information [3]. The main role of telemedicine is to provide rapid access to experienced health care professionals at a distance using telecommunications and information technologies, no matter where the patient is located.

Fig: How Telemedicine Technology Works

1.2 Background and Present State of the Problem

The total population of Bangladesh is over 160 million and 70% people live in the rural areas. In the last decade, child mortality and maternal death have reduced; immunization coverage and life expectancy of citizens have also increased significantly due to substantial improvement in health care and management system [1]. However, most known doctors and hospitals are in divisional town or capital due to economic inequality, geographic location, transportation system etc - as a result large, there is a gap of health care facilities in rural and urban areas and large portion of the people in rural areas are deprived from the modern health care facilities [2]. To overcome this disparity telemedicine can play a vital role to improve the quality and access to health care service delivery to underserved communities with reduced cost and minimum resources [3-4]. Telemedicine deliver health care services between geographically separated locations using the information and communication technology (ICT) and physicians or specialists can provide diagnosis, treatment and consultation to patients at a remote site at low cost [5]. Telemedicine system may be implemented in 3-ways: store and forward, teleconferencing

and videoconferencing. In 1999, Swifine Charitable of UK started telemedicine in Bangladesh and since then many projects and initiatives on telemedicine are taken by government, non government and private sector [6-9]. Advancement in sensor network and ICT are making remote monitoring an actuality, contributing to a level of care that is unprecedented. In this project, an attempt is made to develop a web based telemedicine system for delivering health care services to the rural communities through videoconferencing.

1.3 Objectives with Specific Aims

The main goal of this project is to develop a generalized telemedicine web based application through videoconferencing which is cost effective in terms of implementation. The specific objectives of this project are:

- ✓ To design and develop a web based telemedicine for rural communities.
- ✓ To maintain a database of doctors, specialists, health professionals and patients.
- ✓ To prepare and maintain schedule of appointment of doctors and patients.

1.3.1 Possible Outcome

The developed web based telemedicine system is a prototype and may be used commercially after further enhancement.

1.4 Outline of Methodology/Experimental Design

Telemedicine is not just using simple communication technology to connect patient with provider, but it is a complex interaction between technology, clinical practitioners, organizational management and human factors. The system provides a complete doctor-patient consultation system through videoconferencing as predefined schedule. The following steps have been followed to develop the system:

i. A high level entity-relationship (E-R) model has been established and E-R model relational tables is created.

ii. Various input-output forms/graphical user interface has been designed and developed using PHP and MySQL RDBMS and Tokbox (OpenTok) video conferencing software has been used for videoconference system.

iii. The system has been populated with sufficient sample data for testing and validation.

1.5 Organization of the Project Report

Chapter 1: Introduction: The project documentation starts with the introduction of the Telemedicine background and present state of the problem. This section also describes the object and aim of the project.

Chapter 2: Telemedicine and its Scope: In this chapter, the detailed about Telemedicine and Telehealth described in details. Also brief some prescribing issues with application and benefit of Telemedicine technology.

Chapter 3: System Analysis and Design: In this chapter, the detailed description of the System analysis along with my developed system architecture provided. E-R diagram, relational database and data dictionary included in this chapter.

Chapter 4: Implementation and Testing: In this chapter, the detailed of the developed system has been provided. All modules screenshot and details has been added and also mentioned the difference between traditional video conferencing systems with developed system.

Chapter 5: Conclusion and Future Scope: Finally conclusion on the project and recommendations for the future is made.

Chapter 2

Telemedicine and its Scope

2.1 What are Telemedicine and Telehealth?

Telemedicine is a part of Medicare that provided by technology to remote areas. Medicare, state Medicaid programs and technology advocates have used two terms, sometimes interchangeably, to describe the use of technology to provide health care services – telemedicine and telehealth. Each program or definition identifies the scope of services, the types of technologies and the locations where patients can receive telehealth services [10]. Basically, "telemedicine" has been used to describe a narrower range of health care services, while the term "telehealth" has been used to refer to a broader scope of health care support, including non-clinical services such as training and education that are provided at a remote area.

2.1.1 What is Telemedicine?

Telemedicine as the use of medical information interchange from one site to another via electronic communications to improve a patient's clinical health status. Telemedicine includes a growing variety of applications and services support using two-way video, smart phones, wireless tools and other forms of telecommunications technology. Starting over forty years ago with demonstrations of hospitals extending care to patients in remote areas, the use of telemedicine has spread rapidly and is now becoming integrated into the ongoing operations of hospitals and clinic, specialty health care departments, home health agencies, private physician offices, as well as consumer's homes and workplaces [10].

Telemedicine is not a separate medical sector. Products and services related to telemedicine are often part of a larger investment by health care technology institutions in either information technology or the delivery of clinical health care. Even in the settlement fee structure, there is usually no distinction made between services provided on site and those provided through telemedicine and

often no separate coding required for billing of remote services, particularly in rural areas. Telemedicine and telehealth to be interchangeable terms, encompassing a wide definition of remote healthcare [4]. Patient consultations via video conferencing, transmission of still images, e-health including patient portals, remote monitoring of vital signs, continuing medical education, consumer-focused wireless applications and nursing call centers, among other applications, are all considered part of telemedicine and telehealth.

2.1.2 What is Telehealth?

Telehealth is the use of technologies to deliver health care, health education, and public health services by connecting multiple users in separate locations. Telehealth encompasses a broad definition of technology-enabled health care services. Telehealth includes telemedicine and services such as assessment, monitoring, communications, avoidance and education. It involves a global range of telecommunications, health information, videoconferencing, and digital image technologies [11].

The term telehealth is occasionally used to refer to a broader definition of remote healthcare that does not always involve clinical services, the terms in the same way one would refer to medicine or health in the common language. Telemedicine is closely allied with the term health information technology. However, health information technology more commonly refers to electronic medical records and related information systems while telemedicine refers to the actual delivery of remote clinical services using technology support.

2.2 The Dynamics of Telemedicine

Telemedicine services are currently delivered in three major ways:

- ✓ Video conferencing, which is used for real-time patient-provider consultations, provider-to provider discussions, and language translation services via a system.
- ✓ Remote patient monitoring, in which electronic devices transmit patient health information to health care supports.
- ✓ Save & forward technologies, which electronically transmit pre-recorded videos and digital images, such as X-rays, video clips and photos, between primary care providers and medical specialists.

Telemedicine can also be delivered in a similar manner and includes a broad range of activities, such as classes, patient portals and online discussion forums for patients, and training programs for all levels of health professionals. These services can be live interactive multimedia with multiple users communicating in real time, or pre-recorded on-demand video streaming support that can be downloaded to computers or devices [12].

Telemedicine technologies can be transmitted a number of different ways.

These include:

- ✓ Encrypted Internet connections.
- ✓ Major broadband networks. These networks deliver secure, private data transmission, explicit quality of service, and prioritization of emergency medical communications. They allow all network users to connect with each other, and to connect with non-network users via the public Internet. These networks involve large numbers of users, and can be easily expanded to accommodate new users.
- ✓ High-speed telecommunications lines, which allow dedicated secure connections to other sites with similar connectivity.
- ✓ Private point-to-point broadband connections, which provide secure transmissions, but unlike broadband networks, connect specific facilities to one another.
- ✓ Patient monitoring centers, which receive transmissions from at-home and other remote measurement devices.
- ✓ Single-line telephone and video lines, which connect providers with patients at home.
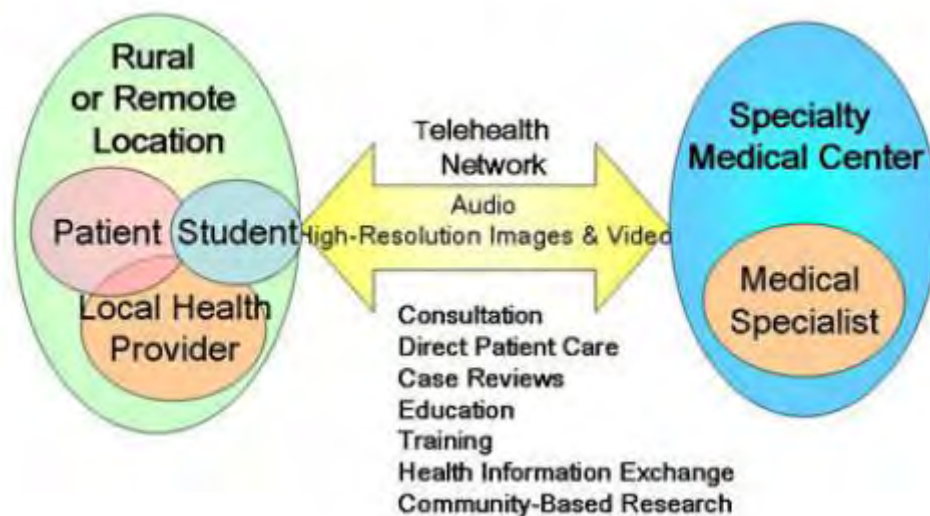

Fig: Telehealth Network

2.3 What Services can be provided by Telemedicine?

Telemedicine is best understood in terms of the services and supports provided and the mechanisms used to provide those services [12]. Here are some examples. Keep in mind that this list grows annually:

- ✓ Primary care and specialist referral services may involve a primary care or allied health professional providing a consultation with a patient or a specialist assisting the primary care physician in rendering a diagnosis. This may involve the use of live interactive video or the use of store and forward transmission of diagnostic images, vital signs and/or video clips along with patient data for later review.
- ✓ Remote patient monitoring, including home telehealth, uses devices to remotely collect and send data to a home health agency or a remote diagnostic testing facility (RDTF) for interpretation. Such applications might include a specific vital sign, such as blood glucose or heart ECG or a variety of indicators for homebound patients. Such services can be used to supplement the use of visiting nurses.
- ✓ Consumer medical and health information includes the use of the Internet and wireless devices for consumers to obtain specialized health information and online discussion groups to provide peer-to-peer support.
- ✓ Medical education provides continuing medical education credits for health professionals and special medical education seminars for targeted groups in remote locations.

2.4 Prescribing Issues Related to Telemedicine

Telemedicine encounters happen when the patient and provider are in two different locations, basically in remote areas. The provider is not physically there with the patient and they may never come into physical contact with each other [13].

A growing area of concern is the use of the Internet to provide diagnostic treatment services (including prescribing of medications) to patients, in that way increasing the likelihood of a physical encounter never taking place, as in the more conventional patient-provider relationship.

For a prescription to be valid, it must be issued for a justifiable medical function in the usual course of professional practice, meaning that, with limited

exceptions, a doctor must conduct at least one medical evaluation of the patient in person or via telemedicine.

The practice of telemedicine is defined as the practice of medicine by a practitioner who is at a location remote from the patient and is communicating with the patient or health professional treating the patient via a telecommunication system so long as the patient "is being treated by, and physically located in, a hospital or clinic" or "while the patient is being treated by, and in the physical presence of, a practitioner."

2.5 Applications of Telemedicine

There are several applications of telemedicine technology. We can share medical resources to others that could be useful for us. Doctor can monitor medical prescription by this telemedicine technology. The system is cost effective too [8].

2.5.1 Sharing of Medical Resources via Linking

In some areas countries due to the lack of transportation, medical services and many patients will be suffering from diseases even when they can be easily treated. To tackle these types of problems telemedicine network connections established form base hospital to the particular urban or rural areas where patient is residing. Patient will be benefited. To establish these medical delivery, in some hospitals residents can also be trained efficiently.

2.5.2 Monitoring, Diagnosis of Disease and Management

Diabetic retinopathy, neuro ophthalmology and cataracts can be diagnosed and managed through telemedicine in the form of taking digital images and transferred to ophthalmologist via connecting of medical devices.

2.5.3 Research and Clinical Trial Using Telemedicine

The research and study may be most of the time multicentric. In Children and aging patients may not be able to come at exact date to the base hospital. They

can be reviewed in the vision centers/community Cost Effective Tele-Ophthalmology with Special Reference to Telemedicine in Rural Areas centers which will be nearby to their houses. With telemedicine medical institutions cost will be less. i.e., no need to base the transportation charges and, reviews for patients will save time also. In these cases both patients and researcher will be benefited. The eyes digital image will be transferred through mail using store and forward telemedicine.

2.5.4 Telemedicine in Continuing Education and Distance Learning

Telemedicine also helps in distance learning and continuing education. Expertise from other state or country can also deliver their talk via telemedicine. It may save time and will be a real time communication transfer. Medical information available in one site can be stored digitally on a computer, and transmitted to another location where may be stored again for review. E-Mail is a store and forward system.

2.5.5 Cost Effectiveness of Telemedicine

In telemedicine, telemedicine equipments computers, installation of hardware and software are difficult. Have to maintain separate system and server for transmitting data. Computers should have the maximum configurations like IBM- compatible or Macintosh any suitable system will be needed. It should have a maximum image resolution and speed of transfer, because while sending large images it should not hang. If user have systems with higher configurations then developed system can easily transfer the data's, images via networks.

Telemedicine technology is an effective solution for providing specialty healthcare sector in the form of improved access and reduced cost of the rural patients and the reduced professing isolation of the rural doctors, ageing populations need more medical case demanding, it can be provided to everybody at a reasonable cost, It will reduce time, travels expenses and confirmation of diagnosis (ie., second opinion) data security is one of the important constraint. Even we can use inexpensive instruments instead of using very expensive instrument.

2.6 Benefits of Telemedicine

Telemedicine improves support for patients and families. Patients can stay in their local communities and, when hospitalized away from home, can keep in contact with family and friends. Telemedicine technology is used in applications like screening, diagnosis and distance learning for health care etc., Can be performed in real-time using store and forward and technology [13]. Patients those who are not able to spent money for their health, there is no accompany while going to the hospital, aged patients will be benefited through this. When compared the cost effectiveness, screening in Vision centers/community centre visit is benefited instead of going to base hospitals. Particularly it is widely used in primary care where are distances to a doctor can be significant obstacle to satisfactory diagnosis and treatment. In India exciting new technology like this will help to rural and urban people in the form of quality medical services. Telemedicine technology is best fitted for rural areas.

Chapter 3

System Analysis and Design

3.1 System Analysis

System analysis is part of software development procedure. The development of a computer-based information system includes a system analysis phase. This helps produce the data model, a precursor to creating or enhancing a database [14]. There are a number of different approaches to system analysis. When a computer-based information system is developed, system analysis (according to the Waterfall model) would constitute the following steps:

- ✓ The development of a feasibility study: determining whether a project is economically, socially, technologically and organizationally feasible
- ✓ Fact-finding measures, designed to ascertain the requirements of the system's end-users (typically involving interviews, questionnaires, or visual observations of work on the existing system)
- ✓ Gauging how the end-users would operate the system (in terms of general experience in using computer hardware or software), what the system would be used for and so on

Another view outlines a phased approach to the process. This approach breaks system analysis into 5 phases:

- ✓ Scope Definition: denoting an instrument for observing, viewing, or examining
- ✓ Problem analysis: analyzing the problem that arises
- ✓ Requirements analysis: determining the conditions that need to be met
- ✓ Logical design: looking at the logical relationship among the objects
- ✓ Decision analysis: making a final decision

System analysis is important in that it provides an avenue for solutions in the system through the various tasks involved in doing the analysis. Through these various tasks, the overall quality of a system can be easily modified or improved and occurrences of errors can ultimately be reduced.

3.2 The Systems Development Life Cycle (SDLC)

The Systems Development Life Cycle (SDLC) is a conceptual model used in project management that describes the stages involved in an information system development project from an initial feasibility study through maintenance of the completed application. It is used by a system analyst to develop an information system, including requirements, validation, training, and user ownership through investigation, analysis, design, implementation, and maintenance [15]. SDLC is also known as information systems development or application development. An SDLC should result in a high quality system that meets or exceeds customer expectations, within time and cost estimates, works effectively and efficiently in the current and planned information technology infrastructure, and is cheap to maintain and cost-effective to enhance. SDLC is a systematic approach to problem solving and is composed of several phases, each comprising multiple steps.
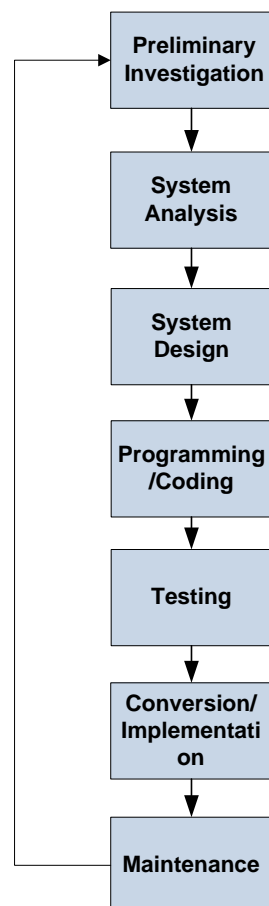
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Fig: Different Phase of SDLC

3.2.1 Step One: Needs Analysis & Environmental Analysis

It is costly, time consuming and challenging to start a telemedicine program even though it may sound easy. Organizations that perform a formal assessment of readiness have the advantage of identifying potential problems and addressing them early. They also gain a lot of support for the project by engaging people early.

3.2.2 Step Two: Define Services, Program Model and Technology Models

Research should be done prior to program model development, pertaining to the technological capabilities and costs of acquiring and maintaining the resources. Developer could face problems when resources that do not allow for optimal technology and the program is reduced or implemented at lower quality as a result. What elements can be sacrificed if necessary? Prioritize components of the program by essential, would be helpful, and not necessary.

3.2.3 Step Three: Business Model Development

Costs, benefits, risks and opportunities need to be identified analyzed and consolidated into a comprehensive business case report as part of program development efforts.

3.2.4 Step Four: Development of Detailed Implementation Plan

Create a detailed programmatic and technical implementation plan. The most successful telehealth programs come as a result of careful and detailed planning and the deployment of well-considered, integrated and streamlined technologies.

3.2.5 Step Five: Development of Performance Monitoring Plan

Build systems into program to measure and analyze program performance. In the planning stage, determine assessment methods and evaluation and strategies, and build a plan to create routine and regular performance monitoring. Consider the need for formal evaluation of clinical services and operational or cost impacts.

3.2.6 Step Six: Program Implementation

The designated telehealth room should be user friendly, well equipped with reliable and appropriate technology, be comfortable for patients and apply basic principles of room design for video conferencing applications.

3.2.7 Step Seven: Monitor and Improve

After assessing the initial performance of the program, taking into account service utilization, provider and patient satisfaction and other key factors, then begin to implement the QI process going to be developed during the planning process.

3.3 Developed System

The develop system is an independent system that can be used by anyone. It's completely platform free. That means user does not need to install any software into the system. A browser is enough to run the system. But, one thing have to ensure, though the system has video conference feature, that means workstation should have better internet connection and updated browser.

Tools and Languages:-

- ✓ PHP: CakePHP framework (for functionalities of database to frontend)
- ✓ Javascript: jQuery library (for video module)
- ✓ HTML and CSS
- ✓ MySQL: Relational database management system
- ✓ OpenTok video conference library

3.3.1 PHP: CakePHP Framework

PHP (recursive acronym for PHP: Hypertext Preprocessor) is a widely-used open source general-purpose scripting language that is especially suited for web development and can be embedded into HTML.

Instead of lots of commands to output HTML (as seen in C or Perl), PHP pages contain HTML with embedded code that does "something" (in this case, output "Hi, I'm a PHP script!"). The PHP code is enclosed in special start and end processing instructions <?php and ?> that allow developer to jump into and out of "PHP mode."

PHP and related information are available in this address http://php.net/.

CakePHP makes building web applications simpler, faster, while requiring less code. A modern PHP 7 framework offering a flexible database access layer and a powerful scaffolding system that makes building both small and complex systems simpler, easier and, of course, tastier. Build fast, grow solid with CakePHP.

- ✓ Build Quickly: Use code generation and scaffolding features to rapidly build prototypes.
- ✓ No Configuration: No complicated XML or YAML files. Just setup the database and it's ready to bake.
- ✓ Friendly License: CakePHP is licensed under the MIT license which makes it perfect for use in Commercial applications.
- ✓ Batteries Included: The things developer needs are built-in. Translations, database access, caching, validation, authentication, and much more are all built into one of the original PHP MVC frameworks.
- ✓ Clean MVC Conventions: Instead of having to plan where things go, CakePHP comes with a set of conventions to guide the developers in developing the application
- ✓ Secure: CakePHP comes with built-in tools for input validation, CSRF protection, Form tampering protection, SQL injection prevention, and XSS prevention. CakePHP codebase itself has been audited through the Mozilla Secure Open Source program.

CakePHP and related information are available in this address https://cakephp.org/.

3.3.2 Javascript: jQuery Library

JavaScript is a scripting or programming language that allows to implement complex things on web pages — every time a web page does more than just sit there and display static information to look at — displaying timely content updates, interactive maps, animated 2D/3D graphics, scrolling video jukeboxes, etc. — developer can bet that JavaScript is probably involved. It is the third layer of the layer cake of standard web technologies, two of which (HTML and CSS) we have covered in much more detail in other parts of the Learning Area.

JavaScript is a scripting language that enables to create dynamically updating content, control multimedia, animate images, and pretty much everything else. (Okay, not everything, but it is amazing what can achieve with a few lines of JavaScript code.)

All latest news and community information are available at this address https://www.javascript.com/.

jQuery is a fast, small, and feature-rich JavaScript library. It makes things like HTML document traversal and manipulation, event handling, animation, and Ajax much simpler with an easy-to-use API that works across a multitude of browsers. With a combination of versatility and extensibility, jQuery has changed the way that millions of people write JavaScript.

jQuery and related information are available in this address https://jquery.com/.

3.3.3 HTML and CSS

HTML is the markup language that we use to structure and give meaning to our web content, for example defining paragraphs, headings, and data tables, or embedding images and videos in the page.

CSS is a language of style rules that we use to apply styling to our HTML content, for example setting background colors and fonts, and laying out our content in multiple columns.

Community news about HTML and CSS are available at this address https://www.w3.org/standards/webdesign/htmlcss.

3.3.4 MySQL: Relational Database Management System

A database management system (DBMS) is system software for creating and managing databases. The DBMS provides users and programmers with a systematic way to create, retrieve, update and manage data.

A DBMS makes it possible for end users to create, read, update and delete data in a database. The DBMS essentially serves as an interface between the database and end users or application programs, ensuring that data is consistently organized and remains easily accessible.

The DBMS manages three important things: the data, the database engine that allows data to be accessed, locked and modified -- and the database schema, which defines the database's logical structure. These three foundational elements help provide concurrency, security, data integrity and uniform administration procedures. Typical database administration tasks supported by the DBMS include change management, performance monitoring/tuning and backup and recovery. Many database management systems are also responsible for automated rollbacks, restarts and recovery as well as the logging and auditing of activity.

MySQL, the most popular Open Source SQL database management system, is developed, distributed, and supported by Oracle Corporation.

The MySQL website (http://www.mysql.com/) provides the latest information about MySQL software.

- ✓ MySQL is a database management system: A database is a structured collection of data. It may be anything from a simple shopping list to a picture gallery or the vast amounts of information in a corporate network. To add, access, and process data stored in a computer database, developers need a database management system such as MySQL Server. Since computers are very good at handling large amounts of data, database management systems play a central role in computing, as standalone utilities, or as parts of other applications.
- ✓ MySQL databases are relational: A relational database stores data in separate tables rather than putting all the data in one big storeroom. The database structures are organized into physical files optimized for speed. The logical model, with objects such as databases, tables, views, rows, and columns, offers a flexible programming environment. Developers set up rules governing the relationships between different data fields, such as one-to-one, one-to-many, unique, required or optional, and "pointers" between different tables. The database enforces these rules,

so that with a well-designed database, the application never sees inconsistent, duplicate, orphan, out-of-date, or missing data. The SQL part of "MySQL" stands for "Structured Query Language". SQL is the most common standardized language used to access databases.

- ✓ MySQL software is Open Source: Open Source means that it is possible for anyone to use and modify the software. Anybody can download the MySQL software from the Internet and use it without paying anything..
- ✓ MySQL Server works in client/server or embedded systems: The MySQL Database Software is a client/server system that consists of a multi-threaded SQL server that supports different back ends, several different client programs and libraries, administrative tools, and a wide range of application programming interfaces (APIs).

MySQL RDBMS and related information are available in this address https://www.mysql.com/.

3.3.5 OpenTok Video Conference Library

OpenTok is a WebRTC Platform for Video, Voice and Messaging from TokBox. Tokbox a company that provides support of OpenTok. We use this libray into our system to provide video conference system between doctor and patients.

Tokbox web address is https://tokbox.com/.

3.3.5.1 Overview

TokBox enables organizations to easily embed live video, voice and messaging directly into web and mobile apps. Healthcare providers & fitness organizations can now offer their patients, clients and users a superior experience online through real-time communications. Whether for a doctor to share results with a patient or for specialists to collaborate over online medical records, users can get the help or advice that they need, anytime, anywhere.

Fig: OpenTok Overview

The OpenTok platform makes it easy to embed real-time, high-quality interactive video, messaging, screen-sharing, and more into web and mobile apps. The platform includes client libraries for web, iOS, Android, and Windows, as well as server-side SDKs and a REST API. OpenTok uses WebRTC for audio-video communications.

The OpenTok platform has client libraries for JavaScript, iOS, and Android. For requirements on specific clients, see the following:

3.3.5.2 Bandwidth Requirements

- ✓ Video: 300 kbps per stream (recommended lowest level)
- ✓ Audio: 50 kbps per stream (recommended lowest level)

3.3.5.3 Video Specifications

- ✓ Video resolutions — browsers:
  - o 1280 x 720
  - o 640 x 480
  - o 320 x 240
- ✓ Video resolutions — mobile (iOS/Android):
  - o Customizable
- ✓ VP8 video format (the WebRTC standard)

3.3.5.4 Additional Recommendations

- ✓ Headsets with microphone for improved sound quality and privacy
- ✓ USB echo-canceling speakers for meeting room environments

3.4 E-R Diagram of Our System
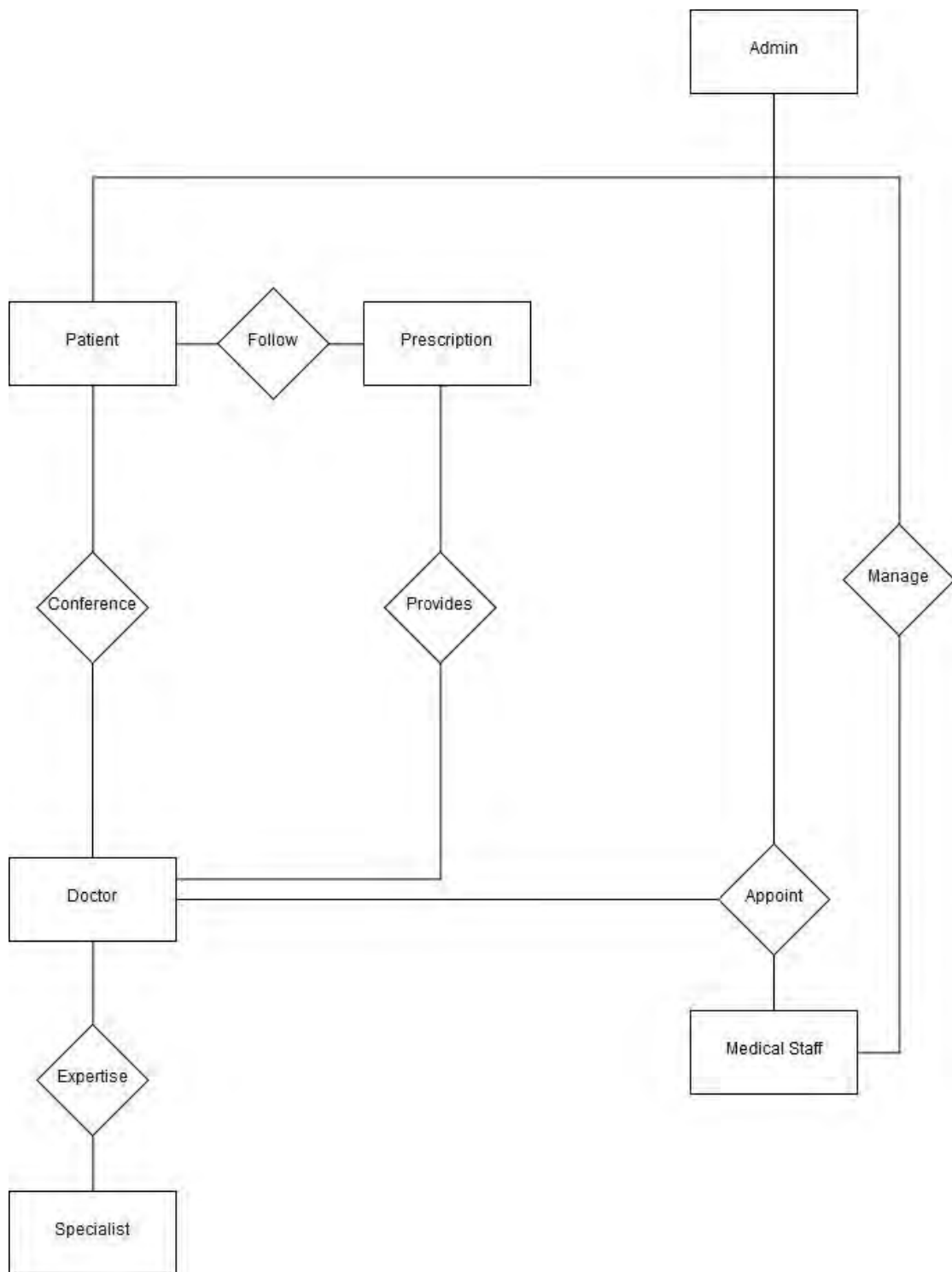
Fig: E-R Diagram

3.5 Relational Database Design
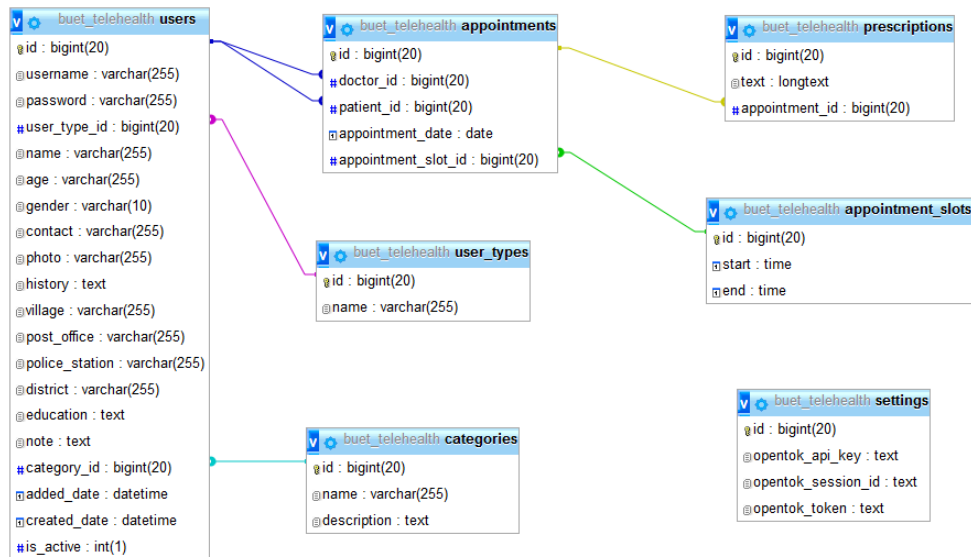
Fig: Relational Database Design

3.6 Data Dictionary

Table No: 01
Entity Name: Appointment
Table Name: appointments

Field Name	Type	Size	PK	FK	Not Null
id	BIGINT	20	+		+
doctor_id	BIGINT	20		+	+
patient_id	BIGINT	20		+	+
appointment_date	DATE	-			+
appointment_slot_id	BIGINT	20		+	+

Table No: 02
Entity Name: AppointmentSlot
Table Name: appointment_slots

Field Name	Type	Size	PK	FK	Not Null
id	BIGINT	20	+		+
start	TIME	20			+
end	TIME	20			+

Table No: 03
Entity Name: Category
Table Name: categories

Field Name	Type	Size	PK	FK	Not Null
id	Bigint	20	+		+
name	Varchar	255			+
description	Text	20			+

Table No: 04
Entity Name: Prescription
Table Name: prescriptions

Field Name	Type	Size	PK	FK	Not Null
id	BIGINT	20	+		+
text	LONGTEXT				+
appointment_id	BIGINT	20		+	+

Table No: 05
Entity Name: Setting
Table Name: settings

Field Name	Type	Size	PK	FK	Not Null
id	BIGINT	20	+		+
opentok_api_key	TEXT	-			+
opentok_session_id	TEXT	-			+
opentok_token	TEXT	-			+

Table No: 06
Entity Name: User
Table Name: users

Field Name	Type	Size	PK	FK	Not Null
id	BIGINT	20	+		+
username	VARCHAR	255			+
password	VARCHAR	255			+
user_type_id	BIGINT	20		+	+
name	VARCHAR	255			+
age	VARCHAR	255			+
gender	VARCHAR	255			+
contact	VARCHAR	255			+
photo	VARCHAR	255			+
history	TEXT				+
village	VARCHAR	255			+
post_office	VARCHAR	255			+
police_station	VARCHAR	255			+
district	VARCHAR	255			+
note	TEXT				+
category_id	BIGINT	20		+	+
added_date	DATETIME				+
created_date	DATETIME				+
is_active	INT	1			+

Table No: 07
Entity Name: UserType
Table Name: user_types

Field Name	Type	Size	PK	FK	Not Null
id	BIGINT	20	+		+
name	VARCHAR	255			+

Chapter 4

Implementation and Testing

4.1 Implementation

The system has been developed in local server. After complete testing it has been uploaded into an online server. Any user can browse the system by visiting this url http://telemedicinebd.com/.

The uploaded system has complete capabilities to handle all the functions that smoothly run into local system. Medical staff can login and manage all doctors, patients, appointments and system Settings. Doctor can login into their system and can check their appointments and prescriptions. Patient can also login into this system and check doctor's prescription and appointments of own. The system provides direct video conference system among doctors and patients.

4.2 All Module Description

Below the entire module briefly described with screenshots.

4.2.1 Login Module

Any user type, like medical staffs, doctors, patient can login into this system by providing username and password. This is the start screen page of my developed system. When any user visits the system, it will ask the credentials to use this system. This service is fully secured by password management system.

Fig: User Login Form

4.2.2 Medical Staff Admin Module

In this system medical staffs will act like admin of the system. They have full customizable interface integrated. Medical staff can manage all internal system, some of them are not accessible from doctor and patient panel.

4.2.2.1 Dashboard

Dashboard is displaying the summary of the statistics of this system. Medical staff can see number of doctors registered, number of patients' entry, number of appointment created and number of prescription provided in this system till now.
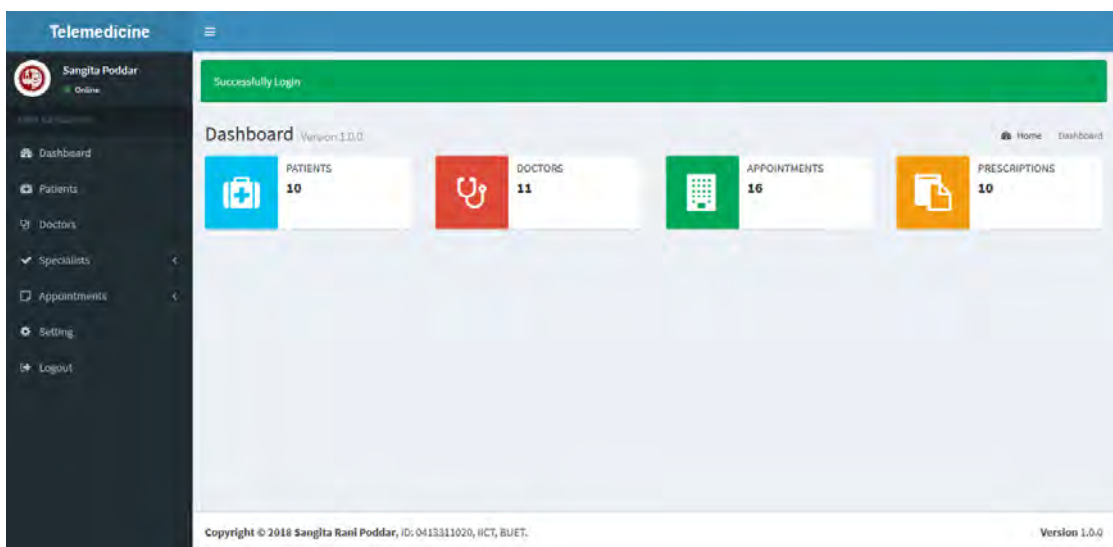
Fig: Dashboard of Medical Staff

4.2.2.2 Patient List

From left menu, by clicking on "Patient" link, medical staff can see all list of patient information entered into system. The list is showing name, patient id, age, gender and contact number in quick view.
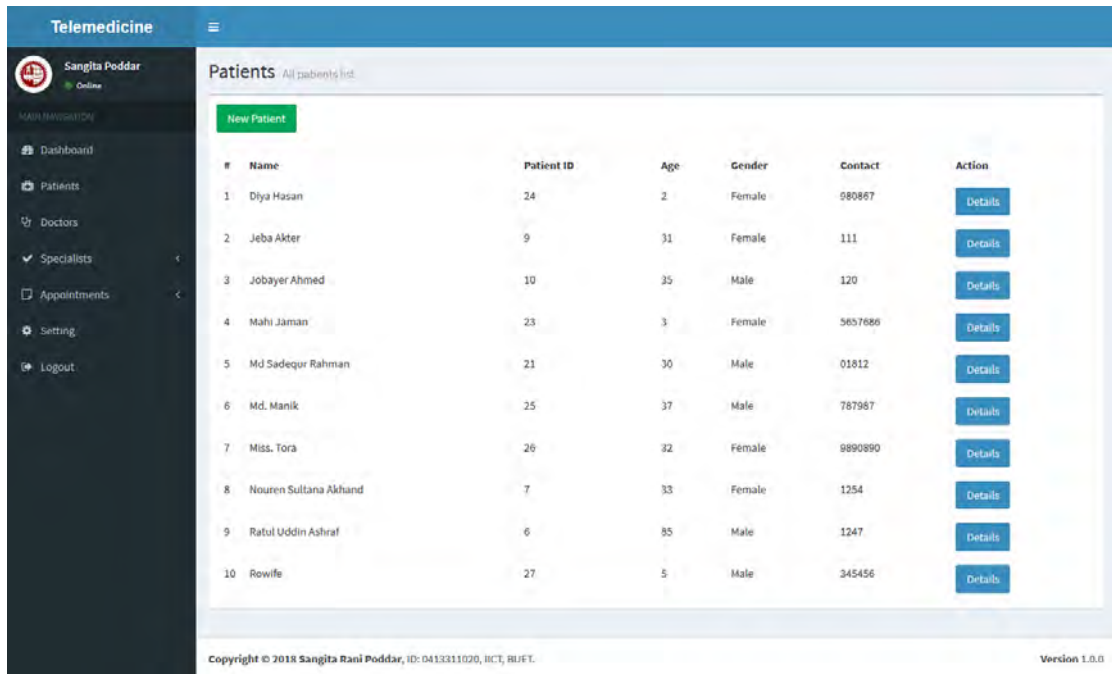
Fig: Patient List of Medical Staff View

4.2.2.3 New Patient

Medical staff can add new patient by clicking 'New Patient" button from patient list page. Staff will see add patient page, where he have to enter username, password, name, age, gender, history, contact number, photo, village, post office, police station and district of the patient. By clicking 'Add' button, medical staff can add new patient.
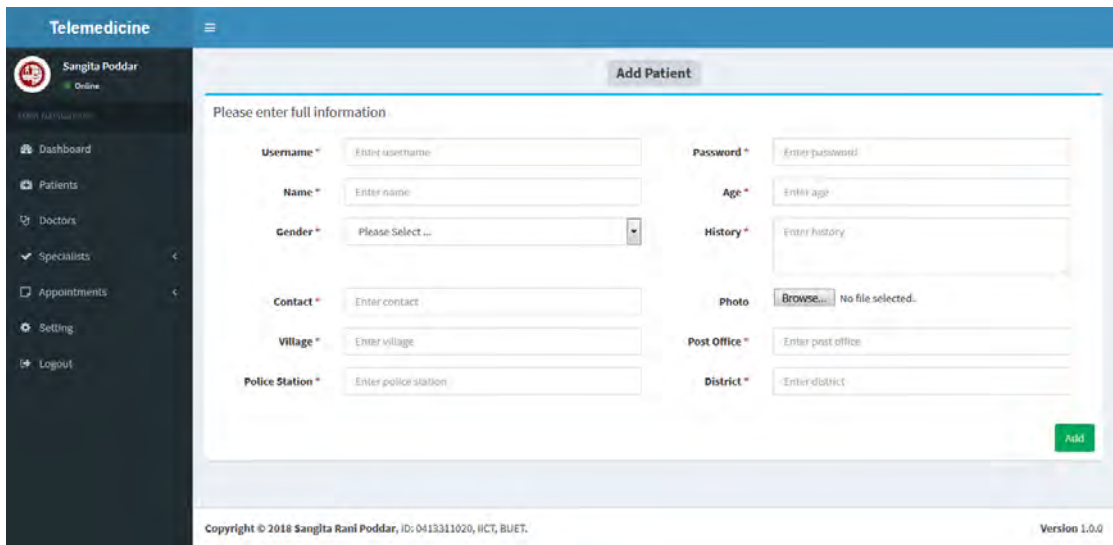
Fig: New Patient of Medical Staff View

4.2.2.4 Patient Details

From patient list page, medical staff can click 'Detail" button to see all information of a particular patient. In this page medical staff can see name, photo of the patient, patient id, username, age, gender, history, contact, village, post office, police station and district.
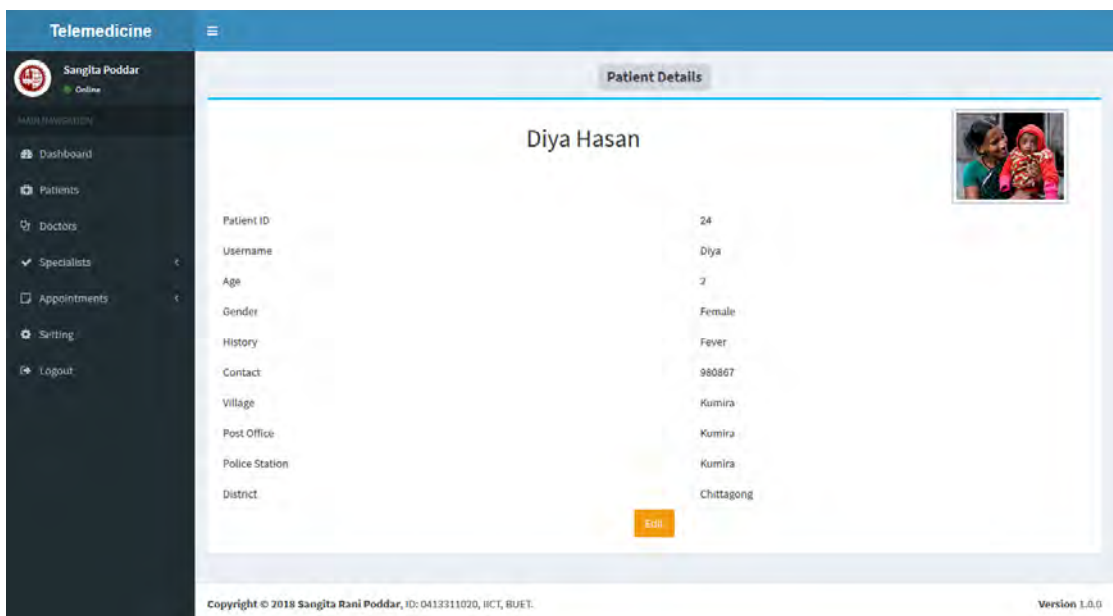
Fig: Patient Details of Medical Staff View

4.2.2.5 Patient Edit

From patient details page, medical staff can edit patient information by clicking "Edit" button. Edit patient information page contain, username, password, name, age, gender, history, contact, photo, village, post office, police station and district field to edit.
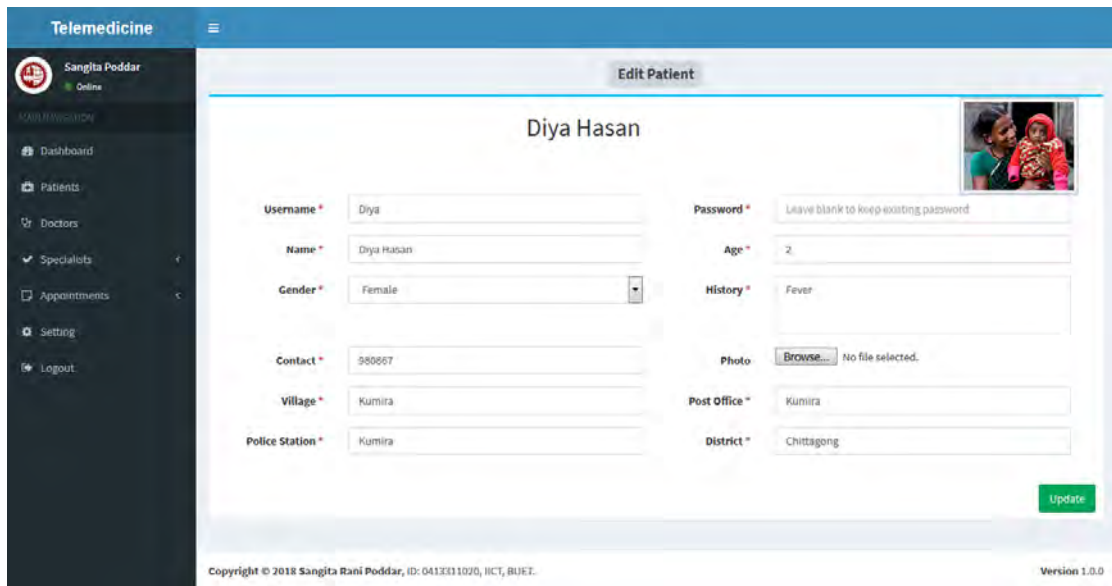
Fig: Patient Edit of Medical Staff View

4.2.2.6 Doctor List

By clicking on left menu "Doctors" link, medical staff can see all doctors list. This page is showing all registered doctors list in the system. In quick view the system is showing doctor name, doctor id, age, gender and education.

Fig: Doctor List of Medical Staff View

4.2.2.7 New Doctor

By clicking on "Add Doctor" button from doctor list page medical staff can register new doctor into the system. To add new doctor medical staff has to enter username, password, name, age, education, note, contact, photo, category and gender of the doctor. By clicking "Add" button medical staff can register new doctor.

Fig: New Doctor of Medical Staff View

4.2.2.8 Doctor Details

By clicking 'Details" button, medical staff can check full doctor details in separate page. In this page medical staff can see name of doctor, photo, doctor id, username, age, gender, note, contact, education and category of the doctor.
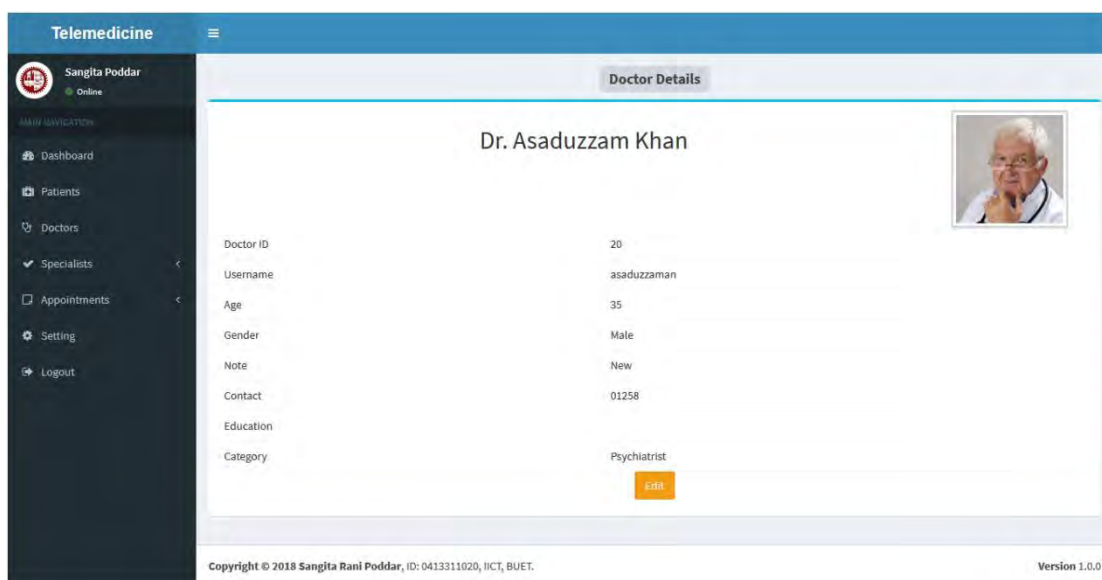
Fig: Doctor details of Medical Staff View

4.2.2.9 Doctor Edit

But clicking 'Edit" button, in doctor details page, medical staff can update information of the doctor. In that page medical staff can update username, password, name, age, education, note, contact, photo, category and gender of the doctor.
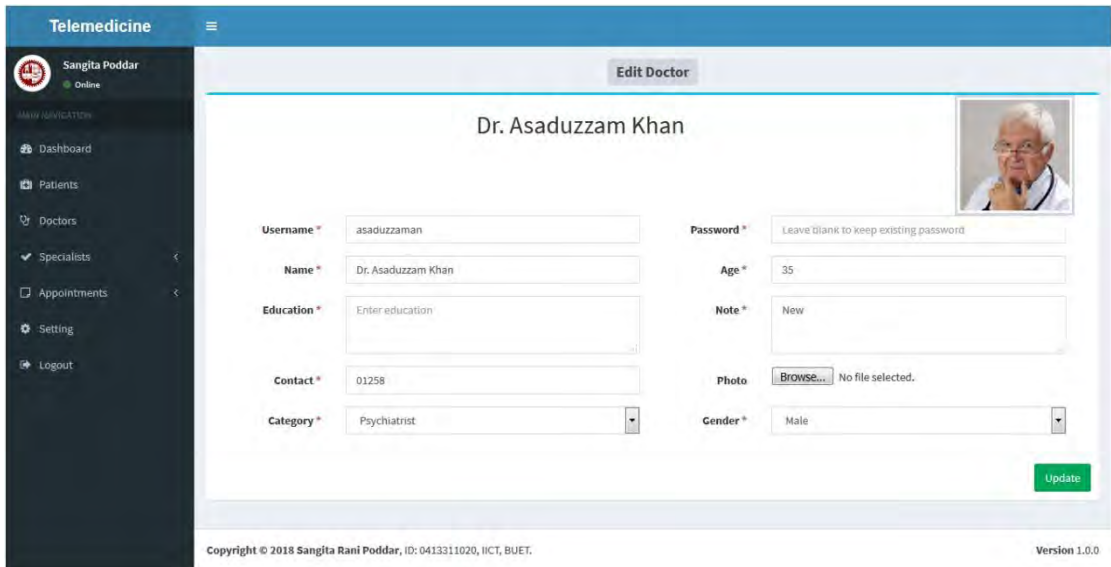
Fig: Doctor Edit of Medical Staff View

4.2.2.10 Specialist Category List

From left menu, medical staff can see all categories of specialists of doctors. By clicking 'Category" link under "Specialist" list will show all categories of the system. In quick view, medical staff can see category name and description.

Fig: Specialist Category List of Medical Staff View

4.2.2.11 New Specialist Category

From category list page, medical staff can add new category into the system. Medical staff should click on 'New Category" button to add new category. New category page contain name and description field to fill up.
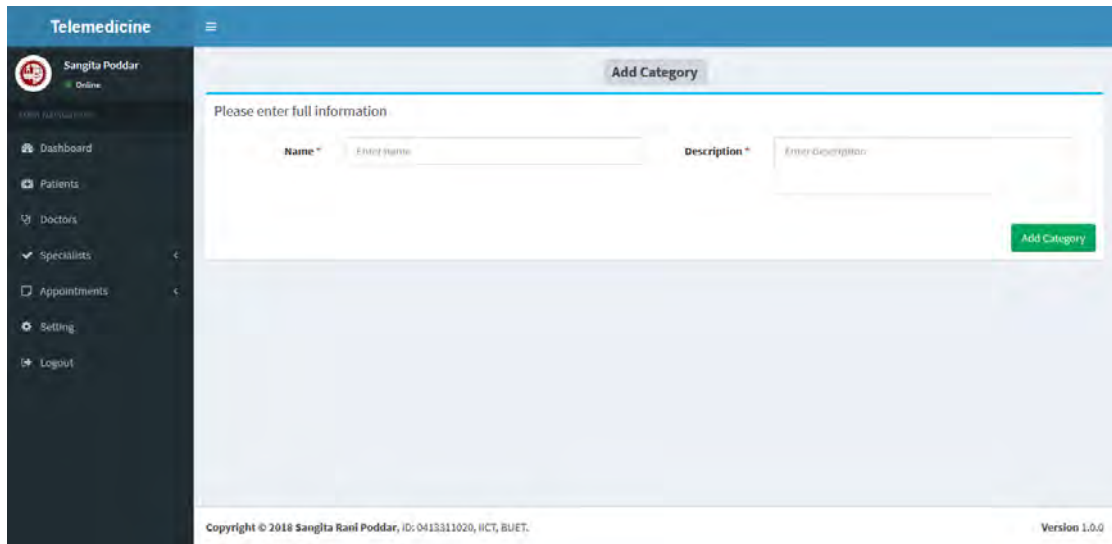
Fig: New Specialist Category of Medical Staff View

4.2.2.12 Specialist Category Edit

From category list page medical can edit category information. By clicking "Edit" button medical staff can update the information. The edit page contain name and description field.
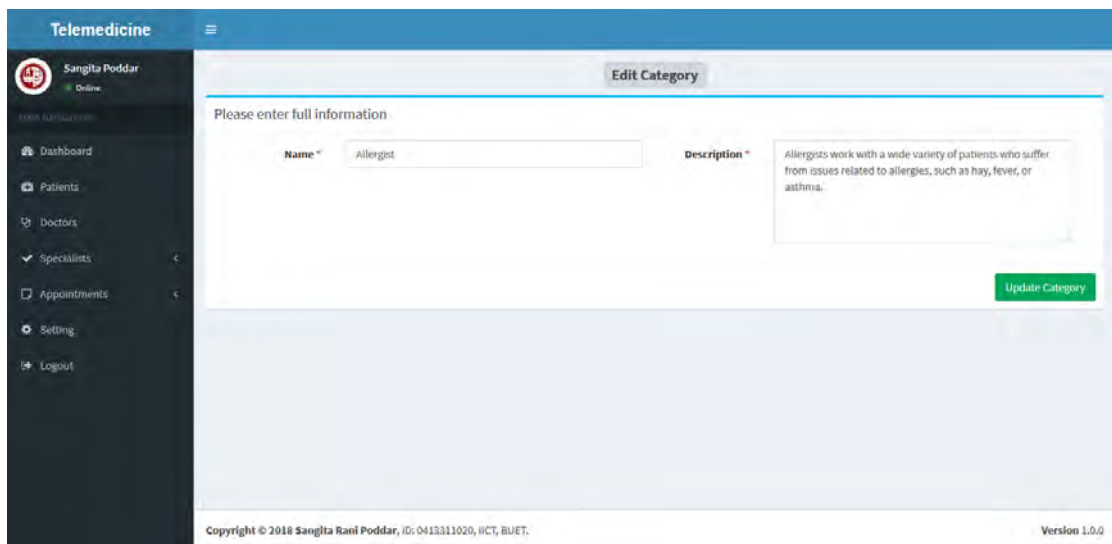
Fig: Specialist Category Edit of Medical Staff View

4.2.2.13 Doctor Appointment List

Medical staff sees and add appointment into the system. Medical have to click on "Appointments" link on left menu. After clicking the menu medical staff will see list of doctors with name, specialist and gender information.
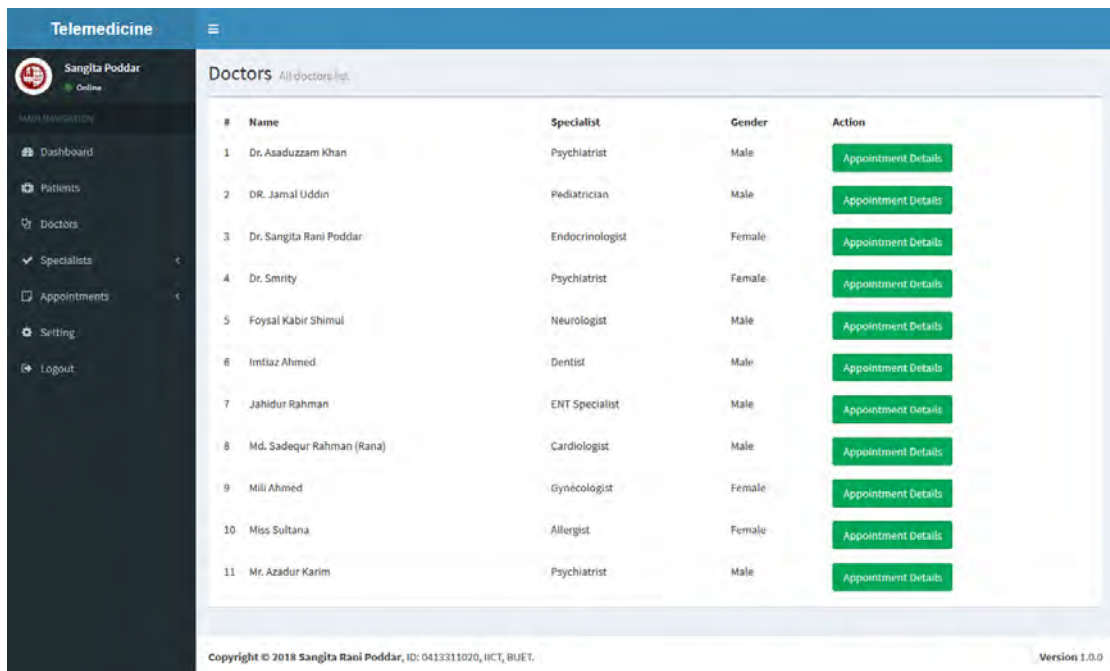
Fig: Doctor Appointment List of Medical Staff View

4.2.2.14 Doctor Appointment Details

Medical staff can create new appointment from appointment list page. Staff has to click on "Appointment Details' button of particular doctor. In new page list of upcoming thirty days will be displayed.

Fig: Doctor Appointment Details of Medical Staff View

4.2.2.15 New Appointment

From appointment details page medical staff can create new appointment for patient. Staff has to click on "New appointment" button beside date. A new page will be displayed. In that page medical staff will choose time slot and click on "Select Patient" button. A modal box will open, that contains patient list. Medical staff will select the patient name and click "Add" button. A confirmation message will confirm the appointment.
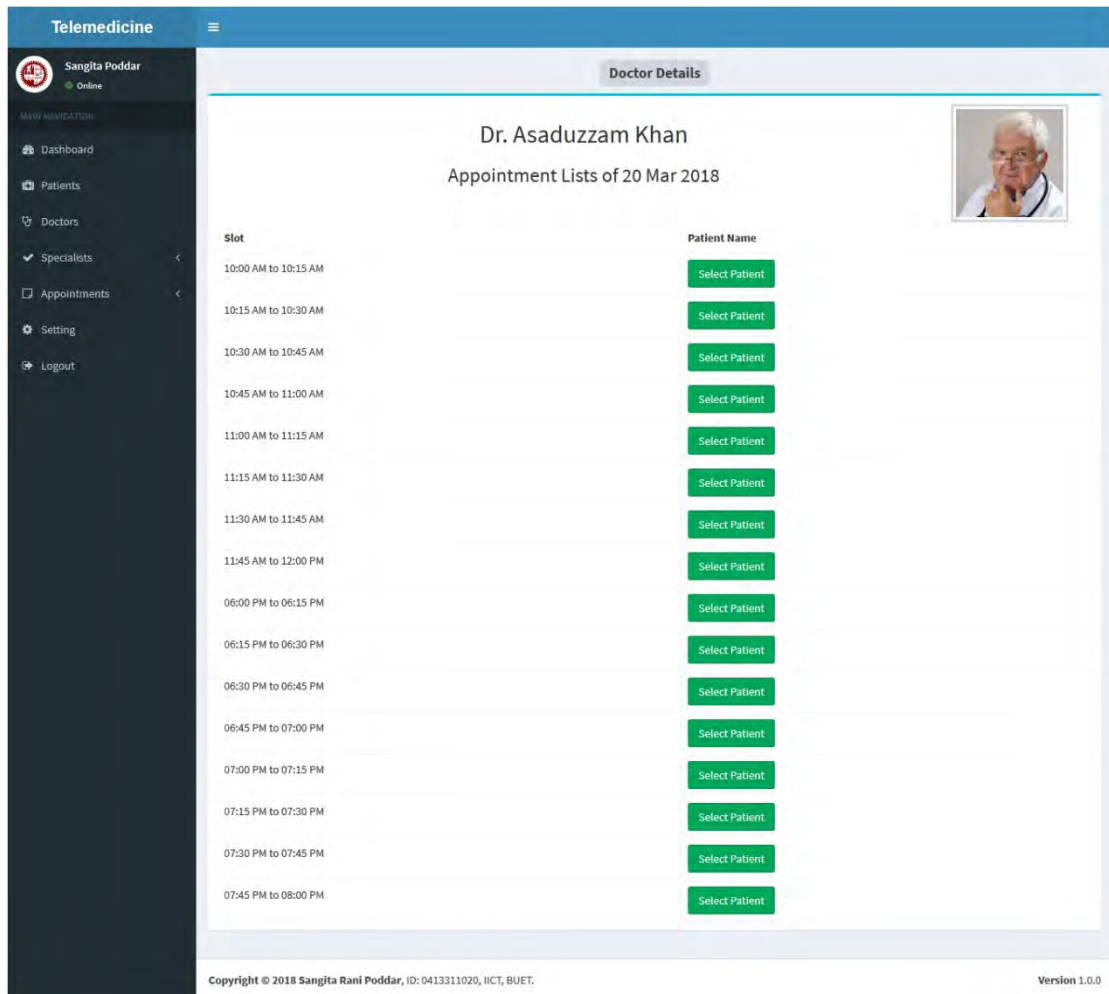
Fig: New Appointment of Medical Staff View

4.2.2.16 Settings

Medical staff can update core settings of the system. The system using OpenTok video service. To use this registration in OpenTok site is must and get API Key, Session ID and Token. The information can expire. So, medical staff should update the information in this page.
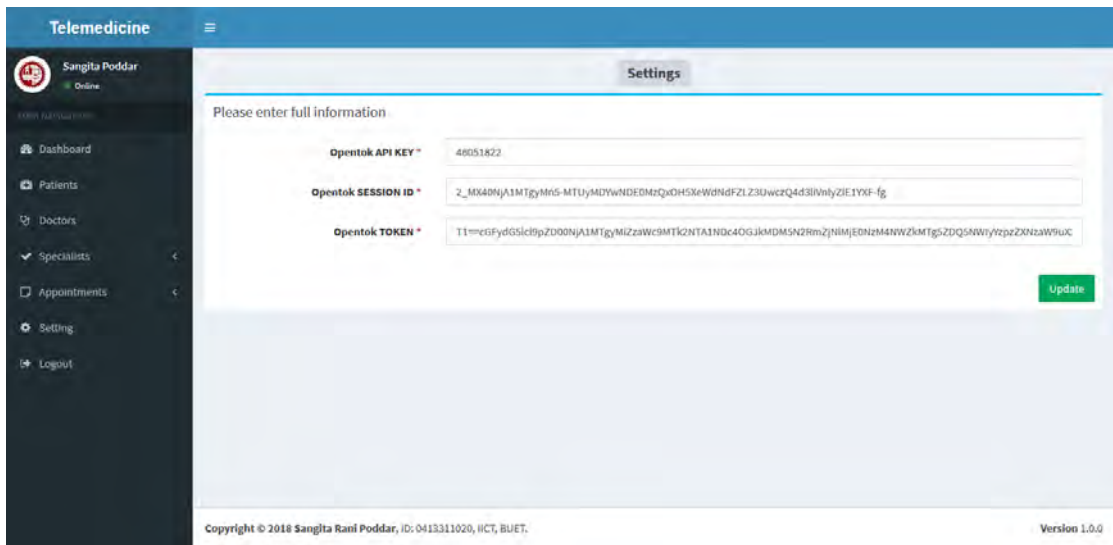
Fig: Settings of Medical Staff View

4.2.3 Doctor Module

In this system, doctors can login. Doctor can login and check his profile. Doctor can also check appointments and prescription of her patient.

4.2.3.1 Dashboard

After login doctor will see dashboard that contain information of the logged in doctor. This page will display doctor name, photo, doctor id, username, age gender, note, contact and category.
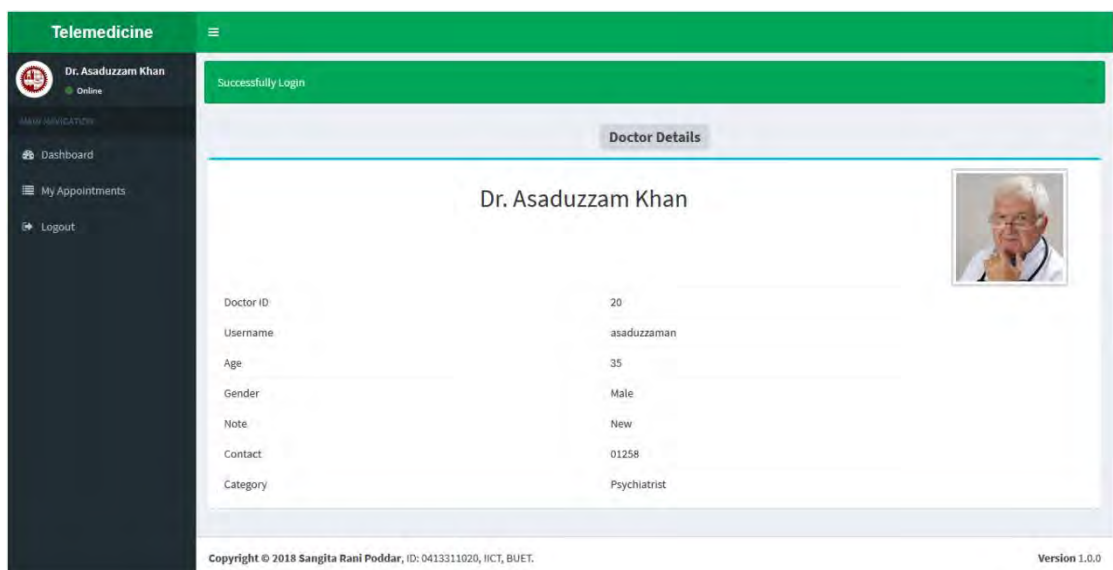
Fig: Dashboard of Doctor View

4.2.3.2 My Appointments

By clicking on "My Appointments" link doctor can see all appointments of him. By clicking "View Prescription" button he can see the prescription he provides to patient. This page contains date, time and patient name.
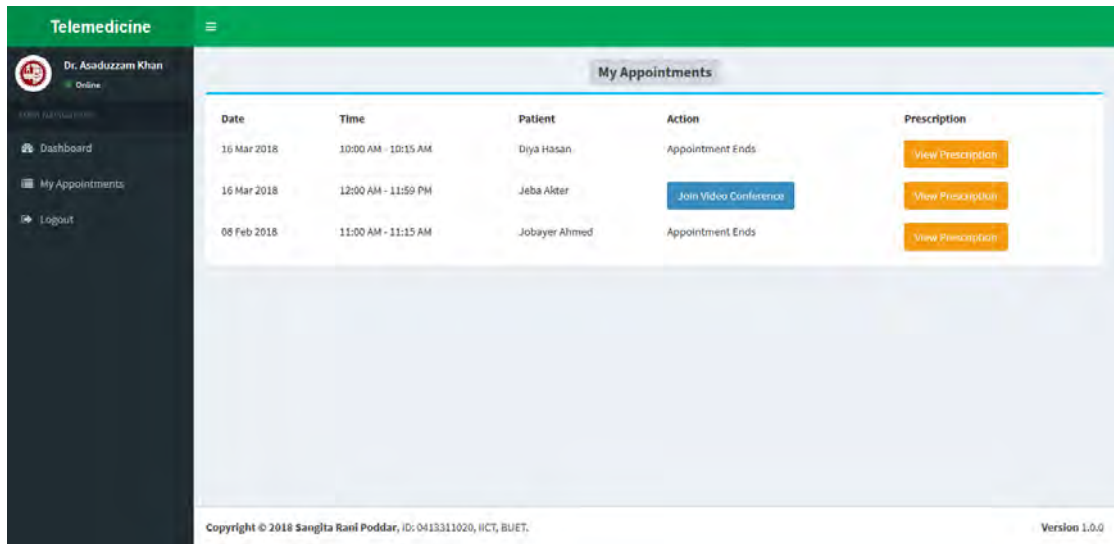
Fig: My Appointments of Doctor View

4.2.3.3 Video Conference

By clicking "Join Video Conference" button from my appointment page, doctor can start view conference with patient. In that page doctor can add or update prescription of the patient. There are two video streaming boxes. One box is for doctor and another is for patient.
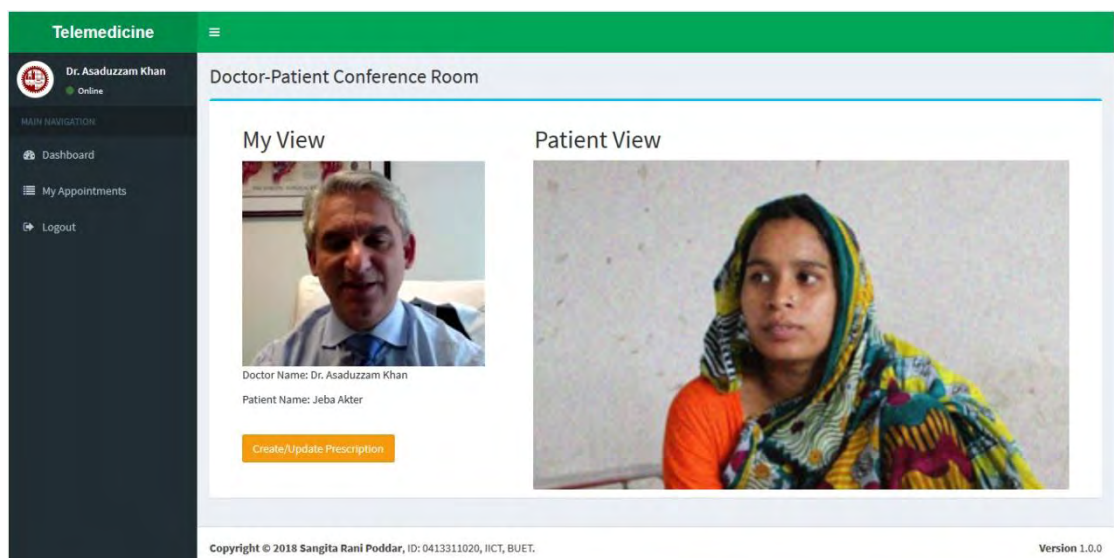
Fig: Video Conference of Doctor View

4.2.4 Patient Module

In this system, patient can login. Patient can login and check his profile. Patient can also check appointments and prescription of the doctor.

4.2.4.1 Dashboard

After login patient will see dashboard that contain information of the logged in patient. This page will display patient name, photo, patient id, username, age gender, contact, village, post office, police station and district.
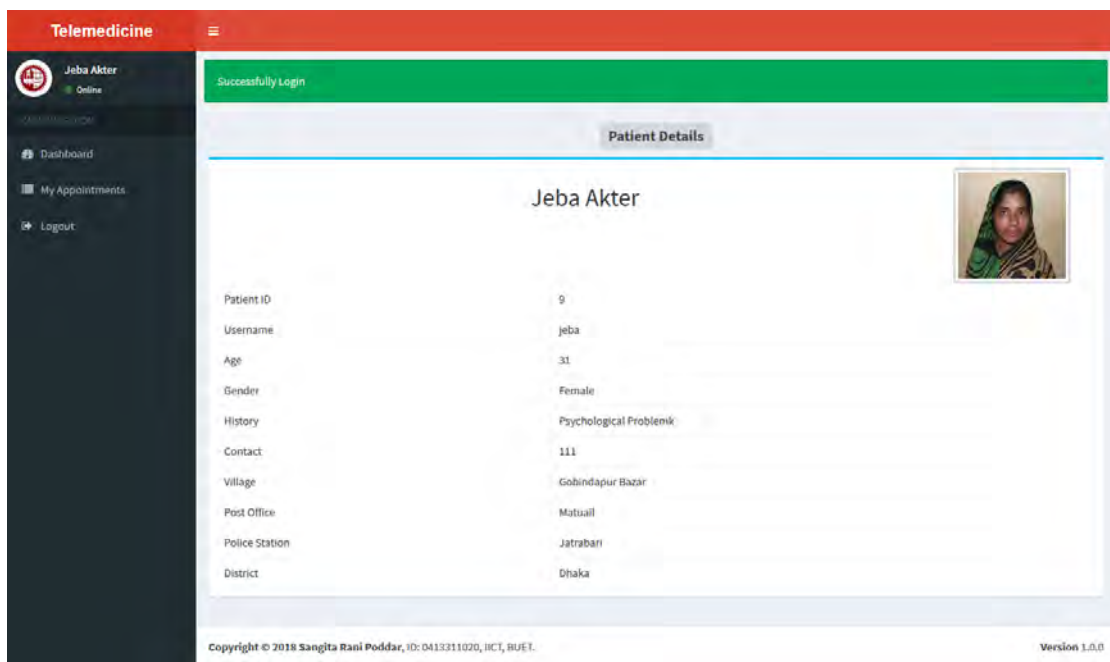
Fig: Dashboard of Patient View

4.2.4.2 My Appointments

By clicking on "My Appointments" link patient can see all appointments of him. By clicking "View Prescription" button he can see the prescription of the doctor that provided to him. This page contains date, time and doctor name.
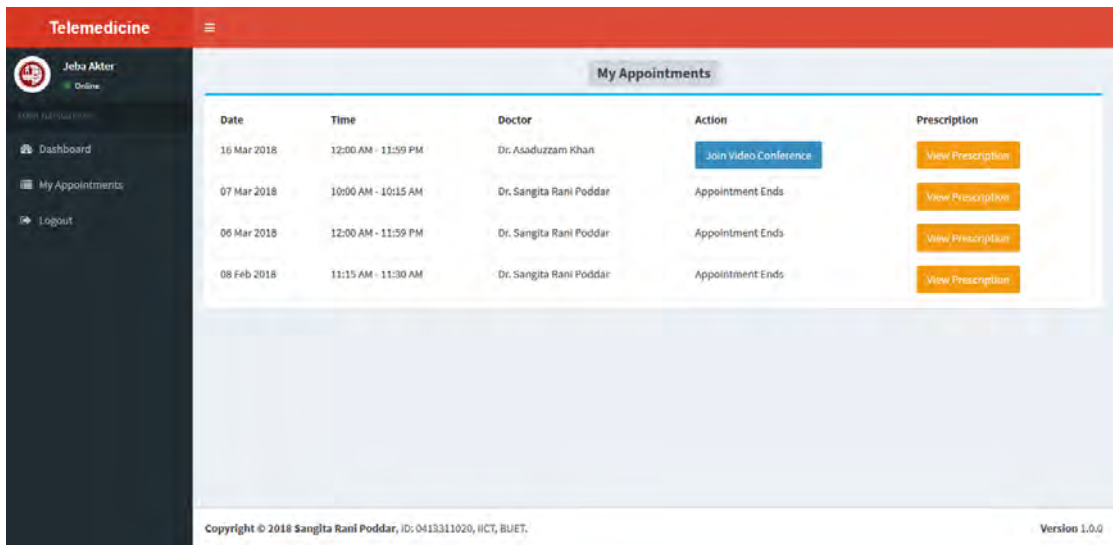
Fig: My Appointments of Patient View

4.2.4.3 Video Conference

By clicking "Join Video Conference" button from my appointment page, patient can start view conference with doctor. In that page patient can view prescription of the doctor. There are two video streaming boxes. One box is for doctor and another is for patient.
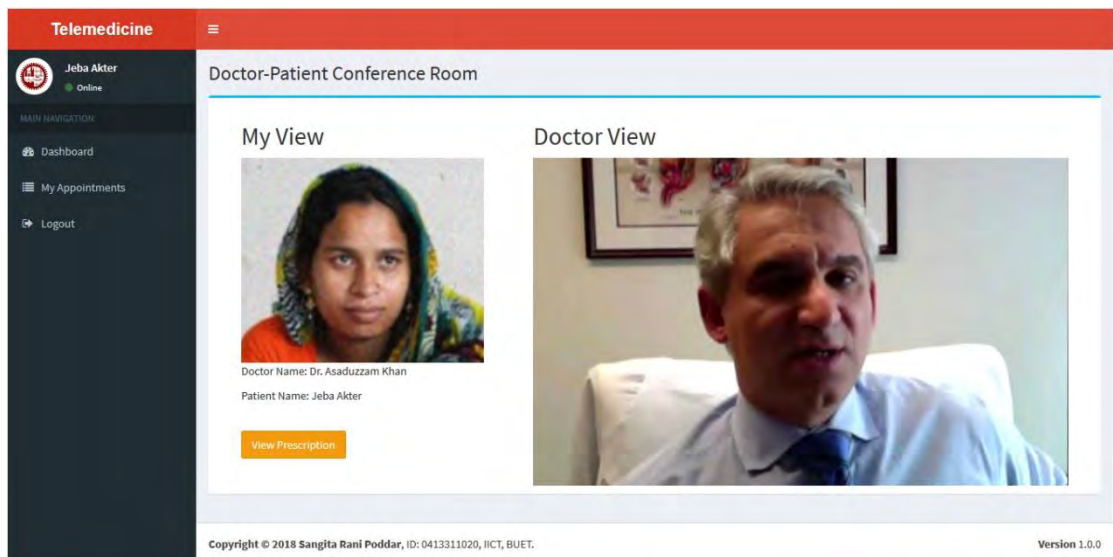
Fig: Video Conference of Patient View

4.3 Testing Report

The system is running smoothly in the system. All the data saved into the database perfectly. Video streaming is related to internet speed. When the internet speed is good, then the streaming showing perfect resolution for the users.

Sometimes rural areas people are not capable to manage computer device. Though the system is hosted by computer system, they can face hurdle to manage the system. That's why we keep the system operation based on Medical staff. They will update all the system information.

One thing patient and doctor have to manage the video conference part of their own. But, there is a solution too. If a community takes responsibility to manage the patient part, like a Medicare community in rural area, then the system will be applicable for all people.

4.4 Difference between Our System and Traditional Video Conferencing System

The system is different from traditional video chat service. Some details are given below:-

4.4.1 Quality and Reliability of Service

Traditional system cannot offer reliable service. Call or videos can be dropped anytime. But our system can ensure continuous service. Our system can ensure clear audio and video also.

4.4.2 Scheduling

In our system we can schedule our video service by scheduling. But In traditional system we cannot manage proper scheduling. Sometimes, in existing system we have to maintain manual schedule.

4.4.3 Content Sharing

In our system we can easily share the contents between end users; like doctor can send file or any records through our system when video conferencing. But in existing system, it is sometimes impossible.

4.4.4 Costing

Our system is completely free for use. Just need the cost for hosting solution. The bandwidth is depending on network provider of rural area. In existing system, there are lots of free services. But maximum of them are not reliable when service is free. They ask for payment for better service.

4.4.5 Platform Dependency

Our system will be platform independent. Our solution is web based service. So, any user from any web browser can use our service. In existing system, most of them are platform dependent. Like there are applications for windows, Linux or mobile app etc.

4.4.6 High Resolution Video Conferencing

Our system will provide high resolution video. For this doctor can easily observe patients by camera of video conference. Existing systems do not provide high resolution video conferencing. Most of them are for family use purpose.

4.5 Benefits and Drawbacks

Telemedicine can be beneficial to patients in isolated communities and remote regions, who can receive care from doctors or specialists far away without the patient having to travel to visit them. Recent developments in mobile collaboration technology can allow healthcare professionals in multiple locations to share information and discuss patient issues as if they were in the same place. Remote patient monitoring through mobile technology can reduce the need for outpatient visits and enable remote prescription verification and

drug administration oversight, potentially significantly reducing the overall cost of medical care. Telemedicine can also facilitate medical education by allowing workers to observe experts in their fields and share best practices more easily.

Telemedicine also can eliminate the possible transmission of infectious diseases or parasites between patients and medical staff. This is particularly an issue where MRSA is a concern. Additionally, some patients who feel uncomfortable in a doctor's office may do better remotely. For example, white coat syndrome may be avoided. Patients who are home-bound and would otherwise require an ambulance to move them to a clinic are also a consideration.

The downsides of telemedicine include the cost of telecommunication and data management equipment and of technical training for medical personnel who will employ it. Virtual medical treatment also entails potentially decreased human interaction between medical professionals and patients, an increased risk of error when medical services are delivered in the absence of a registered professional, and an increased risk that protected health information may be compromised through electronic storage and transmission. There is also a concern that telemedicine may actually decrease time efficiency due to the difficulties of assessing and treating patients through virtual interactions; for example, it has been estimated that a teledermatology consultation can take up to thirty minutes, whereas fifteen minutes is typical for a traditional consultation. Additionally, potentially poor quality of transmitted records, such as images or patient progress reports, and decreased access to relevant clinical information are quality assurance risks that can compromise the quality and continuity of patient care for the reporting doctor. Other obstacles to the implementation of telemedicine include unclear legal regulation for some telemedical practices and difficulty claiming reimbursement from insurers or government programs in some fields.

Another disadvantage of telemedicine is the inability to start treatment immediately. For example, a patient suffering from a bacterial infection might be given an antibiotic hypodermic injection in the clinic, and observed for any reaction, before that antibiotic is prescribed in pill form.

Chapter 5

Conclusion and Future Scope

5.1 Conclusion

Telemedicine is the use of telecommunication and information technology to provide clinical health care from a distance. It has been used to conquer distance barriers and to improve access to medical services that would often not be consistently available in distant rural communities. It is also used to save lives in critical care and emergency situations.

Although there were distant precursors to telemedicine, it is essentially a product of 20th century telecommunication and information technologies. These technologies allow communications between patient and medical staff with both convenience and fidelity, as well as the transmission of medical, imaging and health informatics data from one site to another.

Early days of telemedicine achieved with telephone and radio have been supplemented with video telephony, advanced diagnostic methods supported by distributed client/server applications, and additionally with telemedical devices to support in-home care.

Telemedicine technology is a priceless tool that patients can use to be evaluated and treated by health care providers from wherever they may be. Telemedicine services are often offered at lower costs and make availability for some to obtain health care easier to achieve. With the use of economic tools, providers and facilities are determining this to be true. As more Americans are obtaining health care insurance, there is an increasing need and demand for health care that continues to rise as fewer providers are available, and telemedicine can provide an expansion to the health care industry. Cost analysis provides facilities and provides with the significant figures when determining the value of implementing a telemedicine system. The greatest value associated with telemedicine is not only the lower wait times and the reduced costs that are achieved but the improvement in patient satisfaction and allowing the patient more involvement in the care they receive.

5.2 Future Scope

In the future, a lot of work could be done in the three main aspects of telemedicine technology systems to enhance the healthcare services. The three main aspects are type of sensors, signal processing algorithms, and data communication technology. In the sensor layer wireless sensor network of wearable non invasive sensor units can be designed. Fabrication of sensors can be improved to obtain small size and low power sensors to improve patient's mobility and prolong network lifetime. Also we can increase the number of transmitted vital signs to have a complete picture of patient's case. For more improvement in telemedicine systems, many medical algorithms can be developed to help in patient diagnosis and early detection of cardiovascular diseases and real-time analysis of vital signs can be performed in the place where the vital signs are acquired. The newest achievement on a smart phone market provided an opportunity to integrate smart phones in telemedicine systems. For example, android based mobile phones patient monitoring application could be developed which allows doctors to monitor the health status of a patient using the easy to understand user interface (UI). This application also provides alerts, reminders, and emergency notifications for vital measurements to help doctors to take timely decisions in emergency situations. Finally for data communication technologies, in many countries, 3G mobile networks are currently installed and operating, which provide bandwidth up to 2 Mbps maximum (typically hundreds of kbps). This will enable the transmission of more information like continuous 12 leads of ECG when monitoring cardiac patients from a moving ambulance vehicle. Furthermore, the current introduction of new services like video telephony through wireless networks is an addition that can help with communications between a healthcare provider (nurse, paramedics) and an expert doctor. The current activities in what is termed as the 4G mobile networks promise ubiquitous access to differing radio network technologies, thus offering, beyond extended coverage, also the most effective connection mode at the point of contact, even using simultaneously more than one wireless access technologies and seamlessly moving between them. The use of locating systems such as the global positioning system (GPS), the geographical information systems (GIS), and intelligent traffic control systems also has the potential to improve healthcare services, for example, when a moving ambulance vehicle is trying to reach a patient using the fastest route or when an ambulance vehicle carrying a patient is trying to get to the base hospital.

Appendix

In this section some of the program code has been added to understand the project easily. The program is given below:

Doctor Controller:

```php
<?php

App::uses('AppController', 'Controller');

class DoctorController extends AppController {

    public $uses = array();
    public $helpers = array('Html', 'Form');

    public function beforeFilter() {
        parent::beforeFilter();
        $this->Auth->allow('');
        $this->loadModel('User');
        $this->loadModel('Category');
    }

    public function lists() {
        $doctors      =      $this->User->find('all',      array('order'      =>
array('User.name ASC'), 'conditions' => array('User.user_type_id' => 2)));
        $this->set('doctors', $doctors);
    }

    public function add() {
        if ($this->request->is('post')) {
            $data = $this->request->data;

            if   (!$this->User->is_username_exist($data['User']['username']))
{

                if ($data['User']['photo']['error'] == 0) {
                    $imageFileType                                        =
strtolower(pathinfo($data['User']['photo']['name'], PATHINFO_EXTENSION));
                    if ($imageFileType != "jpg" && $imageFileType != "png"
&& $imageFileType != "jpeg" && $imageFileType != "bmp") {
                        $this->Session->setFlash(__('Sorry,  only JPG,  JPEG,
PNG & BMP files are allowed.'), 'flash/danger');
                        return     $this->redirect(array('controller'     =>
'doctor', 'action' => 'add'));
                    }

                    if ($data['User']['photo']['size'] > (1024 * 500)) {
                        $this->Session->setFlash(__('Sorry, your file is too
large. Max file size is 500KB.'), 'flash/danger');
                        return     $this->redirect(array('controller'     =>
'doctor', 'action' => 'add'));
                    }

                    $temp_name = time();

                    if
(is_uploaded_file($data['User']['photo']['tmp_name'])) {
```

```
                                $temp_name              =             $temp_name          .
$data['User']['photo']['name'];

move_uploaded_file($data['User']['photo']['tmp_name'],       WWW_ROOT         .
'/files/profile_image/' . $temp_name);
                                $data['User']['photo'] = $temp_name;
                            }
                    } else {
                        unset($data['User']['photo']);
                    }

                    $data['User']['user_type_id'] = 2;
                    if ($this->User->save($data)) {
                            $doctor_id = $this->User->getLastInsertId();
                            $this->Session->setFlash(__('New doctor information has
been saved.'), 'flash/success');
                            return $this->redirect(array('controller' => 'doctor',
'action' => 'details/' . $doctor_id));
                    }
                            $this->Session->setFlash(__('Unable    to    save    doctor
information.'), 'flash/danger');
                } else {
                        $this->Session->setFlash(__('Username    already   exists.'),
'flash/danger');
                }
        }

        $categories   =   $this->Category->find('all',   array('order'   =>
array('Category.name ASC')));
        $this->set('categories', $categories);
    }

    public function details($id = 0) {
        $doctors = $this->User->find('first', array(
            'conditions' => array(
                'User.id' => $id
            )
        ));

        $this->set('doctors', $doctors);
    }

    public function edit($id = 0) {
        if ($this->request->is('post')) {
            $data = $this->request->data;

            if   (!$this->User->is_username_exist($data['User']['username'],
$id)) {
                if ($data['User']['photo']['error'] == 0) {
                    $imageFileType                                    =
strtolower(pathinfo($data['User']['photo']['name'], PATHINFO_EXTENSION));
                    if ($imageFileType != "jpg" && $imageFileType != "png"
&& $imageFileType != "jpeg" && $imageFileType != "bmp") {
                        $this->Session->setFlash(__('Sorry,  only JPG, JPEG,
PNG & BMP files are allowed.'), 'flash/danger');
                        return     $this->redirect(array('controller'   =>
'doctor', 'action' => 'edit/' . $id));
                    }

                    if ($data['User']['photo']['size'] > (1024 * 500)) {
                        $this->Session->setFlash(__('Sorry, your file is too
large. Max file size is 500KB.'), 'flash/danger');
                        return     $this->redirect(array('controller'   =>
'doctor', 'action' => 'edit/' . $id));
                    }

                    $temp_name = time();
```

```
                if
(is_uploaded_file($data['User']['photo']['tmp_name'])) {
                    $temp_name            =            $temp_name        .
$data['User']['photo']['name'];

move_uploaded_file($data['User']['photo']['tmp_name'],        WWW_ROOT        .
'/files/profile_image/' . $temp_name);
                    $data['User']['photo'] = $temp_name;
                }
            } else {
                unset($data['User']['photo']);
            }

            if (trim($data['User']['password']) == '') {
                unset($data['User']['password']);
            }


            if ($this->User->save($data)) {
                $this->Session->setFlash(__('Doctor information has been
udpate.'), 'flash/success');
                return  $this->redirect(array('controller' => 'doctor',
'action' => 'details/' . $id));
            }
                $this->Session->setFlash(__('Unable   to   update   doctor
information.'), 'flash/danger');
        } else {
                $this->Session->setFlash(__('Username   already   exists.'),
'flash/danger');
            }
        }

    $doctors = $this->User->find('first', array(
        'conditions' => array(
            'User.id' => $id
        )
    ));

    $categories   =   $this->Category->find('all',   array('order'   =>
array('Category.name ASC')));
    $this->set('categories', $categories);

    $this->set('doctors', $doctors);
    }

}
```

User Model:

```php
<?php

App::uses('AppModel', 'Model');

class User extends AppModel {

    var $useTable = 'users';
    public $belongsTo = array(
        'Category' => array(
            'className' => 'Category',
            'foreignKey' => 'category_id'
        ),
        'Usertype' => array(
            'className' => 'Usertype',
```

```
                'foreignKey' => 'user_type_id'
            ),
    );
    public $validate = array(
        'username' => array(
            'unique' => array(
                'rule' => 'isUnique',
                'required' => 'create'
            ),
            'alphanumeric' => array(
                'rule' => 'alphanumeric',
                'message' => 'Slug can only be letters, numbers, dash and
underscore'
            )
    ));

    public function beforeSave($options = array()) {
        if (isset($this->data['User']['password'])) {
            $this->data['User']['password'] = AuthComponent::password($this-
>data['User']['password']);
        }
        return true;
    }

    public function is_username_exist($username = '', $user_id = 0) {
        if ($user_id == 0) {
            $count = $this->find('count', array('conditions' =>
array('User.username' => $username)));
        } else {
            $count = $this->find('count', array('conditions' =>
array('User.username' => $username, 'User.id != ' => $user_id)));
        }

//          echo $count;

        if ($count > 0) {
            return TRUE;
        } else {
            return FALSE;
        }
    }

}
```

Default Layout:

```
<!DOCTYPE html>
<html>
    <head>
        <meta charset="utf-8">
        <meta http-equiv="X-UA-Compatible" content="IE=edge">
        <link rel="icon favicon" href="<?php echo $this->Html->url('/');
?>img/buet.jpg">
        <title>BUET PGD ICT Project: Telemedicine</title>
        <!-- Tell the browser to be responsive to screen width -->
        <meta content="width=device-width, initial-scale=1, maximum-scale=1,
user-scalable=no" name="viewport">
        <!-- Bootstrap 3.3.6 -->
        <link rel="stylesheet" href="<?php echo $this->Html->url('/');
?>css/bootstrap.min.css">
        <!-- Font Awesome -->
        <link rel="stylesheet"
href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/4.5.0/css/font-
awesome.min.css">
        <!-- Ionicons -->
```

```html
        <link rel="stylesheet"
href="https://cdnjs.cloudflare.com/ajax/libs/ionicons/2.0.1/css/ionicons.min
.css">
        <!-- jvectormap -->
        <link rel="stylesheet" href="<?php echo $this->Html->url('/');
?>plugins/jvectormap/jquery-jvectormap-1.2.2.css">
        <!-- Theme style -->
        <link rel="stylesheet" href="<?php echo $this->Html->url('/');
?>css/AdminLTE.min.css">
        <!-- AdminLTE Skins. Choose a skin from the css/skins
                folder instead of downloading all of them to reduce the load. -
->
        <link rel="stylesheet" href="<?php echo $this->Html->url('/');
?>css/skins/_all-skins.min.css">
        <link rel="stylesheet" href="<?php echo $this->Html->url('/');
?>css/custom.css">


        <!-- HTML5 Shim and Respond.js IE8 support of HTML5 elements and
media queries -->
        <!-- WARNING: Respond.js doesn't work if you view the page via
file:// -->
        <!--[if lt IE 9]>
        <script
src="https://oss.maxcdn.com/html5shiv/3.7.3/html5shiv.min.js"></script>
        <script
src="https://oss.maxcdn.com/respond/1.4.2/respond.min.js"></script>
        <![endif]-->



        <!-- jQuery 2.2.3 -->
        <script src="<?php echo $this->Html->url('/');
?>plugins/jQuery/jquery-2.2.3.min.js"></script>
        <!-- Bootstrap 3.3.6 -->
        <script src="<?php echo $this->Html->url('/');
?>js/bootstrap.min.js"></script>
        <!-- FastClick -->
        <script src="<?php echo $this->Html->url('/');
?>plugins/fastclick/fastclick.js"></script>
        <!-- AdminLTE App -->
        <script src="<?php echo $this->Html->url('/');
?>js/app.min.js"></script>
        <!-- Sparkline -->
        <script src="<?php echo $this->Html->url('/');
?>plugins/sparkline/jquery.sparkline.min.js"></script>
        <!-- jvectormap -->
        <script src="<?php echo $this->Html->url('/');
?>plugins/jvectormap/jquery-jvectormap-1.2.2.min.js"></script>
        <script src="<?php echo $this->Html->url('/');
?>plugins/jvectormap/jquery-jvectormap-world-mill-en.js"></script>
        <!-- SlimScroll 1.3.0 -->
        <script src="<?php echo $this->Html->url('/');
?>plugins/slimScroll/jquery.slimscroll.min.js"></script>
        <!-- ChartJS 1.0.1 -->
        <script src="<?php echo $this->Html->url('/');
?>plugins/chartjs/Chart.min.js"></script>

        <!-- AdminLTE for demo purposes -->
        <script src="<?php echo $this->Html->url('/');
?>js/demo.js"></script>
    </head>
    <body class="hold-transition <?php echo $theme_color; ?> sidebar-mini">
        <div class="wrapper">
            <?php
            echo $this->Element('top_menu');
            echo $this->Element('left_menu');
            ?>
```

```
            <div class="content-wrapper">
                <?php
                echo $this->Flash->render();
                echo $this->fetch('content');
                ?>
            </div>
            <?php
            echo $this->Element('footer');
            ?>

        </div>
        <!-- ./wrapper -->

    </body>
</html>
```

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