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GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

A NEW WEB-BASED EDUCATION AND MONITORING SYSTEM FOR PATIENTS WITH TYPE-2 DIABETES MELLITUS

M.Sc. THESIS

Hafsa Elif ÖZÇİFTCİ
(601514008)

Department of Computer Engineering

Thesis Advisor: Assistant Professor Yalçın İŞLER

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TİP-2 DİYABET HASTALARI İÇİN WEB TABANLI YENİ BİR EĞİTİM VE İZLEME SİSTEMİ

YÜKSEK LİSANS TEZİ

Hafsa Elif ÖZÇİFTCİ
(601514008)

Bilgisayar Mühendisliği Ana Bilim Dalı

Tez Danışmanı: Dr. Öğr. Üyesi Yalçın İŞLER

TEMMUZ 2018

Hafsa Elif ÖZÇİFTCİ, a **M.Sc.** student of **IKCU Graduate School Of Natural And Applied Sciences**, successfully defended the thesis entitled "**A NEW WEB-BASED EDUCATION AND MONITORING SYSTEM FOR PATIENTS WITH TYPE-2 DIABETES MELLITUS**", which she prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

Thesis Advisor :

Assist. Prof. Dr. Yalçın İŞLER .....
İzmir Katip Çelebi University

Jury Members :

Assist. Prof. Dr. Mustafa YENİAD .....
Ankara Yıldırım Beyazıt University

Assist. Prof. Dr. Rukiye UZUN .....
Zonguldak Bülent Ecevit University

Date of Submission :15.08.2018
Date of Defense :15.08.2018

To my beloved husband and family,

FOREWORD

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June 2018 Hafsa Elif ÖZÇİFTCİ

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ABBREVIATIONS

DM	**:** Diabetes Mellitus
DIMS	**:** Diabetic Monitoring System
FAQ	**:** Frequently Asked Questions
HDL	**:** High-Density Lipoprotein
LDL	**:** Low-Density Lipoprotein
WHO	**:** World Health Organization
CDAS	**:** Centralized Doctor Appointment System
PHP	**:** Hypertext Preprocessor
MYSQL	**:** My Structured Query Language
SQL	**:** Structured Query Language
UX	**:** User Experience
UI	**:** User Interface
OOP	**:** Object-Oriented Programming
ORM	**:** Object Relational Mapping
MVC	**:** Model View Controller
CLI	**:** Command-Line
HTML	**:** Hypertext Markup Language
ADA	**:** American Diabetes Association
FEND	**:** Federation of European Nurses In Diabetes

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A NEW WEB-BASED EDUCATION AND MONITORING SYSTEM FOR PATIENTS WITH TYPE-2 DIABETES MELLITUS

ABSTRACT

Diabetes Mellitus (DM) is a chronic disease that progresses rapidly. Today, the number of diabetic patients is increasing day by day, but treatment methods are beginning to be inadequate due to the insufficient time, financial deficiencies and other restrictions. Diabetes education and treatment are very important for the diabetic to survive. Diabetes treatment is practiced in many areas of life from the nutrition habits to the social life activities. In terms of the course of diabetes treatment, it is necessary for the self-management of the patient to follow the diabetes education and applicability of the education.

In this study, there is a web application for the education of the diabetic and the follow-up of this education. With this developed web application, the patient is controlled by an authorized and experienced healthcare staff registered in the system. In addition to the healthcare staff, diabetics can create their own self-management screens that can graphically display the sugar and biological values that were recorded by the diabetic in the system. For the education of the patient as part of self-management, there are training packages, system questionnaires, and opportunities that diabetics may ask questions about the problems experienced during their illness to authorities. Through the regular and proper use of this application, it is aimed to facilitate life and increase the quality of life by struggling with Diabetes Mellitus which is widespread and affecting life negatively.

TİP-2 DİYABET MELLİTUSLU HASTALAR İÇİN YENİ WEB TABANLI EĞİTİM VE İZLEME SİSTEMİ

ÖZET

Diabetes Mellitus (DM), hızlı bir şekilde ilerleyen kronik bir hastalıktır. Günümüzde diyabetli hasta birey sayısı her geçen gün artmakla beraber, geliştirilen tedavi yöntemleri, vakit yetersizliği, mali eksiklikler ve diğer kısıtlamalar dolayısıyla yetersiz kalmaya başlamıştır. Diyabetli bireyin hayatını devam ettirebilmesi için diyabet eğitimi ve tedavisi büyük önem teşkil etmektedir. Diyabet tedavisi, bireyin beslenme alışkanlığından, sosyal yaşamda gerçekleştirdiği aktivitelere kadar hayatının bir çok alanında uygulanmaktadır. Diyabet tedavisinin seyri açısından bireyin kendi öz-yönetimi için diyabet eğitiminin ve bu eğitimin uygulanabilirliğinin takibi gerekmektedir.

Bu çalışmada, diyabetli bireyin eğitimi ve bu eğitimin takibi için oluşturulmuş bir web uygulaması bulunmaktadır. Geliştirilen web uygulaması ile bireyin, sistemde kayıtlı, yetkili ve deneyimli bir sağlık personeli tarafından kontrolü sağlanmaktadır. Sağlık personelinin yanı sıra diyabetli bireyin kendi öz-yönetimini sağlayabileceği, şeker ve biyolojik değerlerini sisteme girip grafiksel olarak görüntüleyebileceği ekranlar oluşturulmuştur. Öz-yönetimin bir parçası olan bireyin eğitimi için eğitim paketleri, sistem anketleri ve diyabetli bireylerin yetkililere hastalığın seyrinde yaşadığı problemler hakkında sorular yöneltebileceği alanlar bulunmaktadır. Uygulamanın düzenli ve doğru kullanımı ile diyabetli bireyin yaygınlaşan ve hayatı olumsuz etkileyen diyabet hastalığı ile mücadele ederek yaşamını kolaylaştırması ve yaşam kalitesini arttırması hedeflenmiştir.

1. INTRODUCTION

1.1 Definition of diabetes

Diabetes is defined as a chronic, metabolic disease that occurs as a result of insufficiency in insulin release or in use of produced insulin. This metabolic disease is an important health problem diagnosed based on the level of sugar in the blood is constantly high [1]. Diabetes is a chronic metabolic disease that develops concomitant macrovascular and microvascular complications because of insufficiency of insulin secretion or insulin-induced.

Diabetes is accepted as one of the most important health problems of our time due to increasing frequency of occurrence, a necessity of lifelong treatment and care, causing complications, imposing significant limitations on human life, and creating heavy financial burden [2-3-7]. At the same time, it is a health problem that needs to be addressed first because that the complications caused by diabetes are and diabetes can be prevented [4].

In healthy patients, blood sugar is transported to the cells with the help of insulin hormone secreted by the pancreas. Insulin in diabetics is incomplete or ineffective, so they cannot enter the sugar cell and the amount of insulin increases steadily.

Since glucose cannot be used for energy production in insulin insufficiency, cells use fat and proteins for energy need. Increased use of fat and protein causes weight loss, rapid fatigue, and lethargy. Because the glucose cannot enter the cell, the hunger mechanism is activated and an increase in food intake (polyphagia) occurs. As a result of the use of fats for energy consumption, the level of free fatty acids increases. The liver converts free fatty acids into ketone bodies (beta-hydroxybutyric acid, acetoacetic acid, and acetone). Symptoms such as ketonemia, nausea, and vomiting develop. Ketone bodies are attempted to be removed from the body by urination. At this stage, the ketone is released in the urine (ketonuria). If the keto acids are too much in the urine not to be expelled from the body, they accumulate, the respiratory rhythm accelerates when the pH falls below 7.1 [5].

1.2 Diabetes in the world

Due to many factors affecting the health of patients, especially nutritional disorders, the number of diabetics is increasing in both developed and undeveloped countries. According to the International Diabetes Association, in 2013, 382 million people are diabetic in the 20-79 age groups in the world, that the majority is in the 40-59 age range, and it is estimated that this number will rise to 592 million by 2035. On a regional basis, 138 million diabetics live in the North Pacific, 72 million in South East Asia, 61 million in the United States and 56 million in Europe. The three countries where diabetes is most common are China (98 million), India (65 million) and the United States (24 million). Perhaps the biggest problem is that 80% of diabetic patients are more likely to be found in developing countries [6].

Because of the high incidence of diabetes increase deaths and treatment costs, the World Health Organization and the International Diabetes Federation are working to reduce the density of diabetes and treat in low and moderate developed countries. These studies include activities such as prepare diabetes prevention guidelines, improving diabetes diagnosis and care standards and norms, increasing awareness of diabetes, preparing diabetes education tools and conducting research on risk factors for diabetes [6].

1.3 Diabetes in Turkey

Because of both changes in demographic structure (growth of the elderly population) and development in socio-economic determinants in Turkey, chronic diseases and complications are increasing in a similar structure to developed countries. Diabetes, which is a chronic disease, is a global issue as well as an important problem for our country and it is thought that many people affected by diabetes in our country [8]. According to the World Health Organization estimates for 2013, we have around seven million diabetics in our 20- to 79-year-old population and the prevalence of the disease is estimated at 14.58%. In the same estimates, the average diabetes frequency in the world is 8.3% while it is 6.8% in European countries [6]. According to the World Health Organization 2008 data, 10.1% of men and 9.8% of females over 25 years old have a normal blood sugar level in our country [14].

In our country, an increase beyond the estimates of diabetes and is one of the main causes of deaths and injuries, "Turkey Diabetes Prevention and Control Program; Strategic Plan and Action Plan" were initiated by Ministry of Health in 2009. Within the program, the establishment of national guidelines for diagnosis, treatment, and follow-up of diabetes, diabetes prevention, diabetes awareness, various efforts to improve the diabetes patients' education and care is planned. All these efforts are aimed to prevent diabetes, prevent risks factors, increase the quality of diabetes care in patients and reduce diabetes-related deaths and injuries [8].

1.4 Classification of diabetes

Every living individual is more likely to be a diabetic when environmental and genetic factors are taken into consideration. There are four types of diabetes. Type 1 diabetes, often referred to as "juvenile diabetes" or "insulin-dependent diabetes", because it is usually seen at a young age [9]. Type 1 diabetes is a type of diabetes that develops as the result of insufficiency or lack of absolute insulin secretion caused by genetic and environmental causes of damage to pancreatic β (beta) cells [9]. Type 1 diabetes is 5-10% of all diabetes. This type mostly occurs in childhood and young adult ages. Acute complications such as ketoacidosis coma and hypoglycemia are the most common in this diabetes type [10].

The second type of diabetes is "Non-insulin dependent" Type 2 diabetes. Type 2 diabetes produces pancreatic insulin, but the body is resistant to insulin and therefore cannot use insulin adequately [9]. About 90-95% of all diabetics in the world are Type 2 diabetic. In the treatment of this type of diabetes, insulin is often not needed because there is no disruption in β (beta) cells. The disease is usually seen in the elderly, in those with low physical activity and in obese. Symptoms of the diabetes are mild, but chronic complications are the most common in this type [10].

The third type of diabetes is gestational diabetes, which occurs only during pregnancy and disappears after birth [9]. Gestational diabetes occurs in about 7% of pregnancies [10]. The disease is caused by genetic factors and it especially occurs at 26-28 weeks of pregnancy. Oral glucose tolerance test is performed at 6th-8th weeks of gestation and it is repeated at 24th-26th weeks. In patients with gestational

diabetes, the risk of Type 2 diabetes is high in 25 years, and regular exercise is recommended to reduce the risk of disease [15].

The last type of diabetes is called other specific types of diabetes. This diabetes occurs as result of drug and chemical use (HIV treatment, organ transplantation, etc.), pancreatic diseases such as cystic fibrosis and pancreatitis, endocrine diseases, infections and genetic pancreas and beta (beta) cell disorders [9].

1.5 Tests used in the diagnosis and follow-up of diabetes

In the presence of diabetes-specific symptoms and complications, diabetes can be diagnosed easily. There are many test management methods for this recognition. These tests can be used to determine treatment management to minimize the inconvenience of the diabetic. Besides, it is also used as a guide for the health personnel in order to determine benefits and harms, activities and the diets for the nutrition and the treatment.

The purpose of diabetes treatment is; to ensure that the metabolism that is defected by insulin insufficiency or absence is returned to normal as much as possible and to ensure the risk factors of chronic complications of diabetes are controlled [11].

1.5.1 Measurement of fasting blood glucose

Measuring fasting blood glucose gives information on the mechanisms that determine the amount of blood glucose [17-20]. The blood glucose value measured after at least a 12-hour night's fasting should be between 60-110 mg/dl. If fasting blood glucose in plasma is more than 126mg/dl, the diabetes diagnosis is made reliably [17-18-19].

1.5.2 Measurement of postprandial blood glucose

The measurement of postprandial blood sugar is done to assess the response of the body to the absorption of carbohydrates two hours after meals. Diabetes is diagnosed when the blood glucose level measured after two hours is higher than 140 mg/dL [17-19-20-21-22].

1.5.3 Glycosylated hemoglobin measurement (HbA1c)

Hemoglobin is a protein in erythrocytes that carries oxygen to all body cells in the lungs. Glucose, which is constantly in the bloodstream, binds to hemoglobin, meaning that it is glycosylated. Once hemoglobin is glycosylated, the lifespan of erythrocytes remains glycosylated for 120 days. Glycosylated hemoglobin occurs in proportion to the level of sugar. Measurement of the level of glycosylated hemoglobin constitutes an important part of the metabolic control, i.e. long-term diabetes control. If the HbA1c value of the diabetics is less than 6.5%, the level is at good control value, if between 6.5% and 7.5%, levels are border control value and if greater than 7.5%, the level is worse control value [20-23-24].

1.5.4 Control of blood lipids

Regular lipid control should be done to prevent peripheral vascular diseases and cerebrovascular diseases. The parameters monitored in lipid control are HDL, LDL, and Triglyceride. Diabetics should have HDL>40 mg/dL in male, HDL>50 mg/dL in female, LDL<100 mg/dL and Triglyceride<150 mg/dL [11-12-13].

1.6 Self-care

Self-care is individuals' duty to protect themselves, their lives, their health and well-being. An individual should have a constant personal effort for his/her own health and wellbeing [11]. It is the ability to initiate and implement health events that include actions and views, which determine the performance of the individual, in maintaining and promoting self-care. Cognitive, sensory, motor, emotional factors, and interpersonal characteristics are influential in the development of this ability. The nurse should assess the self-care power of the individual in order to meet the patient's self-care needs, qualifications, limitations, and inadequacies in ability, knowledge, motivation, and skill [13].

1.7 Self-cafe of diabetic

The diabetic should be monitored at each control whether he or she does self-care behaviors such as self-monitoring of blood glucose, compliance with treatment, nutrition, exercise, smoking, alcohol abstinence/reduction, daily foot care [11].

The aim of diabetes management and control is to improve the quality of life by being healthy, improving the metabolic control, preventing the progression of complications.

In diabetes management of diabetics should; proper use of oral antidiabetics, proper administration of insulin, correct application of insulin, recognition and treatment of insulin effects and side effects, not smoking and not drinking alcohol, personal hygiene and other daily activities, proper nutrition / diet, regular exercise, control of blood glucose, care activities [16]. The main aim of caregiving is to provide convenience for the patient or caregiver to achieve the optimal level of independence in self-care activities.

1.8 Education of diabetic

Education plays an important role in the management and treatment of chronic diseases such as diabetes [25-26-27]. The key to success in the treatment of diabetes is the developments in self-care skills that can control own disease. Systematic investigations have emphasized that patient management is highly effective in the treatment of diabetes [28-29]. It is known that diabetes education has been an important element in the treatment of diabetes since the 1930's [30-31]. The aim of diabetes education is to provide the knowledge and skills necessary to prevent and treat acute and chronic complications, to reduce the cost of treatment and to increase the quality of life by providing an effective role in the treatment of the diabetic and providing metabolic control [32-30-31].

Today, it has been understood that the path to success in the treatment of chronic diseases is closely related to the education of patients and their relatives [35]. According to WHO, "education" is the cornerstone of diabetes treatment and is vital in integrating diabetics into society. Diabetic patient education contains all the

information and experience to ensure that diabetic patients feel better, to protect side effects of diabetes with better control, reduce treatment costs, to ensure that the patient can use the new technology [35-36].

The diabetes educator should inform patients about the theories of education/training. Individual assessment should be done before individual and group training. The medical story of the trained patient should take into account health beliefs and behaviors, diabetes knowledge, treatment skill, learning desire, cohesion, physical limitations, psychological status, cultural level, family support and beliefs, learning habits [33]. Every diabetic has different cultural, psychosocial, and demographic characteristics. For this reason, the training program to achieve the targeted knowledge and skills should be organized taking into account individual characteristics and self-care needs [33-34].

1.9 Internet usage in health sector

With the development of today's technology, the use of the internet in many places has become widespread. Among the areas where the use of the Internet has become widespread, the health sector has come to the front. With the projects developed in state-owned health institutions, health personnel and patients have been tried to be adapted to internet usage. Web-based systems that many patients are actually using have made life easier for many users. For example; The CDAS (Centralized Doctor Appointment System) developed by the Ministry of Health provides faster access to treatment for many patients receiving health services. It is aimed to get drug needs faster and safer thanks to the systems developed for Online Prescription. With the widespread use of the system, it is aimed to reduce unregistered drugs and to keep all data about drugs.

1.10 Internet usage in diabetes education

The Internet is frequently used to provide education and information in health-related areas. The Internet is easy to use and provides access to many people [37-38-39-40]. Due to this feature, there are also advantages and disadvantages of web-based education. The advantages are; receiving education at the desired time and place,

learning ability according to the learning capacity, receiving training in a short period of time without disrupting business processes and production, education hours, determining the breaks, being able to look ahead to what they have already learned [41]. The disadvantage of Internet education is that it is difficult for group evaluation [41, 42].

Examination of seventeen studies on web-based patient education found that web-based education had a positive effect on the availability and usefulness for patients [43]. In a literature review by Lewis [44], 66 articles on web-based education were audited and it was emphasized that web-based education should be supported because the patients got the information immediately.

1.11 Other studies on web-based diabetes education given to diabetics

In an experimental study by Conlin [74], which was launched in 2004, based on the internet, diabetes education and care management, HbA1c, blood pressure and depression levels are assessed in experimental and control groups. According to the first data of the study, the A1c level of the patients in the experimental group decreased by 50%. A randomized controlled, interactive, web-based study of the interaction between the patient and doctor, 600 patients who applied to the clinic were divided into two groups as experiment and control group and they were given education in the experiment group by the internet. When the satisfaction level of the patients was examined, the satisfaction level of the experimental group was 80% while the satisfaction level of the control group was 60% [45].

Grant, Cagliero, Chueh, Meigs [46] found that patients with Type 2 diabetes who use the internet to get information about their illnesses, A1c, LDL, blood pressure results and self-care behaviors are better than those who do not use the internet ($p< 0.001$).

In a study examining the results of internet education for twelve months, the subjects in the experimental group (n: 52) and the control group (n: 52) were trained in polyclinics. At the beginning of the study, in the third, sixth, ninth and twelfth months, the A1C, LDL, HDL, total cholesterol and blood pressure results of the experimental group were found to be better than the control group ($p <0.05$) [47]. In 7 out of a total of 26 studies published in “Diabetes Care between 1990 and 2004,

Internet education has been found to increase the use of healthcare, knowledge, attitudes, and skills [48].

In a study that examined the effects of the education and registration system on diabetics with Type 2 diabetes on the Internet, experiment (n: 91) and control (n: 163) groups were chosen. While the experiment group was informed about providing education on the internet and entry of personal health records, only routine clinical education and care were applied to the control group. At the beginning of the study and at the sixth month of the evaluations, A1c, LDL, total cholesterol and blood pressure values of the test group were found to be better than the control group [49].

Kim [60] studied the effect of web-based diabetes education on HbA1c in a study conducted by patients with type 2 diabetes (n: 51). Continuous education was given to the control group while the experiment group provided online education. At the same time, reminder messages were sent to the experiment group via telephone. At the end of the third month, HbA1c values were examined in both groups and observed a more rapid decrease in the experimental group (-2.15%, p: 0.007) than the control group (-0.22%, p: 0.336). It was obtained the importance of continuous monitoring of diabetics and nurses could do this monitoring. In the other three studies conducted with diabetics, those who use the Internet to get information about their diseases had better results than those who did not use the internet ($p < 0.05$; $p < 0.001$) [50-51-52].

In Elif Ünsan Avdal's doctoral dissertation in 2010, web-based education was given to diabetics and the results of this education were observed. The positive effects of web-based diabetes education on the A1c level and the behavior of coming to health control were determined in the research. The results have been supported by the fact that web-based training and Essential Care Nursing Theory are effective in improving self-care behaviors of diabetics [53].

Literature researches have shown that diabetes education has many positive outcomes such as; self-care and diabetes treatment. It is aimed to integrate the developed systems with new technologies to make them both visual and functional. It is determined that integrating and updating these technologies considering the factors as age and gender.

The diabetic may not be able to express himself adequately because of time pressure, or the time may not be enough for the health personnel to understand the problem and start the treatment and follow-up period. One of the major obstacles to reaching healthcare providers is the individual limitations of the patient. Some patients cannot leave their workplace due to their responsibilities, and others cannot leave without their help out of their homes due to physical limitations. For these reasons, the use of the web may be considered as a complementary tool to the obstacles experienced in the patient monitoring process [53].

Unlike the other web-based diabetic education systems, new software tools and software perspectives have been used in this study. It is aimed to develop a system, which diabetic and healthcare personnel can access easily. By comprehensible and easy to reach ways, diabetics are provided instant access to both system administrators and health personnel so that they can quickly and safely find solutions. The system not only focuses on the education of the diabetic but also aims to improve the social orientation of the patient by communicating with other diabetics. It is not obligatory to input all of the blood and biological values at the same time, but it allows the diabetic to input data into the system separately at the time when he/she can make the measurements. This provides a suitable environment for the diabetic to reduce the obstacles of follow-up and enable more flexible planning and accurate data entry.

1.12 Content management systems

Today, rapid developments in communication technology have brought together mobile technologies with new application software. Thanks to this developed software, accessing the internet almost everywhere has become quite easy. With smartphones, tablets, notebooks, and other devices that support wireless networking, users have access to internets wherever and whenever they want. With such widespread use of Internet access, the capacity of data presented over the Internet has increased and the management of these data has become more difficult every day. Experts could only do sending and transmitting data over the internet. That was necessary to process and management for the users who are not experts with the

growing needs, so Content Management Systems have been developed to meet the needs [54].

A content management system is mainly computer software for the creation, organization, and management of documents and other content together. Sometimes content management systems are used to update and manage content in web applications. There are two interfaces, which are user and administrator. Users visit the website as usual. Administrators can create, update and manage the contents with an administration interface. Portal systems, wiki systems, and web-based intranet systems are common for content management systems. Content management systems are used for Education Management Systems, File-Program-Document Sharing Systems, Image-Video Sharing Systems [55-56-57].

1.13 Education portals

Portal term is used to describe internet sites that contain multiple contents at the same time. Portal is referring to the main page that takes to multiple options with a front page. For example, on the front page education, news, chat, shopping, music, entertainment, travel, tourism, economy, finance options can appear. The Internet user selects from these main topics to address his / her interests and reaches related visuals and contents.

The goal of the portal site designs in to be appearing before other similar pages on search engines. Today, many newspapers and magazines, internet network providers, companies that provide computer and internet related software services, search engines have become portal sites. Portal sites that have a variety of contents, up-to-date, easy to use interface, are more preferred.

The greatest benefit of portal sites is undoubtedly access to knowledge. These sites provide coordination between customers and seller. Portal sites make information easy to access from anywhere. The purpose of educational portals is to have educational content in certain areas. Likewise, academic portals also include scientific knowledge.

1.14 Learning content management system and diabetic monitoring system

The main aim is to manage the content and learning objects with the right learning philosophy at the right time. Learning content management system includes content creation, distribution, management and reuse of learning materials. It makes the information learnable and has the ability to explain in different ways according to learning goals. The system consists of a central repository and database where the contents are organized, a collection of meaningful entities created and published. Content/lessons in the learning management system are commonly designed with web-based tools and are displayed via a web browser. A learning content management system includes HTML pages, multimedia, learning objects, lessons, and tutorials. There are many open source commercial learning content management systems with different features [58].

It is aimed to present both the content management system and the education portal concepts to the user with the Diabetic Monitoring System (DIMS). Education portals provide a variety of contents that are fully processed, semi-processed or raw data of synchronous and asynchronous, text, graphics, animation, voice, and video.

2. METHODS

Diabetic Education and Monitoring System is designed as a web-based software. Diabetics and administrators are defined to the system. The pages that provide education and follow-up are designed. The following methods were applied during the designing of the Diabetic Monitoring System;

1- Interface design

2- Development of frontend software processes

3- Determination and design of database architecture

4- Development of backend software processes

Diabetic Education and Monitoring system is a web-based software developed using PHP language, which is widely used in web-based software. During the software process, the XAMPP web server was used in the local environment. Laravel is chosen as the PHP framework. Materialize library is used to develop visual items. This library is responsive, so it can suit any device. Users can log in and they can be monitored by the administrators. MySQL was used as the database.

Sublime Text 3 editor was used as software development tool for developing Diabetic Monitoring System. The total size of the project is 54,2MB and the size of the database is 12 KB.

2.1 Interface design

Diabetic Monitoring System is as web-based software that individuals can access online. The system design is started with the user interface design that individuals will be able to access the website. The interface is designed due to the end user needs. Users and administrative pages were made through easily accessible standardized designs. This makes it easier to integrate users who are actively using web technologies into the system. MockFlow was used during the interface design of the user and admin profiles. MockFlow provides a full stack UX solution for design teams that includes wireframing, sitemaps, UI spec systems, design approvals and more. Plan and design better user interfaces together within a single suite.

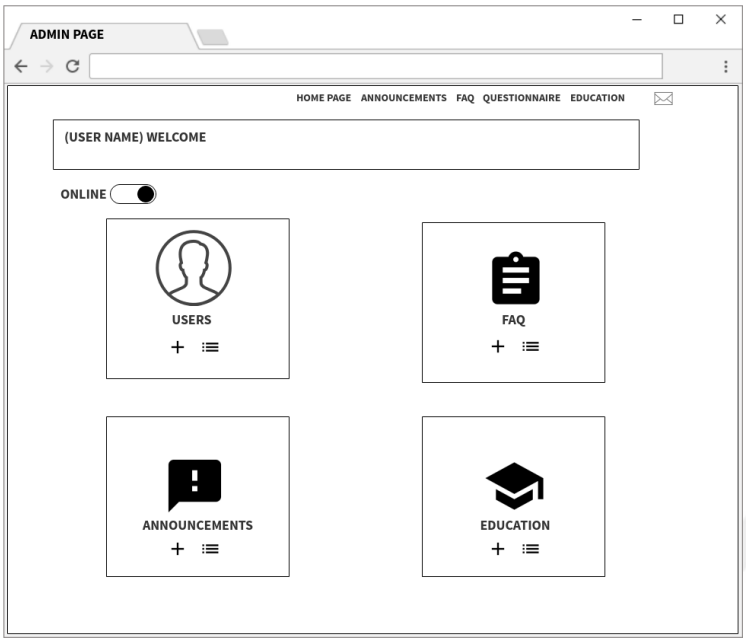

Figure 2.1 : MockFlow admin page interface design.

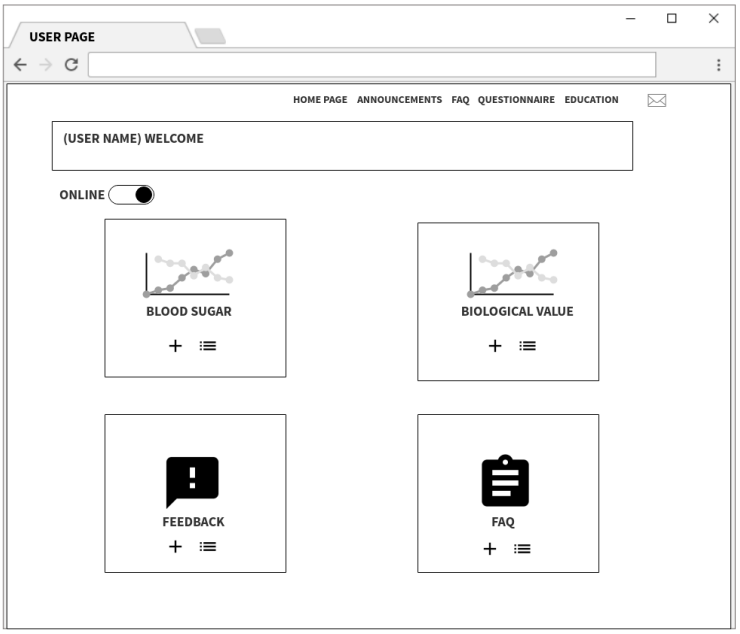

Figure 2.2 : MockFlow user page interface design.

Design templates for Admin and User login pages using MockFlow are given as an example (Figure 2.1, Figure 2.2). Interface design was performed before Frontend software was implemented.

2.2 Development of frontend software processes

Frontend software phase was started after interface development is completed. Materialize Library (Shown in Figure 3) is used to develop Frontend software. It was developed on Started Template of Materialize Library. Created and designed by Google, Material Design is a design language that combines the classic principles of successful design along with innovation and technology. Google's goal is to develop a system of design that allows for a unified user experience across all their products on any platform.

Figure 2.3 : Materialize front-end framework.

Materialize (Figure 2.3) is a modern and responsive front-end framework based on material design. Since the library offers a responsive base structure, it can offer a visual interface compatible with every device.

2.3 Database architecture determination and database preparation

Figure 2.4 : XAMPP server logo.

After the database architecture was determined, the database application was developed with the XAMPP server (Figure 2.4). XAMPP (Extended Apache/MariaDB/PHP/Perl) is a web server software. PHP, MariaDB, Perl and

Apache, FileZilla and MercuryMail can be installed with XAMPP to create a ready web server. phpMyAdmin is ready to use after XAMPP server installation. phpMyAdmin is an open source tool developed in PHP. Its main use is to manage MySQL database over the Internet. It is free software for creating and deleting databases, adding/changing/deleting tables, adding/changing/deleting fields, running SQL queries, managing users, authority and domain keys.

MySQL is a relational database management system. It supports many programming languages and can be used with multiple users.

2.3.1 Apache–MySQL–PHP package

A database is a collection of data with a predefined structure. The set of data it represents can range from as little as a shopping list to a large volume of information in a corporation's network. A database management system is needed to manipulate the data stored in a computer database [61]. One of the most popular database management systems is MySQL server; it uses the Structured Query Language commonly referred to as SQL. SQL is arguably the most commonly used standardized language for manipulating databases. SQL statements can be used in various ways, they might be entered directly or embedded into a code written in a different language, or use an API that hides the SQL syntax altogether. In our project, we will use the second option of embedding the SQL statements into a different programming environment [61-69].

2.4 Development of backend software processes

Figure 2.5 : Laravel logo.

Laravel (Figure 2.5) was chosen as the PHP Framework for the development of the backend software process for Diabetic Education and Monitoring System. Laravel is

an open source PHP framework, which is developed in PHP and OOP, and it has many advanced features and allows developing web applications.

2.4.1 Architecture

Laravel is a web application framework that tries to ease the development process by simplifying repetitive tasks used in most of today's web applications, including but not limited to routing, authentication, caching and sessions [70].

Since it manages to do all essential tasks ranging from web serving and database management right to HTML generation, Laravel is called a full stack framework. This vertically integrated web development environment is meant to offer an improved and smooth workflow for the developer [62-69].

Unlike other vertically integrated environments, Laravel is unique in its way of prioritizing convention over configuration. In fact, while many PHP frameworks demand a heavy-duty XML configuration before starting the actual project, Laravel needs only a few lines of PHP code to be edited and it becomes ready to use. Avoiding or using a minimum amount of configuration files gives all Laravel web applications a similar code structure, which is very characteristic and identifiable. This might be considered at first glance as a serious constraint on how a developer might wish to organize the structure of her/his own web application. However, these constraints make it actually a lot easier to build web applications [62].
The backend software is based on MVC architecture. MVC consists of the initials of Model, View, Controller words and each word represents a different layer of MVC.

2.4.2 MVC architecture

MVC architecture (Figure 2.6) was used in the Diabetic Monitoring System. MVC architecture is defined in three main headings.

2.4.2.1 Model layer

This layer is the most basic part of the software, which is a database process. In other words, it is the management structure of CRUD (Create-Read-Update-Delete) operations in the database. A Model is a mode by which the developer can manipulate the data. It consists of a layer residing between the data and the

application. The data itself can be stored in various types of database systems such as MySQL or even simple XML or Excel files [63-67-69].

2.4.2.2 View layer

This layer is actually the most visited place of the visitor. The View layer is a layer that is open to the public and allows the use of all layers. They can be easily built using the Blade template language that comes with Laravel or simply using plain PHP code. Blade is driven by template inheritance and sections. When Laravel renders these Views it examines first their file extension, and depending on it being either ".blade.php" or simply ".php", determines if Laravel treats our View as a Blade template or not [69-71-72].

2.4.2.3 Controller layer

This layer is the layer that provides the control of the software that as the name implies. It acts as a coordinator between View and Model layers. The Controller takes the user's data entry and then interacts with the Model layer to perform some operations and pass the result to the View layer. The developer has the option to write her/his business logic either in Routers or Controllers. Routers can be useful when dealing with a small web application, or in rapidly defining static pages. Writing Controllers for every single page of the web application is thus not necessary [63-69-73].

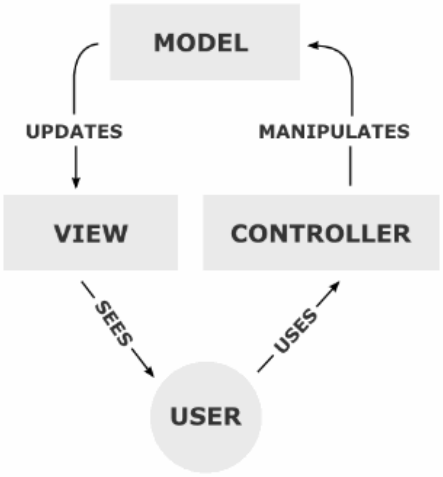

Figure 2.6 : MVC diagram.

2.4.3 Artisan command system

A developer would have to interact usually with the Laravel framework using a command line utility that creates and handles the Laravel project environment. Laravel has a built-in command-line tool called Artisan. This tool allows us to perform the majority of those repetitive and tedious programming tasks that most of the developers shun to perform manually [61-63-69].

Artisan can be utilized to create a skeleton code, the database schema and build their migrations, which can be very handy to manage our database system or repair it. We may as well create database seeds that will allow us to seed some data initially. It can also be employed to generate the basic Model, View and Controller files right away via the command-line and manage those assets and their respective configurations [61-63]. Artisan let us even create our very own commands and do convenient things with them such as sending pending emails to recipients or anything that can be necessary to properly run our web application. Unit tests for our web application can also be run through Artisan [61- 63].

Artisan CLI interface in Laravel system speeds the projects. Controller, Model, Migration can be created using Artisan interface. Artisan uses the command window to create and manage the Laravel Controller. It is called (CLI) PHP Artisan, which makes many things that the developer can do through console during development. Schema of an application can be added and edited with Artisan console. This structure allows you to create or update your database on your system without using the database management system.

Laravel (Figure 2.5) is a database system that works with the ActiveRecord mechanism built on the Eloquent ORM system. The Eloquent model can be used to query the corresponding database table, while at the same time it represents a particular row within the table.

ORM stands for Object Relational Mapping. ORM is a technique that connects relational and objects oriented programs and can use object models to manage information in the relational database. It is possible to access, control and query the database without writing SQL cues.

ORM is independent of the database, so same codes can be used for various databases such as MySQL, SQLite, PostgreSQL, MSSQL, and Oracle.

2.4.4 Database

2.4.4.1 Eloquent ORM

The Eloquent ORM provided with Laravel includes a simple PHP ActiveRecord implementation, which lets the developer issue database queries with PHP syntax where instead of writing SQL code, methods are simply chained. Every table in the database possesses a corresponding Model through which the developer interacts with said table [64-69].

2.4.4.2 Schema builder

The Laravel Schema class provides a database agnostic (i.e. can function with a multitude of DBMS) way of managing all database related work such as creating or deleting tables and adding fields to an existing table. It works with a multitude of databases systems supported by Laravel and MySQL being the default one. The Schema class has the same API across all of these database systems [65-69].

2.4.4.3 Managing the database with migrations

Migrations can be considered as a form of version control for our database. They allow us to change the database schema, describe and record all those specific changes in a migration file. Each Migration is usually associated with a Schema Builder to effortlessly manage our application's database. A migration can also be reverted or “rolled back” using the same said file [66-69].

2.4.5 Composer

Another feature that makes Laravel stand out from the other frameworks is that it is Composer ready. In fact, Laravel is itself a mixture of different Composer components; this adds a much-needed interoperability to the framework. Composer is a dependency management tool for PHP. Essentially, Composer’s main role in the Laravel framework is that it manages the dependency of our project’s dependencies. For example, if one of the libraries we are using in our project is dependent on three

other libraries and that there is a need to upgrade all those libraries, then there is no necessity to manually find and update any files. It is possible to update all four libraries via a single command through the command-line, which is, "$ composer update" [67-69].

Composer has the ability to manage a dependency up to a given nth level, meaning that all dependencies of our project can be managed via a single tool, which is a handy option to have when we are dealing with a multitude of libraries. Another advantage of using Composer is that it generates and handles an autoload file at the root of our vendor/ directory, which will contain all the project's dependencies that wire up the autoloading of classes when it is included in a PHP script. In doing so, there is no need from the developer side to remember all dependencies' paths and include each of them on every file of the project; she/he just needs to include the autoload file provided by Composer [63-68-69].

Composer is the way the PHP community is heading to, thus there are thousands of thoroughly tested packages already available in the Composer package archive. Laravel was designed in such a way that it integrates Composer packages easily. All that Composer needs to do is to read the contents of the composer.json file and connect to Packagist, which is an online repository of packages, to resolve all the dependencies, recursively. These dependencies are then downloaded to our local directory called vendor/, and then their state is recorded to a file named composer.lock [69- 71].

2.5 Necessary configuration for diabetic monitoring system

In order to use the DIMS locally, five installation and configuration steps must be achieved. These steps are;

1- Installation of environmental variables
2- Creating MySQL Database
3- Laravel configuration settings
4- Laravel Artisan commands
5- Work locally

2.5.1 Installation of environmental variables

There are two steps for the installation of environmental variables. Environment variables can be set according to the operating system used and project files can be run on Linux, Windows, and Mac.

2.5.1.1 Installation of composer

Composer is a dependency management tool for PHP. It allows you to define, build and update the libraries your project needs.

Install the composer version from **https://getcomposer.org/** that is suitable for your operating system. Make sure composer is added to your system path for Windows. In order to verify this path of Composer must be at "Advanced system settings > Environmental variables > Path".

2.5.1.2 Installation of PHP

Hypertext Preprocessor (PHP) is a web-based, server-side, widely used, embeddable in HTML, and general purpose scripting and programming language.

Complete the PHP installation by following the appropriate installation steps for your operating system at **http://php.net/manual/en/index.php** under the name of the configuration installation heading.

If you do not want to install PHP manually, you can continue the process by installing WampServer [72], XAMPP [74].

2.5.2 Creating MySQL database

Create a database to keep all data of the system with MySQL command line or other SQL interfaces.

In order to do this; enter data from the phpMyAdmin page by typing the following code at the command line.

"CREATE DATABASE IF NOT EXISTS `diyabet_sys` DEFAULT CHARACTER SET utf8 COLLATE utf8_general_ci;"

Once the database table is created, the text file with the SQL extension given in the setup file is imported.

2.5.3 Configuring Laravel configuration settings

Enter and save the MySQL database name, MySQL username, and MySQL password in the env file in the root directory of the project (Figure 2.7).

```
DB_CONNECTION=mysql
DB_HOST=127.0.0.1
DB_PORT=3306
DB_DATABASE=veritabanismi
DB_USERNAME=mysql_kullanici_adi
DB_PASSWORD=mysql_parola
```

Figure 2.7 : Configuration settings of database.

2.5.4 Processing Laravel Artisan command lines

Once you have completed the above steps, open the command line in the project root directory and enter the commands below one by one.

2.5.4.1 Creating database tables

To create the database tables *"php artisan migrate"* command is used.

2.5.4.2 Adding the first user admin

To add the first user admin "php artisan tinker" command is used. After typing this command, the tinker command line will be opened. Then enter the following command while in tinker command. Command lines can be customized personally and other admins are created.

"DB::table('users')->insert(['isim'=>'Elif','soyisim'=>'Özciftci,'email'=> 'hafsaelif@gmail.com','d_tarihi'=>'1992-10-17,'telefon'=>'05309491710','admin'=>'1','password'=>bcrypt('123123'),'online' =>'0']);"

2.5.4.3 Local file save configuration

Prior to running the project, in the root directory; *"php artisan config:cache"* command must be entered. With this command, the address of the root directory of the computer that the project has previously worked in has been cleared, and then the current root directory of work, will be provided.

After this process is completed, *"php artisan storage:link"* command will be entered to eliminate the possible problems to save the files that worked on locally. If the problem is still present in the attachments added, the same folder can be restored by running the same commands after backing up the folder named storage in the public folder of the project file.

2.5.5 Running in local environment

After completing all the steps correctly, from the root directory of the project; *"php artisan serve"* can make the project run.

This project uses the following address as its local broadcast address: http://127.0.0.1:8000

3. SOFTWARE REALISATION

3.1 Diabetic education and monitoring system

It is aimed to monitor the treatment and education process with designed Diabetic Education and Monitoring System. Administrative and user panels provide a managerial control over the education and treatment of diabetics. The administrators need to have adequate knowledge and experience in order to follow the training and treatment of diabetics. Users identified as administrators may be healthcare personnel, as well as software and design personnel to receive system feedback and follow systematic improvements. It is aimed that the system will be developed by the health personnel, systematic troubles and feedbacks come from the users who are in the diabetes treatment process.

3.1.1 Design of DIMS

DIMS is based on two different authority users. These authorities are divided into administrators (health professional or system responsible) and users (diabetics). Users with administrative authority are responsible for technical management of the system as well as for monitoring the education, questionnaires and data entry of diabetics.

3.1.1.1 Home page of DIMS

Access to the system is provided on the home page (Figure 3.1). On the top banner, there is Announcements and Frequently Asked Questions (faq) tabs that can be accessed by all users, even who are not registered to the system. To log in to the system, use the "Login" button on the top banner or the "Login to System" button on the main page.

At the bottom of the home screen (Figure 3.2), there are links to the Ministry of Health for easy access for users, and possible social-media links to be set up by the administrators.

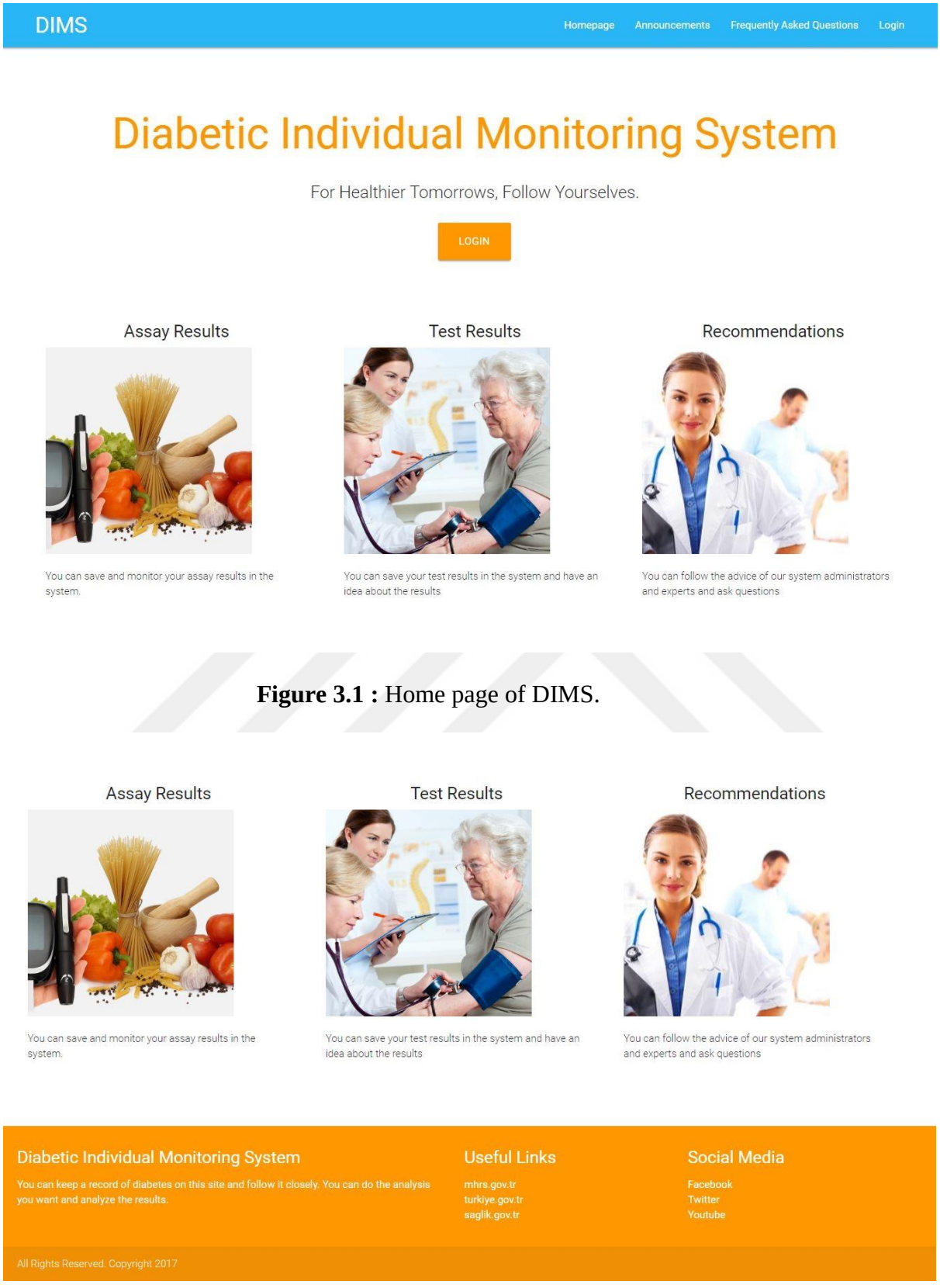

Figure 3.1 : Home page of DIMS.

Figure 3.2 : Useful links and social media links of DIMS.

3.1.1.2 Announcements tab

Announcements page can be accessible with anyone even a member or nor of the system.

This tab allows patients to access announcements added by system administrators. It is aimed to be able to follow the information of systematic changes, innovations or added education (Figure 3.3).

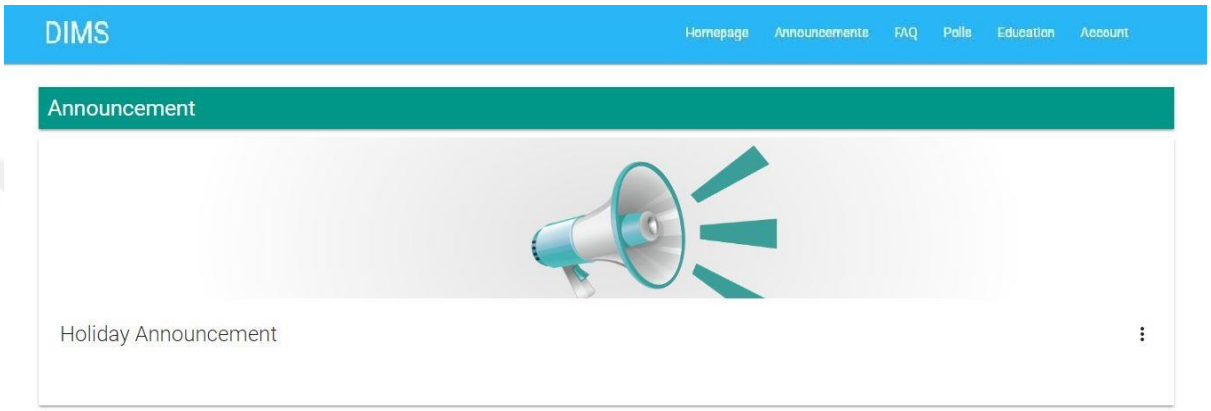

Figure 3.3 : Announcements tab.

3.1.1.3 Frequently asked questions tab

Frequently Asked Questions is a page that includes the questions asked by diabetics who registered to the system. It is aimed that to raise awareness of diabetics and to publish of general problems that diabetic face (Figure 3.4).

Figure 3.4 : Frequently asked questions tab.

3.1.1.4 Login page

Login page allows users to log in to the system with an e-mail and password. There are two different user profiles in the system, which are diabetic, and admins. Diabetic and admin pages are designed for both user profiles. The user is directed to one of these screens according to the authority registered on the database (Figure 3.5).

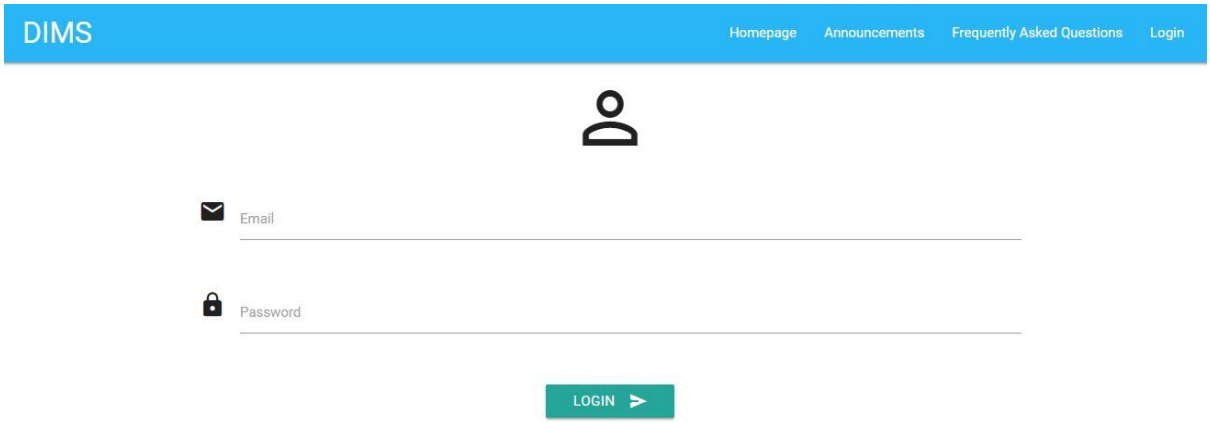

Figure 3.5 : Login page.

3.1.2 Diabetic's user profile

This page allows diabetics to be able to reach easily to the submenus of the system. There are tabs where diabetic can access the account information (Figure 3.6).

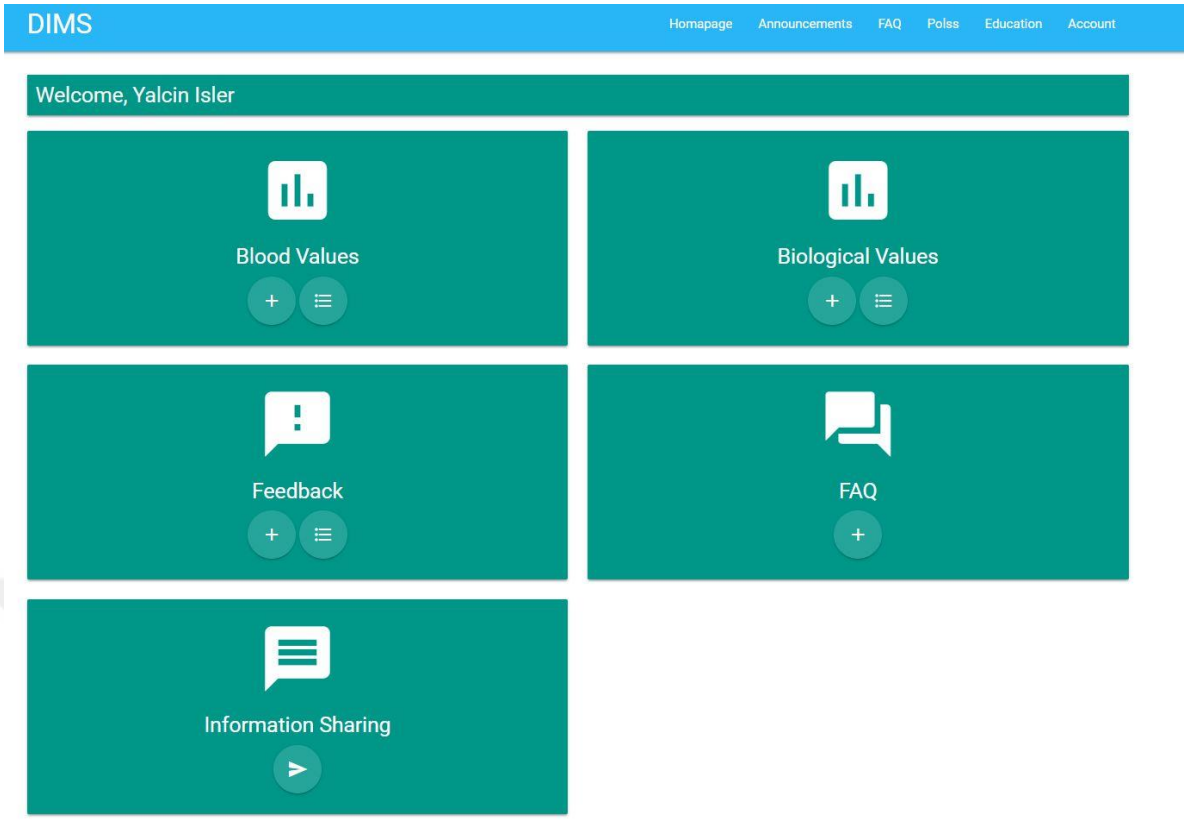

Figure 3.6 : User profile page.

3.1.2.1 Blood glucose entry page

Blood Glucose Entry Page allows the diabetic easily to add daily, weekly, monthly blood values to the system (Figure 3.7). The administrator can follow the data that the diabetic has entered. Diabetics can get information about fasting blood sugar, postprandial blood sugar, pulse and blood pressure. Diabetics can record entry by entering at least one of the stated values.

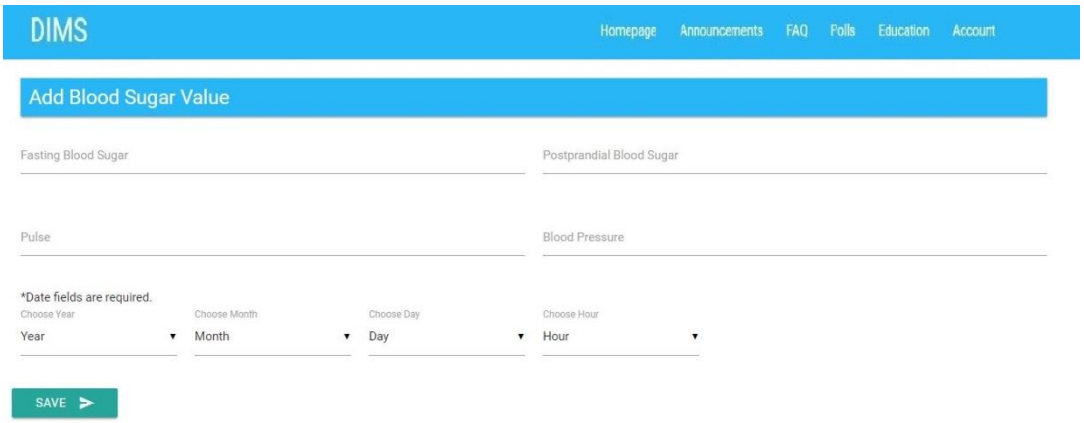

Figure 3.7 : User profile blood value entry page.

3.1.2.2 Display screen of blood value

The blood value input of diabetic can be accessed by the determined date range with a display screen of blood value. Diabetics can enter both blood glucose values at the same time. Diabetics can select the desired date range op the appearing page (Figure 3.8). Through the directed page, diabetic also has authority to edit and delete entries and that he/she has access to the reports of the graphical data displayed on the screen (Figure 3.9).

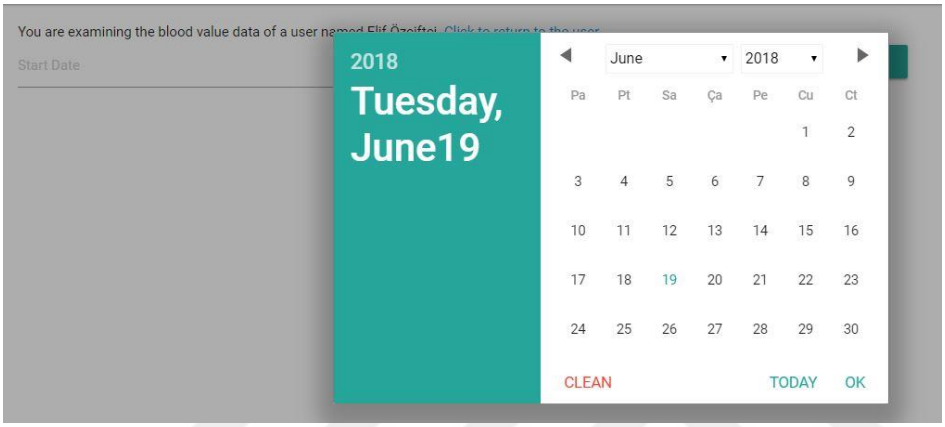

Figure 3.8 : Blood value listing date selection page.

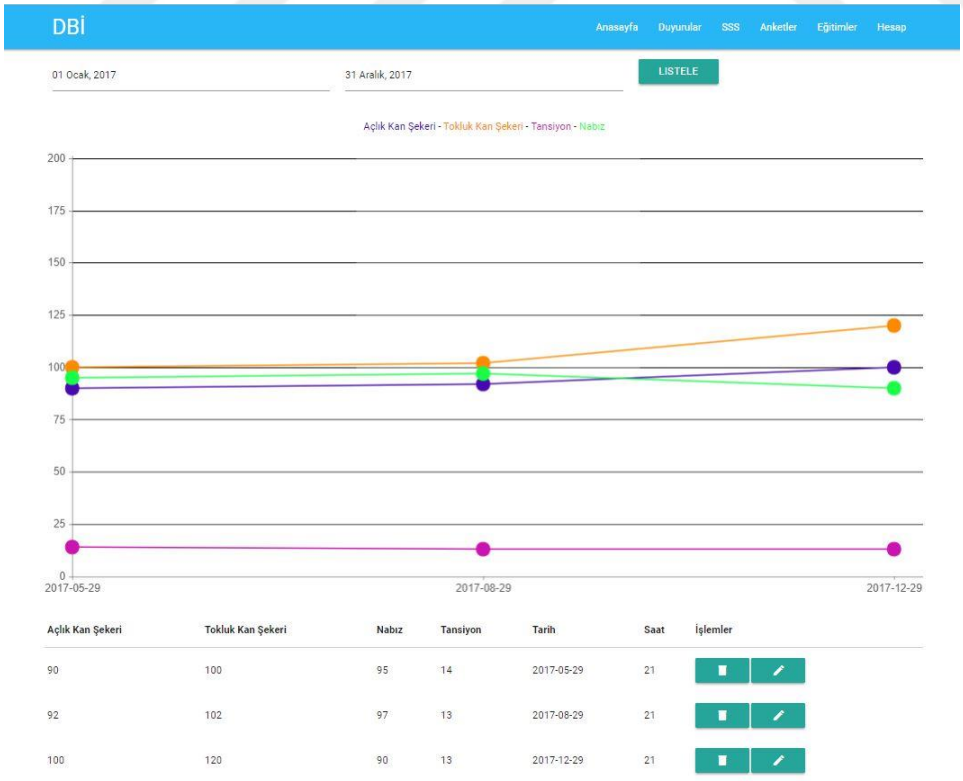

Figure 3.9 : Blood value listing page.

Diabetics can correct the desired blood glucose entries with the help of the edit button in the operations section on this page (Figure 3.10) and also can delete the entries with the delete button (Figure 3.11).

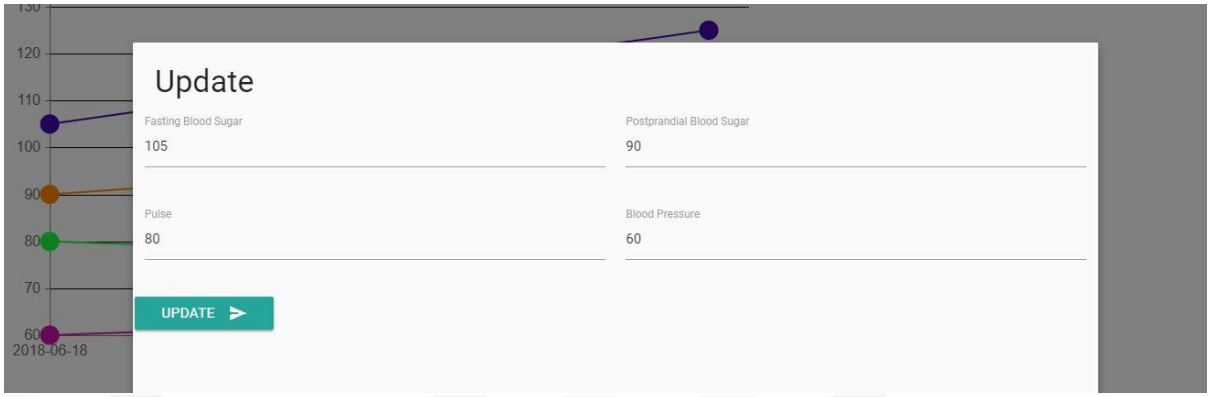

Figure 3.10 : Blood value editing page.

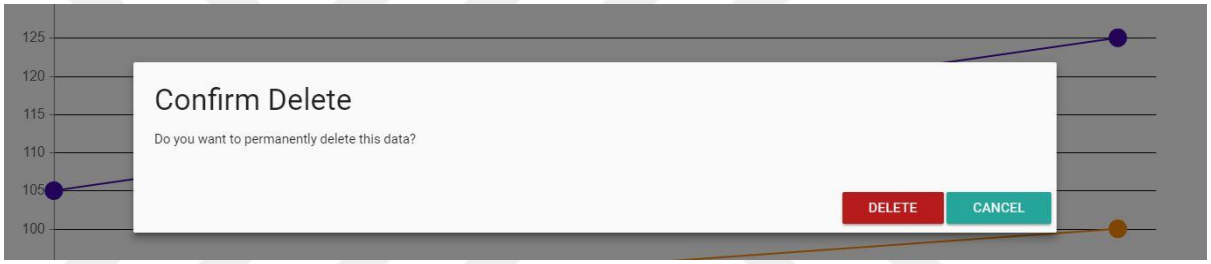

Figure 3.11 : Blood value deleting page.

3.1.2.3 Biologic value entry page

Diabetics can enter the HbA1c, LDL, HDL, Triglyceride values on biologic vale entry page (Figure 3.12). A recording is done by adding date and time. The record can be completed by entering at least one blood value. The administrator can follow the data that the diabetic has entered.

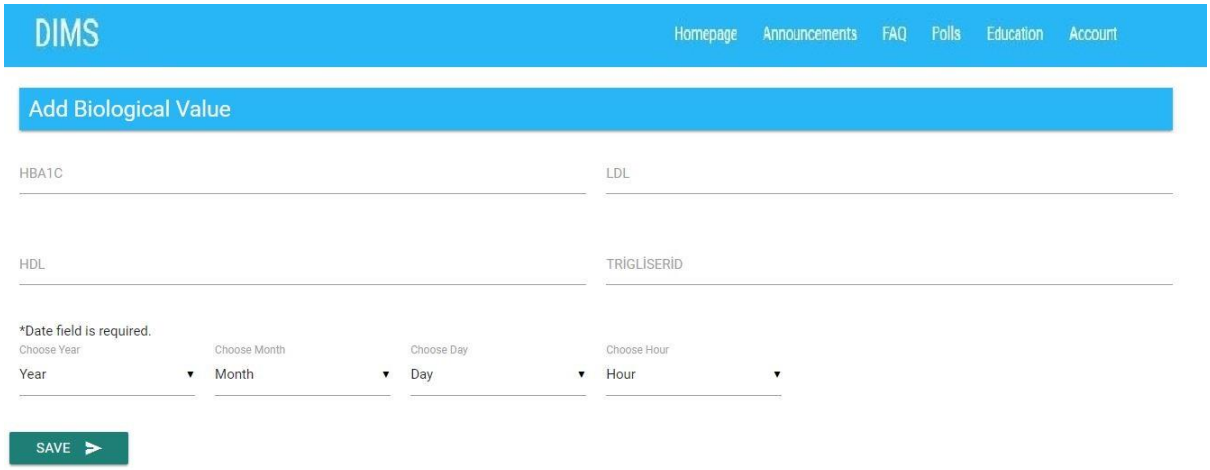

Figure 3.12 : User profile biological value entry page.

3.1.2.4 Biological value display page

Diabetics can access the data on a determined date with biological value display page. With this page, diabetic also has authority to edit and delete entries and that he/she has access to the reports of the graphical data displayed on the screen (Figure 3.13).

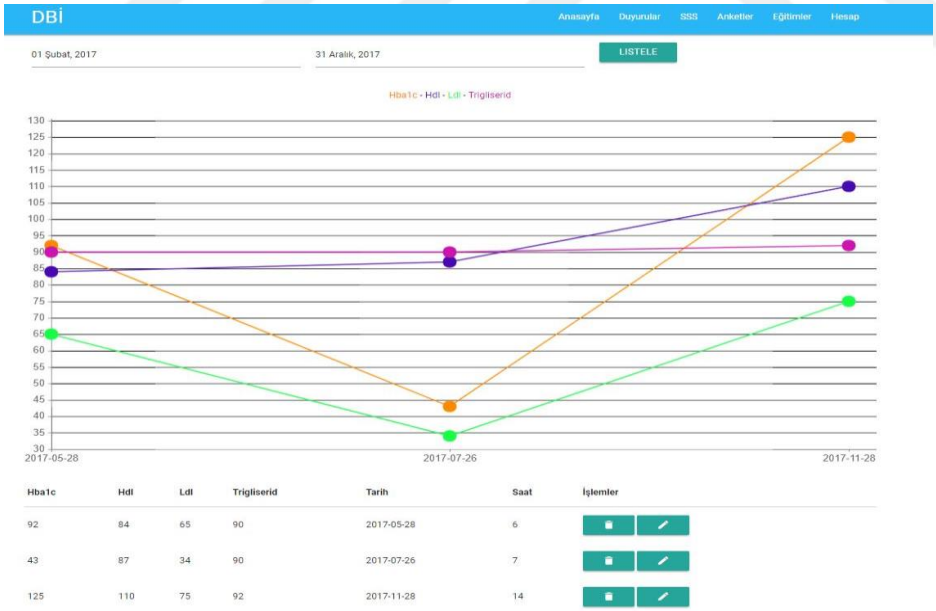

Figure 3.13 : Biological value listing page.

Diabetics can correct the desired blood glucose entries with the help of the edit button in the operations section on this page (Figure 3.14) and also can delete the entries with the delete button (Figure 3.15).

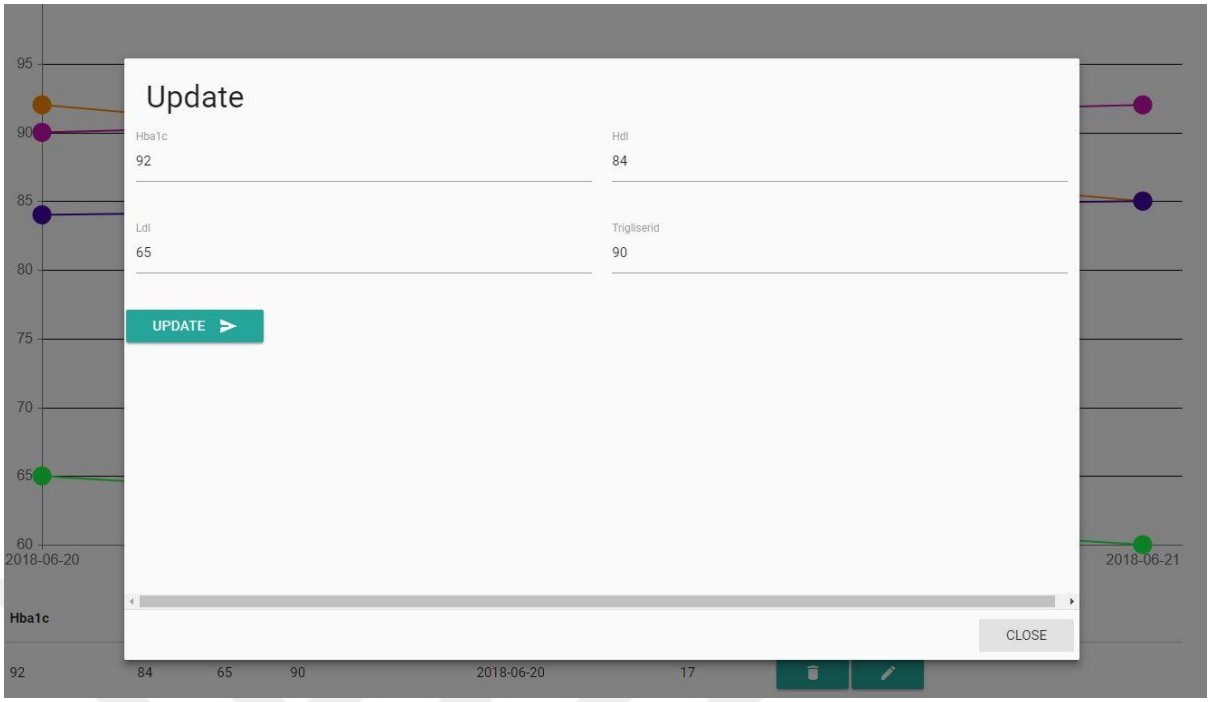

Figure 3.14 : Biological value editing page.

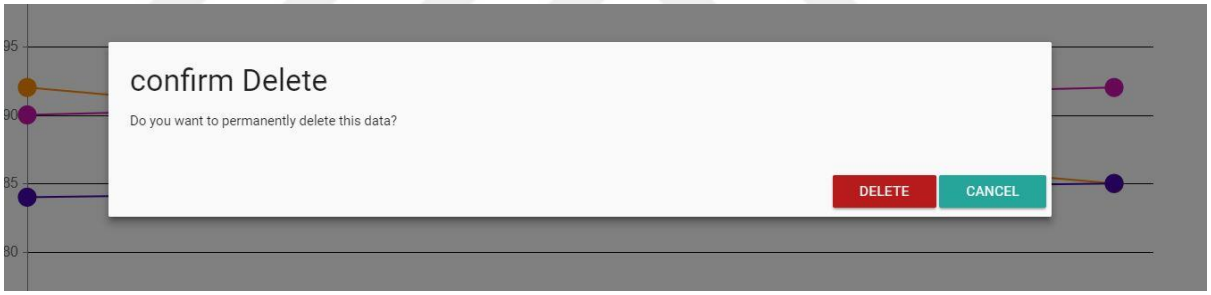

Figure 3.15 : Biological value deleting page.

3.1.2.5 Feedback adding and listing page

Feedback adding and listing page provides diabetics to share questions, opinions, and suggestions about the system. Opinions of diabetics help to prevent the problems that may occur in the system. Feedbacks are transmitted to admins by not sharing personal information of diabetics (Figure 3.16). It is aimed to produce a quick and effective solution to the systemic problems of the diabetics. With the display list of feedbacks (Figure 3.17), the diabetics can follow the feedback he/she has done before and search in the feedbacks.

Figure 3.16 : User profile feedback adding page.

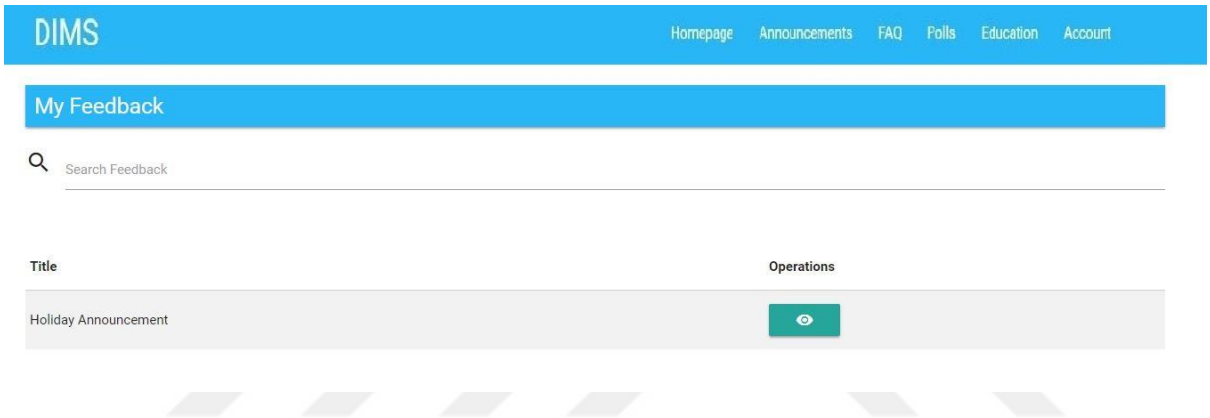

Figure 3.17 : User profile feedback listing page.

In order to see the details of the feedback, display button on the operations can be used to display corresponding feedback (Figure 3.18).

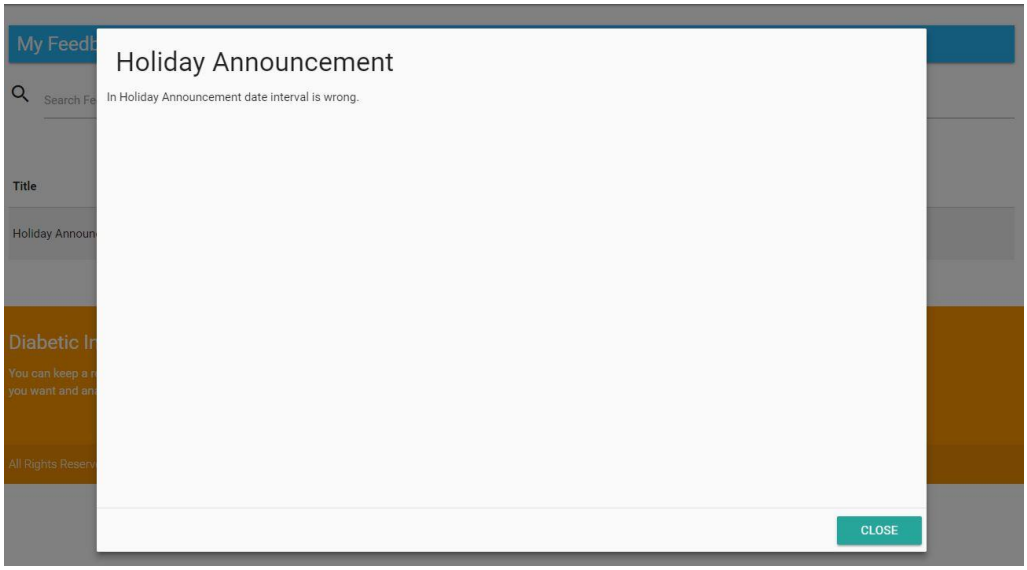

Figure 3.18 : Feedback viewing page.

3.1.2.6 Frequently asked questions adding page

Diabetic can interact with the admins in the system about the education process (Figure 3.19) on this page. Diabetic can get answers from admins by asking questions with this page. Admins can set the questions to the public by publishing the questions and send mail to the diabetic with the integrated mail system.

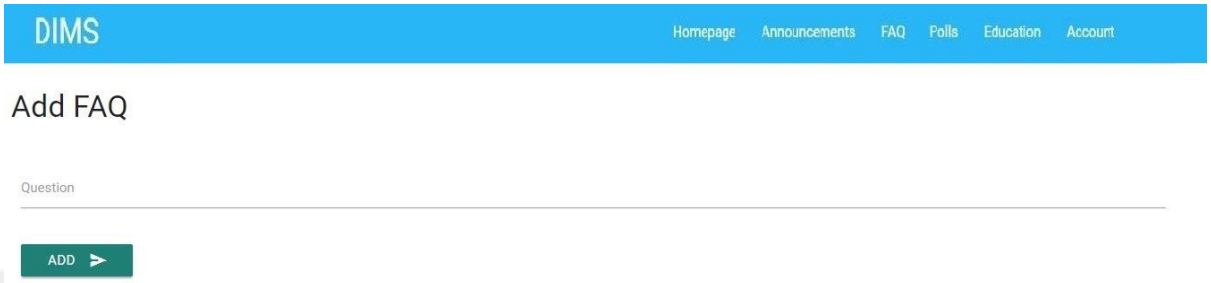

Figure 3.19 : User profile faq adding page.

3.1.2.7 Knowledge sharing screen

Diabetics can communicate with each other (Figure 3.20). Online admins can be seen on this page. Diabetics can get fast feedbacks, share suggestions and opinions with knowledge sharing systems.

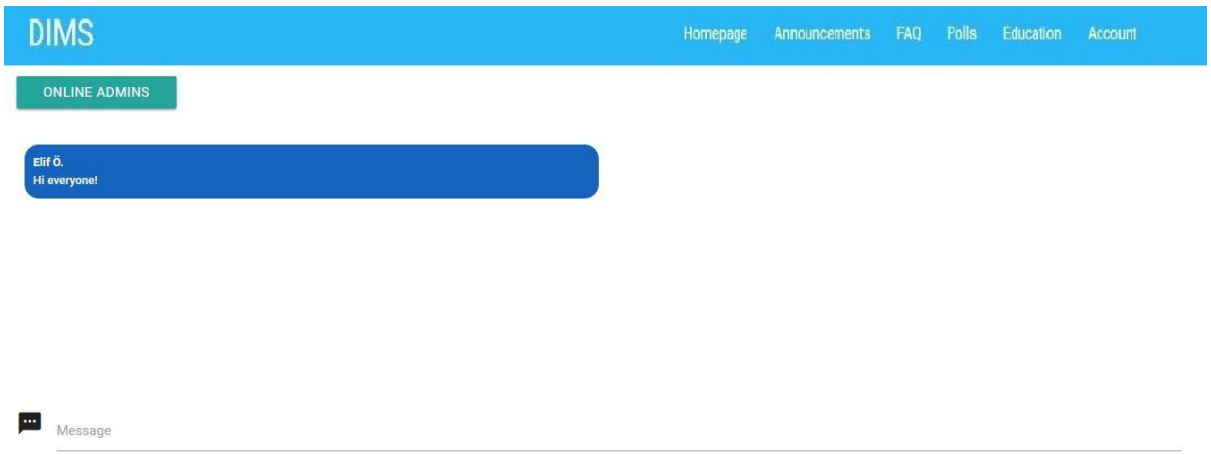

Figure 3.20 : User profile information sharing page.

3.1.2.8 Polls

Diabetics participate in polls organized by admins (Figure 3.21, Figure 3.22). Results of the polls are shared proportionally by admins without sharing user information.

Confidentiality is aimed with this method. After diabetic participated in the polls, the polls are removed from the list.

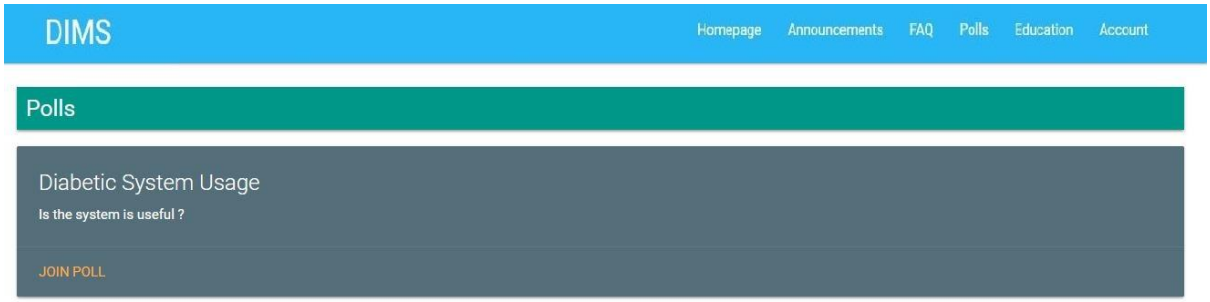

Figure 3.21 : User profile polls page.

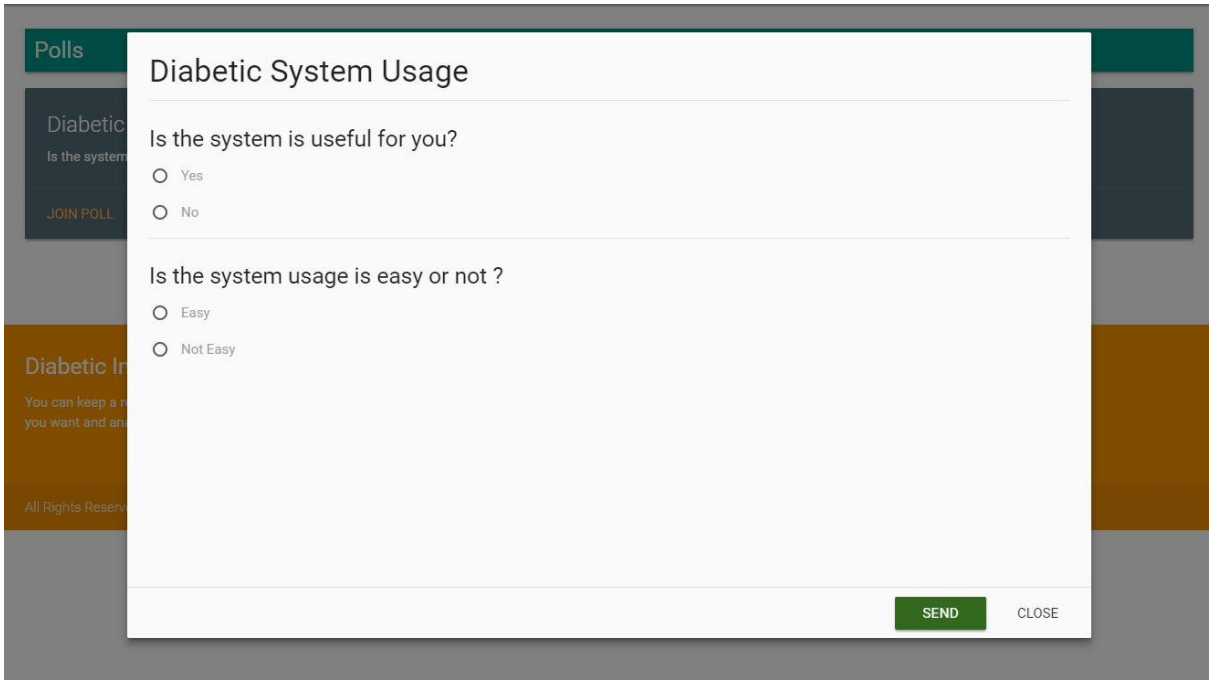

Figure 3.22 : User profile polls viewing page.

3.1.2.9 Education tab

Diabetics can reach the educations added by the admins (Figure 3.23). Diabetic can complete his/her education by reaching the materials. The system also targets the development of diabetic besides monitoring diabetes. Education of diabetic is the most accurate way to monitor diabetes.

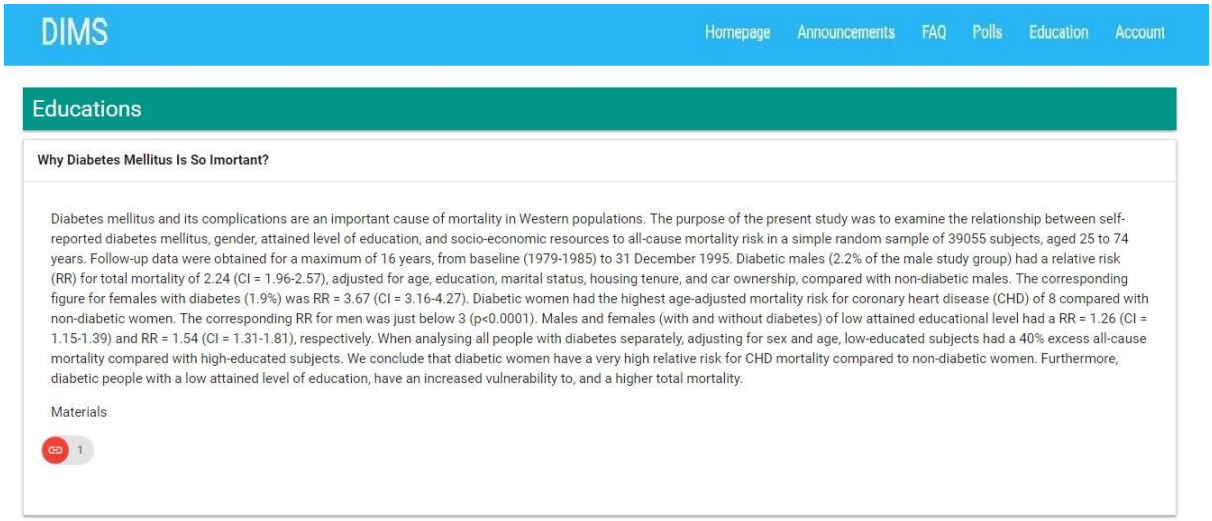

Figure 3.23 : User profile education adding page.

3.1.2.10 User profile page

Diabetics are able to log off user accounts, view profile information (Figure 3.25), and update the profile (Figure 3.24). Diabetic can also check the incoming (Figure 3.26) and outgoing (Figure 3.29) mailboxes. He/she can read incoming messages (Figure 3.27) and delete (Figure 3.28) when necessary. Diabetics can write to admins or other diabetics and communicate with each other (Figure 3.30).

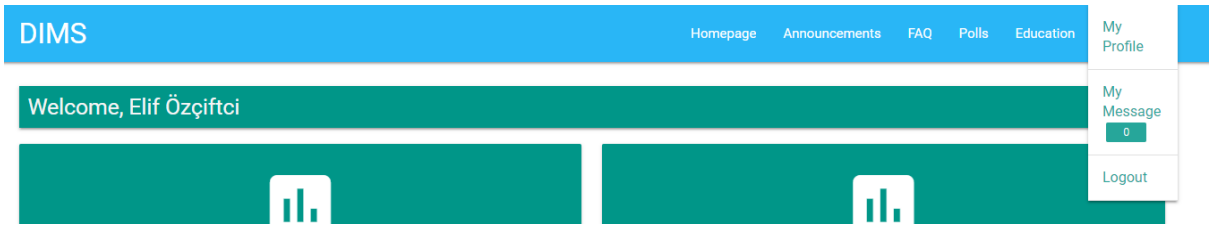

Figure 3.24 : User profile account page.

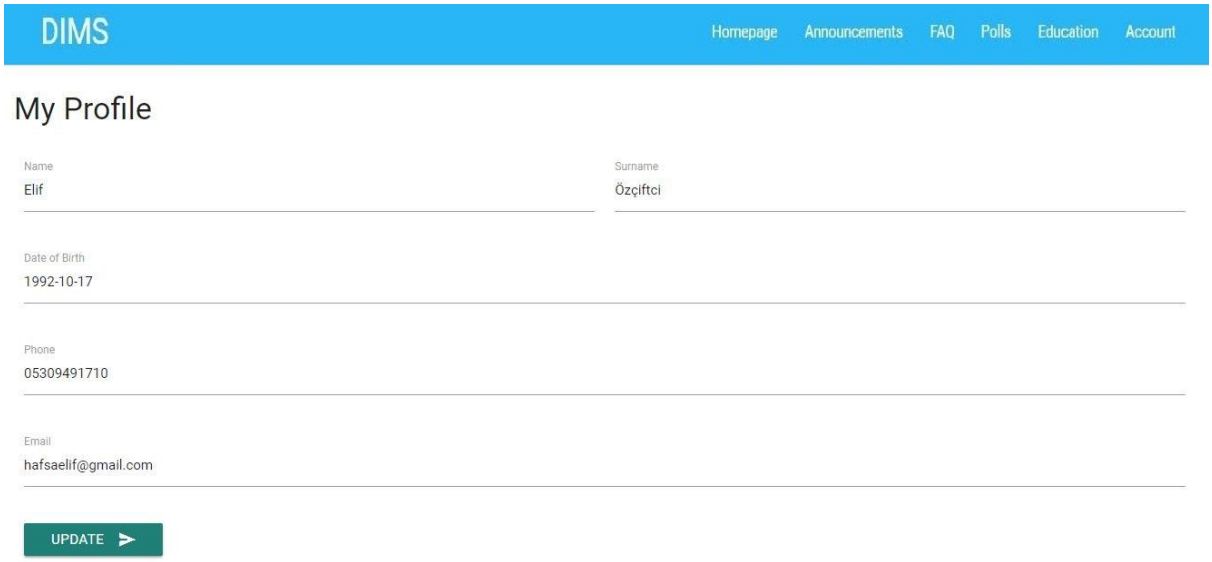

Figure 3.25 : User profile my profile page.

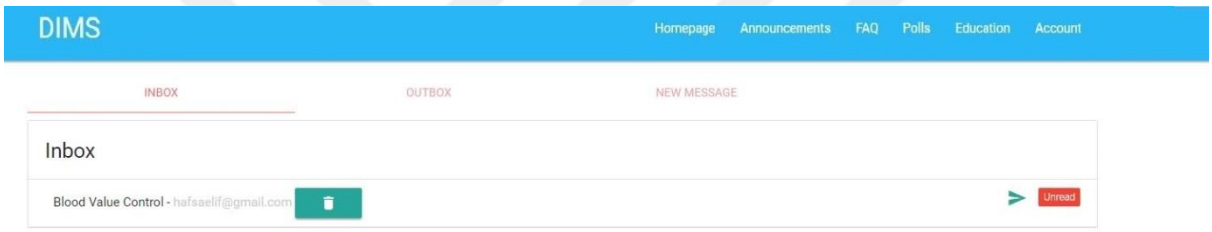

Figure 3.26 : User profile inbox page.

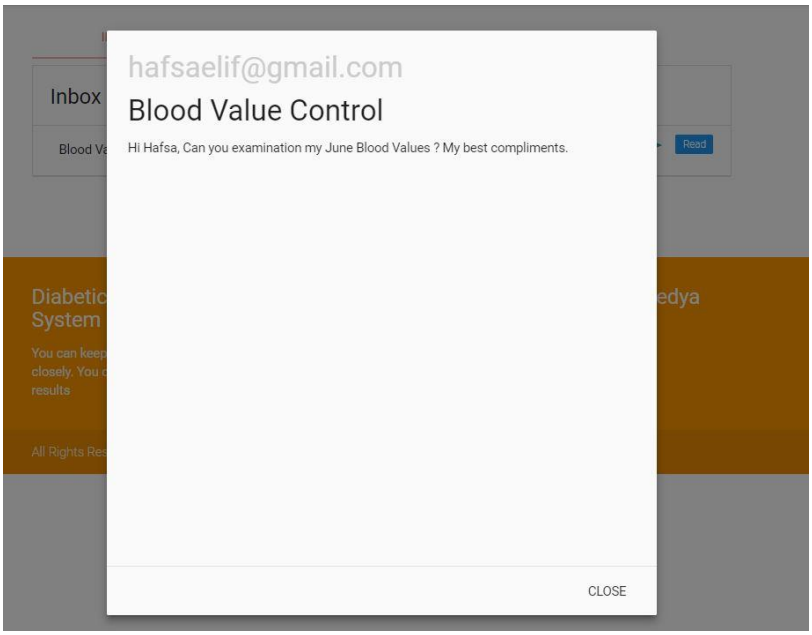

Figure 3.27 : User profile inbox reading page.

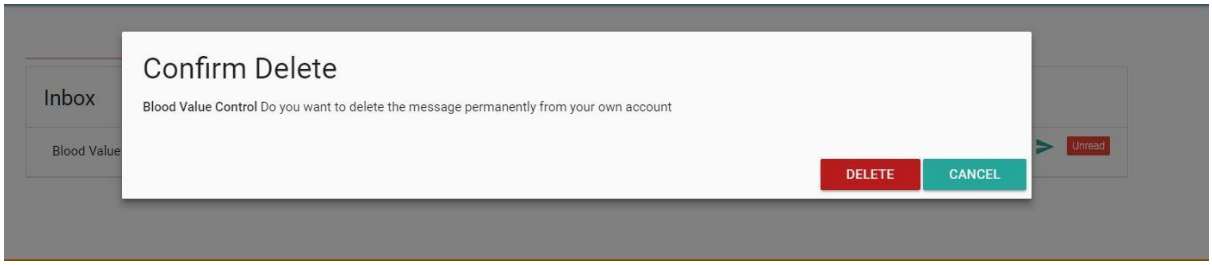

Figure 3.28 : User profile inbox deleting page.

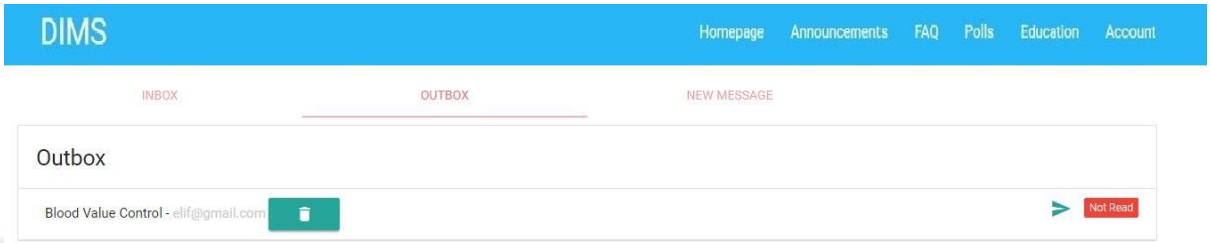

Figure 3.29 : User profile outbox page.

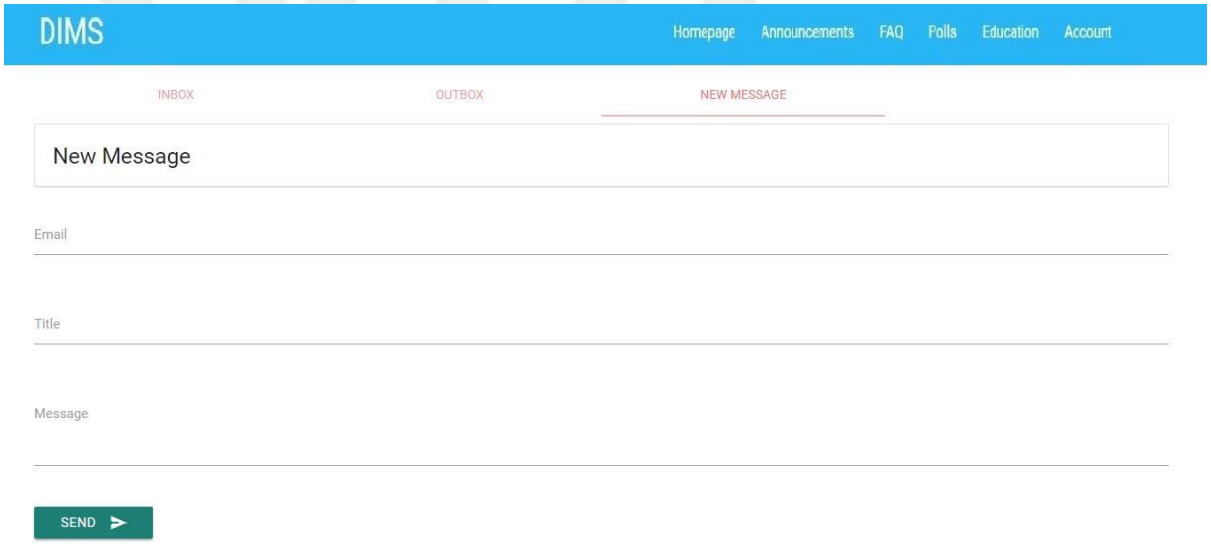

Figure 3.30 : User profile creating a new message page.

3.1.3 Diabetic monitoring system administrator profile

Users with administrator authority can access the DIMS Admin page (Figure 3.31, Figure 3.32). Administrators manage diabetics and the system with this page. Admins can leave notes about the followed-up users. In addition, admins communicate directly with diabetics when false data entry or anomalies of values. So, it is prevented that wrong nutrition, wrong data entry or any problems that may occur in blood and biological values.

Admins can create polls for users and these polls can be followed up as well. Admins can create educations that may have a positive influence on diabetics as well as the polls. Admins can enhance the education by adding visuals to written papers to the educations.

Knowledge Sharing page is located on the admin's page. Admin can define himself/herself as Online or Offline with the help of the button on the home page. Admins are added to the Online Admins List, which is located on Knowledge Sharing page.

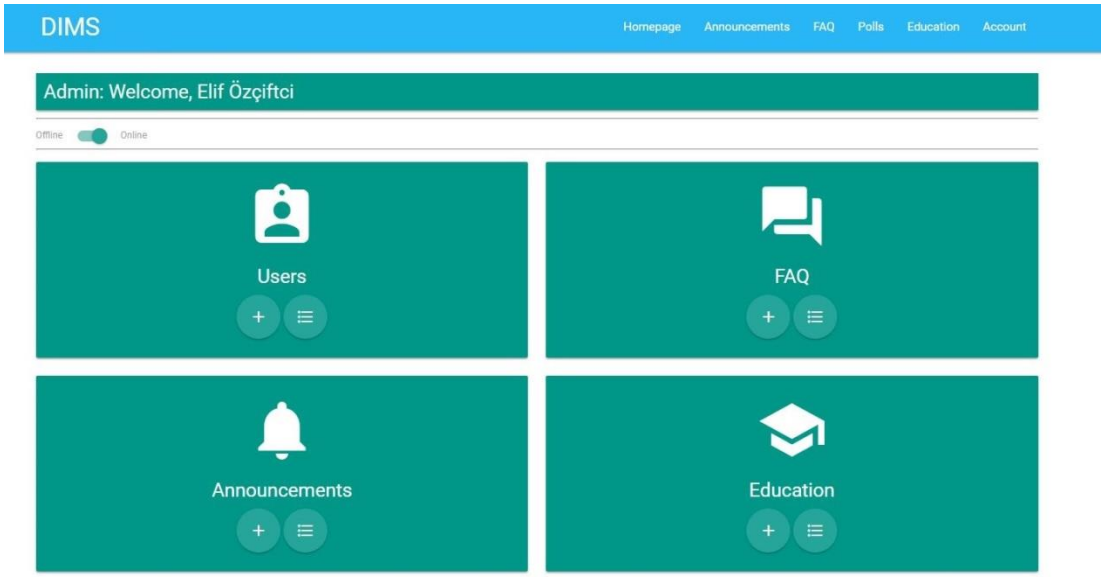

Figure 3.31 : Admin profile top side.

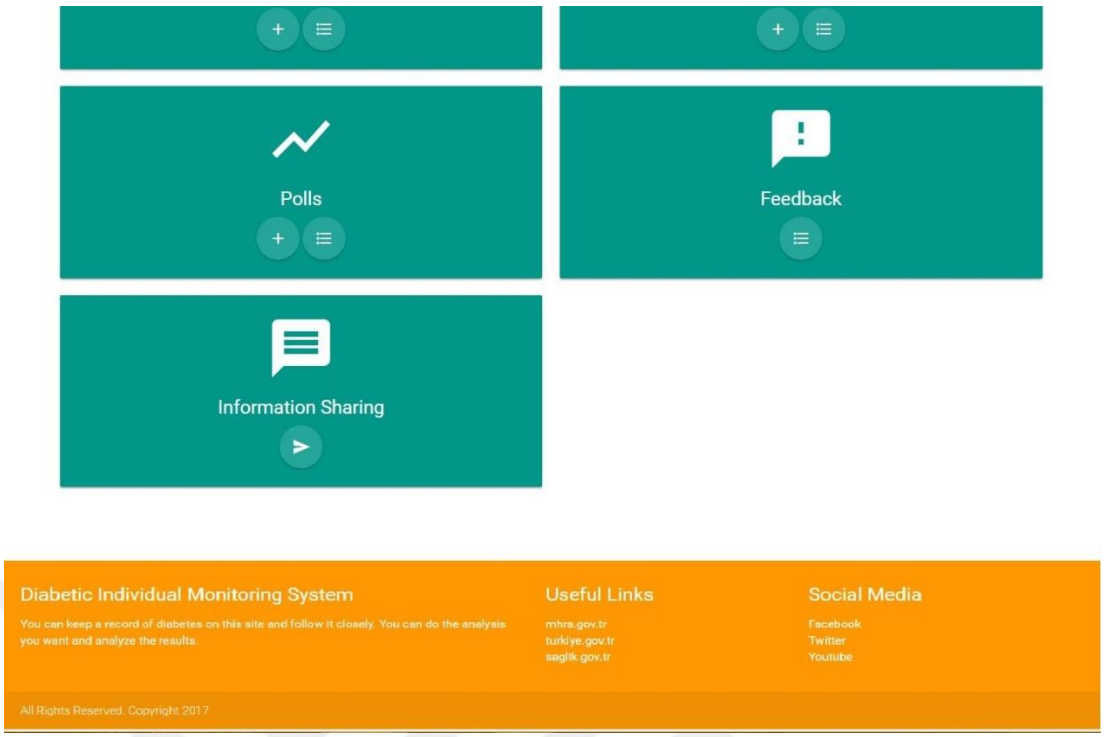

Figure 3.32 : Admin profile bottom side.

3.1.3.1 User listing page

Admins can access the list of users registered to the system with user list page. Blood values and biological information recorded in a system can be monitored as graphics. Notes can be added to the user (Figure 3.37), the status of the user can be listed (Figure 3.33) users can be removed from the system (Figure 3.35) and user information can be edited (Figure 3.36) in operations menu (Figure 3.34), by admins.

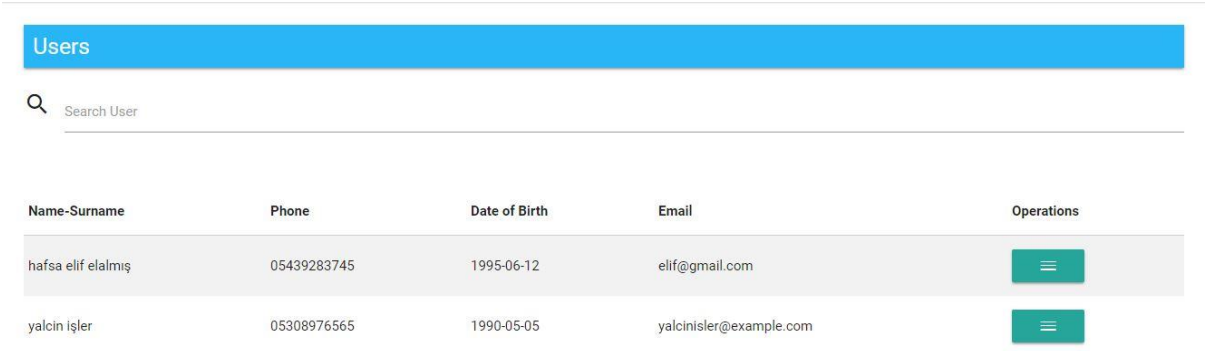

Figure 3.33 : Admin profile user listing page.

Figure 3.34 : Admin profile user listing operations menu.

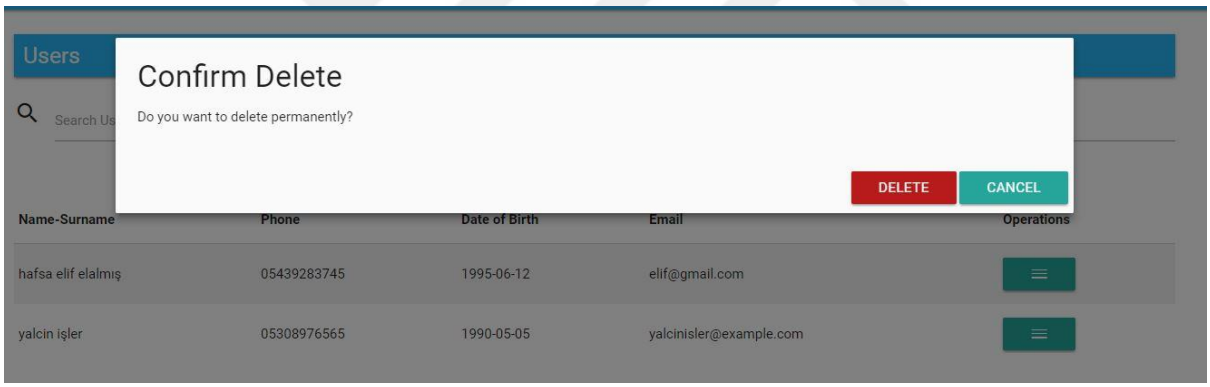

Figure 3.35 : Admin profile user deleting page.

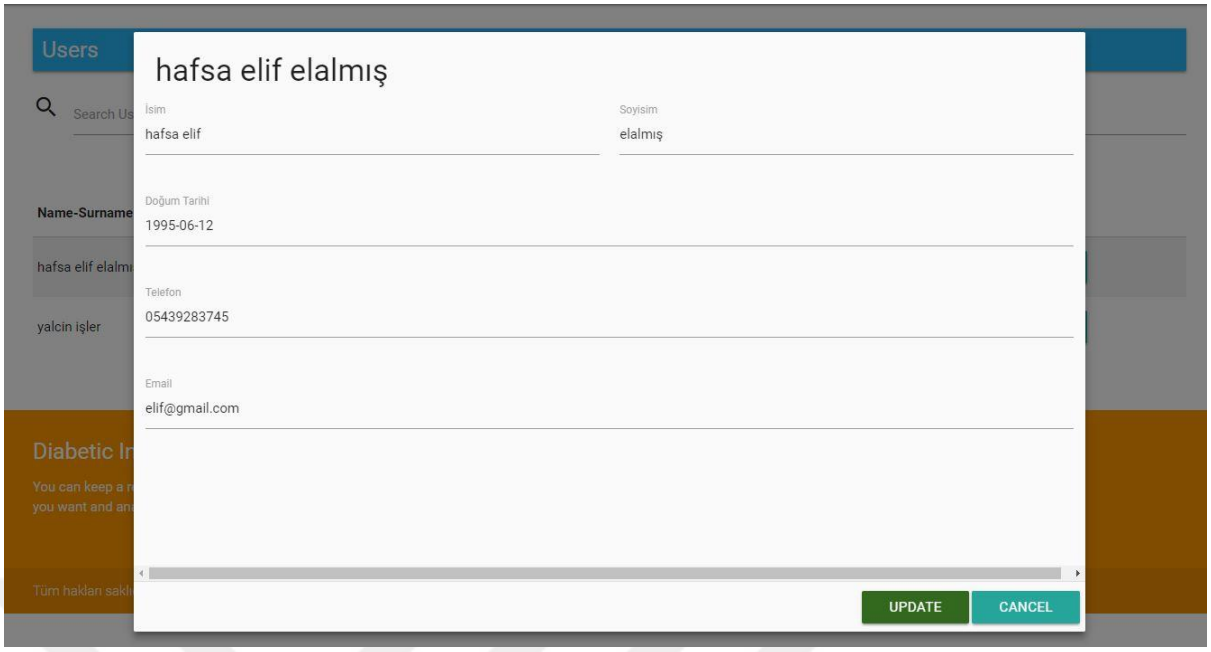

Figure 3.36 : Admin profile user editing page.

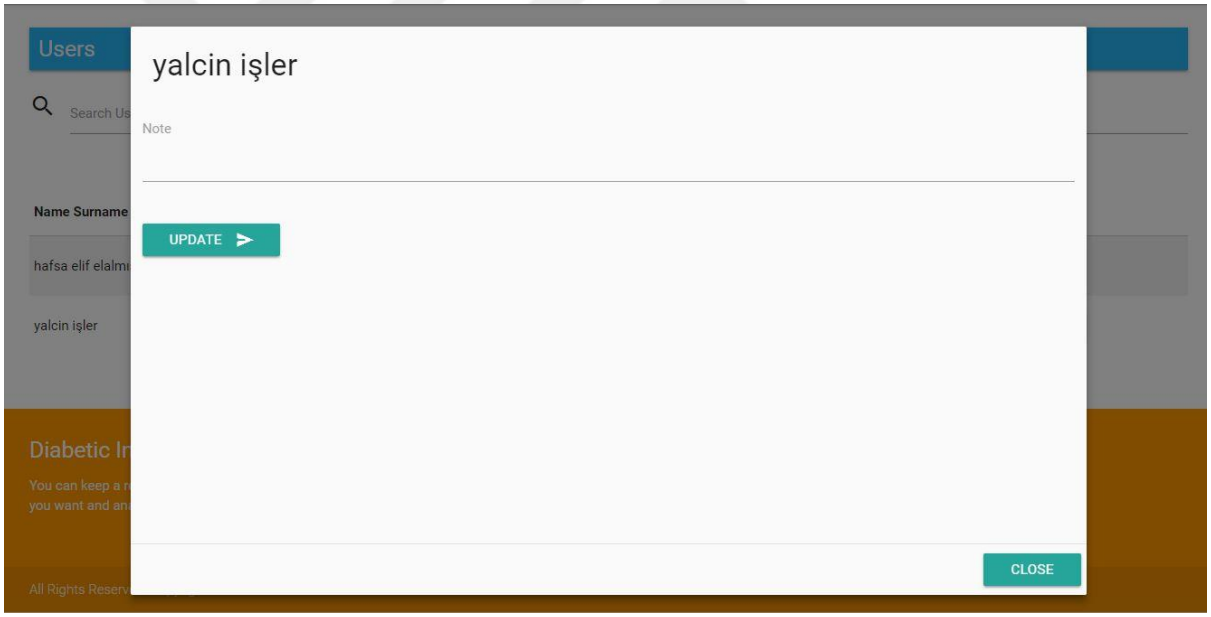

Figure 3.37 : Admin profile adding and editing notes page.

Admin can access the biological and blood values of diabetics who registered to the system with operations button (Figure 3.38, Figure 3.39).

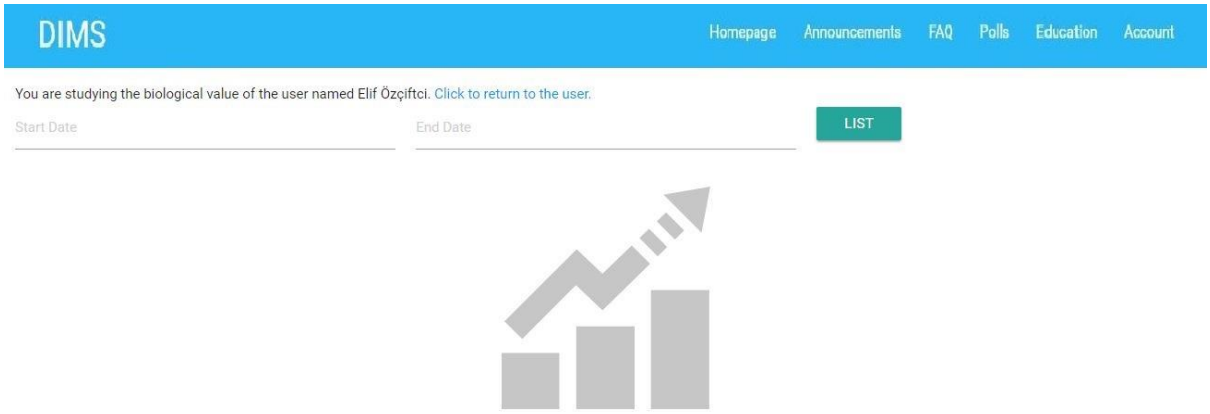

Figure 3.38 : Admin profile biological value listing page.

Figure 3.39 : Admin profile blood value listing page.

3.1.3.2 Add user page

Admin can add a new diabetic user to the system as well as a new admin. With adding name-surname, date of birth, phone, e-mail, and password that is used to login to the system, the new user becomes created. If the new user is an admin, the user is added by ticking the admin box (Figure 3.40).

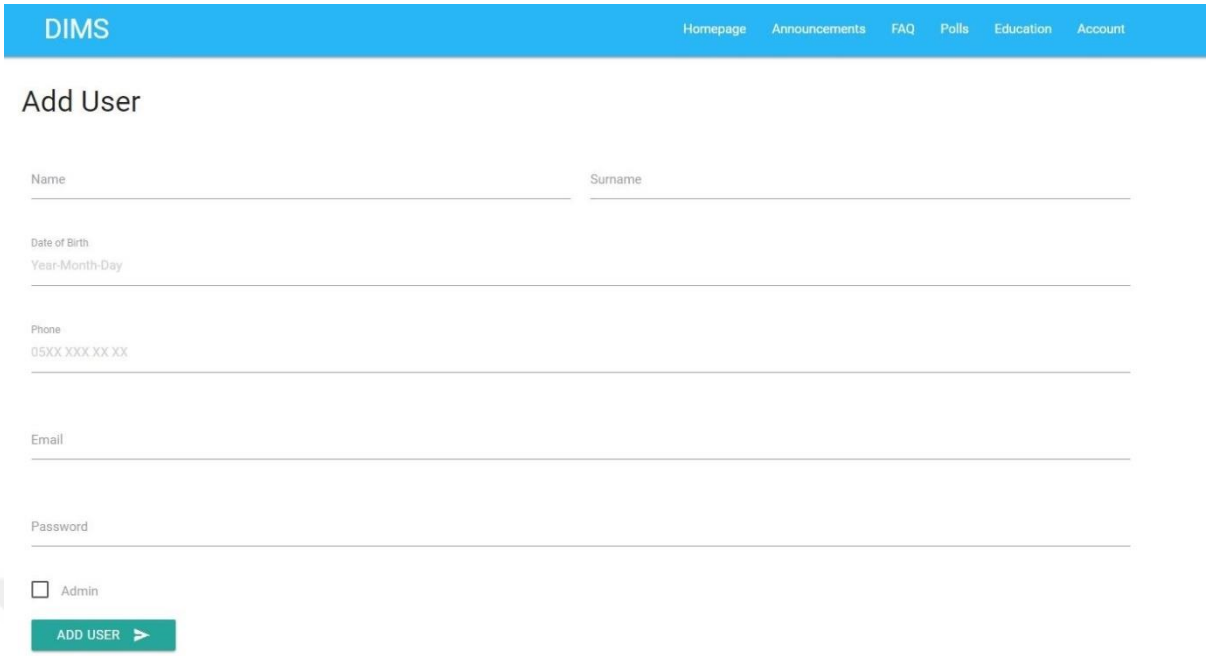

Figure 3.40 : Admin profile adding new user page.

3.1.3.3 Add faq page

Admins can share information for diabetics after researches to raise awareness, as well as questions from diabetics on faq page (Figure 3.41).

Figure 3.41 : Admin profile faq adding page.

3.1.3.4 Faq listing page

Admin can follow added faqs (Figure 3.42), the unanswered faqs can be answered, faqs can be edited (Figure 3.43) and deleted (Figure 3.44). At the same time, admins can publish and release the desired faq bi the listing page (Figure 3.45).

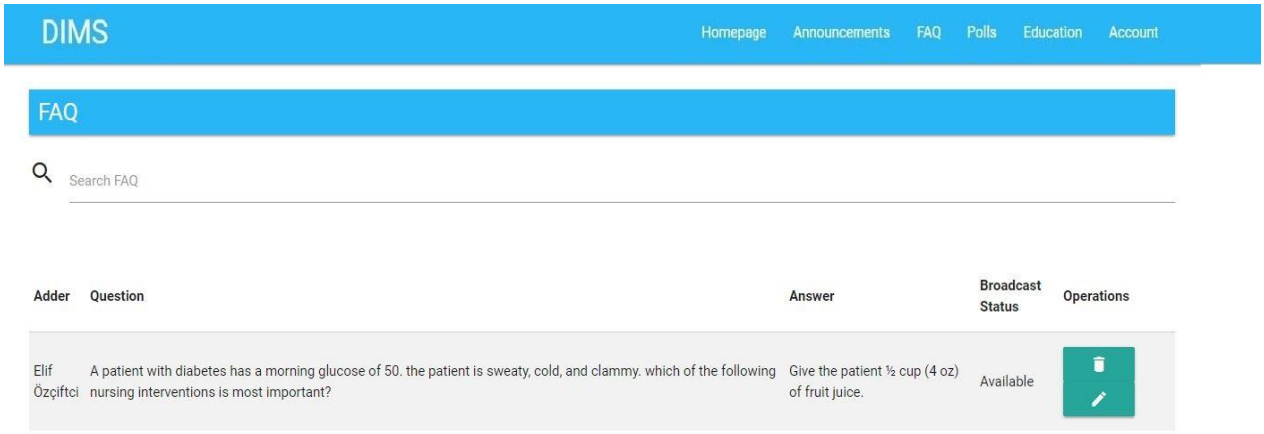

Figure 3.42 : Admin profile faq listing page.

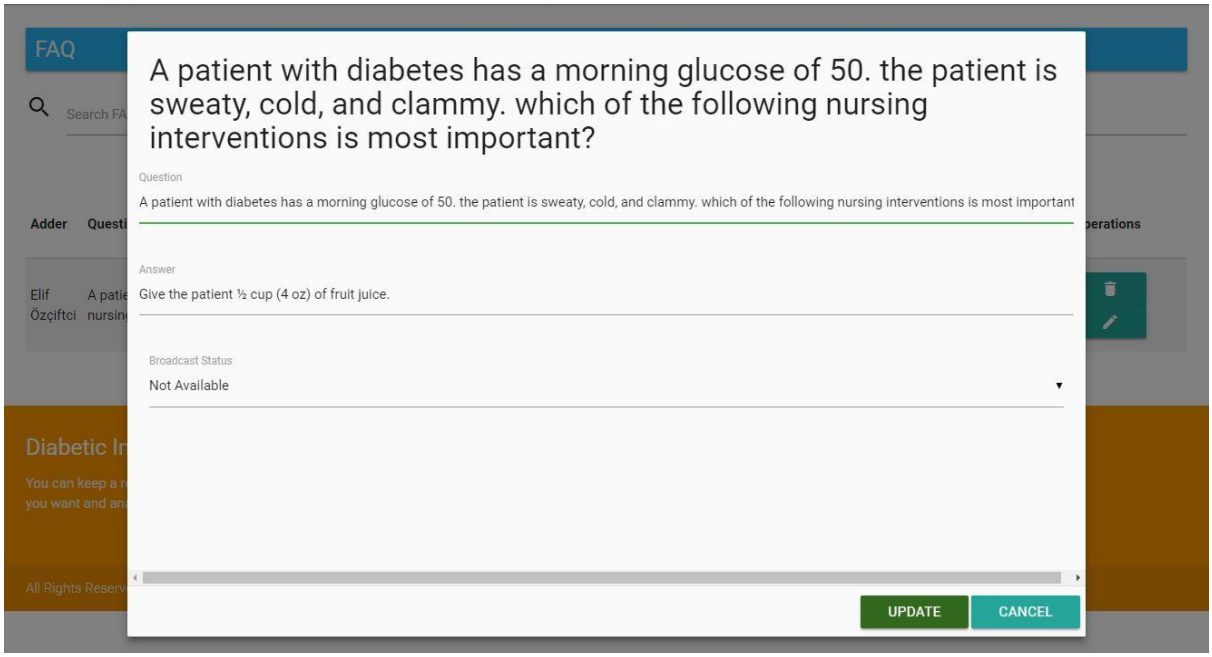

Figure 3.43 : Admin profile faq editing page.

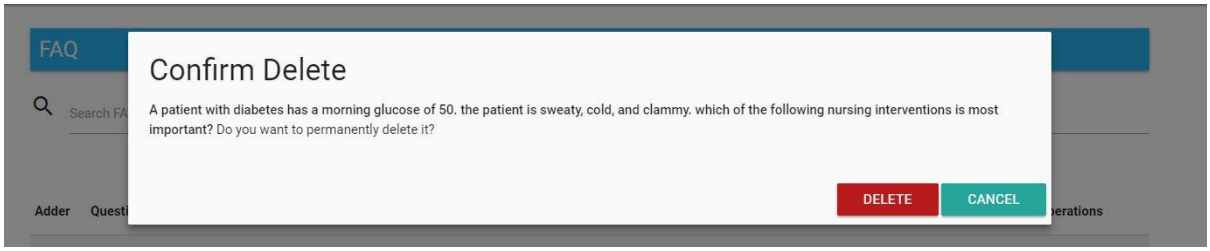

Figure 3.44 : Admin profile faq deleting page.

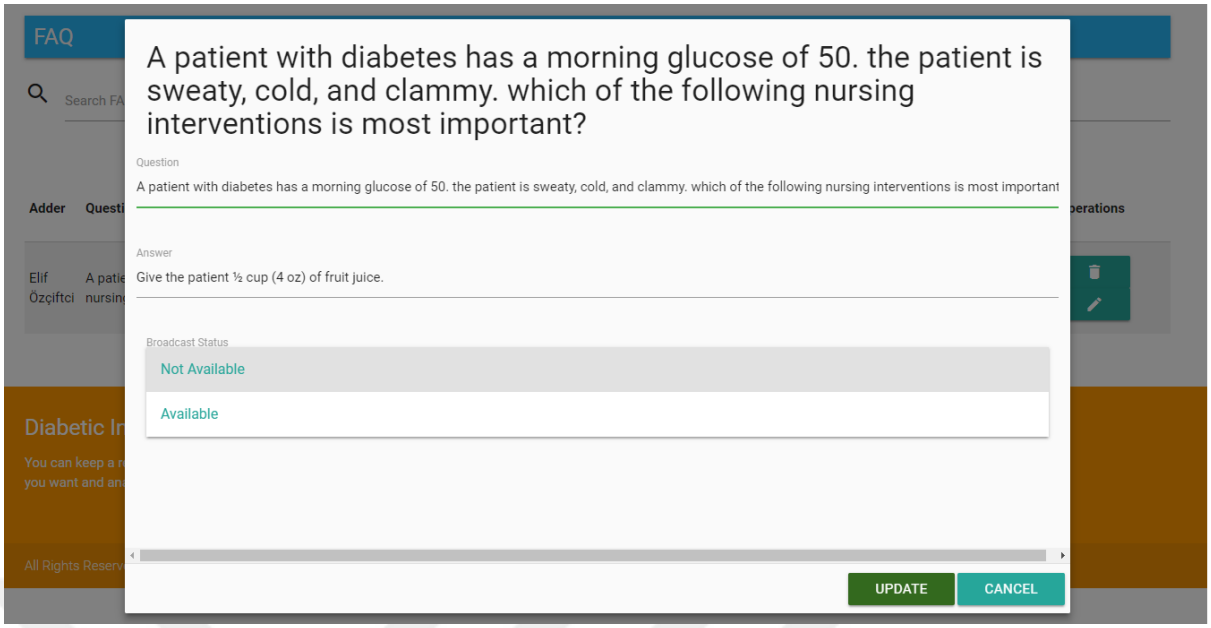

Figure 3.45 : Admin profile faq publishing page.

3.1.3.5 Announcement adding page

Admin can inform a user about system related changes, polls and education programs (Figure 3.46). Announcements can be tracked by with and without login to the system.

Figure 3.46 : Admin profile announcements adding page.

3.1.3.6 Announcement listing page

Admins can see the announcements added with the announcement listing page (Figure 3.47) and also can edit (Figure 3.49) or delete (Figure 3.48) the announcements.

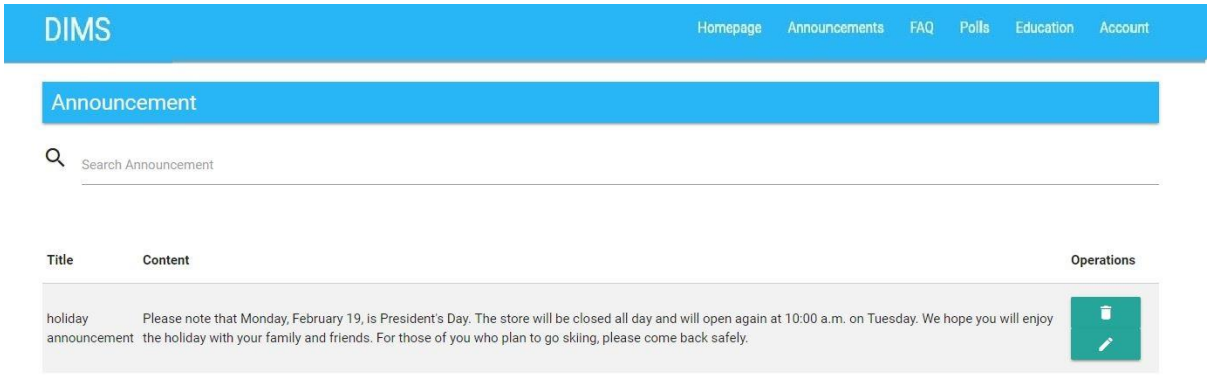

Figure 3.47 : Admin profile announcements listing page.

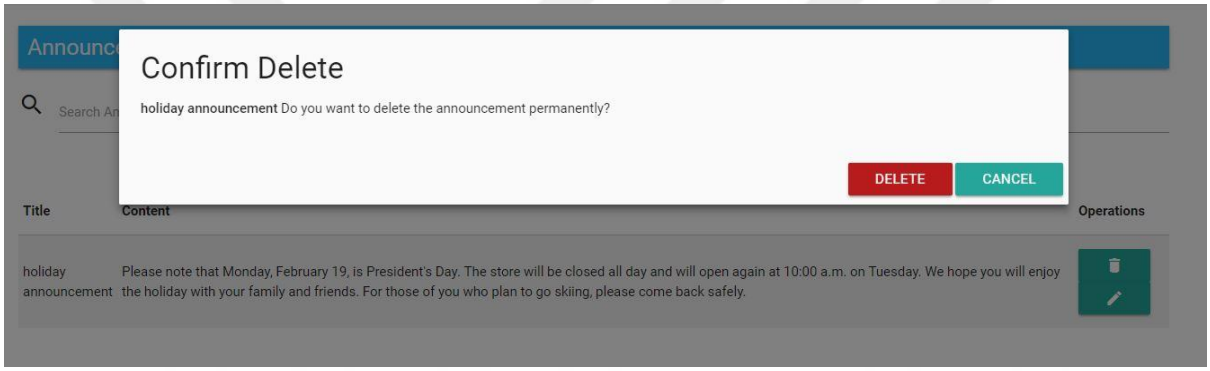

Figure 3.48 : Admin profile announcements deleting page.

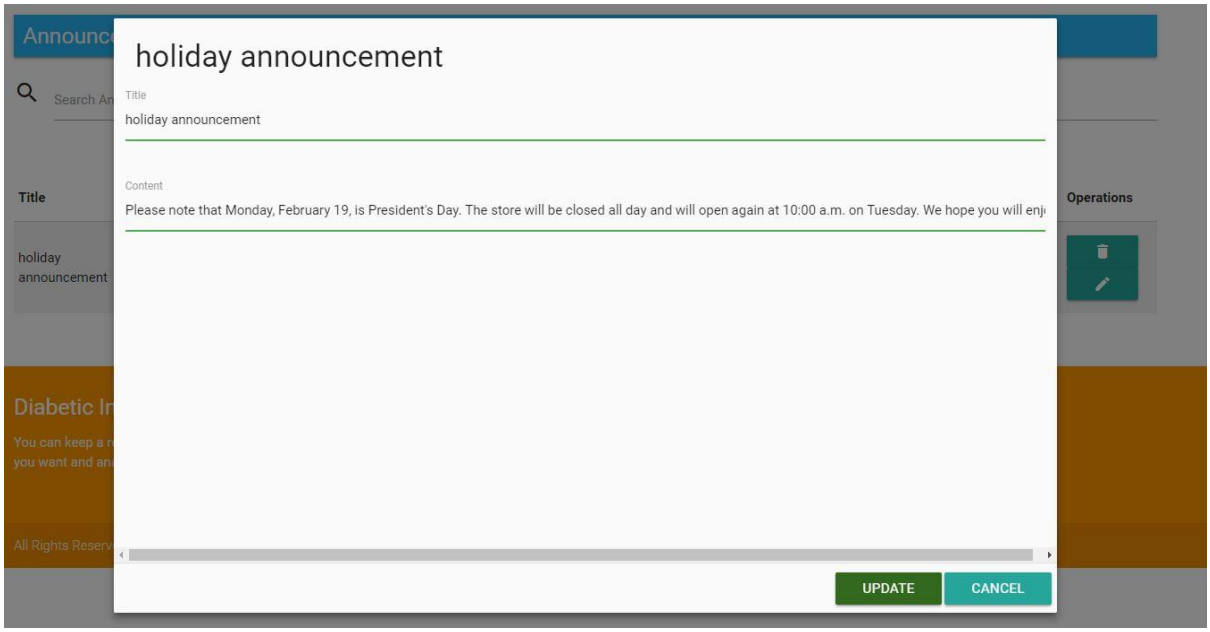

Figure 3.49 : Admin profile announcements editing page.

3.1.3.7 Education adding page

Education Adding Page is the page where admins can add many different materials such as education plans, educational video links and useful information to make it easier for diabetics to continue their lives. Suggestions like nutrition, sports or daily activities for diabetics are given on this page (Figure 3.50).

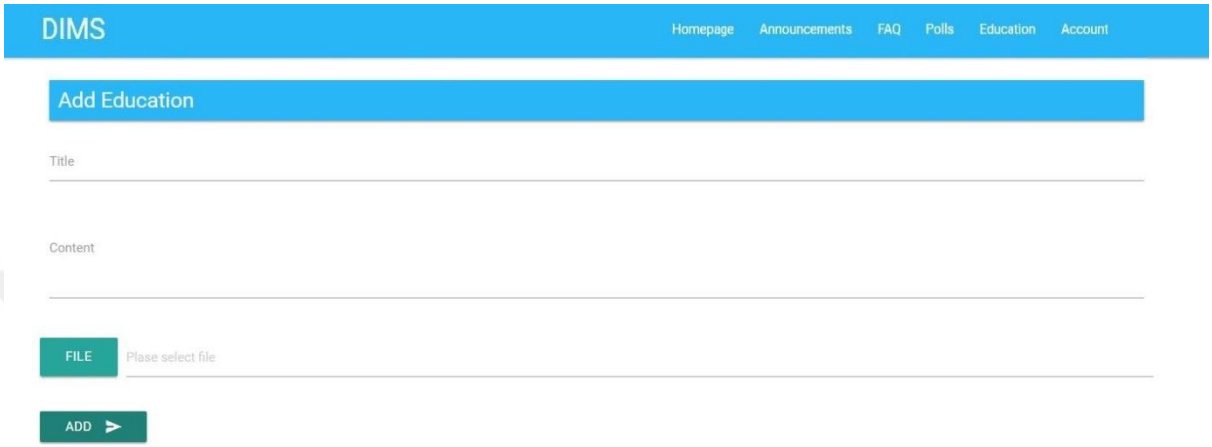

Figure 3.50 : Admin profile education adding page.

Title size is limited to 191 characters when adding education. In addition, the content is limited to 65,535 bits, which is 65 KB. These limits of relevant areas are high, but the title and content should be short and descriptive. This information should be brief and accurate for the users who benefit the educations.

Detailed information should be added as a plugin with the File option. Files can be uploaded to the system by selecting the files about education with File option on the education adding page. There are no limitations on adding files, such as size and count. Because the project is running locally, any number of files in any size and any number can be added. During the migration of the project to the internet, the limitation of adding files and sizes can be determined according to the server and the system load.

3.1.3.8 Education listing page

The admin can follow up the educations added using the education listing page (Figure 3.51). Educations can be edited (Figure 3.52) and deleted (Figure 3.53) from the system.

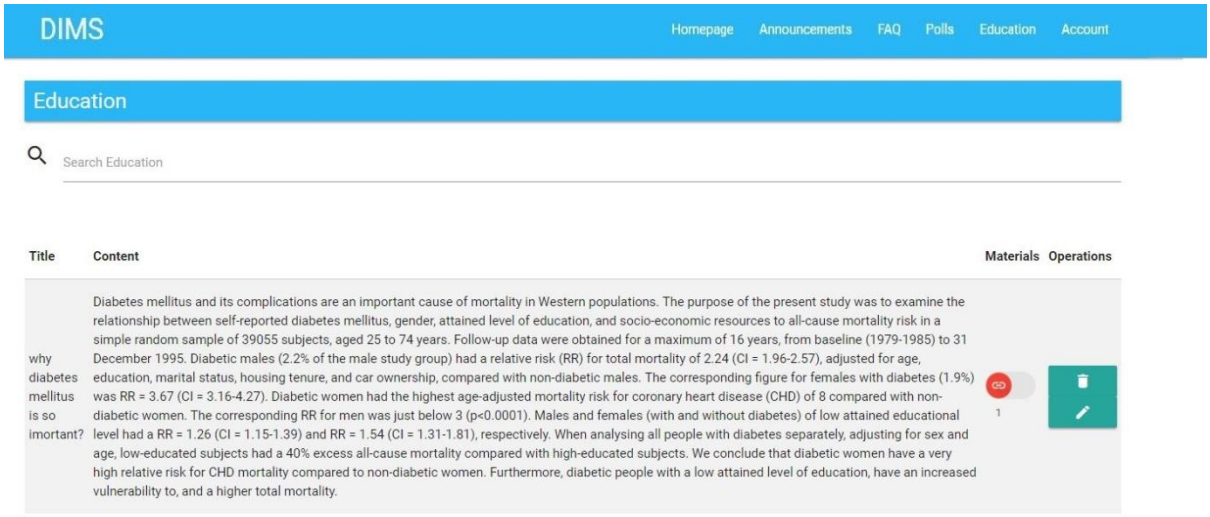

Figure 3.51 : Admin profile education listing page.

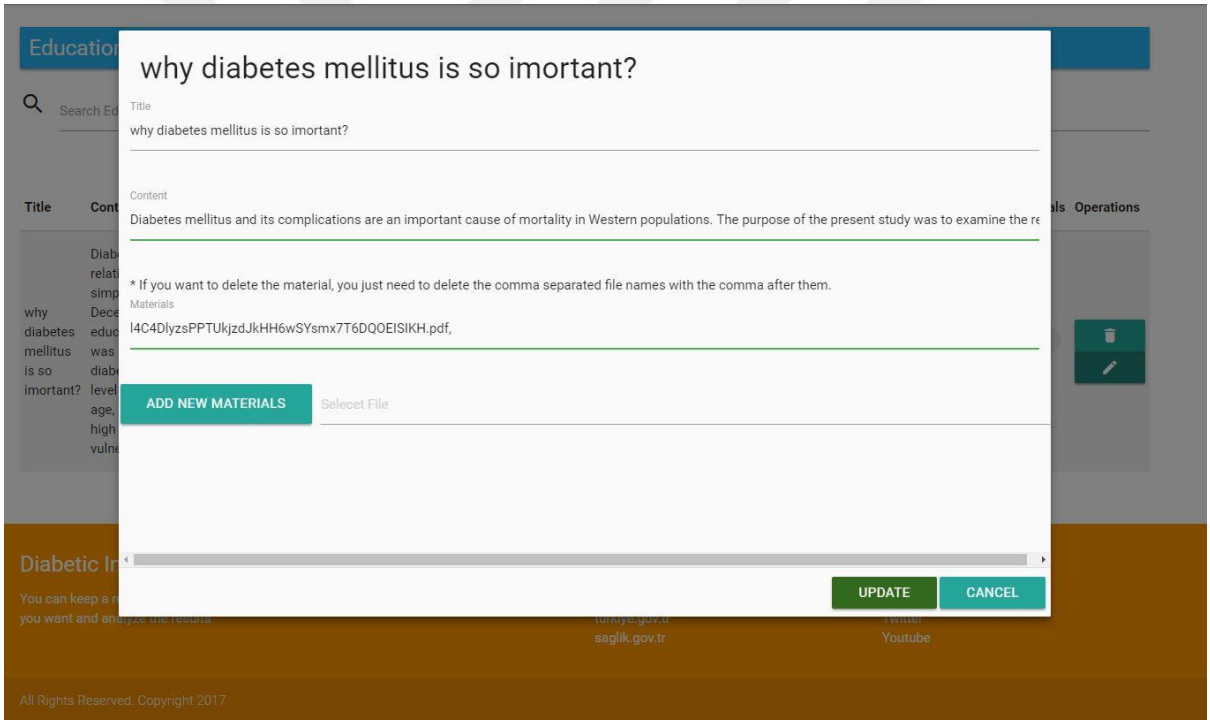

Figure 3.52 : Admin profile education editing page.

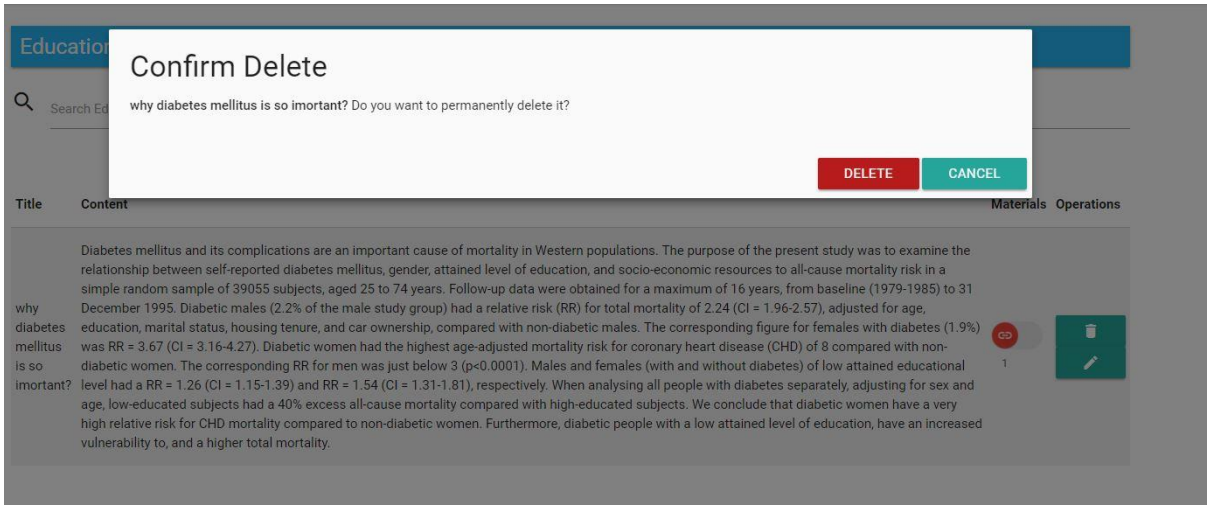

Figure 3.53 : Admin profile education deleting page.

3.1.3.9 Polls adding page

Admins can create polls that diabetics can participate in with Polls Adding Page. With the Polls System, it is aimed to revise the educations and the systems with the feedbacks come from polls with the experiences of participated users (Figure 3.54).

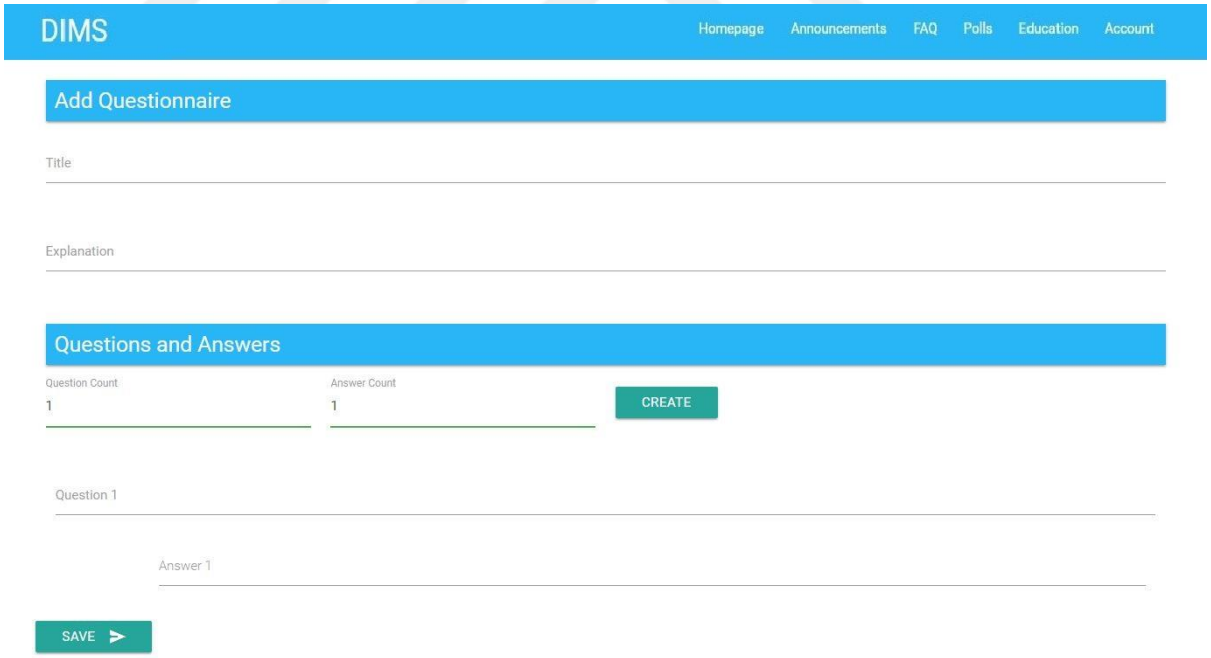

Figure 3.54 : Admin profile education adding page.

Admin can create a draft version of a poll by pressing the create button after entering the number of questions and the number of answers. Once all the required fields are completed, clicking the Save button publishes the poll.

3.1.3.10 Polls listing page

With the Polls Listing Page (Figure 3.55), admins can access only statistical results on the answers, without accessing the personal information of the users (Figure 3.56). Also, admins can delete the polls with this page (Figure 3.57).

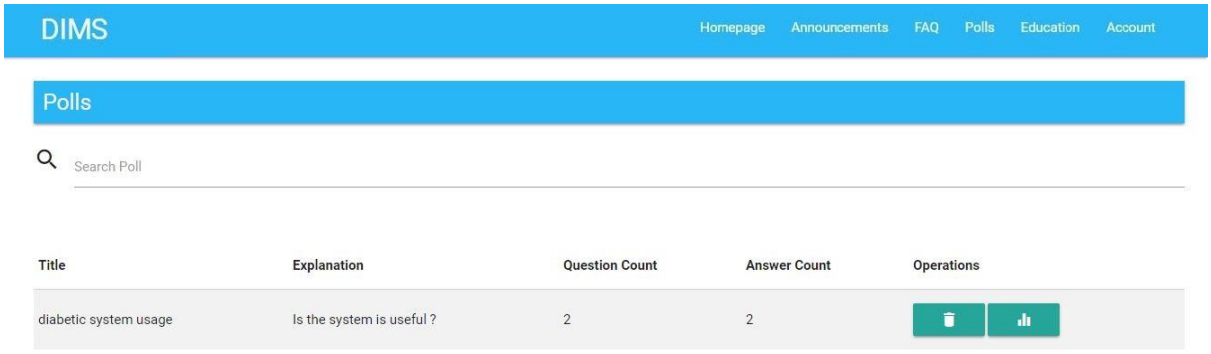

Figure 3.55 : Admin profile poll listing page.

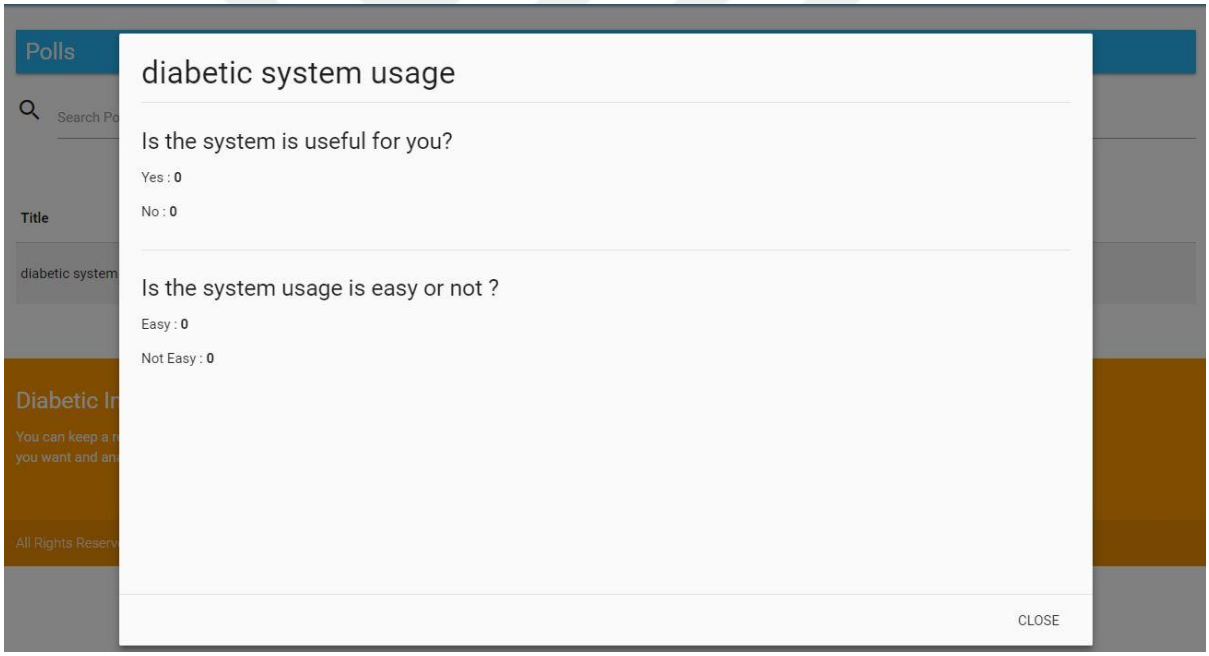

Figure 3.56 : Admin profile poll results page.

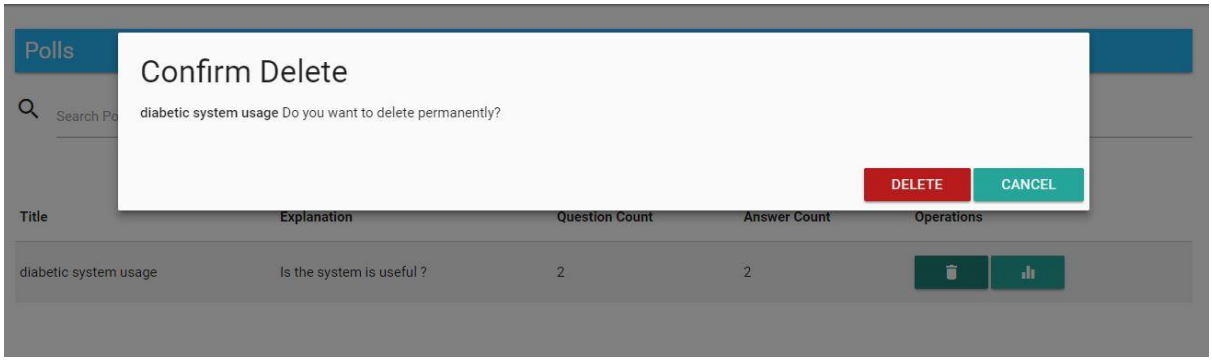

Figure 3.57 : Admin profile poll deleting page.

3.1.3.11 Feedback listing page

Admins can control (Figure 3.58) and delete (Figure 3.59) the system related feedbacks of diabetics with Feedback Listing Page.

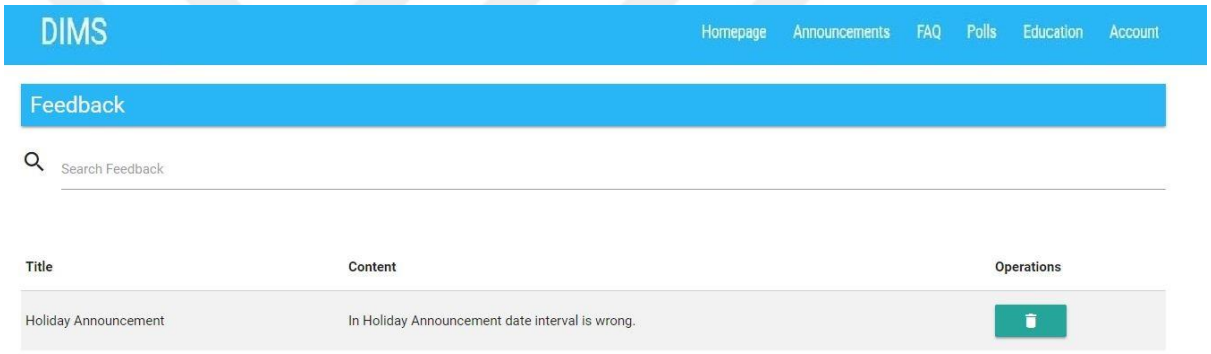

Figure 3.58 : Admin profile feedback listing page.

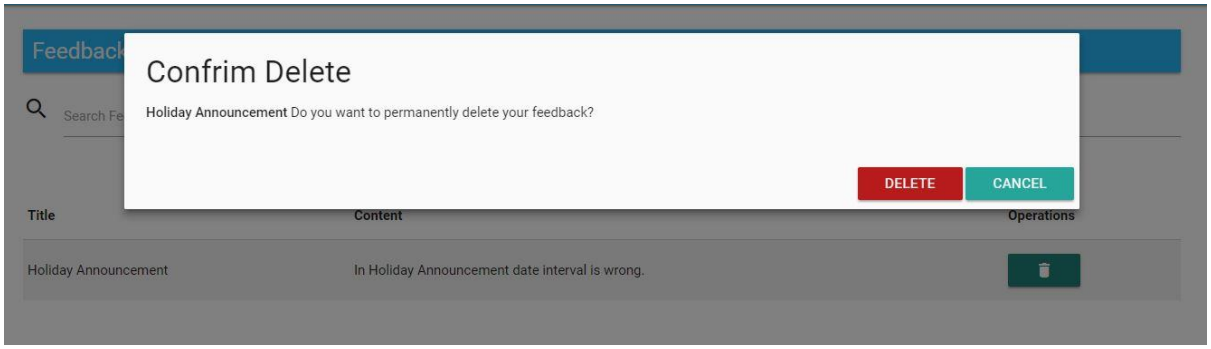

Figure 3.59 : Admin profile feedback deleting page.

3.1.3.12 Knowledge sharing page

Knowledge Sharing Page allows admins to communicate with each other and with diabetics (Figure 3.60). It is provided to be able to see online admins (Figure 3.62). In addition, there is a Chat clearing feature on the Knowledge Sharing Page (Figure

3.61). It is aimed to prevent unintentional conversations and to prevent unnecessary sharing of information.

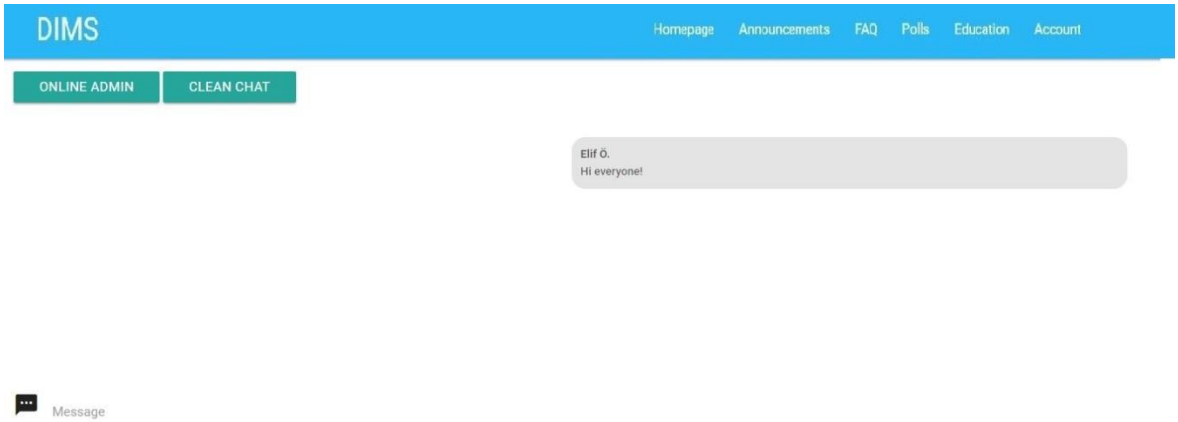

Figure 3.60 : Admin profile knowledge sharing page.

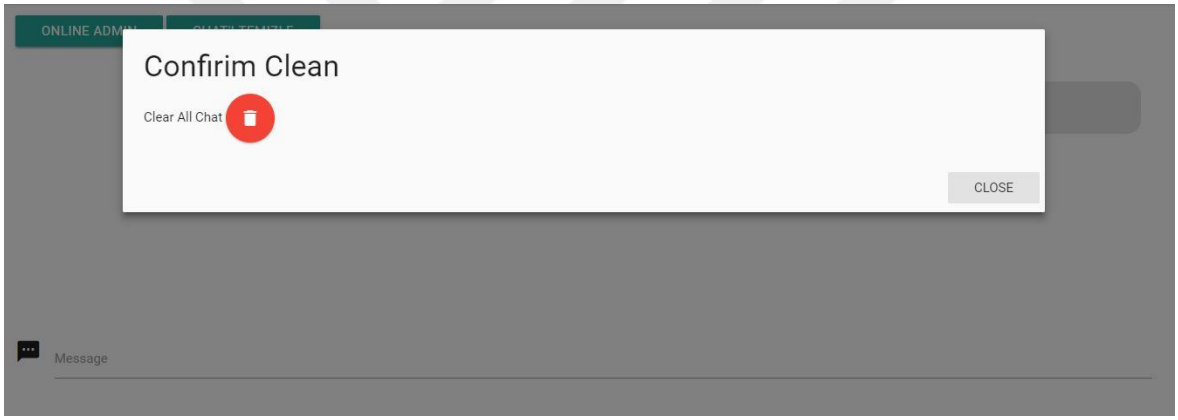

Figure 3.61 : Admin profile knowledge sharing cleaning chat page.

Figure 3.62 : Admin profile knowledge sharing viewing online admins page.

3.1.3.13 Admin profile page

Admins are able to log off user accounts, view profile information (Figure 3.63), and update the profile (Figure 3.64). Admins can also check the incoming (Figure 3.65) and outgoing (Figure 3.68) mailboxes. He/she can read incoming messages (Figure 3.66) and delete (Figure 3.67) when necessary. Admins can write to other admins or diabetics and communicate with each other (Figure 3.69).

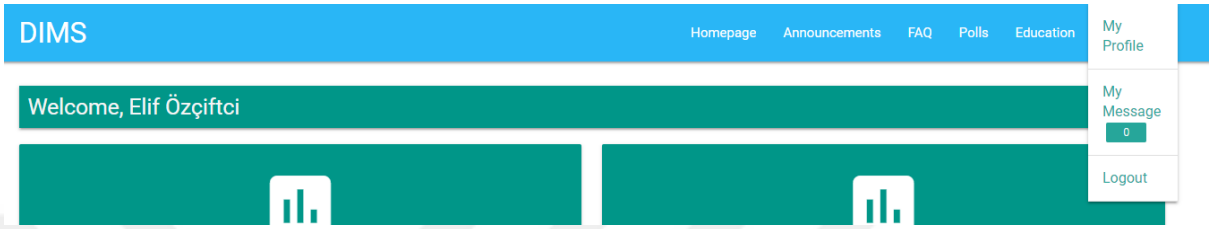

Figure 3.63 : Admin profile account page.

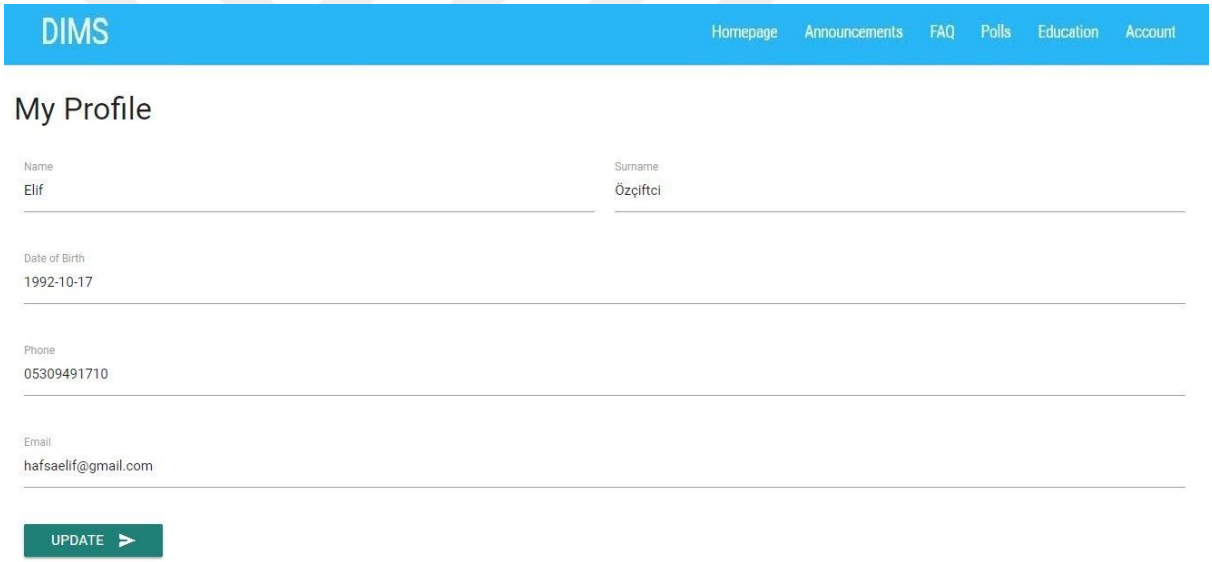

Figure 3.64 : Admin profile my profile page.

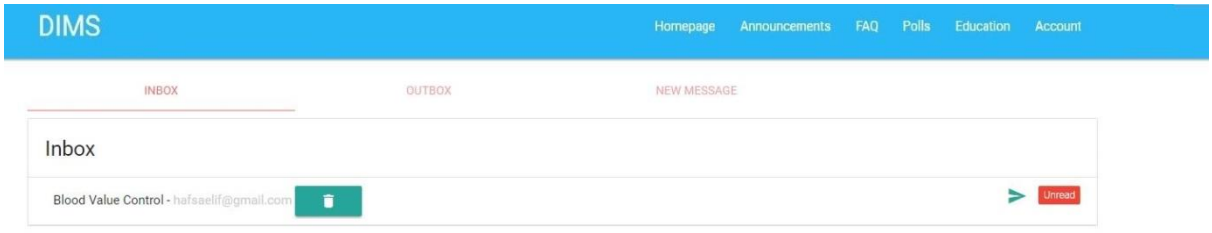

Figure 3.65 : Admin profile inbox page.

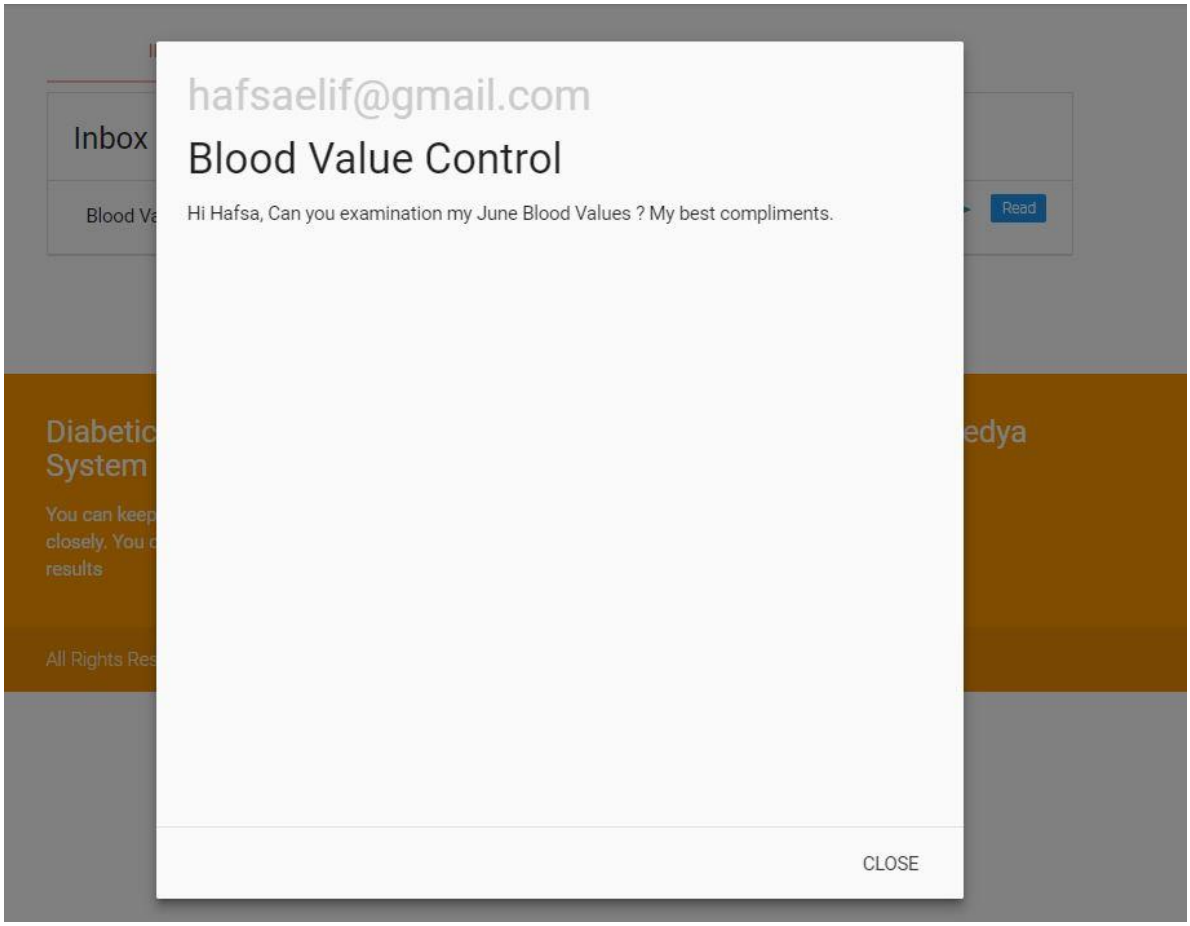

Figure 3.66 : Admin profile inbox reading page.

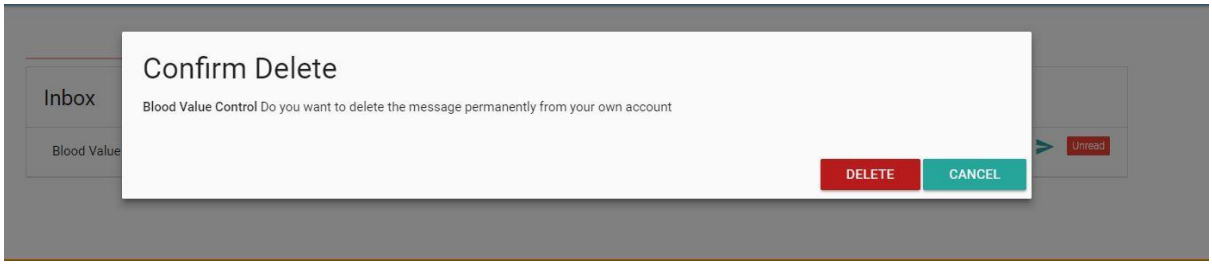

Figure 3.67 : Admin profile inbox deleting page.

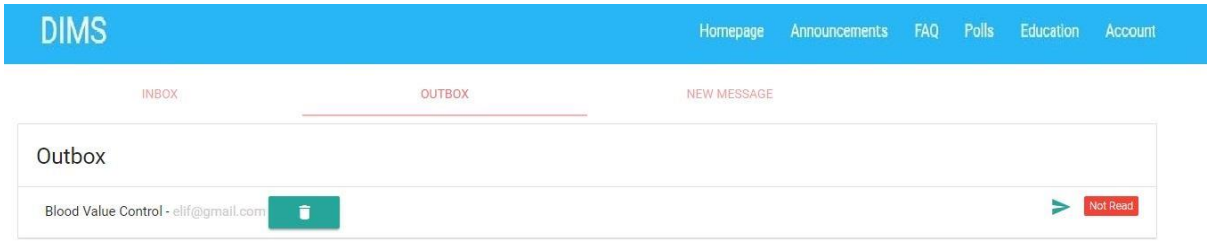

Figure 3.68 : Admin profile outbox page.

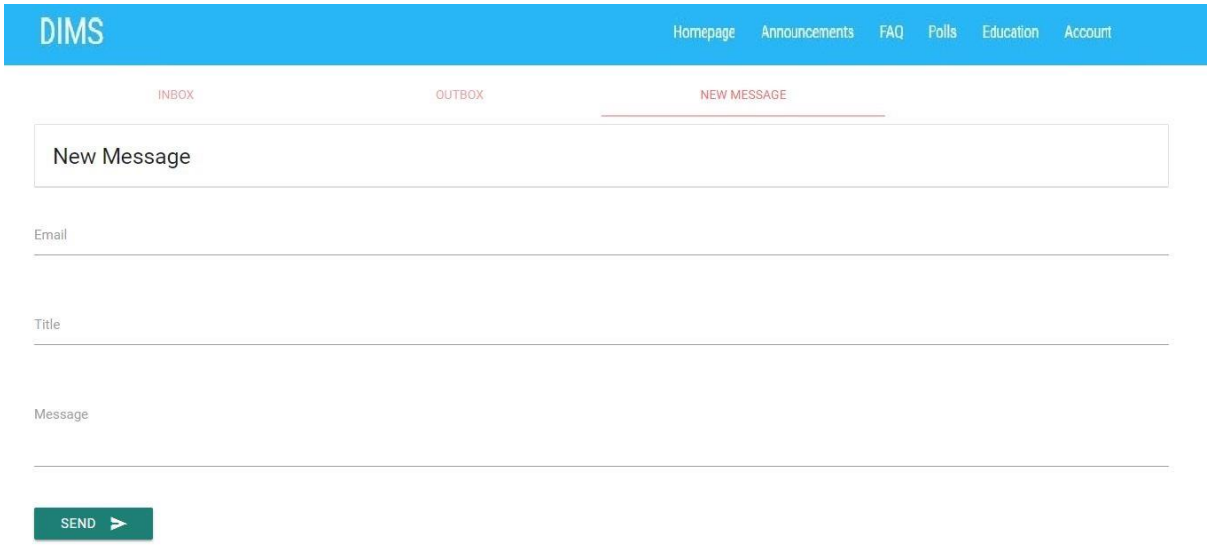

Figure 3.69 : Admin profile creating a new message page.

4. RESULTS

There are two user profiles in the Diabetic Monitoring System. User scenarios were created through these profiles. When the user logs in via the homepage, the login scenario is executed (Figure 4.1). According to the authority, the users are directed to the User Page and the operations of that authority. Those who have the admin authority are directed to the Admin Page and the operations of admin authority.

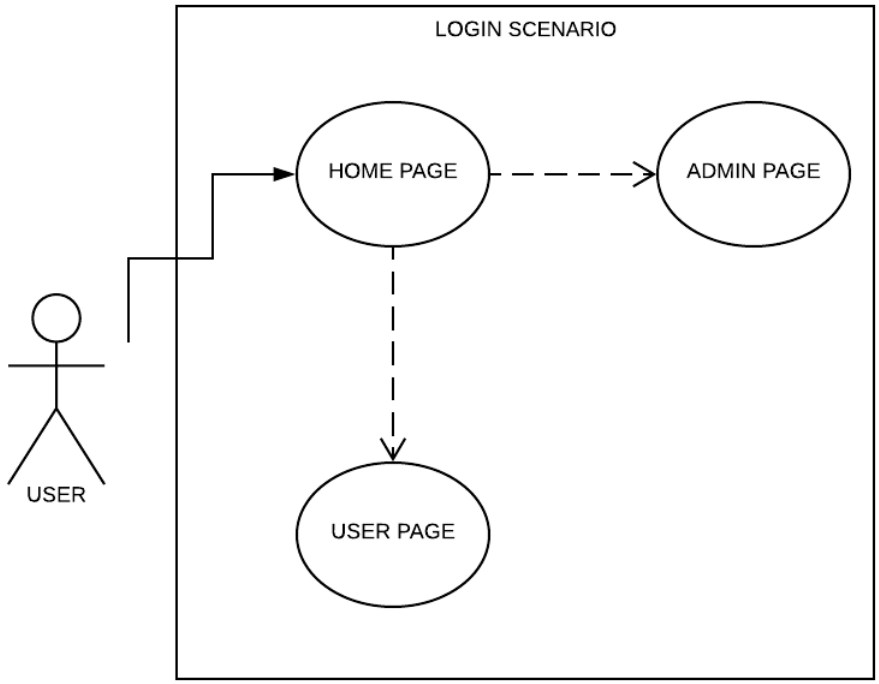

Figure 4.1 : Homepage Use Case scenario.

A user who has standard user authority is directed to the Diabetic scenario from entry scenario. Diabetics can enter and list Blood Values, enter and list Biological Values, add, list and view Feedbacks, add faqs and add messages over Information Sharing pages over this scenario (Figure 4.2).

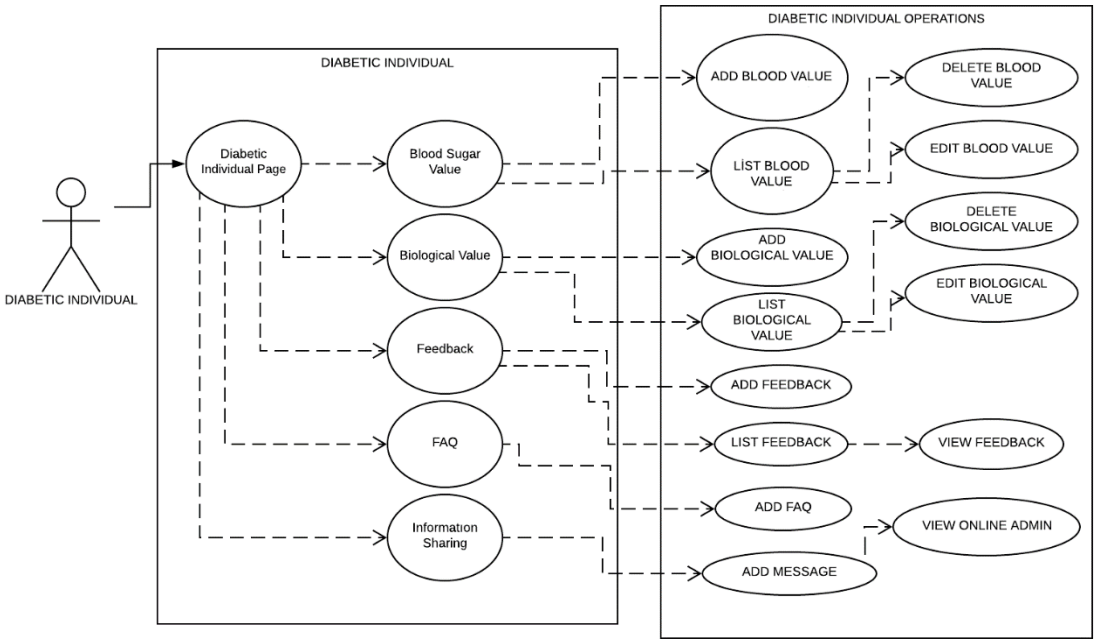

Figure 4.2 : Diabetic Use Case scenario.

A user who has admin authority is directed to the Admin Operations scenario from entry scenario. Admin can add, delete, view, research diabetics' values and add notes to the users through this scenario. In addition, admin can also search, add, edit and delete operations on faq, Announcements, Education, Polls, and Feedback pages.

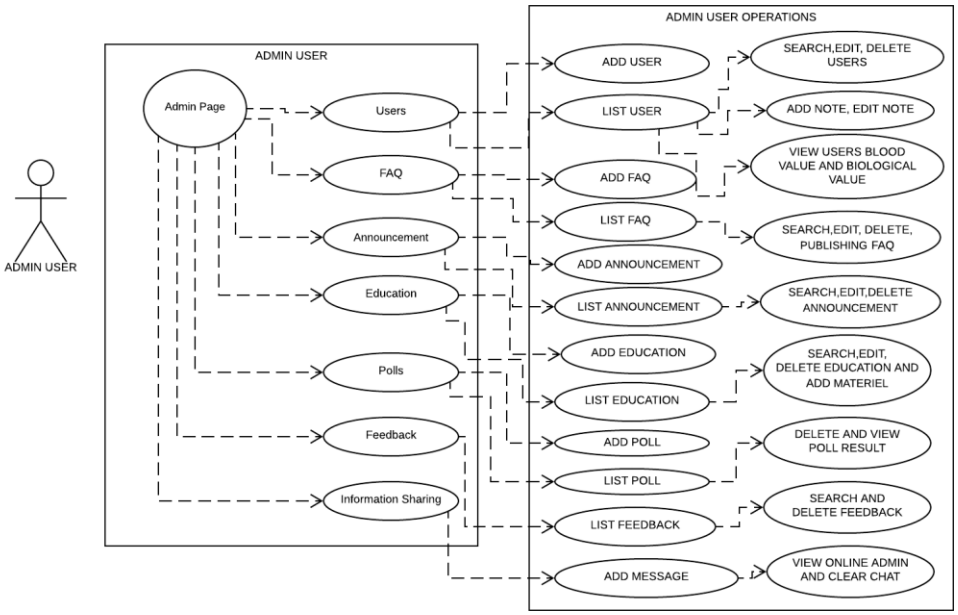

Figure 4.3 : Admin Use Case scenario.

Unlike the Information Sharing screen on the diabetic scenario (Figure 4.2), there is also the option to clear the Chat screen on the screen (Figure 4.3) for the administrator's authority. Through this scenario, users with both authorities can participate in polls with top menus, announcements, faqs, training. They can send and receive emails. Also, they can update own profile (Figure 4.4).

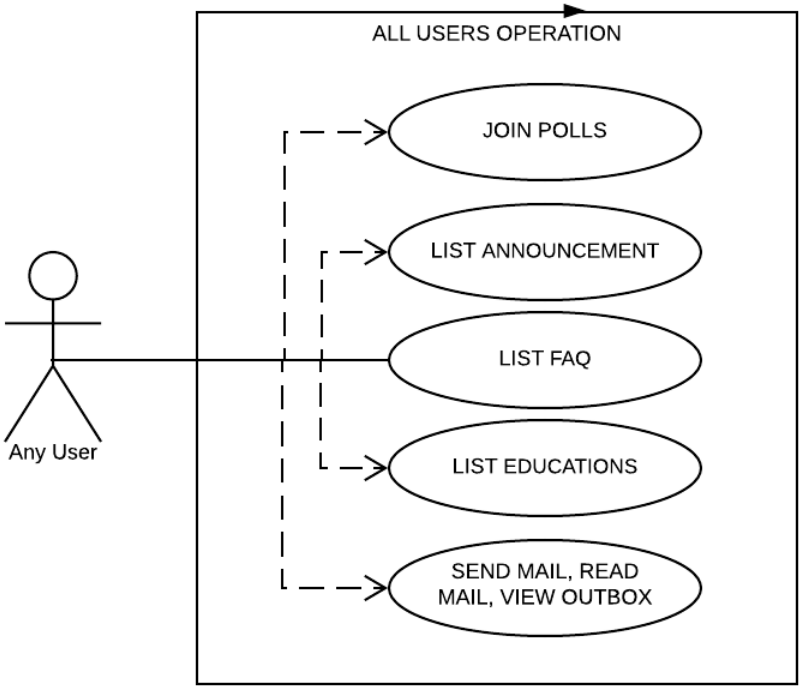

Figure 4.4 : Admin and users common Use Case scenario.

The user-id part is added to each user who registers the primary key for each table during the creation of a database of DIMS (Figure 4.5). Tables are related to each other in this way and filtering is done considering this relation for queries.

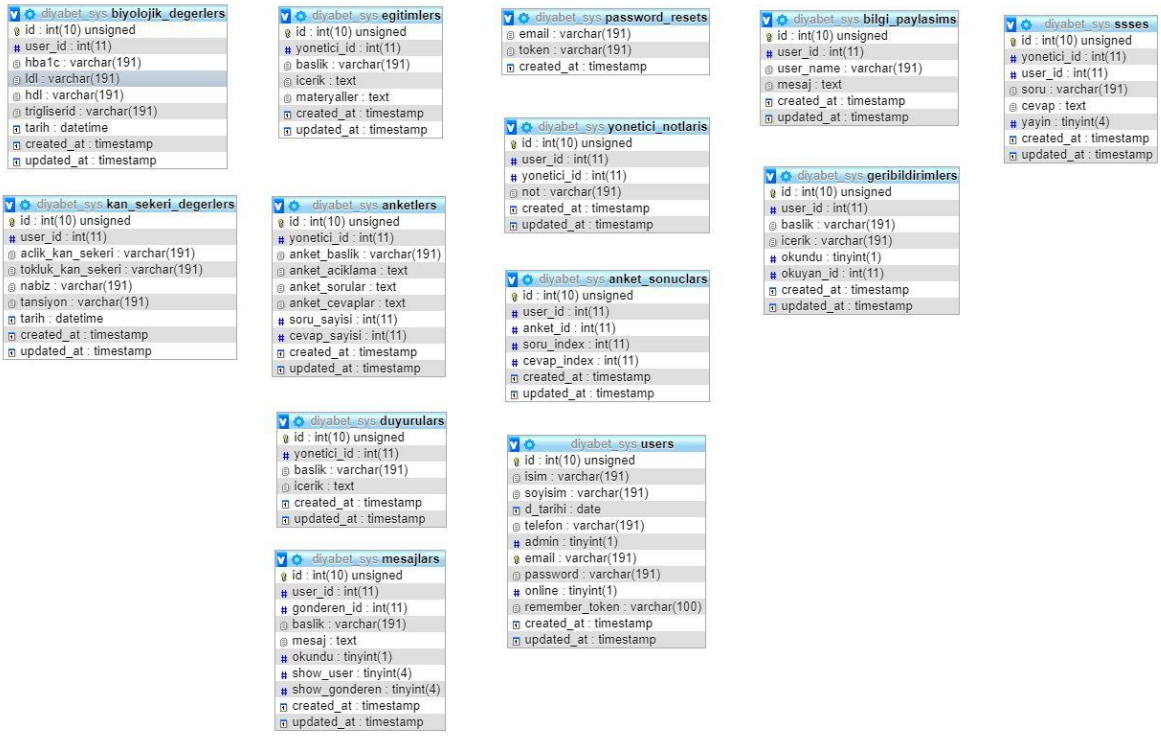

Figure 4.5 : DIMS database tables.

With the help of the Diabetic Monitoring System, it is aimed that the patients fighting with diabetes continue their education online and treatment processes out of the hospital without problems. Today, many information systems are becoming web-based, which makes our lives easier. By integrating web-based systems into the health sector, it is aimed to be able to control the health of patients while they continue their lives. It is aimed that diabetics will be able to reach to the solutions quickly and without time loss by continuous contact with the system administrators. Most diabetics cannot complete diabetes education because of an individual or institutional obstacles. With internet usage, this obstacle can be overcome; it is aimed that diabetics can understand the importance of going to glycaemic control and health checks and those diabetic complications may be reduced.

Feedbacks about the DIMS were obtained from three different end-user types. It is underlined that it is a useful system and easy to use for patients by the feedbacks from health personnel. In the feedback from software and interface developers, it is emphasized that the layout of the design and visual documents are easily understandable by the users.

4.1 Neslihan KATIRANCI's user comment

Park Cam Sanayi ve Ticaret A.Ş. - Bilgi İşlem Uzmanı

Merhabalar,

Öncelikle böyle güzel bir uygulama yazdığınız için sizi tebrik ederim. Diyabet hastalığının takibi ve paylaşım açısından güzel bir uygulama. Öneri olarak uygulama içeriğinde Diyabetli Birey Kullanıcı Profilinde açlık ve tokluk şekeri için ölçüm saatinin yanına yemek yediği saat eklenebilir. SSS ekranının olması ve maille soru sorulabilmesi akıllardaki soru işaretlerine cevap olması açısından harika bir özellik. Anket sistemi ile de memnuniyetsizliklerin belirlenebilmesi ve sistemin değiştirilip geliştirilebilmesi sayesinde sürekli gelişebilen ve yararlı bir sistem olmuş.

Park Cam Sanayi ve Ticaret A.Ş. - Information Technologies Specialist

Hi,

First of all, I congratulate you for developing such a good application. It is a good application in terms of following and sharing of diabetes. As a recommendation, in the diabetics profile, the meal time can be added next to the measuring time for fasting and postprandial blood glucose. Having a faq screen and asking questions by mail is a great feature in terms of being able to answer all questions of diabetics. With the polls system, it has become a system that is constantly developing and useful thanks to the determination of dissatisfactions and continuous developments.

4.2 Samed SARIAYDIN's user comment

Özyeğin Üniversitesi Bilgi Teknolojileri Birimi - Web - Mobil Yazılım Ekip Lideri

Merhaba,

Kullanıcının kolayca anlayabileceği şekilde bir menü düzeni tasarlanmıştır. Hem görsel hem fonksiyonel olarak düzenlenmiş olması kullanıcı desteklerinin azalamasını sağlayabilir. Admin yetkine sahip olan kullanıcının SSS'lerin yayınlanmasının ve online chati'i yönetebilmesi özelliği istenilmeyen durumların önüne geçmek adına iyi bir çözüm olarak tasarlanmış. Kullanıcıların aradığı özellikleri bulmaları adına sisteme bir search alanı açılması daha yararlı olabilir.

Ozyegin University Information Technologies Department - Web - Mobile Software Team Leader

Hi,

A menu layout is designed so that the user can easily understand. A both visually- and functionally-organized system can reduce user effort. The feature of publishing faqs and managing online chat is a good solution to prevent unwanted situations. It may be more useful to add a search option on the system in order to find the things the users are looking for.

4.3 Dilruba Büşra ELALMIŞ's user comment

Çanakkale Onsekiz Mart Üniversitesi Tıp Fakültesi Bölümü - Intern

Günümüzde diyabetli bireylerin görülme sıklığı git gide artmaktadır. Muayene için gelen hastalar içerisinde farklı sorunlar ile gelmiş olsalar bile diyabetik yatkınlık ve diyabetli olma kriteri karşımıza çıkmaktadır. Bu açıdan sistem diyabetli bireylerin kontrolünün sağlanabilmesi adına iyi düşünülmüş bir alt yapıya sahip. Görsel olarak güzel tasarlanmış ve kullanım kolaylığı düşünülmüş. Bireylerin yaş ortalamalarına göre alınacak verimin değişeceğini düşünüyorum. Yaşlı ve engelli hastalarda bu oranın az olmasını genç ve orta yaşlı hastalarda ise daha fazla verim alınacaktır. Yararlı ve çözüm odaklı bir sistem tasarımı olmuş.

Canakkale Onsekiz Mart University Faculty of Medicine - Intern

Hi,

The incidence of a diabetic is increasing day by day. We face patients who come for examinations have diabetic predisposition and diabetes, even though they have come up with different problems. In this regard, the system has a well-thought-out infrastructure for controlling diabetics. It is easy to use and visually-beautiful designed. I think that the efficiency will vary depending on the age of the individuals. The efficiency will be lower in elderly and disabled patients and higher in younger and middle-aged patients.

It has been a useful and solution-oriented system design.

4.4 Duygu ÖZDEMİR's user comment

GATA Tıp Fakültesi Bölümü - Intern

Merhaba,

Diyabetes mellitus hastalığı takip programı öncelikle hastalara kan glikozu regülasyonunun ne kadar önemli oldugu bilincini veriyor. Kişiye hastalığını önemseyip glikoz değerlerinin normal aralıklara uygun çıkması için yaşam şeklini düzenleyip ilaçlarını kullanması açısından motivasyon veriyor. Programda kan glikozuyla birlikte başka parametrelere de yer verilmesi hastalığı etkileyen birçok durumun oldugunu bu hastalıkta takip edilmesi gereken birçok verinin olduğunu hastaya öğretiliyor. Hastalığın prognozu için önem arz eden hasta eğitimi sistemde vurgulanmış ve yararlı görsel ögeler ile hastaya kolay bir şekilde sunulmuş. Ayrıca böyle bir veri tabanının oluşturulması bilimsel çalışmalarda kullanılabilir ve makalelerde referans olarak gösterilebilir.

Health Sciences University - Gulhane Faculty of Medicine - Intern

Hi,

The diabetes mellitus disease follow-up program recognizes the importance of disease blood glucose regulation. It makes patients care about the disease, motivate to use their medicines and regulate their lifestyles so their glucose values match the normal ranges. The program also teaches the patient there are many parameters along with blood glucose and these things need to be followed. Important details for the prognosis of the disease is emphasized in the system and presented to the patient with helpful visual cues. In addition, the creation of such a database can be used in scientific studies and can be referenced in the articles.

5. DISCUSSION

Diabetic Monitoring System is not only a system in which the biological and blood values of diabetics are entered but also a system in which diabetics can share information and receive an education. The individual can share information online with both the administrators and other diabetics about diabetes education.

The main objective of the studies on diabetics is to keep diabetes under control. The use of the web-based developed Diabetic Monitoring System depends entirely on the individual's self-management. For this reason, patients who have not completed diabetes education or who have not developed self-management skills cannot get enough benefit from this system when they don't use correctly and regularly. The correctness of data is important because patients will provide follow-up and treatment for their diabetes through the data they enter into the system. Diabetic Monitoring System is based on a human factor, therefore, the effect of diabetes education on non-educated individuals will be lower than on individuals who are well educated and have strong self-management capability.

A follow-up application can be developed that reminds registered users to enter their blood and biological values via mail and cell phone. With this application, diabetics can be prevented from forgetting value entry while daily activities.

Regular measurement of blood values can lead to some physical harm to diabetics. For this reason, a portable device can be designed for use by patients. MQTT protocol can be useful to send values over the internet for low package usage. Therefore, decreasing the human factor makes this system more effective.

Nowadays, social media activities are at a higher level. Using this powerful network, a module that allows patients to share the effects of food they consume on their diabetes can be integrated into this system. With this integrated system, patients can share their eating habits and the positive and negative effects of these habits on diabetes treatment with other diabetics. Thus, the eating and drinking habits of the patient can be managed and arranged.

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CURRICULUM VITAE

Name Surname: Hafsa Elif ÖZÇİFTCİ

Place and Date of Birth: Ankara / 17.10.1992

Address: Harmandere Mahallesi Reyhan Caddesi No:65 C Blok Daire:15 Pendik/İstanbul

E-Mail: hafsaelif@gmail.com

Education: 2014, Süleyman Demirel University, Faculty of Engineering, Department of Computer Engineering

List of Publications:

Diyabetli Birey İzlem Sistemi (Monitoring System for Patients with Diabetes Mellitus), Akıllı Sistemlerde Yenilikler ve Uygulamaları 2017 Konferansı (ASYU-2017), October 5-7, Alanya-Antalya/Turkey, Bildiri Ozetleri Kitabi (ISBN: 978-608-65137-5-7), 45, 2017.