



## Application of Small Ruminant Database and Data Analysis System (Desktop and Android Application)

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### Abstract

In today's world, various information systems have been designed for helping the physicians in medicine field. By means of these systems, the data associated with the patients are stored, shared easily or the analysis about the patients can be done. In animal health, which is also as important as human health, it is seen that analyses about the illnesses are quite limited. In our opinion, one of the most important reasons for this is the lack of a system with which the data on the animals are stored and shared. Because of the lack of this kind of system, limited studies have been done on animal illnesses and alternative solutions could not be provided in detail for illnesses and deaths. Thus, the decrease in animals and animal productions has been rising day by day and the economy of the country has been affected negatively. In this study, a system has been provided in order to store, share and run data analysis regarding the records of animals. In addition, visual interfaces have been prepared to facilitate the database procedures.

### Key Words

database management systems, data mining, data analyze, small ruminant, veterinary

## **1. INTRODUCTION**

With the development of technology, data is able to be stored easily using databases in various fields. In the healthcare field, it is important to obtain, process, analyze, evaluate, present and archive accurate information about patients and diseases. Through databases, these processes have become easy to implement while at the same time resulting in an infrastructure for computer-aided diagnosis being created. This is because database management systems (DBMS) contribute to the data mining process, such as selecting and purifying related data. In other words, they start the data mining process by preparing the data for data mining.

Although there are a large number of data mining studies conducted on medical databases in the medical field today, it has been observed that the number of software applications developed for medical databases is insufficient and there is no free subsidiary database management system for veterinarians.

Çataloluk has designed a system that can be used by physicians in the field of medicine, capable of predicting the diagnosis of dermatological diseases and capable of analyzing the relationships between the qualities of patient records (Çataloluk, 2012). A software tool has also been developed by Dinçer and Duru to analyze medical data taken from laryngeal cancer operations (Dinçer & Duru, 2009). Şentürk has prepared visual interfaces that will facilitate the database processing of the cancer diagnosis system (Şentürk, 2011). Taşbaş et al. established an information system for use in chronic pancreatitis research. Thanks to this system, both sufficient non-clinical information has been retained as well as this information has been used to help in the doctor's decision-making process (Taşbaş et al., 2012).

Today, patient information systems used in healthcare institutions help store and share patient data and also provide support for clinical decisions made by the doctor. In a number of studies on clinical decision support systems' impact on decision-making, disease management, diagnosis and treatment, it has been reported that these systems improve patient care quality (Taşbaş et al., 2012).

The decrease in the number of small ruminant and animal products in our country causes the rural sector to become more impoverished. In order to prevent impoverishment, it is essential to increase profitability or yield performance in this sector first. This requires increasing the demand for sheep. In order to increase demand for sheep, it is necessary to reduce the rates of disease and mortality. For this reason, it is important to keep information about Akkaraman lambs and sheep which constitute approximately 87% of the sheep population in our country and to make estimations and analyses about their diseases and deaths in the database.

In order to make forecasts and analyses in animal health, it is necessary to have easy access to the database. Data obtained from many fields are mutually shared. In this manner, various analyses are made on the data and contributions are provided to science. However, obtaining data in the veterinary field is very difficult and data is not shared for various reasons. This makes analysis difficult for animals. For these reasons, it is known that the interdisciplinary study between the veterinary and the computer science fields is very low (Cihan et al., 2017).

In this study, information system was created that veterinarians can use in the field of veterinary medicine. Through this system, both a limited number of data can be easily stored with visual interfaces as well as its analysis can be done easily.

## **1. MATERIAL AND METHOD**

### **2.1. Dataset**

The dataset used in the study was collected from two sheep farms in the Kars province in 2009. The data gathering study was conducted on 301 Akkaraman hybrid sheep and the 347 lambs that were born to them. In this study, lambs tagged with numbers between 200-300 were studied. The features in the dataset have a complex structure. This complexity is reduced through the interface that was created. In short, the features were blood levels taken from the mother before the birth of the lamb, blood levels (colostrum) taken from the lamb before taking milk from the mother after the lamb was born, and blood levels taken from the lamb after the milk was absorbed from the mother. Information such as the birth weight of the lambs, type of birth, twin or single births, information that the mother is sick or healthy is also recorded. Information such as whether or not the lamb was neonatal, post-neonatal and whether or not the lamb was healthy / patient / dead during the time covering these two periods was recorded, as well. Again, weight gain and disease types belonging to these three cycles are involved. The characteristics of the data set consisting of a total of 42 features are presented in Table 1.

**Table 1.** The characteristics of the data set consisting of a total of 42 features

Features	Abbreviation	Features	Abbreviation
Lamb Number	lambno	Live Total Gained Weight Between 28-84 Days	WGPN
Immunoglobulin G (Belongs to Lamb)	IgG	Live Daily Gained Weight Between 28-84 Days	MDGPN
Gamma Glutamyl Trasnfereraz (Belongs to Lamb)	GGT	Type of Birth	twin
Laktoferrin (Belongs to Lamb)	LT	Sex	gender
Total Protein (Belongs to Lamb)	TP	Dams parity	perity
Albumin (Belongs to Lamb)	ALB	Dams Age	age
Immunoglobulin G (Colostrum Level)	IgGK	Farm	farm
Gamma Glutamyl Trasnfereraz (Colostrum Level)	GGTK	İllness week	Hweek
Laktoferrin (Colostrum Level)	LTK	İllness month	Hmonth
Total Protein (Colostrum Level)	PRTK	Dam Health Status	AH
Albumin (Colostrum Level)	ALBK	Neonatal Health Status	NGH
Immunoglobulin G (From the Dam Before the Birth)	IgGA	Postneonatal Health Status	PNGH
Gamma Glutamyl Trasnfereraz (From the Dam Before the Birth)	GGTA	First 3 month period Health Status	PWGH
Total Protein (From the Dam Before the Birth)	TPA	Neonatal Disease Result	NHS
Birth Weight	BW	Postneonatal Disease Result	PNHS
Live Weight After 28 Days	WG28	First 3 month period Disease Result	PWHS
Daily Live Gained Weight After First 28 Days	MDG28	Neonatal Disease Type	NT
Live Weight After 84 Days	WG84	Postneonatal Disease Type	PNT
Daily Live Gained Weight After First 84 Days	MDG84	First 3 month period Disease Type	PWT

## 2.2. Methods and Tools

In this study, JAVA SE was used for the desktop application, PostgreSQL was used for the database and R programming was used for the data analyses.

## 3. RESULTS

In this study the developed application can be summarized under two steps. The first is the implementation of database operations with the help of the interface, and the second is various analyses done using the information in the database.

### 3.1. Database Operations

The physical data display of the lambs in the database, the addition of physical data to the database, the deletion of physical data from the database and the updating of the physical data in the database are performed with the help of the desktop interfaces shown in Figure 1 and the mobile interface shown in Figure 2.

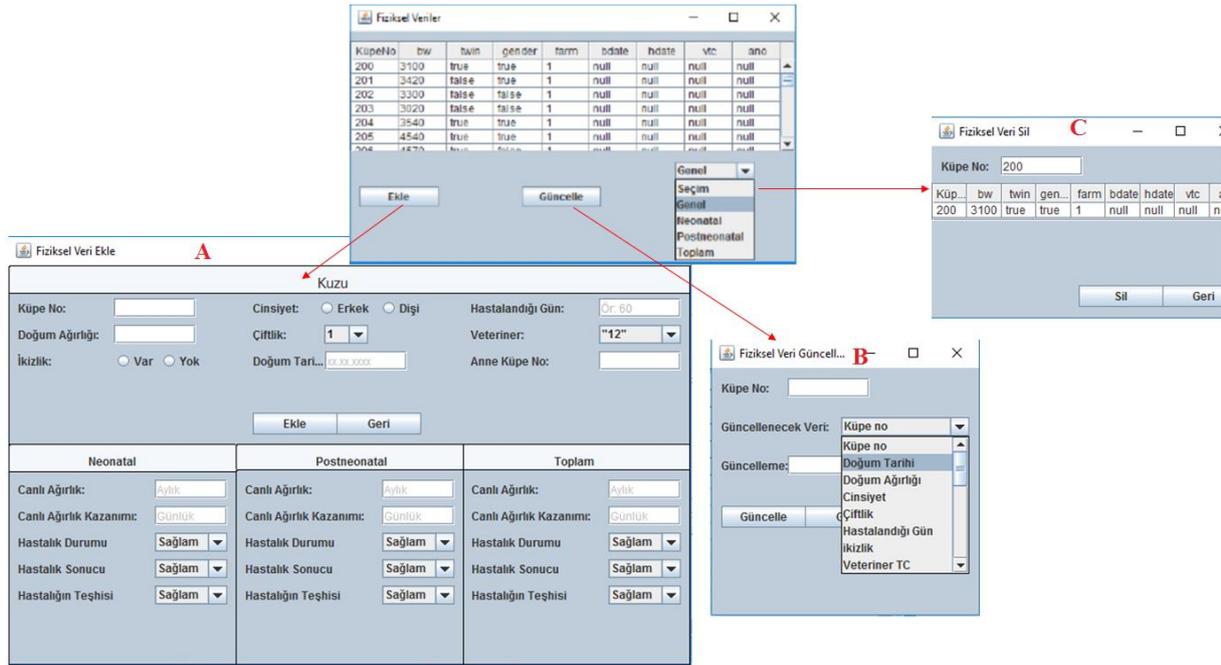


Figure 1: Physical data processing in the database; (A) add, (B) update, (C) delete data on desktop application.

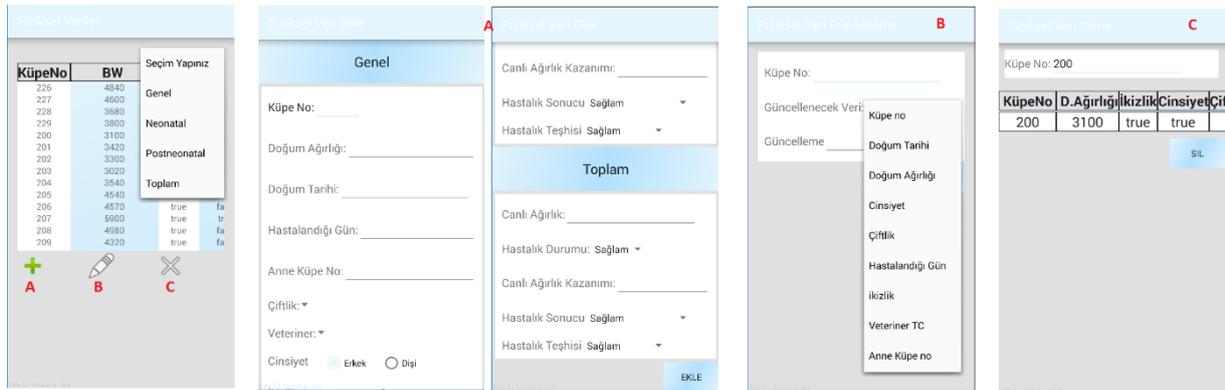


Figure 2: Physical data processing in the database; (A) add, (B) update, (C) delete data on mobile application.

Through the interface shown in Figure 1 and Figure 2, the user can view the physical data in the database and can add, update and delete data from it. The user can view the information of the desired turnover via this interface, as neonatal period (0-28 days), post-neonatal period (28-84 days) or all period (0-84 days).

The process of adding the lamb's physical data to the database is performed through the desktop interface shown in Figure 1A and mobile interface shown in Figure 2A. With this interface, information such as the lamb's tag number, dam tag number, sex, birth weight, type of birth (twin or single), treating veterinarian can be added to the database. Through the same interface, it is also possible to add data such as neonatal, post-neonatal, and, for the time covering the two periods, the lamb's weight, weight gain, health status (healthy/ill), disease outcome (healthy/survive/dead), and disease information (enteritis/pneumonia/septicemia/anorexia/ pneumoenteritis).

Updating the physical data in the database is performed through the desktop interface shown in Figure 1B and the mobile interface shown in Figure 2B. The user must first enter the lamb's tag number to update the lamb's data. Then update the list by selecting the property to be updated and entering its new value.

The deletion of the physical data of the lamb from the database is performed through the desktop interface shown in Figure 1C and mobile interface shown in Figure 2C. The data deletion is done using the tag number of the lamb. After entering the lamb's tag number, the information about that tag number is shown to the user in order to prevent erroneous deletion. If the data to be deleted is correct, then it can be deleted from the database by pressing the delete button. If the data of another lamb is about to be erased, another tag number must be entered.

Biochemical data viewing of the lambs in the database, adding biochemical data to the database, deleting biochemical data from the database and updating the biochemical data in the database are performed with the help of the desktop interfaces shown in Figure 3 and mobile interfaces shown in Figure 4.

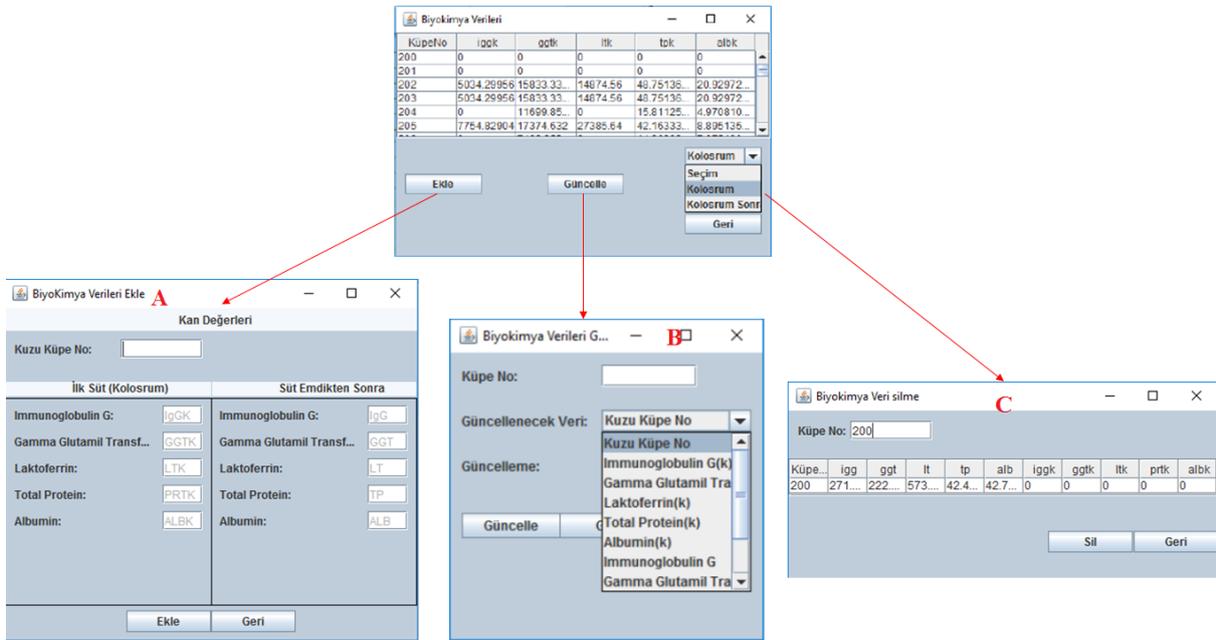


Figure 3. Biochemical data processing in the database; (A) add, (B) update, (C) delete data on desktop application.

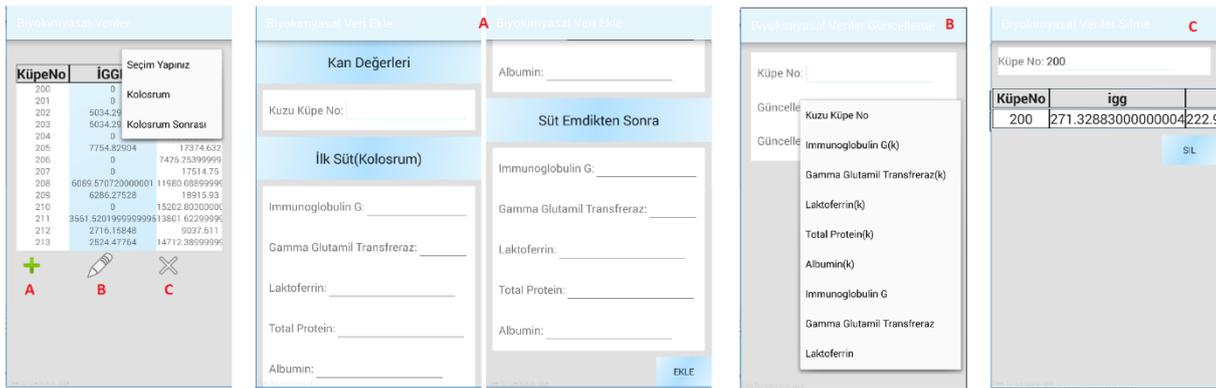


Figure 4. Biochemical data processing in the database; (A) add, (B) update, (C) delete data on mobile application.

Through the desktop interface shown in Figure 3 and mobile interface shown in Figure 4, the user can view the biochemical data in the database and can add, update and delete data from it. If it displays blood levels taken from the milk, it selects the colostrum from the list, and if it displays blood levels after milk has been absorbed, it selects the colostrum.

The addition of the biochemical data in neonatal and post-neonatal periods of the lamb to the database is performed through the desktop interface shown in Figure 3A and the mobile interface shown in Figure 4A. When adding data, the blood volume of the colostrum and the colostrum is entered after the lamb's tag number is entered.

The updating of the biochemical data in the database is performed through the desktop interface shown in Figure 3B and the mobile interface shown in Figure 4B. The user selects the feature to be updated from the list by entering the tag number of the lamb for the data to be updated and data can be updated by entering the new information into the update section.

The deletion of the lamb's biochemical data from the database is performed through the desktop interface shown in Figure 3C and the mobile interface shown in Figure 4C. The user enters the lamb's tag number for the lamb to be deleted.

The data in the database for that dam is displayed, the addition of new sheep data to the database, the deletion of the sheep in the database and the updating of the data of the sheep in the database are performed with the help of the desktop interfaces in Figure 5 and the mobile interfaces in Figure 6.

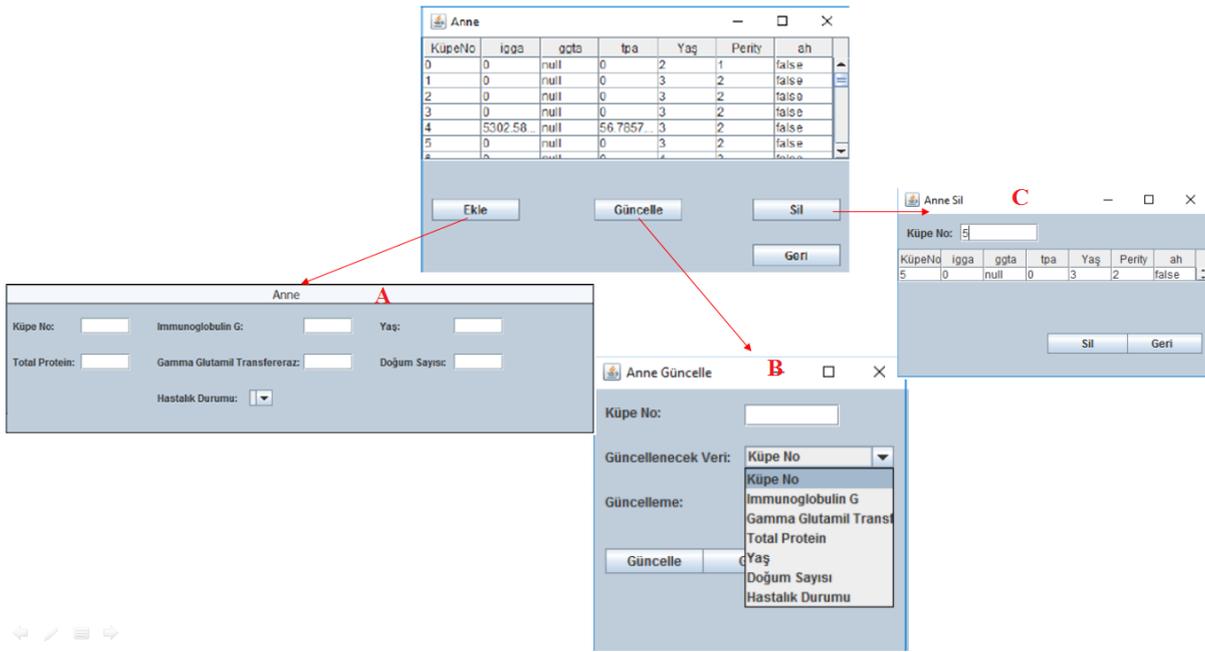


Figure 5. Data processing in the database; (A) add, (B) update, (C) delete dam's data on desktop application.

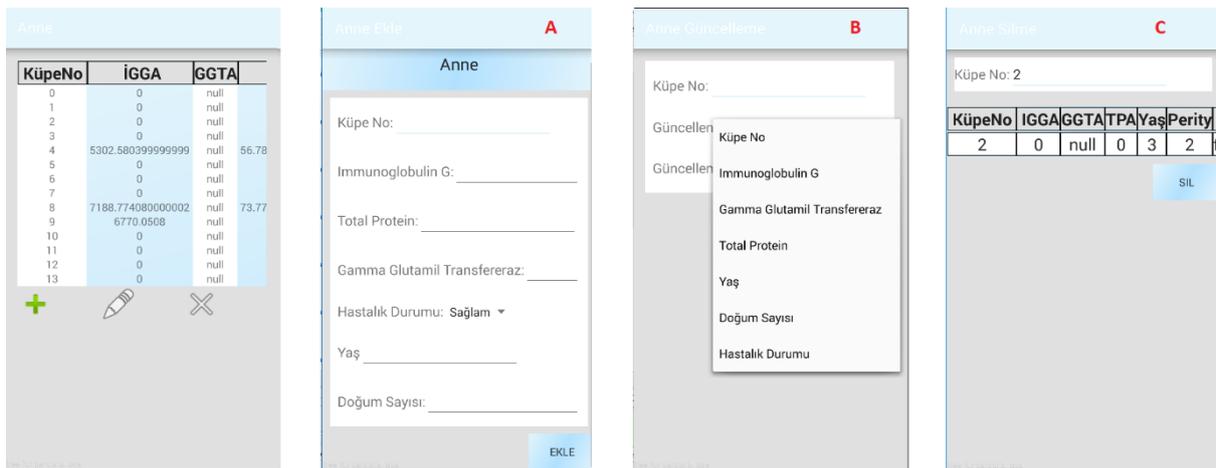


Figure 6. Data processing in the database; (A) add, (B) update, (C) delete dam's data on mobile application

Through the desktop interface shown in Figure 5 and the mobile interface shown in Figure 6, the user can view the data of the dam and can add, update and delete the data there.

The interface in which new dam can be added to the database is shown in Figure 5A and 6A. The tag number, blood levels, age and number of births are entered in this interface. In addition, health status information of the dam is entered by selecting one of the ill or health options from the list.

Updating the data of the database in the database is performed through the interfaces shown in Figure 5B and 6B. The user selects the feature to be updated from the list by entering the tag number of the dam for the data to be updated and the information is updated by entering the new information in the update section.

Deletion of the database data from the database is performed through the interface shown in Figure 5C Figure 6C. The user performs the deletion by entering the dam tag number.

The interface on which the veterinary information is displayed, added, updated and deleted is shown in Figure 7 and Figure 8.

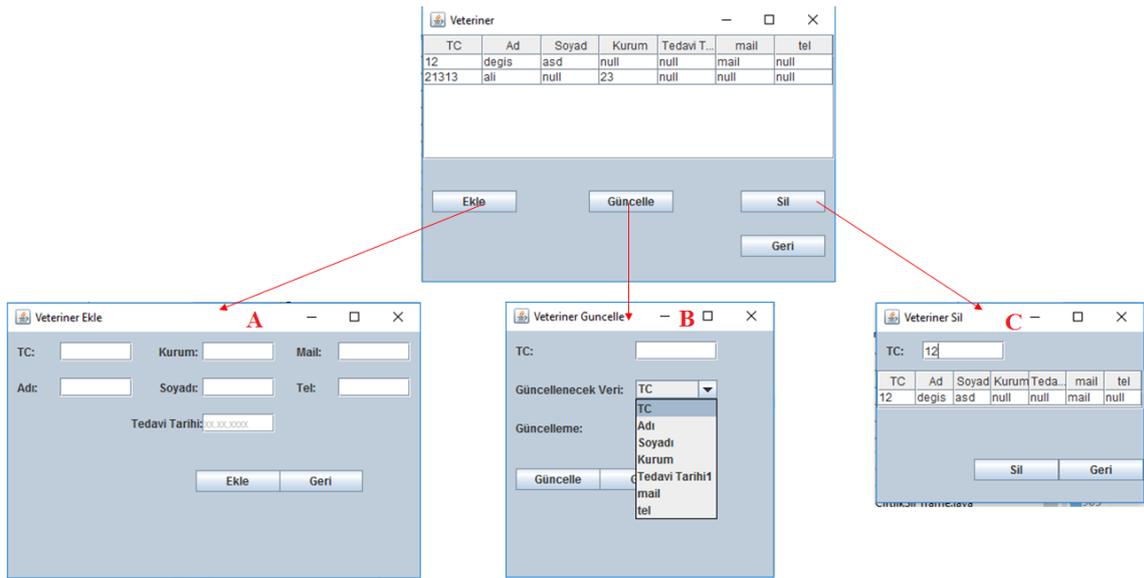


Figure 7. Veterinarian processes in the database; (A) add, (B) update, (C) delete veterinarian’s data on desktop application.

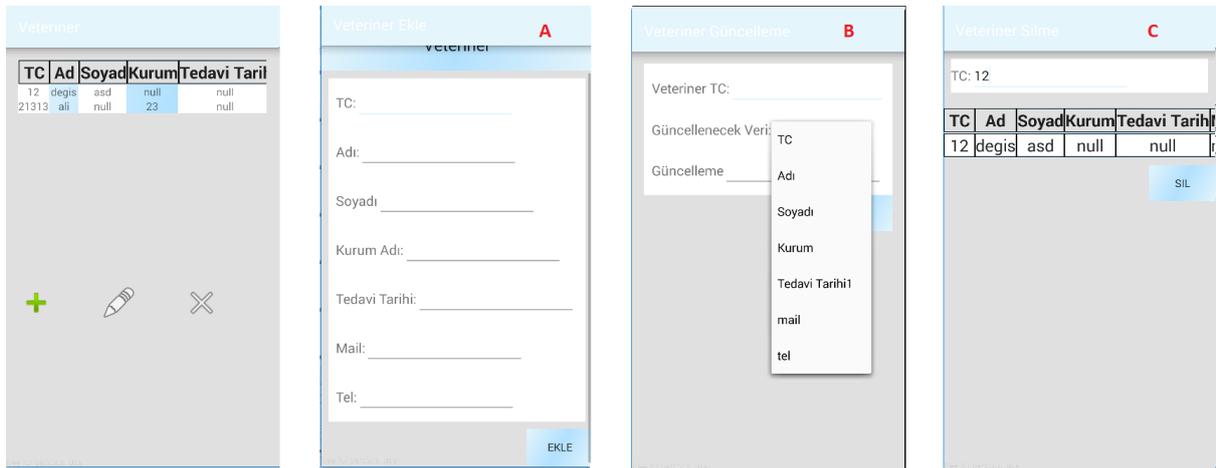


Figure 8. Veterinarian processes in the database; (A) add, (B) update, (C) delete deleting veterinarian’s data on mobile application. Through the interface shown in Figure 7 and Figure 8, the user can view the veterinarian information in the database and add new veterinarians to the database as well as update and delete preexisting ones.

The interface in which the user can add a new veterinarian to the database is shown in Figure 7A and 8A. Through this interface, TC number, name, surname, institution, mailing address, telephone and physician’s treatment history are added to the database.

The updating of the veterinary information in the database is performed through the interface shown in Figure 7B and Figure 8B. After entering the veterinarian’s TC number, the feature to be updated is selected and the information is updated by entering new information into the update section.

Through the interface of Figure 7C and Figure 8C, the information for the veterinarian whose TC number has been entered is deleted from the database.

### 3.2. Data Analysis

Minimum, maximum and average (ill and healty lamb’s) values of neonatal and post-neonatal periods shown in Figure 9.

Nümerik Değişkenler					
Özellik	Kısaltma	Min	Max	Ortalama(Hasta)	Ortalama(Sağlıklı)
İmmunoglobulin G	IgG	41	5302	2212	2621
Gamma Glutamil Transferraz	GGT	0	7517	2485	1839
Laktoferrin	LT	0	2028	910	936
Total Protein	TP	0	108	65	70
Albumin	ALB	0	47	38	38
Doğum Ağırlığı	BW	200	5900	3759	4158
28. Gün sonundaki vücut ağırlığı	WG28	20	12629	7271	8850
Ortalama günlük kilo kazanımı	MDG28	55	246	126	168
Anne Yaşı	Age	1	111	4	4
Anne Doğum Sayısı	Parity	1	4	3	3

Nümerik Değişkenler					
Özellik	Kısaltma	Min	Max	Ortalama(Hasta)	Ortalama(Sağlıklı)
İmmunoglobulin G	IgG	41	5302	2088	2807
Gamma Glutamil Transferraz	GGT	0	7517	1992	1956
Laktoferrin	LT	0	2028	919	937
Total Protein	TP	0	108	70	69
Albumin	ALB	0	47	41	36
Doğum Ağırlığı	BW	200	5900	3903	4181
28. Gün sonundaki vücut ağırlığı	WG28	5864	18650	10902	13247
Ortalama günlük kilo kazanımı	MDG28	105	333	195	237
Anne Yaşı	Age	1	111	4	4
Anne Doğum Sayısı	Parity	1	4	3	3

Figure 9. The features statistical analysis neonatal and post-neonatal period.

Using the user statistical analysis module, detailed information regarding the characteristics arising from the neonatal and post-neonatal periods can be obtained. While there are descriptions and abbreviations of the features in this module, you can see the minimum and maximum values of each property. It is also important to be able to observe how the values of these traits change between ill and healthy lambs. For this reason, the average of the characteristics is found separately for both ill lambs and healthy lambs. When the relationship between risk factors and presence of disease in neonatal period, the mean IgG level of the lambs of the ill was 2212, while the average IgG level of the healthy lambs was 2621. The average GGT level of the patient lambs was 2485, while the mean GGT level of healthy lambs was 1839. In the same manner, veterinarians can make similar comments for other variables using this module.

One type of information held in the database is the disease type for the lamb. The health status of lambs were recorded by investigators in the neonatal period (first month of life), followed by visits by the investigators in the next 8 week period (post-neonatal period) every 2 days (Gökçe & Erdoğan, 2009). The types of these diseases and the number of sick lambs are presented in the graphic shown in Figure 10.



Figure 10. Pie chart of disease diagnosis for the lamb.

Using the disease diagnosis module, the user can select the neonatal, post-neonatal or total of the two period to access detailed information about the diseased lambs.

In Figure 11, a graph showing the result of the disease for the lambs is displayed.



Figure 11. Pie chart of disease outcomes for the lambs.

Looking at the disease outcome chart, it can easily be observed how many lambs are healthy, ill, or dead from among the neonatal, post-neonatal or total of the two periods.

#### 4. DECISION SUPPORT AND DISEASES

##### 4.1. Decision Tree

In the system, veterinary can create a decision tree in order to conclude a better diagnosis. After creating the tree, if the result does not satisfy the veterinary can create a new tree by clicking the reload button at the bottom of the page; also sliding the screen shows the post-neonatal tree. Decision tree result shown in Figure 12.

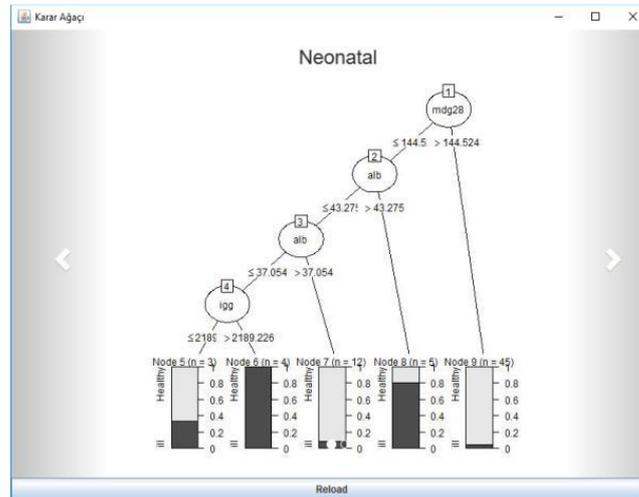


Figure 12. Decision Tree result

##### 4.2. Clustering

Same as the decision tree module, veterinary can use the clustering method to conclude a better diagnosis. Veterinary can reload the page until he or she is satisfied with the result. The important part here is if the veterinary is satisfied with the result, he or she can use it for the rest of his/her study without doing any further changes. An example of clustering shown in Figure 13.

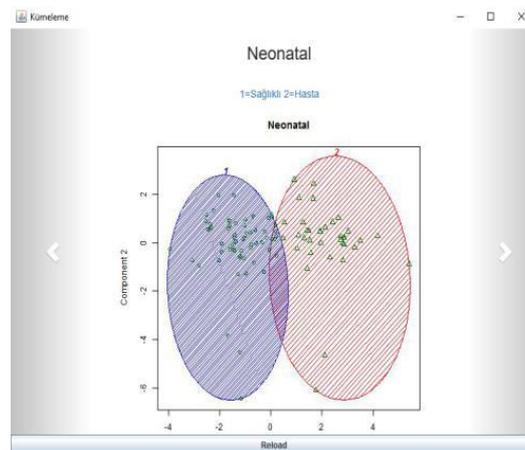


Figure 13. Clustering result for neonatal period.

Veterinary can add, delete and update all the diseases on the diseases module. Besides the names of the diseases, causes and the symptoms of the diseases can be reached in this module. Update operation is done on a new screen. Here, veterinary choses the feature that needs to be changed then enters the new value for it. Diseases module shown in Figure 14.

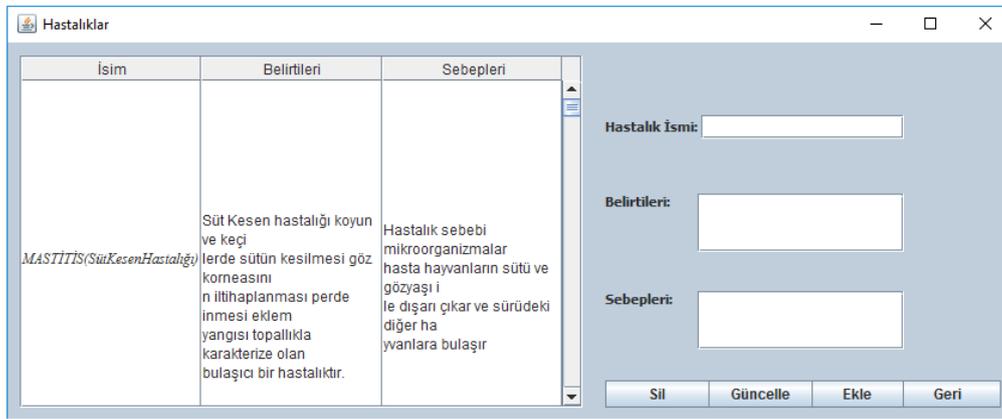


Figure 14. Diseases Module.

## 5. CONCLUSION

Data mining is becoming more and more advanced everyday as a result of having a multitude, not a lack, of data and the incredible increase in data storage and processing speed of computers. The fact that the data is ready for data mining is one of the most important parts of data mining. In this study, a system has been provided in order to store, share and run data analysis regarding the records of animals. Analyses are done with decision tree and clustering methods. Along with this system, veterinarians can diagnose more accurately and this will help to protect the animal health.

## ACKNOWLEDGE

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