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YILDIZ TECHNICAL UNIVERSITY
DEPARTMENT OF COMPUTER ENGINEERING

COURSE ATTENDANCE TRACKING AND FAKE SIGNATURE DETECTION

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SENIOR PROJECT

Advisor
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TABLE OF CONTENTS

LIST OF ABBREVIATIONS

API	Application Programming Interface
ER	Entity Relationship
FN	False Negative
FP	False Positive
MB	Megabyte
RAM	Random Access Memory
SDK	Software Development Kit
TN	True Negative
TP	True Positive

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

COURSE ATTENDANCE TRACKING AND FAKE SIGNATURE DETECTION

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Department of Computer Engineering
Senior Project

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In most schools, teachers determine attendance through the attendance list. Thanks to these attendance lists signed by the students, teachers can identify which students are absent. However, students may not go to school and other friends can sign for them. It can be difficult for teachers to read attendance list and identify fake signatures.

Signatures signed by other students instead of themselves often look different. By looking at these signatures, teachers can presume fake signatures that they see differently enough. In this project, an Android application has been made that determines the attendance status and detects fake signatures from the attendance list photographed.

To determine attendances, the image is cropped and rotated first. Then the pictures are converted to grayscale format. Afterwards, the lines in the image are recognized and the areas between these lines are split into different images as signature areas. Then, the numbers, name and surname information are recognized from the picture. Afterwards, the pictures are compared and the attendance results are determined. E-mails are sent to students who are absent. Finally, attendance results are stored in a server-side database.

The feature of displaying statistical information with charts has been added to the application. Marking absent students and different signatures on the photo has been added. Also, reminder notification has been added to scan the attendance list when

the time of course has expired. With such features, the application has been made more useful.

Keywords: Android programming, image processing, attendance list, image recognition, client-server architecture

ÖZET

YOKLAMA LİSTESİ TARATARAK SINIF MEVCUDU BELİRLEME VE FARKLI İMZALARI TESPİT ETME

İlkem İnan AK
Helim Doğuş Toygur KUKUL

Bilgisayar Mühendisliği Bölümü
Bitirme Projesi

Danışman: Dr. Öğr. Üyesi Mehmet Amaç GÜVENSAN

Günümüzde çoğu okulda öğretmenler yoklama listesi üzerinden yoklama takibi yapmaktadır. Öğrencilerin imzaladıkları bu yoklama listeleri sayesinde öğretmenler hangi öğrencilerin devamsızlık yaptığını tespit edebilmektedir. Fakat öğrenciler okula gelmeyip, başka arkadaşları onların yerine imza atabilmektedir. Öğretmenlerin imzaları okuması ve sahte imzaları tespit etmesi zor olabilmektedir.

Başka öğrencilerin arkadaşları yerine attığı imzalar genellikle farklı görünür. Öğretmenler bu imzalara bakarak yeterince farklı gördüklerini sahte imza sayabilir. Bu projede fotoğrafı çekilen yoklama listesinden devam durumunu belirleyen ve sahte imzaları tespit eden bir Android uygulaması yapılmıştır.

Yoklama alımı sırasında ilk olarak resim kırpma ve döndürme işlemi yapılır. Daha sonra, resimler grayscale formata dönüştürülür. Sonrasında, resimdeki çizgiler belirlenir ve bu çizgiler arasında kalan alanlar imza bölmeleri olarak farklı resimlere bölünür. Daha sonra, resimden yazılarak okunarak numaralar, isim ve soyisim bilgileri alınır. Sonrasında, resimler karşılaştırılır ve yoklama sonuçları belirlenir. Devamsızlık yapan öğrencilere e-mail gönderilir. Son olarak, yoklama sonuçları sunucu tabanlı bir veritabanında saklanır.

Uygulamaya grafikler ile istatistiksel bilgileri görüntüleme özelliği eklenmiştir. Devamsız öğrencileri ve farklı imzaları fotoğraf üzerinde işaretleme eklenmiştir. Ayrıca dersin süresi geçince bildirim ile yoklama listesini taratma hatırlatması da eklenmiştir.

Bu gibi özelliklerle uygulama daha kullanışlı bir hale getirilmiştir.

Anahtar Kelimeler: Android programlama, görüntü işleme, yoklama kağıdı, görüntü tanıma, istemci-sunucu mimarisi

1
Introduction

Students usually sign attendance lists to indicate their attendance at the lesson. Students who have been absent more than a certain number fail the course. Instructors check the signatures on these attendance lists to see the attendance of the students.

Sometimes students do not come to class and someone else signs for them. In this case, the signature might not be similar to the previous signatures of the student. Instructors should also compare signatures of the students from previous weeks. Thus, instructors can see if students are indeed coming to lecture. However, counting and comparing signatures on the attendance list can sometimes be tedious job for instructors. It is also important to inform students about how their absenteeism is.

In this project, an Android application will be written to facilitate instructors' work. Application will check the attendance list, identify attendances from the signatures and determine different signatures. Image processing methods will be used to check the signatures. The instructor will take a photo of the attendance sheet. The application will transmit the signature sections to different images. Signatures of the students will be compared with empty signature sections and the student's previous signatures. In this way, the attendance status of the students will be determined. Also, if students become absent, students will be automatically mailed by the system. With this application, it is aimed to create a common system that all instructors in the university can use.

In the preliminary examination section, similar studies in the literature and their results are explained. In the feasibility section, required conditions for the project to be done on various topics are explained. In the system analysis section, the aims and requirements of the project are explained with details. In the system design section, the methods used in the project and the content of the database are explained. In the application section, the usage of the application is explained and screenshots are given. In the experimental results section, the results obtained as a result of the attendance determination are shown in tables. In the performance analysis section,

the experimental results are interpreted and inferences are made. In the result section, the project is summarized and the conclusions are explained.

2
Preliminary Examination

There is no very similar study on this subject in the literature. However, many methods are used to determine attendance. The most common method is to read the signed attendance paper. Many studies have been done to facilitate the work of instructors such as determining attendance with QR code, RFID and fingerprint.

In their study, [1] Fadi Masalha, Nael Hirzallah purposed to make the attandence control faster and safer by using face scanning. In this process, students login the system with encrypted QR code that instructor displayed. Along with the student's facial image captured by the mobile application at the time of the scan, the Mobile Module will communicate the information collected to the Server Module to confirm attendance.

Arulogun O. T., Olatunbosun, A., Fakolujo O. A., and Olaniyi, O. M [2] designed a RFID based students attandence system. In this system, while every student given a specific RFID tag attends the lecture through entrance door, a serial number of tag is associated with the student database entry. So if a student uses his/her card, the entries will be entered into the database with the time stamp.

In their study, [3] Mohammed Alhothaily, Mohammed Alradaey, Mohammed Oqbah, Amin El-Kustaban designed a fingerprint attandence system. In this system, a teacher takes the portable fingerprint device and passes it in the class to all students. At the end of a class the teacher moves all data from the portable fingerprint device to a computer.

In this study, it is aimed to take a different approach that will make it easier to read the attendance list. In this approach, attendance will be determined from the image of the attendance list.

3
Feasibility

3.1 Technical Feasibility

3.1.1 Software Feasibility

The project is made for the Android operating system. Android Studio is used as application development environment. The programming language which the application is written is selected as Java. A server-based database is used. The database management system is selected as SQL Server. The reason for choosing the application development environment as Android Studio is that it is very convenient for developing Android applications and it is free. The reason that the application is written in the Java programming language is that Android Studio supports the Java language and the project members know the Java language well. The reason for choosing the database management system as SQL Server is that it is sufficient for the system to store the planned number of data and it is free.

3.1.2 Hardware Feasibility

A phone with Android operating system is required to run the application. The minimum SDK version of the Android phone required for the app to run must be 15. This means that it must be a phone with at least Android 4.0.3 version. The application uses approximately 150 MB ram. The application uses an average of 15% CPU. These values were measured by Simple System Monitor [4] application. Hardware requirements are shown in Table 3.1.

Table 3.1 Hardware Requirements

Requirement	**Value**
Minimum Operating System	Android 4.0.3
RAM Usage	150 MB
CPU Usage	15%

The application requires internet access.

3.2 Time Feasibility

Tasks in the project with their distribution by project members and time are shown in Figure 3.1.

Title	Start date	Due date	Assignee
Preliminary Examination	10/02/2020	12/02/2020	Doğuş
Feasibility	13/02/2020	14/02/2020	İnan
System Analysis	17/02/2020	20/02/2020	Doğuş, İnan
System Design	21/02/2020	25/02/2020	Doğuş, İnan
Cropping module	26/02/2020	02/03/2020	İnan
Converting image to grayscale	26/02/2020	03/03/2020	Doğuş
Line detection	04/03/2020	16/03/2020	İnan
Splitting image	17/03/2020	24/03/2020	Doğuş
Extracting text from image	25/03/2020	30/03/2020	Doğuş
Image comparison	31/03/2020	08/04/2020	İnan
Database operations	09/04/2020	17/04/2020	Doğuş, İnan
Server side operations	20/04/2020	30/04/2020	Doğuş, İnan
User interface	01/05/2020	08/05/2020	Doğuş, İnan

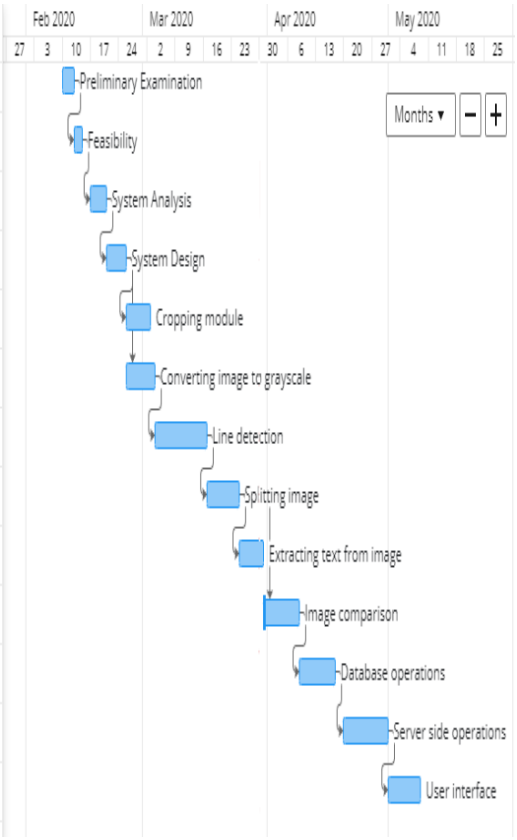


Figure 3.1 Gantt Chart

3.3 Legal Feasibility

All of the libraries and API's which will be used in this project are open source and free. The project complies with laws and regulations. The project does not violate any patent rights.

3.4 Economical Feasibility

Android Studio which is the project development environment, is free. An average computer to code the project can be bought for 3500 TL. An average phone with Android operating system that can run the application can be purchased for 2500 TL. Since the project is done by two people, the cost of computers is 7000 TL and the cost

of phones is 5000 TL. Total expenses of the project are 12000 TL. No earning will be obtained from the application. Expenses for the project are shown in Table 3.2.

Table 3.2 Hardware Expenses for the Project

Device	**Price**
Computer 1	3500 TL
Computer 2	3500 TL
Mobile phone 1	2500 TL
Mobile phone 2	2500 TL
Total	**12000 TL**

4
System Analysis

4.1 Aims of the Project

The main aim of the project is to facilitate the work of the instructors to read the attendance list. For this, it is aimed to detect the presence and absence of the signatures on the attendance list. It is also aimed to identify different signatures of the same person.

4.2 Requirements Analysis

Some requirements have been considered in order to start to the project. First of all, the general working structure of the system was planned to create a roadmap. The first requirement is to crop the image of attendance list. Because users can take photos remotely. Another requirement is to convert the photo to grayscale. Because if the same signatures are made with different colored pens, they should be determined. The picture should be divided to the partitions on the signature paper. For this, the lines in the picture should be determined. By comparing the divided pictures, it can be determined whether the a person is present or whether their signatures are fake. The instructor can scratch the signature areas of students who are absent. It has been considered that it can be easier to detect the crosses that are scratched. Also, another requirement is to read texts from the image, because the student numbers are needed to be kept in the database. Another requirement is to keep the attendance information in a server-side database. Thus, after the attendance information is determined, information will be sent to a remote server and information will be received from there.

The requirements analysis model has been selected as the object oriented model. The use case diagram is shown in Figure 4.1.

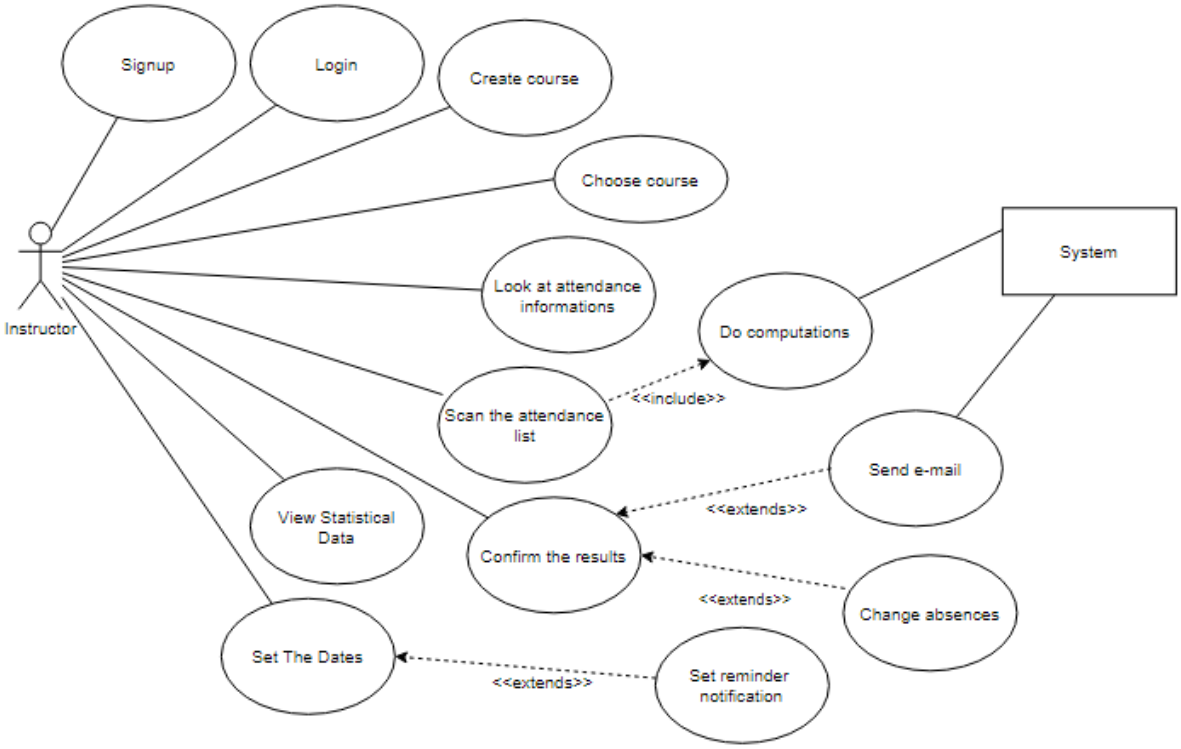


Figure 4.1 Use Case Diagram

Architecture of this project is client-server model. The system architecture diagram is shown in Figure 4.2.

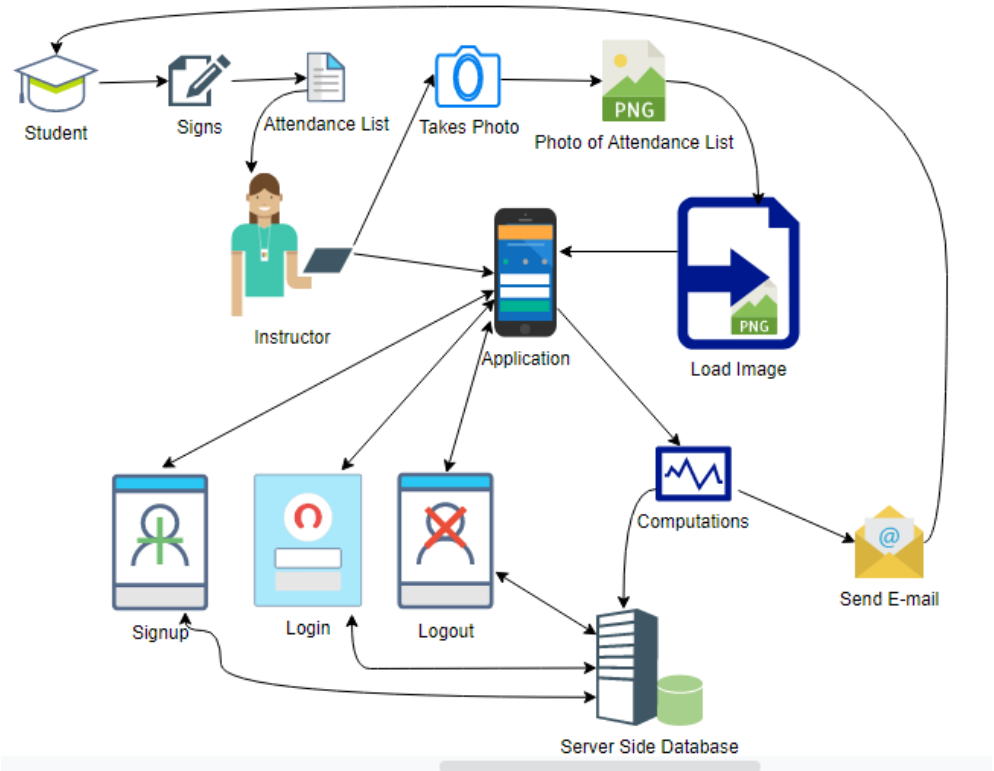


Figure 4.2 System Architecture Diagram

The draft class diagram is shown in Figure 4.3.

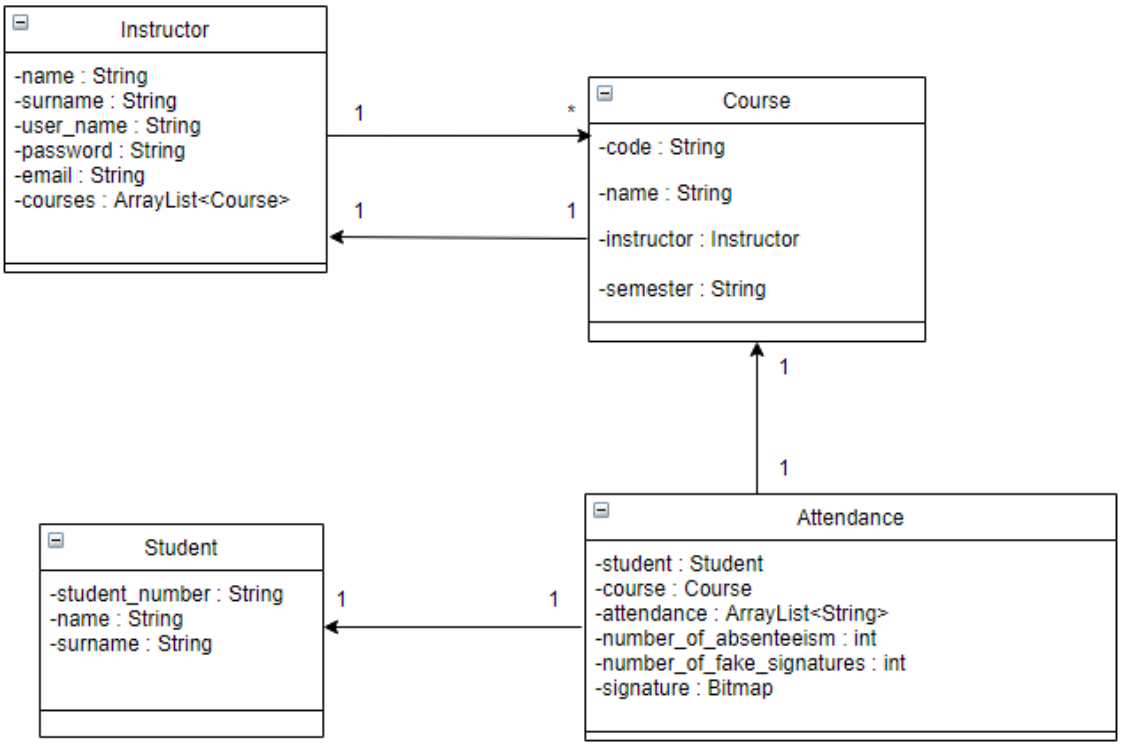


Figure 4.3 Draft Class Diagram

4.3 Roadmap of the Project

- An API will be used for the photo cropping and rotation module.
- The cropped image will be converted to grayscale format.
- The lines in the photo will be detected. For this, it was decided to look at the hexadecimal color codes of the picture.
- The areas between the detected lines will be divided into different images and stored.
- Texts from the divided images will be recognized.
- The signature areas among the divided images will be compared.
- University e-mail addresses of the students will be created from the student numbers and e-mails will be sent to students who are absent.
- The obtained results will be stored in a server-side database.

4.4 Performance Metrics

Some performance metrics are applied to measure the success of the project. After the signature comparisons, the similarity between the results determined by the system and the real values are measured. True-Positive Rate, False-Positive Rate, Accuracy and Performance Speed are used as performance metrics in this project.

True-Positive Rate: It is used to calculate the correct estimation rate of the selected class (4.1).

$$TPRate = \frac{TP}{TP + FN} \tag{4.1}$$

False-Positive Rate: It is used to calculate the wrong estimation rate of the selected class (4.2).

$$FPRate = \frac{FP}{FP + TN} \tag{4.2}$$

Accuracy: It is ratio of correctly predicted observation to the total observations. (4.3)

$$Accuracy = \frac{TP + TN}{TP + FP + TN + FN} \tag{4.3}$$

Performance Speed: It is determined by the time between uploading the photos and getting the results.

5
System Design

5.1 Software Design

The project consists of nine basic stages. These stages are described in detail below.

5.1.1 Photo Cropping and Rotation

In order to use the attendance list properly, some operations must be done on the photo. UCrop library [5] is used for the operations because this library provides cropping, rotating and zooming operations with a user-friendly interface. Figure 5.1 shows a sample attendance list image before and after rotating and cropping.

Figure 5.1 Photo Cropping and Rotation

5.1.2 Converting Image to Grayscale Format

The purpose to do this operation is that the attendance list can be signed with different colored pens. So when comparing signatures, the colors of the pixels in similar

positions are checked. Figure 5.2 shows a sample of cropped attendance list before and after converting to grayscale format.

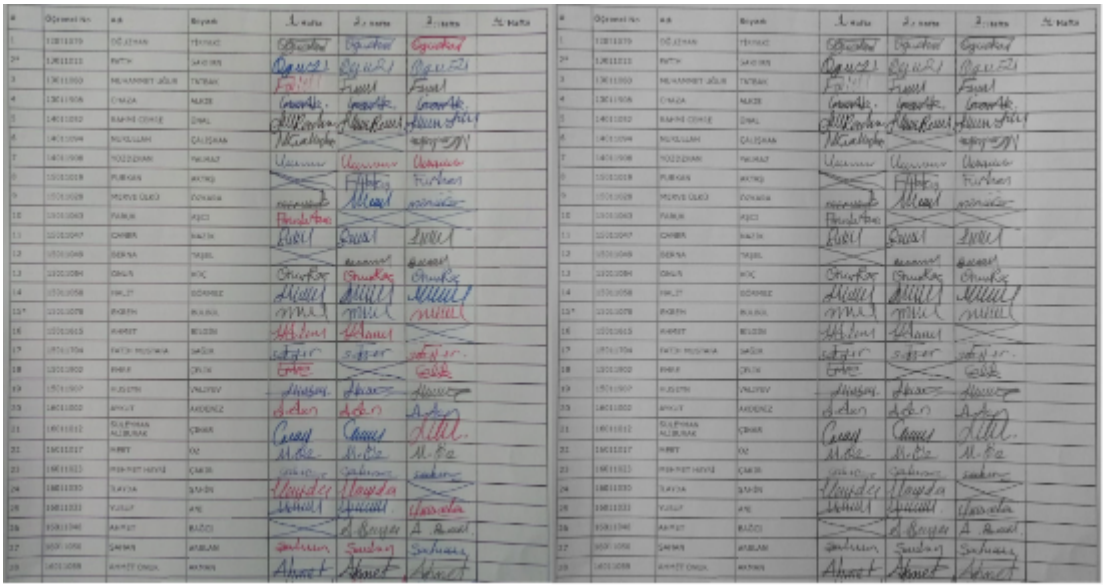


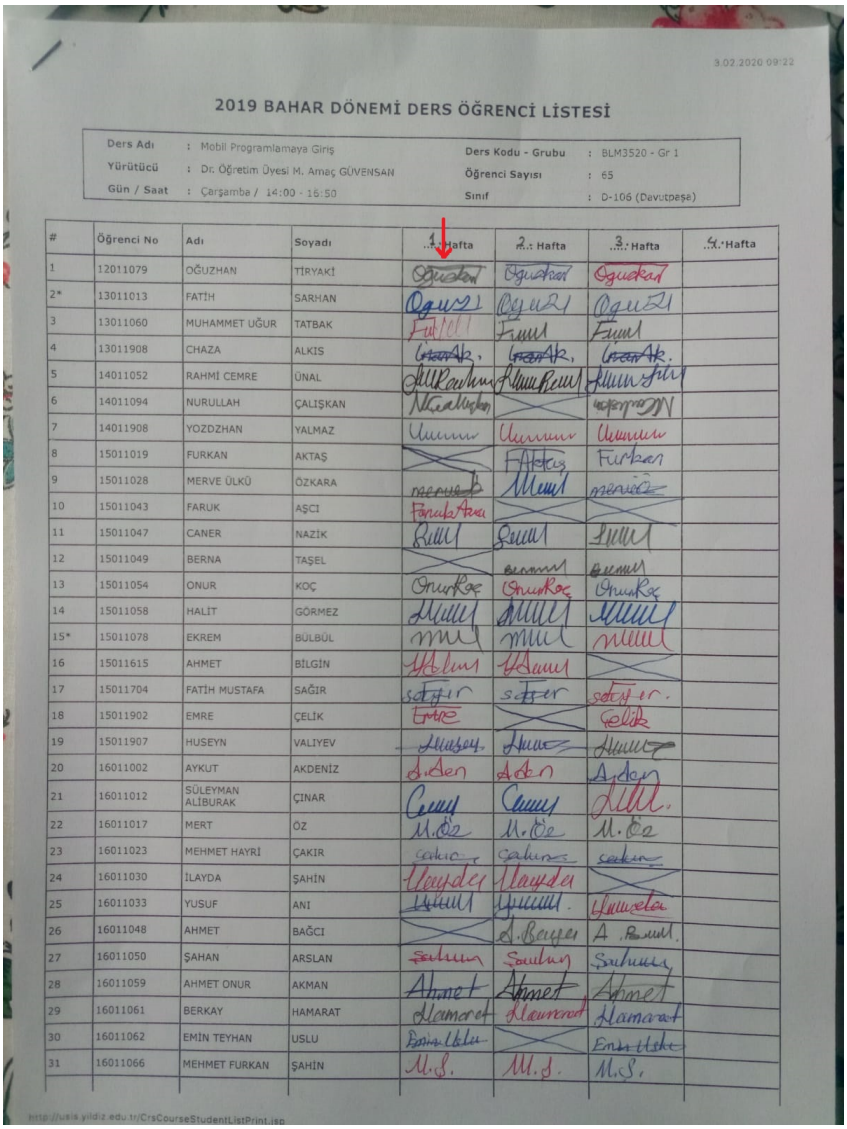
Figure 5.2 Converting Image to Grayscale Format

5.1.3 Detecting Lines From Images

In order to obtain the student information and signatures in the photograph separately, it is necessary to separate the photograph into pieces. The lines in the photograph must be recognized to determine the boundaries of the pieces. If there are too many points in a direction are black, it is a line. But black has many different shades. For this reason, the points should be checked with two different colors, black and white. If the hexadecimal color codes of pixels are smaller than certain values, they are considered as black.

Although the image is rotated, it is very difficult for all lines to be straight. Therefore, the line detection criterion should not be black pixels in an entire row or column. Instead, if a certain percentage of black pixels is present, the line must be detected.

The number of lines which the application detects may decrease when the skewness in the lines increases while detecting the columns. Also, if many signatures are made along a top-down line, the ratio of black pixels will increase. If more than a certain percentage of black pixels are detected, columns that are not actually present can be detected. Figure 5.3 shows an example of this situation. As a solution to these problems, the percentage of line control is changed until 9 columns are detected.



3.02.2020 09:22

2019 BAHAR DÖNEMİ DERS ÖĞRENCİ LİSTESİ

Ders Adı	: Mobil Programlamaya Giriş	Ders Kodu - Grubu	: BLM3520 - Gr 1
Yürütücü	: Dr. Öğretim Üyesi M. Amaç GÜVENSAN	Öğrenci Sayısı	: 65
Gün / Saat	: Çarşamba / 14:00 - 16:50	Sınıf	: D-106 (Davutpaşa)

#	Öğrenci No	Adı	Soyadı	1. Hafta	2. Hafta	3. Hafta	4. Hafta
1	12011079	OĞUZHAN	TİRYAKİ				
2*	13011013	FATİH	SARHAN				
3	13011060	MUHAMMET UĞUR	TATBAK				
4	13011908	CHAZA	ALKIS				
5	14011052	RAHMİ CEMRE	ÜNAL				
6	14011094	NURULLAH	ÇALIŞKAN				
7	14011908	YOZDZHAN	YALMAZ				
8	15011019	FURKAN	AKTAŞ				
9	15011028	MERVE ÜLKÜ	ÖZKARA				
10	15011043	FARUK	AŞCI				
11	15011047	CANER	NAZİK				
12	15011049	BERNA	TAŞEL				
13	15011054	ONUR	KOÇ				
14	15011058	HALİT	GÖRMEZ				
15*	15011078	EKREM	BÜLBÜL				
16	15011615	AHMET	BİLGİN				
17	15011704	FATİH MUSTAFA	SAĞIR				
18	15011902	EMRE	ÇELİK				
19	15011907	HUSEYN	VALIYEV				
20	16011002	AYKUT	AKDENİZ				
21	16011012	SÜLEYMAN ALİBURAK	ÇINAR				
22	16011017	MERT	ÖZ				
23	16011023	MEHMET HAYRİ	ÇAKIR				
24	16011030	İLAYDA	ŞAHİN				
25	16011033	YUSUF	ANI				
26	16011048	AHMET	BAĞCI				
27	16011050	ŞAHAN	ARSLAN				
28	16011059	AHMET ONUR	AKMAN				
29	16011061	BERKAY	HAMARAT				
30	16011062	EMİN TEYHAN	USLU				
31	16011066	MEHMET FURKAN	ŞAHİN				

http://usis.yildiz.edu.tr/CrsCourseStudentListPrint.jsp

Figure 5.3 An Arrow Indicates That a Column May Be Detected Incorrectly

While detecting rows, some rows may not be detected. Unlike columns, distances between rows are generally similar. Thanks to this situation, for the lines that are not detected, the most repeating line difference is added as rows based on previous and next rows.

5.1.4 Recognizing and Storing Images

After the lines are found, the picture is divided into pieces according to the places where the lines intersect. Pieces are stored in a matrix based on their location. Figure 5.4 shows a sample attendance list divided into pieces after lines are detected. In Figure 5.4, eight signature areas are shown as an example, separated from each other.

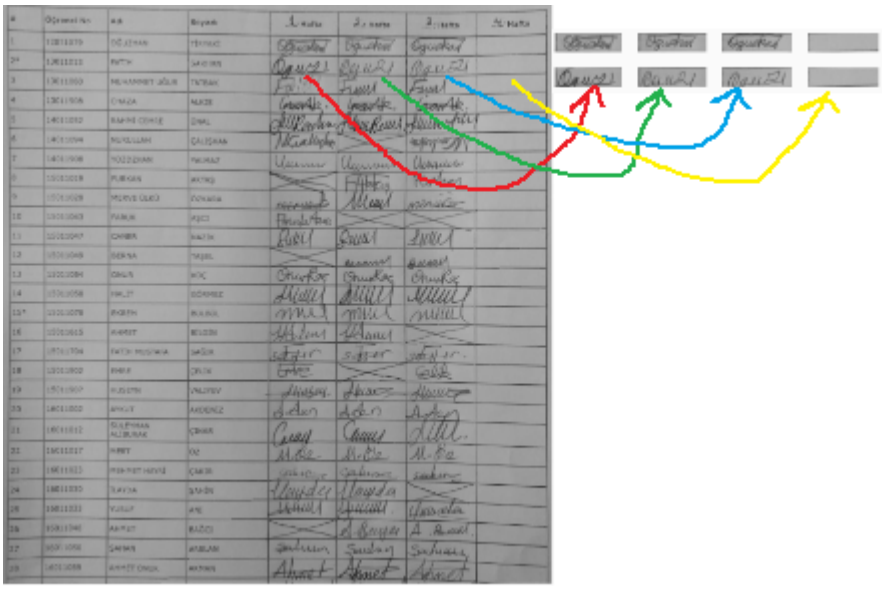


Figure 5.4 Recognizing and Storing Images

5.1.5 Recognizing Texts From Images

Student information must also be obtained to know which signature belongs to which student. In order to make this process, it is necessary to use a text recognition API. In this project, Google Vision API [6] is used for this process. After the student information is recognized, they are placed in a matrix.

5.1.6 Comparing Images

5.1.6.1 Method

Comparing images are used to understand whether a student is absent, whether signature piece is crossed out and whether a signature is fake.

If the student has been absent, the signature area may be empty or the instructor may have crossed out that area. Firstly, it should be determined whether the student is absent or not. So, if the ratio of black pixels in the signature areas is lower than a certain value, the absence is detected. If there is more than a certain ratio of black pixels along the cross region in a signature area, the absence is detected too.

The previous signatures of the students are compared to identify fake signatures. When comparing signatures, the points at the same location of two different signature images are compared. If the points differ above a certain rate, the signature is determined as a fake.

5.1.6.2 Comparison Algorithm to Identify Different Signatures

Gaps and crosses are detected first. Thus, absenteeism is determined. Then absenteeism is not taken into comparison. The student is compared with the signature of the last week they arrived. If the attendance of the first week is taken, everyone who was not absent is considered to be present.

The signatures of the weeks in which the attendance is taken are compared pixel by pixel. When comparing, each picture is compared to three pixels to the right, left, up and down shifts.

When the picture is divided according to the lines, the lines usually do not fit in an only one pixel and can overflow in the divided pictures. Figure 5.5 shows sample of two signatures with enlarged scale to be compared. As shown in Figure 5.5, lines usually overflow to the first 2 pixels in rows and columns. Therefore, lines formed by the first 2 pixels in rows and columns are not compared. Otherwise, the lines appear at the same points and the similarity rate increases.

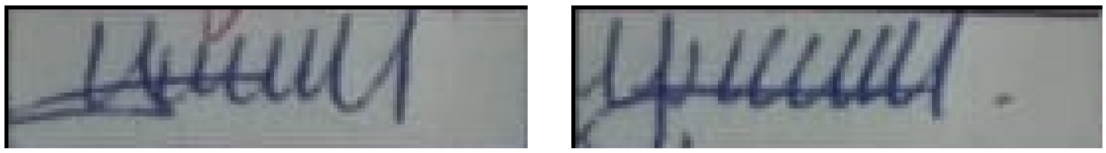


Figure 5.5 Sample of Two Signatures with Enlarged Scale

When deciding whether the picture is similar or different, there are three criteria: similarity rate, difference rate and black pixel rate.

Similarity rate: It is the ratio of the maximum number of similar pixels obtained by comparing their shifted states to the number of pixels (5.1).

$$SimilarityRate = \frac{NumberOfSimilarPixels}{NumberOfPixels} \tag{5.1}$$

Difference rate: It is the ratio of the minimum number of different pixels obtained by comparing their shifted states to the number of pixels (5.2).

$$DifferenceRate = \frac{NumberOfDifferentPixels}{NumberOfPixels} \tag{5.2}$$

Black pixel rate: It is the ratio of the average of the black pixels numbers in two picture to the number of pixels (5.3).

$$BlackPixelRate = \frac{BlackPixelsInFirstPicture + BlackPixelsInSecondPicture}{2 * NumberOfPixels} \tag{5.3}$$

When deciding on the result, it is examined at different intervals according to the number of black pixels. According to intervals, if the similarity rate is more than a certain value and the difference rate is lower than a certain value, it is considered as similar.

When too many black pixels exist, even if the images are different, most pixels could be considered as similar because they will match. But they should not be considered as similar. Therefore different intervals according to the black pixel rate are chosen. As an example, two sample of signatures which are different, but with a lot of black pixels, are shown in Figure 5.6. If a certain similarity rate was sought in all pictures, these pictures could be considered as similar although they were different.

Figure 5.6 Sample of Two Different Signatures with a lot of Black Pixels

5.1.7 Sending E-mails to Students

University e-mail addresses of the students are created from the student numbers. If a student is absent, he/she is informed by e-mail. Java Mail API [7] is used to send e-mail.

5.1.8 Storing Information in a Server-Side Database

Information collected from the attendance lists are stored in a server-based database. jTDS [8] is used to connect to the server based database. The server was leased with SmarterASP.NET [9].

5.1.9 GUI and Other Useful Features

GUI of the application is created with the XML files. There should be several features in a user-friendly interface.

5.1.9.1 Displaying Statistical Information with Charts

Statistical information with charts are displayed with the MP Android Charts API [10]. The instructor can view bar charts by week or courses. If the instructor chooses to display in weeks, they can display the number of attendances, number of absentees and number of fake signatures in the weeks. If the instructor chooses to display in courses, they can display the average numbers of attendances, absentees and fake signatures in the weeks of their courses. Each chart shows maximum of 5 weeks of results and the user can choose which weeks to display. The instructor can also choose to show attendance information with a line chart. If the line chart is selected, the attendance, absenteeism and fake signature numbers of the scanned weeks are shown.

5.1.9.2 Marking Absentees and Fake Signatures on Image

After attendance list is scanned, absentees are marked in red and fake signatures are marked in blue on the image of attendance list. The attendance list marked is shown below the listed attendance results.

5.1.9.3 Reminder Notification to Scan the Attendance List

Reminder notification are sent to scan the attendance list when the time of course is expired. The reminder notification is sent every 4 weeks, 5 hours after the start of the lesson. Reminder notification is sent to the user via Broadcast Receiver and AlarmManager.

The class diagram is shown in Figure 5.7.

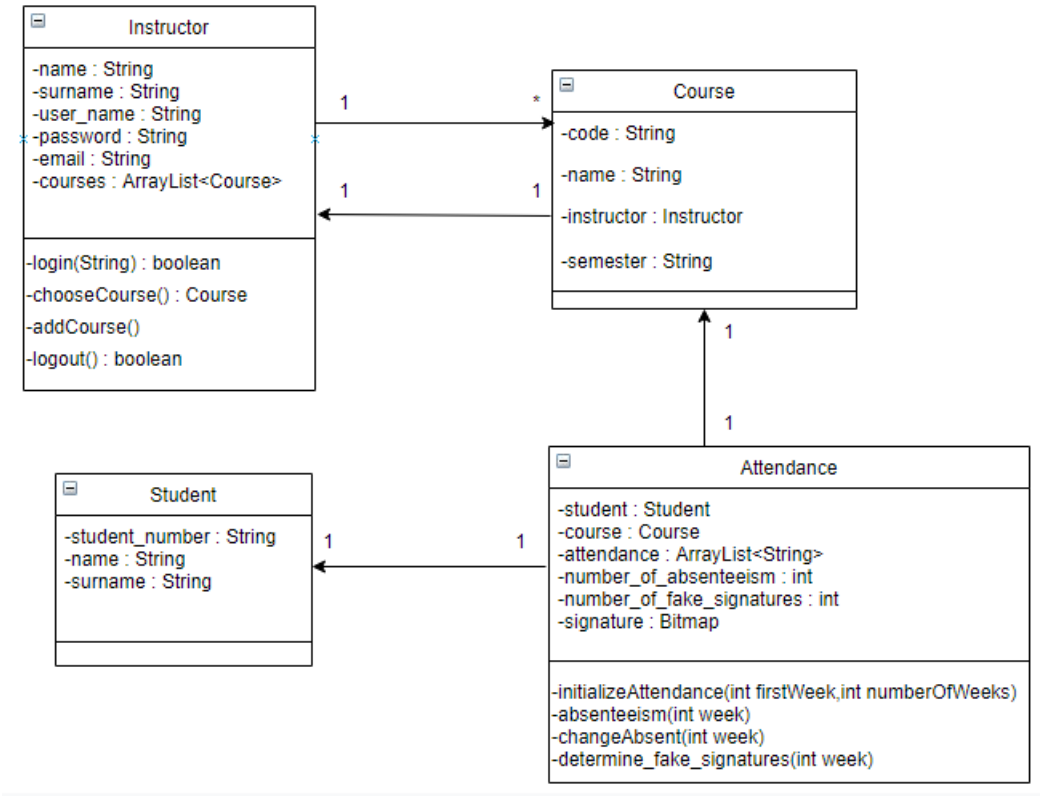


Figure 5.7 Class Diagram

5.2 Database Design

The data is stored in a server-based database with four tables. These tables are instructor, student, class and attendance. The attendance information of a student in a course are stored in an attendance table. The information stored by these tables are as follows.

5.2.1 Instructor

In the instructor table, name, surname, username, password and e-mail address of the instructor are stored.

5.2.2 Course

In the course table, the user name of the instructor who conducts the course, the course name, semester, id of the course and dates are stored.

5.2.3 Student

In the student table, name, surname and student number are stored.

5.2.4 Attendance

The student object and the course object are stored for each attendance object in the attendance table. It also stores one-semester attendances in the related course for the student they own.

E-R diagram of the project is shown in Figure 5.8.

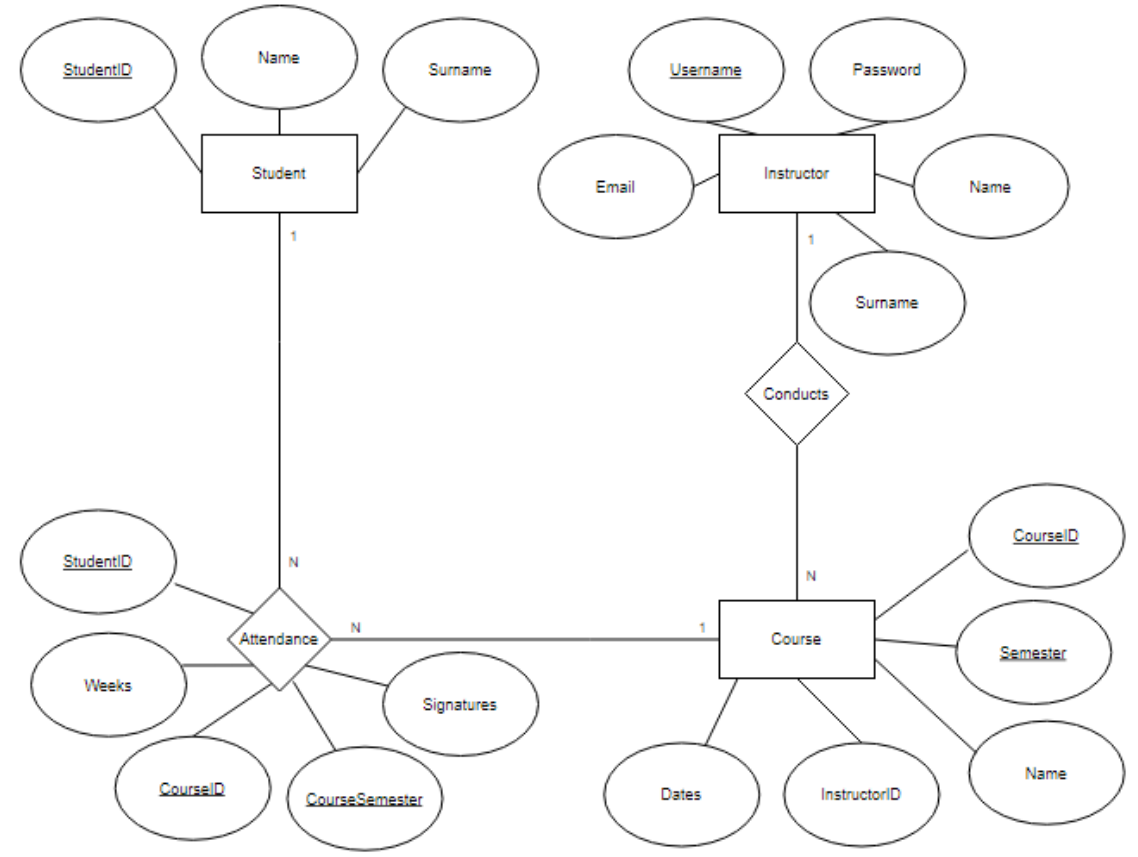


Figure 5.8 E-R Diagram

5.3 Input-Output Design

The instructor logins into the system with username and password. The instructor chooses the course which attendance information will be entered. The system requests the attendance list photo as input. This photo can be selected from the gallery or taken with the camera. After the computations, the students who are absent are shown. The students and attendance information in the image are recognized and stored in the database in the attendance information of the related course.

6
Application

Instructors login in the application in order to use it. There are information such as user name and password. If an instructor is not registered yet, the instructor can press sign up button. The login screen appears as shown in the Figure 6.1.

Figure 6.1 Login Module

The sign up screen appears as shown in the Figure 6.2. There are five necessary information for signing up process. These are name, surname, username, password and email. If the username is already in use, the process is not performed.

Figure 6.2 Sign up Module

When an instructor logged in the application, courses of the instructor are listed. There are two option, a course can be selected or a course can be added. The screen that the courses are listed appears as shown in the Figure 6.3.

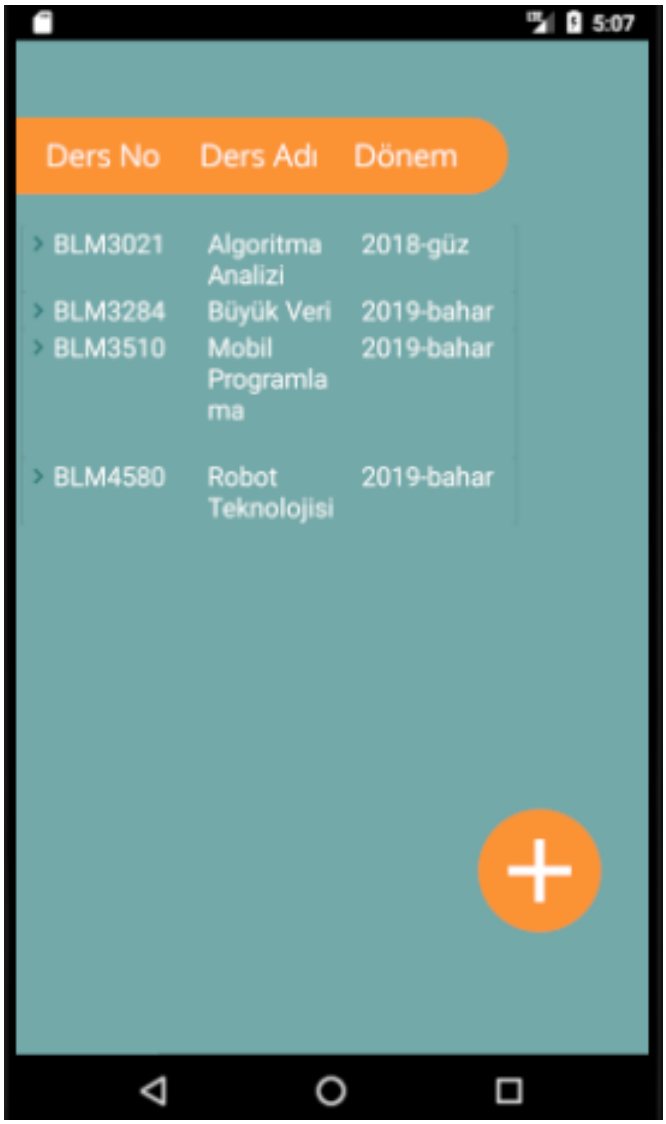


Figure 6.3 List of Instructor's Courses

If an instructor want to create a course, the instructor can press add course button. Three information must be entered in this screen such as course id, course name and semester. If a course with same id and same semester is already exists, the process is not performed. Add course screen appears as shown in the Figure 6.4.

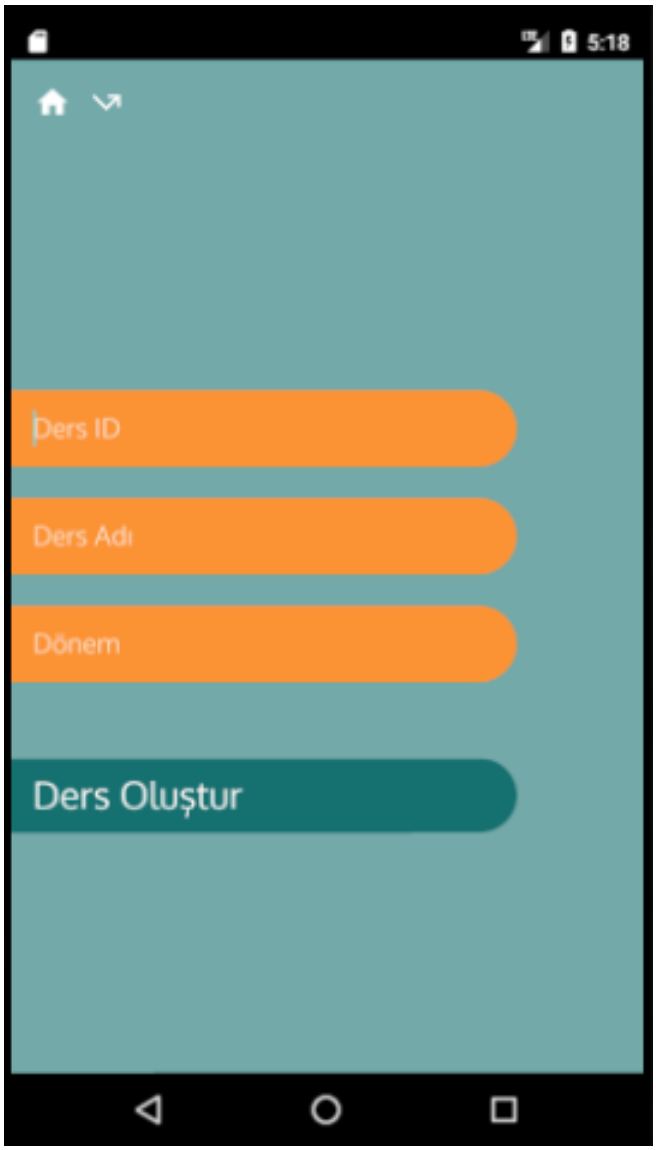


Figure 6.4 Adding Course Module

Four operations can be done for one course. These operations are scanning new attendance list, showing attendance information of the course, showing attendance statistics of the course and setting dates. The screen to choose the operation appears as shown in the Figure 6.5.

Figure 6.5 Actions

The scanning attendance screen appears as shown in the Figure 6.6. In this screen firstly, two information must be determined that are number of weeks to be entered attendance information and the first of the weeks to be entered attendance. Then a photo of attendance list is added. The process can be done with two different ways that are taking photo of attendance list or adding attendance photo from gallery.

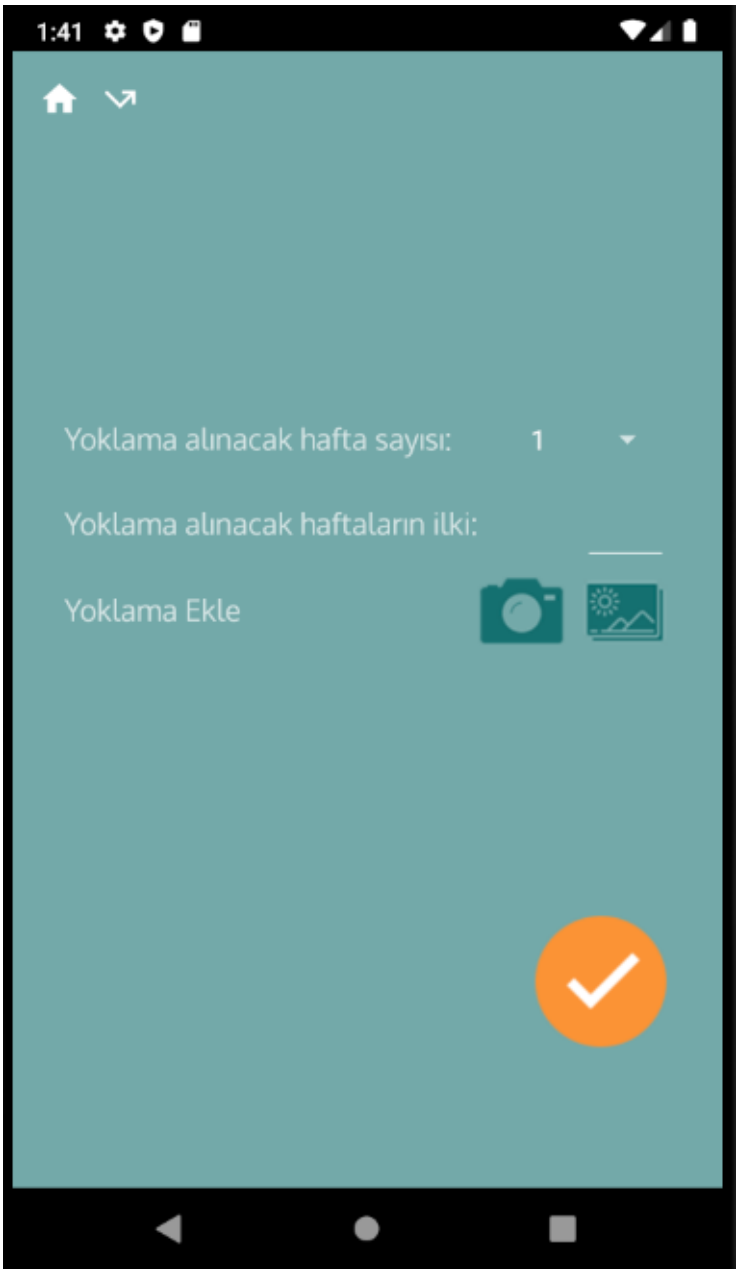


Figure 6.6 Adding Attendance List

When a photo of attendance list is selected, the cropping screen appears as shown in the Figure 6.7.

Figure 6.7 Cropping Module

After the comparison process is completed, attendance list of 4 weeks is shown in Figure 6.8. The attendance status can be changed by clicking to the plus, minus or question mark symbols. On this screen, the user can return to the courses screen by saving the results, can go to the attendance results screen by saving the results or send emails to the absent students.

Figure 6.8 Results of Comparing Images

When the attendance list results are scrolled down, the marked attendance list appears as in Figure 6.9. Absents are marked in red, fake signatures are marked in blue.

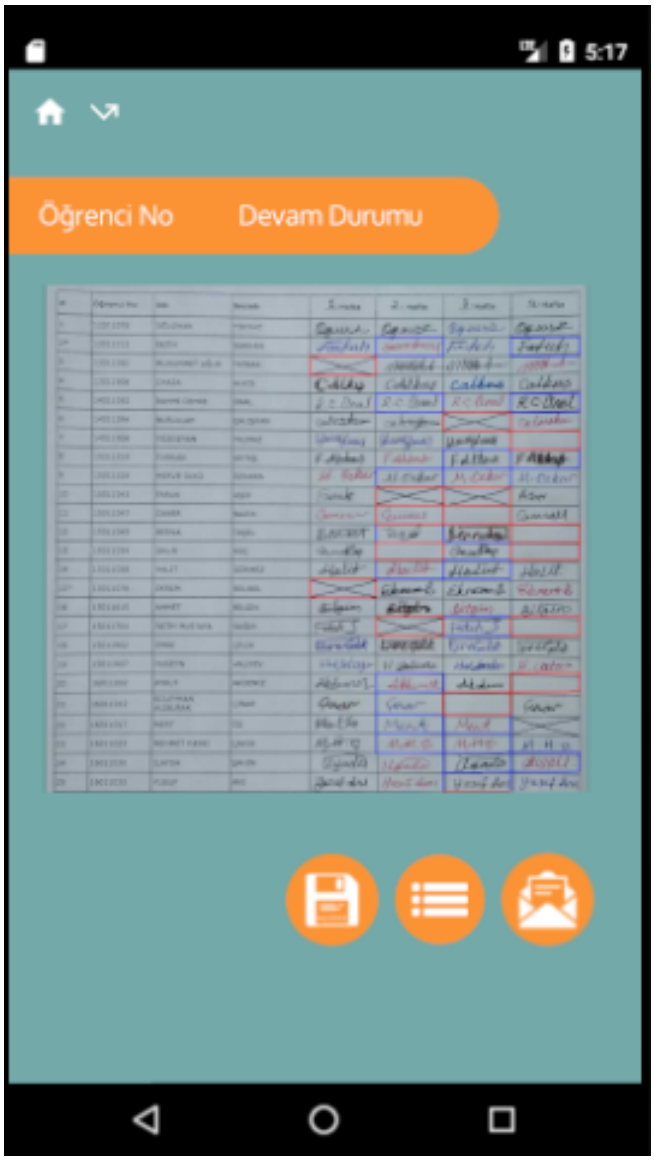


Figure 6.9 Marked Attendance List

Another option of the operations is listing attendance information. The screen appears as shown in the Figure 6.10. As can be seen, the number of absenteeism and the number of fake signatures are listed by the student numbers along with the number of weeks scanned.

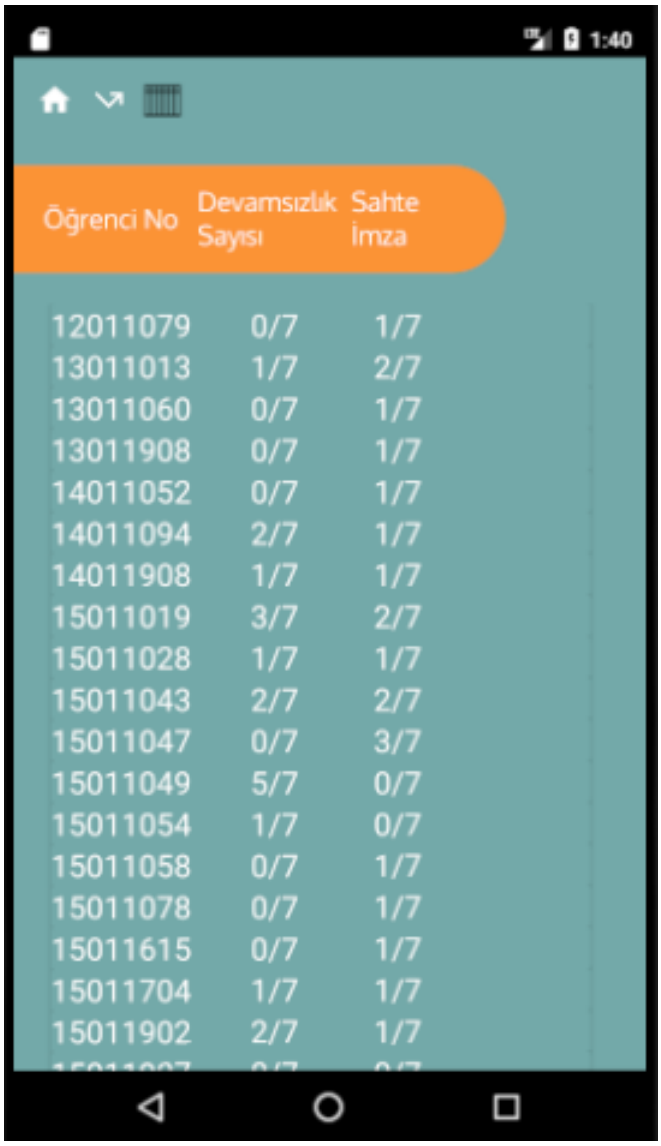


Figure 6.10 Attendance Results of Course

Attendance results can also be displayed by weeks. It shows up to 5 weeks of results and the user can choose which weeks to display. Figure 6.11 shows the attendance results of the first 5 weeks.

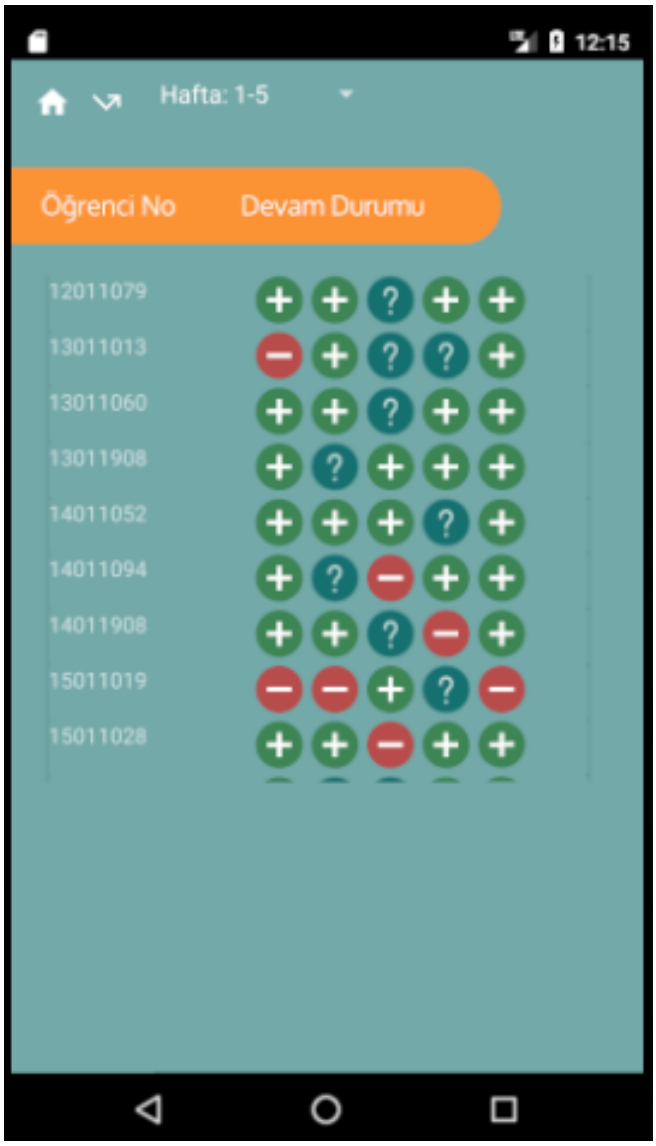


Figure 6.11 Attendance Results of Course by Weeks

Another option of the operations is showing statistical data. For this, bar charts and line charts are used. Green columns symbolize the number of days attended, red columns symbolize absenteeism and blue columns symbolize fake signatures. The instructor can view bar charts by week or courses. The instructor can also view line chart of the scanned weeks. Statistical data by the weeks with bar chart are shown in Figure 6.12.

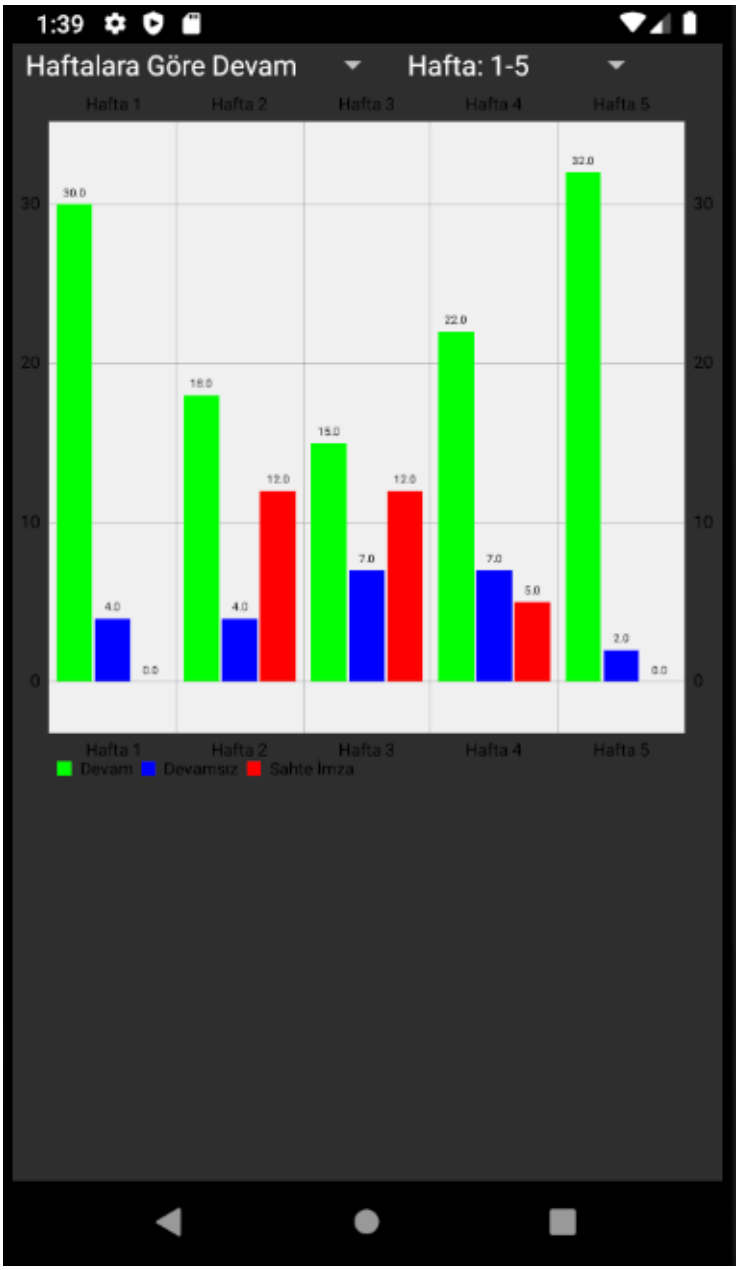


Figure 6.12 Attendance Statistics of Course

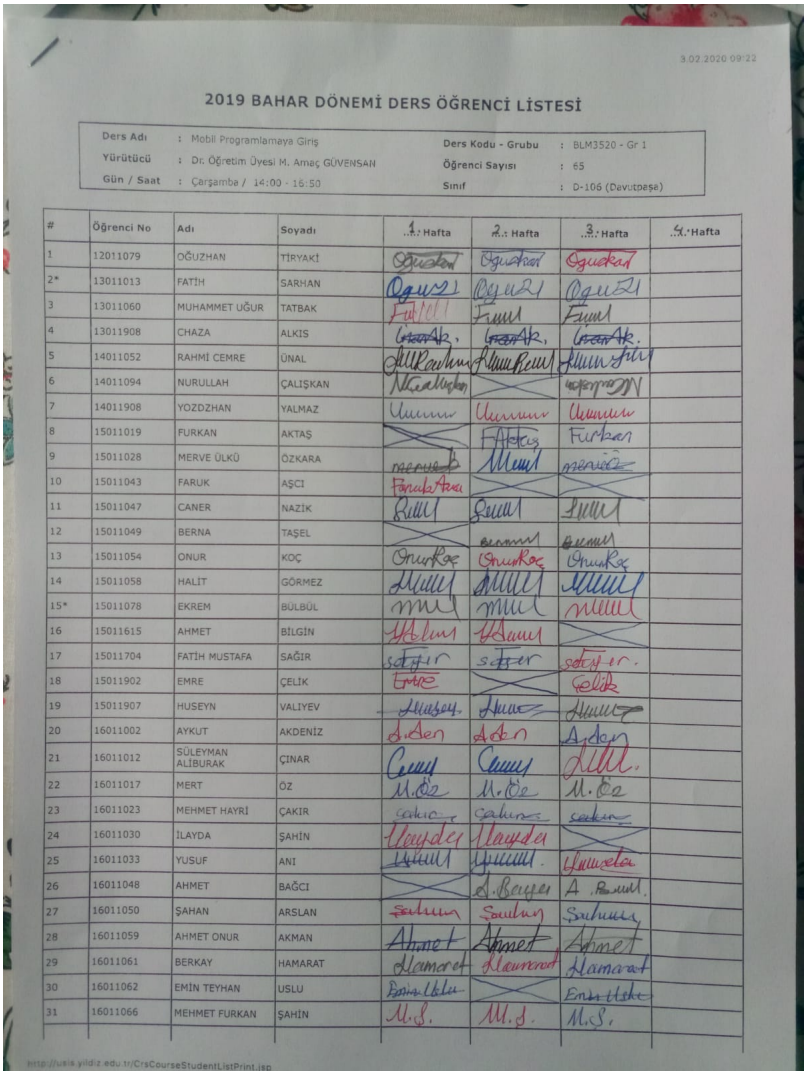
The determining date screen appears as shown in the Figure 6.13. In this screen, new dates can be determined or existing dates can be checked. If reminder is selected, a notification will arrive every four weeks when the time of the course has passed.

Figure 6.13 Determining Date Module

7
Experimental Results

When the attendance list is scanned, absentees and fake signatures are determined. Determination of absentees and fake signatures are examined separately for three different attendance lists.

Image of the first attendance list tested is shown in Figure 7.1.



3.02.2020 09:22

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Gün / Saat	: Çarşamba / 14:00 - 16:50	Sınıf	: D-106 (Davutpaşa)

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2*	13011013	FATİH	SARHAN				
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4	13011908	CHAZA	ALKIS				
5	14011052	RAHMİ CEMRE	ÜNAL				
6	14011094	NURULLAH	ÇALIŞKAN				
7	14011908	YOZDZHAN	YALMAZ				
8	15011019	FURKAN	AKTAŞ				
9	15011028	MERVE ÜLKÜ	ÖZKARA				
10	15011043	FARUK	AŞCI				
11	15011047	CANER	NAZİK				
12	15011049	BERNA	TAŞEL				
13	15011054	ONUR	KOÇ				
14	15011058	HALİT	GÖRMEZ				
15*	15011078	EKREM	BÜLBÜL				
16	15011615	AHMET	BİLGİN				
17	15011704	FATİH MUSTAFA	SAĞIR				
18	15011902	EMRE	ÇELİK				
19	15011907	HUSEYN	VALIYEV				
20	16011002	AYKUT	AKDENİZ				
21	16011012	SÜLEYMAN ALİBURAK	ÇINAR				
22	16011017	MERT	ÖZ				
23	16011023	MEHMET HAYRİ	ÇAKIR				
24	16011030	İLAYDA	ŞAHİN				
25	16011033	YUSUF	ANI				
26	16011048	AHMET	BAĞCI				
27	16011050	ŞAHAN	ARSLAN				
28	16011059	AHMET ONUR	AKMAN				
29	16011061	BERKAY	HAMARAT				
30	16011062	EMİN TEYHAN	USLU				
31	16011066	MEHMET FURKAN	ŞAHİN				

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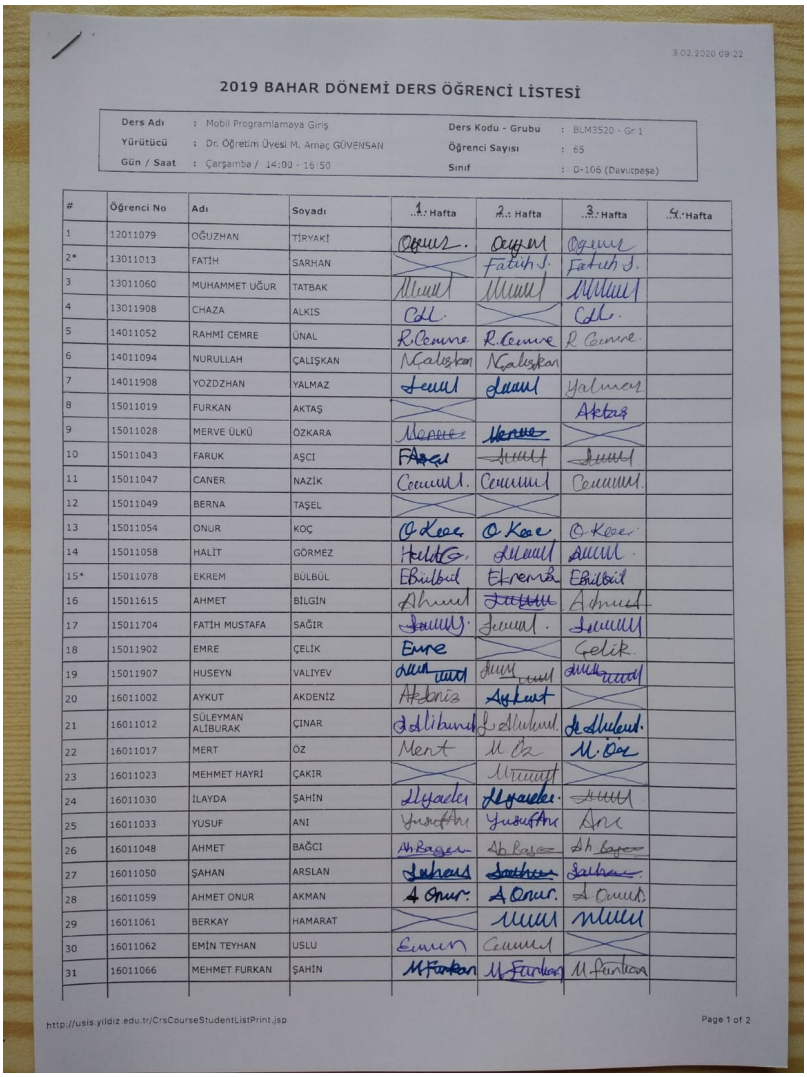
Figure 7.1 Image of the First Attendance List Tested

Image of the second attendance list tested is shown in Figure 7.2.



3.02.2020 09:22

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4	13011908	CHAZA	ALKIS				
5	14011052	RAHMİ CEMRE	ÜNAL				
6	14011094	NURULLAH	ÇALIŞKAN				
7	14011908	YOZDZHAN	YALMAZ				
8	15011019	FURKAN	AKTAŞ				
9	15011028	MERVE ÜLKÜ	ÖZKARA				
10	15011043	FARUK	AŞCI				
11	15011047	CANER	NAZIK				
12	15011049	BERNA	TAŞEL				
13	15011054	ONUR	KOÇ				
14	15011058	HALİT	GÖRMEZ				
15*	15011078	EKREM	BÜLBÜL				
16	15011615	AHMET	BİLGİN				
17	15011704	FATİH MUSTAFA	SAĞIR				
18	15011902	EMRE	ÇELİK				
19	15011907	HUSEYN	VALIYEV				
20	16011002	AYKUT	AKDENİZ				
21	16011012	SÜLEYMAN ALİBURAK	ÇINAR				
22	16011017	MERT	ÖZ				
23	16011023	MEHMET HAYRİ	ÇAKIR				
24	16011030	İLAYDA	ŞAHİN				
25	16011033	YUSUF	ANI				
26	16011048	AHMET	BAĞCI				
27	16011050	ŞAHAN	ARSLAN				
28	16011059	AHMET ONUR	AKMAN				
29	16011061	BERKAY	HAMARAT				
30	16011062	EMİN TEYHAN	USLU				
31	16011066	MEHMET FURKAN	ŞAHİN				

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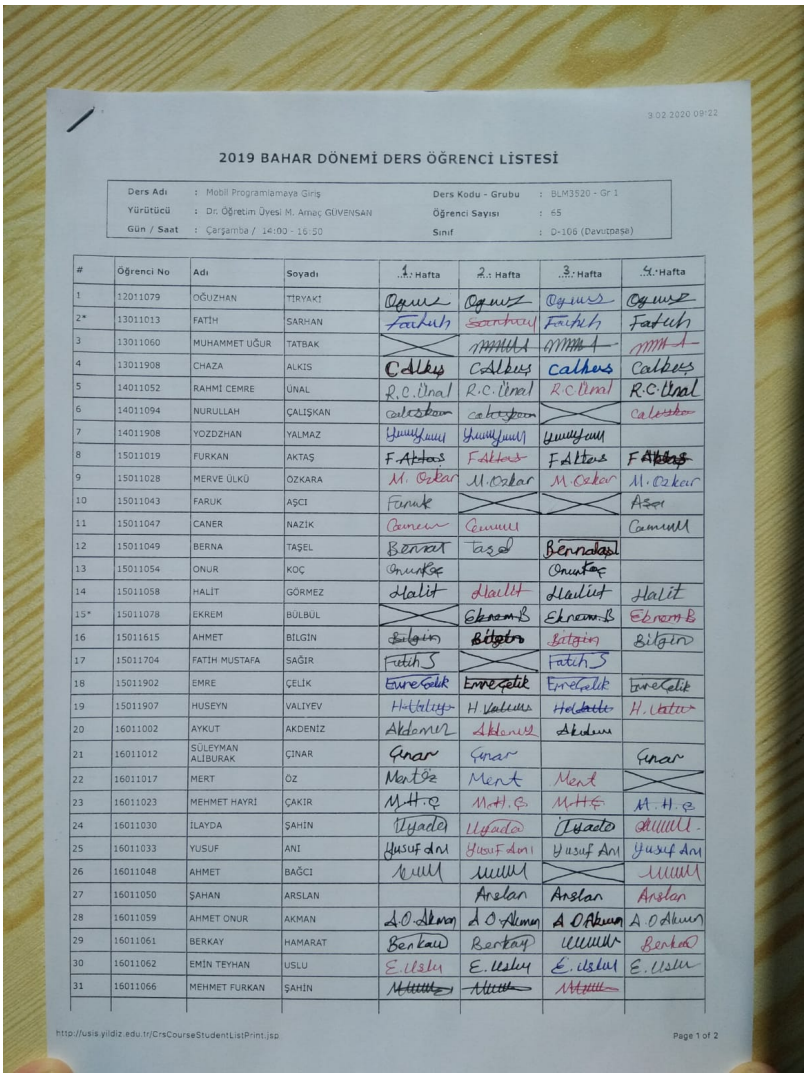
Page 1 of 2

Figure 7.2 Image of the Second Attendance List Tested

Image of the third attendance list tested is shown in Figure 7.3.



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5	14011052	RAHMİ CEMRE	ÜNAL				
6	14011094	NURULLAH	ÇALIŞKAN				
7	14011908	YOZDZHAN	YALMAZ				
8	15011019	FURKAN	AKTAŞ				
9	15011028	MERVE ÜLKÜ	ÖZKARA				
10	15011043	FARUK	AŞCI				
11	15011047	CANER	NAZİK				
12	15011049	BERNA	TAŞEL				
13	15011054	ONUR	KOÇ				
14	15011058	HALİT	GÖRMEZ				
15*	15011078	EKREM	BÜLBÜL				
16	15011615	AHMET	BİLGİN				
17	15011704	FATİH MUSTAFA	SAĞIR				
18	15011902	EMRE	ÇELİK				
19	15011907	HUSEYN	VALIYEV				
20	16011002	AYKUT	AKDENİZ				
21	16011012	SÜLEYMAN ALİBURAK	ÇINAR				
22	16011017	MERT	ÖZ				
23	16011023	MEHMET HAYRİ	ÇAKIR				
24	16011030	İLAYDA	ŞAHİN				
25	16011033	YUSUF	ANI				
26	16011048	AHMET	BAĞCI				
27	16011050	ŞAHAN	ARSLAN				
28	16011059	AHMET ONUR	AKMAN				
29	16011061	BERKAY	HAMARAT				
30	16011062	EMİN TEYHAN	USLU				
31	16011066	MEHMET FURKAN	ŞAHİN				

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Page 1 of 2

Figure 7.3 Image of the Third Attendance List Tested

These pictures were taken with care. So they can give good results. The average results of 5 careless taken photographs are also shown in the tables.

The numbers of True Positive, True Negative, False Positive and False Negative results are represented by TP, TN, FP and FN respectively.

Confusion matrix for determination of absentees is shown in Table 7.1.

Table 7.1 Confusion Matrix for Determination of Absentees

Measurements/Real class	**Absentee**	**Attendance or Fake Signature**
Absentee	TP	FP
Attendance or Fake Signature	FN	TN

Performance measurements for determination of absentees is shown in Table 7.2.

Table 7.2 Performance Measurements for Determination of Absentees

Image	**TP**	**TN**	**FP**	**FN**	**TP Rate**	**FP Rate**	**Accuracy**
Image 1	5	83	0	5	100%	0%	94,62%
Image 2	14	77	1	1	93,33%	1,28%	97,84%
Image 3	17	105	1	1	94,44%	0,94%	98,38%
Average of other 5 images (*)	16	85	21	2	88,88%	19,81%	81,45%

* : The average results of 5 careless taken photographs.

Confusion matrix for determination of fake signatures is shown in Table 7.3.

Table 7.3 Confusion Matrix for Determination of Fake Signatures

Measurements/Real class	**Fake Signature**	**Attendance or Absentee**
Fake Signature	TP	FP
Attendance or Absentee	FN	TN

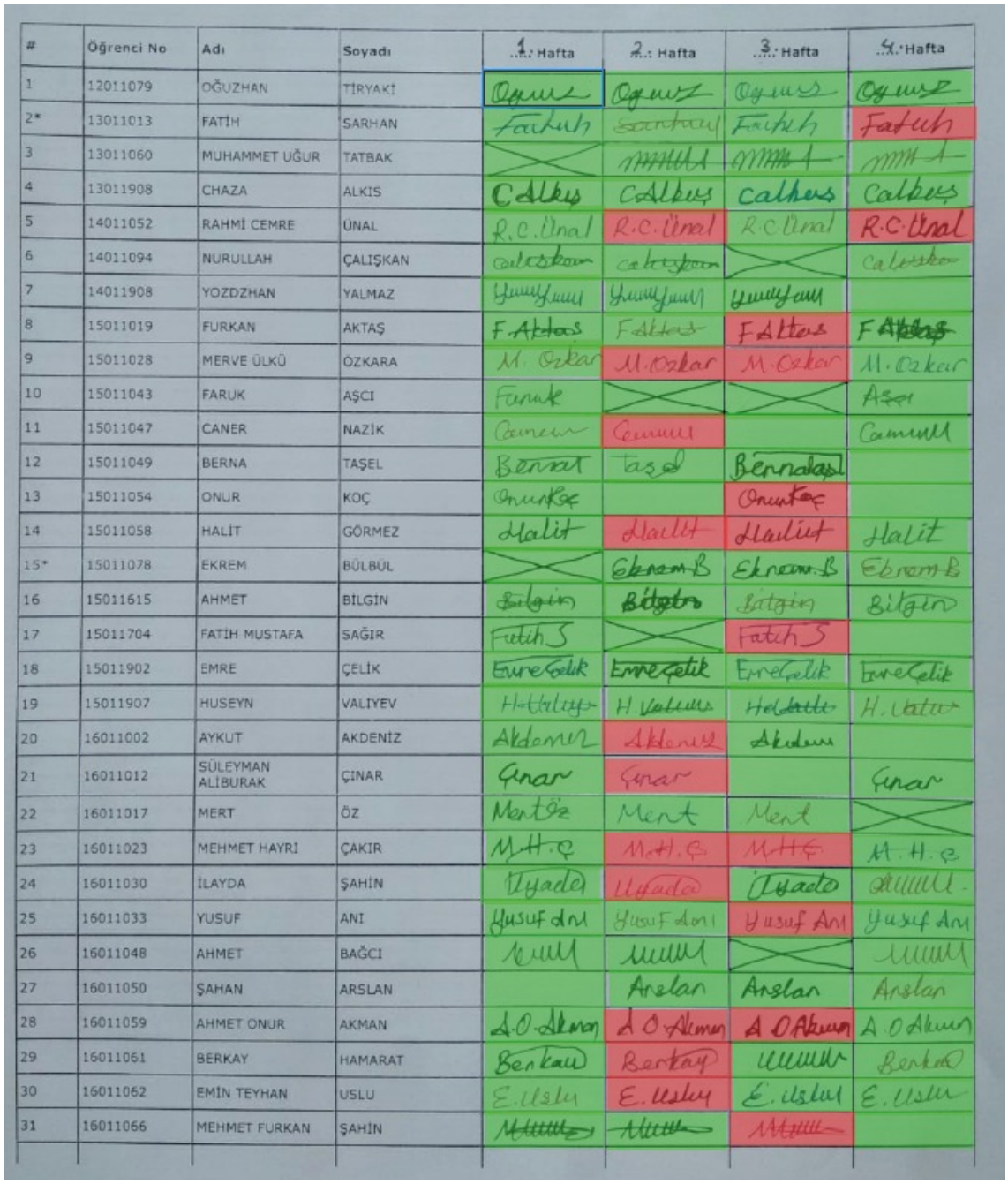
Performance measurements for determination of fake signatures is shown in Table 7.4.

Table 7.4 Performance Measurements for Determination of Fake Signatures

Image	**TP**	**TN**	**FP**	**FN**	**TP Rate**	**FP Rate**	**Accuracy**
Image 1	3	81	6	3	50%	6,89%	90,32%
Image 2	11	68	12	2	84,61%	15%	84,94%
Image 3	5	99	19	1	83,33%	16,10%	83,87%
Average of other 5 images (*)	3	116	2	3	50%	1,69%	95,96%

* : The average results of 5 careless taken photographs.

Performance measurements are marked on the image of third attendance list. Figure 7.4 shows the performance measurements with attendance list. Correctly calculated signatures are marked in green, while miscalculated ones are marked in red. For example, if an absent signature area is detected as absentee, it is marked in green. However, if an absent signature area is detected as a fake signature, it is marked in red.



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5	14011052	RAHMİ CEMRE	ÜNAL				
6	14011094	NURULLAH	ÇALIŞKAN				
7	14011908	YOZDZHAN	YALMAZ				
8	15011019	FURKAN	AKTAŞ				
9	15011028	MERVE ÜLKÜ	ÖZKARA				
10	15011043	FARUK	AŞCI				
11	15011047	CANER	NAZİK				
12	15011049	BERNA	TAŞEL				
13	15011054	ONUR	KOÇ				
14	15011058	HALİT	GÖRMEZ				
15*	15011078	EKREM	BÜLBÜL				
16	15011615	AHMET	BİLGİN				
17	15011704	FATİH MUSTAFA	SAĞIR				
18	15011902	EMRE	ÇELİK				
19	15011907	HUSEYN	VALIYEV				
20	16011002	AYKUT	AKDENİZ				
21	16011012	SÜLEYMAN ALİBURAK	ÇINAR				
22	16011017	MERT	ÖZ				
23	16011023	MEHMET HAYRI	ÇAKIR				
24	16011030	İLAYDA	ŞAHİN				
25	16011033	YUSUF	ANI				
26	16011048	AHMET	BAĞCI				
27	16011050	ŞAHAN	ARSLAN				
28	16011059	AHMET ONUR	AKMAN				
29	16011061	BERKAY	HAMARAT				
30	16011062	EMİN TEYHAN	USLU				
31	16011066	MEHMET FURKAN	ŞAHİN				

Figure 7.4 Performance Measurements with an Attendance List

For three different pictures, the time between uploading the photographs and getting the results is shown in Table 7.5.

Table 7.5 Measurements of Performance Speeds

Image	**Performance Speed**
Image 1	86 seconds
Image 2	91 seconds
Image 3	98 seconds

8
Performance Analysis

8.1 Performance Analysis for Determination of Absentees

When Table 7.2 is analyzed, it is seen that the average of the accuracy measurements of the three images is 96.94%. While the average of True Positive Rate measurements is 95.92%, the average of False Positive Rate measurements is 0.74%. It can be inferred from these results that, the application detects absenteeism with a very high success.

The highest accuracy rate was obtained from the third image with 98.38% accuracy rate. While 94.62% accuracy rate was obtained from the first image, 97.84% accuracy rate was obtained from the second image. Although the accuracy rate of the third image is the lowest, the True Positive Rate of the third image is the highest with 100% rate. This is because there are no false positive measurement results in the third image.

The average accuracy of 5 careless taken photographs is 81.45%. While the average of True Positive Rate of 5 other images is 88.88%, the average of False Positive Rate measurements is 19.81%. It is seen that worse results are obtained compared to the photographs taken with care. This shows the importance of taking photographs with care.

8.2 Performance Analysis for Determination of Fake Signatures

When Table 7.4 is analyzed, it is seen that the average of the accuracy measurements of the three images is 86.37%. While the average of True Positive Rate measurements is 72,64%, the average of False Positive Rate measurements is 12.66%. It can be inferred from these results that, the application detects fake signatures successfully even though it gives worse results than the detection of absentees.

The highest accuracy rate was obtained from the first image with 90.32% accuracy rate. While 84,94% accuracy rate was obtained from the second image, 83,87% accuracy rate was obtained from the third image. Although the accuracy rate of the

first image is the highest, the True Positive Rate of the first image is the lowest with 50% rate. This is due to the fact that true positive and false positive results are less in the first picture.

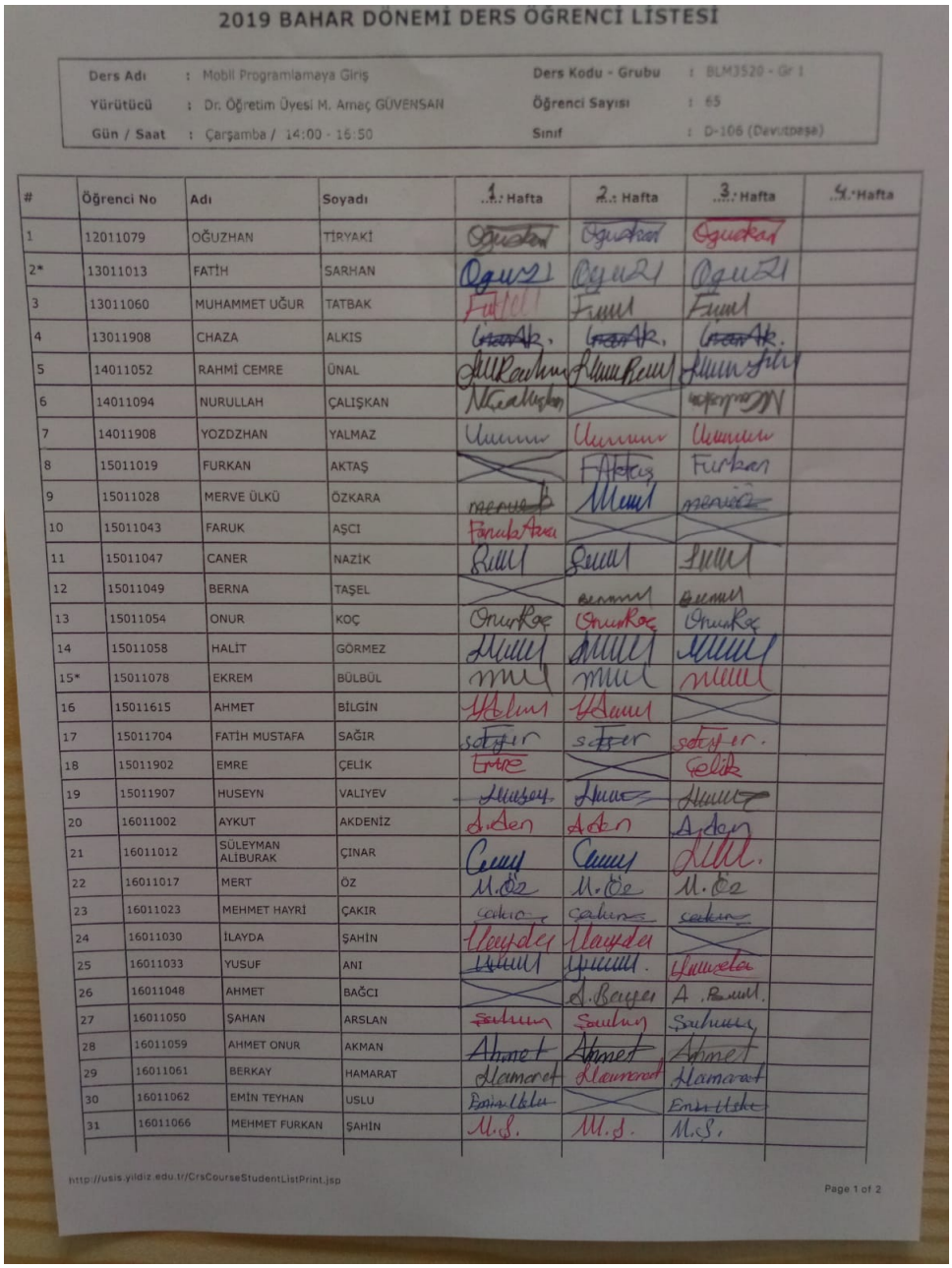
The average accuracy of 5 careless taken photographs is 95.96%. While the average of True Positive Rate of 5 other images is 50%, the average of False Positive Rate measurements is 1.69%. It is seen that good accuracy results are obtained. The reason of this is that most signature areas are detected absentee instead of the fake signature. Thus, True Positive Rate and False Positive Rate were also low.

8.3 Performance Analysis for Speed

When Table 7.5 is analyzed, it is seen that the average of the performance speeds of the three images is 91,66 seconds. The third image was scanned in the longest time with 98 seconds, while the first image was scanned in the shortest time with 86 seconds. The reason for the third image to take the longest time is 4 weeks of attendance list is scanned in the third image. In the first and second images, the 3 weeks of attendance list was scanned.

8.4 Discussion

When the photograph is taken with care, it can give successful results. However, if it is not paid enough attention to the photographing, the lines become harder to detect. This affects the results. As an example, a badly taken photograph is shown in Figure 8.1. When this photograph is examined according to the angle of capturing, it narrows from top to bottom. The columns will not be detected because they are not straight. Also, wrinkles in the picture may also cause it to give bad results.



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13	15011054	ONUR	KOÇ				
14	15011058	HALİT	GÖRMEZ				
15*	15011078	EKREM	BÜLBÜL				
16	15011615	AHMET	BİLGİN				
17	15011704	FATİH MUSTAFA	SAĞIR				
18	15011902	EMRE	ÇELİK				
19	15011907	HUSEYN	VALIYEV				
20	16011002	AYKUT	AKDENİZ				
21	16011012	SÜLEYMAN ALİBURAK	ÇINAR				
22	16011017	MERT	ÖZ				
23	16011023	MEHMET HAYRİ	ÇAKIR				
24	16011030	İLAYDA	ŞAHİN				
25	16011033	YUSUF	ANI				
26	16011048	AHMET	BAĞCI				
27	16011050	ŞAHAN	ARSLAN				
28	16011059	AHMET ONUR	AKMAN				
29	16011061	BERKAY	HAMARAT				
30	16011062	EMİN TEYHAN	USLU				
31	16011066	MEHMET FURKAN	ŞAHİN				

http://usis.yildiz.edu.tr/CrsCourseStudentListPrint.jsp

Page 1 of 2

Figure 8.1 A Badly Captured Photograph

9
Result

At the universities, usually attendance is taken by signing from the students. It takes a long time to be checked and be recorded with this way. Also, fake signatures can cause big problems. Different methods have been developed to solve this problem. In this project, the photo of the attendance list was used to detect absenteeism and fake signatures. Image processing methods were done on the image of attendance list. An Android application was made to scan the attendance list.

First of all, cropping and rotating operations are done in order to detect the photo properly. The picture is converted to grayscale format so that lines and signatures can be detected. Then, lines are detected and the picture is divided into pieces according to the places where the lines intersect. The reason for this is that each signature and student information are recognized separately and text recognizer is performed to determine student information. After signatures are recognized, absentees and fake signatures are determined. The results are stored in the database with the approval of the instructor. An e-mail module was created to inform the students if the instructor wants. A user-friendly interface was made and additional features were added so that instructors can easily understand the actions they will take in application.

The primary advantage of this project is that the attendance list is stored quickly and simply in the database. All it takes is to take a photo of the attendance list and upload it to the application. The remaining process will be done by the application. Another advantage of the project is that different instructors can scan attendance lists of their courses through the same application. In addition, attendance statistics can be displayed and analysis can be done. The critical point of the project is that care must be taken while photographing. Otherwise bad results may occur. Skews in the photograph may result in poor results. Considering all this, this application will provide great convenience to instructors during the attendance processes.

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Project System Informations

System and Software: Android Operating System, Java
Required RAM: 150MB
Required Disk: 4MB