



**YILDIZ TECHNICAL UNIVERSITY  
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**SENIOR PROJECT**

**PEN DICTIONARY**

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## INDEX

Abbreviation List.....	i
Figure List.....	ii
Table List.....	iii
INTRODUCTION.....	iv
Abstract.....	v
Önsöz.....	vi
1. Feasibility Study.....	1
1.1 Social Feasibility Study.....	1
1.2 Technical Feasibility Study.....	1
1.2.1 Establishing the Hardware to be Used.....	1
1.2.2 Establishing the Software to be Used in the Study.....	1
1.2.2.1 Basic Software Tools.....	1
1.2.2.2 Why C# has been chosen?.....	2
1.2.2.3 Why Microsoft Access Has Been Chosen.....	2
1.2.2.4 The Operating System.....	3
1.3 Economical Feasibility Study.....	3
1.3.1 Project Development Cost.....	3
1.3.1.1 Human Resources Cost.....	3
1.3.1.2 Software License Cost.....	3
1.3.1.3. Hardware Cost.....	3
1.4. Time Feasibility Study.....	4
1.4.1. Gantt Diagram for Time Feasibility Study.....	4
2. The Technologies that is Used in Project.....	5
2.1. Digital Image Processing.....	5
2.1.1. What is Digital Image Processing?.....	5
2.1.2. History of Digital Image Processing.....	5
2.2. OCR (Optical Character Recognitions).....	6
2.2.1. What is OCR?.....	6
2.2.2. History of OCR.....	7
2.3. NLP (Natural Language Processing).....	8
2.3.1. What is NLP.....	8
2.3.2. Fuzzy Logic.....	9
2.3.2.1. What is Fuzzy Logic.....	9
2.3.2.2. History of Fuzzy Logic.....	9
2.3.2.3. Fuzzy Matching Usage in Project.....	9
2.4. Bluetooth.....	10
3. Convert Picture into White and Black with K- Means Algorithm.....	11
3.1. Standard K-Means Algorithm.....	11
4. The Main Flow Chart of The Program.....	12
5. Use Case.....	13
5.1. Template of Use Case.....	13
5.2. Use Case Diagram.....	14
6. Class Diagram.....	14
7. Output from the Program.....	15
7.1 Computer Mode.....	15
7.2. Camera Mode.....	16
References.....	17

**Abbreviation List**

CPU	Central Processing Unit
DIP	Digital Image Processing
OCR	Optical Character Recognition
NLP	Natural Language Processing
MIT	Jet Propulsion Laboratory
MICR	Magnetic Ink Recognition
FZ	Fuzzy Logic

**Figure List**

Figure 2-1 The basic processes of an OCR system.....	6
Figure 2-2 The working process of the OCR engine.....	7
Figure 2-3 Bluetooth Connection.....	10
Figure 3-1 Flow Chart of the Program.....	11
Figure 4-1 Diagram of Use Case.....	13
Figure 5-1 Class Diagram.....	13
Figure 6-1 The Main Window of the Program.....	14
Figure 6-2 Example for Computer Mode.....	14
Figure 6-3 The View of Camera.....	15
Figure 6-4 The View of the Mobile Phone.....	15

**Table List**

Table 1-1 Hardware Requirements.....	1
Table 1-2 for Gant Diagram.....	4

**INTRODUCTION**

In The World that everything are developed very rapidly, it is very important to save our time. People fiddle away much more than neccessery when they do something. We want that, they achieve the meaning of the English word in Turkish without writing at keyword. In this way, they can follow on their reading without interrupt and gain lots of time.

**Acknowledgments**

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**ABSTRACT**

Today, many electronic dictionaries are used when book or documents in foreign language is translated. To write the word again to translate with using keyboard takes lots of time. This is also difficult to transport dictionaries with us.

The aim of this Project, to show that a small and useless dictionary could be designed instead of another dictionaries. Operating principle of the project is that, to determine the word with a sign, take the photo of word with a camera, convert picture to text with an OCR algorithm, translate to Turkish and show the word together with the meaning of the word in Turkish through a mobile phone screen.

## **ÖNSÖZ**

Günümüzde, yabancı bir kitap veya dokümandan çeviri yapılırken kullanılan çeşitli elektronik sözlükler vardır. Çevrilmek istenen kelimenin tekrar sözlük klavyesine yazılması ise kişiye zaman kaybettirmektedir. Ayrıca sözlüğün her zaman hali hazırda taşınması da zahmetlidir.

Projede, bu sözlükler yerine daha küçük ve kullanışlı bir sözlüğün tasarımı yapıldı. Tasarlanan kalem sözlüğün ana çalışma prensibi, çevrilecek kelimenin bir işaretle belirlenmesi, bir kamera ile fotoğrafının çekilmesi, fotoğraftaki kelimenin bir OCR algoritması ile resimden metin formatına çevrilmesi, kelimenin Türkçe'ye çevrilmesi ve kelimenin kendisiyle beraber Türkçe anlamının bir ekrana gönderilmesidir.

## 1. Feasibility Study

Feasibility studies are based on the following criteria. These are:

### 1.1 Social Feasibility Study

Owing to this project, it is possible to achieve meaning of the an English word in Turkish with a click. It provides quick and without stress translation. It also provides to save lots of time.

### 1.2 Technical Feasibility Study

#### 1.2.1 Establishing the Hardware to be Used

In order to make our system working well, it is advisable to buy the following hardware, the hardware taken below are in reasonable and minimum price.

Table 1-1 Hardware Requirements

Hardware Units	Features
Processor	1.5 Ghz
Hard Disk	16 Gb
Memory	256 Mb
Mother Card	Intel or Amd mainboard
Video Card	64 Mb video Card
Other Related Devices	Standard

#### 1.2.2 Establishing the Software to be Used in the Study

##### 1.2.2.1 Basic Software Tools

The programming of the this study will have been completed in C# programming language with Visual Studio 2008 . And we use Access Database for our database implementation and processing data. We use Access for the dictionary database.

### 1.2.2.2 Why C# has been chosen?

Some advantages of C#

- C# includes more primitive types and the functionality to catch arithmetic exceptions.
- Includes a large number of notational conveniences over Java, many of which, such as operator overloading and user-defined casts, are already familiar to the large community of C++ programmers.
- Event handling is a "first class citizen"; it is part of the language itself.
- Allows the definition of "structs", which are similar to classes but may be allocated on the stack (unlike instances of classes in C# and Java).
- C# implements properties as part of the language syntax.
- C# allows switch statements to operate on strings.
- C# allows Anonymous methods providing closure functionality.
- C# allows iterator that employs co-routines via a functional-style yield keyword.
- C# has support for output parameters, aiding in the return of multiple values, a featured shared by C++ and SQL.
- C# has the ability to alias namespaces.
- C# has "Explicit Member Implementation" which allows a class to specifically implement methods of an interface, separate to its own class methods. This allows it also to implement two different interfaces which happen to have a method of the same name. The methods of an interface do not need to be "public"; they can be made to be accessible only via that interface.
- C# provides integration with COM.

### 1.2.2.3 Why Microsoft Access Has Been Chosen

Microsoft Access, is a relational database management system (RDBMS) software product released by Microsoft Corporation, has become a major feature of database computing nowadays. The good features of Microsoft Access are:

- Simple to use
- Almost all computer users have it.
- Does not occupy CPU more
- Does not necessey large Memory

#### 1.2.2.4 The Operating System

Windows XP operating system is chosen based on the fact that the project will be developed with many programs on this system.

### 1.3 Economical Feasibility Study

Project development cost are an important part of the cost of the project, this cost value is mainly approximate and if project development duration ends later than planned period, the cost will be greater. In addition to this, hardware and software are in the project development cost. And also marketing is an another cost for this project, for selling this project there must be a marketing cost for us. A special attention has been paid to have the legal and licensed software in the system design.

#### 1.3.1 Project Development Cost

##### 1.3.1.1 Human Resources Cost

Work cost per month for one employee	:3000 \$
Total employee count	:2
Total work period	:3 months
Total work cost	:18000\$

##### 1.3.1.2 Software License Cost

Visual Studio 2008	Free
Microsoft Access Database	Free
MS Windows XP Media Center Edition 2005	100\$ (microsoft.com)

##### 1.2.1.3. Hardware Cost

Webcam	:49 TL
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### 1.4. Time Feasibility Study

A plan was made to implemet project in time. Every step is completed commonly on time and honest to the plan completely.

#### 1.4.1. Gantt Diagram for Time Feasibility Study:

Table 1-2 for Gant Diagram

ID	Task Name	Start	Finish	Duration	Sub 2006		Mar 2006			Apr 2006				May 2006				Haz 2006			
					15/2	22/2	1/3	8/3	15/3	22/3	29/3	5/4	12/4	19/4	26/4	3/5	10/5	17/5	24/5	31/5	7/6
1	RESEARCH AND SUGGESTION OF PROJECT	13.02.2009	27.02.2009	11d																	
2	ACCEPTANCE OF PROJECT	20.02.2009	27.02.2009	6d																	
3	FEASIBILITY STUDY	27.02.2009	20.03.2009	16d																	
4	RESEARCH PROGRAMMING LANGUAGE AND DATABASE	20.03.2009	27.03.2009	6d																	
5	RESEARCH FOR OCR ALGORITHMS	20.03.2009	03.04.2009	11d																	
6	1. REPORT STUDY	27.03.2009	03.04.2009	6d																	
7	TO FORM CLASS DIAGRAM	03.04.2009	08.04.2009	4d																	
8	TO DESIGN MAIN PAGE OF PROGRAM	08.04.2009	10.04.2009	3d																	
9	TO TAKE PHOTO OF WORD AND PROCESS IT	10.04.2009	13.04.2009	2d																	
10	RESEARCH CLEANING ALGORITHMS AND FIND THE WORD FROM TEXT	13.04.2009	17.04.2009	5d																	
11	IMPLEMENT OCR ALGORITHM FOR THE WORD	17.04.2009	30.04.2009	10d																	
12	2. REPORT	24.04.2009	01.05.2009	6d																	
13	CREATE DATABASE, CONNECT DATABASE WITH PROGRAM AND FIND THE MEANING OF THE WORD IN TURKISH	04.05.2009	08.05.2009	5d																	
14	RESEARCH FOR BLUETOOTH AND CONNECT MOBILE PHONE	11.05.2009	13.05.2009	3d																	
15	TO ASSEMBLE PROJECT MODULE	14.05.2009	21.05.2009	6d																	
16	3. REPORT AND TEST	18.05.2009	29.05.2009	10d																	
17	PROJECT BOOK AND TEST	01.06.2009	10.06.2009	8d																	

## **2. The Technologies that is Used in Project**

- Digital Image Processing (DIP)
- Optical Character Recognition(OCR)
- Natural Language Processing(NLP)
- Database Connection with ADO.NET
- Bluetooth Connection to Mobile Phone

### **2.1. Digital Image Processing**

#### **2.1.1. What is Digital Image Processing?**

Digital image processing is the use of computer algorithms to perform image processing on digital images. As a subfield of digital signal processing, digital image processing has many advantages over analog image processing; it allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing.[1]

#### **2.1.2. History of Digital Image Processing**

Many of the techniques of digital image processing, or digital picture processing as it was often called, were developed in the 1960s at the Jet Propulsion Laboratory, MIT, Bell Labs, University of Maryland, and a few other places, with application to satellite imagery, wirephoto standards conversion, medical imaging, videophone, character recognition, and photo enhancement. But the cost of processing was fairly high with the computing equipment of that era. In the 1970s, digital image processing proliferated, when cheaper computers and dedicated hardware became available. Images could then be processed in real time, for some dedicated problems such as television standards conversion. As general-purpose computers became faster, they started to take over the role of dedicated hardware for all but the most specialized and compute-intensive operations.

With the fast computers and signal processors available in the 2000s, digital image processing has become the most common form of image processing, and is generally used because it is not only the most versatile method, but also the cheapest.[2]

## 2.2. OCR (Optical Character Recognitions)

### 2.2.1. What is OCR?

OCR is the acronym for Optical Character Recognition. This technology allows a machine to automatically recognize characters through an optical mechanism. Human beings recognize many objects in this manner our eyes are the "optical mechanism." But while the brain "sees" the input, the ability to comprehend these signals varies in each person according to many factors. By reviewing these variables, we can understand the challenges faced by the technologist developing an OCR system.[3]

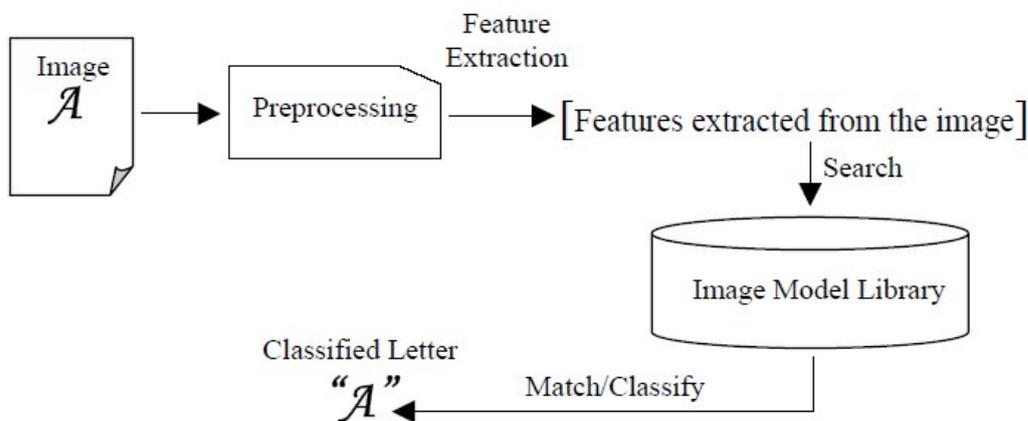


Figure 2-1 The basic processes of an OCR system

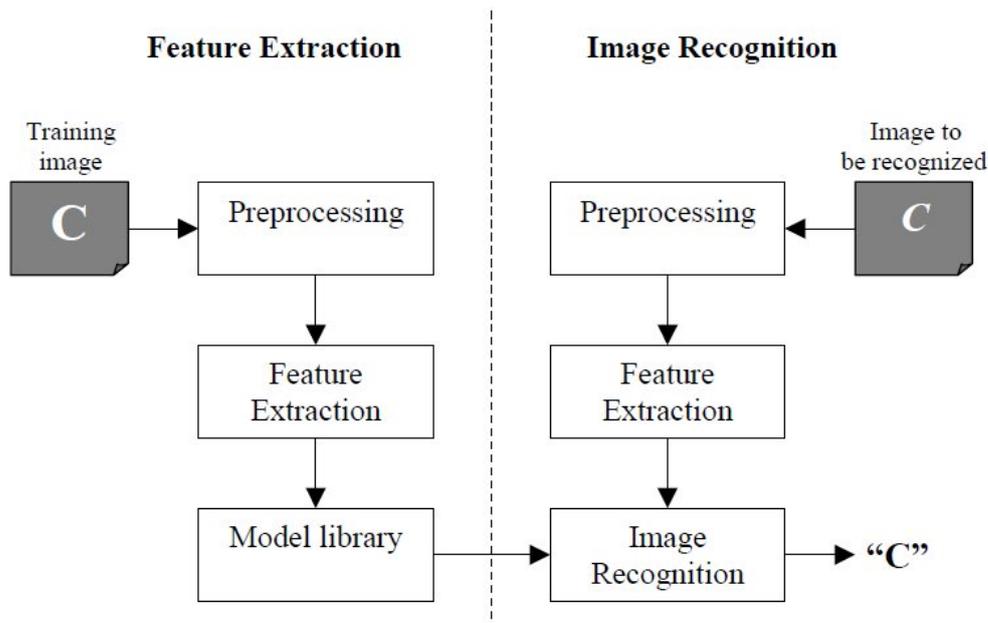


Figure 2-2 The working process of the OCR engine.

### 2.2.2. History of OCR

The engineering attempts at automated recognition of printed characters started prior to World War II. But it was not until the early 1950's that a commercial venture was identified that justified necessary funding for research and development of the technology. This impetus was provided by the American Bankers Association and the Financial Services Industry. They challenged all the major equipment manufacturers to come up with a "Common Language" to automatically process checks. After the war, check processing had become the single largest paper processing application in the world. Although the banking industry eventually chose Magnetic Ink Recognition (MICR), some vendors had proposed the use of an optical recognition technology. However, OCR was still in its infancy at the time and did not perform as acceptably as MICR. The advantage of MICR was that it is relatively impervious to change, fraudulent alteration and interference from non-MICR inks.

The "eye" of early OCR equipment utilized lights, mirrors, fixed slits for the reflected light to pass through, and a moving disk with additional slits. The reflected image was broken into discrete bits of black and white data, presented to a photo-multiplier tube, and converted to electronic bits.

The "brain's" logic required the presence or absence of "black" or "white" data bits at prescribed intervals. This allowed it to recognize a very limited, specially designed character set.

To accomplish this, the units required sophisticated transports for documents to be processed. The documents were required to run at a consistent speed and the printed data had to occur in a fixed location on each and every form.

The next generation of equipment, introduced in the mid to late 1960's, used a cathode ray tube, a pencil of light, and photo-multipliers in a technique called "curve following". These systems offered more flexibility in both the location of the data and the font or design of the characters that could be read. It was this technique that introduced the concept that handwritten characters could be automatically read, particularly if certain constraints were utilized. This technology also introduced the concept of blue, non-reading inks as the system was sensitive to the ultraviolet spectrum.

The third generation of recognition devices, introduced in the early 1970's, consisted of photo-diode arrays. These tiny little sensors were aligned in an array so the reflected image of a document would pass by at a prescribed speed. These devices were most sensitive in the infra-red portion of the visual spectrum so "red" inks were used as non-reading inks.[4]

## **2.3. NLP (Natural Language Processing)**

### **2.3.1. What is NLP**

The field of Natural Language Processing (NLP) aims to convert human language into a formal representation that is easy for computers to manipulate. Current end applications include information extraction, machine translation, summarization, search and humancomputer interfaces.

While complete semantic understanding is still a fardistant goal, researchers have taken a divide and conquer approach and identified several sub-tasks useful for application development and analysis. These range from the syntactic, such as part-of speech tagging,

chunking and parsing, to the semantic, such as wordsense disambiguation, semantic-role labeling, named entity extraction and anaphora resolution.[5]

## **2.3.2. Fuzzy Logic**

### **2.3.2.1. What is Fuzzy Logic**

FL is a problem-solving control system methodology that lends itself to implementation in systems ranging from simple, small, embedded micro-controllers to large, networked, multi-channel PC or workstation-based data acquisition and control systems. It can be implemented in hardware, software, or a combination of both. FL provides a simple way to arrive at a definite conclusion based upon vague, ambiguous, imprecise, noisy, or missing input information. FL's approach to control problems mimics how a person would make decisions, only much faster.[6]

### **2.3.2.2. History of Fuzzy Logic**

The concept of Fuzzy Logic (FL) was conceived by Lotfi Zadeh, a professor at the University of California at Berkley, and presented not as a control methodology, but as a way of processing data by allowing partial set membership rather than crisp set membership or non-membership. This approach to set theory was not applied to control systems until the 70's due to insufficient small-computer capability prior to that time. Professor Zadeh reasoned that people do not require precise, numerical information input, and yet they are capable of highly adaptive control. If feedback controllers could be programmed to accept noisy, imprecise input, they would be much more effective and perhaps easier to implement. Unfortunately, U.S. manufacturers have not been so quick to embrace this technology while the Europeans and Japanese have been aggressively building real products around it.[7]

### **2.3.2.3. Fuzzy Matching Usage in Project**

Fuzzy logic is used the Project. For example it is found wrong the word. Generally, the letter “w” can be found as double “v”. When this time the word can no be found the database. It is found from the data base the most similar word, and it is send the mobile phone.

**Example:**

- What is the meaning of the word “where” in Turkish?
- We may be convert it to text with OCR as “vvwhere”.
- We find the similar words from the database. And we give them weight. And send the word that has biggest weight.
- Similar words may be “where” and “when”. But, “where” more similar than “when”. So “where” is sent to mobile phone and we find the correct answer.

**2.4. Bluetooth**

Bluetooth wireless technology is a short-range communications system intended to replace the cables connecting portable and/or fixed electronic devices. The key features of Bluetooth wireless technology are robustness, low power, and low cost. Many features of the core specification are optional, allowing product differentiation.

The Bluetooth core system consists of an RF transceiver, baseband, and protocol stack. The system offers services that enable the connection of devices and the exchange of a variety of data classes between these devices.[8]



Figure 2-3 Bluetooth Connection

Bluetooth is used in the Project to send the result that it come from OCR and database. We write the word together with the meaning of the word in Turkish into a text file. After that it is send to mobile phone with by bluetooth.

### 3. Convert Picture into White and Black with K- Means Algorithm

#### 3.1. Standard K-Means Algorithm

The most common algorithm uses an iterative refinement technique. Due to its ubiquity it is often called the k-means algorithm; it is also referred to as Lloyd's algorithm, particularly in the computer science community.

Given an initial set of  $k$  means  $m_1(1), \dots, m_k(1)$ , which may be specified randomly or by some heuristic, the algorithm proceeds by alternating between two steps:

Assignment step: Assign each observation to the cluster with the closest mean (i.e. partition the observations according to the Voronoi diagram generated by the means).

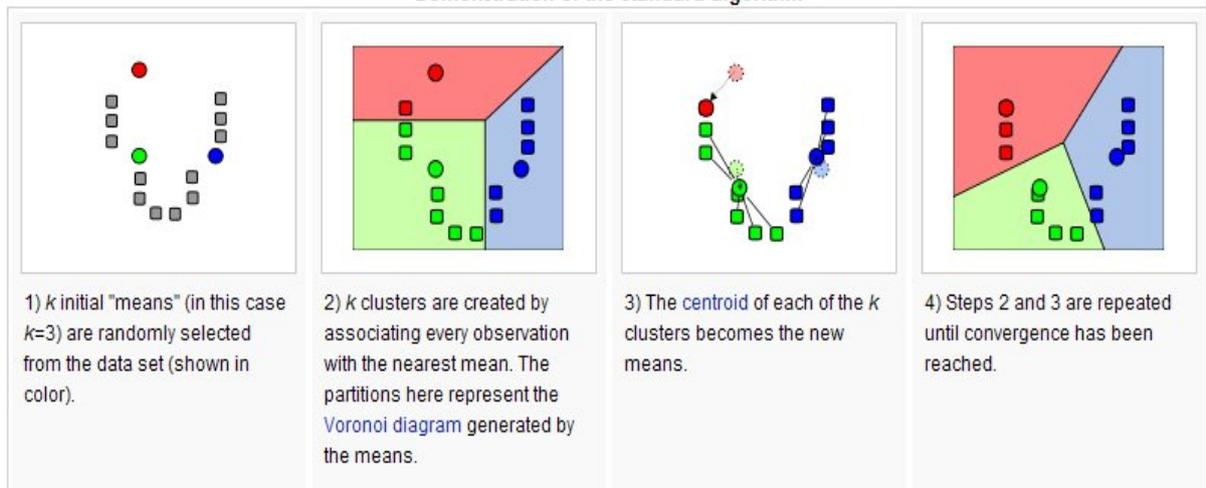
$$S_i^{(t)} = \left\{ \mathbf{x}_j : \|\mathbf{x}_j - \mathbf{m}_i^{(t)}\| \leq \|\mathbf{x}_j - \mathbf{m}_{i^*}^{(t)}\| \text{ for all } i^* = 1, \dots, k \right\}$$

Update step: Calculate the new means to be the centroid of the observations in the cluster.

$$\mathbf{m}_i^{(t+1)} = \frac{1}{|S_i^{(t)}|} \sum_{\mathbf{x}_j \in S_i^{(t)}} \mathbf{x}_j$$

The algorithm is deemed to have converged when the assignments no longer change.[9]

Demonstration of the standard algorithm



#### 4. The Main Flow Chart of The Program

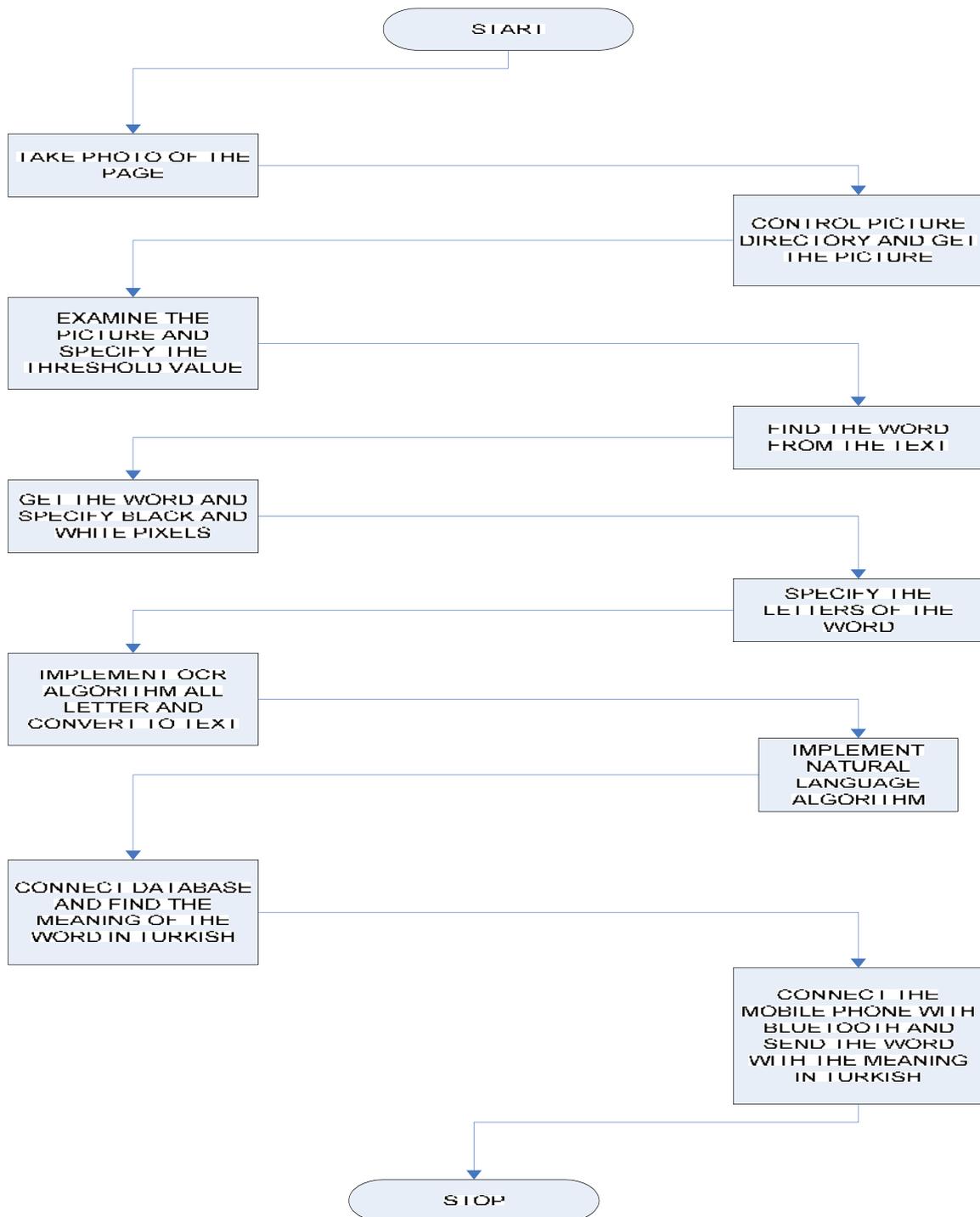


Figure 3-1 Flow Chart of the Program

## 5. Use Case

### 5.1. Template of Use Case

In this use case, it is described that how a user can use the program, some rules about program to use it and what it is done if there is an unexpected event.

**Goal:** A user can enter to the program easily and select a mode that it can be computer mode and camera mode.

**Summary:** A user enters the program. After that he/she selects the mode what he/she wants. If it is selected the computer mode, the user can find meaning of the word in Turkish that the word is on the whenever of computer screen. Whether the user selects the camera mode, he/she can find the meaning of the word in Turkish that the word is on the a book or another document. After the user finishes the study, he/she closes the program safely.

**Primary Actor:** Users

**Expectation:** : A primary actor wants that to enter system safely and learn the meaning of the words in Turkish quickly and truly.

**Preconditions:** The user wants that to enter program safely and use it easily.

**Close Conditions:** The user wants that to quick from the program normally.

**Basic course of events:**

1. Run the program.
2. Select the mode what you want.
3. Specify the word what you want to know the meaning of the word.
4. See the meanin of the word on competer screen or mobile phone screen.

**Alternative path:**

- 1a. User may want to change mode of program.
  1. Open the window of program and change the mode.

### 5.2. Use Case Diagram

There is one actor to use the program that is the user. He/she runs the program, selects the word uses it. After the user selects the mode, he/she change it. After the user finished the study he/she close the program safely.

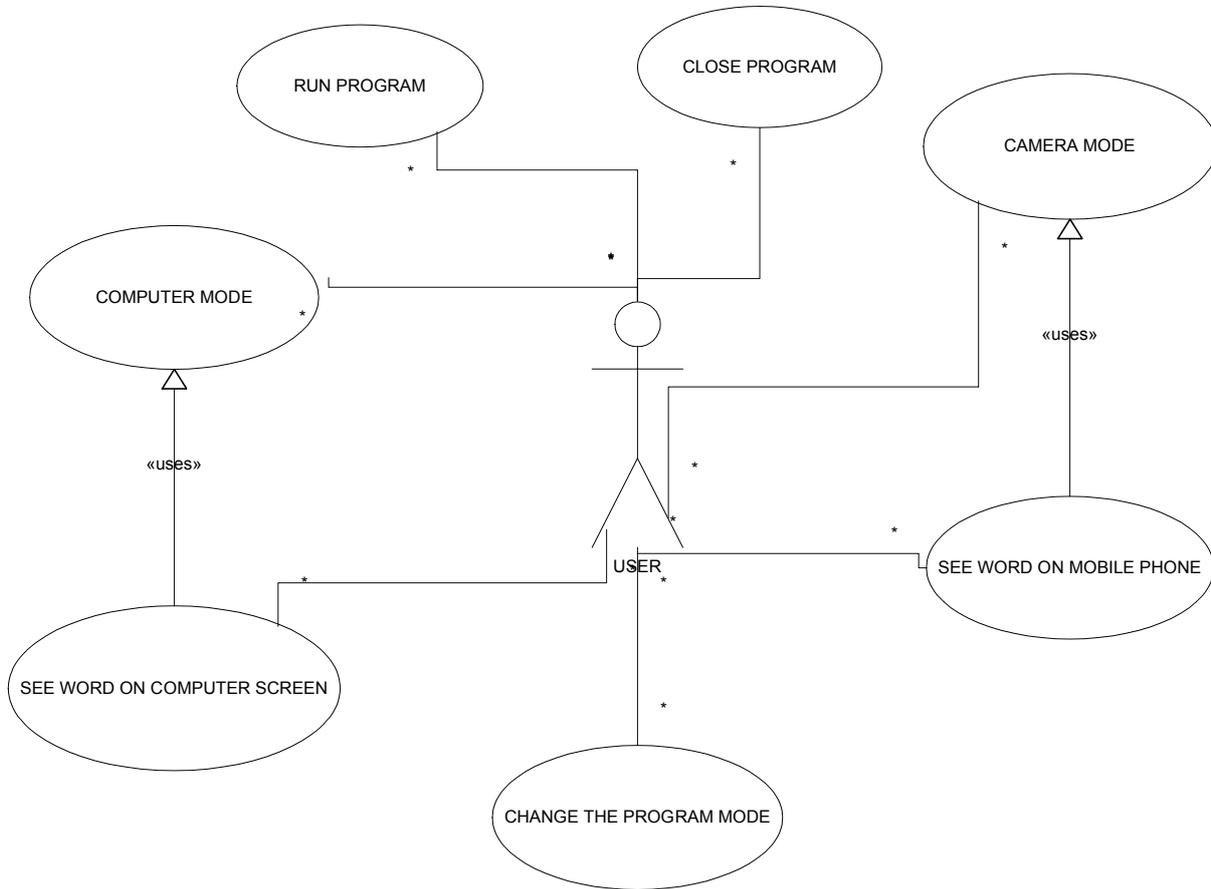


Figure 4.1. Diagram of Use Case

### 6. Class Diagram

There are three class in the program. Main class produce computer mode or camera mode class. Camera mode class has extra one function unlike compure mode class.

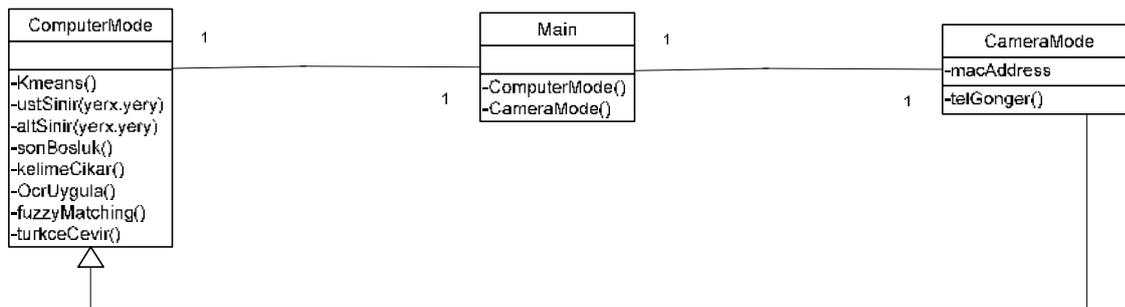


Figure 5-1 Class Diagram

## 7. Output from the Program

After opening the program, it can be selected camera mode or computer mode. It can be changed with “Cihaz Tara” button what it is wanted to send which mobile phone.



Figure 6-1 The Main Window of the Program

### 6.1 Computer Mode

To learn the meaning of the word in Turkish, the top of the plumage is placed the start of the word and Mouse is clicked. After that the word together with its meaning in Turkish are shown in the pop-up.



Figure 6-2 Example for Computer Mode

## 6.2. Camera Mode

It is replaced the top of the significative tip the beginning of the word and clicked the camera button.

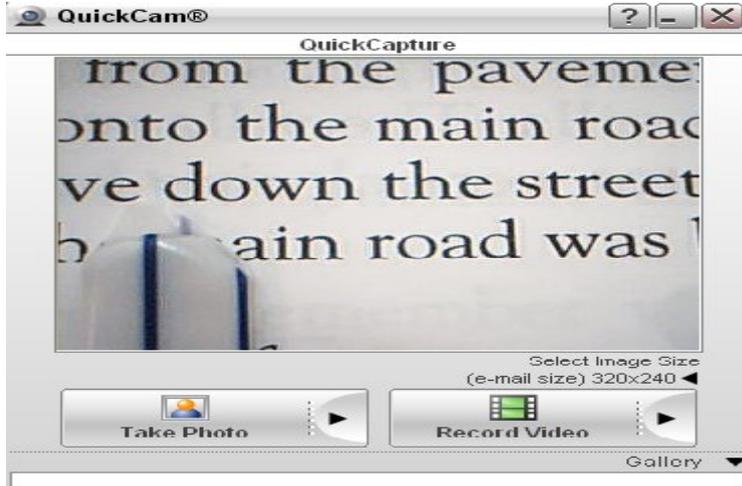


Figure 6-3 The View of Camera

After the photo of the word is taken, it is sent the computer, converted the text, found the meaning in Turkish and sent to the mobile phone.

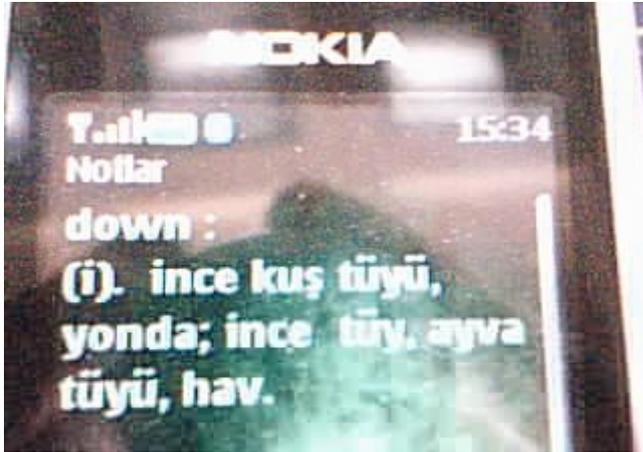


Figure 6-4 The View of the Mobile Phone

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