

**REPUBLIC OF TURKEY
FIRT UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND
APPLIED SCIENCES**



**INVESTIGATING THE USABILITY OF
CONCEPTUAL LEARNING APPLICATION**

Shwan Hadi Saeed

**Master Thesis
Department of Software Engineering
Supervisor: Dr. Oğuzhan ÖZDEMİR**

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Shwan Hadi Saeed
151137108

Department of Software Engineering
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Thesis Supervisor: Yrd.Doç.Dr. Oğuzhan ÖZDEMİR (F. U.)

Other Juries: Prof. Dr. Asaf VAROL (F. U.)

: Assoc. Prof. Dr. Cihan VAROL (SHSU, USA)

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ABSTRACT

INVESTIGATING THE USABILITY OF CONCEPTUAL LEARNING APPLICATION

Hearing capacity is given bestowed to humans. The significance is underappreciated in its presence. However, children with hearing loss feel challenges to be faced in learning and moving socially. According to National Institute of Deafness and other Communication Disorders (NIDCD) survey three children out of 1000 are born deaf in the United State but generally diagnosed between 2-5 years. Deaf education has come a long way since its inception in 15th century. Most common educational approaches available for deaf children include bilingual-bicultural, auditory/oral, and total communication. First approach uses a sign language, second approach without it, while the third approach combines visual communication and auditory. There is need for further investigation on education to deaf children by building applications and investigating the usability of them. In this information age, this research focuses on the use of Information and Communication Technology (ICT) and web technologies bestowed by Web 2.0 for developing software which can leverage e-Learning process for deaf children. Microsoft .NET platform with ASP.NET technology and C# programming language are used to build web application for teaching deaf children the language basics. The application is intuitive with appropriate use of multimedia. It has two roles such as teacher and student with respective functionalities.

The outcome of the research is the software which can run in PC and handheld devices to provide good learning experience to deaf children. A web based portal has been built for educating deaf children to learn language basics. The usability of the conceptual learning application has been investigated and the results revealed that the web portal is usable and having intuitive user interface.

Key Words: Education, Usability, E-Learning, Deaf children, Teaching for deaf, Language learning material.

ÖZET

KAVRAMSAL ÖĞRENME UYGULAMASININ KULLANILABİLİRLİĞİNİN İNCELENMESİ

İşitme yeteneği insanoğluna bağışlanmıştır. Varlığında önemi gereğinden az takdir edilmektedir. Bununla birlikte, işitme kaybına sahip olan çocuklar öğrenme ve sosyal olarak hareket etme konusunda zorlukları hissederler. İşitme engeli ve diğer iletişim bozuklukları araştırma enstitüsünün (NIDCD) incelemesine göre, Amerika'da her 1000 çocuktan 3'ü işitme engelli olarak doğmakta ancak genelde 2-5 yıl arasında teşhis edilmektedir. İşitme engelli eğitimi, 15. yüzyılda başlamasından bu yana uzun bir yol kat etmiştir. İşitme engelli çocuklar için en yaygın eğitimsel yaklaşımlar, iki dilli iki kültürlü, işitsel/sözlü ve bütün iletişim özelliklerini içerir. Birinci yaklaşım işaret dilini kullanmakta, ikinci yaklaşım işaret dili olmadan, üçüncü yaklaşım ise görsel ve işitsel iletişimi birleştirmektedir. İşitme engelli çocuklara eğitim uygulamaları konusunda uygulamalar geliştirilmesi ve bunların kullanılabilirliklerinin araştırılması yoluyla daha fazla araştırma yapılmasına ihtiyaç duyulmaktadır. Bu bilgi çağında, bu araştırma, işitme engelli çocuklara yönelik e-Öğrenme sürecini daha uygun hale getirecek yazılım geliştirmek için Web 2.0 tarafından sağlanan web teknolojilerinin ve Bilgi ve İletişim Teknolojisinin (BT) kullanımına odaklanmaktadır. ASP.NET teknolojisi ve C # programlama diline sahip Microsoft .NET platformu işitme engelli çocuklara dilin temel özelliklerini öğretecek web uygulaması oluşturmak için kullanılmıştır. Uygulama, multimedyanın uygun kullanımı ile sezgisel hale getirilmiştir. İlgili işlevleri ile öğretmen ve öğrenci gibi iki rolü vardır.

Araştırmanın sonucu, işitme engelli çocuklara iyi öğrenim deneyimi sağlamak için PC ve avuç içi cihazlarda çalışabilen bir yazılımın ortaya konulmasıdır. İşitme engelli çocukların dilin temel özelliklerini öğrenmesini sağlayacak web tabanlı bir portal oluşturulmuştur. Kavramsal öğrenme uygulamasının kullanılabilirliği araştırılmış ve sonuçlar, web portalının kullanılabilir olduğunu ve sezgisel kullanıcı arabirimine sahip olduğunu ortaya koymuştur.

Anahtar Kelimeler: Eğitim, Kullanılabilirlik, E-Öğrenme, İşitme Engelli Çocuklar, İşitme Engelliler için Öğretim, Dil Öğrenme Materyali

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ABBREVIATIONS

ADHD	: Attention Deficit Hyperactivity Disorder
ASL	: American Sign Language
BSL	: British Sign Language
COVIS	: Competition between Verbal and Implicit Systems
CS	: Creative Science
ERD	: Entity Relationship Diagram
GSL	: German sign language
GUI	: Graphical User Interface
HCI	: Human-Computer Interaction
ICT	: Information and Communication Technology
IDE	: Integrated Development Environment
IT	: Information Technology
LAD	: Language Acquisition Device
LD	: Learning Disabilities
MOOC	: Massive Open Online Course
NJCLD	: National Joint Committee on Learning Disabilities
NUI	: Natural User Interface
UML	: Unified Modeling Language
RB	: Rule-based
SFP	: Science Fiction Prototyping
VR	: Virtual Reality

1. INTRODUCTION

Children are born with abilities for language development. It is understood in 1960's that children have Language Acquisition Device (LAD). Children use it to understand language with ease. They make experiments in speaking language in terms of application of grammar. This happens by the time a child reaches the age of five. However, LAD works well when people sign or talk to children constantly, with visual aids if needed. LAD closes down as children grow in age. That is the reason language learning is easier in the early years of childhood [1]. This chapter provides information that helps to understand the need for the research and development of e-Learning portal for educating deaf children to acquire language skills.

1.1. Case of Deaf Children

Deaf children have no hearing capacity or hard of hearing. When there is one-to-one conversation with a deaf child, there is possibility to convey something through speech or sign as they cannot overhear conversations. They miss many opportunities pertaining to incidental learning by listening to radio, watching TV and listening to a group of people involved in conversations [2]. Thus they lack background knowledge of different topics and thus they do not have good imagination on different topics as well. When compared with children without hearing problem, deaf children receive very less information in school and home. With respect of learning language there are many factors that affect deaf child include age at which hearing loss occurred (by birth or later age), degree of hearing loss, the quality of language input, parents' hearing status, the quantity of language input, early intervention and age of diagnosis [3].

1.2. Motivation

By the time a deaf child enters school, it is essential to have good vocabulary of language and good exposure to basic language skills. Otherwise, it will be very difficult to cope with studies in school. With technology innovations and the emergence of computing or communication trends, it is believed that a web portal that can work in all devices can

help deaf children to acquire basic language skills. The web portal with edutainment which has language learning material that can support e-learning for deaf children. With simple training of usage of web portal children can operate and self learn language skills. Of course deaf children are to be helped to make use of the software initially. Therefore, the aim of this thesis is to build a web based application that can be used in all devices. The proposed software has learning material for deaf children which has impact on them in learning language basics. The skill will go a long way in their life in the context of school and afterwards. This is the motivation behind taking up this thesis.

1.3. Problem Definition

Deaf children have no natural hearing equipment. They have difficulties in learning subjects taught in school. Therefore they need to learn basic language skills before they enter school. Deaf children have many common language difficulties. They include that limited vocabulary, grammar and syntax of language, difficulty in understanding common expressions and idioms, difficulty in asking questions and giving answers, and inability to catch complete conversation [4]. These problems encountered by deaf children are challenges to be addressed. By developing software which can address these issues can help children to have good language basics before joining school.

1.4. Aims and Objectives

1.4.1. Aim

The aim of the thesis is to develop software for deaf children in such a way that it provides language materials of traditional and sign approaches to ensure that they grasp basic language skills before entering school.

1.4.2. Objectives

The following are the objectives identified in order to achieve the aim of this thesis.

1. To review the present state-of-the-art of using ICT for deaf education particularly language acquisition.

2. To use the insights to develop a methodology for deaf child education in the language acquisition perspective.
3. To develop software that is supported by all devices and provides language acquisition material which deals with edutainment (education through entertainment). It incorporates traditional teaching methods to deaf and sign language.
4. To evaluate the software and investigate usability of the e-Learning portal.
5. To draw conclusions and provide recommendations for future work.

1.5. Scope of the Research

The scope of the thesis is limited to developing a web portal software that can work in various devices to support education of deaf children in terms of acquiring language skills. The proposed software provides language materials that can help deaf children to grasp basics of language with ease. The web portal incorporates both traditional and sign language approaches in order to help deaf children acquire language basics. This paves way for them in life to overcome learning issues in education. The research also includes investigation of usability of the proposed application.

1.6. Structure of the Thesis

The remainder of the thesis is structured as follows. Brief overview of each chapter is provided here to help the reader to understand the essence of the chapters.

Chapter 2

It reviews literature on the present state-of-the-art of deaf education for children. It provides details of different technologies or methodologies used for educating language basics to deaf children. It gives insights on the ways and means in which deaf children can be taught of language basics like English.

Chapter 3

It covers system analysis and methodology used to implement web portal for educating deaf children. It throws light into functional requirements, non functional requirements, usability and methodology of the research carried out.

Chapter 4

This chapter covers system design. It includes modelling of the proposal web portal based system for e-Learning. The modelling is for both front end using Unified Modeling Language (UML) notations and backend using Entity Relationship Diagram (ERD).

Chapter 5

This chapter covers the implementation details of the web portal. It talks about the environment in which the application was implemented and the technologies used to implement it. The business logic used to implement functionalities of the system.

Chapter 6

This chapter provides the results of the implementation. It provides a graphical view of the proposed system implementation. It provides screens that reflect the functionalities of the web portal used for educating deaf children to explore language basics in English.

Chapter 7

This chapter provides the analysis on the investigation of usability of the conceptual learning application or web portal developed for deaf children.

Chapter 8

This chapter provides conclusions and recommendations. The conclusions are drawn from the experience of the portal application development while the recommendations provide possible future work to be carried out.

2. LITERATURE REVIEW

2.1. Introduction

This chapter covers literature on the learning processes involved. Especially it throws light into e-Learning approaches, learning approaches for children and adults, learning approaches for disabled and so on. This chapter also reviews research insights related to the usage of Information and Communication Technology (ICT) in the process of learning courses. It covers the learning aids for disabled people and the need for secure e-Learning courses for such people. The insights of this chapter provide useful information that helps in understanding the need for different kinds of instruction and methodologies for teaching children, adults and impaired people in the world.

2.2. Academic Thinking on e-Learning Education

Fichten et al. [5] made a review of research on learning and digital technology of post secondary students with disabilities. They emphasized e-Learning for disabled children as part of Information and Communication Technology (ICT) which is the use of Information Technology (IT) and telecommunications. They found that providing good environment is essential for deaf students at home and school. Smart watches and Google Glass are wearable devices that can help people with disabilities. Autism Swanwick and Marschark [6] focused on educational research for deaf. They made a review of deaf education research available. They found research gap between practice and research.

Whyte et al. [7] focused on learning methods of children with autism. They focused on methods that can help such children to understand idioms. Hendrix, Eick and Shannon [8] studied the difficulties in teaching complex science topics to students. The process of conceptual learning and the effect of student attitude were studied. They found that creative drama has good impact on the enrichment of students in terms of knowledge and skills. The learning cycle they studied include phases such as preliminary, focus, challenge, and application [9].

Luckner, Slike and Johnson [10] focused on helping students with hearing problems to succeed in life and education. There are many challengers for educators to deal with

deaf students. They include issues pertaining to vocabulary, language, and literacy delays, gaps in domain knowhow, inadequate use of strategies to learn, deficits in social skills and dependence on assistive technology. They considered different types of hearing loss such as chronic middle ear infections, severe deafness, hard of hearing, and hearing loss in one year. They said that interesting reading materials can improve the vocabulary of deaf students. Mann and Marshal [11] investigated British Sign Language (BSL) for improving vocabulary of deaf children. The tasks involved in the process include meaning recognition, form recognition, form recall and meaning recall. Target and distracter pictures are used to promote learning. Target picture, phonological distracter, semantic distracter, and visual distracter are used in the learning process. In [12], studies for special interest groups are discussed.

Easterbrooks and Stephenson [13] focused on instructional strategies that led to improvements in the learning process of deaf and hard of hearing. They identified six key factors in teaching deaf. They include phonemic awareness, alphabetic, vocabulary, fluency and motivation. There are ten literary strategies that can be used to influence learning process. The strategies include independent reading, technology, phonological awareness and phonics, meta cognitive strategies, fluency, morphographemic-based vocabulary instruction, shared reading and writing, scaffolding content-area reading materials, and writing to promote reading. Smith [14] focused on deaf adolescent females and their health information details. Healy and Powell [15] focused on understanding the reasons in difficulties in learning of mathematics and how to overcome the problems. The research is pertaining to deaf students who do not have hearing abilities. Learning English as foreign language for deaf children is given special focus in [16].

Hoffmeister and Caldwell [17] studied on the deaf children acquiring language skills in English via print. In absence of natural hearing ability, deaf children cannot properly learn language in childhood. Language acquisition needs social interaction tool which is not possible by deaf children. The researchers [17] focused on describing a model in which deaf children can acquire language by reading and writing. Their model allows children to learn language in different stages. In stage 1 translation equivalents are mapped. In stage 2, translation is broken down into words and sentences. American Sign Language (ASL) is employed to learn English language via print. In [18] recommendations are given to educate deaf children while different frameworks of learning are given in [19].

Humphries et al. [20] focused on the actions needed by linguists in order to teach deaf children. They opined that home and school environments should be different for deaf children to ensure that they feel better in language acquisition. The recommendation provided by them is that irrespective of hearing aids all deaf children should learn a sign language. Other recommendations include update of medical education including linguistic considerations, medical care should consider coordination among healthcare professionals, adequate advice is needed from medical officers, second language learning needs more research, need to be in touch with deaf children who know sign language, considering parents, making sign language accessible, funding from governments, and the risk of cochlear implants. Kubus, Morford, Rathmann, and Villvock [21] focused on German sign language (GSL) for word recognition in deaf readers. They tried cross-language activation with GSL. ICT was given importance in [22].

In [23] an online course by name Massive Open Online Course (MOOC) was explored. MOOC supports learning of materials in different subjects. It serves people who wanted to learn subject. MOOC has no restrictions to class, gender, race or country. It also provides education to people who have disability which is very important. It provides good learning experience to thousands of people across the globe. When traditional approaches are compared with online approaches there are many advantages of MOOC which saves time and money. In case of conventional education, a deaf child cannot hear voice of the teacher. With the online courses like MOOC there is provision for learning in spite of deafness. Thus the disabilities are ignored and deaf people also can participate in learning. The inclusiveness, guaranteed quality and diverse learning subjects are important features of MOOC. MOOC is the learning platform that covers all possible sources and it was found very useful to people of all walks of life. Human rights with respect to disabilities are explored in [24].

Artificial intelligence can help in different fields. It also can help educating children. In [25], the authors explored it well. There are many products in the real world that make use of AI. For instance, Watson system of IBM, AlphaGo from Google, Google Assistant from Google, Alexa from Amazon are systems to help people in learning to mention few. These tools can help in education and change lives of people effectively. AI is used in education in order to have better results. In education it is used to simulate how human brain works and how certain aids can help in learning process.

Natural User Interface (NUI) is one of the phenomena which help people to understand things easily. It is explored in [26] for game-based learning approaches. Natural interfaces and NUI devices can easily capture gestures of both and sounds in order to have interaction between computer and user. With NUI people can interact with the system by using expressions, movements, gestures and other innovations. Human Computer Interaction (HCI) is made more useful with NUI. Ability to interact with computer with body gestures can help disabled people also to have interaction and learning experience. Games can be built and played in order to teach students effectively. Subjects like elasticity can be taught with ease with the help of computer simulations or emulation. When game like interfacing is given, it can help disabled people also to play and learn things with ease. With the help of such interfaces the learning abilities of students is improved. Helping deaf children in hearing and tasking is done in [27].

In [28] a device known as Raspberry-Pi based Assistive Device is explored. Such device is used to support blind people, deaf people and dumb people. It is said that 82% of impaired people are suffering from poverty. It is understood that 9.1 million of world population are deaf and mute. They face many problems in their day to day life. In many countries sign language is taught to enable them to have communication. The sign language depends on sign patterns in order to have communication possible. It also includes body language and movements of arm to convey other people. Deaf people are able to communicate with visual signs. However, it is not possible for all deaf people to learn the language as it involves cost as well. Thus there is communication gap. In [29] children with special disabilities are explored along with their educational needs.

Some sort of educational games can help deaf people to understand intended subject. In the era of globalizations, the technologies are shared across the nations. It is important to have skilled society and that could include deaf people. Therefore it is important to have mechanisms to educate deaf people as well. There were many changes in the education system. However, it still needs innovations in order to support deaf education. It needs to use Information and Communication Technology (ICT) in order to provide better results. Information technology can help in providing needed Human Computer Interface (HCI) [30]. With respect to policies that are to be followed in rendering education to deaf children, Europe has its own policies as explored in [31]. In the same fashion, human qualities that are to be considered while rendering education to deaf

are found in [32]. E-learning is also there for adults having hearing problem. The modalities for such education is explored in [33].

User experience plays an important role in real world applications. In [34] Completely Automated Public Turing test to tell Computers and Humans Apart (CAPTCHA) is explored to enable applications to have security from malicious bots. It is important to have good user experience when education is given to people with disabilities. Malicious programs are to be restricted by using CAPTCHA in order to have better user experience. As software bots are created by adversaries, it is essential to have this kind of check in educational services. Therefore CAPTCHA plays an important role in protecting people from unnecessary disturbances or login without the consent of genuine users. With CAPTCHA, cyber threats can be avoided. The threats to computers and computer networks became more and more every year. Therefore, cyber threats are to be avoided to ensure formal education to deaf people in the real world. The process of teaching a foreign language to deaf children is studied in [35]. In the same fashion how to evaluate an education system for deaf children is investigated in [36]. As far as disability is concerned, the world wide disability details are focused in [37]. The information that is important for individuals to maintain equality among people with humanity is studied in [38].

In [39] virtual environments are explored for promoting learning experience of students. It is important for students to have game based learning. The rationale behind this is that it provides business rules or game rules besides the educational content for learning. Similar kind of work was done in [40, 41]. In the field of natural science and technology, the usage of such virtual environments is crucial for better results. The usage of the method provides some sort of Virtual Reality (VR) which is one of the promising tools for having powerful interface in learning. It is a tool used in education in order to improve the performance of students. The game based learning can engage learners well and provide the needed information that can guide the learners to do things correctly. Therefore virtual reality and virtual devices play an important role in the real world applications. In every aspect of human life it is important to have such education system where users can have self learning approaches. Therefore virtual reality can help people to learn subjects by exploiting the virtual platform as much as possible.

With respect to public education, it is important to understand the pros and cons. The problems involved in public education are studied in [42]. Technology is required in order to have better education systems. The technology requirements for education are

discussed in [43]. The technology like virtual reality in education system can help to visualize concepts. This kind of research is found in [44-46].

When it comes to learning age has its role to play. In [47] the role of the age is explored with respect to auditory and executive functions. The learning process needs to be divided in order to make the learning is simple. The more kinds of learning like speech, music, and other aspects of learning are possible with the help of training. In the process the role of age is ascertained. When it comes to learning novel things, age has its role to play and find difference between children and adults. The learning abilities generally differ between children and adults. When it comes to language learning, children have more abilities. Thus it is important to have language acquisition at the early age of life. Therefore, it is concluded there are fundamental differences in learning between children and adults. Specifications for different educational programs that are suitable for deaf children are discussed in [48].

In [49] different kinds of instructions for teaching and different kinds of courses are explored in education systems. They explored different means of finding the importance of classroom learning and the other learning approaches. They found the differences between computer aided learning approaches and the traditional class room approaches. They found that it depends on the individual needs to choose the kind of learning process. For some individuals online classes are preferred and some individuals, traditional courses are suitable. Different learning approaches like problem based learning; instructor-led learning and other approaches are explored. The specified the important of learning without the traditional class room learning. Specific information for deaf children with respect to learning is found in [49]. In [50] and [51] various technologies are explored for teaching deaf children in a better way are investigated. Different e-learning platforms that are useful to deaf children are explored in [52]. Another research related to teaching computer skills in education to deaf children is found in [53]. In the learning process for deaf children, the importance of sign language is studied in [54].

2.3. Summary

This chapter has covered different approaches that can be used in education for productivity. It focused on the education for children and adults besides different kinds of learning approaches. This chapter throws light into the ways and means of teaching deaf

people and other disabilities. It shows different approaches like traditional class room training and online training. It emphasizes the need for e-Learning so that people learn subject in their own pace. The review of literature revealed the need for having special e-Learning procedures and approaches for teaching deaf children about languages. Learning languages for deaf children is very challenging. In this thesis we proposed a methodology and implemented an e-Learning portal to fulfil the research gaps with respect to e-Learning for enabling deaf children to acquire language skills in English.



3. SYSTEM ANALYSIS

3.1. Introduction

This chapter covers system requirements, functional requirements, and non-functional requirements. It also shows the difference between the existing system and proposed system. It throws light into the advantages of the proposed system. In addition to this, this chapter provides a detailed methodology that helps in understanding the procedure using which the proposed system is built. The aim of the thesis is to build a web portal for e-Learning. The portal is intended to be used by deaf children for gaining language basics in English.

3.2. Existing System

Deaf children have no natural hearing equipment. They have difficulties in learning subjects taught in school. Therefore, they need to learn basic language skills before they enter school. Deaf children have many common language difficulties. They include that limited vocabulary, grammar and syntax of language, difficulty in understanding common expressions and idioms, difficulty in asking questions and giving answers, and inability to catch complete conversation. These problems encountered by deaf children are challenges to be addressed. By developing software which can address these issues can help children to have good language basics before joining school.

3.3. Proposed System

The proposed system is a web portal which serves deaf children to learn language basics. In fact it is an e-Learning platform that helps deaf children to equip with language basics. It helps them to learn in their own pace as it is done online. The scope of the project is limited to developing web portal software that can work in various devices to support education to deaf children in terms of acquiring language skills. The proposed software provides language materials that can help deaf children to grasp basics of language with ease. The web portal incorporates both traditional and sign language approaches in order to

help deaf children acquire language basics. This paves way for them in life to overcome learning issues in education.

3.4. Advantages of the Proposed System

The impact of this research is very high when it results in desired outcomes. The advantages of the thesis are described here. It helps teachers dealing with educating deaf children to have a platform for providing materials and ensure learning language basics.

- Helps deaf students to have self learning without much training as the software provides edutainment that attracts students to learn subject without strain.
- Helps parents across the globe to have a good platform for teaching their children early in their life to acquire basics language skills. This will get rid of problems in school as the child will have good vocabulary and imagination.
- Helps schools to have a reference material and teaching aid to help students to complete prerequisites to cope with subjects in school.
- Helps researchers to take the work to next level by understanding the present work and improve it further to the level of satisfaction.
- The software can have impact on the society as the deaf children have mechanisms and platforms to learn basic language skills.
- The impact of the software on deaf children is significant as the children can feel good with learning and build in confidence much needed by them to face the world of children without hearing loss.
- The proposed software can trigger a series of patches or improvements to reach satisfactory level in such a way that it can be reused by all stakeholders across the globe.
- More importantly the software can help children to have their own pace in learning and acquiring language skills without any pressure.
- The software can have its impact on the learning speed of deaf children as it is based on edutainment which makes acquiring basic language skills fun.

3.5. Functional Requirements

There are many functional requirements of the proposed system. It is used by two types of users with two important roles: administrator and student. The administrator role performs different functionalities as given below.

1. Authentication
2. Registering deaf children to enable them e-Learning usage.
3. Adding/Updating/Deleting language material like
 - a. Alphabet
 - b. Numbers
 - c. Animals
 - d. Fruits
 - e. Vegetables
 - f. Etc.
4. Viewing learning material
5. Sign out

In the same fashion, the users of student role have certain functionalities. They are as follows.

1. User authentication
2. Viewing learning material
3. Understanding language skills
4. Sign out

3.6. Non Functional Requirements

Non-functional requirements are important characteristics but not compare to functional parameters. For example attributes such as performance, usability, security, compatibility are not feature of the system but are required characteristics.

Each requirement must be objective and countable means there must be some way to measure. Here some examples of non-functional requirements:

Performance Requirements: Requirements about resources are response time, transaction rates, throughput, benchmark specifications are under the performance category

Operating Constraints: System Resources, people, needed software under this category.

Platform Constraints: User requirements are generally under this category. If user does not care, there are still platform constraints

Accuracy and Precision: Requirements relating to the accuracy and precision.

Modifiability: Requirements about the effort to change in the software.

Portability: The effort required to move the software from one place to another place, that means carrying to easy

Reliability: The reasons for failing of the software

Security: Requirements about protection of your system and data. This measurement expressed in various ways to break into the system.

Usability: Requirements about how to difficult to operate the system or to learn the process.

Legal: Legal issues involving privacy of data, property rights, export of restricted technologies, etc.

3.7. Software Requirements

Table 3.1. Software Requirements

SL.NO	SOFTWARE	DESCRIPTION
1	SQL Server 2008	For creating database
2	Visual Studio 2012 (.NET 4.5)	It is an Integrated Development Environment (IDE)
3	STAR UML/Rational Rose	To draw UML modelling for project

Microsoft .NET

It is an application development framework that provides various pre-defined classes and interfaces for building different kinds of applications. It offers many things to developers such as programming languages, technologies and development environments. This framework is used in building web portal for deaf children. ASP.NET technology is used to build web portal. C# is used to provide functionality and ADO.NET is used to have database interaction. Visual Studio is used for rapid application development.

C# (C Sharp)

It is the main programming language used in the project. It is used to provide functionality to web interface. For both administrator and student roles, this language is used to provide required functionality. It is an object oriented programming language which is widely used with Microsoft.NET platform.

ASP.NET

It is server side technology used to build web pages. It supports different features like code behind, master pages, multiple views and so on. It also supports session management that helps in managing different user session at a time. Therefore the web portal developed using this technology supports multi-user environment.

AJAX

Asynchronous JavaScript and XML (AJAX) is the client side technology that enables browsers to have calls to server without user intervention explicitly. This technology provides rich user experience and highest speed in performing operations.

ADO.NET

It is the API supported by .NET for interacting with relational databases. It helps in connecting to SQL server and performs DML operations. SQL commands are categorized into DML, DCL, TCL and DDL.

HTML

Hyper Text Markup Language (HTML) is used to design static web pages needed. Even when dynamic web pages are designed, the server returns HTML content to web browser for presentation at client side.

SQL Server 2008 R2

It is the Relational Database Management System (RDBMS) used to store and retrieve data related to the e-Learning portal. It is highly secure and provides secure database interactions. This is used to have programmatic interaction between the database and web portal.

Visual Studio 2012

It is an integrated development environment (IDE) used to build web based applications easier. It provides pre-defined building blocks supported by .NET for building applications faster. It is user friendly or developer friendly that promotes productivity.

3.8. Hardware Requirements

Processor - Intel I5
Speed - 1 GHz or higher
RAM - 1 GB or higher
Storage Disk- 300 GB or higher

3.9. Methodology

This section provides methodology to complete the research and implementation of e-Learning web portal for helping the deaf children with language basics in English. It shows both language acquisition activities and non-functional requirements that can provide rich user experience. The end result of the project is to have an efficient e-Learning portal for deaf children which demonstrate proof of the concept.

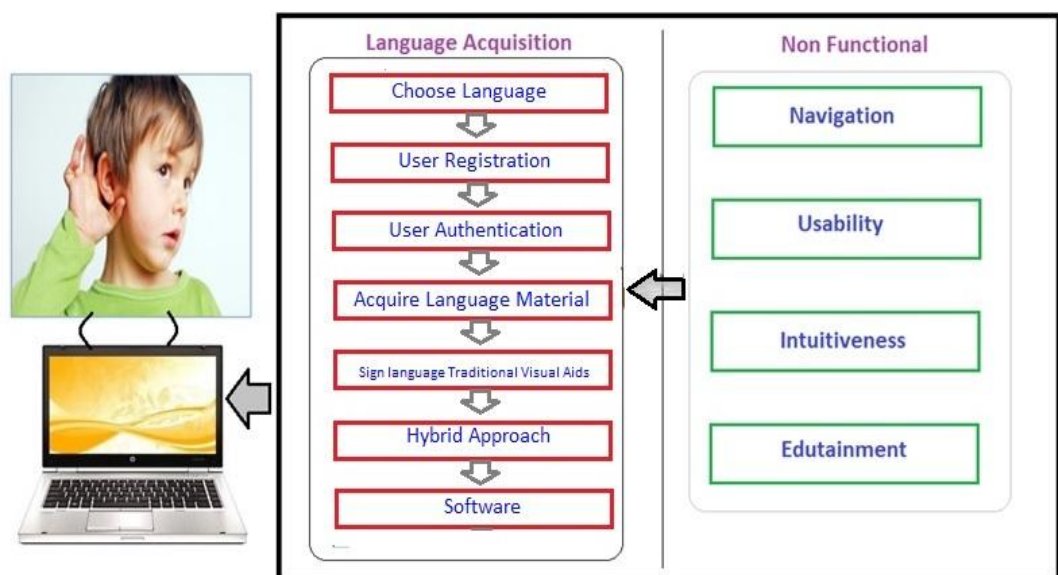


Figure 3.1. Methodology for Proposed e-Learning Portal

As shown in Figure 3.1, it is evident that the language acquisition process includes a series of easy steps. It involves user registration, user authentication, and other activities. After successful authentication, deaf children (teachers or administrators help in registration and login) can have their dashboard with all the possible actions they can make to acquire language skills in English. Default language is English. Language selection option can help to choose different language in future. Language material can be obtained and understood with visual aids. Language material includes alphabets, numbers, vegetables, animals, and so on. On choosing the kind of language material, the user gets visual aids in the form of image and video to understand the specific material. For instance the letter A in English is understood by deaf children by using the visualization of image and video. The video emphasizes lip movement so as to enable the learner to grasp the subject faster. A hybrid approach is followed which combines textual, graphical, audio and video features for making the learning experience good with the proposed e-Learning framework.

3.9.1. Navigation

Navigation is very important for e-Learning portal. Navigation is made simple and effective for the deaf children to have rich user experience. Navigation is made efficient with all the features kept in the dash board so as to enable the student to learn with his/her own pace. There is no concept of moving to different pages. All pages come to the place where users can view and learn subject. There is no need for by hearting options. Links are used with master pages so as to have a visual inheritance which promotes good navigation in the web pages of the portal.

3.9.2. Usability

It refers to learnability and ease of use of the portal created for e-Learning. Usability is given high importance while designing the web application. The application is made user friendly and that is realized by the users. It is actually used by teachers (administrator role) and deaf children (student role). The degree with which users feel it easier is the actually usability attributes of the web portal. The portal is built with usability

attributes in mind and the navigation, appearance and other options are made simple. The complexity of the web portal is not shown to users. Users feel it easier and very useful.

3.9.3. Intuitiveness

The web portal is intuitive in nature. In other words, it is user friendly. Users need not to memorize commands to operate the web portal. Instead, users can get all needed options after successful authentication. The rationale behind this intuitiveness kept as part of the framework is that it helps users feel it easier. Deaf children look at the user interface as natural as possible. The intuitiveness in the user interface can help them to like it and come to the web portal from time to time for learning subject with interest.

3.9.4. Edutainment

The target audience or the target users play important role in the design decisions of any web portal. In the e-Learning framework, this is considered and the portal is determined to be built to support edutainment. Edutainment refers to the education through entertainment. As the deaf children start learning English basics, the web portal has different media to support learning and provide entertainment as well. The audio and video presentations can help them to learn the subject interestingly and they learn through entertainment.

3.10. Summary

This chapter has provided the system requirements specification with details such as functional requirements, non functional requirements, and system requirements like hardware and software requirements. Apart from this, it threw light into the methodology that covers the approach in building web portal which is hybrid in nature besides the activities needed for language acquisition and non-functional requirements that improve user experience.

4. SYSTEM DESIGN

4.1. Introduction

This chapter provides system design specification which provides useful communication between all stakeholders of the proposed system. It throws light into modeling the system or visualizing the system so as to provide better means of implementation. UML is the language used to model the system which provides static and dynamic view of the system. The design specification helps in converting the design into working solution for e-Learning which helps deaf children to learn language basics.

4.2. Design Specification

This section provides design specification with different notations using in UML. The design is made using Star UML software obtained from Internet sources. The UML diagrams used as part of the modeling include use case diagram, sequence diagram, collaboration, diagram, activity diagram, component diagram and deployment diagram.

4.2.1. Use Case Diagram

Use case refers a specific functionality of the system. Use case diagram provides different use cases involved in the system. There are external entities known as actors. Actors initiate use cases. There are different notations used in the diagram. Ellipse is used to represent use case. Line drawn indicates the link between actor and use case. Stick man symbol denotes actor.

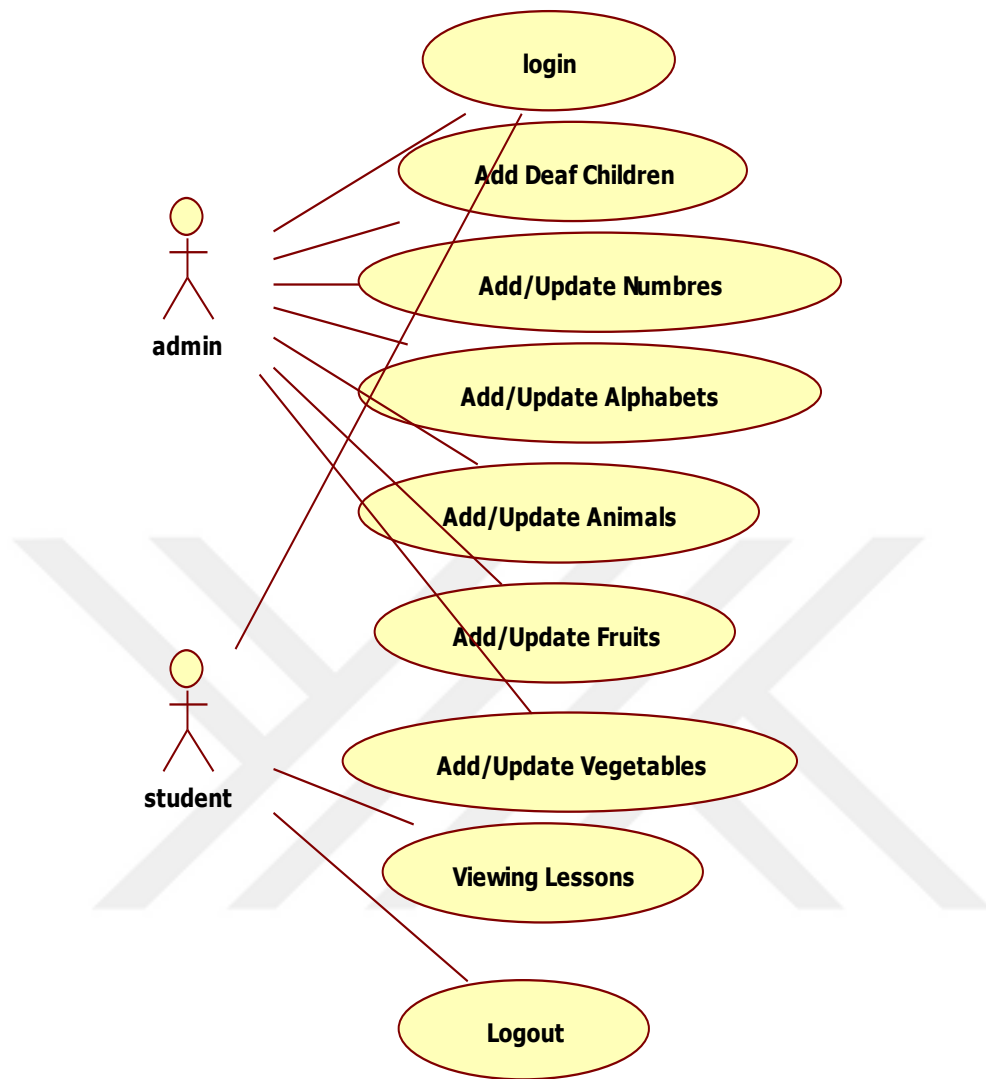


Figure 4.1. Use Case Diagram

As shown in Figure 4.1, it is evident that there are many use cases involved in e-Learning platform proposed in this thesis. The use cases involved are registration, user authentication, adding material, viewing material, and sign out. However, these use cases are mapped to corresponding actors. Admin actor initiates use cases such as registration, authentication, adding and manipulating materials, and sing out. In the same fashion, student actor involves in use cases like authentication, viewing material for learning and sign out.

4.2.2. Class Diagram

Class diagram is used to present different classes involved in the proposed system. It also provides the relationships among the classes. There are three kinds of relationships broadly. They are called IS A, HAS A and USES relationships.

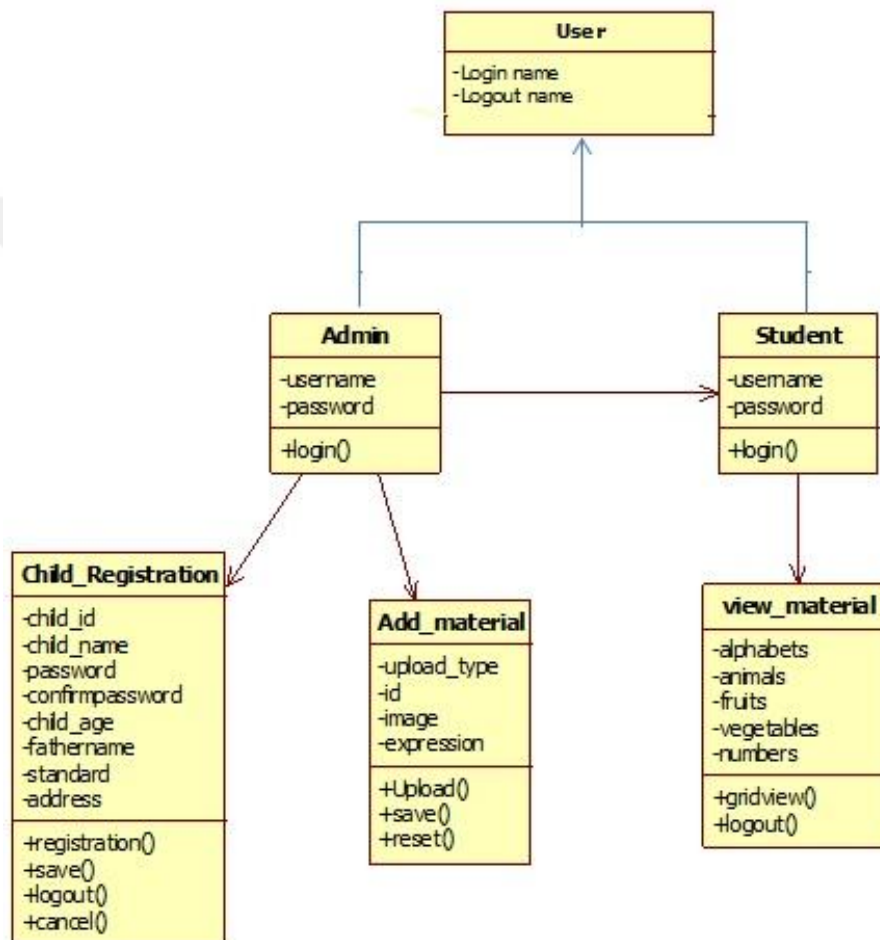


Figure 4.2. Class Diagram

As shown in Figure 4.2, the class diagram contains classes like Admin, Student, ViewMaterial, AddMaterial, and ChildRegistration. There is relationship shown among the diagrams. Each class provides details of instance variables, class name and operations supported by the class. The operations and other members of class have different accessibility which is shown in the figure.

4.2.3. Sequence Diagram

Sequence diagram is known as an interaction diagram. It shows interactions among different objects involved in the system. The objects involved in the interaction can send and receive messages. It has notations to denote an object (rectangle symbol), message (arrow symbol), life line (dotted lines) and activations (small rectangles on life lines). Activations refers to the fact that object is busy in that point of time.

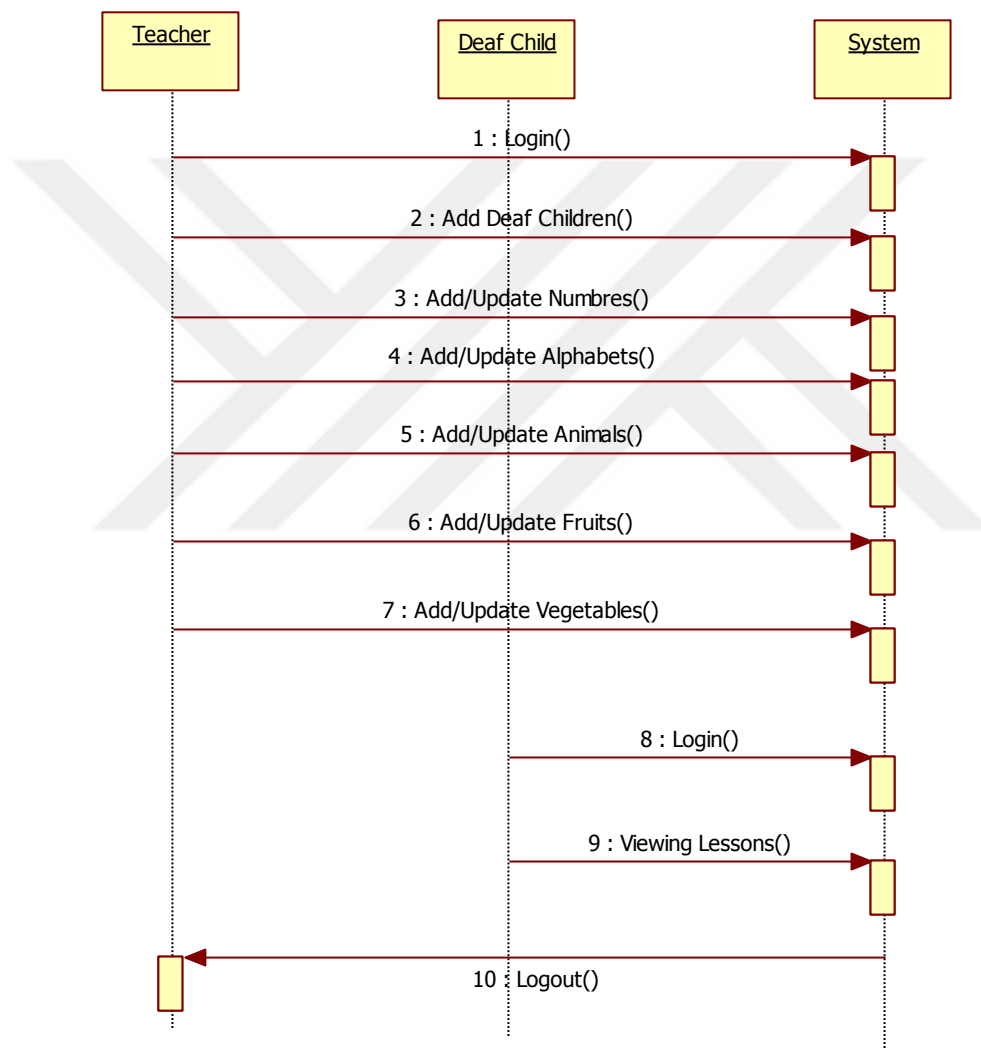


Figure 4.3. Sequence Diagram

As shown in Figure 4.3, it is evident that there are three objects involved in the interactions. They include admin, student, and system. There is interaction between admin

and system and student and system. As this is an interaction diagram that provides both messages that indicate incoming request and the return message.

4.2.4. Activity Diagrams

This section provides activities of the users of two roles namely administrator and student. The roles have different functionalities. These functionalities are shown in the form of activities. The following sub sections provide the activities of both student and administrator roles respectively.

4.2.4.1. Student Activity Diagram

This diagram provides detail of activities of users in student role. It is nothing but the functionalities performed by deaf student who participate in the e-Learning platform from time to time for learning English language basics.

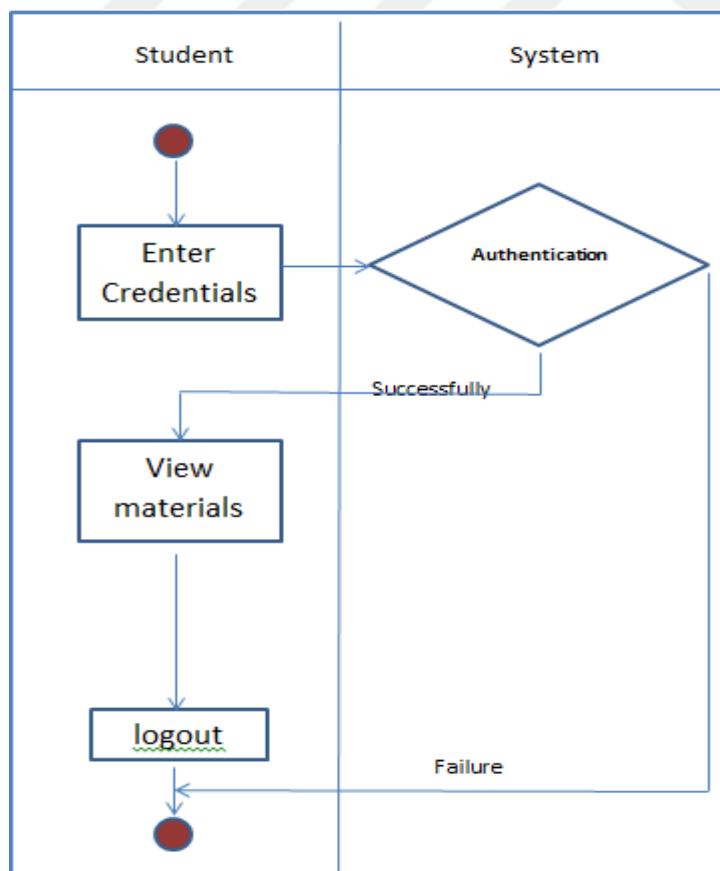


Figure 4.4. Student Activity Diagram

As shown in Figure 4.4, it is evident that the student role has very simple functionalities. In fact only one functionality is important to student that is learning with e-Learning platform. Viewing language materials with multimedia in order to learn language basics is done by student. This is done by deaf children in spite of their impaired hearing abilities. Before learning with the help of materials, the deaf children need to get authenticated by the portal. After completion of the learning, their session ends when they opt for sign out.

4.2.4.2. Admin Activity Diagram

Activity diagram for administrator provides all activities of the users who are in the role of administrator. Teachers act as administrators. When administrator logs in, the dashboard of the e-Learning portal provides interface to have these activities.

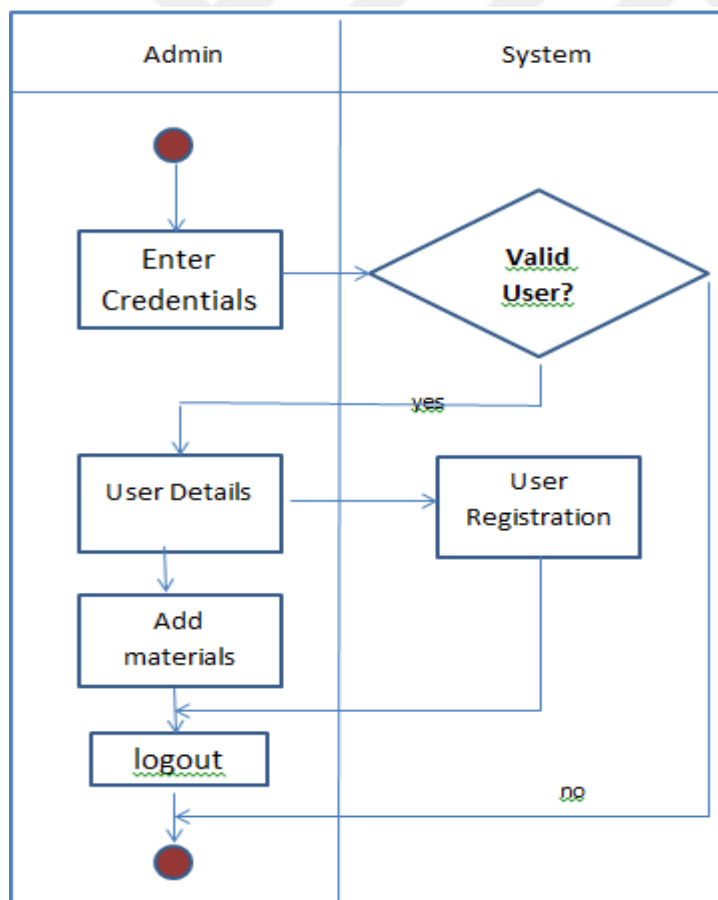


Figure 4.5. Admin Activity Diagram

As presented in Figure 4.5, the administrator has important activity known as adding learning materials for administrator. Material is related to language basics such as alphabet, numbers, animals, vegetables and fruits. These materials are added and manipulated by the administrator from time to time to provide good learning experience to deaf children who play student role in the proposed e-Learning platform.

4.2.5. Component Diagram

The component diagram is used to know different components involved in the system. The main components in the e-Learning system are administrator and student. Administrator and student components are involved in the interactions among them.

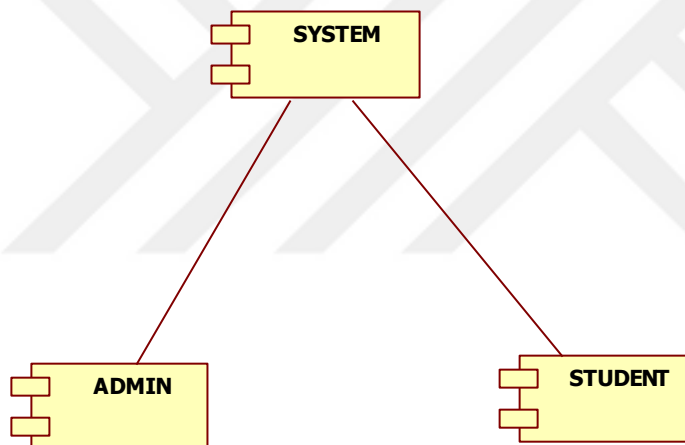


Figure 4.6. Component Diagram

As shown in Figure 4.6, it is evident that the administrator and student components have specific functionalities that are part of e-Learning platform. The interactions among the components fulfill the needs of the system.

4.3. Entity Relationship Diagram

Entity Relationship Diagram (ERD) is used to model backend of an application. In this thesis, ERD is designed using Dia software. The ERD reflects different entities, attributes of entities and the relationships among entities.

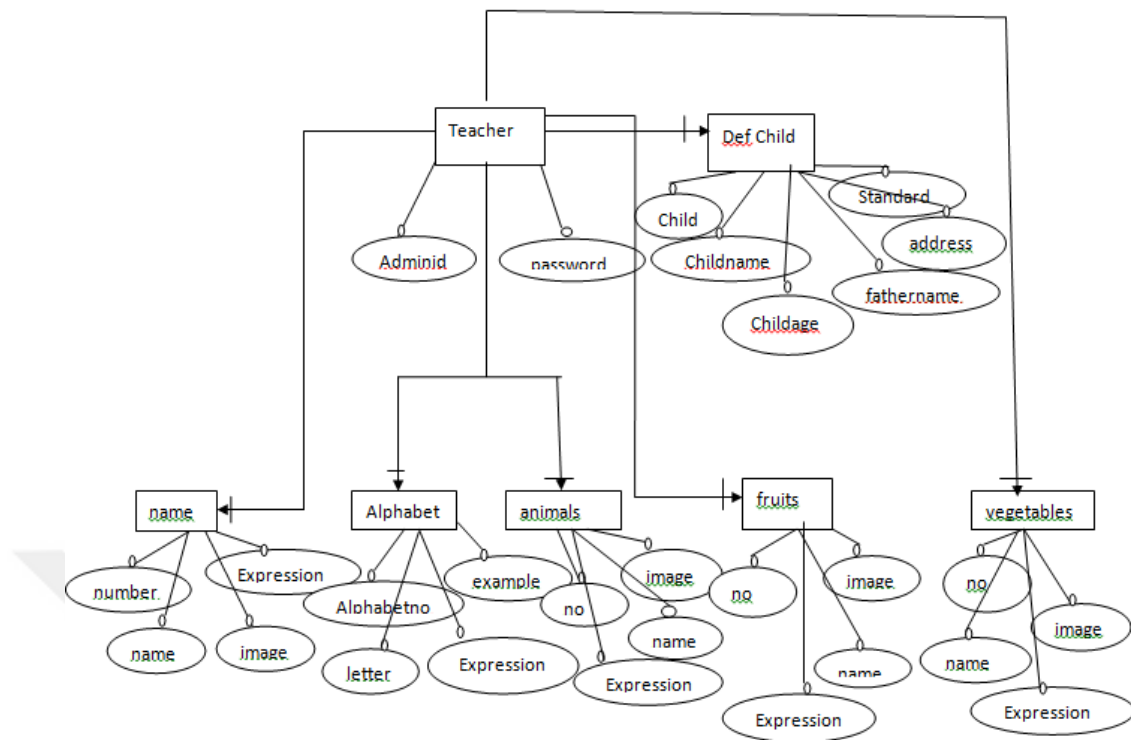


Figure 4.7. Entity Relationship Diagram

As shown in Figure 4.7, it is evident that there are many entities involved in the e-Learning system. They include teacher, deaf child, numbers, alphabet, animals, fruits and vegetables. These entities have corresponding attributes. There is relationship among entities in the form of one to one, one to many and many to many.

4.4. Backend Design

This section provides the backend design details. The relational tables are provided here. These tables are drawn from the ERD. The mapping of ERD to relational tables is presented in the subsequent sessions.

4.4.1. List of Tables

Table 4.1. List of Tables

SL. NO	TABLE NAME	PURPOSE
1	Admin	Holds admin credentials
2	Deaf_children	Holds the children's details
3	Alphabet	Holds the alphabets (A-Z)
4	Fruits	Holds the fruits details
5	Animals	Holds the animals details
6	Vegetables	Holds the vegetables details
7	Numbers	Holds number details

As shown in Table 4.1, it is evident that there are many tables involved in the backend of e-Learning system. The tables include Admin, Deaf_Children, Alphabet, Fruits, Animals, Vegetables and Numbers. These tables are populated with values when the e-Learning system is being used by users of the both administrator and student roles.

4.4.2. Admin Table

Table 4.2. Admin Table

SL. NO.	COLUMN NAME	PURPOSE	DATA TYPE	CONSTRAINTS
1	Admin_Id	Holds user id for administrator	Varchar	Primary Key
2	Password	Holds password for administrator	varchar	Not null

4.4.3. Alphabet Table

Table 4.3. Alphabet Table

SL. NO.	COLUMN NAME	PURPOSE	DATA TYPE	CONSTRAINTS
1	Alaphbet_sno	Holds alphabet sno for deaf children	Varchar	Primary Key
2	Letter	Holds Alphabet image for deaf children	Binary	Not null
3	Example	Holds fruit image (respective Letter) for deaf children	binary	Not null
4	Expression	Holds the video for how the alphabet name pronounced((in terms of lip movement)	varchar	Not null

4.4.4. Deaf children Table

Table 4.4. Deaf Children Table

SL. NO.	COLUMN NAME	PURPOSE	DATA TYPE	CONSTRAINTS
1	Child_Id	Holds children sno	Varchar	Primary Key
2	Child_name	Holds children name	varchar	Not null
3	Child age	Holds children age	Int	-
4	Father_name	Holds the father name	varchar	-
5	Address	Holds the Children address	varchar	-
6	Standard	Holds the Children class name	Varchar	-

4.4.5. Fruits Table

Table 4.5. Fruits Table

SL. NO.	COLUMN NAME	PURPOSE	DATA TYPE	CONSTRAINTS
1	Fruit_Id	Holds fruit id	Varchar	Primary Key
2	Fruit name	Holds fruit name	varchar	Not null
3	Fruit image	Holds fruit image (respective fruit image)	binary	Not null
4	Expression	Holds the video for how the fruit name is pronounced (in terms of lip movement)	varchar	Not null

4.4.6. Animal Table

Table 4.6. Animal Table

SL. NO.	COLUMN NAME	PURPOSE	DATA TYPE	CONSTRAINTS
1	Animal_sno	Holds animal sno for deaf children	Varchar	Primary Key
2	Animal name	Holds animal name for deaf children	varchar	Not null
3	Animal image	Holds animal image (respective Animal name) for deaf children	binary	Not null
4	Expression	Holds the video for how the animal name pronounced((in terms of lip movement)	varchar	Not null

4.4.7. Vegetable Table

Table 4.7. Vegetable Table

SL. NO.	COLUMN NAME	PURPOSE	DATA TYPE	CONSTRAINTS
1	vegetable_sno	Holds vegetable sno for deaf children	Varchar	Primary Key
2	Vegetable name	Holds vegetable name for deaf children	Varchar	Not null
3	Vegetable image	Holds vegetable image (respective Vegetable name) for deaf children	Binary	Not null
4	Expression	Holds the video for how the vegetable name pronounced (in terms of lip movement)	Varchar	Not null

4.5. Design Goals Considered

The design goals considered in the e-Learning platform are as follows.

1. User friendly interface for e-Learning process. The interface needs to be good for easy understanding and learning.
2. The design of the system should be consistent across the pages and the navigation should have clear guidance with intuitiveness.
3. Database needs to be in strict conformation with the user interface forms so as to make the application consistent.
4. The roles are considered to have very well defined functionalities in order to have clarity in the scope of the roles.

4.6. Summary

This chapter has provided the design specification for both backend and front end. The UML modeling is done with different notations. The design is based on two distinct

roles such as student and administrators. The design includes database side and application side. The backend side relations are also provided in this chapter. It is basis for the development of e-Portal platform for educating deaf children on language basics in English.



5. IMPLEMENTATION

5.1. Introduction

This chapter provides implementation details of the proposed e-Learning portal. It covers an architecture that is used for the implementation. The architecture reflects different aspects of the project including roles, their interaction with the system. It also throws light into different layers of the proposed application. The three tier architecture of the proposed e-Learning platform is also explored in this chapter. It also provides technical implementation details involved in this project.

5.2. Three – Tier Architecture of the Proposed System

Since it is a web based application, three-tier architecture is used to implement the proposed system. It has three tiers. The first tier is known as web tier. User agent or browser acts as web tier. It has built in functionality that allows users to have interaction with the e-Learning system. Browser helps users to connect to remote server. The middle tier is known as web tier. It is used to have business logic implementation. It is in the web server. The data tier is with the database management system. It is used to have persistence.

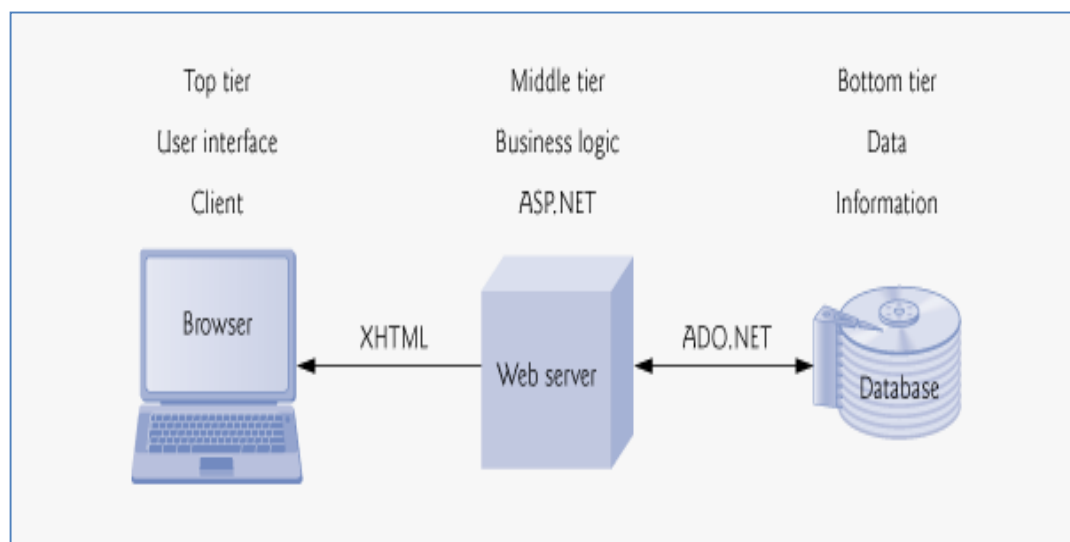


Figure 5.1. Three-tier architecture used in the implementation

As shown in Figure 5.1, it is evident that there are three tiers. The middle tier contains business logic which is implemented using ASP.NET. The business logic is written actually using C# programming language. ADO.NET is used to have interactions with database. The ASP.NET application runs in web server which provides user interface in the browser.

5.3. Overview of the Application Level Architecture

This section provides information about the application level architecture of the proposed e-Learning system. The roles involved in the system are teacher (administrator) and student (deaf children). Both the users can have registration and login. However, deaf children' registration is made by the administrator. After registration and authentication, they can make use of database connectivity for performing various activities.

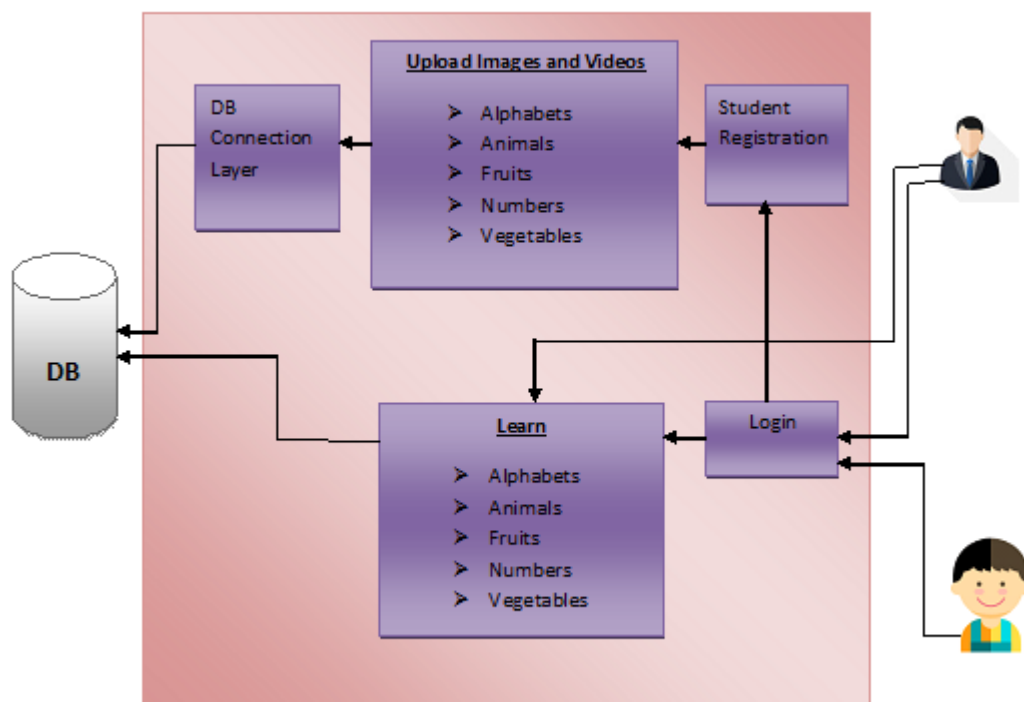


Figure 5.2. Architecture Diagram

As shown in Figure 2, student role is meant for learning English language basics while the teacher role is to add learning material for deaf children. The administration activities after successful logic include adding or manipulating materials like alphabet, animals, numbers, and vegetables. User can view all these material added by administrator.

However, the users do not have permission to manipulate training material. However, the administrator can do this as and when needed.

5.4. Modules

The functional requirements are logically divided into two major modules. The modules are known as teacher and student. Actually these two encapsulate the roles such as teacher and student respectively. The teacher module is also known as administrator while the student role represents deaf children for which e-Learning portal is built in order to facilitate them to learn language basics.

5.4.1. Admin Activities

Admin activities are as follows.

- a. Adding deaf children (students)
- b. Adding learning material like
 - a. Alphabets
 - b. Numbers
 - c. Animals
 - d. Fruits
 - e. Vegetables
 - f. Etc.
- c. Modifying learning material

5.4.2. Student Activities

- 1. Login
- 2. Viewing Lessons on
 - a. Alphabets
 - b. Numbers
 - c. Fruits
 - d. Vegetables
 - e. Animals

- f. Etc.
- g. Logout

5.5. Business Logic

Business logic of e-Learning portal is implemented in a layered approach. Business logic is written in such a way that it can be reused. Standards are followed while implementation of business logic. More details on business logic are found Appendix.

5.6. Validations

Validations are made using validation controls provided by ASP.NET. Validations are applied to each and every form where user gives inputs. The inputs fields are validated in order to have correct input sent to server. This could save wait time of users and also improve the overall performance of the application. The e-Learning web portal shows highly accurate outputs such as showing learning material and allowing deaf children to learn English language basics.

5.7. Session Management

Session management is the concept in which developer writes code in such a way that the web server maintains identify of conversation of different users concurrently. This technique is used by the developer in this thesis to implement sessions so as to support concurrency. The users of the e-Learning portal can have learning experiences in their own pace. Each user gets the learning material based on their session and conversation. It does mean that web server remembers the identity of all users logged into the application and provides learning experience to all users.

5.8. Summary

This chapter has provided the implementation details of the e-Learning portal. It includes the three tier architecture, application level architecture that provides implementation specific details, and business logic implemented. It also covers the

validations made in the project, session management and other technical details. The business logic is implemented using ADO.NET which is used to interact with relational databases



6. RESULTS

6.1. Introduction

This chapter presents results of the e-Learning portal built as part of this thesis. It is built with usability and good navigation. It is useful to educational institutions and individuals and parents who are involved in helping deaf children in teaching language basics. Deaf children can learn language basics in their own pace. It is web based application that enables them to have edutainment that is the education through entertainment. Moreover, the portal is having content management features associated with administrators or teachers. It has two roles in fact. All teachers who provide training material through the e-Learning portal are in the role of administrator while the deaf children who learn language basics using the portal are in the student role.

The following section provides the usage of the web portal in user friendly fashion. This chapter throws light into showing different aspects of the portal and how it is useful to deaf children to have useful sessions to understand English language basics. The web portal has incorporation of training material in the form of audio, video, images and text. With these media, deaf children can have their right to education in terms of learning language basics. This knowhow paves way for them to grow faster in learning other subjects as they grow. For helping users online, the web portal is deployed over Internet. Its URL is www.elearningfordeaf.com. The functionalities of the e-Learning portal are thoroughly tested and the screens of systematic usage of the portal are kept in the ensuing section.

6.2. Screens of E-Learning Portal

This section provides the result of different functionalities of users playing teacher/administrator role and student (deaf children) role. Right from the home page of the web portal, it walks through all functionalities of both the roles. These screens provide effective understanding of the realization of the proposed e-Learning portal.

6.2.1. Homepage

This is the default page which appears when web portal is accessed by using the URL www.elearningfordeaf.com. It takes the user to Default.aspx page which provides authentication feature for users of both the roles.



Figure 6.1. Homepage

The above screen describes the Home page of the e-Learning Portal. It helps deaf children and teachers to get authenticated and obtain their respective home pages that contain their functionalities.

6.2.2. Login Page

This page is meant for user authentication. User authentication is needed to have secure and controlled access to web portal. It avoids unauthorized access and software robots to misuse the e-Learning portal.

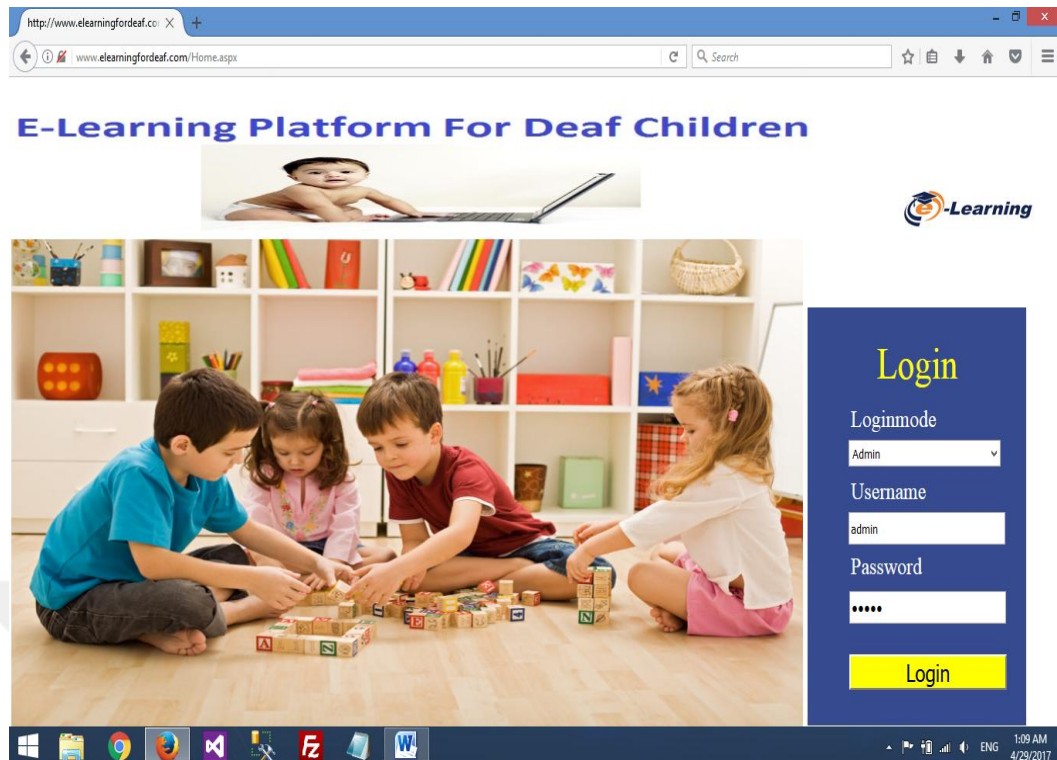


Figure 6.2. Login page

As shown in Figure 6.2, it is evident that the login screen helps users to provide their user name and password. Then the user needs to select the role in order to get authenticated by web server. Once authentication is completed, corresponding user interface appears for further usage of the web portal.

6.2.3. Admin Page

Microsoft.NET supports the concept of master pages. Master pages are example for visual inheritance. Navigation and other reusable aspects are designed in the master page. This UI in the master page is automatically inherited to child pages. Thus it promotes reusability and avoids reinvention of the wheel as much as possible.

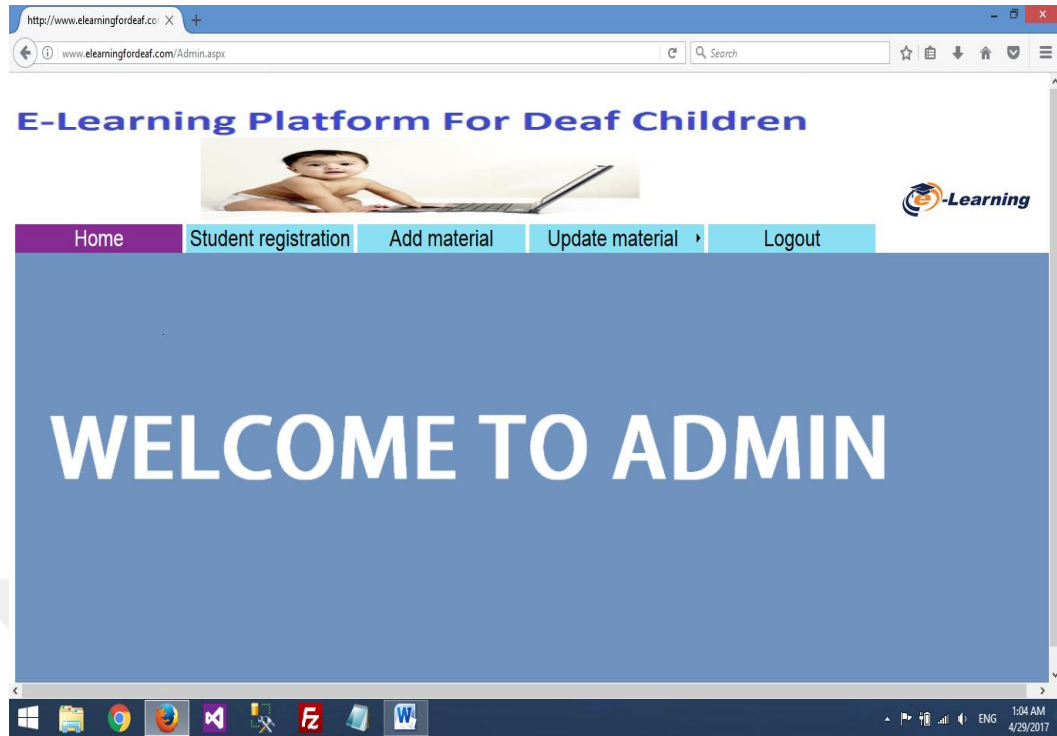


Figure 6.3. Admin page

After providing valid credentials of the admin the above screen is displayed. This page is admin welcome page. After login the operations like student registration and add materials performed by admin. As shown in Figure 6.3 the admin page contains features like adding different kind of learning materials, updating the material loaded, registering deaf children (students) for creating login credentials for them and sing out.

6.2.4. Student Registration Page

This page is used by administrator in order to register deaf children or students. This activity is crucial in order to give login credentials to deaf children. Educating deaf children in language basics is the main purpose of this e-Learning portal.

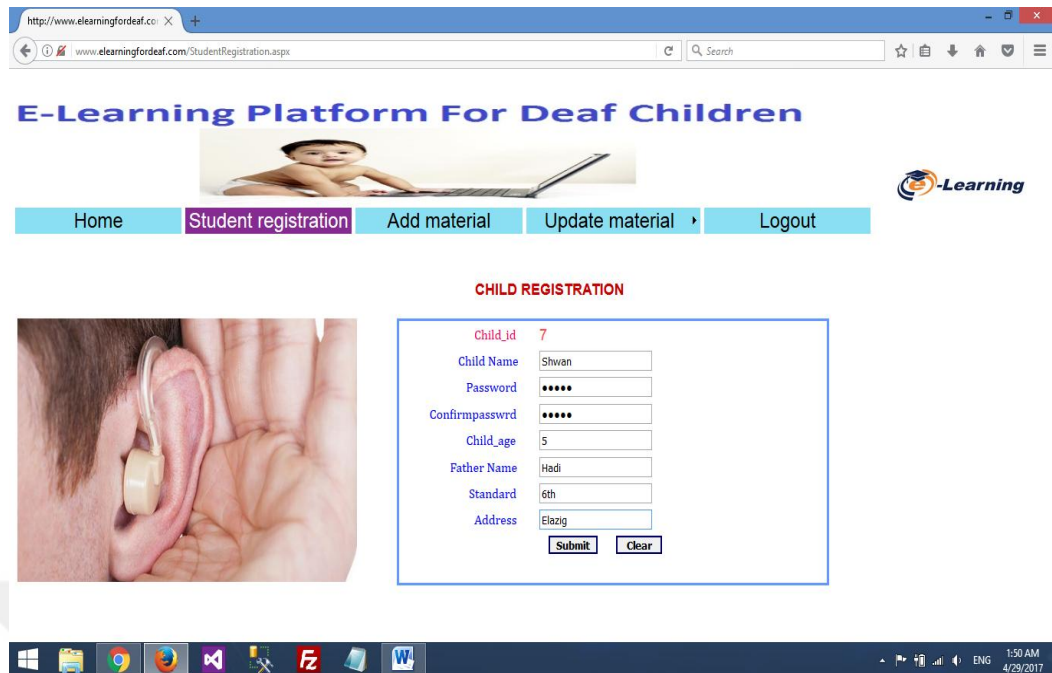


Figure 6.4. Student Registration page

Mouse Click on the Student registration the above screen is displayed then user provides the valid new Student details in the textboxes and clicks the Submit Button as shown the above screen. As shown in Figure 6.4, new deaf child registration takes place. This registration is mandatory for gaining access to the web portal. This registration is done by teacher or administrator on behalf of deaf children.

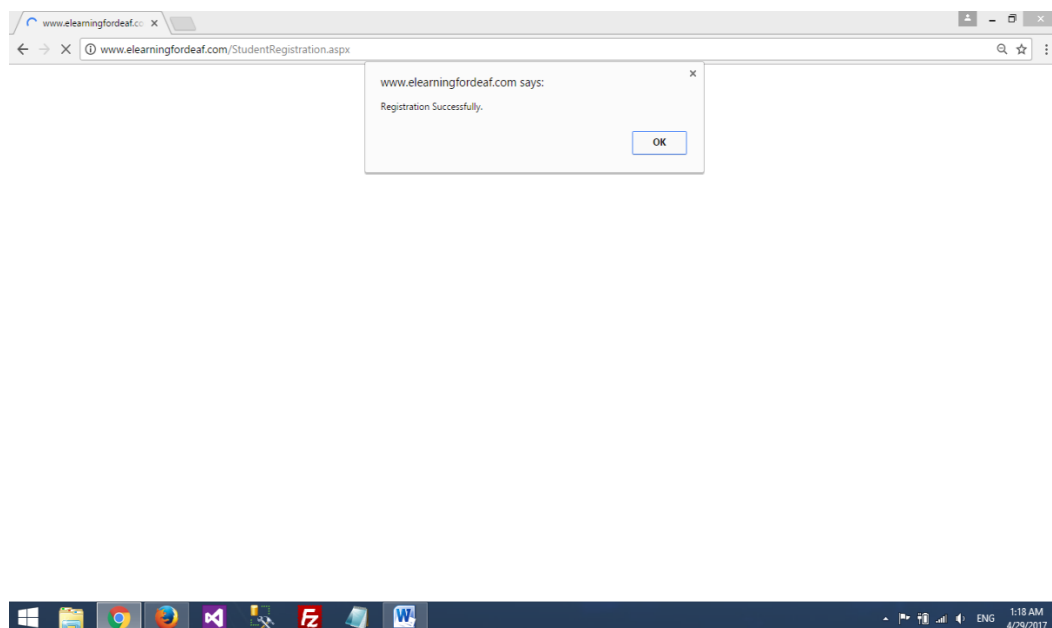


Figure 6.5. Student Registration Success page

After Click the Submit button the new student details are stored in the database and display the alert like “Registration Successfully” as shown the above screen shot.

6.2.5. Display Materials Page

This page allows administrator to upload training material for deaf children. The material includes alphabets, numbers, animals, and fruits, vegetable and so on. Every category of material is added with text, audio, video and images. Thus it provides rich user experience or great learning experience to deaf children.

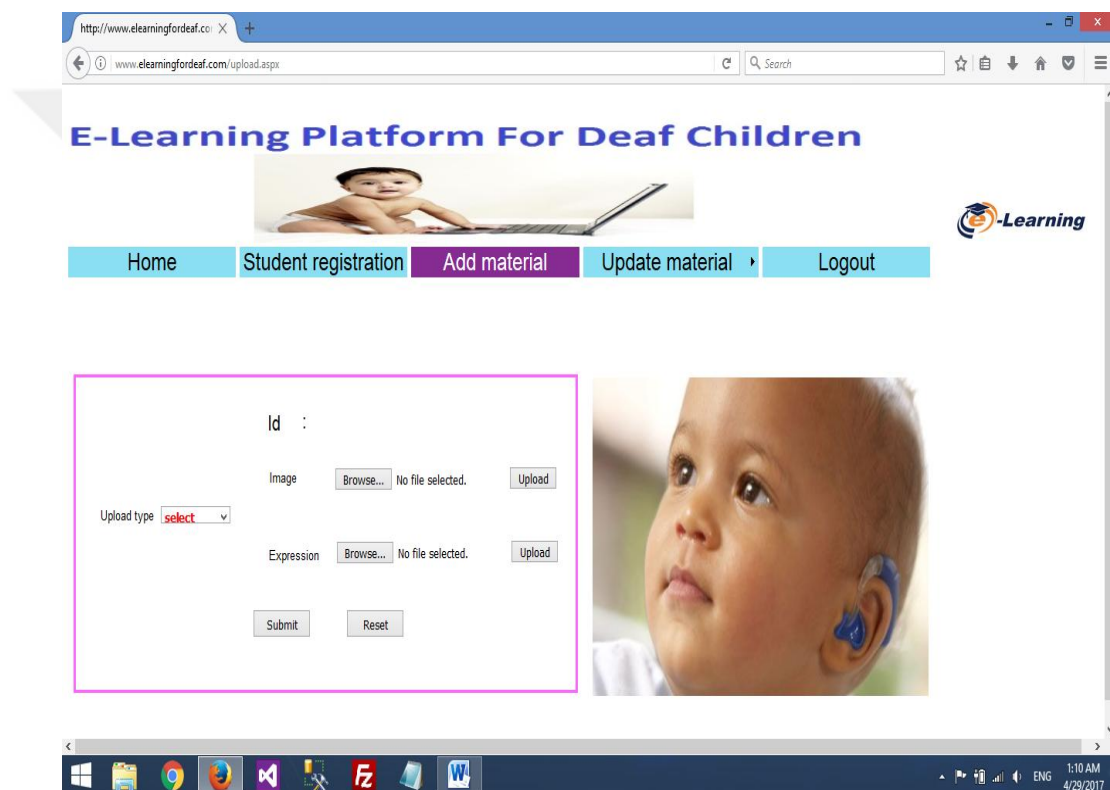


Figure 6.6. Display Materials Page

Mouse Click on the Add material the above screen is displayed as shown the above screen. The screen contains UI that helps administrator upload training material. The uploaded material is saved to relational database for future retrieval and revisions. There is provision for expression videos that help deaf children to understand the basics of English language. The rationale behind this is that the video contains lip movements and gestures besides textual appearance of the learning content.

6.2.6. Add Materials Page

This page is used to add materials related to deaf child education on English language basics. It throws light into different kinds of materials needed. It includes materials like alphabets, numbers and so on.

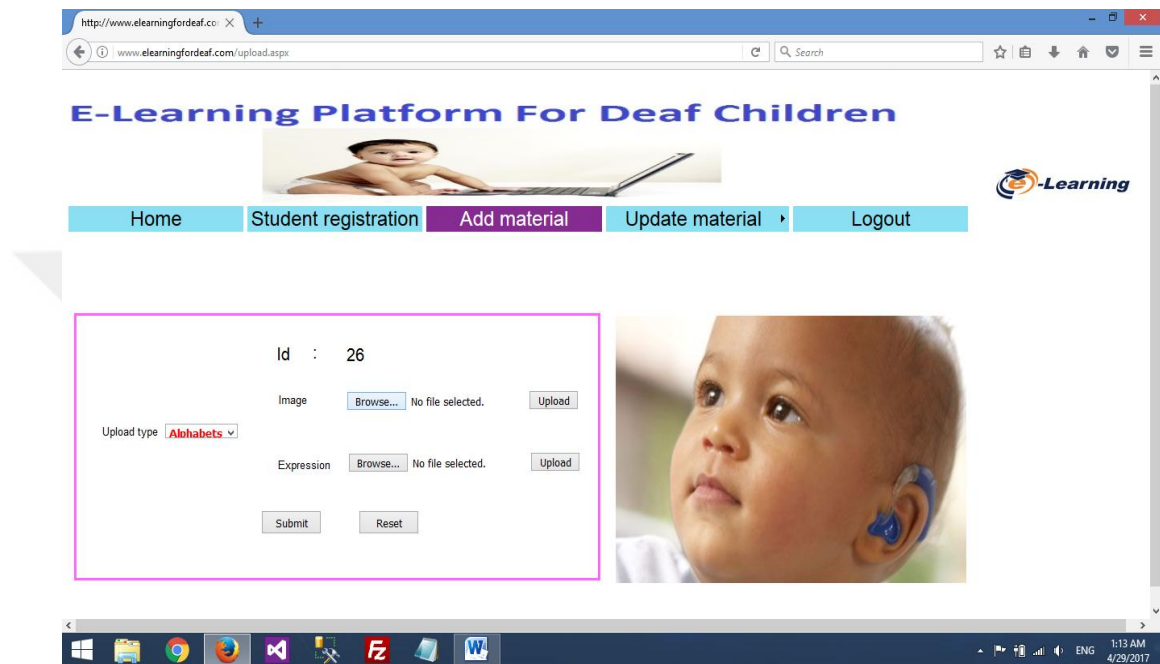


Figure 6.7. Add Material Page

Mouse Click on the Add material the above screen is displayed and provides the valid new material; details in the textboxes and click the Submit Button as shown the above screen. The Figure 6.7 shows a number 26 and its visual aids getting uploaded for intuitive learning experience to deaf children. This is the same interface for loading multiple materials of English language. After uploading materials, at any given point of time, administrator can modify them. Finally the UI helps the administrator to close his session securely and gracefully.

6.2.7. Student Login Page

This is student authentication page. This page takes credentials from deaf child and helps to move to learning page. In this area, teachers need to help deaf children or give some training to enter credentials.

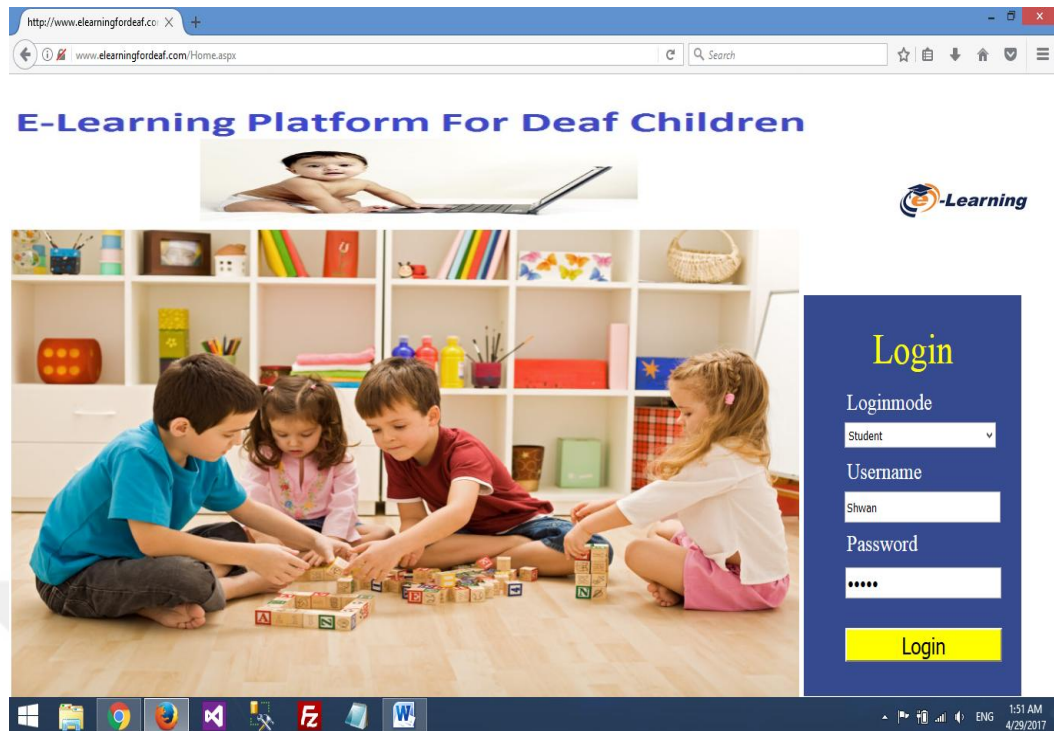


Figure 6.8. Student Login Page

Select the Student login mode from Login mode dropdown list and provide valid credentials of the Student and click on the Login Button as shown above screen. Once authentication is done it moves to the home page of student where the learning material is available. The material helps in learning in his/her own pace without any restrictions. Moreover, as mentioned earlier, visual aids help the student to have better learning experience.

6.2.8. Student Page

This page is crucial for supporting education to deaf children in terms of learning language basics. Children with hearing problems can view the material and grasp subject. English language at basic level is understood by the student. This knowledge goes a long way in the life of deaf children in learning other subjects with the knowledge of English.



Figure 6.9. Student Page

After provide valid credentials of the Student the above screen are displayed. This page is student welcome page. After login the operations like view materials performed by student. As shown in Figure 6.9, it is evident that the view material tab provides learning material that caters to the needs of deaf children. It enables them to learn English language right from alphabet to cat, mat, fat etc.

6.2.9. View Materials Pages

This page is designed with great care and keeping the design goals of the e-Learning portal. The design goals are provided in section 4.5 of Chapter 4. The materials are presented graphically and there usability and intuitiveness come into surface. It aids the deaf children to make well informed and spontaneous decisions while choosing category and the content in the learning process.



Figure 6.10. View Materials Page

After Click the View material the above screen is displayed. The above screen describes the display of each material. As presented in Figure 6.10, it is evident that the learning materials are presented as different categories like alphabet, fruits, vegetables, animals and so on. The visualization of the material helps the deaf children to learn subject with intuitive user interface. The natural abilities of learning come into picture with intuitive user interface and graphical content. Moreover, the visual aids in the form of text, video, audio and images play vital role in giving rich learning experience to students.

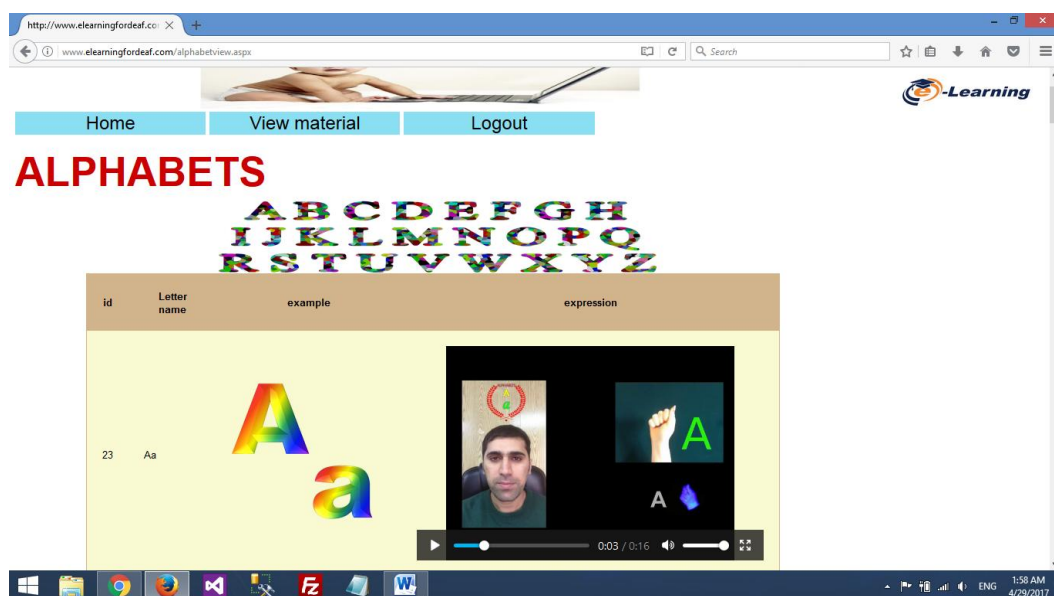


Figure 6.11. View Alphabets Materials Page

The above screen describes the display video of alphabets. The graphical images and the video as shown in Figure 6.11 provide the deaf children to grasp intended subject well. It is like education through entertainment. Though this web portal is for education, it makes the learning experience pleasant and users come to the web portal repeatedly. It also has appealing user interface and the utility of the content presentation.

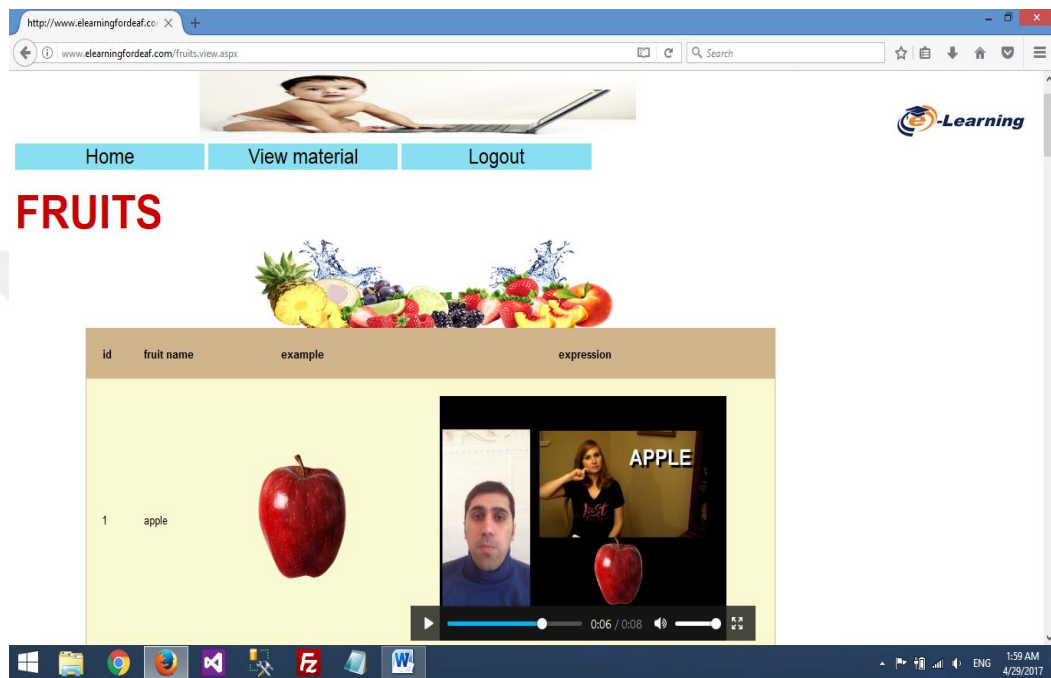


Figure 6.12. View Fruits Materials Page

The above screen describes the display video of Fruits. As shown in Figure 6.12, it is evident that the student is able to learn about fruits. The video content, text, audio (of course deaf child cannot hear) and images make the student to grasp the intended word and relate the word with picture presented. In this case apple is the picture presented and the video provides lip movements that help deaf child to understand how to recognize it and speak on it.

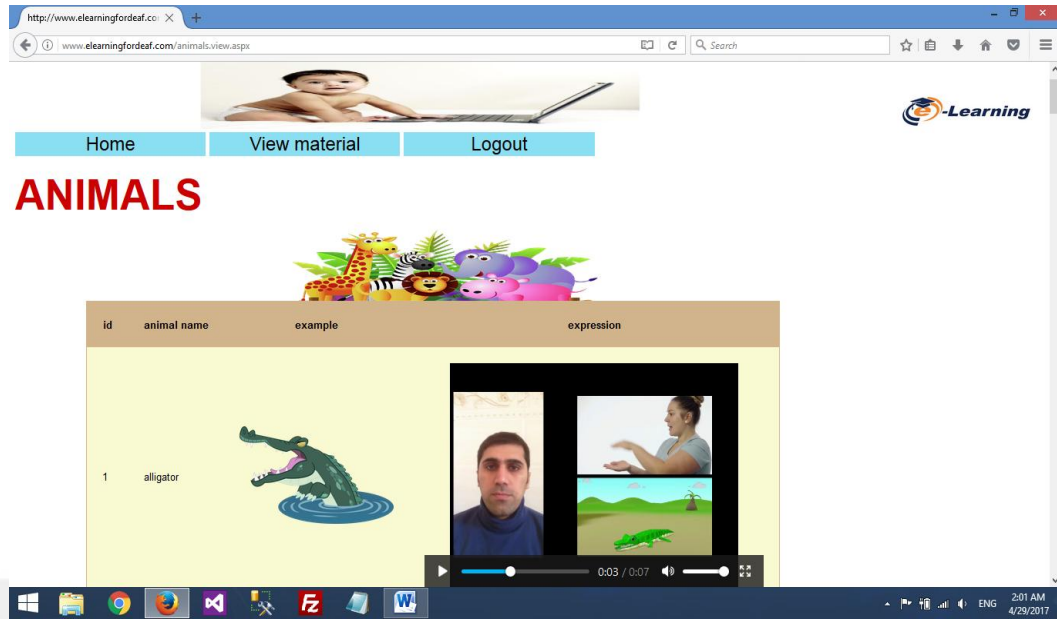


Figure 6.13. View Animals Materials Page

The above screen describes the display video of animals. This is the page as shown in Figure 6.13, which provides learning experience on different animals. The video supports the student to understand that it is an animal and lives in water. Thus the imagination of the student gets improved with the visual aids. The student can related the animal with its habitat and thus can have better understanding of the animal intuitively.

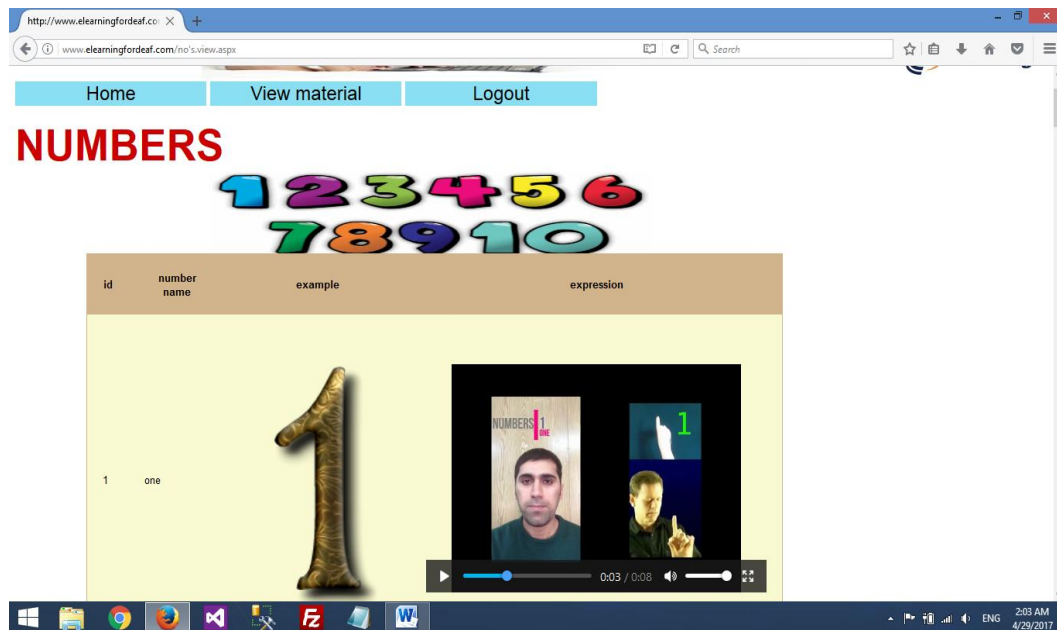


Figure 6.14. View Numbers Page

The above screen describes the display video of Numbers. As shown in Figure 6.14, it is evident that the numbers are chosen by the student. The deaf child is able to view numbers one by one and understand it in terms of appearance, pronunciation with the help of lip movement in the video and the gesture in the image showing one finger up. Thus there is wonderful learning experience in this web page that leads to effortless learning of English language basics. Moreover, the student of this e-Learning portal can get benefited from the wonderful and customized video content. This way all numbers are learned by the children. This e-Learning web portal is effective in educating deaf children for teaching language basics.

6.3. Summary

This chapter has provided sufficient evidence of the results of the research and implementation of e-Learning portal. The portal helps deaf children to learn English language basics effortlessly. It incorporates training materials on alphabet, numbers, animals, fruits and vegetables. Moreover, it has no limits on the training content as users in administrator/teacher role can add more content and manipulate the content as well. An important USP of the e-Learning portal is to have visual aids in the form of text, audio, video, and images. These visual aids provide very good learning experience to users. Moreover, the training material is prepared and presented with great care and love by the author of this thesis. There was lot of effort involved in the preparation of training videos and incorporating them with the portal business logic. This e-Learning web portal presented in this chapter is useful for deaf children as it is intuitive and provides rich user experience and learning scope. It also helps teachers across the globe who are involved in giving training to deaf children. Most importantly, the author of the thesis made the e-Learning portal public by giving free access. However, registration is needed with permission in order to explore it and use it for free. It has support for multiple users so as to support concurrent usage and scalability.

7. USABILITY ANALAYSIS

7.1. Introduction

This chapter provides insights on usability of the conceptual learning application developed for deaf students. The e-Learning portal built as part of this thesis is useful for deaf children in learning language basics in English. The previous chapter of the thesis provided analysis of results pertaining to the said application. In this chapter, investigation is made into the usability of the proposed application targeted for deaf children. Education to deaf children in learning language basics was the rationale behind the research. However, usability plays vital role in adapting particular portal or web application. Usability has its impact on the usage of the portal. Therefore, this chapter throws light into the usability aspects of the application.

7.2. Usability

It is the measure which helps in understanding the ability of the web application or any application to be used by end users. In other words, it refers to the degree of ease of use of an object or application made by humans. There are different aspects pertaining to usability. They include navigation, intuitiveness, training and so on [55]. Navigation is very essential feature of any web application. Users need to feel comfortable to navigate to the different sections of the application easily. Intuitiveness refers to the ability of the web application to help users to understand things just by a glance. The intuitiveness make the users feel easy and help them in repeated use of the web application. Training refers to the amount of training needed in order to use the web application properly. Usability guidelines when followed by the designers of web site, little training are needed for end users. Interactivity is another feature of web sites. Such web sites can help users to have their personalized information or to have what they need explicitly.

7.3. Usability of Educational Web Sites

Hoyle and Bruton [56] proposed certain features to be made available with educational web sites for better usability and interactivity. The guidelines they provided

include consistency in navigation interface in all pages, clear hierarchical order in moving to different pages of web site, visible search functionality, multimedia content as per the need, avoiding distractions like unnecessary graphics, clearly identified and tested hyperlinks, using icons or visualizations to make users understand things intuitively.

7.3. Usability of the Proposed Conceptual Learning Application

7.3.1. Navigation and Intuitiveness

The proposed application has easy navigation which helps deaf children to move to topics easily. The navigation is as preferred in [56] as it is consistent and helps users to have ease of movement. The proposed conceptual learning application which is a web portal has intuitive interface. Just by a glance deaf children can understand the interface and follow the interface intuitively without the need for explicit training. The rationale behind this is that the interface is clearly provided with graphics that help in imparting edutainment. Education through entertainment is one of the ways in which children are attracted to studies. The e-Learning web portal is intuitive in nature and helps deaf children to navigate and use it intuitively.

7.3.2. Distractions

Though the e-Learning application is targeted to deaf children with multimedia content, every care is taken that no unnecessary graphics are placed. Any unnecessary graphical content distracts the children from learning or edutainment. This is the main reason for the proposed application to have multimedia objects such as images, audio and video to the extent needed for the training of language to deaf children.

7.3.3. Design

Aesthetic design of web application is preferred for educational sites [55]. The design of the e-Learning portal proposed in this thesis was made with design principles in mind. The principles followed include visual attractiveness to let users to stay in the web site, master pages to have consistent look and feel in all pages, appropriate use of images to

have meaningful web pages, appropriate selection of fonts, consistency in font and colour combination, navigation position, and page design.

7.3.4. Content

The content in e-Learning web portal is carefully chosen. The multimedia objects are specifically identified and tailor made to impart language skills to deaf children. The videos provided to end users make good sense and help in delivering the purpose for which they are created. The images are placed appropriately.

7.3.5. Search Option

The e-Learning portal has used master pages concept for page layout and design. It helps the users to navigate to all the required pages from master page. Therefore it is ensured that all interface elements are visible in the master pages. Thus there is no explicit utility of search bar in web portal designed and implemented as part of this thesis. However, it is good idea to have such facility when the navigation is complex and there is plethora of web pages to be visited.

7.3.6. Architecture

The architectural design is simple. It is a three tier architecture and web based. Here the user uses a browser and gain access to the web application. The complexity of the architecture is hidden from user's view. Since user uses browser it is made easy. There is no installation involved in the user's machine.

7.4. Usability Evaluation

As explored in [57] usability evaluation of the proposed e-Learning portal is made using certain factors such as ease of use, intuitiveness (no need to memorize things), error freeness, and satisfaction of users. The usability evaluation ensured that the proposed portal is able to provide good usability to attract deaf children to learning language basics with ease. As presented in [58] the web portal is evaluated in terms of appearance,

consistency, navigation, hyperlinks leading to expected pages, quality of content, content delivery and user satisfaction. In this thesis, these are considered and evaluated. The content is appropriate, content delivery is meaningful and user satisfaction is good as the training includes multimedia objects including training videos appropriately.

7.5. Summary

This chapter has provided usability investigation on the conceptual application used to impart training to deaf children. The web portal is subjected to usability analysis based on different parameters considered for educational sites. The usability investigation reveals that the e-Learning portal is able to meet usability requirements as much as possible.

8. CONCLUSION

8.1. Introduction

This chapter provides conclusions on the research work carried out on the deaf education and the e-Learning portal created to help deaf children to learn language basics easily. It also throws light into summary of research and useful insights on the work done in this thesis.

8.2. Summary of Findings

In the review of literature it is understood that there are many e-Learning portals across the globe. These portals targeted both children and adults. There are some portals dedicated for deaf and dumb people, too. However, little information is found on the web portals that provide education to deaf children in terms of teaching language basics. We found this is the research gap and motivation to work in this thesis. The literature review insights resulted in a research hypothesis that investigated into the need for having an e-Learning portal for deaf children with intuitive interface. This research hypothesis has been tested with the proposed e-Learning portal which proved to be very user friendly and makes learning experience good with visual aids such as text, audio, video and images. Usability analysis revealed that the application is usable and intuitive in nature.

8.3. Conclusions

The aim of the project is to build an e-Learning portal for helping deaf children to learn language basics in their own pace. From the experience of the research and development of e-Learning portal, the following are the conclusions drawn.

- Investigations in the literature provided insights that paved way for understanding the need for building an e-Learning portal for deaf children. Especially, it is difficult to teach deaf children any subject unless they are good with language basics. This is the motivation with which an e-Learning portal is proposed.

- Analysis is done to understand the existing e-Learning systems. This knowhow has provided very useful information. Then a new e-Learning portal is proposed. The portal is intended to provide best learning experience to deaf children. The portal's usability and utility are considered for making it useful piece of software that can be accessed by all authorized users.
- E-Learning portal is designed with UML modelling. While its design two roles are identified and system is modelled accordingly. The two roles include administrator (teacher) and student (deaf child). These roles have distinct functionality in the e-Learning portal. Broadly, administrator adds learning material while the student exploits them to learn language basics. At present supports English.
- E-Learning portal is implemented using Microsoft.NET platform. It provides C# programming language for providing functionality to UI. ASP.NET is used to design web pages and support session management. ADO.NET is used to interact with relational databases built using SQL SERVER. The e-Learning portal is built in such way that it promotes usability, user-friendliness and scalability. It incorporated learning materials in the form of alphabet, numbers, vegetables, fruits and animals. However, there is no limit for learning content. Administrator can add new content and manage the existing content as well.
- The student role is implemented to support good learning experience to deaf children. Deaf children can learn language basics in their own pace. Interestingly, they use the e-Learning portal to have edutainment. Education through entertainment. In other words, the e-Learning portal has support for visual aids such as text, images, audio and video. The video content provided in the e-Learning portal is unique and it is tailor made to provide rich learning experience to deaf children. The lip movements in the videos, the text appearance, and the images showing the symbol or any learning aid provide good user experience. Deaf children who use this portal can learn language basics with ease and without time and geographical restrictions.
- The e-Learning portal has secure access to legitimate users. Users of both the roles can gain access to training materials only after due authentication. This is to avoid unauthorized access and also prevent software robust to misuse the application. Thus the portal is secured from malicious behavior.

- Usability analysis revealed that the application is usable and intuitive in nature. It is user friendly and does not need explicit training to users to operate it. It used images, video and audio appropriately to serve the purpose of educating deaf children on language basics.

8.4. Recommendations for Future Work

The wealth of experience gained by the author of the thesis while doing literature survey, analysis, design and implementation of the e-Learning portal helped him to come up with the following directions for future work.

- The e-Learning portal as of now supports only English. Though it is very useful to have English language skills for deaf children in order to excel in other subjects, it may be useful to have support for other languages as well. This is our first direction for improving the portal in future.
- The e-Learning portal can be improved to have responsiveness and give support in all devices. Even smart phones should be able to present the learning content without usability issues. The current e-Learning portal is designed and implemented with this in mind. However, it is yet to be tested with all devices and necessary changes are to be made it to be portal across devices. Then its utility will be improved significantly.
- When the portal is ported in all devices, it leads to have more users and thus there is need for maintaining concurrent sessions that grow day by day. Thus it is better to move the e-Learning portal to cloud computing environment to make it remain scalable and maintainable with less effort.
- The portal in future can be improved to incorporate training content to target other physically impaired individuals. Further investigation is needed in this area to have meaningful improvements to the current e-Learning portal which is made live and available at www.elearningfordeaf.com.

8.5. Summary

This chapter has provided summary of findings in this research which is aimed at implementing an e-Learning portal for deaf children. The findings include useful insights from the literature and the need for having such portal. Apart from this, this chapter provides conclusions and recommendations needed for possible future work.



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APPENDIX

This section provides the source code used to perform various critical modules of the e-Learning system. Business logic related to most important aspects of the e-Learning platform is presented in this section.

Student Registration

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Web;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Data;
using System.Data.SqlClient;
using System.Web.Configuration;
public partial class StudentRegistration : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {
        SqlConnection con1 = new
        SqlConnection(WebConfigurationManager.ConnectionStrings["con1"].ToString());
        con1.Open();
        SqlCommand cmd1 = new SqlCommand("select count(*) from Deaf_children", con1);
        SqlDataReader dr;
        object j = cmd1.ExecuteScalar();
        int i = Convert.ToInt32(j);
        int p = i + 1;
        lblchild.Text = Convert.ToString(p);
    }
    protected void Button1_Click(object sender, EventArgs e)
    {
        SqlConnection con = new
```

```

SqlConnection(WebConfigurationManager.ConnectionStrings["con1"].ToString());
con.Open();
SqlCommand cmd = new SqlCommand("insertchild", con);
cmd.CommandType = CommandType.StoredProcedure;
cmd.Parameters.AddWithValue("@child_id", lblchild.Text);
cmd.Parameters.AddWithValue("@child_name", txtchildname.Text);
cmd.Parameters.AddWithValue("@password", txtpass.Text);
cmd.Parameters.AddWithValue("@confirmpasswr", txtconfirm.Text);
cmd.Parameters.AddWithValue("@child_age", txtage.Text);
cmd.Parameters.AddWithValue("@father_name", txtfather.Text);
cmd.Parameters.AddWithValue("@standard", txtstandard.Text);
cmd.Parameters.AddWithValue("@address", txtaddress.Text);
int x = cmd.ExecuteNonQuery();
if (x == 1)
{
    //Response.Write("Registration Successfully");
    //Label1.Visible = true;
    // Label1.Text = "Registration Successfully";
    string message = "alert('Registration Successfully.')";
    ScriptManager.RegisterClientScriptBlock((sender as Control), this.GetType(), "alert",
    message, true);
}
}

```

Updating Material

```
using System;
using System.Data;
using System.Data.SqlClient;
using System.Web.Configuration;
using System.Collections.Generic;
using System.Linq;
using System.Web;
using System.IO;
using System.Web.UI;
using System.Web.UI.WebControls;
public partial class UpdateAnimals : System.Web.UI.Page
{
    int s, id;
    SqlConnection con1 = new
    SqlConnection(WebConfigurationManager.ConnectionStrings["con1"].ToString());
    protected void Page_Load(object sender, EventArgs e)
    {
        if (!Page.IsPostBack)
        {
            BindData();
        }
    }
    protected void GridView1_RowEditing(object sender, GridViewEditEventArgs e)
    {
        GridView1.EditIndex = e.NewEditIndex;
        BindData();
        id = Convert.ToInt32(GridView1.DataKeys[e.NewEditIndex].Value);
        Session["id"] = id;
        FileUpload fup = GridView1.Rows[e.NewEditIndex].FindControl("FileUpload1") as
        FileUpload;
        FileUpload fup1 = GridView1.Rows[e.NewEditIndex].FindControl("FileUpload2") as
```

```

FileUpload;
Button btn = (Button)GridView1.Rows[e.NewEditIndex].FindControl("btnupload1");
Button btn1 = (Button)GridView1.Rows[e.NewEditIndex].FindControl("btnupload2");
LinkButton link =
(LinkButton)GridView1.Rows[e.NewEditIndex].FindControl("lnkbtnCancel");
link.Visible = true;
fup.Visible = true;
fup1.Visible = true;
btn.Visible = true;
btn1.Visible = true;
//e.Row.Cells[3].Visible = false;
//e.Row.Cells[5].Visible = false;
}
protected void GridView1_RowUpdating(object sender, GridViewUpdateEventArgs e)
{
con1.Open();
string strQuery = "update animals set
animal_name=@animal_name,animal_image=@animal_image,expression=@expression
where animal_sno=@animal_sno";
SqlCommand cmd = new SqlCommand(strQuery, con1);
cmd.CommandType = CommandType.Text;
cmd.Parameters.Add("@animal_sno", SqlDbType.Int).Value = Session["id"];
cmd.Parameters.Add("@animal_name", SqlDbType.VarChar).Value =
Session["filename"];
cmd.Parameters.Add("@animal_image", SqlDbType.VarChar).Value = Session["img"];
cmd.Parameters.Add("@expression", SqlDbType.VarChar).Value = Session["video"];
cmd.ExecuteNonQuery();
//Response.Write("Alphabets data inserted successfully");
string message = "alert('Animals data Updated successfully.')";
ScriptManager.RegisterClientScriptBlock((sender as Control), this.GetType(), "alert",
message, true);
BindData();
con1.Close();

```

```

}
protected void GridView1_RowDeleting(object sender, GridViewDeleteEventArgs e)
{
    con1.Open();
    string cmdstr = "delete from animals where animal_sno=@animal_sno";
    SqlCommand cmd = new SqlCommand(cmdstr, con1);
    cmd.CommandType = CommandType.Text;
    cmd.Parameters.Add("@animal_sno", SqlDbType.Int).Value = Session["id"];
    cmd.ExecuteNonQuery();
    //Response.Write("Alphabets data inserted successfully");
    string message = "alert('Animals data Deleted successfully successfully.')";
    ScriptManager.RegisterClientScriptBlock((sender as Control), this.GetType(), "alert",
    message, true);
    BindData();
    con1.Close();
}
public void BindData()
{
    SqlDataAdapter da = new SqlDataAdapter("select * from animals", con1);
    DataSet ds = new DataSet();
    da.Fill(ds);
    GridView1.DataSource = ds;
    GridView1.DataBind();
}
protected void image()
{
    foreach (GridViewRow row in GridView1.Rows)
    {
        if (row.RowType == DataControlRowType.DataRow)
        {
            FileUpload fup = row.FindControl("FileUpload1") as FileUpload;
            if (fup.HasFile && fup.PostedFile != null
            && fup.PostedFile.FileName != "")

```



```

{
    string filename = fup.FileName;
    fup.PostedFile.SaveAs(Server.MapPath("~/Uploadimage/") + filename);
    string path = "~/Uploadimage/" + filename.ToString();
    Session["img"] = path;
}
}
}
}

public void video()
{
    foreach (GridViewRow row in GridView1.Rows)
    {
        if (row.RowType == DataControlRowType.DataRow)
        {
            FileUpload fup1 = row.FindControl("FileUpload2") as FileUpload;
            if (fup1.HasFile && fup1.PostedFile != null && fup1.PostedFile.FileName != "")
            {
                string filename1 = Path.GetFileNameWithoutExtension(fup1.FileName);
                Session["filename"] = filename1;
                fup1.PostedFile.SaveAs(Server.MapPath("~/") + filename1);
                string path1 = ("~/") + filename1;
                Session["video"] = path1;
            }
        }
    }
}

protected void btnupload1_Click(object sender, EventArgs e)
{
    image();
    string message = "alert('Image uploaded.')";
    ScriptManager.RegisterClientScriptBlock((sender as Control), this.GetType(), "alert",
    message, true);
}

```

```
}  
protected void btnupload2_Click(object sender, EventArgs e)  
{  
    video();  
    string message = "alert('video uploaded.')";  
    ScriptManager.RegisterClientScriptBlock((sender as Control), this.GetType(), "alert",  
    message, true);  
}  
}
```



CURRICULUM VITAE

SHWAN HADI SAEED

Nationality: Iraq
Place of birth: Erbil
Date of birth: 01 / 03 / 1984
Marital status: Single



EDUCATION

09/ 2015 – 07/ 2017 MCE (Master of Software Engineering), Firat University,
Elazig, Turkey
09/ 2003 – 07/ 2007 Bachelor of Computer Science, Salahaddin University, Iraq
09/ 2000 – 05/ 2003 High School, Rizgary High School Erbil, Iraq
09/ 1997 – 05/ 2000 Intermediate School, Shawes intermediate School Erbil, Iraq

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