

**AL-AHGAFF UNIVERSITY**

**Faculty of Computer Science and Engineering  
Department of Computer Information Systems**



# **Autism Children Technical System (ACTS)**

**A Case of Hadramout Foundation for Autism**

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**Submitted in partial fulfilment of the requirements for the  
award of Bachelor of Science (B.Sc.) in Computer  
Information Systems (CIS)**

**Supervisor**

**Dr. Hamzah Alaidaros**

**June, 2023**

# Certificate

This is to certify that the project entitled

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## **Acknowledgement**

First of all, all praises and great thanks are to Allah, who bestowed us the life of the world and gave us the ability to achieve completion of this project entitled **Autism Children Technical System (ACTS)** developed for Hadramout Foundation for Autism, and peace of Allah be upon our prophet Mohammed.

We are very grateful to our parents for their love, support, and prayers. Special thanks should go to our second father, the president of Al-ahgaff University, **Prof. Abdullah Baharun** and our second family, the Faculty of Computer Science and Engineering. We will not forget **Prof. Dr. Sadiq Maknon**, who has our respect, and we would like to thank our supervisor **Dr. Hamzah Alaidaros** who guided us in preparing and completing this project, as well as for his support to improve our skills in scientific research. Finally, we would like to thank our classmates who kept us in good spirits throughout the study journey.

## **ABSTRACT**

This project attempts to develop ACTS for Hadramout Foundation for Autism. ACTS has been created to overcome all limitations of the manual system, which has a lot of complexities in speed, time, and accuracy. All the aforementioned issues have a negative impact on the management of students enrolled in Hadramout Foundation for Autism. Therefore, ACTS has been developed to solve all the problems of manual systems. These problems were detected throughout meetings with the director of the foundation, and interviewing the end users of the traditional approach in Hadramout Foundation for Autism. The collected data were then analysed and used to design the proposed solution. Then, ACTS has been developed with aiming of overcome the manual systems' challenges. Mainly, ACTS focuses on improving the management of child's performance and goals, as well as the tracking the children together with reporting their status in easily and effective manner.

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# Chapter One

## Introduction

## **1.1 Introduction**

Autism is a spectrum of strongly related disorders with a common core of symptoms. It appears in early childhood, causing delays in several important areas of development like learning to speak, move, and interact with others. Most of autistic children have a learning disability, also known as mental retardation. There are many theories have been proven that the origins of autism may be caused by a genetic susceptibility to an environmental. The children who have autism may look normal, but their behaviour could be downright difficult. The signs and symptoms of autism vary widely in individuals with autism, as do its effects. Some of children have only mild impairments, but others have more obstacles to overcome.

Generally, every child with autism shares problems with each other, at least in these three areas: Relating to others and the world around them, communicating verbally and non-verbally, and behaving and thinking flexibly. The education of autistic children is not limited to school or individual therapies and is a twenty-four-hour process that must be continued in all aspects of life.

This project aims to propose an Autism Children Technical System (ACTS) for Hadramout Foundation for Autism. ACTS can manage the situation of the child on the technical side of the foundation. It enables tracking how the child performs the goal and then evaluates the goal with a description by the teacher. It allows printing monthly and/or annual reports on the stage, that child has reached. This project has been applied on the Hadramout Foundation for Autism, as it is the existing foundation cares on the autism.

### **1.1.1 Hadramout Foundation for Autism**

Hadramout Foundation for Autism was established on 2012 with the aim of training, rehabilitation, education and service of children with special needs and

their families. It aims to implement projects for the rehabilitation and training for autism centres and societies in Hadramout according to the latest educational methods and with the participation of accredited specialists from outside Yemen. The foundation started under the auspices of 50 children with disabilities (autism - down syndrome - learning difficulties). In 2015, the number of children increased to 120, and the number of children joining it reached 197 children and 131 of the educational and administrative cadres worked, and the number of reserve children from those wishing to join the foundation reached more than 200 children. In that time, the foundation was unable to receive them due to lack of the capacity of the current building and the absence of an operational budget. The foundation celebrated the graduation of more than 60 of its children and enrolled in public schools and more than 20 children to qualify the professional to practice their lives normally [1]. Figure 1.1 shows the building of the Hadramout Foundation for Autism.



Figure 1.1: Building of Hadramout Foundation for Autism

Hadramout Foundation for Autism consists of three main departments, in which the employees are distributed, including children and training teams, as follows:

(1) The Department of Autism: which is considered as the largest section.

The foundation has been named by it and includes 153 children.

(2) The Department of Down Syndrome: which includes 20 children.

(3) The Department of Learning Difficulty: which includes 24 children.

## **1.2 Problem Statement**

Bases on the challenges explained in chapter2 the manuals system section, it is clear the Hadramout Foundation for Autism has different problems in managing the autism children. For example, the cost of paper and printing, especially the large number of paper and reports that are spent for children per month. Some of the problems faced are described in the following points:

- The number of children increases with a few in the educational staff, which leads to the employment of one trainer for more than three children, each child with his/her own program.
- The number of child files also increases which are filled with papers of programs and plans.
- Difficulty in accessing child information due to the large number of paper plans.
- Each program and plan for each child is manually written (daily, monthly, and annually).

## **1.3 Study Objective**

This study aims to develop an Autism Children Technical System (ACTS) for Hadramout Foundation for Autism. In particular:

- ACTS transfers the manual management and education system with special needs into an integrated computer system that facilitates the many written and complex written processes for easier operations in dealing with data (programs, plans, child data, etc. ...) and editing them.
- ACTS facilitates the schedule process and evaluate the plans for the trainer.
- ACTS schedules, organizes, and maintains the child programs and plans in a safe manner.
- ACTS displays child data in a simple way (general data, programs, plans).
- ACTS keeps the data of each child in a way that cannot be damaged or lost.

## **1.4 Study Scope**

Hadramout Foundation for Autism consists of two main aspects, technical and administrative. This study focused on the technical aspect, which is the aspect that responsible for train and qualify the child through the use of the portage or other training programs. In addition, the foundation does not have a system for managed the technical aspect. However, this study not focused on the administrative aspect because the foundation already has an electronic system.

## **1.5 Study Significance**

The significance of the current study directed to help the Hadramout Foundation for Autism in managing and training the greatest possible number of children through the use of ACTS. In addition, ACTS has facilitated the work of personnel responsible for the technical component of the Foundation. It also increased the

parents' trust so that detailed reports about the child are submitted to them more quickly and credibly.

## 1.6 Operational Definition

This section defines the different terms used in this study.

- **Performance:** is an exercise or activity that meant to help the child. If the child can't or not good enough in the performance, then the performance assigned to the child as a Goal. Examples: "Count to ten", "Refer to three parts of the body".
- **Goal:** is a performance that assigned to specific child to enhance the child in that performance. If the child is good enough in that goal, then it is marked as completed. The child exercises his/her goals until he/she completes it.
- **Program:** is a collection of performances that enhance the child to perform them. One of the famous programs for children with autism called Portage.
- **Field:** is a category to classify the performances. Examples: "Knowledge", "Speaking", "Movement", "Self-care", "Social".
- **Evaluation:** is a record that describe how a teacher evaluate the child goal and the result of the evaluation. Teachers must describe and write note for how they evaluate the child and what is the result of the evaluation for specific goal.

# **Chapter Two**

## **Existing Systems**

## **2.1 Introduction**

This chapter explains the study background and describes the manual system and then propose the alternative system. After that, it provides different examples of the similar existing systems and highlights their similarities and differences.

## **2.2 Manual System**

When a child registers, the Hadramout Foundation for Autism evaluates the child by set of performances known as Portage program. In Portage program there is collection of performances. the teacher evaluates the child in these performances and each performance is evaluated as either needed or existed. These performances are divided into sets based on child age.

So, the Hadramout Foundation for Autism evaluates the child by the performances that fit into the child age. After completing the evaluation, the teacher creates an annual plan based on the evaluations results. The annual plan has five fields: Knowledge, Speaking, Movement, Self-care, and Social.

In each field there are approximately seven goals to achieve and seven strength performances. Moreover, there is monthly plan driven by annual plan goals. At the end of the month, the Hadramout Foundation for Autism evaluates each goal if child has passed the goal, then next month will be another goal, otherwise the goal will be assigned again in the next month.

In addition, there is form for teachers to describe how they evaluate the children for each goal, to make sure goals evaluated correctly. Figure 2.1 shows a side of the meeting hold with the administration of Hadramout Foundation for Autism.



Figure 2.1: Photos of meeting with Hadramout Foundation for Autism

### 2.3 Proposed System

The proposed system starts after the head of department receives a report on the child's result in the child's performance testing stage. The report contains the child's strengths and weaknesses. Then, the head of department registers the child in the system and adds his/her data together with selecting the performance by displaying a list of the performances in one of the programs that have been

already created by the head of department or the admin before registering any child, such as the Portage program.

Based on the age of the child, the performances assigned to his age displays each performance in the field designated for it, such as the field of communication and other existing and previously created fields. Then, they determine whether the performance is a weakness or strength for the child, and from which the weaknesses turn into goals that the child must perform to become points of strength. Also, the head of department can add special goals and fields that are not previously present in the specified program.

When the head of department finishes registering the child and defining his/her goals, the role of the teacher comes to use the system. The child trains with the teacher and achieves the goal. The teacher evaluates the goal of the child with the addition of the rest of the necessary data for evaluation, including a description of the way the goal works. And whether it needs to be mainstreaming or not, as well as adding notes if they would be applied. The explanation above is on how the system works periodically and at any time. In chapter 4, wireframe technique used to explain the scenario through wireframe webpages interface.

To this point, the role of displaying the goals of the child is highlighted. It is a very important point in order to know the level of the child in each goal, with a page dedicated to displaying all the goals of the child, each goal, whether the child is proficient or continuing in it. Finally, the reports are printed. The teacher or head of department can select a specific date “from – to or all” to display the goals within the specified period, and then a ready-to-print form is presented that contains the student’s plan, goals, and other data.

In ACTS, there are also different pages for users' accounts management, child management, programs management, and fields' management. More discussion on these pages is provided in Chapter 5.

## 2.4 Examples of the Similar Existing Systems

There are systems that focuses on helping children with autism, which produced by specialized companies. These systems do not fully match the specifications of Hadramout Foundation for Autism required. Especially when Hadramout Foundation for Autism treats different special needs, one of which is autism. The following subsections explain some examples of similar systems.

### 2.4.1 Management System of Children with Autism (MSCA)

Management System of Children with Autism (MSCA) is a system based electronic healthcare technologies to care with autistic child. It is centralized database which contains the patients' profiles; the system enables the nurse to access the database and enter details of patients for subject them to a set of tests; then these data held on a database and the system identifies the type of autism to determine the suitable treatment to each type [2]. However, this system does not support Arabic language. It focuses on Autism only. Figure 2.2 shows MSCA layout.



The screenshot shows a Windows application window titled "Patient Management". The main area is a data grid with columns labeled: id, name, age, gender, email, mobile, address, and state. The data grid contains 23 rows of patient information. At the bottom of the grid, there are two buttons: "Add a new patient" and "Edit patient data".

	id	name	age	gender	email	mobile	address	state
►	11	Ammar Majeed	8	male	ammar@yahoo...	07801166554	Karbala	Normal
	12	Ali Hassan	5	male	ali@yahoo.com	07801166987	Hilla	Normal
	13	Mohamed Ab...	6	male	aabood@yahoo...	07806584356	Najaf	Normal
	14	Ahmed Hussain	7	male	Ahmed@yahoo...	07803698412	Basrah	Normal
	15	Iehab Ali	5	male	Iehab@yahoo...	07803697351	Karbala	Normal
	16	Ali Jasim	7	male	jasim@yahoo...	07706598365	Koot	Normal
	17	Hussain Jubair	6	male	hussain@yahoo...	07706598145	Najaf	Normal
	18	Muntadhar M...	4	male	muntadhar@...	07701265985	Karbala	Normal
	19	yousif Naji	5	male	yousif@yahoo...	07801565423	Amerli	Normal
	20	Ali Falah	4	male	falah@yahoo...	07801566914	Najaf	Normal
	21	Hassan Falah	6	male	hassan@yahoo...	07703641265	Karbala	Normal
	22	Ameer Salah	4	male	Ameer@yahoo...	07716984265	Najaf	Normal
	23	cara nazier	5	female	cara@yahoo...	07701236542	Kadhala	normal

Figure 2.2: MSCA System

## 2.4.2 The Autism Management Platform (AMP)

The Autism Management Platform is an application to track student progress in the special education environment. It can be used anywhere by parents or special teachers. AMP's original main goal was to ease the lives of parents of children with autism. Communication amongst those involved in a particular child's life. It was developed by Ryan Thomas Burns, in Chapman University. But this platform does not support Arabic language. And focuses primarily on the mobile front-end interface. Also, focusing only on the events of the child and where did he get, there is no list of students or their teachers. Furthermore, the events are random in each random field.

Moreover, there is no existing goals or events that help to specify the current level of child's performance (depending on the age of the child, determine specific goals). Figure 2.3 shows (AMP) layout.

The screenshot displays the AMP mobile application's user interface for entering a new event. At the top, the AMP logo is visible. Below it, a 'Patient' dropdown menu is set to 'Ace'. To the right, a 'Description' input field contains the text 'Very productive day today'. A 'Recipients' section lists 'Angie Jackson' and 'Derek Jackson'. In the bottom right corner of the description area is a 'Submit' button. Below the recipient list, there are three categories: 'Attachments', 'Milestone', and 'Tags'. Under 'Attachments', there are two entries: 'Image attached' and 'Tantrum Timer attached'. Under 'Milestone', there are two entries: 'Rolling over' and 'Hugging'. Under 'Tags', there are two entries: 'Bedtime' (with a checked checkbox) and 'Snacktime' (with an unchecked checkbox).

Figure 2.3: AMP System

### 2.4.3 Autism Treatment Evaluation Checklist

ATEC is an application made to help other parents of children with autism spectrum disorder and professionals dealing with autistic children. The application is based on the ATEC test from the American Autism Research Institute. The test is used to assess the dynamics of improvements in children with autism or also for initial testing of children who may have an autism spectrum disorder (ASD). Basically, the lower the score, the fewer the problems. But it does not have any security and authentication. Figure 2.4 shows (ATEC) layout.

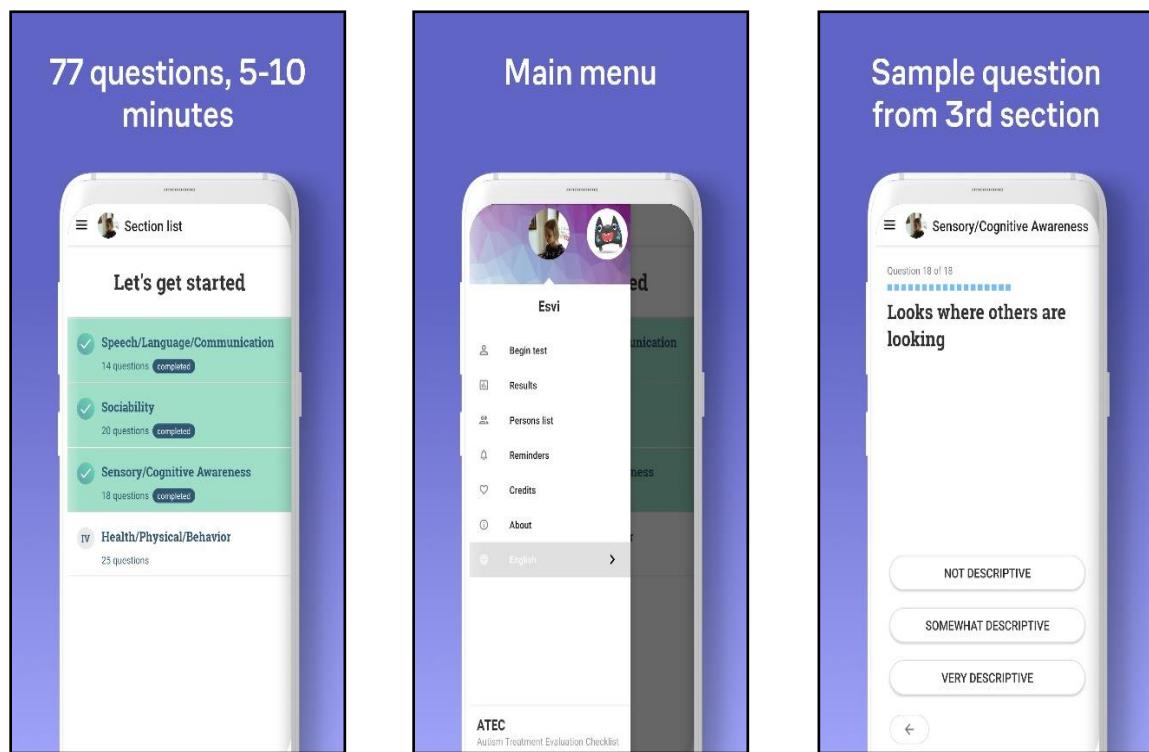


Figure 2.4: ATEC Mobile Application Preview

### 2.4.4 Fast ForWord

Fast ForWord is an application made by Gemm Learning. It has a way of tracking activity remotely making it ideal for home use with remote coaching (Gemm

Learning model) and it is backed by 200+ studies and white papers. They claim to help students with diagnoses some consider fixed or permanent. Fast ForWord does not support Arabic language and it considers strict in term of configuration capabilities. Figure 2.5 shows ForWord layout.

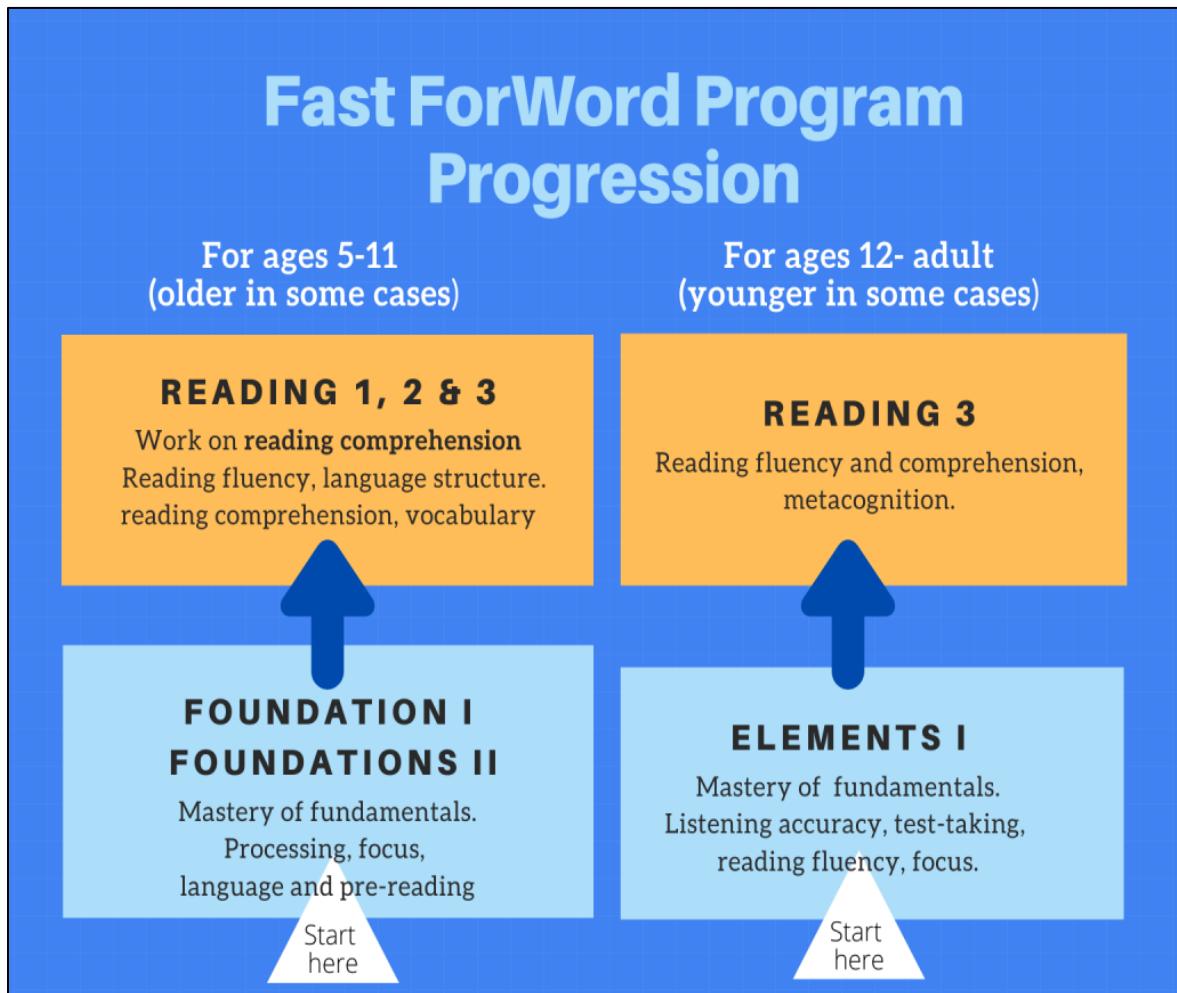


Figure 2.5: Fast ForWord Application Preview

## 2.5 A Comparison between Existing Systems

From Table 2.1, it is clearly that the proposed system matches the requirements of Hadramout Institution for Autism. The proposed system has flexibility and security. In addition, it supports both Arabic and English languages.

**Table 2.1: A Comparison between existing systems**

Existing Systems	Company	System Type	Security	Flexibility	Language Support	Special Needs Support
MSCA	Karbala University	Desktop Application	Yes	No	English	Only Autism
AMP	Chapman University	Mobile Application	Yes	Yes	English	Autism and special needs
ATEC	Zakhar Lobanov	Mobile Application	No	No	Arabic & English	Only Autism
Fast ForWord	Gemm Learning	Mobile Application	No	No	English	Autism and special needs
Proposed System	Our Team	Web Application	Yes	Yes	Arabic & English	Autism and special needs

From the above table, it is clear that the proposed system (ACTS) contains the best features of the existing systems.

# Chapter Three

## Methodology

### **3.1 Introduction**

This section highlights the methodology used to achieve this project's goal. This study employs the Agile approach for its suitability for developing university students' projects. The Agile approach has many methods, which are widely accepted approaches within different organizations due to their multiple benefits over the previously used traditional methods. The common meaning of Agile is to 'move quickly and easily, thus using Agile methods makes the work progresses easily, and projects are delivered in a serialized process rather than at completion [3]. The Global Project Management survey [4] indicates that 71% of the participating organizations report greater agility over the last five years, signifying that agility is recognized in helping them to remain competitive. Moreover, the 12th annual state of the Agile survey shows that most organizations (97%) practice Agile methods [5].

Scrum and Kanban are considered the two powerful Agile methods that handle and manage the progress of software development. These two methods influence different Agile team members and projects in diverse situations, as they can optimize the setting-up of the teams, identify their tasks, and manage the development time efficiently [6]. According to [5] report, 56% of the respondents practice Scrum compared to the other Agile methods. However, various studies confirm that the Kanban method has achieved popularity in recent years as it embraces numerous advantages that help improve project management. Therefore, this study employed the Agile Kanban method, which is explained in the following section.

## **3.2 Agile Kanban**

The concept of Kanban was introduced at Toyota in 1947. This term has originated from a Japanese term denoting 'signboard'. It is a visual process management system that can manage knowledge and work by considering the Just In Time (JIT) delivery approach. The JIT does not require overload team members since the Kanban method focuses on removing bottlenecks and waste and reducing waiting times, which leads to an increase of the throughputs amount [3].

In 2004, David J. Anderson, anticipated the Kanban as a software development method. He is considered the father of Kanban and one of the top leaders behind the movement. He described Kanban as "an approach to incremental, evolutionary process, and systems change for organizations" [7]. The Agile Kanban method can enhance the workflow's understanding, visibility, and control. It can help the management by identifying the bottlenecks during the development process of software projects [3]. This method uses the pull system as the core approach in continuously exposing system process problems and stimulating collaboration to improve the system [7].

### **3.2.1 Kanban Principles and Practices**

Anderson has defined five principles for the Agile Kanban method. These include limiting work in progress (WIP), visualizing workflow, measuring and managing the flow, making process policies explicit, and using models to recognize improvement opportunities [7]. These principles are briefly described.

- a) Limiting WIP: This is a core principle of the Agile Kanban method, defined as the maximum number of tasks for each Kanban board stage. The project

manager commonly identifies it to prevent roadblocks and make tasks move quickly on the board.

- b) Visualizing workflow: This is another core principle of the Kanban method, which is defined as the process of highlighting the mechanisms, interactions, waiting, queues, and delays, which are involved in implementing a part of valuable software.
- c) Measuring and managing the flow: This principle of measuring and controlling flow highlights a focus on keeping work or tasks moving and the need to use the flow as the driver for improvement. The mastering is the focus on flow rather than on waste removal.
- d) Making process policies explicit: This principle reflects the effectiveness and reality of a work that must be well defined to encourage all team members. This is important to ensure that all team members can think about the development process as a group of policies instead of considering workflows as a restricted technique.
- e) Using models to recognize improvement opportunities: The Kanban method adopts the quantitative scientific approach to create improvements.

### **3.2.2 Kanban Board**

The Agile Kanban method has a board that is used to visualize the workflow and monitor the project progress by showing the activities of the development process and keeping the WIP in control [3]. The Kanban board also allows the developers to concentrate on a few tasks. Thus, resources and time waste would be reduced due to switching between the tasks on Kanban board [6]. The Kanban board has two types, which are simple and detailed boards.

Usually, a project manager determines the kind of Kanban board, either a simple or detailed board, based on several criteria, such as the project size, number of tasks, and team members [3]. The simple Kanban board has three stages: To Do, Doing, and Done. However, the detailed Kanban board may have more and different stages. For instance, Backlog, Analysis, Development, Test, and Deployment or Done are stages of the detailed Kanban board.

### 3.2.3 Kanban Steps

- a) Visualize your current workflow.
  - You map the process you currently use to deliver work products to the customer on a visual control board, either physical or digital.
  - Each column represents a step for adding value to a unit's work. Make sure you map every step from conception to delivery to the end consumer.
  - You may optionally have columns in between steps representing necessary "wait states" or buffers.
- b) Apply Work-in-Process (WIP) limits.
  - You implement WIP constraints in Kanban by only allowing a limited number of work units in any given column simultaneously.
  - The exact limit on a column depends on your context, but I have found the best number to be the number of individuals (or pairs) who work in that step.
  - Work does not move into the next step until a space opens up for it.
  - The effect is a system where the end consumer gradually pulls work items through like a vacuum.

c) Make policies explicit.

- Assign different classes of service to different work items. Common classes are "Standard" (FIFO), "Expedite", and "Fixed Date" classes.
- Some classes are allowed to skip to the front of the queue. The idea is that if everything is FIFO, a high cost-of-delay item can get stuck waiting behind a low one just because it arrived later in the line. Or an unanticipated item causes other planned work to stop while you address it.
- If you split demand into classes, while some items may end up with slightly longer lead time, overall, the flow is smoother and more regular.
- We want to increase throughput, but in business, predictability is often worth a slightly longer average lead time. High throughput is less valuable if it is bursty and unpredictable.

d) Manage and measure flow.

- We are optimizing for speed and quality simultaneously. We use cycle time, or its mathematical equivalent, throughput.
- Cycle time is calculated by the average time it takes a unit of work to move through the system.
- Throughput is the number of units that move during a given period.

e) Optimize iteratively with data.

- Make the change, and allow the team to use the board in that configuration for a period of time.
- Measure whether it improves performance, and change it if it doesn't work.

### **3.2.4 Kanban Benefits**

- In the Kanban board, the project managers limited the WIP to assist them in monitoring the progress and make the team members focus on only one task at a specific time.
- Kanban method has better visibility and understanding of the whole development process and effectively controls the workflows and WIP limits.
- Kanban method is a flexible, responsive, and reliable method.
- Agile Kanban method can improve communication and work transparency, customer satisfaction, and team coordination among different stakeholders.
- Kanban helps motivate team members and supports project managers in monitoring all project activities during the development process of software projects [6].

### **3.2.5 Using Kanban in developing ACTS**

In this study, Kanban method has been used to organize team work and to achieve the projects' goals. As shown in Figure 3.1, the team members can easily see what is going on and what others up to do. Even though some members don't have to know what others can do, but this approach clarifies all members' steps and if there is any recommendation by others can be shared right away.

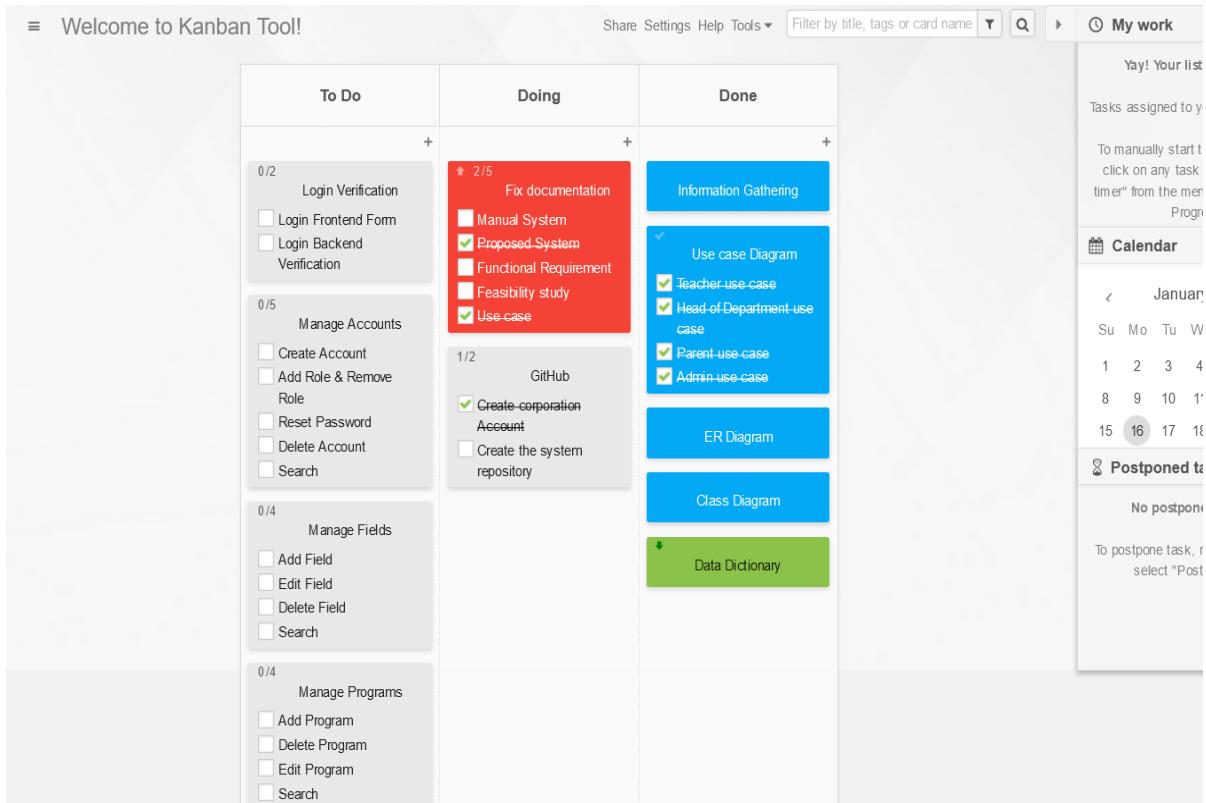


Figure 3.1 Kanban board used during work developing ACTS

### 3.3 Feasibility Study

#### 3.3.1 Economic Feasibility

The developed ACTS is cost-effective in the sense that it has eliminated the paperwork. The system is time effective because the calculations are automated and are made to the user's requirement. The result contains minimum errors and is highly accurate as the data is required. The system uses the current intranet of Hadramout Foundation for Autism.

#### 3.3.2 Operational Feasibility

ACTS is easy to use and learn due to its simple attractive interface. Users do not require special training to operate the system.

### **3.3.3 Technical Feasibility**

Technical feasibility study analyst focuses on the hardware and software requirements, such as suggested input devices that can enter a large amount of data in a specific time. Output devices can produce a large amount of data in a particular time and match output into proper input. It also focuses on the availability of resources required, such as programmer tester. For developing ACTS, all needed technologies currently exist at the foundation, including the local server, and clients.

#### **3.3.3.1 Hardware & software requirement for client:**

ACTS is a web-based application, so it runs on any operating system and device that can run a web browser. Furthermore, ACTS application needs a web browser capable of running Javascript language. But not all browsers run Javascript code. Therefore, we need any web browser that is capable of running Javascript based on EcmaScript specification. Which tells how JavaScript should be implemented by the browser. Example of popular browsers with EcmaScript specification: Chrome, Firefox, Edge, Safari. Each browser has its own hardware and software requirements. So, below is an explanation about Google's Chrome browser, because it is overwhelmingly popular with more than 3.3 billion users.

**a) Chrome browser hardware requirements:**

- **Processor:** 1 gigahertz (GHz) or faster processor or SoC
- **RAM:** 1 gigabyte (GB) for 32-bit or 2 GB for 64-bit
- **Hard disk space:** 16 GB for 32-bit OS or 20 GB for 64-bit OS
- **Graphics card:** DirectX 9 or later with WDDM 1.0 driver

**b) Chrome browser software requirements:**

It's possible that Chrome might install on other platforms or versions not listed here. However, Google enterprise level support is limited to systems that meet the minimum requirements. Google does not provide support if you install Chrome on any system that does not meet the specified criteria.

- **Windows:** To use Chrome browser on Windows, you'll need:
  - Windows 10 or later.
  - Windows Server 2016 or later.
  - An Intel Pentium 4 processor or later that's SSE3 capable.
- **Mac:** To use Chrome browser on Mac, you'll need:
  - macOS High Sierra 10.13 or later.
- **Linux:** To use Chrome browser on Linux, you'll need:
  - 64-bit Ubuntu 18.04+, Debian 10+, openSUSE 15.2+, or Fedora Linux 32+.
  - An Intel Pentium 4 processor or later that's SSE3 capable.
- **Android:** To use Chrome browser on Android, you'll need:
  - Android 7.0 Nougat

### **3.3.3.2 Hardware & software requirement for server:**

The server is the provider for the users. The system is running on the server and the user just request and the server response. The server system requirements aren't a straightforward question to answer as it really depends on a number of factors. Such as expected web traffic and resources the application allocated (CPUs/Memory/Disk space). Therefore, the system requirements are not strict requirements. But for smooth and efficient experience we recommend:

- **Hardware requirements:**

- Windows 10 OS.
- 4 GB RAM.
- 10 GB free space.

- **Software requirements:**

- Web server: Node.Js.
- Database: MySQL.

## **3.4 Requirements Specifications**

In this section, the system requirements specifications are discussed. It is also known as software requirements specifications. For this study, requirements specifications of ACTS consist of:

### **3.4.1 Functional Requirements**

Functional requirements of ACTS explain what must be done by identifying the necessary tasks, actions or activities that must be accomplished. The functional requirements of the system include the following:

- Login: to access the system through the username and password of each account.
- Manage Children:

- Add new child information.
  - Choose a parent for the child.
  - Select child's teachers.
  - View all children information.
  - Search by child information.
  - Report about children progress:
    - i. Filter Report configuration such as yearly, monthly and weekly.
    - ii. Show report result.
    - iii. Print report result.
  - Edit a child information.
  - Delete a child record.
- Manage Programs:
    - Add new program information.
    - Select program's performances.
    - View all programs information.
    - Search by program information.
    - Edit a program information.
    - Delete a program record.
  - Manage Performances:
    - Add new performance information.
    - Choose a performance's Field.
    - Choose a performance's Program.
    - View all performances information.
    - Search by performance information.
    - Edit a performance information.
    - Delete a performance record.

- Manage Goals:
  - Add new goal to child's goals:
    - i. Choose a program, then show a list of performances that in the chosen program. And child age is in the performance's minimum & maximum age. After that, user choose a performance in that list.
    - ii. Create special performance that doesn't belong to a program. Show Add special performance form.
    - iii. Whether a performance is chosen or created as above, the goal's State should be determined either Strength or Continuous.
  - View all goals information. The default should show all goals that have State of Continuous. Or the goal's Assign Date is less than 30 days of current date. Unless specified otherwise.
  - Search by goal information.
  - Report about goals:
    - i. Filter goals within specific period such as yearly, monthly and weekly. Also, filter goals with specific state.
    - ii. Show report result.
    - iii. Print report result.
  - Edit a goal information.
  - Evaluate a goal.
  - Delete a goal record.
- Manage Fields:
  - Add new field information.
  - View all fields' information.
  - Search by field information.
  - Edit a field information.
  - Delete a field record.

- Manage Accounts:
  - Add new account information:
    - i. Assign at least one role such as Teacher or Head of Department...etc.
  - Add & remove role.
  - View all accounts' information.
  - Search by account information.
  - Edit an account information.
  - Add child to parent's children. Parent is an account with parent role.
  - Reset account's password.
  - Delete an account record.
- Manage Evaluations:
  - View all evaluations.
  - Search by evaluation information.
  - Report about evaluations:
    - i. Filter evaluations within specific period such as yearly, monthly, and weekly. Also, filter evaluations by the evaluator.
    - ii. Show report result.
    - iii. Print report result.
  - Edit an evaluation. Teacher can edit his/her evaluations only.
  - Delete an evaluation. Teacher can delete his/her evaluation only.
- Create Backup and Restore.
- Change user language preference.
- Reset user password.

### **3.4.2 Non-Functional Requirements**

Non-functional requirements specify the quality attribute of a software system. It judges the software system based on Responsiveness, Usability, Security, Accuracy and other non-functional standards that are critical to the success of the software system.

#### **a) Security**

Security is essential in ACTS because data is stored in the database. User authorization is applied during login to ensure that only authorized users can access the information. Furthermore, the password is encrypt using hashing, and each user has salt which is random number concatenated to the user password before check. Salts are used to safeguard passwords in storage.

#### **b) Efficient**

The application load time should be less than three seconds for the users; three seconds are acceptable. The programming language used supports asynchronous and non-blocking functions.

#### **c) Usability**

The application's interface has to be user-friendly, easy to use and confident in the user's eyes. We use Angular as frontend, which has User Interface (UI) component library as design material called Angular Material. Angular Material is built based on the W3C recommendation and guidelines.

#### **d) Accuracy**

100% of accuracy is required. The system should provide an accurate real-time report.

# **Chapter Four**

## **System Analysis and Design**

## **4.1 Introduction**

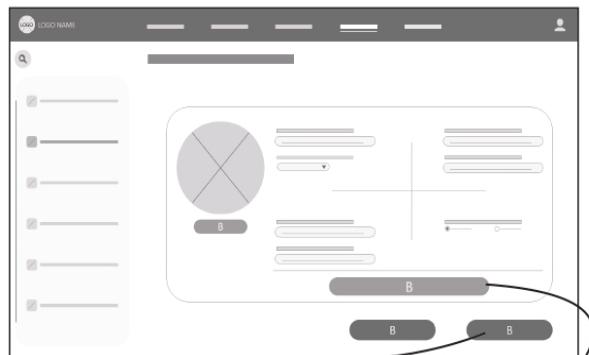
Designing is the essential phase of software development, such that planning and thinking are two necessary techniques before software development. Scheming or planning software means designing how the different parts of the software achieve the target mission, such that if the phase contains any error, then response time and so on. System analysis and design concern the design of (USECASE, ER, CLASS and SEQUENCE Diagrams).

## **4.2 Wireframe**

Wireframe is a diagram or a set of diagrams that consists of simple lines and shapes representing the skeleton of a website or an application's user interface (UI) and core functionality.

1. The head of department registers the child in the system

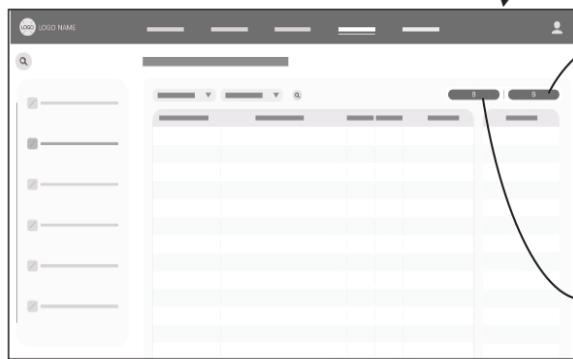
- Register child Page: Adding child's data



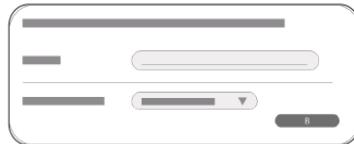
An existing list of performances



- Child's Goals Page: selecting the performance

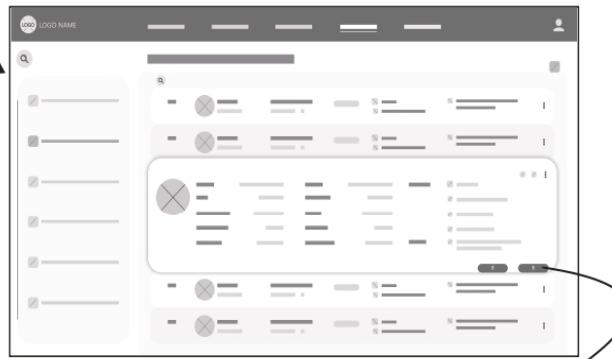


Adding special goal

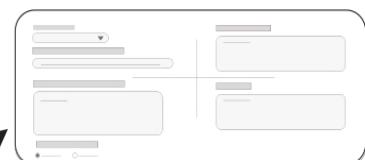
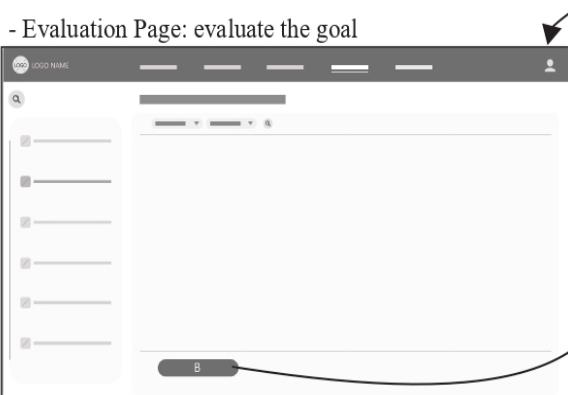


2. The teacher evaluates the goal of the child

- Children Page: list of children that are registered



Select goal,  
and add the necessary data for evaluation



Here are the main information about the child with his goal and the result of the evaluation

- Children Page: list of children that are registered



- List of child's Goals that are managed



- List of child's Evaluated goals



## 4.3 Use Case Diagram

Using case diagram model behaviour within a system helps the developers understand what the user requires.

- The purpose is to show the interactions between the use case and actors.
- To represent the system requirements from the user's perspective.
- An actor could be the system's end-user or an external system.

A use case is a description of a set of sequences of action. It is rendered as an ellipse with a solid line including only its name. A use case diagram is a behavioural diagram that shows a set of use case and actors and their relationships. It is an association between the use cases and actors. An actor represents a real-world object. A use case diagram displays the relationship among actors and use cases. The two main components of a use case diagram are use cases and actors

**Actor:**



A coherent set of roles that users of the use case play when interaction with the use cases.

**Use case:**

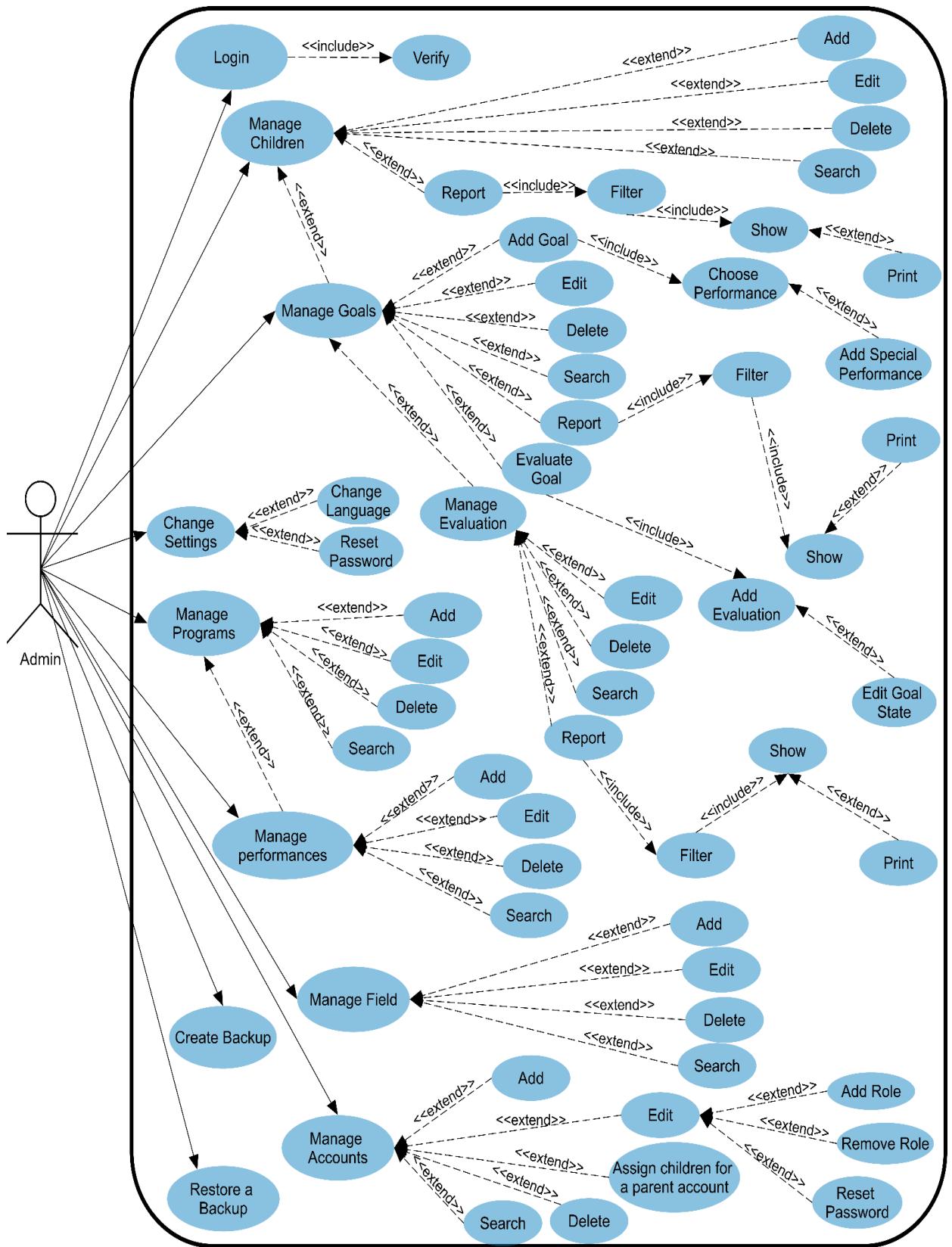


A description of sequences of action including variants that a system performs.

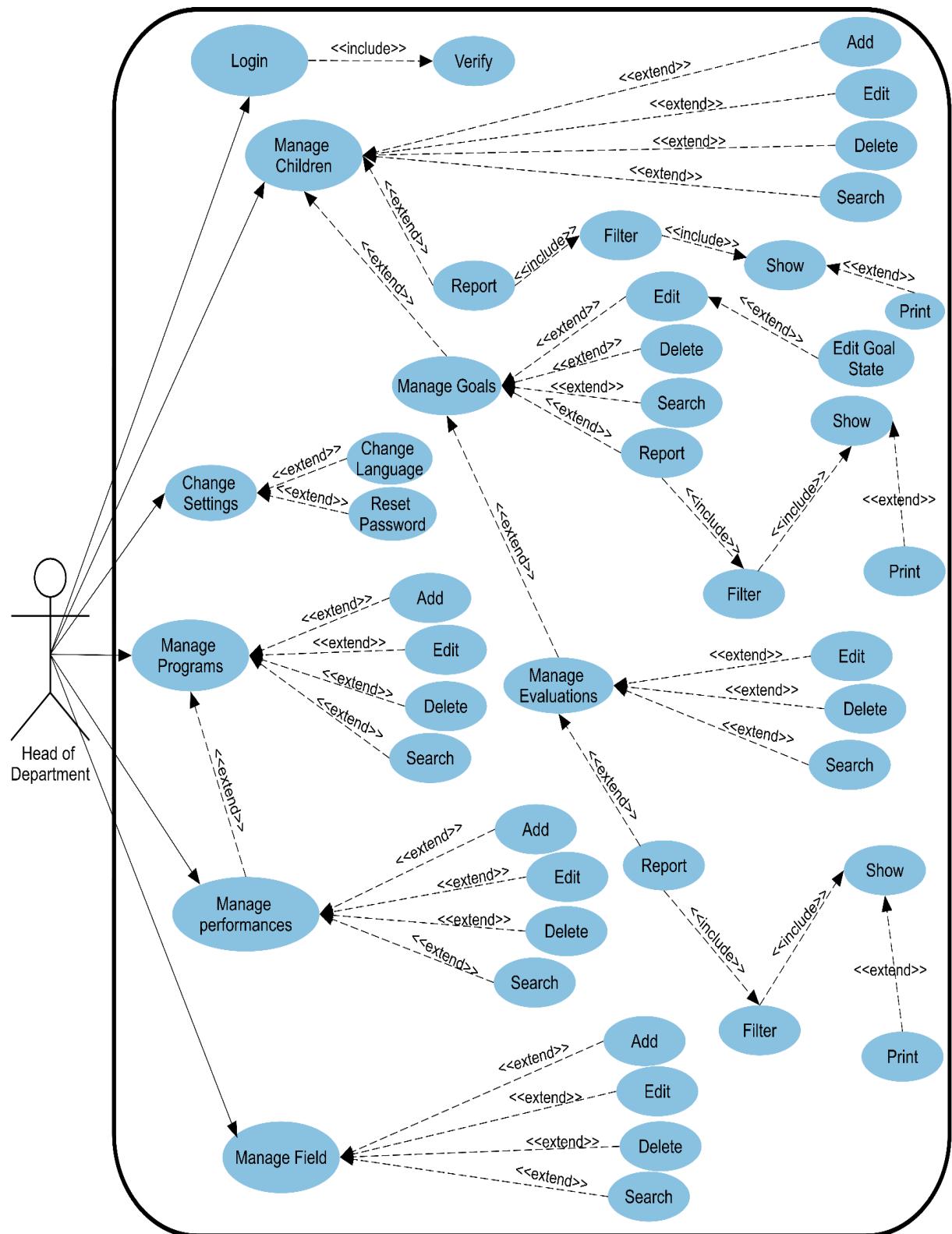
**Boundary:**

A system boundary is a rectangle that you can draw in a use-case diagram to separate the use cases that are internal to a system from the actors that are external to the system.

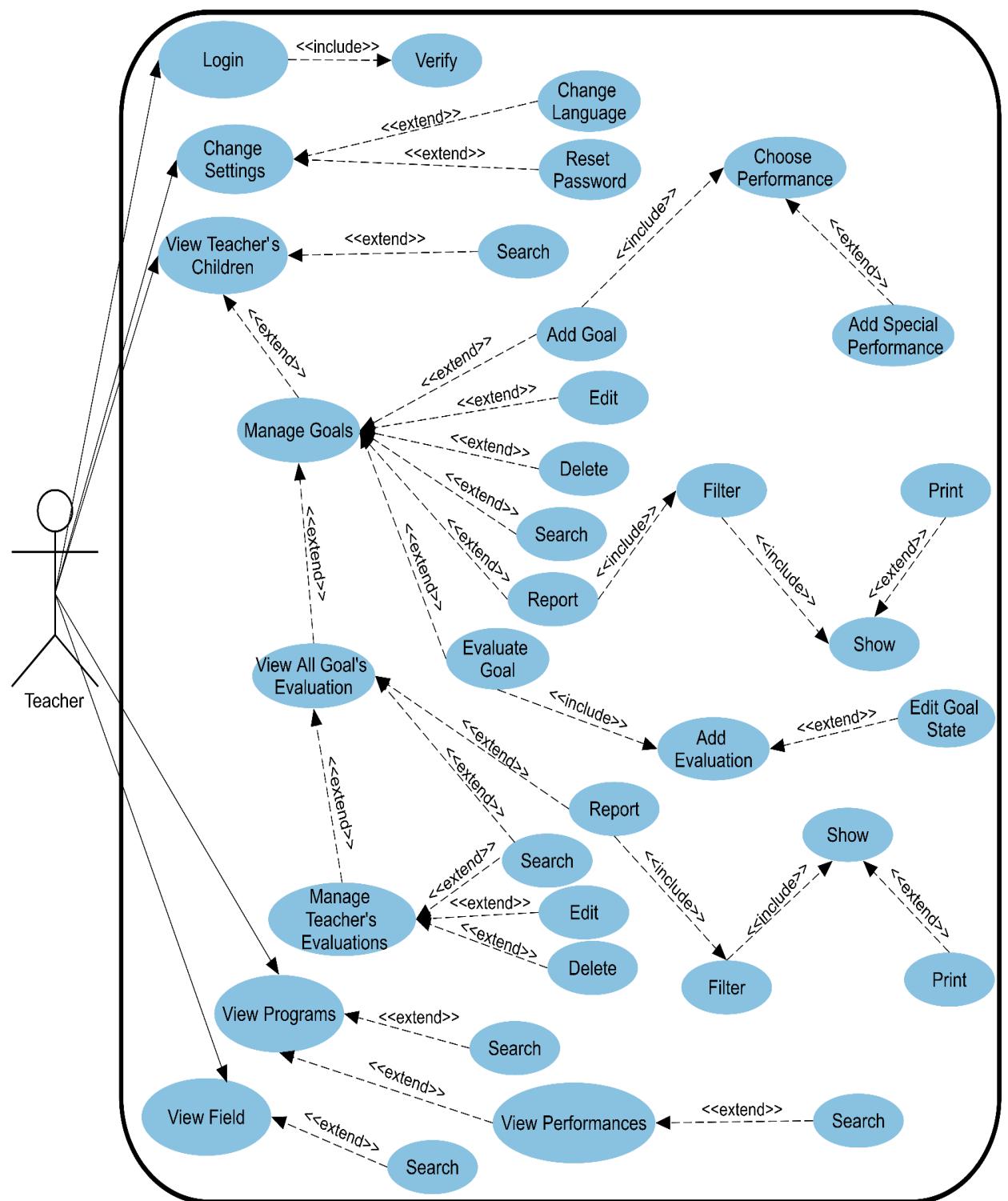
### 4.3.1 Use Case Diagram of Admin



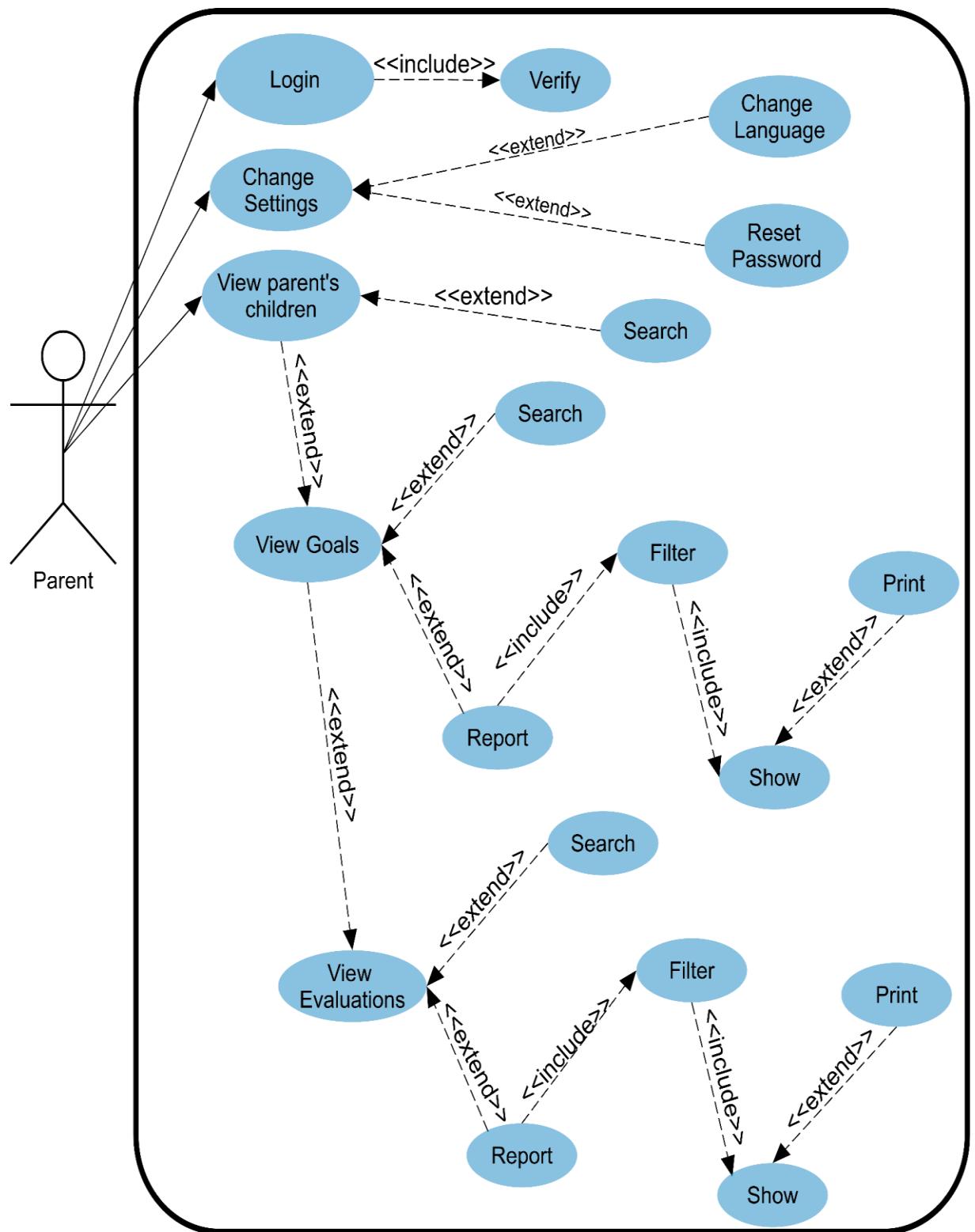
### 4.3.2 Use Case Diagram of Head of Department



### 4.3.3 Use Case Diagram of Teacher



#### 4.3.4 Use Case Diagram of Parent



## 4.4 Use Case Specifications

Use case specification is known as use case description. The Use case specification includes:

- **Brief description:** Summary of use case
- **Pre-conditions:** List all the conditions that must be complete before entering the use case.
- **Characteristic of activations:** This shows how to activate the use case.
- **Basic flow:** Describe the use case as a normal flow.

### 4.4.1 Use case login

- **Brief description:** this use case is entailed by the users. This use case enables the users of the system to explore the system.
- **Pre-condition:** the user must have username and password and must be active.
- **Basic flow:**

Actor	System
1. This use case begins when the user connects to the system.	
	2. The system displays the login form.
3. The user enters the username and password.	
	4. The user clicks login button.
5. The system verify's the entered information. (E-1 username or password is invalid), (A-1 forget password).	
	6. The system shows the main page.

- **Alternative flow: A-1 forget password:** The admin resets the user's password. If admin forget the password, then a technician must fix the problem.
- **Exceptional flow: E-1** username or password is invalid after five times the system prevents user enter username and password for one minute, after that if the user enters invalid username or password the system prevents for 2 minutes, then 4 minutes, and so on in exponential rising.
- **Post condition:** the user has access to the system.

#### 4.4.2 Use case view & manage children

- **Brief description:** The head of department and admin can manage children information by adding, deleting, and editing. All actors can view and search children information. But parent can view and search his/her children. And teacher can view and search his/her teaching children.
- **Pre-condition:** user must login into the system to view and search. But if user has role head of department or admin then he/she can add, edit and delete.
- **Basic flow:**

Actor	System
1. The user selects the option manage / view children.	
	2. The system displays the children page.
3. The user selects the option (A-1 search), (A-2 add child), (A-3 edit), (A-4 delete).	
	4. The system displays information that is needed to be selected.

- **Alternative flow:**
  - **A-1 Search child:**
    - If the user wants to search on children information, the user should click on search button.
    - The user can select the type of search.
    - If the user enters the search keywords.
    - The system collects the search information.
    - The system displays the information.
  - **A-2 Add child:**
    - If the user clicks to add button.
    - The system open add child form.
    - The user should enter valid child information.
    - The system should save information and display successful message.
  - **A-3 Edit child information:**
    - If the user wants to edit child information, the user should select the child to be edited.
    - The user click edit button.
    - The system open edit child form.
    - The user should enter valid child information.
    - The user confirms the information.
    - The system should save updated information and display successful message.

- **A-4 Delete child information:**

- The user should select the child who need to be deleted.
- The system displays child information.
- The user clicks delete button.
- The user can confirm the delete information.
- The system should save change and display successful message.

#### **4.4.3 Use case view & manage goal:**

- **Brief description:** Evaluation record contains evaluation information and how the evaluator evaluate, and we concern on evaluation because Admin and Teacher may change the goal state by evaluating a goal.

The Admin and Teacher only can add and evaluate goal. Adding goal require choosing a performance or create a new one that doesn't belong to a program (Special performance). Goal state should be either Continuous or Strength. Furthermore, evaluate goal means create an evaluation record. Moreover, Admin, Teacher and Head of department can edit and delete a goal. Where only Admin and Head of Department can change goal state directly.

Teacher can edit goal state, but this require evaluating the goal, to explain why the teacher would change goal state. Furthermore, all actors in this use case can view, search, and make report about goals information.

- **Pre-condition:** Choose a child to view his/her goals.

- **Basic flow:**

<b>Actor</b>	<b>System</b>
1. The user selects the option manage goals.	
	2. The system displays the child's goals page.
3. The user selects the option (A-1 search), (A-2 create goal by existing performance), (A-3 create goal by new performance), (A-4 edit a goal), (A-5 delete a goal), (A-6 report) and, (A-7 evaluate a goal).	
	4. The system displays information that is needed to be selected

### **Alternative flow:**

#### **A-1 Search:**

- If the user wants to search goal information, the user should click on search button.
- If the user enters the search keywords.
- The system collects the search information.
- The system displays the information.

- **A-2 Create goal by existing performance:**

- If the user clicks to create goal by existing performance button.
- The system opens the programs list.
- The user selects a program.
- The system opens the program's performances list.
- The user selects a performance and add require and optional goal information.
- The system should save information and display successful message.

- **A-3 Create goal by new performance:**
  - If the user clicks to create goal by adding new performance button.
  - The system open add new performance form.
  - The user should enter valid performance information and add require and optional goal information.
  - The system should save information and display successful message.

- **A-4 Edit goal information:**

**Note:** If the user wants to edit a goal, the goal information only can be edited otherwise the performance information should be edited from Manage Performance page unless the goal is (special goal) which is added by (Create goal by new performance).

- The user should select the goal to be edited.
- The user click edit button.
- The system open edit goal form.
- The user should enter valid goal information.
- The user confirms the information.
- The system should save updated information and display successful message.

- **A-5 Delete goal information:**

**Note:** deleting a goal can lead to delete all evaluation records about that goal. If the goal is achieved, the user should evaluate the goal and change its state to Completed. In the Manage goals page show only goals with Continuous state.

- The user should select the goal that needs to be deleted.
- The system displays goal information.
- The user clicks delete button.
- The user can confirm the delete information.
- The system should save changed and display successful message.

- **A-6 Report child's goals:**

- The user should click the report button.
- The system displays report filter goals configuration (e.g., goals within specific period, and goals with specific state, ...etc).
- The user chooses the appropriate configuration and click display button.
- The system displays the report information.

- **A-7 Evaluate a goal:**

- The user should select the goal to be evaluated.
- The user click evaluate button.
- The system open evaluation form.
- The user enters valid evaluation information.
- The user could change goal state wither change it to Completed or remain Continuous.
- The user confirms the information,
- The system should save information and display successful message.

#### **4.4.4 Use case view & manage evaluations:**

- **Brief description:**

Creating an evaluation is processed in the goal management. Admin and Head of Department can edit and delete all evaluation records. But Teacher can edit and delete his/her own evaluations only. Moreover, all users can view, search and report about evaluations.

- **Pre-condition:**

Select a goal from child's goals.

- **Basic flow:**

Actor	System
1. The user selects the option goal's evaluations.	
	2. The system displays the goal's evaluations page.
3. The user selects the option (A-1 search), (A-2 report), (A-3 edit), (A-4 delete).	
	4. The system displays information that is needed to be selected

- **Alternative flow:**

- **A-1 Search:**

- If the user wants to search an evaluation information, the user should click on search button.
    - If the user enters the search keywords.
    - The system collects the search information.
    - The system displays the information.

- **A-2 Report goal's evaluations:**

- The user should click the report button.
    - The system displays report filter configuration such as evaluations within specific period and who is the evaluator...etc.
    - The user chooses the appropriate configuration and click display button.
    - The system displays the report information.

- **A-3 Edit evaluation information:**

- The user should select the evaluation to be edited.
    - The user click edit button.
    - The system open edit evaluation form.

- The user should enter valid evaluation information.
  - The user confirms the information.
  - The system should save updated information and display successful message.
- 
- **A-4 Delete evaluation information:**
    - The user should select the evaluation that needs to be deleted.
    - The system displays evaluation information.
    - The user clicks delete button.
    - The system shows confirmation message.
    - The user confirms the delete information.
    - The system should save change and display successful message.

#### **4.4.5 Use case view & manage performances**

- **Brief description:**

Performances are assigned for children as goals. Also, performances are grouped into a field. In addition, performances may belong to a program. We say “may” because some performances are created only for specific child. These performances are called Special performance. So, performances can be viewed, searched, and reported by Admin, Teacher, and Head of Department. But performances are edited and deleted by head of department and admin only.

- **Pre-condition:**

Select a program from manage programs page.

▪ **Basic flow:**

<b>Actor</b>	<b>System</b>
1. user click on manage performances page.	
	2. The system displays the performances page.
3. The user selects the option (A-1 search performance), (A-2 add), (A-3 edit), (A-4 delete).	
	4. The system displays information that is needed to be selected

• **Alternative flow:**

▪ **A-1 Search:**

- If the user wants to search a performance, the user enters search keywords.
- The user clicks on search button.
- The system collects the search information.
- The system displays the information.

▪ **A-2 Add performance:**

- If the user clicks to add button.
- The system open add performance form.
- The user should enter valid performance information.
- The system should save information and display successful message.

▪ **A-3 Edit performance:**

- If the user wants to edit performance information, the user should select the performance to be edited.
- The user click edit button.
- The system open edit performance form.
- The user should enter valid performance information.
- The user confirms the information.
- The system should save updated information and display successful message.

- **A-4 Delete performance:**

- The user should select the performance that needs to be deleted.
- The system display performance information.
- The user clicks delete button.
- The user can confirm the delete information.
- The system should save changed and display successful message.

#### **4.4.6 Use case manage programs**

- **Brief description:**

Each program has collection of performances. Head of Department and Admin can add, edit, and delete a program information. All actors in this use case can view and search the programs.

**Pre-condition:**

User must login as teacher, head of department or admin to view and search programs. Furthermore, head of department and admin can add, edit, and delete a program.

- **Basic flow:**

<b>Actor</b>	<b>System</b>
1. user click on manage programs page.	
	2. The system displays the programs page.
3. The user selects the option (A-1 search program), (A-2 add), (A-3 edit), (A-4 delete).	
	4. The system displays information that is needed to be selected

- **Alternative flow:**
- **A-1 Search:**
  - If the user wants to search for a program, the user enters search keywords.
  - The user clicks on search button.
  - The system displays the information.
- **A-2 Add program:**
  - If the user clicks to add button.
  - The system open add program form.
  - The user should enter valid program information.
  - The system should save information and display successful message.
- **A-3 Edit program:**
  - If the user wants to edit program information, the user should select the program to be edited.
  - The user click edit button.
  - The system open edit program form.
  - The user should enter valid program information.
  - The user confirms the information.
  - The system should save updated information and display successful message.
- **A-4 Delete program:**

**Note:** The system won't delete a program that has a performance which is assigned to a child; because of dependency problem, the performance depends on the program. So, the user should be sure the program's performances are not assigned to any child.

- The user should select the program that needs to be deleted.
- The system displays program information.
- The user clicks delete button.
- The user can confirm the delete information.
- The system should save changed and display successful message..

#### **4.4.7 Use case manage field**

- Brief description:**

Each performance must belong to a field. Fields are assigned to performances when they are created and can be edited. And these fields are created, edited, and deleted by Admin and Head of Department only, in a manage field page; to reduce system complexity. All actors in this use case can view and search the fields.

- Pre-condition:**

User must login into the system as admin or head of department to add, edit, delete, view, and search. Or as teacher to view and search only.

- Basic flow:**

<b>Actor</b>	<b>System</b>
1. user click on manage field page.	
	2. The system displays the field page.
3. The user selects the option (A-1 search field), (A-2 add field), (A-3 edit), (A-4 delete).	
	4. The system displays information that is needed to be selected.

- Alternative flow:**

- A-1 Search:**

- If the user wants to search for a field, the user enters search keywords.
    - The user clicks on search button.
    - The system collects the search information and display successful message.

- A-2 Add field:**

- If the user clicks to add button.
    - The system open add field form.

- The user should enter valid field name.
- The system should save information and display successful message.
- **A-3 Edit field:**
  - If the user wants to edit field information, the user should select the field to be edited.
  - The user click edit button.
  - The system open edit field form.
  - The user should enter valid field name.
  - The user confirms the information.
  - The system should save updated information and display successful message.
- **A-4 Delete field:**
  - The user should select the field that needs to be deleted.
  - The system displays field name.
  - The user clicks delete button.
  - The user can confirm the delete information.
  - The system should save changed and display successful message.

#### **4.4.8 Use case manage account:**

- **Brief description:**

Each user should be one of four: Admin, Head of Department, Teacher, and Parent. Each one has specific privilege and permission on the system. Account page is sensitive and secure page that should only be accessed by the Admin. The Admin can add, edit, and delete user information. Also, reset a user password, and add or remove role. So, that a head of department can works as a teacher. This can make the system more flexible.

- **Pre-condition:**

User must login into the system as an Admin.

- **Basic flow:**

<b>Actor</b>	<b>System</b>
1. User clicks on manage accounts page.	
	2. The system asked for password.
3. The user enters password.	
	4. The user clicks login button.
5. The system verifys the entered information. (E-1 password is invalid).	
	6. The system displays accounts page.
3. The user selects the option (A-1 search), (A-2 add account), (A-3 edit), (A-4 delete), (A-5 reset an account password), (A-6 add or remove role), (A-7 Assign children to a parent).	
	4. The system displays information that is needed to be selected.

- **Alternative flow:**

- **A-1 Search:**

- If the user wants to search for an account, the user enters search keywords.
- The user clicks on search button.
- The system collects the search information.
- The system displays the information.

- **A-2 Add account:**

- If the user clicks to add button.
- The system open add account form.
- The user should enter valid account information.
- The system should save information and display successful message.

- **A-3 Edit account:**

- If the user wants to edit account information, the user should select the account to be edited.
- The user click edit button.
- The system open edit account form.
- The user should enter valid account information.
- The user confirms the information.
- The system should save updated information and display successful message.

- **A-4 Delete account:**

**Note:** deleting teacher account may cause some dependency problem, because there may be some evaluations made by the teacher account. So, be careful when deleting teacher account. Because all evaluations made by that account can have empty evaluated by.

- The user should select the account that needs to be deleted.
- The system displays account information.
- The user clicks delete button.
- The user can confirm the delete information.
- The system should save changed and display successful message.

- **A-5 Reset account password:**

- If the user wants to reset account password, the user should select the account.
- The user click reset button.
- The system opens new password form.
- The user should enter valid password.
- The user confirms the information.
- The system should save updated information and display successful message.

- **A-6 Add or remove a role:**

- If the user wants to add or remove role, the user should select the account.

- The user clicks add/remove button.
  - The system opens role list.
  - The user selects the role.
  - The user confirms the operation.
  - The system should save updated information and display successful message.
- **A-7 Assign children to a parent:**
- If the user wants to add/remove a child to a parent, user should select the account with parent role.
  - The user clicks add/remove child button.
  - The system opens parent's children list.
  - The user selects the child.
  - The user confirms the operation.
  - The system should save updated information and display successful message.
- **Exceptional Flow:**
- **E-1** Password is invalid after five times the system prevents the user to enter the password for one minute, after that if the user enters invalid username and password the system prevents for 2 minutes, then 4 minutes, and so on in exponential rising.

#### **4.4.9 Use case Backup & Restore:**

- **Brief description:**

Backup is essential to save the system data from a disaster such as disk failure. So, backup saves all data in desired location. So that the user can store multiple backups to different disks. To restore data the user should specify the backup that location.

- **Pre-condition:**

User must login into the system as admin.

- **Basic flow:**

<b>Actor</b>	<b>System</b>
1. The user clicks on backup button.	
	2. The system displays Save As window.
3. The user specify the location path of the backup.	
	4. The system save the backup data in the specified location.
5- The user clicks on restore button.	
	6- The system displays Open File window.
7- The user specifies the backup location.	
	7- The system reset data to the specified backup data.

#### **4.4.10 Use case change language**

- **Brief description:**

English language is essential to gain popularity especially in software industry. So, our program supports Arabic & English language.

- **Basic flow:**

<b>Actor</b>	<b>System</b>
1. The user clicks on settings button.	
	2. The system displays settings board.
3. The user choose prefer language.	
	4. The system reload the page with user's preferred language. 5- The system saves user language preference. So that all pages are loaded with user preferred language.

#### **4.4.11 Use case change password**

- Brief description:**

Because our system does not allow users to register for security reasons. When an admin creates an account, the password can be whatever admin decided. But the user should have an option to change the password to what the user wants. So, user after login can change the account password with what the user prefers not the administrator. To change the password the user should provide the old password and the new password for security reasons.

- Pre-condition:**

User must login into the system.

- Basic flow:**

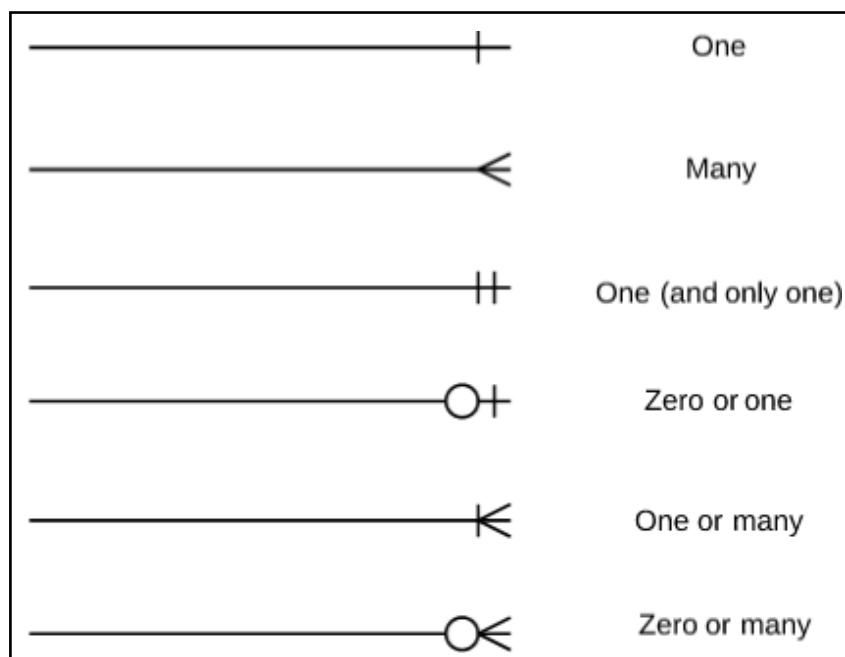
<b>Actor</b>	<b>System</b>
1. The user clicks on settings button.	
	2. The system displays settings board.
3. The user click change password button.	
	4. The system displays a form for the old and new password.
5. The user enter the old and new password.	
	6. The system validate the old password (E-1 old password is invalid). 7. The system saves change and display successful message.

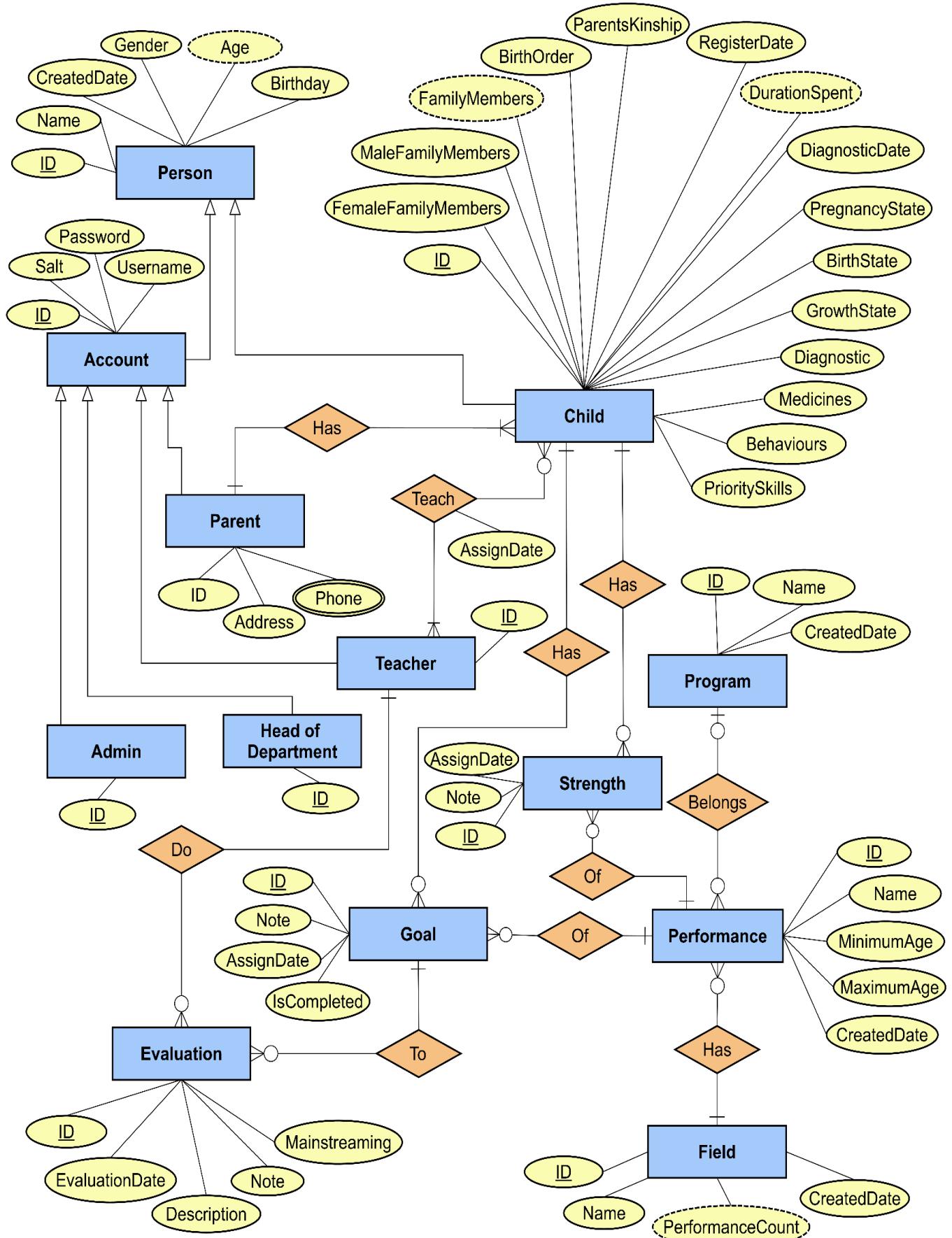
- Exceptional flow:**

- E-1** The system shows error message.

## 4.5 Entity Relationship (ER) Diagram

An ER diagram shows the relationship among entity sets. An entity set is a group of similar entities, and these entities can have attributes. In terms of DBMS, an entity is a table or attribute of a table in the database, so by showing the relationship among tables and their attributes, ER diagram shows the complete logical structure of a database.





## 4.6 Sequence Diagram

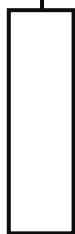
The sequence diagram demonstrates the behaviour of objects in the use case by describing the objects and the messages they exchange. The diagram is read from left to right and descending. A sequence diagram is an introduction that emphasizes the time ordering of the message.

Sequence diagram elements:

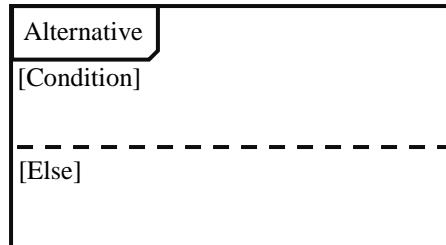
- Object



- Lifeline



- Alternative



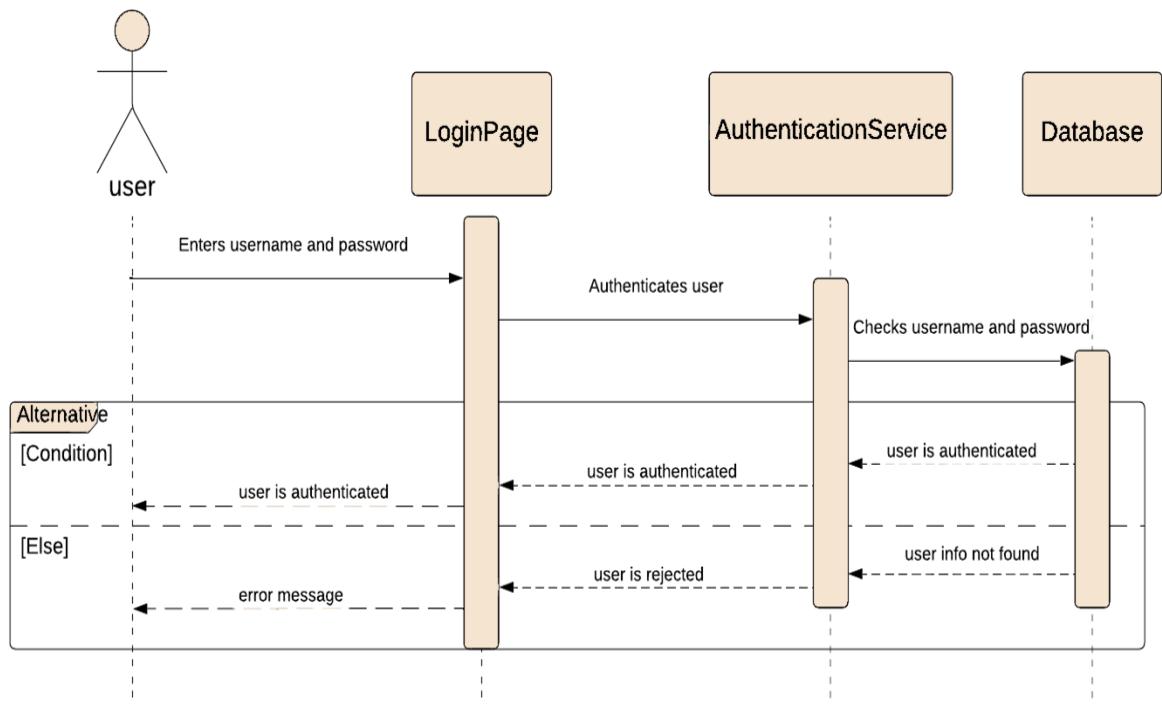
- Message



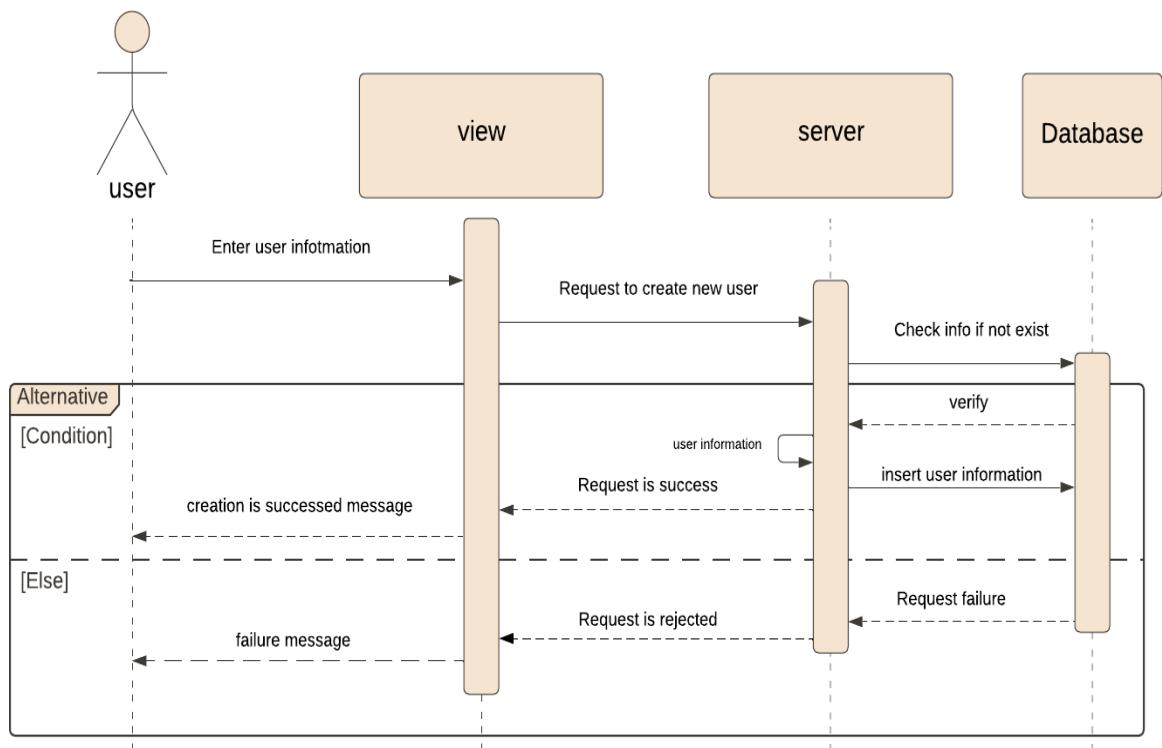
- Return message



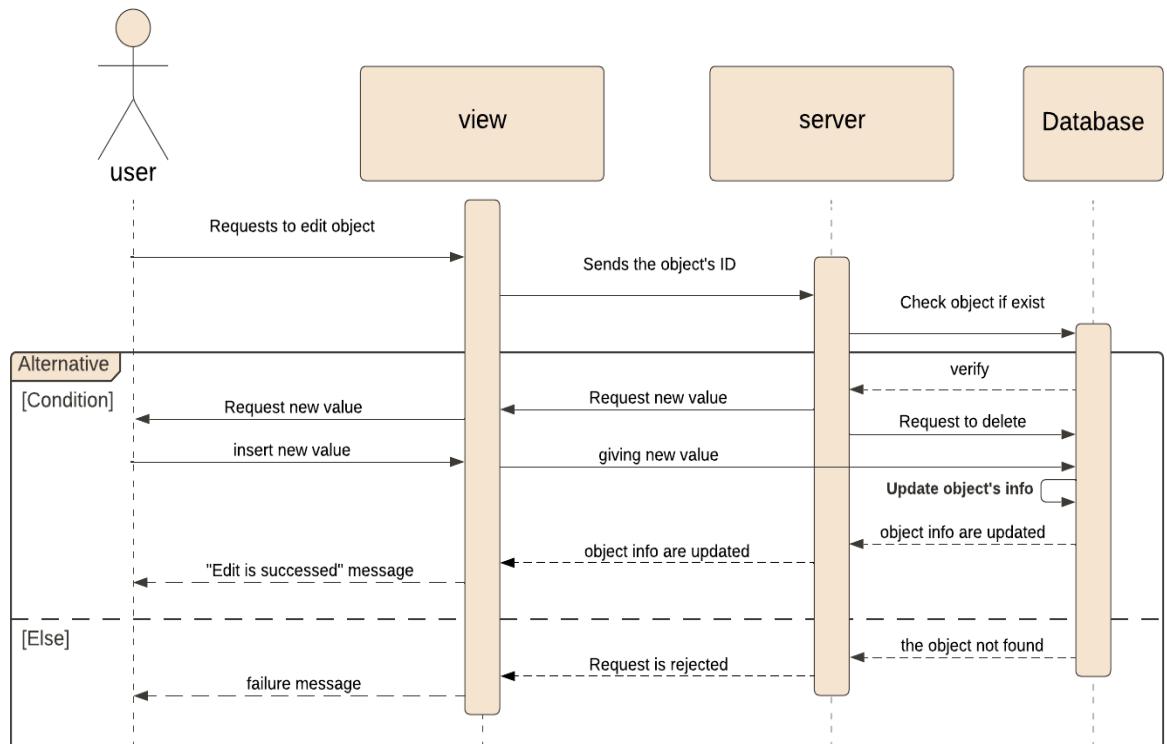
#### 4.6.1 Sequence Diagram of Login



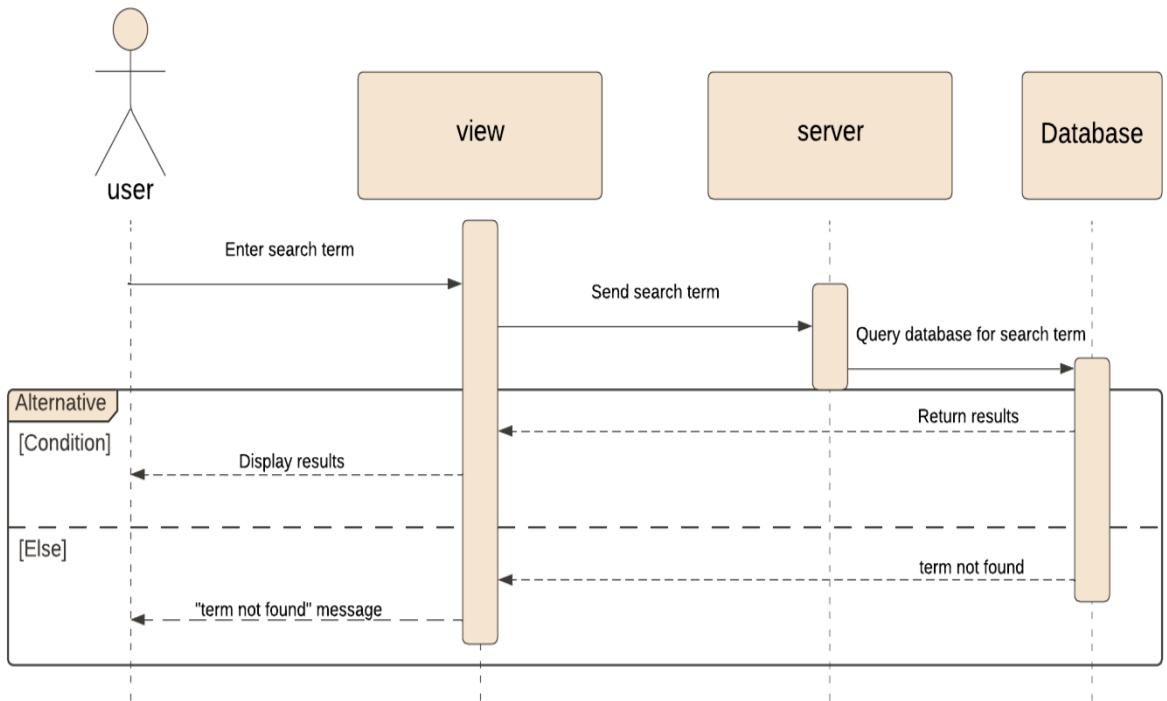
#### 4.6.2 Sequence Diagram of Creating



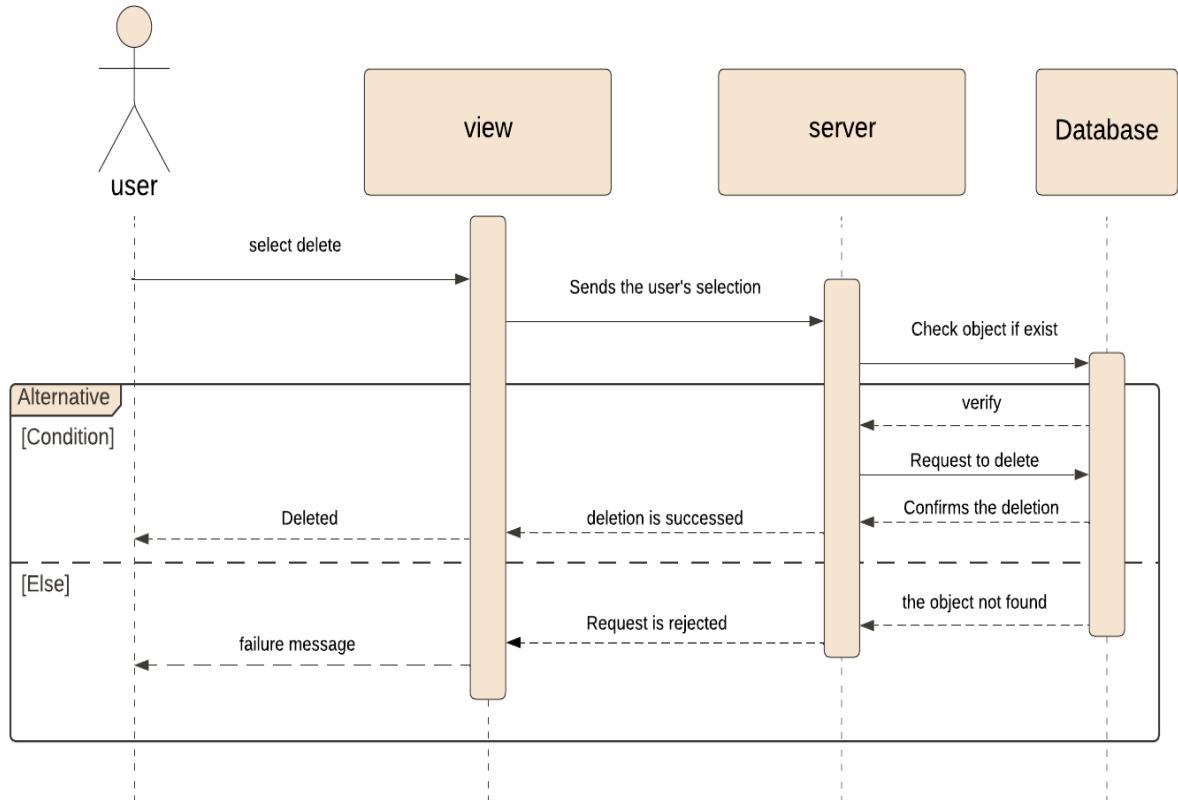
### 4.6.3 Sequence Diagram of Editing



### 4.6.4 Sequence Diagram of Searching

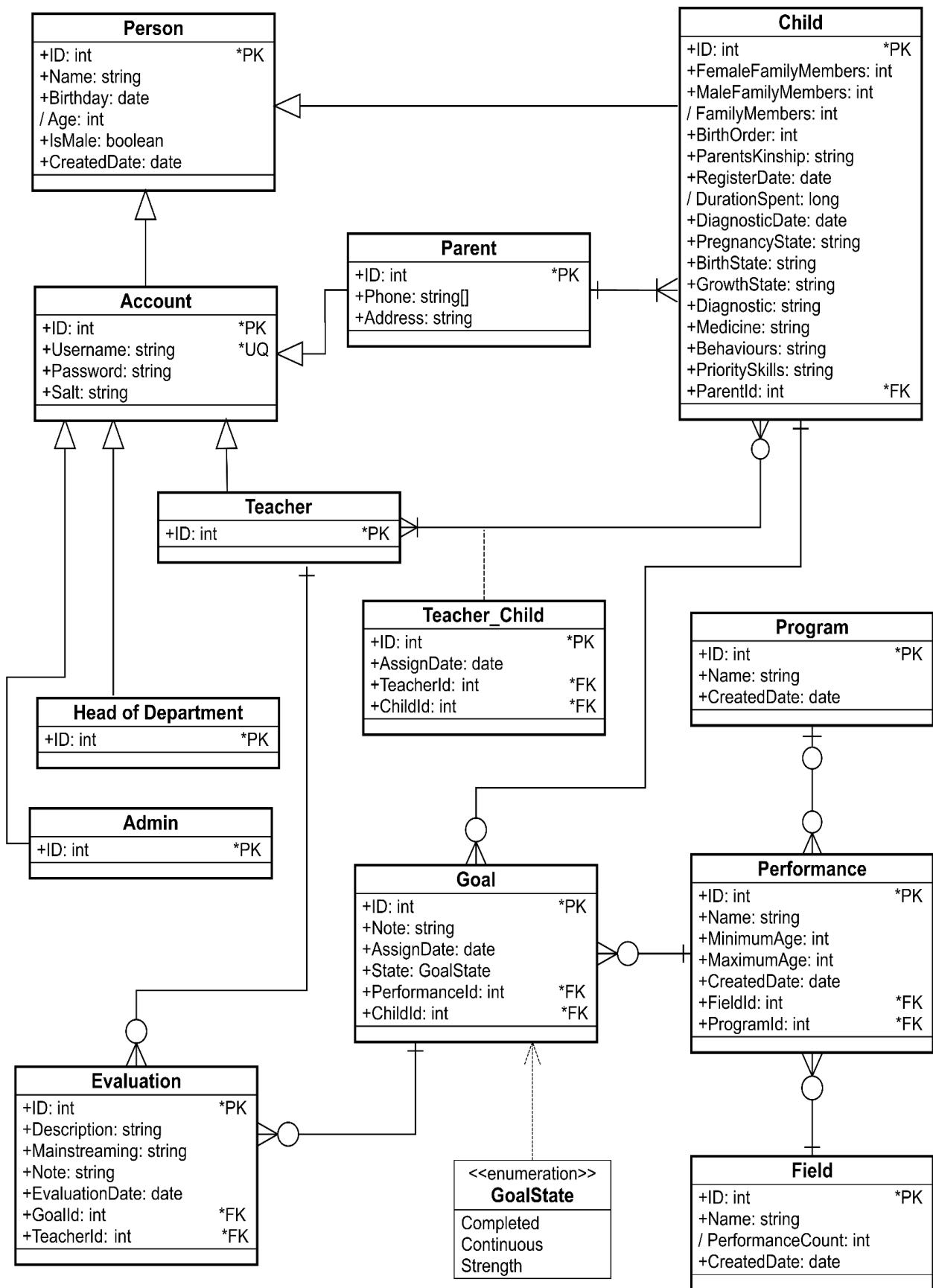


#### 4.6.5 Sequence Diagram of Deleting



#### 4.7 Class Diagram

A class diagram is a static model that shows the classes and the relationships among classes that remain constant in the system over time. The class diagram depicts classes, including behaviours and states, with the relationships between the classes.



## 4.8 Data Dictionary

### 1- Person Table

Key	Field Name	Data Type	Nullable	Description
PK	ID	int	Not null	Unique ID
	Name	nvarchar(50)	Not null	Name of the person
	Birthday	date	Allow null	Birthday of the person
	IsMale	boolean	Allow null	To determine the person gender
	CreatedDate	date	Not null	When this record created

### 2- Parent Table

Key	Field Name	Data Type	Nullable	Description
PK	ID	int	Not null	Unique ID
	Phone	nvarchar(50)	Allow null	Phone number
	Address	nvarchar(50)	Allow null	Home address
FK	AccountId	int	Not null	Unique account's ID

### 3- Teacher Table

Key	Field Name	Data Type	Nullable	Description
PK	ID	int	Not null	Unique ID
FK	AccountId	int	Not null	Unique account's ID

#### 4- Head of Department Table

<b>Key</b>	<b>Field Name</b>	<b>Data Type</b>	<b>Nullable</b>	<b>Description</b>
PK	ID	int	Not null	Unique ID
FK	AccountId	int	Not null	Unique account's ID

#### 5- Admin Table

<b>Key</b>	<b>Field Name</b>	<b>Data Type</b>	<b>Nullable</b>	<b>Description</b>
PK	ID	int	Not null	Unique ID
FK	AccountId	int	Not null	Unique account's ID

#### 6- Teacher\_Child Table

<b>Key</b>	<b>Field Name</b>	<b>Data Type</b>	<b>Nullable</b>	<b>Description</b>
PK	ID	int	Not null	Unique ID
	AssignDate	date	Not null	When teacher become the child teacher. Default is now
FK	TeacherId	int	Not null	The child teacher's ID
FK	ChildId	int	Not null	The teacher child's ID

#### 7- Program Table

<b>Key</b>	<b>Field Name</b>	<b>Data Type</b>	<b>Nullable</b>	<b>Description</b>
PK	ID	int	Not null	Unique ID
	Name	nvarchar(50)	Not null	Program name
	CreatedDate	date	Not null	When this record created

## 8- Child Table

<b>Key</b>	<b>Field Name</b>	<b>Data Type</b>	<b>Nullable</b>	<b>Description</b>
PK	ID	int	Not null	Unique ID
	Female Family Members	int	Allow null	how many female family members
	Male Family Members	int	Allow null	How many male family members
	BirthOrder	int	Allow null	The child order between his/her brothers and sisters
	ParentsKinship	nvarchar(256)	Allow null	How the parents related to each other
	RegisterDate	date	Not null	When the child registered. Default is now
	DiagnosticDate	date	Allow null	When the child symptoms appear
	PregnancyState	nvarchar(256)	Allow null	The state of the child pregnancy
	BirthState	nvarchar(256)	Allow null	The state of the childbirth
	GrowthState	nvarchar(256)	Allow null	The state of the child growth
	Diagnostic	nvarchar(256)	Allow null	Diagnostic description
	Medicine	nvarchar(256)	Allow null	Medicines the child use
	Behaviors	nvarchar(512)	Allow null	A description of child behaviors
	PrioritySkills	nvarchar(512)	Allow null	skills the child need it
FK	ParentId	int	Not null	The child parent's ID
FK	PersonId	int	Not null	Unique person's ID

## 9- Performance Table

<b>Key</b>	<b>Field Name</b>	<b>Data Type</b>	<b>Nullable</b>	<b>Description</b>
PK	ID	int	Not null	Unique ID
	Name	nvarchar(256)	Not null	Short description of the performance
	MinimumAge	int	Allow null	Minimum child age that can perform
	MaximumAge	int	Allow null	Maximum child age that can perform. Maximum age should be less than minimum
	CreatedDate	date	Not null	When this record created
FK	FieldId	int	Not null	The performance field's ID
FK	ProgramId	int	Not null	Which program the performance belongs

## 10- Goal Table

<b>Key</b>	<b>Field Name</b>	<b>Data Type</b>	<b>Nullable</b>	<b>Description</b>
PK	ID	int	Not null	Unique ID
	Note	nvarchar(512)	Allow null	A note of the goal
	AssignDate	date	Not null	When the goal assigned to the child
	State	int	Not null	Whether the goal is Strength, Continuous or Completed. These states are saved as number in database
FK	PerformanceId	int	Not null	The goal performance's ID
FK	ChildId	int	Not null	The goal child's ID

## 11- Evaluation Table

<b>Key</b>	<b>Field Name</b>	<b>Data Type</b>	<b>Nullable</b>	<b>Description</b>
PK	ID	int	Not null	Unique ID
	Description	nvarchar(512)	Not null	A description of how the evaluation performed by the teacher
	Mainstreaming	nvarchar(512)	Allow null	How the teacher adjusts the evaluation process
	Note	nvarchar(512)	Allow null	A note of the evaluation process
	EvaluationDate	date	Not null	When the evaluation happened. Default is now
FK	GoalId	int	Not null	The evaluation goal's ID
FK	TeacherId	int	Not null	The evaluator ID

## 12- Account Table

<b>Key</b>	<b>Field Name</b>	<b>Data Type</b>	<b>Nullable</b>	<b>Description</b>
PK	ID	int	Not null	Unique ID
	Username	nvarchar(32)	Not null	Used to login
	Password	char(64)	Not null	Hashed password in hexadecimal format
	Salt	char(64)	Not null	Random hexadecimal number used to validate password more securely
FK	PersonId	int	Not null	Person's unique ID

# **Chapter Five**

## **System Development and Implantation**

## 5.1 Introduction

This chapter focuses on the design and development of user interfaces (UI) for ACTS, and covers various techniques and technologies used in the development of ACTS.

It provides an overview of the most commonly used programming languages, frameworks, and libraries, then shows the user interfaces of ACTS which is the point of interaction between a user and a computer program, and it plays a critical role in determining the user's experience with the system.

## 5.2 Used Techniques

In this study, four techniques were used to develop ACTS. The techniques, which are Node.Js, Angular, MySQL, and Nest.js, are explained in the following subsections.

### 5.2.1 Node.Js

Node.Js is an open-source, cross-platform JavaScript runtime environment and library for running web applications outside the client's browser. Node.Js has numerous features as explained below [8].

- **Asynchronous and Event Driven** – All APIs of Node.Js library are asynchronous, that is, non-blocking. It essentially means a Node.Js based server never waits for an API to return data. The server moves to the next API after calling it and a notification mechanism of Events of Node.Js helps the server to get a response from the previous API call.
- **Very Fast** – Being built on Google Chrome's V8 JavaScript Engine, Node.Js library is very fast in code execution.
- **Single Threaded but Highly Scalable** – Node.Js uses a single threaded model with event looping. Event mechanism helps the server to respond in

a non-blocking way and makes the server highly scalable as opposed to traditional servers which create limited threads to handle requests. Node.Js uses a single threaded program and the same program can provide service to a much larger number of requests than traditional servers like Apache HTTP Server.

- **No Buffering** – Node's applications never buffer any data. These applications simply output the data in chunks.

### 5.2.2 Nest.js

Nest.js is one of the fastest-growing Node. js frameworks for building efficient, scalable, and enterprise-grade backend applications using Node.Js. It is known for producing highly testable, maintainable, and scalable applications using modern JavaScript and TypeScript [9]. In this project, Nest.js has been chosen due to the following features:

- Nest.js is easy to learn and master, especially for developers coming from the Angular world
- The framework is known for having a great architectural structure for enterprise applications right out of the box, which makes building highly scalable and maintainable enterprise applications a breeze.
- You can build backend services ranging from RESTful APIs, GraphQL applications, MVC applications, Web sockets, CLI, and Cron jobs with Nest.js with ease. Some of the standard architecture is already built into the Nest.js framework.
- Because Nest.js uses modern technologies such as TypeScript, bullet-proof architectural patterns, excellent documentation, and easy unit testing, you can build scalable and maintainable enterprise-ready applications.

- Nest.js is created for building large-scale monolith and microservices applications in which the architecture is already handled, and you only need to build out your business logic.
- Nest.js supports and provides large community-based, nest-supported modules to build out any specific feature of your choice, from concepts like TypeORM, Mongoose, and GraphQL to logging, validation, caching, WebSockets, and much more

### 5.2.3 Angular

Angular is TypeScript. Google maintains it, and its primary purpose is to develop single-page applications. As a framework, Angular has clear advantages while also providing a standard structure for developers to work with [10]. Angular has different characteristics such as:

- **Document object Model** – Document Object Model (DOM) treats an XML or HTML document as a tree structure in which each node represents a part of the document. Angular uses regular DOM. Consider that ten updates are made on the same HTML page. Instead of updating the ones that were already updated, Angular will update the entire tree structure of HTML tags.
- **TypeScript** – TypeScript defines a set of types to JavaScript, which helps users write JavaScript code that is easier to understand. All of the TypeScript code compiles with JavaScript and can run smoothly on any platform. TypeScript is not compulsory for developing an Angular application. However, it is highly recommended as it offers better syntactic structure—while making the codebase easier to understand and maintain
- **Data Binding** – Data binding is a process that enables users to manipulate web page elements through a web browser. It employs dynamic HTML

and does not require complex scripting or programming. Data binding is used in web pages that include interactive components, such as calculators, tutorials, forums, and games. It also enables a better incremental display of a web page when pages contain a large amount of data. Angular uses the two-way binding. The model state reflects any changes made in the corresponding UI elements. Conversely, the UI state reflects any changes in the model state. This feature enables the framework to connect the DOM to the model data through the controller.

- **Testing** – Angular uses the Jasmine testing framework. The Jasmine framework provides multiple functionalities to write different kinds of test cases. Karma is the task-runner for the tests that uses a configuration file to set the start-up, reporters, and testing framework. Now that you're familiar with Angular's basic features, you need to understand its architecture if you want to work with Angular daily. You can also expand your Angular knowledge by taking the Angular Certification Training Course and learning concepts such as TypeScript, Bootstrap Grid System, dependency injections, SPA, forms, pipes, promises, observables, and Angular class testing.

#### 5.2.4 MySQL

MySQL is a relational database management system. The database structure is organized into physical files optimized for speed. The logical data model, with objects such as data tables, views, rows, and columns, offers a flexible programming environment [11]. The selection of MySQL was due to the following features:

- **Ease of use** – Developers can install MySQL in minutes, and the database is easy to manage.

- **Reliability** – MySQL is one of the most mature and widely used databases. It has been tested in a wide variety of scenarios for more than 25 years, including by many of the world's largest companies. Organizations depend on MySQL to run business-critical applications because of its reliability.
- **Scalability** - MySQL scales to meet the demands of the most accessed applications. MySQL's native replication architecture enables organizations (e.g. Facebook) to scale applications to support billions of users.
- **Performance** – MySQL HeatWave is faster and less expensive than other database services, as demonstrated by multiple standard industry benchmarks, including TPC-H, TPC-DS, and CH-benCHmark.
- **High availability** – MySQL delivers a complete set of native, fully integrated replication technologies for high availability and disaster recovery. For business-critical applications, and to meet service-level agreement commitments, customers can achieve.
- **Security** – MySQL Enterprise Edition provides advanced security features, including authentication/authorization, transparent data encryption, auditing, data masking, and a database firewall.
- **Flexibility** – The MySQL Document Store gives users maximum flexibility in developing traditional SQL and NoSQL schema-free database applications. Developers can mix and match relational data and JSON documents in the same database and application.

### 5.3 ACTS Interfaces

Figure 5.1 shows the login page, whereby user can submit the username and password to use the ACTS. New users of ACTS can be added by admin.

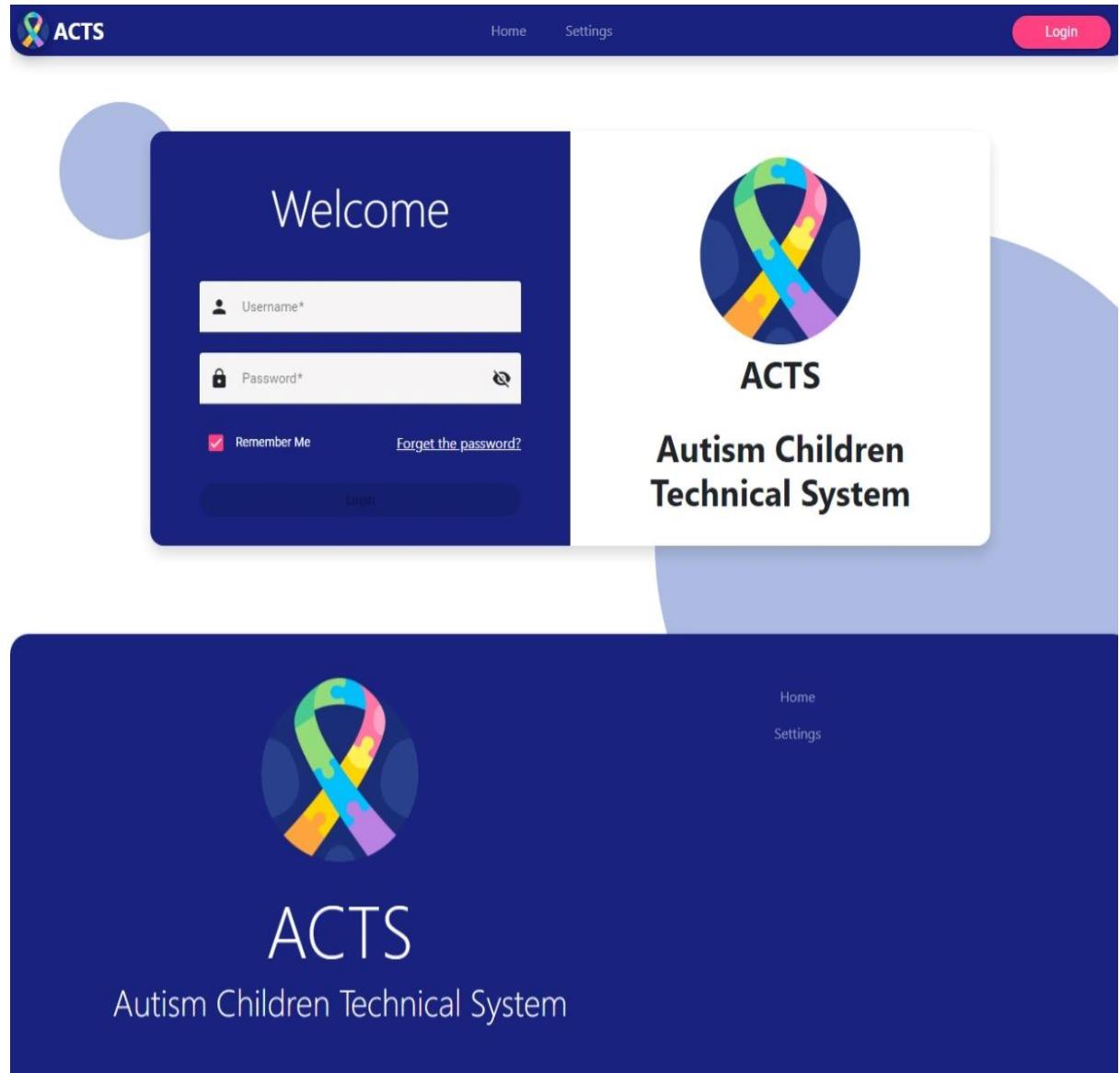


Figure 5.1: Login Page

Figure 5.2 depicts the home page, which contains a video about how to use ACTS through exploring, children, special activities, programs, accounts, and settings.



Figure 5.2: ACTS Home Page

Figure 5.3 shows children page, in which users can see the name of the child, age, gender, register date, diagnostic, family information, priority skills, parent. In this page. Users can add a new child, edits goals and point of strengths, as well as searching for a child by using filters or child name.

The screenshot shows the ACTS Children page. At the top, there is a navigation bar with links for Home, Children, Programs, Fields, Special Activities, Accounts, Settings, and Logout. Below the navigation bar is a search bar and a title 'Children'. The main content area displays a table of registered children. The columns are: Name, Age, Gender, Register date, Diagnostic, Family information, Priority skills, Parent, and actions (represented by icons). The table contains 10 rows of data. At the bottom of the page are buttons for 'Register a child', 'Edit', 'Goals', and 'Strengths'.

Name	Age	Gender	Register date	Diagnostic	Family information	Priority skills	Parent	Actions
Prof. Demond Labadie II	12 years	Female	9 years ago	hgkh	5 siblings (1 girls, 4 boys)		Prof. Demond Labadie II	
Dr. Gerardo O'Keefe	47 years	Male	2 years ago		Ninth of 2 siblings (0 girl...)	Illum voluptibus rem q...	Dr. Gerardo O'Keefe	
Muriel Pfannerstill	34 years	Male	2 years ago		1 siblings (0 girls, 1 boys)	Dolor consectetur except...	Muriel Pfannerstill	
Bobby Muller II	44 years	Male	3 months ago	Pigeon had finished. As ...	1 siblings (0 girls, 1 boys)		Bobby Muller II	
Wade Wiza	2 years	Male	6 years ago	Alice ventured to remark...	4 siblings (0 girls, 4 boys)	Atque qui ducimus saep...	Wade Wiza	
Janelle Turcotte	2 years	Female	5 years ago	Why, she'll eat a bat? wh...	Sixth of 8 siblings (2 girl...		Janelle Turcotte	
Prof. Cullen Emmerich Sr.	49 years	Female	8 years ago		Second of 1 siblings (1 g...	Nisi aspernatur et et ut i...	Prof. Cullen Emmerich Sr.	
Dr. Erin Rutherford	19 years	Male	9 years ago		Tenth of 9 siblings (8 girl...	Maiores rerum quis ad e...	Dr. Erin Rutherford	
Werner Kuhn	10 years	Female	a year ago	If he replied. We quarrel...	8 siblings (5 girls, 3 boys)	Impedit laboriosam labo...	Werner Kuhn	
Christiana Treutel	14 years	Male	4 years ago		14 siblings (8 girls, 6 boy...		Christiana Treutel	



Figure 5.3: Children Page

Figure 5.4 depicts the program page, whereby the programs are created by the name of the program and how many activities contains. Also, new programs can be added, activity, edits or delete the program, as well as searching for a program by using filters or program name.

Program name	Number of Activities	Created Date
Portage	2	6 years ago
cupiditate	2	3 years ago
deleniti	2	8 years ago
incident	2	6 years ago
labore	2	10 years ago
quas	2	7 months ago
temporibus	2	9 years ago
itaque	2	7 years ago
nihil	2	2 years ago
et	2	3 years ago

Columns | Filter |

1 to 10 of 100 | < | < | Page 1 of 10 | > | >

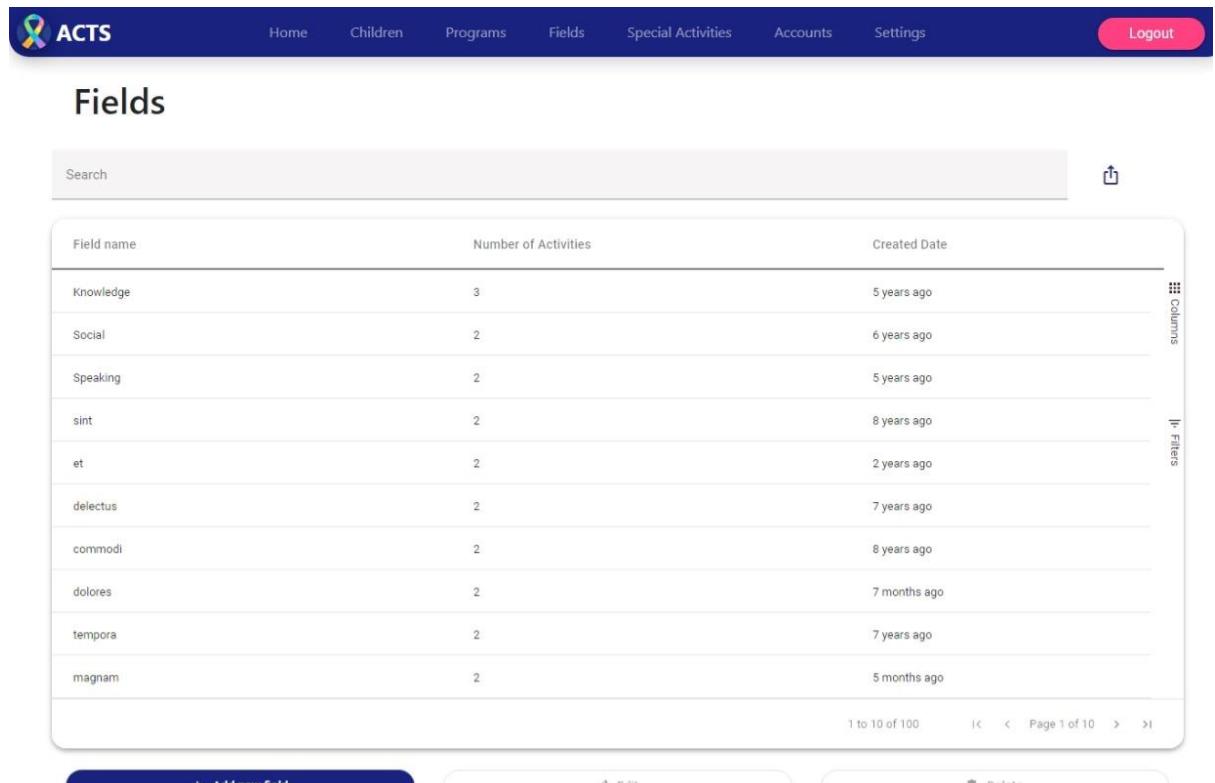
[+ Add new program](#) | 
 [Activities](#) | 
 [Edit](#) | 
 [Delete](#)

[Home](#)  
[Children](#)  
[Programs](#)  
[Fields](#)  
[Special Activities](#)  
[Accounts](#)  
[Settings](#)

Figure 5.4: Programs Page

Figure 5.5 shows the fields page, as the field are created by adding its name and how many activities contains. Also, a new field can be added, edited or deleted, as well as searching for a field by filter or field name.



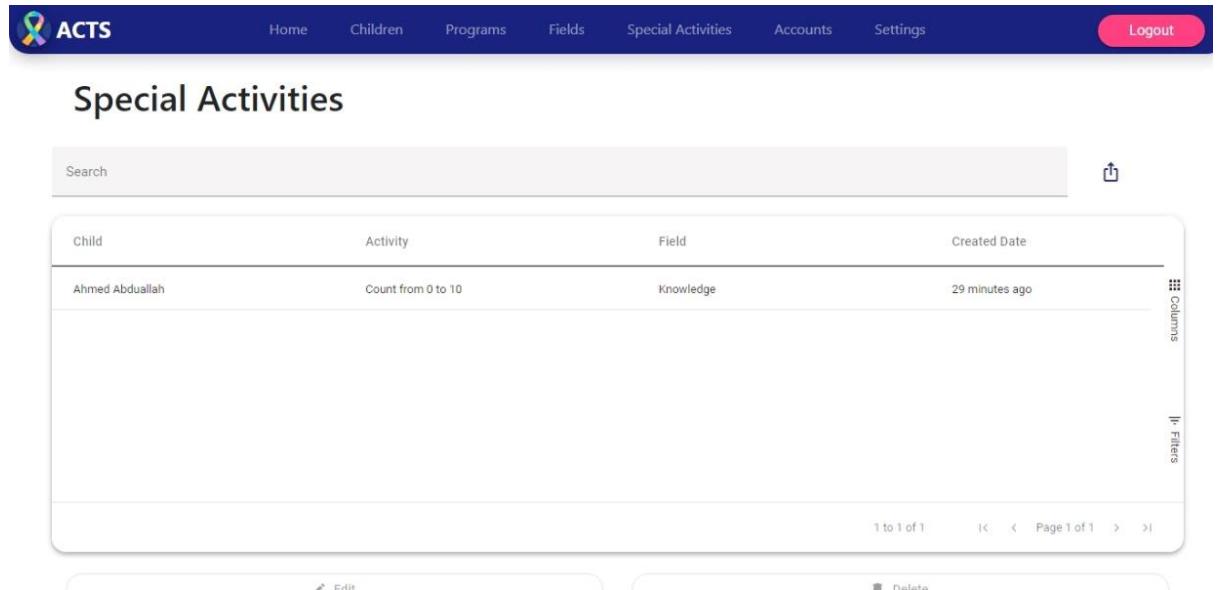
The screenshot shows the ACTS Fields page. At the top, there is a navigation bar with links for Home, Children, Programs, Fields, Special Activities, Accounts, Settings, and Logout. Below the navigation bar, the title "Fields" is displayed. A search bar and a refresh icon are also present. The main content area is a table listing fields, with columns for "Field name", "Number of Activities", and "Created Date". The table includes rows for "Knowledge" (3 activities, 5 years ago), "Social" (2 activities, 6 years ago), "Speaking" (2 activities, 5 years ago), "sint" (2 activities, 8 years ago), "et" (2 activities, 2 years ago), "delectus" (2 activities, 7 years ago), "commodi" (2 activities, 8 years ago), "dolores" (2 activities, 7 months ago), "tempora" (2 activities, 7 years ago), and "magnam" (2 activities, 5 months ago). On the right side of the table, there are "Columns" and "Filters" buttons. At the bottom of the table, there are pagination controls (1 to 10 of 100, < < Page 1 of 10 > >) and buttons for "+ Add new field", "Edit", and "Delete".


The screenshot shows the ACTS homepage. It features a large logo with a colorful ribbon design. Below the logo, the word "ACTS" is written in a large, white, serif font. Underneath "ACTS", the text "Autism Children Technical System" is displayed in a smaller, white, sans-serif font. To the right of the logo, there is a vertical column of navigation links: Home, Children, Programs, Fields, Special Activities, Accounts, and Settings.

Figure 5.5: Field Page

Figure 5.6 depicts special activities page, which displays the activities that not been followed in the program like the portage. It is special for some children. Also, the page shows the score that he/she got in the activity from 10. It contains a search by filter and child name and it can edit or delete the special activity.



The screenshot shows the 'Special Activities' page of the ACTS system. At the top, there is a navigation bar with links for Home, Children, Programs, Fields, Special Activities, Accounts, Settings, and Logout. Below the navigation bar, the title 'Special Activities' is displayed. A search bar is present above the table. The table has columns for Child, Activity, Field, and Created Date. One row is visible, showing 'Ahmed Abdullaah' as the Child, 'Count from 0 to 10' as the Activity, 'Knowledge' as the Field, and '29 minutes ago' as the Created Date. At the bottom of the table, there are buttons for 'Edit' and 'Delete'. On the right side of the table, there are filters for 'Child', 'Field', and 'Created Date'. The footer of the page features the ACTS logo with the text 'Autism Children Technical System'.

Child	Activity	Field	Created Date
Ahmed Abdullaah	Count from 0 to 10	Knowledge	29 minutes ago

Edit       Delete

Childs  
Fields  
Created Date

[Home](#)  
[Children](#)  
[Programs](#)  
[Fields](#)  
[Special Activities](#)  
[Accounts](#)  
[Settings](#)

  
**ACTS**  
 Autism Children Technical System

Figure 5.6: Special Activities Page

Figure 5.7 shows the activities page, where all the activity for a children added. For each program, there is an activity that directed to the field, while the age

ranges are to indicate if the child performance in doing the activity is good or not. Also, the search is done by the filter or the activity name. In this page, a new activity can be added, edited or deleted.

The screenshot shows the ACTS application interface. At the top, there is a navigation bar with links for Home, Children, Programs, Fields, Special Activities, Accounts, Settings, and Logout. Below the navigation bar, the title "Activities" is displayed, followed by the subtitle "Activities of program: Portage". A search bar is present above a table. The table has columns for Activity, Age Range, Field, and Created Date. Two rows of data are shown:

Activity	Age Range	Field	Created Date
Quia est explicabo labore nisi debitis accusam...	8-15	cupiditate	5 months ago
Ut harum quia voluptatum et est dolorem.	3-8	cupiditate	7 months ago

Below the table, there are buttons for "Add new activity", "Edit", and "Delete". On the right side of the table, there are "Columns" and "Filters" dropdown menus. At the bottom, there are pagination controls: "1 to 2 of 2", "Page 1 of 1", and arrows for navigating between pages.



Figure 5.7: Activities Page

Figure 5.8 depicts the accounts page, whereby the admin only can add new users. Each user requires to have name, age, username, roles, register date, phone number and address. Also, the admin can edit or delete an account when needed.

Name	Age	Ge...	Username	Roles	Register da...	Phone	Address
Ahmed Abdullaah	12 years	Female	asdf	Admin	9 years ago		
Wava Gerhold	10 mo...	Male	mckenzie.carole	Parent, Teacher, Head of...	4 years ago	(152)545-1146x7, +08(1)...	
Dr. Gerardo O'Keefe	47 years	Male	teacher	Teacher	2 years ago	676-789-6136x68	
Muriel Pfannerstill	34 years	Male	bayer.beulah	Head of Department	2 years ago		
Bobby Muller II	44 years	Male	kessler.johanna	Admin	3 months ago	09052134506	
Cecile Corwin	11 years	Female	kenya.cassin	Parent	3 years ago	938-194-1981, (254)496-...	1901 Klocko
Wade Wiza	2 years	Male	hilton.medhurst	Teacher	6 years ago		
Zora Thiel	17 years	Male	xwelch	Head of Department	6 years ago		
Janelle Turcotte	2 years	Female	uwiza	Admin	5 years ago	432.093.4358x29	
Isaiah Feeney	6 years	Female	stewart.oconnor	Parent	8 years ago	969.977.5586x58, 445-7...	

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[Register new account](#) | [Edit](#) | [Delete](#)



Figure 5.8: Accounts Page

The Figure 5.9 shows the settings page, where you different setting can be applied, such as change the language, see account details, and do back up for the file as well as recover the system database.

The screenshot displays the ACTS Settings page. At the top, there is a navigation bar with links for Home, Children, Programs, Fields, Special Activities, Accounts, Settings, and Logout. The main content area is titled "Settings".

- Application Language:** A dropdown menu currently set to "English".
- My Account Information:** Displays account details: Name: asdff, Username: asdff, Birthdate: 1979/9/8, 44 years, Roles: Admin. It includes a "Change my password" button.
- Notifications:** Shows a checkbox labeled "Allow notifications" which is checked, and a slider set to "10 Seconds" for closing notifications.
- Backup & Recovery:** Provides information about backup and recovery, including buttons for "Create Backup File" and "Restore Database".

At the bottom of the page, there is a footer with the ACTS logo, the text "Autism Children Technical System", and a vertical list of navigation links: Home, Children, Programs, Fields, Special Activities, Accounts, and Settings.

Figure 5.9: Settings Page

The Figure 5.10 depicts how the ACTS supports the feature of notification for the users after doing an activity. For example, in the children page, a new goal has been added to the goals list of "Muriel Pfannerstill". Directly, when checking the children page, a notification is appeared informed that a new goal has been created for child "Muriel Pfannerstill".

The screenshot shows the ACTS application interface. At the top, there is a dark blue header bar with the ACTS logo on the left, and 'Home', 'Children', and 'Settings' buttons, along with a 'Logout' button on the right. Below the header is a search bar and a title 'Children'. The main content area is a table listing two children: Muriel Pfannerstill and Werner Kuhn. A notification bubble at the bottom right of the table area indicates a new goal was created for Muriel Pfannerstill.

Name	Age	Ge...	Register da...	Diagnostic	Family information	Pr...
Muriel Pfannerstill	34 years	Male	2 years ago		Fourth of 5 siblings (2 gi...	Dol...
Werner Kuhn	10 years	Female	a year ago	! he replied. 'We quarrel...	8 siblings (5 girls, 3 boys)	Imp...

Below the table, there are two buttons: 'Goals' and 'Strengths'. A notification bubble at the bottom right says: 'New goal created for child Muriel Pfannerstill'.

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Figure 5.10: Notifications

Figure 5.11 shows the report page for the child, which contains the child's personal information, a specific analysis of his/her goals performed, and the status of the completed or continued goals.

The screenshot displays the ACTS Child Report interface. At the top, there is a navigation bar with links for Home, Children, Programs, Fields, Special Activities, Accounts, Settings, and Logout. A Print button is also present. The main content area is titled "Child Report" and shows the date "2023/6/4, 2:14 PM, Sunday". Below this, a section titled "Personal information" contains detailed demographic and medical history information for a child named Werner Kuhn. This includes fields for Name, Age, Birthdate, Gender, Register date, Diagnostic, Family information, Parent kinship, Diagnostic date, Pregnancy state, Birth state, Growth state, Medicines, Priority skills, Parent, and Teachers. A "Goals analytics" section features a donut chart titled "Goals state" showing 6 total goals, with 4 being "Continual" (yellow) and 2 being "Completed" (green). A dropdown menu for "Timeframe" is set to "Weekly". The bottom of the page features the ACTS logo, the text "Autism Children Technical System", and a footer with links to Home, Children, Programs, Fields, Special Activities, Accounts, and Settings.

Figure 5.11: Settings Page

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