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Development of iSpeak: Augmentative and Alternative Communication for Malaysian Population

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Abstract: Augmentative and Alternative Communication (AAC) refers to a variety of communication techniques that can be used in addition to or in place of speech or writing and for those who have difficulties expressing or understanding spoken or written language. iSpeak system is used to enhance decision-making quality more methodically and lower the likelihood of making mistakes. The feedback after using the system prototype will be considered for the upcoming iteration of prototypes, which will help to enhance system functioning. To utilise the system, both users and administrators need an email and a password. System functioning is examined to confirm that system development objectives are met. Testing is done to make sure the system was designed to fully benefit its users.

Keywords: Augmentative and Alternative Communication, Speech Language Pathologist

1. Introduction

Augmentative and Alternative Communication (AAC) refers to a variety of communication techniques that can be used in addition to or in place of speech or writing and for those who have difficulties expressing or understanding spoken or written language. [1]

There are several ways on how AAC works such as unaided ways of communication, such facial expression, body position, gesture, or sign language, are possible with AAC by using communication books and tablets. The requirements of the person with a disability and their communication partners define the best modes of communication. Apart from that, aided communication systems call for the usage of tools or equipment in addition to the user's body. Paper and pencil, communication books or boards, speech generating devices (SGDs), and gadgets that provide written or spoken output are all examples of aided communication techniques. [2] Also, messages can be created using graphic symbols, letters, words, and phrases by using electronic communication devices.

Different spoken languages can be produced by some gadgets by programming. The most common problem encountered on AAC is that speech-language pathologist (SLPs) may not want to use the AAC device because

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they think it would restrict the client's verbal communication, which is a typical problem with AAC devices. Therefore, it is critical to inform SLPs, careers, and regular communication partners about the advantages of AAC for clients and how it could improve verbal abilities. The effectiveness of AAC depends on the support of family members and other communication partners, thus this is a crucial problem to solve. Aside from that, the financing of the devices is another problem in the AAC industry. Finding funding for an AAC device is complicated, drawn-out, and time-consumingFamilies, doctors, speech-language pathologists (SLPs), schools, and maybe manufacturers are some of the important stakeholders in obtaining financing for AAC devices. The gadget may be financed in part by some public schools. The kid is not permitted to take the gadget home or elsewhere since the school now owns it. [3]

By developing iSpeak: Augmentative and Alternative Communication for Malaysian Population which is a reliable auditory and visual model and easing the anxiety associated with controlling the oral motor motions necessary to talk, aids verbal speaking in English Language. It improves receptive language, lessens frustration and behavioral issues, gives children more control over their lives, promotes social connection, helps learning and cognitive development, and generally makes life more enjoyable and engaging. iSpeak intervention does not often need anything other than a willingness to communicate. Anyone may utilize iSpeak.

2. Literature Review

2.1 Augmentative and Alternative Communication (AAC)

There are numerous causes why someone could not be able to speak. They can have a developmental disorder that has hampered their capacity to speak. The person's capacity for speech may have been hampered by an acquired condition. AAC can help a wide range of persons with various speech problems, impediments, and communication difficulties.

When communicating, many people can need symbols or images. Those who are still unable to read or spell are included in this. Visual symbols that symbolize words or sometimes phrases can be used. [4] AAC not only provides a method of expressive language, but also improves receptive language, lowers frustration and behavioral issues, empowers the kid, promotes social connections, supports learning and cognitive skills, and boosts general life satisfaction and engagement. [5]

2.2 Background of Case Study

Families and professionals could do well to take an eclectic stance considering these complicated challenges. When utilized for purposes other than the rather narrow goal of teaching basic communication skills, notably requests, the usage of AAC may be beneficial. [6] It has been recommended as best practice to use visual supports and other types of AAC in a child's learning contexts. [7] The additional supports that might help with understanding and extending language abilities can benefit all children, even those who show signs of improving spoken language skills. For people who might not use visual cues when learning [8] it is uncertain that using AAC in child-led naturalistic educational contexts will prevent students from learning, including speech. [9]

2.3 Management Information System (MIS)

The Management Information System gathers data, analyses it, and then reports the findings to help with management decisions. This information management system's goal is to make data management more methodical. This system is used to enhance decision-making quality more methodically and lower the likelihood of making mistakes. The likelihood of web-based solutions is increasing as a result of the web's suitability as a medium for spreading correct information. The information on this web-based system is continuously updated as time goes on. The XAMPP database and Visual Studio Code were both used to create the system.

2.4 Comparison with the Existing System

In order to gather data relevant to the system that will be built, observation and research are conducted on the existing system. Additionally, observation is conducted to get more data for this project's study. The following systems have been chosen for comparison which are Do2Learn, LessonPix and Sono Flex.

Do2learn offers tens of thousands of free pages with academic content, transitional guides for career and life skills, communication cards, social skills and behavioral management activities and advice, learning songs and games, and academic material. In addition, it sells high-quality items like View2do, and books. By using the most recent technology and professional advice, it takes an innovative and practical approach to problem-solving. [10]. Do2Learn offers instructional materials, sources, games, and advice to help kids with special needs. Tools, advice, and other resources are available for instructors in the areas of academics, social skills, behaviour management, and functional communication. [11].

LessonPix is an online web-based system online set of tools to develop learning materials, schedules, and visual supports for the home, the classroom, and anywhere was made possible by the professional life and talents of the creators, who are the parents of a child with special needs. [12].

Sono Flex is a flexible mobile-based application platform that adapts to each user's position in their communication journey. It is simple to use and adapt to changing needs. With more than 11,000 symbols and more than 50 pre-set phrases, user may dynamically combine fundamental and topic-based terminology. User can even build their own symbols using photographs. However, it is only available with our Communicator 5 software on the iPhone, iPad devices. [13].

Table 1: Comparison between the existing applications and the proposed application

Feature/System	Do2Learn	LessonPix	Sono Flex	Proposed application
Registration Page	✓	✓	x	✓
Menu Page	✓	✓	x	x
Web-based	✓	✓	x	✓
User Profile	x	✓	x	✓
Activity Log	✓	x	✓	✓
Management System	x	✓	x	✓
Notification Page	x	✓	x	✓
Feedback of the User	x	x	x	✓
Assessment Page	✓	x	x	✓
Administration System	✓	✓	x	✓
Login Page	✓	✓	x	✓
About Us Page	✓	✓	x	✓
Paid membership site	✓	✓	✓	✓

3. Methodology/Framework

This project is being developed using a prototype model. A prototype is built, tested, and then modified according to this software development paradigm in order to create an appropriate prototype. The final framework or application can be developed using this model as a foundation. It functions well in circumstances where project specifications are not understood in full [9].

Furthermore, this model offers various advantages, including lowering the effort required to build the final system because it is included after all needs are well-known and there is less chance that the final system will be incorrect. More user involvement is required during prototyping, which enables users to connect with the product and provide better, more thorough assessments and requests [10]. Figure 1 illustrates the five primary stages of the prototype model: planning, analysis, design, execution, and testing.

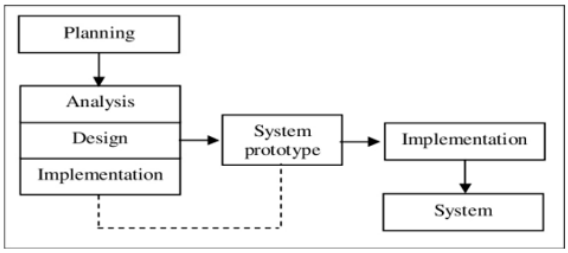

Figure 1: Prototyping Model

The problem statements are recognized during the planning phase, and goals are established to solve the issues. The project's scope is established, together with the intended audience and functional components, and the anticipated results are outlined. To organize the project, priorities it, and complete it more quickly, a Gantt chart has been created.

In the analysis phase, research is also done by reading articles that conduct research about speech delay, and newspaper clippings that report on the level of speech language found in children today. A case study found that just because a communication specialist recommended an AAC programme as part of the kid's educational-therapeutic intervention programme does not mean that a family must immediately start using it with the child. To enable their children to adopt AAC practises, families need assistance in a variety of areas. In every aspect of rehabilitation, the value of early intervention is consistently emphasised.

In the design phase, the development of the interface page is developed by using the HTML5 programming language to structure and present the content on the developed system. The system is fully developed according to the user's needs using the Sublime Text editor code. Data on the system and user data are stored in PhpMyAdmin which is the database that handles MySQL administration. An Entity Relationship Diagram (ERD) is also designed and updated in this phase to identify the tables and attributes involved in data storage as well as to avoid data duplication.

During the implementation phase, the database must also demonstrate its ability to save data without experiencing issues with data security and integrity. In order to ensure that the system is created in accordance with the present and is updated, the programming language and database utilised are also more flexible and cutting-edge.

In the system prototype phase, the prototype system will be evaluated by potential users and developers. Users will find some suggestions using this approach based on their present suitability and needs in the event of flaws and the need for improvement. All upgrades begin with the analysis and design phase and progress through the second prototype phase. This phase of development proceeds repeatedly until the system is good, error-free, and accomplishes its objectives. Lastly, the testing phase is where the produced system is tested to ensure that there are no faults and that all the system's features can be used without any issues. System functioning is examined to confirm that system development objectives are met.

Table 2: Workflow for the development of the proposed system

Phases	Activity	Deliverables
Planning	1. Identify problem statements, objectives, the scope of the project, expected result, and project significance. 2. Set up a work plan. 3. Study online resources and articles that are related to the title. 4. Study the features and functionality of existing applications.	1. Project proposal. 2. Gantt Chart. 3. Literature review. 4. Comparison table between existing applications and proposed applications.

Table 2: (cont.)

Phases	Activity	Deliverables
Analysis	1. Determine system functionality. 2. Conduct interviews, observations, and research Interview with the professional. 3. Analyze hardware and software requirements. 4. Identify functional and non-functional requirements 5. Identify the relationship among all classes.	1. Gather user requirements. 2. Hardware and software requirements. 3. Functional and non-functional requirements. 4. Interview information, research, observation 5. Use system context diagram, data flow diagram, entity relationship diagram.
Design	1. Design the wireframe. 2. Design the user interface. 3. Design the database.	1. Wireframes. 2. User interface. 3. Database specification.
Implementation	1. Develop the system module. 2. Integrate the system. 3. Connect with the database. 4. Perform the initial alpha test.	1. Proposed system. 2. Errors found and fixed.
Prototype System	1. Write programming code 2. Designing the interface page 3. Build a database	1. Prototype system 2. System interface page 3. Database for the system 4. Get recommendations
Testing	1. Conduct system testing 2. Identify the area of improvement	1. Fix and improve the bugs. 2. Fix and ready to release the new system.
System	1. The system is ready to be developed	1. The system is ready to be used by users online.

4. System Analysis and Design

A context diagram for the iSpeak: Augmentative and Alternative Communication is shown in Figure 2. Administrators and users are the two categories of users in the context diagram that is attached below. To utilise the system, both users and administrators need an email and a password. Administrators can log in, change user information, add module, and see users' assessment and send notifications to specific user. appointments for users who need treatment follow-up, and update recommendation information. In this system, administrators can also obtain a list of people who have logged in. Figure 2 shows the System Context Diagram of the proposed application:

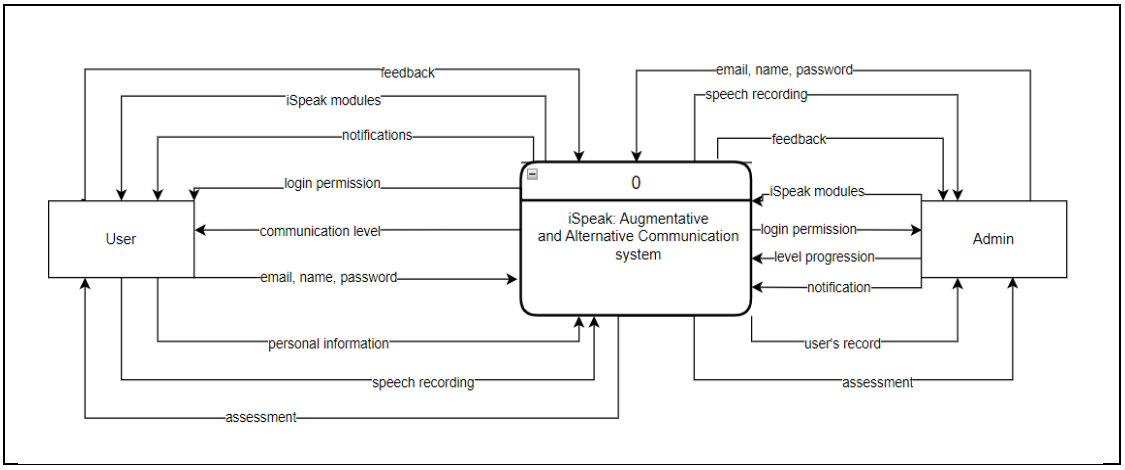

Figure 2: System Context Diagram

4.1 DFD Level 0

A high-level overview of the main parts and data flows in the iSpeak website system is given in this Level 0 DFD. By concentrating on the crucial interactions between the user, interface, processing, and output components, it streamlines the system. Figure 2 shows the DFD Level 0 of the proposed application:

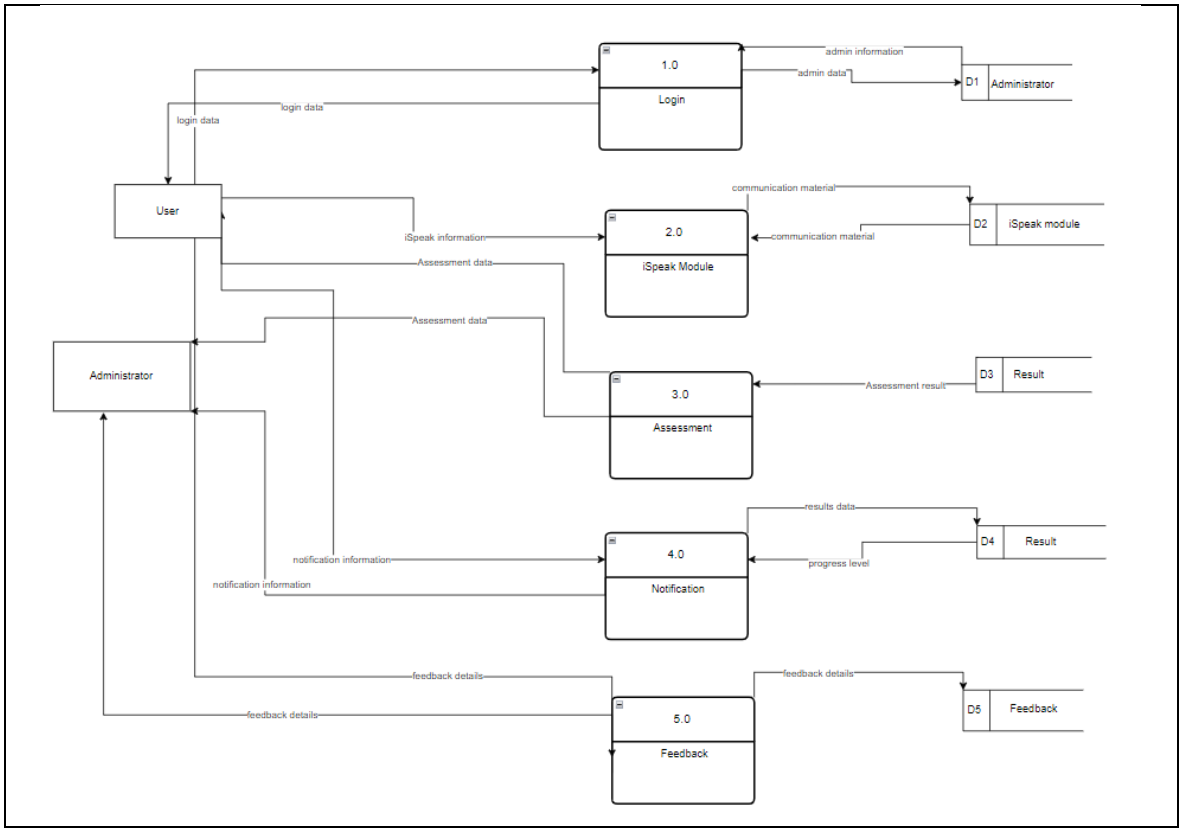

Figure 2: DFD Level 0

4.2 Entity Relationship Diagram

The iSpeak: Augmentative and Alternative Communication system uses as many as seven entities which are users, administrator, iSpeak module, assessment, notification, and feedback. Figure 3 shows the relationship

diagram of the entities involved in developing this system. Each entity is responsible for storing certain data and has link with other entities to ensure there is no duplication of data.

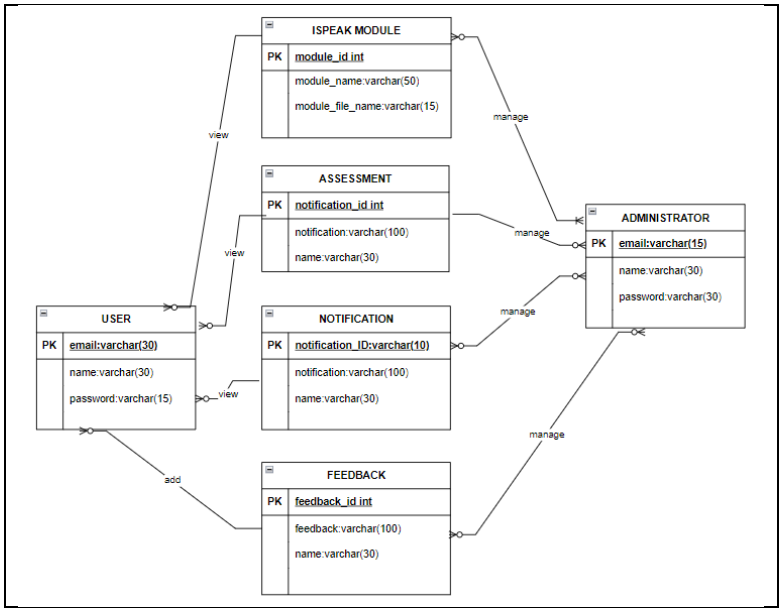

Figure 3: Entity Relationship Diagram

4.3 Flowchart

There are two flowcharts for the iSpeak: Augmentative and Alternative Communication system which are one for administrators and the other for users. These two flowcharts illustrate various system usage patterns for users and administrators. The flow chart for the administrator is displayed in Figure 4 from the interface page all the way to the end. Information, exam questions, suggested activities, and treatment information can all be updated by administrators. After updating is complete, the administrator can proceed to seeing the list of user records.

4.3.1 Admin Flowchart

Figure 4.12 shows a flow chart for admin of the iSpeak website System. Once the admin has successfully logged in, the user can change their profile, see user list, see admin list update iSpeak module, check assessment progresss from the user, add notifications to specific user and view feedback. The administrator will check the user's progress and they will send the notifications to inform the user if they have passed the level they answered. Besides, the administrator may send the notifications if there are any updates about the website, or remind the user to answer the assessment if they have not done.

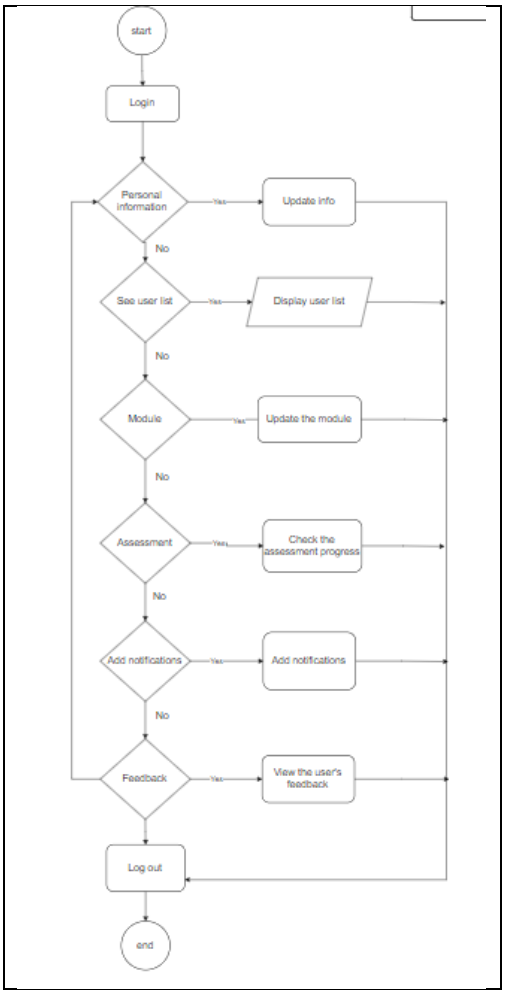

Figure 4: Administrator Flowchart

4.3.2 User Flowchart

Figure 5 shows a flow chart for users of the iSpeak website System. Once the user has successfully logged in, the user can change their profile, send feedback to the system, view the iSpeak module and after they have completed their studies they may begin with the assessment. After the administrator have checked their progress, they will send the notifications to inform the user if they have passed the level they answered. Besides, the administrator may send the notifications if there are any updates about the website, or remind the user to answer the assessment if they have not done.

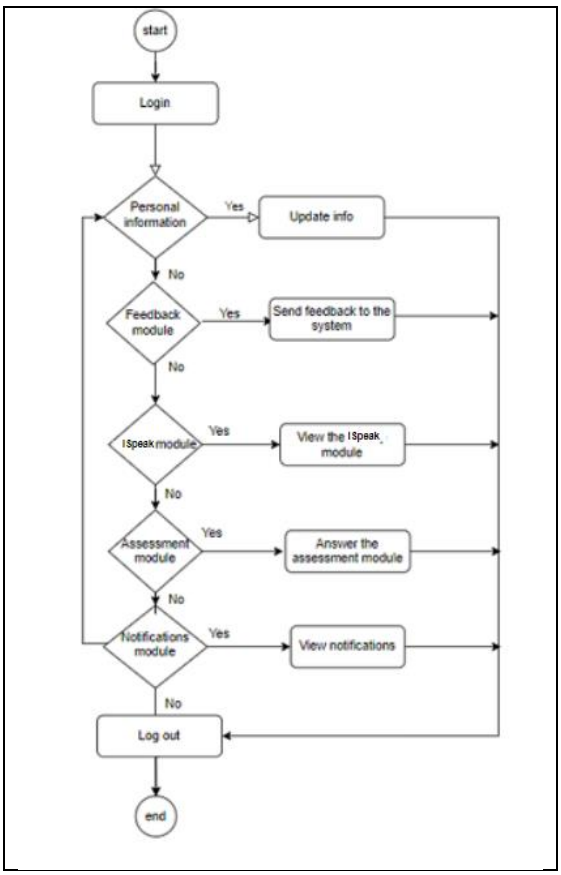

Figure 5: User Flowchart

5. Implementation and Testing

While the testing process makes sure the application is error-free, the implementation step makes sure the application being developed satisfies the specified criteria. Testing will be done following implementation to make sure the system functions as intended and in accordance with the modules.

5.1 Implementation

iSpeak website system is developed in Visual Studio Code using Hypertext Markup Language (HTML0, Cascading Style Sheet (CSS), and JavaScript Programming language. The storage platform for both applications is using MySQL. Hypertext Markup Language (HTML0, Cascading Style Sheet (CSS), and JavaScript Programming language is used to provide the logic part for the web-based. Figure 6 shows the login services that implement in the iSpeak system to authenticate the user. It creates users by using email and passwords.

```
<form class="tt-login-form tt-form-minimal" method="POST" action="../private/config">
    <div class="tt-form-group">
        <label>Email address <span class="required">*</span></label>
        <input type="email" class="tt-form-control" id="login-name" name="email" required>
    </div>

    <div class="tt-form-group">
        <label>Password <span class="required">*</span></label>
        <input type="password" class="tt-form-control" id="login-password"  name="password" required>
    </div>

    <div class="tt-btn tt-btn-primary tt-btn-block margin-top-40">
        <button type="submit" name="login" data-hover="Log in">Log in</button>
    </div>
</form>
```

Figure 6: A code segment for login to the system

Figure 7 shows the code segment for admin to upload photos and audio to the iSpeak modules for each level into the system. It allows admin to upload local files on the device, such as photos and audio from the file explorer. There will be a reminder if the photos or audio did not fully successfully upload.

```
if (isset($_POST['addquestion'])) {
  // receive all input values from the form
  $questionname=mysqli_real_escape_string($db, $_POST['questionname']);
  $moduleid=mysqli_real_escape_string($db, $_POST['moduleid']);
  $questionimage = $_FILES['questionimage']['name'];
  $questionaudio = $_FILES['questionaudio']['name'];

  $filename = rand(100000,999999).basename($questionimage);
  $target = "../../media/".$filename;
  $filename1 = rand(100000,999999).basename($questionaudio);
  $target1 = "../../media/".$filename1;

   // Finally, Inserting The Data
   $query = "INSERT INTO `question`(`questionname`, `questionimg`, `questionaudio`, `moduleid`) VALUES ('$questionname','$filename','$filename1','
    mysqli_query($db, $query);
    move_uploaded_file($_FILES['questionimage']['tmp_name'], $target);
    if (move_uploaded_file($_FILES['questionaudio']['tmp_name'], $target1)) {
          echo "<script>alert('Question Has Been Successfully Inserted !');
          window.location.href='../public/question';
          </script>";
    }else{
    echo "<script>alert('Question Failed To Be Insert !');
    window.location.href='../public/question';
          </script>";
      }
}
```

Figure 7: A code segment for saving the image and audio to Admin site database and MySQL storage

Figure 8 shows the code segment for the user to send feedback through iSpeak website system. The feedback will be saved to the MySQL real-time database, and the data will be retrieved from MySQL on the admin site page side.

```
<form class="tt-form-minimal anim-fadeinup" method="POST" action="../private/config">

    <input type="hidden" name="userid" value="<?= $_SESSION['userid']; ?>">

    <div class="tt-form-group">
        <label>Description <span class="required">*</span></label>
        <textarea class="tt-form-control" rows="6" name="description" placeholder="" required></textarea>
    </div>

    <small class="tt-form-text"><em>Fields marked with an asterisk (*) are required!</em></small>

    <div class="tt-btn tt-btn-light-outline margin-top-40">
        <button type="submit" name="feedback" data-hover="Send Message">Send Feedback</button>
    </div>
</form>
```

Figure 8: A code segment for sending feedback to Admin site database and MySQL storage

Figure 9 shows the code segment for the admin to send notification to specific user they can choose through iSpeak website system. The notifications will be saved to the MySQL real-time database, and the data will be retrieved from MySQL on the admin site page side. With alongside the user will be getting the notification in the notification page.

```
    <?php
    $query = "SELECT * FROM notification INNER JOIN user ON notification.userid = user.userid";
    $query_run = mysqli_query($db,$query);
    while($row = mysqli_fetch_array($query_run))
    {
    ?>
        <tr>
            <td><?php echo $row['notificationid']; ?></td>
            <td><?php echo $row['notificationdetail']; ?></td>
            <td><?php echo $row['name']; ?> ( <?php echo $row['userid']; ?> )</td>
            <td>
                <a href="config.php?notificationid=<?php echo $row['notificationid']; ?>"><button class="btn btn-success-light">Edit</button></a>
                <a href="../private/delete.php?notificationid=<?php echo $row['notificationid']; ?>">
                <button class="btn btn-danger-light">Delete</button></a>
            </td>
        </tr>
    <?php
    }
    ?>
    </tbody>
  </table>
div>
```

Figure 9: A code segment for sending notifications to user

Figure 10 shows the registration process for the website. The user can only register to the website if the email, name, and password are unique. They can log in to the system only with a valid account.

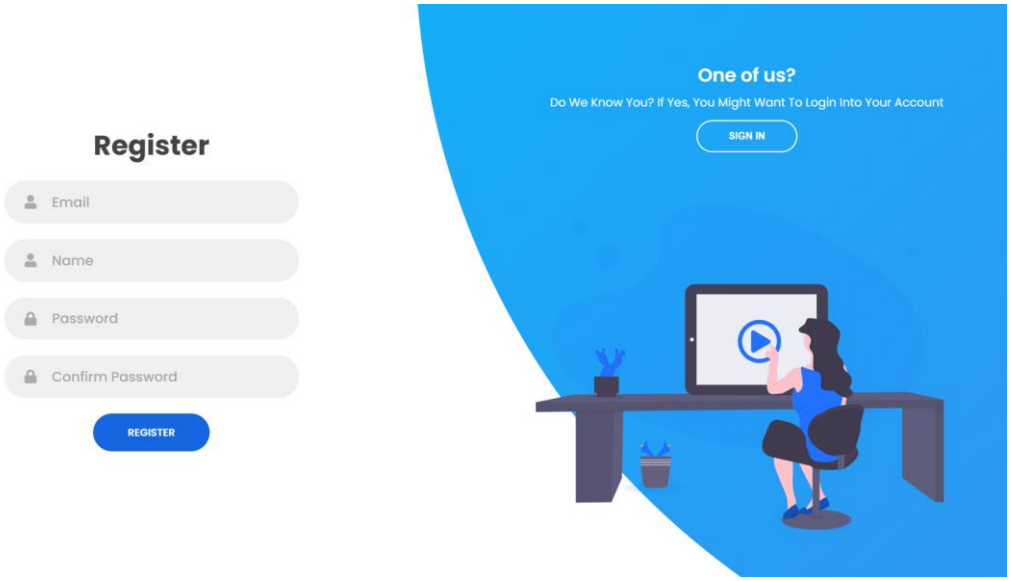

Figure 10: Registration for User Interface Page

To ensure the Speech Language Therapist involved in the system are qualified, the administrator will register the Speech Language Therapist in the system. Once they have a verified account, there are who has already been verified successfully by the iSpeak administrator, as shown in Figure 11.

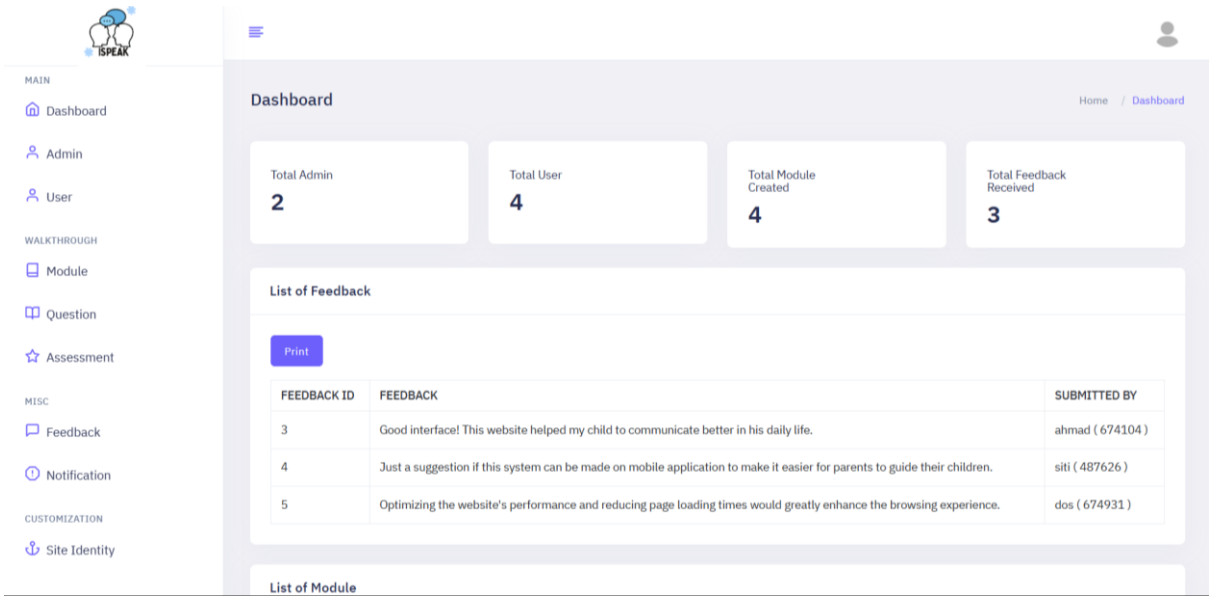

Figure 11: Dashboard for Administrator Interface Page

Figure 12 shows the interface page of modules for users to learn about each word that display in the module page. There will be 4 levels and each level consist of 9 words. User may click the picture to listen to the audio of each picture.

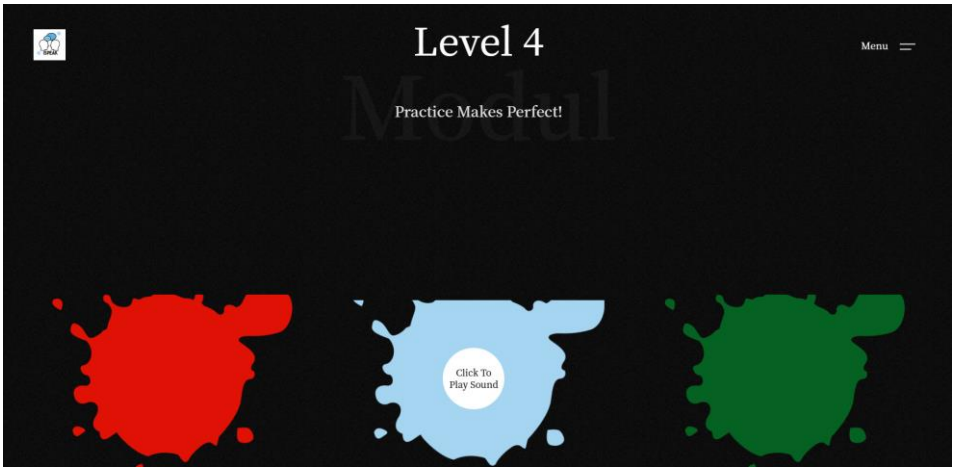

Figure 12: Module for User Interface Page

Figure 13 shows the interface page of assessment for users to send their progress about what they have learn based in the module. User may upload the video once by answering all words based on each level.

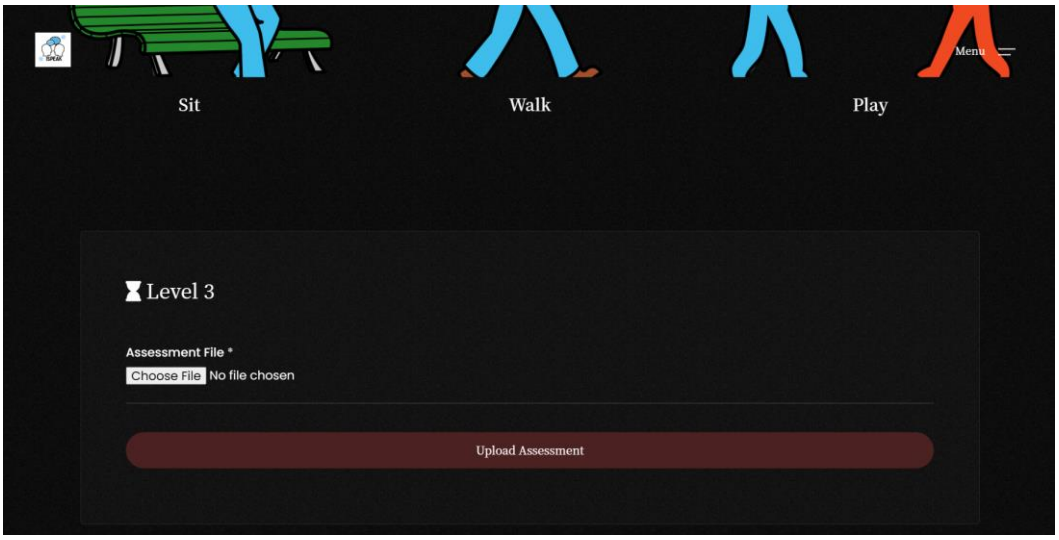

Figure 13: Assessment for User Interface Page

Figure 14 shows the interface page for users to see notifications that display the child's progress information, the results from after answering the assessment whether the assessment results are worrying or successful by getting feedback from speech language therapy.

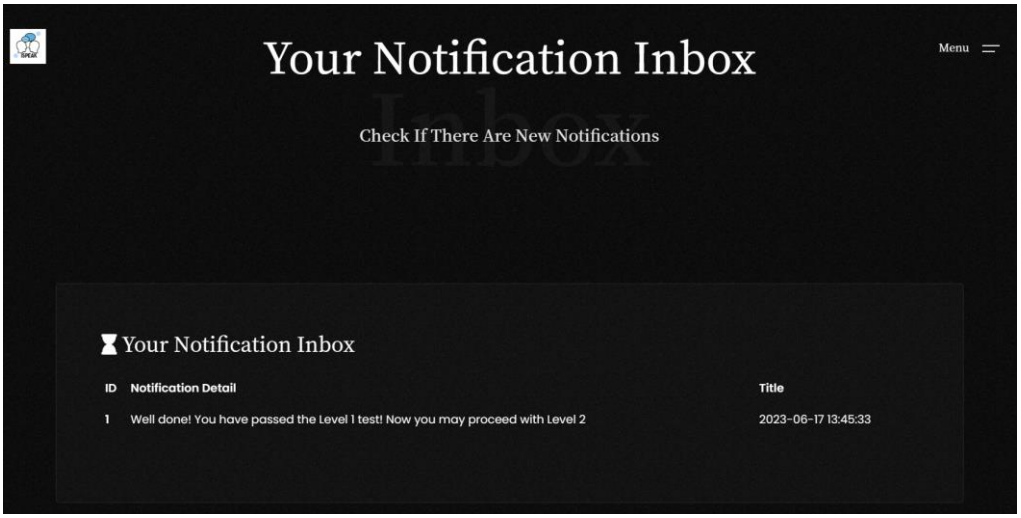

Figure 14: Notification for User Interface Page

5.2 Application Testing

5.2.1 Functional Testing

Table 3 displays the results of the iSpeak website system's functional testing. The Test Plan assists the Developer in estimating the Work Involved to Verify the Quality of the Website. It strives to ensure that each module functions properly and yields the desired results. The development of the functional testing came after the implementation stage. Overall, each module's actual test results for the test plan were successful.

Table 3: Test plan of the system module and results

Module	Functions	Test	Expected Result	Actual Result
Users management module	Registration	Incomplete data input	An alert message will display if the text field is empty.	Pass
		Email address, name, and password	An alert message if already exists	Pass
	Login	Complete input with invalid email or password	Alert message will display, and login request is rejected.	Pass
		Complete form	Login successfully and redirected to the homepage.	Pass
	User profile	Update user profile with valid input	The profile interface will show the changes if successful.	Pass
	Forget password	Update password with validate username	An alert message will be displayed if the username does not exist in the database.	Pass
	Therapists profile details	Update consultation details with valid input	The therapists can update the title, email, name and password.	Pass
Communication between user and speech language therapists	Assessment details	Valid data input	The assessment will save to the database and recorded under question history.	Pass
	Module details	Valid data input	The photo or video and description will upload in the real-time database and storage database.	Pass
Report	Summary	Calculate the total of levels answered	The total question answered will be tracked.	Pass
Administrator panel	Dashboard	The administrator can view the data in the admin database	The administrator is allowed to create, read, update, and delete the data from the database	Pass
	Speech Language Therapist list	Update therapist account status	The administrator can update the therapist's status to verified.	Pass
	User list	Delete the user account	Confirm dialogue will be displayed. If the yes button is clicked, the user will be deleted from the database.	Pass

Table 3: (cont.)

Module	Functions	Test	Expected Result	Actual Result
	Notification details	Create a new notification with valid data	The new notification is created and save to the database.	Pass
	Feedback	Feedback list	All the feedback that exists in the database will be displayed in the database	Pass

5.2.2 User Acceptance Testing

User Acceptance Testing (UAT) is a method of testing in which the end-user or customer verifies and accepts the software system before it is moved to the production environment. Due to time limitations, only 15 users have been involved in this testing: five speech language therapist, five experienced users, and five newbies' users. The outcome is evaluated and presented in a graph after the data collected from the user, as shown in Figure 15 and Figure 16.

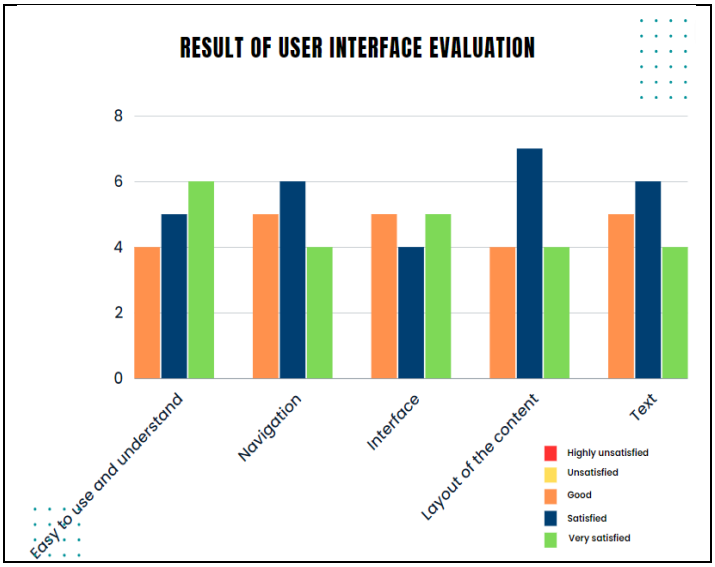

Figure 15: Result of user interface evaluation

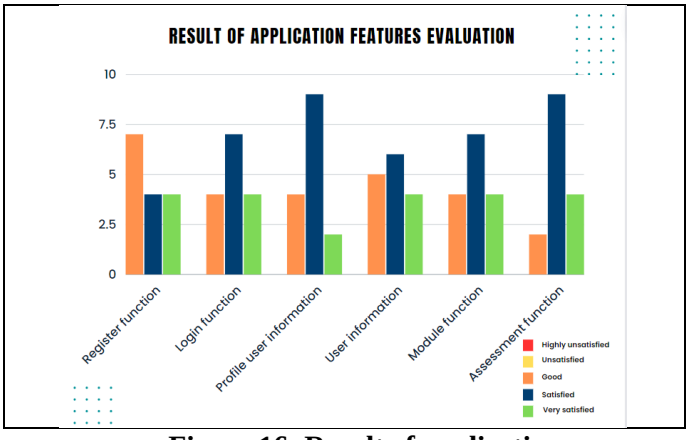

Figure 16: Result of application features evaluation

6. Conclusion

In conclusion, the iSpeak website system has been successfully created. This website still has some limitations. The application's drawbacks are that users must search what they wished for by scrolling the website because there is no implemented searching mechanism in the system. Additionally, there is only basic information available about the Speech Language Therapist and no review or rating system from experienced users. Besides, users do not have the opportunity to send messages to the Speech Language Therapist if they have problem with appointment since this system did not implement chat messages between user and admin.

Future system development will be aided by the benefits, drawbacks, and recommendations identified during the time spent creating current one. The iSpeak website system has been carefully created with the aim that it will meet the needs of its user. This system has gone through the phases of planning, analysis, design, implementation and testing repeatedly to ensure the completeness of its functions. The knowledge gained during the development of this system is expected to be used for the development of the system in the future.

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