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Abangmanis: Speech Theraphy for Autism Monitoring Mobile Application

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***Abstract*—The number of children with autism continue to rise every year. To support families with children who have autism, the government of Indonesia has setup a special body called Pusat Layanan Autis (Autism Service Centre or ASC) in every province in Indonesia, under the jurisdiction of the Ministry of Education and Culture. In the Riau Islands province, the ASC is located in Batam. To lower the obstacles and problems in autism-related behavior in order to improve the live quality and functional freedom, a number of therapies can be performed, such as applied behavior analysis, speech therapy, occupational therapy, physical therapy, social therapy, play therapy, behavior therapy, development therapy, visual therapy, and biomedical therapy. Currently in ASC Batam, there are six therapists, which consist of speech therapists, occupational therapists, and physiotherapist. These six therapists serve 65 children, with every session is designed as one-on-one (one therapist per children in every session). Therapies for children with autism must be performed comprehensively and every child would need different types of therapies. The type and number of therapy that any particular child need would depend on the development of the child in every therapy session. Therefore, the monitoring of child therapy development is very crucial. However, with the high number of children that needs the service and the very crowded schedule that must performed by a therapist, this monitoring are performed manually using paper and pen. On the other, the type of notes is limited due to the media; moreover, there are probably items that are less detailed in the recording. These problems are more pronounced in the speech therapy. Based on the preliminary study, we observed that there is a requirement for free open source software to facilitate a special need in ASC that is to simplify the recording and tracking of the development of speech therapy for children with autism. The solution that we developed was called Abangmanis, a short of the autism speech therapy monitoring mobile application, which is equipped with multimedia contents such as audio recording to improve the quality of the recorded data.**

Keywords—Autism, speech therapy, monitoring, multimedia, mobile

I. INTRODUCTION

Autism or *Autism Spectrum Disorder (ASD)*) is a spectrum of condition which classified as neurodevelopmental disorders in the Diagnostic and Statistical Manual of Mental Disorders version 5 (DSM-5) which was published by the American Psychiatric Association on May 2013 [1]. An individual who has been diagnosed with ASD has two main symptoms namely lack of communication and social interaction, and pattern of behavior, interest, and activity that were limited and repeated. Both of these symptoms may manifest since early age (less than three years old) [1]. Lack of social skills as a consequence of those symptoms caused an individual with ASD became isolated form other human beings [2].

According to Judarwanto [3], the characteristics of an individual with autism appeared in many spectrums, namely: (1) difficulty in communication, such as speaking and understanding a language; (2) difficulty in interacting with other people or with surrounding objects and connecting events; (3) playing with toys or other objects unnaturally; (4) difficulty to accept any disruption on their routine and environment; (5) repeated body movement or following certain patterns.

To lower the obstacles and problems in autism-related behavior in order to improve the live quality and functional freedom, a number of therapies can be performed, such as applied behavior analysis, speech therapy, occupational therapy, physical therapy, social therapy, play therapy, behavior therapy, development therapy, visual therapy, and biomedical therapy.

The number of individuals with autism continues to increase each year. According to UNESCO, in 2011 it is predicted that 6 in 1000 people has autism or about 35 million people in the whole world. According to the US government data, in 2014, around 1.5% of children or about 1 in 68 is autistic, increasing from 30% from 2012. While in England, about 1.1% of the population above 18 years old is autistic. In Indonesia, there is no official survey about the number of children with autism. However in 2013, Direktur Bina Kesehatan Jiwa Kementrian Kesehatan estimated that the number of children with autism in Indonesia was around 112 thousand between 5-19 years old. This estimation was based on the autism prevalence which was 1.68 per 1000 children under 15 years old. dr Widodo Judarwanto of klinikautis.com in 2015 estimated that one in 250 children has autism or about 12.800 children with autisms and 134.000 of children with autism spectrum in Indonesia.

The government of Indonesia, through the Ministry of Education and Culture, established the Autism Service Center (ASC) in every province in Indonesia in order to assist families with children with special needs, especially autism, to provide them with affordable and reliable therapy services.

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In Riau Islands province, ASC is located in Batam. Currently, the Batam ASC is managed by the Education Board of Riau Islands province and led by Miss Riniatun, S.Pd. The therapist's in this center consists of six personals, categorized as speech therapists, occupational therapists, and physiotherapists. Meanwhile, the registered children with autism is 65 children, with the waiting list consists of around 200 children.

ASD is a form of development disorder; therefore all types of therapy will take a long time. Moreover, these therapies must be performed comprehensively and every child would need different types of therapy. Therefore, each child would have their own schedule, where in each session, a therapist can only handle one child (*one-on-one*). In Batam ASC, each session lasts for about one hour, and every day, a therapist handles about 8 children or 8 sessions.

The type and number of therapy sessions for each child depends significantly on the development of the child during each session. Therefore the development recording of every child becomes very important. In each therapy session, the therapist must record and documented any actions or exercises given to each child and any milestone achieved by the child. Despite of therapists' busy schedule with numerous children to handle, the monitoring of every child development still performed manually, using pen and paper. On the other hand, the recorded data is limited, only textual data, while there are many other data that might be recorded in each therapy session.

Almost all children with autism retain difficulty in speaking and language. Usually, this speech impairment is the most significant difficulty. There are also many autistic individuals who are non-verbal or having very limited speaking ability [4]. Similar thing happened in Batam ASC. All children registered in the center requires speech therapy, however there is only one therapist available. Therefore this one therapist must handle all children with every child receives different types of therapy.

Based on preliminary evaluation, each child will be determined the targets that must be achieved in the speech therapy specifically about language and verbal communication. Therefore, in the end of each session, the therapist will record and documented all actions during the session. This record documented by the therapist, because it used pen and paper, usually limited only to something like 'the child can say be'. With the current technology and the available facilities, actually the record can be enriched with audio recording or sound of the child when they say those words. This record then can be compared with the early sessions or the next session, therefore the development of the child can be well-monitored.

On the other hand, information technology especially in mobile devices, whether for the clinical officers or the patients has proven to have positive impact [5,6,7,8], including increase information access for electronic medical record therefore increase the interaction between clinical officers with patients, supports the health education, and last but not the least, decrease the time spent for administrative responsibilities thus increase the contact time with patients.

From this explanation, this research aims to develop an application in order to assist the therapist to record the monitoring data for children with autism, specifically in during the speech therapy; therefore the development of each child can be monitored.

The successful of the development monitoring for children with autism is very dependent on the records from the therapist, therefore the requirement to build a supporting application, more specifically mobile application, in order to give a detail and complete insight about the development of each child.

II. Literature Review and Method

A. Literature Review

Information technology has many benefits for both the clinical officers and patients. Many positive impacts have been reported across the world [5-8] including the increase in information access to electronic medical records, providing supporting tools for medical education, and decreasing the time needed to complete administrative tasks. Furthermore, these positive impacts will improve the overall interaction quality between clinical officers and patients.

Electronic medical records have been marketed to health centers, both in small scales, such as private medical doctors or hospitals with many small clinics [9]. Among these softwares, some are specialized as special electronic medical record for medical rehabilitation therapy, such as speech therapy, occupational therapy and physiotherapy. The majority of this software are paid softwares with licenses or monthly subscription scheme. The platforms are also varied, some are desktop based, other using web-based, and some other software can be accessed through mobile device.

The implementation of this readily available software's in ASC is constrained by the high cost of subscription while the ASC itself is a non-profit government body. The free OpenEMR is too complex and irrelevant for implementation because the software does not match with the focus of the ASC services with the features in OpenEMR. OpenEMR itself is more appropriate for a clinic or hospital. Therefore, there is a requirement to implement e-health software which is suitable and free to simplify the recording and tracking of speech therapy development for children with autism in ASC.

Other than the softwares that focused on electronic medical records, there are also some desktop-based softwares which features sound or audio recording, processing, analysis, and database management for audio recording of speech therapy [10]. Unfortunately, these applications are not connected to any electronic medical record applications; therefore the audio recording during therapy cannot be correlated to patient's data. Moreover, the desktop-based

application has its own disadvantage, which is limited mobility.

Mobile device has great potentials to be adopted in speech therapy. Awad, et al [11] has utilized the reliability of computational resources, data storage, and mobility on Android devices for speech therapy. This application can capture patient's voice, processing audio signal, and giving feedback in real-time through its interface. This therapy is focused on hypophonia and hyperphonia disorder. A complementary application has been developed [12] to overcome the noise problems during therapy, and some additional fix on user interface. There are also several games and mobile application built for children with ASD to learn speech autonomously [13-17]. Computer technology, especially websites and mobile applications, have proven to give positive impact in supporting the lives of users with ASD along with their caregivers [18-19].

Based on this preliminary study, it is shown that there is a requirement for an open source application which is free (not paid) to specifically facilitate needs in an ASC, which is to simplify the recording and monitoring/tracking of the development of speech therapy for children with autism.

B. Methodology

Research has been performed in several steps, i.e. data collection, literature study, requirement analysis and system feasibility, system design, application development, application testing, and application evaluation. These steps are illustrated in Figure 1..

Figure 1 represents the methodology of this research which consists of:

1. Data collection : Starting by gathering the required data from the intended environment, which in this case is ASC Batam. This step gave us the existing problem and the existing environment where the application will be implemented later.

2. Literature study : After we discover the problem, we moved on with literature study, which gave us the preliminary result. This gave us an illustration of the current applications or systems in the domain.

3. System analysis : To be able to build a right system, we must define the system requirements by consulting the end-users. Therefore this step gave us a comprehensive look on the application, including the functions or features that will be build inside the application.

4. Application design : After we defined the architecture of the system and all the features and functions, we can further design the application, including the interfaces, database and all related aspects of the application.

5. Application development: Once the design is finished, then we can translate them into a working application using programming language.

6. Application testing: To test whether the application has successfully implemented according to the requirements, this step is performed. Therefore in the end of this step, we can conclude whether the application has been build correctly.

7. Application evaluation: After we tested the application, we need to evaluate further into the real environment, so that we can get the user satisfaction feedback and measurement.

III. RESULTS AND DISCUSSION

We developed an application for monitoring speech therapy development for children with autism. This application will be developed on as an open-source mobile-based Android device application. We called the application as "Abangmanis", which is a shorten form for "*aplikasi mobile perkembangan terapi wicara anak autis*" or mobile application for speech therapy monitoring for children with autism.

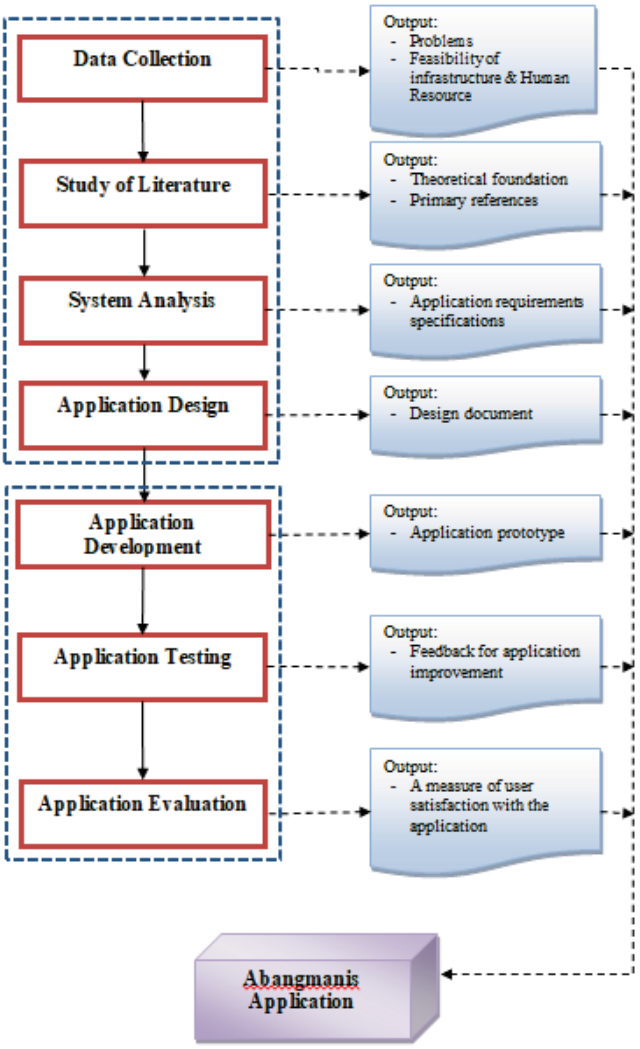

Figure 1. Research Methodology

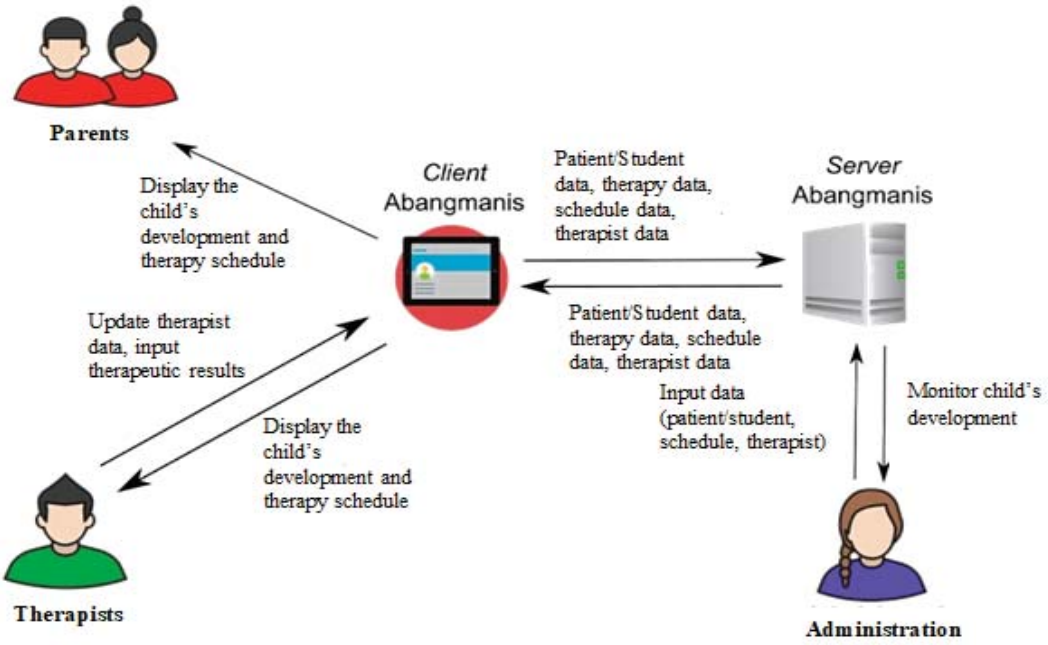

Figure 2. Architecture design

Abangmanis manages several data, namely: (1) *Patient or student* data, i.e. data about each student or patient that is registered to attend the speech therapy; (2) *Therapist* data, i.e. data about the therapists that handle the speech therapy; (3) *Therapy* data, i.e. data about the therapy itself (including the time and place, result of the therapy, etc.); (4) *Articulation test* data, i.e. data about the articulation tests that were performed in each speech therapy session. This data can be categorized based on **phoneme** and **variation** of each phoneme.

The design of application architecture is illustrated in Figure 2, while the user characteristics is shown in Table 1.

Table 1. User characteristics

User category	Task
Therapists	Perform speech therapy and recording children's development
Parents	Monitoring their child's development through records by therapists
Administration	Perform recapitulation of therapy and monitoring all registered children's development

There are 10 functional requirements designed to be implemented in the applications, as shown in Table 2.

Currently, we have developed a prototype of the Abangmanis application. It has gone under the alpha testing in the developer side using the black box methodology. This testing phase tests the previously defined 10 functional (in Table 2). The result of the testing is shown below, with each function is represented by the interface.

Table 2. Functional requirements

Item	Requirements
F001	Therapists and administration are able to perform registration process
F002	Therapists and administration are able to log into the application
F003	The system is able to display the list of students/patients registered in the ASC who need speech therapy
F004	The system is able to display detail of each student
F005	Parents are able to view their child's schedule
F006	Parents are able to view their child's development in speech therapy
F007	Therapists are able to display, add, update and delete speech therapy monitoring records
F008	Therapists are able to display, save, update, and delete documents that record speech therapy (data, audio file, or video)
F009	Therapists and administration are able to display, add, update, and delete their profile
F010	Administration is able to add and update speech therapy schedules

1. The system has implemented the registration feature for users, so that each user is granted an access into the application (according to their role and characteristics). Each user is registered using a username and password

(F001), and each user can manage their own profile (F009) as illustrated in Figure 3.

Figure 3. Manage profile interface

2. The system is able to implement the login function for all categories of users, namely therapists and administration (F002) as illustrated in Figure 4.

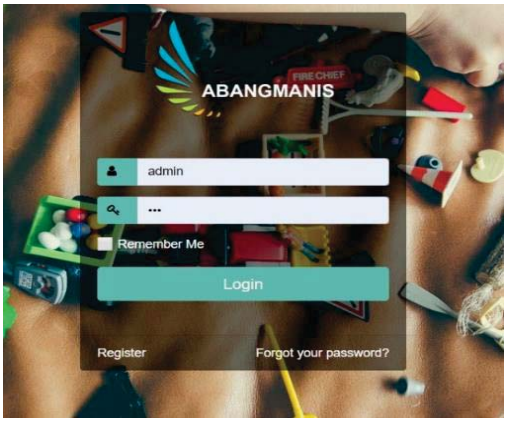

Figure 4. Login interface

3. The system is able to manage students data, both for inserting new student or deploying all students (F003, F004) as shown in Figure 5. Visualization is implemented in order to assist parents and therapist on viewing the speech therapy schedule for each student.

Figure 5. Schedule interface

4. The system is able to manage the data about speech therapy for each student, through the therapy schedule display and the development of each student (F010, F005, F006). This interface model (illustrated in Figure 6) is implemented using coloring concept. The red color shows the schedule that has been cancelled by the therapist, while the blue color marks the therapy that must be performed by each therapist according to the schedule, while the green color marks the therapies that has finished.

Figure 6. Marked schedule interface

5. The system is able to manage the documents that record the speech therapy (F008) and the records of the therapy (F007), as illustrated in Figure 7 and Figure 8. Visualization of the therapy management using a model that is easy to use for therapist.

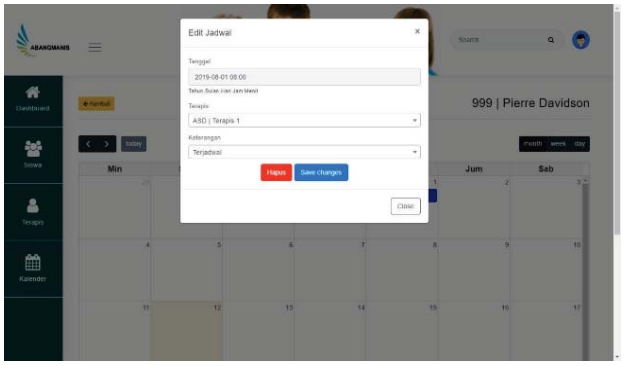

Figure 7. Manage schedule interface

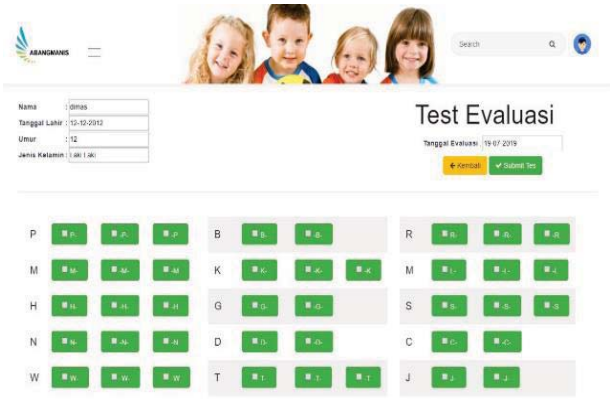

Figure 8. Articulation evaluation testing interface

IV. CONCLUSIONS

The Abangmanis application is still in prototype phase, however based on the alpha testing result, we can conclude that all features stated in functional requirements have been successfully implemented in the Abangmanis application. The test results has demonstrated that all functions work successfully. The users are categorized as therapist, parents and administration. Each user has their own privilege in the application. The application has implemented features for data management for student data, therapist data, therapy data, and articulation data. Data visualization of the speech therapy utilized the models that are easy to use for user (therapy), such as calendar model and coloring.

Therefore, this application progresses to beta testing, which is a test performed in the real environment. The application will undergo certain assessment to measure the level of effectiveness and user acceptance of the application by the users in the real environment.

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