

**DEVELOPMENT OF A MANAGEMENT SYSTEM FOR
THERAPISTS AND FAMILIES OF PATIENTS LIVING WITH
AUTISM**

BY

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CERTIFICATION

This is to certify that this work was carried out by YUSUFF Airat Olamide (CSC/2014/086) in the department of Computer Science and Engineering, Faculty of Technology, Obafemi Awolowo University, Ile-Ife, Osun, Nigeria.

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DEDICATION

This project is dedicated to my wonderful parents, DR and MRS YUSUFF for their never ending support, to Hamdalah for being the source of motivation for this project and to my other siblings for being there for me always.

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All praises and gratitude goes first to Allah SWT for preserving my life and for His never ending mercies and blessings upon me.

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ABSTRACT

Autism Spectrum Disorders are usually managed with the administration of different kinds of therapy. Platforms to aid proper documentation of the therapy reports of these patients are not free or readily available for use by Nigerian therapists. Parents and caregivers of the autistic patients also do not have complete access to these reports and no platform to promptly document their observations. This creates a need to develop a system that addresses and solves these problems.

Research and literary works were reviewed to gain knowledge on the prevalence of Autism in Nigeria as well as existing platforms for therapy reports documentation. Interviews were also conducted to gather insights on types and structure of reports issued for the therapies of focus. The system was designed using different Unified Modelling Language (UML) diagrams and the system was implemented using appropriate tools.

The system was tested by therapists specialised in at least one of the selected therapies and family members with an autistic patient undergoing any of the therapies. Responses and suggestions were collated via an online survey platform and the application was evaluated on interface design, ease of use and relevance.

In conclusion, the application fulfills the aims and objectives of the project. It will be of great use to therapists and family members of the patients to be properly updated on the progress of the therapies.

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CHAPTER ONE

INTRODUCTION

1.1 General Overview

Autism spectrum disorders (ASD) are developmental disorders that affects communication and behavior (The National Institute of Mental Health, 2018). Autism is frequently interchanged with ASD but is however, only one of the four disorders categorised under ASD. Although it can be diagnosed at any age, it is described as a “developmental disorder” because symptoms generally appear in the first two years of life (The National Institute of Mental Health, 2018). Autism is a spectrum disorder because there are very wide variations in how it affects different people, hence there are several ways to treat and manage the disorder. This usually includes the use of medication and therapy.

There are several kinds of therapy that could help in the development of children living with ASD (Legg & Osborn, 2018) and the different types include:

- i. Applied Behavioral Analysis (ABA),
- ii. Speech and language therapy,
- iii. Cognitive behavioral therapy,
- iv. Occupational therapy,
- v. Social skills therapy and a host of others.

However, there are several issues that could hinder the success of therapy and the overall development of the patient. It has been discovered that there are barely any platforms that aid proper documentation of patients’ progress by therapists or grants families of the patients, full access to these records. This could lead to disparity and inconsistency in the treatments being administered to the patients and ultimately, hinder the developmental progress of ASD patients.

This creates a need to develop a system that allows proper documentation of patient's therapy progress through reports, grants full access of the documentation to families of the patients and also provides a communication platform for therapists and families of the patients where observations and concerns about the patients could be addressed.

1.2 Statement of Problem

Management platforms to aid proper documentation of the therapy reports of autistic patients are not free and readily available for use by Nigerian therapists. Parents and caregivers of the autistic patients also do not have complete access to these reports and no platform to promptly document their observations. These can cause inconsistencies in the therapy being administered to the patient, hence greatly hindering the effectiveness of therapy and ultimately, the development of the patient.

1.3 Aim

The aim of this project is to develop a management system that aids proper documentation of therapy reports of patients living with Autism.

1.4 Objectives

The objectives of this project are to:

- i. carry out research on types of therapy undergone by autistic patients and literature review of similar and existing applications on report documentation and therapy management,
- ii. obtain required data about features to be implemented in the system from correspondence with a specialist,
- iii. design and implement the system.
- iv. test, obtain feedbacks and evaluate the implemented system.

1.5 Research Methodology

- i. Extensive research was carried out by reviewing several articles and publications on Autism worldwide and with focus on Nigeria. Publications on the different kinds of therapy undergone by autistic patient were also reviewed to gather more knowledge and streamline the focus of the system to the common therapies undergone in Nigeria.
- ii. Information needed to develop the features of the reports in the system were retrieved by carrying out a semi-structured interview with a therapist specialised in the selected therapy types. Unstructured interactions with family members also highlighted features to added on the platform. .
- iii. The design of the system was implemented using different Unified Modelling Language (UML) diagrams. The UI of the platform was designed using HTML, CSS3 and other tools that could facilitate a visually appealing and user-experience-optimized interface. The front-end development was implemented using the JavaScript language and a client-side Javascript framework, Vue.js while the backend development will be implemented with a custom API built with Node.js and a Node.js web framework, AdonisJs.
- iv. The system was tested by three families with therapists specialised in at least one of the selected therapies. The app was assessed on interface design, ease of use and relevance. Responses and suggestions were collated via an online survey platform.

1.6 Scope of Project

The management system focused solely on documentation of the reports of autistic patients undergoing either or all three types of therapy: Speech and Language therapy, Behavioural Modification therapy and Social Skills therapy.

It is available to use by therapists and family members with access to smartphones, proficiency in its use and an internet connection.

1.7 Justification

Implementing this project will provide a life-saving solution to parents and guardians of children living with autism in Nigeria to better manage and care for their wards. It will help improve the communication between the patient's therapists and family members, thus ensuring all therapy reports are documented and progress of the patients are well monitored and tracked. It also creates an avenue for family members to properly document daily observations and concerns about the patient.

1.8 Contribution to Knowledge

The proposed technology will serve as a single solution that addresses and solves related problems in the management of patients' therapy reports. It will be a very useful tool for therapists and families to monitor their patients' progress and for easier communication among everyone involved in the therapy process.

CHAPTER TWO

LITERATURE REVIEW

2.1 Background Study

Therapy plays a very important and crucial role in the developmental progress of children with ASD. This stresses the need to ensure that the different forms of therapy being undergone by these children is properly monitored through documentation of records of progress as well as observations and concerns. The development of a platform that aids communication between the therapists and guardians of children with ASD and also serves as a management platform for proper documentation of the undergoing therapy is therefore, very necessary in reducing the problems and complications of inconsistent and poorly managed therapy.

2.2 Autism Spectrum Disorder (ASD)

Autism spectrum disorders (ASD) are a group of complex brain development disorders and covers conditions such as autism and Asperger syndrome (WHO, 2019). According to the World Health Organization(WHO), these disorders persist throughout the lifespan and are marked by the presence of impaired development in social interaction and communication and a restricted repertoire of activity and interest, with or without accompanying intellectual and language disabilities. Autism has been identified as one of the five Pervasive Developmental Disorders (PDD) (Al Ateeqi et al, 2010).

King et al (2014) also described ASD as a lifelong developmental disability characterised by difficulties in social interaction and social communication, and restricted and repetitive behavior. ASD is referred to as a spectrum disorder because there are several variations and no two persons is affected in the same way. The spectrum includes conditions such as Autism, Asperger's syndrome, and Pervasive

Developmental Disorder Not Otherwise Specified (PDD-NOS) (Dempsey & Foreman, 2001).

Statistics show that 1 in 160 children worldwide has an ASD (Elsabbagh, et al., 2012) and local organizations estimate over 1 million children in Nigeria have autism-related disorders. Scientific evidence suggests that various factors, both genetic and environmental, contribute to the onset of autism spectrum disorders by influencing early brain development. Research has also found that ASD can sometimes be detected at 18 months or younger and by age 2, a diagnosis by an experienced professional can be considered very reliable (Lord, et al., 2006). Diagnosis of young children comprises of general developmental screening as well as additional evaluation by several professionals like speech-language pathologists, neuropsychiatrists and pediatricians (The National Institute of Mental Health, 2018). Older children and adults are similarly evaluated and diagnosed with more difficulty. In the current revised version of Diagnostic and Statistical Manual of Mental Disorders (DSM), all diagnoses carry an umbrella term “Autism Spectrum Disorder”.

There are several signs and symptoms that indicate a child has autism. They usually revolve around social communication/interaction behaviors and repetitive behaviors. The National Institute of Mental Health (2018) highlighted some of these as:

- i. Making little or inconsistent eye contact,
- ii. Rarely sharing enjoyment of objects or activities by pointing or showing things to others,
- iii. Failing to, or being slow to, respond to someone calling their name or to other verbal attempts to gain attention,
- iv. Having facial expressions, movements, and gestures that do not match what is being said,

- v. Having an unusual tone of voice that may sound sing-song or flat and robot-like,
- vi. Having trouble understanding another person's point of view or being unable to predict or understand other people's actions,
- vii. Repeating certain or unusual behaviors. For example, repeating words or phrases, a behavior called echolalia,
- viii. Having a lasting intense interest in certain topics, such as numbers, details, or facts,
- ix. Having overly focused interests, such as with moving objects or parts of objects,
- x. Getting upset by slight changes in a routine,
- xi. Being more or less sensitive than other people to sensory input, such as light, noise, clothing, or temperature, etc

No cure exists for autism spectrum disorder (Tager-Flusberg & Caronna, 2007), and there is no one-size-fits-all treatment. Treatment of ASD will however, help reduce the symptoms and support development and learning. Early intervention helps in learning critical social, communication, functional and behavioral skills. Treatment usually is in form of therapy and medications.

Medications basically help control symptoms and reduce problems with irritability, hyperactivity, attention problems, and repetitive behavior amongst others. People with ASD may also be referred to doctors who specialize in providing behavioral, psychological, educational, or skill-building interventions.

2.3 Autism Treatment

Treatment for ASD should begin as soon as possible after diagnosis. Early treatment for ASD is important as proper care can reduce individuals' difficulties while helping them learn new skills and make the most of their strengths (The National Institute of Mental Health, 2018). As previously outlined, therapy and medication are mainly used in the treatment and management of autism. It should also be noted that autism has no cure and can only be managed.

Legg & Osborn (2018) outlined some medications used to control conditions associated with autism and they include:

- i. **Antipsychotics.** These medications help with aggression, self-injury, and behavioral problems in both children and adults with ASD. The FDA recently approved the use of risperidone (Brand name: Risperdal) and aripiprazole (Brand name: Abilify) to treat symptoms of autism.
- ii. **Antidepressants.** Although researchers aren't sure whether antidepressants actually help with autism symptoms, they may be useful for treating obsessive-compulsive disorder, depression, and anxiety in people with autism.
- iii. **Stimulants.** Stimulants, such as methylphenidate (Ritalin), are generally used to treat ADHD, but they may also help with overlapping autism symptoms, including inattention and hyperactivity. A review (LeClerc & Easley, 2015) suggested that about half of children with autism benefit from stimulants, though some experience negative side effects.
- iv. **Anticonvulsants:** Some people with autism also have epilepsy, so anti-seizure medications are sometimes prescribed.

Alternative treatments are also administered and NCCAM (2010), defined complementary and alternative medicine (CAM) as “a group of diverse medical and health care systems, practices, and products that are not generally considered to be part of conventional medicine”. It may include placing these children on special diets. Many parents have reported a reduction in autism symptoms when certain dietary interventions have been tried. These diets (SPECIAL DIETS, n.d.) include the following:

- i. Casein-free diet (casein is a protein found in milk; this diet eliminates milk and all by-products of milk).
- ii. Gluten-free diet (gluten is a protein found in many grains; this diet eliminates such grains).
- iii. Feingold diet (eliminates additives and chemicals).
- iv. Specific Carbohydrate diet (removes specific carbohydrates including all grains, lactose and sucrose).
- v. Yeast-free Diet (eliminates yeast and sugar).

There are also several therapy approaches that help improve social functioning, learning, and quality of life for both children and adults with autism. Bertin (2016) in his article suggested that behavioral and speech language therapy are typically the foundation of intervention and that the most proven approach for children with autism is behavioral therapy.

2.3.1 Behavioral Therapy

Behavioral therapy is employed by therapists to reinforce wanted behaviors and reduce unwanted behaviors in children with ASD. It basically involves carefully observing current behaviors and then targeting specific ones for change.

Geraldine Dawson, Chief Science Officer of Autism Speaks stated that early intensive behavioral treatments can help guide brain and behavioral development back toward a normal pathway (Dawson, 2008). There are several forms of behavioral therapy approaches which are effective and safe in their treatments, although costly and labor-intensive.

Applied Behavior Analysis (ABA) is the most studied and commonly used behavioral intervention and has been around for more than 50 years (Bertin, 2016). It is a highly structured, scientific approach that teaches play, communication, self-care, academic and social living skills, and can reduce problematic behaviors. It investigates environmental variables influencing socially important behaviors and uses those findings to implement interventions that will improve such behaviors (Cooper et al, 2007). There are different types of ABA approaches and they include:

- i. **Discrete Trial Training (DTT):** It is the most deliberate and purest form of ABA. It involves teaching new skills in a controlled, step-by-step way. The breaking of tasks and behaviors into several small steps increases the likelihood of achieving success with learning the skill.
- ii. **Positive Behavioral and Support (PBS):** It is used to figure out why a certain problem behavior is being exhibited by the child. Changes that could make a correct behavior more positive for the child are enacted.
- iii. **Pivotal Response Training (PRT):** Its aim is to improve "pivotal" skills, such as motivation and taking initiative to communicate and the training takes place in the child's everyday environment.
- iv. **Early Intensive Behavioral Intervention (EIBI):** It provides individualized, behavioral instruction to very young children with ASD and usually requires a large time.

Relationship Development Intervention (RDI) is a relatively new form of behavioral therapy that focuses on the social behaviors of the child. Activities are set and carried out usually by parents intensively. This therapy is more effective on younger children but also appears to work on older children.

Sensory Integration therapy is another form of behavioral therapy that is concerned with improving the sensitiveness to sensory stimuli that may be overwhelming to children with ASD. Stimuli like loud noises, bright lights and touches are usually worked.

Cognitive Behavioral therapy (CBT) is also another form of therapy used in reducing challenging behaviors like obsessions or emotional meltdowns and it helps in the regulations of emotions and impulse control.

2.3.2 Speech and Language Therapy

Speech-language therapy can help people with autism spectrum disorder (ASD) improve their abilities to communicate and interact with others (Paul, 2008). Speech and language therapists help to assess, diagnose, and support autistic people by working to enhance their communication skills, so that individuals with autism can effectively communicate their thoughts, needs and feelings (RCSLT, 2009). They can help improve their spoken or verbal skills as well as their non-verbal communication. Some children on the spectrum are non-verbal, hence therapists focus on the teaching of non-verbal communication skills like the use of hand signals or sign language and also the use of picture symbols.

It could also include improving on social skills and normal social behaviors like learning to make eye contact with other persons, sit and stand in close proximity with “strangers”.

2.4 Therapy Management

There's still very limited understanding about ASD and its implications, hence the management and critical monitoring of a patient's therapy is an area yet to be fully explored. Families are often criticised and isolated from their communities due to limited knowledge about the disorder. There is a need to enlighten the communities to embrace these children and encourage their training and development by not excluding and isolating them. Parents and families are encouraged not to hide these children, rather seek all kinds of extensive care and treatments that could help improve their conditions. They are required to be fully involved in the trainings by the therapists as well as ensure close monitoring and tracking of the developmental progress of the children.

In recent times, a lot of technologies, with more focus on mobile technologies, have been built to manage and help in the management of several aspects of the lives of patients with ASD. These technologies span across several kinds of therapies, as well as location tracking, to help know the locations of ASD patients (especially non-verbal and severe autism patients) at all times. Although these technologies might be lacking in different areas, they each focus on a particular area and help improve conditions in that aspect.

2.5 Related Works

Grigore (2015) proposed an app, Chartered Minds, to aid documentation of therapy reports. It implements a digitized-datasheet approach in which therapists use to assess patients during sessions, upload the datasheets to the app and graphs, statistics and reports are generated. The generated materials can be used to review the patient's progress and provide recommendations on how to improve upon therapy sessions.

It was reviewed as a tool that aids all-round communication amongst everyone involved in the patient's therapy and also reduces the stress of manual documentation of each therapy session. However, it was only a proposed project and was never built due to lack of funding.

Voon et al (2015) worked on the design and development of a mobile communication platform, AutiSay, to be used by autistic children and their caregivers, parents, teachers and therapists. The aim was to make use of advanced mobile and ubiquitous technologies to develop a communication tool to improve the social communication of the autism child and therefore alleviate the quality of life for the child and those around him/her. Similar apps for autism in the communication category were reviewed as well as the limitations on which AutiSay was to improve upon. The app was designed based on the Picture Exchange Communication System (PECS) and a beta version was used to test and note areas of improvement. The feedbacks were used in the development of AutiSay and it had about four features available for use. The benefits were reviewed, from its portability, ease of customization and relatively inexpensive costs. However, it was recommended that other content options should be made available for adults with autism, in place of the pictures. The app was also developed only for iOS and was recommended that an android version be made available.

Eder et al (2016) developed an interactive mobile game application for autistic children. The app was named "Fill Me App" and was primarily focused on the identification of human body parts and a centralized database that could be accessed by parents and caregivers of the child for progress. Existing applications that were useful in the development of social skills and emotional connections were reviewed along with games that were built for education for children with ASD. The features of this game

application included a scoring system for focus monitoring, eye-catching graphics, simple level of exercises, video tutorial and background music that coincide with the current educational teachings. Data on the attention span of children in different age groups was collected and analysed. It was concluded that the app was effective in improving the attention span of autistic children and keep them more motivated than traditional methods.

Gang et al (2017) developed an interactive story books app (ISB) as a speech-language therapy tool for special needs children in Malaysia. It was designed for Malaysian children with cognitive disabilities and speech-language impairments. The app was developed using the Android platform and included three parts (ISB, speech exercise and animated songs). Although the speech technology in computer-assisted language learning is also widely used in Malaysia, this app is aimed at being a form of interactive entertainment, in which the player can explore, learn and practice by themselves. The platform was developed using JavaScript with a Graphical User Interface (GUI) in HTML, hence it is platform independent and can run on all mobile operating systems. Information required to develop the app was gathered through the use of survey questionnaires on parents and children in the speech-language therapy area of a Malaysian clinic. The app was then evaluated by experts, parents and children on its usefulness and contribution to ease of learning. Conclusions showed that parents as well as therapist experts agreed the app was a speech-language therapy tool for the children and suggested on improvements.'

A review of an article by Prospero (2014) highlighted 13 best Autism apps for iPhones and iPads. Some of them like Proloquo2Go and TouchChat HD helped in speech and language impairments, Pictello and ABA Flash cards help to improve recognition and self-care patterns, EASe personal listening therapy and Autism Tracker

monitors and documents moods and behaviors of patients and Kid in Story helps improve social interaction. It was however noted that these apps were mostly paid with heavy subscriptions in foreign currency and were only available on iOS. Some apps also had Android versions, however they still all had limitations and none addressed exactly documentation of therapy reports.

Doeniyas et al (2014) conducted a study in Turkey to teach picture sequencing skills to children with autism using a web-based iPad application. It was noted that the use of technological advancements has more effect in the training of autistic children. The application was designed to improve upon existing sequencing applications and five sequencing apps were reviewed along with their limitations. It was built based on ABA methods and hence had three different design conditions and two types of session. The app was web-based and built on HTML5 and CSS3, along with JavaScript/jQuery for compatibility on all platforms. Three Turkish boys with autism of age 4, 11 and 15 participated in the evaluation of the application. Results from testing showed that the app was more suitable if built in different versions for different age groups, identified the communication and vocabulary skill level of the child and provided a generalization check to ensure the child can communicate activities carried out on the app to third parties.

Soron (2017) discussed the different technologies that can be used to assist in the treatment of ASD. Mobile phone apps can be used to assist in the screening, providing interventions as well as of follow-ups of the patients. The development of a global technology based mobile hub of the sign- symptoms and challenging behavior of autism can also help to track the time trends, sociocultural and regional influence. A mobile-based text message service can also be used as an assistive device to help augment communication and keep the caregivers updated and trained at their

convenient time remotely. It can also be very useful in tracking the signs and symptoms of the children. Another major technology solution is to provide an internet-based cognitive behavior therapy for caregiver's anxiety and depression that they may develop in the course of the managing the children. Social media is also an explosive technology that can be used in assisting the treatment of autism by providing a platform for families of children with ASD to connect and share their experiences. Interactive computer games and programs can also help improve communication and social skills of children with ASD. Final conclusions highlighted that the use of mobile-based services has great potential in taking care of autism.

Kim et al (2017) examined the smartphone apps currently available for autism and the clinical evidence supporting its use and effectiveness. It was discovered that there were nearly 700 "autism apps" amongst about 95.1% were either no longer available, completely outdated or had no clear direct or indirect evidence supporting their benefits. It was concluded that there needed to be structural guidelines to follow as well as clinical evidence supporting its benefits before the development and release of any autism-related application.

Costa (2011) gave a brief summary of how robots can be used to help the treatment of ASD. A robotic project was developed with the goal of improving the social life of children with autism with a main focus on promoting their social interaction and communication. The advantages and disadvantages of the implementation was examined and discussed. The problems included tailoring the robotic activities to each child's specific needs as ASD is a spectrum disorder and doesn't affect any two persons in the exact same way. The specific adaptation could lead to complications in its use but the problem can be averted by specifying a wide range of activities. It was also highlighted that engaging in activities with the robot can

promote isolation as the child plays alone. This contradicts the efforts being made to increase patient's interaction with his/her environment. This can be averted by making use of the robotic tool, only as a third party between the patient and the therapist.

Vlachou & Drigas (2017) evaluated the use and effectiveness of mobile technologies for assessment and as treatment interventions for children and adults with ASD. They reviewed three prototype applications developed for the purpose of updating the assessment and diagnosis of children with autism (CWA), as well as the therapeutic interventions. They included The Walden Monitor, (a wearable prototype for recording observable data, with a head-mounted bullet camera based on a Tablet PC for the research assistant to capture the child's data), Abaris (an Environmental Prototype for Recording Discrete Trial Data where therapists use a tablet application to customize the child's daily therapy and to record data) and Care-Log (a distributable prototype for recording semi-structured data that consists of a mobile system using the configuration of capture and access devices designed to collect this information). Although found useful, it was concluded that these prototypes were not flexible enough to support the cyclical activities involved in caring for CWA and although different variations were made (including iPad mobile applications), they still fell short in terms of individualizing each user's needs. Mobile tools for interventions were also reviewed and three major domains were analysed: Augmentative or Alternative Communication (AAC), Academics and Entertainment. It was concluded that mobile technology assessment tools were very important for initial diagnosis of autism and for updating assessments throughout a patient's therapeutic intervention and that there was always space for further development.

Alzrayer & Banda (2017) outlined some guidelines for special education teachers to improve communication skills of students with autism by implementing

tablet-based devices. It was outlined that research supports the use of tablets for improving communication skills in individuals with ASD and other developmental disabilities and that augmentative alternative communication (AAC) devices and methods were often used to address their communication needs. The following guidelines were recommended to special education teachers in the selection of an iPad/iPod and AAC app that meets the student's requirements and assists in the implementation of the methods effectively: Assessment of the student's related abilities, selection of a device and app, conducting a preference assessment, train using systematic instructional methods, collection of intervention data and evaluation of progress, program generalization and finally, teaching of operational skills. It was concluded that the implementations of these guidelines by teachers could have positive effects on students with ASD.

Fletcher-Watson, et al (2016) evaluated a technology-based early intervention for social communication skills in preschoolers in a randomised controlled trial. The study evaluated 54 children who tried out the iPad apps. Results showed that there were no significant group differences in parent-report measures nor in a measure of parent-child play at follow-up. It was concluded that there were no significant benefits of playing the app on real-world social communication behaviours, although there were indications of positive impact.

Crespo & Martin (2017) reviewed several applications with Spanish versions focused on support for individuals with autism spectrum disorder. A systematic search was conducted to gather scientific publications that evaluated these mobile applications and data was extracted from these documents using bibliometric analysis. Results from search showed that there were applications available with and without Spanish versions, with the predominant language being English and from approach showed that the

applications were categorized mainly as communication, learning, leisure support tools, emotions and social behavior, and resources for parents and professionals, with about 44% being multipurpose and learning being the most popular category. Results from platform perspective showed that most of these applications were developed for iOS platforms and from the price, age of use and scientific validation perspective, only 32% were free applications, about 71% were for individuals of all ages and only about 4% had scientific evidence to support them. It was concluded that the use of apps and mobile devices should be seriously considered when seeking to acquire communication and social skills, as well as social behavior improvements in people with ASD. It's also recommended that more apps developed for these interventions should be more generalized in terms of language.

Chukwueloka (2016) in her dissertation thesis evaluated the attitudes of Nigerian mothers towards their autistic children. Information was gathered through the interviews of eight Nigerian mothers caring for their autistic children in South-Eastern Nigeria. The findings were interpreted in seven themes, one of which was a conclusion that Nigerian mothers recognize Autism as a developmental disorder and no exact cause for it, although attributed to genetic and environmental influences. Studies also showed that the mothers and immediate families of the children treated them with love and care, engaged and interacted with them as well as participated in their treatments. It was also found out that members of the community still viewed autism as “abnormal” and “spiritual” and that more efforts needed to be made on spreading awareness about the disorder. The participants also reported that they engage the children in different forms of therapy as treatment but there were also hindrances like inadequate specialist care, expensive treatments and no involvement from the government. Findings also showed that the mothers and families had challenges raising autistic children, as they exhibit

behaviors that require patience and perseverance. It also showed that there was lack of assistance to provide quality care for these children. It was advised that measures should be put in place to ease these psychological burdens and that quality and affordable assistance services by professionals should be made readily available in the society.

Ann-Baba (2014) wrote a paper on living and dealing with autistic children using a Nigeria family in the United States as a case study. The main aim was to examine how a family coped with living with and caring for an autistic child. Data was collected by observing participants and through semi-structured interviews. The findings showed seven key parental concerns and feelings: social stigma, readjustment of family plans, financial burden, and feeling of helplessness, fear of the future for children, fight for a cure, and a vision to create of an Autism Family Center. Analysis of results showed that the family had different coping mechanisms and although siblings will live longer with these special needs children, some tend to exhibit sense of withdrawal due to “courtesy stigma”, stigma by association to an autistic child. Results also showed that the family had reduced social interactions with other families and members of the community but they made efforts to educate people and the community about autism and get rid of the superstitious beliefs. It was highlighted that general outings were challenges but working collectively together and from a live-in nanny helped ease the challenges a little. Analysis also showed that both parents exhibited different concerns, one of which was worry about stigma while the other was keen interest in how to get better treatments for the autistic children.

Tilahun et al (2016) examined the stigma experiences, explanatory models, unmet needs, preferred interventions and coping mechanisms of caregivers of children with developmental disorders in a low-income African country. The country of study was Ethiopia and it was conducted in two public referral hospitals with specialist

expertise in child developmental disorders. The study population included all available caregivers of children below the age of 18 and data was collected through the use of questionnaires structured into five parts of socio-demographic characteristics, family experience of stigma, explanatory model of illness, type of intervention used or desired and caregiver coping strategies. Results from demographics estimated that 4.9% of caregivers had one or more children with developmental disorders, on family experience of stigma, almost all participants cited one kind of stigma or the other and also cited a mixture of biological and spiritual factors as causes of the child's condition. It was concluded that caregivers of children with ASD in Ethiopia face many challenges, including high levels of stigma and a lack of appropriate provision for their children.

Eseigbe et al (2015) researched on the level of knowledge of autism and its management amongst medical doctors in Nigeria. The study was limited to one state, Kaduna, Nigeria and a self-administered tool, the Knowledge about Childhood Autism among Health Workers (KCAHW) questionnaire, was used in assessing knowledge of autism among 175 medical doctors (participants) attending an annual scientific meeting in northwest Nigeria. Other parameters were socio-demographic and professional characteristics of the participants and challenges encountered in the management of autism. It was observed that specialists like pediatricians and psychiatrists had a better understanding of the disorder than general practitioners who were about 80% of the participants. Final conclusions showed that there is a significant gap in the identification and provision of health and social services for autism in Africa and the dearth of specialist services, cost of accessing care and poor caregiver perspectives were major challenges of management. It also highlighted the need to improve on the knowledge of childhood autism amongst medical doctors, hence increasing the level of madness.

Audu & Egbochuku (2010) investigated the existence of autism among primary school pupils in Benin metropolis and the implications of counselling. The study was as a result of parents and teachers having little understanding of the causes, symptoms and effects of the disorder. Research was done using survey questions to collect data from parents and teachers. Data gathered indicated that a lot of pupils in primary schools exhibit some symptoms of autism and boys were more afflicted than girls. It was also observed that guidance and counselling of pupils, especially those with learning disorders, fell short of expectations. Teachers misjudged and labeled pupils as either bright achievers or underachievers. Final conclusions also showed that autism difference in occurrence by age, awareness level of parents should be increased to prevent problems at home and school environments and guidance and counselling of these special kids should also be encouraged.

Frank-Briggs (2012) reviewed the clinical features and management of autism as well as its challenges in Nigeria. It was highlighted that autism is a pervasive developmental disorder and can be distinguished by a myriad of symptoms. Patients with autism experience difficulties in social development and communication and also exhibit several abnormal behaviors which the Repetitive Behaviour Scale-17 Revised (RBS-R) categorized as stereotype behaviors, compulsive behaviors, sameness, ritualistic behaviors, restricted behavior and self-injury. Diagnosis is also done using popular diagnostic instruments like Autism Diagnostic Interview-Revised (ADI-R), a semi-structured parent interview, and the Autism Diagnostic Observation Schedule (ADOS) which uses observation and interaction with the child. Final conclusions show that although there are limited resources to educate people in Nigeria about autism, efforts should be made to create awareness about the disorder amongst parents and

guardians and effectively manage the treatments whether in form of therapy or medications.

A systematic review of research on autism spectrum disorder by Abubakar et al (2016) showed that there was a dearth of published works and information on the prevalence of autism in sub-saharan Africa. Findings showed that research carried out in this area were only found in two countries, Nigeria and South Africa and even these researches were estimated to be over a decade. Four databases were searched as well as the Google Scholar database for traces of overlooked researches. It was also discovered that there were few to no studies with validated screening and diagnostic measures. It was concluded that the current evidence base is too scanty to provide the required information, thus making it difficult to estimate the burden of ASD in this population, identify risk factors, or even plan effective intervention strategies.

Preece et al (2017) carried out research on understanding of ASD by Nigerian Teachers. A survey was carried out on mainstream urban and rural schools in Lagos state, Nigeria and results showed that over 50% of urban teachers and 70% of rural teachers had low level of understanding in ASD. It was concluded that there is an urgent need for improved professional education and training about the disorder and that educational interventions in ASD can have a transformative impact on the lives of children with ASD, their families and their teachers within this region.

Spain et al (2018) carried out a systematic review to establish a relationship between the core symptoms of ASD and social anxiety in individuals with ASD. Data was gathered from five databases and were extracted based on study designs, sampling frame, sample size, participant demographics in clinical and comparator groups, methods of ASD diagnosis, outcome measures employed, study results; and methodological considerations. The data was then analysed using a narrative approach

and the study quality assessed using the quality assessment tool for quantitative studies. Results showed that ASD individuals do experience anxiety and worry about social interactions. The need to extend evidence base was recommended so that prevention, early detection, and targeted interventions for SA could be achieved.

Schaefer et al (2008) evaluated clinical genetics in identifying the etiology of autism spectrum disorders. Findings show that influences have resulted in a marked increase in the number of referrals to clinical geneticists for evaluation of persons with autism spectrum disorders. The primary role of the geneticist in this process is to define etiology, if possible, and to provide counseling and contribute to case management. Studies showed that genetics had a crucial role in autism related disorders and that males are 4 times more affected than females. Final suggestions on how to improve the study of clinical genetics were outlined, including referrals, counselling and follow-ups.

Scott-Croff (2017) discussed the impact of diagnosis of autism spectrum disorder on nonmedical treatment options within the learning environment from the perspectives of pediatricians and parents. The research study captured the experiences of five parents and pediatricians of children on the spectrum. Results concluded that parents had little or no knowledge on the diagnosis of their children and there were little or no resources to shed more light on treatment options for these affected children. The results also indicated that the initial training received by the pediatricians was not enough to address the needs of the children diagnosed with autism and recommendations included hands-on training for parents, ongoing additional professional development for pediatricians, support groups for parents, and resources immediately available for parents at the time of diagnosis.

Volkmar et al (2014) published a practice parameter for the Assessment and Treatment of Children and Adolescents with Autism Spectrum Disorder. It targeted children and adolescents with ASDs and three assessment and four treatment recommendations were deduced. The treatment recommendations included behavioural, communication, educational and other interventions.

Bello-Mojeed & Bakare (2013) emphasized the importance of improving the treatment of children with ASD in low and middle-income countries by reinforcing non-specialist care providers. They outlined that although pharmacological interventions are easier to implement and used to correct behavioral problems like aggression or self-injury, they do not treat the core features of autism. It was noted that psychosocial interventions that encompasses all behavioral, educational, socialization skills/trainings could be effectively delivered by non-specialist care providers. The research however uncovered that there were scarcity of adequately trained care providers as well as necessary tools and facilities needed. Implementation of non-specialist care with sustainable facilities, adequate training and retraining of specialists as well as other recommendations were advised.

Ospina, et al (2008) conducted a systematic review to summarize the evidence on the effectiveness of behavioural and developmental interventions for ASD. Searches and studies were conducted to observe the effects of a behavioural or developmental intervention in individuals with ASD. Data was abstracted based on randomization, therapeutic regimens, intervention providers, and treatment fidelity and analysis was conducted to classify and describe interventions that fall within the continuum of behavioural and developmental interventions for ASD. A review was carried out on the effects of the eight broad types of interventions for ASD (Applied Behaviour Analysis interventions, communication-focused interventions, contemporary

developmental approaches, environmental modification programs, integrative programs, sensory motor interventions, and social skills development interventions). It was demonstrated that there was a lack of agreement on the clinically relevant effects of these interventions and there is no clarity on the most effective therapy to improve ASD children. Detailed review of each intervention led to the conclusion of including interventions that address the behavioural, social, and communication deficits associated with the disorder.

Lofthouse et al (2012) conducted a review of complementary and alternative treatments (CATs) for ASD. It was acknowledged that several therapy treatments as well as medications are known to improve AD symptoms. However, the cost and availability of these options led to the review of other effective alternative treatments though the effectiveness remain unproven. Several kinds of CATs were being used by families of ASD patients in different countries, however the study highlighted 13 ingestible and 6 non-ingestible CATs with their descriptions, research support, limitations and possible clinical outcomes. The ingestible CATs included: Melatonin, B6 and Magnesium, Methyl B12, Multivitamin/Mineral Supplements, Folic Acid, Omega-3 Fatty Acids, Probiotics and GI Medication, Iron Supplementation, Chelation, L-Carnosine, Ascorbic Acid, Cyproheptadine and Immune Therapies. The non-ingestible CATs included: Massage Therapy, Acupuncture, Exercise, Music Therapy, Animal-Assisted Therapy (AAT) and Neurofeedback (NF). Final conclusions were that the authors could only recommend two ingestible CATs (melatonin and RDA/RDI multivitamin/mineral) and one non-ingestible CAT (massage therapy). It was also recommended to try these other CATs if the above mentioned were found to be ineffective: Ingestible CATs like B6 and magnesium, multivitamin/mineral, folic acid, omega-3, L-Carnosine, probiotics and GI medication, iron supplementation and

chelation and the non-ingestible CATs were listed as CATs: Acupuncture, exercise, music therapy and animal-assisted therapy. It was also noted that N-Acetylcysteine (NAC) was an ingestible CAT with great potential for effectiveness.

Weston et al (2016) carried out a systematic review and meta-analysis on the effect of cognitive behavioral therapy (CBT) on people with ASDs. Studies have shown that CBT was effective on children and adolescents with anxiety disorders and social skills training. The main aim was to examine how CBT could be adapted for the treatment of actual ASD symptoms rather than affective disorders and to investigate the differences in the outcomes for children, adolescents and adults. Systematic searches were carried out on electronic databases and the obtained data was analysed for ASDs and for affective disorders. Results showed that there were little to no changes on the minimal effects of CBT on ASDs compared to affective disorders. These results could be as a result of the difficulties of ASD patients in reporting symptoms as they may be very confusing to them. It was also reported that there were a lot of limitations and assumptions made during the study, so the results might as well be inconclusive especially since it is not known whether CBT does truly have an effect on the treatment of ASD.

Batool & Ijaz (2015) conducted a study to evaluate the effectiveness of speech and language therapy for ASD. The study was conducted by evaluating two children with Asperger-like symptoms selected using purposive sampling technique from the Center of Mentally & Physically Affected Special Students, (COMPASS). The therapy training lasted six and half months and evaluation afterwards showed that the children showed some improvements in specific aspects of communication and understanding and hence therapy was found to be effective. However, this study does not prove

effectiveness of the therapy on ASD children with autism or more severely related disorders on the spectrum.

Gee et al (2018) explored the role of occupational therapy in the treatment of children with ASD. It was outlined that occupational therapists address issues of ASD patients relating to adaptive behaviors, rest, sleep as well as social participation and that specific intervention techniques used for individuals with ASD included establishing new functional skills, modifying activity demands, creating healthy lifestyles, maintaining existing performance, and preventing future difficulties for clients at risk. They also explored the different therapeutic approaches that can be used by occupational therapists to assist in the growth and development of children with ASD. The approaches included: 1) Sensory processing treatment approaches like Ayres sensory integration intervention, sound-based interventions, weighted blankets and vests, 2) Task-oriented treatment approaches like Treatment and Education of Autistic and Related Communication-Handicapped Children (TEACCH) and Cognitive orientation to occupational performance (CO-OP), 3) Behavioral treatment approaches like Applied behavior analysis (ABA) and 4) Social-emotional treatment approaches like Developmental, individual difference, relationship-based model (DIR/Floor time). It was concluded that occupational therapists needed to be more involved in the training of children with ASD.

Vitásková & Kytnarová (2017) explored the impacts of a speech and language therapist in improving communication pragmatics of children with ASD. The assessment was aimed at comparing the responses of children with ASD to communication interventions compared to children with specific language impairments. The assessment material prepared for assessment of children's pragmatic communication behavior was based on individually focused direct observation and

performance testing, developed specifically for a speech therapist and intended primarily for children with ASD aged 5-18 years. Although research assumptions were that children with other disorders will perform better than children with ASD, the difference in results were found to be minimal and negligible. It was also concluded that age had a negligible effect on the effectiveness of the therapy despite results that some younger children had better performance than the older ones.

2.6 Overview of Project

The literature works reviewed showed that there was still need to educate and create more awareness about ASD and it also highlighted that mobile technology is now being used to aid development and progress of interventions in ASD patients. Although the reviewed technologies tackled specific areas of interventions, there was a lack of technology to provide full access to records of progress and trainings by therapists for parents and caregivers of children with ASD. There was also a lack of a communicative platform where records of observations and concerns by relatives could be logged for easy access by the therapists. Hence, this project will bridge the access and communication gap between therapists and caregivers of children with ASD.

CHAPTER THREE

METHODOLOGY

Methodology describes actions to be taken to investigate a research problem and the rationale for the application of specific procedures or techniques used to identify, select, process, and analyze information applied to understanding the problem, thereby, allowing the reader to critically evaluate a study's overall validity and reliability (Kallet, 2004). This section outlines the steps and procedures used in gathering information required for analysis, system features and requirements, design, implementation and testing methods of the Management Platform for Therapists and Families of Autistic Children.

3.1 Requirements Gathering and Analysis

The development of the management system required detailed information targeting the area of therapy for autism and its effectiveness as well as management by both therapist professionals and families of the patients.

3.1.1 Research Analysis

Data used in outlining major systems requirements and features were collected via research and reviews of existing platforms as well as correspondence with specialists and family members.

The research conducted revealed the low levels of awareness of the disorder, the stigma still being associated with it and how the patients, their family members and care providers have to cope with this stigma in their daily lives. The research also revealed the efforts being made to increase awareness about these disorders in order to reduce and eventually end the stigma associated with them.

Several types of therapy can be used to manage autism and ASD. However, from reviews of several publications by Nigerians, it showed three common therapies for Nigerian patients. These therapies were referred to in different but similar terms to:

- i. speech and language therapy,
- ii. behavioral therapy and
- iii. social skills therapy.

Speech and Language therapy addresses communication problems, either through specialist approaches on the speech organs or training patients on alternative form of language, most common being the sign language. Behavioral therapy summarily focuses on correcting unwanted behaviors by reinforcing desired behaviours through incentives, encouragement and other specialist approaches. It is a very wide field and split into different categories depending on the patient. Social skills therapy attempts to improve patient's interactions with external factors like the environment, family members and people generally.

The reviews of applications focused on therapy management showed that there were several mobile apps built over time that addressed different aspects of therapy, from teaching patients using Picture Exchange Communication System (PECS), speech therapy tools to documentation apps for reporting daily moods, behaviours and eating habits of patients. Only one app, Chartered Minds, by Grigore (2015) targeted online documentation of therapy reports by taking snapshots of therapy session notes, uploading and other premium features. The app was however never built due to no fundings.

3.1.2 Interviews

A semi-structured interview was conducted with an autism specialist of the Patrick Speech and Language Centre, Ikeja, Lagos. The interview was via email correspondence and featured questions targeted at the kinds of reports kept for the selected therapies. Some of the questions included:

- i. Areas of specialization,
- ii. How do you track the progress therapy training on a patient?
- iii. What are the different kinds of progress reports provided for these therapies?
- iv. What are the details included/required in these reports?
- v. Please give a brief summary of the general course of actions in a typical therapy session.

The full interview structure and respondent's answers are included in the appendix. The responses revealed that reports were indeed sent manually, in hard copy format to parents of patients and that other family members are not usually actively involved in these therapies because they are not constantly up-to-date on the patient's progress.

Unstructured online interactions with family members of patients living with autism also further emphasized the fact that families of these patients face a lot of stigma and do not often interact with society. However, after being assured of confidentiality, it was gathered that a large percentage of the parents and family members don't have a proper and well-updated knowledge of treatments. Also, progress reports and other documentations are also not readily available and accessible to them.

The correspondents agreed that a platform to help them gain easy access to reports provided by therapists would help keep them up-to-date about the patient's progress without having to be physically present during therapy sessions. They also expressed that they'd love to have a platform with a means where they can easily

document and send reports of observations or concerns about the patient. Coupled with the knowledge gained from research, these details were used to define a formal user specifications of the system.

3.2 System Specifications

There are three users of the system: Therapist, Parent and Caregiver. The Caregiver is a sub-user to the Parent and they are both categorized as Families of the patient. The system flow was structured to focus on the patient (a non-user of the system).

3.2.1 Features

Features accessible to the therapists are outlined below:

- i. **Account registration and verification:** This includes obtaining personal and professional information of the therapist and a verification of the account is sent via email.
- ii. **Patient registration:** This logs information required about the patient and the parent/guardian's basic information. Only parents with parent accounts on the platform can be attached to patients and this is done via their email addresses. The parent is sent a verification email to confirm relationship to the patient.
- iii. **Activity Lists creation:** This involves creating a document for each patient that highlights activities for the patients at different periods of the day and it is to be assessed and used by parents/caregivers daily.
- iv. **Session reports creation:** This involves creating reports about each therapy session, includes all necessary details on the concluded session and is also accessible by parents/caregivers.

- v. **Monthly Reports creation:** This gives a detailed summary of the work done over the month, progress achieved and next course of action. It's accessible to parents/caregivers.
- vi. Therapists also have access to observations reports to be created by parents and caregivers.

Parents' features are outlined below:

- i. **Account registration and verification:** This includes obtaining personal information about the parent and a verification of the parent account is sent via email. Parents are also required to confirm relationship to patients when they get a notification email.
- ii. **Caregivers Account creation:** Caregivers accounts are to be created using this feature. This gives the added caregiver access to all the documentation available on the patient. Caregivers will receive emails with instructions on creating their passwords and account activation.
- iii. **Observations Reports creation:** This includes creating reports with details on concerns and observations about the patient and can be accessed by the intended therapist.
- iv. Parents also get access to activity list of patient, all session and monthly reports created by the therapists.

Caregivers' features are outlined below:

- i. **Activation and Login:** This involves activation of the account via the email sent as well as password creation for the new account.
- ii. **Observations Reports creation:** This includes creating reports with details on concerns and observations about the patient and can be accessed by the intended therapist.

- iii. Caregivers also get access to activity list of patient, all session and monthly reports created by the therapists.

3.2.2 Assumptions

The system was built upon the following assumptions:

- i. The family have only one autistic patient and one or more therapists.
- ii. The users of the system have access to internet and have email addresses and phone numbers.
- iii. The users can operate a smartphone or laptop.

3.2.3 Operational Requirements

The management system is a progressive web app (PWA) that is accessible on all devices with JavaScript enabled browsers. This includes mobile phones with all kinds of OS, laptops and tablets.

PWAs are websites that look and behave like a native mobile app (Rouse, 2017). They can be added to smartphones like apps without having to download from the Play Store or App Store (for iOS). They are also optimized for weak network connections depending on the kind of assets or data that can be cached on the website, for offline use.

3.2.4 Software Requirements

The UI design was implemented using HTML, CSS and a template, to ease design of the interface. The frontend development was based on the JavaScript language and a frontend JavaScript framework, Vue.js and other Vue packages that facilitate the platform like:

- I. Vue-Notifications, a package for rendering notifications,
- II. Vuelidate, for validating form information,

- III. Vue Spinners, to improve user experience by showing loading animations when requests are being processed and a host of others.

The backend development involved a custom server-side API developed with Node.js, a server-side JavaScript runtime environment and AdonisJs, a Node.js framework. MySQL was used as the database. The API was deployed on a server hosting platform, Heroku while the web app was deployed on a free web hosting platform, Netlify.

3.3 System Modelling

System modeling is the process of developing abstract models of a system, with each model presenting a different view or perspective of that system. Models are used to help derive the requirements for a system, describe the system to engineers implementing the system and to document the system's structure and operation (Sommerville, 2016). The system was modeled using Unified Modeling Language (UML).

3.3.1 Class Diagram

Class diagram is a graphical representation of the static view of the system and represents different aspects of the application. They are used to specify the common structure and behavior of a set of objects. Objects are instances of a class that can be created, modified or deleted during execution and they have attributes and relationships with other objects. Figure 3.1 shows the class diagram for the system.

3.3.2 Object Diagram

Object diagram is an instance representation of a class diagram. They are used to render a set of objects and their relationships at a particular moment. Figure 3.2 and 3.3 show object diagrams for patient addition by a therapist and caregiver addition by a parent.

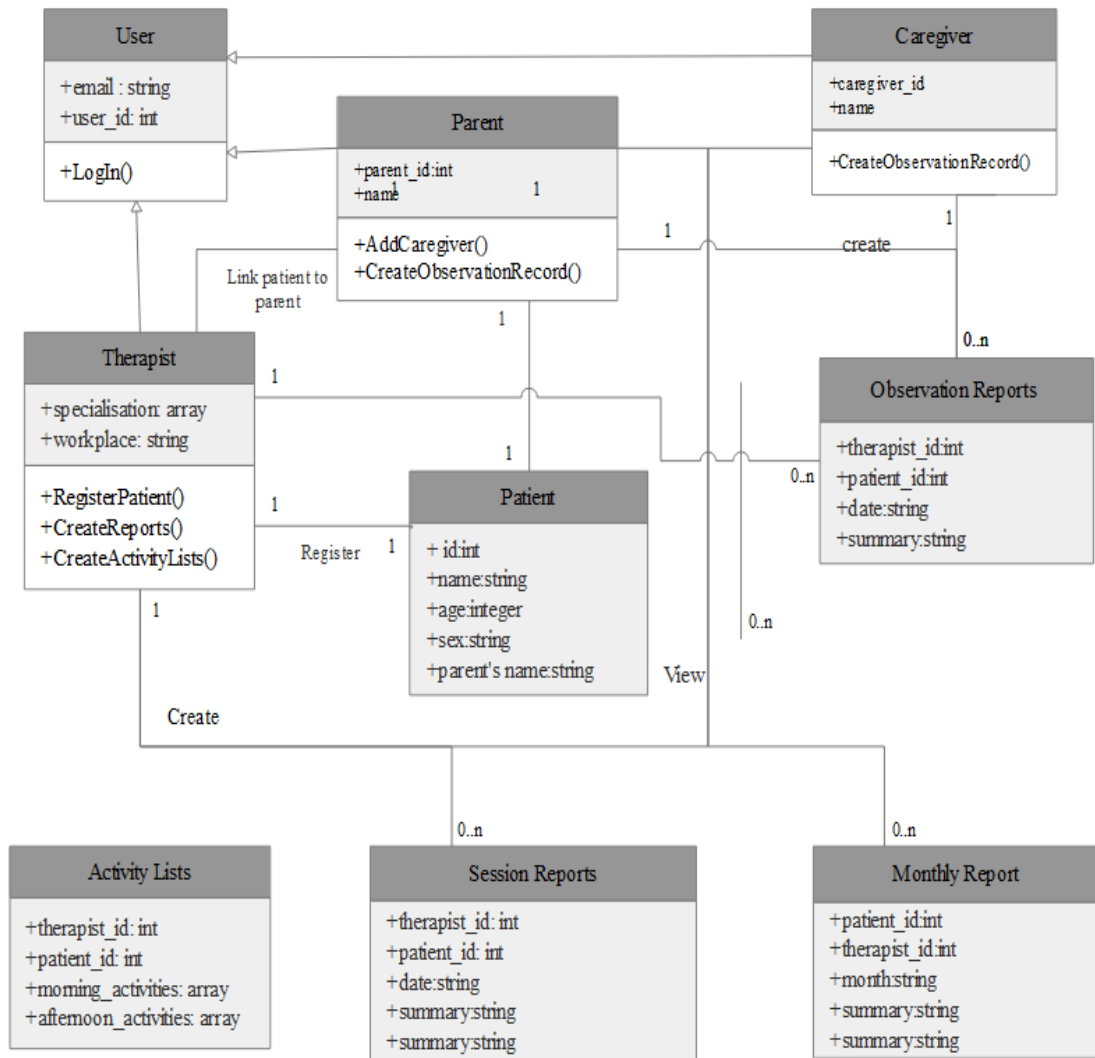


Figure 3.1: Class diagram for the system.

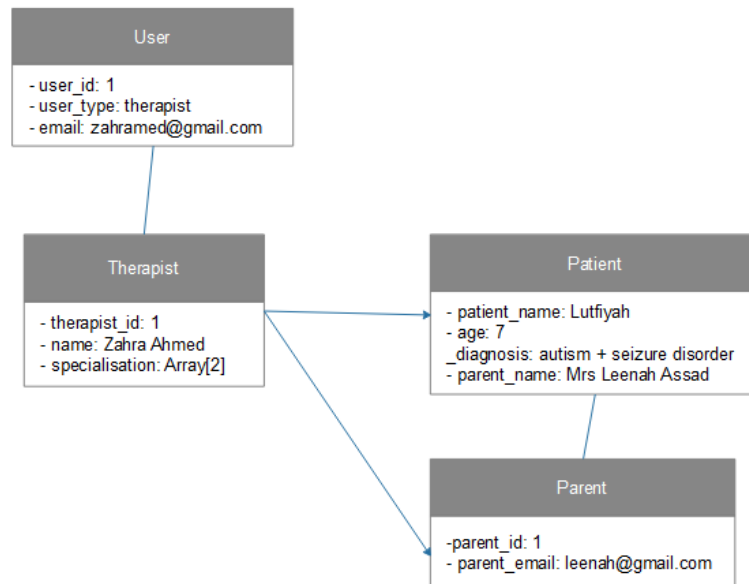


Figure 3.2: Object Diagram of Patient Addition by Therapist

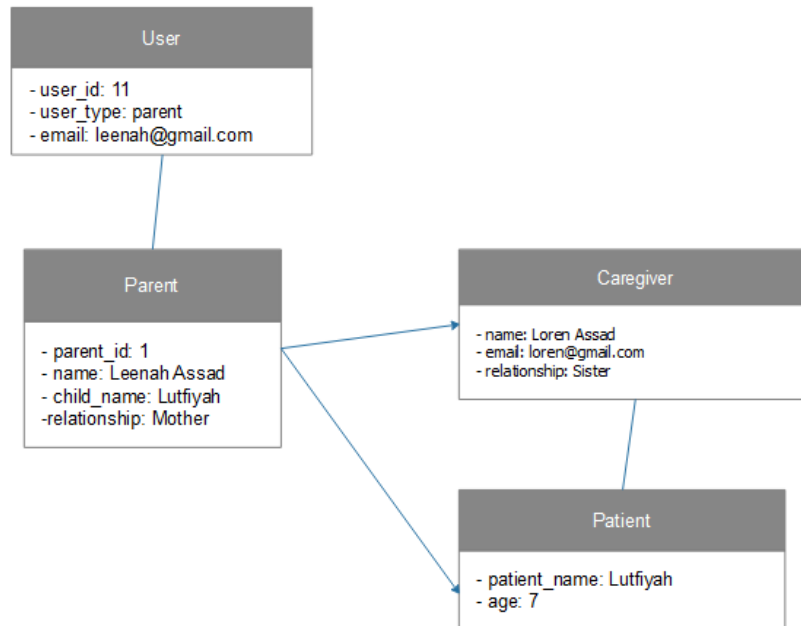


Figure 3.3: Object Diagram of Caregiver Addition by Parent

3.3.3 Activity Diagram

Activity diagram is a representation of the flow from one activity to another activity in the system. An activity is a function performed by the system and are associated with constraints and conditions.

Figure 3.4 show the activity diagram of the system, activities of the therapist user, parent and caregiver users and how they interact with common states as well as conditions and constraints.

3.3.4 Use-Case Diagram

Use-case diagrams is a graphical representation of a user's interaction with the intended system and also capture the dynamic behavior of the system. Use cases focus on the system behavior based on an external point of view. A use case describes an action that can be executed by an actor. An actor is an entity that interacts with the system through the use cases. The actors are outside the boundary of the system while the use cases are inside the system boundary.

Figure 3.5, 3.6 and 3.7 show use case diagrams for the main users of the system. The three actors are the therapist, parent and caregiver. The therapist is responsible for the creation of most reports which are also accessible to parents and caregivers. The parents and caregivers create observation records and also have access to the patient's records.

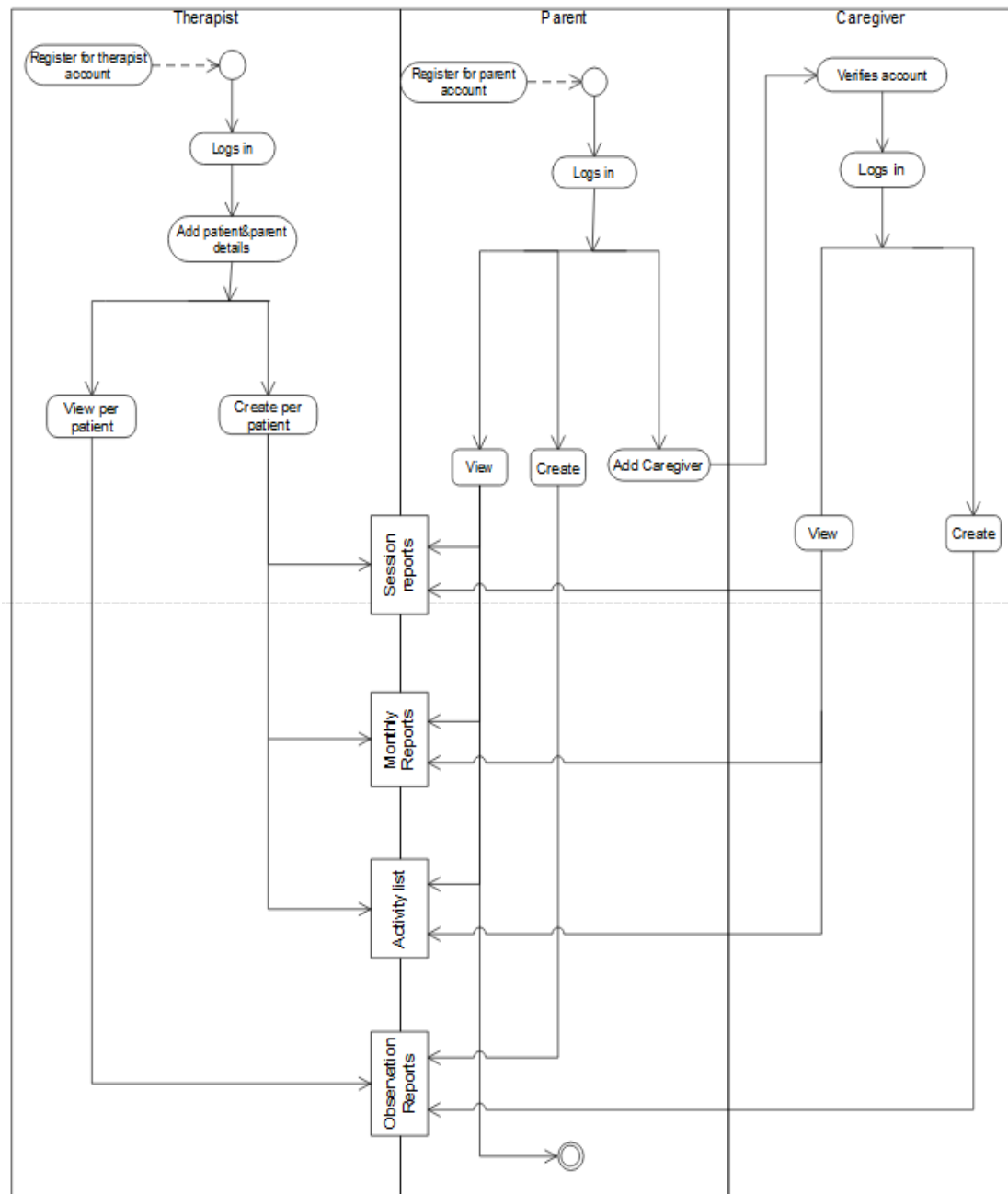


Figure 3.4: Activity Diagram for the system

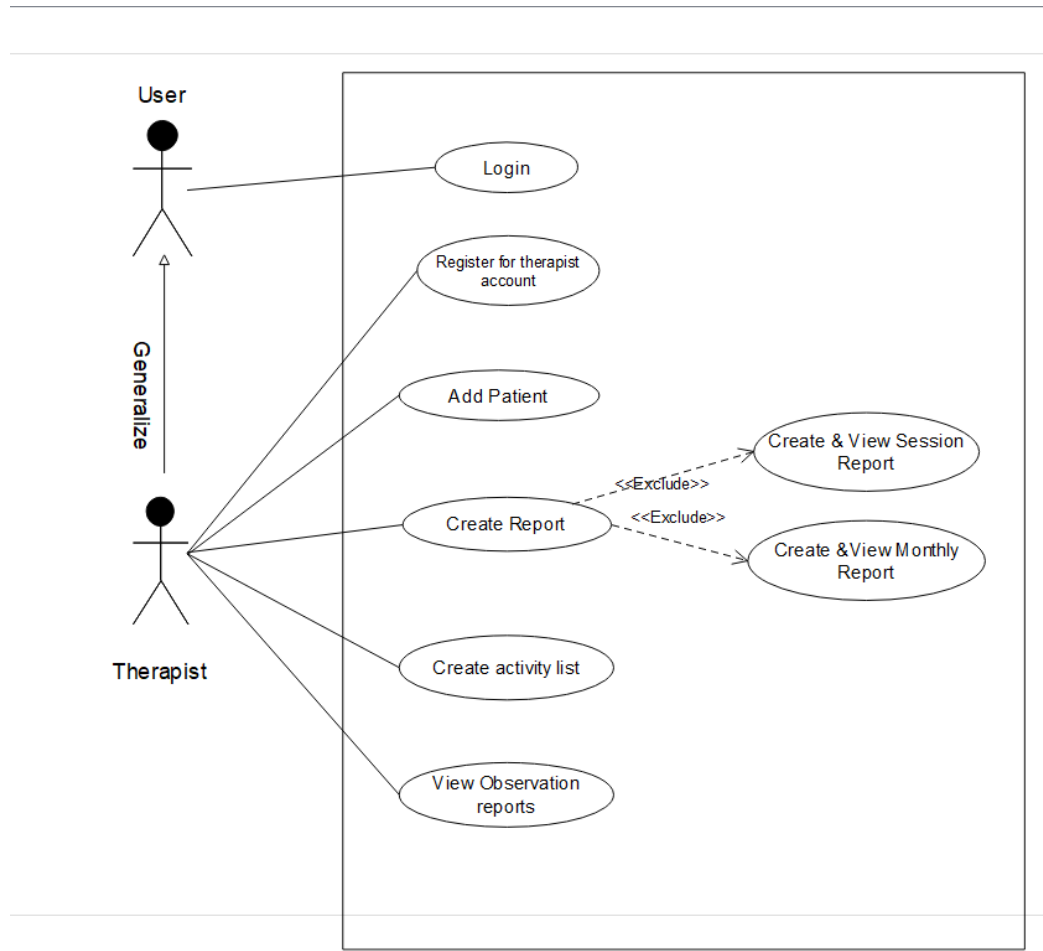


Figure 3.5: Use Case Diagram of a Therapist user.

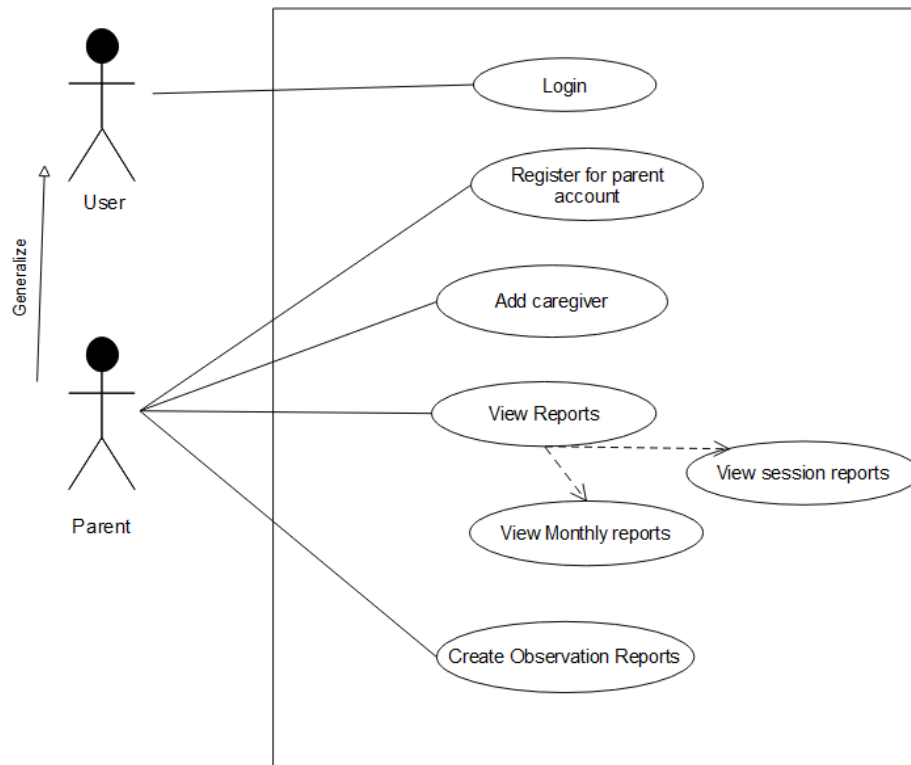


Figure 3.6: Use Case Diagram of Parent user.

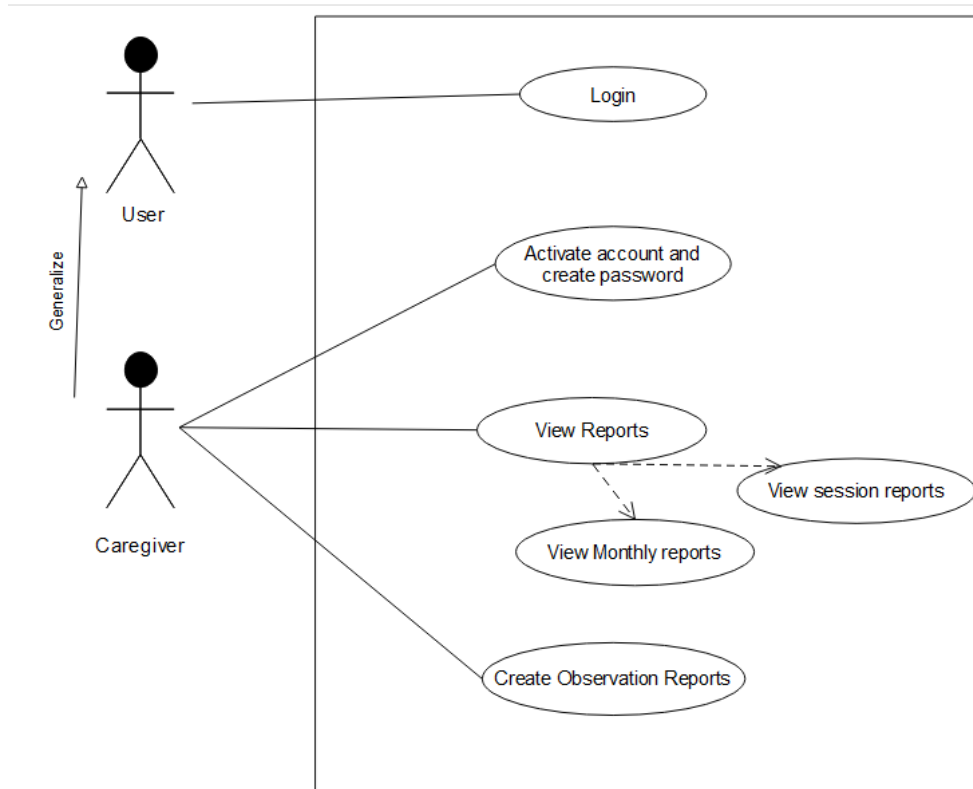


Figure 3.7: Use Case Diagram of a Caregiver user.

CHAPTER FOUR

IMPLEMENTATION

This chapter outlines a detailed implementation of the management system. It includes an overview of the database design and development of the API, relationships between the different objects, the UI design, tools used for the different screens of the platform, and the integration of the API endpoints with the UI. It also entails the processes implemented in optimizing the system into a PWA, deployment of the server and the PWA on different free hosting platforms. The chapter ends with results and overall feedback gathered from users that tested the web app.

4.1 API Development and Database Design

As specified in the system requirements, the features and users of the system were grouped into classes and the relationships between them were established. The database used is MySQL and the API was built using AdonisJs, a Node.js framework.

4.1.1 AdonisJs and MySQL

AdonisJs is a Node.js MVC framework that runs on all major operating systems and it offers a stable ecosystem to write server-side web applications. Adonis applications are served either locally using an HTTP server or deployed to an online server. It has several concepts like routing, controllers, models, middleware, migrations and validators that make development easy.

MySQL is a relational database management system based on Structured Query Language. It was set up on the local machine using phpMyAdmin. phpMyAdmin is a free software tool intended to handle the administration of MySQL over the Web. It can perform various tasks such as creating, modifying or deleting databases, tables, fields or rows; executing SQL statements; or managing users and permissions.

4.1.2 Relationships and Models

The API was structured based on the different relationships between the different features of the system. The primary object of the structure is the User. The therapist, parent and caregiver models have a one-to-one relationship with the user model. The patient model is central to the API, it has a one-to-many relationship with therapist, caregiver, monthly reports and session reports as well as a one-to-one relationship with parent model and activity lists. The controllers contained the methods for requests and responses pertaining to each object, the middleware files were used to assign levels of authorization access to the different users and the model files were used to specify the relationship each object had with the others. Validators were included to ensure specified attributes required valid inputs for execution of methods in the corresponding controllers.

The database folder included schema files to be used for migration of the different object tables and their attributes to the MySQL database. The configuration file *.env*, specified parameters needed for the database connection and was successfully migrated. Figure 4.1 and 4.2 show the component diagrams of the database schema and the API.

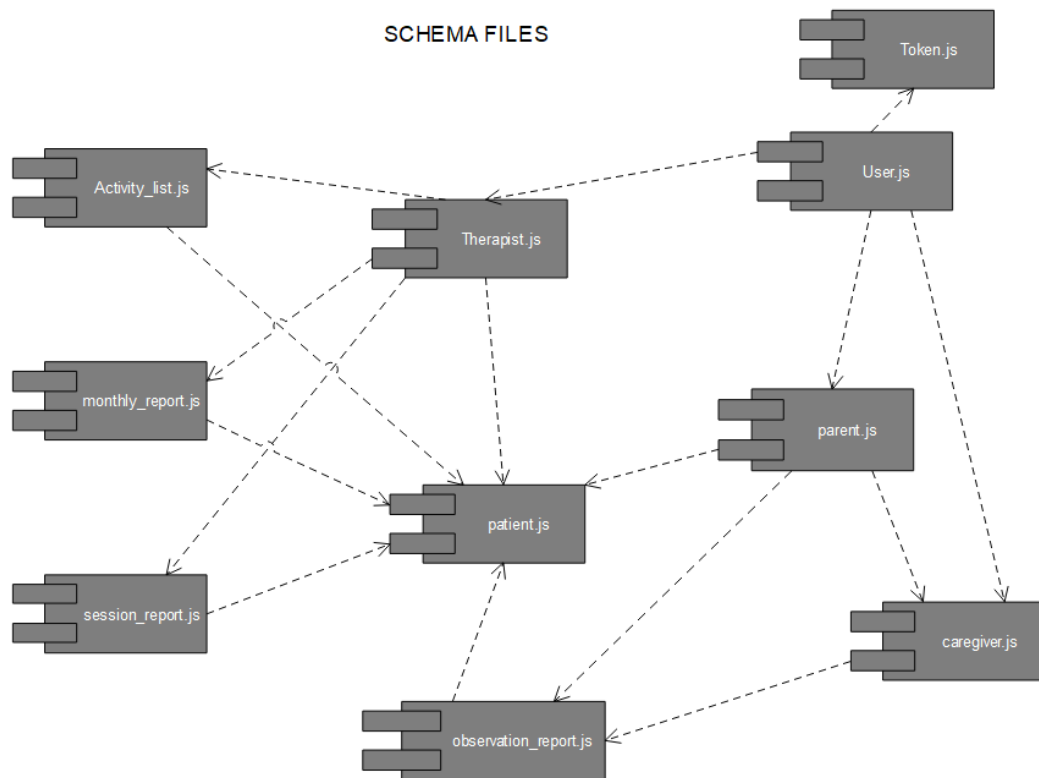


Figure 4.1: Component Diagram for the Database Schema

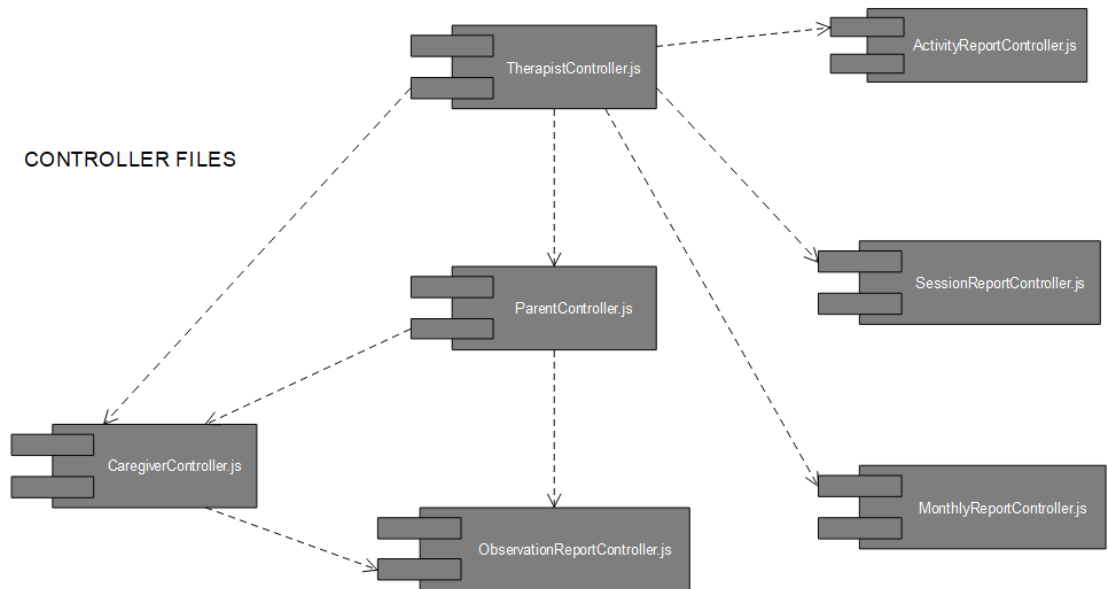


Figure 4.2: Component Diagram of the API

4.2 UI Design

The frontend of the system involves UI design and integration of the API endpoints to the UI. The frontend was structured to import static files like fonts, images as well as CSS and 3rd-party JavaScript files that were needed. The configuration files also imported 3rd-party Vue-compatible libraries required as well as functions for uploading image files to the online media management service, Cloudinary.

The interface was divided into different sections, common features were identified and specific features were tailored based on the sections they belonged. The different screens and pages of each section were written as Vue files with HTML and CSS. They were structured into different folder to ease accessibility and linkages between related files.

4.3 Frontend Development

The endpoints are routes to access the API, send requests and receive response data. They were integrated into the appropriate Vue files and error conditions were also accounted for. Conditions of empty patients list, activity lists, session reports, monthly reports and observation reports were also accounted for.

4.3.1 Authentication and Authorization

Therapist and parent users are required to sign up for a therapist/parent account on the platform, after which they can be authenticated via login. Caregiver users have to activate their account via email and set their passwords. Figure 4.3, 4.4 and 4.5 show screens for these sections.

4.3.2 Therapist Section

Therapist users have authorization for specific features like patient registration, session and monthly reports creation, activity lists creation and have read-only access to observation reports.

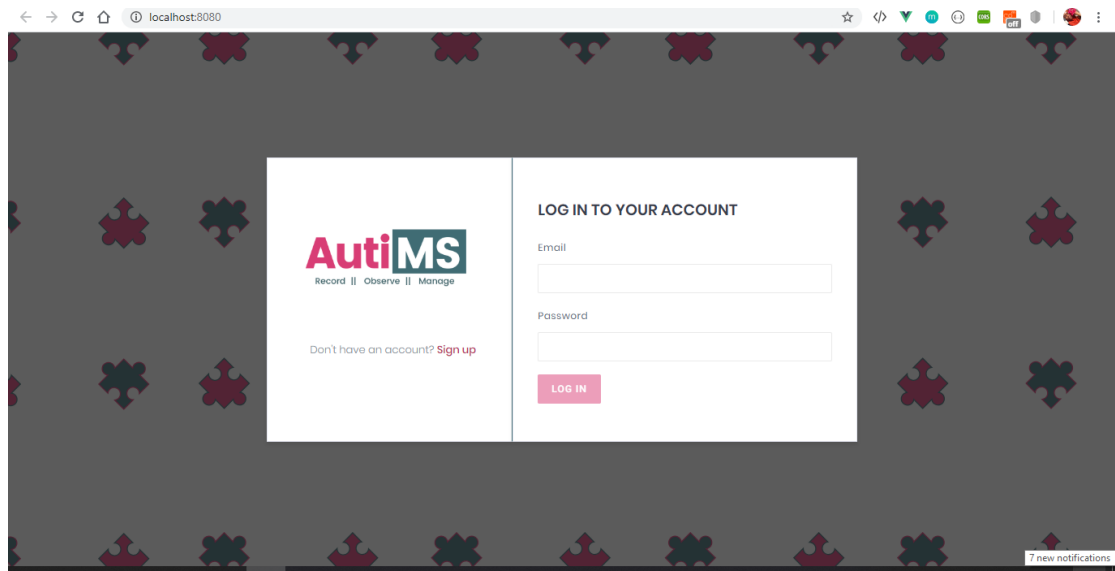


Figure 4.3: Login page for AutiMS.

The image shows a web browser window with the URL `localhost:8080/signup`. The page has a dark gray background with a repeating pattern of interlocking puzzle pieces in dark blue and red. On the left side, there is a white vertical panel containing the AutiMS logo (with 'Auti' in red and 'MS' in white on a dark blue background) and the tagline 'Record || Observe || Manage'. Below the logo, it says 'Already got an account? [Log in](#)'. The right side of the page is a white form titled 'NEW USER? SIGN UP' with a sub-header '**Register for a Therapist or Parent Account.' Below this are two tabs: 'Therapists' (which is selected and highlighted in light blue) and 'Parents'. The form contains several input fields: 'Full Name', 'Email', 'Phone Number', 'Gender' (a dropdown menu with 'Choose' selected), 'Name of Workplace', 'Workplace Address', 'Area(s) of Specialisation' (a dropdown menu with 'Choose' selected), 'Password', and 'Confirm Password'. At the bottom of the form is a pink button labeled 'SIGN UP'.

Figure 4.4: Signup page for therapist and parent accounts on AutiMS.

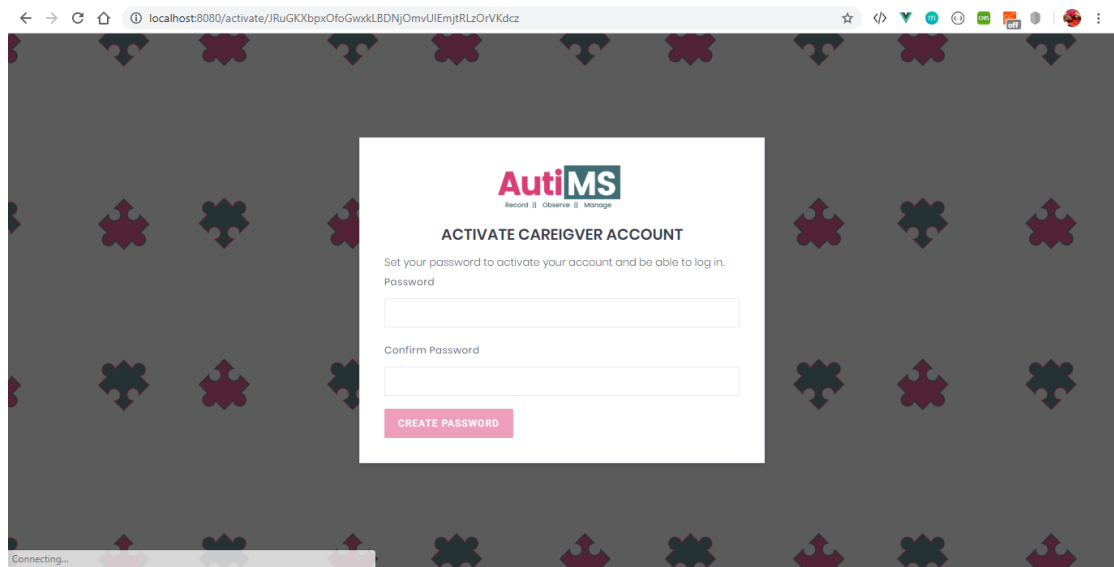


Figure 4.5: Activate Caregiver and Set Password page for AutiMS.

Therapist can Create, Read, Update and Delete (CRUD) patients and each patient must be linked to a parent account on the system. Therapists can then perform Create, Read and Update (CRU) operations on the activity lists and the other reports. Therapists can add only one activity list per patient but can add multiple session and monthly reports.

Different therapists can add the same parent account for the same patient. Two screens for features of the therapist section are shown in Figure 4.6 and 4.7.

4.3.3 Parent Section

The parent user is authorized for actions like caregiver account creation and observation reports but have read-only access to patient's activity list, session and monthly reports. Parent users only gain access to patient's documentation after being added as a patient's guardian by the therapist and relationship has been confirmed. Parent can perform CRUD operations on observation reports and can create multiple observation reports specific for different therapists of the patient. Figure 4.8 and 4.9 show screens from the parent section.

4.3.4 Caregiver Section

Caregiver users can also be authenticated after activating the account and setting a password via an email sent upon parent's caregiver account creation. Caregivers are sub-users of parent users, hence have same authorization and read-only access to features except caregiver account creation. Figure 4.10, 4.11 and 4.12 show screens from the caregiver section of the system.

The screenshot displays the AutiMS web application interface for a therapist. The browser address bar shows the URL `localhost:8080/therapist/patients`. The application has a dark teal sidebar on the left with a 'Welcome, New Therapist' message and a list of navigation options: Dashboard, Profile, Patients (selected), All Patients, Add New Patient, Activity Lists, Reports, and Log Out. The main content area is divided into two panels. The left panel, titled 'PATIENTS LIST' with a 'NEW' button, contains a search filter and a table of patients. The right panel, titled 'DETAILS OF HAMDALAH YUSUFF' with an 'EDIT' button, shows the patient's information in a two-column layout.

PATIENTS LIST

Filter:

S/N	Patient Name	Actions
1	Hamdalah Yusuff	+ -
2	Child	+ -

2 records

DETAILS OF HAMDALAH YUSUFF

Patient Name Hamdalah Yusuff	Parent Name Alhaja Yusuff
Age 13	Email parent@gmail.com
Gender Female	Phone Number 09012345674
Diagnosis autism	Relationship mother **Not Verified
Diagnosis Summary restlessness	

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Figure 4.6: All Patients and Patient Information in Therapist Section.

The screenshot displays the AutiMS web application interface. The browser's address bar shows the URL `localhost:8080/therapist/activity-lists/2/new`. The application has a dark teal sidebar on the left with a user profile icon and the text "Welcome, New Therapist". Below this, a menu lists: Dashboard, Profile, Patients, Activity Lists, Reports, and Log Out. The main content area is titled "NEW ACTIVITY LIST" with a "SAVE" button in the top right corner. It is divided into three sections: "Morning Activities", "Afternoon Activities", and "Evening Activities". Each section contains a "New Activity" label, a text input field, and a red "ADD" button. To the right of each input field is a box containing the text "No Activity Added". At the bottom of the page, a small copyright notice reads: "Copyright © 2019 AutiMS. All rights reserved."

Figure 4.7: Add Activity List for New Patient in Therapist Section.

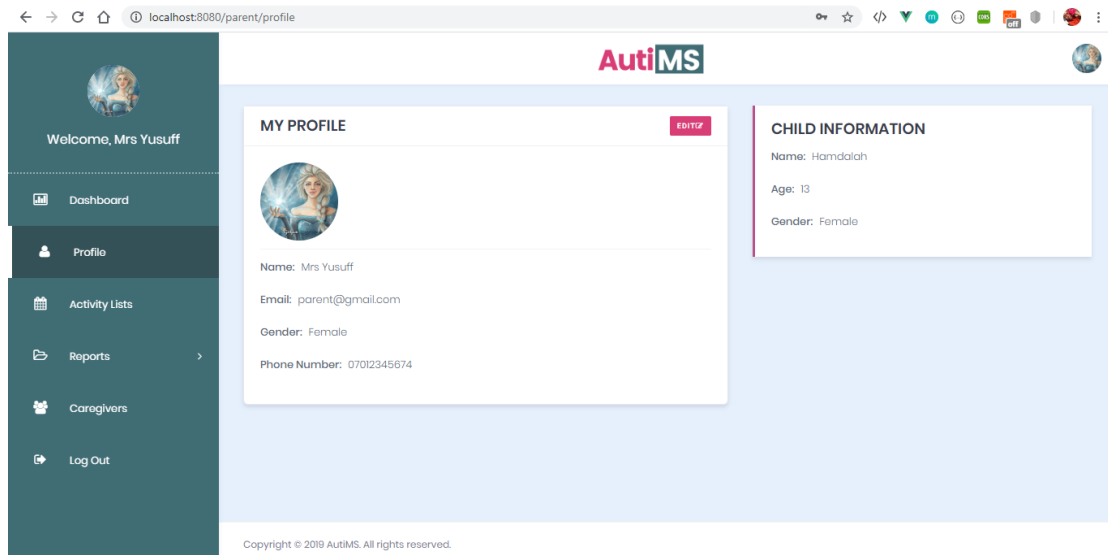


Figure 4.8: Profile Information in Parent Section.

The screenshot displays the AutiMS web application interface. The browser address bar shows 'localhost:8080/caregivers'. The application has a dark teal sidebar on the left with a user profile 'Welcome, Mrs Yusuff' and navigation links: Dashboard, Profile, Activity Lists, Reports, Caregivers (selected), and Log Out. The main content area has a light blue header with the 'AutiMS' logo. Below the header, the 'CAREGIVERS' section includes a 'Filter:' search box and a table with 3 records. The table columns are S/N, Name, Email, Phone Number, and Relationship. Below the table, there is a 'NEW CAREGIVER' form with input fields for Name and Email. The footer text reads 'Copyright © 2019 AutiMS. All rights reserved.'

S/N	Name	Email	Phone Number	Relationship
1	Aishah Yusuff thothamrigarlan	caregiver@gmail.com	0702345675	Sister
2	Khairah	airah@gmail.com	0802345678	Sister
3	another person	another@gmail.com	0802345656	Sister

Figure 4.9: All Caregivers and Add New Caregiver views in Parent section.

The screenshot displays the AutiMS web application interface. The browser address bar shows the URL `localhost:8080/observation-reports/1/new`. The application header includes the AutiMS logo and a user profile icon. A dark teal sidebar on the left contains a welcome message for 'Aishah Yusuff thatothenigerian' and a list of navigation items: Dashboard, Profile, Activity Lists, Reports (with a dropdown arrow), and Log Out. The 'Reports' dropdown is open, showing 'Session Reports', 'Monthly Reports', and 'Observation Reports'. The main content area is titled 'NEW OBSERVATION REPORT FOR HAMDALAH' and features a 'CREATE' button. The form includes a 'Date' field with a 'Choose date' placeholder, a 'Title' field, a 'Summary' text area, and a 'Suggestions' text area. The footer of the page states 'Copyright © 2019 AutiMS. All rights reserved.'

Figure 4.10: New Observation Report in Caregivers section.

The screenshot displays the AutiMS web application interface. The browser address bar shows the URL: `localhost:8080/observation-reports/2&New%20Therapist`. The application header includes the AutiMS logo and a user profile icon. A dark teal sidebar on the left contains a welcome message for 'Aishah Yusuff thatothenigerian' and a menu with options: Dashboard, Profile, Activity Lists, Reports (expanded), and Log Out. The 'Reports' menu is further detailed with: Session Reports, Monthly Reports, and Observation Reports. The main content area is titled '30/01/2020 REPORT FOR NEW THERAPIST' and includes 'EDIT' and 'BACK' buttons. It contains four input fields: 'Title' (with placeholder text 'by caregiver'), 'Date' (with value '30/01/2020'), 'Summary' (with placeholder text 'wesrdgftb nczsdefrtjfyh'), and 'Suggestions'. The footer of the application states 'Copyright © 2019 AutiMS. All rights reserved.'

Figure 4.11: View Single Observation Report in Caregiver section.

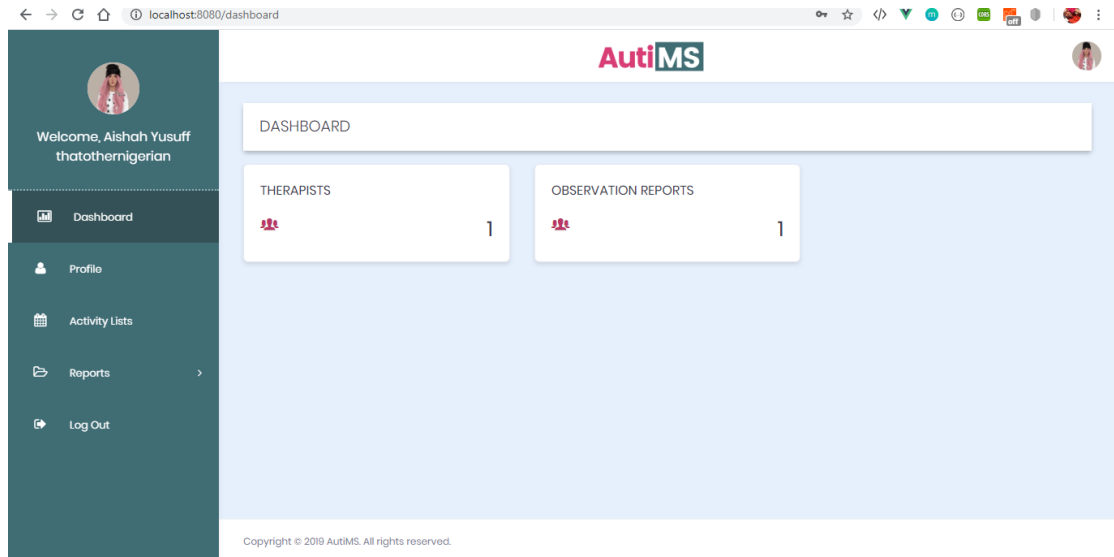


Figure 4.12: Dashboard in Caregiver section

4.3.5 PWA

The application was also optimized into a PWA. Service workers and Manifest file was set up as these are basic requirements for PWAs. They included details to appear when being added as an app, such as app name, app icons to be displayed and other necessary features. Splash screens were also set up for Android and only specific iOS devices due to restrictions by Apple. Figure 4.13 and 4.14 show different splash screen setups for iPhone 7 (iOS) and Samsung J7 (Android).

4.4 Deployment

Deployment of frontend applications are made very easy by storing all files in a GitHub repository and this app was deployed on Netlify with the free hosting package. The platform was connected to the repository, the start page was specified since the application is a Single Page Application (SPA) and the build command was also specified. The settings also included automated redeployments to target changes that might be made in the repository files.

A Netlify configuration file, *netlify.toml* was set up to override the defect of broken links of SPAs upon refresh of pages. It specified the start page and redirects the pages properly upon refresh.

4.4.1 Server Deployment

The API was initially served locally via an HTTP server and was deployed on Heroku for commercial use. Configuration parameters needed to setup the API online and its database connection were located in *.env* file. However, this file contains sensitive information and hence not deployed to the GitHub repository used for the API. Heroku provides an option of entering these configuration parameters through its config variables on the platform dashboard and this was used.

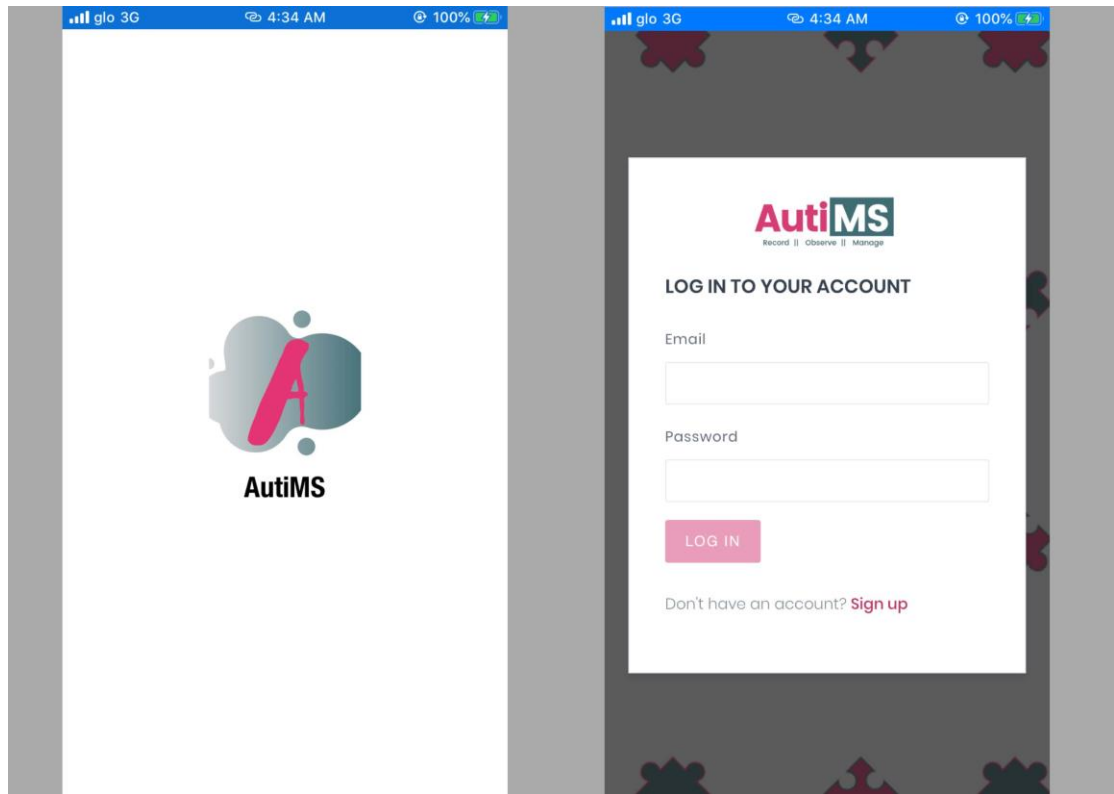


Figure 4.13: Splash screen and start page of the app on iPhone 7 (iOS)

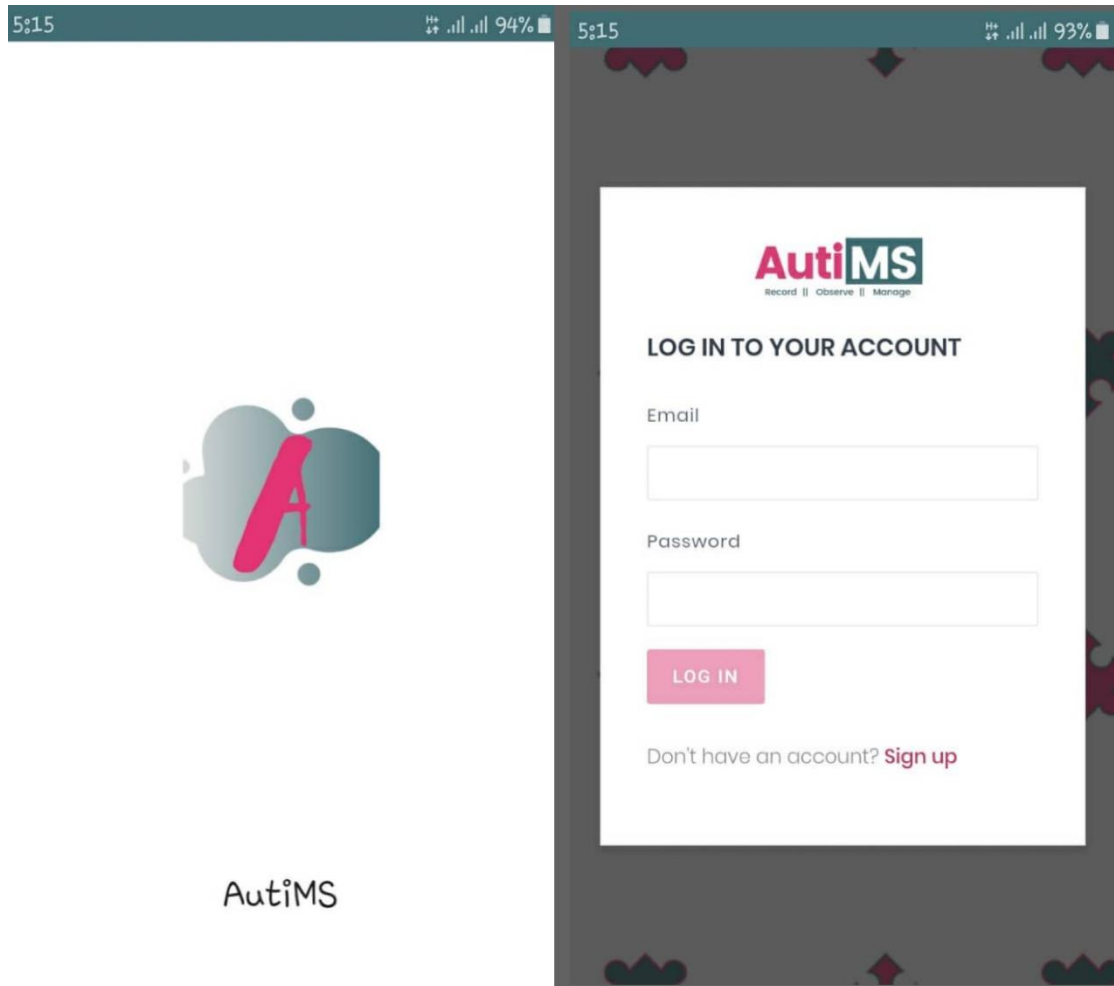


Figure 4.14: Splash screen and start page of the app on Samsung J7 (Android)

A free version of a Heroku add-on, ClearDB MySQL, was used as the online MySQL database and its config variables were also set.

The dashboard was linked to the API files stored in the GitHub repository and set up to automate deploys in case of any changes in the API files. After successful deployment, the URL provided was then added to the Vue app as the API entry endpoint instead of the previously set localhost.

4.4.2 System Conditions and Limitations

There are conditions attached to different features of the system before they can be used or accessed. They include:

- i. Therapists can only add patients with parents that have an account on the platform. This is to ensure parent accounts are linked to patient upon creation and grant read access to the reports.
- ii. Parents have to verify their relationship to said patient before being granted access to patient's reports. This is to prevent unverified access through patient's reports without being related as a guardian.
- iii. Caregiver accounts can only be created by parent accounts, to link them to the patient the account is attached to.
- iv. The app requires an internet connection to function properly.

The system has the limitation of parent accounts being linked to only one patient, although the said patient can be attached to several therapists.

4.5 Testing and Evaluation

Testing was carried out by users with a family member living with autism and other related conditions that make use of the therapies the system is focused on. The users included the therapist, the father/mother and siblings of the patient.

4.5.1 Internal Acceptance Testing

Internal acceptance testing is also known as Alpha testing and is defined as a type of software testing performed to identify bugs before releasing the product to real users or the public (Guru99, What is Alpha Testing? Process, Example, n.d.). It was carried out after all basic features of the app has been implemented.

The Vue app was first tested on localhost, an HTTP server was started for the Adonis app locally, the local MySQL database was set up using phpMyAdmin. Test runs were made for different features by creating dummy accounts and user data locally. After deployment of both the Vue and Adonis app, the application was also tested to ensure everything functioned properly and implemented functionalities were developed as intended. Figure 4.15 shows a Google Lighthouse audit of the app.

4.5.2 User Acceptance Testing

User acceptance testing is a type of testing performed by the end user or the client to verify/accept the software system before moving the software application to the production environment (Guru99, n.d.). It was carried out after deployment by the users from the case study for a first interaction with the app.

Correspondence with the volunteer family members were based on confidential grounds, a summary of the application and its features were sent to encourage their participation. The application was tested and feedbacks were recorded by creating two Google survey forms for the therapists' and families' opinions.

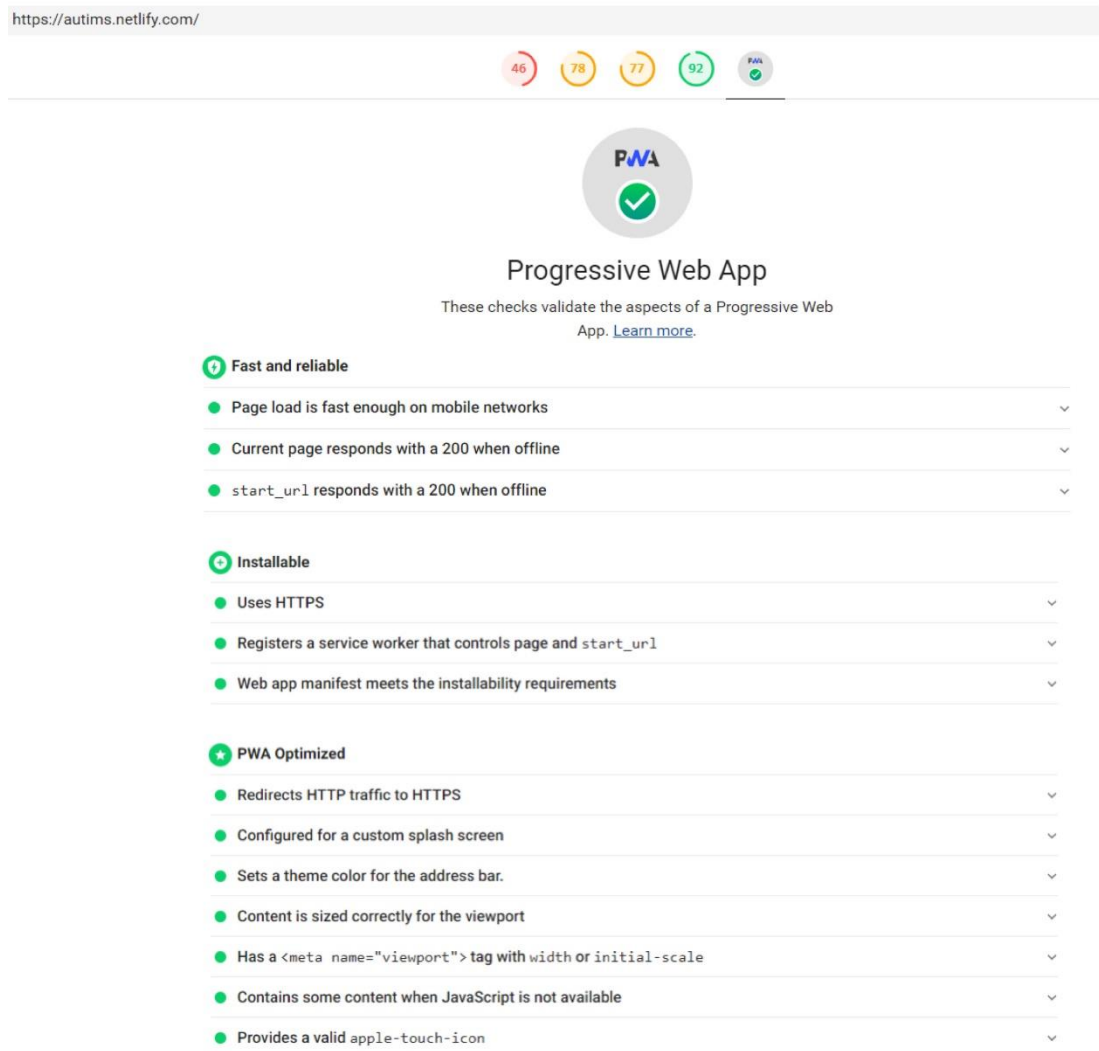


Figure 4.15: App Audit results

They included questions targeting interface design, ease of use, ease of navigation, importance of features, relevance of the app and suggestions on improvement features.

The number of correspondents were limited due to the difficulty in contacting families with autism patients and many seeking privacy as a result of the stigma still surrounding the disorder. However, two therapists were able to participate in the testing of the therapist section while five members from three families tested the other sections. Figure 4.16 and 4.17 show the surveys used by the correspondents. The results collated from the survey revealed the following for the therapist section:

- i. One therapist rated the interface design “Fantastic” while the other rated it “Good”,
- ii. Both were able to add the app as a PWA and navigate easily through the app,
- iii. One therapist responded that the features were “great features”,
- iv. Both affirmed the app was an accurate representation of the current manual method used for documentation,
- v. Both affirmed that the app would help ease documentation and also increase involvement of family members due to easy access to reports,
- vi. One therapist rated the app 10/10 while the other rated it 7/10.

The therapists suggested that the weekly and bi-weekly reports should also be included and also a feature to schedule family sessions. They also suggested to consider implementing a feature for Individualized Educational Plan (IEP), which specifies the educational schedule, is tailored to individual patients and is reviewed after a specified period.

1/9/2020 Feedback on AutiMS (Family)

Feedback on AutiMS (Family)

AutiMS is a management system for documenting reports of therapy undergone by patients living with Autism. This form will help assess the relevance of the system from a family member's point of view.

The platform can be added as an app to your home screen without having to download from the Play Store.

Steps on how to add:

- 1) Click the Menu icon for your browser, it could be the ☰ icon (for Android) or the "Share" icon (for IOS)
- 2) Scroll and click "Add to Home Screen"

***Required**

1. Interface Design: What did you think of the website look? *

2. The platform is a web app i.e you can add it to your Home Screen without having to download from Play Store. Were you able to add the app with the steps above? *

Mark only one oval.

☐ Yes

☐ No

3. Ease of Use: Did you find it easy to navigate through the app? *

Mark only one oval.

☐ Yes

☐ No

☐ Not exactly

4. If No or Not Exactly, what features of the app did you find it difficult to navigate through?

Figure 4.16: Google Feedback Form for Family Members

2/9/2020

Feedback on AutiMS (Therapist)

Feedback on AutiMS (Therapist)

AutiMS is a management system for documenting reports of therapy undergone by patients living with Autism. This form will help assess the relevance of the system from a therapist's point of view.

The platform can be added as an app to your home screen without having to download from the Play Store.

Steps on how to add:

- 1) Click the Menu icon for your browser, it could be the : icon (for Android) or the "Share" icon (for IOS)
- 2) Scroll and click "Add to Home Screen"

***Required**

1. Interface Design: What did you think of the website look? *

2. The platform is a web app i.e you can add it to your Home Screen without having to download from Play Store. Were you able to add the app with the steps above? *

Mark only one oval.

☐ Yes
 ☐ No

3. Ease of Use: Did you find it easy to navigate through the app? *

Mark only one oval.

☐ Yes
 ☐ No
 ☐ Not exactly

4. If No or Not Exactly, what features of the app did you find it difficult to navigate through?

Figure 4.17: Google Feedback Form for Therapists

The results collated from the survey revealed the following for the parent and caregiver sections:

- i. Correspondents described the interface design as “Minimal”, “Calm” and “Nice” and “user-friendly and looks good”.
- ii. All five users were able to add the app as a PWA and navigate easily through the app,
- iii. They described the observation report feature as “accessible”, “well detailed and self-explanatory”, “a very good way to make monitoring the patient easier”, “useful” and “vital and useful for documenting data on patient’s progress”.
- iv. They also affirmed that the observation report feature covered the details they’d like to share with therapists,
- v. They affirmed that the other reports covered details they’d like to know about and that the app will help keep them easily updated,
- vi. 60% rated the app a 9/10 while 40% rated it a 10/10.

They also suggested that the app should include a previous health history of the patient, a feature to document medications of the patients as well as concerns about it and to add any other features that can make the app better.

From the results, it can be concluded that the app was well implemented in its interface design, it’s very user-friendly because of its ease of use, works effectively as an app with its PWA feature, covers all user specifications and fulfills the app objectives. It has an average rating of 9.1/10 on a scale of relevance, from results of all seven participants. It also included some bug reports, all of which was fixed and reevaluated by the correspondents as well as helpful suggestions on how to improve the application.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

From the results of evaluation of the app, it can be concluded that the aim and objectives of the project has been realized. The literature review and methodology was properly carried out and includes detailed research on the existence and awareness of autism and its related disorders, the kinds of therapy for patients living with autism as well as details on the types of reports and the reports formats to be used by the therapists and accessible to family members. It also outlined the full structure of the app, assumptions, operational requirements and UML diagrams to illustrate the inner workings and functionalities of the system. The implementation covered extensively the use of specified tools to develop the system and details of the processes involved.

5.1 Conclusions

The implemented system will provide a life-saving solution to parents and family members of atients living with autism by helpin in the proper documentation of therapy reports as well as easy access to them. It will also be useful for family memebbers to properly document observations and concerns they might have about the patient. Hence, it will serve as a very useful tool for therapists and family members of the patients.

5.2 Recommendations

The system has a lot of room for improvements and further development. It can be further developed by improving on some features:

- i. Download of reports and activity lists/Forwarding to emails,
- ii. Suspension of caregiver accounts by parents,
- iii. Disabling caregivers' access to some documents.

New features can also be added based on responses from users who tested and gave feedbacks on the app. Some of these features include:

- i. Inclusion of weekly/bi-weekly reports,
- ii. Addition of feature to schedule family sessions,
- iii. Addition of feature to document patient's medical history as well as medications,
- iv. Option for creating Individualized Educational Plans (IEP) for patients.

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APPENDIX

Interview Questions

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING,
FACULTY OF TECHNOLOGY,
OBAFEMI AWOLOWO UNIVERSITY,
ILE-FE.

BACKGROUND INFORMATION REQUIRED FOR THE DEVELOPMENT OF A MANAGEMENT SYSTEM FOR THERAPISTS AND FAMILIES OF AUTISTIC CHILDREN.

This interview is structured to collect basic information that will help in the development of a platform to aid the documentation of therapy reports of patients as well as keep therapists and family members of patients living with ASD updated on the progress. The information provided will be solely used for better development of intended platform.

Please provide your contact information below:

- 1) Name: _____
- 2) Place of work: _____
- 3) Email address: _____
- 4) Professional Qualifications/Information: _____

Please provide answers to the following questions as explicit as possible.

- 5) Area of therapy specialization? _____
Please expatiate.
- 6) What kind of patients do you train?
- 7) With emphasis on autistic children, what is the age range of patients that you train?
- 8) What are the different kinds of therapy that could help develop an autistic child?
- 9) What information are required about the child for assessment before commencing therapy?
- 10) What are the factors (actions/behaviors) monitored/observed when assessing a potential patient?

- 11) What are the different kinds of conclusions that could influence commencement of therapy for a potential patient after completion of assessment?

-
- 12) What are the beginner general exercises to carry out on therapy commencement?
- 13) How do you track the progress/effects of the therapy training on a patient?
- 14) Are families/relatives of the patient required to be actively involved for the success of the therapy?
- 15) If yes, in what areas are crucial for active involvement?
- 16) Please give a brief summary of the general course of actions in a typical therapy session?
- 17) What are the details included/required in the monthly report submitted to the parent/guardian of the patient?
- 18) What are the different kinds of progress reports provided for these therapies?

An interactive communication platform is to be built to help therapists better communicate progress and reports of their patients to their relatives. The therapist's section of the platform includes different features like:

- Patient registration
- Activity List creation
- Session report creation
- Monthly report creation

- 19) What other features would you advice/require to be added to the platform?
- 20) Any remarks or comment?

Correspondent Answers

NAME- YINUSA ABIDEMI ALIU

PLACE OF WORK- PATRICK SPEECH AND LANGUAGES CENTRE

EMAIL ADDRESS- y.bidemi@yahoo.com

PROFESSIONAL QUALIFICATIONS/INFORMATION- CERTIFIED AUTISM SPECIALIST

AREA OF THERAPY SPECIALIZATION? SPEECH, BEHAVIOUR AND SOCIAL SKILLS DEVELOPMENT

WHAT KIND OF PATIENTS DO YOU TRAIN? CHILDREN AND ADULT LIVING WITH AUTISM

WITH EMPHASIS ON AUTISTIC CHILDREN, WHAT IS THE AGE RANGE OF PATIENTS THAT YOU TRAIN? 2-40 YEARS

WHAT ARE THE DIFFERENT KINDS OF THERAPY THAT COULD HELP DEVELOP AN AUTISTIC CHILD? It depends on the child's needs. Speech and language therapy is used to develop and build child's communication and understanding of language. It is also used to improve child's articulation challenges and production of sounds. Behavior modification therapy is used to address behavioral challenges of a child living with autism. The interventions in this domain are used to modify some inappropriate behaviours such as attention seeking, task avoidance, transfer of aggression, self-injurious, flapping, rocking, stimming with objects and others. Some children find it challenging to interact or engage other peers therefore, social skill therapy will be introduced to address such challenges.

WHAT ARE THE FACTORS (ACTIONS/BEHAVIORS) MONITORED/OBSERVED WHEN ASSESSING A POTENTIAL PATIENT? The behaviors observed while assessing a child were stated above.

WHAT ARE THE DIFFERENT KINDS OF CONCLUSIONS THAT COULD INFLUENCE COMMENCEMENT OF THERAPY FOR A POTENTIAL PATIENT AFTER COMPLETION OF ASSESSMENT? 1. If a child exhibited challenging behavior that prevents him/her from learning 2. Limited words or speech delay to express his needs. 3. Inability to play or interact with his peers. 4. If the child's academic performance is not age-appropriate. 5. Inability to do age-appropriate activities of daily skills and others.

WHAT ARE THE BEGINNER GENERAL EXERCISES TO CARRY OUT ON THERAPY COMMENCEMENT? The question is not clear.

HOW DO YOU TRACK THE PROGRESS/EFFECTS OF THE THERAPY TRAINING ON A PATIENT? By keeping record of their progress and through review of their performance.

ARE FAMILIES/RELATIVES OF THE PATIENT REQUIRED TO BE ACTIVELY INVOLVED FOR THE SUCCESS OF THE THERAPY? Yes

IF YES, IN WHAT AREAS ARE CRUCIAL FOR ACTIVE INVOLVEMENT? Communication, interaction, redirecting their inappropriate behavior, watching their diet and enlighten the people around them about the challenges of the child.

PLEASE GIVE A BRIEF SUMMARY OF THE GENERAL COURSE OF ACTIONS IN A TYPICAL THERAPY SESSION?

To keep a child that is hyperactive to do a given task, firstly, such child need to do light exercises like jumping on the trampoline, walking round the compound, picking of balls from one place to another and others. Thereafter, such child should stay on a task for not more than 20 minutes before changing the task. Reward such as praises and other things he/she likes should be used to motivate his involvement in the task given.

WHAT ARE THE DETAILS INCLUDED/REQUIRED IN THE MONTHLY REPORT SUBMITTED TO THE PARENT/GUARDIAN OF THE PATIENT? The activities that the child did, level of performance, Challenges facing if there any, involvement in group work and behavior.

WHAT OTHER FEATURES WOULD YOU ADVISE/REQUIRE TO BE ADDED TO THE PLATFORM? Family session.

ANY REMARKS OR COMMENT? Working with children living with autism is unique because of the passion or interest the therapist must have first before any other thing.

Source Code (Main.js)

```

import Vue from "vue";
import VueJWT from 'vuejs-jwt'
import App from "./App.vue";
import router from "./router";
import { store } from "./store";
import axios from 'axios'
import Notifications from 'vue-notification'
import Vuelidate from 'vuelidate'
import Multiselect from 'vue-multiselect'
import VModal from 'vue-js-modal'
import { CircleSpinner, BounceSpinner } from 'vue-spinners'
import { ClientTable } from 'vue-tables-2';
import DatePicker from 'vuejs-datepicker';
import "../public/registerServiceWorker.js";

// Static files
import './assets/css/ionicons.min.css';
import './assets/css/core.min.css';
import './assets/css/app.min.css';
import './assets/css/custom.css';
import './assets/css/spacing.css';
import './assets/css/vue-multiselect.min.css';
import './assets/vendor/datepicker.js';

Vue.use(VueJWT)
Vue.use(ClientTable);
Vue.use(Notifications)
Vue.use(Vuelidate)
Vue.use(VModal)

Vue.component('circle-spin', CircleSpinner)
Vue.component('bounce', BounceSpinner)

```

```

Vue.component('multiselect', Multiselect)
Vue.component('datepicker', Datepicker)
function retrieveToken(name) {
  return localStorage.getItem(name)
}
// For API calls
axios.defaults.baseURL = 'http://localhost:3333/api'
axios.interceptors.request.use(function(config) {
  const token = retrieveToken(window.btoa('userToken'))
  config.headers.Authorization = token ? `Bearer ${token}` : "";
  config.origin = true;
  return config;
});
// For Cloudinary img uploads
const instance = axios.create({
  baseURL: 'https://api.cloudinary.com/v1_1/khairahscorner/image/upload',
})
export {instance};
router.beforeEach((to, from, next) => {
  let userToken = retrieveToken(window.btoa('userToken'))
  if (to.matched.some(record => record.meta.reqToken)) {
    if (userToken === null) {
      next("/")
    }
    else {
      next();
    }
  }
  else {
    next();
  }
});
Vue.config.productionTip = false;
new Vue({
  router,
  store,

```

```
render: h => h(App)
}).$mount("#app");
```

Source Code (Router.js)

```
import Vue from "vue";
import Router from "vue-router";
import Login from "../views/auth/Login.vue";
import allMixins from '../mixins.js';
import axios from 'axios'
Vue.use(Router);
const router = new Router({
  mode: "history",
  base: process.env.BASE_URL,
  linkExactActiveClass: "nav-active",
  routes: [
    { name: 'login', path: "/", component: Login, meta: { title: 'Login' },
      beforeEnter(to, from, next) {
        let userToken = allMixins.methods.retrieveToken(window.btoa('userToken'))
        if(userToken == null){
          next()
        }
        else {
          let details = Vue.$jwt.decode(userToken)
          if(details == null) {
            localStorage.clear()
            next('/')
          }
          else {
            if(details.data.user_type == 'therapist') {
              next('/therapist/dashboard')
            }
            else if (details.data.user_type == 'parent') {
              next('/parent/dashboard')
            }
          }
        }
      }
    }
  ]
})
```



```

    }
    else if (details.data.user_type == 'caregiver'){
      next('/dashboard')
    }
    else {
      localStorage.clear()
      next('/')
    } } } }},
    { path: "/signup", component: () => import("./views/auth/Signup.vue"), meta: { title:
'Sign Up' } },
    {
      path:      "/activate/:confirmation_token",      component:      ()      =>
import("./views/auth/Activation.vue"), meta: { title: 'Activate Caregiver Account' } },
    {
      path:      "/verify/:parent_email",      component:      ()      =>
import("./views/auth/ParentVerification.vue"), meta: { title: 'Verify Relationship' } },
    { path: "/login", redirect: "/" },
    { path: "*", redirect: "/" },
    //Therapist Section
    {
      path: "",
      component: () => import("./views/therapist/Home.vue"),
      children: [
        {path:      "/therapist/dashboard",      component:      ()      =>
import("./views/therapist/Dashboard.vue"), meta: { title: 'Dashboard', reqToken: true }
},
        {path: "/therapist", redirect: "/therapist/dashboard" },
        {path:      "/therapist/profile",      component:      ()      =>
import("./views/therapist/Profile.vue"), meta: { title: 'My Profile', reqToken: true } },
        {path:      "/therapist/patients",      component:      ()      =>
import("./views/therapist/Patients.vue"), meta: { title: 'Patients', reqToken: true } },
        {path:      "/therapist/patients/new",      component:      ()      =>
import("./views/therapist/AddPatient.vue"), meta: { title: 'New Patient', reqToken: true }
},

```

```

    {path:      "/therapist/activity-lists",      component:      ()      =>
import("./views/therapist/ActivityLists.vue"), meta: {title: 'Activity Lists', reqToken:
true} },

    {path:      "/therapist/activity-lists/:patient_id/new",      component:      ()      =>
import("./views/therapist/CreateActivityList.vue"), meta: {title: 'New Activity List',
reqToken: true} },

    {path:      "/therapist/activity-lists/:patient_id/edit",      component:      ()      =>
import("./views/therapist/EditActivityList.vue"), meta: {title: 'Edit Activity List',
reqToken: true} },

    {path:      "/therapist/session-reports",      component:      ()      =>
import("./views/therapist/SessionReports.vue"), meta: {title: 'Session Reports',
reqToken: true} },

    {path:      "/therapist/session-reports/:patient_id/new",      component:      ()      =>
import("./views/therapist/CreateSessionReport.vue"), meta: {title: 'New Session
Report', reqToken: true} },

    {path:      "/therapist/session-reports/:report_id",      component:      ()      =>
import("./views/therapist/SingleSessionReport.vue"), meta: {title: 'Session Report',
reqToken: true} },

    {path:      "/therapist/monthly-reports",      component:      ()      =>
import("./views/therapist/MonthlyReports.vue"), meta: {title: 'Monthly Reports',
reqToken: true} },

    {path:      "/therapist/monthly-reports/:patient_id/new",      component:      ()      =>
import("./views/therapist/CreateMonthlyReport.vue"), meta: {title: 'New Monthly
Report', reqToken: true} },

    {path:      "/therapist/monthly-reports/:report_id",      component:      ()      =>
import("./views/therapist/SingleMonthlyReport.vue"), meta: {title: 'Monthly Report',
reqToken: true} },

    {path:      "/therapist/observation-reports",      component:      ()      =>
import("./views/therapist/ObservationReports.vue"), meta: {title: 'Observation
Reports', reqToken: true} }

],

beforeEnter(to, from, next) {

  let userToken = allMixins.methods.retrieveToken(window.btoa('userToken'))

  let details = Vue.$jwt.decode(userToken)

```

```

    if(details == null) {
      localStorage.clear()
      next('/')}
    else {
      if (details.data.user_type == 'therapist') {
        next()
      }
      else{
        next('/')
      } } }},
    // Parent section
    {
      path: "",
      component: () => import("./views/parent/Home.vue"),
      children: [
        {path:          "/parent/dashboard",          component:          ()          =>
import("./views/parent/Dashboard.vue"), meta: {title: 'Dashboard', reqToken: true} },
        {path:"/parent", redirect: "/parent/dashboard" },
        { path: "/parent/profile", component: () => import("./views/parent/Profile.vue"),
meta: {title: 'My Profile', reqToken: true} },
        {path:          "/parent/activity-lists",          component:          ()          =>
import("./views/parent/ActivityLists.vue"), meta: {title: 'Activity Lists', reqToken:
true} },
        {path:          "/parent/session-reports",          component:          ()          =>
import("./views/parent/SessionReports.vue"), meta: {title: 'Session Reports', reqToken:
true} },
        {path:          "/parent/monthly-reports",          component:          ()          =>
import("./views/parent/MonthlyReports.vue"), meta: {title: 'Monthly Reports',
reqToken: true} },
        {path:          "/parent/observation-reports",          component:          ()          =>
import("./views/parent/ObservationReports.vue"), meta: {title: 'Observation Reports',
reqToken: true} },

```

```

    {path:    "/parent/observation-reports/:patient_id/new",    component:    ()    =>
import("./views/parent/CreateObservationReport.vue"), meta: {title: 'New Observation
Report', reqToken: true} },
    {path:    "/parent/observation-reports/:payload",    component:    ()    =>
import("./views/parent/SingleObservationReport.vue"), meta: {title: 'Observation
Report', reqToken: true} },
{ path: "/caregivers", component: () => import("./views/parent/Caregivers.vue"), meta:
{title: 'All Caregivers', reqToken: true} },
],
beforeEnter(to, from, next) {
  let userToken = allMixins.methods.retrieveToken(window.btoa('userToken'))
  let details = Vue.$jwt.decode(userToken)
  if(details == null) {
    localStorage.clear()
    next('/')
  }
  else {
    if (details.data.user_type == 'parent') {
      next()
    }
    else{
      next('/')
    }
  }
},
// Caregiver section
{
  path: "",
  component: () => import("./views/caregiver/Home.vue"),
  children: [
    {path:    "/dashboard",    component:    ()    =>
import("./views/caregiver/Dashboard.vue"), meta: {title: 'Dashboard', reqToken: true}
  },
    { path: "/profile", component: () => import("./views/caregiver/Profile.vue"), meta:
{title: 'My Profile', reqToken: true} },

```

```

    {path:          "/activity-lists",          component:          ()          =>
import("./views/caregiver/ActivityLists.vue"), meta: {title: 'Activity Lists', reqToken:
true} },
    {path:          "/session-reports",          component:          ()          =>
import("./views/caregiver/SessionReports.vue"), meta: {title: 'Session Reports',
reqToken: true} },
    {path:          "/monthly-reports",          component:          ()          =>
import("./views/caregiver/MonthlyReports.vue"), meta: {title: 'Monthly Reports',
reqToken: true} },
    {path:          "/observation-reports",          component:          ()          =>
import("./views/caregiver/ObservationReports.vue"), meta: {title: 'Observation
Reports', reqToken: true} },
    {path:          "/observation-reports/:patient_id/new", component:          ()          =>
import("./views/caregiver/CreateObservationReport.vue"), meta: {title: 'New
Observation Report', reqToken: true} },
    {path:          "/observation-reports/:payload", component:          ()          =>
import("./views/caregiver/ObservationSingleReport.vue"), meta: {title: 'Observation
Report', reqToken: true} },
  ],
  beforeEnter(to, from, next) {
    let userToken = allMixins.methods.retrieveToken(window.btoa('userToken'))
    let details = Vue.$jwt.decode(userToken)
    if(details == null) {
      localStorage.clear()
      next('/')
    }
    else {
      if (details.data.user_type == 'caregiver') {
        next()
      }
      else{
        next('/')
      }
    }
  }
}]

```

```

});
const DEFAULT_TITLE = 'AutiMS';
router.afterEach((to, from) => {
  document.title = `${to.meta.title} - ${DEFAULT_TITLE}`;
});
export default router;

```

Source Code (Mixins.js)

```

const allMixins = {
  methods: {
    retrieveToken(name) {
      return localStorage.getItem(name)
    }
  }
}
export default allMixins

```

Source Code (Store.js)

```

import Vue from "vue";
import Vuex from "vuex";
import axios from 'axios';

Vue.use(Vuex);
export const store = new Vuex.Store({
  state: {
    user_id: null,
    patient_details: {},
    parent_details: {},
    caregiver_details: {},
    therapist_details: {},
    therapist_name: "",
    monthly_report: {},
    session_report: {},
    observation_report: {}
  }
});

```

```

},
mutations: {
  SAVE_USER_ID: (state, payload) => {
    state.user_id = payload
  },
  SAVE_THERAPIST_NAME: (state, payload) => {
    state.therapist_name = payload
  },
  SAVE_PATIENT_DETAILS: (state, payload) => {
    state.patient_details = payload
  },
  SAVE_PARENT_DETAILS: (state, payload) => {
    state.parent_details = payload
  },
  SAVE_CAREGIVER_DETAILS: (state, payload) => {
    state.caregiver_details = payload
  },
  SAVE_THERAPIST_DETAILS: (state, payload) => {
    state.therapist_details = payload
  },
  SAVE_MONTHLY_REPORT: (state, payload) => {
    state.monthly_report = payload
  },
  SAVE_SESSION_REPORT: (state, payload) => {
    state.session_report = payload
  },
  SAVE_OBSERVATION_REPORT: (state, payload) => {
    state.observation_report = payload
  } },
actions: {
  fetchAllTherapistPatients: () => {
    return axios.get('/therapist/view_patients/')
  },
},
});

```