What is autism

Why combine with AI

How AI can be applied to the treatment of autism

Aut·Ism

POLITECNICO DI MILANO
Final Thesis by Qian Li
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CONTENT

ABSTRACT (EN)

This thesis starts with autistic children, thoroughly examines the current state of autistic children in some economically disadvantaged areas, attempts to help them through artificial intelligence, and is not content with offering services to a single object. Instead, it aims to create a whole ecosystem, connecting all the pertinent autistic child groups, creating a platform for improved communication, preventing information gaps in their communication, and the project is centered around products.

The project combines product and application design to assist parents with autism screening, disseminating relevant information, and monitoring their child's progress in treatment. It is necessary for children with autism to wear brainwave monitoring devices while they play games. During the game, the APP will record eye movements. Later, the AI will gather and evaluate the data, sending it to parents, educators, and medical professionals. data end to aid in their discussion about the best course of action and to assist them comprehend the child's knowledge.

The goal of this project is to assist autistic children and the groups that support them in learning fundamental life skills in a fun way, enhancing their quality of life and helping them better integrate into society.

KEYWORDS (EN)

Children with autism and their related groups, AI monitoring and analyzing data, building platforms to connect all groups, communication.

ABSTRACT (IT)

Questa tesi parte dai bambini autistici, esamina a fondo lo stato attuale dei bambini autistici in alcune aree economicamente svantaggiate, cerca di aiutarli attraverso l'intelligenza artificiale e non si accontenta di offrire servizi a un singolo oggetto. L'obiettivo è invece quello di creare un intero ecosistema, collegando tutti i gruppi di bambini autistici pertinenti, creando una piattaforma per migliorare la comunicazione, prevenendo le lacune informative nella loro comunicazione, e il progetto è incentrato sui prodotti.

Il progetto combina la progettazione di prodotti e applicazioni per assistere i genitori nello screening dell'autismo, nella diffusione di informazioni rilevanti e nel monitoraggio dei progressi del bambino nel trattamento. È necessario che i bambini con autismo indossino dispositivi di monitoraggio delle onde cerebrali mentre giocano. Durante il gioco, l'APP registrerà i movimenti oculari. In seguito, l'intelligenza artificiale raccoglierà e valuterà i dati, inviandoli ai genitori, agli educatori e ai professionisti del settore medico. per aiutarli a discutere del miglior corso d'azione e per aiutarli a comprendere le conoscenze del bambino.

L'obiettivo di questo progetto è assistere i bambini autistici e i gruppi che li sostengono nell'apprendimento di abilità fondamentali per la vita in modo divertente, migliorando la loro qualità di vita e aiutandoli a integrarsi meglio nella società.

KEYWORDS (IT)

Children with autism and their related groups, AI monitoring and analyzing data, building platforms to connect all groups, communication.

1. Introduction

Can technology be used to help autistic people in economically disadvantaged areas?

In certain areas of low-income communities, there is a lack of awareness about autism. When parents notice their child is acting strangely or has mood swings, they often assume it's just a slow learner. However, when they eventually realize something is wrong and want to check, they find it difficult to sort through the vast amount of information available online and end up rushing to a big city to find a qualified doctor. When they finally decide to take their child to the hospital for an examination, they may not be able to understand the diagnosis after the advice given by the doctor.

They might have to travel quickly to a large city in order to locate a qualified physician when they need to visit the hospital for checks, and they might not be able to comprehend the advice that the physician gives them after making a diagnosis. Thus, this study attempts to examine the range of issues that parents encounter after learning that their children have autism from their perspective and to suggest more effective ways to lessen their stress.

1.1. Background

Despite China's fast economic progress, there are few people with impairments. This is not because the country has a small number of disabled people; rather, it is due to China's inadequate infrastructure and humanistic care for disabled people, which is a problem in both developed and developing countries. However, rather than dismissing them, we should pay greater attention and provide them with support if we are to truly improve society. Instead, we should provide them more attention and aid. Counting the number of skyscrapers is insufficient to assess a region's level of development; instead, one should consider how well it serves a limited number of poor populations.

There is a category of persons in the minority group known as autism, and they receive even less attention because they are able-bodied in all four limbs and do not appear to be any different from typical people on the outside, except that their brains are not quite the same. Autism is a developmental illness caused by a neural system dysfunction that manifests as atypical social skills, communication abilities, interests, and behavioral patterns.

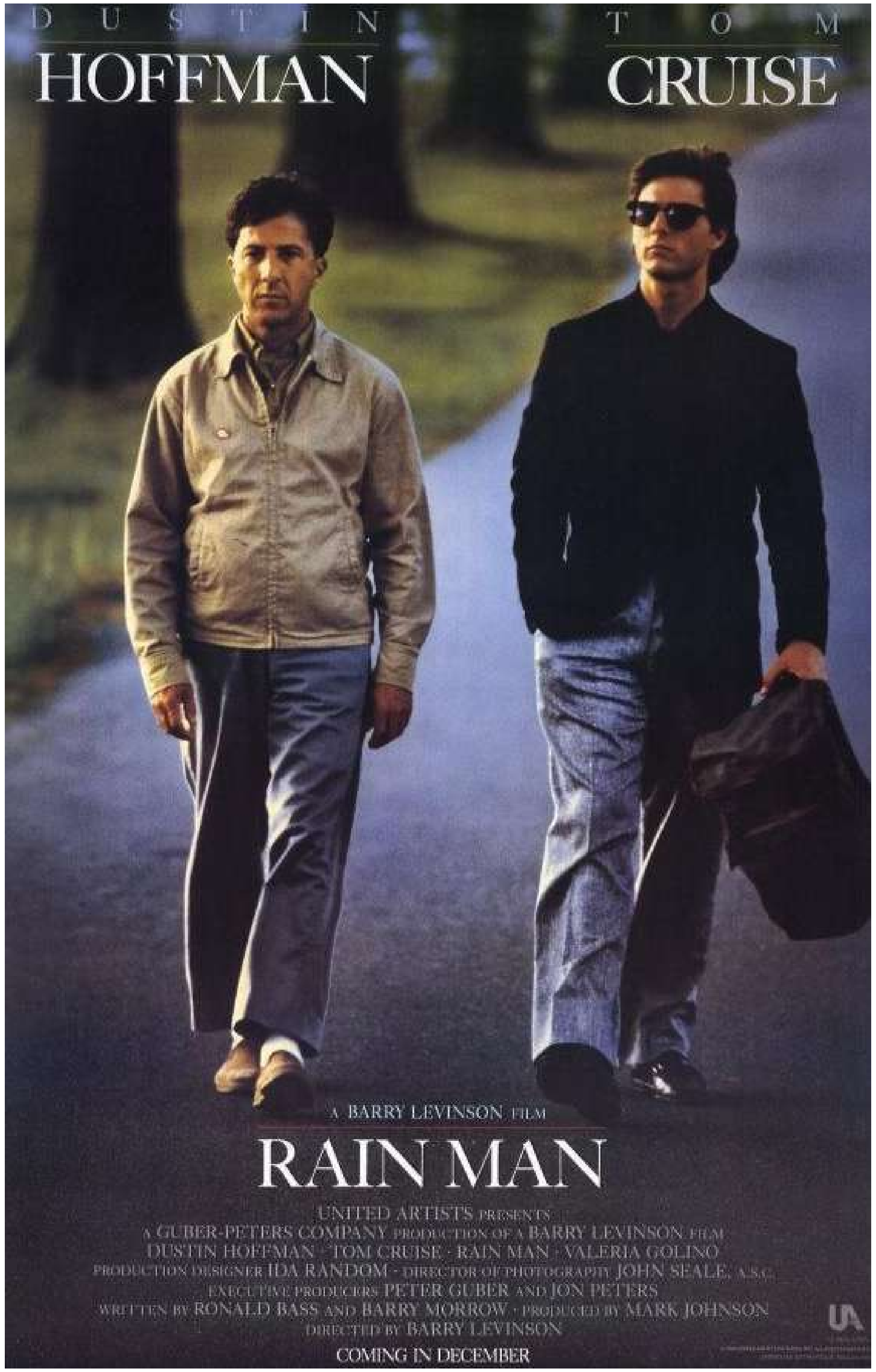
Autistic children are also referred to as "star children" since they are often silent and glittering alone in the distant, black night sky. Economically developed regions actively assist them by passing suitable policies, providing autism screening services, medical assistance, as many career options as possible, and assisting them in their eventual integration into society, among other things. These treatments do benefit people, but they are only available in developed countries, and implementing them in economically backward regions is challenging since they do not have enough financial revenue to sustain these services. The lack of awareness regarding autism makes it difficult to implement some of the activities, which is a significant problem for both parties.

Society must provide them with as much assistance as possible, whether it is a group of autistic children or their families. The majority of them are under a lot of mental and economic pressure. To help them relieve that pressure, try to take advantage of the conditions of high-speed development of science and technology, the use of AI and other technological means to alleviate the burden as much as possible, to reduce a certain amount of labor costs, may be a feasible measure.

2 . Analysis of children with autism

2.1 Definition on autistic children

What is Autism? Before we can help them we need to have some knowledge about them, autism is a biological neurodevelopmental disorder that usually appears before the age of 3. It is a spectrum disorder that affects people in different ways, people with autism usually have difficulties with verbal and non-verbal communication, social interactions, and leisure or play activities for example, they often have repetitive and restrictive behaviors, they are over or under-sensitive to noise, touch, smells or tastes, and many people who don't know enough about them often think that children with autism are stupid, but this is not the case, and people with ASD can vary greatly from one another. For example, some people with ASD may have advanced conversational skills, while others may be nonverbal. Some people with ASD need a lot of help in their daily lives; others can work and live with little support.



However, people with autism often suffer from multiple comorbidities, which can include allergies, asthma. Epilepsy, sleep disorders and feeding disorders to name a few, so they need more patient care and companionship. Autism doesn't actually affect life expectancy per se, but statistics have shown that people with autism have twice the risk of dying than the general population, often because they are more likely to die from other accidents, such as drowning.

As far as the current state of medicine is concerned, it seems that we cannot completely cure autism, but the inconveniences caused by autism can be greatly improved and even overcome through early intervention and treatment.

RAINMAN

RAIN MAN

1988/12/12
USA

Oscar 1989

Raymond in Rain Man is only allowed to eat a certain amount of food at each meal, watch a certain number of TV shows at a certain time, and go to bed at a certain time, and any accident that disrupts this repetitive behavior causes him to become fearful, lose control of his emotions, and yell.

200,000
In China, the number of autistic children aged 0-14 had exceeded 2 million in 2006.

Data source: 'Analysis of residents' knowledge and acceptance of autism' Youth and Society 35, 2019

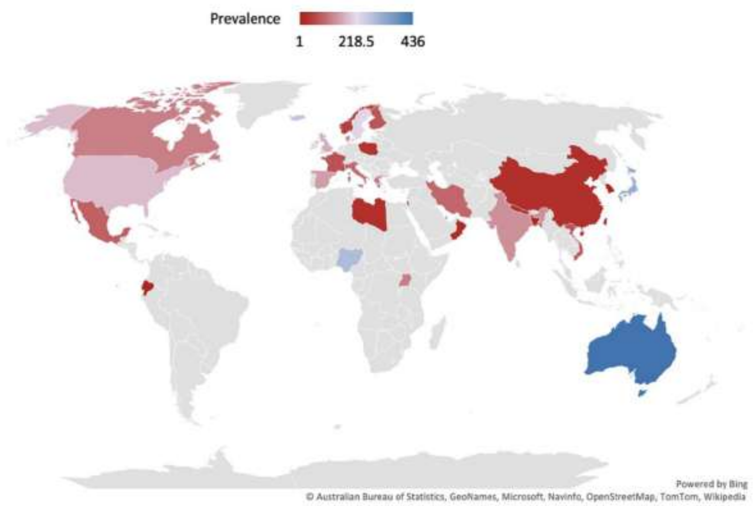
32.4%
Their families' financial situation makes it difficult for them to afford autism education.

52.4%
One of them had to give up her job to stay home with the kids.

10,000,000
In China, the number of autistic people had already exceeded 2 million in 2006.

85.13%
Don't know what autism is.

2.2 Statistics on autistic children



Map of global distribution of children with autism

In all the literature, the prevalence of autism ranges from 1.09 to 436 per 10,000 population.

According to the World Health Organization (WHO), globally, about one in every 100 children has autism, although this is an average value.

According to World Population Review data published in 2023, the prevalence of autism in Qatar is 151.2 per 10,000 children, while in France the rate is 69.3 per 10,000 children, i.e. there is a marked difference in prevalence rates by region, and it is important to note that in many low-income and even middle-income countries, the prevalence of autism varies significantly, but the prevalence of autism in the world is not as high as in other countries. What is even more important to note is that in many low-income and even middle-income countries, the prevalence of autism is unknown.

The prevalence of autism varies not only by region, but also by gender, ranging from 0.8:1 to 6.1:1, with a median of 4.2, which means that the prevalence of autism is 4 out of every 100 for boys and 1 out of every 100 for girls.

In 2016, China's autism population has reached 10 million, although the autism rate is not high, but because of the large population base, so the overall number is still among the world's high, in this 10 million people, 0-14 years of age with children may be more than 2 million, and is growing at an annual rate of 10%.

A questionnaire in 2019 showed that 85.13% of the population in China do not understand what autism is, of which 8.38% have never even heard of it, and only 14.57% of the population know about autism, so the author boldly speculates that there is a considerable part of children suffering from autism but because of the lack of relevant knowledge, they do not even go to hospitals, nor do they have the data statistics.

In China, more than 80% of people with autism do not have any socialization. It is difficult for them to integrate into the community in terms of learning and employment. Not only do autistic people lack regular education, but the general public also lacks the correct knowledge and understanding of autism, and many people even reject the attitude towards autistic people.

Why is this so? According to the "China Autism Education and Rehabilitation Industry Development Status Report II", although the term autism first appeared in China in the 1950s, the real diagnosis and research began with the publication of "Diagnosis of Infantile Autism and the Problem of Attribution" by Prof. Tao Guotai in Nanjing in 1982, which reported that the earliest cases of autistic children in mainland China were found and diagnosed. In other words, research on autism in mainland China is 40 years behind that in the United States.

In such an environment, people naturally lack a proper understanding of autism, which makes it more difficult for autistic people to integrate into society.

2.3 Autistic families in distress

In China, because autistic people are not so different from normal people in appearance, people who lack knowledge about autism often think that it is faked and there is no such condition, or simply attribute autism to mental illness.

A parent of an autistic child said an incident that was still fresh in his mind. Once when he was taking his child on an airplane, because the child had never been in contact with this mode of transportation before and was autistic, the roar of the plane made him very nervous, and coupled with the large number of strangers, he developed serious emotional and behavioral problems, and in the end, the parents and the child were taken off the plane, and what was even more difficult for the parents was that, due to the delay of the time, some people around them began to complain. These words have caused indelible damage to the parents' hearts.

"Why bring this kind of idiot out? What a hassle, why don't you just hide at home!"

80%

of people with autism have no socialization and are not independent, They have to stay home.

60%

of autism parents believe families and children will be discriminated against.

In recent years, due to the gradual improvement of medical care and the popularization of the Internet, etc., more and more people have begun to recognize autism, but this knowledge is very limited, according to the Youth and Society data in the article "Survey Analysis of Residents' Understanding and Acceptance of Autism" published in Issue 35, 2019, we can learn that most people still believe that the causes of autism are mainly a lack of family care and psychological disorders, that is, they believe that autism is caused by parental indifference in terms of affection and over-formalization of upbringing. However, a large number of studies have shown that autism is a congenital neurodevelopmental disorder that has little to do with parenting styles. Although the specific causes of the disease have not yet been fully confirmed, it is certain that 60% of autism cases are genetically related.

As mentioned in the previous article, it is difficult for autistic people to integrate into society in terms of education and employment, but to what extent is it difficult? In terms of education, the public welfare organization "Integration China" network of parents' organizations conducted two data surveys in 2017 and 2018, and the data is heartbreaking: 27% of autistic children between the ages of 6 and 15 have been asked to withdraw from school, and 26% of school-age autistic children are facing the prospect of not being able to go to school. Lacking practical teaching materials, professional teachers and specialized teaching resources in ordinary primary and secondary schools, they do not receive targeted training.

They are also unable to receive regular and systematic education like ordinary children to learn the skills to survive and develop in society, leading to a further disconnect between autistic children and society.

"According to Inclusion China, in Guangzhou, for example, about 40% of the disabled are employed, while only 4% of the mentally challenged are employed.

There is a systematic chain of rehabilitation, education and care for people with mental disabilities, from early childhood to schooling, vocational training, work and employment, and finally to old age. Each step in the chain imposes an unbearable burden on families. Especially for moderate to severe and older autistic people, there is "nowhere to go", and the road to recovery is bumpy and long.
In such an environment, parents of autistic children have to bear great psychological and financial pressure. Those who don't know about autism think that parents are too indifferent to their children, which leads to their children's illnesses; China's autism research started late, which leads to the treatment of autism being more difficult and expensive; and many families can't afford to pay for the expenses for their autistic children's visits to special schools and hospitals, so what should they do?

Data source: China Autism Parents' Needs Questionnaire, 4,136 questionnaires were sent to autistic families across the country and 3,867 were returned, with 3,581 valid questionnaires.

2.4 Basic autism treatment methods

There are numerous techniques to treat autism, which are typically classified into the following groups.

One method is the behavioral approach, which focuses on modifying behavior by understanding what happens before and after it. This strategy is widely acknowledged by educators and healthcare professionals, and it is employed in a variety of schools and treatment facilities. Applied behavior analysis (ABA) is a popular behavioral treatment for people with autism spectrum disorder (ASD). ABA helps people learn a variety of other skills by promoting desired actions and discouraging undesired behaviors, so enhancing "key skills" such as proactive interpersonal communication.

In autism treatment, many studies have shown that ABA can be effective in increasing behavior and teaching new skills There are dozens of interventions for ABA that are used to increase contact with the social environment, engage in the learning and enhancement of new skills, and practice social interaction and communication skills The following are some of the most common interventions.

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· Video modeling
· Visual activity schedules
· Direct instruction
· Self-management interventions
· Picture Exchange Communication System (PECS)
· Behavioral sibling training

As an example, an activity schedule is a visual display of pictures or words showing a sequence of events. Visual schedules can be created for the steps of any activity, such as personal hygiene, riding public transportation, completing chores, or completing homework at school, to help children better understand that these tips are necessary for building social relationships and accessing preferred items and activities.
The second strategy is developmental, and it focuses on increasing individual developmental skills, such as linguistic or physical capabilities, as well as larger connected developmental abilities. Developmental techniques are frequently integrated with behavioral approaches. For example, consider speech and language therapy. This improves comprehension and application of speech and language. Some individuals with autism spectrum disease communicate vocally. Others may communicate via signs, gestures, photographs, or computer communication gadgets.

The third option is educational treatment, which takes place in a classroom setting. TEACCH believes that persons with autism thrive on consistency and visual learning. It helps teachers manage their classes and improve academic and other outcomes.

The fourth is social relationship therapy, which focuses on improving social skills and building emotional bonds. It encourages parents and therapists to follow the patient's interests in order to expand opportunities for communication.

Fifth is pharmacological approach, there are no drugs to treat the core symptoms of autism spectrum disorders. However, the presence of autism is often accompanied by a number of other psychological and physical problems, such as self-injurious behaviors, such as head-banging or hand-biting. Medical conditions such as epilepsy, sleep problems, and stomach or other gastrointestinal problems require the use of pathologic approaches.

There is also an approach known as complementary and alternative therapy. Complementary and alternative therapies are often used to supplement more traditional methods. They may include special diets, herbal supplements, chiropractic care, animal therapy, art therapy, positive thinking therapy, or relaxation therapy.

Commonly used treatments for autism are the ones listed above, and while we may not be able to help more medically, we may be able to help autistic people design a game that relies on ABA and other methods of learning, and in areas where there are no special education facilities, it may be possible to rely on a cell phone as a medium for play.

2.5 Help for families with autism in developed regions

England

In order to better help families with autism, it is necessary to refer to what economically developed regions do. Here, we take England as an example to analyze what kind of support the government of England has provided to families with autism.

The Department of Health of England published the first autism strategy in March 2010. First of all, it is necessary to raise people's awareness and understanding of autism, not only ordinary people, but also professionals, so as to better help them.

Secondly, it is to help them improve the pathway for confirmation of diagnosis and follow-up diagnosis and treatment, so that families with autism can seek medical treatment more conveniently. Finally, various organizations are set up to help them better integrate into society, such as learning and employment, which will be arranged and planned by professional organizations.

In helping autistic children, the focus of special education is clearly defined in terms of communication, cognition, mental health, and expression of sensory or physical needs, so that autistic children can also express their emotions clearly and communicate better with the outside world.

In addition, in order to help children with autism, the government of England has made mandatory provisions under the Children's Act.

Under section 17 of the Children Act 1989, local authorities have the duty to "safeguard and promote the welfare of children in need within their area ...... general duty to provide a range of services appropriate to the needs of those children".

Local authorities are responsible for assessing whether local children are in need. If the local authority decides to provide a service following that assessment, it should draw up a multi-agency plan setting out which organizations and agencies will provide which services for children and families.

With legal regulations in place, autism-related organizations can be better built and run. In order to reduce the burden on families with autism, the Government of England has introduced the Personal Independence Payment (PIP) to replace the Disability Living Allowance (DLA) for people of working age. The PIP assessment aims to provide a more 'holistic' assessment of the impact of a health condition on a person's ability to participate in everyday life than the DLA assessment. PIP also aims to provide more targeted support to those who need it most.

Scotland

The Scottish Government and the Convention of Scottish Local Authorities (COSLA) published the Scottish Autism Strategy in November 2011 with £10 million of funding over four years. The content contained 26 recommendations including leadership and cross-agency working, improving diagnostic pathways and supporting people into employment.

In 2014, the Scottish Government reported on progress and noted the publication of a 'menu of interventions', which provided each local authority with a one-off investment of £35,000 to develop a local autism strategy.

Northern Ireland

The Autism Act (Northern Ireland) 2011 requires the Northern Ireland Department of Health to publish an autism strategy (for all ages) and to report on its implementation at three yearly intervals.242

The structure of the Action Plan set out thirty-four cross-Governmental actions reflecting the following eleven themes and associated strategic priorities:

- Awareness
- Accessibility
- Children, young people and family
- Health and wellbeing
- Education
- Transitions
- Employability
- Independence, choice and control
- Access to justice
- Being part of the community
- Participation and active citizenship

2.6 The dilemma of autistic groups in economically backward areas-taking Jingzhou as an example

As we can see from the previous section, developed regions already have a relatively perfect system to help the autistic group, such as improving laws and regulations, establishing corresponding organizations, etc. However, how can economically backward regions help the autistic group? However, how can economically backward regions help autism and other minority groups? The author's hometown, Jingzhou, is a small city in central China's Hubei Province. This time, I will use Jingzhou as an example to analyze how economically backward places can help the autistic community.

The Jingzhou government has stipulated that autistic children between the ages of 0-14 should be provided with categorized assistance, including basic and individualized rehabilitation services such as surgery, rehabilitation training, and adaptive fitting of assistive devices, with the main purpose of alleviating dysfunctions, improving functional conditions, and enhancing the ability to take care of themselves and participate in society. They are provided with a certain amount of subsidized surgery, and, with the consent of the county (city or district) disability federations, children with disabilities may receive rehabilitation at rehabilitation institutions determined by the relevant authorities in a different part of the province, and the rehabilitation costs incurred are subsidized in accordance with the standards for assistance at this level. Moreover, the Government has proposed to support the development of special education institutions.

From the information available, it appears that the government has provided some assistance to the autistic community, but the regulations promulgated are not particularly clear and unambiguous, so how much has this regulation actually helped the autistic community? The results seem to be less than satisfactory, according to the national authority to publish data show that in 2018, the number of autistic children under the age of 5 in Hubei province was 19,636, but less than 2,000 children received treatment.

"At present, there are 29 institutions treating children with autism in Hubei province, which sponsored a total of 1,439 children last year, less than one-tenth of the total number of children with the disease." After an interview with Xu Haiqing, the chief expert of the pediatric protection department of Hubei Maternal and Child Health Hospital, she answered this way.

As one of the first national demonstration bases for early childhood development, Hubei Maternal and Child Health Hospital has more than 2,000 new cases of autism every year, but less than 20% of the children receive formal treatment, and 80% of the children are "abandoned" for various reasons. Not only that, but since 2008, the hospital has been organizing regular parent training courses every month, but parents often fail to make appointments. Regular callbacks are often unanswered.

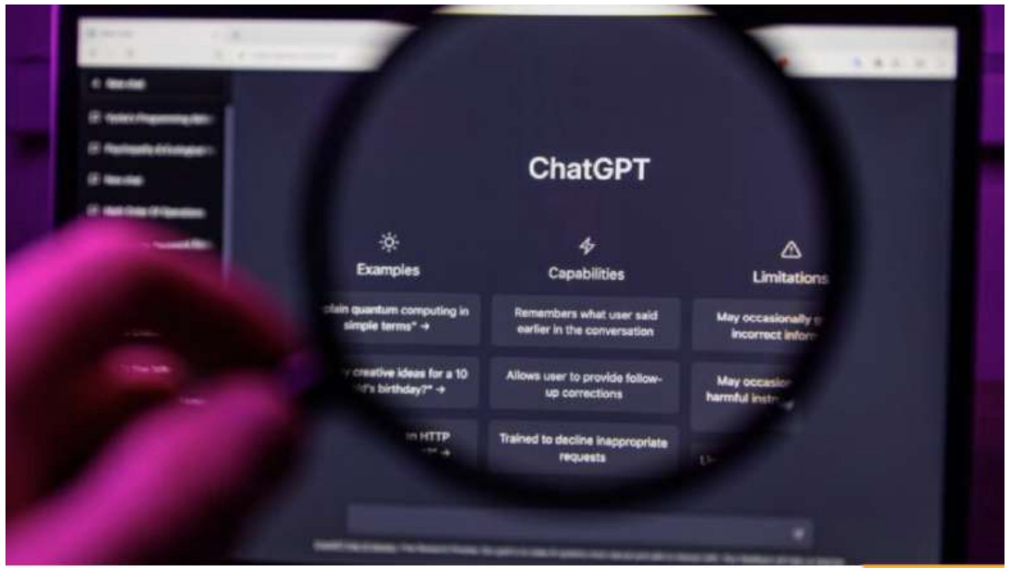
Parents' lack of knowledge about autism is one of the reasons for the slow progress in helping the autistic group. In economically backward areas, many parents' knowledge about health still stays in the physical aspect, and they don't care about mental health, they think that having enough to eat and wear warm clothes is no longer a problem, while on the other hand, the government's help is not doing enough, Jingzhou TV station has once received a request for help, and nearly 100 parents of autistic children have joined together, hoping that the government can provide a venue for them to teach their autistic children some basic life skills, to be able to have contact with people other than their family members. Parents of nearly 100 autistic children have joined together in the hope that the government can provide a venue for them to teach their autistic children some basic life skills and contact with people other than their family members. With the help of the Jingzhou Civil Affairs Bureau, they have set up a non-civilian enterprise called "Jingzhou Autistic Parents Mutual Help Association". However, they have not been able to find a suitable venue, and no progress has been made until the end of the report.

In economically backward areas, the resources of medical institutions and educational institutions to help autism are far from enough. The difficulties of the autism community can be analyzed in two phases according to the time period: First, before diagnosis, the general public lacks the knowledge of autism, or even has no concept of autism, and is reluctant to go to receive treatment. Secondly, after diagnosis, many families cannot afford the high cost of long-term diagnosis. In addition to the consultation fee, in some small cities, there are even no medical institutions and educational institutions to treat autism, so these families need to go to other cities for treatment, which also costs more time and energy.

How do people recognize autism? What should I do if my child is diagnosed with autism? In the search engine query related issues, can be found in the forefront of the information are almost all advertisements, so it is difficult to distinguish, each page of knowledge is very confusing, and does not apply to all stages of the population, so is it possible to autism groups to communicate with the integration of information to help?

3. Artificial intelligence related analysis

3.1 Definition of artificial intelligence



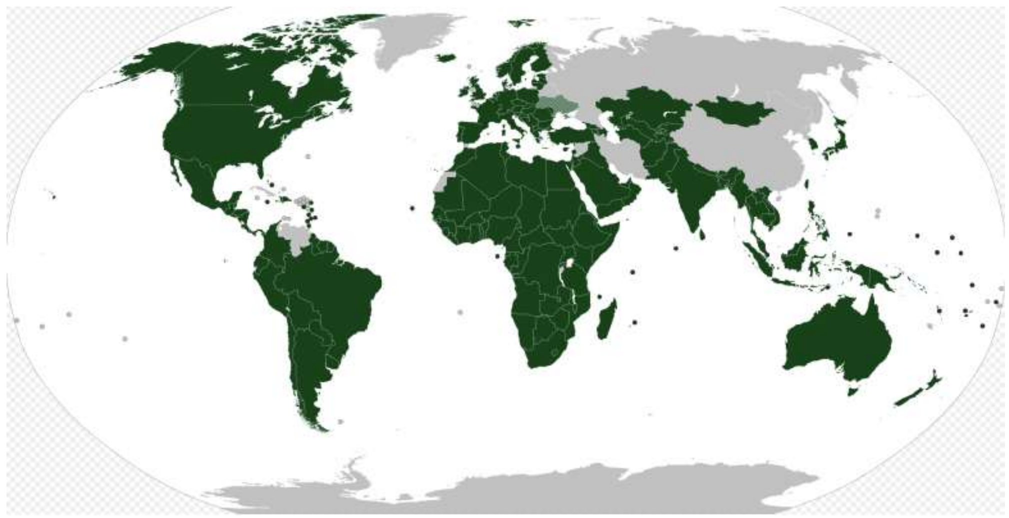
At the end of 2022, OpenAI introduced ChatGPT to the world, taking the Internet by storm. In just five days, it had already surpassed one million users, and two months later, it reached one hundred million.

And that's just the beginning. Throughout 2023, ChatGPT's monthly visits will remain above one billion, and it's estimated that ChatGPT will generate $1 billion in revenue by 2024.

With the rapid development of artificial intelligence having a considerable impact on society, is it possible to use technology to do something to help minorities? The first thing to understand is, what is Artificial Intelligence? Also known as machine learning, it is a software system based on neural networks, a technology that was actually pioneered decades ago but has recently boomed thanks to powerful new computing resources. Artificial intelligence enables effective speech and image recognition, as well as the ability to generate synthesized images and speech.

In more accurate terms, AI should actually be called imitative intelligence, because what it does is closer to a computer than to a brain, integrating and then optimizing information to give an answer. Using CHATGPT as an example, if you're looking for a job right now, and you need it to write a cover letter for you, it can do some work on the model by using a specialized dataset (e.g., the thousands of job applications that happen to exist), and it can do some work on the model.) to fine-tune the model with some additional training. This allows the model to gain a better understanding of how it can help you in that area, without throwing away the general knowledge gathered from the rest of the training data.

Thinking about the problem raised in the previous section, when people collect autism-related information online, they are unable to learn effectively because the information is cluttered and heavy, perhaps we can use AI to construct a large language model, so that when a user needs to learn and doesn't know where to start, he or she only needs to answer the relevant questions on a webpage or an app, so that the AI understands the user's level of knowledge and preferences and makes relevant recommendations, allowing the AI to help the user with his or her knowledge. related recommendations, so that artificial intelligence to help the user to generalize and organize, may be able to greatly improve efficiency.



ChatGPT Global Availability Map

3.2 Feasibility analysis of artificial intelligence to benefit autism

Over the past decade, significant advances have been made in the field of autism intervention science, providing promising evidence for improving developmental outcomes for individuals with autism.

Obtaining a diagnosis of autism is difficult, particularly because of disagreements about characteristics, the diagnostic process, and the ways in which it overlaps with other disorders, such as intellectual disability.

The prospects for an accurate diagnosis depend on many external factors. The prospects for an accurate diagnosis depend on many external factors. Assessments themselves are inconsistent and confusingly standardized, and are subject to There are inconsistencies and confusing standards in assessment itself, and many people with autism take a long time to be seen, limited by the number of healthcare professionals involved. According to the latest statistics from NHS Digital (August 2020), between April 2019 and January 2020, the number of individuals aged 18 and over waiting for a referral and diagnosis of autism is estimated to be around 1.5 million.

Individuals aged 18 and over waiting for referral and diagnosis waited an average of 361 days from first contact to diagnosis. The older the individual, the longer the wait, with 45 to 54 and 55 to 64 year olds waiting an average of 361 days from first contact to diagnosis.

Individuals aged 45 to 54 and 55 to 64 waited an average of 480 days.

Due to the lack of specialists and given the uncertainty under clinical visits, people are starting to use artificial intelligence to help diagnose autism. Scientists need to know enough about autism to program autism-related knowledge into an AI diagnostic tool and then use it to conduct the visit, which may help to shorten the wait time for a large number of people with autism.

A study by Chen et al32 suggests that it is possible to identify "neuroimaging biomarkers" 'using MRI to differentiate between autistic and non-autistic patients. Their approach involves applying "data-driven artificial intelligence" to help differentiate between various neuroimages, including brain scans during the diagnostic process. This includes brain scans during the diagnostic process. This approach is fully consistent with the animating principles of the Research Domain Criteria (RDoC) that guide contemporary thinking in American and European psychiatry.

However, this approach is not without its drawbacks; it is extremely deep in terms of depth of understanding and requires a large amount of data to support it; the researchers believe that the data provided by AI is more objective, but this does not prove it, and the study of AI in relation to autism assessment tends to "deal with the problem of categorization of autism spectrum disorders in a static, open-ended way. ".

Why do we say that AI approaches the problem from a static perspective? Because clinical encounters are constructed from competing and changing norms. But AI often relies on data derived from past cases, which may have been collected according to associating various behaviors with deficits that need to be remedied, and which are outdated from the date of their collection as new data are generated that change the basis for judgments and so on. So AI does not necessarily objectively explain the specific case being investigated at this moment, but rather brings in a collection of data from previous cases, and in a sense it does objectively fit into some generalized situations.

n summary, while AI and machine learning hold great promise for autism diagnosis, there is also a great danger that these technologies will simply represent and/or rely on the same biases, conceptual deficiencies, and practicalities, so their use needs to be judged and used selectively by clinicians on a case-by-case basis.

Robot-assisted therapy has emerged as a promising frontier in the care and therapeutic support of children with autism. The convergence of advanced technologies such as robotics, artificial intelligence, and developmental psychology has resulted in specially designed robots that can interact with children with autism spectrum disorders, and these robots have unique characteristics that make them ideal for these interventions. They can provide repeatable and predictable interactions, which is particularly beneficial for children who often find social situations unpredictable and overwhelming. Additionally, these robots can be adapted to a child's individual needs, allowing for effective and efficient individualized treatment. They also eliminate the fear of social criticism often experienced by children with autism, creating a more comfortable and safe learning environment. After a search of papers with the keywords robotics, autism, and children, I found a large number of examples of successful robot-assisted therapy. This will be presented in a table below.

Selected Research Findings on Assistive Robots - Cite Paper Assistive Robots in Early Childhood Autism Treatment

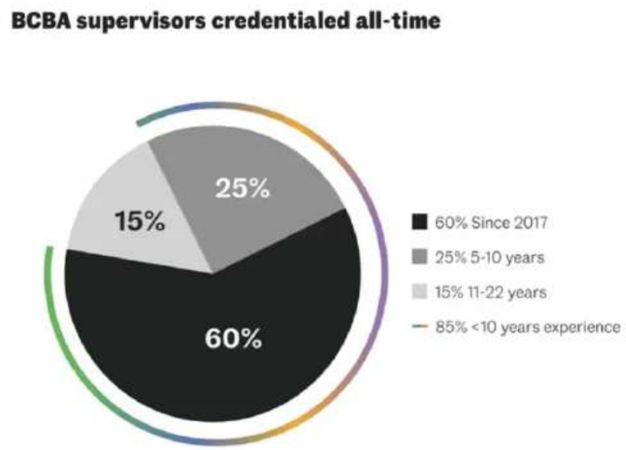
Authors	Type of Study	Sample (Total of Males) and Age	Intervention	Scale and Evaluation Methodology	Result
Pop et al. [37]	Case study	N = 20 Ages = 4 to 9 years	Robot Probo. CG (n = 7): G1 computer-presented social stories (n = 6); G2 robot-assisted therapy (n = 7). It was used as a story-telling agent.	Asking questions, eye gaze, asking for help, and greeting	The use of the social robot to implement a social story intervention was more effective in improving the independence to express social skills in participants than the computer screen.
Wainer et al. [52]	Case study	N = 6 (1 female) Ages = 8.5 ± 0.55 years	Robot KASPAR. Imitative and collaborative games with autistic children accompanied by a partner with and without the presence of the robot. ABAB, 'A'-interacting with a human. adult, and 'B' interacting with the robot KASPAR. 20 sessions.	Promoting to choose, urging to comply, other forms of talking, successful shape selection, pose, gaze, and gaze shift, positive affect	The data did not show that KASPAR increased the persistence of a positive affect in other children, but showed that the duration of positive affect when looking at other children was longer.
Dehkordi et al. [40]	Case study	ADS: N = 35 Ages = 4.7 ± 2.56 years Normal: N = 16, Ages = 4.5 ± 2.2 years	Parrot robot. The robot was used to talk, sing, move, and react to interactions to capture the children's attention. The experiment was carried out in two modes: (a) individual interaction mode (this therapy had a duration of 8 to 12 min) and (b) group interaction mode (in group of six children with 20 to 30 min of therapy).	The evaluation was carried out with videos that were observed by an expert. Different parameters were evaluated: eye contact or if the duration was less than 3 s, smile, physical proximity to the robot, gaze or pointing, attention, etc.	The robot could encourage children to interact according to their preferences that match the three functionalities of the robot (verbal, functional, and perceptual).
Boccanfuso et al. [38]	Pilot study	EG: N = 8 Ages = 3 to 6 years CG: N = 3 aged = 3 to 6 years	Robot Charlie. The robot interacted with the children through various interactive games and activities. The interaction involved the robot responding to the children's actions, providing positive sensory feedback, and promoting engagement and trust through fun and social exchanges. The intervention divided into three parts: one hour of speech therapy per week for 6 weeks (MLSUD provides a total meaningful spoken language score during the evaluation period of 1.0–1.5 h), two 30-min sessions per week for a total of 6 weeks, or 12 total intervention sessions with the robot.	(1) VABS-II Communication Domain, (2) VABS-II socialisation domain, (3) VABS-II Receptive and Expressive Communication v-scale scores, (4) MLSUD, (5) UIA social imitation, (6) UIA requesting (7) UIA joint attention, (8) MIS and (9) EVT2	The results within the group showed an increase in social interaction skills, as reported by caregivers on the Vineland II Parent/Caregiver Rating Form. Increases between groups in the Receptive Language and Play and Leisure scales.
David et al. [53]	Case study	N = 5 (1 female) Ages = 4.68 ± 0.81 years	Robot NAO. The interaction involves giving the child an instruction to pay attention to what the robot is looking at, waiting for the child's response, and providing feedback based on the child's answer. 1. Baseline measurements (BM) for six to eight measurements, until a stable baseline level has been established. 2. Robot-enhanced treatment (RET) for 8 sessions. 3. Standard human treatment (SHT) for 8 sessions. 4. RET or SHT, depending on which of the treatments worked best for each child, for 4 sessions. Each session lasted 10 min each day.	Head orientation, pointing, relevant verbalisation (vocal instructions that are in the context of the experiments/tasks being implemented) and delays in performing such behaviours.	Children kept their interest throughout the sessions, showing great adherence to the treatment and improving their joint attention skills.
So et al. [54]	Case study	N = 45 ADS n = 15 (6 females) Ages= 5.83 ± 0.83 years CG: ADS n = 15 (6 females): Ages = 5.67 ± 0.35 years TD: n = 15 (6 females) Ages = 5.33 ± 0.67 years	Robot NAO. EG: received four 30-min robot-based gestural training sessions. The social robot narrated five stories and gestured. Children with ASD were told to mimic gestures during training. CG and TD: children of the same age received gestural training after the completion of the research.	The patients were diagnosed with ADOS test. PEP3, SCQ, BOT, ANT, and gestural recognition task	Children with ASD in the intervention condition were more likely to produce accurate or appropriate intransitive gestures in training and novel stories than those in the wait list control. Positive learning outcomes were maintained in delayed post-tests.
Zhang et al. [55]	Pilot study	ADS: N = 20 (2 females) Ages = 6.79 ± 0.93 years	Robot NAO. The therapy lasted 25 min. Each child participated in a series of tasks in the following order: warm-up session, distrust and deception tasks, and a short interview about their anthropomorphic thinking of the robot.	The different groups were studied with Welch's t-test to compare the distrust and deception tasks, respectively.	This study shows how children with ASD learn to be distrustful. This learning is less than in children with TD.
Zheng et al. [50]	RCT	N = 20 Ages = 1.64 to 3.14 years	Robot NAO. The child interacts through joint attention games, visual tracking of stimuli, and responses to social cues from the robot. Participants were divided into a waiting list control group (WLC: n = 11) and an immediate robotic intervention group (RI; n = 12). Each group received interventions between 3 and 9 weeks. Duration: 10 min.	After and before intervention measured: prompt level and target hit rate.	Patterns of significant improvement and worsening performance within the system strongly suggest that robotic intervention systems may not be an appropriate additional intervention tool for all young children on the autism spectrum.
Davide et al. [56]	Case study	N = 24 (5 females) Ages = 5.79 ± 1.02 years	Robot Cozmo. The robot stands between two squares of different colours. The child responds verbally or manually. Depending on the response, the robot changes its expression. There were different phases: initiating, responding, and maintaining social interaction, joint attention, and behavioural request. Each training session: 12 turns of a robot game for ten minutes.	The ADOS test is used to measure social interaction, behaviour request, and joint attention. The ESCS evaluates the child's ability to communicate efficiently, making requests, and responding to the activities proposed by the adult. The results are then statistically compared.	Iteration-based therapies obtained better results than individual therapies.

CG: control group. EG: experimental group. RCT: randomised controlled trial. VABS-II: Vineland Adaptive Behaviour Scale II. SCQ: Social Communication Questionnaire. MLSUD: mean length spontaneous utterance determination. UIA: unstructured imitation assessment. MIS: motor imitation scale. EVT2: motor imitation scale 2. TD: typically developing. ESCS: Early Social Communication Scale.

3.3 Representative products that utilize artificial intelligence to benefit autism

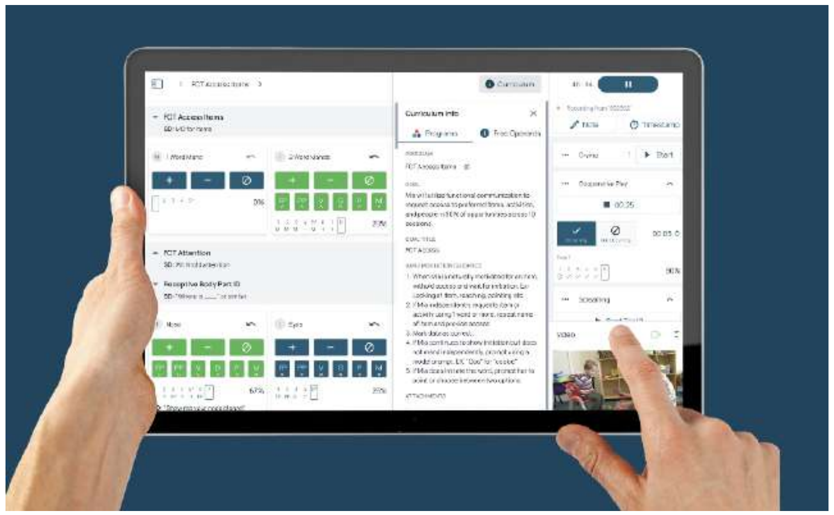
3.3.1 Screening for autism

Nowadays, there are already many companies using AI to intervene in autism treatment with good results, and representative products will be selected and analyzed in this article next.



The previous article has already mentioned the use of ABA digital therapy for autism treatment, ABA as an intensive and long-term treatment, the average weekly treatment time to reach 25-40 hours, but the ABA professional health care workers are facing a serious supply and demand imbalance, in the United States, there are even more than 54% of the areas without ABA professionals, not to mention the economically backward areas, and a large number of ABA professionals experience less than 5 years, which can easily have an impact on treatment, and if the treatment is not appropriate, it may strengthen the negative behavior of the patient, because its efficacy monitoring relies solely on the information provided by the treatment staff and the patient's parents, which is highly subjective and lacks objective criteria, if the medical staff's inexperience produces a wrong judgment, so all things considered, the medical staff of ABA is far from enough.

In this case, Ling Shao wanted to do something. With four children suffering from autism, a lack of ABA professionals to treat them, and the high cost of treatment, she decided to narrow the healthcare inequity by providing quality and affordable care for children with autism, and by bringing together physicians/families and payers. She founded SpectrumAi, which launched Twyll, an ABA electronic medical record, and Patterns, a web analytics platform, as two tools dedicated to improving the quality of ABA rehabilitation treatment.



In the case of routine treatment by healthcare professionals, if they record the relevant details halfway, it will interrupt the patient's treatment. Twyll is a good solution to this problem, in which artificial intelligence algorithms can automatically acquire images, sounds, text and other treatment data, and then the system automatically generates an analysis report, and the therapist can also remotely supervise the progress of the patient's treatment to simplify the process of record-keeping, and it can also provide the payer with a medical-grade ABA analytics for payers, eliminating paperwork and improving the efficiency of managing autism therapy coverage.

In other words, SpectrumAi's primary demographic is autism parents and healthcare providers, and it helps them streamline the treatment process, as well as provide remote services to facilitate communication between parents and healthcare providers.

It's not just SpectrumAi that uses speech-to-text to record, it's also SocialMind. To help parents interact with their children, Dr. Friedgut founded SocialMind Astium in 2019, which is designed to train and supervise adults, focusing on interactions between adults and children.

SocialMind's software platform relies on the Azure backbone, which consists of a powerful database that interacts with a variety of front ends, including web and mobile interfaces, to provide a seamless user experience.

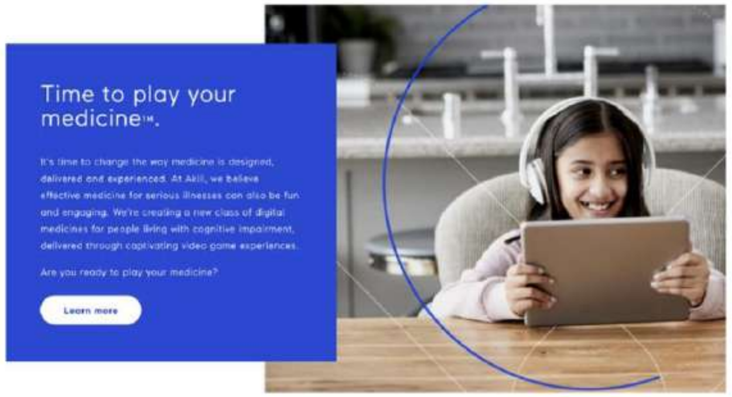
The Azure technology is speech-to-text. As users record themselves and their children, SocialMind can transcribe the interaction for further study. Advances in artificial intelligence and machine learning mean that Azure Cognitive Services' speaker categorization technology has improved significantly in recent years, enabling its speech-to-text algorithms to accurately distinguish between multiple speakers with high precision and efficiency.

By taking notes, parents can also observe how they are doing when interacting with their children and try to do better.

"You don't need to be highly educated to help your child communicate, play or explore the world. " Dr. Friedgut puts it this way, "That's what I created SocialMind for. "

3.3.2 Treatment of autism

Playing games can cure diseases?



Utilizing digital therapies to help with autism is also a very popular way to help with autism, what are digital therapies?

DigitalTherapeutics (DTx) is a subset of digital health and is an evidence-based therapeutic intervention driven by high-quality software programs for the prevention, management or treatment of medical disorders or diseases. It can be broadly defined as treatments that use digital and Internet-based health technologies to stimulate behavioral change in patients.

The history of using digital therapies to improve health
outcomes dates back to the 2000s, when researchers utilized advanced technological devices to improve clinical care, resulting in two distinct types of digital therapies, the first of which extends the therapeutic value of traditional medications, such as providing therapeutic recommendations through companion software to help patients manage their conditions. The second type of therapy, highlighted here, utilizes devices such as tablets to deliver sensory stimulation through gaming to treat insomnia or depression, thereby replacing traditional medications.

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In fact, the idea of applying games to the medical industry is not a wild idea, but to prove that this is really feasible needs to undergo extremely harsh scrutiny, because games are used as drugs and medical treatment in practice, which is obviously a thing that needs to be taken seriously.

Akili is a company with a very clear goal: to change the way drugs are traditionally designed and delivered by combining the best in technology and entertainment with a more comfortable experience for the user. And indeed, they've already produced a landmark product.

Akili Interactive's game-based digital therapeutic device, EndeavorRx, is the first game product to receive FDA approval for marketing in 2020.

EndeavorRx, as a game-based prescription drug, is not a "drug" as people traditionally think of it in terms of appearance and experience. In this video game, players will experience the game content by exploring new worlds, building their own universes, capturing mysterious creatures, and unlocking new characters by solving tougher challenges, which are of course based on rigorous therapeutic theories. Of course, the game design is based on rigorous therapeutic theories, and patients are treated as they play, and their attention problems will improve as a result of using the software.

Prior to FDA approval, EndeavoRx had been in development for nearly seven years and had undergone five clinical trials with more than 600 children with ADHD on 15 continents in the U.S. The data from these studies showed that EndeavoRx did indeed improve the attention span of 8-12 year olds with ADHD.

And, according to officials, the studies did not find any serious adverse effects associated with it, except for the most common side effect of frustration, which is why EndeavoRx has become so popular, given that traditional treatments, both pharmacologic and non-pharmacologic, are subject to a number of uncontrollable factors that can cause them to be less effective than they should be, such as drug abuse, side effects, and non-pharmacologic treatments that are effective. This is why EndeavoRx has become so popular.

In terms of the usage of EndeavoRx, the official website also gives a clear description: "It is recommended that patients play for 25 minutes a day, 5 days a week for 4 weeks or as directed by a doctor. In addition, the official website emphasizes that a recent trial has shown that the second month of treatment leads to better results.

"It's time to change the traditional way of designing and distributing medications, and we believe that effective medications used to treat disease can be fun," the company said. On Akili Interactive's website, the team communicates the mission and significance of their work in a light-hearted tone to visitors to the

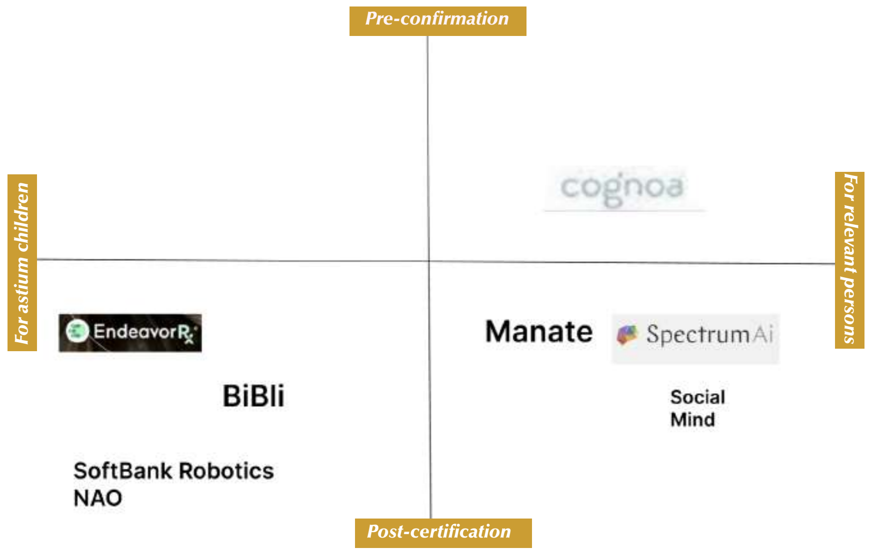
3.4 How to use artificial intelligence to better help autism

The previous post introduced several products that utilize artificial intelligence to help the autism community. Here, we can do a simple categorization.

Categorized by time period, we can take diagnosis as the node. The first category is pre-diagnosis, i.e., to help autism screening; the second category is post-diagnosis, i.e., to help autism better treatment.

According to the classification of user groups, it can be divided into patients and related groups, such as family members of autistic patients, special educators, related medical personnel, and so on.

The main purpose of products for autistic people is to improve their communication with the outside world and cognitive ability, such as companion robots.



Competitor Analysis Chart

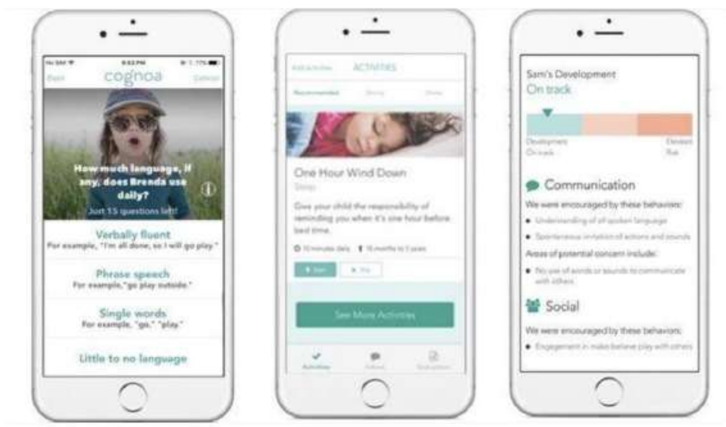
After a simple division of the more commonly used autism products available on the market, it can be found that almost all designs are only for a certain group of people at a certain stage of the use of the needs of a certain group of people, and no product is designed with a complete chain of use that encompasses an entire group of people.

There are many kinds of products for related groups, such as remote-assisted therapy, helping parents to learn relevant knowledge to communicate with patients, analyzing the future trend of patients' diseases, etc. Compared with traditional diagnosis and treatment, these products are more effective than traditional diagnosis and treatment, and are more effective than traditional diagnosis and treatment.

Compared with traditional diagnosis and treatment, these products have greatly increased the number and efficiency of autism screening and treatment, saving a lot of energy for autistic family members, especially those in economically backward areas. But they are not perfect, and they have very significant drawbacks. For example, companion robots are very expensive, and the communication skills that autistic children are learning at this time are with robots. Can they be directly applied to other areas? Just because you can communicate with a robot doesn't mean you can apply it perfectly to a real person. That's a question worth pondering. In addition, many products are not simple enough to be used by children with autism.

The next step will be to use the autism screening software Cogona as an example to compare the difference between it and the traditional way of autism screening. Cogona learns from the onset of 100,000 children with autism and then trains a set of screening algorithms, using which parents can screen for autism by answering 15 to 20 questions. If the results of the questionnaires are not clear enough to draw a conclusion, parents can upload a few videos of the child's daily life and a medical professional will analyze them in conjunction with the results of the questionnaires, and the parents can be informed of the results after about 15 minutes.

Comparative Dimension	Traditional Autism Screening	Cogona Autism Screening
Time/space	Parents make appointments in advance to bring their children to the hospital	Screening via app anytime, anywhere
Required time	Approximately 1 hour (screening only)	Approximately 15 minutes
Other factors	Results are influenced by subjective factors such as doctor's level and experience	Less subjective, but may template

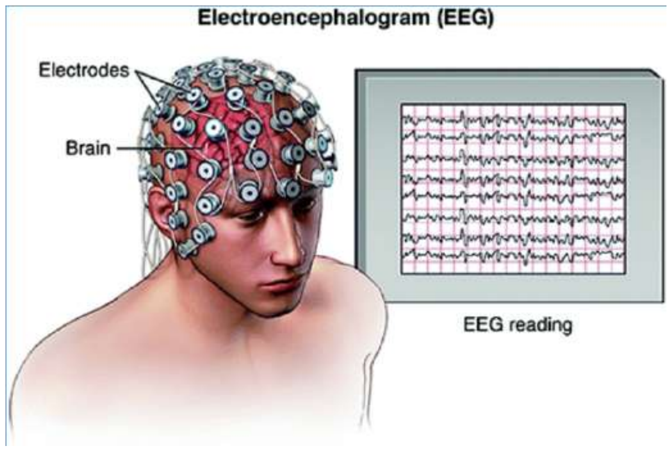


COGNOA Interface Design

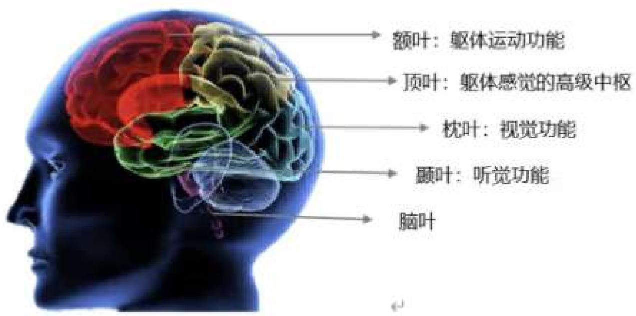
3.5 EEG principles and mainstream EEG devices

In order to design a rational brainwave monitoring device, it is important to understand the EEG principle and the mainstream EEG devices available today.

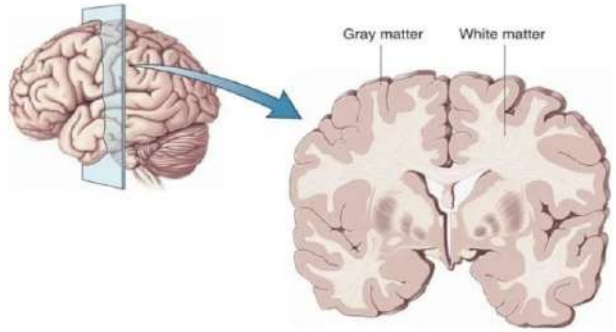
Electroencephalogram (EEG) is an electrophysiologic monitoring method for non-invasive recording of brain electrical activity, where electrodes are placed along the scalp, and then the brain's spontaneous electrical activity over a period of time is recorded through multiple electrodes placed on the scalp. The graph obtained by amplifying and recording the spontaneous bio-potentials of the cerebral cortex of the brain from the scalp by means of a sophisticated instrument is the spontaneous, rhythmic electrical activity of groups of brain cells recorded by electrodes.



The surface of the brain has many sulci and gyrus, and it is these sulci and gyrus that divide the brain into four brain regions. Specifically, the central sulcus, the parieto-occipital fissure, and the lateral cerebral fissure divide the brain into the frontal, parietal, occipital, and temporal lobes. The temporal lobe is dominated by auditory functions, the occipital lobe is dominated by visual functions, the parietal lobe is the higher center of somatosensory perception, and the frontal lobe is dominated by motor functions of the body. The liaison areas between the prefrontal cortex and the temporal, parietal, and occipital cortex are associated with higher brain activities such as complex perception, attention, and thought.



The thickness of the cerebral cortex is very thin, an average of only 2.5mm, its outermost layer is a layer of dark-colored structures, which is where the cell bodies of the nerve cells are located, which we also call gray matter, and it is also the area where we collect the EEG signals; the structure below the cortex is the axon of the nerve cells, which serves to transmit the signals from the neurons in the cortex, and because the axon is wrapped by a layer of lighter-colored myelin sheath, it is also called white matter. Because the axons are surrounded by a lighter colored myelin sheath, they are also called white matter. The higher center that governs our movements is the cerebral cortex, also known as gray matter. The bioelectricity captured by the EEG is the firing of neurons in the gray matter, which allows us to explore the workings of the gray matter.



The principles used in EEG acquisition systems on the market are similar, the biggest difference lies in the electrodes and anti-interference ability, common electrodes are dry electrodes and wet electrodes, as well as special electrodes. Dry electrodes are more convenient in the preparation stage of the experiment, but the signal quality is slightly worse than that of wet electrodes.

Wet electrodes reduce the impedance between the electrode and the skin by means of a conductive paste or saline, but they take longer to prepare, but the signal quality is better than that of dry electrodes. Wet electrodes are also categorized into metallic and non-metallic electrodes, metallic electrodes are more conductive than non-metallic electrodes, but some special scenarios such as magnetic resonance are not applicable, which requires the use of non-metallic electrodes.

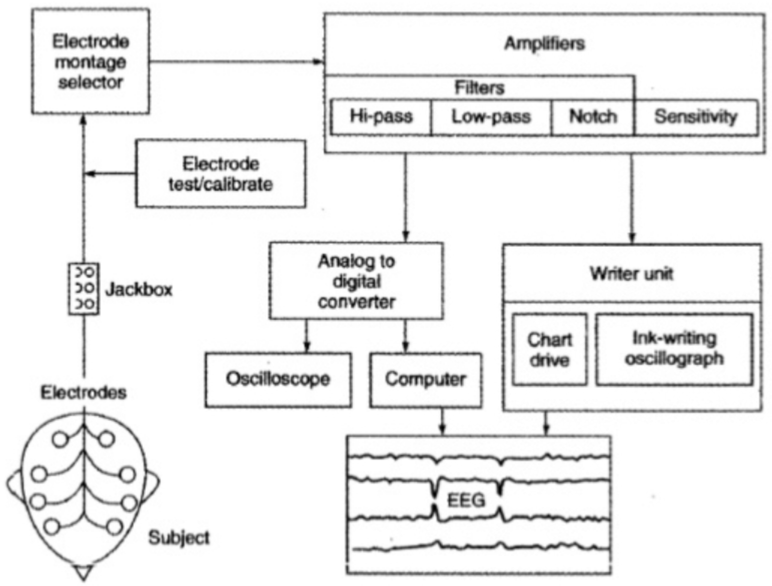
Dry electrode

Dry conductive paste electrodes (wet electrodes)

Frontal electrode

The NE, manufactured by Neuroelectrics in Spain, and the SAGA, manufactured by TMSi in the Netherlands, are two of the main EEG devices on the market today. Most of these devices contain electrodes, amplifiers, filters and analog-to-digital converters. Wireless or portable EEGs contain batteries, while wired EEGs connect directly to a computer.

Dynamic EEG machines are used to extend the duration of EEG readings. Often used to diagnose sleep disorders or epilepsy, dynamic EEGs record for up to 72 hours, compared to 1-2 hours for traditional EEG tests.



SCHEMATIC DIAGRAM OF AN EEG MACHINE

Spain's Neuroelectrics, or NE for short, consists of dry electrodes (no need for conductive paste and preparation time is reduced to 5 minutes) and wet electrodes (conductive paste electrodes), as well as special electrodes, namely forehead electrodes (only used for forehead testing), in addition to these electrodes there are also solid gel electrodes (which are the few solid gel electrodes available on the market), the NE's advantage is that it has a three-axis accelerometer added to the acquisition unit, allowing simultaneous acquisition of acceleration and EEG. accelerometer, which allows the simultaneous acquisition of acceleration and EEG. In terms of data presentation, the NE adds real-time power spectrograms and spectrograms, and a 3D modeling function for the finite (FEM) method has been set up within the software to display the electric field in white or gray matter and to visualize its values.

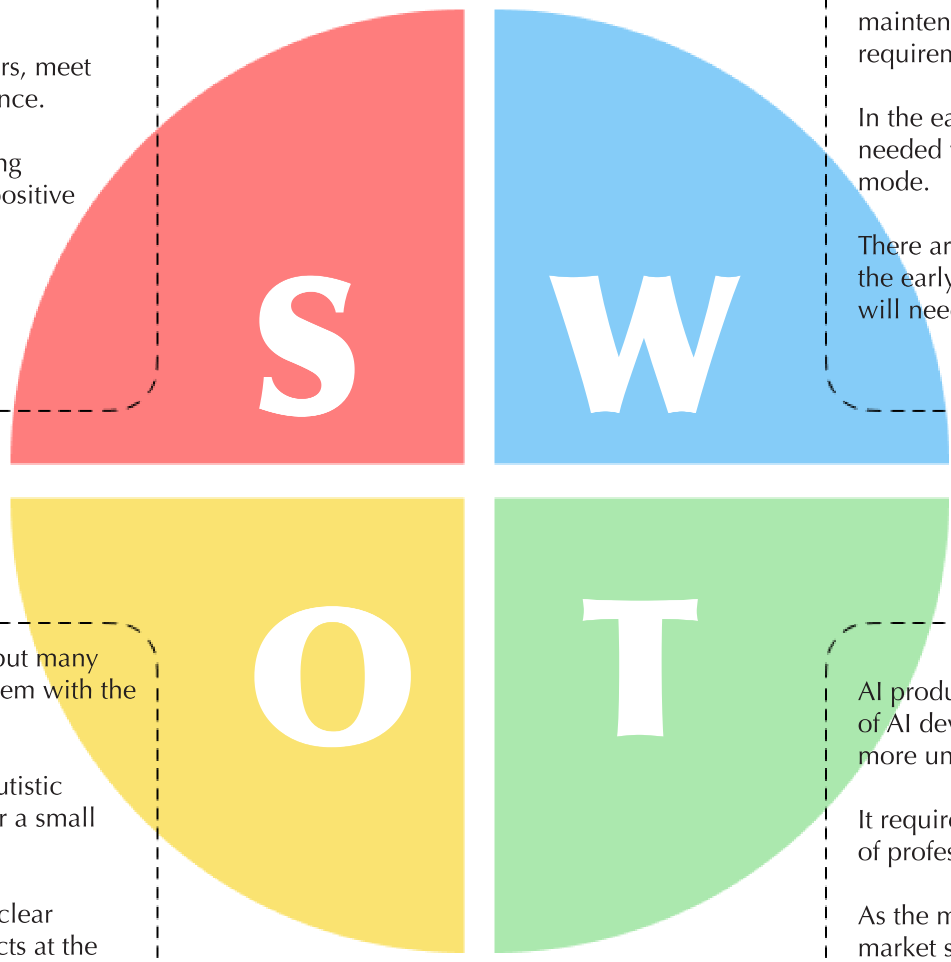
SAGA EEG test system produced by TMSi in the Netherlands is mainly wet electrodes, and all of them are metal electrodes, including ring electrodes (which can be used in conjunction with transcranial magnetic stimulation), cup electrodes (Ag/AgCI cup electrodes, good durability), saline electrodes, and special electrodes, i.e., the cEGrid periauricular electrode grille (which specializes in testing the EEG signals around the ear).

Its advantages are that the acquisition unit and the data receiving unit are separate, allowing both wired and wireless connections, and most importantly, SAGA utilizes active shielding technology to eliminate the influencing factors of power supply noise interference and wire disturbances. It can collect up to 64 channels of data with a maximum frequency of 4096Hz.

To summarize, the SAGA EEG test system produced by TMSi in the Netherlands would be more in line with the needs of this design, and when designing the appearance of the product, it is necessary to take into account whether the electrodes are located in a position that covers the detectable range of the brain.

4.0 Design concept

4.1 SWOT analysis



Supported by collecting all autism-related knowledge, it can provide users with more convenient and authoritative help.

Covering all groups related to autistic children, the overall ecological chain is more comprehensive.

Combined with AI, it can make usage plans for users, meet users' 0-1 usage needs, and improve user dependence.

Adhering to humanistic design principles and paying attention to minority groups can establish a more positive market image and gain people's recognition.

In the process of collecting and integrating databases, it may be affected by copyright issues.

The development and subsequent updates and technical maintenance of AI may increase technology and cost requirements.

In the early stage, the support and help of relevant experts are needed when developing and designing the APP operating mode.

There are many types of autism, and the APP developed in the early stage may only take into account a few of them, and will need to be developed and maintained later.

There are a huge number of children with autism, but many places are lagging behind and unable to provide them with the necessary support.

The existing products on the market designed for autistic children are not comprehensive and can only cover a small number of groups.

The services provided by existing products are not clear enough, and users may have to use multiple products at the same time, which is complicated.

The rapid development of AI can provide more help to autistic children while saving some costs.

As society develops, people will pay more attention to and support minority groups.

AI products are updated and iterated quickly, and the degree of AI development will affect the results of use and bring more uncertainty.

It requires a large amount of capital investment and the help of professionals in related fields.

As the market grows, more competitors may enter to carve up market share.

Some backward areas have no understanding of autism. Without awareness, they will not use related products.

4.2 Offering map

Astium Kids

Use the app in a playful way

- App eye-tracking monitoring
- Play games
- Learning skills

Astium Parent

Learning and communicating about autism is important for new parents

- Learn about autism
- Communicate better with their children
- Share experiences with each other
- Check on their children remotely

Astium Teacher

Managing a group of autistic children can be very draining for teachers

- Better management of children
- Learning and sharing of experiences
- Better communication with parents

Astium Doctor

The need for the most comprehensive and up-to-date data to predict and analyze the best treatment options for patients

- Be more aware of children's status
- Make better decisions with the help of AI
- Share your experiences with others
- Save time

4.3 Interview

Three autism stakeholders were interviewed for this article, and the following are some of the findings that have been compiled.

Ms. Lam, aged 36, has a 7-year-old son with autism, The child has been diagnosed with autism for two years.

Q: How did you find out your child was autistic?
A: I found out when I was about 5 years old. The child is not quite like other children, sometimes he likes to yell and scream, and then he will only do one thing at a fixed point, if for example he will eat at 12 o'clock, if 12 o'clock. Didn't get his meal, he would get very angry.

Q: And how did you diagnose your child with autism?
A: At first I didn't have the concept of autism, it was at the suggestion of my relatives. Only then did I know this concept of autism. Then I looked up some information on the Internet and felt that my child matched some symptoms, so I went to the clinic and then the doctor confirmed the diagnosis before determining that my child was autistic.

Q:What do you think is the biggest difference between your child and ordinary children?
A:Sometimes he can't express his emotions through words, he may have to use some body language, and then he can be more irritable sometimes. And there are some things that we think are common sense that he may find it hard to understand, such as being happy. Why is he laughing? Why is sadness crying? He doesn't really understand.

Q:Do you find it stressful when taking care of him?
A: There is a certain amount of pressure in all aspects, because I live in a small city, and we don't really have any particularly well-known autism treatment organizations or educational institutions, so I have to go to a big city for treatment. So it takes a lot of time and energy. And then because there's no organization to teach him, I want to try to teach him myself, but I don't know a lot about autism and I don't know where to start.

Q: Can you tell me one of the more troubling things you've encountered so far in caring for him?
A: As I said earlier, there is no autism education organization near my home, so I want to try to teach him, but I don't know much about autism, so I hope I can find a better platform to learn about autism, and then I can also exchange learning experiences with other parents.

Q: Have you ever been discriminated against by other people?
A: Yes, at first I was very reluctant to let others know that my child is autistic, and I don't want others to think he is a disabled person. Also, some people would think that it is the mother's problem, that the family doesn't give enough care. I would think so at first, but I found out that it is not the case after I looked up the information.

Q:Do you think there are any shortcomings in the autism communication platforms on the internet nowadays?
A:The knowledge they give is very one-sided, and they can't provide me with a plan, so I sometimes I don't know what kind of knowledge I should learn. There are also some platforms, which are fraudulent platforms, who claim that autism can be cured by using biased remedies, and there are some platforms that do autism screening on them, and the result can be obtained in 1 minute. Like these, he will also mislead us ordinary parents.

Q: May I ask if you are taking care of your child now?
A: Yes, I used to send him to a regular school, but the teachers reacted that he didn't get along well with other children, so now I take care of him at home, and I also look for a better educational institution in the neighborhood, but I haven't found one yet.

Q: That takes a lot of energy on your part, doesn't it?
A: Yes, because I'm not able to work right now, so I'm under a lot of financial pressure.

Ms. Cao, 43, has a 12-year-old autistic son who has been diagnosed for 5 years.

Q: How did you find out your child was autistic? How long has it been since then?
A: It was a friend who told me that it has been 8 years since the diagnosis.

Q: Do you think there is anything noticeably different between your child and others?
A: He is really different from other kids and has very unique hobbies. When he sees the wheels of a car, he will immediately stare straight at the wheels, and his little body will follow the direction of the wheels and rotate, and finally his whole body will hit the ground with a "thud". Every day at 7 o'clock, he must watch the beginning of the news broadcast. Except for observing the wheels of the car and watching the beginning of the news broadcast, he can hardly be quiet at any other time, and even when he has a bowel movement, he will move around.

Q: Has your child ever been to school?
A: He has been to kindergarten, but on the first day he jumped on the piano and overturned other children's block toys. Sometimes he would run into the teacher who was teaching the class, and the teacher had to stop teaching. In the end, he had to leave after one day.

Q: After so many years, do you have experience in taking care of children now?
A: Yes, I think it's better in the countryside. When I was in the institution, I had less time and could not go out until after 4:00 p.m. He was prone to internal anxiety, which manifested itself in his behavior by tearing his clothes. But when he came to a village with fresh air and close to nature, he was much quieter, and now he can basically take care of himself.

Ms. Zhang, who has been in the special education industry for 6 years, works as a teacher in a medium-sized educational institution.

Q: What are some of the most difficult issues encountered when helping children with autism?
A: The most difficult thing to deal with is that some children's ability is very low, their overall improvement is very limited, the actual age of the child is very mismatched with his existing ability, and there is very little room for him to grow, which will lead to a big problem for them to adapt to the society.

Q: What is the most effective way to help autistic children? Why?
A: Using behavioral analysis, or ABA, we start from the root of the child's ability, and enhance what is missing.

Q: What is the most helpful thing on the market today for children with autism and why?
A: That would be the special education teachers, because many parents actually they meet this kind of children can not help, need to formal teacher after training to help him learn, if there is a kind of training can also train the parents, I think it will be much better.

Q: If I were to design a product for autistic children, would different patterns, colors, and textures affect their acceptance?
A: The colors could be brighter and not have sharper parts.

Q: What do you think is the biggest difficulty parents face in raising an autistic child?
A: There are several kinds of situations, such as the family conditions are better, when there is a child with autism, at least they have enough money to support the child to go to a long-term intervention, but assuming that the economic conditions of the family is not good, then it is worse, first of all, they do not have the money can not give the child a long-term rehabilitation, but also will be subjected to some external pressure.

Q: Are there any difficulties in taking care of autistic children in the organization?
A: Sometimes there are too many children to manage because they are not obedient like ordinary children, and then it is a little bit troublesome to communicate with the parents, some parents will be more worried, but we don't have so much energy to explain.

4.4 Persona

“I want to use my free time to learn more about autism.”

Lin Yang

- 39
- Engineer
- Jingzhou, Hubei, China
- Family composition: 37-year-old wife, 5-year-old child

About

Lin Yang is very busy at work every day and has to go out at 9 o'clock every day. His wife is a freelancer and occasionally goes out to work part-time, but he has encountered something unpleasant recently. He suspects that his child has autism.

Personality

Frustrations

- Lin tried to search the internet for some knowledge and cases of autism and then identify them, but too many ways overwhelmed him.
- The nearby hospital didn't have a doctor who specialised in autistic children, so Lin tried to book an appointment with a specialist in the next city the following week and took time off work to go to the clinic.
- After a series of tests, the doctor diagnosed his child with autism, but Lin didn't understand the terminology.
- Lin and his wife were unable to devote themselves to their child's home education, and he was under tremendous financial pressure, so they had to work, and eventually they chose to send their child to a special education institution.
- Lin doesn't know how the child is doing in the institution. He worries whether the child will be well taken care of. At the same time, he has to think about when he can take his child to the hospital for a follow-up appointment.

Goals

- Lin needs a place where he can learn all he needs to know about autism and someone who can help him plan his learning so he can take his time.
- Lin needs to talk to other parents with autistic children and learn from their experiences.
- Lin would like to learn about his child's condition remotely as well.
- For follow-up appointments, he needs to go to a big city, which takes too much time and effort, and Lin would like to be able to do this remotely.

LiLi Zhang

- 35
- Autism Teacher
- Wuhan, Hubei, China
- 7 years in special education

About

She works in a special education facility and is responsible for teaching two classes that require 15 children with autism in one class.

Frustrations

- She has to lead a dozen or so autistic children a day, which is very draining on her energy.
- Each child has his or her own characteristics and things that must be done at a certain time that she sometimes does not remember.
- There is a need to communicate with parents, but sometimes there is not enough time or energy to do so.

Goals

- Wish there was an app that could keep track of the child's specifics and characteristics and could remind her of them.
- Wish parents could be more understanding of her work without spending too much time on communication.
- Feels that she can share some basic knowledge about autism education with parents.

Qinli Li

- 47
- Autism Doctor
- Wuhan, Hubei, China
- She has been working in the autism field for over a decade.

About

She attended one of the country's leading medical schools, and after graduation, she took a job at a provincial hospital, where she has worked for more than a decade and is an expert in the field of autism.

Frustrations

- When she communicates with parents, they do not always understand her conclusions, which has an impact on subsequent treatment.
- She sometimes worries that some of her decisions are too subjective and ponders whether there is a better solution.
- Some parents who came from far away for follow-up appointments were always unavailable, making her worry about the follow-up of their children.

Goals

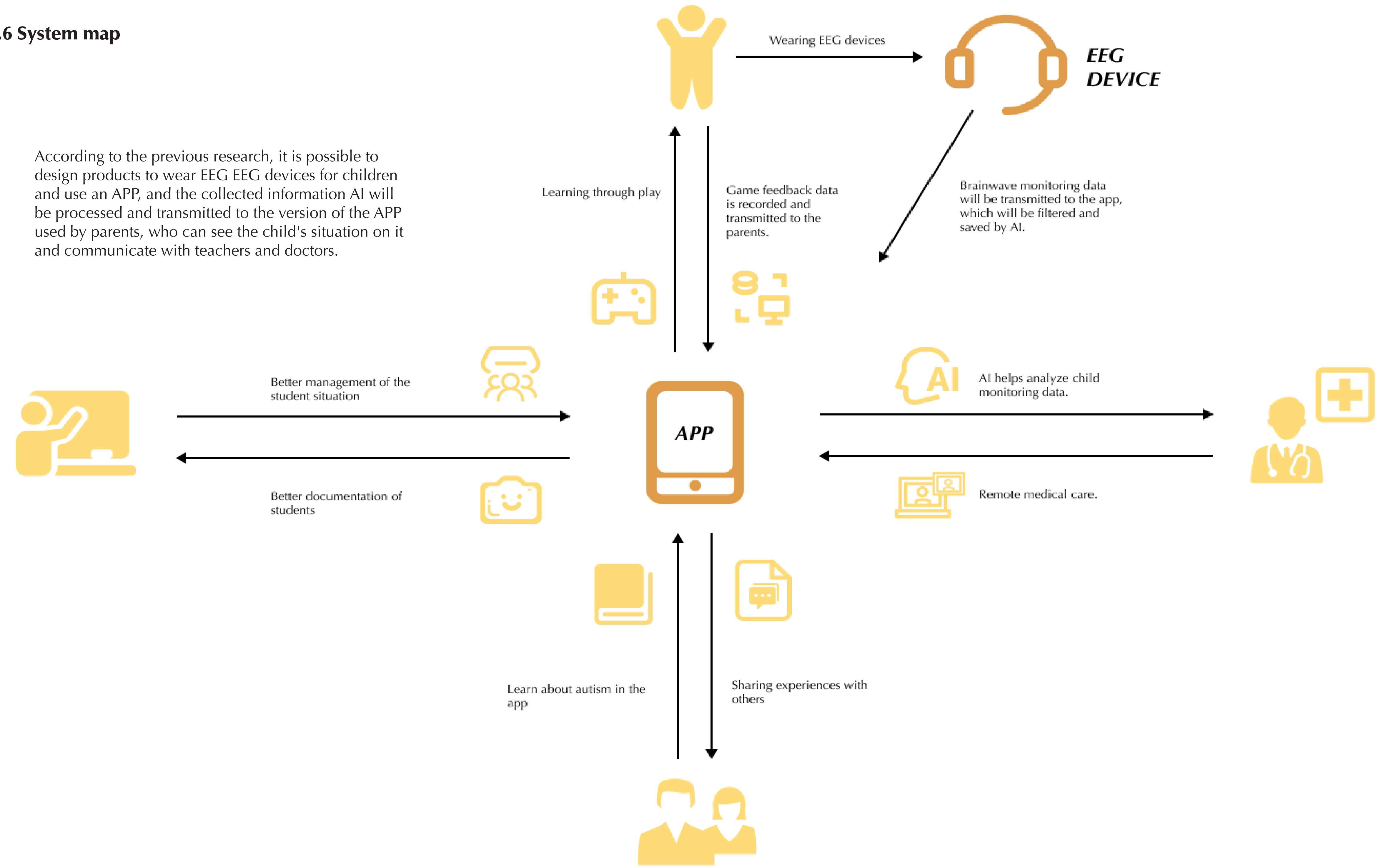
- She wants someone who can record her conclusions, convert them into plain language and explain them to parents to save time.
- She would like to have others to discuss with to help her decide.
- She feels there could be remote viewing services.

4.5 User journey map

USER STEPS	Scepticism	Face-to-face examination	Programmatic		Developmental
USER ACTIONS	• Compare it to other children. • Go online to find information about what autism is. • Find the right information on how to recognise autism and compare. • Check local healthcare providers for children with autism and register for counselling.	• Find a doctor for a consultation. • The doctor will find out about the child's growth and development and ask about the medical history of the child and his/her relatives. • Various assessment forms like ADOS, CARS etc. are filled up. • Based on the clinical presentation, laboratory tests such as EEG, CT, and genetics-related tests are selected. • Determine the need for referral to a more specialised facility. • Parents and doctors communicate with each other and make requests as to what needs to be addressed.	• The doctor develops an improved treatment plan for the patient. • Doctors recommend behavioural interventions based on Applied Behavioural Analysis (ABA) as the mainstay, along with other interventions such as Structured Education (TEACCH), Relationship Development Intervention (RDI), etc. • Dietary modifications, such as supplementation with radicicchioidin. • The choice of whether to use medication such as diazepam or carbamazepine tablets needs to be based on the doctor's instructions.	• Parents need to learn how to use educational interventions and search for relevant courses to study. • Parents who are unable to do both need to send their child to a special education institution for learning. • Parents send their children to school after choosing a suitable educational institution. • Parents communicate with teachers to inform them of their child's basic condition and treatment plan.	• Teachers provide educational interventions in institutions to teach children basic communication skills. • Teachers supplement the child's food or medication as prescribed by the doctor. • Parents are also required to provide educational interventions while the child is in school and during holidays. • Depending on the stage of the child's condition, the child is sent to the hospital for follow-up.
FEELINGS	*"What is autism? "*	*"What do I hope will happen to the child afterward? I don't know."*	*"I think I might have to spend a lot of time with my kids, but I don't really have that much time or energy."*	*"I don't know how to start learning about autism."*	*"Will the teacher look after my child? I'm taking my child for a follow-up appointment."*
PAIN POINTS	• Each website has different knowledge about autism to learn from. • It is very difficult to identify on your own and there is no particular specialized way to do it. • There are no suitable hospitals around, and it is very troublesome to go to another city for medical treatment.	• Filling out evaluation forms, conducting psychological evaluations and screenings takes a long time and the child is not always cooperative. • I don't know what the doctor told me about autism and I can't remember it. • I don't know what will happen to my child in the future, and I am very confused.	• The treatment options that the doctor talked about were not very clear to him or her, and he or she did not learn them. • The multiple treatment options given by the doctor were not so energetic to implement on their own.	• Want to learn about autism and pick an school but there are so many adverts it's hard to tell. • There is no suitable organisation and parents need to learn on their own but don't know how to arrange it. • Parents need to inform the teacher of their child's basic situation, but are unable to express it in a particularly professional way.	• Parents are concerned about whether their children are being properly cared for at school. • Parents want to use their free time to learn communication skills with their child. • Parents want to take their child for a follow-up appointment but have difficulty expressing this and wonder if it will affect the doctor's judgement.
OPPORTUNITIES	• Create a website with a complete knowledge base of autism related knowledge. • Contact a doctor to design a professional identification method using a combination of questionnaires and AI in conjunction with the app data to help parents identify. • Try to do the data transfer first and make an appointment with the doctor for an online visit.	• Helps parents save time by having their child complete a psychological evaluation online. • Converts the doctor's findings into an online archive that parents can view at any time. • Show parents past cases to help them plan.	• APP can record the doctor's program for easy access at any time. • APP deterdumines how parents should intervene in their children's ecation based on the doctor's recommendations and the parents' specific situation.	• Provides a database that integrates all knowledge of autism and categorizes it for easy viewing by parents. • Helps parents to select viable organizations for them to pick from. • Provides the data of the child present in the app and the doctor's recommendations to the teachers for easy planning.	• Helps parents to know the recent situation of their children even remotely. • Provide a platform for parents and other parents of autistic children to share their experiences with each other. • Allow doctors to view the child's data on the app and give advice.

4.6 System map

According to the previous research, it is possible to design products to wear EEG EEG devices for children and use an APP, and the collected information AI will be processed and transmitted to the version of the APP used by parents, who can see the child's situation on it and communicate with teachers and doctors.

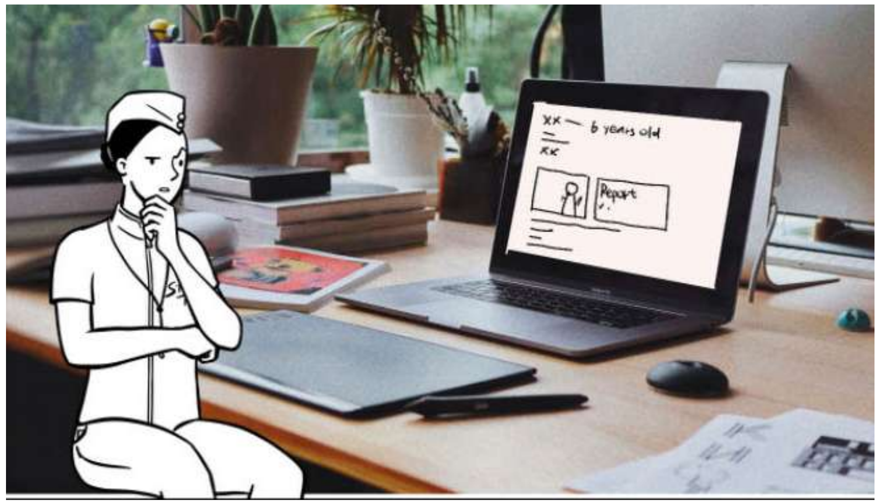


4.7 Storybroad

A little girl with autism is wearing an EEG device on her head and is playing a game.

A teacher used an app to record the preferences of different autistic children to teach, and the children were happy.

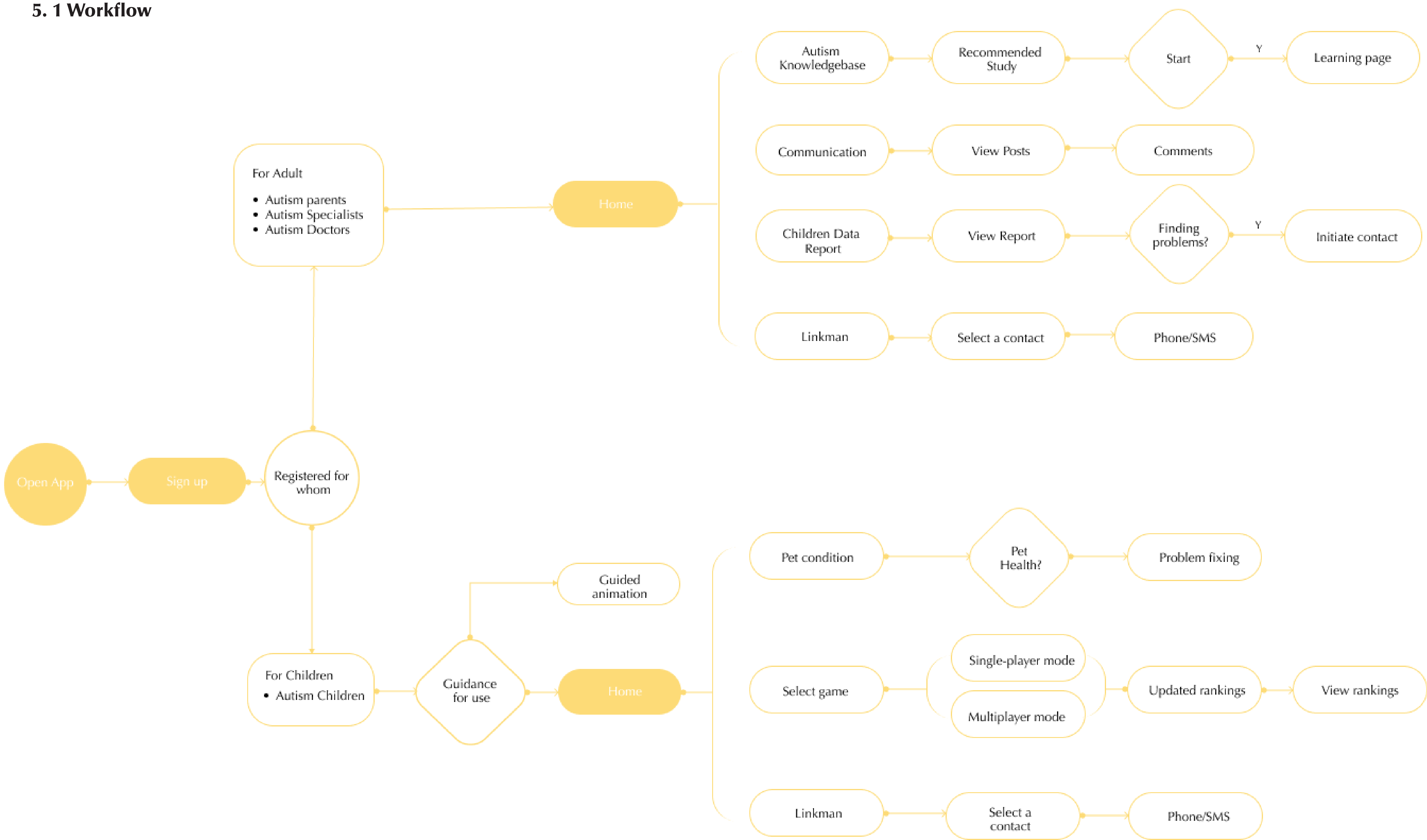
Two autistic children are using an app to play a multiplayer game of PK, and the winning side is so happy that the EEG device records their brainwave data.



The doctor receives the latest data on the child from the parent and the AI is helping her analyze it.

5. Design development

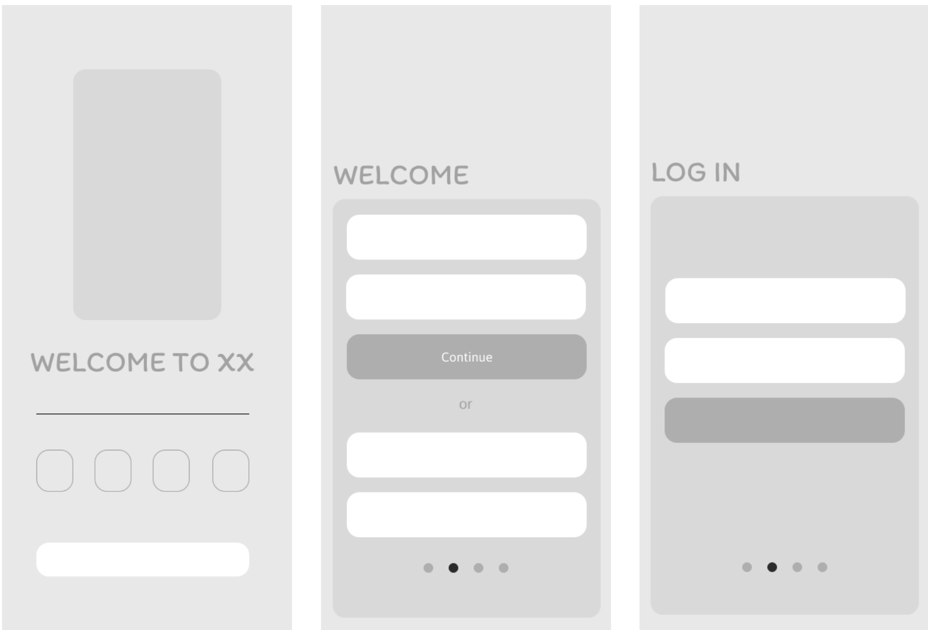
5. 1 Workflow



5. 2 Wireframe

Based on the previous planning of the structure of the APP, I determined that there will be two versions of the APP, one is the game version used by autistic children, and the other is the version used by autistic relatives, special education teachers, and doctors. Below is the medium fidelity wireframe created, which is technically rougher than the standard wireframe, but can express the design need and design meaning more intuitively, and is the optimal way to realize the solution quickly.

Wireframe design of the login screen



Autism Knowledge Push Interface Design

5. 3 Visualization of the design process

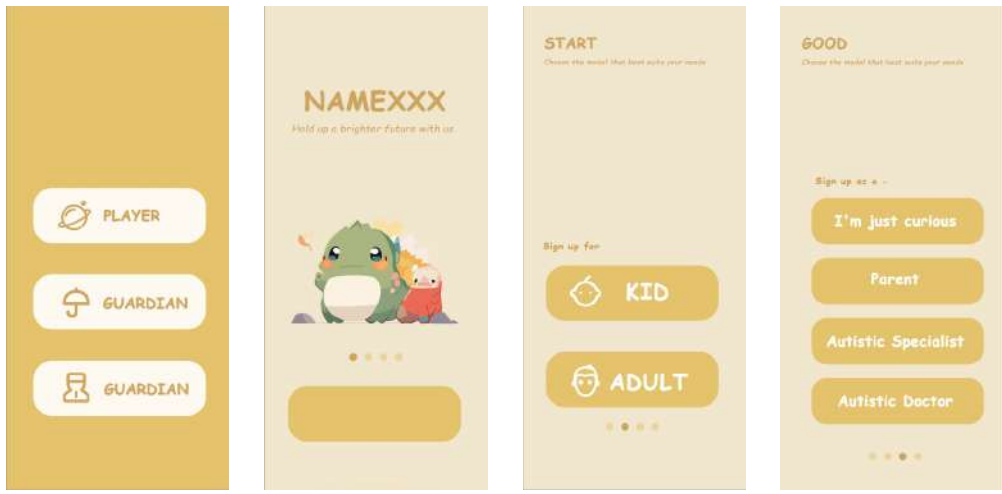
The visualization of the APP was not completed at one time, and very many modifications were made in the middle.
In the process of design, considering the theme related to the children's category, the target children's population is about 6-12 years old, so I hope it is a vivid and lively atmosphere, in the theme color, the use of bright warm yellow, it will not be too harsh, not too dark, fonts are also used in a rounded and vivid fonts.

At this time, the name of the APP is tentatively named NAMEXXX, on the homepage, I want to design an IP image to lead people to use it, mainly because children will not have the patience and it is difficult to read through too much of the use of the introduction.

Not only the regular selection of the login method, but also need to make a choice on the interface of the use of the crowd, the choice of different will present a different APP, and considering the coverage of all the autism-related population, in the back of the further division of the crowd to choose, which will affect the follow-up of the APP's related data push.

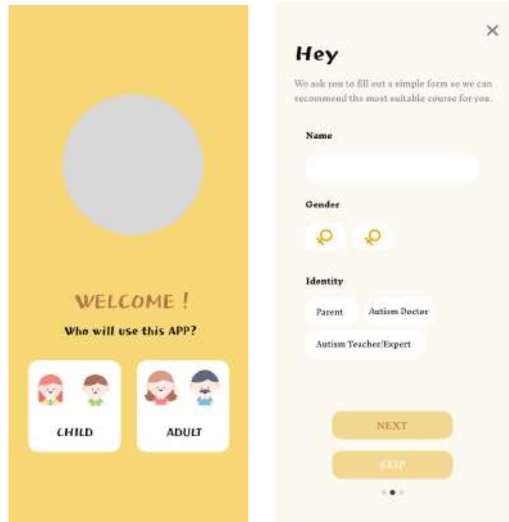
Based on the above points, the first version of the landing interface of the APP appeared, and it can be seen that a lot of attempts have been made in the demographic options.

Vision 1

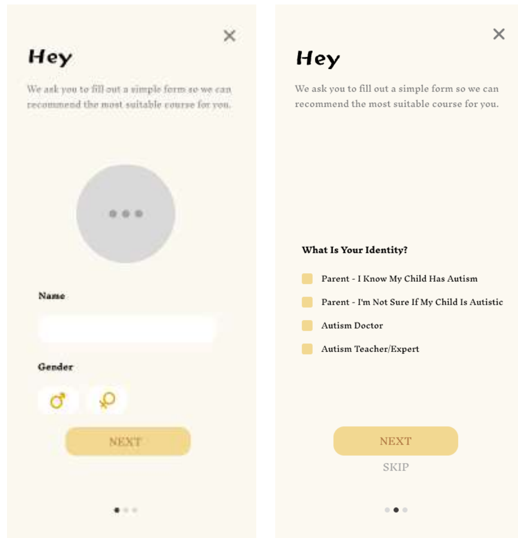


Vision 2

In order to push the subsequent related articles more accurately, in the early stage in the registration of the APP need to make some choices and personal information to fill in, in order to avoid the user feel cumbersome, I optimized the option interface, after the download is completed, you need to carry out the first step of the division of the use of the crowd, if it is a child to use, it is not necessary to fill in so many personal information.



Vision 3



Further changes have been made to the subsequent login screen, if parents use the app and communicate in it, then it may be important to consider that avatars and names need to be able to be freely altered, people like some real display, so it is better to have the option of being able to upload an avatar in the login screen.

Secondly, in the second version of the design, the design language is slightly confusing, for example, the part that can be inputted - name, and the choice of identity later should use a different design, because the user's input instructions are different, the gender can use the same white box as the name, because it is a simple icon, so the identity option is made redesigned. And, when we design the options, we are subjective, when facing some of the options, we would like the user to execute the instruction as we think, such as the filling of the information, we don't want the user to skip it because it will affect the subsequent use, so when designing the NEXT and SKIP, we have to differentiate between the design of the design, instead of designing their weights are almost the same, so the weight of the SKIP is diluted later on. SKIP's weight.

Vision 1

In the homepage push interface, we can see its function division, the filtering of the crowd in the front determines the main push content of this page, and it is also the section for parents of autistic children to learn, at the same time, teachers and doctors can also share their experience here, you can clearly see the search at the top, the daily recommendation as well as the categories in the middle, the guess what you like in the lower part, as well as the five sub-categories at the bottom.

Vision 2

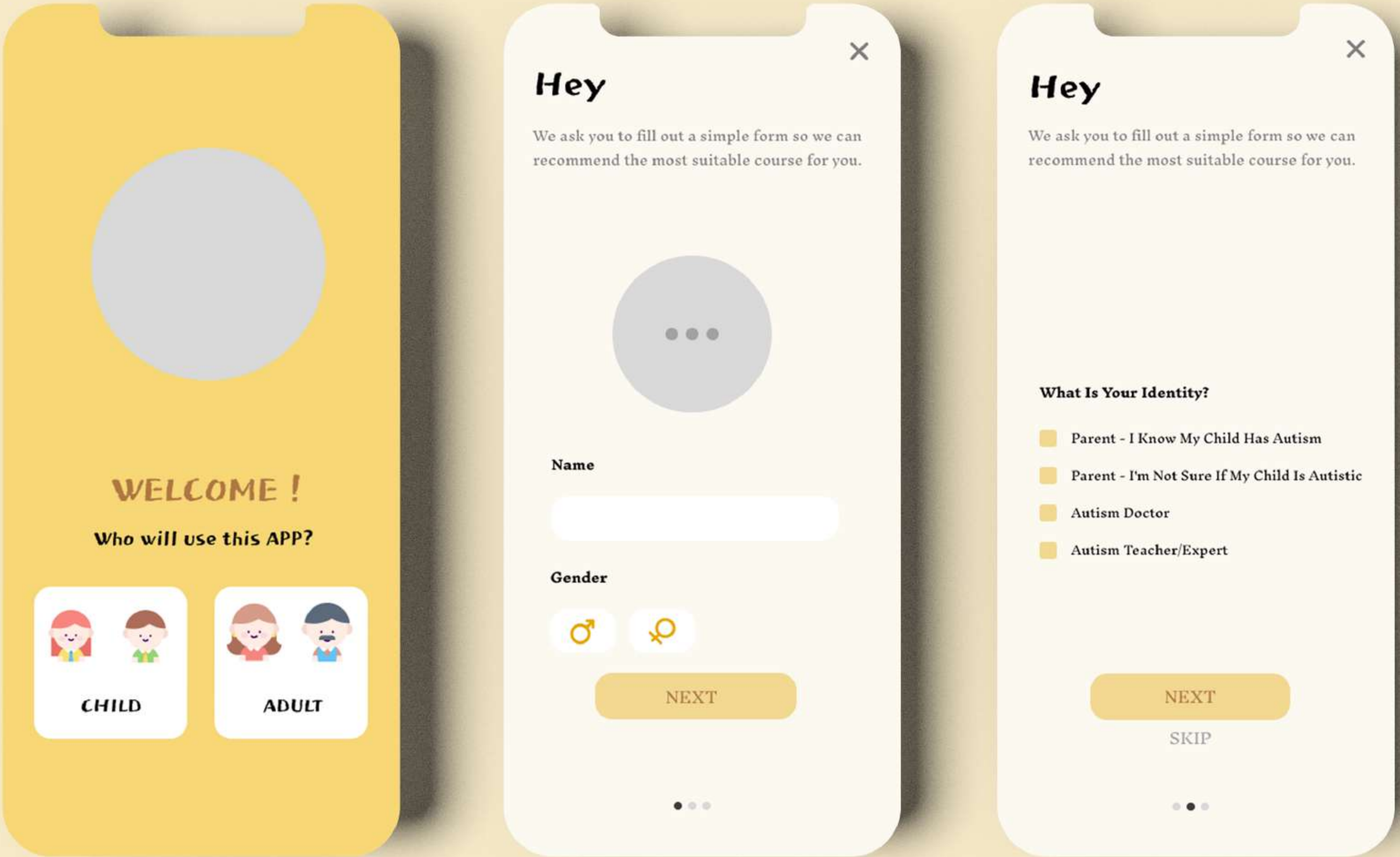
The top design of the first version was originally the name of the app and the question "How can I help you?". But in fact, the input box and the search button are already enough to tell people its function, so there is no need to add this question, at the same time, the original large partition is not clear enough, and the choice of fonts has also been changed, instead of using completely rounded and lovely fonts, which may make people a little bit visually fatigued, it is only partially used in the lively fonts, because if it is completely abandoned, it may be too different from the version used by the children. The version used differed too much, and in the lower part of the book recommendations an attempt was made to see if wireframes should be used. and at the bottom, the division of functions.

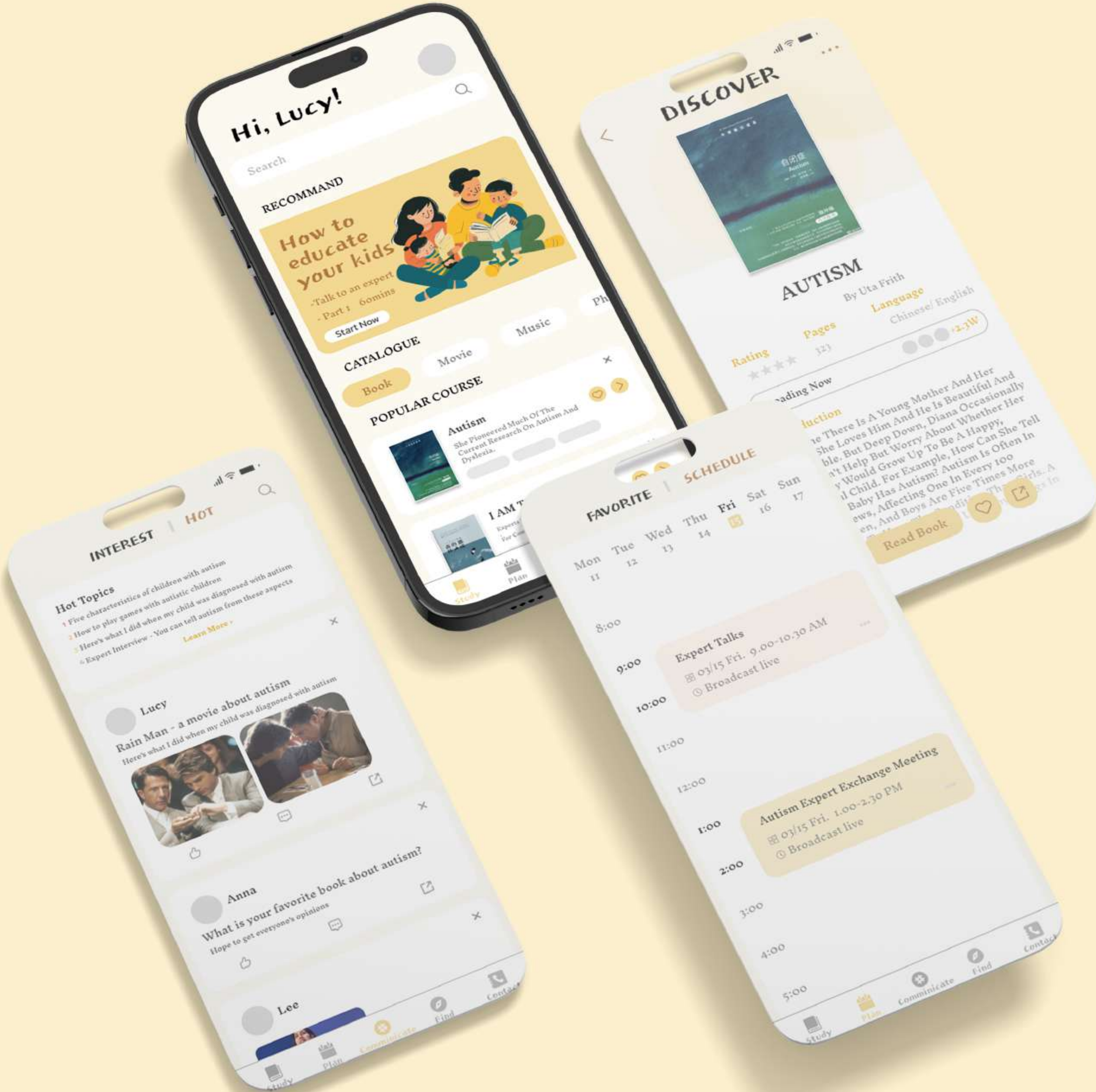
Vision 3

Does the main Banner image need to be more prominent? I did a lot of different effects, such as shaped borders to try, the top and bottom of the shadow to try, the blurring of the border, etc., but in the end, the right version is still used, which is for the sake of the design language can be unified. In the font color, size after modification, has been enough to achieve eye-catching effect.

Also for the sake of unity, the author eliminated the use of wireframes at the bottom, as too many different design approaches would have made the version slightly confusing. Immersive thinking from the user's point of view, the original homepage will not only push autism-related lectures, books and other knowledge, but also recommend doctors and teachers in related fields for parents to conduct remote exchanges and other behaviors, and all such as live booking and doctor's appointments are all designed to be in the timetable area, but if they are placed in the same partition, the user needs to slide down for a long time before they find it, so for the convenience of the user, this needs to be So in order to facilitate the users, it is necessary to divide it out, FIND is the area to find doctors and teachers, while PLAN will only have the user's scheduled live broadcasts and favorite books, and so on.

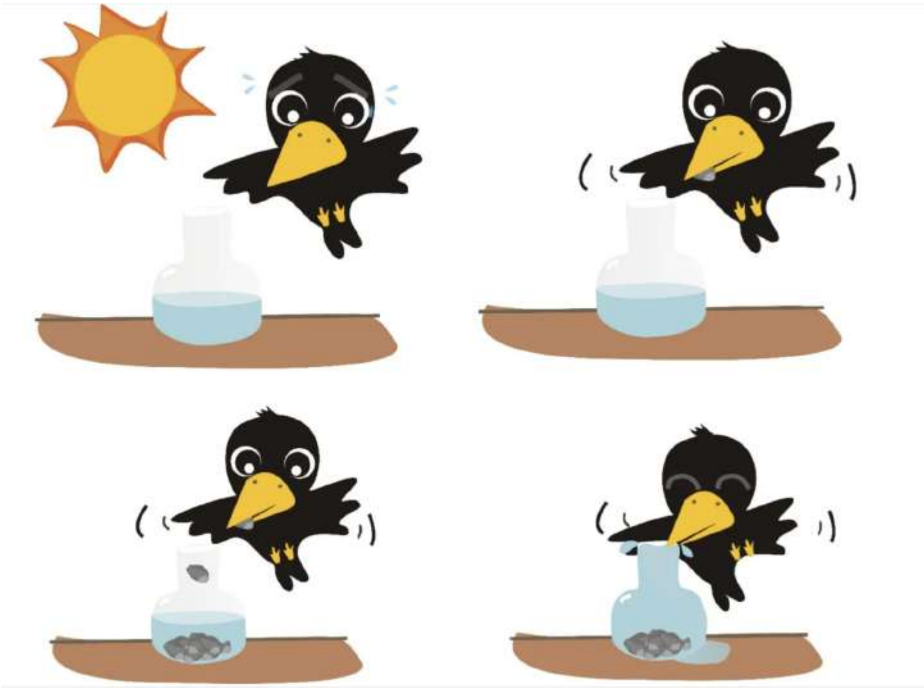
5. 4 Final vision




Hi, Lucy!
Search
RECOMMAND
How to educate your kids
-Talk to an expert 60mins
- Part 1
Start Now
CATALOGUE
Book
Movie
Music
POPULAR COURSE
Autism
DISCOVER
AUTISM
By Uta Frith
Rating
Pages
323
Language
Chinese/ English
Read Book
INTEREST
HOT
Hot Topics
Lucy
Rain Man - a movie about autism
Anna
What is your favorite book about autism?
Hope to get everyone's opinions
Lee
FAVORITE
SCHEDULE
Mon
Tue
Wed
Thu
Fri
Sat
Sun
Expert Talks
03/15 Fri. 9.00-10.30 AM
Broadcast live
Autism Expert Exchange Meeting
03/15 Fri. 1.00-2.30 PM
Broadcast live


MINE
MY CHILDREN
Name: LUCAS
Gender: Female
Age: 7
Autism type: ASD
Diagnosis time: 09/2023
Data
Activities
GOOD
GOOD
PERFECT
Generate analysis report
CONTACT
Dr. Zhao Lei
Deputy Chief Physician
Book Consultation
Dr. Zhao Lei
Deputy Chief Physician
Book Consultation
Study
Plan
Comminicate
Find
Contact
DOCTORS
TEACHERS
Search
Distance
Dr. Li Liu
Deputy Chief Physician, Tongji Hospital
€ 65
Per Person
600+
Number Of People Served
Dr. Zhao Lei
Deputy Chief Physician, Tongji Hospital
€ 65
600+
Dr. Li Liu
Deputy Chief Physician, Tongji Hospital
€ 65
600+
Dr. Li Liu
Deputy Chief Physician, Tongji Hospital
€ 65
600+
Study
Plan
Comminicate
Find
Mine
DOCTORS
TEACHERS
Search
Distance
0-10 Km
10-50 Km
No Limit
Price
Low To High
High To Low
Working Year
0-2
2-4
4-6
4-6
Treatment Method
Online
Face To Face
Reset
Finish
Deputy Chief Physician, Tongji Hospital
€ 65
600+
Dr. Li Liu
Deputy Chief Physician, Tongji Hospital
€ 65
600+
Study
Plan
Comminicate
Find
Contact

5. 5 Origin of ip image design



Chinese Traditional Tale of the Crow Drinking Water

The children's version of the app has a theme of "use in the form of play", that is, the game mode.

Initially, the author brought in a traditional Chinese fable about a crow drinking water. A crow was thirsty and wanted to drink water from a slender bottle, but its beak was too big, so it couldn't reach in, and after thinking for a long time, it finally brought in a bunch of small stones and threw them in, and the water level rose, and it successfully drank the water.

Taking this as a starting point, the IP image is set as a small bird, and the user's image in the game is this small bird, and their behavior will be in the same frequency with the game. Simply put, if the user eats normally, this small bird will also eat normally, if not, the small bird will be mentally unstable, and in order to take care of this small bird, perhaps the user will form some basic self-care consciousness.

The game Traveling Frog, which was once a hit, is this type of game.

At the same time, the gameplay will also be centered around the life and living of the bird. For example, in the mini game Drinking Out Loud, the user makes a sound, and the louder the sound, the higher the water level, and the bird can easily drink from the bottle.

But is this playbook really feasible? Will it be too complicated? Will children have questions as to why it is a bird and not other images such as a puppy, kitten, etc.? Whether this will have an impact on the cognition of the animals later on is something to consider.

Game Traveling Frog IP

With such questions, the author interviewed two children aged 6-10 years old and a teacher of autism respectively, and the following is a part of the interview transcripts after being organized.

Children's Interview

Q: Do you like to play multiplayer or single player?
A: Sometimes I would prefer multiplayer, I would play with my classmates and show who is better.

Q: If you were asked to take care of animals in the game, would you enjoy it?
A: It would, but maybe it would be a little boring if it was the same action every day.

Q: Would you enjoy completing the game and getting rewards?
A: Yes, I would, I would show my reward items to my classmates, I would like to get something different.

Teacher's Interview

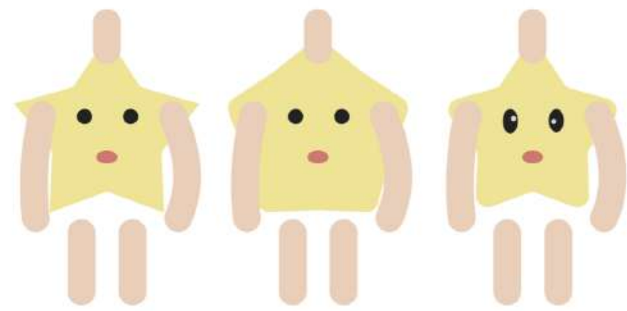
Q: Do you think that overly complex image design will affect the use of children with autism?
A: Yes, they will be more comfortable with simple and clear styles.

Q: Do you think repeating a single behavior will bore children with autism?
A: A big part of autism is repetitive behaviors, but making some variations can train them better.

Q: Do you have any suggestions for game play?
A: You can design several big categories, different categories train children different abilities, there will be a lot of small levels in the big categories, appropriate rewards are also needed.

After the interview, the author revised it again. As mentioned in the previous article, autistic children are called star children in China, so the IP image of the star was born. Based on the anthropomorphism of the star, the design of different facial expressions and different skin colors helps to help the children understand the concept of diversity and feel the meaning of friends and facial expressions.

Vision 1



Vision 2

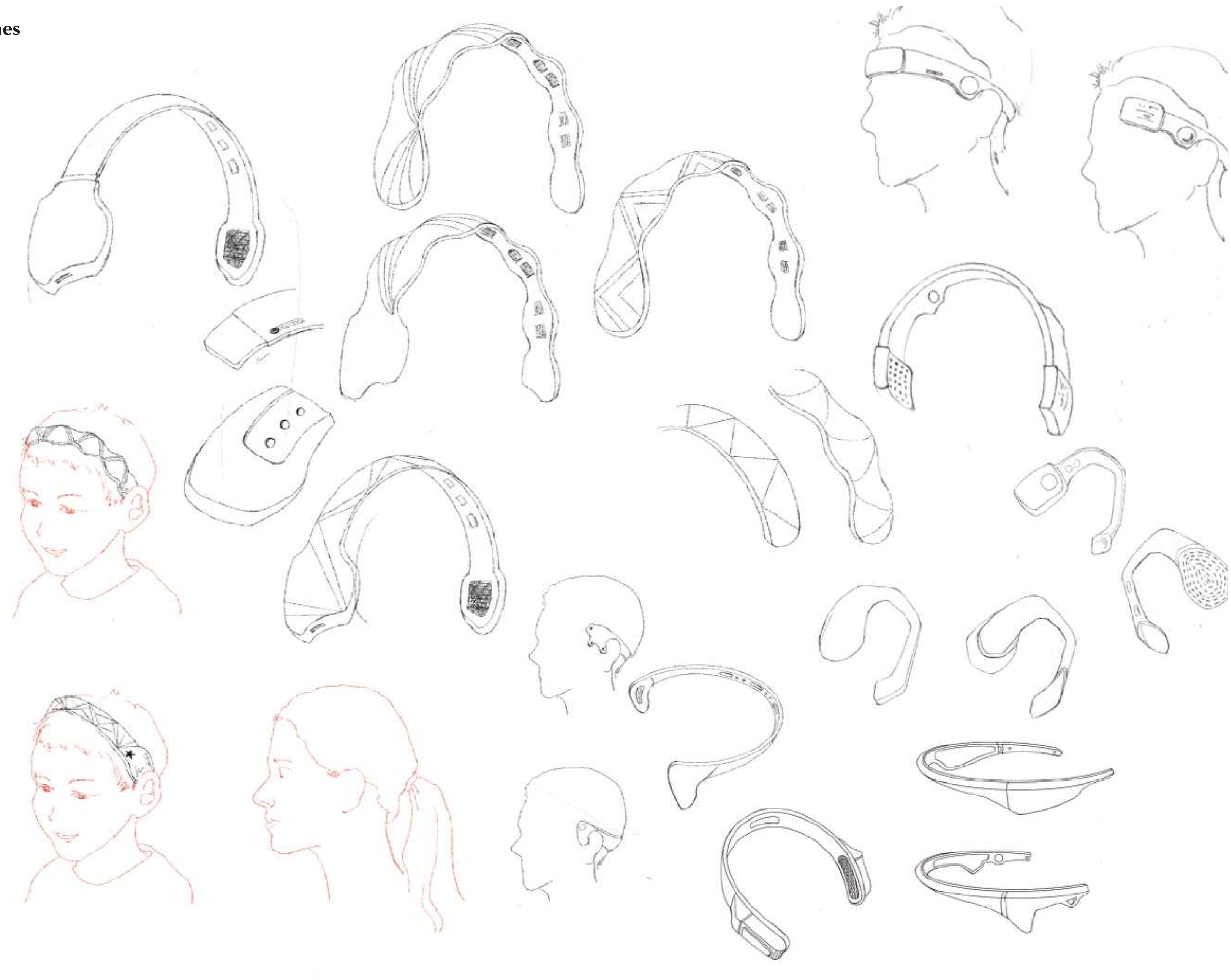
Vision 3

5. 6 Final vision


PICK A MOOD CUBE
PICK A MOOD CUBE
WHICH ONE IS ME?
WHICH ONE IS ME?
STAGE 1-1
Your Score
2,562

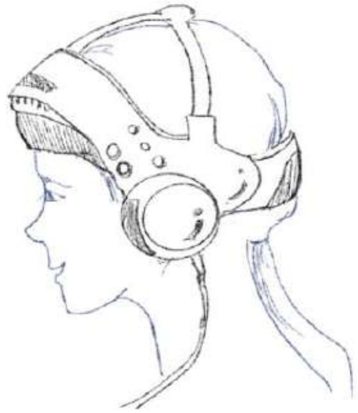

Hi, Lucy!
Search
RECOMMAND
How to educate your kids
-Talk to an expert
- Part 1 60mins
Start Now
CATALOGUE
Book
Movie
Music
POPULAR COURSE
Autism
She Pioneered Much Of The Current Research On Autism And Dyslexia.
I AM THAT
Study
Plan
Comminicate
Find
Contact
Hey
We ask you to fill out a simple form so we can recommend the most suitable course for you.
Name
Gender
NEXT
SKIP
Autism Teacher
Dr. Li Liu
Deputy Chief Physician, Tongji Hospital
Dr. Zhao Lei
€ 65
Per Person
600+
Number Of People Served
Distance
Mine
MINE
MY CHILDREN
Name:
LUCAS
Gender:
Female
Age:
7
Autism type:
ASD
Diagnosis time:
09/2023
DISCOVER
Expert Exchange Meeting
Broadcast live
2:00
3:00
4:00
5:00
Your Score
2,562

5. 7 Sketches

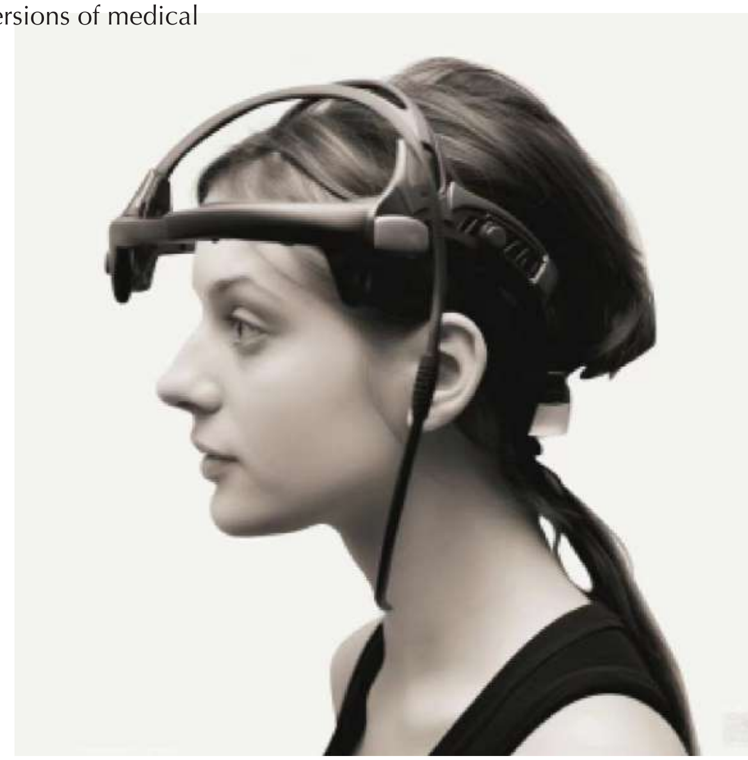


5. 7.1 Other styling derivations

On the basis of the original, the author has designed other modeling styles, such as the future may be combined with VR rather than just with cell phones, then the eye will also be covered by the device for data capture, to obtain more accurate results.

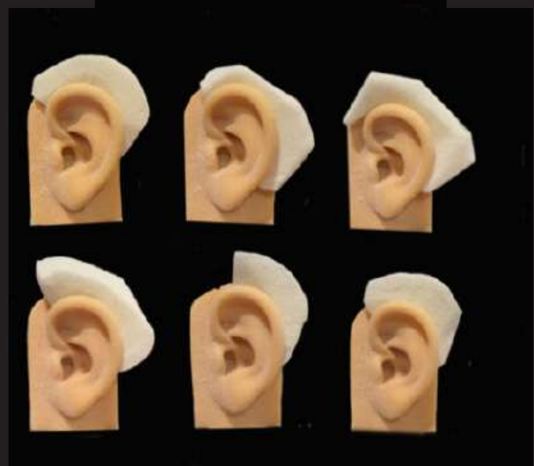


AI software was used to generate different styles of references, which are more accurate versions of medical devices.



5.8 Morphological derivation

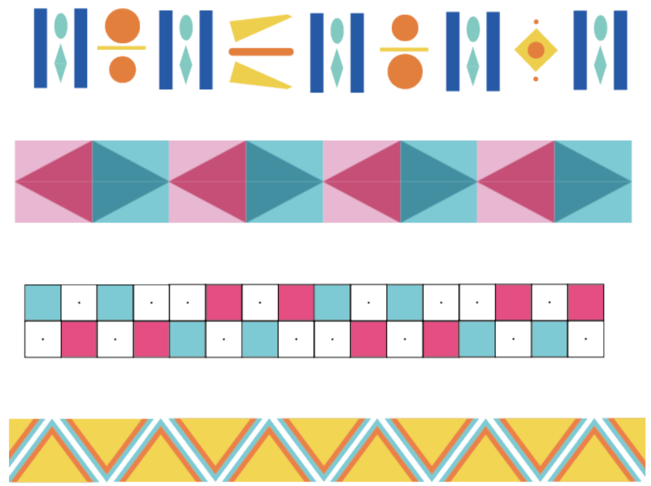
Since the end of the product hangs behind the ear, the design of this part must conform to the contours of the ear, paying attention to the comfort of use, since children will use it for a long time. At the same time, the form must not be too complex, because we have to take into account the actual production difficulties, so the author used foam and ear models to do some form of attempt.



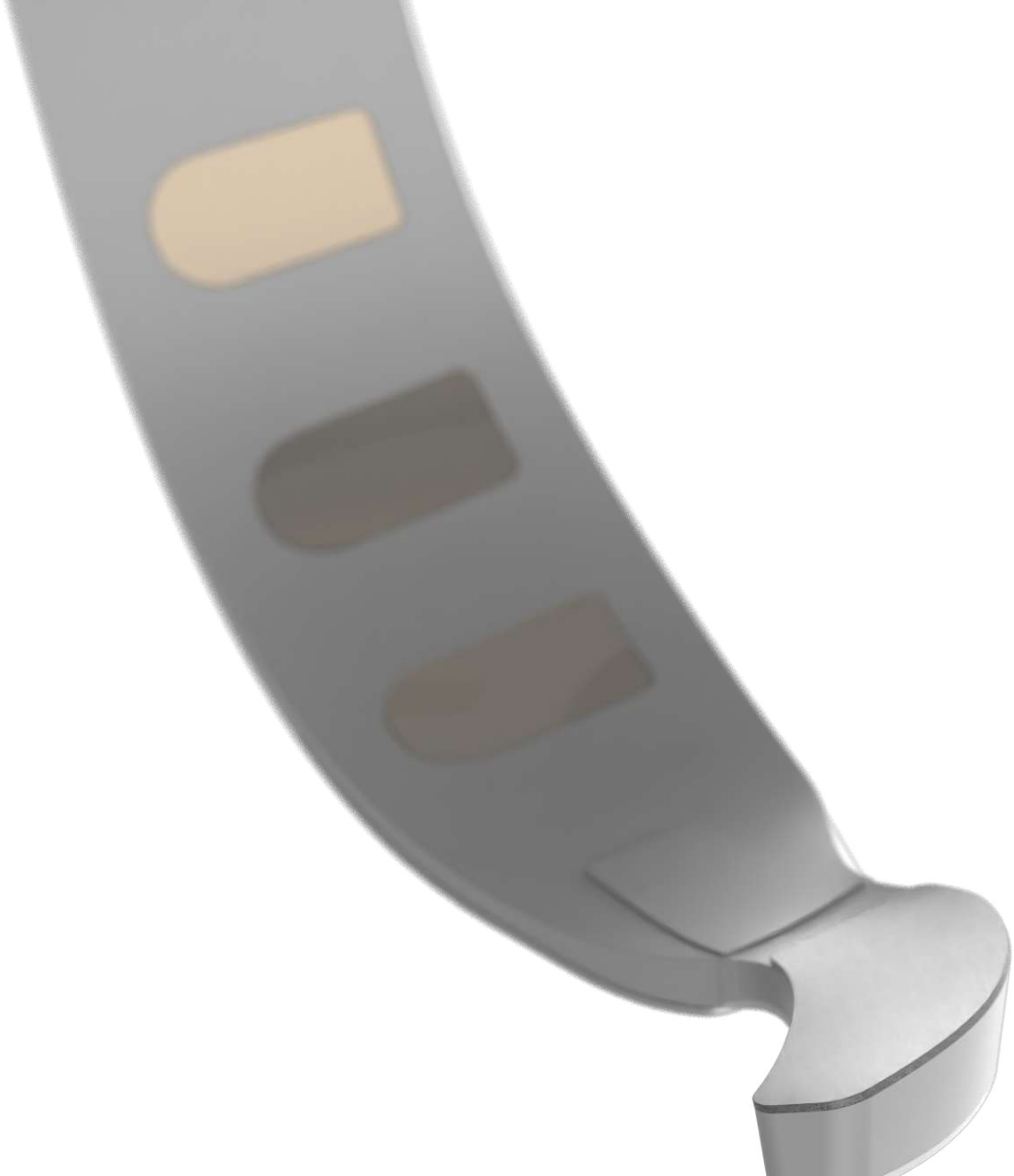
5. 9 Pattern design

The author had been to Sicily and was shocked by the splendor and complexity of the local Sicilian ceramic patterns, so in the process of designing, he also tried to add the Sicilian style and refer to D&G's use of the Sicilian culture, to design a set of more lively and vivid wearable products, so that the EEG device does not only look like an electronic device or a medical device, but also a beautiful piece of decoration.

Referring to Sicilian ceramic patterns and D&G's Sicilian-inspired clothing, the author designed these four patterns.



5. 10 Renders



Exterior decoration

Designed to replace different versions.

Amplifiers

Amplifying brainwave signals for analysis.

Sensors

Amplifying brainwave signals for analysis.

Filters

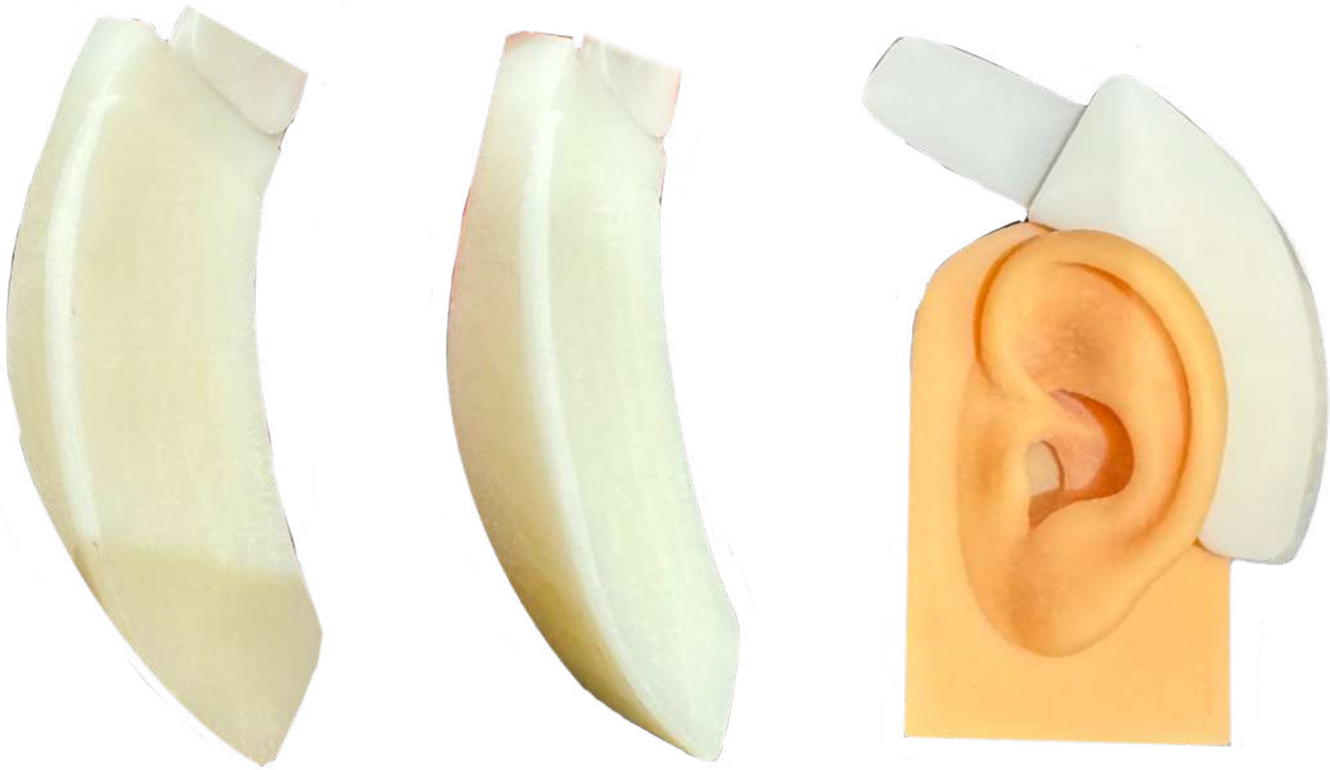
Filtering of brainwave signals.

Metal connections

The connecting part can be dimensioned according to the connection position.

Data processing and transfer

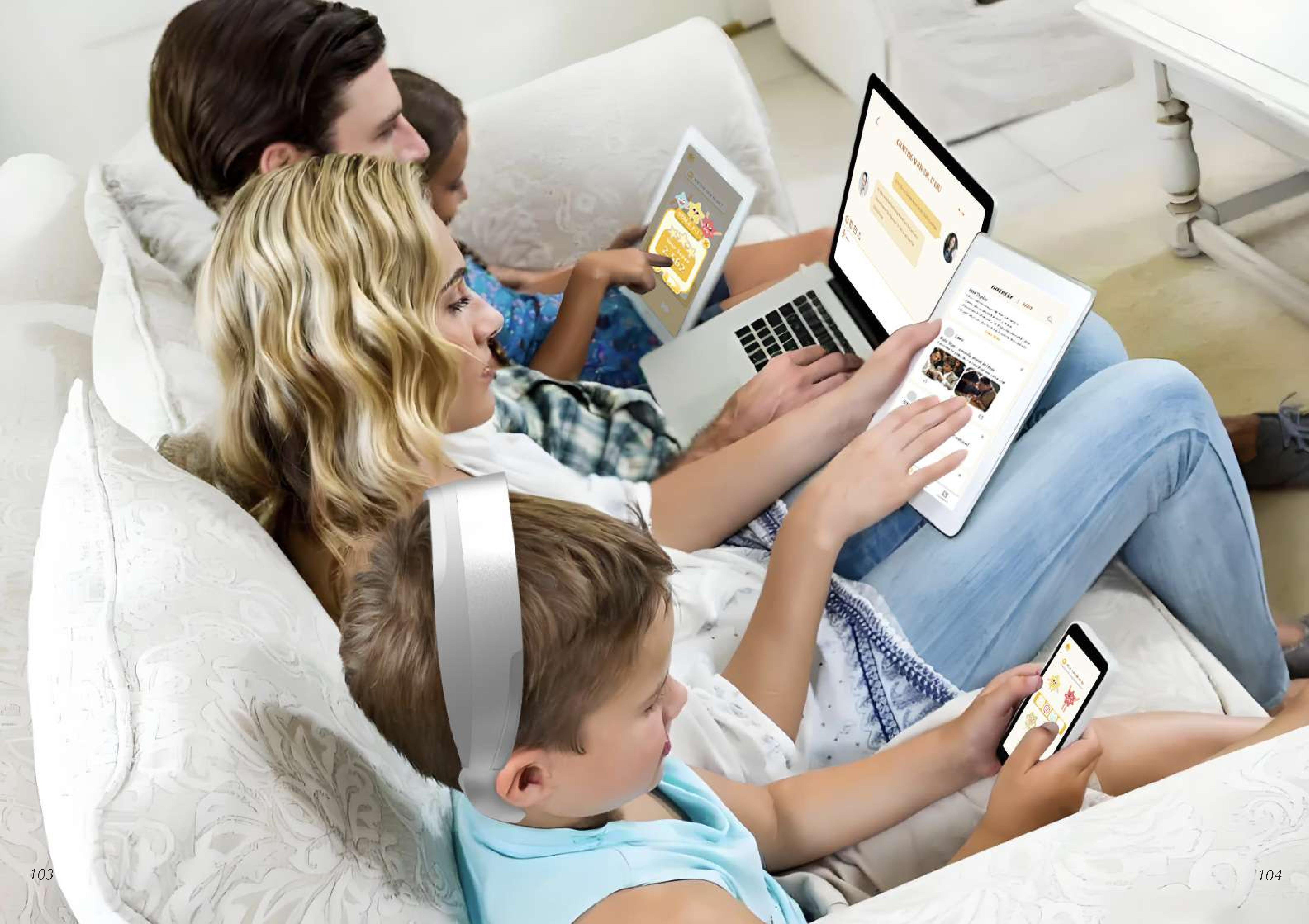
The brainwave signals are further filtered and transmitted to the APP.



3D model testing

The part that transmits the data was printed and tested for its curvature, which is not a very pronounced rounded shape, but has a certain curvature that is very soft. It does not make the user uncomfortable by making the contours of the ear to which it fits feel sharp.

5. 11 Usage



6. Conclusions

After the analysis and arguments in this paper, it can be concluded that artificial intelligence can indeed be used to help the autistic population.

The problems faced by the autistic population are problems that our society needs to use innovative thinking to solve and optimise, so this paper starts with the autistic population, collects a large amount of research and conducts fieldwork to get a feel for the problems they face and the pressures they face in all areas.

This paper does not look at one aspect of the problem in isolation, but rather explores and thinks about it in an all-round way, and proposes feasible solutions for economically backward areas based on the help provided by the governments and institutions in developed areas, and uses more advanced technology such as artificial intelligence to make up for the shortages of relevant medical equipment, medical personnel and educational personnel.

This paper will not separate artificial intelligence and human beings, human beings are the users of artificial intelligence, we can use it to complete some trivial small things, so as to reasonably plan the time and make the final decision.

In the process of designing the device, this paper has carried out a lot of research to determine its feasibility, including the parts of the device that need to be covered and so on.

The only unfortunate point is that the author tried to buy the latest model of the internal sensor and transmission device, but it is not available for sale to private individuals individually, so the author can only set the size of the device based on the data provided by the official website, and can't really make the real thing, but maybe one day, it can be made.

But it is still an innovative and promising design, in the case study, we can see that the previous design is often designed only to face a certain stage of a group of people with autism, but autism is a long process, for many people, they don't want to change apps or devices frequently, moreover, people need to communicate and need to learn through communication, so this design cleverly brings the people together.

This project might be more applicable to government-led, so that it can make up for the lack of staff and funding, and let people use it in a public service nature.

Meanwhile, thanks again to those who have helped me in the preparation of this thesis.

Many thanks also to my predecessors who have researched and helped minorities in this field, your spirit is very touching.

Maybe in the future, I can make this design in kind, maybe it is not like this, or it will be a brand new version, VR technology is getting more and more mature, maybe in the future the children at home learning can be a three-dimensional interface for learning, not only can feel the auditory and visual, but also can feel the sense of touch and so on.

I sincerely look forward to this day.

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THANKS

I have been thinking about what is design,
who am I going to design for, and in each different design process,
I got a different answer, maybe design, is an optimisation of the existing life.