بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of Post Graduate Studies

Designing an Application to Classify the Level of Intelligence for Deaf Children by Raven's Scale

تصميم تطبيق لتصنيف مستوى ذكاء الأطفال الصم بمقياس رافن

A Thesis Submitted in Partial Fulfillment of the Requirement for the M.Sc. Degree in Biomedical Engineering

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الآية

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

إقرا باسم ربك الذي خلق(١) خلق الإنسان من علق(٢)

إقرا وربك الأكرم(٣) الذي علم بالقلم(٤) علم الإنسان مالم يعلم(٥)

صدق الله العظيم

سورة العلق

DIDICATION

For all children who suffer from weak or loss hearing, for all parents whose suffer to rehabilitation their children to live a normal life with all its details. To my respective parents who have been my constant source inspiration to my sisters and brothers.

And last but not least to me myaad 2022

ACKNOWLEDGMENTS

My sincere appreciation thanks and respect provided to Dr. Zainab Adam Mustafa for her supervision. And heartily thankful to our doctors in Biomedical Engineering Department.

Also I would like to thanks the people who gave their help in this project.

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ABBREVIATIONS

CPM	colored progressive matrix
CI	cochlear implant
AVTs	Auditory verbal therapists
IQ	intelligence quotient
dB	decibels
HZ	Hertz
AUD	Audiologist
HIS	Hearing instrument specialist
RSPM	Raven standard progressive matrix
RCPM	Raven colored progressive matrix
RAPM	Raven Advanced progressive matrix

ABSTRACT

There are conflicting opinions about the extent of the impact of hearing disability on mental development.

50 A comparative study conducted on the levels of intelligence between the hard of hearing and the normal, and the statistics from these studies proved that hearing impairment in itself does not affect the IQ, and that is on the performance tests, but there are certain types among the categories of hearing impairment where there is a defect or defect in the device Neurological impairment in addition to hearing impairment, and there is a high rate of intellectual weakness in these, which indicates that brain injury is the reason behind mental retardation and not auditory impairment, in addition to the fact that the ability to abstract thinking does not differ in the hearing impaired from ordinary children, whether they are children or adolescents. This trend is supported by the presence of a large number of deaf people who excel in statistics and mathematics.

Which makes us conclude that if the mental development of the child is healthy, he will have the ability to rehabilitate and learn the language quickly.

The aim of this project was to determine the mental ability and the level of intelligence of hearing-impaired children to estimate the preparatory years spent in learning and acquiring the language after providing the child with the auditory aid (cochlear - a hearing aid) by designing a model hypertext preprocessor that includes the colored successive matrices test by John Raven.

المستخلص

تضاربت الآراء حول مدى تأثير الإعاقة السمعية علي النمو العقلي، فهناك من يرون أن للإعاقة السمعية تأثيراً سلبياً علي النمو العقلي، بينما يقرر آخرون أنه ليس ثمة علاقة واضحة للإعاقة السمعية علي النمو العقل

50 دراسة مقارنة أجريت على مستويات الذكاء بين ضعاف السمع والأسوياء ، وأثبت الإحصاء من هذه الدراسات أن ضعف السمع في حد ذاته لا يؤثر على نسبة الذكاء، وذلك على الاختبارات الأدائية ، إلا أن هناك نوعيات معينة من بين فئات الضعف السمعي يتواجد بها خلل أو عطب في الجهاز العصبي بالإضافة إلى الضعف السمعي، وتكثر في هؤلاء نسبة الضعف الفكري، مما يدل على أن الإصابة الدماغية هي التي تكمن وراء التخلف العقلي وليس الضعف السمعي، إضافة إلى أن القدرة على التفكير المجرد لا تختلف لدى ضعاف السمع عن العاديين، أطفالاً كانوا أم مراهقين. ويؤيد هذا الاتجاه وجود عدد كبير من الصم المتفوقين في الإحصاء والرياضيات.

مما يجعلنا نستنتج أنه اذا كان النمو العقلي للطفل سليم سيكون لديه القدرة علي التأهيل وتعلمة للغة سريعا

فكان الهدف من هذا المشروع تحديد القدرة العقلية ومستوي ذكاء الاطفال ضعاف السمع لتقدير السنوات التأهيلية المستغرقة في تعلم اللغة واكتسابها بعد تذويد الطفل بالمعين السمعي (قوقعه إلكترونيه _سماعه) عن طريق تصميم نموذج معالج أولي للنص التشبيعي يتضمن إختبار المصفوفات المتتابعة الملون لجون رافن.

CHAPTER ONE

INTRODUCTION

1.1 General Review:

Over 5% of the world's population – or 430 million people – require rehabilitation to address their 'disabling' hearing loss (432 million adults and 34 million children). It is estimated that by 2050 over 700 million people – or one in every ten people – will have disabling hearing loss. Hearing loss is the third most common chronic physical condition in the United States, and is more prevalent than diabetes or cancer [1].

Hearing loss divided to three type but sensorneural the most common type of hearing loss. It occurs when the inner ear nerves and hair cells are damaged sensorneural hearing loss can be treated with hearing aids or cochlear implants, depending on the severity of the loss. common process to treated child's from sensorneural hearing loss is cochlear implant(CI) which is a surgically implanted a small electronic device that electrically stimulates the cochlear nerve and modified the sound[2], cochlear implant and hearing aid need for rehabilitation[3] ,this process require normal mental health child , so should measure skills and intelligence, There are many scales of measuring intelligence, like Bint scale_ Wechsler scale _ Raven's progressive matrices . _ Raven's progressive matrices (CPM) This test appeared for the first time in 1947 (and was modified in 1956), The preparation and development of this test is about (30) years from the life of the English scientist John Raven, it is Cultural-Cross tests Applicable in various environments and cultures, It is a test that is not affected by cultural factors - that is Where the aim of the application is to move away from the impact of language and culture on the subject. To get a full picture of the mental activity of the individual.

1.2 Problem Statement:

The future of rehabilitation for deaf children is seem to be indefinite because of the absence of clear time plan for the rehabilitation that child's need, this make the process of rehabilitation has financial and social impact on their families.

1.3 Objective:

Estimation the expected duration of time need for rehabilitation of deaf children.

Specific objective

1- To identify the duration of time through calculation of child's IQ by using Raven's colored progressive matrices scale.
2- To classify the description level of child's IQ according to Raven's colored progressive matrices scale.

1.4 Methodology:

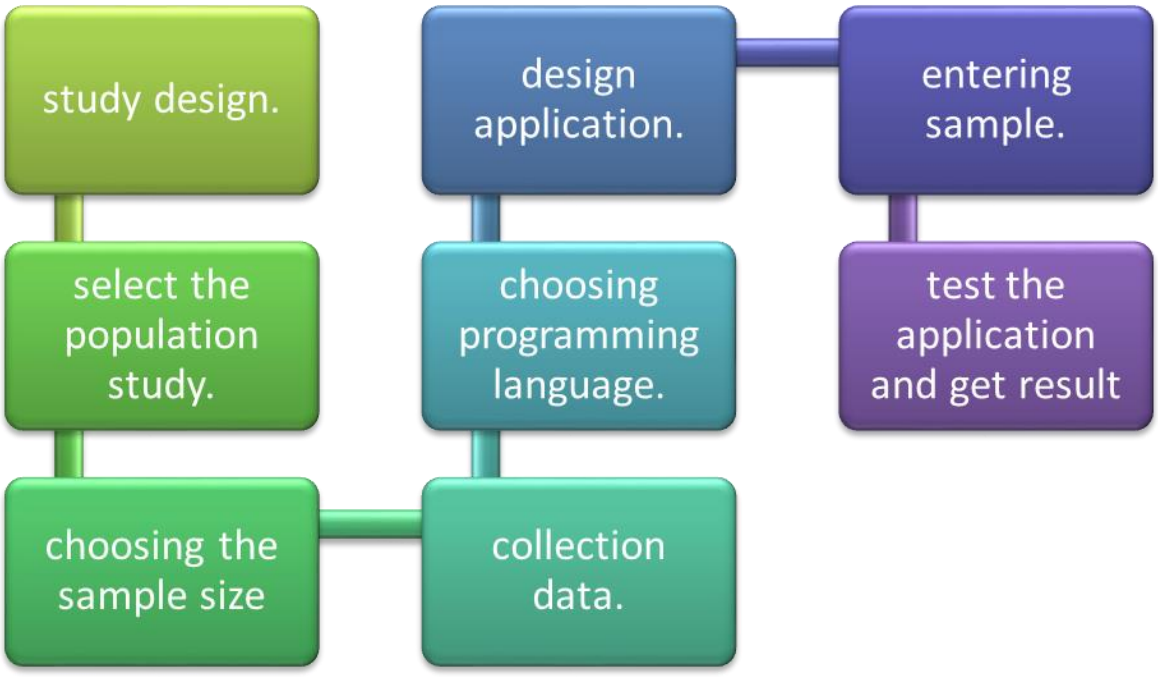


Figure (1-2) flow chart of research methodology

1.5 Thesis Layout:

The layout of this project consists of five chapters; chapter one is introduction and general reviews of the project, while chapter two includes the theoretical background about this thesis and related studies.

The research methods of the project in chapter three however in chapter four the results and discussion would be found, and finally conclusion and recommendation are contained in chapter five and then the references and the questionnaire attached at the end of the thesis.

CHAPTER TWO

LITRETURE REVIEW

2-1The Raven's Colored Progressive Matrices in Healthy Children: A Qualitative Approach.

In 2020 they conducted a survey for healthy primary school students the survey was aimed at investigating the neurodevelopment of cognitive functions in healthy children, whose parents had given informed consent were examined. And it was approved by the local ethical committee and school board. A sample of 947 healthy children participated in the study, 476 boys and 471 girls, subdivided in 12 age groups ranging from 6 to 11 years. They were volunteers for participating in the survey; of medium social status; and they had no history of neurological or psychiatric diagnosis, learning disability, or developmental delay. The RCPM was administered individually, without time limit, in the book format, according to Raven's procedure. Children were asked to choose the missing element from six options in a drawing. One point was given for each correct answer, and the total score was the sum of the correct answers, with a maximum score of 36.A qualitative analysis of the items, based on the cognitive abilities required on each item, was performed. Following the analysis of the existing literature, the factorial structure of the RCPM was presented on the basis of criteria that grouped the items through the cognitive processes involved. The sample was divided into twelve age groups, spaced 6 months from each other, and the performance on each age group was calculated according to the factor clustering, on which mean scores and standard deviations of correct answers were calculated. The independent t-test was used to compare mean scores between age groups. In addition, mean and standard deviation values were also calculated according to a breakdown of the sample by age and sex

[4].

Result from this study was the intelligence depend on 2 factor the first continuous and discrete pattern completion, second closure and abstract reasoning. Group performance improves with increasing age, but no group has achieved full scores.

2-2 Hearing and speech benefits of cochlear implantation in children.

In 2020 they the paper was review published literature demonstrating predictive effects of a number of factors on acquisition of hearing development and speech recognition. Of the many variables that contribute to an individual child's development after implantation, age at implantation, the presence of medical comorbidities, social determinants of health, and the provision of bilateral versus unilateral hearing are those that can vary widely and have consistently shown clear impacts. Specifically, age of implantation is crucial to reduce effects of deafness on the developing auditory system and capture the remarkable plasticity of early development. Language development after cochlear implantation requires therapy emphasizing hearing and oral communication, education, and other support which can be influenced by known social determinants of health [5].

The result specifically, outcomes in children decline with reductions in socioeconomic status and levels of parental education. Medical co-morbidities also slow rates of progress after cochlear implantation. On the other hand, benefits of implantation increase in children who are provided with access to hearing from both ears. In sum, cochlear implants promote development of hearing in children and the best outcomes are achieved by providing early access to sound in both ears. These benefits can be limited by known social determinants of health which restrict access to needed support and medical comorbidities which add further complexity in care and outcome.

2-3 Impact of COVID _19 on the access to hearing health care services of children with cochlear implants: a survey of parents.

In 2020 this study was carried out when the covid-19 pandemic aims to understand the impact of COVID-19 on access to hearing healthcare services for children with CI. HAS affected on The world in an unprecedented manner, it has aggravated psychological distress in parents of children with cochlear implant, This study at the audiology unit of University Hospital Al Sharjah United Arab Emirates, for a period of two months from May 2020 to June 2020.Study sample Convenience sampling strategy was used to recruit participants during the study period. The study was targeted towards parents of CI children residing in the region close to the study

center. To establish contact with the relevant study participants, professionals such as audiologists, speech language pathologists, auditory verbal therapists (AVTs) and otolaryngologists were identified and contacted in the region. These participants were randomly selected Minor revisions were made to questionnaire based on the parent's feedback. Two questions had ambiguous phrases, which were modified and reformulated in the final version of the questionnaire, for better comprehension of the parents. The questionnaire was self-administered in nature, with a completion duration of less than five minutes. All the questions were created and presented in simple language to the parents of CI children. Care was taken while formulating the questions to capture the parents' current feelings during the pandemic without referring to their past experiences [6].

the questions relating to the parents, all of the parents (100%) reported that the COVID-19 pandemic has had an impact on availing timely hearing healthcare services for their children. 96%of the parents reported that they had difficulty in accessing OF the services , the parents agreed that the home training methods were challenging AND the parents reported that they could not follow up with their CI mapping dates with their centers.to note that 88% of the parents felt that the COVID-19 pandemic has been psychologically distressing for them. Challenges pertaining to the CI users were also reported and seemed to be drastically affecting the parents. With respect to the speech processor breakdown, Therefore, shown the results the fact that the current pandemic situation has significantly affected children with CI. It is an undisputable fact that hearing healthcare access is a complex.

2-4 comparison of IQ in children with and without cochlear implant longitudinal finding and Association with language.

In 2019This study evaluated nonverbal IQ in a multicenter, national sample of 147 children with CIs and 75 typically hearing peers. IQ was evaluated at baseline, prior to cochlear implantation, using the Bayley Scales of Infant and Toddler Development and the Leiter International Performance Scale. School-age IQ was assessed using the Wechsler Intelligence Scales for Children. For the current study, only the Perceptual Reasoning and Processing Speed indices were administered. Oral language was evaluated using the Comprehensive Assessment of Spoken Language. Children in the CI group scored within the normal range of intelligence at both time points. However, children with additional comorbidities scored

significantly worse on the Processing Speed, but not the Perceptual Reasoning Index. Maternal education and language were significantly related to school-age IQ in both groups. Importantly, language was the strongest predictor of intellectual functioning in both children with CIs and normal hearing [7].

The results suggest that children using cochlear implants perform similarly to hearing peers on measures of intelligence, but those with severe comorbidities are at-risk for cognitive deficits. Despite the strong link between socioeconomic status and intelligence, this association was no longer significant once spoken language performance was accounted for. These results reveal the important contributions that early intervention programs.

CHAPTER THREE

THEORETICAL BACKGROUND

3.1 Introduction.

This chapter will discuss all matters related to hearing loss, starting from the anatomical and functional aspect of ear, types of hearing loss and finally to options of treatment to the sensory neural deafness that representing in the installation of hearing aids or cochlear implants, It will also address one of nonverbal intelligence scales, Where it has being used to design an application used in classification the intelligence level for deaf children's in this research.

3.2 Anatomy of the ear.

Human ear contains sense organs that serve two quite different functions:

1-hearing.

2-Equilibrium and coordination of head and eye movements

Anatomically, the ear has three distinguishable parts: the outer, middle, and inner ear

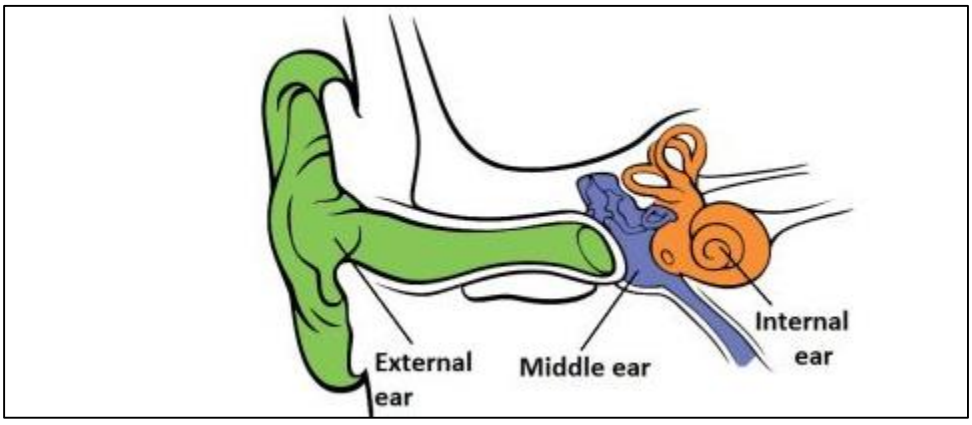


Figure (1-3) ear anatomy [8]

3-2-1The Outer Ear:

Consists of the visible portion called the auricle, or pinna, which projects from the side of the head, and the short external auditory canal, the inner end of which is closed by the tympanic membrane, commonly called the eardrum. The function of the outer ear is to collect sound waves and guide them to the tympanic membrane.

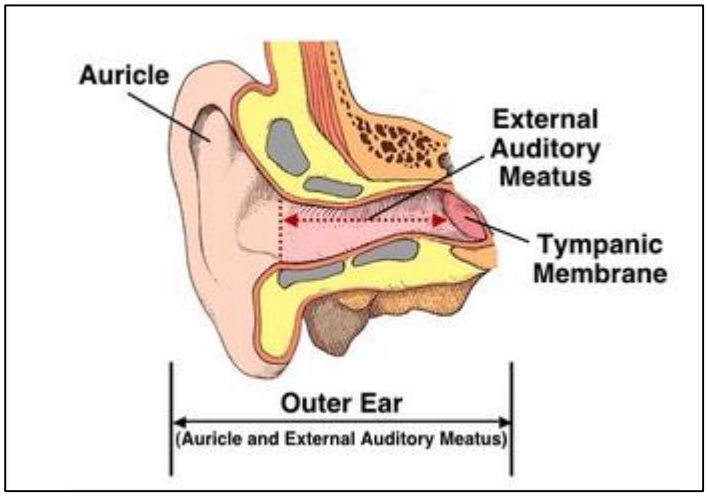


Figure (2-3) outer ear [9]

3-2-2The Middle Ear.

Is a narrow air-filled cavity in the temporal bone.it is spanned by a chain of three tiny bones the malleus (hammer), incus (anvil), and stapes (stirrup), collectively called the auditory ossicles, This ossicular chain conducts sound from the tympanic membrane to the inner ear, which known as the labyrinth. It is a complicated system of fluid-filled passages and cavities located deep within the rock-hard petrous portion of the temporal bone [9].

3-2-3The inner ear.

Consists of two functional units: the vestibular apparatus, consisting of the vestibule and semicircular canals, which contains the sensory organs of postural equilibrium; and the snail-shell-like cochlea, which contains the sensory organ of hearing. These sensory organs are highly specialized endings of the eighth cranial nerve, which called the vestibulocochlear nerve [9].

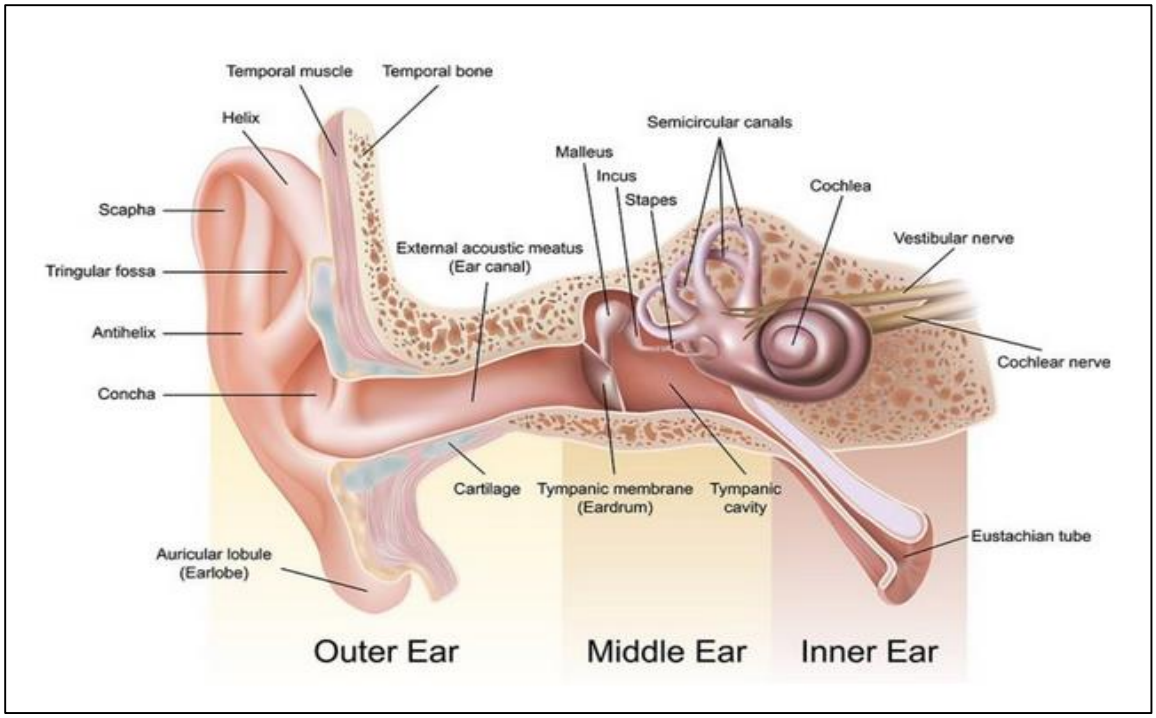


Figure (3-3) inner ear component [10]

3-3Types of hearing loss.

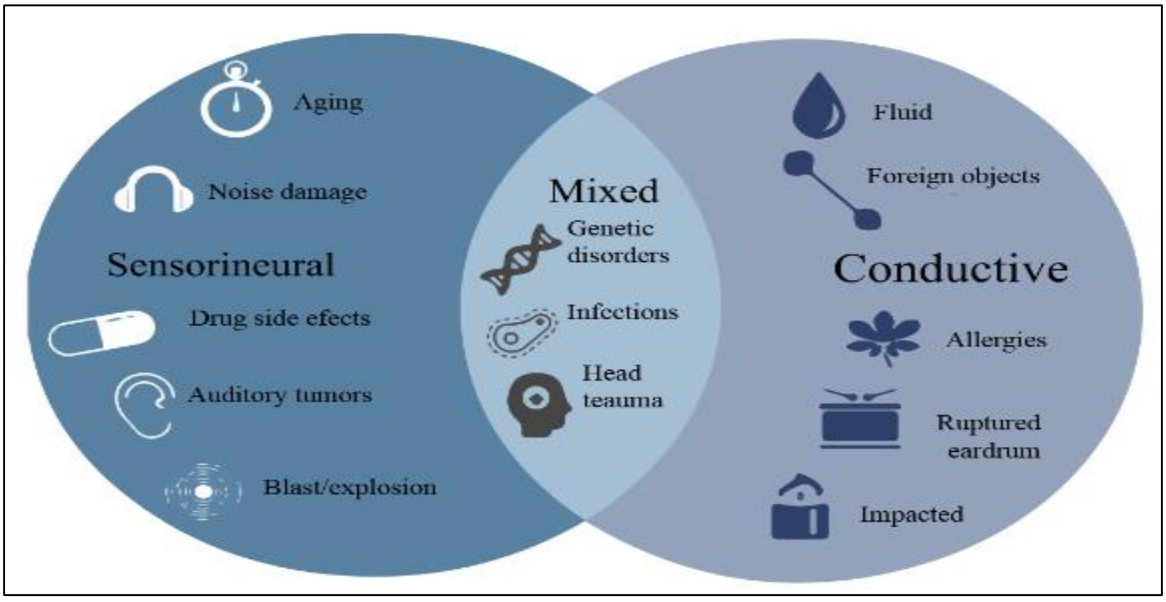


Figure (4-3) type of hearing loss [11]

3-3-1 Conductive hearing loss:

Conductive hearing loss occurs when damage to the outer ear or middle ear blocks sound vibrations from reaching your inner ear, or cochlea. With this type of hearing loss, ears may feel plugged and speech may sound muffled [11].

3-3-1-1 Common causes include:

- Malformations at birth such as Microtia and Atresia.
- Syndromes such as Down, Goldenhar and Treacher Collins.
- Chronic mastoiditis or middle ear infections.
- Skin growth or cyst (cholesteatoma).
- Draining ears.
- Chronic ear infections.
- Previous ear surgeries.
- Benign tumors.

3-3-1-2 Treatment options include:

- Medication.
- Surgery.
- Bone conduction solutions.

3-3-2 Sensorineural hearing loss:

Occurs when the inner ear (cochlea) or hearing nerve is damaged or does not work properly. With sensorineural hearing loss, sounds are not only softer, but also difficult to understand especially when it is noisy [11].

3-3-2-1 Common causes include:

- Congenital hearing loss
- Ageing
- Exposure to the loud noise
- Head injury
- Genetics
- Illness

- Adverse reaction to medications.

3-3-2-2 Treatment options include

- Hearing aids.
- Cochlear implants.

3-3-3 Mixed hearing loss:

Refers to a combination of conductive and sensorineural hearing loss. This means there may be damage in both the outer or middle ear and the inner ear [11].

3-3-3-1 Common causes include:

.Any of the causes of conductive hearing loss plus any of the causes of sensorineural hearing loss

3-3-3-2 Treatment options include:

- Medication.
- Surgery.
- Hearing aids.
- Bone conduction solutions.

3-4 Degrees of Hearing Loss:

The loudness of sound is primarily measured in units called decibels (dB). Prolonged exposure to sounds louder than 85 dB can cause damage to your hearing; sound at 120 dB is uncomfortable and 140 dB is the threshold of pain. This is known as noise-induced hearing loss.

The other way sound is measured is frequency, or pitch. It's measured in Hertz (Hz). When hearing ability is tested, a range of 250 Hz to 8000 Hz is measured because it encompasses the speech frequencies, the most important range for communication [12].

3-4-1 Moderate Hearing Loss:

In addition to missing consonant sounds, vowel sounds then become more difficult to hear. People with a moderate hearing loss often comment that without hearing aids they hear, but can't always understand.

3-4-2 Moderately Severe Hearing Loss:

Without hearing aids, speech is inaudible. Even with hearing aids, speech may be difficult to understand. Increasing the amplification doesn't always make it clearer.

3-4-3 Severe Hearing Loss:

Without hearing aids or cochlear implants, speech is inaudible.

3-4-4 Profound Hearing Loss:

Without hearing aids, may be unable to hear very loud sounds like airplane engine.

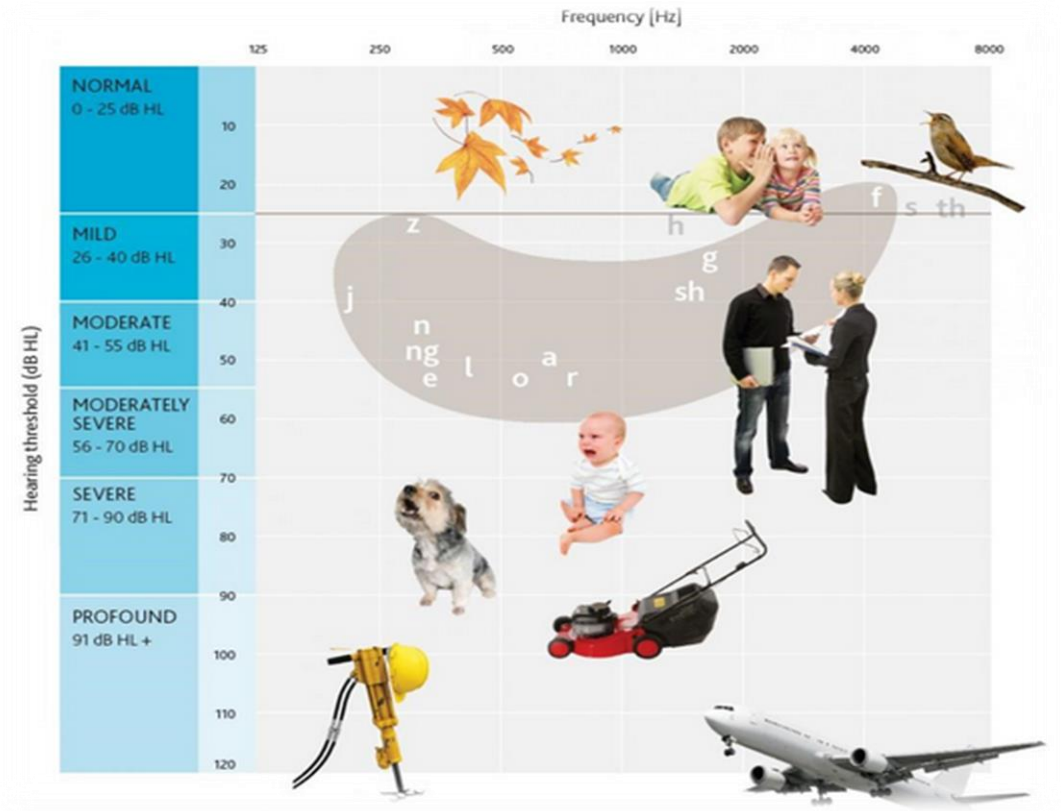


Figure (5-3) hearing threshold [12]

3-5 Hearing aids and Cochlear implants

3-5-1 Hearing aid.

Figure (6-3) hearing aid

Is a device designed to improve hearing by making sound audible to a person with hearing loss, Hearing aids are classified as medical devices in most countries, and regulated by the respective regulations, Modern devices are computerized electroacoustic systems that transform environmental sound to make it audible, according to audio metrical and cognitive rules. Modern devices also utilize sophisticated digital signal processing to try and improve speech intelligibility and comfort for the user. Such signal processing includes feedback management, wide dynamic range compression, directionality, frequency lowering, and noise reduction.it is require configuration to match the hearing loss, physical features, and lifestyle of the wearer. The hearing aid is fitted to the most recent audiogram and is programmed by frequency. This process is called "fitting" and is performed by a Doctor of Audiology, also called an audiologist (AUD), or by a Hearing Instrument Specialist (HIS). The amount of benefit from hearing aid delivers depends in large part on the quality of its fitting [13].

3-5-2 Cochlear implant (CI).

Figure (7-3) cochlear implant device [14]

A cochlear implant (CI) is a surgically implanted neuroprosthesis that provides a person who has moderate-to-profound sensorineural hearing loss with sound perception. With the help of therapy, cochlear implants may allow for improved speech understanding in both quiet and noisy environments. A CI bypasses acoustic hearing by direct electrical stimulation of the auditory nerve. Through everyday listening and auditory training, cochlear implants allow both children and adults to learn to interpret those signals as speech and sound.

The implant has two main components. The outside component is generally worn behind the ear, this component, sound processor, microphones, electronics that include digital signal processor (DSP) chips, battery, and a coil that transmits a signal to the implant across the skin. The inside component, the actual implant, has a coil to receive signals, electronics, and an array of electrodes which is placed into the cochlea, which stimulate the cochlear nerve [15].

The surgical procedure is performed under general anesthesia. Surgical risks are minimal and most individuals will undergo outpatient surgery and go home the same day. However, some individuals will experience dizziness, and on rare occasions, tinnitus or facial nerve bruising.

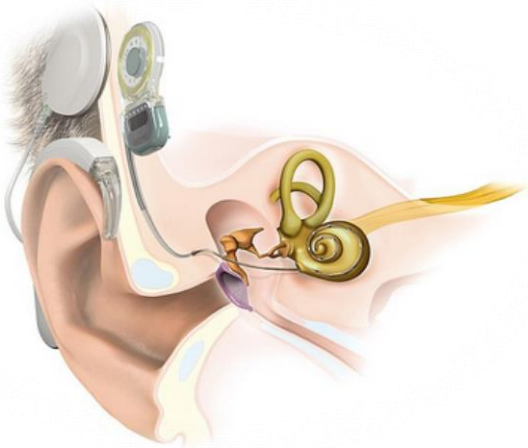


Figure (8-3) cochlear implant in human ear [16]

One of the challenges is that hearing and speech understanding skills after implantation show a wide range of variation across individual implant users. Factors such as age of implantation, parental involvement and education level, duration and cause of hearing loss, how the implant is situated in the cochlea, the overall health of the cochlear nerve, but also individual capabilities of re-learning are considered to contribute to this variation.

3-6 Raven's Progressive Matrices.

Raven's Progressive Matrices (often referred to simply as Raven's Matrices) or RPM is a non-verbal test typically used to measure general human intelligence and abstract reasoning and is regarded as a non-verbal estimate of fluid intelligence. It is one of the most common tests administered to both groups and individuals ranging from 5-year-olds to the elderly. It comprises from multiple questions, listed in order of increasing difficulty. This format is designed to measure the test taker's reasoning ability [17].

The Matrices are available in three different forms for participants of different ability:

3-6-1 Standard Progressive Matrices (RSPM):

These were the original form of the matrices, the booklet comprises five sets with items within a set becoming increasingly complex, requiring ever greater

cognitive capacity to encode and analyze information. All items are presented in black ink on a white background.

3-6-2 Colored Progressive Matrices (RCPM):

The advanced form of the matrices contains 48 items, Items are presented in black ink on a white background, and become increasingly complex as progress is made through each set. These items are appropriate for adults and adolescents of above-average intelligence.

3-6-3 Advanced Progressive Matrices (RAPM):

Designed for children aged 5 through 11 years-of-age, the elderly, and mentally and physically impaired individuals. This test contains sets A and B from the standard matrices, with a further set of 12 items inserted between the two, as set Ab. Most items are presented on a colored background to make the test visually stimulating for participants. This form used in this research.

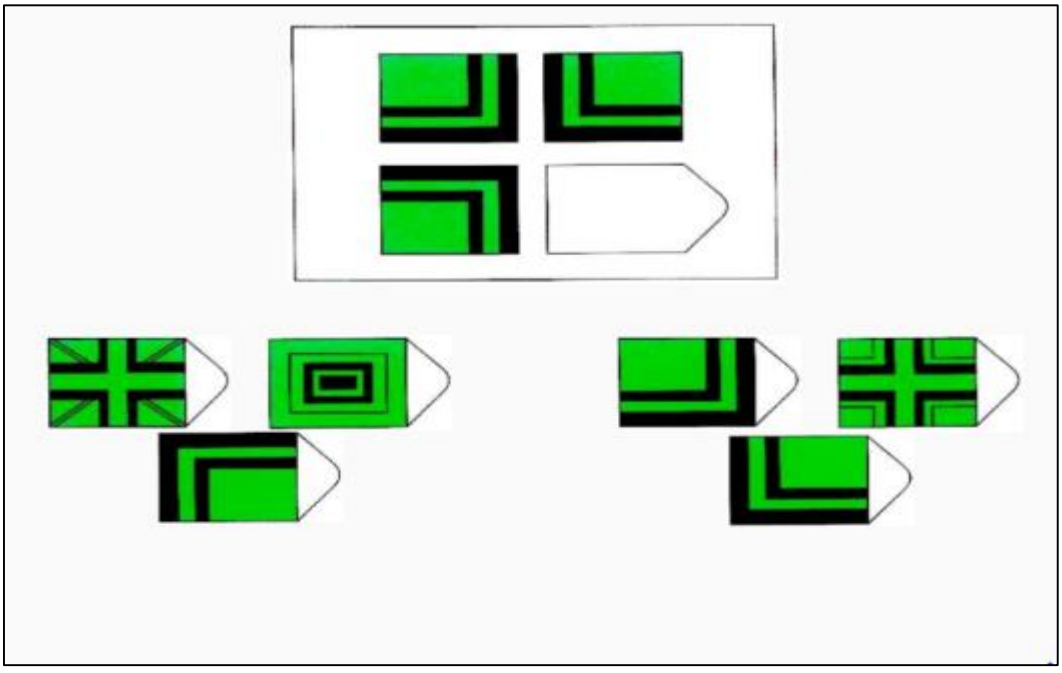


Figure (9-3) progressive matrix set (AB10)

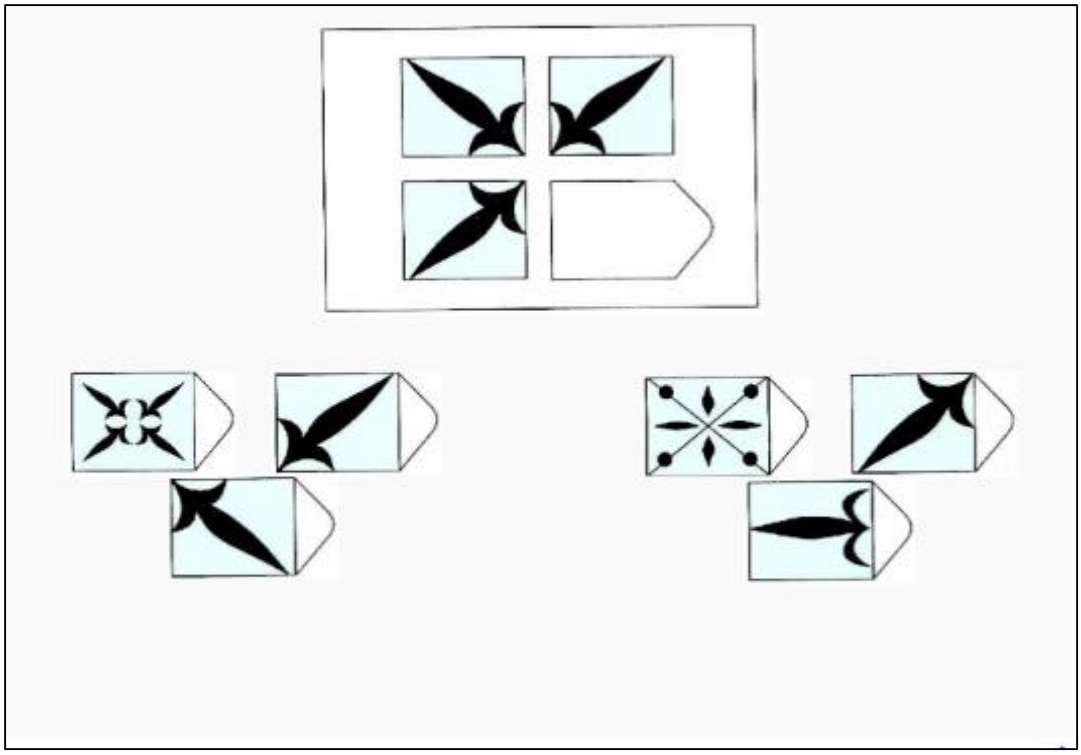


Figure (10-3) progressive matrix set (AB7)

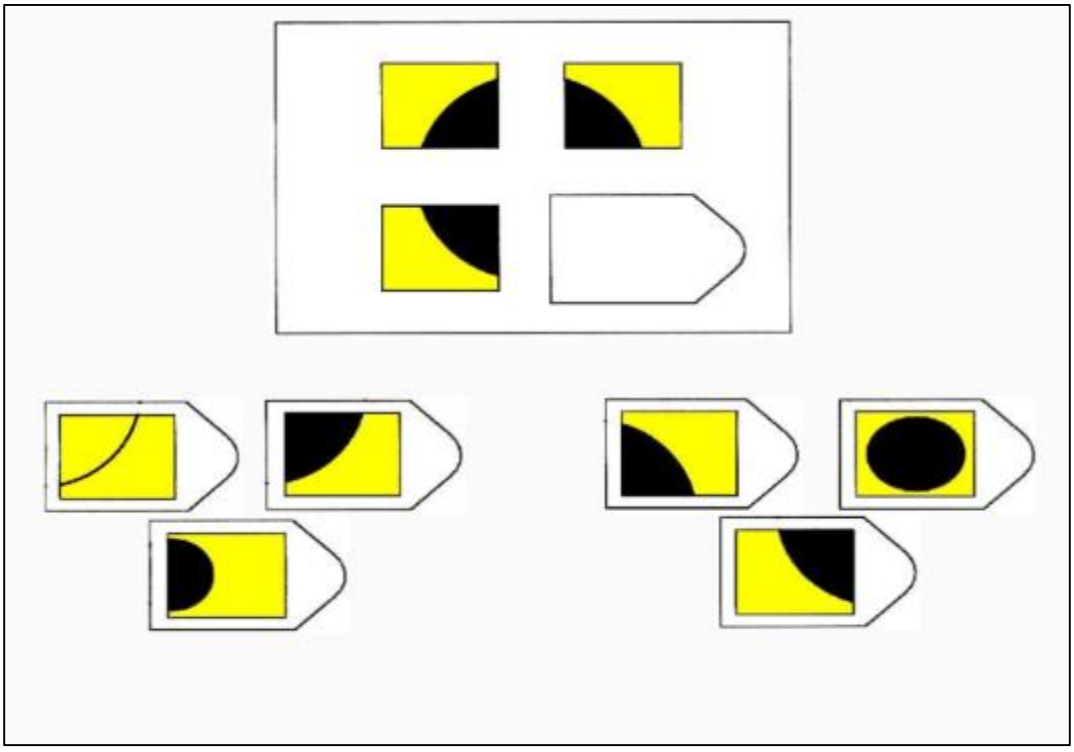


Figure (11-3) progressive matrix set (B4)

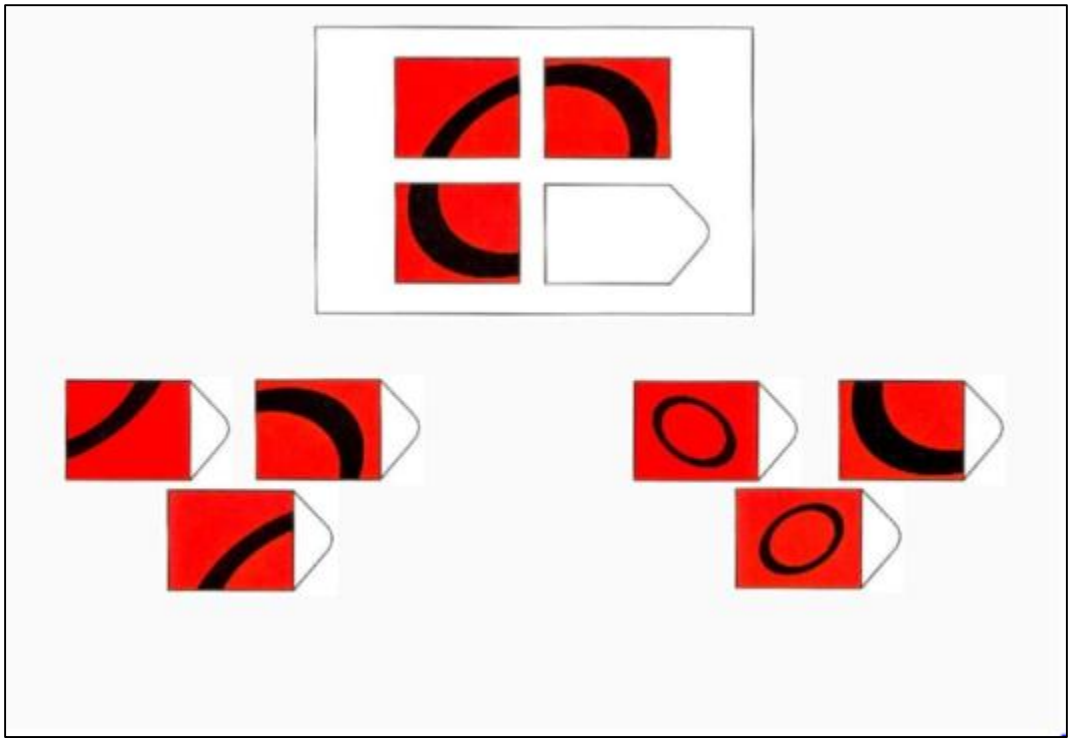


Figure (12-3) progressive matrix set (AB6)

CHAPTER FOUR

METHODOLOGY

This chapter contains the method and steps which followed and used to fulfilled the objectives as follow:

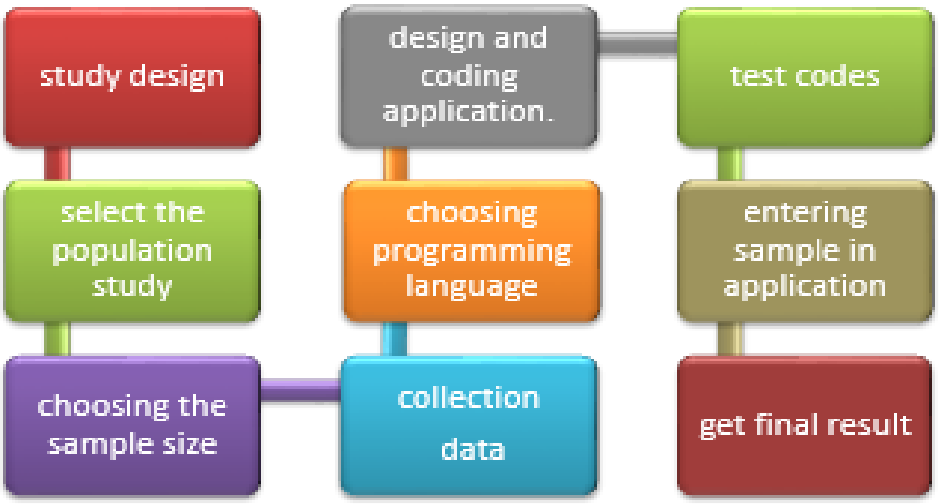


Figure (13-4) methodology steps.

4-1 study design:

Cross sectional study design facility based.

4-1-1 Study population:

All deaf children aged (6-12) year's with cochlear implant or hearing aid who been diagnosed at hearing center or ENT hospital.

4-1-2 Sample size:

Selected sample size about 50 deaf children's used hearing aid or cochlear.

4-2 Data collection:

4-2-1 Test tool.

Percentile Criteria for the Colored Progressive Matrices for IQ Calculator (table).

The equation by which rehabilitation years are calculated has been formulated, which states the following:

(Number of full matrix \ Test result) * 4

-test result

-4: coefficient (The minimum time for auditory a child's rehabilitation, measured in years)

4-2-2 Variables.

4-2-2-1 Socio-demographics.

Child’s name, Age, Sex, Mother’s name, telephone number

4-2-2-2 hearing aid or Cochlear implant data.

Place of implant, Device type, Device implantation type.

4-2-2-3Test date.

4-3 The application sequencing form:

4-3-1 the first screen contains.

Choose the position of the child from among the available options

1- A child with a cochlear implant

2-A child using a hearing aid

3-A child not using a hearing aid

(Each category is required to complete personal information)

Children with cochlear implants must complete this data

Name, gender, age, time of cochlear implantation, type of implanted device, place of implantation, address, mother's name, phone number, test date

Children using hearing aids must complete this information

Name, gender, age, time of use of hearing aid, type of hearing aid , address, mother's name, phone number, test date

Children who do not use a hearing aid

Name, gender, age, address, mother's name, phone number, test date.

4-3-2 the second screen contains

Entering the colored Progressive matrices test, which includes 36 matrices to choosing the correct answer the number of correct answers is collected through the correction key.

The number of correct answers is compared with the table (1-4) of the percentile criteria for the colored matrices to classify the level of intelligence (table). After that, the number of habilitation years is calculated from the sum of the correct answers achieved in the test via the equation ()

The percentile criteria for the colored progressive matrices test (Individual test)

percentile								chronological age in years
95	90	75	50	25	10	5		
32	31	25	21	16	13	12	raw grades	6
32	31	25	21	17	15	12		7
32	31	28	22	18	15	13		8
33	32	31	25	19	16	14		9
33	33	31	26	19	16	14		10
35	34	32	27	20	18	16		11
35	35	32	29	23	18	16		12

Table (1-4) the percentile criteria for the colored progressive matrices test (individual test)

4-3-3 the last screen contains

This screen displays IQ levels table of and final results included which included

-The child's name.

- IQ level.

-Number of habilitation years.

Mental level description	Percentile centile	Mental level
Excellent	*More than 95*	**Level 1 [excellent]**
Superior	*94-90*	**Level 2 [Above average in mental ability]**
Very good	*89-75*	
Good	*74-50*	**Level 3 [Average mental ability]**
Less than good	*49-26*	
Weak	*25-11*	**Level4 [mental ability below average]**
Very weak	*11-6*	
Retardation	*5-0*	**Level 5 [Retardation]**

Table (2-4) IQ levels description

4-4 Design and coding.

We used to convert the idea into a programming language NODE JS which is an open-source, cross-platform, back-end JavaScript runtime environment that runs on the V8 engine and executes JavaScript code outside a web browser. Node.js lets developers use JavaScript to write command line tools and for server-side scripting—running scripts server-side to produce dynamic web page content before the page is sent to the user's web browser.

Then we used Mongo DB to set up the database which is a source-available cross-platform document-oriented database program. Classified as a SQL database program,

After that the last step is to find a server to call the program where we used (Heroku) which is a cloud platform as a service supporting several programming languages.

4-4-1 Test Codes.

The application was tested via its link and to make sure that there are no problems in calling and executing the codes and the correctness of the required results, as the server program Heroku corrects errors automatically.

4-5 Application sequence.

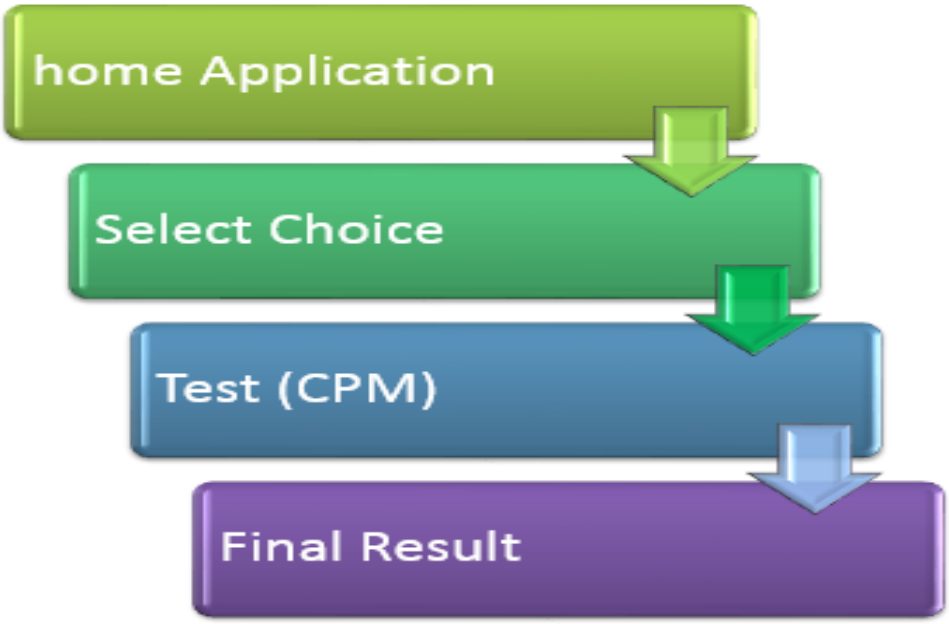
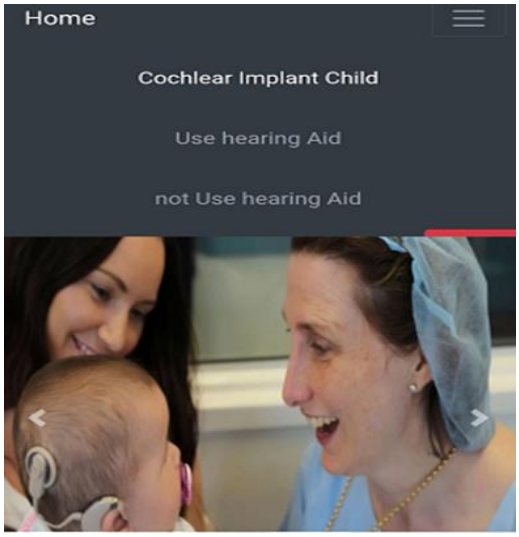
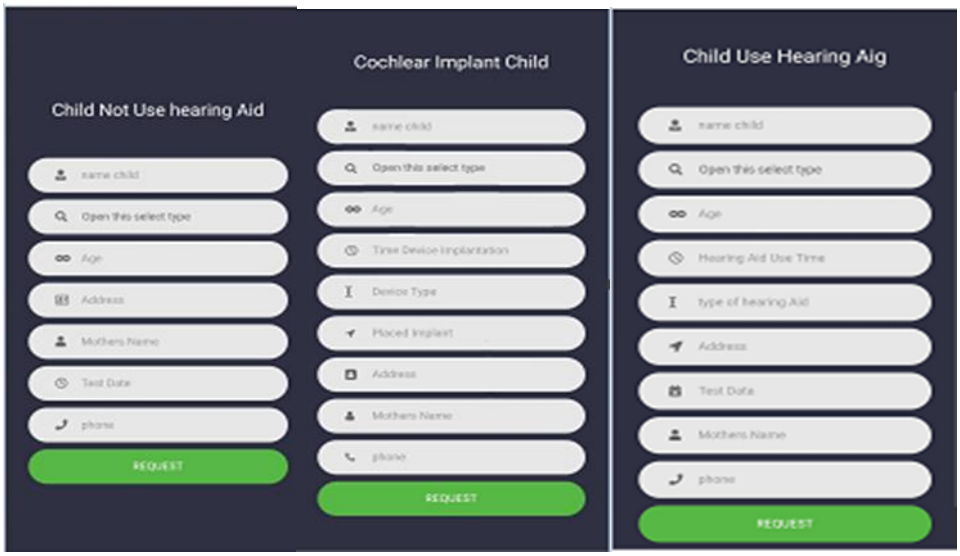


Figure (14-4) Program progress steps.

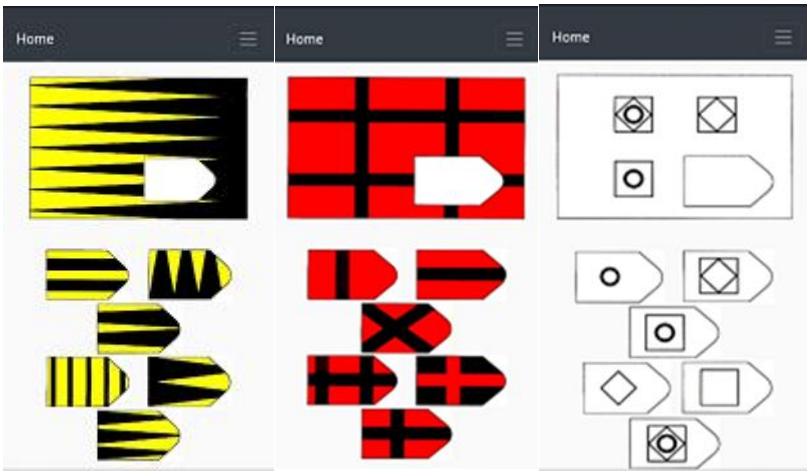
4-5-1 Home Application.



4-5-2 Select Choice.



4-5-3 Test (CPM).



4-5-4 Final result.

CHAPTER FIVE

RESULTS AND DISCUSSION

In this chapter we will review and compare application results for children of ages

Different categories of cochlear implanters and hearing aid users were showing the level of intelligence to which the child belongs by testing his skills through the application

It also shows the number of years the child needs to qualify and develop language abilities after using hearing aids and cochlear implants. The results for all children of each category are explained in this chapter.

5-1 Cochlear implant Children results:

Was 35 child from different age (6, 7, 8, 9, 10, 11, 12).

5-1-1 (6year result).

5-1-2 (7year result):

5-1-3 (8 year result):

5-1-4 (9 years result):

5-1-5 (10 years result):

5-1-6 (11 years result):


Home
Mental level discription
Percentile centile
Mental Level
Excellent
More than 95
level 1
Superior
94-90
level 2
Very Good
89-75
level 2
Good
74-50
level 3
less than good
49-26
level 3
week
25-11
level 4
Very Week
11-6
level 4
Retardation
5-0
level 5
Final Resault
Child Name
Child Rehabitation
Mental Level discription
Omer
4.3
Level 2 Superior


Home
Mental level discription
Percentile centile
Mental Level
Excellent
More than 95
level 1
Superior
94-90
level 2
Very Good
89-75
level 2
Good
74-50
level 3
less than good
49-26
level 3
week
25-11
level 4
Very Week
11-6
level 4
Retardation
5-0
level 5
Final Resault
Child Name
Child Rehabitation
Mental Level discription
Eman
4.8
Level 3 good


Home
Mental level discription
Percentile centile
Mental Level
Excellent
More than 95
level 1
Superior
94-90
level 2
Very Good
89-75
level 2
Good
74-50
level 3
less than good
49-26
level 3
week
25-11
level 4
Very Week
11-6
level 4
Retardation
5-0
level 5
Final Resault
Child Name
Child Rehabitation
Mental Level discription
Sahar
4.2
Level 2 Superior


Home
Mental level discription
Percentile centile
Mental Level
Excellent
More than 95
level 1
Superior
94-90
level 2
Very Good
89-75
level 2
Good
74-50
level 3
less than good
49-26
level 3
week
25-11
level 4
Very Week
11-6
level 4
Retardation
5-0
level 5
Final Resault
Child Name
Child Rehabitation
Mental Level discription
Reem
4.2
Level 2 superior


Home
Mental level discription
Percentile centile
Mental Level
Excellent
More than 95
level 1
Superior
94-90
level 2
Very Good
89-75
level 2
Good
74-50
level 3
less than good
49-26
level 3
week
25-11
level 4
Very Week
11-6
level 4
Retardation
5-0
level 5
Final Resault
Child Name
Child Rehabitation
Mental Level discription
Awaad
4.8
Level 3 good

5-1-7 (12 years result):

5-2 Hearing aid Children results.

Was 10 child from different age (6, 7, 8, 10, and 12).

5-2-1 (6 years result):

5-2-2 (7 years result):

5-2- 3 (10 years result):

5-2-4 (12 year results):

5-3 Result of children without hearing aid.

Was 5 children from different age group (8, 10, 11, 12)

5-3-1 (8 years results):

5-3-2 (10 years result):

5-3-3 (11 years result):

5-3-4 (12 years result):

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1Conclusion:

The program provided an excellent service for deaf children by determining the IQ and rehabilitation years through advanced programming techniques that combined two things that are very important for deaf children of (all groups) to acquisition the abilities and skills to preparation for a normal life.

and also contributed and helped Many parents in determining the mental abilities of the child and pointing to the importance of realizing the mental level to contribute to the efforts of family members to rehabilitate the hearing-impaired child

6-2 Recommendations:

1-Use the applications and programs in the development and rehabilitation of deaf children.

2-Approval of the application by hearing centers, speech and rehabilitation centers to follow up deaf children.

3-Adding the addictive system to the application and creating a special database to save all the data of the deaf children who took the test to compare their data every period to know the extent of development in the level of intelligence and to calculate the remaining years in rehabilitation.

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APPENDIX

ورقة إجابة اختبار المصفوفات المتتابعة الملون لـ . "جون رافن"

ورقة إجابة المصفوفات المتتابعة الملون

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الاسم:	النوع: ذكر – أنثى	تاريخ الميلاد: / /	العمر:	العنوان: مدينة – مخيم – قرية – منطقة إسكان
الموافقة: موافق – لاجئ	تاريخ التطبيق: / /٢٠١٠	الصف:	المدرسة:	

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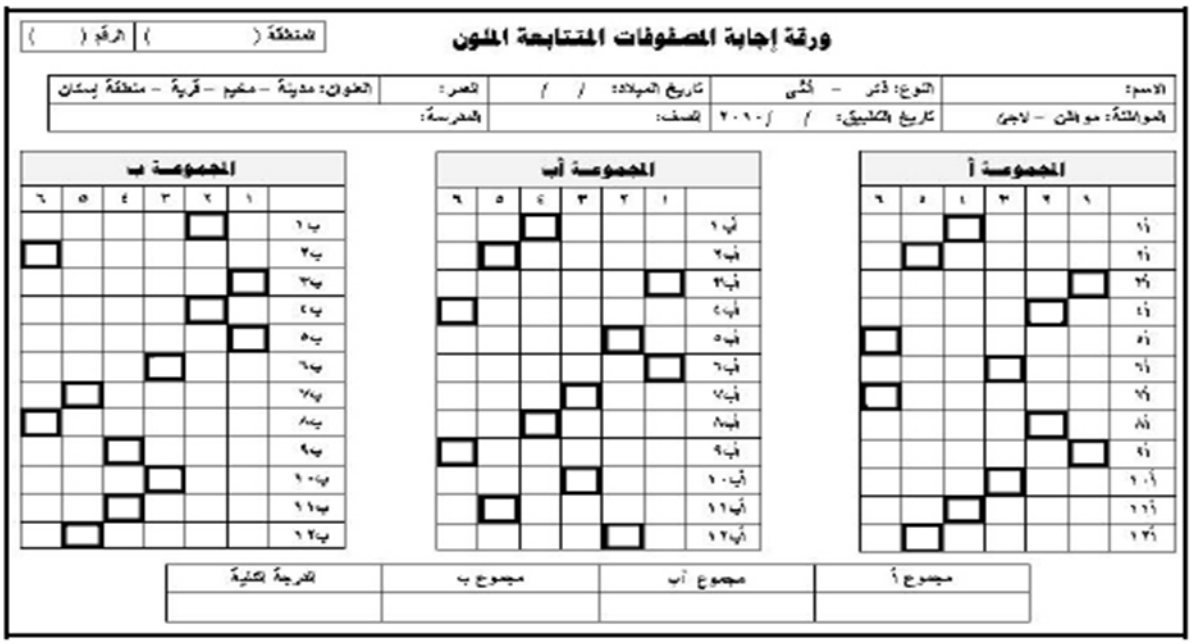

ورقة إجابة المصفوفات المتتابعة الملون

المنطقة ( ) الرقم ( )

الاسم:	النوع: ذكر – أنثى	تاريخ الميلاد: / /	العنوان: مدينة – مخيم – قرية – منطقة بسكان
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مجموع أ	مجموع أب	مجموع ب	الدرجة الكلية

معايير اختبار المصفوفات المتتابعة الملون لـ . "جون رافن"

المستوى العقلي	توصيف المستوى العقلي	الدرجة المئينية	نسبة الذكاء IQ
المستوى الأول (ممتاز)	ممتاز جداً	95 فما فوق	120 فما فوق
المستوى الثاني (أعلى من المتوسط في القدرة العقلية)	أ- ممتاز	94 -90	110 -100
	ب- جيد جداً	89 -75	
المستوى الثالث (المتوسط في القدرة العقلية)	أ- جيد	74 -50	99 -90
	ب- أقل من الجيد	49 -26	
المستوى الرابع (أقل من المتوسط في القدرة العقلية)	أ- ضعيف	25 -11	89 -80
	ب- ضعيف جداً	11 -6	
المستوى الخامس (التخلف العقلي)	متخلف عقلياً	5 -0	70 فأقل