

**ALIZA: SMART MIRROR AS AUTISTIC EDUCATION
ASSISTANT**

2020-079

Project Proposal Report

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B.Sc. (Hons) Degree in Information Technology

Department of Software Engineering

Sri Lanka Institute of Information Technology

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DECLARATION OF THE CANDIDATE & SUPERVISOR

We declare that this is our own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

| Name | Student ID | Signature |
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| Uthayan j | IT17035040 |  |

The supervisor/s should certify the proposal report with the following declaration.

The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor:

Date:

ABSTRACT

Autism is a condition that is characterized with a condition of specially challenges to social skills, speaking, repetitive actions, writing and all. According to a survey in 2019 1 in 160 children have autism spectrum disorder. They have to be handled more carefully when comparing with the normal children. So, when we consider special education schools, they are doing their best but still they can't consider about each and every student and treat them individually. Achievers like Paul Dirac and Albert Ainsten also have been discovered with autism but still they have achieved bigger. The only thing we have to do is to identify the children's special talent and guide him according to that. In our manual way of teaching will not help in this case.

Our smart mirror 'Aliza' will be a solution for this. We have come up with an idea of implementing a smart mirror that have numeric learning, shape learning, voice assistance, and attention tracking. Our system will have individual profile for each and every student. Its very user friendly so that the student can use it in their home without anyone's help. At the very beginning we will evaluate the student's IQ level and give activities according to that. We will compare their improvement with a normal student and calculate their improvement level and treat them according to that. These activities are full and full developed with animations so it will be just like playing some cartoon games. So instead of asking for a man help to study I think this is a better and easy way of studying.

By using our Aliza, we are expecting a student who can count, write and identify numbers between 1-10. And this will be a step up ahead in a new way of learning in special education schools.

Key Words: Emotion, Smart, IQ, Autism

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1. Introduction

1.1 Background

Persons who have Autism spectrum disorder will be facing problems in social and motor skills. They can't socialize with other people, like small child who don't have anyone to play or talk with them what will be the child's behavior when comparing with the other children, that child will have disability in speaking and lack of knowledge. That is what happening with the ASD child, they are living in a different world we can't expect them to do things like normal people do, we have to get into their world and used to it. Then only we can educate a student with ASD. When we consider an ASD student's education they are way more behind from our education system. At the beginning of our project we visited some special education schools in Colombo. There are using simple mathematics to teach them. No matter what the students age is they are been educated in the same way, even if the student can count number from 1-10 that's a big achievement for them.

Each ASD student have a special talent in them we just have to identify that talent. With our traditional way of teaching won't be that much effective for them. Each of the student have to be treated individually. With the lack of sources, we can't to do that. Even if a student has the ability to do math question there finding issues in identifying the different symbols. An article says albert Einstein Nicola tesla had autism, but they still able achieve bigger in their life, we can also identify a new Einstein or a Nicola if we pay special attention on them.

1.2 Literature survey

There are some products which is already available in the market to teach math for the autism children. They are using the same method that been used in pre education schools. Because ASD children will find hard to solve basic math question.

In special education schools they are using activities like connecting dots, rote counting, one to one correspondence, object counting and some other techniques [3]. When students with autism they are getting more attention when they learn something with objects. ASD students always wish to learn in a visual way because they have disability in understanding symbols and communication. Their socializing skills are not enough to interact with a person.

The mobile application Otsimo [2] is developed for the autism children to learn emotions, letters, math. They are giving simple activities like connecting the object, writing number, connecting dots all that. Everyone will be given the same activities to do so. It can be used in android and iOS both. They also provide analytical and report of the sessions.

Also, there are some several apps like basic math tutor, first then visual schedule, choice works calendar to learn numbers for the ASD students. Moreover, these applications are commonly used by everyone, they are cheap and user-friendly applications.

Away from that there are some researches on how to teach math to autism children. From all those researches the conclusion is to use visual objects rather than talking, step by step approach, play games, abacus [4].

1.3 Research Gap

Nowadays everything is automated technology have conquered manpower. In education also we have come up with some automated solution. We don't need lecturers, teachers to learn these days instead of that we are using robots or AI for that. So, when we consider special education those children need special care and attention.

Using a manual teaching model won't help them improve. With lack of sources special education schools can't pay special attention to each student. So, using IOT devices or an AI system is the best way. When we consider this there are some mobile application like Otismo, match and find that teach basic mathematics for autism children. But those don't have a pre-evaluation to find the level of the student. They treat everyone in the same way. Even Otismo provide an analytical report consumer have to pay 14\$ every month for its premium package.

| Product | Pre evaluation | Level ups | type | Cost |
|--------------------|----------------|-----------|---------------------|----------|
| ALIZA | ✓ | ✓ | Smart mirror | Moderate |
| Otismo | ✗ | ✗ | Mobile application | cheap |
| Other applications | ✗ | ✗ | Mobile applications | cheap |

Table 1.1.Comparison of similar products

The smart mirror concept which is proposed have a pre evaluation plan that will calculate the level of the user. Level ups when it identifies develop in the student. Always keep track of the attentiveness and keep them focused on the session.

1.4 Research Problem

Math is the needed in our day to day life. Math makes people better problem solvers. Many technologies use math and are developed by math. IT technologies that is in the current trend uses math as a base. Even AI or machine learning algorithms are developed by math. On the other hand, “Students with autism spectrum disorder (ASD) frequently have difficulty with math word problem solving” [6] it is not that they do not understand math but general math solving with equations and with symbols make it difficult for them. Each individual is unique in their problem-solving skills. But they ASD children prefer math learning in a visual way. Use of flash cards, connecting dots, counting toys make the number learning process easy.

A child’s brain development begins in the adolescent age. Approximately at the age of 5 experts says that 85% of the brain development has occurred [7]. Thus, advancement of the technology can be used for the math learning. Numerous numbers of apps and robot were introduced to facilitate such numeric learning. Even though there are ample of study material the parents of these kids prefer manual learning processes and method due to unavailability of understanding users’ levels, and expensive to afford. (The milo robot costs 5000\$ = 1,000,000LKR)

Addressing this issue this study plans to build an innovative IOT device, a smart mirror. This study purpose of “Aliza” is to give ASD children an affordable cost of therapy and learn math in an organized way that is easy and fun with animations [8].

2. Objectives

2.1 Main Objectives

Implementing a smart mirror to make use for special education to autism children. Education playing a major role in everyone's life but when we consider an autism child this will be the beginning to his social life. School is the only place where autism children get to familiarize with others.

It's being too difficult for ASD student to learn basic lessons. We are implementing a mirror that can make a change in the way of educating an ASD student. Moreover, it will be more user friendly, so the student doesn't need to have a support of others while they are using the smart mirror. By using this mirror the student will develop his communication, social skills, memory power and improvement in their IQ levels.

2.2 Specific Objectives

- A student who can count numbers 1-10

Autistic students have a difficulty in remembering. It's a big achievement if they can count numbers until 8. But our target it's to make them count until 10. We are going to achieve this by giving them different activities using animations. There is also a voice assistance that will always guide the student to do the correct thing. The system will make the activities harder when finding an improvement in the student.

- Able to identify numbers between 1-10

The system Aliza is developed with touch screen, so we have activities like connecting the dots, or matching numbers with quantity and more. By giving these activities again and again at the end student will have a knowledge to connect or match the given numbers.

- Improving IQ level

At the beginning we will evaluate the student's IQ level and give them basic activities according to that, after onwards when they complete each and every level we will compare their improvement with a normal student and continue the session according to that as a result the ASD child's IQ level will rise.

3. Methodology

The system 'ALIZA' is being implemented with the following methodology

- Collecting data
- Designing activities and level ups
- CNN algorithm
- Comparison

Collecting data

When developing a system like 'ALIZA' we need so many data sets to build the system. We are planning to get sample data from randomly selected 100 ASD students from Colombo and Jaffna. Also, we are collecting data from students who don't have ASD to compare the improvement in between those two. With that data we can figure out in how many ways they write a number, it can be curvy or in an angle. With the data collected we have to find out the number which is been written by the student. For that we have to use CNN algorithm to identify the edges, lines and curves. Then we have to convert the number written on the screen into an image (Figure 3.1. image data)

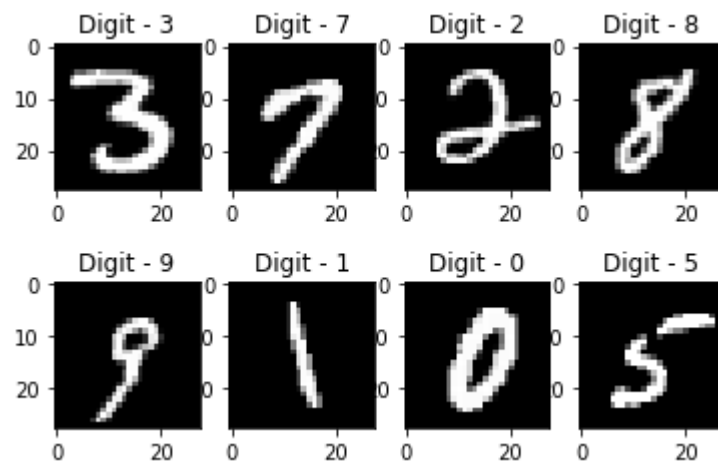


Figure 3.1. Image data of CNN algorithm

(<https://towardsdatascience.com/computer-vision-auto-grading-handwritten-mathematical-answersheets-8974744f72dd>)

Designing activities and level ups

In the beginning we evaluate the ASD student to identify his/her knowledge level. System will ask a student to draw a straight line on the screen, an animation hand will guide the student. If the student passes the activity, then they have to touch an object which is moving on the screen. From these two activities we can identify the level of the student and give them the math activities. These activities have 4 sub-groups

- Connecting the dot
- Writing numbers
- Identifying numbers
- Counting the objects

As a beginner the student will start from connecting the dot activity. The activity is to connect the dots given in the shape of a number (Figure 3.2. connecting the numbers). So, the student will have a muscle memory of the number without knowing what's the number is. On the following sessions they will remember the shape that they have already written.

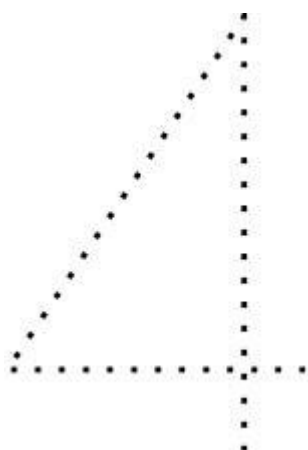


Figure 3.2. Connecting the dots

(<http://www.kidsmathgamesonline.com/worksheets/connectthedots.html>)

The second activity is to write a number in between the edges. An animation will show up like a snake going between a wall the student will have to follow the snake's path and write the number. On the third activity ASD student have to identify a number which is showing on the screen. For example, the system will show a number on the screen and the jumble it with some other numbers the student has to touch the number

which is shown before. At last the student have to count the objects on the screen and touch the correct number, if there are 3 eggs on the screen the student has to touch the number 3.

CNN algorithm

ASD children have problem in their motor skills so they can't write a number in the perfect way (for example – they can write it slightly, curvy). we can't force them write It in a proper way the only thing we can do it to identify the number which have been written by the student. That's where we are going to use CNN Algorithm.

As the first process the system will convert the number written in the screen into a $28 * 28$ -pixel image. each image will be different from the perfect image. The image is consisting of $28 * 28 = 784$ neurons (neuron will hold a number). Neurons will indicate 0 for black pixel and 1 for white pixels. The number in the neuron is called activation. These 784 neurons will create the first CNN layer [Figure3.3]. The last layer neurons will have numbers 0-1 represent how much the given image correspond with the given digit. There are two hidden layers in between the first and last layer which will have 16 neurons each (which can be changed according to the use). These layers will pass the activations according to the brightness of the pixel to the next layer, each layer will do the same task last layer the neuron which has the brightest pixel will be selected as the number on the screen.

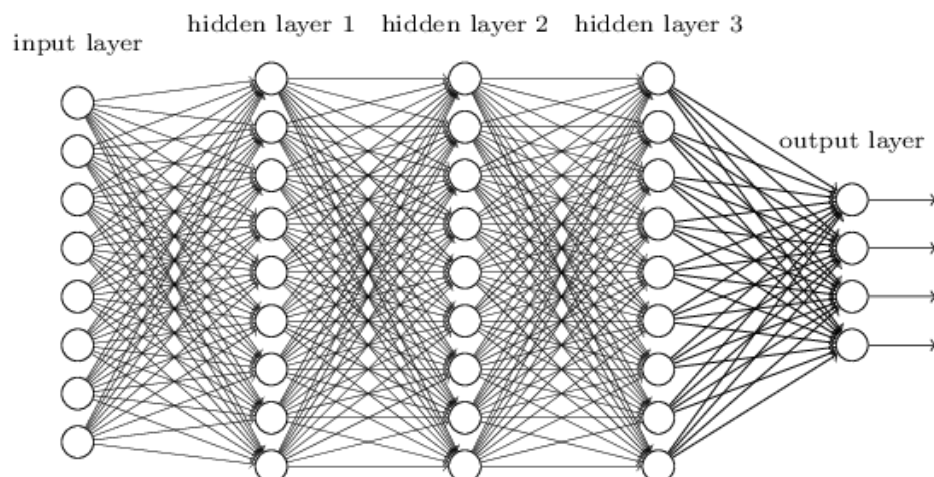


Figure 3.3. Convolutional neural network
(<https://www.semanticscholar.org/paper/Proposition-of-a-Theoretical-odel-for-Missing-Data-Leke-Marwala/3905cc61489bc8ad41204f96b17c3432f524975a>)

Hidden layers the function is to identify some special characters in the number for example 8,9 have loop top so it can be used to identify the number. We have to convert the loop top into edges and each edge will have a weight according to the brightness of the pixel. That weight has to multiplied with the number on the neuron and the following number will be assigned to the next layer neuron. This weight can have any number but to our process we only need numbers from 0-1 to one. So, we have to compress the activation using sigmo method. From the weight of the neurons the actual number will be identified.

Comparison

After each activity the difficulty of the session will be increased. So, the students will work more than the previous level. To check the improvement of the ASD student the system will compare the results of each session with the results of a normal student and prepare a report showing the improvement and process. If the student doesn't have any improvement in the process, then the activity will continue as the same. Or else they will have level ups in each activity.

4. High-level System Architecture

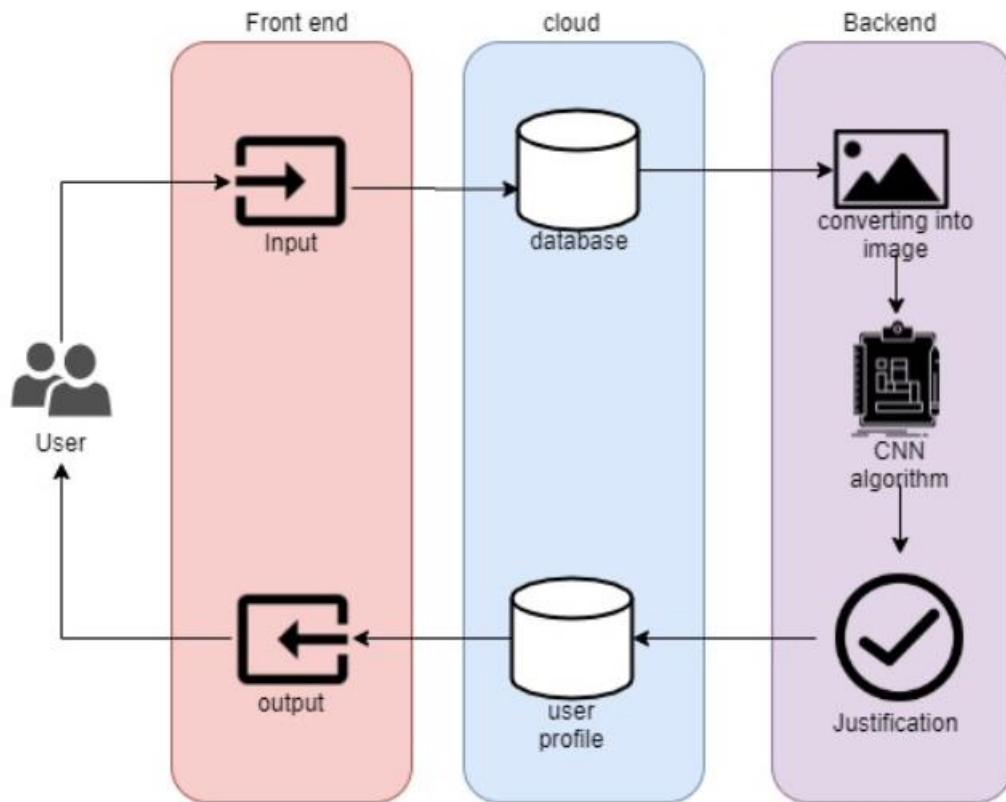


Figure 4.1.High level system architecture

5. Description of Personal and Facilities

- Implementing the smart mirror
- Gather sample data from multiple ASD students
- Convert data from the screen as a picture
- Evaluation of answer from ASD student with the actual answer
- Analyzing the improvement of the ASD student
- Compare the knowledge improvement of the ASD child and a normal child
- Specify what data should be stored in the database

5.1 Work Breakdown Structure (WBS)

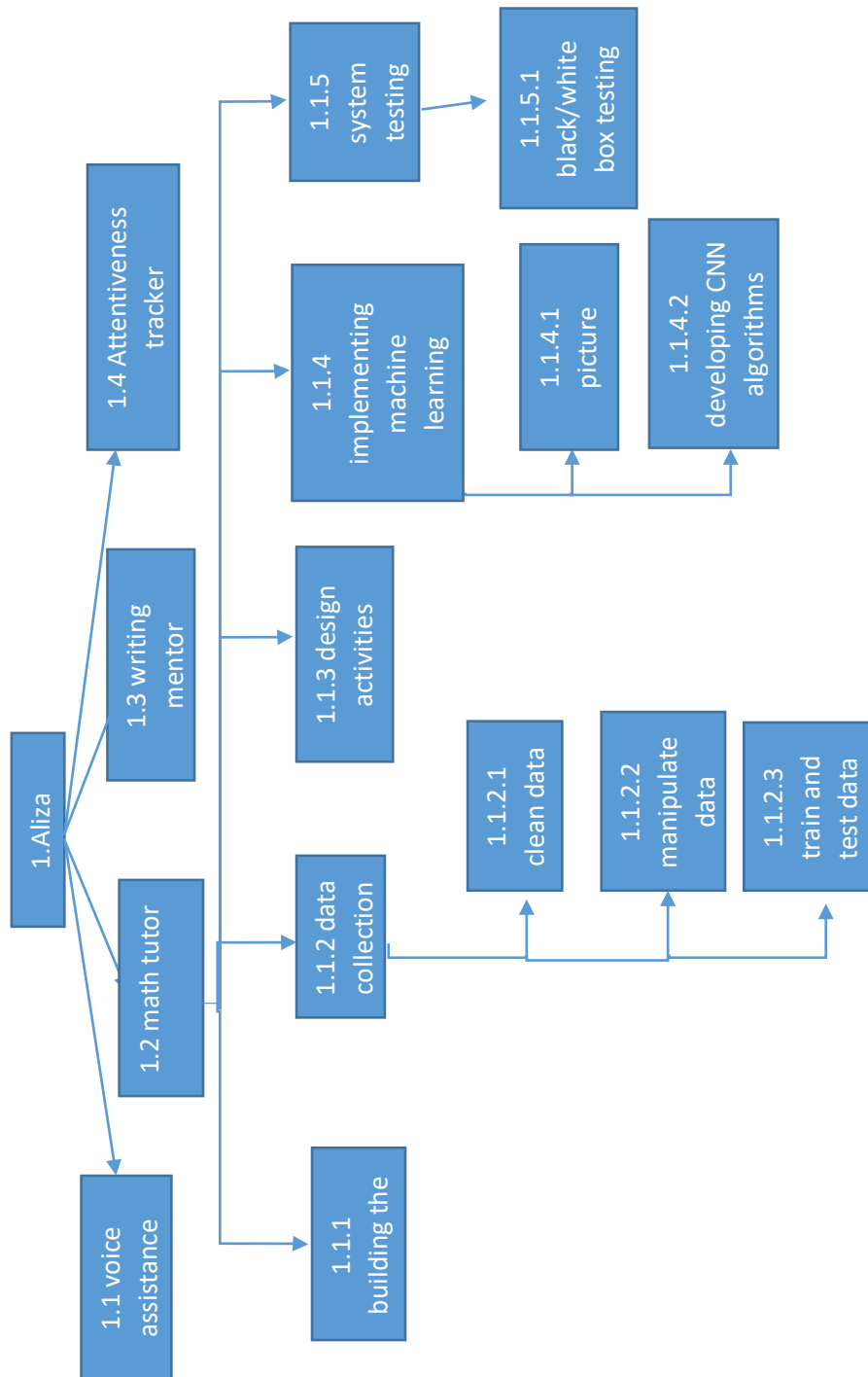


Figure 5.1. Work breakdown structure

5.2 Self-evaluation Plan

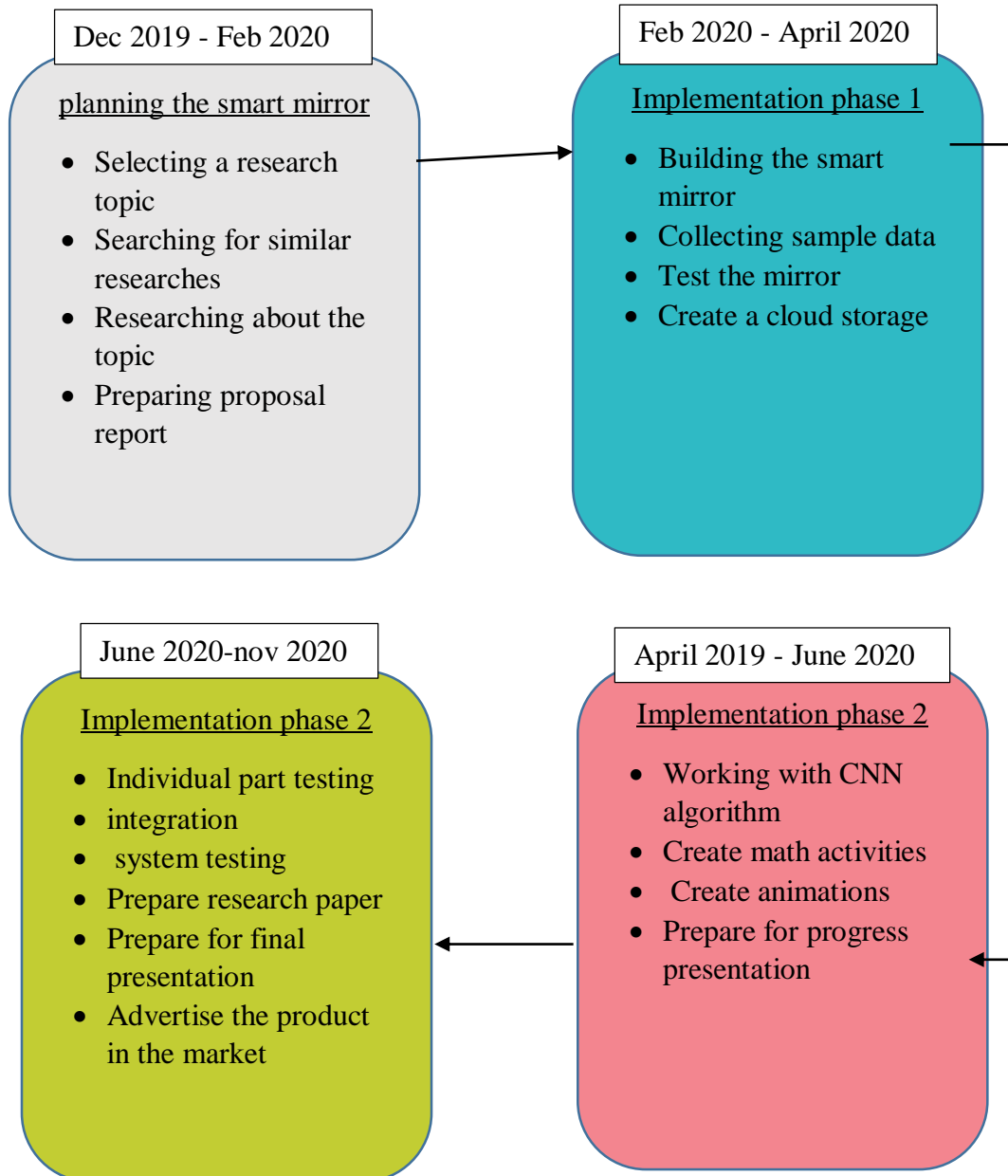


Figure 5.2. Self-evaluation plan

6. Requirements

6.1 Functional Requirements

- The user will be able to create individual account for each of them
- Students will be given activities to improve their math knowledge
- The answers from the students have to be evaluated real time
- Important data from the students have to be stored in the database

6.2 Non-Functional Requirements

- Usability

ASD students are with lack of motor skills also have to be able this system without any others help. Everyone actions have to be easier so that even a student with low IQ level will be able to use the system easily.

- Affordability

The price of the system have to be lesser so that middle class people who is in need for this will be able to buy and install it in their home.

- Entertainable

If we consider a normal student they can't even sit in a place and study for too long so we can't expect a ASD to child to do the activities with full concentration. So the activities should not bore the student. It have to more fun with animations so the student wont lose their attention on the session.

- Security

ASD students faces, personal details and other data must be more secured. They have to maintained confidentially. Even their parents hesitate to share their details.

7 Budget

| Product | Price (LKR) | Justification |
|--------------|--------------|--|
| Mirror | 2500 | Basic materials need to build smart mirror with touch sensor |
| frame | 2000 | |
| Raspberry pi | 7500 | |
| Power unit | 1000 | |
| IR panel | 18000 | |
| Touch screen | 12500 | |
| Others | 5000 | Database cost, transport |
| Total | 48500 | |

Table 7.1. Budget of Research

8 Commercial Value

The commercial value of the proposed solution is increased through below mentioned information:

- The system accommodates many users through one mirror which can be used in schools and homes as well.
- The system provides parents with the facility to easier way to track their child's progress.
- Since the system is wall mounted smart mirror therefore easy to use and attracts many users.
- The system provides the facility to swap game activities by user as per their convenience.

Especially this smart mirror has a user friendly voice assistant.

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