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Development Of An Automated Assistive Device For Behavioural Treatment Of Autism Children

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Abstract

Autism is a subset of pervasive developmental disorders characterised by abnormal behaviour. The growing role of technology has provided different hopes for improving the lives of different individuals with Autism Spectrum Disorder (ASD). Existence use of audio-visual support, a cognitive tool to enable behaviour adjustment, is one of the interventions required to support autistic kids. Although audio-visual support is successful in assisting in reducing many of the difficulties associated with autism, its creation, distribution, and use are challenging and time-consuming. Furthermore, most interventions are still handled manually and require parents to constantly monitor them. To solve this problem, prototype devices were created with the use of audio-visual prompts and IoT, including a control module consisting of a processor panel with a series of inputs and outputs. According to the findings of the study, the device can accurately deliver instructions as it guided the autistic youngster through the stages and collected the data in real time using mobile apps. In order to improve the existing device, the system can be upgraded by providing more prompts, such as inserting video in terms of the visual aspect.

Keywords: Autism Spectrum Disorder (ASD), Intervention, Behaviour, Self-care Skills, Assistive Device.

1. INTRODUCTION

Autism is a complex neurodevelopment disorder that affects communication and social skills and behavioural and intellectual abilities. Symptoms and severity of autism vary widely(Lord et al., 2018). Children with autism spectrum disorder (ASD), as well as the parents and caregivers who support them, may find it extremely difficult to learn how to take care of themselves. Self-care skills are harder for people with ASD to learn than they are for people without it, and in more severe cases, they might never be able to carry out self-care tasks without help(Hirano et al., 2010).

Incorporating assistive device into daily activity can provide autism children with an opportunity to take control of their behaviours and self-care skills. Increase, maintain, or improve the functional capabilities of kids with autism is the aim of this assistive technology(Mechling et al., 2009). Tactile, auditory/vocal, gestural, textual, pictorial, and video prompts are among the prompt types that have been shown to be successful(Mechling et al., 2009).

The Internet, robots, virtual reality, assistive and prompting devices, and voice output communication devices are some of the technologies that have been used to this aim. Children with ASD and their caregivers can utilise the assistive gadget described in this study to

independently assist with self-care activities. The system follows a child with ASD through an activity using Internet of Things vision and provides auditory and visual cues as necessary. Utilizing technology to develop novel interventions is one method to satisfy the needs of people with ASD while lessening the burden on caregivers(Bennett et al., 2013).

2. METHODOLOGY

The An Automated Assistive Device For Behavioural Treatment Of Autism Children device creation, pilot testing, and evaluation are discussed in this study. This ASD device was created to assist children with ASD in doing routine self-care tasks. Through pilot testing of a functioning prototype as the kids worked on the activity, this study aimed to find out how well the gadget worked and how easy it was for kids and their parents to use.

2.1. Project Designing Process

This assistive device for ASD consisted of a flat-screen LCD mounted over the device, a voice module, push button and ultrasonic sensor as shown in Figure 1. This ASD assistive technology employs specially created audio-visual prompts for the child via speakers and an LCD. Recorded verbal prompts and display prompts that may be used at any step of the activity were both different sorts of prompts. Components for hardware are utilized in this section.

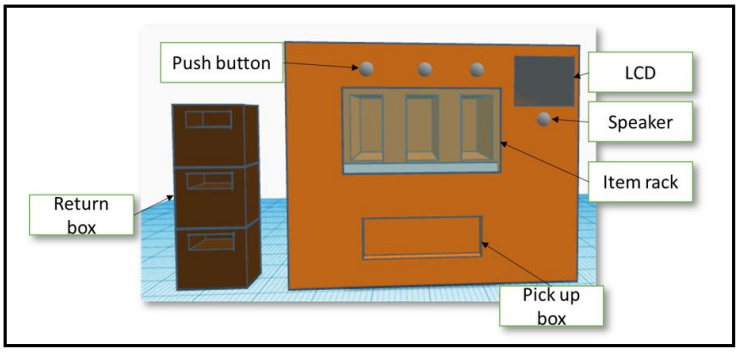


Figure 1: Project design

Thinkercad is used to design this project. This assistive device is design to fit on top of a desk and not be too tall. Recycle wood will be used as the casing of this device and sturdy plastic are used for the front panel. This device also consists of item rack to store the items, IR sensor to detect item collection and return, LCD to display the option, push button to select the item, and MP3 module with speaker to give instruction to the autistic child.

2.2. Project Development Process

This project will undergo the designing development process. One of the most important steps in creating this assistive equipment is the designing process. As listed in Table 1, the project's hardware components include the push button, LCD, MP3 module and speaker, IR sensor, servo motor, and server (Wi-Fi module; ESP32). Each components have their crucial function in order to ensure that this device can be operated according to its function.

Table 1: List of hardware components

Components	Picture	Function
Push button		A push button switch regulates a machine's or other process's action. In this project, user can choose the product by pressing the related button.
LCD		LCDs are a commonly used to display data in devices. LCD is to show the information such as the items and when making a selection.
MP3 module & speaker		It is a speaker-dependent module with speaker and reproduces sounds stored on a memory card. Any sound could be trained as command to give instruction to the user.
IR sensor		An IR sensor can detect motion of object or if there is any object present in its's surrounding. In this device it's use to detect if the item has been collect.
Servo motor		Precision rotating and pushing pieces of a machine are accomplished by electronic devices and rotary or linear actuators. It is used to control the rotation of the coil and dropping of the product
Server (Wi-fi module; ESP32)		It is mainly utilized for IoT-based embedded applications development. It is capable of handling various functions of the Wi-Fi network from another application processor. The ESP32 then will send the data to apps, Blynk.

2.3. Project Block Diagram

The operating system of the project is depicting in Figure 2 with block diagram showing the mechanism and flow of the process of this work which consist of three parts; input, process and output. The mechanical system representing the physical prototype which have push button, LCD monitor, MP3 module, IR sensor, servo motor, and Wi-fi module (ESP32), are group together as they are the main components used to build the device. All components will be controlled by

ESP32 microcontroller. The ESP32 then will send the data to apps (Blynk). Servo motors move to rotate the coild and dispense the item.

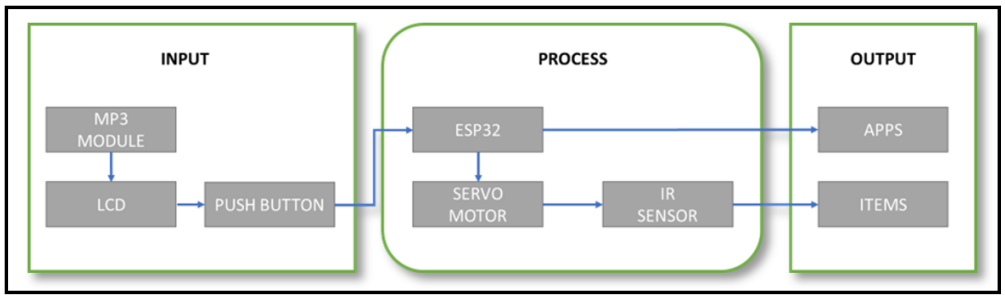
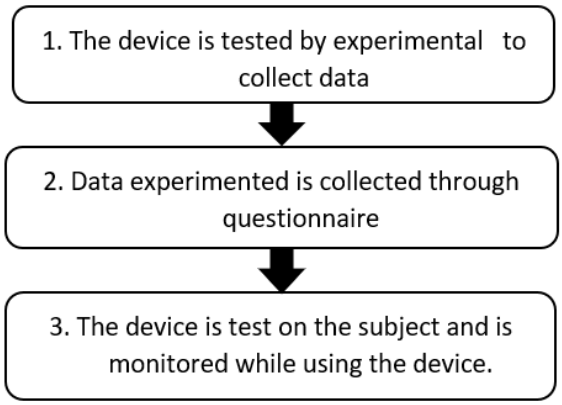


Figure 2: Project block diagram

2.4. Data analysis method

Data analysis has been carried out following the conclusion of the designing and developing phase. The approaches for data analysis include examining each circuit component and how it affects the outcome. The development of a control module with a processing panel and a range of input and output is one of the primary objectives of this project. The results of component testing indicate that all the elements and aspects of this device can perform in accordance with its aims. Several project parameters have been reviewed. In addition, subject testing and data collecting from the survey have been completed. According to the survey data, parents and other caregivers were in agreement that this gadget may be utilised as an aid for children with autism. Additionally, subject testing data demonstrated that this tool can accomplish its goals of guiding autistic youngsters with voice and visual prompts used in this project.



3. RESULT AND DISCUSSION

The hardware for the assistive device has been constructed, as shown in Figure 3. The board's coding is programmed using the Arduino IDE. The goal of this is to improve the project's production. Also utilised in this project is Blynk. It can be used by caregivers to support autistic children throughout the process as well as to monitor the activity of the autistic child. There were three buttons, one for each component of the gadget, as seen in Figure 3. Additionally, a speaker and LCD are available to assist in instructing and guiding the youngster throughout the procedure. The corresponding step progress on applications would display the progress status for each step when a child completed a step of the task.

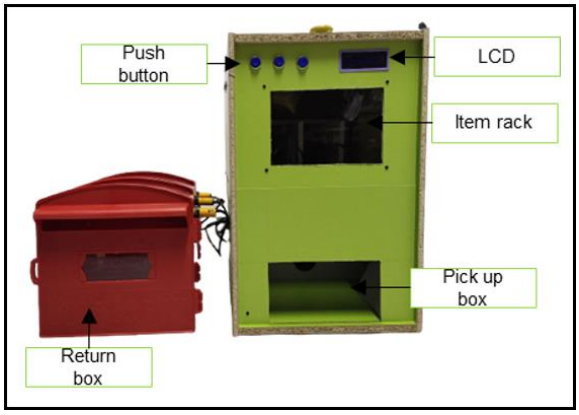


Figure 3: Actual device prototype

3.1. Application interface

The application interface that we can see from user's phone is shown in Figure 4. As we can see, by using this application (Blynk), parents can easily check the stock left for every item. The LCD on this application will display the same information as the LCD on the device, so that the parents can know which item their kids are choosing. When the work is complete, a percentage rate will be shown at the bottom of the programme. The application also shows progress for each step that the child has completed. Parents also can help their child to choose an item using the application by selecting the selection button for each item on the application display.

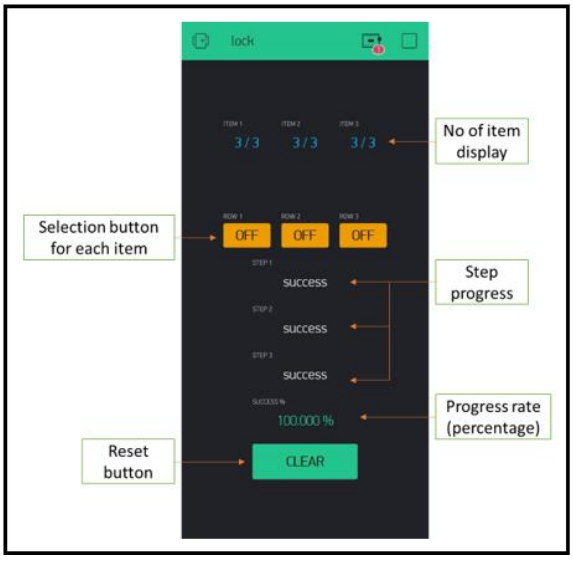


Figure 4: Application interface

3.2. Project Flowchart

The five states that make up this device's state cycle are: system asking the user to choose an item, user choosing, product delivery, product return, and progress data update on apps. The MP3 module will first provide instructions when the switch on button is pressed, and then the machine will be ready for consumers to choose the product. The design is in its initial state at this point. The user will then choose the product to be dispensed after this. This condition may fall

under one of items 1, 2, or 3. Let's assume that the user chooses input item 1. The machine will initially determine whether or not the products are in stock. The item will then be delivered to the pickup box by the machine when it travels to the item state. The user must put the item in the return box when returning it. The applications will update each step's progress and progress rate at the end of the steps simultaneously.

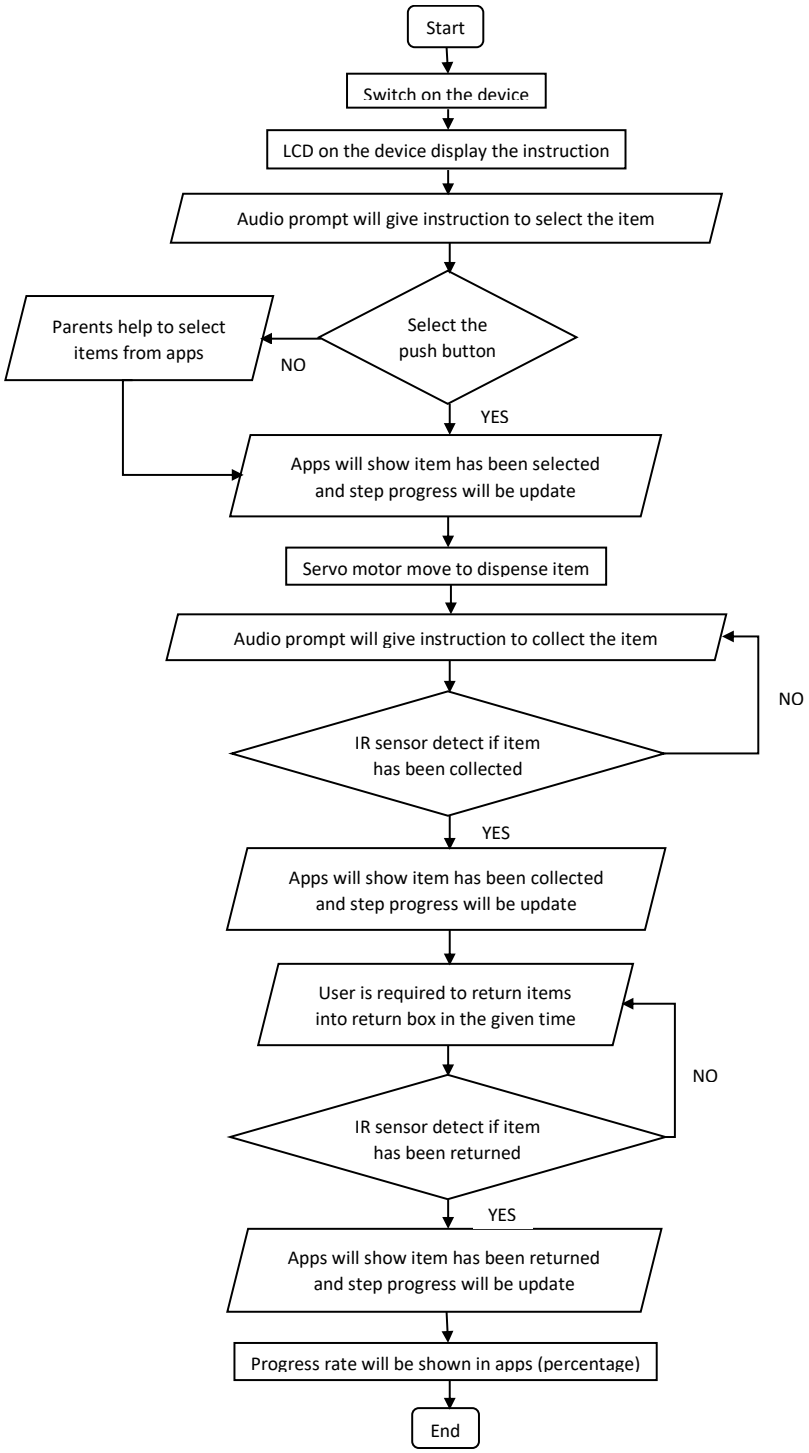


Figure 5: Project flowchart

3.3. Standard Operation Procedure (SOP) for An Automated Assistive Device for Behavioural Treatment of Autism Children

The method developed to carry out an experiment is shown in Figure 6. Before utilising the assistance equipment and after using the assistive device, the procedure will be recorded.

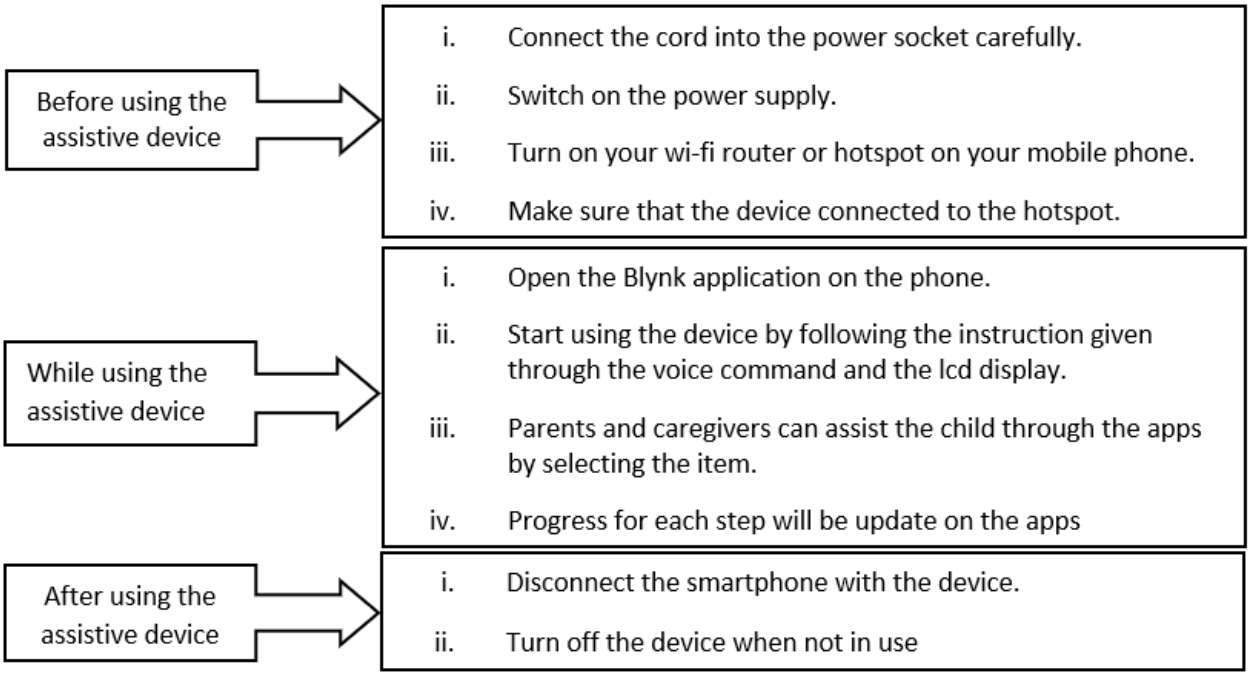


Figure 6: SOP for Automated Assistive Device for Behavioural Treatment of Autism Children

3.4. Subject experiment data

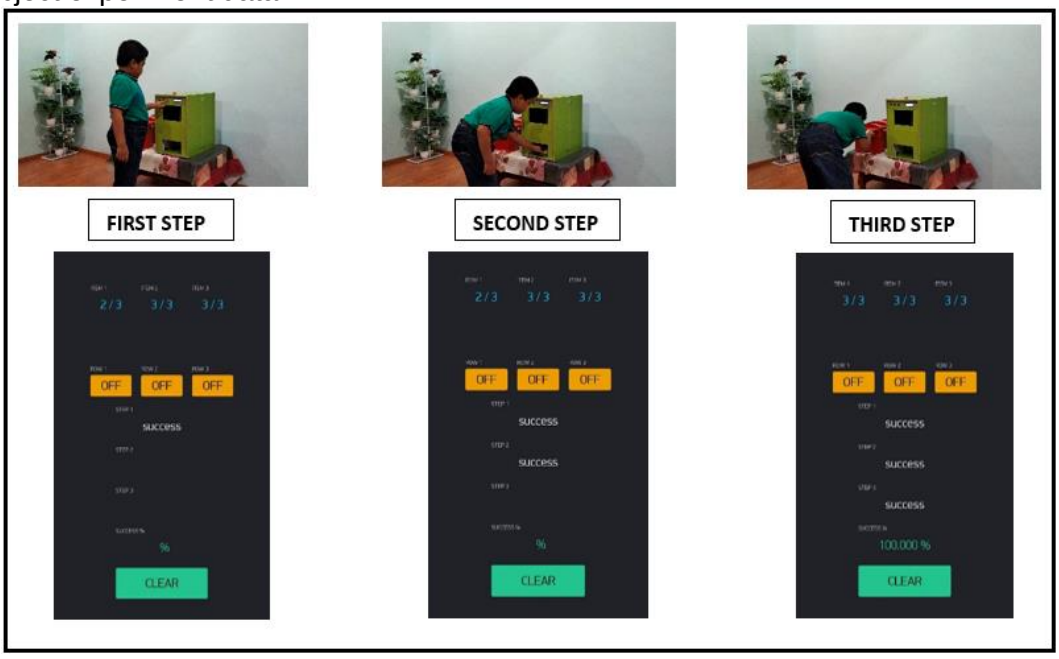


Figure 7: Subject can follow instruction successfully without parents' assistance

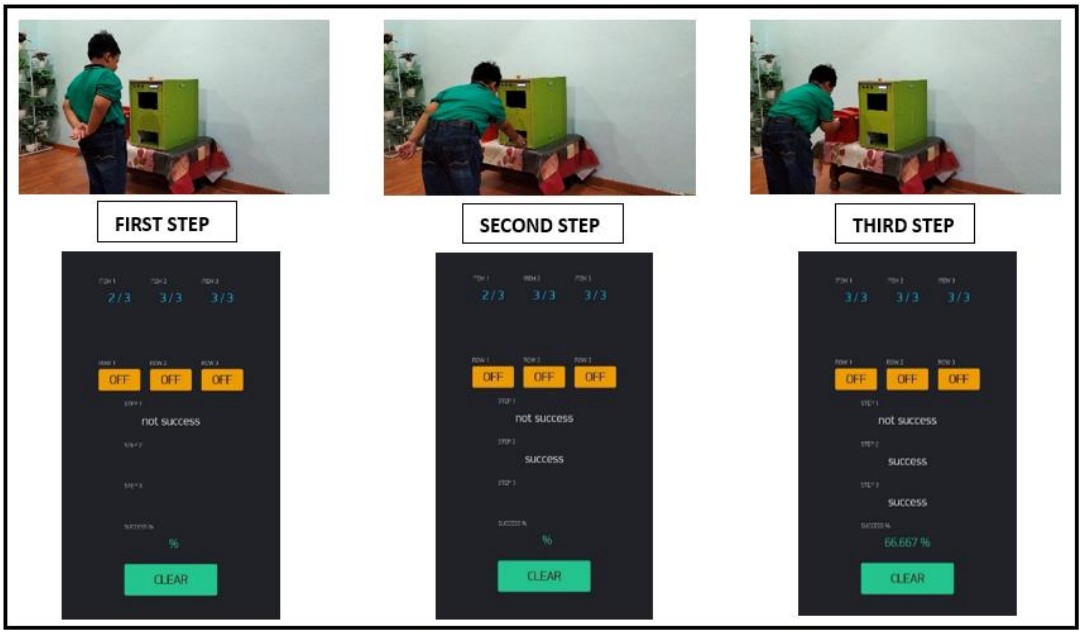


Figure 8: Subject need parents assistance through apps

This experiment sought to determine whether the ASD device was a suitable intervention and could carry out its intended functions. The study was done to determine how ASD youngsters responded to this gadget, as illustrated in Figure 7 and Figure 8. Other than that, the purpose of this experiment is to analyse the real time response by the parents through apps in assisting behavioural treatment for autism children.

Figure 9's result shows that 83% of the trial was successfully completed by the child without the help of parents or other caregivers. Only child 1 got a total of 66.67% successful rate during the second trial, but for the third trial he managed to follow through the steps successfully. From this we conclude that this device success in giving 2 mode of prompt which is audio and visual to meet the needs of the autism children's behaviour in completing through the task.

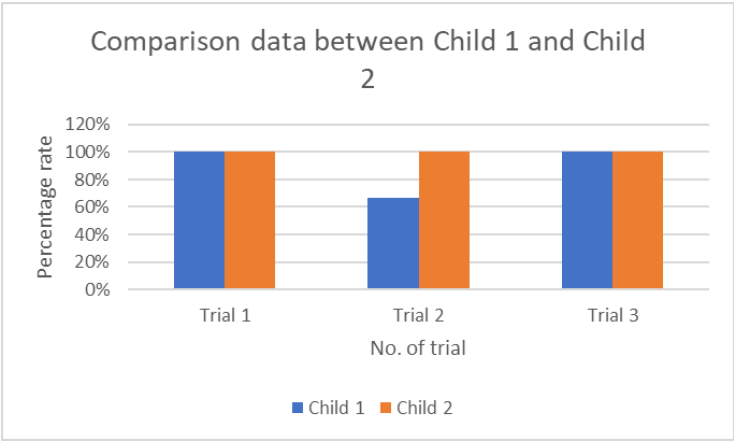


Figure 9: Subject data analysis graph

4. CONCLUSION

An assistive device has been designed to assist parents and caregivers to monitor progress of self-care activity and behaviour of autism children using ESP32 and Blynk. This device's innovation consist with 2 mode options which is the visual and audio aspect has been successfully developed test for autism children. Behavioural autism activity has been successfully test and can be used as an assistive device for behavioural treatment for autism children. This automated assistive device for behavioural treatment of autism children is a low cost intervention that pursued to develop a device that resulting audio-visual prompts to serve as an effective self-prompting device to assist children with ASD. This device allows the autistic children in improving behaviour while perform multi-step tasks. The impact of giving children with autism numerous instructions for two different setup options—an audio prompt and a visual prompt—will be evaluated across the activity. Data will also be recorded using programmes for additional analysis.

5. ACKNOWLEDGMENT

I would like to express my sincere appreciation to my supervisor, Madam Suryani binti Ilias, for giving me the chance to complete this wonderful project on the subject of An Automated Assistive Device For Behavioural Treatment Of Autism Children. She also encouraged me to conduct extensive research and complete the project within the allotted time. I learned a tonne of new information as well, and I appreciate my supervisor so much for that.