

Sri Lanka Institute of Information Technology



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A learning tool for children

Proposal Document

Group 9

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1. Background

1.1 Background

Children learn best through **multi-sensory interaction**. Traditional tools often rely on passive memorization, which can be boring or ineffective. Our project introduces a **modular embedded system** that teaches alphabets and colors using **touch, rotation, sound, light, and optional visual feedback**. By integrating optional features like **OLED display** and **EEPROM memory**, we enhance usability and accessibility for all learners.

2. Problems and Motivations

2.1 Problems

- Children struggle to memorize letters and colors without feedback.
- No memory of previous selections.
- No visual display for children with hearing difficulties.
- Traditional tools lack modularity and adaptability.

2.2 Motivations

- Make learning **fun, inclusive, and interactive**.
- Use **Arduino-based sensors and actuators** to build a real-world educational tool.
- Add **optional features** for better feedback and future scalability.

3.Aim and Objective

3.1 Aim of the Project

To develop a **dual-module embedded learning tool** that helps children identify alphabets and colors using touch and rotation, with **audio, light, and optional visual/memory feedback**

(can upgrade the system with more advance features)

3.2 Objectives of the Project

- Use **TTP229 capacitive touch keypad** for alphabet input.
- Use **potentiometer** for color selection.
- Play audio using **DFPlayer Mini** and speaker.
- Display selected color via **RGB LED**.
- **Optional:** Show selected letter and color name on **OLED display**.
- **Optional:** Save last selected values using **EEPROM**.
- Ensure both modules operate **independently** and intuitively.

4. System Diagram

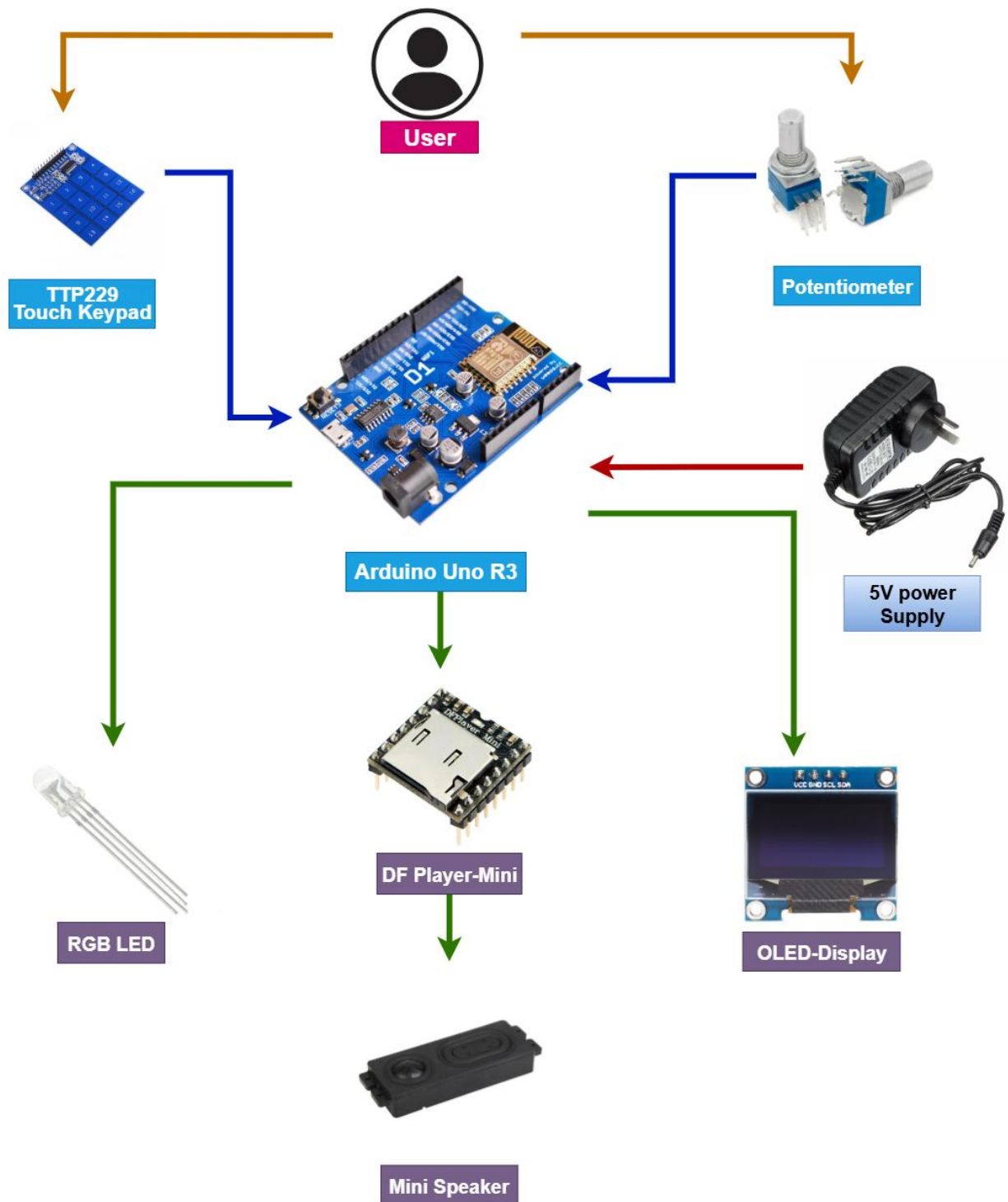


Figure 1 - System Diagram

5.Methodology

5.1 System Overview

This tool helps children learn letters and colors interactively. A touchpad lets them select alphabet letters, while a potentiometer adjusts color. The system gives feedback using an RGB LED, sound via DFPlayer Mini, and optionally an OLED display. An Arduino UNO controls all components, making the experience simple, engaging, and modular for young learners.

5.1.1Core Functional Flow

1. System Initialization

- Arduino UNO powers up and initializes all modules: TTP229 touchpad, potentiometer, RGB LED, DFPlayer Mini, and optional OLED.
- EEPROM is checked for saved user progress (optional feature).

2. User Input Phase

- Alphabet Selection:
 - User touches a key on the TTP229 pad.
 - Arduino reads the key value (1–16) and maps it to a corresponding alphabet letter.
- Color Selection:
 - User turns the potentiometer.
 - Arduino reads analog values from A0 (or A1 if dual gang) to determine hue or brightness.

3. Feedback Phase

- Visual Feedback:
 - RGB LED lights up in the selected color.
 - OLED (if used) displays the selected letter and color name.
- Audio Feedback:
 - DFPlayer Mini plays a pre-recorded pronunciation of the selected letter or word.

4. Memory & Progress (Optional)

- EEPROM stores the last selected letter and color for continuity.
- Can be expanded to track learning progress or repeat missed letters.

5. Loop & Interaction

- System resets for next input.
- Child can continue exploring letters and colors interactively.

5.2 Hardware and software requirement

This section outlines our system's hardware and software workflows

5.2.1 Electronics

Component	Quantity	Purpose	Type
Arduino UNO R3	1	Main controller	Core
TTP229 Touch Keypad	1	Alphabet input	Core
Potentiometer (10k)	1	Color selection input	Core
DFPlayer Mini	1	Audio playback	Core
Speaker	1	Sound output	Core
RGB LED	1	Color display	Core
Micro SD card	1	Stores audio files	Core
OLED Display (0.96")	1	Visual feedback	Optional
EEPROM (built-in)	—	Saves last input	Optional
Jumper wires, resistors	—	Circuit connections	Core

5.2.1.1 Arduino Uno

- **Role:** The brain of your project.
- **Function:** Reads sensor inputs, processes logic, and controls outputs.
- **Why it fits:** Easy to program, widely supported, perfect for beginners and embedded systems.



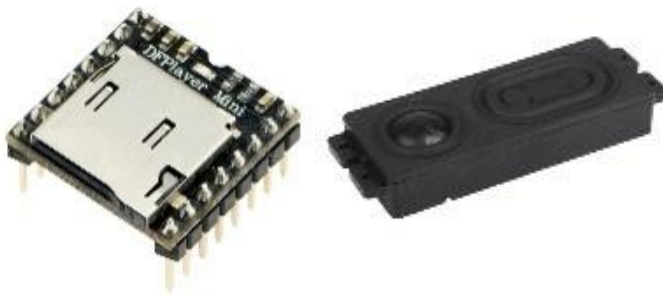
5.2.1.2 TTP229 Touch Keypad

- **Role:** Alphabet input interface.
- **Function:** Detects finger touches on 16 keys (A–P or custom).
- **Why it fits:** No moving parts, child-friendly, uses only 2 Arduino pins in serial mode.



5.2.1.3 DFPlayer Mini + Speaker

- **Role:** Audio output.
- **Function:** Plays pre-recorded sounds (e.g., “A is for Apple”) from microSD card.
- **Why it fits:** Engaging sound feedback, easy to control via Arduino serial.



5.2.1.4 OLED Display (optional)

- **Role:** Visual display.
- **Function:** Shows selected letter and color name.
- **Why it fits:** Enhances clarity and accessibility for group presentations.



5.2.1.5 Potentiometer



- **Role:** Color selector
- **Function:** Sends one analog value (0–1023) to Arduino based on knob position
- **Why it fits:** Simple, intuitive control for selecting multiple colors using just one input

5.2.1.6 RGB LED



- **Role:** Visual feedback.
- **Function:** Mixes red, green, and blue light based on potentiometer values.
- **Why it fits:** Simple, colorful output that reinforces learning.

5.2.2 Software

We will use below mentioned Software accessories for our System.

Platform

- ✚ **IDE:** Visual Studio Code with PlatformIO
- ✚ **Board:** Arduino Uno
- ✚ **Language:** C++ (Arduino framework)

Optional OLED Display

- ✚ **Library:** Adafruit_SSD1306

Memory (EEPROM){optional}

- ✚ **Purpose:** Save last selected letter and color
- ✚ **Library:** EEPROM.h

Circuit Designer IDE & Wowki

- ✚ To design the Circuit Diagram and to check Program simulation

Draw.io

- ✚ Use to design our System diagram

6.Evaluation Method

6.1 Unit Testing

Test Case	Description	How to Test	Expected Outcome
Touch keypad → DFPlayer + OLED	Verify correct letter audio and display	Touch key and observe output	Plays correct sound and shows letter
Dual Gang Potentiometer → RGB LED	Verify analog input maps to color output	Rotate knob and observe LED	Red and Green change smoothly; Blue adjusts
EEPROM (if used)	Confirm last selected color is saved	Power off/on and check LED state	LED resumes last color setting
OLED Display (optional)	Confirm color name is shown	Rotate knob and observe OLED	Displays “Red”, “Green”, etc.

- Test each module separately:
 - ✓ Touch keypad → correct letter audio + OLED display (if used)
 - ✓ Potentiometer → correct color + RGB + OLED (if used)
- Confirm EEPROM stores and retrieves last values (if used)
- Validate OLED updates correctly with each input

6.2 Feedback Collection

- Observe child interaction and ease of use
- Collect feedback from teachers on clarity and engagement
- Evaluate accessibility for children with hearing or speech challenges

7.Estimated Budget

Component	Count	Unit price	Price
Arduino Uno R3	×1	2200/=	2200 /=-
DF Player Mini	×1	600/=	600/=
32 GB Micro SD card	×1	700/=	700/=
830 pin Breadboard	×1	600/=	600/=
TTP229 Touch Keypad keyboard	×1	600/=	600
Potentiometer (10k)	×1	100/=	100/=
0.96-inch OLED Display Module	×1	800/=	800/=
RGB LED	×1	50/=	50/=
470μF Capacitor	×1	5/=	5/=
220 Ω Resistor	×2	1/=	2/=
Jumper wires	×25	200/=	200/=
Estimated Total			5855/=

8.References

- MS CO-Pilot (our Main Resource Provider)
- Chat GPT
- Circuit Diagram IDE to create circuit Diagram
- YouTube-IOT Projects
- DFPlayer Mini tutorials
- <https://www.arduino.cc/en/Tutorial/HomePage>.
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