UGV - Toycar

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Contents

***Abstract*—This project presents a method for controlling a toy car (UGV) using both Bluetooth and speech commands. The toycar is built using an ESP32 microcontroller and L293D motor driver IC to drive two DC motors. Users can control the toycar through a mobile app that provides a gamepad interface or takes voice commands. This system offers a low-cost and easy-to-build platform to study motor control, wireless communication by combining basic autonomous navigation.**

I. Introduction

Autonomous navigation has been a major area of research in robotics, with pioneering projects such as Stanley, which won the DARPA Grand Challenge [**?**], and Boss and Junior, which competed in the DARPA Urban Challenge [**?**], [**?**], demonstrating autonomous navigation in complex environments. End-to-end learning approaches, such as NVIDIA's system for self-driving cars [**?**], have further simplified navigation pipelines by mapping sensor inputs directly to control outputs. Surveys on intelligent vehicles highlight a wide variety of autonomous driving applications [**?**], and research on fully autonomous systems explores both the hardware and software required for robust navigation [**?**]. In parallel, speech-based human-robot interaction has enabled intuitive control of robots in constrained environments, including intelligent wheelchairs and mobile robots [**?**], [**?**], [**?**], and robust speech recognition datasets such as Google's Speech Commands [**?**] have accelerated development of voice-controlled systems. Inspired by these high-level projects, this work presents a scaled-down prototype using an ESP32 microcontroller and an L293D motor driver IC to build a voice-enabled toy car, integrating simple navigation with bluetooth control and speech commands for user interaction.

II. List of Components

II.1 UGV Kit - 1 set - For assembling the toycar chassis.
II.2 ESP32 - 1pc - Microcontroller used for control and wireless communication.
II.3 L293D Motor Driver IC - 1pc - For driving and controlling the DC motors.
II.4 Power Bank - 1pc - Provides portable power supply to the system.
II.5 DC Motors - 2pcs - Used for propulsion of the toy car.
II.6 Breadboard - 1pc - For making circuit connections.
II.7 Jumper Wires - 11pcs - For making electrical connections between components.
II.8 Micro-USB cable - 1pc - For connecting the ESP32 to the power bank.

III. Hardware Setup

III.1 Assemble the chassis, fix the motors and mount the wheels to build the toycar.
III.2 Fix the breadboard on the base of the toycar.
III.3 Plug the **L293D** motor driver IC in Fig. I.4 on the breadboard.

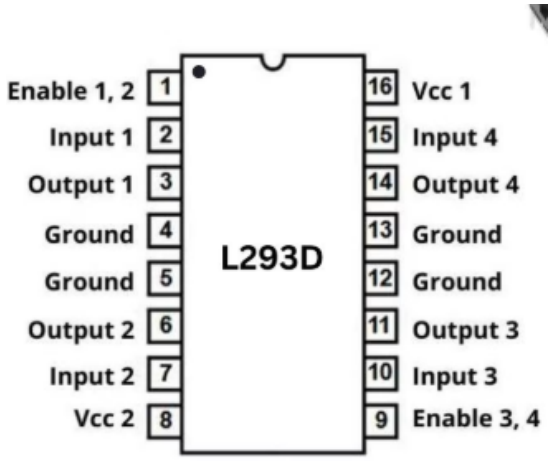

Fig. III.3. L293D Motor Driver IC

III.4 The connections between the L293D output pins and the motors (M_1, M_2) are according to Table I.5

L293D IC	3	6	11	14
Motors	M_1 (+)	M_1 (-)	M_2 (+)	M_2 (-)

TABLE III.4
L293D & Motors connections

III.5 Connect any 4 GPIO pins (**Ex**: 25, 26, 33 & 32) of **ESP32** in Fig. I.6 to L293D inputs
III.6 The connections between the ESP32 and the L293D input pins are according to Table I.7

ESP32	32	33	25	26
L293D IC	3	6	11	14

TABLE III.6
L293D & ESP32 connections

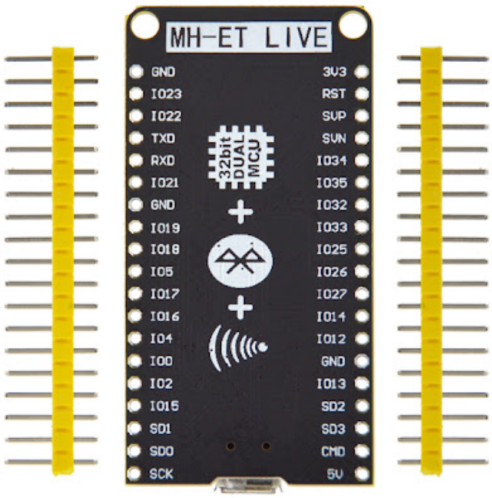

Fig. III.5. ESP 32

III.7 Connect the ground pins of the L293D IC and the ESP32 to a common ground on the breadboard.

III.8 Connect the 5V pin of the ESP32 to the VCC 1 pin of the L293D IC.

IV. Implementation

A. Dabble

IV.1 Install **Dabble** app using Google Playstore in an Android mobile.

IV.2 Upload the following code to the ESP32 using any IDE.

wget https://github.com/Satyanarayana-123456/UGV_toycar/blob/main/codes/dabble_gamepad.cpp

IV.3 After uploading the above code, plug the ESP32 to a power bank via a micro-USB cable.

IV.4 Open the Dabble app and connect to the ESP32 via bluetooth. The app interface looks like Fig. II.4

IV.5 Now use the **Gamepad** of the app in Fig. II.5 to control the toycar.

IV.6 Operate the left-side control buttons labeled *Forward, Back, Left & Right* to give the respective commands.

B. Arduino Bluetooth Controller

IV.7 Install **Arduino Bluetooth Controller** app using Google Playstore in an Android mobile.

IV.8 Upload the following code to the ESP32 using any IDE.

wget https://github.com/Satyanarayana-123456/UGV_toycar/blob/main/codes/ABC_voice.cpp

IV.9 After uploading the above code, plug the ESP32 to a power bank via a micro-USB cable.

IV.10 Open the Arduino Bluetoth Controller app and connect to the ESP32 via bluetooth. The app interface looks like Fig. II.10

IV.11 Now use the **Voice Control** section of the app to control the toycar.

IV.12 The commands which the voice control takes are *Left, Right, Forward, Back & Stop*.

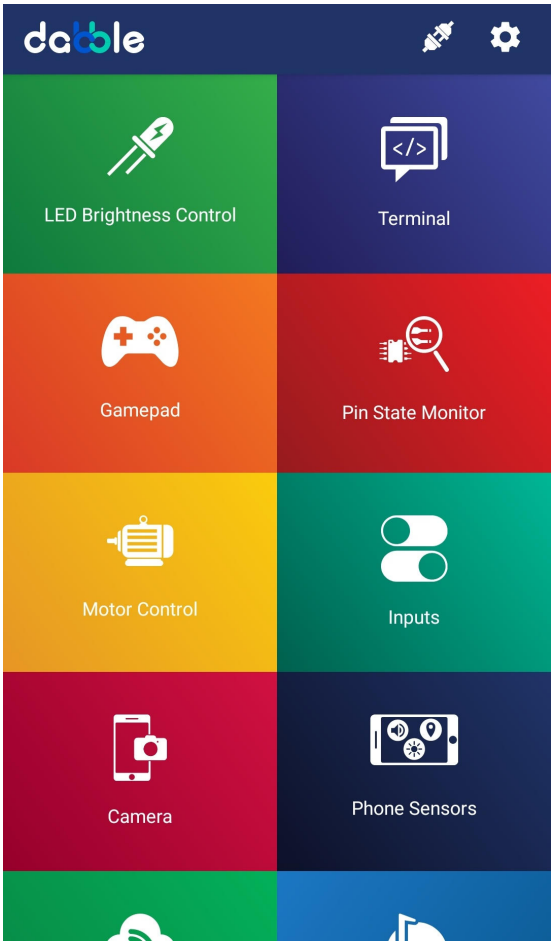

Fig. IV.4. Dabble Interface

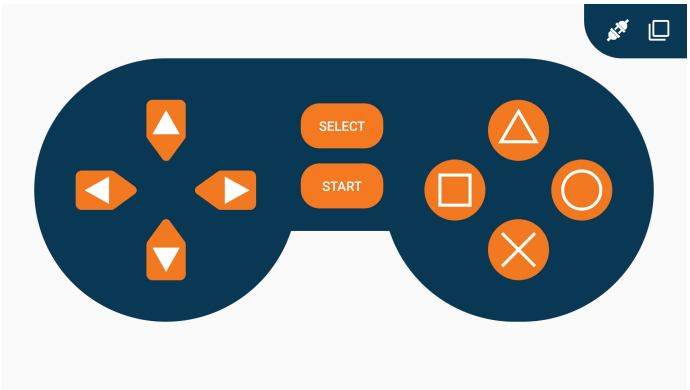

Fig. IV.5. Gamepad in Dabble App

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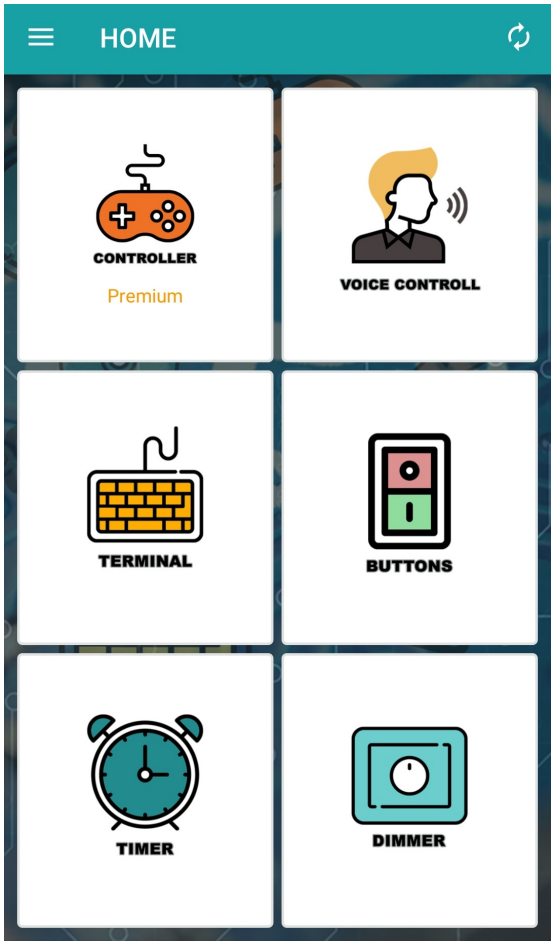

Fig. IV.10. Arduino Bueetoth Controller Interface

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