Advanced Driver-Assistance Systems

SW252 - Course Project – Phase 1

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A. Component List

1. Arduino Uno Rev3 with CH340 Uploader
2. Bluetooth Module HC-05 3. L298 Motor Driver Module
4. DC Geared Motor Dual Shaft 3:6VDC 450 rpm with Wheel (D: 65mm X W: 26mm)
5. HC-SR04 Ultrasonic Wave Detector Sensor 3.3V~5V
6. 4 Li-ion Battery 3.7V Rechargeable (Recycled) 18650-1200mAh
7. Photo-resistor LDR Light Sensor Module
8. Character LCD 2x16 Blue with Soldering Serial interface IIC/I2C Module
9. Red LED 5mm
10. Green LED 5mm

B. System architecture schematic

Connections Overview

1. Bluetooth Communication
   - HC-05 TX → Arduino Pin 10
   - HC-05 RX → Arduino Pin 11
   - Used to receive:
     - Movement commands (F, B, L, R, S)
     - Speed levels (0–9, q)
2. Motor Control (L298 Module)
   - ENA (PWM speed control) → Arduino Pin 3
   - ENB (PWM speed control) → Arduino Pin 9
   - IN1 → Arduino Pin 5
   - IN2 → Arduino Pin 4
   - IN3 → Arduino Pin 7
   - IN4 → Arduino Pin 6

These pins control:

- Forward / backward movement
- Left / right turning
- Smooth acceleration and deceleration using PWM

3. Ultrasonic Sensor (HC-SR04)
   - Trig → Arduino Pin 12

- Echo → Arduino Pin 8

Used to:

- Measure distance to obstacles
- Calculate Time-To-Collision (TTC)
- Reduce speed automatically when unsafe

4. Light Detection System

- LDR Output → Arduino A0
- Headlight LED → Arduino Pin 2

If ambient light is low, headlights turn ON automatically.

5. LCD Display (I2C)

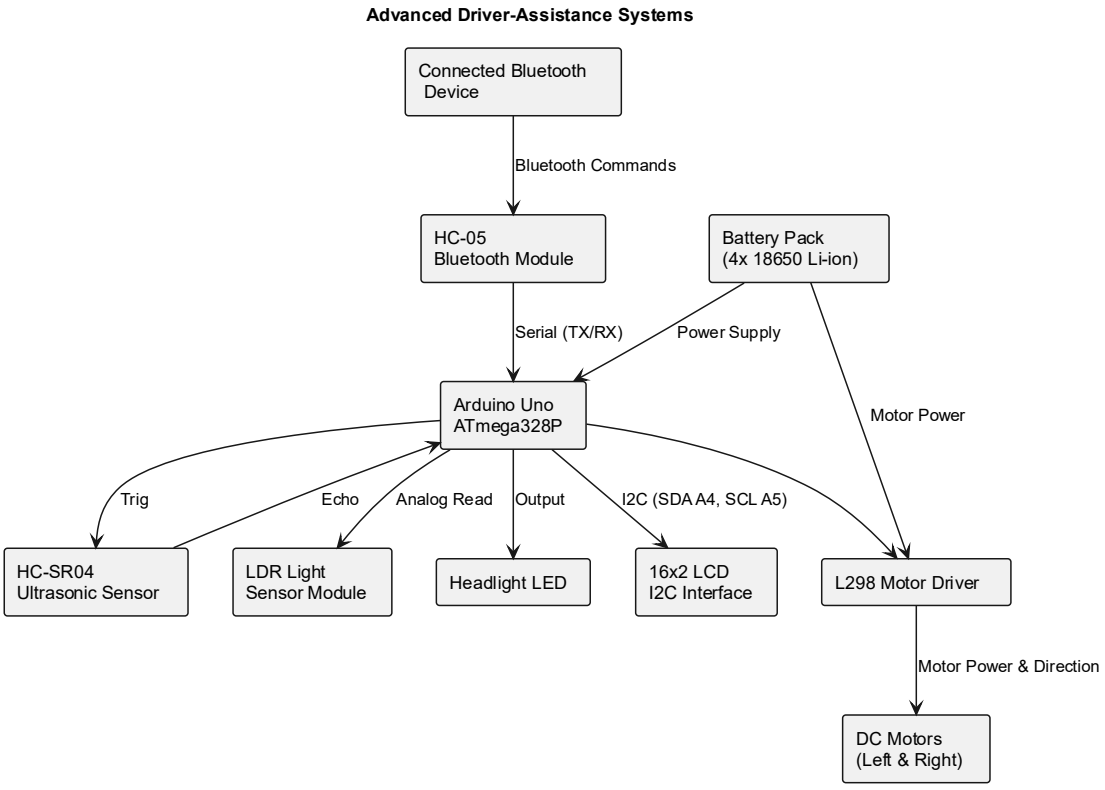
- SDA → Arduino A4
- SCL → Arduino A5

Displays:

- Speed value
- Light status
- Obstacle safety state

6. Power Supply

- 4× Li-ion batteries
- Motor driver powered directly
- Arduino powered through regulated input



C. Program Modules with Comments

1. Initialization Module (setup())
    - Initialize serial communication
    - Initialize Bluetooth
    - Initialize LCD
    - Configure all I/O pins
    - Display startup message

2. Main Control Loop (loop())
    - Continuously read inputs
    - Apply safety logic
    - Control motors
    - Update display

3. Bluetooth Command Processing
    - Maps Bluetooth characters (0–9, q) to PWM speed values
    - Updates target motor speed

4. Ultrasonic Distance & Safety Module
    - Measure obstacle distance
    - Calculate Time To Collision (TTC)
    - Reduce speed automatically when TTC is unsafe
5. Speed Control Module (Smooth Acceleration)
    - Gradually adjust motor speed
    - Prevent sudden acceleration or braking
    - Uses PWM on ENA and ENB pins

6. Movement Control Module

Command	Action
F	Move forward
B	Move backward
L	Turn left
R	Turn right
S / default	Stop

Motor Direction Logic:
Implemented using IN1–IN4 pin combinations.

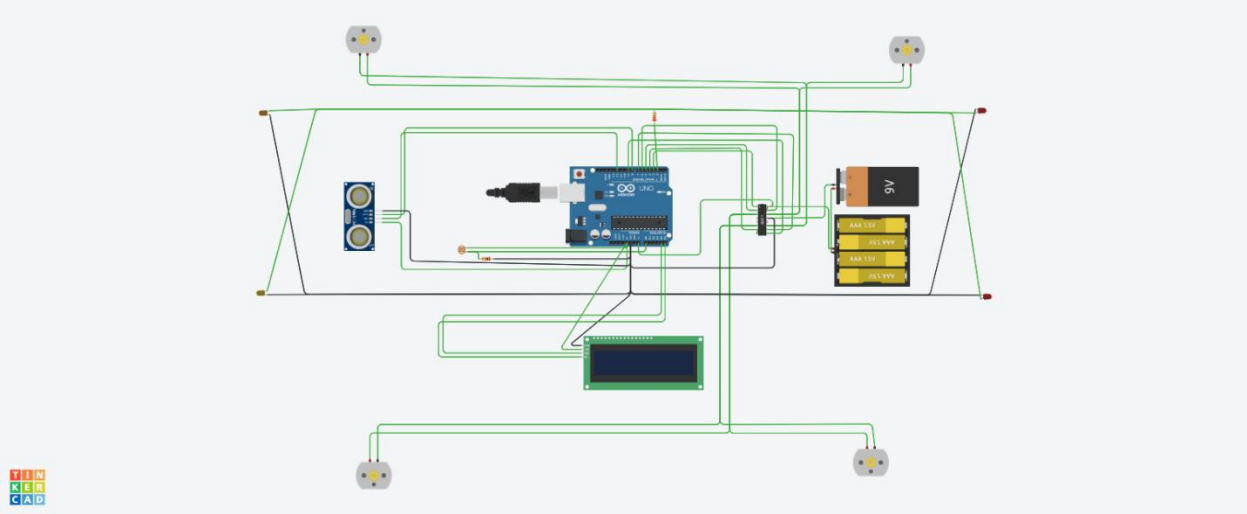
7. LDR

- Detect surrounding light
- Turn headlights ON/OFF automatically

8. LCD Display Module

Displays:

- Speed
- Light status (ON/OFF)
- Safety state (SAFE / OBSTACLE)



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