Obstacle-Avoiding Robot Car Using STM32F072B-DISCO – One-Page Proposal

1. Problem Definition

Autonomous navigation is essential in indoor environments such as malls, factories, and storage areas. Manually controlled robots are inefficient and prone to collisions. A compact robot that can detect obstacles and react immediately improves safety and reliability. This project aims to build an embedded system–based robot that can move independently, sense its surroundings, and avoid obstacles without human intervention.

2. Objectives

- Develop a fully autonomous robot car using the STM32F072B-DISCO board.
- Measure distance with the HC-SR04 ultrasonic sensor and detect obstacles in real time.
- Control motor direction and speed using GPIO and PWM at register level.
- Use an LDR as an ADC input to adjust motor speed based on ambient light.
- Send real-time debug data wirelessly through an HC-06 Bluetooth module.

3. System Overview

The robot uses the STM32F072RBT6 microcontroller as its core controller. The HC-SR04 sensor provides distance information: a TRIG pulse is generated on PA1, and the returning ECHO signal is captured through TIM2 Input Capture on PA2. According to the measured distance, the robot moves forward or performs avoidance maneuvers such as reversing and turning.

Motor direction is set using PB0 and PB1, while motor speed is controlled through PWM output on PA8 (TIM1 CH1). An LDR connected to PA4 (ADC_IN4) provides variable speed control depending on environmental light. Wireless communication is achieved through UART pins PA9 and PA10, enabling the HC-06 Bluetooth module to transmit distance values and robot state to a PC or smartphone. All peripherals are programmed at the register level for low-level understanding and precise timing.

4. Expected Results

- Smooth forward movement with automatic direction changes when obstacles are detected.
- Accurate distance measurement using input capture.
- Stable motor control using PWM and dynamic speed adjustment via ADC.
- Wireless monitoring of distance, movement decisions, and speed.
- A complete demonstration of sensor processing, decision making, and actuation on an embedded platform.