

Design document

Project title: Moving car system design

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- *Description*

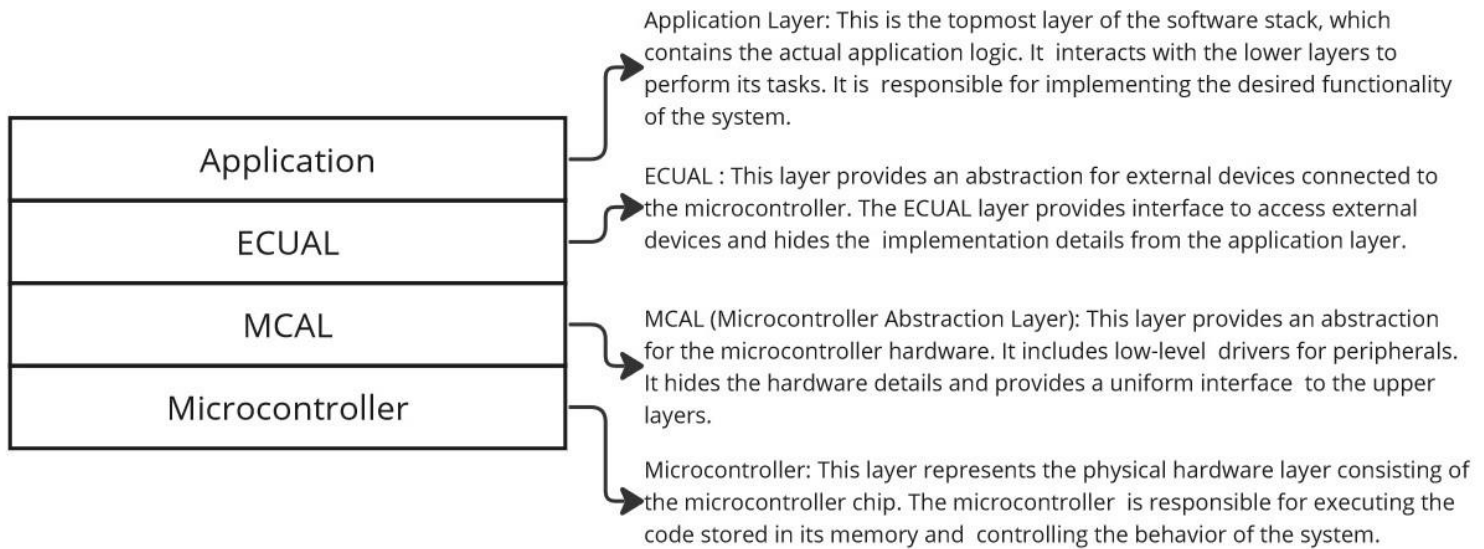
1. **Car Components:**

1. **Four** motors (**M1, M2, M3, M4**)
2. **One** button to start (**PB1**)
3. **One** button for stop (**PB2**)
4. **Four** LEDs (**LED1, LED2, LED3, LED4**)

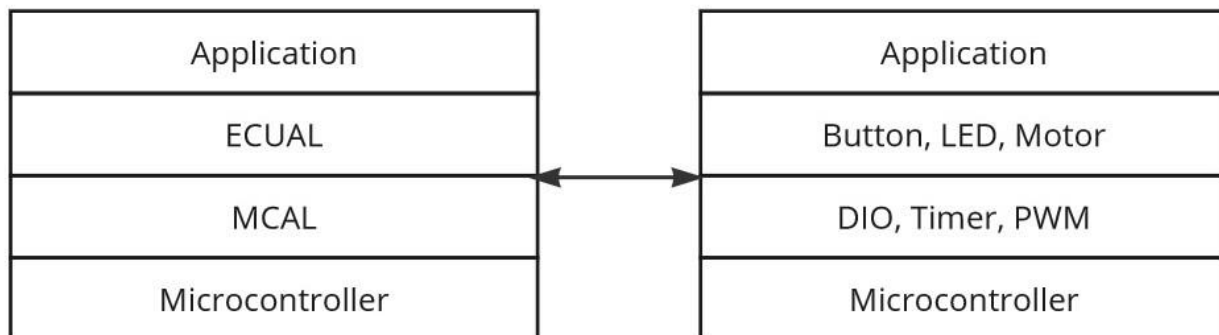
2. **System Requirements:**

1. The car **starts initially** from **0 speed**
2. When **PB1** is **pressed**, the car will **move forward after 1 second**
3. The car will move forward to **create the longest side of the rectangle for 3 seconds with 50% of its maximum speed**
4. After finishing the first longest side the car will **stop for 0.5 seconds, rotate 90 degrees to the right, and stop for 0.5 second**
5. The car will move to **create the short side of the rectangle at 30% of its speed for 2 seconds**
6. After finishing the shortest side the car will stop for **0.5 seconds, rotate 90 degrees to the right, and stop for 0.5 second**
7. Steps **3 to 6** will be **repeated infinitely** until you press the **stop button (PB2)**
8. **PB2** acts as a **sudden break**, and it has the highest priority.

Layered architecture:



system modules/drivers



- Button module will use DIO module to detect its state
- LED module will use DIO module to detect its state
- Motor module will use PWM module to control its speed
- DIO module provides low-level hardware access to the microcontroller
- Timer module can be used by both the PWM module and the Application layer to implement timing functions.
- PWM module can be used by Motor module to control its speed

Program APIs:

//DIO.h

```
EN_return DIO_init (EN_ports port, EN_pins pin, EN_direction direction);
EN_return DIO_write (EN_ports port, EN_pins pin, EN_state state);
EN_return DIO_read (EN_ports port, EN_pins pin, uint8_t* value);
```

//LED.h

```
EN_return LED_init (EN_ports port, EN_pins pin);
EN_return LED_on (EN_ports port, EN_pins pin);
EN_return LED_off (EN_ports port, EN_pins pin);
```

//button.h

```
EN_return button_init(EN_ports port, EN_pins pin);
EN_return button_read(EN_ports port, EN_pins pin, EN_state* state);
```

//interrupt.h

```
EN_int__error_t EXI_Enable (EN_int_t Interrupt);
EN_int__error_t EXI_Disable (EN_int_t Interrupt);
EN_int__error_t EXI_Trigger(EN_int_t Interrupt, EN_trig trigger);
void EXI_SetCallBack(EN_int_t Interrupt, void(*ptrf)(void));
```

//pwm.h

```
EN_return PWM_init(EN_ports port, EN_pins pin);
EN_return PWM_set_duty_cycle(EN_ports port, EN_pins pin, uint8_t duty_cycle);
EN_return timer_init();
```

//timer.h

```
void timer_start();
void timer_stop();
uint32_t timer_get_elapsed_time();
EN_return motor_init();
```

//Motor.h

```
void motor_set_state(EN_motor_state state);
void motor_move_forward(uint8_t speed);
void motor_move_backward(uint8_t speed);
void motor_turn_left(uint8_t speed);
void motor_turn_right(uint8_t speed);
```

//program.h

```
void APP_init();
void APP_start();
```