Special assignment

BLUETOOTH – CONTROLLED CAR USING 8051 MICROCONTROLLER

Project report

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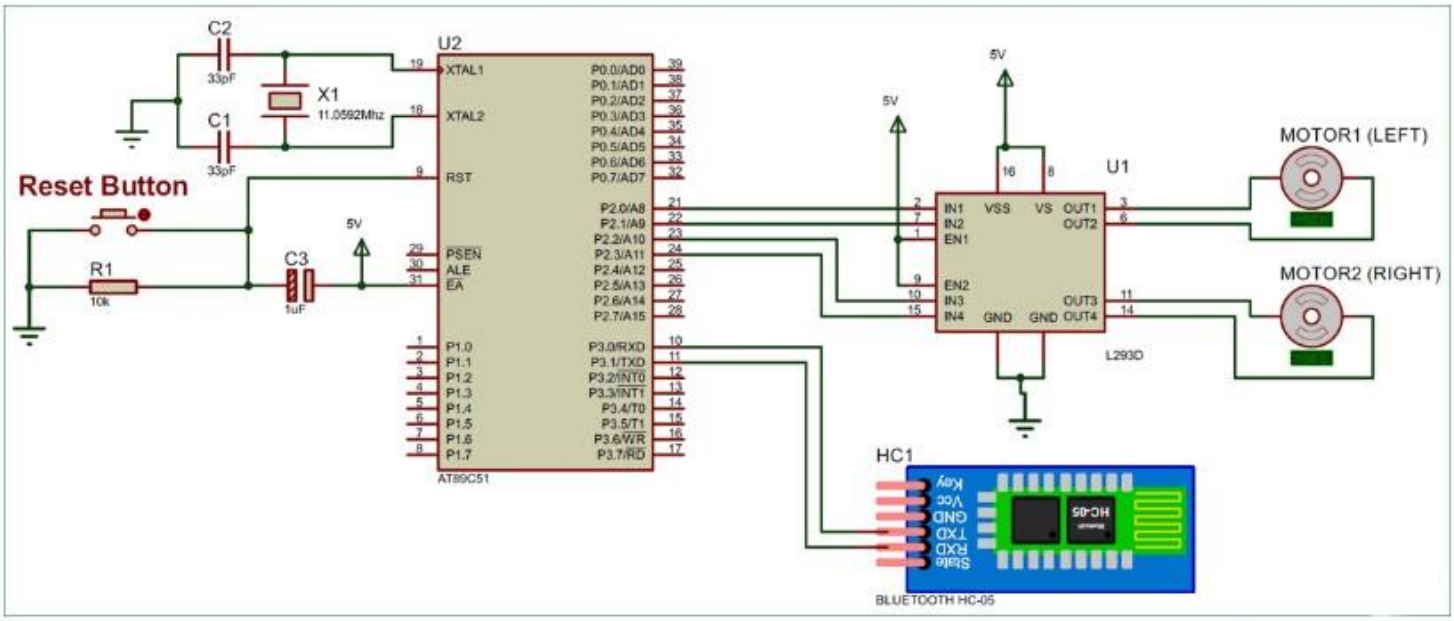
INTRODUCTION:

Remote control is an exciting modus operandi of machinery in the realm of robotics. In this project, we venture into the exhilarating universe of Bluetooth technology, with a Bluetooth-enabled car controlled from a smartphone or any other device that supports Bluetooth technology.

An 8051 microcontroller will be used to control the car using commands received from Bluetooth module HC-05. Using this project, you will connect the 8051 to the Bluetooth module and exchange messages wirelessly between the car and the controller.

This project helps us understand the working of 8051 microcontroller, HC-05 bluetooth module, motor driver and interfacing between them.

CIRCUIT DIAGRAM:



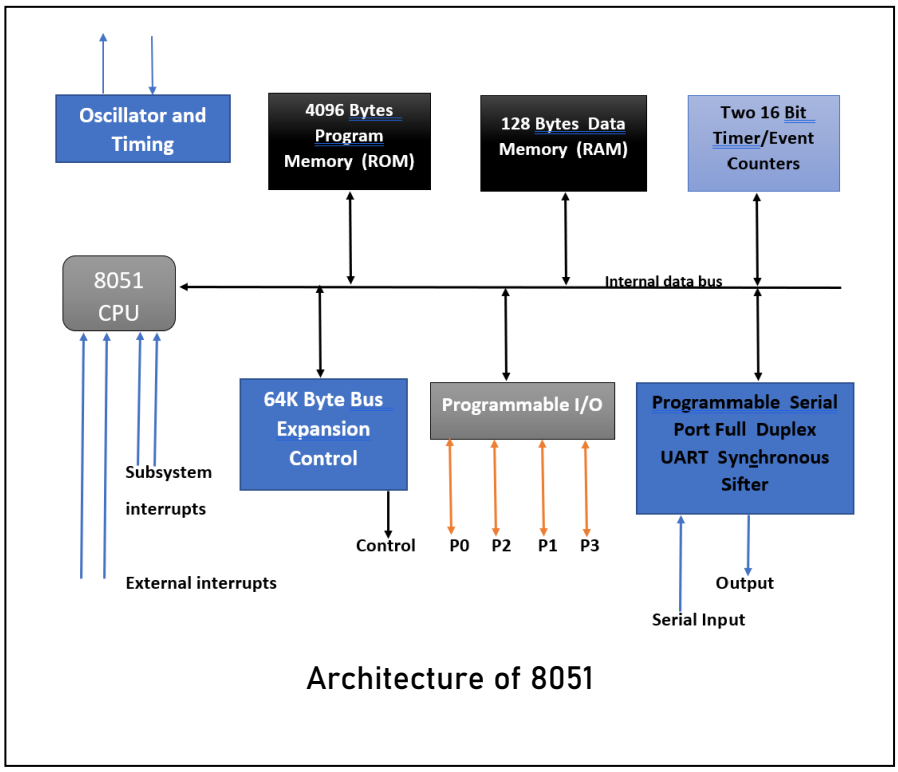
COMPONENTS USED:

1. Microcontroller 8051 (AT89C51)

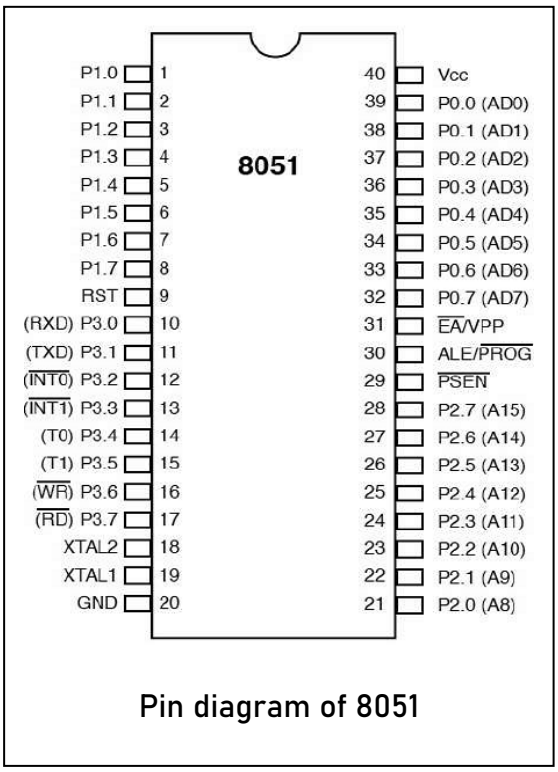
8051 is a 8-bit microcontroller. The Key features of the 8051 Microcontroller –

- 4 KB on-chip ROM (Program memory).
- 128 bytes on-chip RAM (Data memory).
- The 8-bit data bus (bidirectional).
- 16-bit address bus (unidirectional).
- Two 16-bit timers.
- Instruction cycle of 1 microsecond with 12 MHz crystal.
- Four 8-bit input/output ports.
- 128 user-defined flags.
- Four register banks of 8 bit each.
- 16-byte bit-addressable RAM.

- The general purpose registers are 32 each is 8-bit.
- 8051 has two external and three internal interrupts.
- 8051 microcontroller specifies some special function features like UARTs, ADC, Op-amp, etc.
- It has a 16-bit program counter and data pointer.



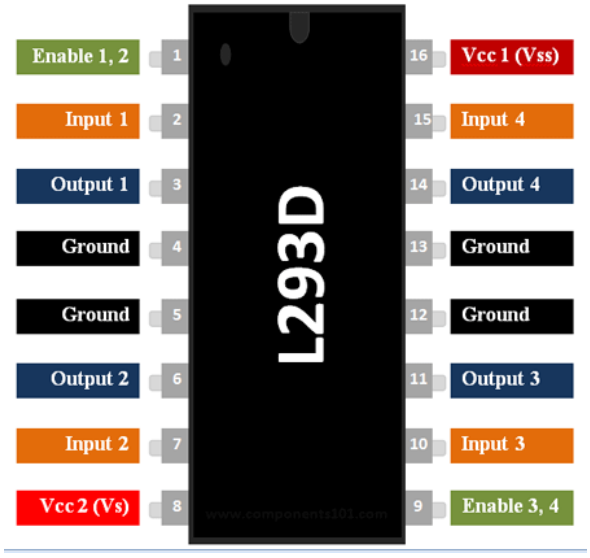
Architecture of 8051



Pin diagram of 8051

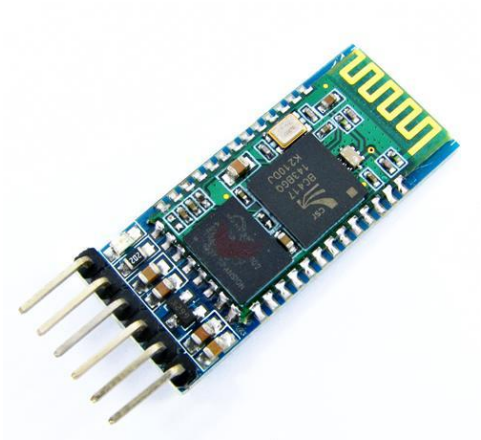
2. Motor driver (L293D)

The motor needs a large amount of current, while the controller circuit produces a low-current signal. Therefore, the role of the motor drivers is to accept low current control signal and then process it into a high current signal that is capable of driving a motor. The motor driver function is to conduct the task of taking electrical energy from an electrical source and then supply electrical energy to the motor, in such a way that the required mechanical output is accomplished. Usually, this is the motor's speed, the torque, and the motor shaft's position.



3. Bluetooth Module (HC-05)

HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration.



Bluetooth serial modules allow all serial enabled devices to communicate with each other using Bluetooth.

It has 6 pins,

1. Key/EN: It is used to bring Bluetooth module in AT commands mode. If Key/EN pin is set to high, then this module will work in command mode. Otherwise by default it is in data mode. The default baud rate of HC-05 in command mode is 38400bps and 9600 in data mode.

HC-05 module has two modes,

1. Data mode: Exchange of data between devices.

2. Command mode: It uses AT commands which are used to change setting of HC-05. To send these commands to module serial (USART) port is used.

2. VCC: Connect 5 V or 3.3 V to this Pin.

3. GND: Ground Pin of module.

4. TXD: Transmit Serial data (wirelessly received data by Bluetooth module transmitted out serially on TXD pin)

5. RXD: Receive data serially (received data will be transmitted wirelessly by Bluetooth module).

6. State: It tells whether module is connected or not.

4. Crystal Oscillator (11.0592 MHz)

It is used to provide clock of frequency 11.0592MHz to the 8051 microcontroller.

5. DC Motors

It takes electrical energy (i.e. direct current) to produce mechanical energy.

6. Wheels: (for car)

WORKING:

- Connect HC-05 and motor driver to 8051 according to the circuit diagram.
- According to the direction, we want to move the car, we have to set and reset output pins of 8051 connected to input of motor driver.

Instruction received	Motor 1	Motor 2	Status of car
F	Forward	Forward	Moves forward
B	Backward	Backward	Moves backward
R	Forward	Backward	Moves right
L	Backward	Forward	Moves left
S	off	off	Stopped

- These characters are transmitted from the Bluetooth module, HC-05, which is by default in slave mode, received by 8051, and accordingly forwarded to motor driver.

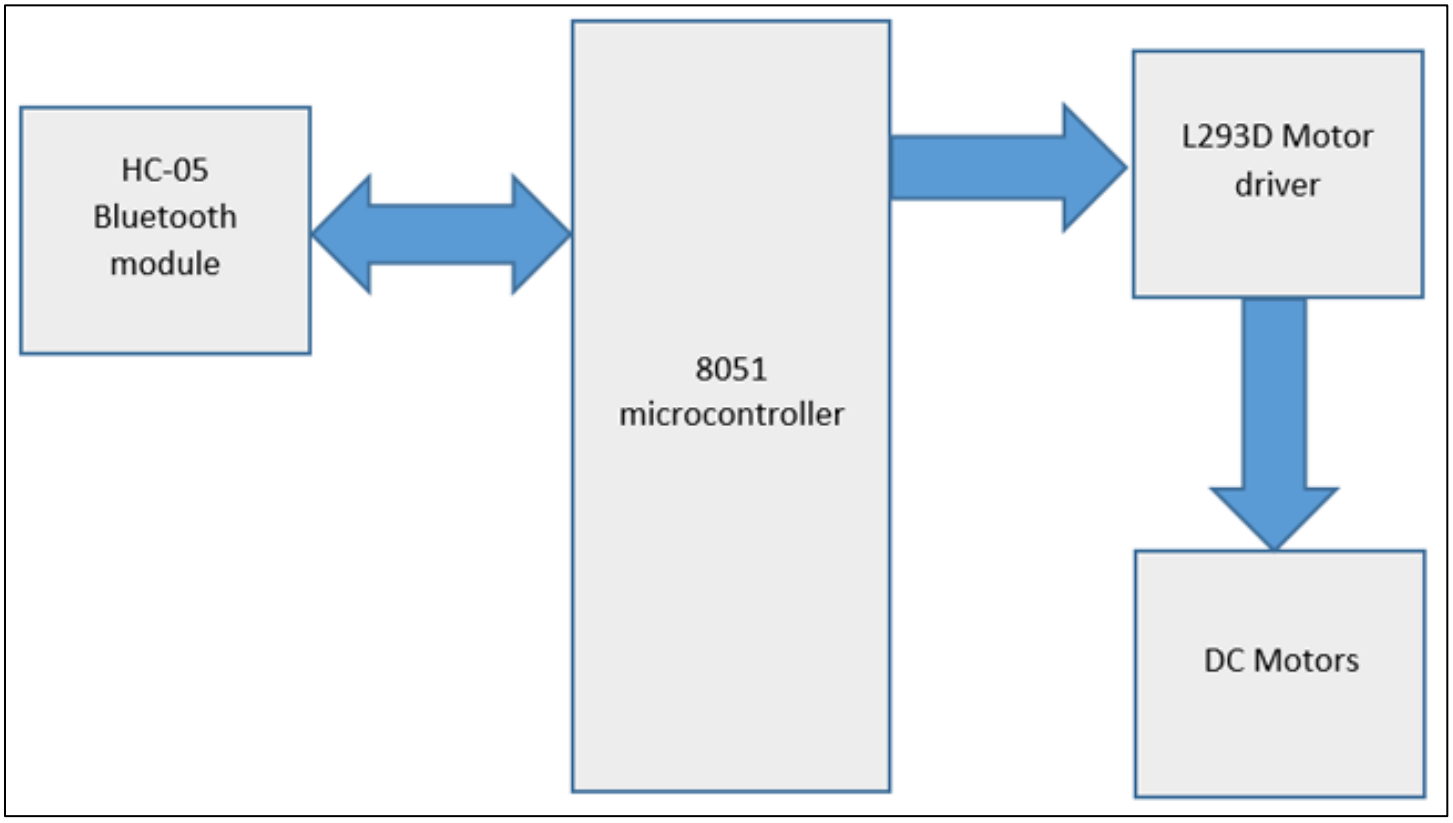
NOTE: The Bluetooth terminal application has to be installed in your smartphone, through which the instructions are given. (Find the link of the application at the end of the document.)

CODE:

```
#include <reg51.h>     // Include 8051 header file (to specify values of )

sbit IN1 = P2^0;         // Motor 1 control pin 1 (L293D)
sbit IN2 = P2^1;         // Motor 1 control pin 2 (L293D)
sbit IN3 = P2^2;         // Motor 2 control pin 1 (L293D)
sbit IN4 = P2^3;         // Motor 2 control pin 2 (L293D)

unsigned char ch;        // Variable to store received Bluetooth character

void delay(unsigned int ms) {
    unsigned int i, j;
    for (i = 0; i < ms; i++) {
        for (j = 0; j < 1000; j++); // a single loop generates 1ms delay
    }
}

void motor_forward() {
    IN1 = 1;
    IN2 = 0;
    IN3 = 1;
    IN4 = 0;
}

void motor_backward() {
    IN1 = 0;
    IN2 = 1;
    IN3 = 0;
    IN4 = 1;
}

void motor_left() {
    motor_forward();  // Move forward to initiate turn
    delay(200);        // Short delay to start turn
    IN3 = 0;            // Stop right motor
}

void motor_right() {
    motor_forward();  // Move forward to initiate turn
    delay(200);        // Short delay to start turn
    IN1 = 0;            // Stop left motor
}

void motor_stop() {
    IN1 = 0;
    IN2 = 0;
    IN3 = 0;
    IN4 = 0;
}

void bluetooth_init() {
    // Set values of special function registers required for bluetooth communication
    SCON = 0x50;       // Serial mode 1,  REN=1
    TH1 = 0xFD;        // Set baud rate at 9600 (to adjust with bluetooth module hc-05)
    TMOD = 0x20;
    TR1 = 1;           // Enable serial communication
}
```

```
57
58  void main() {
59      bluetooth_init();  // Initialize Bluetooth module
60
61      while (1) {
62          ch = SBUF;        // Read received character
63          switch (ch) {
64              case 'F':
65                  motor_forward();
66                  break;
67              case 'B':
68                  motor_backward();
69                  break;
70              case 'L':
71                  motor_left();
72                  break;
73              case 'R':
74                  motor_right();
75                  break;
76              case 'S':
77              default:
78                  motor_stop();
79                  break;
80          }
81      }
82  }
```

BLOCK DIAGRAM:



BILL OF MATERIALS:

Name of component	Quantity	Price
AT89C51 IC	1	Rs. 75/-
L293D	1	Rs. 65/-
HC-05 module	1	Rs. 295/-
Crystal oscillator (11.0592MHz)	1	Rs. 15/-
DC motor	2	Rs. 200/-
Wheels	2	Rs. 70/-
		TOTAL: Rs. 720/-

APPLICATIONS:

- Making a Bluetooth controlled car with an 8051 can be a great way to learn embedded systems design safely. This project can help you to get familiar with microcontroller programming, interfacing with electronic components such as Bluetooth modules and motor drivers, and basic control systems.
- Moreover, a Bluetooth car may pave the way for more sophisticated robotics projects. You can add features like obstacle detection with sensors, alter its design, or test different control interfaces, such as a joystick or even your voice.
- If you attach line sensors to the car and alter the program to follow a path, you will obtain a line follower robot. The robot can navigate along a black line drawn on a white surface. Instead, one may add other features to build a maze-solving robot.

CONCLUSION:

In conclusion, this project has effectively designed and implemented a Bluetooth controlled car using an 8051 microcontroller. The car is wirelessly controlled through Bluetooth communication from a smartphone through the Bluetooth module on board. The coded 8051 successfully decodes the received commands and responds by controlling the car's movement.

Moreover, this project lays a path for future improvement. Potentially, additional features could be added to enable the robot to follow a line or solve a maze. Autonomous obstacle detection sensor implementation could also be accommodated. Other control interfaces, such as joysticks or even voice command, could be investigated. The scope for the expansion of this project is virtually limitless, making it a great learning opportunity and a building block for more complex robotics projects in the future.

REFERENCES:

1. Circuit Digest- Android controlled robot using 8051 microcontroller. https://circuitdigest.com/microcontroller-projects/bluetooth-controlled-robot-using-8051
2. AT89C51 datasheet
3. L293D datasheet
4. The 8051 Microcontroller and Embedded systems – Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay

PFA: Link for Bluetooth terminal application

https://play.google.com/store/apps/details?id=de.kai_morich.serial_bluetooth_terminal