WIRELESSLY OPERATED ROBOT USING BLUETOOTH MODULE AND ARDUINO

A prototype for Racing and obstacle avoidance robot

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Abstract: ***This paper describes about a wirelessly operated robot using HC-05 Bluetooth module as Slave and Arduino mega Microcontroller as Master. The Bluetooth module serially communicates to mobile of user via Bluetooth V2.0+EDR (Enhanced Data Rate). The data from user to module is then passed to and processed by the Arduino microcontroller. The command for movement is then passed to H-bridge motor controller made of relay. The robot thus moves according to the command of the user.***

Index Terms: Arduino, HC-05,Bluetooth, Serial Communication

I. INTRODUCTION:

A wirelessly operated mobile robot is an electronic device that accepts the command of user and performs actions accordingly. The main goal to be reached is a successful "wireless" communication between user and the robot and this can be achieved by various methods

- Via Bluetooth technology
- Via IR remote
- Via wi-fi technology
- Via Hand gesture
- Via voice (using voice assistants)

In this Project Bluetooth technology is taken in use to serially communicate between User and robot. The user, through his mobile/Bluetooth remote sends command to HC-05 module[4], which collects it and passes it to the microcontroller. The microcontroller further processes command and do the specific action (as per the code). The navigation of the robot is thus controlled manually. For this project ARDUINO MEGA 2560 REV3 has been used[3].

II. PURPOSE:

The purpose behind this project is to successfully create a working Wireless robot that accepts and follows the command of user via Bluetooth. The robot is completely controlled using mobile application compatible with HC-05. Using commands with H-bridge the robot can perform following motions[1]:

- Forward
- Backward
- Left
- Right
- Clockwise Rotation
- Anti-clockwise Rotation
- Stop

III. Background:

3.1 About ARDUINO MEGA 2560 REV3:

The **Arduino Mega 2560(**fig.1) is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started(fig.2). The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila[3].

figure 1: Arduino mega 2560

Microcontroller	ATmega2560
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz
LED_BUILTIN	13
Length	101.52 mm
Width	53.3 mm
Weight	37 g

figure 2: Technical details of Arduino Mega 2560

3.2 Interfacing Bluetooth Module with Arduino

figure 3: HC-05 Bluetooh Module

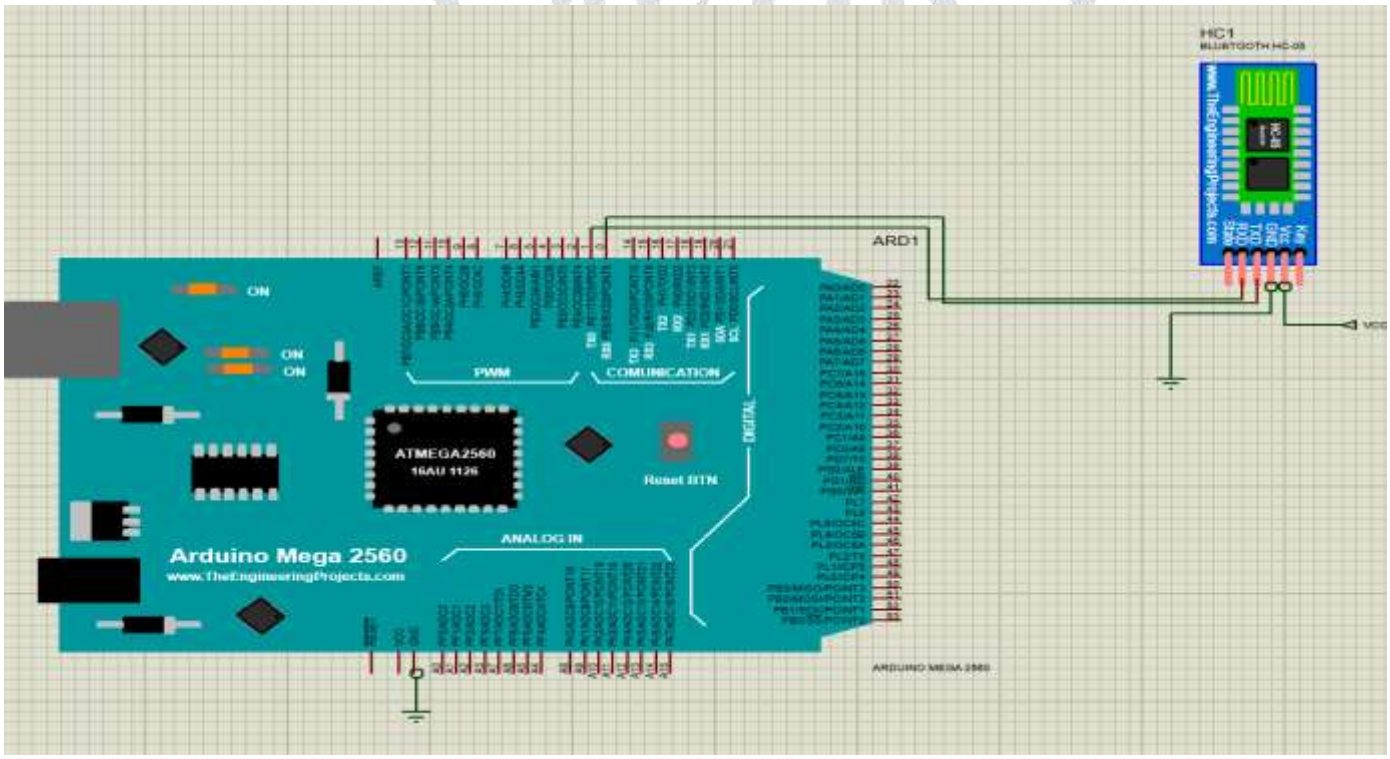

figure 4: Bluetooth module HC05 and its interfacing with Arduino mega

Bluetooth Module has 6 (male) pins(fig.3) namely:

- Enable pin (EN)
- Voltage input Power pin (VCC)
- Ground pin (GND)
- Transfer Data pin (TXD)
- Receive Data pin (RXD)
- State pin (STATE)

A Bluetooth module can either be connected directly or with Resistors (330 Ohm) to Arduino Board. The sensor has to be given input voltage of 3.3V to 5 V. The TXD and RXD of sensor are connected to RX0 and TX0 of Arduino board respectively(fig.4),after code has been uploaded to the board. As soon as the module is connected to the Arduino, it starts blinking at a large frequency and will slow down once its connected to a Bluetooth network[2][4].

3.3 Latency Phenomenon

In this project there are chances of Latency, Latency is the time wasted in giving command, collecting command, analysing and processing time. Once the robot is in motion it also includes the reaction time of the user. Latency can be avoided or reduced by adjusting delay time in the code. Latency is sometime beneficial to move robot perfectly as it provides user some time to think. Latency is preferably in milli to micro seconds.

3.4 Proposed method of Mobility of the Robot

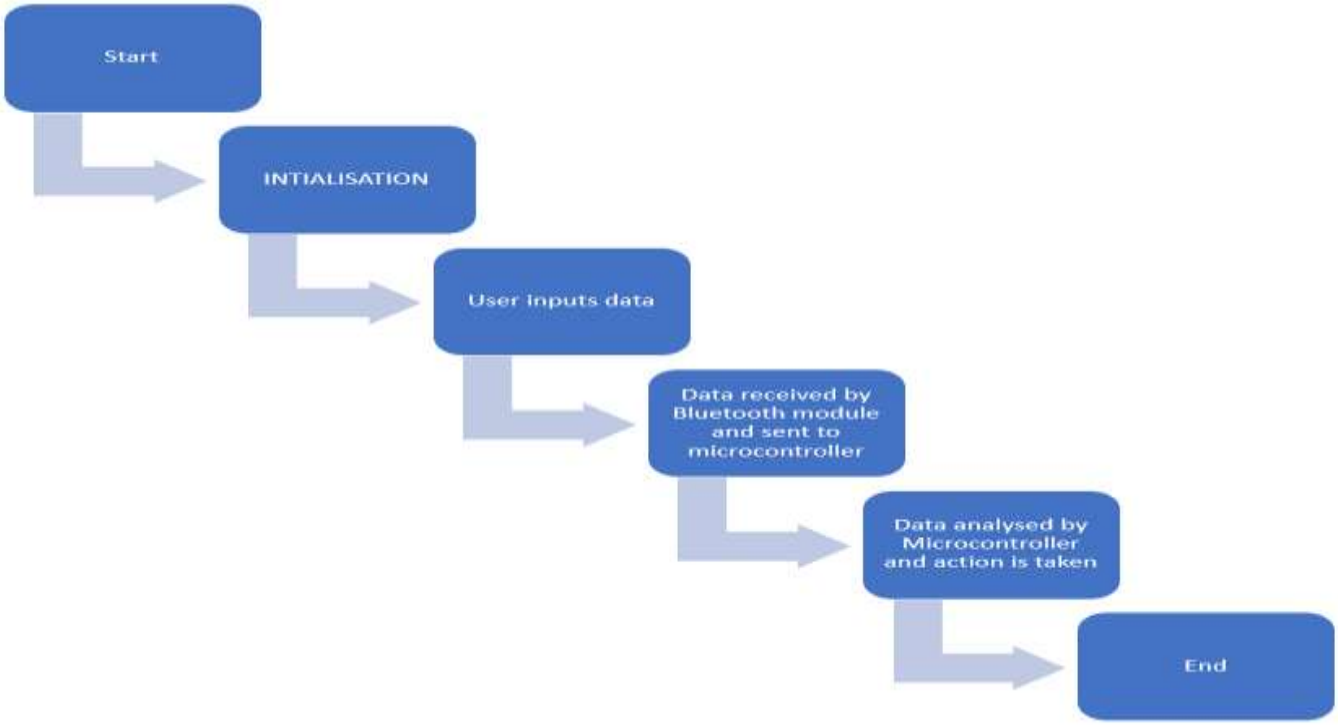

figure 5: Working process of Robot

The user sends data to Bluetooth module Serially via Bluetooth. The data sent is preferably in form of character (char) or string (string). This data is then sent to Arduino Board through Serial Communication, Arduino Board analyse the data and matches it with code commands and performs the action suggested by user. If there is Some message to be displayed, it is displayed in Serial Monitor(fig.5). Additionally (using a USB type A 2.0 to USB type B printer wire), The same robot can be controlled using Serial communicator of Arduino IDE using PC or mobile (using microUSB /USB type C). In this project the action to be taken is to turn switch of Relay HIGH (1), or LOW (2). The Relay H-bridge then turns specific motor on/off in specific direction of rotation.

3.4 Relay

A relay is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current. The heart of a relay is an electromagnet (a coil of wire that becomes a temporary magnet when electricity flows through it)[5].

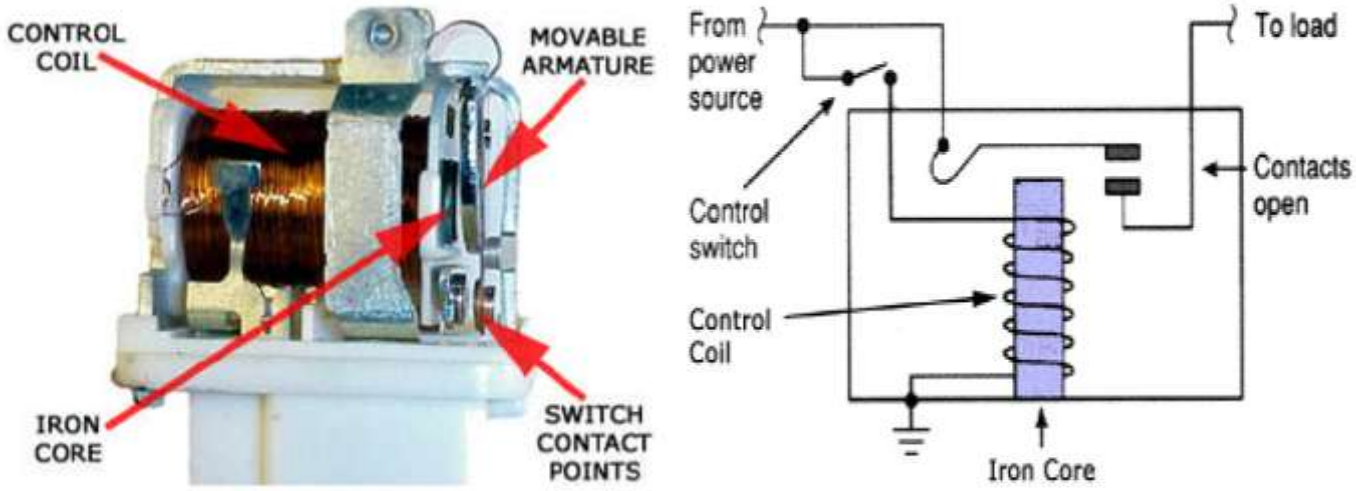

figure 6 & 7: Internal structure and Circuit Diagram of Relay

The fig. 6 & 7 shows an inner section of a relay. An iron core is surrounded by a control coil. As shown, the power source is given to the electromagnet through a control switch and through contacts to the load. When current starts flowing through the control coil, the electromagnet starts energizing and thus intensifies the magnetic field. Thus, the upper contact arm starts to be attracted to the lower fixed

arm and thus closes the contacts causing a short circuit for the power to the load. On the other hand, if the relay was already de-energized when the contacts were closed, then the contact move oppositely and make an open circuit.
As soon as the coil current is off, the movable armature will be returned by a force back to its initial position. This force will be almost equal to half the strength of the magnetic force. This force is mainly provided by two factors that are the spring potential energy and gravity.
In this project we have used 4 SPDT 5V relay to control 12 V from a rechargeable Li-po battery[5].

3.6 H-Bridge using relay

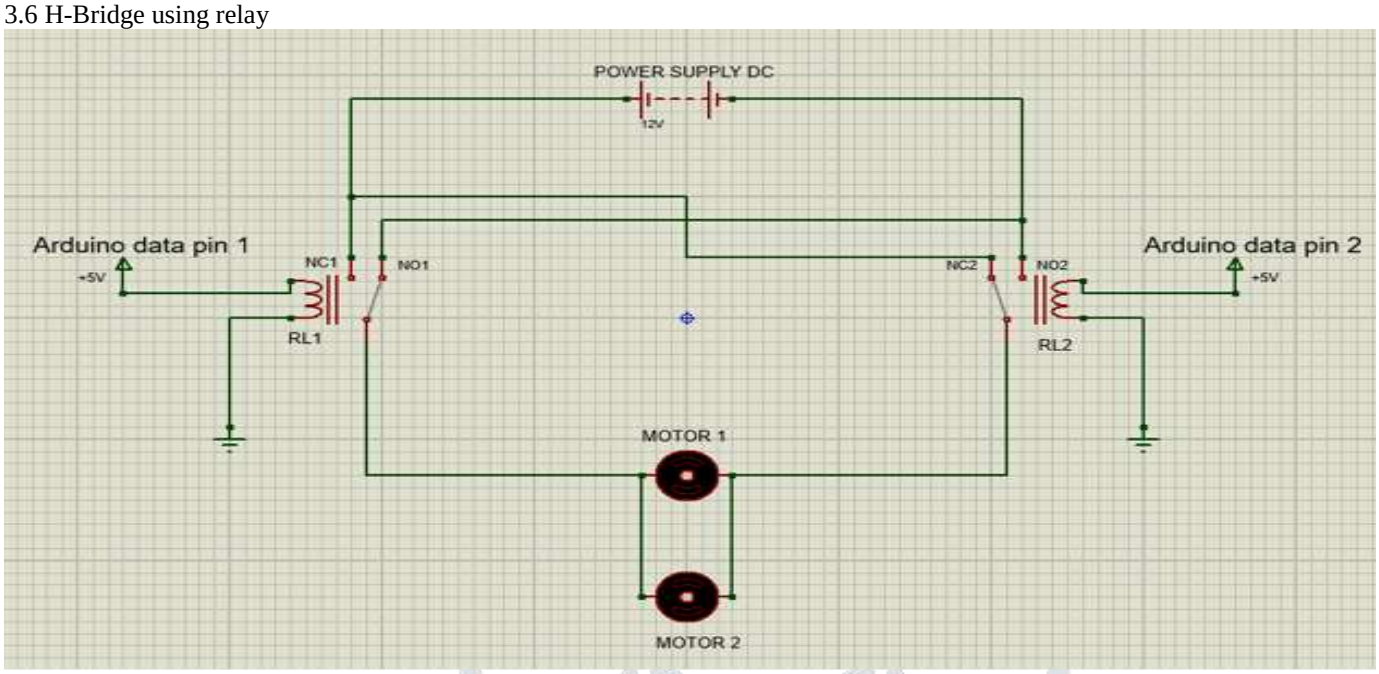

figure 8: One H-bridge construction using 2 relay to control two motors on the same side connected in parellel

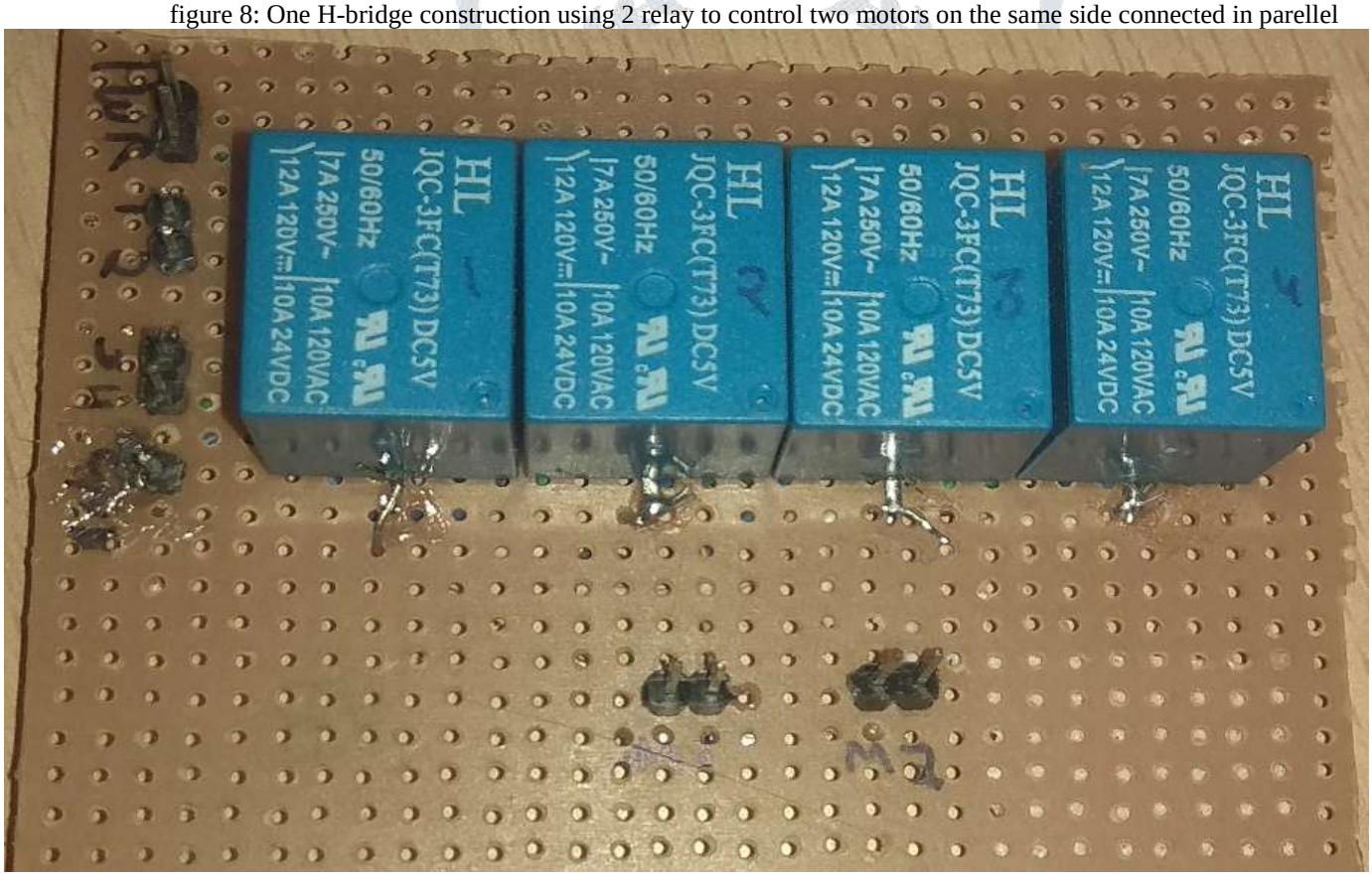

figure 9: Actual pair of DIY H-Bridge made using 4 relay

NC- Normally Close position of Relay
NO- Normally Open position of Relay
RL- Relay
Two SPDT type {JQC-3FC(T73)} 5v Relay (fig.8 & 9)can be used to make One H-bridge. In this project two such H-bridges are used each one control Two motors of one side connected in parallel with each other.
Jumper pins provided are as follows:

- 2 Pair of pins M1 and M2 to control the direction and rotation of motors on each side of robot
- 1 Ground Pin

- 4 data pins 1,2,3,4
- 2 Power pins that are connected with Li-Po battery to receive a voltage of 12 V

IV. CONCLUSION:

These types of robots are based on wireless serial communication by various ways like Bluetooth, Wi-fi etc. The results were as expected, By controlling the delay a bit the robot was able to communicate with user successfully and hence was able to move properly. Future advancements can be made by introducing Machine learning and using various sensors like IR sensor, Proximity sensor, PIR sensor, Ultrasonic Sensor etc. This can help to make the robot independent of user and navigate on its own.

V. REFRENCES:

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