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DC MOTOR SPEED AND DIRECTION CONTROL BY ANDROID

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ABSTRACT

The study point for the development of a control system for D.C motors through a software app made for Android mobile devices. The D.C motors are represented by a fan and the control application communicates with the system via Bluetooth technology. The android user must download an application (DC_CONTROL) on his mobile device, then, the user must turn on the Bluetooth on the mobile device. The user can use various commands to control the dc motor fan such as front, back, stop, and increase & decrease speed. These commands are sent from the Android mobile device to the Bluetooth receiver, which is connected with the control system. The control system has a Bluetooth HC-05 receiver that receives commands from the control application and sends them to the Arduino UNO microcontroller to control the motors through One L298N drivers

Keywords: DC MOTOR, Bluetooth, Control, Arduino UNO, Android.

I. INTRODUCTION

This Nowadays, mobile devices come equipped with high- performance processors, larger storage capacities and have more communication abilities. The smartphone, is a small device that has the processing power to do all 8kind of things and is changing the ways that humans interact with machines. Smartphones gradually became a universal portable device and gave people a daily use for different tasks. In the past years, the Android OS (Operating System) has gained more and more popularity in smartphones. The Android platform comes with a full software package, this software package is made of an OS, a middleware layer and basic applications. The difference from other existing platforms, like the iPhone OS, is that it comes with a software used as a development kit (SDK) .

The D.C motor is mostly used for different drive applications in the industrial field, the main applications are in automation, traction, civil and military systems because of its efficiency, silent operation, small size, reliability, and low maintenance .

Because of the progress in the wireless technology field, several communication methods such as Bluetooth and Wi-Fi are introduced. Each connection has a certain distinctive description and utilization. Among the Wi-Fi connection, Bluetooth technology is mostly used. Bluetooth is mostly used for data transfer and adds new characteristics to smartphones. The Bluetooth technology was invented by Ericsson in the year 1994 and has shown a big advantage by adding this technology in smartphones. The communication method changed the way users utilize their mobile devices at home /office, and it has also helped with the transition of wired devices to wireless devices. A Bluetooth device that acts like a host has the ability to communicate with maximum seven Bluetooth devices in the same time via a single connection. Communication is very important in everyday life and the Bluetooth technology is useful in a control system as means of control [3]. The Bluetooth communication method is used to control the movement direction of the motors. The controlled system is represented by a small fan motor that consists of an Arduino UNO microcontroller connected with a Bluetooth HC-05 module, one L298N driver modules and four D.C motors. When the Android application will be connected to this system via a Bluetooth connection, the user can manipulate fan motor through wireless commands given in the application. The fan motor can move increase & decrease speed, forward and backward.

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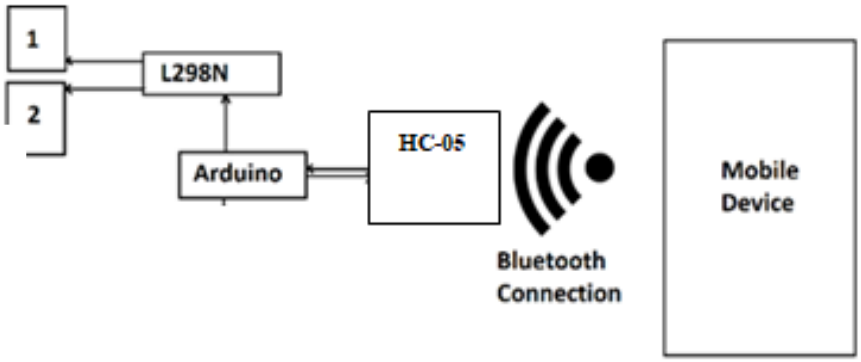

Figure 1: System block diagram

In Figure 1 we have the block diagram of the system. The controlled system receives the users command from the mobile devices via a Bluetooth connection through the HC-05 Bluetooth module, then the Arduino UNO processes the command received and operates the two L298N drivers that are used to select the speed and the direction of the D.C motors.

1.1 Arduino UNO

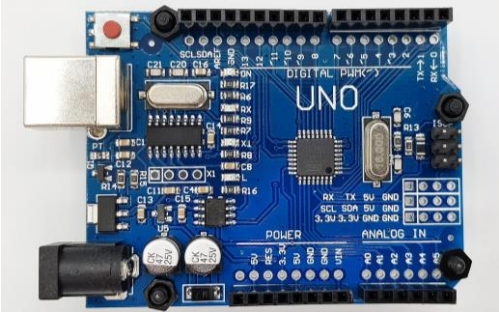

Figure 2:

The Arduino UNO is a type Arduino boards. Here UNO means 'one' in Italian. It was named as UNO to sign the first release of Arduino Software. It was also the chief USB board released by Arduino. It is well-thought-out as the powerful board used in various projects. Arduino.cc developed the Arduino UNO board. It is based on an ATmega328P microcontroller. It is similar but different to use compared to other boards, such as the Arduino Mega board, etc. The board consists of digital & analog In/Out pins (I/O), shields, and other circuits. It includes 6 analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. It is encoded based on IDE, which stands for Integrated Development Environment. It can run on both online and offline sources.

- Microcontroller: Atmega328P
- Working voltage: 5V
- Recommended input voltage: 7V-12V
- Limit input voltage: 6V-12V
- Digital pins: 14 (6 PWM output)
- Analog pins: 6
- Current per I / O pin: 40 mA
- 3.3V current: 50 mA
- Flash memory: 32 KB where 0.5 KB for bootloader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock speed: 16 MHz

1.2 Bluetooth HC-05

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'Bluetooth', the short-range radio link technology planned to "connect" an array of devices including mobile, computers and PDA's, and the strategic choices that Motorola should make in incorporating this nascent technology into its product portfolio.

Figure 3: Bluetooth module

The determination of this paper will be to provide a complex overview of the technology to the head of Motorola's Communications Enterprise, and prepare this business place's to be strategically and As someone knowledgeable about the technology, I work closely with my team members who are directly responsible for integrating Bluetooth into Motorola's product lines. The Bluetooth module HC-05 is a MASTER/SLAVE module. By default the factory setting is SLAVE. The Character of the module (Master or Slave) can be configured only by AT COMMANDS. Slave modules in Bluetooth devices can accept connections but lack the capability to actively seek out and initiate connections with other Bluetooth devices. Master module can initiate a connection to other devices.

Hardware Feature

- Typical -80dBm sensitivity.
- Up to +4dBm RF transmit power.
- 3.3 to 5 V I/O.
- PIO(Programmable Input/Output) control.
- UART interface with programmable baud rate.
- With integrated antenna.
- With edge connector

1.3 DC Motor

A dc motor uses electrical energy to produce mechanical energy, very generally through the interaction of magnetic fields and current-containing conductors. The inverse process, generating electrical energy from mechanical energy, is carried out by an alternator, source or go-getter. Many types of electric motors can be run as sources, and vice verse. The I/P of a DC motor is current/voltage and its O/P is torque (speed).

Figure 4: DC Motor

The DC motor has two basic parts: the rotating part that is called the armature and the stable part that includes coils of wire called the field coils.

The stationary type is also called up the stator. Figure shows a depict of a distinctive DC motor, Figure shows a picture of a DC armature, and The picture shows a special stator. The armature, made of wire coils, wraps around the stator's core. The core has a covered shaft that spins when electricity flows through it. You should also notice

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that the ends of each coil of wire on the armature are finished at one end of the armature. The outcome points, called the commutator, connect to brushes. These brushes touch the commutator to pass electricity from the still part to the moving part of the machine.

1.4 L298N driver

Figure 5: L298N motor driver

The L298N module is a powerful motor driver which is used for driving DC and stepper motors. The L298N module is used for controlling up to 4 D.C motor or for controlling the direction and speed of 2 D.C motors. The module is made from a IC L298, resistors and capacitors, 5V voltage regulator, power supply indicator and a 5V power jumper that is used for activating the voltage regulator when the jumper is inserted. If the user chooses to operate the driver with a power supply that is less or equal to 12V, then the module will be power by the voltage regulator and the 5V pin can supply power to the microcontroller. The pins that are responsible for the motor speed are ENA and ENB, the motor speed is controlled by a PWM input signal. The pins that are responsible for the direction of both the motors are IN1, IN2, IN3 and IN4, the direction is controlled by applying a HIGH logic input signal. The L298N technical specifications are.

- IC model: L298N
- Chip type: Bridge H
- Supply voltage (motors): 46V
- Supply current (motors): 2A
- Operation voltage: 5V
- Module voltage: 5-35V
- Module current: 2A
- Operation current: 0-36mA

The L298N is a dual H-bridge motor driver. It controls speed and direction for two DC motors simultaneously. It's like a switchboard for motors, letting you adjust how fast they spin and which way they turn. Great for projects needing precise motor control. The module can drive DC motor that have voltage beyween 5v and 35v with a peak current up to 2A.

1.5 LCD Module:

One of the most common devices attached to a micro controller is an LCD display. In many microcontroller projects, a popular choice for displays is the 16x2 LCD, showing 16 characters across and 2 lines. In our project, we're using this LCD to show the speed of a DC motor. An LCD show changes of speed, and also show direction modes. Then, the microcontroller sends the speed information to the LCD for display. It's a simple and effective way to monitor and control motor speed in various applications.

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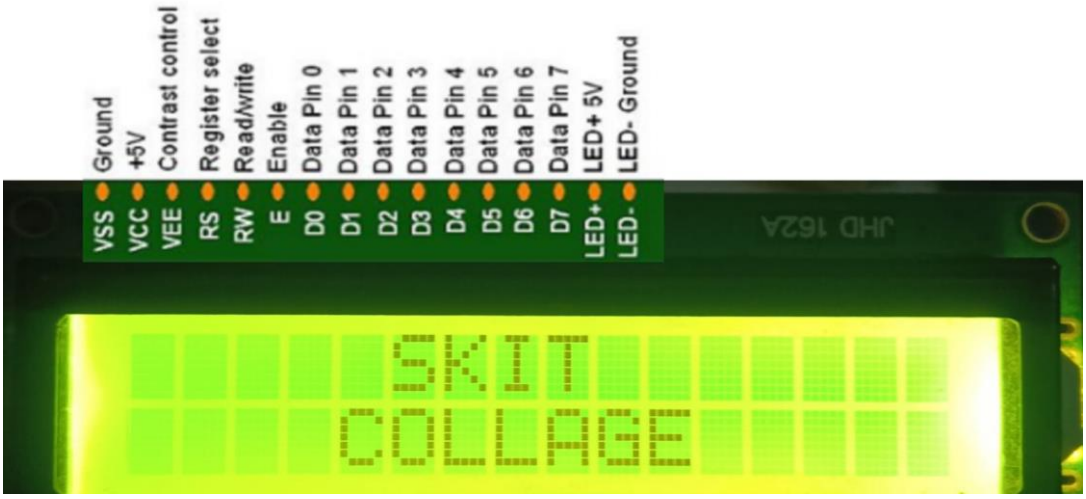

Figure 6: LCD

Features of LCD16x2:

The features of this LCD mainly include the following.

- The operating voltage of this LCD is 4.7V-5.3V
- It includes two rows where each row can produce 16 characters.
- The utilization of current is 1mA with no backlight
- Every character can be built with a 5×8 pixel box
- The alphanumeric LCDs alphabets & numbers
- It work on two modes 4-bit & 8-bit
- These are available in Blue & Green Backlight
- It displays a few custom generated characters.

Registers of LCD:

A 16x2 LCD screen has two important registers: the data register and the command register. The RS (register select) pin switches between these two registers. When RS is set to '0', it's the command register, used for sending instructions to the LCD like clearing the screen or setting cursor position. Conversely, when RS is set to '1', it's the data register, used for sending actual character data to be displayed on the screen. This distinction between registers allows the microcontroller to communicate effectively with the LCD, enabling control over what's displayed and how the screen behaves.

Command Register

The command register stores instructions for the display. It handles tasks like clearing the display, initializing, setting cursor position, and display control. Commands are processed within this register, guiding the display on what actions to take.

Data Register

The data register holds the information to be shown on the LCD screen, typically in ASCII format. When we send data to the LCD, it goes into the data register. From there, the LCD processes the data for display. When the register select (RS) is set to '1', indicating data register selection, the LCD knows to expect character data. This allows for easy communication with the display, enabling content to be shown accurately and efficiently.

1.6 I2C (Inter Integrated Circuit):

I2C stands for Inter-Integrated Circuit. I2C, or Inter-Integrated Circuit, is a serial communication protocol used in devices for short-distance communication. Originally developed by Philips Semiconductor in 1982, it's now widely used. Also referred to as Two Wire Interface (TWI), I2C simplifies communication between integrated

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circuits. It utilizes just two wires for transmitting and receiving data, making it efficient and versatile for connecting various components within electronic devices.

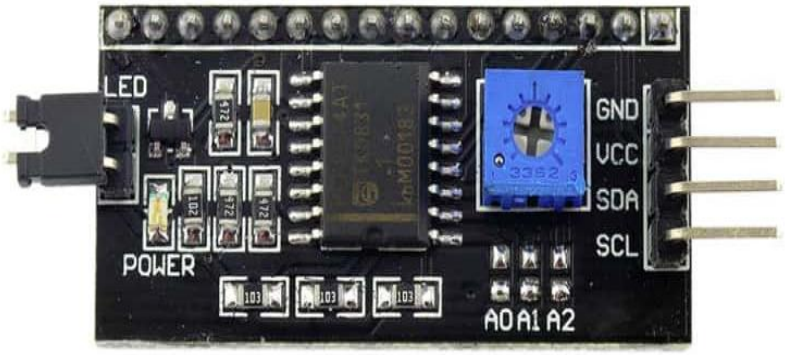

Figure 7: I2C

Working of I2C Communication Protocol:

I2C utilizes just two bi-directional open-drain lines: SDA (Serial Data Line) and SCL (Serial Clock Line). Both these lines are pulled high.

SDA transfers data, while SCL carries the clock signal in I2C communication, facilitating synchronized data exchange between devices.

I2C operates in 2 modes –

Master mode & Slave mode

Data bits on SDA sync with SCL pulses—a transition from high to low—ensuring synchronized communication between devices.

Features and Specifications of I2C Serial Interface Adapter Module:

"I2C adapter offers features like serial communication, enabling easy data transfer between devices."

1. Operating Voltage: 5V DC
2. I2C control using PCF8574
3. Can have 8 modules on a single 12C bus
4. I2C Address: 0X20~0X27 (the original address is 0X20, you can change it yourself via the onboard jumper pins).

1.7 Software application:

The Android control application (DC_CONTROL) has 2 control modes one is remote control and another one is voice but here we only control our fan motor by remote control. In over android application we having 9 buttons where 2 button for Forward & Backward, 1 button for stop and another 1 button connected to HC-05 Bluetooth with application where if Bluetooth not connected with system the a reminder block show "NOT CONNECTED" and if Bluetooth is connected with system then it show "CONNECTED" and remaining buttons for speed variation.

In software application home page include 2 buttons there 1 is for remote control and another 1 is for voice control, there is also a button is name as "Home" button which is used for to back page or shift on home page.

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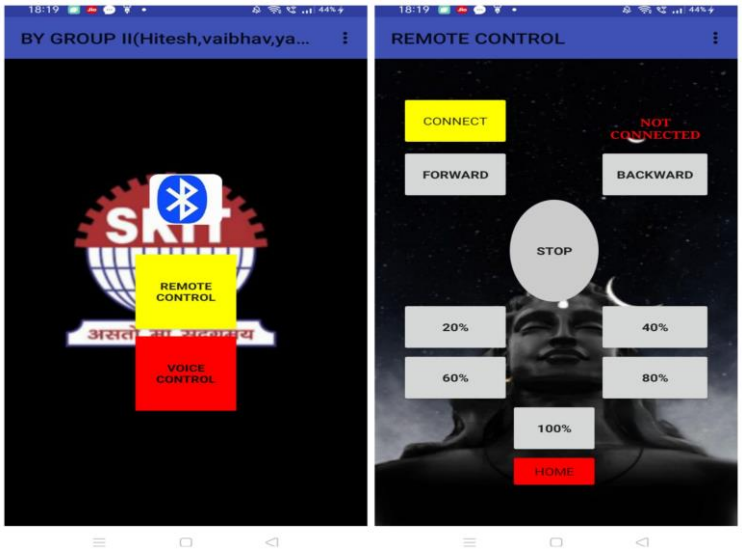

Figure 8: Software application

II. RESULTS

This system ability to control the speed and direction of a DC motor, represented by a fan, using an Android app designed for mobile devices. Through Bluetooth connectivity, the user communicates with an Arduino Uno, which manages L298N motor drivers.

The Android app sends commands via text messages to the HC-05 Bluetooth module. These messages include "F" for forward movement, "B" for backward movement, "S" for stopping the motor, and "V" to "Z" for adjusting speed.

Upon receiving these commands, the Arduino Uno interprets them and instructs the L298N drivers accordingly. For instance, upon receiving "F," the motor moves forward, while "B" prompts backward movement. The "S" command halts the motor, ensuring immediate stopping when necessary.

Additionally, speed adjustments are possible using letters "V" through "Z." Each letter represents a different speed level, allowing users to customize motor performance according to their needs.

Overall, this setup provides a convenient and intuitive interface for users to control DC motors using their Android devices. By leveraging Bluetooth technology and Arduino programming, the system offers flexibility and ease of use in various practical applications, from home automation to robotics.

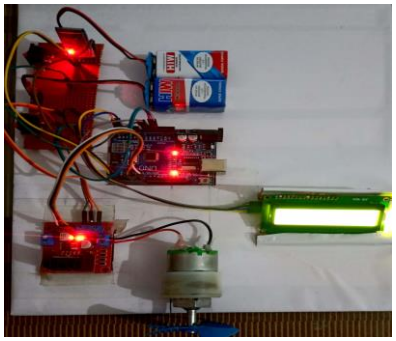

Figure 9: Project output image

III. CONCLUSION

This paper introduces control systems utilizing Bluetooth and Android devices. It explores how smartphones interact with devices for various applications. The Android smartphone operating system is a suitable environment for developing an efficient and easy to customize program, which allows the user to control via a Bluetooth connection the created system. The controlled system employs the Atmega328 microcontroller, designed for electronics, mechatronics, and automation applications, offering versatile solutions in these fields. Most wireless control systems use RF modules, but the paper demonstrates that the use of Bluetooth technology

is a similar or better solution to effectively and securely control certain systems that use a wireless connection. The L298N module simplifies D.C. motor control when combined with development boards like the one utilized in this system. Even small-sized, low-power D.C. motors remain effective for a range of practical applications.

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