

Wireless Dc Motor Speed and Direction Control using Bluetooth

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Abstract: *This article implemented an Android application-based speed and direction control of DC motor using Bluetooth module. This setup consists of two basic primary elements communicating with each other: i) Bluetooth of smartphone which is connected to the Arduino microcontroller, IC and DC Motor interfaced with a L293D motor driver IC and ii) a Bluetooth module HC-05. The android application in smartphone sends/receives data to/from the microcontroller using the Bluetooth. An android application in the smartphone acts as a display panel for the user to send/receive/view the output and input of the DC motor. The display includes a screen showing the commands and responses against each other. The motor can be rotated 0-360 degrees and can even change its direction from left to right until stopped. Thus, this proposed control methodology is applied to control speed and direction of DC motor wirelessly.*

Keywords: Arduino, DC motor, TRIAC, Android layout, LCD

I. INTRODUCTION

Speed controlling of DC motors plays a very crucial role. Monitoring and controlling of speed of a DC motor by using Android Smart phones have involved the Bluetooth technology, so and outer Bluetooth module HC05 is interfaced with the PIC microcontroller unit for the wireless connection. The Bluetooth module obtains signal from the smartphone mobile android app. Therefore, according to the I/P signal, with the using of PIC, IR sensor can be usually used to vary the speed as well as for the DC motor by using PWM techniques. Direct Current motor direction can also be varied with the using of driver circuit or Hedge Bridge network. The electric drive systems should possess some benchmark properties like linear control, reliability, and steady operation. DC driven machines gain some advantage in these aspects. The speed control methods of DC motor play a vital role in the performance of drive. The main purpose of speed controller is to focus on how we can use Bluetooth based device to control speed and direction of a DC motor at a desired speed and the main objective of dc drive is to maintain a system with the stable speed irrespective of load condition. In this paper, we describe a recently developed "Bluetooth based speed control of DC motor", a smart phone control experimental setup that can be accessed via the Bluetooth. This setup consists of two basic primary elements communicating with each other:

Bluetooth of smart phone which is connected to the microcontroller, IC and DC Motor interfaced with a motor driver IC.

a Bluetooth module. The smart phone sends/receives data to/from the microcontroller using the wireless technology via Bluetooth. An application based on Android is created and downloaded in the phone which acts as a display panel for the user to send/receive/view the input and output of the DC motor. In this paper visual display of the current position of the motor using sensors can be sent by the microcontroller to the smart phone. Our microcontroller-based remote-control methodology using an android based smart phone can be readily applied and control the speed of DC motor through it.

These DC Motors are normally used for industrial control, automation, and home electrical appliance. It spans everything from residential washing machines, fans, hand-held power tools, automotive window lift, traction control system, industrial drives and many more. Motor application is not completed without a control system.

The inventions of microprocessor and microcontroller make the control system become easier. This control system is basically controlling the switch, speed, and direction of motor. Control signal is generated by a switch that is connected directly to the control circuit. To control and monitor the motor, user need to be at the place where the switch is located. In [2] By controlling the duty cycle of this PWM signal, the terminal voltage of dc motor is controlled, which in turn directly controls the speed of dc motor. In this system, a dc motor is interfaced with the microcontroller. The major elements used in this system are Adriano UNO, Bluetooth module and DC motor. A 12v transformer powers the entire system. When an android device sends command, it is received by the Bluetooth module, which then sends the commands to microcontroller. Whenever the motor is turned on, it can run in both directions. An LCD is used to display the status and speed of dc motor. To control the signal speed and direction of dc motor, a signal from android device will be sent to microcontroller through Bluetooth module. This signal will be represented by a single direction that denotes the speed and direction of the motor. Different letters will represent the three directions of rotation i.e., clockwise, anticlockwise and stopping of the motor. This letter will vary the speed of motor with reference to Adriano code. The duty cycle of PWM signal is varied in between 0-255 to change the speed of dc motor. By controlling the duty cycle of this PWM signal, the terminal voltage of dc motor is controlled, which in turn directly controls the speed of dc motor. In this system, a dc motor is interfaced with the microcontroller. The major elements used in this system are Adriano UNO, Bluetooth module and DC motor. A 12v transformer powers the entire system. When an android device sends command, it is received by the Bluetooth module, which then sends the commands to microcontroller. Whenever the motor is turned on, it can run in both directions. An LCD is used to display the status and speed of dc motor. To control the signal speed and direction of dc motor, a signal from android device will be sent to microcontroller through Bluetooth module. This signal will be represented by a single direction that denotes the speed and direction of the motor. Different letters will represent the three directions of rotation i.e., clockwise, anticlockwise and stopping of the motor. This letter will vary the speed of motor with reference to Adriano code. The duty cycle of PWM signal is varied in between 0-255 to change the speed of dc motor.

II. COMPONENT LIST

Sr No	Component Name	Quantity	Rate	Total
1.	9V Battery	1	20/-	20/-
2.	Connectors	2	5/-	10/-
3.	Bridge Rectifier	2	10/-	20/-
4.	Capacitor-1000Uf	2	5/-	10/-
5.	Capacitor-1uf	4	3/-	12/-
6.	Capacitor-22uf	4	1/-	4/-
7.	Regulator IC 7805	2	15/-	30/-
8.	LED	3	1/-	3/-
9.	Resistor-220 ohm	2	1/-	2/-
10.	Resistor-10K	7	1/-	7/-
11.	Switches	3	2/-	6/-
12.	Crystal-12Mhz	2	10/-	20/-
13.	Resistor Strip-5	2	3/-	6/-
14.	Resistor Strip-8	1	3/-	3/-
15.	AT 89s52 Microcontroller	2	78/-	156/-
16.	H12 Encoder	1	72/-	72/-
17.	H12 Decoder	1	72/-	72/-
18.	RF Transmitter	1	495/-	495/-
19.	RF Receiver	1	495/-	495/-
20.	16x2 LCD	1	150/-	150/-
21.	Transformer	1	50/-	50/-

22.	PCB Board	2	100/-	200/-
23.	Cable	1	15/-	15/-
24.	Copper Wire	2	10/-	20/-

III. BLOCK DIAGRAM

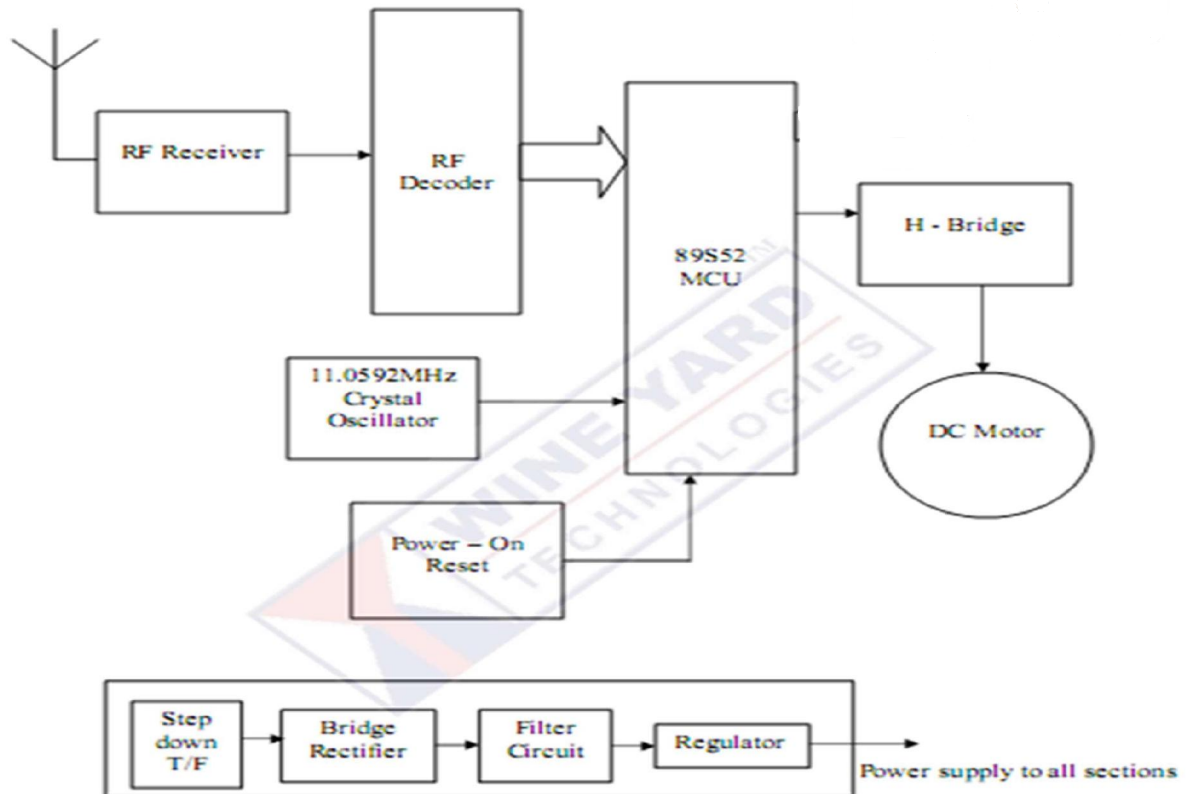


Fig. Block Diagram

This block diagram makes use of a PLC microcontroller. This PLC Microcontroller is capable of communicating with input and output modules. DC motor along with driver and Bluetooth module is interfaced to the microcontroller. When the user presses the button on his Bluetooth enabled smart phone, this data is received by Bluetooth module and transmit this data to the PLC microcontroller then microcontroller control the DC motor. We can see the values of varied speed and direction on LCD. IR sensor is used to measure the RPM

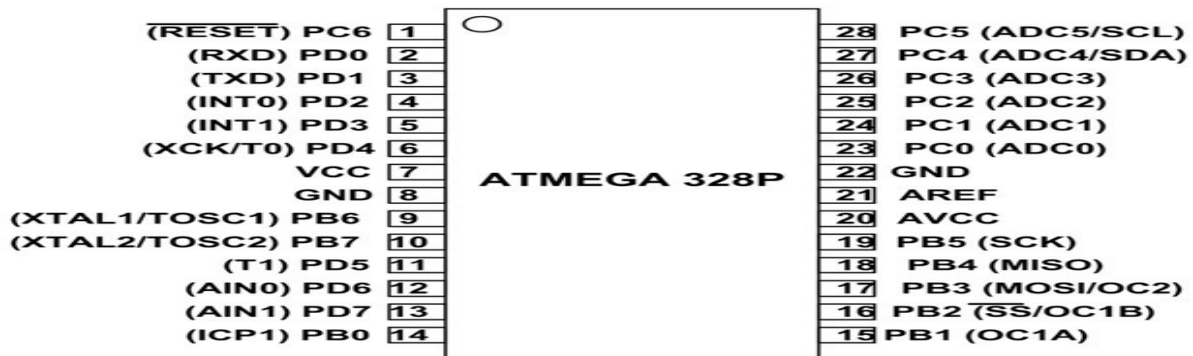
IV. METHODOLOGY

Steps include planning project Stage

1. Connect all parts according to block diagram Stage.
2. Open the android application, it requests Bluetooth connection Stage.
3. Once the application is opened, check for the Bluetooth device and pair it with HC-05 Stage.
4. Give the message from application for increasing or decreasing the speed Stage.
5. The message is received by microcontroller and processed message is forwarded to Adriano Stage.
6. PWM program/coding is stored in Adriano.

It gives the necessary output, and the motor speed varies as per the message given by the client from the application

BLOCK DIAGRAM DISCRPTION



- VCC is a digital voltage supply.
- AVCC is a supply voltage pin for analog to digital converter.
- GND denotes Ground and it has a 0V.
- **Port A** consists of the pins from **PA0** to **PA7**. These pins serve as analog input to analog to digital converters. If analog to digital converter is not used, **port A** acts as an eight (8) bit bidirectional input/output port.
- **Port B** consists of the pins from **PB0** to **PB7**. This port is an 8 bit bidirectional port having an internal pull-up resistor.
- **Port C** consists of the pins from **PC0** to **PC7**. The output buffers of **port C** has symmetrical drive characteristics with source capability as well high sink.
- **Port D** consists of the pins from **PD0** to **PD7**. It is also an 8 bit input/output port having an internal pull-up resistor.
- **AREF** is an analog reference pin for analog to digital converter.

WHY TO USE MICROCONTROLLER

What is Arduino?

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs- light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide

There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

Since **ATmega328P** is used in Arduino Uno and Arduino nano boards, you can directly replace the arduino board with ATmega328 chip. For that first you need to install the **Arduino bootloader** into the chip (Or you can also buy a chip with bootloader – ATmega328P-PU). This IC with bootloader can be placed on Arduino Uno board and burn the program into it. Once Arduino program is burnt into the IC, it can be removed and used in place of Arduino board, along with a Crystal oscillator and other components as required for the project. Below is the **pin mapping between Arduino Uno and ATmega328P chip**.

General Purpose (GP) registers

- ATmega-328 has thirty-two (32) General Purpose (GP) registers.
- These all of the registers are the part of Static Random Access Memory (SRAM).

- All the registers are given in the figure shown below

The basic working of CPU of ATmega328: -

The data is uploaded in serial via the port (being uploaded from the computer's Arduino IDE). The data is decoded and then the instructions are sent to **instruction register** and it decodes the instructions on the same clock pulse.

On the next clock pulse the next set of instructions are loaded in instruction register.

In general purpose registers the registers are of 8-bit but there are 3 16-bit registers also.

8-bit registers are used to store data for normal calculations and results.

16-bit registers are used to store data of timer counter in 2 different register. Eg. X-low & X-high. They are fast, and are used to store specific hardware functions.

EEPROM stores data permanently even if the power is cut out. Programming inside a EEPROM is slow.

Interrupt Unit checks whether there is an interrupt for the execution of instruction to be executed in ISR (Interrupt Service Routine).

Serial Peripheral Interface (SPI) is an interface bus commonly used to send data between microcontrollers and small peripherals such as Camera, Display, SD cards, etc. It uses separate clock and data lines, along with a select line to choose the device you wish to talk to.

Watchdog timer is used to detect and recover from MCU malfunctioning.

Analog comparator compares the input values on the positive and negative pin, when the value of positive pin is higher the output is set.

Status and control is used to control the flow of execution of commands by checking other blocks inside the CPU at regular intervals.

ALU (Arithmetic and Logical unit) The high performance AVR ALU operates in direct connection with all the 32 general purpose working registers. Within a single clock cycle, arithmetic operations b/w general purpose registers are executed. The ALU operations are divided into 3 main categories – arithmetic, logical and bit-function.

I/O pins the digital inputs and outputs (digital I/O) on the Arduino are what allow you to connect the Arduino sensors, actuators, and other ICs. Learning how to use them will allow you to use the Arduino to do some really useful things, such as reading switch inputs, lighting indicators, and controlling relay outputs.

DC gear motor

Gear motors are commonly used in devices such as can openers, garage door openers, washing machine time control knobs, and even electric alarm clocks. Common commercial applications of a gear motor include hospital beds, commercial jacks, and cranes. Regardless of what type of gear motor you're dealing with, they all work in the same manner.

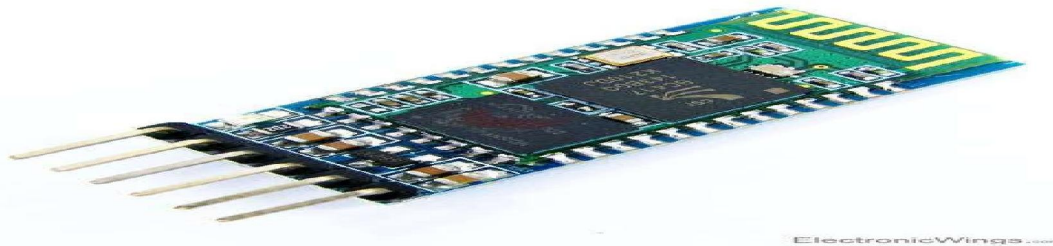
Gear motors are primarily used to reduce speed in a series of gears, which in turn creates more torque. This is accomplished by an integrated series of gears or a gearbox being attached to the main motor rotor and shaft via a second reduction shaft. The second shaft is then connected to the series of gears or gearbox to create what is known as a series of reduction gears. Generally speaking, the longer the train of reduction gears, the lower the output of the end, or final, gear will be.



Bluetooth Module (HC-05):

HC-05 module is an easy-to-use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete

2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle. Bluetooth is a type of wireless communication used to transmit voice and data at high speeds using radio waves. It's widely used in mobile phones for making calls, headset and share data. This type of communication is a cheap and easy way to control something remotely using arduino. For communication with arduino using bluetooth a bluetooth module need to be connected with arduino. Several model of bluetooth module are available. I am using here HC-05 a very common and cheap one. HC-05 module has 6 pins.



L293D Motor Driver IC

L293D Description

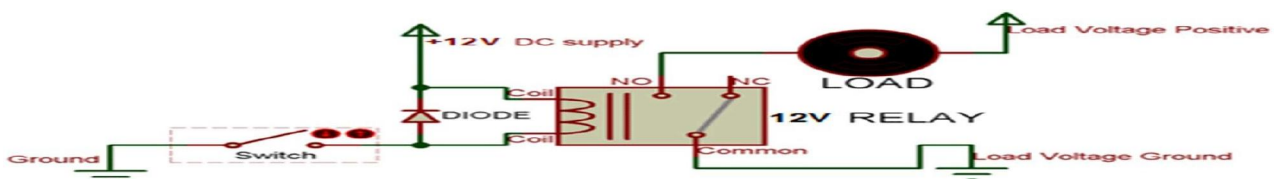
L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge *Motor Driver integrated circuit (IC)*.

The l293d can drive small and quiet big motors as well, check the Voltage Specification at the end of this page for more info.

You can Buy L293D IC in any electronic shop very easily and it costs around 70 Rupees (INR) or around 1 \$ Dollar (approx. Cost) or even lesser cost. You can find the necessary pin diagram, working, a circuit diagram, Logic description and Project as you read through.

Relays:

Relays are most commonly used switching device in electronics. There are two important parameters of relay, first is the Trigger Voltage, this is the voltage required to turn on the relay that is to change the contact from Common → NC to Common → NO. The other parameter is your Load Voltage & Current, this is the amount of voltage or current that the NC, NO or Common terminal of the relay could withstand, in our case for DC it is maximum of 30V and 10A. Make sure the load you are using falls into this range.



The above diagram is for **relay triggering circuit**. Since the relay has 12V trigger voltage we have used a +12V DC supply to one end of the coil and the other end to ground through a switch. For switching we are using a transistor as a switching device. You can also notice a diode connected across the coil of the relay; this diode is called the Fly back Diode. The purpose of the diode is to protect the switch from high voltage spike that can produced by the relay coil. As shown one end of the load can be connected to the Common pin and the other end is either connected to NO or NC. If connected to NO the load remains disconnected before trigger and if connected to NC the load remains connected before trigger.

Step Down Transformer:

Step down transformer is the first part of regulates power supply. To step down the mains 230v AC. We require step down transformer. Following are the main characteristics of electronic transformer

1. Power transformers are usually designed to operate from source of low impedance at a single frequency.
2. It is required to construct with sufficient insulation of necessary dielectric strength.
3. Transformer rating are expressed in volt –amp. The volt-amp of each secondary windings or windings is added for the total secondary VA. T this are added the load losses.
4. Temperature rise of transformer is decided on two well-known factors are losses of transformer and heat or cooling facility provided unit.

Rectifier Unit:

Rectifier unit is a circuit which converts alternating current into pulsating DC generally semi-conducting diode is used as a rectifying element due to this property of conducting current in one direction only. Generally, there are two types of rectifiers.

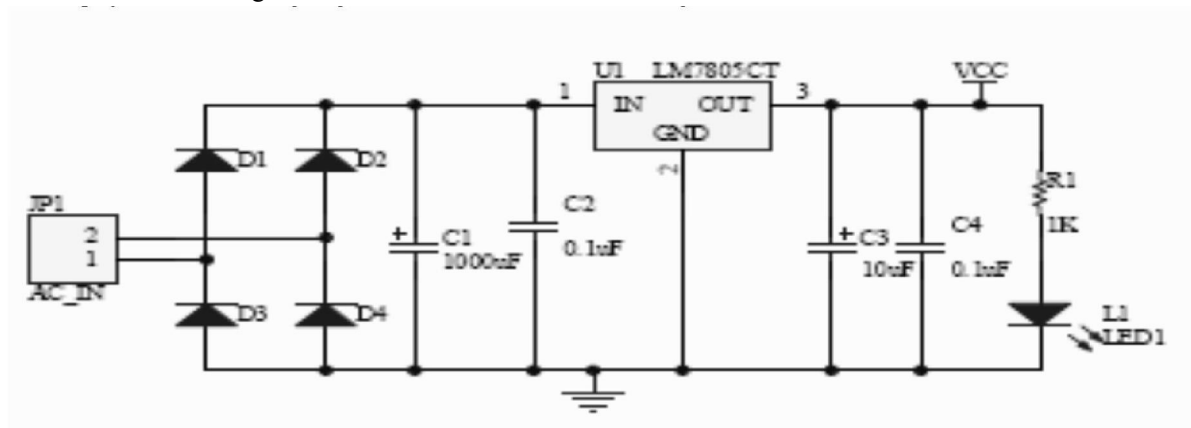
- Half Wave Rectifier.
- Full Wave Rectifier.

In half wave rectifier only half cycle of mains is rectified so its efficiency is very poor. So, we use full wave bridge rectifier, in which 4 diodes are used. In each half cycle, two diodes conduct at a time and we get maximum efficiency at output.

Following are the main advantages and disadvantages of full wave bridge type rectifier circuit.

Three terminal voltage regulators:

A voltage regulator is a circuit that supplies constant voltage regardless of change in load current. IC voltage regulators are versatile & relatively cheaper. The 7800 series consist of three terminal positive voltage regulator s. These IC's is designed to as fixed voltage regulator & with adequate heat sink, can deliver output current in excess of 1A. These devices do not required external component. This IC also has internal thermal overload protection and internal short circuit and current limiting protection. For our project 7805 as a voltage regulator IC. This is shown in bellow fig.



Circuit diagram of power supply:

The controller PIC16F877A requires the supply of 5V and hence there is need of a regulator whose output is 5V regulated dc voltage so we have Consumer products including electronic toys, home security, gate and garage door openers, intercom, fire and safety systems and irrigation controllers.

V. HARDWARE MODEL



VI. RESULT

The project “Speed and Direction control of a DC Motor using Bluetooth by Android Mobile Application” is design to operate a DC motor using PWM and controlling through Bluetooth module and the system able to monitor the motor speed on LCD display. IR sensor is used to measure the RPM of DC motor. By using PWM signal we can control the DC motor

VII. CONCLUSION

It is seen that controlling a DC motor using Android applications gives user many advantages Controlling the speed and direction of a DC motor by giving instruction to the microcontroller will reduce the manual work. This technology will also save the cost of wiring since it is based on wireless technology called Bluetooth. Implementation of this system is extremely easy since the motor is controlled by PWM to accept the desired speed that keyed by the smartphone. This system is also suitable for implementation in industries and homes. It is thus a promise that this method is especially useful to control the speed of DC motor wirelessly. Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus to the best working of the unit Secondly, using highly advanced IC’s with the help of Growing technology, the project has been successfully implemented. Thus the idea of the paper has been successfully designed and tested. The paper presented “Wireless DC Motor Speed and direction

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