

# DC Motor Speed Control Using ATMEGA89S52 and MATLAB GUI Application

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**Abstract:** The purpose of this project is to develop the Graphical User Interface of Motor Control through MATLAB GUIDE, interface the MATLAB GUI with hardware via communication port and control the DC motor through MATLAB GUI. By using MATLAB GUIDE, it provides a set of tools which simplify the process of laying out and programming GUIs and interface with PIC via serial communication port to control the DC motor. The PIC is used to control motor. As a result, the DC motor is able to be controlled through MATLAB GUI and interface the MATLAB GUI with PIC via serial communication port.

**Keywords:** DC motor, MATLAB GUI, Microcontroller, ATMEGA 89S52

## 1. Introduction

DC motors are used in a variety of applications in industrial electronics and robotics that includes precision positioning as well as speed control. In smaller motors it is usually economically infeasible to buy a commercial speed controller as the cost of the controller will far outstrip the cost of the motor itself. The PIC's high speed, low cost, and low power requirements lend it to being an inexpensive "smart chip" controller for DC motors. The concept of PIC operation is generating PWM to drive switching devices. It is very easy to control the speed of DC motor from zero to maximum speed. PWM generator can be applied as switching signal thus reduces the losses energy. There is no effect on power quality and no change in speed regulation.

In order to reduce cost and time, we suggest making a controller based on computer because it is portable.

The main hardware of the project is microcontroller Atmega89S52. The microcontroller takes input from user through MATLAB GUI and controls the speed of DC motor as per the inputs. GUIs (also known as graphical user interfaces or UIs) provide point-and-click control of software applications, eliminating the need to learn a language or type commands in order to run the application. GUIDE (GUI development environment) provides tools to design user interfaces for custom apps. Using the GUIDE Layout Editor, you can graphically design your UI. GUIDE then automatically generates the MATLAB code for constructing the UI, which you can modify to program the behavior of your app.

## 2. Components

The main components of the project are ATMEGA 89S52 microcontroller, DC motor, MATLAB GUI and MAX 232 IC.

## ATMEL AT89S52 MICROCONTROLLER: FEATURES

- Compatible with MCS®-51 Products.
- 8K Bytes of In-System Programmable(ISP)Flash Memory – Endurance: 10,000 Write/Erase Cycles.
- 4.0V to 5.5V Operating Range.
- Fully Static Operation: 0 Hz to 33 MHz.
- Three-level Program Memory Lock.
- 256 x 8-bit Internal RAM.
- 32 Programmable I/O Lines.
- Three 16-bit Timer/Counters.
- Eight Interrupt Sources.
- Full Duplex UART Serial Channel.
- Low-power Idle and Power-down Modes.
- Interrupt Recovery from Power-down Mode.
- Watchdog Timer.
- Dual Data Pointer.
- Power-off Flag.
- Fast Programming Time.
- Flexible ISP Programming (Byte and Page Mode).
- Green (Pb/Halide-free) Packaging Option.

The use of and advancement in microcontroller technology in the recent times have allowed for dc motors to be controlled more efficiently and at a lower cost than ever before.

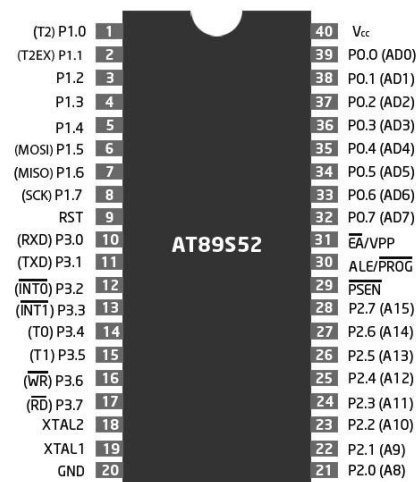


Figure 1.1: Pin Configuration Of AT89S52

## DC MOTOR

A DC motor is an electric motor that runs on direct current (DC) electricity. DC motors were used to run machinery, often eliminating the need for a local steam engine or internal combustion engine. DC motors can operate directly from rechargeable batteries, providing the motive power for the first electric vehicles. Today DC motors are still found in applications as small as toys and disk drives, or in large sizes to operate steel rolling mills and paper machines. Modern DC motors are nearly always operated in conjunction with power electronic devices. It works on the principle of electromagnetism. A current carrying conductor when placed in an external magnetic field will experience a force proportional to the current in the conductor. DC motor speed controllers are very useful for controlling the motion of robotic and industrial automation systems. DC motor can provide a high starting torque and it is also possible to obtain speed control over wide range. For precise speed control of servo system, closed-loop control is normally used. The speed, which is sensed by sensing devices, is compared with the reference speed to generate the error signal and to vary the armature voltage of the motor. There are several controllers that can be used to control the speed of the motor such as by using thyristor, phase-locked-loop control, chopper circuit, Fuzzy Logic Controller and etc. Here, we will use PWM technique.

## MATLAB GUIDE

I am using MATLAB GUI software in my project. GUIs (also known as graphical user interfaces or UIs) provide point-and-click control of software applications, eliminating the need to learn a language or type commands in order to run the application. GUIDE (GUI development environment) provides tools to design user interfaces for custom apps. Using the GUIDE Layout Editor, you can graphically design your UI. GUIDE then automatically generates the MATLAB code for constructing the UI, which you can modify to program the behavior of your app. A MATLAB GUI interface is shown in fig.1.1.

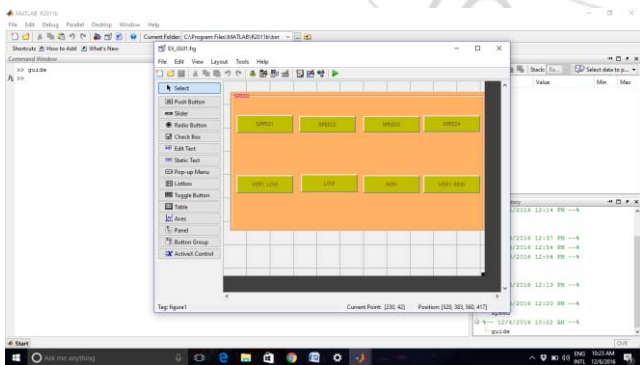


Figure 1.2: A GUIDE Interface

## MAX232

The MAX-232 IC is an integrated circuit which consists of 16 pins and it is a resourceful IC mostly used in the voltage level signal problems. Generally, the MAX-232 IC is used in the RS232 communication system for the conversion of voltage levels on TTL devices that are interfaced with the PC serial port and the Microcontroller. This IC is used as a

hardware layer converter like to communicate two systems simultaneously. The image of MAX232 is shown below.



Figure 1.3: MAX 232 IC

## What does MAX232 IC and interfacing needs

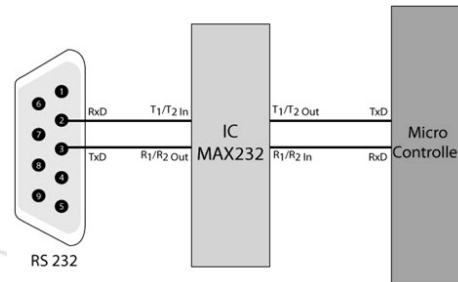


Figure 1.4: MAX232 Interfacing

The Max-232 IC is started by the maxim integrated products in 1987. It is an integrated circuit which converts the signals from the RS232 serial port to the proper signal which are used in the TTL compatible digital logic circuits. The MAX232 can convert the signals like RX, TX, CTS, and RTS and it is a dual driver/receiver. The driver increases the output voltage levels of TIA232 from a 5 volt supply to 7.5 volts by using the external capacitor and on chip charge pumps. The receiver reduces the input levels of the TIA232 from 25 volts to the standard voltage level, i.e. 5volts of TTL levels and there is a threshold of 1.3 volts and hysteresis of 0.5 volts for the receiver. Further the MAX232 IC is extended by the four receivers and transmitters simultaneously with eight receivers and transmitters which are MAX238 and MAX248 and there are many combinations of receivers and transmitters.

## 3. Methodology

There are three main methods in order to develop this project. Before the project is developing using MATLAB, it is needed to do the study on MATLAB GUIDE and the hardware (especially PIC). The flowchart in Figure 1.5 illustrated the sequence of steps for this project. The first method is developing GUI in MATLAB and program every GUI component. Secondly is to develop PIC programming to control 5V DC motor. And lastly is hardware design which is used to interface with MATLAB GUI.

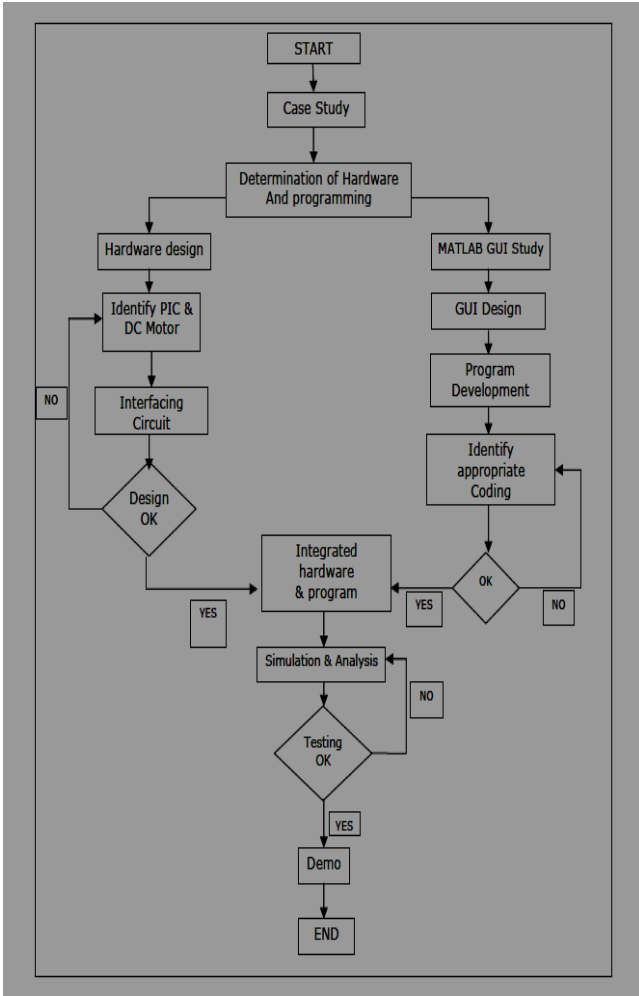


Figure 1.5: Flow Chart of the project

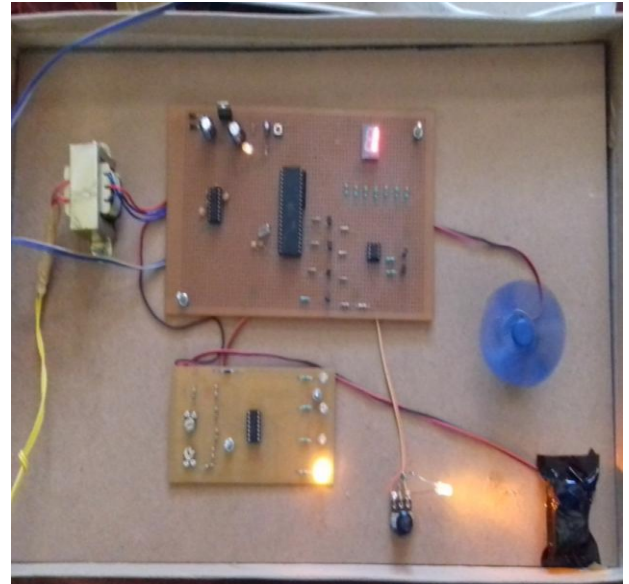


Figure 1.7: Pictorial view of the hardware

#### 4. Experimental Results

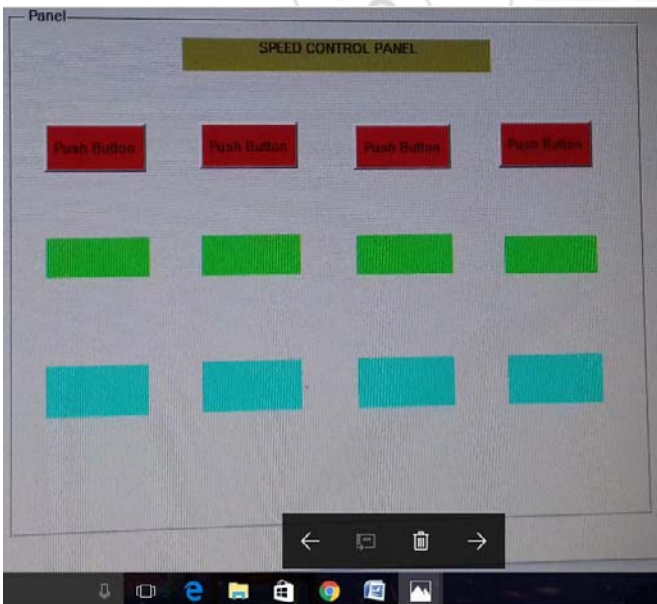


Figure 1.6 GUI panel construction in MATLAB

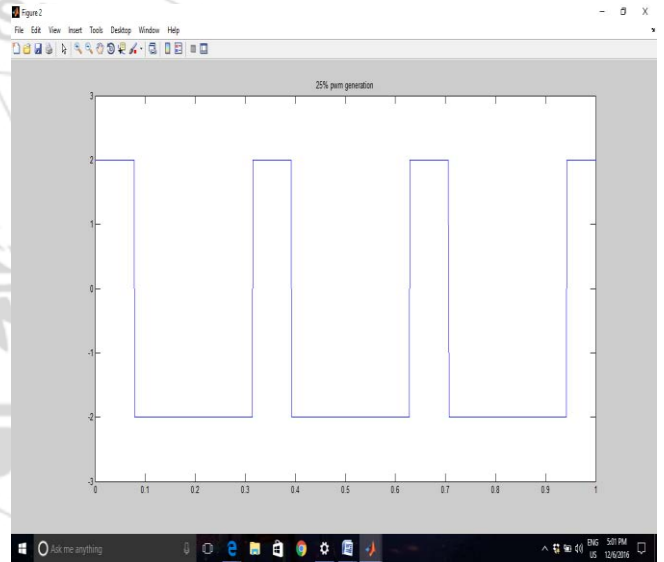


Figure 1.8: (a) Representation of output at low speed of DC motor

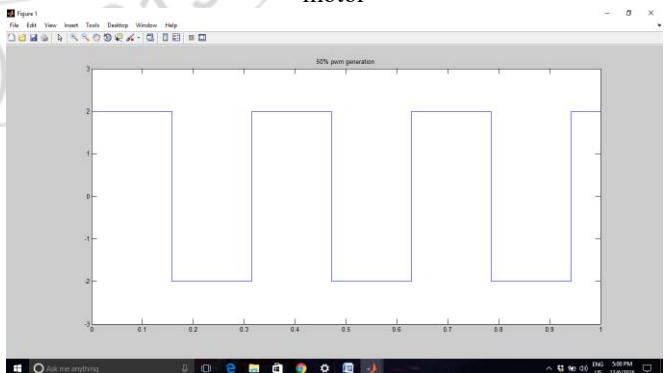


Figure 1.8 (b): Representation of output at medium speed of DC motor



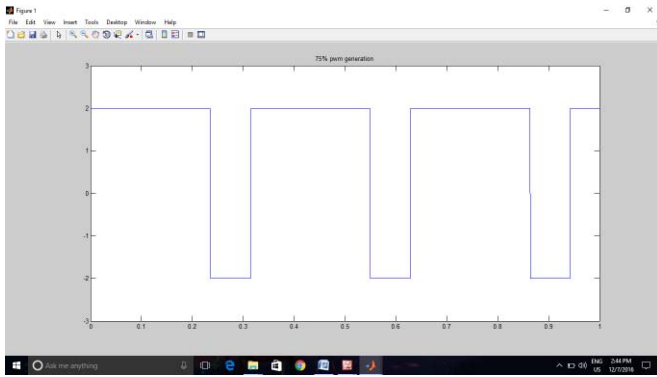


Figure 1.8 (c) Representation of output at high speed of DC motor

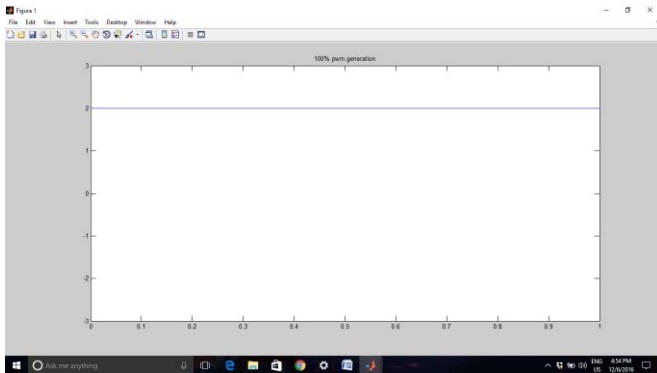


Figure 1.8 (d) Representation of output at very high speed of DC motor

## 5. Conclusion

The Project has following advantages:

- The advantages of a graphical user interface (GUI) are ease of use, higher productivity and better accessibility. Electronic devices with GUIs often let users accomplish tasks at a faster rate over devices that employ older interfaces.
- Graphical User Interface development environment provides a set of tools for creating graphical user interfaces (GUIs). These tools greatly simplify the process of designing and building GUIs. User can use the GUIDE tools to lay out the GUI.
- Simplicity of control.
- Low cost.
- The PIC is used because of wide availability and economical.
- Besides that PIC is a free development tools and can perform many function without needed extra circuitry.
- The PIC also provides analog to digital converter, which is that, can be used to connect with analog temperature sensor.

The purpose of this project was to create an interactive GUI to control the speed of a dc motor. Also a visual aid is more appealing and our aim was to make it interactive. the GUI can be extended to other purposes also and not only learning about the dc motor. It can be used for learning induction motors, alternators, image processing and other. The use of a GUI through MATLAB is quite extensive as it can be coupled with other toolboxes in MATLAB quite effectively

making it an appealing prospective for students to learn about a new topic or area of interest.

## 6. Acknowledgment

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Arpita Srivastava is M. Tech student in Electronics & Communication Department of Buddha Institute of technology, GIDA, Gorakhpur. Prior to this she persued Bachelors in Engineering degree from Institution of Engineers India.