Speed Control and Direction Control of Dc Motor Using Arm7

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ABSTRACT

An armature voltage control is used to control the supplied voltage of an armature of a 2kw separately excited DC motor. A buck regulator is used to vary the supplied voltage of the motor. A pulse width modulation (PWM) generator is implemented to supply the signal to the gate of the switch of the buck regulator. A series or cascade compensator is placed to control the duty cyclone of the pulse width modulation (PWM) generator in the closed loop control system. Pulse width modulation has one additional advantage which is that the pulse reaches the full supply voltage. It will produce more torque in a motor easily overcome motor resistance.SST 433 MHZ transmitter and STR 433MHZ receiver are the RF module used here.AT the end of the transmitter, four switches are provided to control the speed and direction of the DC motor which is located at the receiver side.

KEYWORD: DC motor, ARM7, RF transmitter and receiver.

1. INTRODUCTION

This system is designed to control the speed and direction of DC motor using ARM-7.For speed control we used ARM-7 processor. DC motor is electronic motor and voltage of DC motor is directly proportional to the speed and hence if we increase the voltage level of motor, speed is also increased. DC motor is controlled to the ARM processor. Speed of DC motor or control direction of DC motor can be achieved by changing the duty cycle.

In real time development control system design technique is very useful.in domestic and industrial purpose DC motors are widely used. DC motor can be used in various applications and also can be used in various size and rates. In this system, we are going to control the speed and direction of dc motors. Productivity of material can be increased by increasing the speed of DC motor.

As per our requirements we control speed & this can be achieved by using ARM-7.In this, firstly supply voltage is given to the ARM-7 microprocessor.5V DC pulse is generated by processor which is called PWM signal.PWM signals then given to the driver circuit.Funtion of driver circuit is generate 12V DC pulse and this is necessary to switch or trigger the MOSFET.Using duty cycle speed of DC motor is control. In this control system we used MATLAB software for speed and direction control of DC motor.

DC motors are used in different ways as per their performance. For example the DC motor is used as an application for automobiles, boats, computers, airplanes, traction motors, and printers. DC motors are strongly needed in the extensive usage of DC motors in different applications.

2. LITERATURE SURVEY

Conducting literature survey prior to begin a research project is vital as this will supply us with much needed additional and information on the methodologies and technology available used by other research counterparts around the world on the topic. This chapter provides a condensed summary of literature reviews on key topics related to DC motor control.

While studying IEEE paper, we got the know DC Motor control has been used for variable speed and position applications for many decades and historically were the first choices for speed control applications requiring accurate speed control, controllable torque, reliability and simplicity. The basic principle of a DC variable speed drive is that the speed of a separately excited DC motor is directly proportional to the voltage applied to the armature of the DC motor. [1]

After studying this paper we got to know that in this project firstly they are giving the supply to PIC microcontroller. Then controller generates the pulse generally 5 volts DC, the generated pulse is nothing but PWM signal. This is giving it driver circuit. The function of this driver circuit is to generate 12v DC pulse. This is necessary to switch/ triggering on MOSFET for triggering purpose. [2]

We also got to know about how to use FPGA is monitoring the speed of the DC motor. In This paper the open loop and the closed loop control of theseparately excited DC motor using PI controller, fuzzy logic controller

and ANN controller simulation results are shown. The real time hardware implementation for speed monitoring and control of separately excited DC motor is made on SPARTAN-3E FPGA using Artificial neural network controller. The Controller is implemented in FPGA using VHDL using the concept of Digital System Design. In this paper, simulation results are presented and verified for different controllers to show that the performance and effectiveness of the ANN controller with the load disturbances is better compared to the fuzzy logic controller and conventional PI controller for the speed control of the DC motor. The scopes includes modelling of separately Excited DC motor, implementation of Artificial Neural Network Controller using FPGA and comparison of MATLAB/SIMULINK simulation result with the experimental result.[3]

We also studied a paper on FPGA Implementation of Three-Phase Induction Motor Speed Control Using Fuzzy Logic and Logic Based PWM Technique. This paper presents the design and implementation of FPGA based three phase induction motor speed controller using fuzzy logic and logic based PWM technique. Logic based pulse width modulation (PWM) generation method is used to vary the speed of induction motor. Using sine lookup tables and PWM programmed into the FPGA logic, control signals are generated to drive three phase integrated power module commonly used in AC induction motor drives. Fuzzy logic control (FLC) has developed growing interest in many industrial motor control applications due to its nonlinearity handling features and independence of modelling requirement. The hardware implementation of FLC on FPGA is vital because of the increasing number of fuzzy applications requiring highly parallel and high speed fuzzy processing.[4]

3. WORKING

The binary form of amplitude modulation is on off keying (00k).As he fully supressing the carrier the transmitter is off and the logical 0(data line low) should be sent at that time. IN this form the transmitter current in this form the transmitter current is very low i.e. less than 1MA at the stage when logical is sent the carrier must be fully on as the modulecurrent consumption goes highest about 11MA with a 3v power supply.

For the remote control application where power consumption and cost are the primary factors the on off keying method is to be used

Hence they transmit a 0, the transmitter draws no power they exhibits significantly better power consumption than the fsk transmitter.

As the high oscillators which have very stable centre frequencies they take longer to start up than low Q oscillators. The oscillator can send a maximum data rate
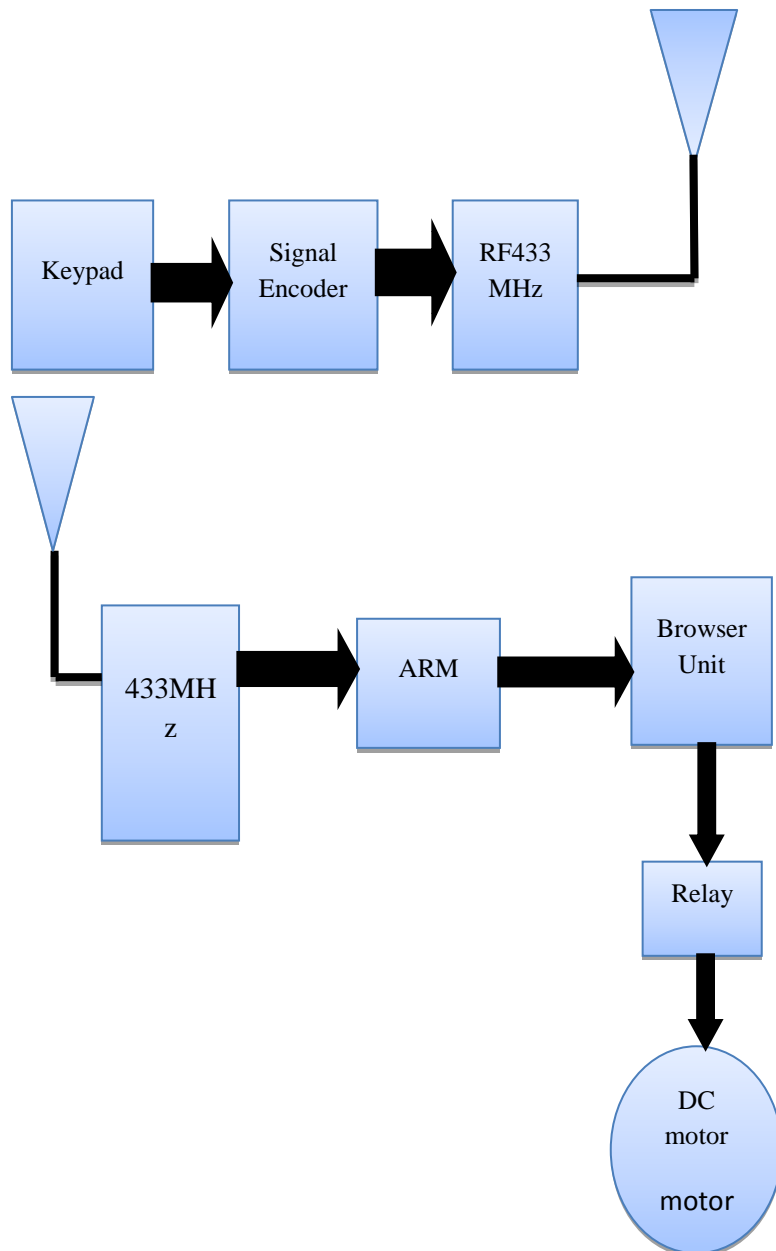
4. BLOCK DIAGRAM

Fig.4.1 block diagram of DC motor control

Block diagram for direction control and speed control of DC motor consist of following block

- Antenna input
- Signal encoder
- RF transmitter and RF receiver
- ARM 7
- DC motor

4.1Block diagram description

1. Antenna input

This device would support most of the antenna types, including antennas integrated directly onto the PCB.The

performances and characteristic of the different antennas varies. The wavelength of the frequency is longer than $1/8^{th}$ it is carrying; it should be a 50 ohm micro strip

2. Signal encoder

An encoder is a device that converts information or data from one format to another format. It can be a transducer, software program, algorithm or person that converts data. The main purpose of encoder is for standardisation, speed, secrecy, security or compression. For example, A multiplexer combines multiple inputs into one output.

Through RF encoder switches are interfaced to RF transmitter. The main purpose of Encoder is to continuously read the status of the switches, transfers the data to the RF transmitter. Then the RF transmitter transmits the data.

3. RF Transmitter

This is the RF signal transmitter block. The main function of RF transmitter is to transfer signal from the encoder. An RF module is small PCB sub assembly able to transmitter a radio waves. Modulation of that radio wave to carry data. Transmitter modules are implemented to provide data to the module which can be transmitted.RF Transmitter usually matter regularity requirements which prescribe the maximum transmitter power output.

4. RF Receiver

This is the RF signal receiving block. The RF receiver transmits the signal received from the RF transmitter. This signal is then given to decoder. An RF receiver module receives the modulated RF signal and this signal is demodulated. There are two type of RF module.

- Super heterodyne receivers.
- Super regenerative receivers.

Super regenerative module is low cost and low power design.it uses series of amplifiers to take out modulated data from a carrier wave. Whereas superhetrodyne receiver has a performance advantage over the super regenerative receiver.it offers high accuracy and stability over a large voltage and temperature range.

5. DC Motor

The vary basic construction of DC motor contains the current carryingarmature, which is connected to supply end through commutated segments,brushs and placed between south and north poles of a permanent or an electromagnet. Operating principal of DC motor is to determine the direction of force acting on armature conducts of DC motor.

Fig.4.2 working of DC motor

Electrical motors are everywhere around us. Electro-mechanical movements present in our surrounding are caused either by an DC or an AC motor. Above block diagram shows electrical energy to mechanical energy. Speed control means purposefully changing the speed of the speed to a required value for performing the particular work process. Speed regulation is the concept of speed control variation. The operator manually control the speed or it is done by means of some automatic control device. The most important feature of the DC motor is that it is relatively easy to control the speed. For constant torque this method is economically beneficial.

A DC motor means a direct current (DC) motor of used in models, robot, toys and cordless tools. These motor are versatile in nature because of their direction and speed can be readily controlled speed by duty cycle or voltage and direction by its polarity. DC motor provides different amount of torque depending on their speed which is measured in revolution per minute. Motor power are measured in torque as higher the torque of motor the more weight it can move. At low RPM DC motor provides poor torque. However, in high torque the speed may be too high for an application
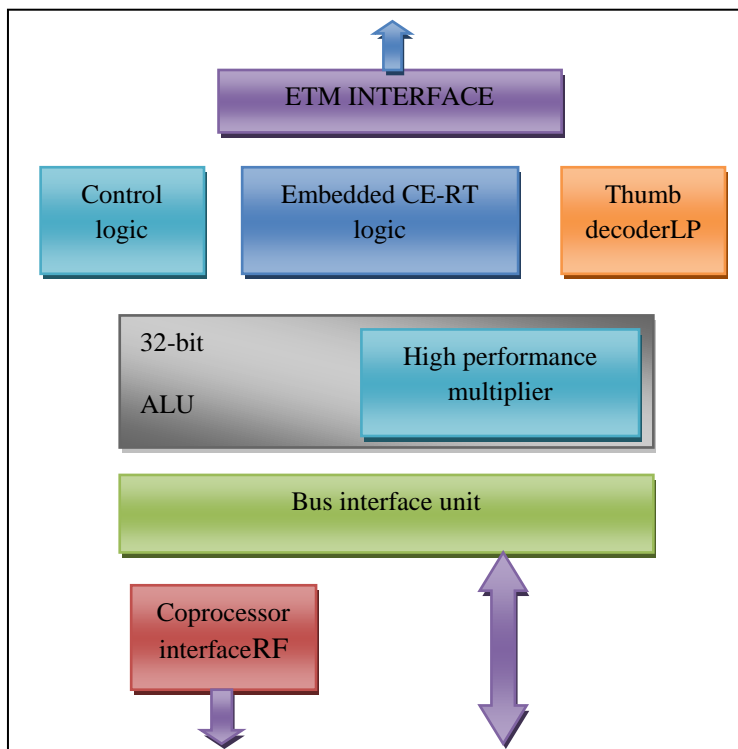
5. ARCHITECTURE OF ARM-7
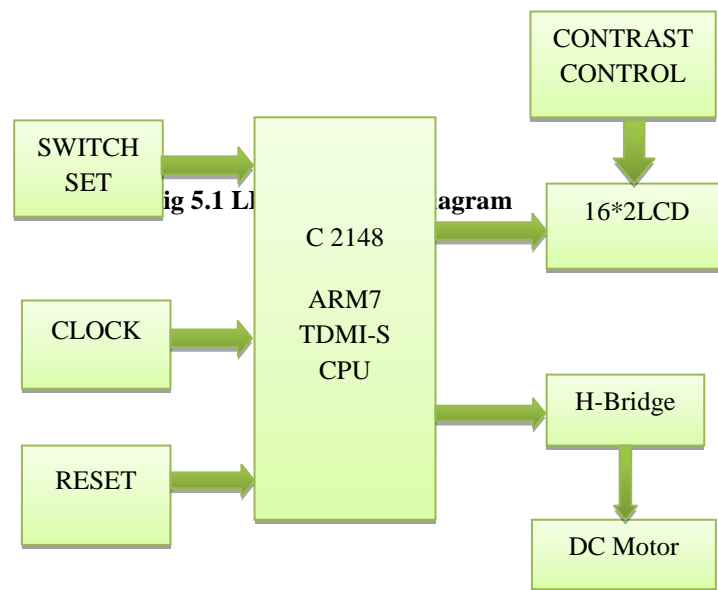
Fig 5.2 Architecture of ARM7

The ARM-7TDMI-S is a general purpose 32-bit microprocessor. It offers high performance and very low power consumption. The architecture of ARM 7 is based on reduced instruction set computer (RISC) principles, instruction set and the decoder mechanism. The reduced instruction set computer (RISC) is simpler than the complex instruction set computer (CISC).due to this it results in a high instruction throughout and impressive real time interrupt response from a small and cost effective processor core.

All part of the processor and memory system can operate continuously using pipeline techniques. When one instruction is executed, its next instruction is being decoded, and the third instruction is being fetched from the memory.ARM-7 processor has mainly two instruction set

- The standard 32-bit ARM set
- A16-bit Thumb set

Advantage of ARM processor over traditional 16-bit processor using 16-register is it allows double density of standard ARM code. It is possible due to Thumb code operation on the same 32-bit register set as ARM code

ARM instruction set consist of data processing instructions, data transfer instructions, control flow instructions and simple assembly language programs. These instruction set move data between ARM registers and memory

The ARM7TDMI has seven modes of operations like user mode(usr),fast interrupt mode(fiq),supervisor mode(svc),abort mode(abt),system mode(sys) and undefined mode(und).all modes are known as privileged mode except user mode.

The LPC 2148 microcontroller is based on a 16 bit or 32 bit ARM7 TDMI-SCPU with real time emulation and

embedded support. This combines the microcontroller with embedded high speed flash memory ranging from 32KB to 512KB.A unique accelerator and a 128 bit wide memory interface enable 32 bit code execution at maximum clock rate. The 16 bit thumb mode reduces code by more than 30% with minimum performance for different code size.

Due to their small size and low power consumption LPC2148 are ideal for different application where access control and point of sale is the main requirement. They are very prevalent in low power embedded applications such as iPods, palm pilots, and network routers.

5.1 Key features

- A tiny LQFP64 package consist of 16-bit/32-bit microcontroller.
- 32 Kb to 512 Kb of on chip flash memory and 8 Kb to 40 Kb of on chip static RAM.
- Interfacing enables high speed 60MHz operation in the wide range of 128 bit
- High speed tracing of instruction execution and the real time debugging with on chi real monitor software are interfaces with embedded ICE RT and embedded trace.
- 2kb of endpoint RAM device controller is the USB 2.0 full speed.
- On chip RAM accessible device to USB by DMA having an additional feature of LPC 2148/46 that provides 8KB.
- Fast general purpose I/O up to 45 of 5v in a tiny LQFP64 Package
- An external crystal from 1MHZ to 25MHZ is operated on the on-chip integrated oscillator.
- Vectored interrupt Controller (VIC) with configurable priorities and vector addresses.
- Power saving modes include idle and power-down
- For additional power optimization, individual enable/disable of peripheral functions as well as peripheral clock scaling is used.
- UARTs, two fast I2C-bus, SPI and SSP are included in multiple serial interfaces
- Up to 21 external interrupt pins available.

6. SOFTWARE DSCRIPTION

1.Keil

2.Embedded C

3 .Express PCB

4. Express schematic

Using MATLAB/PROTEUS software we have done modulation and simulation of this project.

Proteus is one of the best simulation software for various design purpose. Availability of almost all microcontrollers in it is popular. It is a very easy and hand tool to test programs and embedded designs for electronics.one can simulate their program in Proteus simulation software. After the simulation process, circuit in proteus software can directly make PB designs it could be all in one package for students and industries.

Matlab is extensively used in education and industry because of it mathematical programming environment. In Matlab is declared in different form like identified matrix, random matrix, scalar matrix, vector matrix etc. different type of arithmetical operation can be perform on matlab like addition, subtraction multiplication, division. Using matlab we can transpose our matrix to another regular matrix and complete row or columns addressing. Loading and saving of information and defining different function is convenient in Matlab

Matlab is an integrated technical computing environment that combines numeric computation, advanced graphics and visualisation and a high level programming language. Nowadays lots of engineers and scientist use matlab

After obtaining the complete model of DC drive system, the model is simulated by MATLAB

7. ADVANTAGES

- Control of speed and direction by remote
- LCD displays speed level and direction
- Errors related with humans are minimized
- Human related risks are eliminated
- Time variant and cost effective
- It is highly reliable and consumes less power
- Installation of operation is easy

8. APPLICATION

- Process, control, inventory tracking, data links and bar code reading devices are used for RF solutions in the industries.
- Security and access systems, gate control, remote activation, score board and paging systems these are the commercial wireless applications.
- Wireless remote control, remote keyless entry and safety applications these are employed RF by the automotive companies.
- Gate and garage door openers, home security are known as consumer products.
- Medical products-
  1. patient call and monitoring
  2. surgery communication system
  3. ECG monitor
  4. Handicap assistance device
  5. Remote patient data logging
- Uses-
  1. Domestic and industrial application
  2. In mines and geological department for explosives
  3. R&D department
  4. in process control industries
  5. for handicapped people.

9. CONCLUSION

High performance DC motor drives are the robotic manipulators, electric trains like as metro, in the chemical process, and the rolling mills as well as the home electric appliances requires speed controllers to perform tasks these are the recent developments skills in science and technology

provide a wide range scope of applications. Speed, torque and even direction of rotation these functions can be changed at any time to meet new condition, that means DC motor speed control capabilities. Our goal of project is by using ARM7 microprocessor to design a DC motor speed control and direction control.

When there is a variation of load the processor will maintain the speed at the desired speed. We will vary the PWM signal from the microprocessor to the motor driver motor speed can be controlled back to desired value easily.

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