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DC MOTOR CONTROL USING AT80S52 MICROCONTROLLER

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ABSTRACT:

The project aims at developing a speedcontrol system for DC motors in four quadrants i.e. clockwise, anti-clockwise, forward brake and reverse brake. The project is useful to be used in industries for moving motors in both directions i.e. clockwise and anti-clockwise and can even apply forward and reverse brakes whenever required. The brakes functions by applying a reverse voltage in the motor for certain time. The speed is controlled by generating PWM pulses from microcontroller of 8051 family. A pair of push buttons is interfaced to microcontroller which is interfaced to operation motor by motor driver IC. The signals from the button are input to the microcontroller that in turn actuates motors in controlling speed.

(1).INTRODUCTION

Engineering design success depends in great part on reducing the time spent creating modules, mechanisms and machines. The use of accurate mathematical models can speed up the design process, and minimize the time wasted on trial and error design methods. Trial and error design methods are inefficient and costly. Matching a motor to a specific application is not easily accomplished through trial and error. Moreover, the necessity of purchasing and testing many dozens of motors is economically wasteful and time consuming. Instead, best practices make use of mathematical models early in the design process. The functional requirements and design parameters of a motor system can be determined early in the design process and manufacturer's published motor data can be researched in an attempt to find a suitable match. Designers andengineers use mathematical models to optimize the time spent designing modules, mechanisms and machines by: Reducing the number of possible items in the selection set andReducing testing and prototyping time.

1.1. Existing system:

Existing system does and the problem are and leads to a definition of a set of options from which users may choose their required system. This section will be discussing about the domain of this project, the existing system and finally the other techniques that applicable to be used while developing this project. It focused on the how to design and develop the project systematically according to the requirement of minimize the functional of conventional project how to control DC motor in different directions.

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1.2. Proposed System:

Pulse Width Modulation (or PWM) is a technique for controlling power. We use it here to control the amount of power going to the motor and hence how fast it spins. The diagram below shows the signal from the PWM pin of the Raspberry Pi. Every 1/500 of a second, the PWM output will produce a pulse.

1.3. Objectives:

Use experimental data to create mathematical models of motor performance. Use experimentally determined motor performance data along with manufacturer's published data to make useful predictions about DC motor performance. Use their understanding of Newton's laws of motion, torque and rotational speed to compute the performance requirements of a DC motorsystem.Use engineering methods and mathematical models in an effort to most closely match DC motor performance to a given set of functional requirements and design parameters.

1.4. Pulse Width Modulation (PWM)

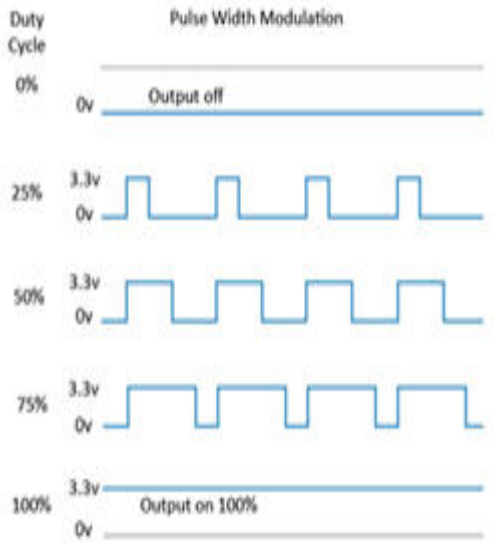

Fig 1 Pulse Width Modulation

1.5.PWM Duty Cycle

This post will demonstrate how to use Pulse Width Modulation (PWM) on the Raspberry Pi with Python programming. PWM is often used to control motors including servo motors used in robots and automation, lights and other electronic devices.

Digital output is either on or off. It cannot vary between on and off as analog output can. If an LED or motor is connected to a normal digital output, it will only operate at full on (output on) or full off (output off).With the use of PWM, we can simulate varying levels of output energy to an electrical device. At any given time, the digital output will still be on or off. But, we can pulse the output with varying widths to control the amount of effective output. Shorter on cycles compared to the off cycle will deliver lower overall output. Longer on times relative to the off time deliver higher overall output. This relationship between the on and off duration is called "duty cycle" and is measured in percent of on time compared to the off time. Thus a 25% duty cycle will have an on time 25% of the total cycle with 75% off. A 50% duty cycle will have equal on and off times. With PWM we can vary the duty cycle from 0% to 100%.We can now use Python to configure Pi's pin number 12 for PWM and then vary the duty cycle. To demonstrate the varying duty cycle we will vary pin 12 from 0% to 100%. This will cycle the LED from full off to increasing levels of brightness until full on. Then we will reverse the cycle from full on and dim the LED until full off, and repeat.

PWM (Pulse Width Modulation) is a modulation technique by which the width of pulse is varied while keeping the frequency constant.

Through PWM technique, we can control the power delivered to the load by using

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ON-OFF signal. The PWM signals can be used for applications such as controlling the speed of DC motors, changing intensity of an LED, controlling Servo motors, etc. The GIF shown below depicts the use of PWM for intensity control of an LED.

1.6. EMBEDDED SYSTEMS

DEFINITIONS:

Embedded system is a combination of hardware and software, it is also named as "Firm ware". An embedded system is a special purpose computer system, which is completely encapsulated by the device it controls. It is a computer-controlled system. An embedded system is a specialized system that is a part of a larger system or machine. As a part of a larger system it largely determines its functionality. Embedded systems are electronic devices that incorporate microprocessors with in their implementations. The main purpose of the microprocessors are simplify the system design and improve flexibility. In the embedded systems, the software is often stored in a read only memory (RAM) chip. Embedded systems provide several major functions including monitoring of the analog environment by reading data from sensors and controlling actuators.

(2) Literature survey:

Literature survey is the most important step in Hardware and software development process. Before developing the tool it is necessary to determine the time factor, economy n company strength. Once these things r satisfied, ten next steps are to determine which operating system and language can be used for developing the tool. Once the programmers start building the tool the programmers need lot of external support. This support can be obtained from senior programmers, from book or from websites. Before building the system the above consideration r taken into account for developing the proposed system.

(3) Hardware Components

A)MICROCONTROLLER (AT89S52)

This project employs the 8-bit microcontroller from ATMEL (AT89S52). The microcontroller in our security system is used for sending signals to the auto dialer and buzzer alarm. A number is already stored in the EEPROM of the microcontroller. When a logic low signal appears at the pin 1 of the microcontroller, the number stored in the memory is sent to the auto dialer.

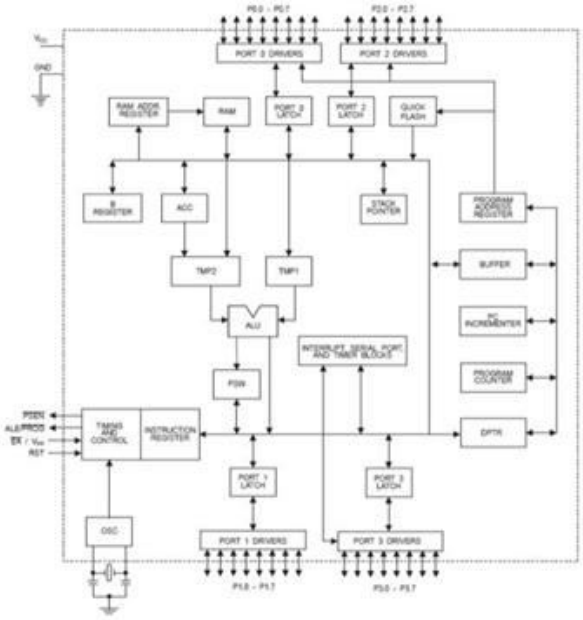

Fig.2. Block Diagram of Microcontroller

Description of 8952 Microcontroller:

The AT89S52 provides the following standard features: 8Kbytes of Flash, 256 bytes of RAM, 32 I/O lines, three 16-bit timer/counters, six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes.

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The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power down Mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next hardware reset. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcomputer which provides a highly flexible and cost effective solution to many embedded control applications with MCS-51 Products.

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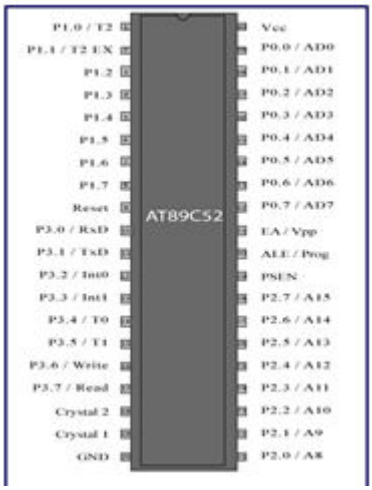

Fig.3.Pin Description:

(B) INTRODUCTION TO DC MOTOR:

An electrical motor converts electrical power to mechanical power.In DC motor power is supplied to the armature directly from a DC source.100 RPM - 12V Centre Shaft DC Geared Motor. Dc motors are widely used in robotics for their small size and high energy output.The typical DC motors operate on as few as 1.5 volts on up to 100 volts.Roboticists often use motors that operate on 6 12 or 24 volts.A low voltage(e.g.12 volts or less) DC motor may draw from 100MA to several amps atstall depending on its design. Main characteristics of DC Motors include: High Speed, Low Torque, Reversibility and Continuos Motion.

Fig 4 DC MOTOR

The DC motor is electric motor that runs on direct current electrically.DC motor works based on the LORENTZ FORCE.In DC motor voltage is proportional to speed.

ADVANTAGES

- Low initial cost
- High reliability
- Simple control of motor speed
- Speed of DC motor is controlled by armature voltage control method
- As the amount of time that the voltage is ON increases compared with the amount of that is OFF, the average speed of the motor increases.

(c) BRIDGE RECTIFIER:

Among the rectifiers, the bridge rectifier is the most efficient rectifier circuit. We can define bridge rectifiers as a type of full-wave rectifier that uses four or more diodes in a bridge circuit configuration to efficiently convert alternating (AC) current to a direct (DC) current.

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Advantages:

- The efficiency of the bridge rectifier is higher than the efficiency of a half-wave rectifier. However, the rectifier efficiency of the bridge rectifier and the center-tapped full-wave rectifier is the same.
- The DC output signal of the bridge rectifier is smoother than the output DC signal of a half-wave rectifier.
- In a half-wave rectifier, only half of the input AC signal is used and the other half is blocked. Half of the input signal is wasted in a half-wave rectifier. However, in a bridge rectifier, the electric current is allowed during both positive and negative half cycles of the input AC signal. Hence, the output DC signal is almost equal to the input AC signal.

Disadvantages:

- The circuit of a bridge rectifier is complex when compared to a half-wave rectifier and center-tapped full-wave rectifier. Bridge rectifiers use 4 diodes while half-wave rectifiers and center tapped full wave rectifiers use only two diodes.
- When more diodes are used more power loss occurs. In a center-tapped full-wave rectifier, only one diode conducts during each half cycle. But in a bridge rectifier, two diodes connected in series conduct during each half cycle. Hence, the voltage drop is higher in a bridge rectifier.

(c)transformer:

A transformer is static (or stationary) piece of apparatus which:

1. Transfers electric power from one circuit to another.

2. It does so without a change in frequency.

3. The principle is based on mutual induction between two circuits linked by a common magnetic flux.

Basic parts of a transformer:

Basically a transformer consists o f a :

1. A primary coil or winding.

2.A secondary coil or winding.

3.A core that supports the coils or the windings.

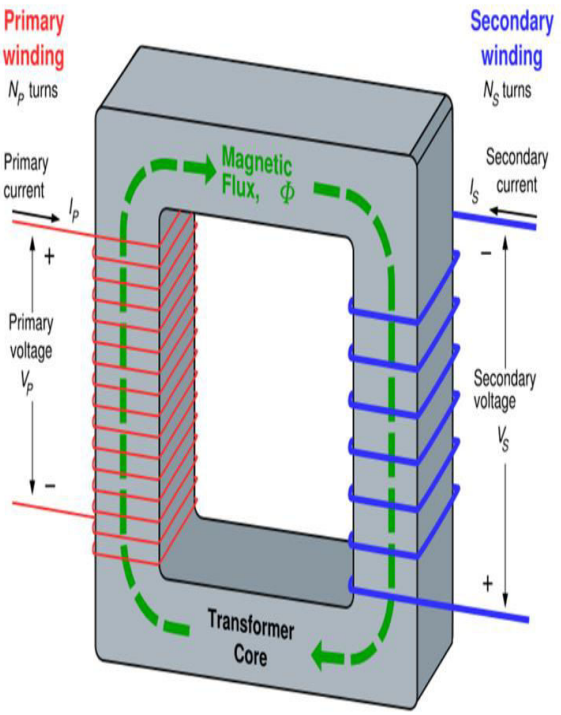

Fig 5 Transformer

Transformer construction:

Main constructional elements of Transformers are -

A) Magnetic circuitCore & clamping structure

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B) Electric Circuit Winding,Insulation,Bracing devices.

C) Terminals Tapping, Tapping switches, Terminal, Insulator, Leads, Bushings

D) Tank Oil, Cooling devices, conservator, piping, Breather

E) Protective Circuit Buchholz relay, WTI, OTI, Oil surge relay & Monitoring pressure relief device, MOG

Transformer construction:

A) Magnetic Circuit:
The core provides closed path for flux. It is made up of CRGO insulated laminations. (CRGO has iron loss of about 1.3 W / Kg at 1.6 Tesla)

B) Electric Circuit:
Winding, insulation & bracing are constructional parts of electrical circuit of transformers. This is the most vulnerable part of transformer because of direct association with power system. Must be designed to withstand voltage stress resulting from system fault, transient over voltage and thermal stresses (lightening or switching surges)

(D) 7805 Voltage Regulator IC:

7805 Regulator Features

- 5V Positive Voltage Regulator
- Minimum Input Voltage is 7V
- Maximum Input Voltage is 25V
- Operating current(I_Q) is 5mA
- Internal Thermal Overload and Short circuit current limiting protection is available.
- Junction Temperature maximum 125 degree Celsius
- Available in TO-220 and KTE package

Table 1 Pin diagram of 7805 Voltage Regulator IC

Pin Number	Pin Name	Description
1	Input (V+)	Unregulated Input Voltage
2	Ground (Gnd)	Connected to Ground
3	Output (Vo)	Outputs Regulated +5V

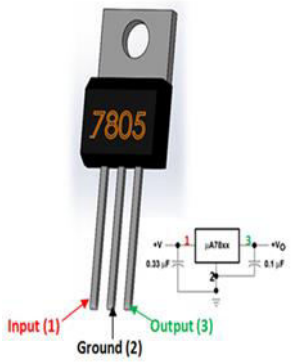

Fig 6 7805 Voltage Regulator IC

(E) VOLTAGE REGULATOR-LM7805:

- Three-terminal positive regulator
- Used with external components to obtain adjustable voltages and currents
- Used for thermal overload protection
- Output current to 1.5 A
- Output voltage to 5V

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Fig 7 Voltage Regulator-Lm7805

(E) Potentiometer:

- A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. If only two terminalsare used, one end and the wiper, it acts as a variable resistor or rheostat.
- A potentiometer is an instrument for measuring voltage or 'potential difference' by comparison of an unknown voltage with a known reference voltage.

Applications:

- DC Motor are found everywhere: robots, drones, RC Cars, etc. By Controlling a DC Motor with Microcontroller, we can develop many motor related projects using Microcontroller.
- Can be used in Microcontroller based robotic applications like Line Follower Robot, Obstacle Avoiding Robot, Quadcopter, Web Controlled Robot etc.
- ROBOTIC CONTROLS.
- SWING MACHINES.
- ELECTRONIC BIKES.
- WINDING MACHINES.
- DC OPERATED DRILL MACHINES.
- MOBILE AIR CONDITION FANS.
- TOYS.
- ELCTRONIC DOOR CONTROLLERS.
- ELECTRONIC CHAIRS (beauty parlor etc.)

(4) CONCLUSION:

The motor responds to the average value of the pulses and not to the individual pulses as the chopper works at high frequency. Changing the duty-cycle of the pulse by changing the speed of regulator changes the average voltage level. It is possible to improve overall performance of the motor speed. We have achieved the required speed and thyristor is a very good device for obtaining the variable DC there by controlling the motor speed. This circuit is just a basic circuit for understanding DC motor speed control. In case of HWR we got zero voltage in negative half cycle that's why has power efficiency.

Future work:

We will focus on improvement of above proposed work and adding features to make a reliable smart Industrial monitoring and controlling system. This paper presents the concept of detection and monitoring of motor control system. The system has been designed to combine various parameter measurements in real-time, improving the delectability of different faults. The monitoring of the motor system presents the measurement of different parameters namely speed, RPM. The data received by the coordinator node is stored and graphically presented in real-time by means of a application developed in visual basics.

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