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D.C. MOTOR SPEED CONTROL AND COMMUNICATION THROUGH CANBUS PROTOCOL

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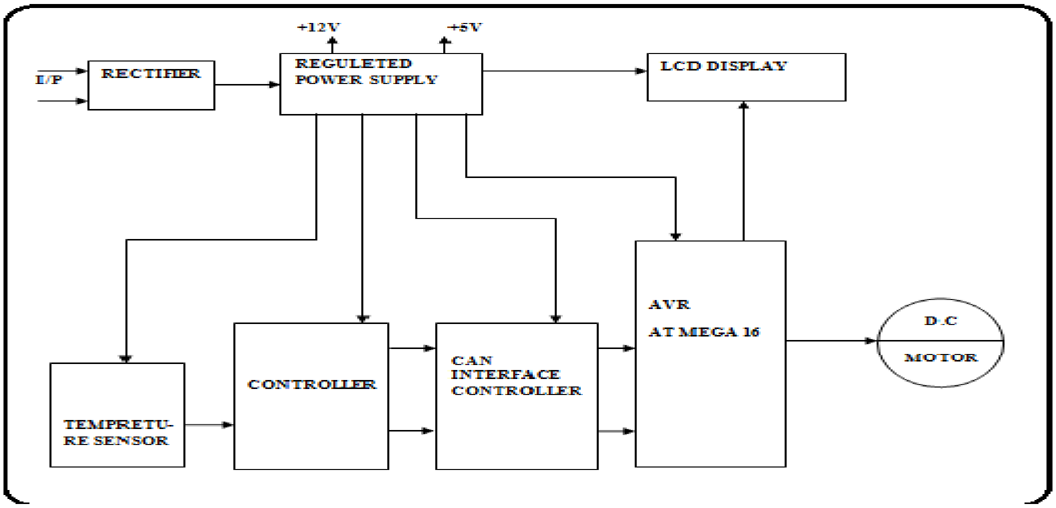
***Abstract* --** This paper describes how to control the DC motor based on the parameters like temperature changes using CAN protocol implementation. This Paper deals with the Control of DC Motor based upon the temperature changes that occur in a process in Industry. The LM35 series are precision integrated circuit temperature sensors, whose output voltage is directly proportional to the Celsius (Centigrade) temperature. The Temperature changes are measured by the ADC and transmitted to the other node using the CAN Bus and the data is received at the other node based upon the data received the speed of the DC motor is Regulated using the PWM (pulse width Modulation) Technique. The Controller Area Network (CAN) is a Serial, Asynchronous, Multi-master communication protocol for connecting electronic control modules in Automobile and industrial applications. CAN have many features like less cost, Ease of implementation, point to point Networking with powerful Error Checking and with High Transmission Rate of 1MBitps.The CAN Network is a Peer to Peer Network consisting of different nodes. Different parameters can be monitored by these Nodes and can be updated to the Central Control Unit. The CAN bus is used in vehicles to connect engine control unit and transmission, or (on a different bus) to connect the door locks, temperature control, seat adjustments etc.

***Keywords*- CAN, Brushless DC motor, LM 35 temperature sensor, AVR controller, AVR studio.**

I.INTRODUCTION

CAN is a message based protocol, designed for various applications like automotive applications, industrial automation and medical equipment. This paper describes the design of a system that shows the operation of several subsystems emulating automotive and industrial applications across the CAN bus. Controller–area network (CAN or CAN bus) is a vehicle bus standard designed to allow microcontrollers and devices to communicate with each other within a vehicle without a host computer.CAN is a message based protocol, designed for various applications like automotive applications, industrial automation and medical equipment. This describes the design of a system that shows the operation of several subsystems emulating automotive and industrial applications across the CAN bus. The temperature sensor lm35 measures the temperature at the industries and send the analog values to the AVR controller. The analog outputs of the sensors are digitized in the AVR controller and based upon the programming in the controller, control measures are to be taken by using the can controller by driving the motors. Here the programming is done using embedded C. The AVR processor stores it's transmit messages to a CAN controller that transmits the bits serially through the bus. The Controller Area Network (CAN) is a Serial, Asynchronous, Multi-master communication protocol for connecting electronic control modules in Automobile and industrial applications.

II.BLOCK DIAGRAM



Block diagram of DC motor speed control

The temperature sensor lm35 measures the temperature at the industries and send the analog values to the AVR controller. The LM35 [5] series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The analog outputs of the sensors are digitized in the AVR controller and based upon the programming in the controller, control measures are to be taken by using the can controller by driving the motors. Here the programming is done using embedded C. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range.

III.DESCRIPTION

A.CAN Bus Overview

The Controller Area Network (CAN) bus is a multi-master message broadcast system that is used in various systems where data is in the form of short messages are needed to be received at multiple locations parallely. As messages are sent to all the nodes in a system, CAN is especially used in systems where consistency in the received messages at all the receiving nodes is needed. Provisions are included in the protocol to reject messages if any destination node identifies an error. In Such a case, all nodes are notified of the rejection, ensuring the data consistency across the network [6]. Messages are sent to all nodes, but the message identifier indicates whether each node should act on the message. However, every node participates in indicating whether the message was sent correctly or not, and thus increasing the reliability of the bus. CAN is a multi-master broadcast serial bus standard for connecting electronic control units (ECUs).Each node is able to send and receive messages, but not at same time. The message consists primarily of an id, which represents the priority of the message, and 8 data bytes. It is transmitted serially to the bus. The modules that are connected through CAN network are typically sensors and other control devices [7].

B. Node Requirements

The host processor decides what received messages mean and which messages it wants to transmit itself. Sensors and control devices can be connected to the host processor.

C. CAN controller

1) Receiving: The CAN controller stores received bits serially from the bus until an entire message is available, which can then be fetched by the host processor (usually after the CAN controller has triggered an interrupt).

2) Sending: The host processor stores it's transmit messages to a CAN controller that transmits the bits serially through the bus.
Bus state with two nodes transmitting

	Dominant	**Recessive**
Dominant	Dominant	Dominant
Recessive	Dominant	Recessive

Truth table for dominant/recessive.

D. Data Transmitter

A CAN message that is transmitted with highest priority will succeed and the node that is transmitting the comparatively lower priority message will sense this and wait. The CAN bus has two states: Dominant and Recessive. A dominant state occurs when the differential voltage between CANH and CANL is greater than a defined voltage. A recessive state occurs when the differential voltage is less than a defined voltage (typically 0V). The dominant and recessive states correspond to the low and high state of the TXD input pin, respectively. However, a dominant state initiated by another CAN node will override a recessive state on the CAN bus. This is achieved by CAN [8] transmitting data through a binary model of "dominant" bits and "recessive" bits where dominant is a logical 0 and recessive is a logical 1. If one node transmits a dominant bit and another node transmits a recessive bit then the dominant bit "wins" (a logical AND between the two).

Logical AND

	0	1
0	0	0
1	0	1

Truth table for logical AND

A dominant bit is asserted by creating a voltage across the wires while a recessive bit is simply not asserted on the bus. If any node sets a voltage difference, all nodes get updated about it. Thus there is no delay to the higher priority messages.

E. Data receive

The RXD output pin reflects the differential bus voltage between CANH and CANL. The low and high states of the RXD output pin correspond to the dominant and recessive states of the CAN bus, respectively.

F. Brushless DC MOTOR

Brushless DC motors utilize the same electromagnetic phenomenon as brushed motors in order to produce mechanical rotation - the force which is exerted on a current carrying conductor placed in a magnetic field [4]. A brushless motor is mechanically simpler than a brushed motor and typically consists of two main parts;

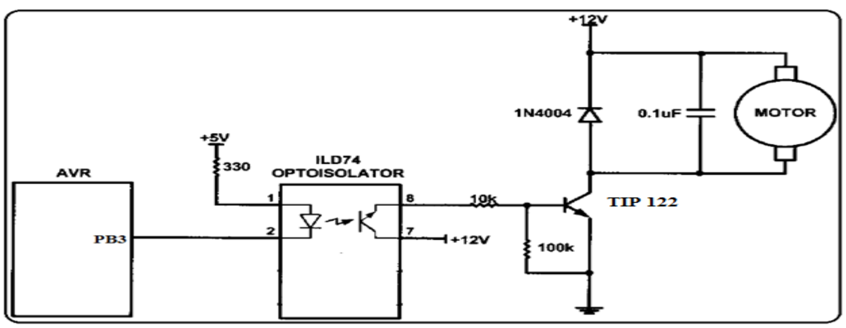
Stator: - The stationary part of the motor around which the rotor revolves. The stator typically takes the form of a central, axially mounted assembly which houses the motor windings, electronics and bearings which hold the rotor in place.

Rotor: - The rotating part of the motor, mounted outside of the central stator. The rotor usually holds the motor's permanent magnets.

One way to consider the construction of a brushless motor is as an "inside out" brushed motor. In a brushed motor, the rotor (rotating part) holds the motor windings and the stator (stationary part) holds the motor magnets. In a brushless motor, this arrangement is reversed. The motor coils are stationary, the magnets rotate and the rotor is on the outside [2].

G. DC MOTOR CONTROL WITH OPTOISOLATOR

Optoisolator for single directional motor control, and the same principle should be used for most motor applications. Separating the power supplies of the motor and logic will reduce the possibility of damage to the control circuit. The connection of a bipolar transistor to a motor. Protection of the control circuit is provided by the optoisolator. The motor and AVR use separate power supplies.



DC motor connection using a Darlington transistor

The separation of power supplies also allows the use of high-voltage motors. We use a decoupling capacitor across the motor; this helps reduce the EMI created by the motor. The motor is switched on by clearing bit PB3.

H. PULSE WIDTH MODULATION (PWM)

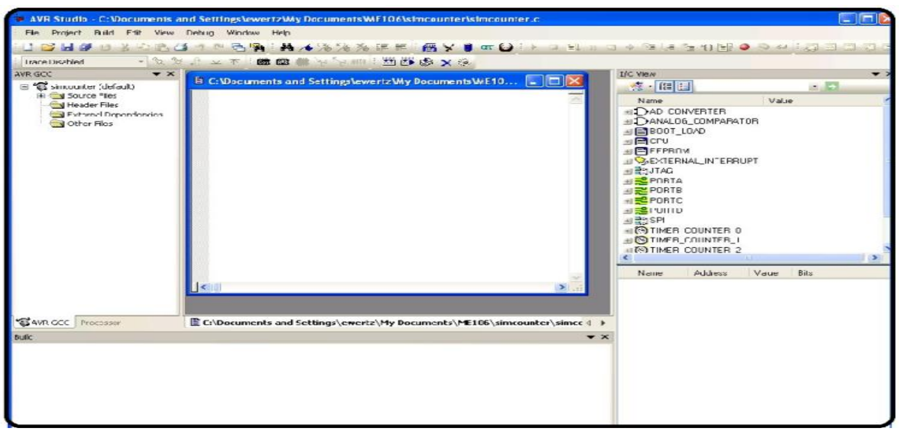
The speed of the motor depends on three factors: (a) load, (b) voltage, and (c) current. For a given fixed load we can maintain a steady speed by using a method called pulse width modulation (PWM). By changing the width of the pulse applied to the DC motor we can increase or decrease the amount of power provide to the motor, thereby increasing or decreasing the motor speed. Although the voltage has fixed amplitude, it has a variable duty cycle. That means the wider the pulse, the higher the speed. PWM is so widely used in DC motor control that some microcontrollers come with the PWM circuitry embedded in the chip.

I. AVR IMPLEMENTATION INTRODUCTION

A microcontroller often serves as the "brain" of a mechatronic system. Like a mini, self-contained computer, it can be programmed to interact with both the hardware of the system and the user. Even the most basic microcontroller can perform simple math operations, control digital outputs, and monitor digital inputs. AVR microcontrollers are much faster, have more memory, and have a host of input and output features that dwarf the ability of earlier models. Most modern controllers have analog-to-digital converters, high-speed timers and counters; interrupt capabilities, outputs that can be pulse-width modulated, serial communication ports, etc [1].

J. AVR STUDIO

It is often believed that without target hardware it is difficult, if not impossible, to develop and test software for a microcontroller project. This is often not the case as many of the microcontroller manufacturers offer software simulators that exist for just this purpose. Microcontroller programs produce outputs dependent on the program's current state and inputs. A simulated stream of inputs can be provided for every general-purpose digital input pin on the microcontroller being simulated. This is done by providing what is called a stimulus file, which is really just a time-line containing the state of some or all of the inputs at every point in time.



Window layout in AVR studio

A project is composed of a list of files to be compiled, the compiler settings, the configuration of the chip being developed for, as well as the layout and contents of the various windows on the screen, etc.

IV. ADVANTAGES

- Easy to implement and extend.
- Well-suited for temporary or small networks not requiring high speeds (quick setup) resulting in faster networks.
- Less expensive than other topologies (But in recent years has become less important due to devices like a switch)
- Cost effective; only a single cable is used.
- Easy identification of cable faults. The breakdown of a CAN station has no immediate impact on the CAN bus. All the other stations can communicate unconstrained.

V. CONCLUSION

In this project we have implemented industrial parameter control through CAN protocol by using AVR ATmega16 microcontroller. By using CAN protocol a vehicle bus standard designed to allow microcontroller and devices to communicate with each other within a vehicle without a host computer. The sensors and other control devices that are connected by CAN protocol.

ACKNOWLEDGMENT

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