Chapter 1: INTRODUCTION

1.1 AIM OF PROJECT

The goal is to make automobiles more reliable, safe and fuel-efficient while decreasing wiring harness weight and complexity. In this project we are implementing various sensors over CAN that is attractive alternative in automation industries due to its ease in use , low cost and provided reduction in wiring complexity.

It was developed by Robert Bosch for communication between various digital devices inside automobiles where heavy electrical interference and mechanical vibrations are present. By networking electronics in vehicles with CAN, however, they could be control from central point, that is Electronic Control Unit (ECU), thus increasing functionality, adding modularity, and making diagnostic processes more efficient. This system can be implemented in various other applications such as home automation , in hospitals , security purpose etc and can reduce human effort of current scenario of India.

1.2 SALIENT FEATURE

a. CAN protocol based controlling which is of ISO 11898 Standard.

b. Microcontroller based interfaced using 8051 MCU (89V51RD2).

c. For sensing engine temperature i.e. RTD.

d. Pressure measurement using pressure sensor.

e. Powered by 12V DC power supply.

f. It reduces human interference.

g. Max 112 nodes can be connected within the Bus

1.3 Literature survey

Vehicle control system implementation using CAN protocol discussed in emphasizes the development and implementation of a digital driving system for a Semi-autonomous vehicle to improve the driver-vehicle interface. It also takes feedback of vehicle conditions like Vehicle speed, Engine temperature etc. The development of such a control framework for the vehicle which is called the digital-driving behaviour consists of a joint mechanism between the driver and vehicle for perception, decision making and control.

CAN has been used as a device which can enhance the utility, performance, speed & security of a system. Two CAN nodes are connected by 2 Mbps CAN bus.
The CAN protocol differs from other protocols with respect to time-triggered communication.
CAN reduce communication overhead and supports a high efficiency and flexibility in the time-triggered traffic.

Chapter 2: DEVELOPMENT STAGES

2.1 PROBLEM DEFINITION

2.1.1 PROBLEM STATEMENT

Although some vehicles have provisions for deciding to either generate warnings for the human driver or controlling the vehicle autonomously, they usually must make these decisions in real time with only incomplete information. So, it is important that human drivers still have some control over the vehicle.

To network the electronics in vehicles in order to make it more comfortable and convenience using different automation leads to incorporate enormous amount of wiring.

2.1.2 SOLUTION TO THIS PROBLEM

As per issues Advancement in-vehicle information systems provide vehicles with different types and levels of intelligence to assist the driver.

We are implementing can bus protocol for vehicle automation so as to come up with the solution for problems.

Basically, here we are interfacing various device to a central unit ECU so we can monitor various vehicle parameters such as engine temperature, fuel level.

2.2 DESIGNING OF BLOCK DIAGRAM

At this stage we have categorized the whole system into different individual modules. The modules (block diagram) will be helpful in understanding the concept and working of the system.

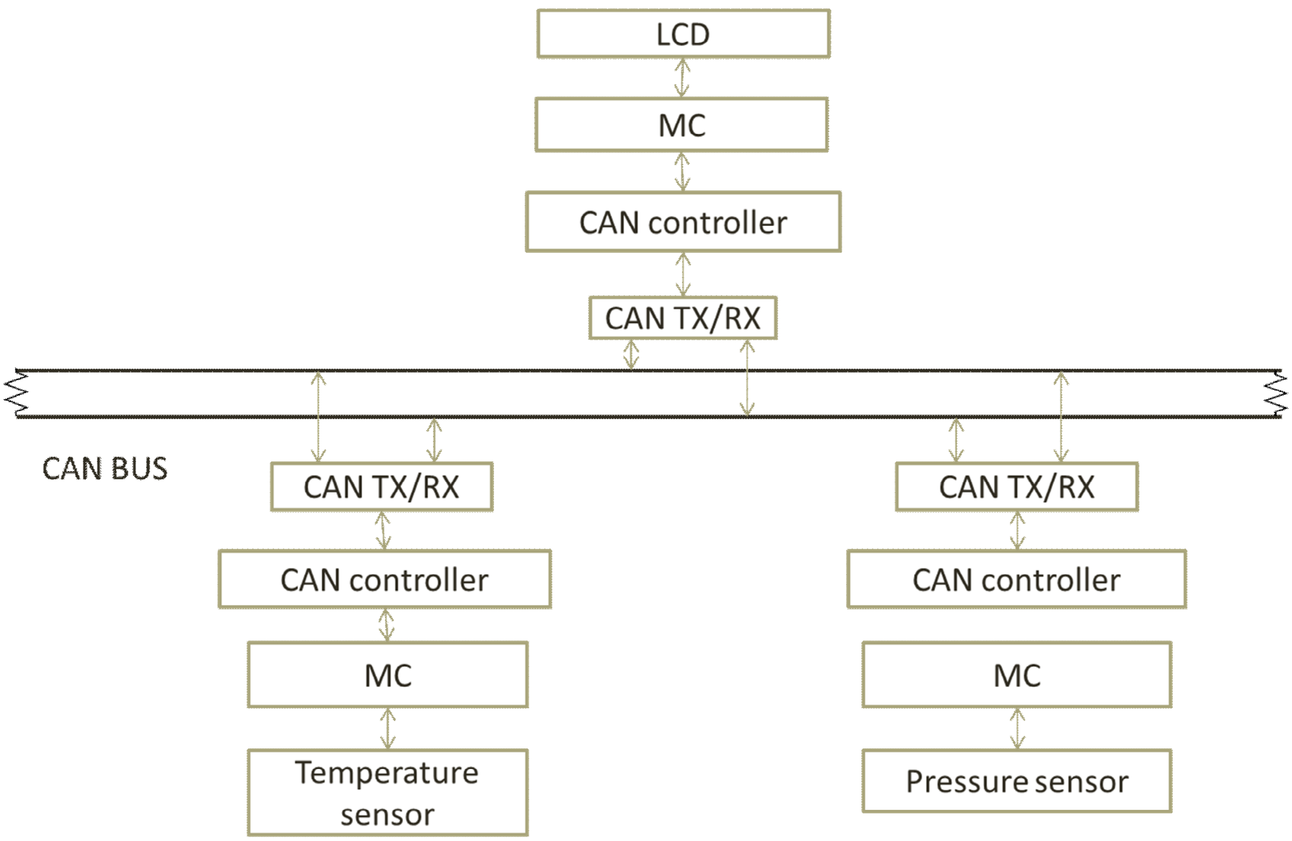


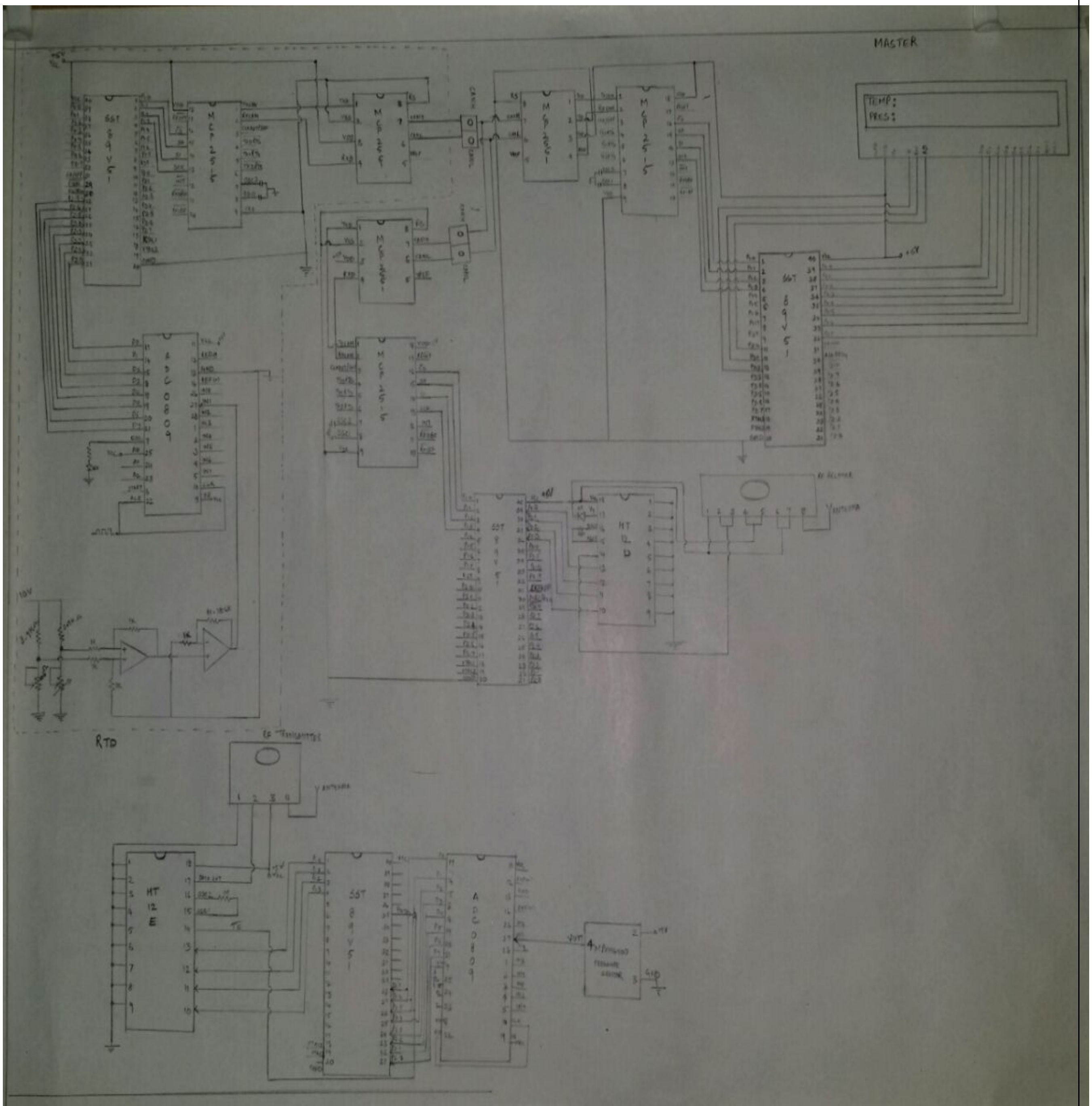
Fig1: BLOCK DIAGRAM

2.3WORKING

This system monitors the engine temperature and pressure of tyre continuously examining the changes in the parameters and accordingly keeps indicating the driver through displaying it. As the temperature of engine is too high for which normal temperature sensor cannot be used therefore here we are taking use of RTD which will be implemented to detect the temperature at the filament. This will continuously monitor the status of the temperature across the engine of the system. The signal is in voltage form which is converted to digital form from Analog to Digital convertor and data is transmitted to microcontroller (slave1), it transmits the data to CAN controller which further transmit the signal to CAN Bus through CAN transceiver. The signal which can be transmitted to the master slave (microcontroller) through this CAN Bus or any other microcontroller which require it to display can read it from the Bus lines. Similarly the wireless pressure sensors are placed at the metal of the tyre which keeps sensing the force of air in the tyre and transmit it to the receiver. From the receiver it is converted to digital form by ADC and similar process is carried out. Accordingly we can even control other parameters if required.

2.4 IMPLEMENTATION OF CIRCUIT

This is actual implementation of circuit of each block. Here we have actually designed each block separately and finally integrate them into complete working system



2.5 DEVELOPING ALGORITHM FOR SOFTWARE

To get the logical flow of the software. The development of algorithm has prominent role. so we have analysed complete system and organised the algorithm in such a manner that one can understand the working of complete system.

2.6 COMPILING OF CODE

The code is implemented on computer for which we used keil installed on PC. It is computer aided program to stimulate the working of microcontroller in real time without burning software into actual IC. Basically for error checking purpose. After compiling several errors now program is converted to machine language i.e Hex format.

2.7 BURNING THE HEX FILE

In this stage the compiled hex format was downloaded into ICs. Using Sst cp program transfer by cpx2013 program downloader cable.

2.8 TESTING AND RUNNING

This time we tested our project for actual working, after loading the programs into ICs. Error found were removed successfully.

Chapter 3: DESCRIPTION OF HARDWARE

3.1 MICROCONTROLLER

AT89C51 is an 8-bit microcontroller and belongs to ATMEL 8051 family. ATMEL 89C51 has 4KB of flash programmable and erasable read only memory (PEROM) and 128 bytes of RAM. It can be erased and program to a maximum of 1000 times.

In 40 pin AT89C51, there are four ports designated as P1,P2,P3 and P0. All these ports are 8-bit bi-directional ports, i.e., they can be used as both input and output ports. Except P0 which needs external pull-ups , rest of the ports have internal pull-ups . When 1s are written to these port pins, they are pulled high by the internal pull-ups and can be used as inputs. These ports are also bit addressable and so their bits can also be accessed individually.

Port P0 and P2 are also used to provide low byte and high byte addresses, respectively, when connected to an external memory. Port 3 has multiplexed pins for special functions like serial communication, hardware interrupts, timer inputs and read/ write operation from external memory. AT89C51 has an inbuilt UART for serial communication. It can be programmed to operate at different baud rates. Including two timers& hardware interrupts, it has a total of six interrupts.

Fig2: IC89V51

3.1.1 PIN DIAGRAM

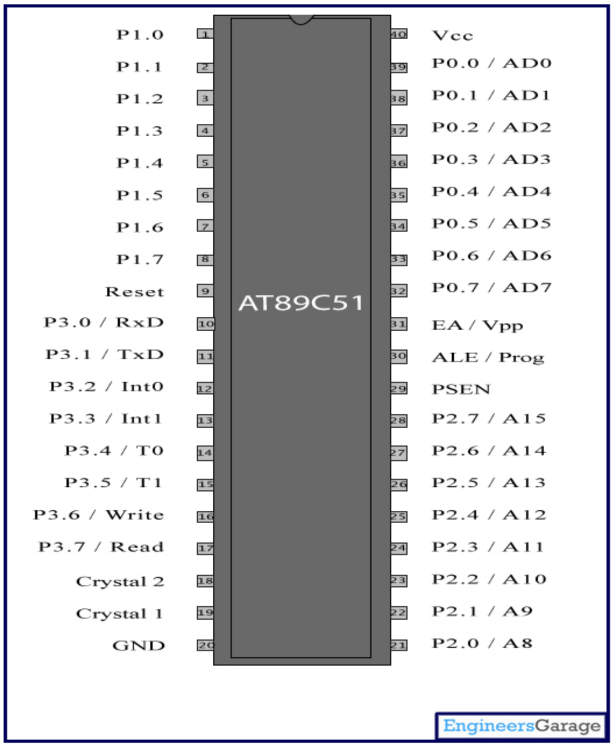


Fig3: PIN DIAGRAM OF µC

3.2 **ADC 0809**

The ADC0808, ADC0809 data acquisition component is a monolithic CMOS device with an 8-bit analog-to-digital converter, 8-channel multiplexer and microprocessor compatible control logic. The 8-bit A/D converter uses successive approximation as the conversion technique. The converter features a high impedance chopper stabilized comparator, a 256R voltage divider with analog switch tree and a successive approximation register. The 8-channel multiplexer can directly access any of 8-single-ended analog signals. The device eliminates the need for external zero and full-scale adjustments. Easy interfacing to microprocessors is provided by the latched and decoded multiplexer address inputs and latched TTL TRI-STATE outputs. The design of the ADC0808, ADC0809 has been optimized by incorporating the most desirable aspects of several A/D conversion techniques. The ADC0808, ADC0809 offers high speed, high accuracy, minimal temperature dependence, excellent long-term accuracy and repeatability, and consumes minimal power. These features make this device ideally suited to applications from process and machine control to consumer and automotive applications.

Fig 4:ADC0809

3.2.1 PIN DAIGRAM

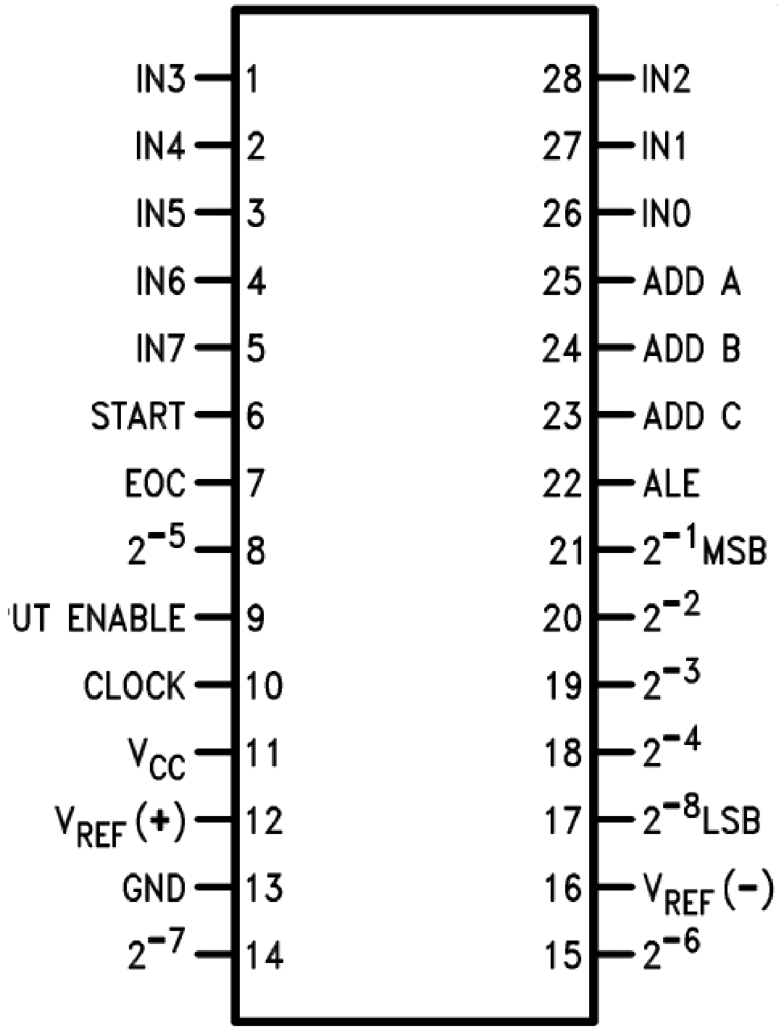


Fig4: PIN DIAGRAM OF ADC

3.2.2 PIN DESCRIPTION

Pin Number	Description
1	IN3 - Analog Input 3
2	IN4 - Analog Input 4
3	IN5 - Analog Input 5
4	IN6 - Analog Input 6
5	IN7 - Analog Input 7
6	START - Start Conversion
7	EOC - End of Conversion
8	2(-5) - Tri-State Output Bit 5
9	OUT EN - Output Enable
10	CLK - Clock
11	Vcc - Positive Supply
12	Vref+ - Positive Voltage Reference Input
13	GND - Ground
14	2(-7) - Tri-State Output Bit 7
15	2(-6) - Tri-State Output Bit 6
16	Vref- - Voltage Reference Negative Input
17	2(-8) - Tri-State Output Bit 8
18	2(-4) - Tri-State Output Bit 4
19	2(-3) - Tri-State Output Bit 3
20	2(-2) - Tri-State Output Bit 2

21	2(-1) - Tri-State Output Bit 1
22	ALE - Address Latch Enable
23	ADD C - Address Input C
24	ADD B - Address Input B
25	ADD A - Address Input A
26	IN0 - Analog Input 0
27	IN1 - Analog Input 1
28	IN2 - Analog Input 2

Fig5: PIN DESCRIPTION TABLE

3.3 CAN BUS

CAN standard defines a communication network that link all nodes connected to bus and enables them to communicate with one another.

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 (e.g.,1.2V). 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.

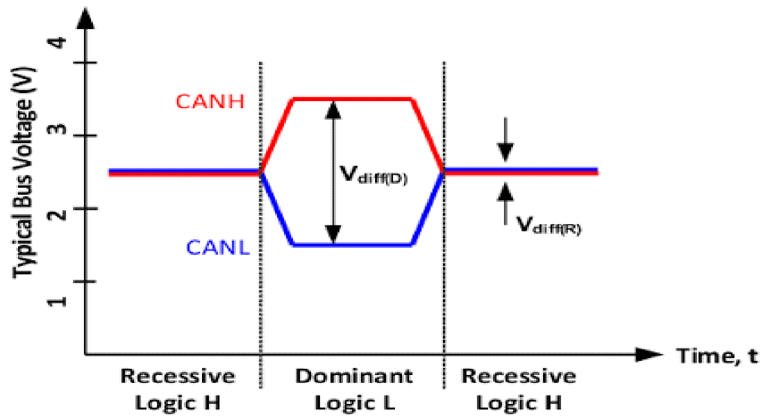


Fig6: VOLTAGE LEVELS OF CAN BUS

It basically consist of two things, that are

1. CAN Controller
2. CAN Transceiver

3.3.1CAN CONTROLLER

Microchip Technology's MCP2515 is a stand-alone Controller Area Network (CAN) controller that implements the CAN specification, version 2.0B. It is capable of transmitting and receiving both standard and extended data and remote frames. The MCP2515 has two acceptance masks and six acceptance filters that are used to filter out unwanted messages, thereby reducing the host MCU's overhead. The MCP2515 interfaces with microcontrollers (MCUs) via an industry standard Serial Peripheral Interface (SPI).

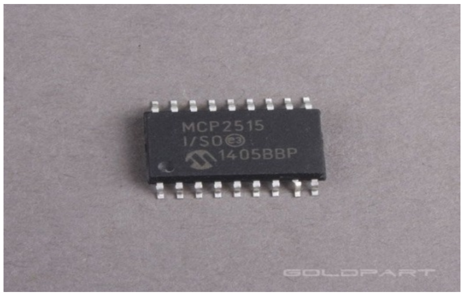


Fig7: IC MCP2515

3.3.1.1 PIN DIAGRAM

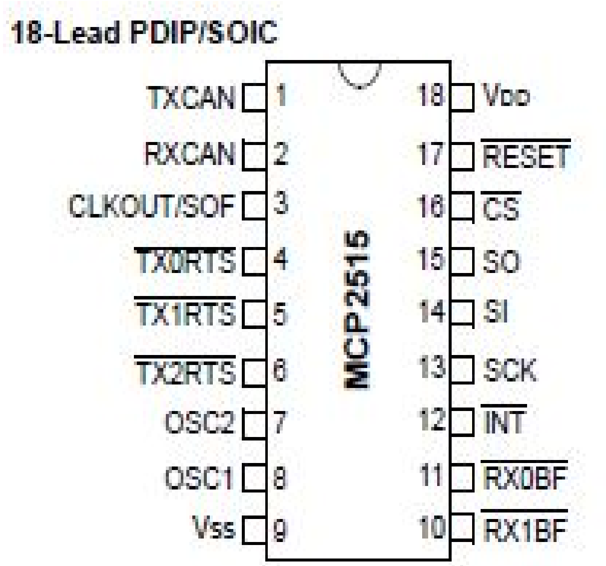


Fig8: PIN DIGRAM OF MCP2515

3.3.2 CAN TRANSCEIVER

Microchip Technology's MCP2515 is a stand-alone Controller Area Network (CAN) controller that implements the CAN specification, version 2.0B. It is capable of transmitting and receiving both standard and extended data and remote frames. The MCP2515 has two acceptance masks and six acceptance filters that are used to filter out unwanted messages, thereby reducing the host MCU's overhead. The MCP2515 interfaces with microcontrollers (MCUs) via an industry standard Serial Peripheral Interface (SPI).

The MCP2551 is a high-speed CAN, fault-tolerant device that serves as the interface between a CAN protocol controller and the physical bus. The MCP2551 provides differential transmit and receive capability for the CAN protocol controller and is fully compatible with the ISO-11898 standard, including 24V requirements. It will operate at speeds of up to 1 Mb/s. Typically, each node in a CAN system must have a device to convert the digital signals generated by a CAN controller to signals suitable for transmission over the bus cabling (differential output). It also provides a buffer between the CAN controller and the high-voltage spikes that can be generated on the CAN bus by outside sources (EMI, ESD, electrical transients, etc.).

Fig9: IC MCP 2551

3.3.2.1 PIN DIAGRAM

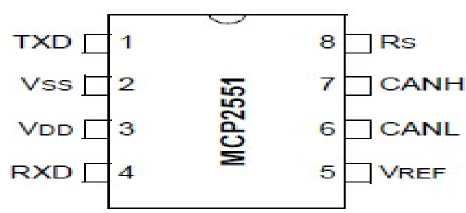


Fig10: PIN DIAGRAM OF MCP 2551

3.4 LCD

A **liquid-crystal display** (**LCD**) is a flat panel display , electronic visual display , or video display that uses the light modulating properties ofliquid crystals. Liquid crystals do not emit light directly.

The LCD screen is more energy efficient and can be disposed of more safely than a CRT. Its low electrical power consumption enables it to be used in battery -powered electronic equipment. It is an electronically modulated optical device made up of any number of segments controlling a layer of liquid crystal and arrayed in front of a light source or reflector to produce images in color or monochrome.

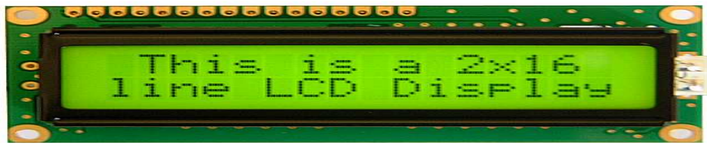


Fig11: LCD

3.4.1 PIN DIAGRAM

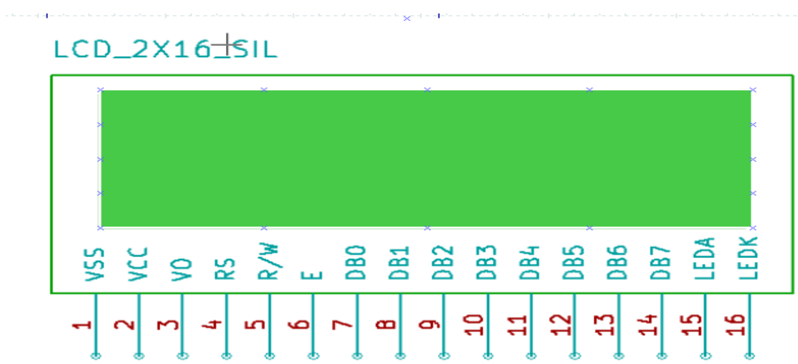


Fig12: PIN DIAGRAM OF LCD

3.4.2 PIN DESCRIPTION

PIN NUMBER	FUNCTION
1	Ground
2	VCC
3	Contrast adjustment (VO)
4	Register Select (RS). RS=0: Command, RS=1:

	Data
5	Read/Write (R/W). R/W=0: Write, R/W=1: Read
6	Clock (Enable). Falling edge triggered
7	Bit 0 (Not used in 4-bit operation)
8	Bit 1 (Not used in 4-bit operation)
9	Bit 2 (Not used in 4-bit operation)
10	Bit 3 (Not used in 4-bit operation)
11	Bit 4
12	Bit 5
13	Bit 6
14	Bit 7
15	Back-light Anode(+)
16	Back-Light Cathode(-)

Fig13: PIN DESCRIPTION TABLE

3.4.3 INSTRUCTION SET OF LCD

Instruction	Code										Description
	RS	**R/W**	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**	
Clear display	0	0	0	0	0	0	0	0	0	1	Clears display and returns cursor to the home position (address 0).
Cursor home	0	0	0	0	0	0	0	0	1	*	Returns cursor to home position. Also returns display being shifted to the original position. DDRAM content remains unchanged.
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction (I/D); specifies to shift the display (S). These operations are performed during data read/write.

Display on/off control	0	0	0	0	0	0	1	D	C	B	Sets on/off of all display (D), cursor on/off (C), and blink of cursor position character (B).
Cursor/display shift	0	0	0	0	0	1	S/C	R/L	*	*	Sets cursor-move or display-shift (S/C), shift direction (R/L). DDRAM content remains unchanged.
Function set	0	0	0	0	1	DL	N	F	*	*	Sets interface data length (DL), number of display line (N), and character font (F).
Read busy flag & address counter	0	1	BF	CGRAM/DDRAM address							Reads busy flag (BF) indicating internal operation being performed and reads CGRAM or

				DDRAM address counter contents (depending on previous instruction).
Write CGRAM or DDRAM	1	0	Write Data	Write data to CGRAM or DDRAM.
Write CGRAM or DDRAM	1	0	Write Data	Write data to CGRAM or DDRAM.

Instruction bit names —

I/D - 0 = decrement cursor position, 1 = increment cursor position;

S - 0 = no display shift, 1 = display shift;

D - 0 = display off, 1 = display on;

C - 0 = cursor off, 1 = cursor on;

B - 0 = cursor blink off, 1 = cursor blink on ;

S/C - 0 = move cursor, 1 = shift display;

R/L - 0 = shift left, 1 = shift right;

DL - 0 = 4-bit interface, 1 = 8-bit interface;

N - 0 = 1/8 or 1/11 duty (1 line), 1 = 1/16 duty (2 lines);

F - 0 = 5×8 dots, 1 = 5×10 dots;

BF - 0 = can accept instruction, 1 = internal operation in progress.

Fig14: INSTRUCATION SET TABLE

3.5 SENSORS

3.5.1 TEMPERATURE SENSOR

Resistance thermometers, also called resistance temperature detectors (RTDs), are sensors used to measure temperature by correlating the resistance of the RTD element with temperature. Most RTD elements consist of a length of fine coiled wire wrapped around a ceramic or glass core. The element is usually quite fragile, so it is often placed inside a sheathed probe to protect it. The RTD element is made from a pure material, typically platinum, nickel or copper. The material has a predictable change in resistance as the temperature changes and it is this predictable change that is used to determine temperature.

They are slowly replacing the use of thermocouples in many industrial applications below 600 °C, due to higher accuracy and repeatability.

Fig15:RTD

3.5.2 PRESSURE SENSOR

MPXxx6400A series sensor integrates on-chip, bipolar op amp circuitry and thin film resistor networks to provide a high output signal and temperature compensation. The small form factor and high reliability of on-chip integration make this pressure sensor a logical and economical choice for the system designer. The MPXxx6400A series piezoresistive transducer is a state-of-the-art, monolithic, signal conditioned, silicon pressure sensor. This sensor combines advanced micromachining techniques, thin film metallization, and bipolar semiconductor processing to provide an accurate, high level analog output signal that is proportional to applied pressure.

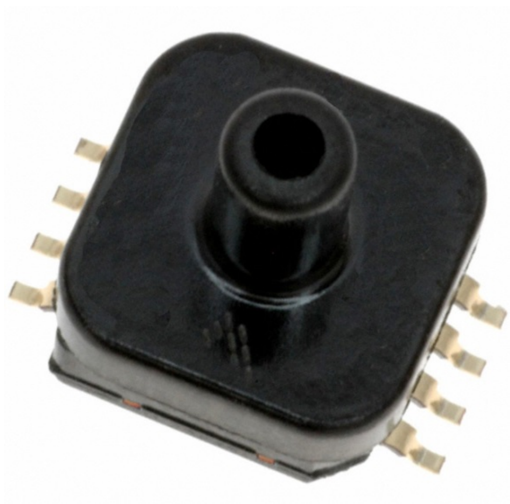


Fig16: MPXH6400AC6U

Accuracy: **1.5 %**	Lead Free Status / Rohs Status: **Lead free / RoHS Compliant**	Maximum Operating Temperature: **+ 125 C**
Minimum Operating Temperature: **- 40 C**	Mounting Style: **SMD/SMT**	Operating Pressure: **3 ~ 58 PSI**
Operating Supply Voltage: **5 V**	Operating Temperature: **-40°C ~ 125°C**	Output: **0 ~ 4.8V**

SPECIFICATION

3.6 RF MODULE

This RF module comprises of an **RF Transmitter** and an **RF Receiver**. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.

The RF module is often used alongwith a pair of encoder/decoder. The encoder issused for encoding parallel data for transmission feed while reception is decoded by a decoder.

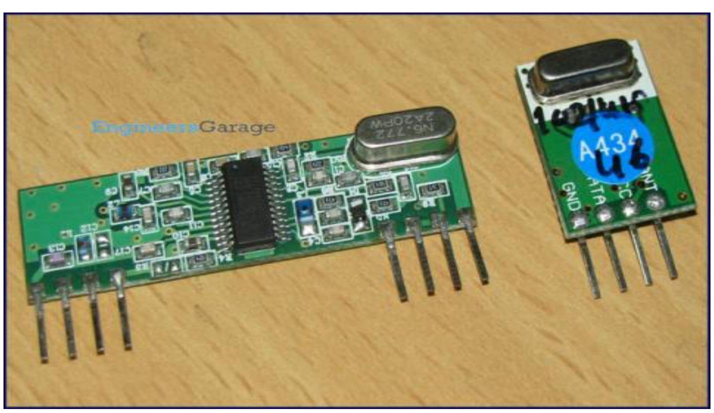


Fig17: RF transmitter & receiver

3.6.1 PIN DIAGRAM:

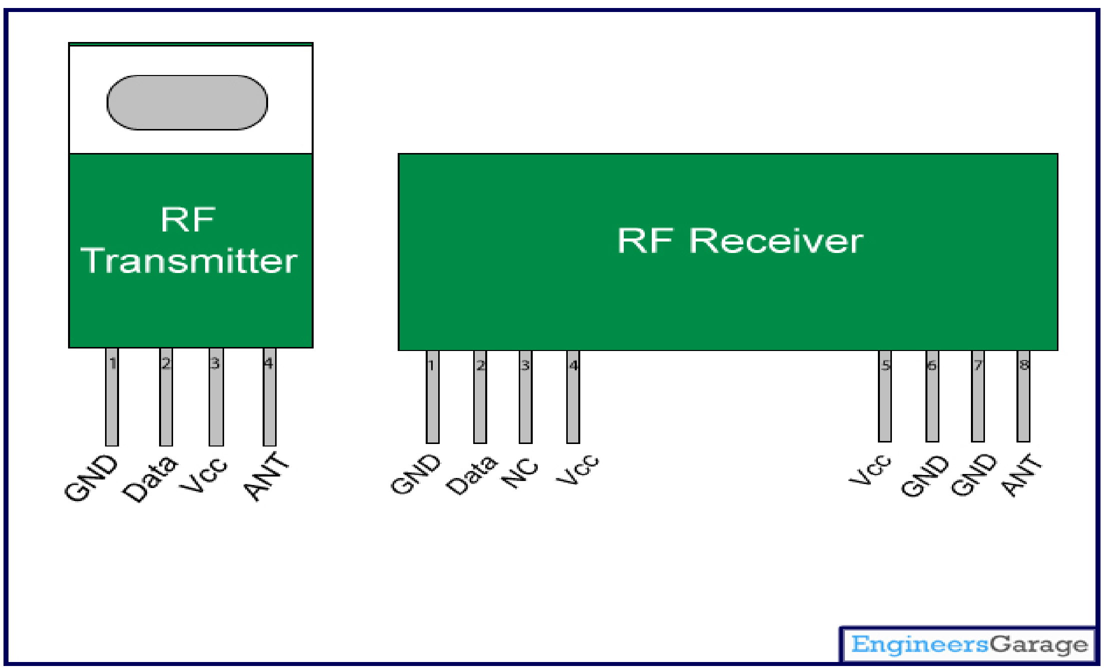


Fig18: PIN DAIGRAM OF RF TRANSMITTER &RECEIVER

3.6.2 Pin Description:

RF Transmitter

Pin No	Function	Name
1	Ground (0V)	Ground
2	Serial data input pin	Data
3	Supply voltage; 5V	Vcc
4	Antenna output pin	ANT

RF Receiver

Pin No	Function	Name
1	Ground (0V)	Ground
2	Serial data output pin	Data
3	Linear output pin; not connected	NC
4	Supply voltage; 5V	Vcc
5	Supply voltage; 5V	Vcc
6	Ground (0V)	Ground
7	Ground (0V)	Ground
8	Antenna input pin	ANT

Chapter 4: RESULTS

4.1 NODE 1

The 1st node is the temperature node and its setup as follow

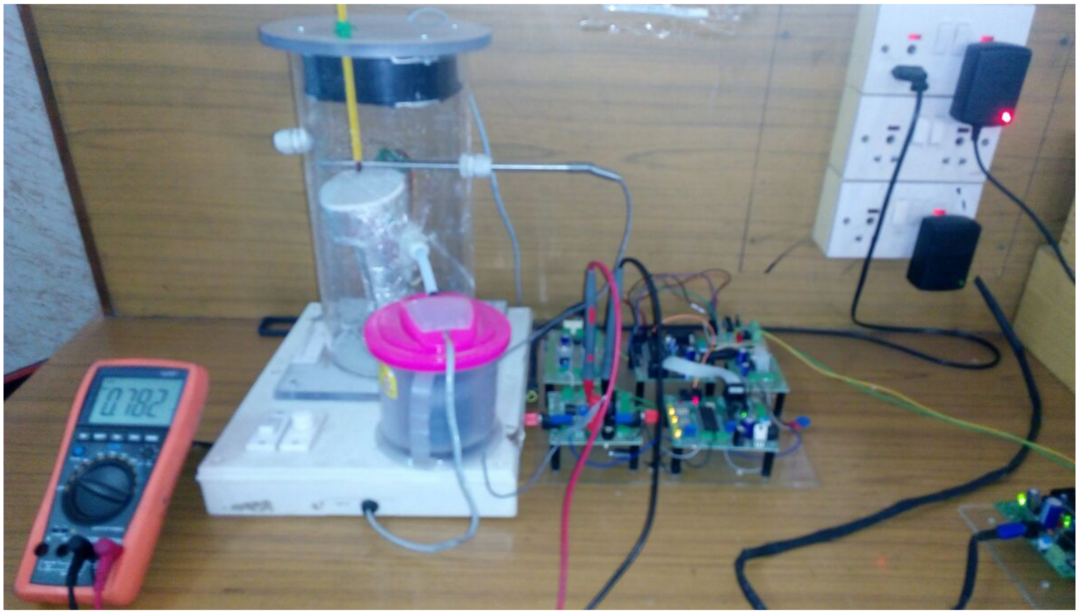


Fig 19: TEMPERATURE NODE

4.2 NODE 2

The 2nd node is for pressure sensing. Here connection is wireless therefore RF transmitter receiver are used.

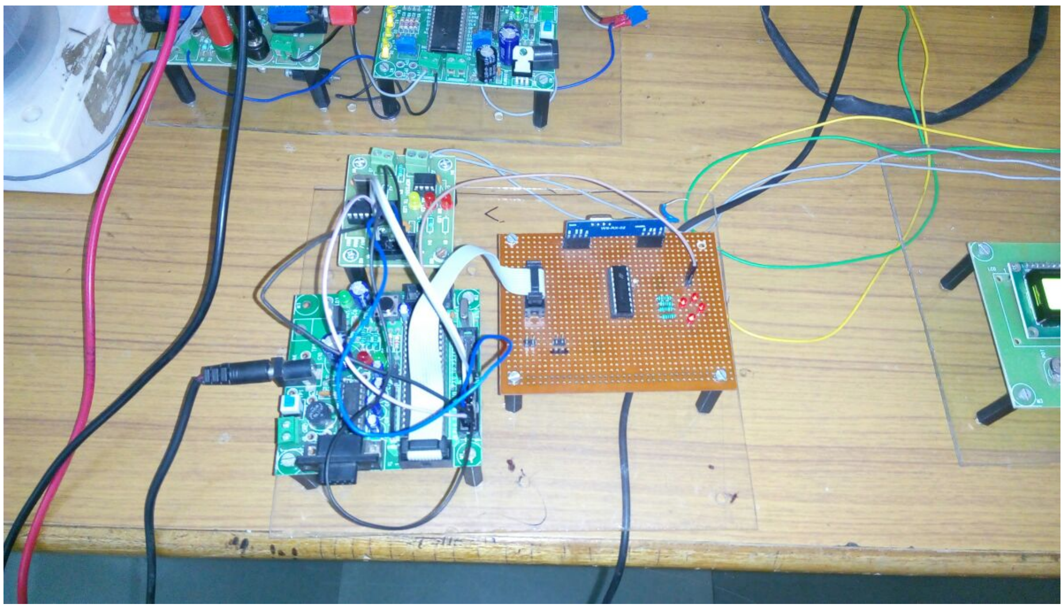


Fig 20: RF receiver node

PRESSURE NODE

4.3 NODE 3

The 3rd node is the master node for displaying the parameter from other 2 nodes.

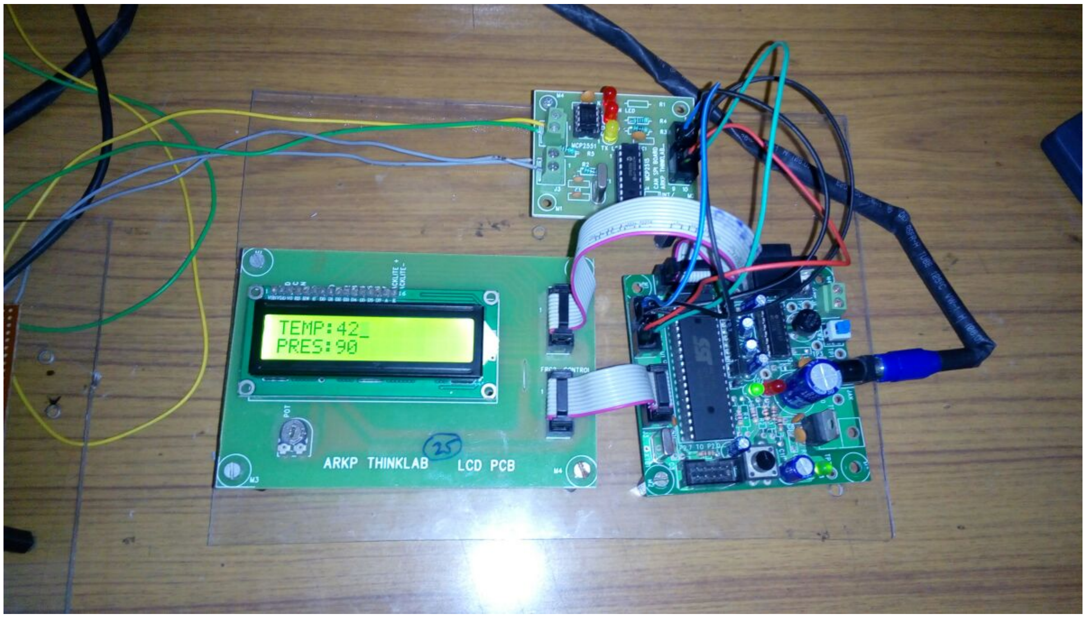


Fig21: DISPLAY

Chapter 5: MERITS DEMERITS & APPLICATION

5.1 MERITS

It is a bus system developed to satisfy the following requirement:

1. It consists of a pair of wires i.e. CAN_L and CAN_H.
2. Allow microcontrollers to communicate with each other.
3. No of nodes are 112.
4. Provide noise immunity as differential voltage is available on the 2 lines.
5. Robustness and Safety
    a. Communication continues even if
        i. Either of the two wires in the bus is broken
        ii. Either wire is shorted to power
        iii. Either wire is shorted to ground
    b. CAN will operate in extremely harsh environments
        i. Data consistency guaranteed
        ii. Uses error correction and confinement
            1. Helpful in noise critical environments like automotive
6. High Speeds at low cost
    a. Speeds of up to 1 Megabit per second
    b. Provides real-time communication
7. Network is flexible allowing expansion
    a. Just input an ECU on the bus
    b. Modularity
    c. 500 million unique identifiers

5.2 DEMERITS

1. Type of Encoding.
2. Synchronization

5.3 APPLICATIONS

Chapter 6: FUTURE SCOPE & CONCLUSION

6.1 FUTURE SCOPE

There are CAN application examples for every market segment where embedded microcontrollers are used. Some of the applications not yet mentioned include avionics, home appliances, building automation and autonomously controlled vehicles (driving, swimming, diving and flying) in both civilian and military applications. The number of applications where CAN is used will further increase over the upcoming years, making it almost impossible for embedded design engineers and system integrators to not get confronted by it sooner or later.

6.2 CONCLUSION

- CAN is ideally suited in application requiring a large number of short messages with high reliability in rugged operating environment.
- Because CAN is messages based and not address based, it is especially well suited when data is needed by more than one location and system-wide data consistency is mandatory.
- This project introduces an embedded system with a combination of CAN bus systems. Digital control of the vehicle is an important criterion of modern technology. With the rapid development of embedded technology, high-performance embedded processor is penetrated into the auto industry, which is low cost, high reliability and other features to meet the needs of the modern automobile industry. The proposed high-speed CAN bus system solves the problem of automotive system applications, also has a certain practical value and significance.
- We successfully completed our project with desired output within given time period.

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