INDUSTRIAL AUTOMATION USING ZIGBEE

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report "INDUSTRIAL AUTOMATION USING ZIGBEE" is the bonafide work of G.ABINAYAMANOHARI, V.R.JANANII, M.B.SARANYA, N.SOWMYA who carried out the project under my supervision.

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INTERNAL EXAMINER   EXTERNAL EXAMINER

ACKNOWLEDGEMENT

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Firstly, we thank our beloved principal **Dr S. Ramachandran** who has been the backbone of all our deeds.

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ABSTRACT

Bluetooth, ultra-wideband (UWB), ZIGBEE, and WI-FI are four popular wireless standards for short-range communications. Specifically, ZIGBEE network is an emerging technology designed for low cost, low power consumption and low-rate wireless personal area networks (LR-WPAN) with a focus on the device-level communication for enabling the wireless sensor networks. In this project, the developed ZIGBEE platforms have been presented for wireless sensor networking applications. Moreover, design issues for ZIGBEE industrial applications and the experimental implementation have been demonstrated via a multi-hop tree network.

In the normal cabled system, the occurrence of the fault happens often, there is a delay in the transmitting signals .The total cost of the system increase because of the copper used in the cable. These problems can be overcome by using the wireless technology .In this project ZIGBEE and RF signals are used for transmission , thus reducing the cost of the entire control system and minimizing the fault and the delay. The sensor network senses the data and sends the data through a wireless medium and the data is received by the controller section. According to the signal received by the controller it routing the value to the Actuator Section, the actuator connected the controller will be activated through wireless medium.

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CHAPTER 1
INTRODUCTION

1.1 WIRELESS COMMUNICATION

Bluetooth, ultra-wideband (UWB), ZIGBEE, and WI-FI are four popular wireless standards for short-range communications. Specifically, ZIGBEE network is an emerging technology designed for low cost, low power consumption and low-rate wireless personal area networks (LR-WPAN) with a focus on the device-level communication for enabling the wireless sensor networks.

Moreover, design issues for ZIGBEE industrial applications and the experimental implementation have been demonstrated via a multi-hop tree network. In general, the wireless networking has followed a trend of throughput increase due to the increasing exchange of data in services such as the Internet, e-mail, and data file transfer. The capabilities needed to deliver such services are characterized by an increasing need for data throughput. However, in applications to the industrial, vehicular, and residential field, sensors may have more relaxed throughput requirements. Moreover, applications to industrial control and home automation require lower power consumption and low complexity wireless links for a low cost (relative to the device cost). The ZIGBEE wireless technology would be the one that suitable for industrial control and home Automation on the device-level communication .Based on the IEEE 802.15.4 standard, ZIGBEE is a global specification created by a multi-vendor consortium called the ZIGBEE Alliance. Whereas 802.15.4 defines the physical and MAC layers of an application, ZIGBEE defines the network and application layers, application framework, application profile, and the security mechanism. ZIGBEE provides users in specific applications with a simple, low-cost global network that supports a large number of nodes with an extremely low power drain on the battery.

standards, the ZIGBEE-based platforms, named ITRI ZB node, have been designed and implemented for practical WSN applications.

Moreover, we will show the experimental implementation of a multi-hop tree network. Thus, our focus will be very much on the functional side of multi-hop topology formation of a ZIGBEE network and not so much on the algorithmic study.

1.2 BLOCK DIAGRAM

1.2.1 Sensor unit

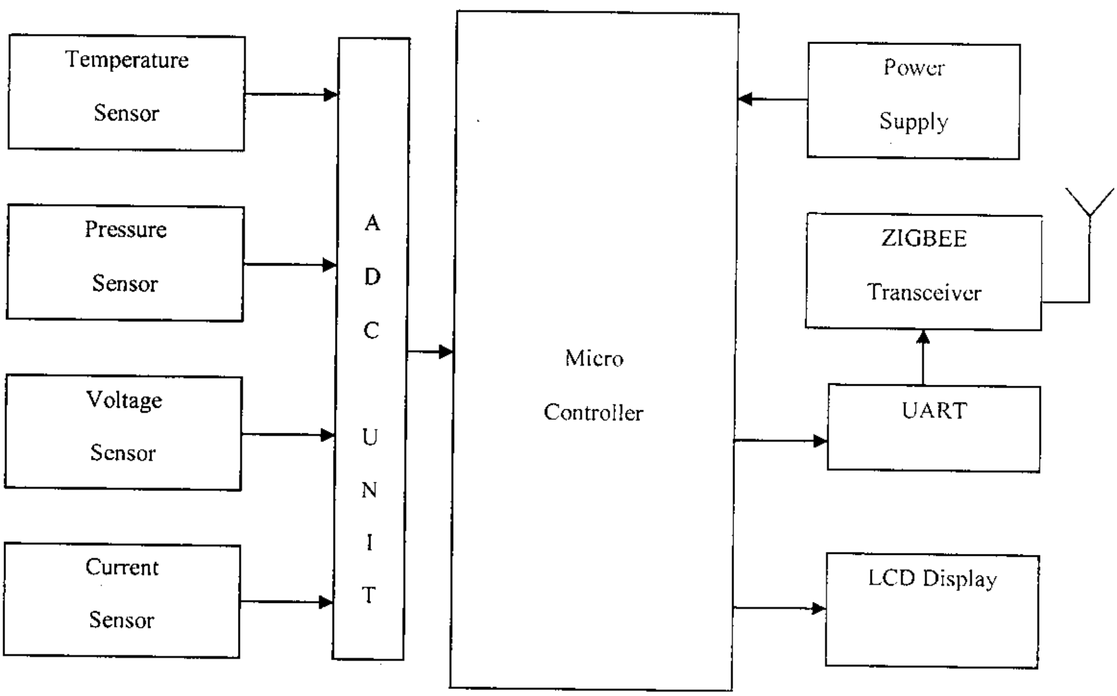


Fig 1:Sensor unit

The sensor unit measures the data from the process parameters and then the data is converted into digital data using ADC and then the digital data is given as the input to micro controller .The data is transmitted via the ZIGBEE protocol which uses the MAX 232 for serial communication.the data is transmitted to the controller unit.

1.2.2 controller unit

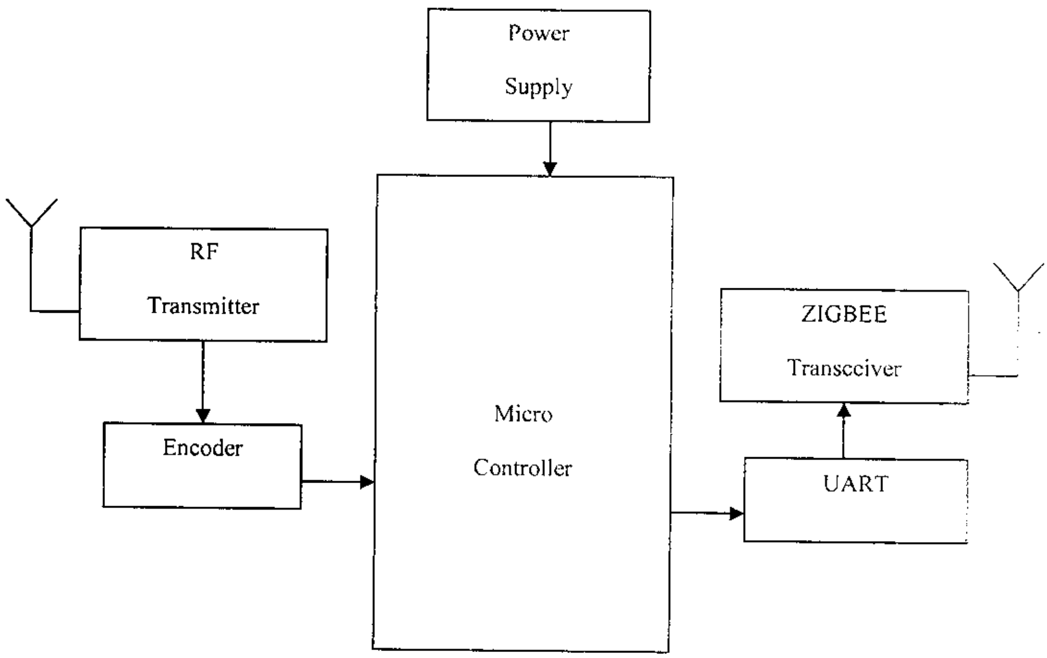


Fig 2:Controller unit

The ZIGBEE transceiver receives the data via the UART and the data is send to the microcontroller .The actuating signal is produced by the controller to control the process and the signal is transmitted via the RF transmitter to the actuator unit.

1.2.3 Actuator unit

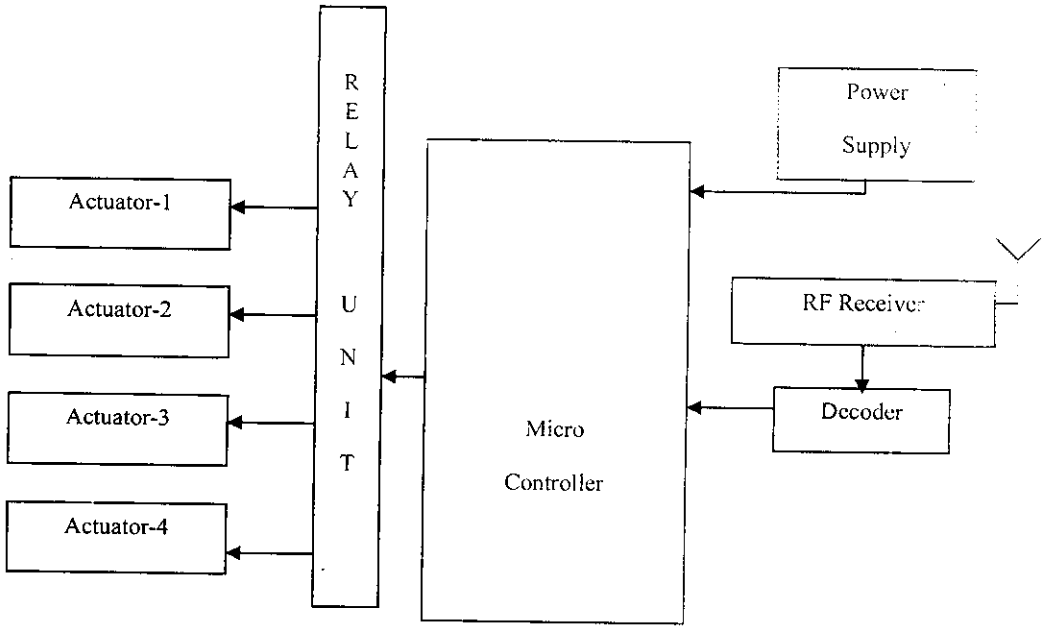


Fig 3: Actuator unit

The actuating signal generated by the microcontroller is received by the RF receiver and then the data is decoded .The microcontroller commands the actuator unit to take the corresponding control action(ON/OFF).

CHAPTER 2

SIGNAL CONDITIONING UNIT

SIGNAL CONDITIONING UNIT

Measurement of dynamic physical quantities requires faithful representation of their analog or digital output obtained from the intermediate stage i.e. signal conditioning stage and this place a severe strain on the signal conditioning equipment .The signal conditioning equipment may be required to do linear process like amplification ,attenuation ,integration ,differentiation ,addition and subtraction .The signal conditioning also performs the non linear functions like modulation, de modulation ,sampling, filtering, clipping and clamping.

2.1 .SENSOR UNIT

SENSOR:

The sensor converts one form of physical quantity into another form of physical quantity. The sensors used in this project are temperature sensor, pressure sensor, voltage sensor, current sensor. The sensor details are given below.

2.1.1. TEMPERATURE SENSOR (LM35)

SENSOR TYPE: LM35

Precision Centigrade Temperature Sensors

2.1.1.1 General Description

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. 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. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy.

It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 μ A from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

TEMPERATURE SENSOR

DIAGRAM

Full range centigrade temperature sensor

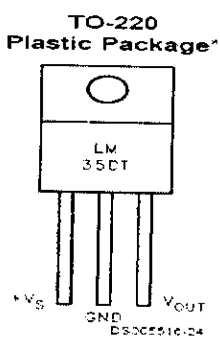


Fig 4: Pin diagram of temperature sensor

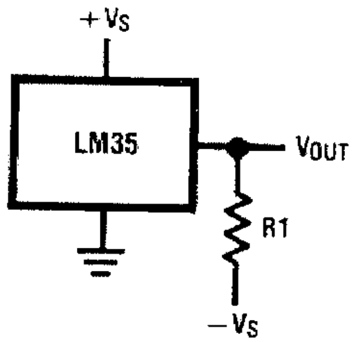


Fig 5: Temperature sensor

Features

1. Calibrated directly in ° Celsius (Centigrade)
2. Linear + 10.0 mV/°C scale factor
3. 0.5°C accuracy guarantee able (at +25°C)
4 .Rated for full −55° to +150°C range
5. Suitable for remote applications
6. Low cost due to wafer-level trimming
7. Operates from 4 to 30 volts
8. Less than 60 μA current drain
9 .Low self-heating, 0.08°C in still air
10. Nonlinearity only ±1⁄4°C typical
11. Low impedance output, 0.1 W for 1 m A load

2.1.2. PRESSURE SENSOR

SENSOR TYPE: Integrated Silicon Pressure Sensor On-Chip Signal Conditioned, Temperature Compensated and Calibrated

The MP3V5050 series Piezo resistive transducer is a state-of-the-art Mono lithic silicon pressure sensor designed for a wide range of applications.

This patented, single element transducer combines advanced micromachining techniques, thin-film metallization, and bipolar processing to provide an accurate, high level analog output signal that is proportional to the applied pressure.

2.1.2.1Features

- 2.5% Maximum Error over 0° to 85°C
- Ideally suited for Microprocessor or Microcontroller-Based Systems
- Temperature Compensated Over –40° to +125°C
- Patented Silicon Shear Stress Strain Gauge
- Durable Epoxy Small Outline Package (SOP)
- Easy-to-Use Chip Carrier Option
- Multiple Porting Options for Design Flexibility
- Barbed Side Ports for Robust Tube Connection

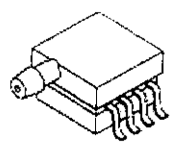


Fig 6:Pressure sensor

SMALL OUTLINE PACKAGE PIN NUMBERS[1]			
1	N/C	5	N/C
2	V_S	6	N/C
3	Gnd	7	N/C
4	V_{out}	8	N/C

1. Pins 1, 5, 6, 7, and 8 are internal device connections. Do not connect to external circuitry or ground. Pin 1 is noted by the notch in the lead.

Table 1:Pin configuration

2.1.3. VOLTAGE SENSOR

POTENTIAL TRANSFORMER

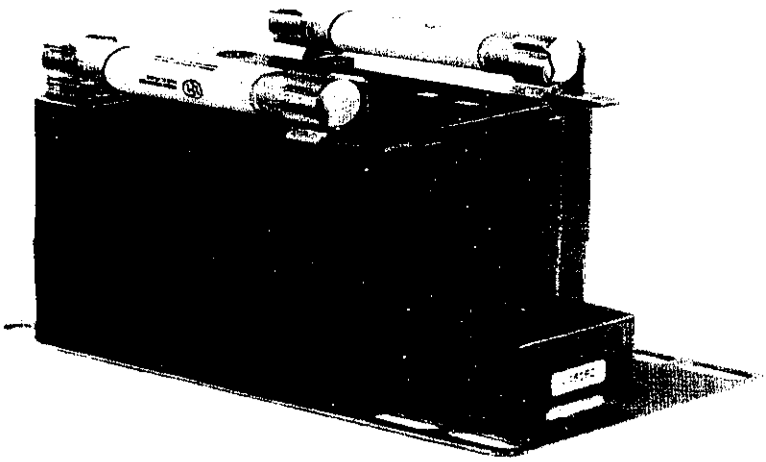


Fig 7:POT

2.1.3.1Features:

1.Frequency range .... 60Hz.

2.Standard Secondary Voltage 120VAC

3. Insulation Class .... 15.5kV, BIL 110KV Full Wave

4.UL Recognized

5.For indoor use only

2.1.3.2Specification:

Accuracy Class

1.0.3 WXMYZ, 1.2ZZ at 100% rated voltage with 120V based

2.ANSI burden. 0.3 WXMY, 1.2Z at 58% rated voltage with 69.3 V based ANSI burden.

3.Insulation Class .... 15.5 kV, BIL 110kV Full Wave

4.Thermal Rating .... 1500 VA at 30OC Amb.

.... 1000 VA at 55OC Amb.

5.Weight .... Approximately 88 lbs.

2.1.3.3Sensor description:

• Primary terminals that are fused are 1/4 - 20 brass screws with one flatwasher, lockwasher and two nuts.

• Secondary terminals are NO. 10-32 brass screws with one flatwasher and lockwasher.

• The transformers are tested for partial discharge to Canadian Standards CAN 3-C13-M83. This test can also be carried out to IEC requirements if requested.

• The core and coil assembly is encased in a plastic enclosure and vacuum encapsulated in polyurethane resin.

• Thermal burden rating is for 120 volt secondaries.

• Plated steel mounting base.

• Fuses have 1.63" Dia. Caps and 11.50" clip centers.

• A test card is provided with each unit.

2.1.4. CURRENT SENSOR

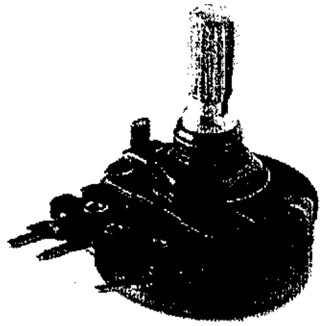


fig 8:Current sensor

A **current sensor** is a device that detects electrical current (AC or DC) in a wire, and generates a signal proportional to it.

The sensed current and the output signal can be:

- AC current input,
  - Analog output, which duplicates the wave shape of the sensed current
  - Bipolar output, which duplicates the wave shape of the sensed current
  - Unipolar output, which is proportional to the average or RMS value of the sensed current
- DC current input,
  - Unipolar, with a unipolar output, which duplicates the wave shape of the sensed current
  - Digital output, which switches when the sensed current exceeds a certain threshold.

2.2. ANALOG TO DIGITAL CONVERSION

Analog to digital conversion converts the analog data into digital data. The technique used in this ADC is successive approximation method.

2.2.1SUCCESIVE APPROXIMATION TECHNIQUE

General Description

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.

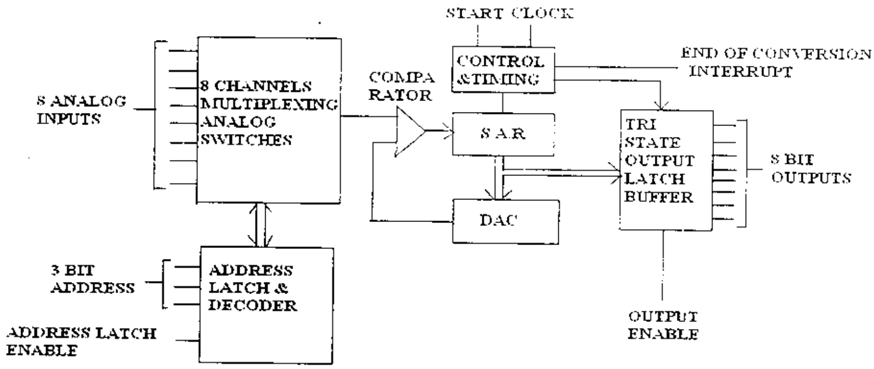
The 8-channel multiplexer can directly access any of 8-single-ended analog signals. The device eliminates the need for external zero and full-scale adjustments. Easy interfacing to microprocessors is provided by the latched and decoded multiplexer address inputs and latched TTL TRI-STATE outputs.

The 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 application.

SUCCESIVE APPROXIMATION METHOD

BLOCK DIAGRAM:

Fig 9:Analog to digital converter



Features

1. Easy interface to all microprocessors.

2. Operates ratiometrically or with 5 VDC or analog span adjusted voltage reference

3.No zero or full-scale adjust required

4.8-channel multiplexer with address logic

5.0V to 5V input range with single 5V power supply

6.Outputs meet TTL voltage level specifications

7.Standard hermetic or molded 28-pin DIP package

8.28-pin molded chip carrier package

9.ADC0808 equivalent to MM74C949

10.ADC0809 equivalent to MM74C949-

2.3 POWER SUPPLY:

DEFINITION:

A **power supply** (sometimes known as a **power supply unit** or **PSU**) is a device or system that supplies electrical or other types of energy to an output load or group of loads. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

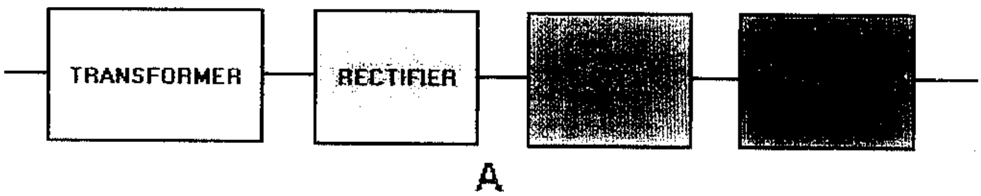


fig 10 :Block diagram of a basic power supply.

The transformer steps up or steps down the input line voltage and isolates the power supply from the power line. The RECTIFIER section converts the alternating current input signal to a pulsating direct current. For this reason a FILTER section is used to convert pulsating dc to a purer, more desirable form of dc voltage.

CHAPTER 3

MICRO CONTROLLER

3.1INTRODUCTION TO ATMEL

FEATURES:

- Compatible with MCS-51™ Products
- 4K Bytes of In-System Reprogrammable Flash Memory
  Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation: 0 Hz to 24 MHz
- Three-level Program Memory Lock
- 128 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Two 16-bit Timer/Counters
- Six Interrupt Sources
- Programmable Serial Channel
- Low-power Idle and Power-down Modes

3.1.1Description:

The AT89S52 is a low-power, high-performance CMOS 8-bit Microcomputer with 4K bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications

3.1.2Block diagram:

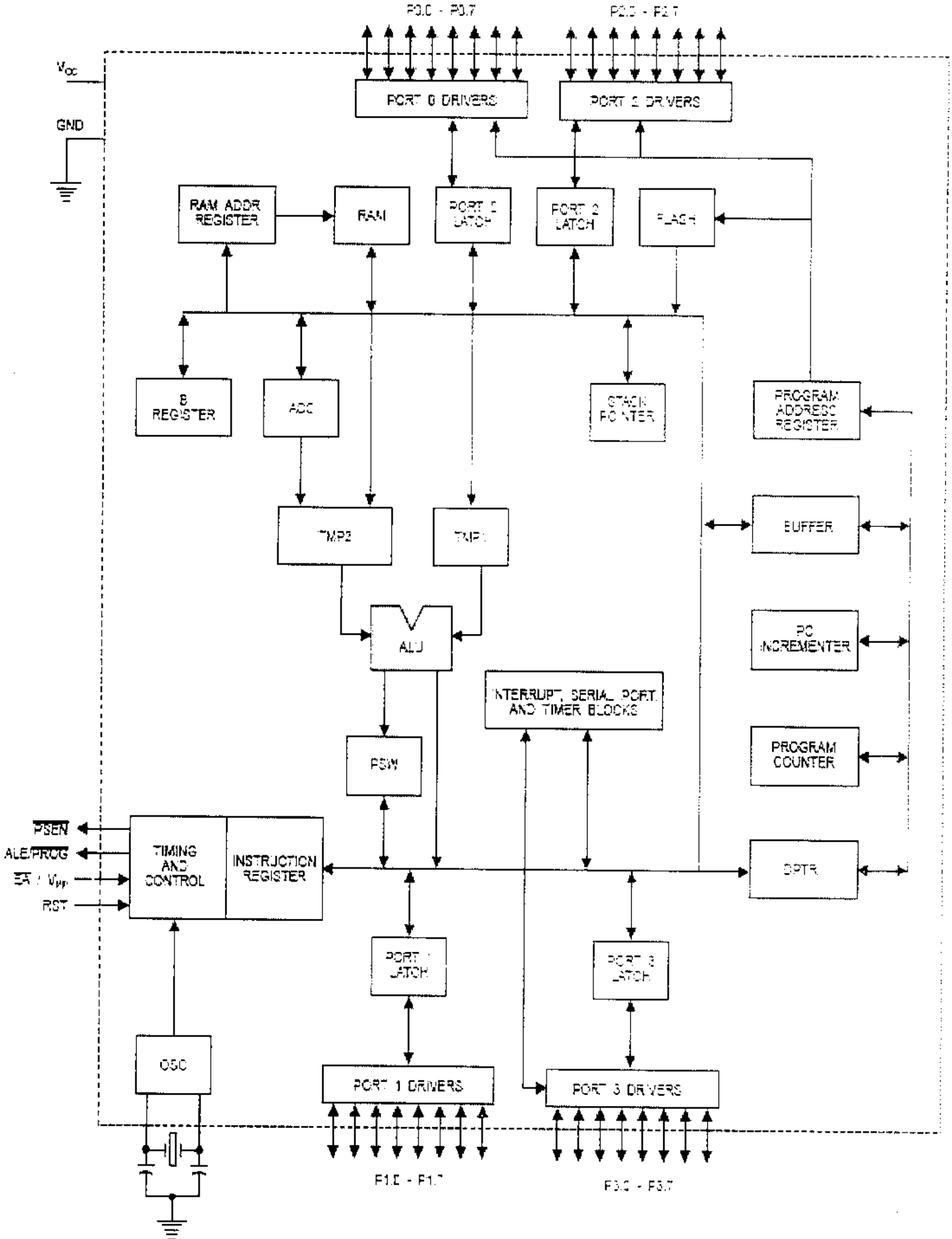
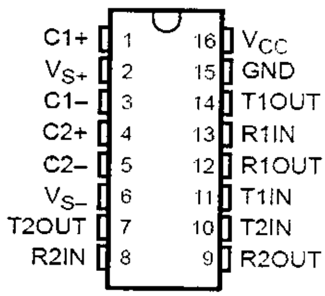


Fig 11: Architecture of AT89S52

The AT89S52 provides the following standard features: 4K bytes of Flash, 128 bytes of RAM, 32 I/O lines, two 16-bit timer/counters, five vector two-level interrupt architecture, a full duplex serial port, and on-chip oscillator and clock circuitry. In addition, the AT89C51 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. 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.

3.2 UART MAX 232

Fig 12:Pin diagram



3.2.1Features of UART MAX232

1.Operate With Single 5-V Power Supply

2.Operate Up to 120 kbit/s

3. Two Drivers and Two Receivers

4.30-V Input Levels

5. Low Supply Current . . . 8 mA

6.Typical Designed to be Interchangeable With
Maxim MAX232

7.ESD Protection Exceeds JESD 22

8.– 2000-V Human-Body Model (A114-A)

3.2.2Applications

1.Battery-Powered Systems

2.Terminals

3.Modems

4.Computers

5.Description /ordering information

The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply EIA-232 voltage levels from a single 5-V supply. Each receiver converts EIA-232 inputs to 5-V TTL/CMOS levels. These receivers have a typical threshold of 1.3 V and a typical hysteresis of 0.5V, and can accept 30-V inputs. Each driver converts TTL/CMOS input levels into EIA-232 levels. The driver, receiver, and voltage-generator functions are available.

CHAPTER 4

WIRELESS COMMUNICATION

4.1 ZIGBEE

ZIGBEE technology is a low data rate, low power consumption, low cost, wireless networking protocol targeted towards automation and remote control applications. IEEE 802.15.4 committee started working on a low data rate standard a short while later. Then the ZIGBEE Alliance and the IEEE decided to join forces and ZIGBEE is the commercial name for this technology. ZIGBEE is expected to provide low cost and low power connectivity for equipment that needs battery life as long as several months to several years but does not require data transfer rates as high as those enabled by Bluetooth.

In addition, ZIGBEE can be implemented in mesh networks larger than is possible with Bluetooth. ZIGBEE compliant wireless devices are expected to transmit 10-75 meters, depending on the RF environment and the power output consumption required for a given application, and will operate in the unlicensed RF worldwide (2.4GHz global, 915MHz Americas or 868 MHz Europe). The data rate is 250kbps at 2.4GHz, 40kbps at 915MHz and 20kbps at 868MHz.

IEEE and ZIGBEE Alliance have been working closely to specify the entire protocol stack. IEEE 802.15.4 focuses on the specification of the lower two layers of the protocol (physical and data link layer). A unique feature of ZIGBEE network layer is **communication redundancy** eliminating "single point of failure" in mesh networks .

4.1.1 EVOLUTION OF LR-WPAN STANDARDISATION

The cellular network was a natural extension of the wired telephony network that became pervasive during the mid-20th century. As the need for mobility and the cost of laying new wires increased, the motivation for a personal connection independent of location to that network also increased.

Coverage of large area is provided through (1-2km) cells that cooperate with their neighbors to create a seemingly seamless network. Examples of standards are GSM, IS-136, IS-95. Cellular standards basically aimed at facilitating voice communications throughout a metropolitan area.

During the mid-1980s, it turned out that an even smaller coverage area is needed for higher user densities and the emergent data traffic. The IEEE 802.11 working group for WLANs is formed to create a wireless local area network standard. Whereas IEEE 802.11 was concerned with features such as Ethernet matching speed, long range(100m), complexity to handle seamless roaming, message forwarding, and data throughput of 2-11Mbps, WPANs are focused on a space around a person or object that typically extend sup to 10m in all directions. The focus of WPANs is low-cost, low power, short range and very small size. The IEEE 802.15 working group is formed to create WPAN standard. This group has currently defined three classes of WPANs that are differentiated by data rate, battery drain and quality of service (QoS). The high data rate WPAN (IEEE 802.15.3) is suitable for multi-media applications that require very high QoS. Medium rate WPANs (IEEE 802.15.1/Bluetooth) will handle a variety of tasks ranging from cell phones to PDA communications and have QoS suitable for voice communications. The low rate WPANs (IEEE 802.15.4/LR-WPAN) is intended to serve a set of industrial, residential and medical applications with very low power consumption and cost requirement not considered by the above WPANs and with relaxed needs for data rate and QoS. The low data rate enables the LR-WPAN to consume very little power.

4.1.2 ADVANTAGE OF ZIGBEE OVER BLUETOOTH

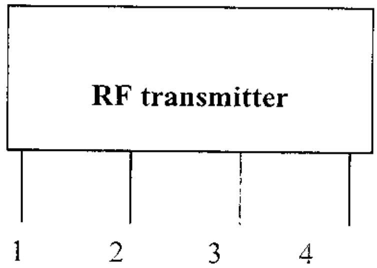
ZIGBEE looks rather like Bluetooth but is simpler, has a lower data rate and spends most of its time snoozing. This characteristic means that a node on a ZIGBEE network should be able to run for six months to two years on just two AA batteries.

The operational range of ZIGBEE is 10-75m compared to 10m for Bluetooth (without a power amplifier). ZIGBEE sits below Bluetooth in terms of data rate. The data rate of ZIGBEE is 250kbps at 2.4GHz,40 kbps at 915MHz and 20kbps at 868MHz whereas that of Bluetooth is 1Mbps.ZigBee uses a basic master-slave configuration suited to static star networks of many infrequently used devices that talk via small data packets. It allows up to 254 nodes. Bluetooth's protocol is more complex since it is geared towards handling voice, images and file transfers in ad hoc networks. Bluetooth devices can support scatternets of multiple smaller non-synchronized networks (piconets). It only allows up to 8 slave nodes in a basic master-slave piconet set-up. When ZigBee node is powered down, it can wake up and get a packet in around 15 m sec whereas a Bluetooth device would take around 3sec to wake up and respond.

4.2RF TRANSMITTER:

- **RF Transmitter**

RF TRANSMITTER MODULE:



Functional block of Tx section where 1,2,3,4 are the pins

1 - Antenna

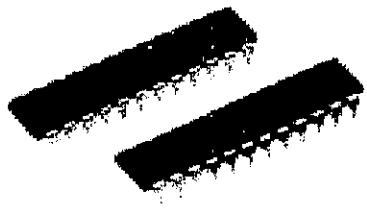
2 - Data input

3 - Ground

4 - VCC

In this transmitting section the 1st pin is the antenna pin where we can able to fix the antenna for transmitting the data in the Radio Frequency, the 2nd pin is the data input pin in which the output of the encoder is given; the 3rd pin is the ground and the 4th pin is the VCC which is given to operate the transmitter section.

4.2.1Encoder (HT12E)



4.2.1.1Features

1. Operating voltage

 2.4V~5V for the HT12A

 2.4V~12V for the HT12E

2.Low power and high noise immunity CMOS technology

3.Low standby current: 0.1_A (typ.) at VDD=5V

4.HT12A with a 38kHz carrier for infrared transmission medium

5.Minimum transmission word

6.Four words for the HT12E

7.One word for the HT12A

8.Built-in oscillator needs only 5% resistor

9.Data code has positive polarity

10.HT12A/E: 18-pin DIP/20-pin SOP package

4.2.1.2General Description

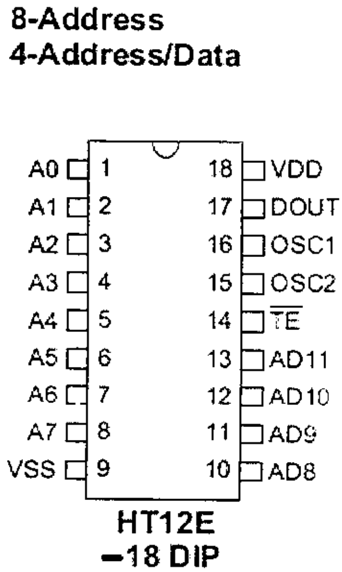
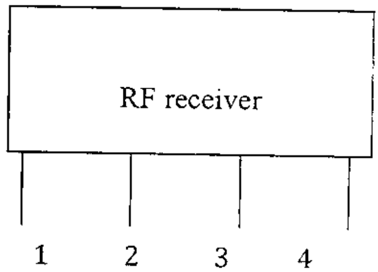


Fig 13:Pin diagram of encoder

The 2^12 encoders are a series of CMOS LSIs for remote control system applications. They are capable of encoding information which consists of N address bits and 12_N data bits. Each address/data input can be set to one of the two logic states. The programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium upon receipt of a trigger signal. The capability to select a TE trigger on the HT12E or a DATA trigger on the HT12A further enhances the application flexibility of the 212 series of encoders. The HT12A additionally provides a 38 kHz carrier for infrared systems.

4.3RF RECEIVER MODULE:

fig 14:RF receiver module



Functional block of Rx section where 1,2,3,4 are the pins

1 - Antenna

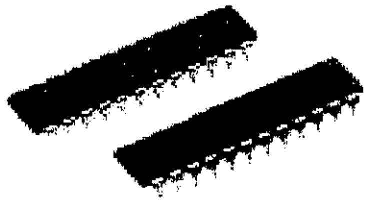
2 - Data input

3 - Ground

4 - VCC

In this receiving section the 1st pin is the antenna pin where we can able to fix the antenna to receive the data in the Radio Frequency, the 2nd pin is the data output pin to the decoder circuit, the 3rd pin is the ground and the 4th pin is the VCC which is given to operate the receiver section.

4.3.1Decoder



4.3.1.1Features

1.Operating voltage: 2.4V~12V

2.Low power and high noise immunity CMOS Technology

3. Low standby current

4. Capable of decoding 12 bits of information

5.Binary address setting

6.Received codes are checked 3 times

7.Address/Data number combination

8.HT12D: 8 address bits and 4 data bits

9.HT12F: 12 address bits only

10.Built-in oscillator needs only 5% resistor

11.Valid transmission indicator

12.Easy interface with an RF or an infrared transmission medium

4.3.1.2General Description

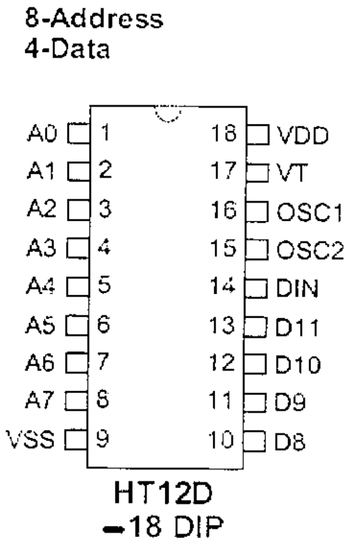


Fig 15:Pin diagram

The 2^12 decoders are a series of CMOS LSIs for remote control system applications. They are paired with Holtek_s 2^12 series of encoders . For proper operation, a pair of encoder/decoder with the same number of addresses and data format should be chosen. The decoders receive serial addresses and data from a programmed 2^12series of encoders that are transmitted by a carrier using an RF or an IR transmission medium. They compare the serial input data three times continuously with their local addresses. If no error or unmatched codes are found, the input data codes are decoded and then transferred to the output pins. The VT pin also goes high to indicate a valid transmission. The 212 series of decoders are capable of decoding information's that consist of N bits of address and 12_N bits of data. Of this series, the HT12D is arranged to provide 8 address bits and 4 data bits, and HT12F is used to decode 12 bits of address information.

CHAPTER 5

ACTUATOR UNIT

5.1 Relay

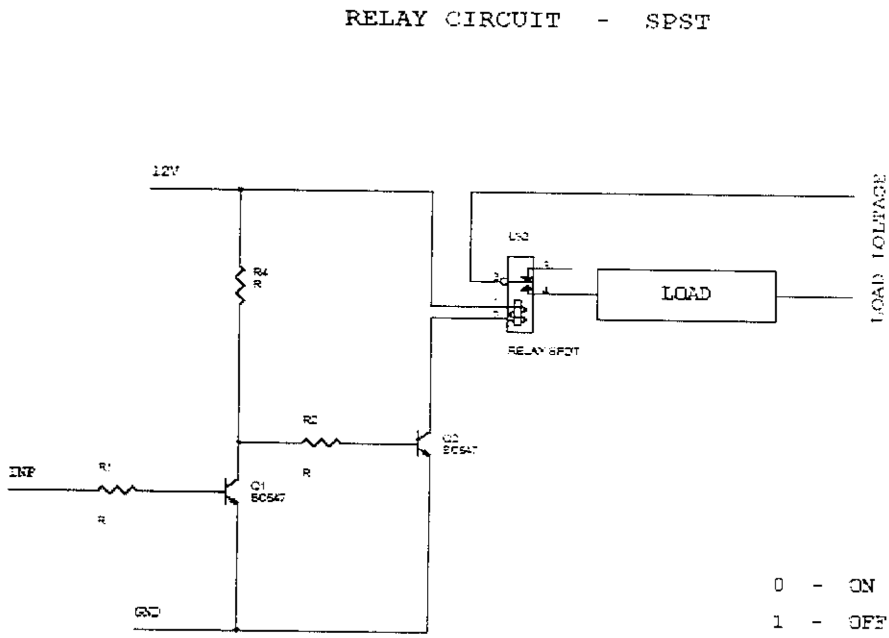
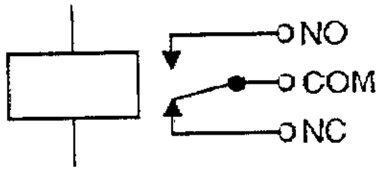


Fig 16:Relay circuit

Relay:

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.



The relay's switch connections are usually labeled COM, NC and NO:

- **COM** = Common, always connect to this, it is the moving part of the switch.
- **NC** = Normally Closed, COM is connected to this when the relay coil is **off**.
- **NO** = Normally Open, COM is connected to this when the relay coil is **on**.

Circuit description:

This circuit is designed to control the load. The load may be motor or any other load. The load is turned ON and OFF through relay. The relay ON and OFF is controlled by the pair of switching transistors (BC 547). The relay is connected in the Q2 transistor collector terminal. A Relay is nothing but electromagnetic switching device which consists of three pins. They are Common, Normally close (NC) and Normally open (NO).

The relay common pin is connected to supply voltage. The normally open (NO) pin connected to load. When high pulse signal is given to base of the Q1 transistors, the transistor is conducting and shorts the collector and emitter terminal and zero signals is given to base of the Q2 transistor. So the relay is turned OFF state.

When low pulse is given to base of transistor Q1 transistor, the transistor is turned OFF.

Now 12v is given to base of Q2 transistor so the transistor is conducting and relay is turned ON. Hence the common terminal and NO terminal of relay are shorted. Now load gets the supply voltage through relay.

5.2Buzzer

Here the buzzer is used to indicate the high pressure. The buzzer indicates when abnormal conditions happens in any process.

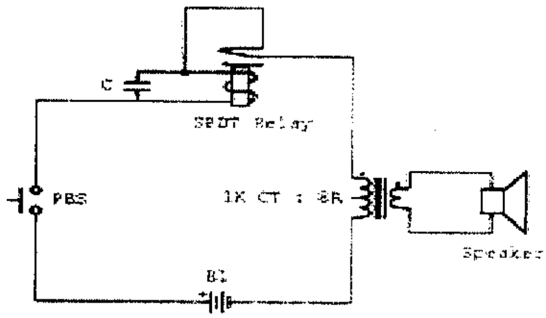


Fig 17:Buzzer circuit

Buzzer:

An electronic signaling device that produces buzzing sound when activated or triggered .

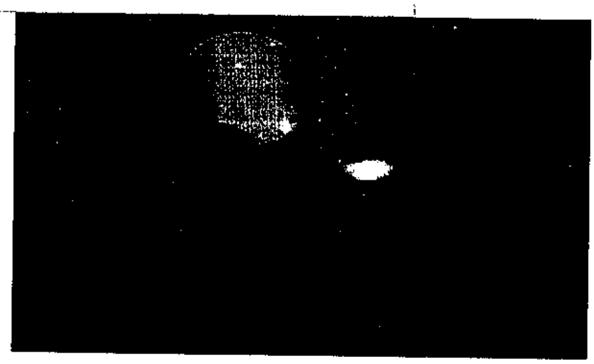
5.3LED:

Here the LED is used for the indication of high voltage and high current from the process.

Type	Passive, optoelectronic
Working principle	Electroluminescence
Invented	Nick Holonyak Jr. (1962)

Electronic symbol

Pin configuration	Anode and Cathode



A **light-emitting diode (LED)** is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962, early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness.

The LED is based on the semiconductor diode. When a diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is usually small in area (less than 1 mm^2), and integrated optical components are used to shape its radiation pattern and assist in reflection.LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability. However, they are relatively expensive and require more precise current and heat management than traditional light sources. Current LED products for general lighting are more expensive to buy than fluorescent lamp sources of comparable output.

CHAPTER 6

INTERFACING UNIT

6.1Circuit diagram

• INTERFACING DIAGRAM

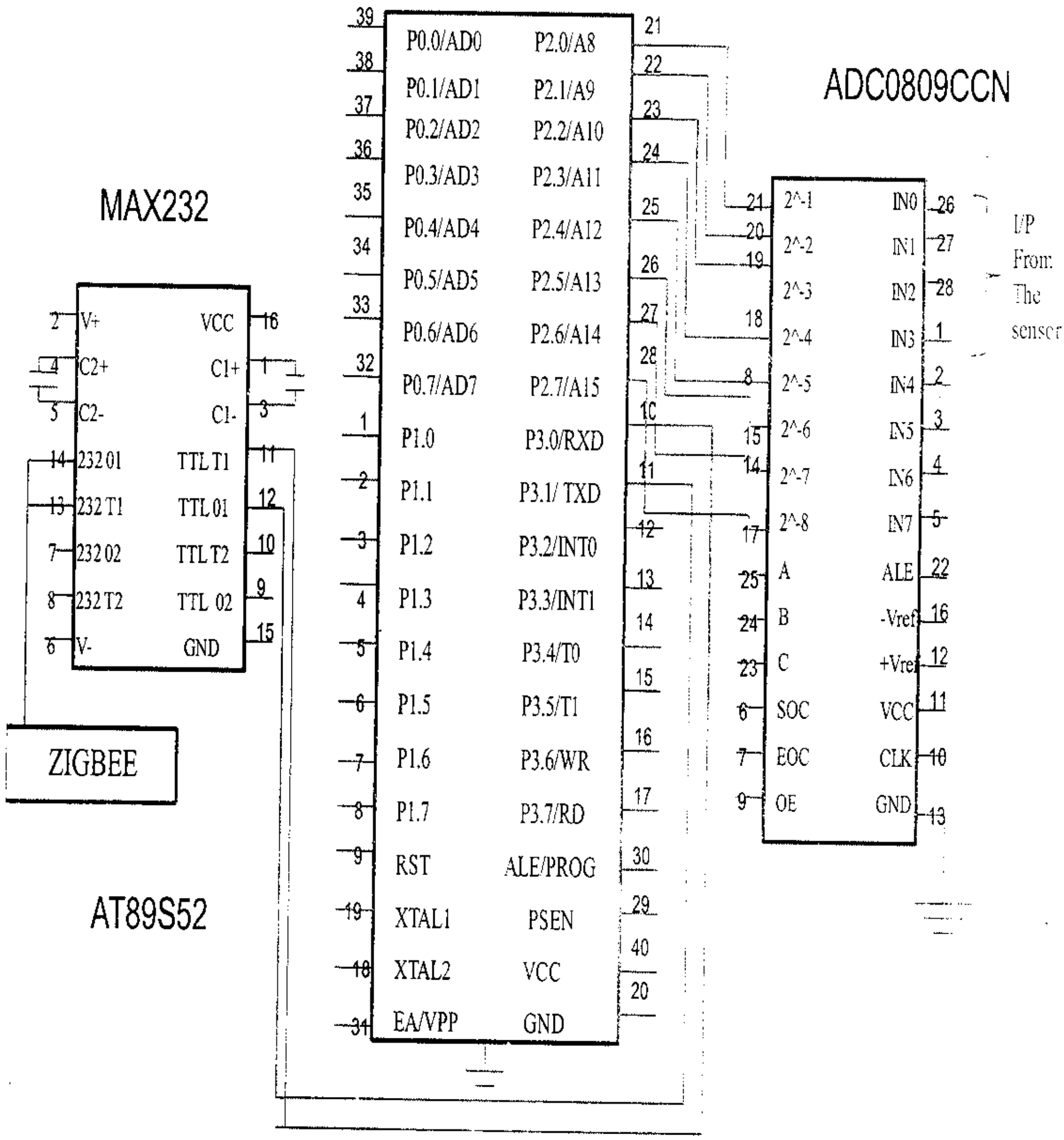


fig 18:Interfacing diagram

6.2Description

The input from the sensor is given to the ADC unit which converts the analog input into the digital data. The digital input is given to the micro controller in the port 2 .Then the data is transmitted via TXD to the MAX 232 which is used for serial communication. ZIGBEE is the protocol used for transmitting the measured data to the controller to provide the necessary control action.

The acknowledgement is sent from the ZIGBEE to the microcontroller and it is received by the RXD .The microcontroller generates the necessary control action and transmits the actuating signal to the actuator via the RF transmitter .The RF signal is decoded by the RF receiver ,then the corresponding actuator takes the ON/OFF position.

CHAPTER 7

OVERALL CIRCUIT DIAGRAM

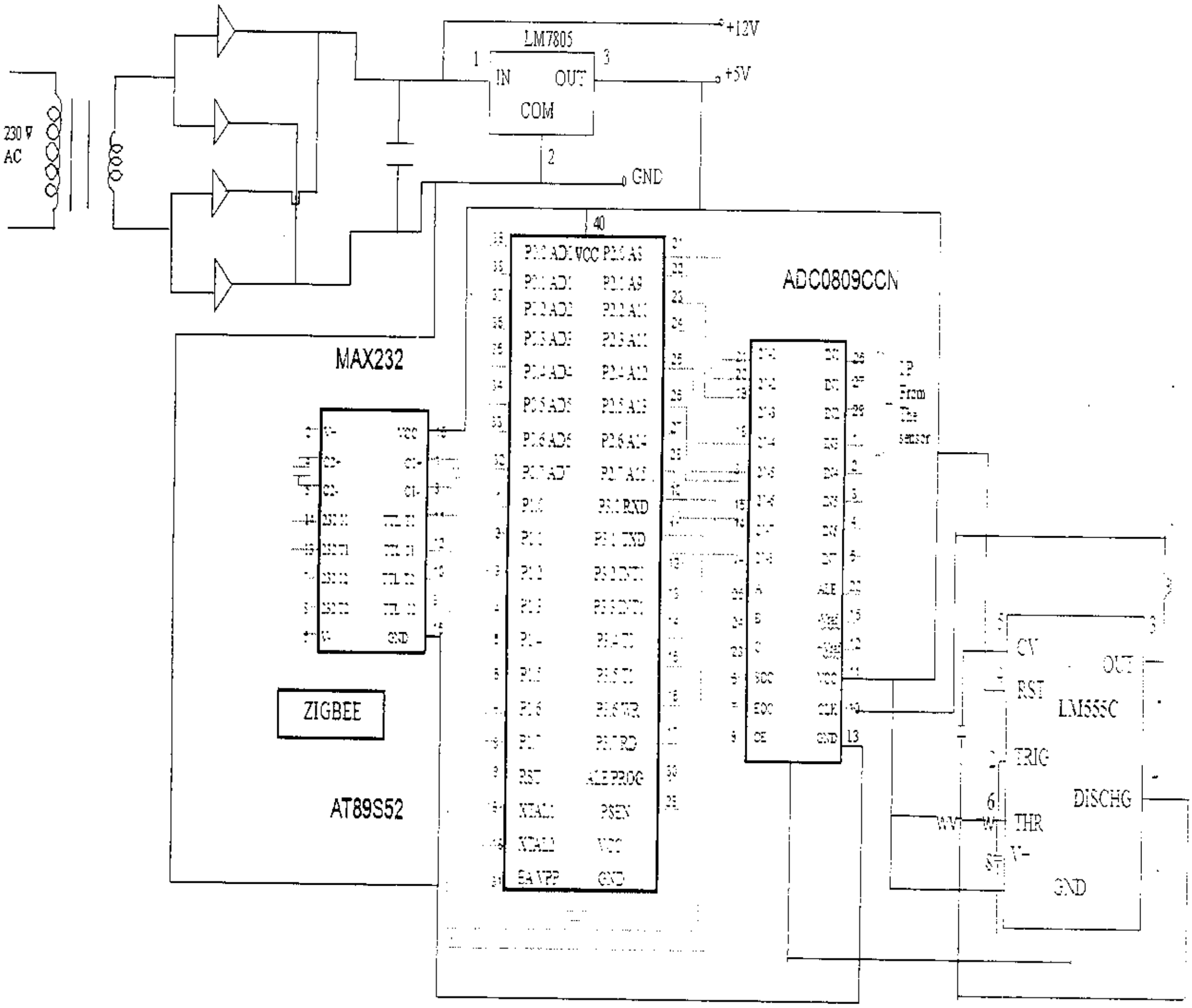


Fig 19:Overall circuit diagram

CHAPTER 8

SOFTWARE

8.1Need for keil cross software

The software used here is embedded C which uses the keil cross compiler.Software from the keil supports microcontroller family.Keil software is limited to 2KB,so the memory size is reduced.It is used for programming in both C and assembly language.

8.2Advantage of embedded C

Many programmers are more comfortable in writing C because it is a middle level language whereas assembly language is a low level language.Embedded C system performs one or few dedicated functions in real time operations.Since it is dedicated to specific tasks,size and cost of the product get reduced and the reliability and the performance increases.

CHAPTER 9

FLOW CHART

9.1 Design flow diagram

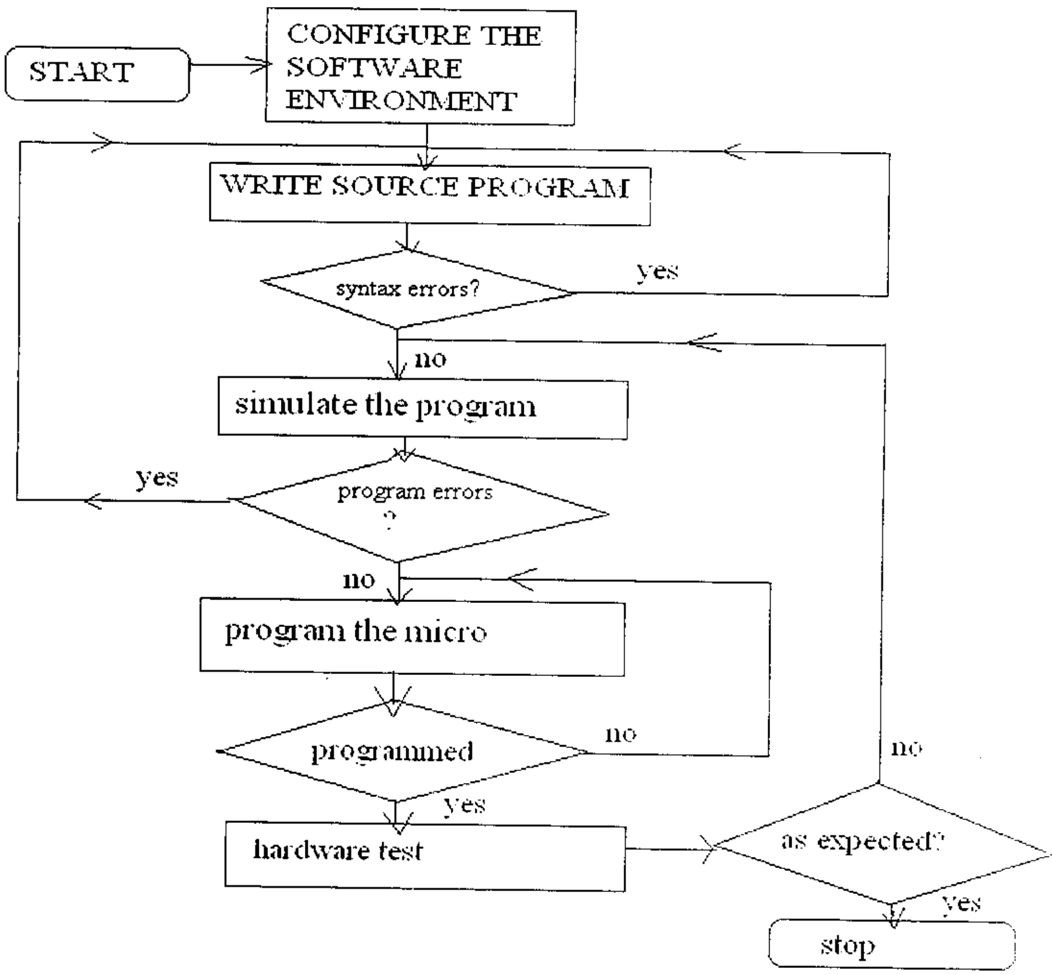


Fig 20:Design flow diagram

9.2.1Temperature control

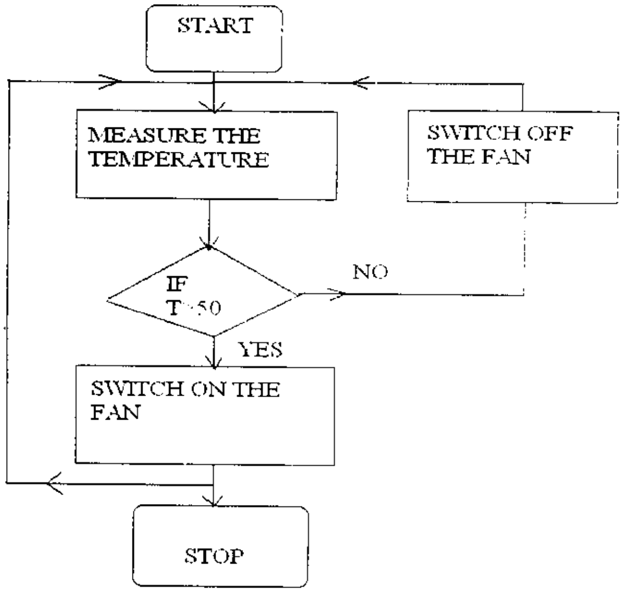


Fig 21: Flow chart of temperature control

9.2.2 Pressure control

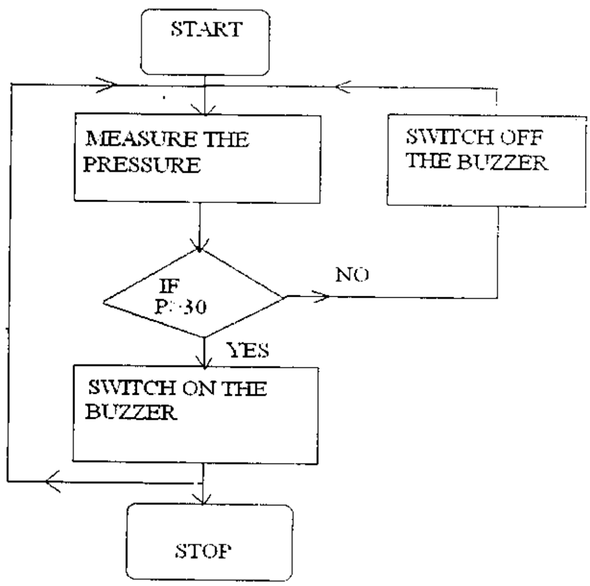


Fig 22:Flow chart of pressure

9.2.3Current and voltage control

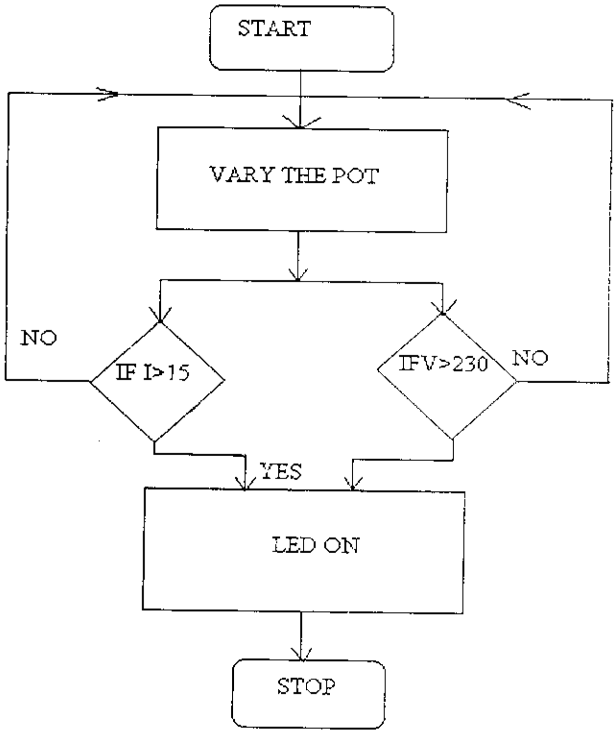


Fig 23:Flow chart of current and voltage control

CHAPTER 10

ALGORITHM

OVERALL ALGORITHM

STEP 1: Start the program

STEP 2: Measure the parameter to be controlled using the corresponding sensor

STEP 3: Set the set point in the controller

STEP 4: Compare the measured parameter with the setpoint

STEP 5: Provide the necessary control action for the deviation from the set point

STEP 6: Stop the process

CHAPTER 11
CONCLUSION

Conclusion:

Thus this project is mainly concerned with the long range communication between sensor unit and controller unit using ZIGBEE technology. RF signal is used between controller unit and actuator unit for shorter distance communication. Thus in our project we have implemented a low cost, low power consumption with a fully automated control system which can operate over a large area. This project is mainly concerned with the Industrial automation and home automation.

CHAPTER 12

APPENDICES

12.Appendix 1

Temperature sensor

The following data is obtained after testing the temperature sensor.

Input : Temperature

Output: Voltage

Range: -55 to 150°C

-1 to 6V

Table 2: Temperature Vs Voltage

Vs(V)	Vout(V)	Temp(oC)
4	-0.32	32
4.33	-0.6	42
4.36	0.7	48
4.38	0.74	54
4.5	1.1	71
4.75	1.27	90
5	1.32	95
5.25	1.45	97
5.75	1.55	99

Pressure sensor

The following data is obtained after testing the pressure sensor.

Input : Pressure

Output:Voltage

Range: 0 to 54Kpa

2.775 to 2.8V

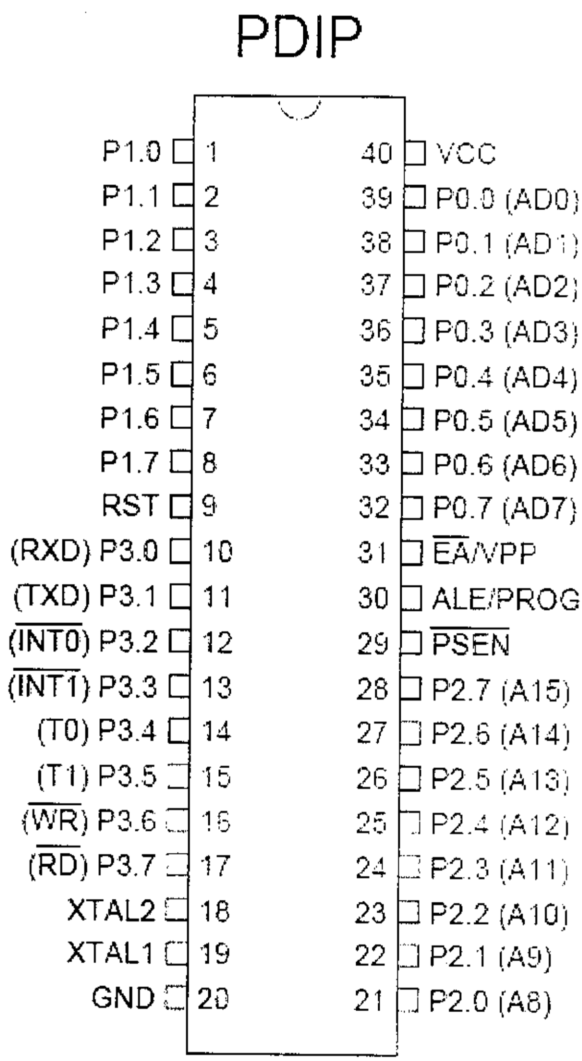
Table 3: Pressure Vs Voltage

Pr(psi)	O/P(v)	Vs(v)
0	0	3
5	0.25	3
10	0.5	3
15	1	3
20	1.25	3
25	1.5	3
30	2	3

<u>Appendix 2</u>

Micro controller AT89S52

<u>**Pin diagram**</u>



PIN DESCRIPTION:

VCC - Supply voltage.

GND - Ground.

PORT 0:

Port 0 is an 8-bit open-drain bi-directional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high impedance inputs. Port 0 may also be configured to be the multiplexed low order address/data bus during accesses to external program and data memory. In this mode P0 has internal pull-ups. Port 0 also receives the code bytes during Flash programming, and outputs the code bytes during program verification. External pull-ups are required during program verification.

PORT 1

Port 1 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups Port 1 also receives the low-order address bytes during Flash programming and verification.

PORT 2

Port 2 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups. Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that uses 16-bit addresses (MOVX @ DPTR). In this application, it uses strong internal pull-ups when emitting 1s. During accesses to external data memory that uses 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register. Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

PORT 3

Port 3 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL) because of the pull-ups. Port 3 also serves the functions of various special features of the AT89C51 as listed below: Port 3 also receives some control signals for Flash programming and verification.

Port Pin	Alternate Functions
P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	$\overline{INT0}$ (external interrupt 0)
P3.3	$\overline{INT1}$ (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)
P3.6	$\overline{WR}$ (external data memory write strobe)
P3.7	$\overline{RD}$ (external data memory read strobe)

RST

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device.

ALE/PROG

Address Latch Enable output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming. In normal operation ALE is emitted at a constant rate of 1/6 the oscillator frequency, and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external Data Memory. If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the microcontroller is in external execution mode.

PSEN

Program Store Enable is the read strobe to external program memory. When the AT89C51 is executing code from external program memory. PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

EA/VPP

External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed.

EA should be strapped to VCC for internal program executions. This pin also receivesthe 12-volt programming enable voltage (VPP) during Flash programming, for parts that require 12-volt VPP.

XTAL1

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

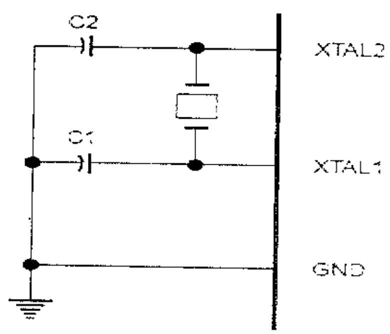
XTAL2

Output from the inverting oscillator amplifier.

OSCILLATOR CHARACTERISTICS

XTAL1 and XTAL2 are the input and output, respectively, of an inverting amplifier which can be configured for use as an on-chip. Either quartz crystal or ceramic resonator may be used. To drive the device from an external clock source, XTAL2 should be left unconnected while XTAL1 is driven as shown in Figure 2. There are no requirements on the duty cycle of the external clock signal, since the input to the internal clocking circuitry is through a divide-by-two flip-flop, but minimum and maximum voltage high and low time specifications must be observed.

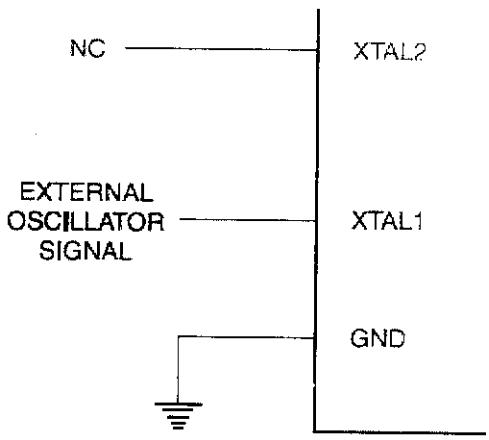
OSCILLATOR CONNECTIONS:



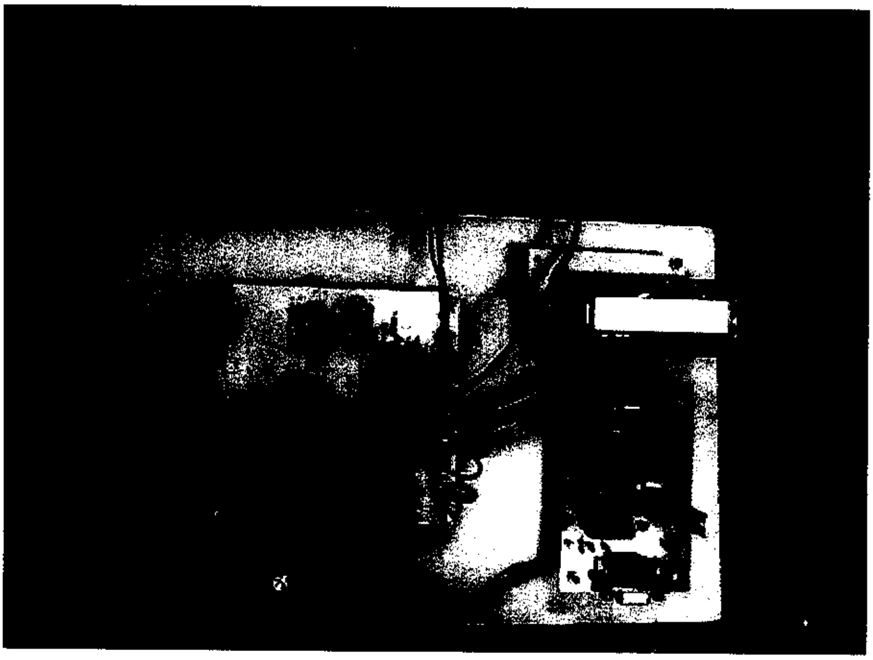
IDLE MODE

In idle mode, the CPU puts itself to sleep while all the on chip peripherals remain active. The mode is invoked by software. The content of the on-chip RAM and the entire special functions registers remain unchanged during this mode. The idle mode can be terminated by any enabled interrupt or by a hardware reset. It should be noted that when idle is terminated by a hard ware reset, the device normally resumes program execution, from where it left off, up to two machine cycles before the internal reset algorithm takes control. On-chip hardware inhibits access to internal RAM in this event, but access to the port pins is not inhibited. To eliminate the possibility of an unexpected write to a port pin when Idle is terminated by reset, the instruction following the one that invokes Idle should not be one that writes to a port pin or to external memory.

EXTERNAL CLOCK DRIVE CONFIGURATION:

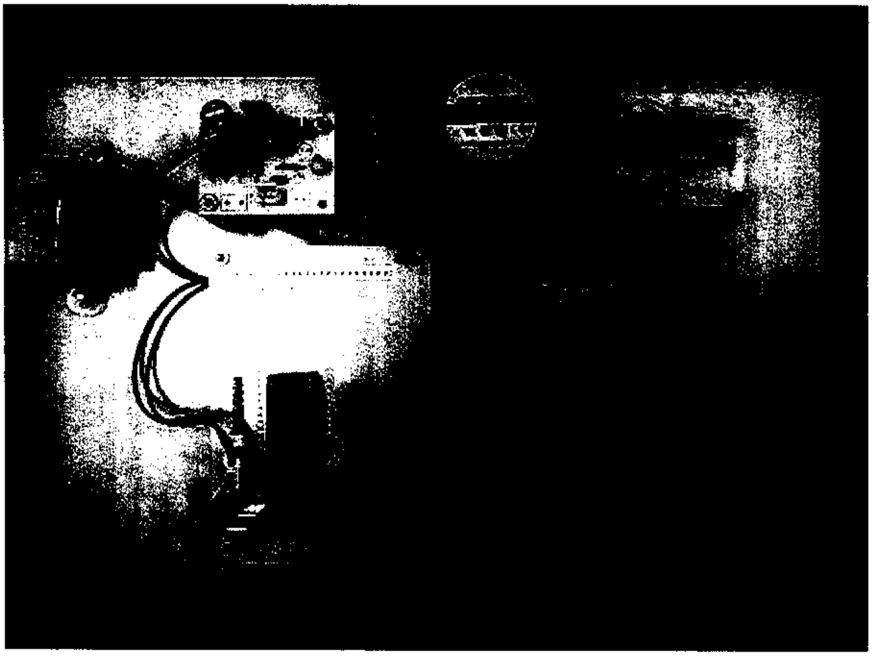


SENSOR UNIT:



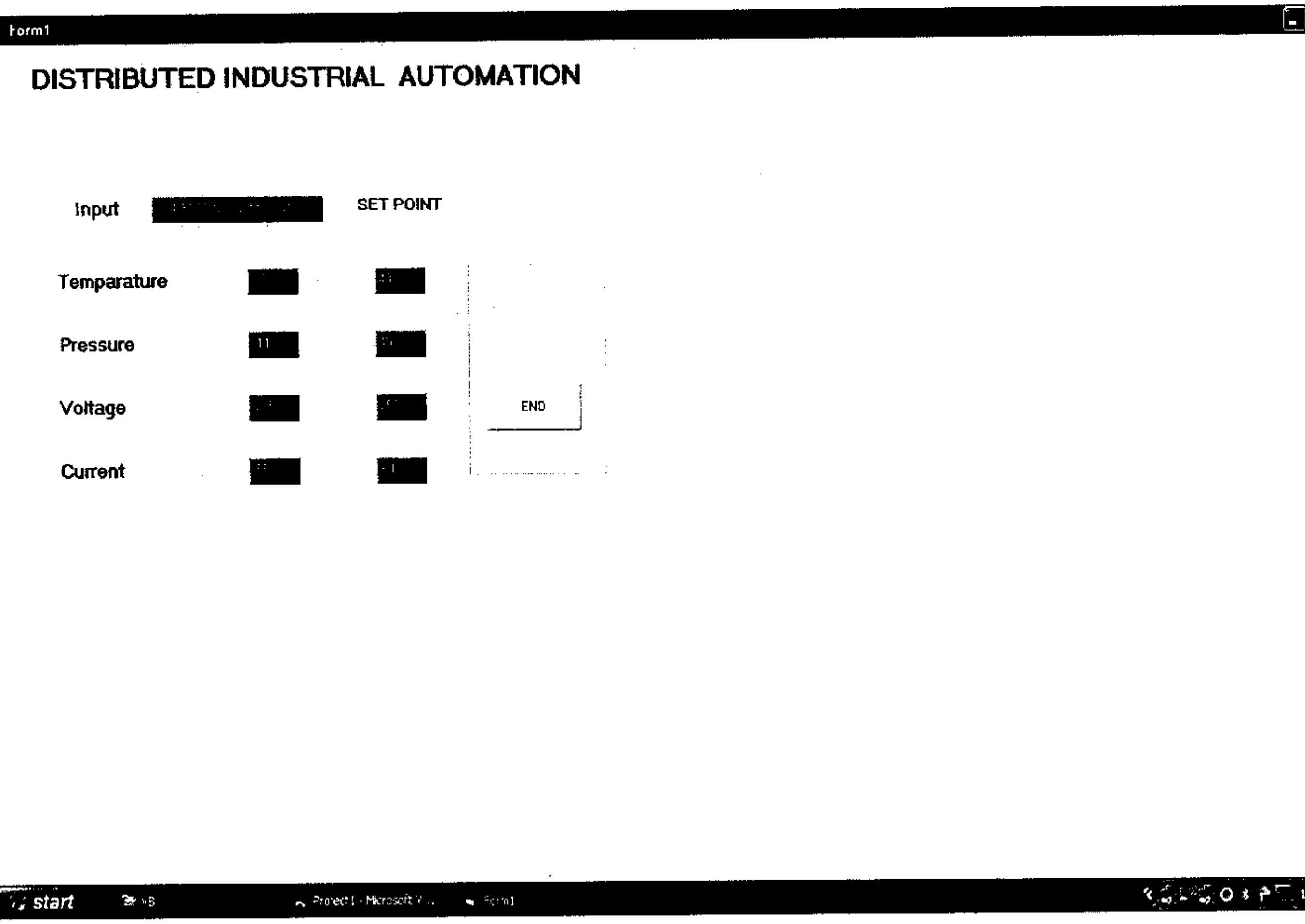
CONTROLLER UNIT

ACTUATOR UNIT:



OVERALL INTERFACING DIAGRAM:

FINAL OUTPUT



CHAPTER 13

LIST OF PHOTOGRAPHS

CHAPTER 14

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CHAPTER 15

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REFERENCES

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