Microcontroller-Based Fire Monitoring System

(Using Smart Sensors and SMS reporting)

A Dissertation Submitted in Partial Fulfillment of the Requirement of Master Degree (M.Sc.) in Computer Engineering

PREPARED BY:

SALAHADDIN AHMED HAMID AL-MOGAHEED

SUPERVISOR:

Dr. ABDULRASOOL JABBAR ALZUBAIDY

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قال صالح:

وعلَّمكَ ما لم تكن تعلَّم وَكَانَ فَضْلُ اللَّهِ عَلَيْكَ عَظِيمًَا

[النساء: 113]
DEDICATION

To my dear parents

To my brothers and sisters

To my dear wife

To all my friends

To my great teachers

To who like the learning

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ACKNOWLEDGEMENT

At the outset I thank God who helped me to complete this research, as well as offer my sincere thanks and appreciation to Dr. Abdulrasool Jabbar Al-zubaidy for his great efforts and continued encouragement to me.

I also thank all who helped me and made this project come true, thank my teachers in the Department of Electronics, and I thank my friends who I lived with them the beautiful days.
ABSTRACT

In this dissertation a fire monitoring system and early warning was developed. Depends mainly on the microcontroller programming in order to receive notices from the heat, smoke and infrared sensors.

The system remains in the case of sensing the sensors environment, when there is a change in the environment surrounding, it enables an alarms and sends SMS which contains the details of the change in the surrounding environment by using GSM intelligent alarm system that uses text messages.

The use of different types of sensors indicate the possibility of a fire or not, and also gives detailed information about room temperature or the presence of smoke or any of the variables that may arise in the environment of the facility.

The system was applied using the sensors and gave the direct alarm of the change in the sensors environment, which gave the system high reliability in fire detection and reporting immediately.
في هذه الأطروحة تم تطوير نظام مراقبة وإيذار مبكر للحرائق يعتمد في الأساس على استخدام المتحكم الدقيق وبرمجته لكي يستقبل الإشارات من محسسات الحرارة والدخان والأشعة تحت الحمراء ويظل في حالة تحسس للبيئة المحيطة وعند حصول تغير في البيئة المحيطة يقوم بالتنبيه وإرسال رسائل نصية تحتوي على تفاصيل التغير في البيئة المحيطة وذلك باستخدام نظام تنبئي ذكي يستخدم تقنية الرسائل النصية.

إن استخدام الأنواع المختلفة من المحسسات توضح احتمالية حدوث الحرائق من عدمها، وتعطي كذلك معلومات تفصيلية عن درجة حرارة الغرفة أو اكتشاف دخان أو أي من المتغيرات التي قد تطرأ على بيئة المنشأة.

لقد تم تطبيق النظام باستخدام المحسسات وأعطى تنبئه مباشر للتغير في البيئة المحيطة بالمحساسات ما يعني النظام موثوقية عالية في اكتشاف الحرائق والإبلاغ عنها فور حدوثها.
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<td><strong>ISP</strong></td>
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<td><strong>ISR</strong></td>
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<td><strong>LAN</strong></td>
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<tr>
<td>LCD</td>
<td>Liquid Crystal Display</td>
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<td>LVDT</td>
<td>Linear Variable Differential Transformer</td>
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<td>MCS</td>
<td>Mini Control System</td>
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<td>MEMS</td>
<td>Micro-Electro Mechanical Systems</td>
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<td>MIPS</td>
<td>Million Instructions Per Second</td>
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<td>MOSFET</td>
<td>Metal oxide semiconductor field-effect transistor</td>
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<td>mV</td>
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<td>PA</td>
<td>Pico Ampere</td>
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<tr>
<td>PC</td>
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<tr>
<td>PIC</td>
<td>Peripheral Interface Controller</td>
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<td>PWM</td>
<td>Pulse-Width Modulation</td>
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<tr>
<td>RAM</td>
<td>Random Access Memory</td>
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<tr>
<td>R</td>
<td>Resistance</td>
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<tr>
<td>RISC</td>
<td>Reduced Instruction Set Computer</td>
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<td>ROM</td>
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<td>RTD</td>
<td>Resistance Temperature Detector</td>
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<tr>
<td>SMS</td>
<td>Short Message Service</td>
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<tr>
<td>SPI</td>
<td>Serial Peripheral Interface</td>
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</tr>
<tr>
<td>UPS</td>
<td>Uninterruptible Power Supply</td>
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<tr>
<td>V</td>
<td>Volt</td>
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<tr>
<td>$V_{out}$</td>
<td>Output Voltage</td>
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<td>$V_s$</td>
<td>Supply Voltage</td>
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<td>WDT</td>
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<tr>
<td>$\mu A$</td>
<td>Micro Ampere</td>
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<td>$\mu Ci$</td>
<td>millicurie</td>
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<td>$\Omega$</td>
<td>Ohm</td>
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CHAPTER ONE
INTRODUCTION
1.1- INTRODUCTION:

Embedded systems have grown tremendously in recent years not only in their popularity but also in their complexity. Gadgets are increasingly becoming intelligent and autonomous. Refrigerators, air-conditioners, automobiles, mobile phones etc are some of the common examples of devices with built-in intelligence. These devices function based on operating and environmental parameters.

The microcontroller is a specialized microprocessor that houses much of the support circuitry onboard, such as ROM, RAM, serial communications ports, A/D converters, etc. In essence, a microcontroller is a minicomputer, but without the monitor, keyboard, and mouse. They are called microcontrollers because they are small (micro) and because they control machines, gadgets, etc. With one of these devices, we can build an “intelligent” machine, write a program on a host computer, download the program into the microcontroller via the parallel or serial port of the PC, and then disconnect the programming cable and let the program run the machine that will enable fire detection and enable alarms to alert employees to evacuation, furthermore send signal to the GSM system Which in turn sends (SMS) message to the concerned authorities (Civil Defense, Hospitals, etc...).

1.2- PROBLEM STATEMENT:

Industry security and safety is a major threat. If there is any unexpected accident like chemical reaction explosions, vibration shocks etc, there might be a great loss to the industry because of late reach of information to the appropriate base station or responsible department or responsible persons. The message may reach very late, by then the disaster may be severe. In order to minimize such disasters and take some necessary precaution our aim is to develop smart sensors to detect the fire and take the necessary and appropriate
measures. This system will employ a microcontroller based design in which the microcontroller will be connected to a GSM system and will be able to send the SMS from the GSM system used in the design. The message to be sent will be typed and the list of recipients will be created and the SMS can be sent on a trigger.

1.3- OBJECTIVES:

1- The aim of this project is to develop a programmable microcontroller based system with smart sensors to remotely monitor and locally control equipment in an industry from the fire risks.

2- Detection of the fire and reported early to minimize the size of the losses and take the necessary measures.

3- Sound the alarm if fire occurs and false Alarm occurrence should be kept minimum.

4- The system should be flexible enough to be easily modified in case if new rooms are added to the building.

5- The system should also provide the flexibility to adjust the temperature and smoke sensitivity levels as per the operating environment.

1.4- EXPECTED RESULTS:

We expect to get a powerful fire monitoring system on different levels to give perfect results that give the system high level of precision and reliability.
1.5- **Approach :**

The microcontroller is connected to the sensors with one of its ports which are configured as input port and process the signals coming from the sensors by the proposed algorithm and sends output through one of its ports which are configured as output port. This process is done automatically at the same moment.

![Figure 1.1 Block diagram of the proposed system](image)

1.6- **RESEARCH OUTLINE :**

It is proposed to take this dissertation in six chapters:

- Chapter one: introduction
- Chapter two: literature review
- Chapter three: the electronic circuit design
- Chapter four: software design
- Chapter five: results and discussion
- Chapter six: conclusion and recommendations
CHAPTER TWO

LITERATURE REVIEW
2.1 EXISTING PROJECTS AND ADDITIONS IN THIS RESEARCH

Most of the research in the field of fire control is a sensor for smoke or heat alarm devices, which alarm in case of smoke detection.

In this case these systems would be unreliable, for example if someone smokes near one of the smoke sensors, the smoke detector will sound the alarm in this case will not be known exactly what is the cause a fire or smoke a cigarette.

Alternative system which developed is a system depends on the heat and smoke sensors as well as infrared sensor and the use of these different types of sensors needed to a processor controls the system work so that the system is more reliable that when use microcontroller, which contains a program written in a particular language. This program monitors work and give the output of sensors on the basis of inputs from these sensors.

This project take the advantage of the GSM technology for reporting on the events detected by sensors, by sending SMS. GSM modem is used to send messages to the competent authorities. The system will have high reliability because it will report the events in detail, for example the presence of smoke, high temperature and infrared.

2.2 SENSORS

A sensor is generally defined as an input device that provides a usable output in response to a specific physical quantity input. The physical quantity input that is to be measured, called the measurand, affects the sensor in a way that causes a response represented in the output. The output of many modern sensors is an electrical signal, but alternatively, could be a motion, pressure, flow, or other usable type of output. Some examples of sensors include a thermocouple pair, which converts a temperature difference into an electrical output; a pressure sensing diaphragm, which converts a fluid pressure into a force or position...
change; and a linear variable differential transformer (LVDT), which converts a position into an electrical output. [8]

The devices that inform the control system about what is actually occurring are called sensors (also known as transducers). As an example, the human body has an amazing sensor system that continually presents our brain with a reasonably complete picture of the environment—whether we need it all or not.

For a control system, the designer must ascertain exactly what parameters need to be monitored—for example, position, temperature, and pressure—and then specify the sensors and data interface circuitry to do the job.[1]

Classification of sensors is conventionally by the convention principle, the quantity being measured, the technology used, or the application. [10]

Most sensors work by converting some physical parameter such as temperature or position into an electrical signal. This is why sensors are also called transducers, which are devices that convert energy from one form to another.

The various types of sensors are the Position Sensors, Angular Velocity Sensors, Proximity Sensors, Load Sensors, Pressure Sensors, Flow Sensors, Liquid-Level Sensors, Vision Sensors, Temperature Sensors, etc.[1].
2. 2.1 SMART AND INTELLIGENT SENSORS

Modern definition of smart or intelligent sensors can be formulated now by the following way: ‘Smart sensor is an electronic device, including sensing element, interfacing, signal processing and one- or several intelligence functions as self-testing, self-identification, self-validation or self-adaptation’. The key word in this definition is “intelligence”.

The self-adaptation is relatively new function of smart sensors. Novel designed self-adaptation smart sensor systems are based on so-called adaptive algorithms, which were used at the first time in various digital measuring systems.[3]

Strong growth expected for sensors based on MEMS-technologies, smart sensors and sensors with bus capabilities. Smart sensors’ capability to have more intelligence built into them continues to drive their application in automotive, aerospace and defense, industrial, medical, and – most recently – homeland security applications. Proprietary algorithms customized for specific applications analyze sensor data on key parameters to optimize machining, processing, and other component product or process quality.[3]

Intelligent wireless sensor-based controls have drawn industry attention on account of reduced costs, better power management, ease in maintenance, and effortless deployment in remote and hard-to-reach areas. They have been successfully deployed in many industrial applications such as maintenance, monitoring, control, security, etc.[2]

Thanks to the semiconductor technologies and its Moore’s law along with the MEMS (Micro-Electro Mechanical Systems) technology, sensors are becoming more cost effective, smaller, less power hungry, with more embedded features.
The sensor not only provides digital data but can also provide the expected information. For instance, functions like portrait/landscape, specific tap and free fall detections can be left to the sensor due to its capability to detect such simple information with values preset by the device manufacturer.[4]

2.2.2 TEMPERATURE SENSORS

Temperature is defined as a specific degree of hotness or coldness as referenced to a specific scale. It can also be defined as the amount of heat energy in an object or system. Heat energy is directly related to molecular energy (vibration, friction and oscillation of particles within a molecule): the higher the heat energy, the greater the molecular energy.

Temperature sensors detect a change in a physical parameter such as resistance or output voltage that corresponds to a temperature change.[7]

Temperature sensors give an output proportional to temperature. Most temperature sensors have a positive temperature coefficient (desirable), which means that the sensor output goes up as the temperature goes up, but some sensors have a negative temperature coefficient, which means that the output goes down as the temperature goes up. Many control systems require temperature sensors, if only to know how much to compensate other sensors that are temperature-dependent. Some common types are discussed next.

2.2.2.1 Bimetallic Temperature Sensors

The bimetallic temperature sensor consists of a bimetallic strip wound into a spiral. The bimetallic strip is a laminate of two metals with different coefficients of thermal expansion. As the temperature rises, the metal on the inside expands more than the metal on the outside, and the spiral tends to straighten out. These sensors are typically used for on-off control as in a household thermostat where a mercury switch is rocked from on to off.
2.2.2.2 Thermocouples

The thermocouple was developed over 100 years ago and still enjoys wide use, particularly in high-temperature situations. The thermocouple is based on the Seebeck effect, a phenomenon whereby a voltage that is proportional to temperature can be produced from a circuit consisting of two dissimilar metal wires.

2.2.2.3 Resistance Temperature Detectors

The resistance temperature detector (RTD) is a temperature sensor based on the fact that metals increase in resistance as temperature rises. RTDs have the advantage of being very accurate and stable (characteristics do not change over time). The disadvantages are low sensitivity (small change in resistance per degree), relatively slow response time to temperature changes, and high cost.

2.2.2.4 Thermistors

A thermistor is a two-terminal device that changes resistance with temperature. Thermistors are made of oxide-based semiconductor materials and come in a variety of sizes and shapes. Thermistors are nonlinear; therefore, they are not usually used to get an accurate temperature reading but to indicate temperature changes, for example, overheating. Also, most thermistors have a negative temperature coefficient, which means the resistance decreases as temperature increases.

2.2.2.5 Integrated-Circuit Temperature Sensors

Integrated-circuit temperature sensors come in various configurations. A common example is the LM34 and LM35 series. The LM34 produces an output voltage that is proportional to Fahrenheit temperature, and the LM35 produces an output that is proportional to Celsius temperature. APPENDIX A gives the
specification (spec) sheet for the LM35. Notice that it has three active terminals: supply voltage ($V_s$), ground, and $V_{out}$.

The output voltage of the LM35 is directly proportional to °C, that is, $V_{out} = 10 \text{ mV/}^\circ\text{C}$ This equation states that for each 1° increase in temperature, the output voltage increases by 10 mV. If only positive temperatures need to be measured, then the simple circuit shown in the spec sheet (bottom middle of datasheet) can be used. If positive and negative temperatures must be measured, then the circuit on the bottom right can be used, which requires a positive- and negative-supply voltage.

The LM35 is a convenient IC to work with because the output voltage is in degrees Celsius. Some ICs, such as the LM135, provide an output that is in degrees kelvin. One degree of kelvin or Celsius represents the same interval of temperature, but the Kelvin scale starts at absolute zero temperature, which is 273°C below freezing. There is also an absolute zero temperature scale for Fahrenheit degrees, called the Rankine scale. These four temperature scales are compared in Figure [2.1].

![Figure 2.1: Comparison of Rankine, Fahrenheit, Kelvin, and Celsius temperature scales.](image)

Another device, the AD7414 (Analog Devices), is a complete digital temperature monitoring system. In a small, 6-pin IC, it has a temperature sensor, a 10-bit ADC, and a serial interface. It can also be programmed with
high and low temperature limits; one of the output pins indicates when a programmed limit is exceeded. [1]

2.2.3 SMOKE DETECTORS:

Smoke detectors operate on two main principles: ionization detectors which will detect the ionized air from a fire even when there is little or no visible smoke, and the optical type, which is design to detect smoke which is present even when there is little or no rise in temperature. In general, the ionization types are used industrially and the optical types in domestic uses.

The ionization type of detector uses a radioactive source, usually americium-241, with a low activity level, typically 0.8 μCi. [10]

The gap between the source plate and the electrode is normally conducting due to the emission of alpha particles (helium ions) by the americium. The ion current is very small, of the order of 10 pA (1pA=10^{-12}A), so that any additional insulation leakage would be substantial in comparison. The acceptable level of insulation leakage is of the order of 0.5 pA. This implies that the insulators must not be touched, and if the ionization chamber has to be replaced, utmost care must be taken to avoid any contamination of the insulation by, for example, solder flux.

In the presence of smoke from a fire, particles entering the ionization chamber will be struck by the alpha particles, and the alpha particles will cling to the much larger particles of smoke. Because the charged units are now much larger, they cannot travel so quickly in air, and the current is reduced. By detecting the reduction in current, the detector can be made to activate an alarm. [10]

2.2.3.1 Ionization smoke sensor

Ionization smoke sensor contains a small amount of radioactive material, americium embedded in a gold foil matrix within an ionization chamber. The matrix is made by rolling gold and americium oxide ingots together to form a
foil approximately one micrometer thick. This thin gold-americium foil is then sandwiched between a thicker (~0.25 millimeter) silver backing and a 2 micron thick palladium laminate. This is thick enough to completely retain the radioactive material, but thin enough to allow the alpha particles to pass.

The ionization chamber as shown in figure 2.2 is basically two metal plates a small distance apart. One of the plates carries a positive charge, the other a negative charge. Between the two plates, air molecules—made up mostly of oxygen and nitrogen atoms—are ionized when electrons are kicked out of the molecules by alpha particles from the radioactive material (alpha particles are big and heavy compared to electrons). The result is oxygen and nitrogen atoms that are positively charged because they are short one electron; the free electrons are negatively charged.

The diagrams [2.2] and [2.3] illustrate how ionization technology works. The positive atoms flow toward the negative plate, as the negative electrons flow toward the positive plate. The movement of the electrons registers as a small but steady flow of current. When smoke enters the ionization chamber as shown in figure 2.3, the current is disrupted as the smoke particles attach to the charged ions and restore them to a neutral electrical state. This reduces the flow of electricity between the two plates in the ionization chamber. When the electric current drops below a certain threshold, the sensor sends a signal telling there is a smoke.
In the smoke-free chamber, positive and negative ions create a small current as they migrate to charged plates.

Smoke particles and combustion gases interact with the ions generated by the alpha particles, restoring them to their neutral electronic state and decreasing the electrical current passing through the cell. As fewer ions are available to migrate to the plates, the disrupted current causes the smoke sensor triggers the microcontroller.[11]
2.2.4 Infrared (IR):

All objects emit infrared energy provided their temperature is above absolute zero (0 Kelvin). There is a direct correlation between the infrared energy an object emits and its temperature.

IR sensors measure the infrared energy emitted from an object in the 4–20 micron wavelength and convert the reading to a voltage. Typical IR technology uses a lens to concentrate radiated energy onto a thermopile. The resulting voltage output is amplified and conditioned to provide a temperature reading.

Factors that affect the accuracy of IR sensing are the reflectivity (the measure of a material’s ability to reflect infrared energy), transmisivity (the measure of a material’s ability to transmit or pass infrared energy), and emissivity (the ratio of the energy radiated by an object to the energy radiated by a perfect radiator of the surface being measured).

An object that has an emissivity of 0.0 is a perfect reflector, while an object with an emissivity of 1.0 emits (or absorbs) 100% of the infrared energy applied to it. (An emissivity of 1.0 is called a “blackbody” and does not exist in the real world). [7]

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2.3 MICROCONTROLLER

2.3.1 Introduction

A microcontroller is a single-chip computer. Micro suggests that the device is small, and controller suggests that it is used in control applications. Another term for microcontroller is embedded controller, since most of the microcontrollers are built into (or embedded in) the devices they control.[6]

A microcontroller is a computer with most of the necessary support chips onboard. All computers have several things in common, namely:

1- A central processing unit (CPU) that ‘executes’ programs.
2- Some random-access memory (RAM) where it can store data that is variable.
3- Some read only memory (ROM) where programs to be executed can be stored.
4- Input and output (I/O) devices that enable communication to be established with the outside world i.e. connection to devices such as keyboard, mouse, monitors and other peripherals.

There are a number of other common characteristics that define microcontrollers. If a computer matches a majority of these characteristics, then it can be classified as a ‘microcontroller’. Microcontrollers may be:
1- ‘Embedded’ inside some other device (often a consumer product) so that they can control the features or actions of the product. Another name for a microcontroller is therefore an ‘embedded controller’.

2- Dedicated to one task and run one specific program. The program is stored in ROM and generally does not change.

3- A low-power device. A battery-operated microcontroller might consume as little as 50 mill watts.

2.3.2 MICROCONTROLLER AND MICROPROCESSOR

Microcontrollers are general purpose microprocessors which have additional parts that allow them to control external devices. Basically, a microcontroller executes a user program which is loaded in its program memory. Under the control of this program, data is received from external devices (inputs), manipulated and then data is sent to external output devices. A microcontroller is a very powerful tool that allows a designer to create sophisticated I/O data manipulation algorithms.

Microcontrollers are classified by the number of bits in a data word. 8-bit microcontrollers are the most popular ones and are used in many applications. 16-bit and 32-bit microcontrollers are much more powerful, but usually more expensive and not required in many small to medium general purpose applications where microcontrollers are used.

The simplest microcontroller architecture consists of a microprocessor, memory, and I/O. The microprocessor consists of a central processing unit (CPU) and the control unit (CU).

The CPU is the brain of a microprocessor and is where all of the arithmetic and logical operations are performed. The control unit controls the internal operations of the microprocessor and sends out control signals to other parts of the microprocessor to carry out the required instructions. [9]
A microcontroller may take an input from the device it is controlling and controls the device by sending signals to different components in the device. A microcontroller is often small and low cost. The components may be chosen to minimize size and to be as inexpensive as possible.

The actual processor used to implement a microcontroller can vary widely. In many products, such as microwave ovens, the demand on the CPU is fairly low and price is an important consideration. In these cases, manufacturers turn to dedicated microcontroller chips – devices that were originally designed to be low-cost, small, low-power, embedded CPUs. [5]

A microprocessor differs from a microcontroller in a number of ways. The main distinction is that a microprocessor requires several other components for its operation, such as program memory and data memory, input-output devices, and an external clock circuit. A microcontroller, on the other hand, has all the support chips incorporated inside its single chip. All microcontrollers operate on a set of instructions (or the user program) stored in their memory. A microcontroller fetches the instructions from its program memory one by one, decodes these instructions, and then carries out the required operations.

Microcontrollers have traditionally been programmed using the assembly language of the target device. Although the assembly language is fast, it has several disadvantages. An assembly program consists of mnemonics, which makes learning and maintaining a program written using the assembly language difficult. Also, microcontrollers manufactured by different firms have different assembly languages, so the user must learn a new language with every new microcontroller he or she uses.

Microcontrollers can also be programmed using a high-level language, such as BASIC, PASCAL, or C. High-level languages are much easier to learn than assembly languages.
In theory, a single chip is sufficient to have a running microcontroller system. In practical applications, however, additional components may be required so the microcomputer can interface with its environment. With the advent of the PIC family of microcontrollers the development time of an electronic project has been reduced to several hours.

Basically, a microcomputer executes a user program which is loaded in its program memory. Under the control of this program, data is received from external devices (inputs), manipulated, and then sent to external devices (outputs).

A microcontroller is a very powerful tool that allows a designer to create sophisticated input-output data manipulation under program control. Microcontrollers are classified by the number of bits they process. Microcontrollers with 8-bits are the most popular and are used in most microcontroller-based applications. Microcontrollers with 16 and 32 bits are much more powerful, but are usually more expensive and not required in most small- or medium-size general purpose applications that call for microcontrollers.

Memory, an important part of a microcontroller system, can be classified into two types: program memory and data memory. Program memory stores the program written by the programmer and is usually nonvolatile (i.e., data is not lost after the power is turned off). Data memory stores the temporary data used in a program and is usually volatile (i.e., data is lost after the power is turned off). [6]

2. 3.3 MICROCONTROLLER FEATURES:

Microcontrollers from different manufacturers have different architectures and different capabilities. Some may suit to a particular application while some others may be totally unsuitable. The hardware features of microcontrollers in general are described below.
2.3.3.1 Supply voltage
Most microcontrollers operate with the standard +5 V supply. Some microcontrollers can operate at as low as +2.7 V and some will tolerate +6 V without any problems. the allowed limits of the supply voltage in the datasheet.

2.3.3.2 The clock
All microcontrollers require an oscillator (known as a clock) to operate. Most microcontrollers will operate with a crystal and two capacitors. Some will operate with resonators or with external resistor-capacitor pair. Some microcontrollers have built-in resistor-capacitor type oscillators and they do not require any external timing components (e.g. PIC12C672). Resonators are not as stable as the crystals but they are more stable than the resistor-capacitor networks. Crystal oscillators should be chosen for applications which require very accurate timing. For applications where the timing stability requirements are very modest, resonators should be chosen. If the application is not time sensitive you should consider using external or internal (if available) resistor-capacitor timing components for simplicity and low cost.

2.3.3.3 Timers
Timers are an important part of any microcontroller. A timer is basically a counter which is driven from an accurate clock (or a division of this clock). Timers can be 8-bits or 16-bits long. Data can be loaded into the timers and they can be started and stopped under software control. Most timers can be configured to generate an interrupt when they reach a certain count (usually when they overflow).

2.3.3.4 Watchdog
Many microcontrollers have at least one watchdog facility, also known as the Watchdog Timer (or WDT). A WDT is usually an 8-bit timer with a prescaler option and is clocked from a free running on-chip oscillator. The watchdog is usually refreshed by the user program at regular intervals and a reset occurs if
the program fails to refresh the watchdog. Watchdog facilities are commonly used in real-time systems where it is required to check the proper termination of one or more activities. All PIC microcontrollers are equipped with a WDT.

2.3.3.5 Interrupts

Interrupts are a very important concept in microcontrollers. An interrupt causes a microcontroller to respond to external and internal (e.g. timer) events very quickly. When an interrupt occurs the microcontroller leaves its normal flow of execution and jumps directly to the Interrupt Service Routine (ISR). The source of an interrupt can either be internal or external. Internal interrupts are usually generated by the built-in timer circuits when the timer count reaches a certain value. External interrupts are generated by the devices connected external to the microcontroller and these interrupts are asynchronous, i.e. it is not known when an external interrupt will be generated. An example is the analogue-to-digital (A/D) conversion complete interrupt, which is generated when a conversion is completed.

2. 3.3.6 Analogue-to-digital converter

Some microcontrollers are equipped with A/D converter circuits. Usually these converters are 8-bits, but some microcontrollers have 10- or even 12-bit converters. Some microcontrollers have multiple A/D channels (e.g. PIC16F877 is equipped with eight A/D channels). A/D converters usually generate interrupts when a conversion is complete so that the user program can read the converted data very quickly. A/D converters are very useful in control and monitoring applications since most sensors produce analogue output voltages.

2. 3.3.7 Serial input-output

Some microcontrollers contain hardware to implement serial asynchronous communications interface. The baud rate and the data format can usually be selected in software by the programmer. The built-in timer circuits are usually
used to generate an accurate baud rate. If serial I/O hardware is not provided, it is easy to develop software to implement serial data transfer using any I/O pin of a microcontroller.

Some microcontrollers incorporate SPI (Serial Peripheral Interface), I²C (Integrated InterConnect), or CAN (Controller Area Network) bus interfaces. These enable a microcontroller to interface to other compatible devices easily, usually over a suitable bus structure.

2. 3.3.8 In-circuit programming

In microcontroller development cycle, a microcontroller is normally removed from its socket and then programmed using a programmer device. The programmed chip is then re-inserted into its socket, ready for testing. This is usually very tedious work, especially during the development of complex software projects. In-circuit programming enables a microcontroller to be programmed while the chip is in the applications circuit, i.e. there is no need to remove the chip for programming. This feature speeds up the program development cycle considerably.

2. 3.3.9 EEPROM data memory

EEPROM type memory is also very common in many microcontrollers. The programmer can store non-volatile data in such memory and can also change this data whenever required. For example, if the microcontroller is used to measure the temperature, the maximum and minimum values during a period can be stored in an EEPROM type memory. Some microcontroller types provide between 64 and 256 bytes of EEPROM data memories, while some others do not have any such memories.

2. 3.3.10 PWM output
Some microcontrollers provide Pulse-width Modulated (PWM) outputs which can be used in some electronic applications. One such application is to provide an effective analog output from a microcontroller by varying the duty cycle of the PWM output. It is possible to modify the period or the duty cycle of a PWM output by loading the appropriate registers.[9]

2.3.4 Microcontroller architectures

Basically, two types of architectures are used in microcontrollers: Von Neumann architecture and Harvard architecture. Von Neumann architecture is used by a very large percentage of microcontrollers and here all memory space is on the same bus and instruction and data are treated identically. In the Harvard architecture (used by the PIC microcontrollers), code and data storage are on separate buses and this allows code and data to be fetched simultaneously, resulting in a more efficient implementation.

2.3.4.1 RISC and CISC

RISC (Reduced Instruction Set Computer) and CISC (Complex Instruction Set Computer) refer to the instruction set of a microcontroller. In a RISC microcontroller, instruction words are more than 8-bits wide (usually 12-, 14-, or 16-bits) and the instructions occupy one word in the program memory. RISC processors (e.g. PIC) have no more than about 35 instructions, and they offer higher speeds. CISC microcontrollers have 8-bit wide instructions and they usually have over 200 instructions. Some instructions (e.g. branch) occupy more than one program memory location. [9]

2.3.5 MICROCONTROLLER TYPES

The predominant family of microcontrollers are 8-bit types since this word size has proved popular for the vast majority of tasks the devices have been required to perform. The single byte word is regarded as sufficient for most purposes and has the advantage of easily interfacing with the variety of IC memories and
logic circuitry currently available. The serial ASCII data is also byte sized making data communications easily compatible with the microcontroller devices. Because the type of application for the microcontroller may vary enormously most manufacturers provide a family of devices, each member of the family capable of fitting neatly into the manufacturer’s requirements. This avoids the use of a common device for all applications where some elements of the device would not be used; such a device would be complex and hence expensive. The microcontroller family would have a common instruction subset but family members differ in the amount, and type, of memory, timer facility, port options, etc. possessed, thus producing cost-effective devices suitable for particular manufacturing requirements.

Memory expansion is possible with offchip RAM and/or ROM; for some family members there is no on-chip ROM, or the ROM is either electrically programmable ROM (EPROM) or electrically erasable PROM (EEPROM) known as flash EEPROM which allows for the program to be erased and rewritten many times. Additional on-chip facilities could include analogue-to digital conversion (ADC), digital-to-analogue conversion (DAC) and analogue comparators. Some family members include versions with lower pin count for more basic applications to minimize costs.[5]

2.4 BUZZER

For alarm purposes a lot of electric bells, alarms and buzzers are available in the market that have got different prices and uses. The buzzer that will used in this project is a 5-12 V buzzer and has got enough alarm sound to be used in a fire alarm system. Louder buzzer would have been even better but then their operating voltages are high as we had a supply of maximum up to 12V available with us on the board.
2.5 GSM SYSTEM

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.

GSM Modem provides full functional capability to Serial devices to send SMS and Data over GSM Network. The product is available as Board Level or enclosed in Metal Box. The Board Level product can be integrated in to Various Serial devices in providing them SMS and Data capability and the unit housed in a Metal Enclosure can be kept outside to provide serial port connection. The GSM Modem supports popular "AT" command set so that users can develop applications quickly. The product has SIM Card holder to which activated SIM card is inserted for normal use. The power to this unit can be given from UPS to provide uninterrupted operation. This product provides great feasibility for Devices in remote location to stay connected which otherwise would not have been possible where telephone lines do not exist.

Application areas

1. Mobile Transport vehicles.
2. LAN based SMS servers
3. Alarm notification of critical events including Servers
4. Network Monitoring and SMS reporting
5. Data Transfer applications from remote locations
6. Monitor and control of Serial services through GSM Network
7. Integration to custom software for Warehouse, Stock, Production, Dispatch notification through SMS.
8. AMR- Automatic Meter Reading. And many more…

2.5.1 SMS Communications

SMS (Short Message Service) is a type of communications process that enables the transmission of short text messages and data transfers to and from mobile devices such as cell phones. Messages are usually limited from 140 to 160 characters in length and are stored and forwarded at SMS centers. This allows messages and data transfers to be retrieved immediately or at a later time via an SMS center.

2.5.2 Advantages of using SMS

SMS communications provide an affordable and convenient means to send and receive data using mobile devices such as cell phones. Businesses and industry often require 24-hour coverage of their operations and have personnel who are on-call after normal work hours to handle work-related issues and emergencies. There are employees who are responsible for the proper functioning of equipment and processes at remote sites. Managers need to be notified of significant events.
CHAPTER THREE

ELECTRONIC CIRCUIT DESIGN
ELECTRONIC CIRCUIT DESIGN

3.1 Introduction

To make the live easier and to make maximum use of time available, the modular design concept is used to implement this system. The entire system is to be divided into different modules, which not only makes troubleshooting easier but is also an effective approach for system modification.

The fire control system will designed to monitor and detect the fire by continuous examining of the pins connected to the output of the sensors and on positive indication sending signal to GSM system indicating the position of the fire and sounding of the alarm.

3.2 SYSTEM OUTLINE:

FIGURE 3.1: Block Diagram of Fire Monitoring System
3.2.1 LM35 HEAT DETECTOR:

3.2.1.1 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 µA 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°C to +150°C temperature range, while the LM35C is rated for a -40°C to +110°C range (-10°C 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-202 package. APPENDIX A gives the specification (spec) sheet for the LM35. Notice that it has three active terminals: supply voltage ($V_s$), ground, and $V_{out}$. 
3.2.1.2 HEAT DETECTION CIRCUIT:
This is the first module of our project in which we have used LM 35 sensor and a comparator.

As illustrated in figure 3.2 the LM 35 has three pins a, b and c. Pin a is connected to $V_{cc}$, pin b is connected with ground while the output is from pin c. The output of this sensor is going to a comparator. As per our requirement we need to send a high signal to the microcontroller when the temperature is 50 degree centigrade. As the output of sensor gives 10mv change with a change of 1 degree centigrade in temperature. So at 50 degree centigrade it will give 0.5 volts as output has a linear relationship with temperature. So to meet our requirement we have set 0.49 volts on the negative input of comparator so that when the output of sensor will give 0.5 volts the comparator will pass high signal to microcontroller. So when the temperature of external environment will be 50 degree centigrade, a high signal will be passed on to the microcontroller through comparator.

![Figure 3.2: LM35 Connection Diagram](image)

Figure 3.2: LM35 Connection Diagram
3.2.2 SMOKE DETECTION CIRCUIT:
The second module of our project is to detect smoke from the environment which is inevitable outcome of fire. So to fulfill this requirement we have used smoke sensor and a comparator. The sensor output is almost zero when there is no smoke in environment. On the contrary when there is a smoke the sensor will give a output voltage according to the intensity of smoke. As soon as the smoke vanishes its output again comes to zero. The internal circuitry of the sensor contains a heater. As the smoke particles will pass through, the heater will ionize the smoke particles and they will act as charge carriers so a voltage will be built at output. The output pin is connected with the positive input of comparator while at its negative input there is constant 3 volts. So as the smoke will produce, there will be voltage at output of sensor. As the smoke intensity increase and the sensor output will reach 3.1 volts the comparator will pass a high signal to microcontroller. As this sensor is quite sensitive to smoke so we have kept 3 volts as a standard at comparator input so that it should detect real fire and do not activate on fake signals just like if someone is smoking. Atypical circuit arrangement is illustrated in block form in figure 3.3, using a MOSFET impedance converter (source follower), comparator and output stage.

---

![Figure 3.3 The Circuit of smoke sensor](image)

3.2.3 IR RECEIVER MODULE
The TSOP4038 is a compact IR receiver for sensor applications. It has a high gain for IR signals at 38 kHz. The detection level does not change when ambient light or strong IR signals are applied. It can receive continuous 38 kHz signals or 38 kHz bursts. IR measure the infrared energy emitted from the fire in the 4–20 micron wavelength and convert the reading to a voltage.

**BLOCK DIAGRAM**

![Block Diagram](image)

**Figure 3.4: IR Receiver Module**

**Table 3.1: Terminal Description of IR receiver**

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Pin name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OUT</td>
<td>OUTPUT TERMINAL</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>GROUND</td>
</tr>
<tr>
<td>3</td>
<td>V_{cc}</td>
<td>POWER SUPPLY</td>
</tr>
</tbody>
</table>
Figure 3.5 Application Circuit of IR receiver

The external components $R_1$ and $C_1$ are optional to improve the robustness against electrical overstress (typical values are $R_1 = 100 \, \Omega$, $C_1 = 0.1 \, \mu F$). The output voltage $V_O$ should not be pulled down to a level below 1 V by the external circuit. The capacitive load at the output should be less than 2 nF. More details about IR receiver illustrated in APPENDIX B.

3.2.4 SENSORS INTERFACING:

Coming to the main stream now the heat sensor LM-35 was interfaced with a comparator that gives an output voltage level for certain temperature. According to the fire environment the output of the heat sensor compares 0.5 Volts DC already set on the comparator IC, hence any increase in the temperature correspondingly increases the output of the sensor and hence the comparator IC was generating the high output thereby giving positive indication of fire.

Similarly smoke sensor will interfaced with the comparator. As the sensor gives certain voltage level upon positive detection of smoke so the comparator was fed with 3 Volts DC to compare with the output of the smoke sensor, as soon as the output of the smoke sensor increases beyond 3Volts the comparator passes high logic on its output hence indicating positive presence of smoke. The output of all of these sensors is fed into the microcontroller. The microcontroller continuously examines these pins and when receives signals from sensors it performs sending the operation condition to the buzzer and sends signal to GSM system that sends SMS messages to the concerned authorities.

Hence giving us a flexibility to interface various sensors at a time with the microcontroller.

3.2.5 MICROCONTROLLER:
The Atmel AVR ATmega32 will be used in this project is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega32 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed. The actual design of single integrated circuit (IC) systems is straightforward. Before starting the design, sufficient I/O port pins, enough internal memory, and sufficient processor speed to do the job. [12]

**Pin Configurations:**

![Pinout ATmega32](image)

The device is manufactured using Atmel’s high density nonvolatile memory technology. The Onchip ISP Flash allows the program memory to be reprogrammed in-system through an SPI serial interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core. The boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit
RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega32 is a powerful microcontroller that provides a highly-flexible and cost-effective solution to many embedded control applications. More details about ATmega32 illustrated in APPENDIX C.

Figure 3.7 Block Diagram of ATmega32
3.2.6 BUZZER:

The buzzer being used in this project is a 5-12 V buzzer and has got enough alarm sound to be used in a fire alarm system. Louder buzzer would have been even better but then their operating voltages are high as we had a supply of maximum up to 12V available with us on the board.

The output current of the microcontroller is very low, as low as a few microamperes, so buzzer cannot be directly driven by the microcontroller as the buzzer must need at least a few milli amperes to sound efficiently and loudly. For this purpose need for a relay to be used was felt that was energized on logic high reception from the microcontroller and in turn was activating the buzzer. Continuous examining of the respective pins of the sensors makes this project highly useful to be used in sensitive and high risk areas. figure 3.8 illustrate the block diagram of buzzer circuit.

![Figure 3.8 Block diagram of buzzer circuit](image)

3.2.7 GSM SYSTEM :

GSM intelligent alarm system II that can sends up to five SMS messages will be used in this project by connecting it with the microcontroller . When a signal received from the microcontroller , the GSM system sends SMS messages to a certain destinations. Figure 3.9 illustrate the GSM intelligent alarm system II .
Figure 3.9 GSM intelligent alarm system II
CHAPTER FOUR
SOFTWARE DESIGN
4.1 INTRODUCTION:
In the last decades the importance of simulation in many fields got cleared, to get primary results before start in implementing the final design. Many designers had gain benefit from simulating to get the best results which could be translated in the real world.
Another importance of simulation is in the case of study where it is difficult implementation in the real world.

4.2 BASCOM AVR COMPILER

4.2.1 INTRODUCTION
In 1995 MCS started to sell BASCOM-LT, a BASIC compiler for Windows 3.1. It was the first Windows application that offered a complete and affordable solution: editor, compiler, simulator and programmer. BASCOM-LT was a 8051 BASIC compiler. The reason why it became popular was that it included a lot of functionality that was easy to use from BASIC. To use an LCD display was simple, just a configuration line to define the used pins, and voila: a working application in minutes. And when you needed a different LCD display, you could simply change the CONFIG line. And when a different processor was needed, you only had to change the definition file.

Lots of high-level language compilers (C, BASIC, PASCAL, etc.) are scattered on the Internet and some are offered free of charge. One is to use the BASIC language compiler for AVR microcontroller products, which BASCOM. Until now this writing, MCS Electronics BASCOM producing only developed for microcontroller ATMEIL products, namely 8051 and AVR. But the AVR will be discussed here only. MCS provides an opportunity for us to download a demo version with limited file size is only up to 4KB code only.

4.2.2 SETTING BASCOM ENVIRONMENT
The following main steps:

1. The first step, open the application BASCOM.
2. Create a new firmware file, give name in accordance with the wishes you (read-making procedure firmware below).
3. On the Menu Bar (top), click Option >> Compiler >> Chip
4. Options dialog box, on the menu bar click Chip >> Chip: according with microcontroller being worked on, ATMega-32, then select m32def.dat
5. Save the file.

Figure 4.1 Select the microcontroller type
Actually, we have to do this basic setting because the entire command or library associated with the microcontroller is stored on m32def.dat file (for ATMega32). Contents of this file including the default declaration of variables of the microcontroller. This procedure in fact we need to do to force the compiler to perform activities for a specific microcontroller. Similar procedure, but other methods can we do with do it in the firmware.

On the top line of our firmware, with example syntax:

$regfile ="m32def.dat"  » to force the compiler environment ATMega32
$crystal = 8000000       » tells the compiler that is used is 8MHz XTAL

Well.

**Open New Project**

1. Open BASCOM
2. On the Menu Bar (top), click File >> New
3. In the Save As dialog box, firmware file name.
4. Click Save.
4.3 SIMULATION FLOWCHART

Figure 4.5 Simulation flowchart
4.4 DESCRIPTION OF FLOWCHART:

This algorithm and in turn the code done in the following sequences:

1- Start the fire monitoring system.

2- Initialize the smoke, temperature and IR sensors and the Microcontroller.

3- The microcontroller will check the sensors continuously.

4- Check if smoke detected. When a smoke is detected, check if smoke and high temperature detected, if there are smoke and high temperature, check if smoke and high temperature and infrared detected, if they exist, the program will print ' Smoke and high temperature and infrared detected ' else the program will print 'smoke and high temperature detected' .

5- If no smoke detected, check if high temperature detected, if they exist, check if high temperature and IR detected, if they exist, the program will print ' High temperature and infrared detected ' else the program will print ' High temperature detected '.

6- If no high temperature detected, check if IR detected, if IR detected, the program will print ' infrared detected '.

7- If no smoke and high temperature detected, check if smoke and IR detected, if they exist, the program will print ' Smoke and IR detected ' else the program will print ' Smoke detected '.

8- The above steps from (3 to 7) Repeated Continuously and permanently.
4.5 WRITE Firmware:

$regfile = "m32def.dat"
$crystal = 8000000

'configure port d for input mode
Config Portd = Input

'configure port b for output mode
Config Portb = Output

Begin:
If Pind.0 = 1 Then 'test
    Goto Ste
Elseif Pind.1 = 1 Then
    Goto Tir
Elseif Pind.2 = 1 Then
    Pinb.2 = 1 'IR detected
    Pinb.7 = 1 'enable buzzer
End If
Waitms 2000
Goto Begin

Ste:
If Pind.1 = 1 Then 'test
Goto Stir
Else
Goto Sir
End If
Waitms 2000
Goto Begin

Stir:
If Pind.2 = 1 Then 'test
Pinb.6 = 1 'smoke and high temp. and IR detected
Pinb.7 = 1 'enable buzzer
Else
Pinb.3 = 1 'smoke and high temp. detected
Pinb.7 = 1 'enable buzzer
End If
Waitms 2000
Goto Begin

Sir:
If Pind.2 = 1 Then 'smoke and IR detected
Pinb.4 = 1
Pinb.7 = 1 'enable buzzer
Else
Pinb.0 = 1 'smoke detected
Pinb.7 = 1 'enable buzzer
End If
Waitms 2000
Goto Begin
Tir:

If Pind.2 = 1 Then 'test
Pinb.5 = 1 ' high temp. and IR detected
Pinb.7 = 1
Else
Pinb.1 = 1 high temp. detected
Pinb.7 = 1 ' enable buzzer
End If
Waitms 2000
Goto Begin

End
4.6 COMPILE FIRMWARE:

The most trivial way is to change firmware of a high-level language, with various things, then change it to machine language, so it's ready to be downloaded to the microcontroller. Here's an interesting illustration, the hierarchy of levels of programming languages.

Occupying the top of the pyramid or the usual called high-level language (i.e. The closest language to language humans). Getting to the bottom position in the This pyramid, then the language is more difficult understood by humans. So on the one level before the base of the pyramid is called with machine language (the most basic itself is hardware, in this instance is microcontroller AVR, PIC, etc.).
Back to the top of the stairs, which is a high-level language, the illustrations cited some of them: Fortran, C, Pascal, BASIC. A language high level will be represented by a file with the extension *.bas (bas stands for BASIC).

At Compile BASCOM do, it will produce some files that represent direct each level of the language above. Files with the extension *.Asm (asm stands for Assembler) is representing the Assembly Language level. And another file with the extension *.Hex (hex stands for the hexadecimal contents of this file is hexadecimal codes and the only recognizable by any machine or microcontroller) which represents the level Machine Language. Some other files BASCOM is produced by the files during the process of linking and so on, but we at most be interested only in the two kinds of files are*.bas and *.hex.
With one sentence is the way the firmware * . Bas » *. Asm » *. Hex, this process is called compiling. So how do the compiling in BASCOM indicated by the following procedure:

The picture shows the contents of a folder bascom simulator, it appears done compiling there is only one file *. bas only.

Figure 4.8 The file with extention .bas

1. To compile, do first save the file *. bas, then the top menu bar Program >> Compile. Can also be done by pressing the F7 key, or It could be a click icon IC picture.

2. Wait a minute, it will BOX status dialog appears compiling, Flash Used: 2% shows the number of memory is used. Because this project put on ATMega-32 with 32kB Flash Memory, then 2%* 32kB=0.64KB. 3. If there is no error message, then firmware has been completed compiled.
Figure 4.9 compile the Firmware

Figure 4.10 Making compile

Figure 4.11 Percentage of memory usage
The picture shows the accretion number of files after the compiling. Files that are important to the next process is the *. Bas and *. Hex Files with the name proj.fire.hex which will be burned to a microcontroller.

Figure 4.12 files types after compiling
CHAPTER FIVE
RESULTS AND DISCUSSION
5.1 RESULTS:

Upon reception of positive signals to the microcontroller from the sensors that continuously monitors them, and depending on the proposed algorithm the microcontroller will send to the GSM system one of the following seven states:

Table 5.1 output of the system

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoke sensor</td>
<td>Send message contain smoke detected and sound the alarm</td>
</tr>
<tr>
<td>temperature sensor</td>
<td>Send message contain high temperature detected and sound the alarm</td>
</tr>
<tr>
<td>IR sensor</td>
<td>Send message contain IR detected and sound the alarm</td>
</tr>
<tr>
<td>Smoke and temperature sensors</td>
<td>Send message contain smoke and high temperature detected and sound the alarm</td>
</tr>
<tr>
<td>Smoke and IR sensors</td>
<td>Send message contain Smoke and IR detected and sound the alarm</td>
</tr>
<tr>
<td>temperature and IR sensors</td>
<td>Send message contain high temperature and IR detected and sound the alarm</td>
</tr>
<tr>
<td>Smoke and temp. and IR sensors</td>
<td>Send message contain Smoke and high temperature and IR detected and sound alarm</td>
</tr>
</tbody>
</table>
5.2 DISCUSSION:

In this project we have obtained an intelligent system contains three types of sensors that constantly sensitive to the surrounding environment.

Depending on the sensors reading of the surrounding environment, the system is divided into several levels and will give the following details:

A - In the event that only one sensor detects a change in the surrounding environment:

1- If the smoke sensor circuit given out signal to the microcontroller, this indicates the presence of smoke in the air or surrounding environment and therefore, the microcontroller sends a signal to the alarm and also sends a signal to the GSM system for the discovery of smoke.

2- If the heat sensor circuit given out signal to the microcontroller, this indicates the presence of high temperature in the surrounding environment and therefore, the microcontroller sends a signal to the alarm and also sends a signal to the GSM system for the discovery of high temperature.

3- If an infrared sensor circuit given out signal to the microcontroller, the microcontroller sends signal to the alarm and also sends a signal to the GSM system reported the discovery of IR.

B - In the case that more of one sensor send a signal to the microcontroller, this means that greater probability of the existence of fire.

1- If sent from each sensor smoke and heat sensor signals to the microcontroller, the microcontroller sends a message to the alarm as well as sends to the GSM system reported the discovery of smoke and high temperature and this indicates the possibility of a fire.
2 - If smoke and IR sensors send signals to the microcontroller, the microcontroller sends a message to the alarm as well as sent to the GSM system for a smoke and IR detection, and this indicates the possibility of a fire.

3 - If each of the temperature and infrared sensors sends signals to the microcontroller, the microcontroller will sends a message to the alarm as well as sends to the GSM system reported the discovery of high temperature and IR and this indicates the possibility of a fire.

4 - in the case that all the sensors send alarm signals to the microcontroller, the risk of fire has become a definite and therefore, the microcontroller sends alert signals to each of the alarm and GSM system to indicate the presence of fire in order to do what is necessary before expanding the scope of the damage.
CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS
6.1- **CONCLUSION:**

In this project we have obtained an intelligent system contains three types of sensors that constantly sensitive to the surrounding environment. And because a smart piece is the microcontroller is used, which contains the program is loaded by using the proposed algorithm. This device is receiving signals from the sensors at the same moment, it automatically send detailed information about anything can happen in the environment by sending messages to the GSM system and the GSM sends SMS messages to the competent authorities and this makes the system have a high reliability.

The fire control system is very important in order to reserve people's lives and preserve property. The attention to this aspect helps to save lives and property while negligence leads to substantial losses could lead to disasters.

SMS is a service of great importance can be used in many areas, a service is very important because it directly bring events at the same moment. There are many systems must use the SMS service to move events and emergency situations and this project is one of them.
6.2- RECOMMENDATIONS:

In this research project was developed monitoring and early warning of fire and inform the service automatically by GSM, using a GSM modem. This system relied on the use of controlled and programmed high-level language to be an intelligent system. In order for this system is more comprehensive and broader in knowing what is happening in the surrounding environment, we recommend as follows:

1- Anyone who wants to expand this project can use groups of monitoring systems, where each group contains different types of sensors so that the distribution of the groups on all sections of the industrial establishment and be connected with each other.

2- Anyone who wants to continue this project can use surveillance cameras with the sensors in order to bring events to visually.

3- Servers can be used to broadcast live and be used by staff related to surveillance cameras in the surrounding environment of sensors.

4- If the servers used, it can be linked with other servers in different places and making network to Link all branches of the facility.
REFERENCES


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APPENDICES
APPENDIX A

The LM35 TEMPERATURE SENSOR DATASHEET
LM35/LM35A/LM35C/LM35CA/LM35D
Precision Centigrade Temperature Sensors

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°C at room temperature and ±1.5°C over a full −55°C to +125°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 it a perfect front-end to readout or control circuitry especially easy to use. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 μA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35A is rated to operate over a −55°C to +125°C temperature range, while the LM35S is rated for −40°C to +85°C range (−10°C with improved accuracy). The LM35 series is available packaged in hermetic TO-82 transistor packages, while the LM35A, LM35CA, and LM35D are also available in the plastic TO-92 transistor packages. The LM35S is also available in an 8-lead surface mount small outline package and a single TO-92 package.

Features

- Calibrated directly in °Celsius (Centigrade)
- Linear +10.0 mV/°C scale factor
- 0.5°C accuracy guaranteed (± 2°C)
- Ralied for full −55°C to +125°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 μA current drain
- Low self-heating, 0.05°C in still air
- Nonlinearity only ±1°C typical
- Low impedance output, 0.1 Ω for 1 mA load

Connection Diagrams

TO-46 Metal Can Package

TO-92 Plastic Package

SO-8 Small Outline Package

Order Number LM35G, LM35GCA or LM35GZ
See NS Package Number Z02A

Order Number LM35GA, LM35GCA or LM35GA
See NS Package Number H06H

Order Number LM35DP
See NS Package Number P05A

Typical Applications

FIGURE 1. Basic Centigrade Temperature Sensor (+2°C to +125°C)

FIGURE 2. Full-Range Centigrade Temperature Sensor

© 1988 National Semiconductor Corporation  LM35 Datasheet Version 1.0
## Absolute Maximum Ratings

(Notes 1)

If any parameter exceeds the Absolute Maximum Ratings, device damage may occur. For more information, please refer to the National Semiconductor Data Manual.

- **Supply Voltage**: +5V to -5V
- **Output Voltage**: 0V to 1.5V
- **Output Current**: 10mA
- **Storage Temp., TO-56 Package**: -55°C to 150°C
- **Operating Temp., TO-92 Package**: -55°C to 150°C
- **Lead Temp.:**
  - TO-46 Package, (Soldering 10 seconds): 300°C
  - TO-92 Package, (Soldering 10 seconds): 260°C
  - TO-202 Package, (Soldering 10 seconds): 220°C

## Electrical Characteristics

### (Note 1) (Note 6)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>LM565A</th>
<th>LM35CA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Typical</td>
<td>Tested Limit</td>
<td>Design Limit</td>
</tr>
<tr>
<td>Accuracy</td>
<td>T&lt;sub&gt;A&lt;/sub&gt;= +25°C</td>
<td>±0.2</td>
<td>±0.5</td>
</tr>
<tr>
<td></td>
<td>T&lt;sub&gt;A&lt;/sub&gt;= -25°C</td>
<td>±0.3</td>
<td>±0.5</td>
</tr>
<tr>
<td></td>
<td>T&lt;sub&gt;A&lt;/sub&gt;= MAX</td>
<td>±0.4</td>
<td>±1.0</td>
</tr>
<tr>
<td></td>
<td>T&lt;sub&gt;A&lt;/sub&gt;= MIN</td>
<td>±0.4</td>
<td>±1.0</td>
</tr>
<tr>
<td>Nonlinearity</td>
<td>T&lt;sub&gt;MIN&lt;/sub&gt;:T&lt;sub&gt;A&lt;/sub&gt;:T&lt;sub&gt;MAX&lt;/sub&gt;</td>
<td>±0.18</td>
<td>±0.35</td>
</tr>
<tr>
<td>Sensor Gain</td>
<td>T&lt;sub&gt;MIN&lt;/sub&gt;:T&lt;sub&gt;A&lt;/sub&gt;:T&lt;sub&gt;MAX&lt;/sub&gt;</td>
<td>+1.00</td>
<td>+0.9</td>
</tr>
<tr>
<td>Line Regulation</td>
<td>T&lt;sub&gt;A&lt;/sub&gt;=+25°C</td>
<td>±0.1</td>
<td>±0.2</td>
</tr>
<tr>
<td>Line Regulation</td>
<td>4V&lt;sub&gt;D&lt;/sub&gt;≤30V</td>
<td>±0.02</td>
<td>±0.04</td>
</tr>
<tr>
<td>Quiescent Current</td>
<td>V&lt;sub&gt;B&lt;/sub&gt;=+5V, +25°C</td>
<td>50</td>
<td>67</td>
</tr>
<tr>
<td>Quiescent Current</td>
<td>V&lt;sub&gt;B&lt;/sub&gt;=+6V</td>
<td>105</td>
<td>131</td>
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<tr>
<td>Quiescent Current</td>
<td>V&lt;sub&gt;B&lt;/sub&gt;=13V, +25°C</td>
<td>65</td>
<td>85</td>
</tr>
<tr>
<td>Change-of-Quiescent Current</td>
<td>4V≤V&lt;sub&gt;B&lt;/sub&gt;≤30V, +25°C</td>
<td>0.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Temperature</td>
<td>Coefficient of Quiescent Current</td>
<td>+0.29</td>
<td>+0.5</td>
</tr>
<tr>
<td>Minimum Temperature for Rated Accuracy</td>
<td>T&lt;sub&gt;MIN&lt;/sub&gt;:T&lt;sub&gt;A&lt;/sub&gt;:T&lt;sub&gt;MAX&lt;/sub&gt;</td>
<td>+15</td>
<td>+2.0</td>
</tr>
<tr>
<td>Long Term Stability</td>
<td>T&lt;sub&gt;MIN&lt;/sub&gt;:T&lt;sub&gt;A&lt;/sub&gt;:T&lt;sub&gt;MAX&lt;/sub&gt; for 1000 hours</td>
<td>±0.08</td>
<td>±2.08</td>
</tr>
</tbody>
</table>

**Note 1:** Unless otherwise noted, these specifications apply to the LM565 and LM35CA at ±5V supplies and a 25°C ambient temperature.

**Note 2:** If the device is operated at temperatures outside the guaranteed limits, the longevity of the product cannot be guaranteed.

**Note 3:** The guaranteed limits are based on typical performance over the operating temperature range.

**Note 4:** The guaranteed limits are not tested.

**Note 5:** The guaranteed limits are based on typical performance over the operating temperature range.

**Note 6:** The guaranteed limits are based on typical performance over the operating temperature range.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>LM35</th>
<th>Design Limit (Note 4)</th>
<th>LM5, LM35C, LM35DC (Note 5)</th>
<th>Design Limit (Note 5)</th>
<th>Units (Max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy,</td>
<td>TA = ±25°C</td>
<td>±0.4</td>
<td>±1.0</td>
<td>±0.4</td>
<td>±1.0</td>
<td>°C</td>
</tr>
<tr>
<td>LM35, LM35C, LM35DC (Note 7)</td>
<td>TA = ±10°C</td>
<td>±0.5</td>
<td>±1.5</td>
<td>±0.5</td>
<td>±1.5</td>
<td>°C</td>
</tr>
<tr>
<td></td>
<td>TA = TA MAX</td>
<td>±0.8</td>
<td>±1.5</td>
<td>±0.8</td>
<td>±1.5</td>
<td>°C</td>
</tr>
<tr>
<td></td>
<td>TA = TA MIN</td>
<td>±0.9</td>
<td>±1.5</td>
<td>±0.9</td>
<td>±1.5</td>
<td>°C</td>
</tr>
<tr>
<td>Linearity</td>
<td>TA = ±25°C</td>
<td>±0.3</td>
<td>±0.5</td>
<td>±0.2</td>
<td>±0.5</td>
<td>°C</td>
</tr>
<tr>
<td></td>
<td>TA = TA MAX</td>
<td>0.0</td>
<td>0.2</td>
<td>0.0</td>
<td>0.2</td>
<td>°C</td>
</tr>
<tr>
<td></td>
<td>TA = TA MIN</td>
<td>0.0</td>
<td>0.2</td>
<td>0.0</td>
<td>0.2</td>
<td>°C</td>
</tr>
<tr>
<td>Temperature Coefficient</td>
<td>TA = ±25°C</td>
<td>±0.39</td>
<td>±0.7</td>
<td>±0.39</td>
<td>±0.7</td>
<td>°C/°C</td>
</tr>
<tr>
<td></td>
<td>TA = TA MAX</td>
<td>±0.59</td>
<td>±0.7</td>
<td>±0.59</td>
<td>±0.7</td>
<td>°C/°C</td>
</tr>
<tr>
<td></td>
<td>TA = TA MIN</td>
<td>±0.59</td>
<td>±0.7</td>
<td>±0.59</td>
<td>±0.7</td>
<td>°C/°C</td>
</tr>
</tbody>
</table>

Note 5: Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output due to heating effects can be computed by multiplying the thermal coefficient by the thermal resistance.

Note 6: Linearity limits are guaranteed to ±1% over the industrial temperature range and supply voltage range. These limits are not used to validate output voltage levels.

Note 7: Load Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output due to heating effects can be computed by multiplying the thermal coefficient by the thermal resistance.

Note 8: Load Regulation is guaranteed to ±1% over the industrial temperature range and supply voltage range. These limits are not used to validate output voltage levels.

Note 9: Load Regulation is guaranteed to ±1% over the industrial temperature range and supply voltage range. These limits are not used to validate output voltage levels.

Note 10: Load Regulation is guaranteed to ±1% over the industrial temperature range and supply voltage range. These limits are not used to validate output voltage levels.

Note 11: Load Regulation is guaranteed to ±1% over the industrial temperature range and supply voltage range. These limits are not used to validate output voltage levels.

Note 12: Load Regulation is guaranteed to ±1% over the industrial temperature range and supply voltage range. These limits are not used to validate output voltage levels.

Note 13: Load Regulation is guaranteed to ±1% over the industrial temperature range and supply voltage range. These limits are not used to validate output voltage levels.
APPINDIX B
IR RECEIVER MODULE
DATASHEET
IR Receiver Module for Light Barrier Systems

FEATURES
• Low supply current
• Photo detector and preamplifier in one package
• Internal filter for 38 kHz IR signals
• Shielding against EMI
• Supply voltage: 2.7 V to 5.5 V
• Visible light is suppressed by IR filter
• Insensitive to supply voltage ripple and noise
• Material categorization: For definitions of compliance please see www.vishay.com/doc78912

DESCRIPTION
The TSOP4038 is a compact IR receiver for sensor applications. It has a high gain for IR signals at 38 kHz. The detection level does not change when ambient light or strong IR signals are applied. It can receive continuous 38 kHz signals or 38 kHz bursts.

PARTS TABLE

<table>
<thead>
<tr>
<th>CARRIER FREQUENCY</th>
<th>SENSOR APPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>38 kHz</td>
<td>TSOP4038</td>
</tr>
</tbody>
</table>

MECHANICAL DATA
Pinning:
1 = OUT, 2 = GND, 3 = Vcc

MECHANICAL DATA
Pinning:
1 = OUT, 2 = GND, 3 = Vcc

ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>SYMBOL</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage (pin 3)</td>
<td>Vcc</td>
<td>Vcc</td>
<td>-0.3 to +5.0</td>
<td>V</td>
</tr>
<tr>
<td>Supply current (pin 3)</td>
<td>Icc</td>
<td>Icc</td>
<td>5</td>
<td>mA</td>
</tr>
<tr>
<td>Output voltage pin 1</td>
<td>Vcc</td>
<td>Vcc</td>
<td>-0.3 to +5.5</td>
<td>V</td>
</tr>
<tr>
<td>Voltage at output to supply</td>
<td>Vcc - Vcc</td>
<td>Vcc - Vcc</td>
<td>-0.3 to (Vcc + 0.3)</td>
<td>V</td>
</tr>
<tr>
<td>Output current (pin 1)</td>
<td>Iout</td>
<td>Iout</td>
<td>5</td>
<td>mA</td>
</tr>
<tr>
<td>Junction temperature</td>
<td>TJ</td>
<td>TJ</td>
<td>100</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>Tst</td>
<td>Tst</td>
<td>-25 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>Topp</td>
<td>Topp</td>
<td>-25 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Power consumption</td>
<td>Ptot</td>
<td>Ptot</td>
<td>10</td>
<td>mW</td>
</tr>
</tbody>
</table>

Note
Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect the device reliability.

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### ELECTRICAL AND OPTICAL CHARACTERISTICS (T_{amb} = 25\,^{\circ}\text{C}, unless otherwise specified)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>SYMBOL</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply current (pin 3)</td>
<td>( E_s = 0, V_{s2} = 6,\text{V} )</td>
<td>( I_{PC} )</td>
<td>0.05</td>
<td>0.05</td>
<td>1.05</td>
<td>mA</td>
</tr>
<tr>
<td>Supply voltage</td>
<td></td>
<td>( V_{CC} )</td>
<td>2.7</td>
<td></td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>Transmission distance</td>
<td>( E_s = 0, \text{test signal see fig. 1}, \text{IR diode TSAL6200}, \text{no lens, M1} )</td>
<td>( d )</td>
<td>3</td>
<td></td>
<td></td>
<td>m</td>
</tr>
<tr>
<td>Output voltage low (pin 1)</td>
<td>( I_{OL} = 0.5,\text{mA, } E_{s} = 1,\text{mW/m}^2, \text{test signal see fig. 1} )</td>
<td>( V_{OL} )</td>
<td></td>
<td>100</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Minimum radiance</td>
<td>Pulse width tolerance; ( t_p &lt; 5,\mu\text{s} &lt; t_o &lt; 0.5,\mu\text{s} ), test signal see fig. 1</td>
<td>( E_{min} )</td>
<td>0.3</td>
<td>0.7</td>
<td></td>
<td>mW/m²</td>
</tr>
<tr>
<td>Maximum radiance</td>
<td>( t_p &lt; 5,\mu\text{s} &lt; t_o &lt; 0.5,\mu\text{s} ), test signal see fig. 1</td>
<td>( E_{max} )</td>
<td>90</td>
<td></td>
<td></td>
<td>W/m²</td>
</tr>
<tr>
<td>Directivity</td>
<td>Angle of half transmission distance</td>
<td>( \theta_{50} )</td>
<td></td>
<td></td>
<td></td>
<td>deg</td>
</tr>
</tbody>
</table>

### TYPICAL CHARACTERISTICS (T_{amb} = 25\,^{\circ}\text{C}, unless otherwise specified)

- **Fig. 1 - Output Active Low**
- **Fig. 3 - Output Function**
- **Fig. 5 - Pulse Length and Sensitivity in Dark Ambient**
- **Fig. 4 - Output Pulse Diagram**

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Rv. 1.2, 28-Mar-12

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APPINDIX C
ATmega32 MICROCONTROLLER
DATASHEET
Features

- High-performance, Low-power Atmel® AVR® 8-bit Microcontroller
- Advanced RISC Architecture
  - 121 Powerful Instructions – Most Single-clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 16 MIPS Throughput at 16 MHz
  - On-chip 2-cycle Multiplier
- High Endurance Non-volatile Memory segments
  - 32Kbytes of In-System Self-programmable Flash program memory
  - 1024Bytes EEPROM
  - 2Kbyte Internal SRAM
  - Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
  - Data retention: 20 years at 85°C/100 years at 25°C
  - Optional Boot Code Section with Independent Lock Bits
  - In-System Programming by On-chip Boot Program
  - True Read-While-Write Operation
  - Programming Lock for Software Security
- JTAG (IEEE std. 1149.1 Compliant) Interface
  - Boundary-scan Capabilities According to the JTAG Standard
  - Extensive On-chip Debug Support
  - Programming of Flash, EEPROM, Fuses, and Lock Bits through the JTAG Interface
- Peripheral Features
  - Two 8-bit Timer/Counters with Separate Prescalers and Compare Modes
  - One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
  - Real Time Counter with Separate Oscillator
  - Four PWM Channels
  - 8-channel, 10-bit ADC
  - 9 Single-ended Channels
  - 7 Differential Channels in TOFP Package Only
  - 2 Differential Channels with Programmable Gain at 1x, 10x, or 20x
  - Byte-oriented Two-wire Serial Interface
  - Programmable Serial USART
  - Master/Slave SPI Serial Interface
  - Programmable Watchdog Timer with Separate On-chip Oscillator
  - On-chip Analog Comparator
- Special Microcontroller Features
  - Power-on Reset and Programmable Brown-out Detection
  - Internal Calibrated RC Oscillator
  - External and Internal Interrupt Sources
  - Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby and Extended Standby
- I/O and Packages
  - 32 Programmable I/O Lines
  - 40-pin PDIP, 44-lead TQFP, and 44-pad QFN/MLF
- Operating Voltages
  - 2.7V - 5.5V for ATmega32L
  - 4.5V - 5.5V for ATmega32
- Speed Grades
  - 0 - 8MHz for ATmega32L
  - 0 - 16MHz for ATmega32
- Power Consumption at 1 MHz, 3V, 25°C
  - Active: 1.1mA
  - Idle Mode: 0.35mA
  - Power-down Mode: < 1μA
Pin Configurations

Figure 1. Pinout ATmega32

PDIP

(XCK/T0) PB0  1  40 PA0 (ADC0)
(T1) PB1  2  39 PA1 (ADC1)
(INT2/AIN2) PB2  3  38 PA2 (ADC2)
(OCIO/AIN1) PB3  4  37 PA3 (ADC3)
(SCK) PB4  5  36 PA4 (ADC4)
(MISO) PB5  6  35 PA5 (ADC5)
(MISO) PB6  7  34 PA6 (ADC6)
(SCK) PB7  8  33 PA7 (ADC7)
RESET  9  32 AREF
VCC  10  31 GND
GND  11  30 AVCC
XTAL2  12  29 PC7 (TOSC2)
XTAL1  13  28 PC6 (TOSC1)
(RXD) PD0  14  27 PC5 (TI0)
(TXD) PD1  15  26 PC4 (TD0)
(INT0) PD2  16  25 PC3 (TMO)
(INT1) PD3  17  24 PC2 (TCK)
(OCIO) PD4  18  23 PC1 (SDA)
(OC1A) PD5  19  22 PC0 (SCL)
(ICP1) PD6  20  21 PD7 (OC2)

TQFP/MLF

(MOSI) PB5  1  19 PA4 (ADC4)
(MISO) PB6  2  18 PA5 (ADC5)
(SCK) PB7  3  17 PA6 (ADC6)
RESET  4  16 PA7 (ADC7)
VCC  5  15 AREF
GND  6  14 AVCC
XTAL2  7  13 PC7 (TOSC2)
XTAL1  8  12 PC6 (TOSC1)
(RXD) PD0  9  11 PC5 (TI0)
(TXD) PD1  10  10 PC4 (TD0)
(INT0) PD2  11  9 PC3 (TMO)
(INT1) PD3  12  8 PC2 (TCK)
(OCIO) PD4  13  7 PC1 (SDA)
(OC1A) PD5  14  6 PC0 (SCL)
(Note: bottom pad should be soldered to ground.)
Overview

The Atmel® AVR® ATmega32 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega32 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

Block Diagram

Figure 2. Block Diagram
The ATmel® AVR® core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code-efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

The ATmega32 provides the following features: 32Kbytes of In-System Programmable Flash Program memory with Read-While-Write capabilities, 1024bytes EEPROM, 2Kbyte SRAM, 32 general purpose I/O lines, 32 general purpose working registers, a JTAG interface for Boundary-scan, On-chip Debugging support and programming, three flexible Timer/Counters with compare modes, Internal and External Interrupts, a serial programmable USART, a byte oriented Two-wire Serial Interface, an 8-channel, 10-bit ADC with optional differential input stage with programmable gain (TGFP package only), a programmable Watchdog Timer with Internal Oscillator, an SPI serial port, and six software selectable power saving modes. The Idle mode stops the CPU while allowing the USART, Two-wire Interface, A/D Converter, SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next External Interrupt or Hardware Reset. In Power-save mode, the Asynchronous Timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except Asynchronous Timer and A/D, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low-power consumption. In Extended Standby mode, both the main Oscillator and the Asynchronous Timer continue to run.

The device is manufactured using ATmel's high density nonvolatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-system through an SPI serial Interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core. The boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the ATmel ATmega32 is a powerful microcontroller that provides a highly-flexible and cost-effective solution to many embedded control applications.

The ATmel AVR ATmega32 is supported with a full suite of program and system development tools including: C compilers, macro assemblers, program debuggers/simulators, in-circuit emulators, and evaluation kits.

### Pin Descriptions

**VCC**
Digital supply voltage.

**GND**
Ground.

**Port A (PA7..PA0)**
Port A serves as the analog inputs to the A/D Converter. Port A also serves as an 8-bit bi-directional I/O port, if the A/D Converter is not used. Port pins can provide internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. When pins PA0 to PA7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated. The Port A pins are tri-state when a reset condition becomes active, even if the clock is not running.
Port B (PB7..PB0)  Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port B also serves the functions of various special features of the ATmega32 as listed on page 57.

Port C (PC7..PC0)  Port C is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running. If the JTAG interface is enabled, the pull-up resistors on pins PC5(TDI), PC9(TMS) and PC2(TCK) will be activated even if a reset occurs.

The TDO pin is tri-stated unless TAP states that shift out data are entered.

Port C also serves the functions of the JTAG interface and other special features of the ATmega32 as listed on page 60.

Port D (PD7..PD0)  Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port D also serves the functions of various special features of the ATmega32 as listed on page 62.

RESET  Reset input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running. The minimum pulse length is given in Table 15 on page 97. Shorter pulses are not guaranteed to generate a reset.

XTAL1  Input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

XTAL2  Output from the inverting Oscillator amplifier.

AVCC  AVCC is the supply voltage pin for Port A and the A/D Converter. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter.

AREF  AREF is the analog reference pin for the A/D Converter.
GSM Home Alarm Base with Text (II)Plus MANUAL
**Functions**

1. Gsm 850/900/1800/1900 Bands Alarm Base For The World
2. Full Duplex Communication With The Base
3. Monitor Living Surroundings
4. Voice And Message Alert
5. Set Alarm On Or Off By Controller
6. Call In Set Alarm On, Off, Monitor, Output
7. Send Sms To Set Alarm On, Off, Monitor, Output
8. 5 Group Phone + Room Number
9. 1 Group Alarm Center Monitor Phone
10. 2 Group Phone To Report Alarm And Disalarm Status
11. Programable 7 Group Alarm Text Messages
12. 3 Zone For Wire Director
13. 16 Zone For Wireless Director
14. Easily Set On Or Off Every Wire Or Wireless Director
15. Relay Output To Power On Camera When Alarm
16. 2 Output For Cooker, Air Condition
17. Sms Inform External Power Failure Or Recovery
18. Indoor And Outdoor Alarm Controller

**CONFIGURATION OF THE BASE**

There are 10 connector outside the back of base:

(GND; SIREN; RELAY1; RELAY2; SPEAKER; O2; O1; I3; I2; I1):

I1; I2; I3, this 3 point for line input, every one point can be connected with ground or open to make alarm out.
**O1; O2;** these 2 point for output, you can call in or send the SMS to set it. If this point output go high, the lamp of OUT 1 or OUT 2 will light in the panel.

**SPEAKER;** this point for voice output, it connect to the speaker. the other point of speaker connect to ground. you can control it by call in or send the SMS. If this function avail, the lamp of OUT 3 will light in the panel.

**RELAY1; RELAY2,** this two point will close 3 minute when alarm happened. you can use this two point to start the power supply of the camera when alarm happened, but you can disable this function by set 16#1#, you can also make this relay close or open anytime by send the SMS or dial (94#1# or 94#0#).

**SIREN,** this point can output siren tone alarm, this connect to the siren. the other point of siren connect to ground.

**GND,** power ground

---

**SOME NOTE:**

1) **About (SIGNAL) lamp**

(SIGNAL) lamp show red in 20 second when the base is power on. In this time, you can fit wireless detector into base, if you do this, the red flash. then, (SIGNAL) lamp flash yellow show it start to get in touch GSM network. If
(SIGNAL) lamp still flash yellow, show SIM card is set un-correctly or GSM network is not good. If (SIGNAL) lamp still on yellow, show not name or phone number in SIM card .if every thing is ok, (SIGNAL) lamp show slow flash green (in outdoor alarm situation)or show fast flash green (in indoor alarm situation), (SIGNAL) lamp show still green (not in alarm situation).if alarm happened, (SIGNAL) lamp show flash red and start dial out and sent SMS.

2) About (OUTPUT) lamp

If the base O1 output high(+5V),the OUT 1 lamp bright; If the base O2 output high(+5V),the OUT 2 lamp bright;

3) About (TALK) lamp (OUTPUT 3)

If the base speaker work,this talk voice output, the output 3 bright;

4) About (RELAY) lamp

If the relay in the base close ,the relay lamp bright

5) About (SIREN) lamp

if the base siren out, the siren lamp bright.

6) About (MONINT) lamp

The monitor lamp bright If the base is work in monitor.
SOME TECHNIQUE PARAMETER

1- Static current: 20mA
2- Power: 9V-12V DC
3- Working temperature: -20°C - +85°C
4- GSM850/900/1800/1900MHz band
5- Receiving code: ASK
6- Frequency: 315/433/868/915MHz
7- Wireless distance: 100 M
8- Wireless detectors: 16
9- Wire detectors: 3