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DESIGN AND DEVELOPMENT OF MULTIFUNCTIONAL AUTOMATED HOME SECURITY SYSTEM

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Abstract—Security is a primary concern in modern times, encompassing protection against both rising crime rates and everyday accidents. This project, the HOME SECURITY SYSTEM, integrates home automation features with a security system to establish a robust home control system. The main objective of the HOME SECURITY SYSTEM is to provide instant alerts in the form of SMS notifications to the user's registered cell phone number in the event of any security threat to the home. Threats to security can include trespassing, burglary, gas leakage, or fire. The project comprises three modules along with a GSM modem. The GSM modem is utilized to send messages to the respective authorities whenever there are changes in any of the three modules. The first module of the project enables door latch opening using a password entered through a keyboard. If more than three incorrect attempts are made, an emergency signal will be activated. The second module consists of intruder checkers equipped with an IR sensor to detect the presence of a person near the door. Finally, the third module is the fire detection module, which includes a temperature sensor.
Keywords—*component, hardware, sensor, architecture, microcontroller, CPU*

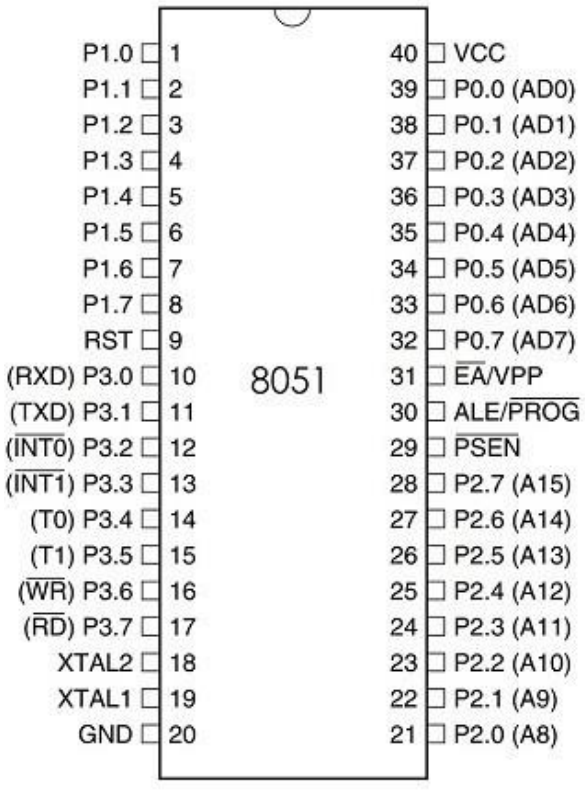
I. INTRODUCTION

8051 Microcontroller:

The 8051 Microcontroller serves as the core of the system, where the central processing of data occurs. It collects data from various sensors and compares it with appropriate prescribed limits. The 8051 Microcontroller is programmed using embedded C or assembly language using a Keil compiler. It is an 8-bit Microcontroller, meaning the data bus of the 8051 Microcontroller is 8 bits wide. It operates on a CISC-based architecture with Harvard Architecture. The 8051 Microcontroller is available in various packages such as 40-pin DIP or 44-lead PLCC and TQFP. Although the pin orientation may vary with the package, the pin configuration remains the same. The 8051 Microcontroller was developed in the 1980s by Intel, primarily for use in embedded systems. It has separate buses for program and data, with storage rooms for both program and data of 64K by 8 sizes. The microcontroller comprises an 8-bit accumulator, an 8-bit processing unit, an 8-bit B register, and several other 8-bit and 16-bit registers.
CPU (Central Processor Unit): The CPU is the central processing unit of the microcontroller, responsible for analyzing and managing all processes. It interprets the program stored in ROM and executes the instructions accordingly. The CPU manages different types of registers in the 8051 microcontrollers.
Memory: Microcontrollers require storage space for programs and data. Program memory, also known as Read-Only Memory (ROM), stores the program commands, while data memory, known as Random Access Memory (RAM), temporarily stores data for processing. The 8051 Microcontroller contains 4KB of ROM for program memory and 128 bytes of RAM for data memory.
Bus: A bus is a group of wires that serve as a communication channel for data transfer. There are two types of buses: the address bus and the data bus. The address bus carries addresses for memory locations, while the data bus carries actual data.

3. Interrupts: Interrupts provide a mechanism for the microcontroller to pause its current operation and handle a more urgent task. The 8051 Microcontroller supports five interrupt sources: two peripheral interrupts, two timer interrupts, and one serial port interrupt. When an interrupt occurs, the microcontroller temporarily suspends its current task, executes the interrupt service routine, and then resumes normal program execution.
4. Terminal functions:

- Pins 1-8 (PORT 1): These pins serve as a bidirectional input/output port with internal pull-up resistors. In some newer 8051 Microcontrollers, certain pins on PORT 1 have additional functions, such as timer triggers or in-system programming.
- Pin 9 (RST): The Reset Input Pin, which resets the microcontroller when held HIGH for a minimum of two machine cycles.
- Pins 10-17 (PORT 3): These pins form another bidirectional input/output port with internal pull-ups. Each pin on PORT 3 has special functions, such as external interrupt triggers or serial communication.
- Pins 18 & 19 (XTAL 2 and XTAL 1): Pins for connecting an external oscillator, typically a quartz crystal oscillator.
- Pin 20 (GND): Ground Pin, connected to the negative terminal of the power supply.
- Pins 21-28 (PORT 2): Another bidirectional port used for general input/output operations. When interfacing with external memory, PORT 2 pins act as the higher-order address byte and also have internal pull-ups.
- Pin 29 (PSEN): Program Store Enable Pin, used for accessing external program memory.



40 - PIN DIP

5) Once the module is powered ON, it can be controlled through AT commands which are sent through the serial interface. The communication baud rate is usually 9600 bps and data bits are 8, no parity, 1 stop bit (8-N-1). The module supports the Hayes AT command set.

6. To communicate with the GSM module, the microcontroller sends AT commands via the serial interface. These commands are used to perform various operations such as making calls, sending SMS messages, checking signal strength, etc.
7. The GSM module responds to these commands and carries out the requested operations. The responses from the module are sent back to the microcontroller via the serial interface, allowing the microcontroller to process the information and take appropriate actions.
8. The GSM module can also send notifications or alerts to the microcontroller by sending SMS messages or making calls, allowing for remote monitoring and control of the system.
9. The SIM900A GSM module is widely used in various applications such as security systems, remote monitoring systems, home automation, and more, due to its reliability, flexibility, and ease of use.

The IR LED emits infrared radiation, which is reflected off nearby objects and detected by the IR photodiode. When an object moves in front of the sensor, it causes a change in the detected infrared radiation. This change is detected by the sensor, triggering it to output a signal.

The LM35 temperature sensor operates based on the principle of the voltage across its terminals, which varies linearly with temperature changes. As the temperature increases, the output voltage of the LM35 also increases linearly.

The PIR sensor detects changes in infrared radiation caused by the movement of objects within its detection range. It consists of an IR transmitter and receiver, and when an object moves in front of the sensor, it interrupts the IR radiation, triggering the sensor to output a signal.

The IR transmitter emits infrared radiation, which is invisible to the human eye. It is typically an IR LED that emits IR radiation when powered.

The IR receiver, usually a photodiode or phototransistor, detects the infrared radiation emitted by the IR transmitter. Based on the intensity of the received radiation, the output of the sensor is determined.

The LM358 operational amplifier (op-amp) is used as a voltage comparator in the IR sensor circuit. It compares the threshold voltage with the voltage drop across the photodiode's series resistor. When the threshold voltage is exceeded, the op-amp output goes high, indicating the detection of an object.

A variable resistor, typically a preset, is used to calibrate the distance range at which objects should be detected by the PIR sensor. Adjusting the variable resistor allows for fine-tuning of the sensor's sensitivity to motion.

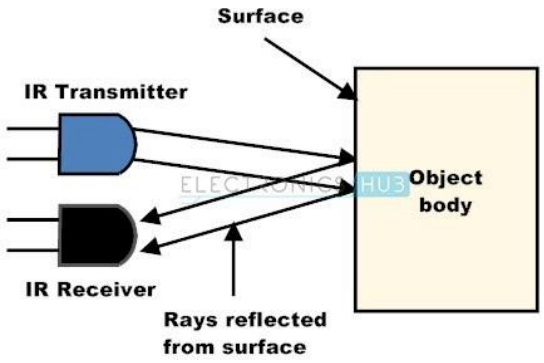


Fig. 3. PIR Sensor Principle

When the IR transmitter emits radiation, it reaches the object, and some of the radiation reflects back to the IR receiver. Based on the intensity of the reception by the IR receiver, the output of the sensor is defined.

Pin configuration:

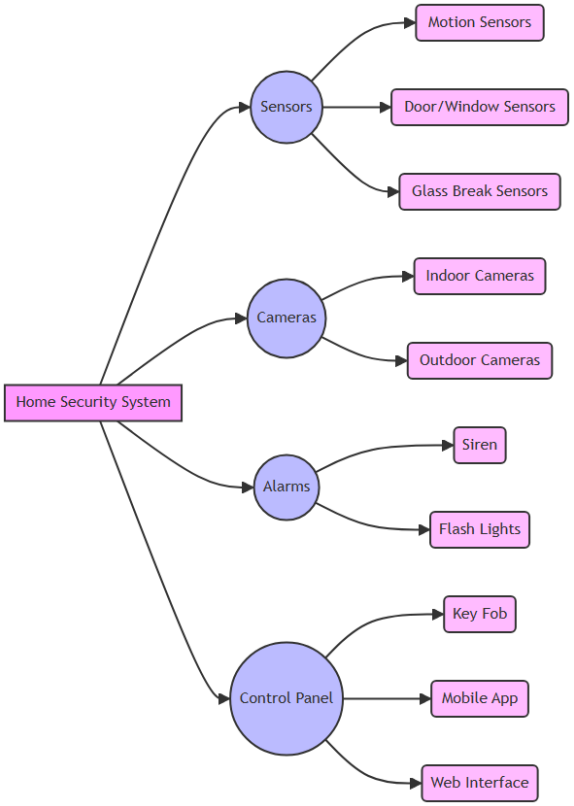
- Operating voltage: 5VDC
- I/O pins are 5V and 3.3V compliant
- Range: Up to 20cm
- Adjustable sensing range
- Built-in ambient light sensor
- Supply current: 20mA
- Mounting hole

ADC0804: This module has 2 screw terminals for motor –A and motor-B and another screw terminal block for ground pin, Vcc, and 5V regulator, which can either be an input or output. The LM298N Motor Driver Module has 4 data input pins used to control the direction of the motor connected to it. It can be used to run two DC motors with the same IC, and speed and direction control are possible. The motor voltage (Vcc2/Vs) ranges from 4.5V to 36V. The maximum peak motor current is 1.2A, and the maximum continuous motor current is 600mA. It operates with a supply voltage (Vcc1) from 4.5V to 7V and has a transition time of 300ns (at 5V and 24V). Automatic thermal shutdown is available.

DC Motor: Permanent magnet DC motors are very common in robotics and mechatronics. They are relatively easy to control in terms of both direction and speed. The motor rotation direction is determined by power supply polarity, and an H-bridge driver is often used when a DC motor is controlled by a microcontroller.

Buzzer: A buzzer is a small yet efficient component used to add sound features to a project/system. It can be powered using a DC power supply ranging from 4V to 9V. A simple 9V battery can also be used, but it is recommended to use a regulated +5V or +6V DC supply. The buzzer is normally associated with a switching circuit to turn it ON or OFF at the required time and interval.

II. BLOCK DIAGRAM



III. CIRCUIT DIAGRAM

Circuit Analysis: Power is supplied to the microcontroller through pin, VCC= 5V and GND pin. At this point when power is supplied, the microcontroller remains or stays in a low state waiting for an input. Port 2.0 senses intrusion via IR sensor, while port 1 senses high temperature. Port 2.2 and port 2.3 are used as output ports from the microcontroller to the input of the MOTOR DRIVER, and port 2.7 is the input to the BUZZER. When an input passes through any one of the sensors, it is sensed by the microcontroller as interrupts. The microcontroller stops other software programs and accesses the address bus of the input signal, loads the program stored in the address register, and sends it to the control register. It computes the signal based on the stored program and runs the instruction. It sends out streams of instructions to the output register or ports. The output instructions set the output high and send information to the GSM Modem, initializing it to send SMS to a programmed number and turn "ON" the buzzer. The sensor unit senses temperature, obstacle, and other detection values, converting them into energy that can be received by the microcontroller. The controlling unit recognizes information from the sensor and sends it to the GSM modem. Then, the GSM modem sends the detected signals to the users, particularly to the mobile phone of the homeowner. For example, if the temperature exceeds the normal values, the microcontroller will automatically send the detected value to the user via the GSM modem so that the user can understand the safety of their house. On the other hand, if intrusion, gas, or fire occurs, the buzzer will provide sound, and the microcontroller will check the result and send it to the GSM modem. Through the GSM network architecture, the homeowner receives a message containing the status of their home.

IV. FLOWCHART ANALYSIS

1. According to the project, there will be three modules in it. We begin the flowchart with the start operation.
2. In the first set, we enter the security pin to open the door lock.
3. If we enter the correct password, the door lock is automatically opened.
4. If the entered password is incorrect, then an SMS is automatically sent to the registered mobile number.
5. In the second set, the PIR sensor collects information and passes it to the microcontroller.
6. If any person is detected, an alert is sent in the form of an SMS to the registered mobile number.
7. In the third set, there is an LM35 temperature sensor.
8. If the room temperature is higher than the normal room temperature, an SMS is automatically sent to the registered mobile number.
9. If there is any change in the three modules, it is automatically notified.
10. Finally, the procedure is ended.

V. RESULT AND CONCLUSION

Home security has been a major issue where crime is increasing, and everybody wants to take proper measures to prevent intrusion. In addition, there is a need to automate homes so that users can take advantage of technological advancements. This project presents a model that provides security to homes via SMS using GSM technology. The basic idea of our project is to provide GSM-based security even if the owner is away from the restricted areas. For this, we adopted wireless mode of transmission using GSM. Besides, there are many methods of wireless communication, but we selected GSM in our project because, as compared to other techniques, this is an efficient and cheap solution. Also, we are much familiar with GSM technology, and it is easily available. This project is designed to provide ubiquitous access to the system for security using extensive GSM technology for communication purposes and a microcontroller for device control. The detailed sensors above are used to sense disturbances and inform the programmed microcontroller, and then information is sent between the controlling unit and homeowner for security purposes. The end product will have a simplistic design, making it easy for users to interact with.

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