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Microcontroller based Home Security System with Remote Monitoring

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ABSTRACT
This paper proposes construction of a micro-controller based automated Home Security System. The door lock is password protected with an LED based resistive screen input panel which operates by detecting difference in light intensity captured by the photo diode which is emitted by surrounding red LEDs and reflected by the finger. The display is a 16X2 LCD panel. IR Laser sensors are used to detect any obstacle while monitoring the windows and doors at night or when away. Fire alarm system uses temperature sensor LM35 which senses sudden considerable increase in temperature and raises alarm.

Keywords
Home Security System; LED Screen; Motion Detector; Fire Alarm System.

1. INTRODUCTION
Monitoring systems are common place in many areas of industry. It is essential that home privacy is protected always and no outsider can affect it by any means. Thanks to the recent trends in home security, there’s no need to worry about home security any longer, as security systems are here to take of care of it. Home security system is the best burglar deterrent one can have. A Home Security System should provide security and safety features for a home by alarming the residents from natural, accidental and/or human dangers such as: fire, flooding, theft, animals invading etc. The prime concern of this project is to provide total security. The main components of the circuit are

IR Sensors

The system is fully digital and also be fully customized. The project consists of basic modules. First is IR transmitter and receiver module which works for the safety of doors at night or in case we are out of home. When the IR sensors are interrupted, a buzzer is turned on indicating someone has entered into the house.

LCD Display

This part of the project serves the functionality of a door opening with a motor using a password entered through the touch screen. This module also turns on buzzer if 3 wrong passwords are entered consequently. The system is fully digital and can also be fully customized. It incorporates a 16X2 LCD display.

Temperature Sensor

The third module of the project is based on temperature controller which is a device that is used to accurately control and process temperature without extensive operator involvement. It is a control system which accepts data from temperature sensor such as thermocouples or resistant temperature detector (RTD) and gives the temperature reading on the LCD display.

CD4016

These are quad bilateral switches which are used for the transmission of analog or digital data. Each of the four bilateral switches has independent control signals which control the switching.

ATmega16

Up to 16 MIPS: The ATmega16, being an AVR core, can execute up to 16 Million instruction per second. This is due to the fact that most AVR instructions are executed on a single clock cycle. So with an 8 MHz clock, you can perform 8 MIPS. Comparatively, an 8051 clocked at 8 MHz, would give a throughput of only 666 KHz, because 8051 need 12 clock cycles per instruction.

EEPROM Memory (512 bytes): Most AVRs, including the ATmega16, come with an on chip EEPROM memory, with ready to use instruction to access this memory. EEPROM is one where your program can store information that won't be lost even in case of power loss.

ISP: In System Programming is becoming a standard in today's microcontroller, and AVRs fully benefit for this technological advance, making it much simpler for developer to test and debug their chips 'in system'.

Very Powerful and versatile timers/counters: Most AVR timers/counters have Prescalers, allowing them to be adapted to wide range of applications, and to dramatically reduce the processor overhead. They also have a high sampling rate, enabling them to count very fast external events.

There is also a set of built-in devices,that importantly reduce the number of components in any project and they are PWM,ADCs, USART/SPI, On-Chip Analog comparator, Internal RC oscillator: This critical feature makes the ATmega16 for example, a microcontroller that can run with only 5V and GND rails, no any other component or connection is needed to be made to make it functional. By the way, any ATmega8, 16, or 32 microcontroller is shipped with the internal oscillator turned ON and tuned to 1 MHz, making it ready to be used with adding ANY external components like crystal resonator or capacitors. The Internal oscillator frequency can be then tuned to different frequencies, up to 8MHz.

Features of ATmega16

The ATmega16 is a low power 8 bit microcontroller based on the AVR enhanced RISC architecture.

ATmega16 is a 40 pin microcontroller.

There are 32 I/O (input/output) lines which are divided into four 8-bit ports designated as PORTA, PORTB, PORTC and PORTD.

ATmega16 has 16 KB programmable flash memory and static RAM of 1 KB.

The 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

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-stated 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 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), PC3 (TMS) and PC2 (TCK) will be activated even if a reset occurs.

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.

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. Shorter pulses might not 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

TABLE 1 - ADMUX REGISTER

7	6	5	4	3	2	1	0
REF S1	REF S0	ADL AR	MU X4	MU X3	MU X2	MU X1	MU X0

Bit 7:6 – REFS1:0: Reference Selection Bits: These bits select the voltage reference for the ADC. If these bits are changed during a conversion, the change will not go in effect until this conversion is complete (ADIF in ADCSRA is set). The internal voltage reference options may not be used if an external reference voltage is being applied to the AREF pin.

TABLE 2 - VRS

REFS1	REFS0	Voltage Refrence Selection
0	0	Aref,Internal Vref Turned Off
0	1	Avcc With External Capacitor
1	0	Reserved
1	1	Internal 2.56 Voltage Ref With External Capacitor At Ref Pin

Bit 5 – ADLAR: ADC Left Adjust Result: The ADLAR bit affects the presentation of the ADC conversion result in the ADC Data Register. Write one to ADLAR to left adjust the result. Otherwise, the result is right adjusted. Changing the ADLAR bit will affect the ADC Data Register immediately, regardless of any ongoing conversions.

Bits 4:0 – MUX4:0: Analog Channel and Gain Selection Bits: The value of these bits selects which combination of analog inputs are connected to the ADC .These bits also select the gain for the differential channels. If these bits are changed during a conversion, the change will not go in effect until this conversion is complete (ADIF in ADCSRA is set).The Combinations are as follows:-

TABLE 3 -MUX ADC COMBINATIONS

MUX 4..0	ADC SELECTED
00000	ADC0
00001	ADC1
00010	ADC2
00011	ADC3
00100	ADC4
00101	ADC5
00110	ADC6
00111	ADC7

TABLE 4 - ADCSRA

7	6	5	4	3	2	1	0
AD EN	AD SC	ADA TE	AD IF	AD IE	ADP S2	ADP S1	ADP S0

Bit 7 – ADEN: ADC Enable: Writing this bit to one enables the ADC. By writing it to zero, the ADC is turned off. Turning the ADC off while a conversion is in progress will terminate this conversion.
Bit 6 – ADSC: ADC Start Conversion: In Single Conversion mode, write this bit to one to start each conversion. In Free Running Mode, write this bit to one to start the first conversion. The first conversion after ADSC has been written after the ADC has been enabled, or if ADSC is written at the same time as the ADC is enabled, will take 25 ADC clock cycles instead of the normal 13. This first conversion performs initialization of the ADC.ADSC will read as one as long as a conversion is in progress. When the conversion is complete, it returns to zero. Writing zero to this bit has no effect.
Bit 5 – ADATE: ADC Auto Trigger Enable: When this bit is written to one, Auto Triggering of the ADC is enabled. The trigger source is selected by setting the ADC Trigger Select bits, ADTS in SFIOR.
Bit 4 – ADIF: ADC Interrupt Flag: This bit is set when an ADC conversion completes and the Data Registers are updated. The ADC Conversion Complete Interrupt is executed if the ADIE bit and the I-bit in SREG are set.ADIF is cleared by hardware when executing the corresponding interrupt handling vector. Alternatively, ADIF is cleared by writing a logical one to the flag.
Bit 3 – ADIE: ADC Interrupt Enable: When this bit is written to one and the I-bit in SREG is set, th ADC Conversion Bits 2:0 Complete Interrupt is activated.
Bits 2:0 – ADPS2:0: ADC Pre Scalar Select Bits:These bits determine the division factor between the XTAL frequency and the input clock to the ADC.

TABLE 5 – DIVISION FACTOR

ADPS2	ADPS1	ADPS0	DIVISION FACTOR
0	0	0	2
0	0	1	2
0	1	0	4
0	1	1	8
1	0	0	16
1	0	1	32
1	1	0	64
1	1	1	128

METHODOLOLY

In case of Fire in the house the temperature will automatically rise, in order to detect this a temperature sensor is being used which will detect the temperature of the surroundings and send to the microcontroller which will alarm in case of very high temperature.
An ATmega16 AVR microcontroller is used to carry out all the computation and control. It has an in-built analog to digital converter, hence an external ADC is not required for converting the analog temperature into digital value. An inexpensive temperature sensor LM35 is used for sensing the ambient temperature.
The system will get the temperature from the sensor IC and will display the temperature on LCD. The temperature is compared with the set point temperature declared by the user, if its more than that then the buzzer is activated else not.
Analog voltage from LM35 in fetched to ADC of microcontroller and converted to temperature using following conversion :
val=ADCRead(0)
voltage= ((val)/255.0)*5
voltage=((val)/255.0)*5*1000); //Voltage is in mV
t=((val)/1023.0)*5*100); //t is in degree centigrade
The block diagram of the system is shown in Figure 1.The outputs of both sensors are given to microcontroller. The Microcontroller in turn drive the stepper motor for door opening, show display on LCD and buzzer in case of fire.

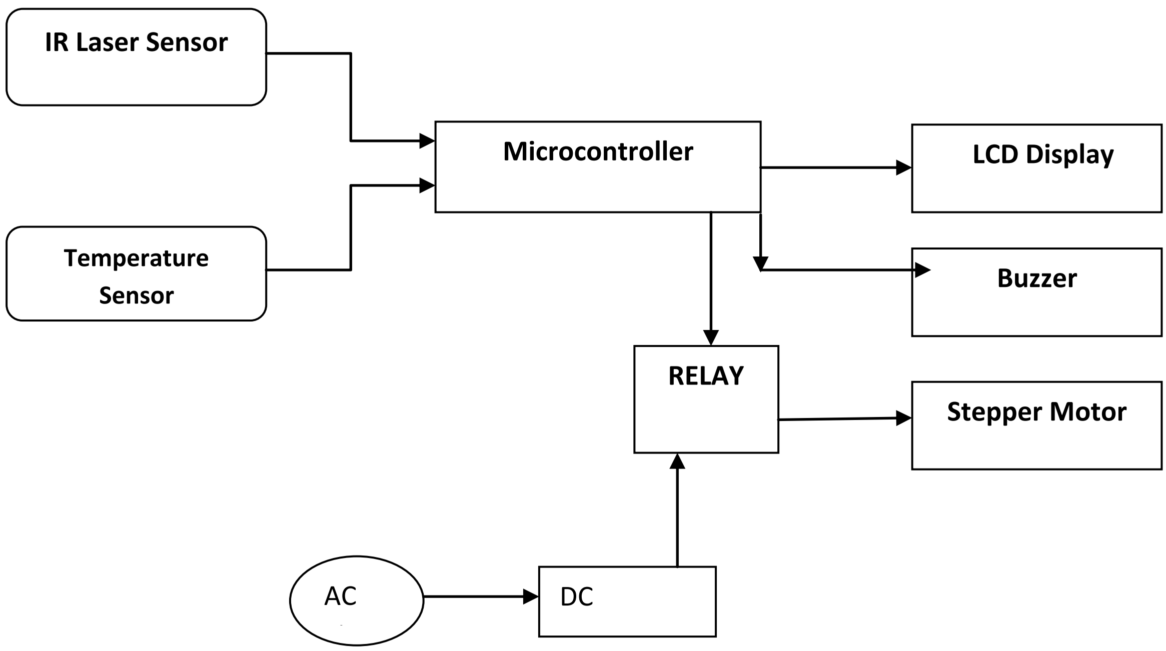

Fig 1: Block Diagram of the System

2. RESULTS

Fire Alarm System: In this system the alarm is fired when the temperature goes above a predefined value. When in this condition the owner is notified through SMS about the alert.

Motion Detector System: This is used at the doors or windows for safety when not in the house. It works on the principle of amount of light falling on the photodiode. When the laser light is falling continuously on the photodiode its reading is 255 in decimals. But when it's interrupted by an obstacle / burglar the voltage falls less than 50 in decimals. This fires the alarm and notifies the owner about the break in.

3. ACKNOWLEDGMENTS

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4. REFERENCES

[1] Jun Zhang, Hui Wang, TianhuaMeng and Guangming Song, 2011,“Design of a Wireless Sensor Network Based Monitoring System for Home Automation”, International Conference on Future Computer Sciences and Application (ICFCSA), pp. 57-60, Nanjing, June 2011.

[2] K.K. Griffiths and R. Melanie,2012, "Smart Home Security" , Homebuilding & Renovating. Retrieved University of Leeds

[3] I.K. Hwang and J.W. Baek, 2007,“Wireless Access Monitoring and Control System based on Digital Door Lock,” IEEE Transactions on Consumer Electronics, 53(4), pp. 1724-1730, Taipei.

[4] Huiping Haung, 2010,“ A Remote Home Security System Based on Wireless Sensor Network and GSM Technology” , Second International Conference on Network Security Wireless Communication and Trusted Computing (NSWCTC) Proceedings,Volume 1, Page 535-538

[5] David Crouse et al,2004 “ Wireless Home Security System” ,University of Connecticut, ECE 209, Spring.

[6] MegalingamR.K, Nair R.N.,Prakhya S.M,Mohan M,2011 “ Low Power, intelligent,wireless,home security sytem for elderly people”, Third International Conference on Electronics Computer Technolohy(ICECT) Proceedings , Volume 4, Page 320 -324.

[7] Chun-Liang HSU, Sheng-Yuan Yang and Wei-Bin Wu, 2009,“Constructing Intelligent Home- Security System Design With Combining Phone-Net And Bluetooth Mechanism”, Proceedings of the Eighth International Conference on Machine Learning and Cybernetics, St. John's University, Taiwan.

[8] Ayush Agarwal, R.C.Joshi, “ WSN and GSM based Home Security Sytems”, IJCA Proceedings on International Conference on Recent Advances and Future Trends in Information Technolgy (iRAFIT 2012), Number 2.

[9] I.Syam Krishna, J. Ravindra, “ Design and Implementation of Home Security Sytem based on WSNS and GSM Technology” International Journal of Engineering Science and Technology” Volume 2,Special Issue 1,Page 139-142.

[10] Chun Pai,Jimmy Hsieh, Yang Cao “ Home Security Sytem” A Cornell University ECE 476,Final Project.

[11] Sheikh IzzalAzid andSushil Kumar, 2011,“*Performance of a Low Cost Based Home Security system”,* International Journal of Smart Home, The University of South Pacific, Fiji..

[12] Y. Zhao and Z. Ye, 2008,”*A Low Cost GSM/GPRS Based Wireless Home Security System*”, IEEE Transactions on Consumer Electronics, 54(2), pp. 567-572, 2008.