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Break-in Detector and Alarm System

Group No. : B3

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ABSTRACT

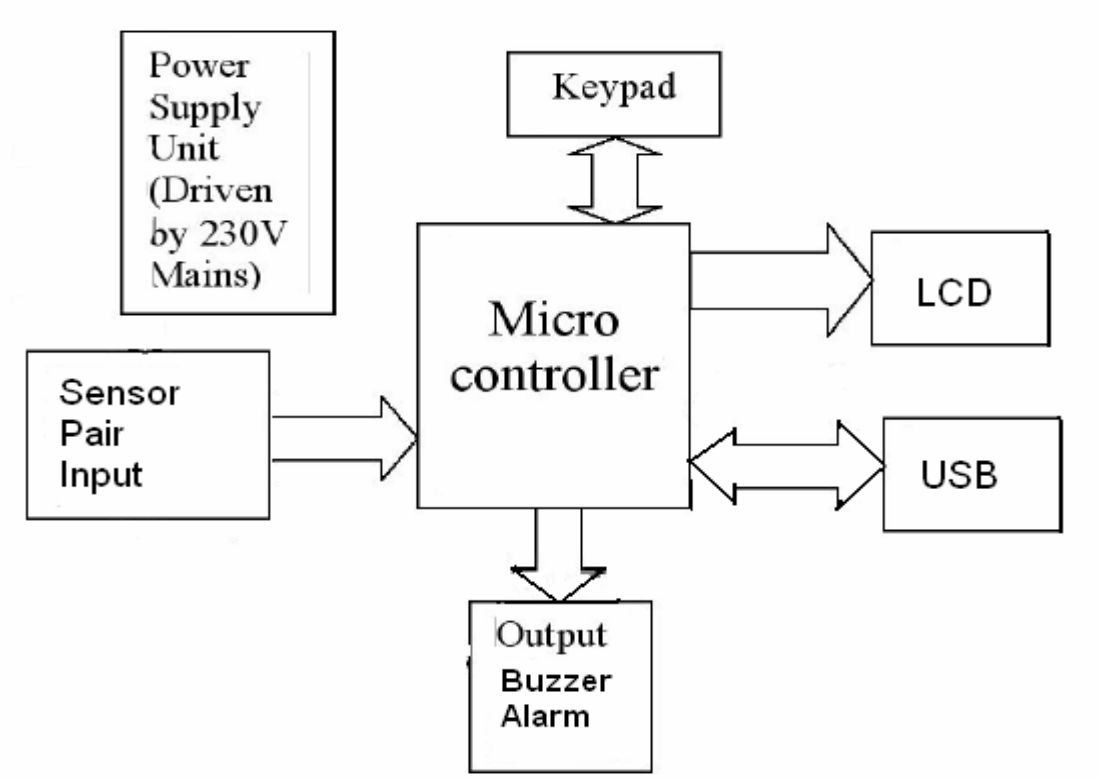
This project is aimed at making a system which can detect motion and raise an alarm if a break-in is attempted. It will also record the event of break-in and the time of its occurrence using a software-based real time clock. The time of last interrupt will be shown on an LCD screen. Also, the data record of break-ins can be retrieved from the microprocessor's flash memory through USB interface.

1. Introduction

The object is to develop an alarm system which can detect a break-in across the several pairs of sensor pairs placed at glass windows of the room. The alarm system will contain a real-time clock which helps keep a record of the time of occurrence of the detected break-in. It will also ring a buzzer alarm as a prevention system.

The project also provides a USB interface using which data (about record of break-in times) can be taken from the flash memory of the microprocessor to a computer. We are also working on providing a battery-backup for the alarm system, so that system may continue working in case of a mains AC supply failure.

2. Block diagram



2.1 Microcontroller

The microcontroller used in this project is the MSP430 based mixed-signal microcontroller, MSP430F148, developed by Texas Instruments [1]. The Texas Instruments MSP430 family of ultralow-power microcontrollers consists of several devices featuring different sets of peripherals targeted for various applications. The architecture, combined with five low power modes is optimized to achieve extended battery life in portable measurement applications. The device features a powerful 16-bit RISC CPU, 16-bit registers, and constant generators that attribute to maximum code efficiency. The digitally controlled oscillator (DCO) allows wake-up from low-power modes to active mode in less than 6 μs.

The MSP430F148 microcontroller has configuration with two built-in 16-bit timers, a fast 12-bit A/D converter, two universal serial synchronous/asynchronous communication interfaces (USART), and 48 I/O pins.

Typical applications include sensor systems that capture analog signals, convert them to digital values, and process and transmit the data to a host system. The timers make the configurations ideal for industrial control applications. Hence, this microcontroller is well-suited for our project.

2.2 Keypad

A 4X4 matrix keypad has been used for taking user input, i.e. the full specification of the present time, which includes feeding date, month, year also alongwith time in hours, minutes and seconds. This is essential for the Real-time-clock of the microprocessor to work properly.

2.3 LCD

We are using LMB162A model of LCD. The no. of characters is 16 character X 2 lines. This is sufficient for our system as we just need to display the occurrence of the last interrupt or break-in attempted.

2.4 Sensor-pairs

An LED-phototransistor pair is used for sensor-pair. The LED is an infrared LED with a high current rating and a good range suited for alarm system requirements. The LED is fed a square wave generated by using a 555 timer. The phototransistor output is fed to an opamp to classify the output as normal working or a break-in attempt.

2.5 Buzzer alarm

The output of the microprocessor (to ring alarm or not) decides powering up of a 555 timer which feeds the sound wave frequency signal to the speaker. Audio amplifier LM386 is used to amplify this signal and make a good alarm on sensing a break-in.

2.6 Power Supply

Our alarm system can be connected directly on 230 V mains, and hence we need to use a transformer-rectifier-filter-regulator arrangement. To supply current to all the sensor pairs, we have used a 230-12 V transformer with a rated current of 0.5 A. The AC supply from the transformer is regulated by a bridge-rectifier and filter circuit.

The device requires three different voltage levels; 3.3 V for microcontroller, LCD ; 5V supply to LEDs and phototransistors (in sensor pairs), buzzer system, and 12 V (approx) for opamp power supply.

3.Software

3.1 Keypad and Real-time clock

The initial preset time is fed to the real-time clock using the keypad. The programming is done so that year, month, date, hour, minutes and seconds are appropriately stored in the 16-bit registers of the microprocessor. For this, each

individual digit obtained from keypad is processed according to the state machine which decides the value of the number fed and what it signifies.

The real-time clock is built such that on receiving 1s timer interrupts, it updates the seconds, minutes, hours, date, month, year (including leap year) accordingly. Here, other registers of the microprocessor are used for temporary storage and calculation purpose.

3.2 LCD

The LCD programming is done such that it displays the last break-in time alongwith information about which sensor pair was triggered (in second line of LCD display). This can be used, for example, to know which room was broken into.

3.3 Sensor-Pair Input

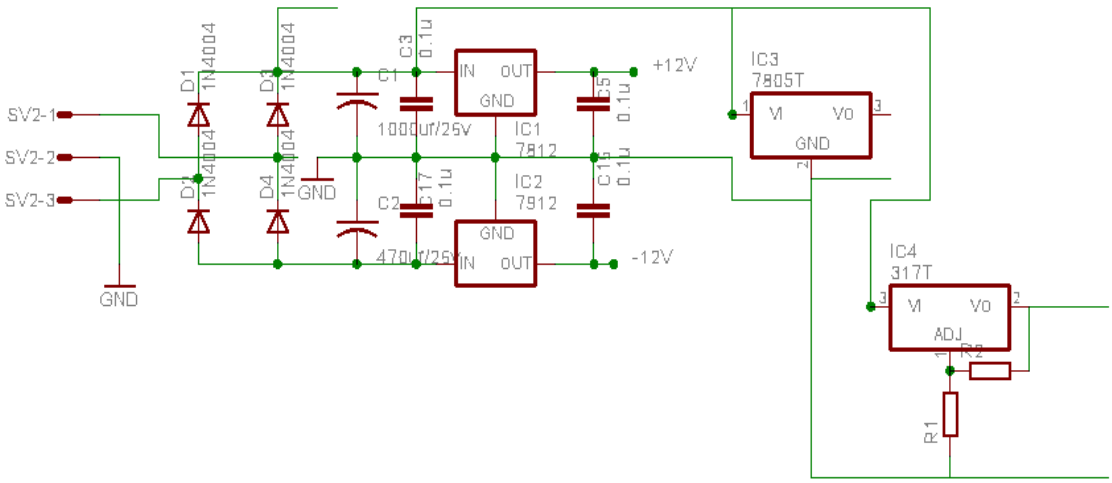
The input from sensor pairs is read through Port 1 which is programmed to supply an interrupt when it receives a low-to-high signal. This input is read and tested for which sensor pair was triggered and accordingly output by the LCD. This also triggers a 10 minute buzzer alarm.

3.4 Flash memory storage

If a valid break-in is detected, apart from the buzzer alarm and LCD display, data about time of occurrence of the break-in is also stored in the flash memory of the microcontroller. This data can be later retrieved using the USB interface.

4. Hardware

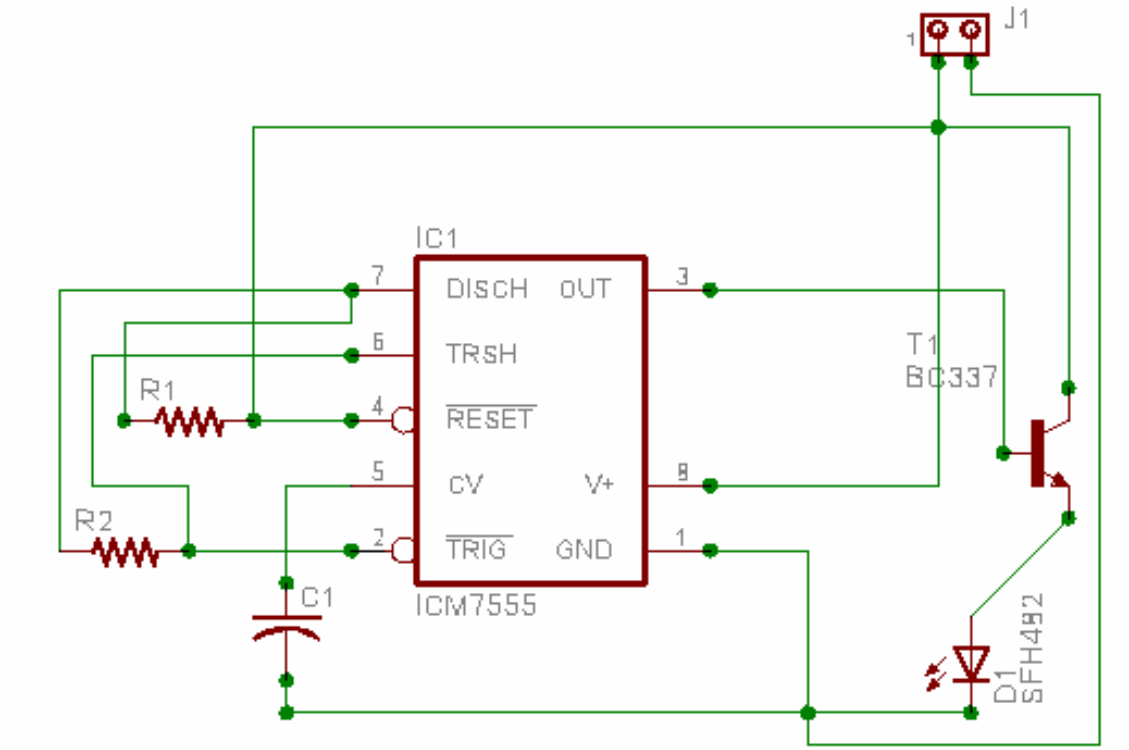
4.1 Power Supply



The power supply schematic is as shown above. It is able to supply at three different voltages as described in the power supply details.

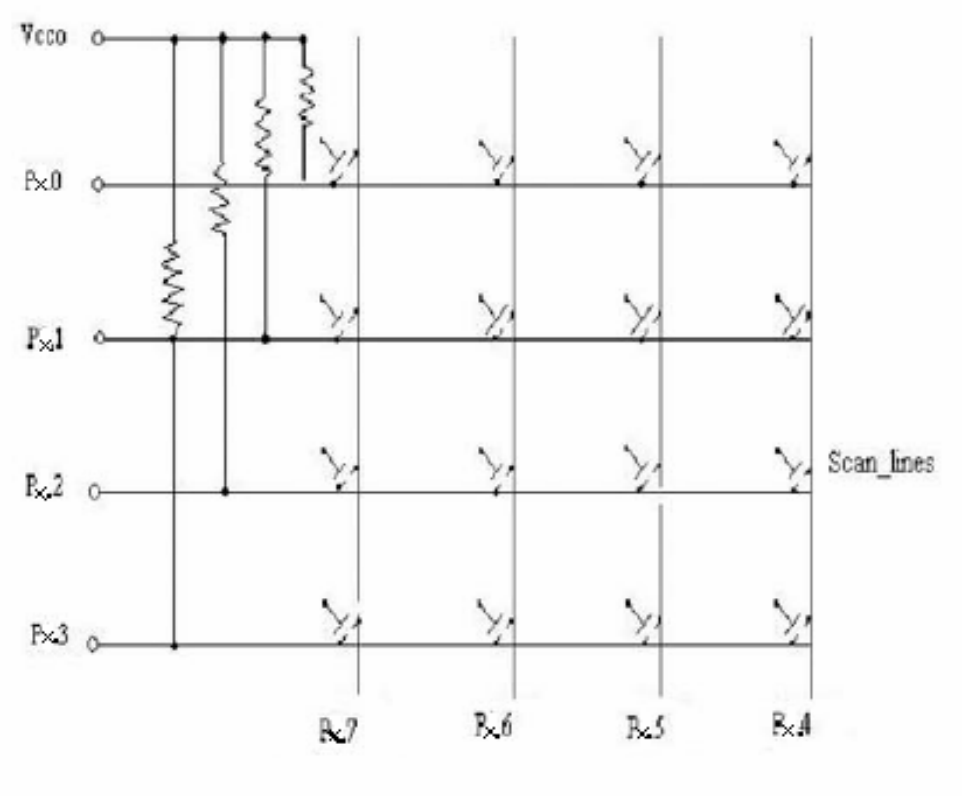
4.3 LED (transmitter)

The Schematic of the transmitter arrangement (consisting of LED powered by a LM555 timer) is shown below.

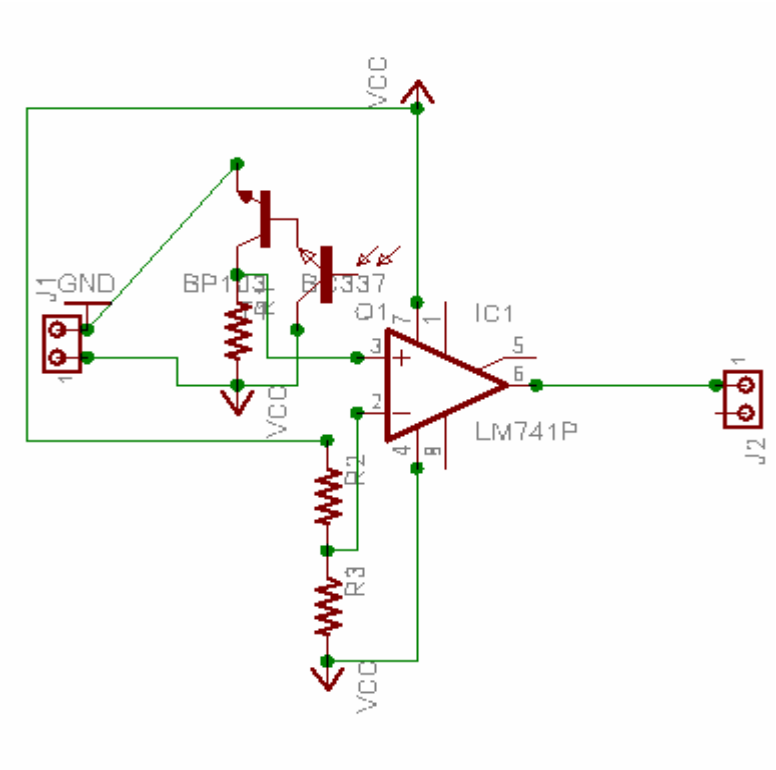


4.3 Keypad

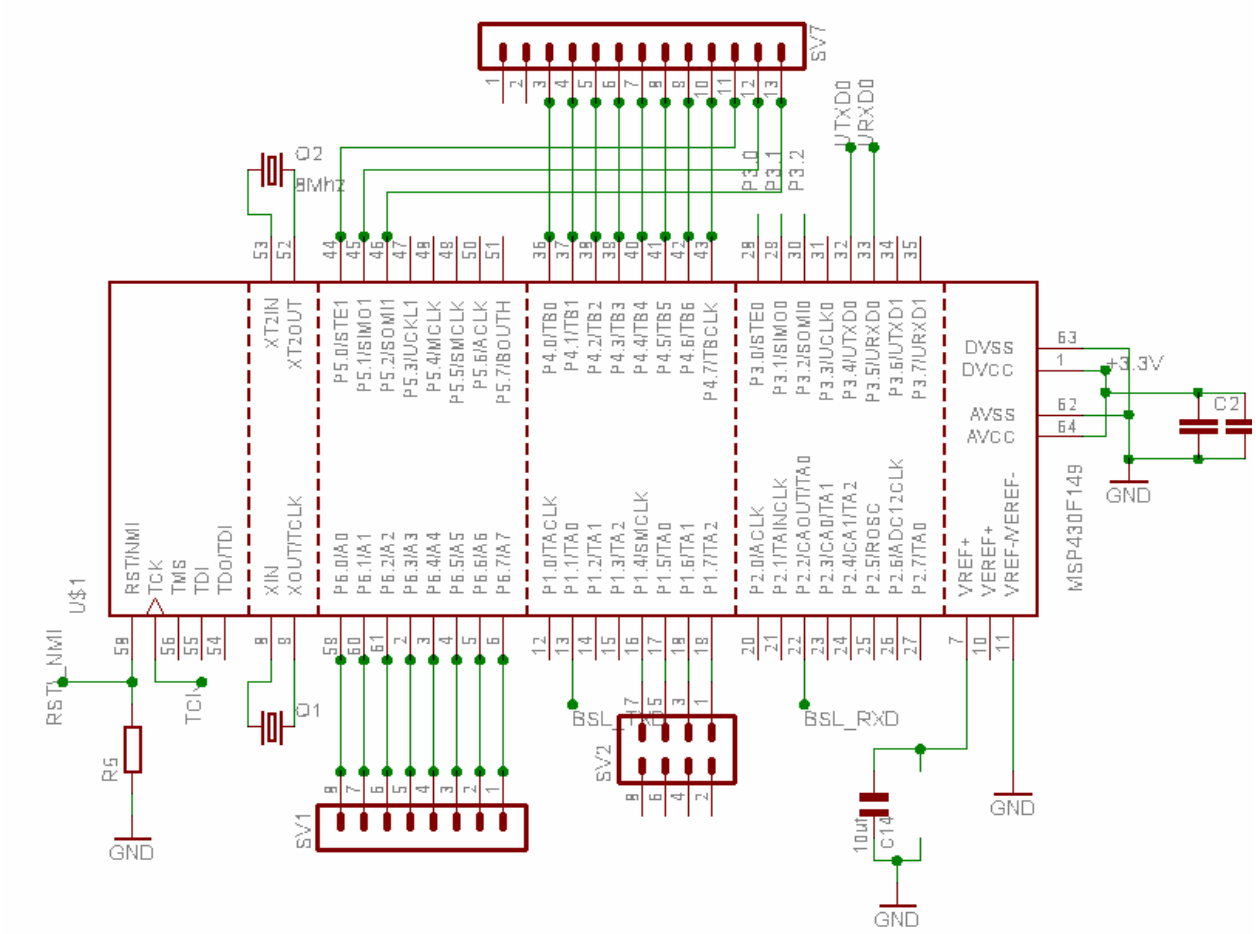
4X4 Matrix Keypad is used in the project. It is interfaced with the microcontroller MSP430 using 8 data lines. The circuit diagram is given below. The scan lines are polled by the microcontroller to detect a key press. The use of keypad is to enter the preset time.



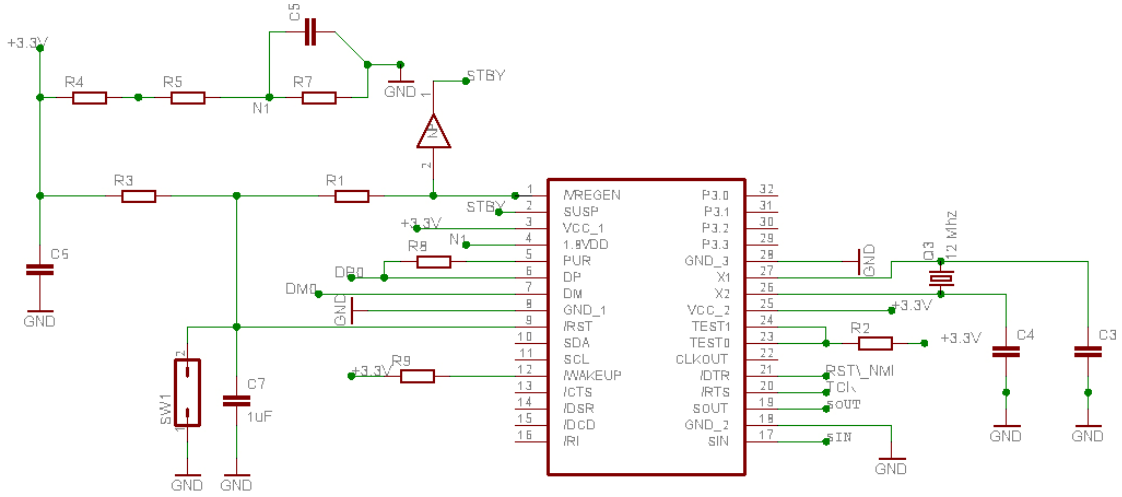
4.4 Phototransistor (receiver)



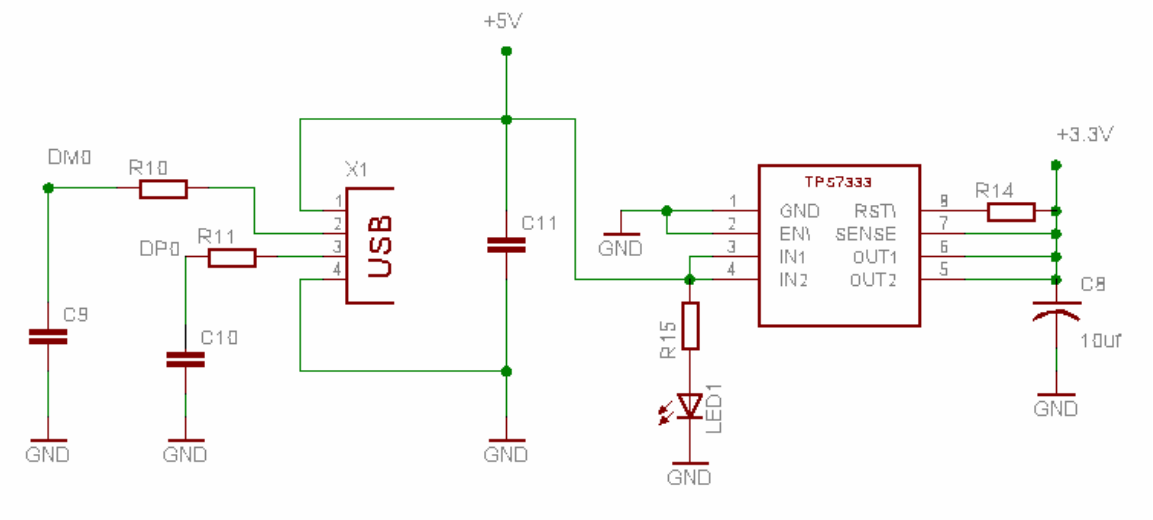
4.4 MSP programming and execution board - schematic



TUSB 3410 (USB controller)



USB Interface :



5. Suggestions for further improvements

We can improve the project in following ways :

1. *Coverage* : The number of sensor-pairs can be increased and the coverage of the security alarm system can be expanded. This will also require changes in software and how the ports of the microprocessor are utilized.

2. *Range & Accuracy* : The range of a single sensor-pair can be increased by using stronger LEDs. Also, we can use better filtering in that case to improve the accuracy. This can be especially helpful in using for bigger window/door sizes.

3. *Wireless Connectivity* : All the signals are transmitted through wires. In an advanced version of this project, it can be made wireless and therefore easier to handle.

We can improve on this alarm system such that it can be used in a variety of settings without many changes. This is especially possible if the sensor-pairs are made more robust and more sensitive without increasing probability of false alarm.

6. Acknowledgements

We would like to acknowledge the immense help provided by
Prof. M.C. Chandorkar and Mr. V.K. Tandon, which played a very important part in this project. We would also like to thank the lab assistants, seniors and the TAs.

7. References

[1] Texas Instruments, MSP 430 F148 datasheet, *http://www.ti.com*

[2] A.S. Sedra and K.C.Smith, *Microelectronic Circuits*, Fourth Edition (1982), New York, Oxford University Press, 2003.

[3] IAR Systems, IAR Embedded Workbench for MSP430, http://www.iar.com

[4] mspgcc documentation, http://gcc.gnu.org

[5] EE Department, IIT Bombay (electronics design lab webpage), http://sharada.ee.iitb.ac.in/~edlab