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Break-in Detection and Alarm System

Group no: B6

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Abstract
This report discusses the approach, design and implementation of a circuit for detecting a break-in and raising an alarm. The circuit also records the break-in time and duration and has the provision of transferring the information to a computer through USB interface. The circuit is interfaced with an LCD to display last break-in information and also to a keypad to set the time for real-time clock that is implemented in a microcontroller.

1. Introduction

The circuit mainly uses a laser beam as source and a photo-transistor as the detector. The laser pointer is driven through a MOSFET acting as a switch that is controlled by the microcontroller MSP430F148. The microcontroller is also interfaced with the audio amplifier circuit for raising the alarm. We have used reflectors that guide the laser beam to the receiver so as to cover maximum area without using more than one Laser pointer. We have currently implemented a regulator circuit for converting mains supply to DC and supplying power to various devices. The microcontroller is also interfaced with the USB controller to exchange data with a computer through USB.

2. The Laser and sensor circuitry

A 680 nm laser of power less than 1mW is controlled by the Microcontroller through a CMOS pair acting as a switch. The microcontroller drives the laser through the MOSFET. The beam is reflected through the mirrors and it falls back on the phototransistor, which is continuously poled by the microcontroller to detect any break-in. CD4007 is used as the CMOS IC, it has three CMOS pairs that can be used independently, one of the remaining two is used to drive the audio amplifier input from microcontroller.

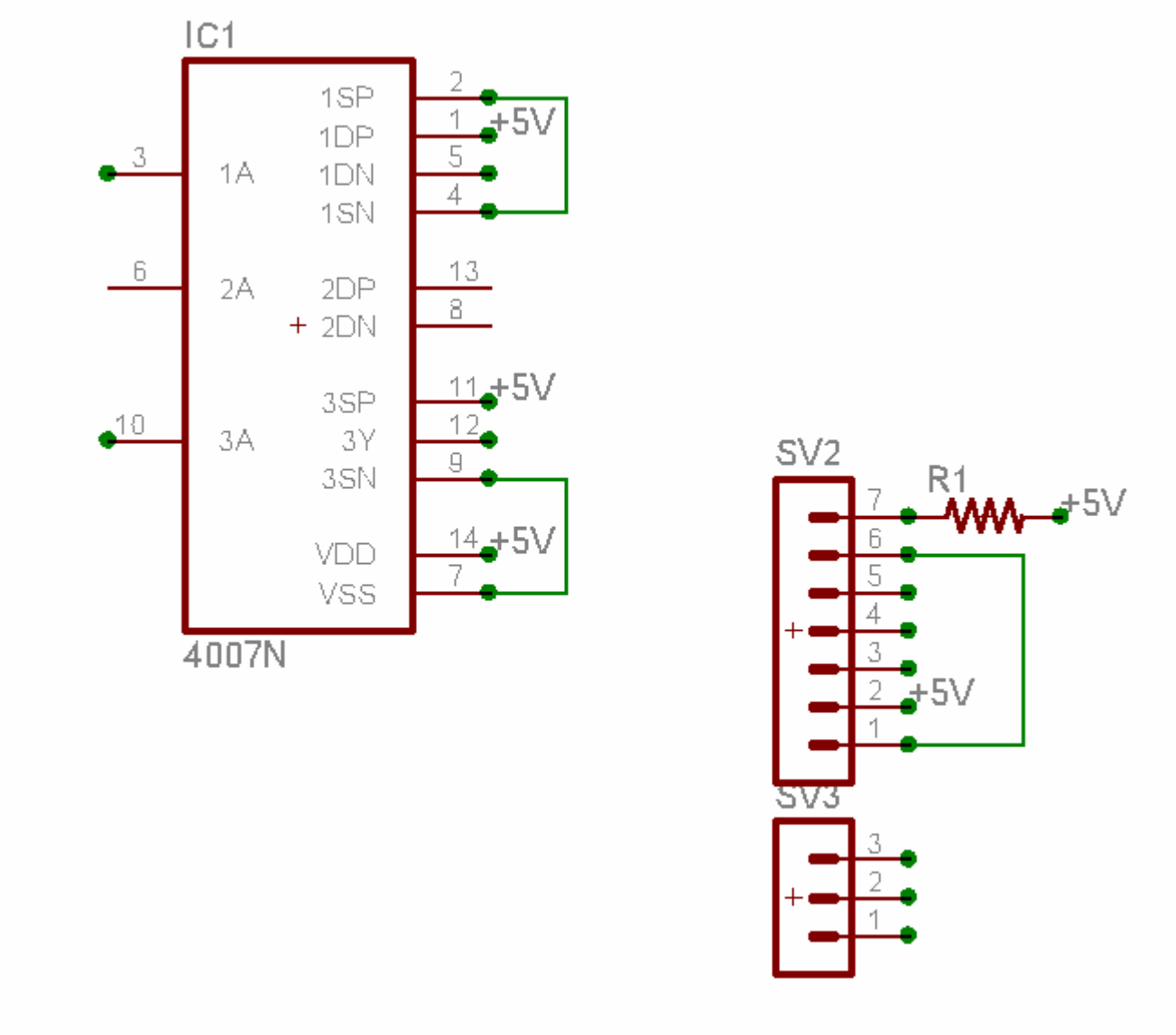

Fig 1 Schematic: Laser and Sensor board

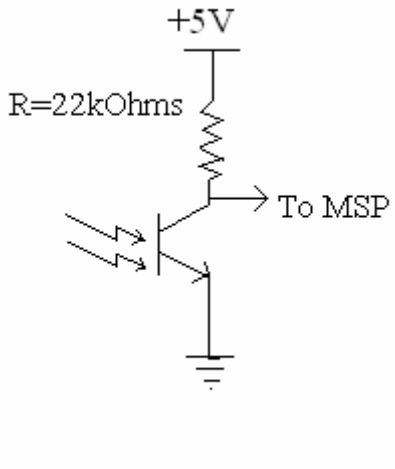

Fig 2 Circuit: Phototransistor

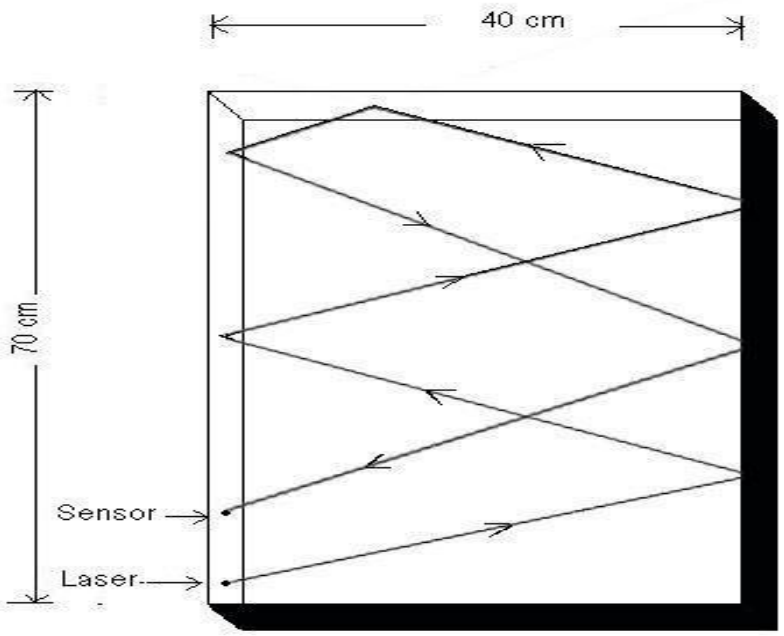

Fig 3 Reflector Assembly

3. Audio amplifier circuit

The audio amplifier circuit used for alarm raising is as follows:
We have used the IC LM386 for audio amplification as shown in the circuit diagram. The input to the IC is controlled by microcontroller through a MOSFET and timer.

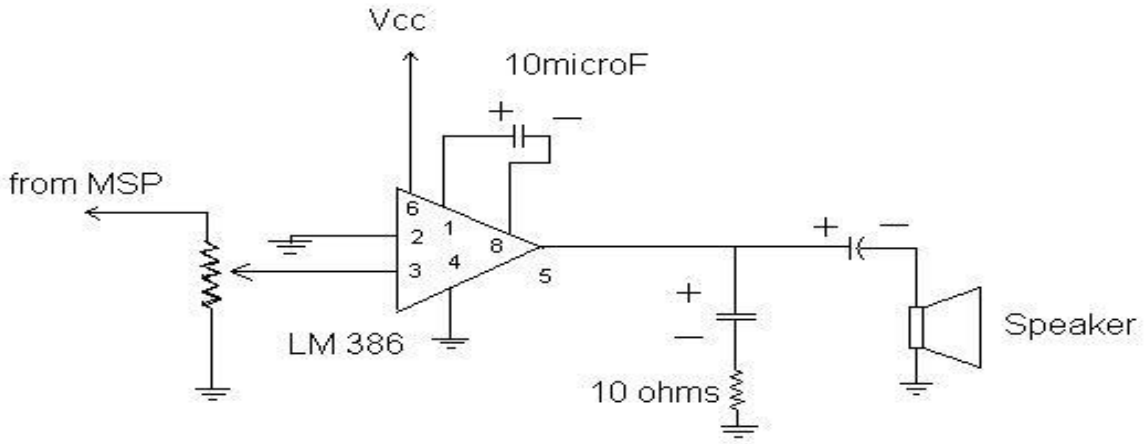

Fig 4Audio Amplifier Circuit

4. Power Supply Circuit

We require a +3.3V supply for the MSP430 microcontroller and +5V supply for CD4007 IC and timer IC555. Also, the audio amplifier circuit is driven at +12V. We have used a 230 to 15V step down transformer and a diode bridge and capacitor filter together with IC 7812 and 7805 to get the required DC supply. The circuitry is as follows:

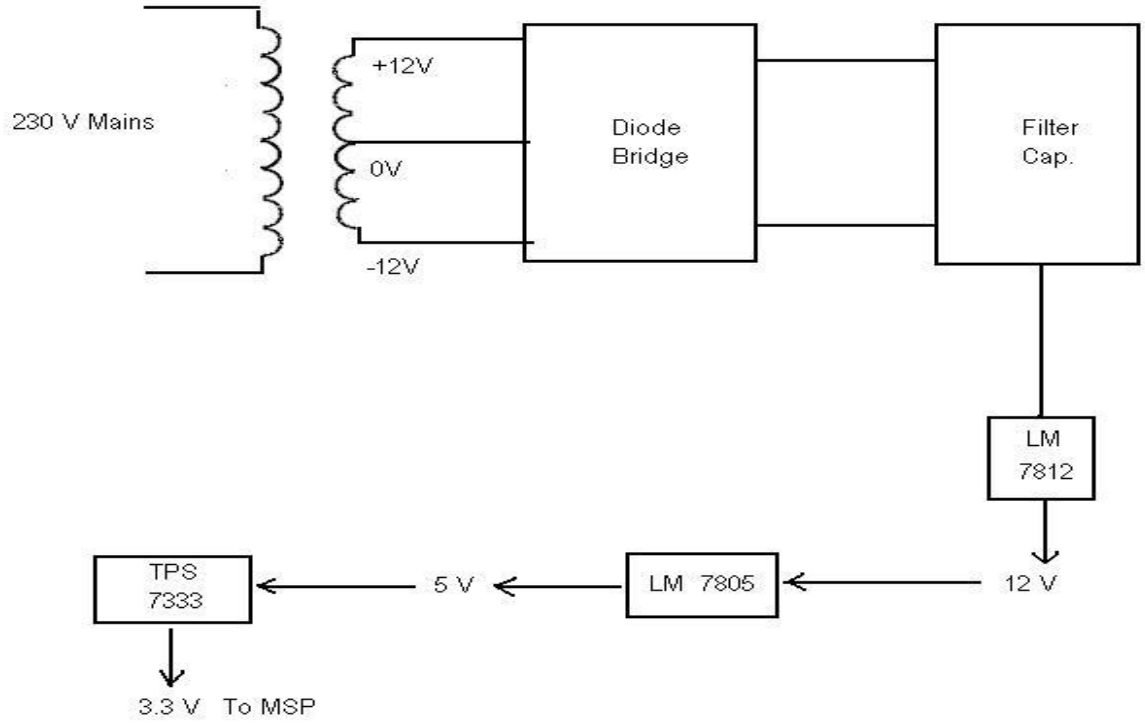

Fig 5 Power Supply Circuit

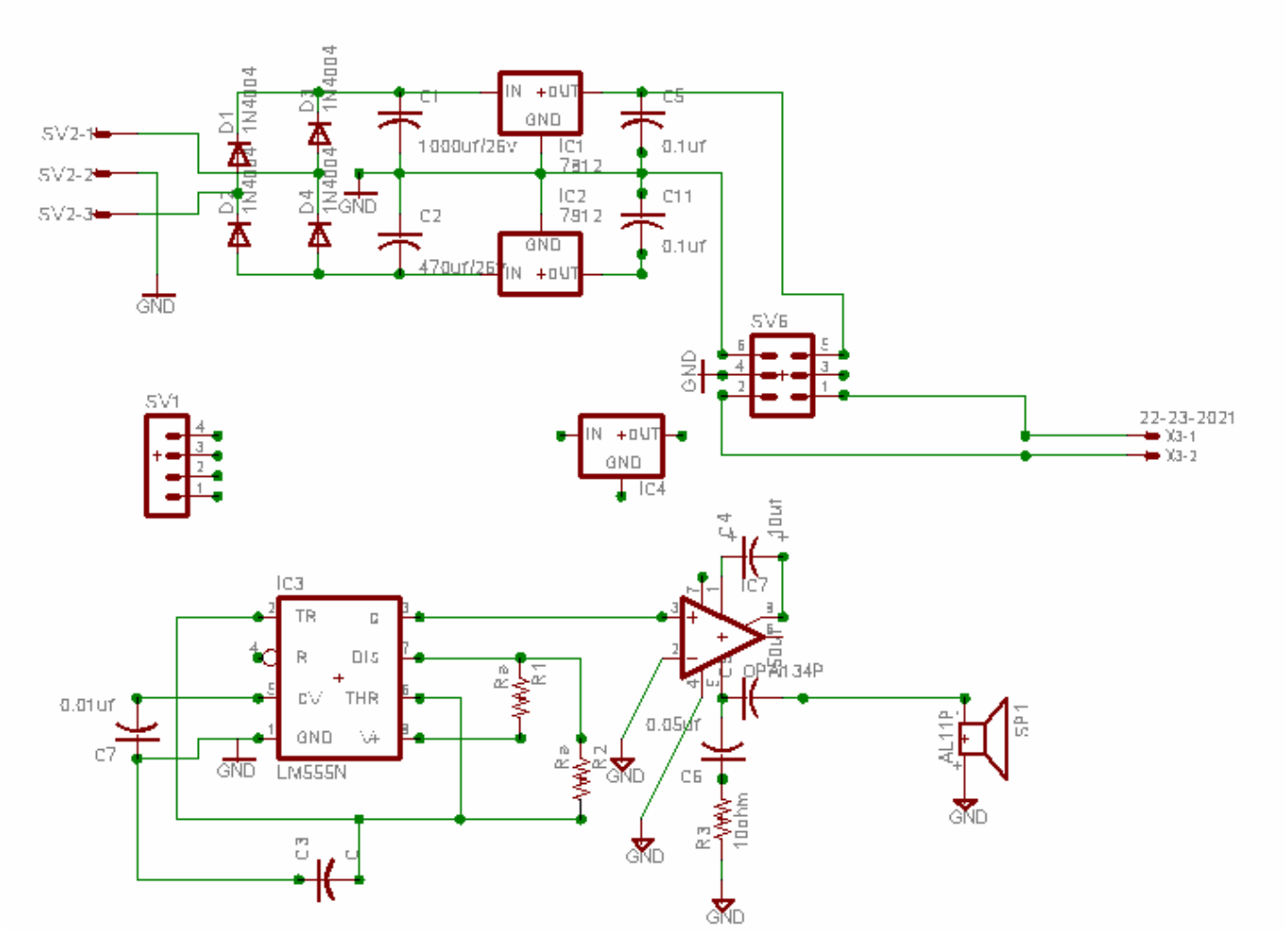

Fig 6 Schematic: Power Supply and Audio Amplifier

5. Microcontroller (MSP430F148)

We have used MSP430 microcontroller in this circuit. It has 256 bytes of information memory which is used to store the timings for break-in so that the information is not lost even if there is a power failure. It is also used to drive the Laser through a MOSFET and to detect a break-in using the photo-transistor. It is also used to control the audio-amplifier input. An LCD and a keypad is interfaced to the microcontroller to display the last break-in time and to enable the user to set the time for the real-time clock implemented inside the microcontroller. The microcontroller is also connected to the USB controller so that the information can be transferred to a computer.

The keypad is polled continuously using timer B of the microcontroller and a state machine is implemented which governs the effect of a key press. The sensor output is checked every 10ms while the input to the MOSFET that is connected to the laser is kept high. If sensor output, which is checked periodically by the microcontroller, goes low then a break-in is detected. The sensor output is then polled till it toggles and the time is noted. This time is the duration of the break-in. This is then transferred to information memory. The real time clock is implemented using the timer of the microcontroller and the alarm circuit is turned on for 5 minutes once a break-in is detected.

The block diagram of the micro controller circuit is as follows:

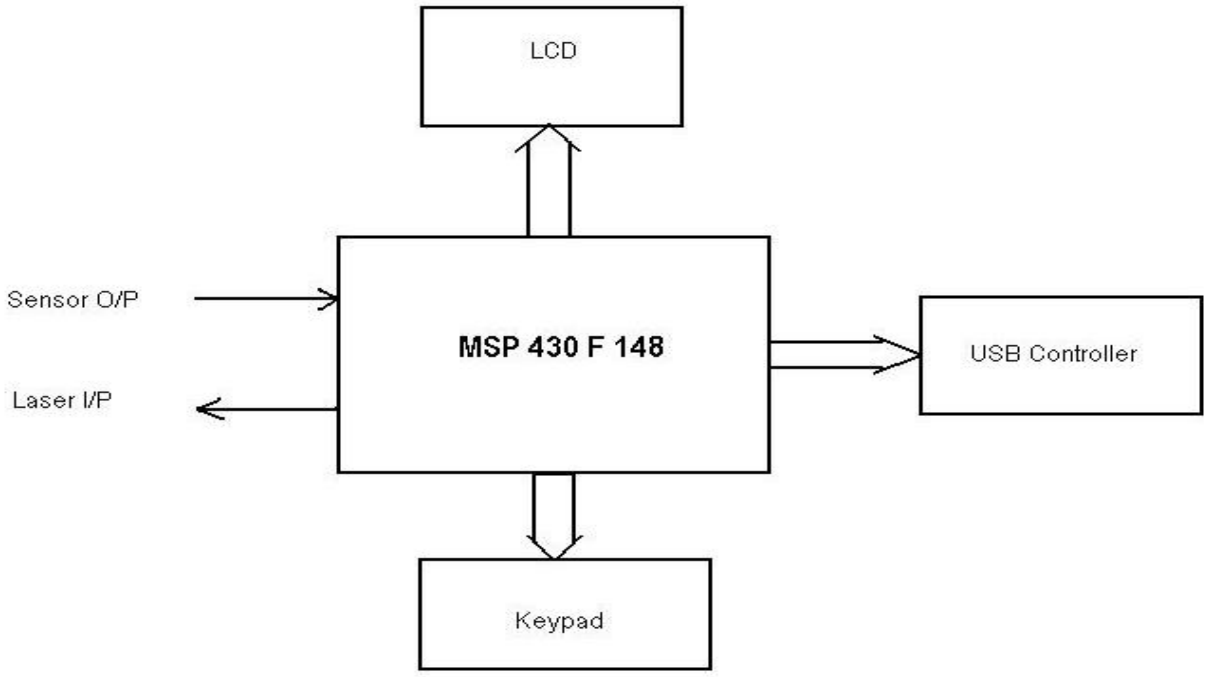

Fig 7 Block Diagram

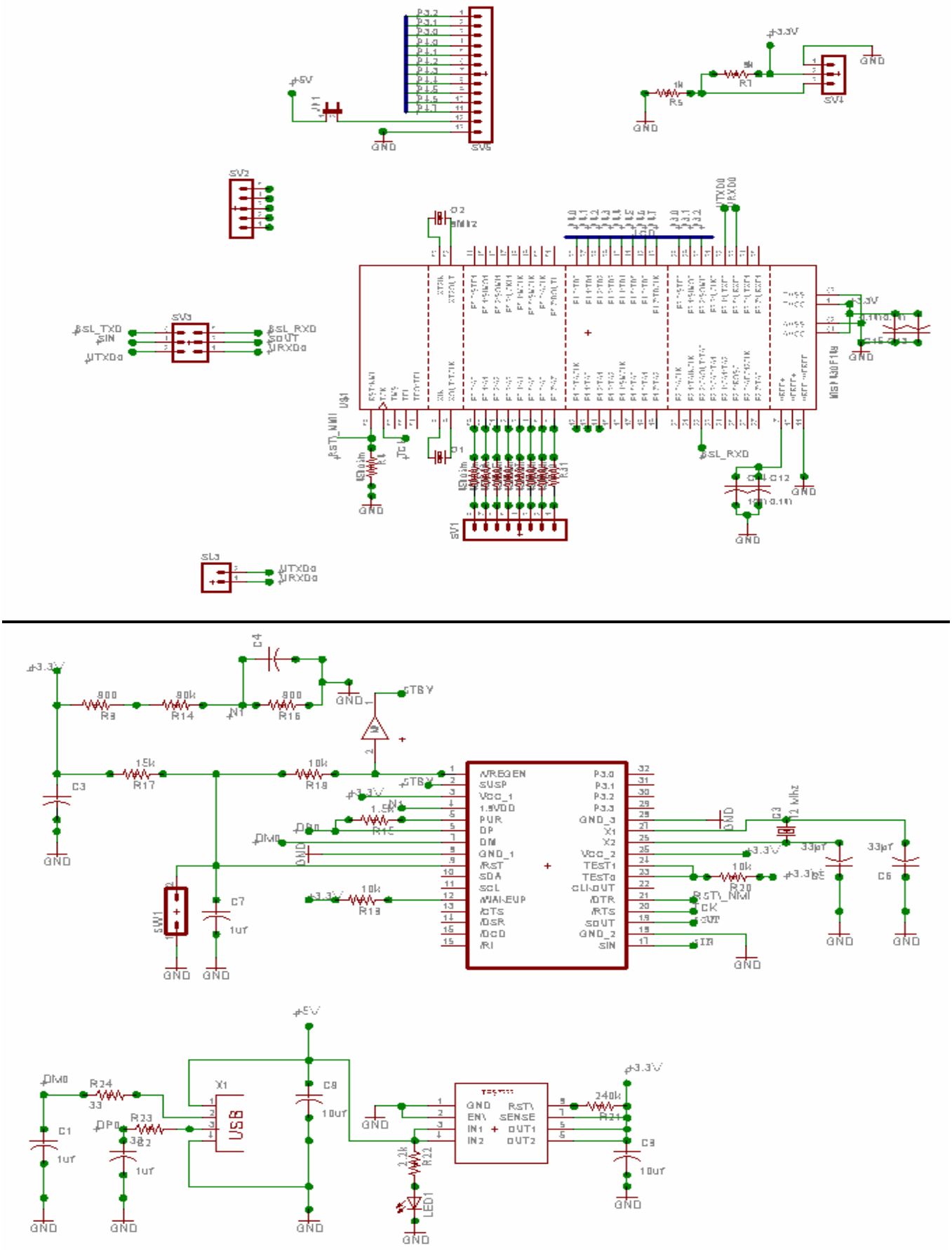

Fig 8 Schematic: MSP Programmer

6. Precautions taken during the project

1. Class 2 and Class 3A laser pointers are not toys and can cause damage to the eye.

2. Never aim the pointer at people.

3. Remove all unnecessary shiny reflecting surfaces from the work area. Remove jewelry from hands and wrists, and wear adequate protective eyewear before aligning a laser beam, changing its path, and putting samples or optical elements on or taking them off from its path.

4. When observing diffuse reflections or scatter, keep the laser beam away from eye level, and keep your eyes away from the level of the beam. NEVER LOOK DIRECTLY INTO THE BEAM even when wearing protective eyewear.

5. If your eye is accidentally exposed to laser light, the services of an ophthalmologist should be obtained immediately.

6. Never leave an unblocked invisible laser beam unattended.

7. When turning a laser on, check to make sure the beam will fall on a beam block.

8. Work with maximum ambient room light to keep the pupil of your eye from becoming any larger than necessary. The larger the pupil, the easier it is to damage the retina.

7. Conclusion and Further Developments

The break-in detection and alarm system is designed. A break-in is detected, an alarm is raised and the time is stored in microcontroller.
In this circuit we have used the mains supply. We can implement a circuit which can detect a power failure and switch the circuit to battery operated mode (battery back-up). This circuit scheme can also be implemented in network of windows using a master controller.
The reflectors we are using are simple mirrors which cause lot of scattering of the beam and loss of power, hence limiting the number of reflections. We can apply beam stirrers instead to maintain the intensity of the beam.

References

[1] Texas Instruments, MSP430F148 datasheet, http://www.ti.com

[2] A.S.Sedra and K.C.Smith, *Microelectronic Circuits* , Fourth Edition (1982)

[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*

Appendix

1. User's Manual

The break in alarm system will prove very useful in protecting valuables from thieves, the frame provided with the product can be attached to the window of the room to be guarded. The invisible network of beams whenever interrupted an alarm will be sounded, listening to which one should get alert and take necessary actions. User does not have to worry about power failures as the product is well equipped for such conditions with a battery back-up.

2. Precautions for the user

Lasers, (Light Amplification by Stimulated Emission of Radiation) are an extremely bright source of light. A 1 mW visible laser is about one million times more brilliant than a 100 watt light bulb and such light can, under certain conditions, cause damage to the eye. Lasers are classified into four main classes to identify the risk associated with them. Class 1 represents the least hazardous where exposure of the eye to direct or reflected beams is not expected to produce any damage. Class 2 lasers have an output of up to 1 mW and do not damage the eye when the exposure to the eye does not exceed 250 milliseconds. This is normally the time that it takes to react to a bright source of light and close one's eye (the blink reflex). Class 3 lasers are subdivided into Class 3A (output < 5mW) and Class 3B (output > 5mW). Class 3 and 4 lasers can damage the eye in a time less than the blink reflex and because of this Class 3B and 4 lasers are subject to strict controls.

Laser pointer used in this product is a Class 2 laser. It emits a beam of 680 nm wavelength and 1mW power. Exposure of a person's eyes to a momentary sweep of a Class 2 or Class 3 laser beam can result in temporary flash blindness, afterimage and glare which can be particularly dangerous if the individual is engaged in a vision-critical activity. Never look directly into the beam.