

ATMEL AVR Design Contest 2006**Project Number: AT2951****Project Title: Automatic Egg Incubator****AVR Device: ATMEGA32****Abstract**

AUTOMATIC EGG INCUBATOR

There are prominent needs for egg incubators around the globe, because of many factors. A person fascinated by birds likes to raise ornamental birds but he couldn't find or get a broody bird as such, non vegetarians eat birds where in most cases they are imposed to take birds that are raised through artificial injections, in many cases even if we have an egg in hand we can't hatch the egg naturally since it is difficult to find the bird and get it hatched etc. All these matters expose the importance of this project called Automatic Egg Incubator.

The project that is being portrayed here implements an Automatic Egg Incubator using ATMEL AVR ATMEGA32. The main four parameters in any bird hatching would be incubation temperature, relative humidity inside the incubator, ventilation and egg turning. Hatching temperature, optimum relative humidity, number days for hatch etc depends on the bird species. The incubation area is an enclosed chamber with various mechanisms and controls. There is a carrier which holds the eggs inside the chamber for an easy rotation of eggs.

Above mentioned four vectors have its own importance that failure in any one of them can cause lose of entire hatch. Temperature of the incubation decides quality of the batch. Both low and high temperatures lead to decreased hatchability and produce weak chicks. So keeping incubation temperature at optimum value is a must. Mixing ensures uniformity of temperature and humidity inside the chamber to prevent localization of any factors. Aeration takes in fresh oxygen and removes carbon dioxide gas evolved out of egg shells out. Egg turning ensures entire mixing of albumen to provide sufficient nutrients. Looking holistically, all of the above factors matters a lot and an over all stability has to be attained by adjusting all of them. AVR ATMEGA32 maintains this equilibrium perfectly by using the features and peripherals available on it.

The design files and relevant documents explains how the entire system is setup and ATMEGA32 manage those four vectors. Two digital thermometer chips DS1631 acts as dry and wet electronic thermometers, DS1307 acts as the time keeping RTC for the entire system and the LCD provided shows live status of the incubator. Both digital thermometer chips and RTC utilize the TWI available on the ATMEGA32 microcontroller.

Temperature control of the chamber is met through a motorized kerosene wick lamp. Depending on the wet temperature reading, AVR controls exposure of the wick to keep

temperature within the range. Relative humidity is calculated from the dry and wet electronic thermometer readings and duration of aeration is decided on this reading. RTC maintains overall timing of the system which includes; aeration, mixing of air inside the chamber, rotation of eggs, tracking the number of days etc

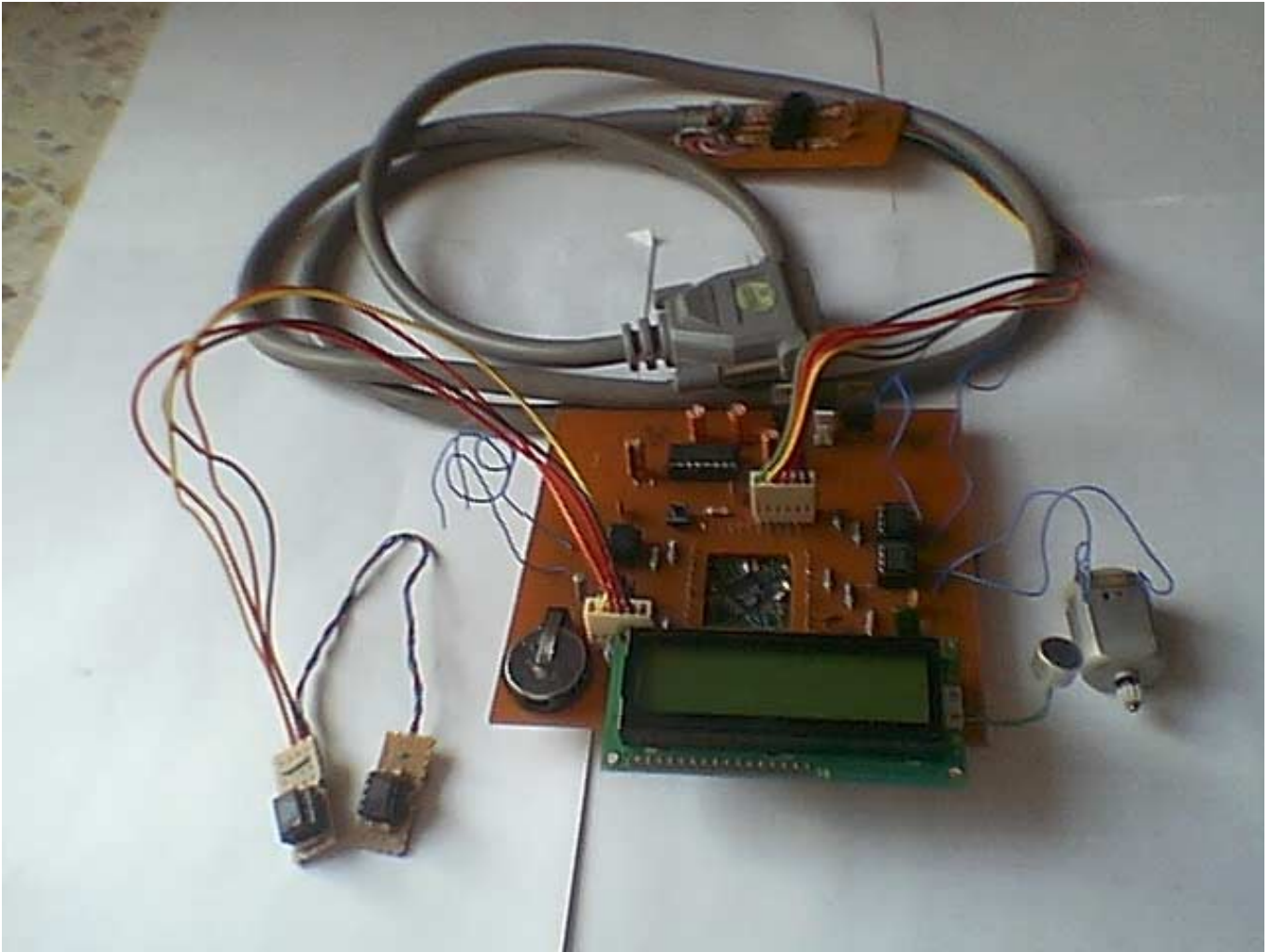
Additional features of the system are: signaling first hatch and monitoring the baby, by detecting sound of the baby bird once baby breaks egg shell. This feature is being implemented by utilizing ADC of ATMEGA32. Sound is picked up using a condenser microphone and is amplified and fed to ADC input. Risk in any malfunction of motorized wick lamp is monitored using a LM35 based temperature to voltage converter, with the voltage fed to another ADC channel. A siren will blow sound in case of wick lamp. And a C application has been developed to configure the no of days for hatch, temperature etc depending on the bird. The communication protocol between PC and the AVR is serial, implemented using USART module available on ATMEGA32.

DC motors are provided for rotation, mixing, aeration and wick lamp control, which are driven through motor driver chips. Separate voltage regulator is provided for these motors to prevent spurious signals and momentary currents from entering the AVR supply line. To provide necessary torque, simple gear from a mechanical clock is used.

The entire board works on 5V power supply. For normal operation, system is powered from 230V line with rectifiers to convert AC to DC. NiCd Battery back up is provided to power the system during power failures. There is a relay which manages the switching between the rectifier supply and battery supply. A 2200uF capacitor provided on the rectifier output eases the switching task without any fluctuations in the voltage. AVR manages charging intervals of the battery along with RTC.

Although there are many incubators available in market, most of them are not affordable to the common man and many of them rely on heating coils which uses AC power supply. Those incubators can't be used in remote areas and where there are frequent power failures. As a remedy for this problem, this project implements a kerosene lamp based design, which is more reliable. In the case of remote locations, whole control circuit and related stuffs can be powered from a 12V solar panel.

Photo of the assembly of project

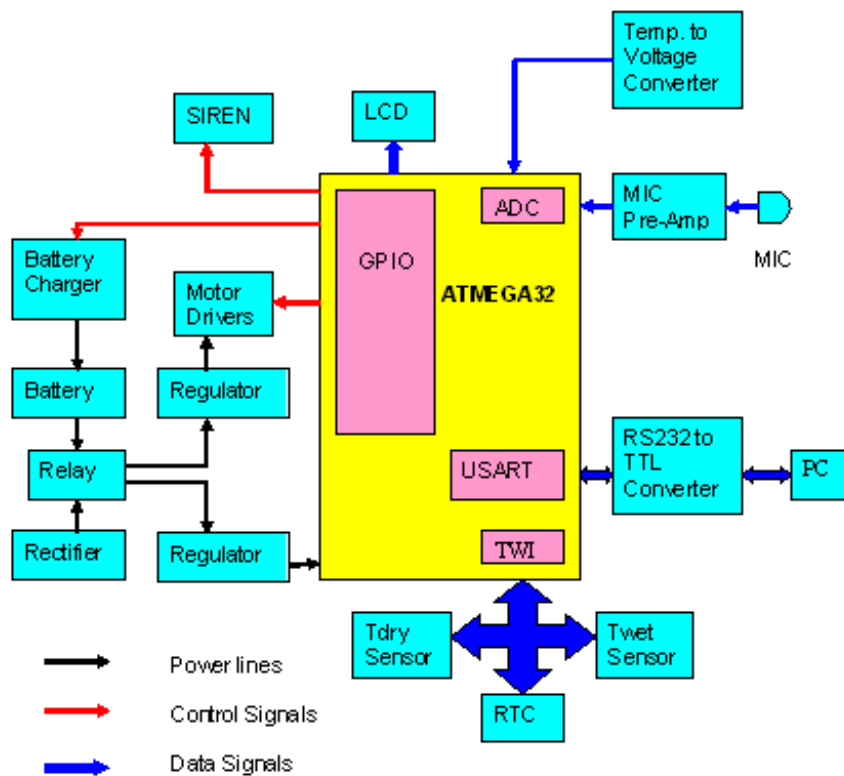


(Figure above shows the main controller board of Automatic Egg Incubator. ATMEGA32 sits at the centre. It is on a small board which is placed below the main board and is soldered to the top using four 11 pin connectors)

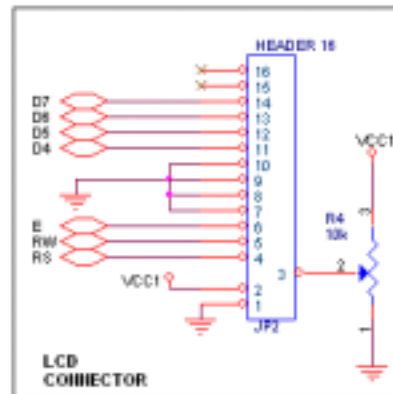
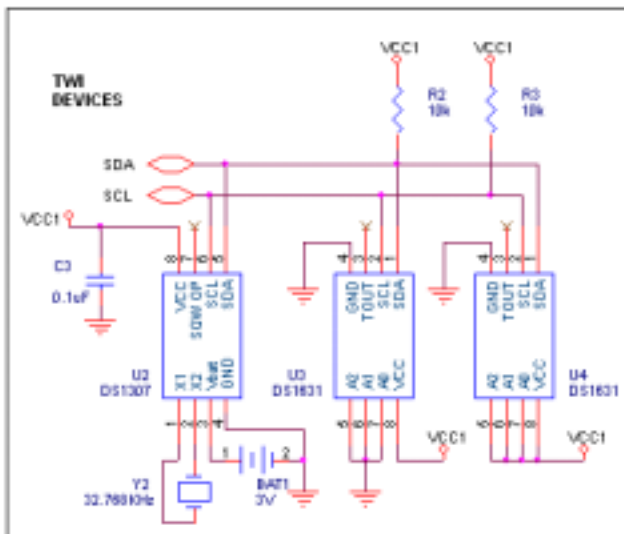
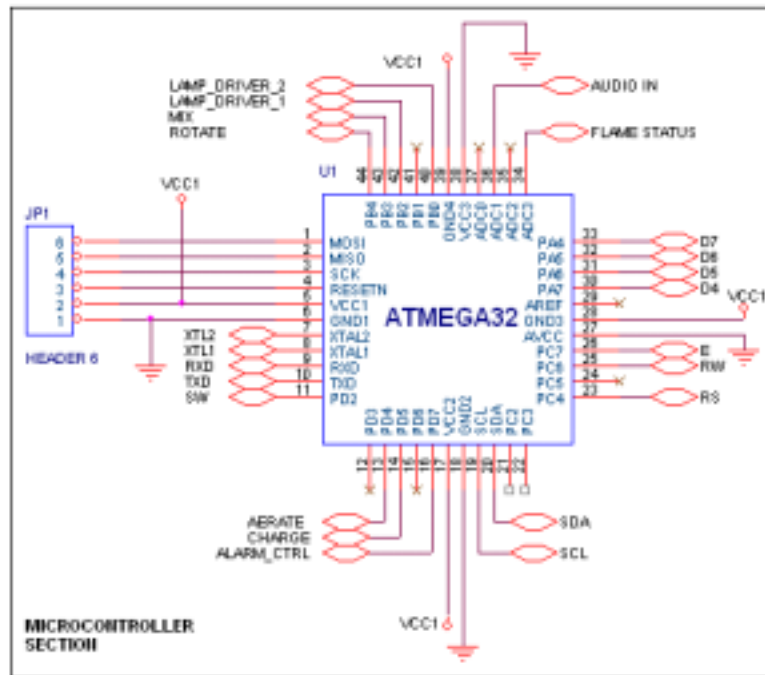
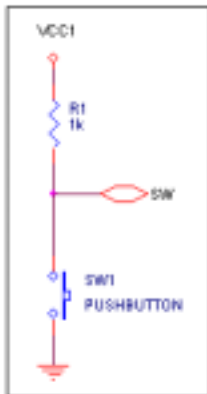
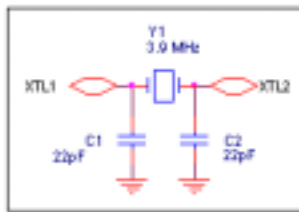


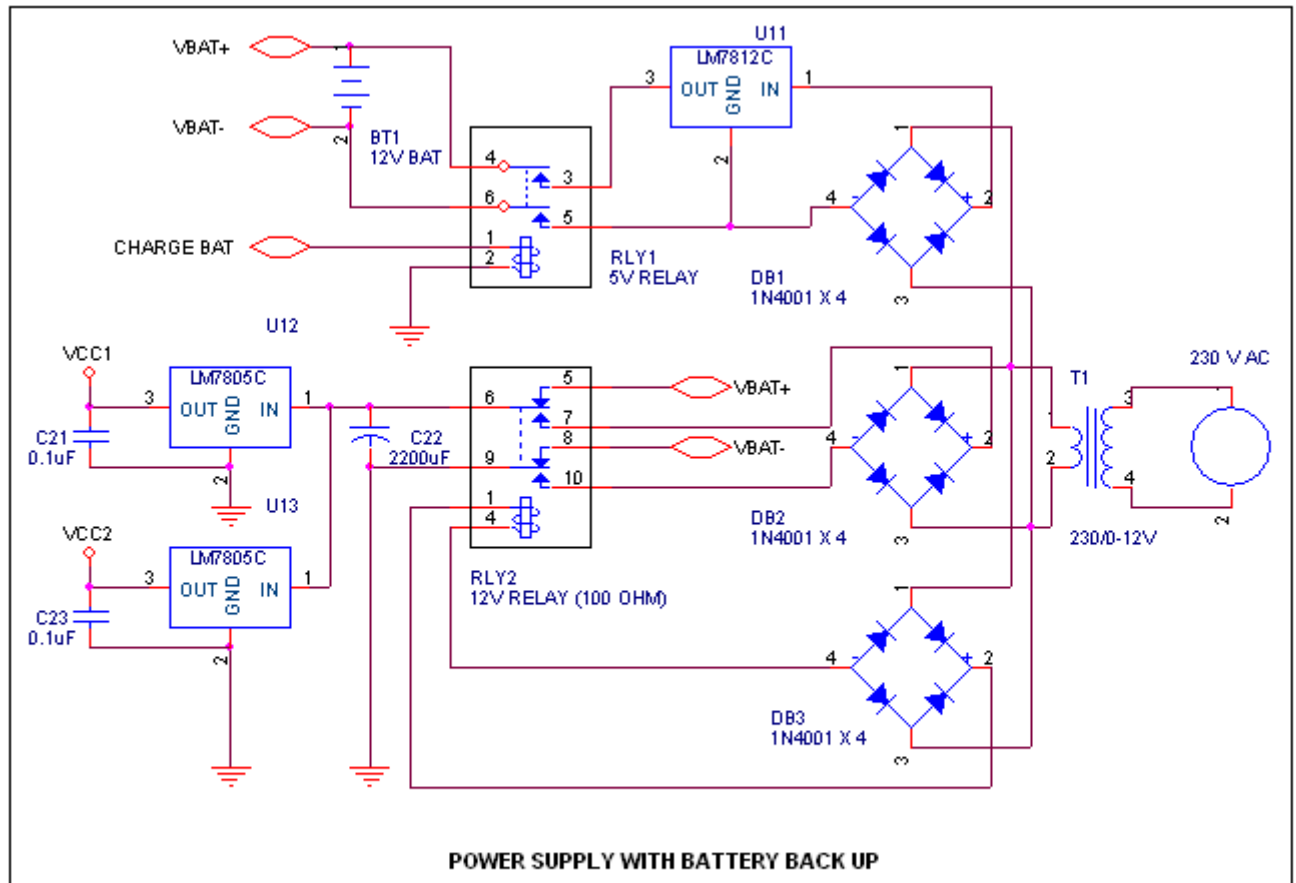
(Figure shows the full system view. Main Controller board is inside the rose box. ATMEGA32 can be seen through the slit. Figure shows other parts of the system)

Block diagram



Schematics





Code snippet

Entire code is available in.
Code below shows a part of it.

```
//code section which monitor wick lamp flame temperature
adc_capture(0x03);
while(!(ADCSRA & (1<<ADIF)));
while(adc_complete_flag != 1);
adc_complete_flag = 0;
dont_mix = 0;
if (value > 280) //if LM35 sensor reads higher than 70 degrees
{
    clear_bit_ALARM_CTRL(); //switch on siren
    set_bit_MIXIGCNTRL(); //turn on blower fan to extinguish lamp
    for (i=0;i<5;i++)
        delay(400000);
    //flame will be put off by this time
}
```

```

        clear_bit_MIXIGCTRL();
        siren_status = 1;
    }

    if (value < 200) //if LM35 sensor reads below 50 degrees
    {
        clear_bit_ALARM_CTRL(); //switch on siren
        dont_mix = 1;           //since magnetic reed switch is on, mixing
signal will
                                //put off wick lamp flame..so
disable mixing for the time
                                //being
        siren_status = 1;
    }

    if (siren_status == 1)
    {
        if ( (PORTD & 0x04) == 0x04) // push button pressed
            set_bit_ALARM_CTRL();
    }

    //code section which detects first hatch
    adc_capture(0x01);
    while(!(ADCSRA & (1<<ADIF)));
    while(adc_complete_flag != 1);
    adc_complete_flag = 0;
    if(value > 200)
    {
        // counter to ensure sound is really produced by chick
        //expects sound to be repeated 10 times in 5 minutes
        if (sound_counter == 0)
        {
            sound_minute_trigger = Minute_current + 0x05;
            if (( sound_minute_trigger & 0x0F) > 0x09)
                sound_minute_trigger = sound_minute_trigger + 0x06;
            if (sound_minute_trigger > 0x59)
                sound_minute_trigger = 0;
        }

        sound_counter++;
        if (sound_counter == 10)
        {
            I2CSendAddr(RTCADDR,WRITE);
            I2CSendByte(0x10); // store first hatch details starting from this
location
            I2CSendByte(Minute_current); //first hatch happened at this minute

```

```
        I2CSendByte(HR_current); //in hour
        I2CSendByte(Date_current); //at this date
        I2CSendByte(Month_current); //of this month
        I2CSendStop();
        sound_counter = 0;
    }
}

if ((Minute_current == sound_minute_trigger) && (sound_counter < 10))
    sound_counter = 0;

    cmdroutine(0xCD);
    dataroutine(' ');
```