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Development of an Automatic Electric Egg Incubator

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ABSTRACT: An electric powered incubator using a forced draft principle was developed using the available local materials and it was tested with hatchable hen egg.The aim was to produce a low-cost incubator and increase the production of day-old chicks for small and medium scale poultry farmers.Factors that were considered during the performance evaluation of the incubator were humidity, 55% and temperature, 37 ℃ during the first 18 days and was maintained at 37.5℃ till hatching. Turning of eggs was achieved with the use of tilting trays mechanism using an electric gear motor (0.5 h p). The trays were lifted through an angle of 40° either side of horizontal at every hour and lasted for four minutes.

KEYWORDS: Development, Automatic, Electric, Incubator, Egg Incubator.

I. INTRODUCTION

Incubation is the management of a fertilized egg to ensure satisfactory development of the embryo inside the fertilized egg into a normal chick.An artificial incubator is a chamber in which temperature, humidity and ventilation are controlled for the purpose of hatching a relatively large numberof eggs than a single hen can handle at a time.The heat required for incubation is usually provided by coal, oil, gas or electricity. For small incubator about 58% relative humidity is kept at 120°F (38° to 39°C) up to the 18th day of incubation after which, the humidity goes to 70% and the temperature is lowered to 96°F (36°C) until the chick is hatched.

Eggs selected should be of normal shape, a minimum of 56.7 g in weight, with good shell texture, and free from faults.

The world's population is growing at an alarming rate and so is the demand for protein especially in the rural areas, poultry is a good source of protein and it is affordable. A broody hen (a hen that wants to set and hatch eggs and raise the chicks) can hatch just about 10-12 eggs at once in 21 days, which reduces its productivity as it takes time to incubate and hatch the chicks. In contrast, some large birds, such as condors and albatross, may lay only a single egg every two years. For the world growing population, relying on this natural type of incubation is not enough, hence the need for artificial incubation. This way, a female bird just concentrates on laying eggs while the incubation is done for her artificially.

II. INITIATIVE

The start of the project involved literature surveys in which a number of research paper were read to get an overview of the work that has been previously done related to Egg incubation process.To make concepts more clear about Egg incubator a visit to the Poultry Farm house was made to see everything in real and a demonstration of process of incubation was observed.

III. LITERATURE REVIEW

Incubation is the process by which birds hatch their eggs, and to the development of the embryo within the egg. The most vital factor of incubation is the constant temperature required for its development over a specific period. Especially in domestic fowl, the act of sitting on eggs to incubate them is called brooding, and most egg laying breeds of chicken have had this behaviour selectively bred out of them to increase production. Naturally, all birds lay eggs declared Dunne and Eisenbeis (1972), but most reptiles lay eggs, even birds lay their eggs in heaps of soil or decaying vegetation and pay no more attention to them. Their young are able to fly almost at once after hatching. The process of egg incubation has left a lot for wonder.Yet all other birds incubate their eggs by supplying heat from their bodies, and give the young devoted care. But during the incubation period, Bucher (1983) found that prepiping and

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hatching levels of oxygen consumption are lower than in some precocial species.

However, it is without doubt that more benefits accrued to artificial incubation and production of eggs. But also, with same token, researcher, such as Van Der Heyden (1987) claims that artificially incubating to increase egg production is risky and that many aviculturists have lost more than they've gained by it. Surrogate or foster parents have been successfully used to incubate and raise eggs (Gee, 1983; Harrison, 1987; Stoodley, 1984) with the same benefits as artificial incubation. Although evidences have shown that the production of rare species can be significantly increased by artificial incubation.

IV. MATERIALS

- **Arduino UNO R3**

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. You can tinker with your Uno without worrying too much about doing something wrong."Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

Specification:

Operating voltage – 5V.
Input voltage – 7-12V.
Clock speed – 16MHz.
Operating temp- 10-60°C.

- **DHT11 Sensor**

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor. complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high- performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

- **Relay Module**

A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a micro controller. When activated, the electromagnet pulls to either open or close an electrical circuit.

A simple relay consists of wire coil wrapped around a soft iron core, or solenoid, an iron yoke that delivers a low reluctance path for magnetic flux, a movable iron armature and one or more sets of contacts. The movable armature is hinged to the yoke and linked to one or more set of the moving contacts. Held in place by a spring, the armature leaves a gap in the magnetic circuit when the relay is de-energized. While in this position, one of the two sets of contacts are closed while the other set remains open.

- **LCD Display**

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines.In this LCD each character is displayed in 5x7 pixel matrix.Connection port is 0.1" pitch, single row for easy breadboarding and wiring.

- **DC gear Motor**

A gear motor is an all-in-one combination of a motor and gearbox. The addition of a gear head to a motor reduces the speed while increasing the torque output. The most important parameters in regards to gear motors are speed (rpm), torque (lb.-in) and efficiency (%). In order to select the most suitable gear motor for your application you must first compute the load, speed and torque requirements for your application. ISL Products offers a variety of Spur Gear Motors, Planetary Gear Motors and Worm Gear Motors to meet all application requirements. Most of our DC motors can be complemented with one of our unique

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gearheads, providing you with a highly efficient gear motor solution.

Specification:

Voltage: 6V to 12V;
Shaft diameter: 24 x 6 mm
Overall size: 80 mm x 40mm
RPM: 10r/min at 12V
Torque Range: 5 Kg-cm (Approx.).

- **Micro Servo Motor**

Tiny and lightweight with high output power. Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos. Good for beginners who want to make stuff move without building a motor controller with feedback & gear box, especially since it will fit in small places. It comes with a 3 horns (arms) and hardware.

Position "0" (1.5 ms pulse) is middle, "90" (~2ms pulse) is middle, is all the way to the right, "-90" (~1ms pulse) is all the way to the left.

Specification:

Weight: 9 gm
Operating voltage: 3.0V~ 7.2V
Servo Plug: JR
Stall torque @4.8V: 1.2kg-cm
Stall torque @6.6V: 1.6kg-cm

- **L293D Motor Driver**

L293D IC is known as a motor driver. It is a low voltage operating device like other ICs. The other ICs could have the same functions like L293D but they cannot provide the high voltage to the motor. L293D provides the continuous bidirectional Direct Current to the motor. The polarity of current can change at any time without affecting the whole IC or any other device in the circuit. L293D has an internal H-bridge installed for two motors.

H-Bridge is an electrical circuit that enables the load in a bidirectional way. L293d bridge is controlled by external low voltage signals. It may be small in size, but its power output capacity is higher than our expectation. It could control any DC motor speed and direction with a voltage range of 4.5 – 36 Volts. Its diodes also save the controlling device and IC from back EMF. To control the max 600mA amount of current an internal "Darlington transistor sink" installed in it, which could be used to control a large amount of current by providing a small amount of current. It has also internal "pseudo-Darlington source" which amplifies the input signal to control the high voltage DC motor without any interception.

- **Other Materials**

1. Lamp(Bulb): To provide required heat for hatching of eggs.
2. Fan: To control the humidity.

V. INTERFACING

1. Relay Interfacing with Arduino

A relay is used between Arduino's pin and bulb to protect Arduino from high voltage or current.

The relay has two groups of pins "LOW Voltage Group" and "HIGH Voltage Group"

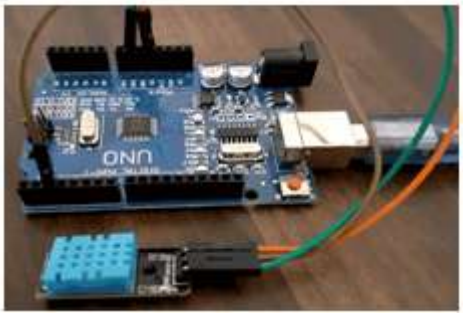
Pins in the low voltage group are GND pin, VCC pin & IN pin which receives the control signal from Arduino. These pins are connected to Arduino.

Pins in the high voltage group are COM pin, NO pin, NC pin which are connected to bulb.

In this project we used normally open mode, so IN pin is connected to HIGH (5v), so the switch is closed and the bulb is ON.

2. DHT11 Interfacing with Arduino

DHT11 sensor has 3 pins first pin is VCC pin, second pin is DATA pin & third pin is GND.



At first the VCC & GND pin is connected to Power pin(5v) & ground pin of the Arduino respectively. The DATA pin is connected to digital pin 2 of Arduino.

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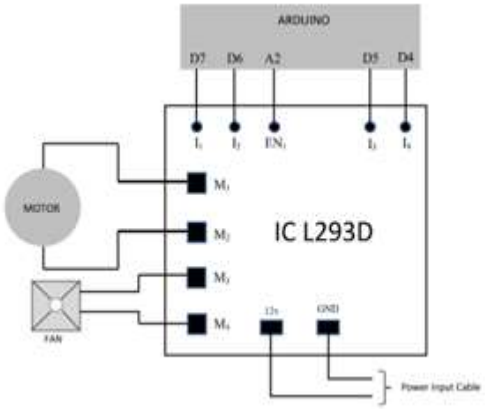


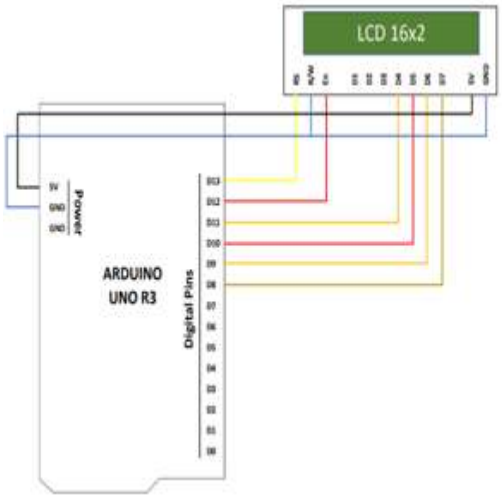
3. Motor Interfacing with Arduino using IC L293D

An L293D has 4 input pins, 4 output pins, 2 enable pins, Vss, Vcc and GND.Vccis the voltage that it needs for its internal operation. L293D will not use this voltage for driving the motor. For driving the motor, it has a separate provision to provide motor supply Vss.

Here we are using only one DC motor, hence the first two input pins of the IC are used. These are connected to any two digital pins of Arduino (here they are, 6&7). Two output pins M1 & M2 of L293D are connected to a gear motor and M3 & M4 are connected to a fan.E1 pin (Enable Pin) of L293D is then connected to analog pin-2 of Arduino. Input pins I1,I2,I3,I4 of L293D are connected to PWM pins 7, 6, 5, 4 of Arduino respectively.

4. LCD Display Interfacing with Arduino

The LCD module is use liquid crystal to print visible text on display.



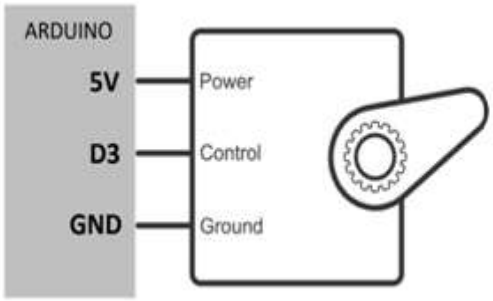
LCD pin 1 (GND) is connected to the ground pin of the Arduino. Pin 2 (Vcc) connect with 5V Vcc pin of Arduino.

RS pin & En pin are connected to digital pins 13 & 12 of Arduino respectively. R/W pin is connected to the ground pin of the Arduino.

LCD pins D4, D5, D6 & D7 are connected to digital pins 11, 10, 9 & 8 of Arduino respectively.

5. Micro Servo Motor Interfacing with Arduino

Servo motors are very easy to interface with Arduino because It have built-in motor controllers.



Servo motor has 3 pins namely power pin, control pin & ground pin.

Power and ground pin of servo is connected with 5V and GND pin of Arduino. Control pin is connected with digital pin-3 of Arduino Uno R3.

VI. WORKING PRINCIPLE

An incubator is based on the principle that microorganisms require a particular set of parameters for their growth and development.All incubators are based on the concept that when organisms are provided with the optimal condition of temperature, humidity, oxygen, and carbon dioxide levels, they grow and divide to form more organisms.

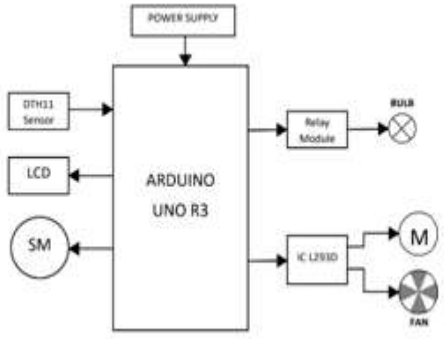


Figure: Block Diagram of Electric Egg Incubator

Before using the incubator, it should be made sure that no remaining items are present in the incubator from the previous cycles. The door of the incubator should be closed after the eggs are placed in the egg tray, and then the incubator is switched on. The incubator has to be heated up to the desired temperature for the growth of the particular organism.

When the supply is provided the bulb will glow and sensor gives the temperature and humidity details which is displayed on the LCD.

It takes 21 days to hatch chicken eggs. In order for chicks to develop properly, temperature and humidity should be monitored. First 18 days the range of relative humidity is 45-55%. Final 3 days 60-65%. The egg was turned in order for the embryo to sweep into fresh nutrients, allowing the embryo to develop. During the first 17 days, the temperature and humidity are monitored, adding water to the water reservoir as necessary to maintain the humidity. Changes in the embryo is observed in day7 and day 14. The final 3 days chicks have hatched and dried off. Day 21 is a hatch day where eggs will begin to rock around a bit as the chick "pips" the shell. Hatching will be slow process usually takes a full of 24 hours for chicks to complete the hatch. After making sure that the chicks are completely dry and fluffy, they can be taken out of the incubator.

VII. CONCLUSION

Looking back on this project, the overall outcome of results to be observed. This can be evaluated by looking at how well our objectives were met. The Hatching period of egg in the incubator will decreases exponentially.The rate of hatching of eggs will be higher than the normal or natural hatching rate. It can full fill the market demands on chicks by faster hatching system. Due to oscillating motion in the incubator which increase the healthy growth rate in the chicks.

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