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# Arduino Based Automated Sericulture System

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***Abstract – Sericulture is the science that deals with the production of silk by rearing of silkworm. Silk is called the queen of textiles due to its glittering luster, softness, elegance, durability, and tensile properties. Producing silk is a lengthy, complex process. Silkworm is one of the most important domesticated insects, which produces luxuriant silk thread in the form of cocoon by consuming mulberry leaves during larval period. The seasonal differences in the environmental components considerably affect output of silkworm crop such as cocoon weight, shell weight, and cocoon shell ratio. The variations in the environmental conditions day to day and season to season emphasize the need of management of temperature and relative humidity for sustainable cocoon production. Also the mulberry plantation, which is the only food for the silkworms, requires regular irrigation which is both time consuming and also requires the presence of farmer on land. The main objective of this project is to minimize manual intervention of the farmer, by automating the process of irrigation of mulberry plantation and also temperature monitoring and control of the Silkworm rearing unit. By using a Low cost micro-controller board (Arduino UNO).***

***Key words – Aurduino UNO Microcontroller Board, Sensors, Solenoid Valves, Driver Circuit & Relay Unit.***

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## I. INTRODUCTION

Sericulture is the science that deals with the production of silk by rearing of silkworm. Silk is called the queen of textiles due to its glittering luster, softness, elegance, durability, and tensile properties. Producing silk is a lengthy, complex process. Silkworm is one of the most important domesticated insects, which produces luxuriant silk thread in the form of cocoon by consuming mulberry leaves during larval period. The seasonal differences in the environmental components considerably affect output of silkworm crop such as cocoon weight, shell weight, and cocoon shell ratio. The variations in the environmental conditions day to day and season to season emphasize the need of management of temperature and relative humidity for sustainable cocoon production. Also the mulberry plantation, which is the only food for the silkworms, requires regular irrigation which is both time consuming and also requires the presence of farmer on land.

The motivation for this project came from the countries where economy is based on agriculture and the climatic conditions lead to lack of rains & scarcity of water. The farmers working in the farm lands are solely dependent on the rains and bore wells for irrigation of the land. Most of the farmers are small land holders and depend on other sources of income. Even if the farm land has a water-pump, manual intervention by farmers is required to turn the pump on/off whenever needed.

## II. BLOCK DIAGRAM

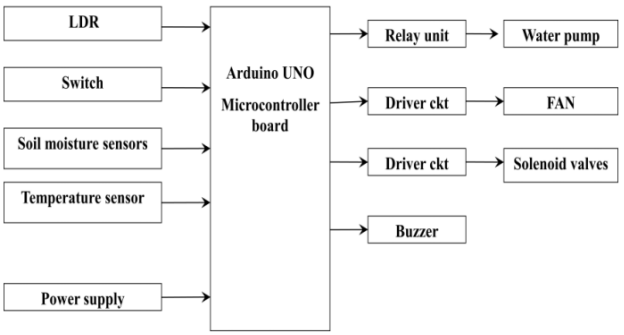


**Figure: Block Diagram of the project**

- **MICROCONTROLLER BOARD**

Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power

tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems. Some microcontrollers may use four-bit words and operate at clock rate frequencies as low as 4 kHz, for low power consumption (single-digit milliwatts or microwatts). They will generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just nanowatts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption.

- **SOIL MOISTURE SENSOR**

The Soil Moisture Sensor is used to measure the volumetric water content of soil. This makes it ideal for performing experiments in courses such as soil science, agricultural science, environmental science, horticulture, botany, and biology. Use the Soil Moisture Sensor to:

- Measure the loss of moisture over time due to evaporation and plant uptake.
- Evaluate optimum soil moisture contents for various species of plants.
- Monitor soil moisture content to control irrigation in greenhouses.

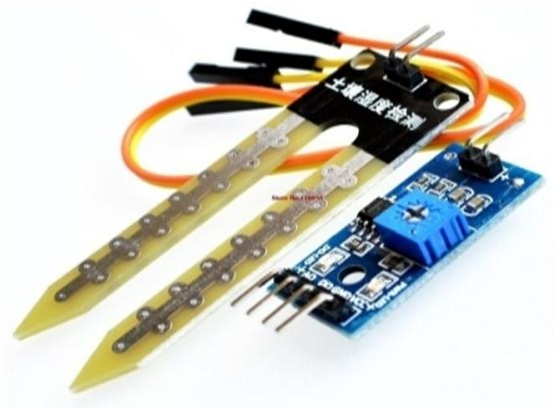

**Figure : Moisture Sensor**

- **LM35 TEMPERATURE SENSOR**

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device is rated to operate over a −55°C to 150°C temperature range, while the LM35C device is rated for a −40°C to 110°C range

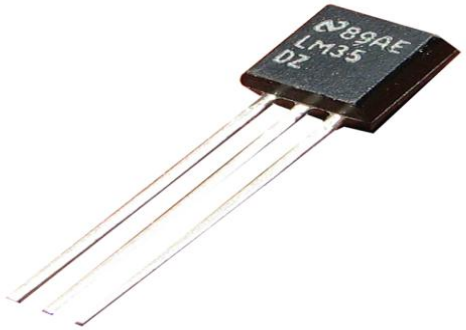


**Figure : Temperature Sensor**

A photoresistor (or light-dependent resistor, LDR, or photoconductivecell) is a light-controlled variable resistor. The resistance of a photoresistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity.

**Figure : Photo Resistor**

A photo resistor is made of a high resistance semiconductor. In the dark, a photo resistor can have a resistance as high as several megohms (MΩ), while in the light, a photo resistor can have a resistance as low as a few hundred ohms. If incident light on a photo resistor exceeds a certain frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electrons (and their hole partners) conduct electricity, thereby lowering resistance. The resistance range and sensitivity of a photoresistor can substantially differ among dissimilar devices. Moreover, unique photoresistors may react substantially differently to photons within certain wavelength bands.

A relay is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current. The heart of a relay is an electromagnet (a coil of wire that becomes a temporary magnet when electricity flows through it). You can think of a relay as a kind of electric lever: switch it on with a tiny current and it switches on ("leverages") another

appliance using a much bigger current. Why is that useful? As the name suggests, many sensors are incredibly sensitive pieces of electronic equipment and produce only small electric currents. But often we need them to drive bigger pieces of apparatus that use bigger currents. Relays bridge the gap, making it possible for small currents to activate larger ones. That means relays can work either as switches (turning things on and off) or as amplifiers (converting small currents into larger ones).


**Figure : Relay Module**

- **SOLENOID VALVES**

Direct operated (direct acting) solenoid valves have the most simple working principle. The medium flows through a small orifice which can be closed off by a plunger with a rubber gasket on the bottom. A small spring holds the plunger down to close the valve. The plunger is made of a ferromagnetic material. An electric coil is positioned around the plunger. As soon as the coil is electrical energized, a magnetic field is created which pulls the plunger up towards the centre of the coil. This opens the orifice so that the medium can flow through. This is called a Normally Closed (NC) valve. A Normally Open (NO) valve works the opposite way: it has a different construction so that the orifice is open when the solenoid is not powered. When the solenoid is actuated, the orifice will be closed. The maximum operating pressure and the flow rate are directly related to the orifice diameter and the magnetic force of the solenoid valve. This principle is therefore used for relatively small flow rates. Direct operated solenoid valves require no minimum operating pressure or pressure difference, so they can be used from 0 bar up to the maximum allowable pressure. The displayed solenoid valve is a direct operated, normally closed 2/2 way valve.

**Piezo buzzer** is an electronic device commonly used to produce sound. Light weight, simple construction and low price make it usable in various applications like car/truck reversing indicator, computers, call bells etc. Piezo buzzer is based on the inverse principle of piezo electricity discovered in 1880 by Jacques and Pierre Curie. It is the phenomena of generating electricity when mechanical pressure is applied to certain materials and the vice versa is also true. Such materials are called piezo electric materials.

**Figure : Buzzer**

## III. IMPLEMENTATION

The implementation of this project mainly requires development of the hardware using sensors microcontroller and actuators and then programming it to achieve the desired result. For the sake of simplicity we will divide the entire implementation of the project into different modules.

### 1. Control Conditions.

These are the conditions based on which the whole system operates. The conditions are based on two sensor readings, the switch and the LDR. Depending on the sensor output, whether high or low four conditions arise.

Switch 0, LDR 0. System Idle, the system does not perform any action, it enters a loop and waits for one or both the conditions to become true.

Switch 0, LDR 1. Irrigation function. The LDR input high indicates that the AC power is available and hence the system performs Irrigation function.

Switch 1, LDR 0. Temperature function. The switch input high indicates that it has been turned on and the system has to perform temperature control operation, but as the LDR reads low, the system cannot control the temperature hence an alarm is raised by turning on the buzzer.

Switch 1, LDR 1. Both temperature and Irrigation function are performed.

**2. Irrigation function.**

The Irrigation function is carried out by reading the soil moisture sensor inputs, the microcontroller then compares the readings with the predefined values. Based on the predefined conditions it then decides whether to turn on the water pump or not and which of the two solenoid valves is to be turned on.

**3. Temperature function.**

To monitor the temperature of the room, The system uses a temperature sensor LM35, the sensor output is given to the microcontroller. The microcontroller compares it with the predefined values and then turns on the fan or a heater.

## IV. SOFTWARE REQUIREMENTS

The project uses Arduino IDE as software to program microcontroller. The program is written in Arduino IDE and compiled and fed into the microcontroller. The following steps are involved into programming a microcontroller using Arduino IDE.

Before you can start doing anything with the Arduino, you need to download and install the Arduino IDE (integrated development environment). From this point on we will be referring to the Arduino IDE as the Arduino Programmer.

The Arduino Programmer is based on the Processing IDE and uses a variation of the C and C++ programming languages

## V. ADVANTAGES

- Reduced labour.
- Reduced monitoring.
- Maximized output with low input cost in the long run.
- More effective and efficient than manual work.
- Allows seri culturist to expand area of cultivation.
- Not affected by power cuts.

## CONCLUSION

This system avoids over irrigation, under irrigation, top soil erosion and reduce the wastage of water & the system's action can be changed according to the situation (crops, weather conditions, soil etc.). This system also monitors and controls the temperature of the silkworm rearing room continuously, within the fixed temperature range hence improving the yield.

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