# ARDUINO based Approach to Provide Optimum Conditions for Indoor Cultivation

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***Abstract*::-** This work describes a framework to provide an optimum environment for indoor cultivation. The optimum conditions like temperature, soil moisture and solar radiation can be controlled by using an ARDUINO microcontroller. The system is basically aclosed loop system where the gathered data from the sensors (say measure data) will be compared with the user data(which is set by user and can be incremented or decremented through switches). If both the data i.e., user data and measured data are same, then the controllers will not execute. The controllers will execute the control action only if the user data and measured data have different readings so that these controllers can adjust for optimum environment (temperature, soil moisture and solar radiation). An LCD is provided to display both the readings. The indoor cultivation system consists of both hardware and software. Hardware includes microcontroller, temperature sensor(LM35), soil moisture sensor, an LDR sensor, anLCD, a relay, a halogen light, a water pump, solar radiation controller,a fan and switches. Software includes ARDUINO IDE.

***Keywords::-*** *ARDUINO microcontroller, ARDUINO IDE,Indoor Cultivation, LM35, an LDR, Soil Moisture Sensor.*

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## I. Introduction

India is a country where catastrophic events occur at random. The catastrophic events like heavy rain, heavy landslide, heavy flood, drought and acid rain creates imbalance in the ecosystem thereby causing the destruction of crops. These events create adverse impact on human's life as humans are totally dependent on crops for food. Also, farming is the only occupation for a farmer i.e., a farmer is totally dependent on agriculture. If a farmer's life is adversely affected by any of these catastrophic events (flood, rain, drought), it can create unemployability which is also a major crisis in India.

Considering the adverse effects of catastrophic events, we have developed a system known as Indoor Cultivation System. The primary factors that can be controlled for indoor cultivation to provide optimum environment are temperature, soil moisture and solar radiation [1][2]. In this work, temperature is controlled by temperature sensor using LM35, soil moisture is controlled by soil moisture sensor and solar radiation is controlled by solar radiation sensor using anLDR. Similar work related to temperature control investigated the use of heating, ventilation and air conditioning (HVAC) system to control room, space or building [3][4][5]. An ARDUINO based approach is a method to reproduce and execute a smart way of human's knowledge to control a system. Using this approachcomplex system can be handled efficiently [2][3][4][5].An ARDUINO is a microcontroller that can be applied in many controllers, one of which is ventilation controller that mainly aims to improve the energy consumption and comfort conditions with respect to cooling, dehumidification and air quality [4]. Earlier research that has been done in this area involved wireless systems and computer based systems and the major drawbacks of these systems were complexity and expensiveness.

The purpose of using an ARDUINO is that it does not require any external circuitry thereby reducing the system complexity [6]. Also, its programming is easy. This framework is nothing but a small initiative towards a huge upcoming success in the agriculture science.

## II. Design

An ARDUINO based approach for controlling temperature, soil moisture and solar radiation is designed using both hardware and software. The block diagram for controlling optimum conditions is shown in Fig 1.

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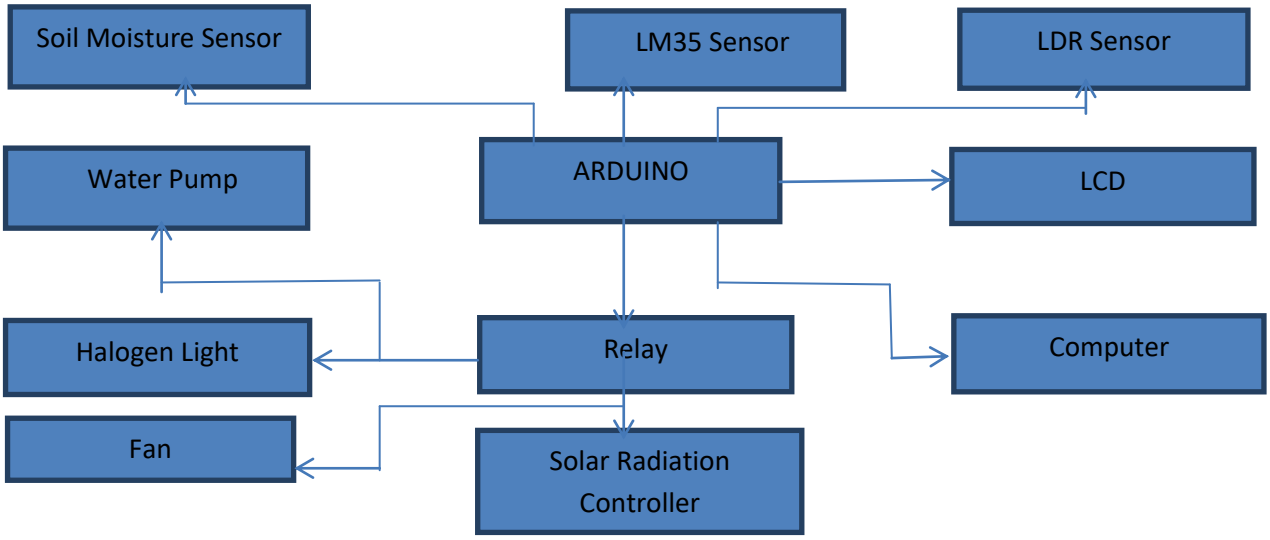


**Fig 1: Block Diagram for Indoor Cultivation System**

Practical setup of automatic control system to provide optimum environment for indoor cultivation is shown in Fig 2.

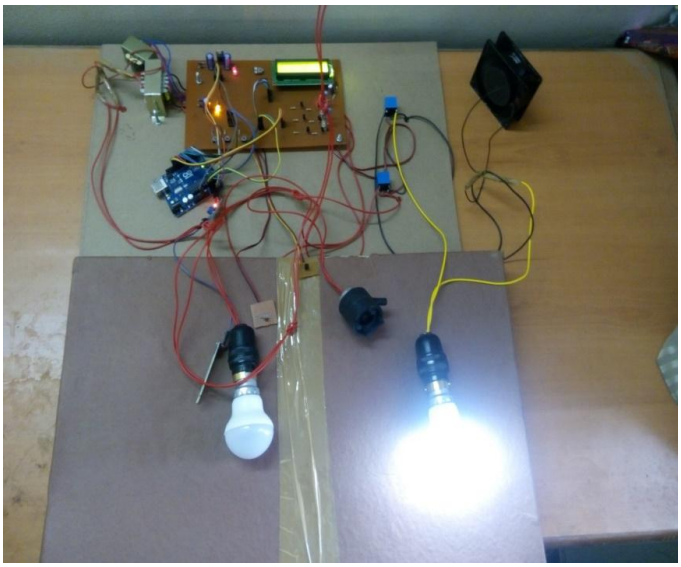

**Fig 2: Automatic control system for indoor cultivation**

The description of sensors and software is given below:

**ARDUINO:** ARDUINO is a microcontroller which has 14 digital input/output pins, 6 analog inputs, a 16MHz crystal, an ICSP header, a reset and a power jack and it is based on ATmega328P. ARDUINO can be simply connected to a computer using a USB cable or it can take power with a AC-to-DC adapter or battery to get started.

**Temperature Sensor:** Here, we have used LM35 as temperature sensor.The temperature on which it is operated ranges from -55 ℃ to 150 ℃. Any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°Cis not required in LM35. LM35 uses a scale factor of 0.1 V/ ℃. The accuracy maintained in LM35 is +/-0.4 ℃ at room temperature and +/- 0.8 ℃ over a range of 0 ℃ to +100 ℃.

**Soil Moisture Sensor:** To measure the volumetric water content of the soil, soil moisture sensor is used. It has volumetric water content present in the soil which ranges from 0-45%. It has typical accuracy of ±4%. Its operating temperature ranges from -40 ℃ to 60 ℃. Moisture sensor reads value greater than the user value when soil moisture is low.

**Solar Radiation Sensor:** In this project, LDR (Light Dependent Register) is used as solar radiation sensor.Typical value of resistance ranges from 1.8 kΩ to 4.5 kΩ. Maximum power dissipation is 200mW.

**ARDUINO IDE:** It is an open source software and a good platform to write code easily on it. It supports operating system like Windows, Mac OS X and Linux. The programming languages supported by ARDUINO IDE are C, C++ and Java. The Window in which program is written is shown in Fig 3.

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**Fig 3: Programming Window**

**Steps:**

The working of indoor cultivation is categorized in three steps. These steps include:

1. **Sensor Stage:**

At sensor stage temperature sensor (LM350), soil moisture sensor and solar radiationsensor (an LDR) sense the data individually.

2. **Controller Stage:**

ARDUINO is used to provide proper environment condition which takes decision based on acquired data from sensors.

3. **Actuators:**

Motor drivers and relays are used as actuators to control the parameters (temperature, solar radiation and moisture).

## III. Result

In this project, data for temperature, soil moisture and solar radiation is acquired by sensors. ARDUINO takes decision by comparing the sensor's readings with user input readings individually and the controllers will execute the control action automatically thereby adjusting the optimum conditions. The output for different conditions is listed in Table 1.

| Optimum Conditions | Measurements | Conditions | | | |
|---|---|---|---|---|---|
| | | Fan | Halogen Light | Water Pump | Solar Radiation Controller |
| Temperature | Sensor reading = Set point | Off | Off | N/A | N/A |
| | Sensor reading > Set point | On | Off | N/A | N/A |
| | Sensor reading < Set point | Off | On | N/A | N/A |
| Moisture | Sensor reading = Set point | N/A | N/A | Off | N/A |
| | Sensor reading>Set point | N/A | N/A | On | N/A |
| Solar Radiation | Sensor reading = Set point | N/A | N/A | N/A | Off |
| | Sensor reading < Set point | N/A | N/A | N/A | ON |

**Table 1: Table Showing Conditions According to Measurements**

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The output of ARDUINO IDE is shown in Fig 4.

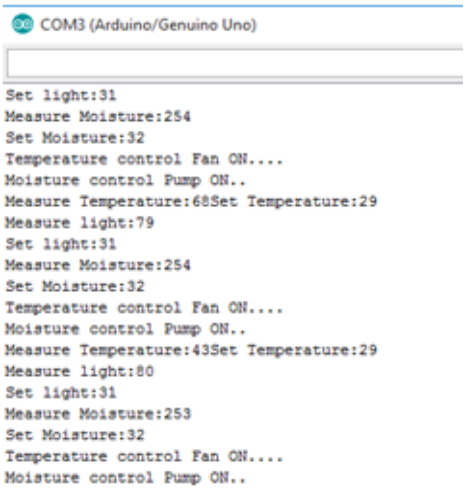


**Fig 4: ARDUINO IDE Output**

## IV. Conclusion and Future Work

The automatic control system to provide optimum environment for indoor cultivation is initially developed and experimented using ARDUINO based approach. For proposed system, the experimental result shows that this approach provides accuracy and precision & if this system is usedinside a room, it will be safe from catastrophic events (heavy rain, floods, landslides etc.).

In future enhancements, we can use neural networks to provide optimum conditions for indoor cultivationto add artificial intelligence and to get better efficiency and accuracy.

## References:

[1] Niamul Hassan, ShihabIbne Abdullah, Ahmad Shams Noor, MarziaAlam, “An Automatic Monitoring and Control System Inside Greenhouse”, 3rd International Conference on Green Energy and Technology (ICGET), 2015.

[2] Pringgo W. Laksono, Wakhid A. Jauhari, IrwanIftadi, “A system based on fuzzy logic approach to control humidity and temperature in fungus cultivation”, Joint International Conference on Electric Vehicular Technology and Industrial, Mechanical, Electrical and Chemical Engineering (ICEVT & IMECE), pp 344-347, 2015.

[3] J. Singh, N. Singh and J.K. Sharma, “Fuzzy Modelling and Control; of HVAC systems-A Review”, Journal of Scientific & Industrial Research, Vol 65, pp 470-476, 2006.

[4] B.S.K.K. Ibrahim, N. Aziah.M.A, S. Ahmad, R. Akmeliawati, Nizam, H.M.I, A.G.A. Muthalif, S.F. Toha and M.K. Hassan, ” Fuzzy-based Temperature and Humidity Control for HVAC of Electric Vehicle”, Procedia Engineering 41, pp 904 – 910, 2012.

[5] M.M Gouda, ”Fuzzy Ventilation Control for Zone Temperature and Relative Humidity”, American Control Conference, pp 507-512 ,2005.

[6] S. V. Devika, Sk. Khamuruddeen, Sk. Khamurunnisa, JayanthThota, KhaleshaShaik, “Arduino Based Automatic Plant Watering System”, International Journal of Advanced Research in Computer Science and Software Engineering, pp. 449-456, 2014.