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AUTOMATIC SYSTEM FOR FACILITATING PLANT GROWTH BY CONTROLLING VARIOUS PARAMETERS

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Abstract - *Plants are an integral part of our environment but ecological circumstances are not always compatible to facilitate their growth. Moreover, major scientific advancement in the fields of medicine sciences and biology involve conducting experiments in control atmosphere in which parameters like humidity, temperature and soil moisture content are controlled. This project aims to develop prototype of a device that simulates the ideal conditions necessary for plant growth or seed germination that can be control manually by feeding the required value of temperature, humidity content, soil moisture into the microcontroller, in turn connected an analog to digital converter fed by humidity sensor, soil moisture sensor.*

Key Words: **Humidity, Moisture, Microcontroller (AT89S52) Temperature Sensor (LM35), Humidity sensor (HS1011), ADC (0804), Power supply circuit, Display circuit,**

1.INTRODUCTION

Plant failure happens due to adverse weather conditions .Deadly heat waves, flooding rains, increase in moisture content and several other parameters are responsible for making it difficult for a plant to survive. Such conditions are infeasible for the survival of indigenous plant species, thriving in a fragile ecosystem. It is necessary to preserve these species through tissue culture, or other modern techniques to provide them an environment conducive for their growth.

The devices available for this purpose are costly with prices starting from tens of thousands of rupees for a basic model. Such high prices usually cannot be afforded by farmers with small to mid-size income or even budding schools or research facilities with limited funds.

Thus, we aim to develop prototype of a device, having simple circuitry, which can be purchased at a low cost or made from scratch by oneself. This device can not only be used for facilitating seed germination but also for tissue culture and studying the physiological effect of parameters like temperature, humidity and soil moisture content on plant growth. Also, this device can be used in poultry industry for egg incubation with little modification.

1.1 Block Diagram

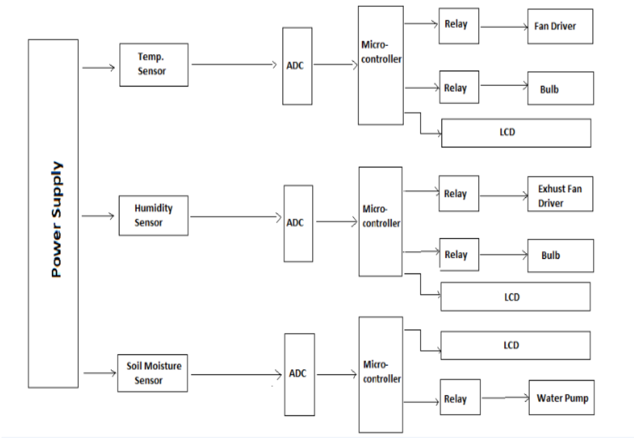

Fig-1: Block diagram of device

The setup consisted of sensors (humidity, temperature and moisture), microcontrollers AT89S52, ADC's (0804), an incandescent bulb, a fan, a water pump and LCD screen attached to each of the sensing circuits. The temperature sensor (LM35), humidity sensor (HS1011F) and soil moisture sensor sense the analog value of current temperature, humidity and soil moisture inside the chamber respectively. These analog values are fed to the ADC (0804),where they are converted to digital values. These digital values in turn are fed to the microcontroller (AT89S52) which has display circuit that is, the LCD screen and relays connected to it. The LCD screen not only displays the current value of parameters but also allows user to set the desired value of each parameter by incrementing and decrementing those values or even reset the system. The relay for temperature sensing circuit has a fan and a bulb connected to it for controlling temperature changes while soil moisture circuit has a water pump connected to it for controlling soil moisture.

2. PROPOSED APPROACH AND EXPERIMENTAL SETUP

The circuit consists of three circuits used for sensing and controlling the following parameters:

- Temperature sensing circuit
- Humidity sensing circuit
- Soil moisture sensing circuit

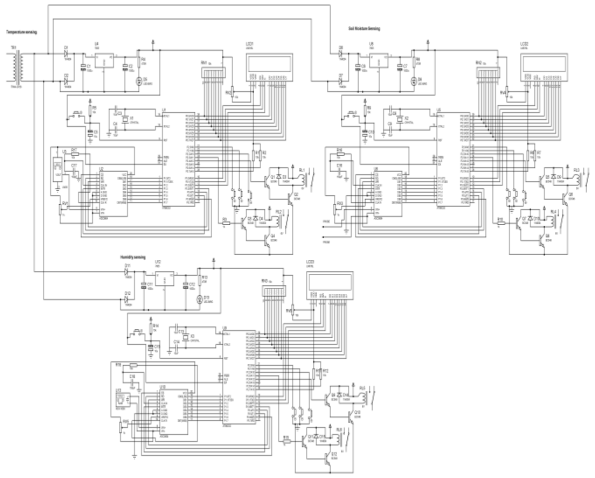

Fig- 2: Complete circuit diagram of the prototype

The setup consists of four circuits for measuring each of three parameters i.e. humidity, temperature and soil moisture content. They are power supply circuit, sensing circuit, processing circuit and display circuit.

2.1 Power Supply Circuit

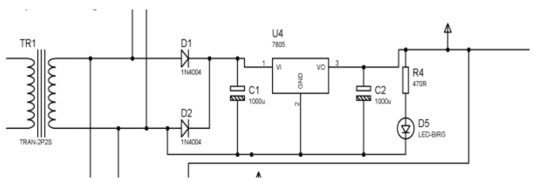

Fig-3: Power supply circuit

The power supply circuit consisting of a 220V AC to 5 V AC transformer, center tapped rectifier for converting 5V AC voltage to 5V DC .This is followed by a 220µF capacitor connected in parallel to a voltage regulator (7805) .A 1000µF capacitor is used to prevent debouncing effect i.e. sudden spikes in voltage upon switching various components on from off state.

2.1 Sensing Circuit

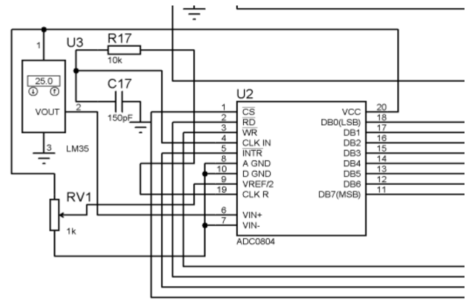

Fig-4: Sensing circuit consisting of ADC (0804) and sensors

It consists of three sensors namely humidity sensor, temperature sensor (LM35) and soil moisture sensor which consists of two conducting rods to measure conductivity of soil depending upon its moisture content and ADC (0804). All the sensors are connected to 3 separate ADC's with their input at its port 6. The reference voltage (Vref) to ADC is provided through a variable potentiometer at port 9. The sensors read the analog value to the three parameters and feed it to the ADC which converts it into digital based on ,if the input value is greater than reference voltage it stands for one else zero.

2.3 Processing Circuit

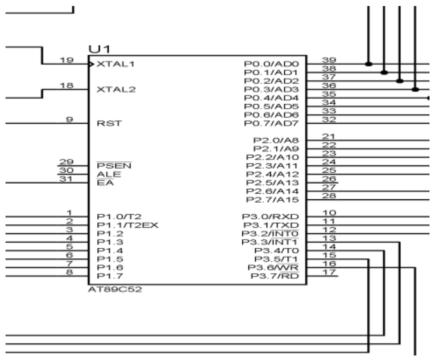

Fig-5: Processing circuit consisting of microcontroller

It consists of three separate microcontrollers (AT89S52) for each sensing circuit. A bulb and fan are connected by means of a relay to the microcontroller for temperature sensing circuit while a pump is connected to soil moisture sensing circuit.

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2.4 Display Circuit

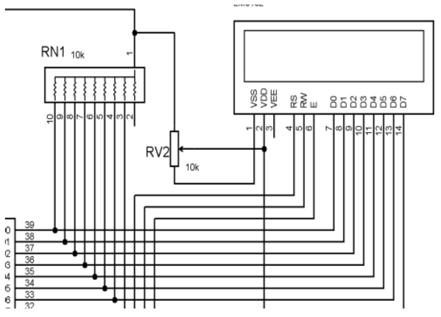

Fig-6: Display circuit consisting of LCD and a variable resistor

It consists of a Liquid Crystal Display (LCD) screen whose data input lines D7 to D14 are connected to port 32 to port 39 of microcontroller through a nine pin variable resistor. The sensed digital values are displayed on the LCD screen whose brightness is controlled through a potentiometer.

3. SENSING CIRCUITS

The prototype consists of three sensing circuits namely temperature sensing circuit, humidity sensing circuit and soil moisture sensing circuit.

3. 1 Temperature Sensing circuit

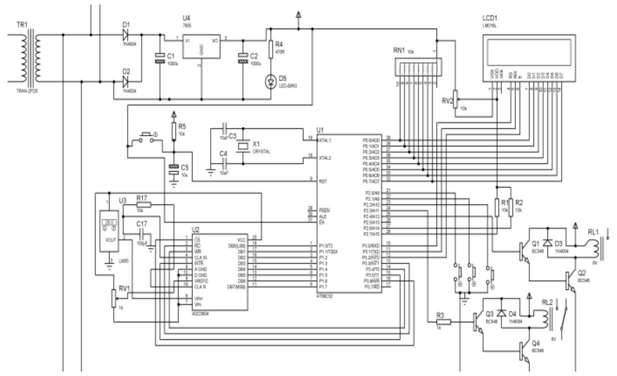

Fig-7: Temperature sensing circuit

The temperature sensor LM35 is connected to ADC at its port 6. The sensor reads the analog value of temperature and feeds it to ADC which converts it to digital based on ,if the input value is greater than reference voltage it stands for one else zero. This value is then fed into the microcontroller where if temperature inside the chamber is less than required then bulb will be turned on while for a temperature higher than that required, the fan will be switched on to expel the hot air.

To control the photoperiod the chamber is fitted a bulb that can be switched on for the required period of time to provide light for photosynthesis.

3.2 Humidity sensing circuit

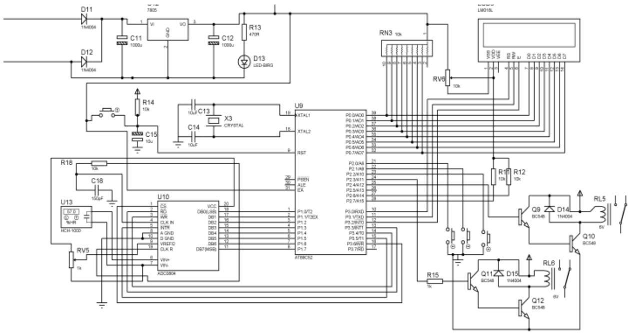

Fig-8: Humidity sensing circuit

The humidity sensor HS1011F is connected to ADC at its port 6.The sensor reads the analog value of humidity and feeds it to ADC which converts it to digital based on ,if the input value is greater than reference voltage it stands for one else zero. This value is then fed into the microcontroller of processing circuit. Temperature and humidity being two interrelated factors dependent on each other that is when temperature decreases humidity increases and vice versa. Therefore, humidity is controlled by the same mechanism as temperature.

Soil Moisture Sensing Circuit

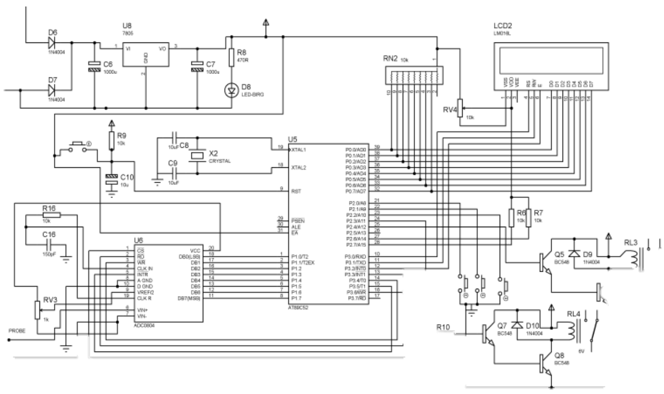

Fig-9: Soil moisture sensing circuit

The soil moisture sensor consists of two conducting rods to measure conductivity of soil depending upon its moisture content.When the soil moisture content is high the current flowing through it increases while it decreases when soil moisture decreases. The sensor reads the analog value of soil moisture and feeds it to ADC which converts it to digital based on ,if the input value is greater than reference voltage it stands for one else zero. This value fed into the microcontroller is compared to the threshold value entered by the user. If the value of soil moisture is less than that entered by the user water pump turns on.

4. REALISTIC CONSTRAINTS

The user must not try to control various parameters beyond the working range of the sensors. Feasible to use this device for a set value of various parameter, as using variable values will require them to be reset again in case of power loss. Moreover, this device cannot be used for studies involving decrementing temperatures to freezing point or refrigeration. Furthermore, in-order to use it for egg incubation the soil moisture circuit may be removed as it stands redundant. To implement this model on a larger scale as in case of a walk- in chamber will require exhaust fans of greater rpm. Moreover, bulbs will need to be replaced by halogens. Also an advanced microcontroller will need to be used.

Table-1: Realistic constraints of the device

Area	Codes& Standard/ realistic Constrains
Economic	None as the project is a stimulation using microcontrollerAT89S52
Environmental	This project is not expected to entail any particular environmental consequences
Efficiency	This project aims for efficiently controlling the various parameters for good growth of a plant
Health and Safety	This project is not expected to entail any health and safety constrains

5. RESULTS AND DISCUSSIONS

It allows the user to input increment or decrement the desired values of temperature, humidity and soil moisture content. According to these values the temperature and its interrelated factor humidity are controlled by the microcontroller. Whenever, the chamber temperature exceeds desired value the exhaust fan switches on, sucking the warm air out. Meanwhile, if the temperature decreases the bulb inside the chamber switches on to increase the temperature to input level.

Soil moisture sensor, consists of two conducting rods to measure conductivity of soil depending upon its moisture content. Whenever, the soil moisture is below required level a pump begins to pump water into the pot.

The level of humidity, temperature and soil moisture can be monitored constantly on the LCD screen. Furthermore, temperature sensor LM35 was used because it does not get oxidized easily and can stand high temperatures. Incandescent bulb was used in the experiment because it was observed that the growth of the plant was more using it than fluorescent bulb. The following table explains it:

Table -2: Plant growth under different light conditions

Week	Fluorescent Bulb	Incandescent Bulb	Sunlight
Week 1	3.4 cm	3.4 cm	3.4 cm
Week 2	4.2 cm	4.8 cm	6.5 cm
Week 3	5 cm	7.2 cm	10.5 cm

AT89S52 has following advantages over other microcontrollers:

Table -3: Advantages of AT8952 over AT89S51

	AT89S52	AT89S51
Number of I/O pins	32	32
Number of Timers	3(16 bit)	2(16 bit)
RAM	256 bytes	128 bytes
Flash memory	8 Kbytes	4 Kbytes

6. CONCLUSION

With the ever changing weather patterns indigenous plant survival cannot be left to natural selection. Therefore, steps have to be taken and techniques need to be developed to protect them. This can be done by seed preservation, seed germination, or conducting research to develop hybrid seed varieties. All these require the use of a device that can approximate near ideal conditions or allows the researchers at all levels to study the effect of parameters like temperature, humidity and light intensities on various strains leading to the development of better varieties. Thus, with this project we have aimed to develop a device that fulfills the above functionality.

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