

Controlled Environment for Accelerated Photosynthesis using Embedded System

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Abstract— To increase crop yield in a global scale, the rate of growth of plants is required to be increased so that the market demand is met by the crop yield. If such a situation is achieved, poverty and hunger can be easily eliminated as a result of abundance of food and low cost of procurement. On analysis, it is found that this can be passively achieved by controlling the vital parameters involved in photosynthesis such as temperature, sunlight intensity and CO₂ concentration. The proposed scheme can be controlled by arduino microcontroller and it is programmed in arduino1.5 version.

Key words: Photosynthesis, Embedded System

I. INTRODUCTION

Modern agribusiness is becoming increasingly reliant on computer-based systems which were formerly performed by humans. One such technological innovation is the embedded system-based sensor array module such as temperature sensor, and mq135 sensor that have been used to monitor the growth characteristics. The greatest advantage of this method is that it helps the farmers to yield more percentage of crops in small area.

II. BASIC DIAGRAM

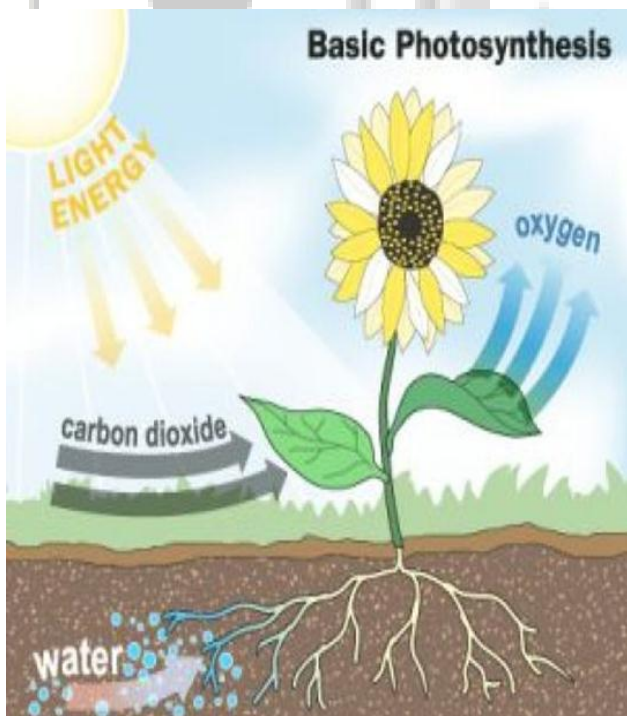


Fig. 1: Basic Diagram

A. Equation: Sunlight



III. BLOCK DIAGRAM

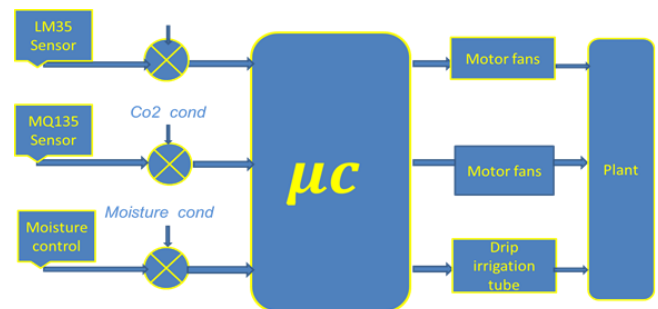


Fig. 2: Block Diagram

LM35 sensor is used to sense the temperature of the controlled environment. Depend upon the temperature, the motor fans supposed to be rotate in either clockwise or anticlockwise direction.

Mq135 sensor is used to sense carbon-di-oxide gases. Normally we are proposed to rotate the motor fans at very low speed. So that the carbon-di-oxide present in the atmospheric air entered in to controlled environment to increase CO₂ content in the controlled environment.

The condition of temperature, carbon-di-oxide is given in PC and it is deployed in microcontroller.

Depending on the sensor signal, the motor fans works according to the condition deployed in the microcontroller board.

IV. METHODOLOGY

A. Setup:

The controlled environment is a closed transparent cubicle with 4 brushless motor fans attached to the 4 sides of the cubicle. We plan to use 1'x1' – 3mm tempered plexi-glass sheets to make the same because of its rigidity, strength and transparency.

B. Temperature Control:

An optimum temperature ranging from 25°C to 35°C is required for a good rate. At temperatures around 0°C the enzymes stop working and at very high temperatures the enzymes are denatured. Since both the stages of photosynthesis require enzyme activity, the temperature has an affect on the rate of photosynthesis. So to maintain the temperature between 25 to 35 degree Celsius, we are planned to use temperature sensor.

Since the foliage of the plants is where various processes like transpiration, absorption of carbon dioxide etc. take place, oscillation of air around it can create better conditions of temperature and humidity. It has been observed that using a motor fan helps mixing of the warm and cool air, reduces humidity around the plants and keeps the stomata open. An additional benefit is the high carbon di

oxide content of the new air. Oscillating air also helps in pest control. A number of garden pests become uncomfortable under the high breeze of the fans and find it difficult to breed in such hostile conditions.

The LM35 series used widely for remote application is a precision integrated circuit temperature sensor, whose output voltage is linearly proportional to the Celsius (centigrade) temperature. LM35's control circuitry and interfacing to readout are made easy as it can be used either in single power supplies or with plus and minus supplies and also through low output impedance, linear output, and precise inherent calibration. It has very low self-heating, less than 0.1 c in still air as it draws only 60 microamps from its supply. So the temperature will be sensed using a LM35 temperature sensor.

The temperature will be controlled by venting out the hot air/ pumping in cold air using 4 brushless motor fans mounted on the walls of the cubicle. The speed of the fans will be controlled using Pulse Width Modulation technique.

Depending upon the temperature the motor fans should runs. If the Temperature is less, then the motor fans should run in reverse direction such that the air present in the atmosphere enters in to controlled environment. If the temperature is high, the motor fans should runs in forward direction such that the air which is present inside the controlled environment is vent out.

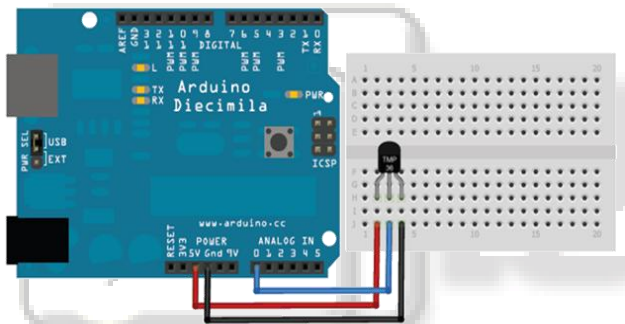


Fig. 3: LM35 Temperature Sensor

C. CO₂ Concentration:

In the atmosphere, the concentration of carbon dioxide ranges from .03 to .04 %. However, it is found that 0.1% of carbon dioxide in the atmosphere increases the rate of photosynthesis significantly. To increase atleast .01%, motor fans be supposed to runs at minimum speed. The CO₂ concentration will be measured using MQ135 gas sensor.

Based on the CO₂ concentration, the rate of venting of inside air by the fans will be adjusted. To sense the carbon di oxide concentration, CO₂ sensor is supposed to be used.

It is an air quality sensor suitable for detecting of nh3, alcohol, benzene and other gases .Analog output with increasing concentration, the higher the concentration ,the higher voltage. It's Operating in DC at 5V .The mqseries of gas sensor use a small heater inside with electro chemical sensor .they are sensitive for a range of gases and are used indoor at room temperature. The output is the analog signal can be read with an analog input of the arduino. The CO₂ concentration will be measured using MQ135 gas sensor.

Based on the CO₂ concentration, the rate of venting of inside air by the fans will be adjusted.

If concentration of carbon-di-oxide is very less, then the motor fans supposed to be rotate at high speed as compared to normal speed.

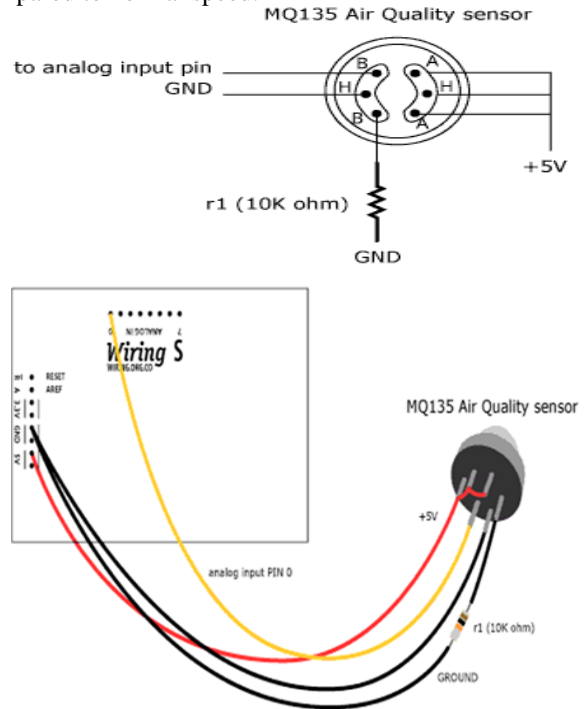


Fig. 4: Air Quality Sensor

D. Sunlight Intensity:

Low light intensity lowers the rate of photosynthesis. As the intensity is increased the rate also increases. However, after reaching an intensity of 10,000 lux (lux is the unit for measuring light intensity) there is no effect on the rate. Very high intensity may, in fact, slow down the rate as it bleaches the chlorophyll. Normal sunlight (usually with an intensity of about 100,000 lux) is quite sufficient for a normal rate of photosynthesis

Most plants use photosynthesis to convert carbon dioxides into organic compounds. Different plants require different levels of direct or indirect sunlight, so, under too much non-transparent cover, they will wither and die. To avoid these we are supposed to be use acrylic transparent glass which is strength and brittle in nature

V. WHOLE SETUP

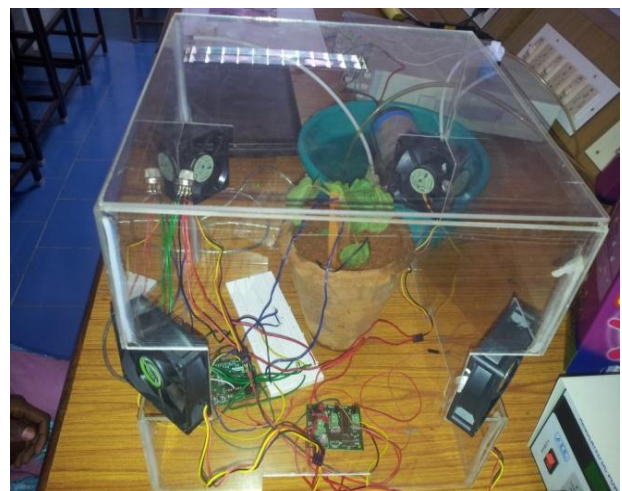


Fig. 5: Whole Setup

VI. INTERFACING

The sensors and Final Control Elements will be interfaced with the microcontroller which is ATMEGA 328 arduino microcontroller board .it is programmed using arduino integral development environment.

VII. CONCLUSION

Today technology occupies an integral position in the agricultural field. Agriculture is considered as the backbone of India which enhances the country's economy by increasing the yield. So the integration of computer technology with agricultural sector is the need of the hour. Here, to monitor the plant growth characteristics using embedded system, a sensor array module with array of sensors such as mq135 sensor and temperature sensor was used. Implementing this concept can considerably help farmers to estimate the final outcome by screening the growth rate and taking preventive measures at the early stage.

REFERENCE

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