Microcontroller and Embedded Systems (ECE3031)
Professor Sumit Kumar Jindal
Slot A1

Project: ARTMOS
(Artificial Atmosphere)

Project Members:

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ABSTRACT

Gardening is one of the popular hobbies among the people in the midst of busy work culture and urban life style. Gardening seems to release the stress, healthy spending of the leisure time effectively. But the apartment living has no free space for gardening. As a result, small scale greenhouse is now the hottest trend in the century. Greenhouse is a structure that the user used to grow the plants. It is built with a specific need for the type of plant they wish to grow. So the structure varies depending on type of plant and scale of size. Although it creates a perfect environment for plants, it needs human care to control the optimum status of the house such as ventilation. Automated greenhouse is to ease people when they wish to grow plants. It helps to monitor the situation, when they are not at home. The main aim of this project is to minimize the human care needed for the plant by automating the green house and monitor the in-house environment status. A single unit of the greenhouse structure prototype has been constructed and integrated with the sensors. The control system is designed with Atmel AT89S52 (8051) microcontroller.. A 12 volt fan is also installed and turns ON when the temperature is too high.

WORKFLOW

- Gather Idea about the sensors and actuators to use.
- Selection of crop
- Create an algorithm for sensing various environmental conditions and actuating controls
- Coding in microcontroller 8051 and attaching various sensors and other peripherals
- Designing the layout of the artificial habitat
- Data Acquisition, Visualisation and analytics of crop data

LITERATURE SURVEY

History of Greenhouse:

Greenhouse structures adapted in the 1960s when wider sheets of polyethylene film became widely available. Hoop houses were made by several companies and were also frequently made by the growers themselves. Constructed of aluminium extrusions, special galvanized steel tubing, or even just lengths of steel or PVC water pipe, construction costs were greatly reduced. This resulted in many more greenhouses being constructed on smaller farms and garden centers. Polyethylene film durability increased greatly when more effective UV-inhibitors were developed and added in the 1970s; these extended the usable life of the film from one or two years up to 3 and eventually 4 or more years.

For a very long time agriculture in Kenya has been one of the major economic activities. Recent developments in this sector have seen the rise and rapid growth of revolutionary and disruptive technologies. These include land reclamation practices such as irrigation, afforestation and reafforestation. Others are research and development in disease and pest resistant crops, agricultural mechanization, animal cross-breeding and animal husbandry, among others. The most recent of these technologies, and which is quickly gaining popularity in the country, is greenhouse farming and greenhouse technology. Most importantly, and which has attracted utmost interest from many stakeholders in the agricultural sector is greenhouse automation. So far, there have been many successes in realizing affordable automation of irrigation and fertigation, and only recently has there been keen interest in automating temperature and humidity control. This has been evidenced by several projects in the country that have gained significant mileage in this endeavor, with the key selling points in mind being affordability, efficiency and convenience. Greenhouse farming is arguably the fastest-growing agricultural technology in the country. This is as a result of the many potential benefits that come with it. However, this does not mean that the technology does not have its own shortfalls like there’s not sufficient skill and knowledge required to manage a successful greenhouse business. Secondly, it is expensive. From soil testing and lot surveying, to installation, to water and drainage setup, to preparation, to training and regular management, to both human and monetary capital, the investment is huge. Thankfully, many of the companies involved in greenhouse technology and agri-business have over the years made commendable efforts to avail this technology easily and affordably. This has been evidenced by the successful introduction of revolutionary irrigation systems that are not only simple and adaptable to both open and greenhouse settings, but also quite affordable. Greenhouse farming, however, goes beyond efficient labour and irrigation systems, low costs, crop efficiency and maximum returns. Other major components of a fully functional greenhouse system include, but not limited to carbon di-oxide concentration, sunlight, temperature, humidity and crop vapour pressure monitoring and control, security and alarms, notifications and manual overrides. In that connection, and as shall be demonstrated in the literature review section, there have been aggressive efforts towards developing efficient and effective temperature and humidity control systems ideal for the greenhouse, with the overall aim of making the technology affordable, less labourintensive through some form of automation. This project was designed to explore a possible approach aimed at making temperature and d humidity monitoring and control fully automated. It also explored how this concept can be adaptable in many scenarios and how other functionalities relevant to the greenhouse can be incorporated, with major focus on affordable automation and minimal labour requirements.

To achieve this, a small model was designed to mock an actual greenhouse environment and ideal conditions simulated in order to trigger appropriate automated responses to fluctuations in these conditions in order to optimize them and to demonstrate minimal human input. The system required an initial configuration where the farmer was required to "inform" the greenhouse about what crop was growing at the time and what stage of growth it was in. From there, the system would take over and implement automation while giving feedback in the form of a digital display. The system also allowed for a manual override in the case where, for instance, there was a power failure or it got corrupted. Various approaches to automation have been proposed, while others have been implemented, with varying results.

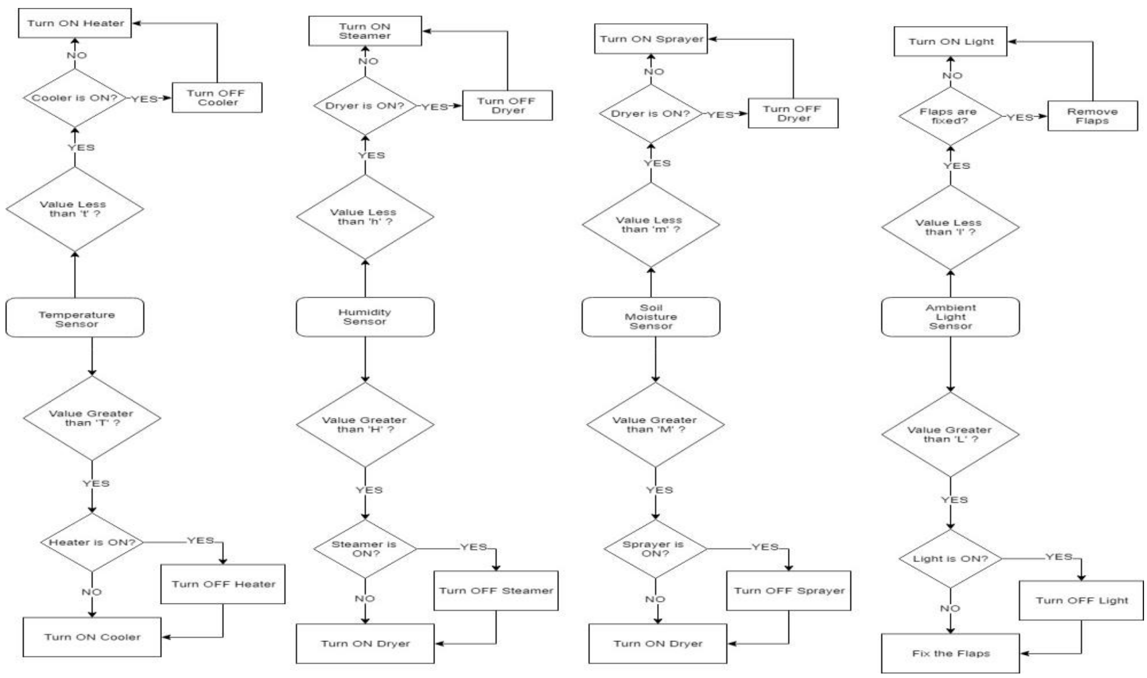
Theory of operation:

The warmer temperature in a greenhouse occur because incident solar radiation passes through the transparent roof and walls and is absorbed by the floor, earth, and contents, which become warmer. As the structure is not open to the atmosphere, the warmed air cannot escape via convection, so the temperature inside the greenhouse rises. This differs from the earth-oriented theory known as the "greenhouse effect".

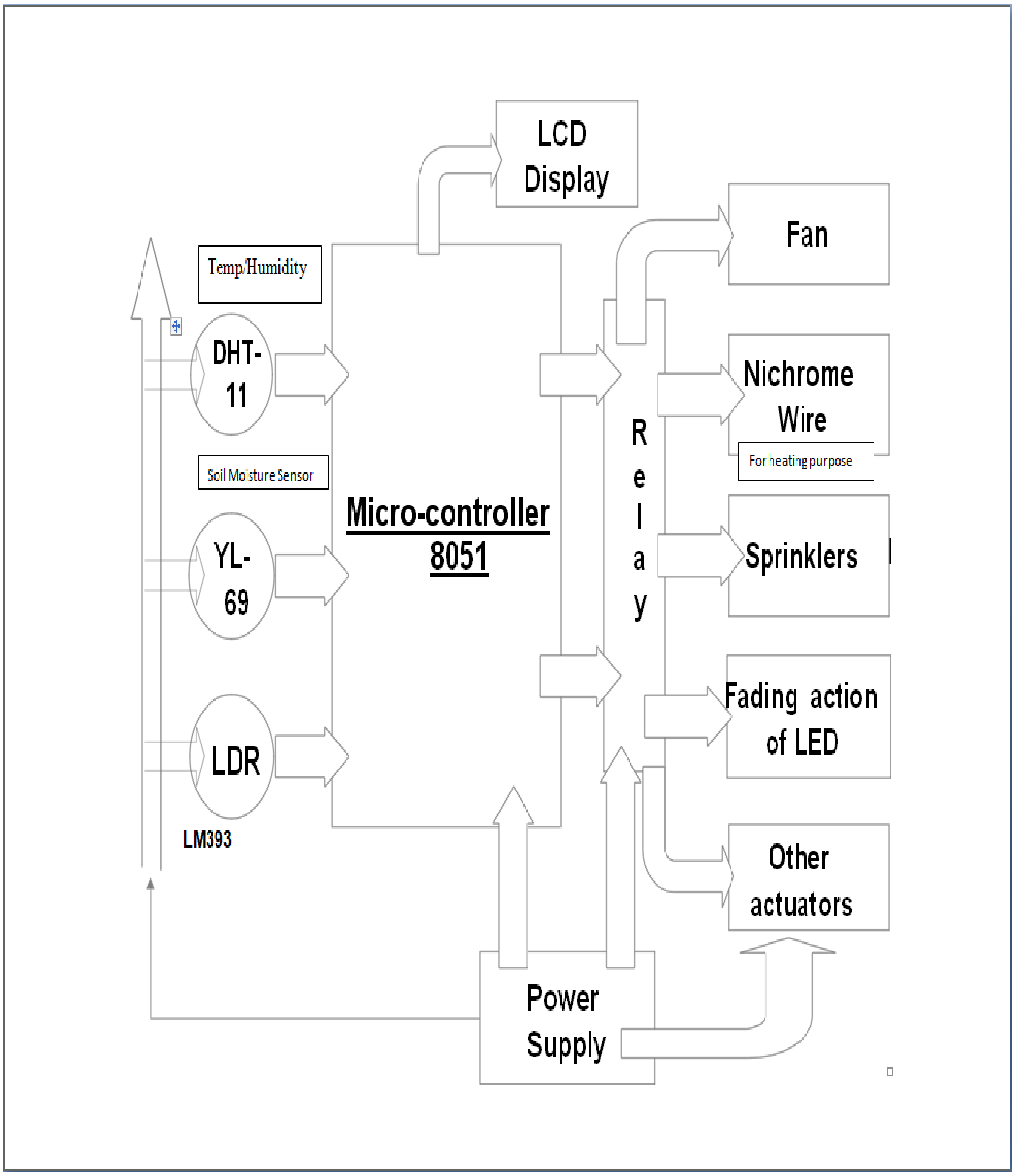
Quantitative studies suggest that the effect of infrared radiative cooling is not negligibly small, and may have economic implications in a heated greenhouse. Analysis of issues of near-infrared radiation in a greenhouse with screens of a high coefficient of reflection concluded that installation of such screens reduced heat demand by about 8%, and application of dyes to transparent surfaces was suggested. Composite less-reflective glass, or less effective but cheaper anti-reflective coated simple glass, also produced savings.

THEORY

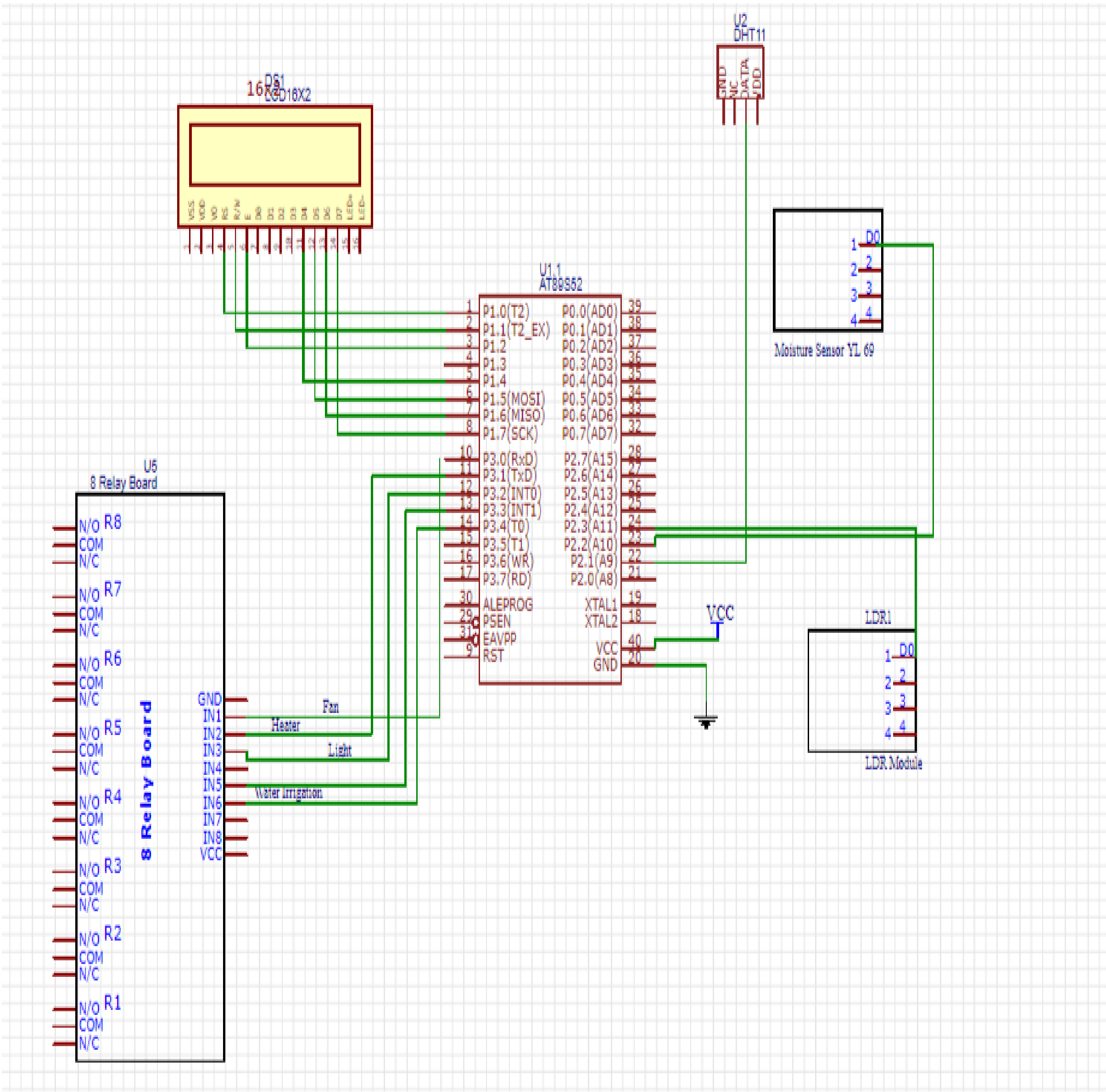
- The microcontroller and other hardware is powered on with crop conditions fed in.
- There are 3 sensors which take care of 4 environmental conditions – Temperature, Humidity, Light Intensity and Soil Moisture
- Various Actuators like Fan, Nichrome Wires, Sprinkler and LEDs have also been interfaced with 8051.
- Once the whole system is on – Sensors always stay active to detect any change in the environment relative to the fed in conditions and accordingly direct the actuators to change those conditions back to match the desired threshold.
- Thus the actuators act as a feedback mechanism in the smart habitat to control the desired output.
- Components used in the project:
    - ATMEL 8051 Development DIP Board
    - LCD screen
    - 8 Channel 5V Relay board
    - Sensors:
        - DHT 11: Temperature and humidity sensor
        - YL69: Moisture Sensor
        - LDR module LM393
    - Actuators:
        - Nichrome Wires(Heater)
        - Fan
        - Sprinkler
        - Flaps and LED
- For a clearer understanding we use the flowchart.



BLOCK DIAGRAM



CIRCUIT DIAGRAM



RESULT AND DISCUSSION

After the model was run, we successfully controlled all the actuators as per the algorithm in which it was coded.

- Temperature
    1. When the temperature becomes less than 15 degree Celsius, then the heater is automatically turned ON to start the increment in the temperature.
    2. When the temperature is optimum, i.e. between 15 degree Celsius and 28 degree Celsius, both the heater and the cooler are OFF
    3. When the temperature exceeds the value of 28 degree Celsius, the cooler is turned ON to start the decrement in the temperature.
- Humidity
    1. When the humidity becomes less than 60%, then the dryer is OFF to keep it at that range.
    2. When the humidity becomes more than 60%, then the dryer is turned ON to start the decrement in the humidity.
- Light
    1. When the light becomes less than the threshold value for a plant, then the Artificial light is turned ON.
    2. When the light is optimum, no action is taken to control the light.
- Soil Moisture
    1. It is noted that a minimum amount of water in the form of moisture should always be present in the soil, hence, when the soil moisture sensor senses that the moisture content is less than the required, then it automatically turns ON the water pump.
    2. When the desired moisture content is reached, the water pump is automatically tuned OFF by the microcontroller.

ADVANTAGES & DISADVANTAGES

Advantages:

- Due to atomisation irrigation becomes very easy job.
- Able to grow any crop in any season at any place. By tuning the desire physical parameters.
- Mobile control can be possible by using GSM module.
- Reduction in unwanted human labour.
- Enhancement in food production in terms of quality.
- No need to relay on un-trusty weather.
- Prevent the external insect attack.

Disadvantages:

- Initial installation cost is quite high.
- Malfunctioning in system can ruin whole crop.
- Can cause radiation hazards.
- Require huge amount of electricity.

CONCLUSION

As the world moves towards automation and humans get busier we are in dire need for things to eliminate unwanted human labour. It would be great if gardens and crops can grow on their own without continuous human monitoring i.e. they sense their own needs and automatically water or heat themselves up. This would lead to reduced human errors and hence would help productivity and growth. We in this project have implement an artificial habitat which can sense its growing needs on its own and take care of themselves.

FUTURE WORK

- Mobile control by using GSM module.
- Artificial Multistage Farming.
- Hydroponics in Artmos.

REFERENCE

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