Green House Management System using EdSim52

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Abstract. Crop cultivation has been around for a long time and plays essential roles in many fields. Growing plants' growth quickly affects climate conditions, especially temperature and relative humidity. Therefore, the simple Green House Management System designed using an SHT75 sensor to detect the temperature and relative humidity inside the greenhouse. The temperature and relative humidity calculated in the form of degree Celsius and percentage. The data then displayed on the LCD monitor. The water pump activated if the temperature and relative humidity are larger than 35°C or below 45%. If the relative humidity is above 45%, the ventilation fan is activated. The user can also use the PC keyboard connected to the activated water pump or ventilation fan. This report explains the design process while highlighting the problems faced by the farmer. Lastly, the conclusion of this project based on the objective and the results obtained. Besides, some suggestions discussed based on the design for the future development of the system.

1. Introduction
The idea of growing plants in environmentally controlled areas had existed when the Romans developed the 'modern lifestyle' and have a high command of the fresh fruits and vegetables which are out of seasons. Since certain crops are destroyed easily against harsh conditions, to make the crops grow very well without any stress, it also noted that the creation of greenhouses that initially called "botanical gardens".

In plants' growth, it undergoes development changes like tissues and organs such as leaves and stem. The development of a plant is solely dependent on the conditions of the environment where the plants are grown. With the continuous development of modern-day technology, people can create a suitable environment for the plants instead of exposed to the outdoors. In this new era, a lot of application using the embedded system for automation, such as monitoring systems [1], medical applications [2], optimisation [3, 4], decision making [5, 6, 7].

A greenhouse invented to protect plants from too much heat or cold and help keep out pests [8]. Temperature control allows greenhouses to become a more suitable area for plants' growth. Thereby improving food production because greenhouses enable certain crops to be grown throughout the year, a conservatory is increasingly vital in the food supply of high latitude countries was discovered [9].

The climate control inside the greenhouse has evolved over the last four decades from manual to digital [10]. Electronic devices became available with the advancement of control techniques that enable more sophisticated control strategies to develop. Therefore, electronic devices such as temperature and humidity sensors always used to detect the temperature and humidity inside the greenhouse.

Marasovic [11] proposed eliminating the system's difficulties by reducing human intervention to the best possible extent using sensors, ADC, microcontroller and actuators. However, the SHT 75 can
convert the data into digital readout; it becomes more simple by eliminating the ADC. When any climatic parameters cross a safety threshold that has to be maintained to protect the crops, the sensors sense the change, and the microcontroller reads this from the data at its input ports. Since the microcontroller used as the heart of the system, it makes the set-up low-cost and effective. As the system also employs an LCD continuously alerting the condition inside the greenhouse, it becomes user-friendly. Thus, Kiran [12] discovered that the system eliminates the drawbacks of the existing set-ups and designed to easily maintain a flexible and low-cost solution.

Today, traditional farming is not efficient as the growers cannot continuously monitor and control these climate factors by themselves. For example, the growers may not know that the plants are required protection from sunlight but leave them exposed under the sun, and the situations that supply excessive water or forget to water the plants would happen.

Generally, plants grow faster with increasing air temperatures up to a point. However, extreme high temperature will slow down the growth and also increase moisture loss. Some annual flowers and vegetables are susceptible to cold, and transplants should not be planted until temperatures are consistently warm. Wide temperature fluctuations can be complex on plants and cause injury on plants with thin and smooth bark.

Plant foliage transpiration relies on moisture from both the roots and surrounding atmosphere. The humidity of the surrounding atmosphere also affected the soil moisture. If the plants are growing in a dry and low humidity level in the atmosphere, the plants forced to rely on the soil moisture, which can cause water stress. The absorption and transportation of water and nutrient are dependent on the condition of the soil. If the moisture level of soil and atmosphere is always not ideal, it can cause stunted growth and reduce pests and diseases [13]. However, when the humidity is too high, it may promote mould and bacteria that cause the plants to die.

In general, a GreenHouse Management System using an 8052 Microcontroller developed. Below is a list of objectives for this project:

- Able to build a greenhouse management system by using EdSim51 Simulator, which implemented with 8052 Microcontroller.
- Able to design and simulate a microcontroller-based circuit to automatically monitor temperature and relative humidity and regulate the greenhouse environment.

2. Methodology

8052 Microcontroller is the leading hardware in this project. It used to complete the task assigned by using Assembly language and improve the project's efficiency.

8052 Microcontroller is an 8bit microcontroller designed by Intel. It built with 40 pins DIP (dual inline package), 4kb of ROM storage and 128 bytes of RAM storage and two 16-bit timers. It consists of four parallel 8-bit ports, which are programmable as well as addressable. An on-chip crystal oscillator is integrated with the microcontroller, having a crystal frequency of 12 MHz. EdSim51 simulator is used in this project as it is an 8052 simulator with virtual peripherals attached to the four ports.

SHT 75 is one of the Sensirion's families of relative humidity and temperature sensors with pins. A unique capacitive sensor element used for measuring relative humidity while a band-gap sensor measures temperature. Both sensors seamlessly coupled to a 14bit analogue to digital converter and a serial interface circuit. SHT 75 consists of a 4-pin single-in line which are namely SCK (serial clock input), VDD (Supply 2.4-5.5V), GND (Ground) and DATA (serial data, bidirectional).

Then, SCK is used to synchronise the communication between the microcontroller and SHT75. Simultaneously, the DATA tristate pin used to transfer data in and out of the device. DATA changes after the falling edge and is valid on the rising edge of the serial clock SCK. The transmission starts with a "Transmission Start" sequence issued. The microcontroller will then send a command to SHT75, which consists of three address bits that only "000" is currently supported and five command bits. The SHT75 indicates the proper reception of command by pulling the DATA pin.
The block diagram of the Green House Management System shown in Figure 1. The block diagram divided into a few parts: data acquisition system, microcontroller, display unit and actuators. The data acquisition system consists of the SHT75 sensor, which senses temperature and relative humidity inside the greenhouse. The sensor will have to take some time to measure and send a digital readout to the microcontroller—the sensor SHT75 represented by the switches in the EdSim51 simulator, P2.0 P2.7.

Besides, the 8051 microcontroller is the heart of the proposed embedded system. It sends the measurement commands to the sensor, continuously monitors the sensor's digitised parameters, and verifies them with the predefined threshold values—the system check for any corrective action be taken for the condition by activating the actuators. Actuators are consists of a water pump motor and ventilation fan. The purpose of demonstrating LEDs is to simulate the water pump and ventilation fan.

An LCD used to indicate the current temperature and relative humidity inside the greenhouse. The information is displayed on the LCD after the data measured. The keyboard used to manually control the actuators by typing ON/OFF, while the switch used to start a new transmission to measure the humidity inside the greenhouse.

3. Result and Discussion
The result divided into two major categories. The first part shows the temperature measurement, and the second part is humidity measurement. Next, discussion relating to the result obtained for both of the measurement acquired.

The upper byte and lower byte data sent to the microcontroller through the sensor after the temperature measurement acquires. The LCD monitor display show "T: 37°C". If the temperature inside the greenhouse is higher than the safety temperature 35°C, the LED 7 will light up and means that the
water pump is activated about 55ms to water the plants. Figure 2 shows the result of temperature reading and water pump status.

![Figure 2: Result of temperature reading and water pump status](image)

After the relative humidity measurement completed, the 8bit data sent by the sensor to the microcontroller. The LCD monitor display will show "H: 89%". Suppose the humidity inside the greenhouse is higher than the safety relative humidity of 45%. In that case, the LED 6 will light up and means that the ventilation fan is activated about 25ms to decrease the greenhouse humidity. Figure 3 shows the relative humidity reading on LCD with the ventilation fan's status on the LED.

![Figure 3: Result of humidity measurement on LCD and ventilation fan condition](image)

The user can type in the external UART TX window to control the greenhouse actuators: water pump and ventilation fan. If the user wants to activate both the water pump and ventilation fan, 'ON_&ON_' is typed and send. Figure 4 shows the text send to control the actuators.

![Figure 4: Setting actuator with sending a message](image)

After the words in the TX window sent, the LED 7 light up and meant that the water pump is activated about 55ms to water the plants, as shown in Figure 5.

![Figure 5: Status of water pump in LED](image)
As the water pump is OFF, only the LED 6 will light up and means that the ventilation fan is activated about 25ms to decrease the greenhouse humidity. The ventilation pump status is shown in the LCD and LED on the simulator in Figure 6.

The modularity coding can further improve the performance of the operating speed and memory capacity. Increasing the number of channels to interface more sensors like light sensor and other electronic devices is possible using advanced microcontrollers. Besides, the LCD can display the current status of the water pump and ventilation fan so that the user can continuously monitor the actuators anytime. This system can also be connected to a communication device such as moderns, cellular phones or satellite terminal to enable the small collection of recorded data or alarming specific parameters.

4. Conclusion
In conclusion, the Simple Green House Management System meet all the project objectives. The component used to build the Greenhouse Management System is 8051 Microcontroller, SHT75 sensor, keyboard, switch, LCD, water pump and ventilation fan. Each of them plays a vital role to complete the project. The system can simulate in the EdSim51 simulator, which implemented with an 8051 Microcontroller without any errors. The system can also monitor the temperature and relative humidity and regulate the greenhouse environment by automatically controlling the actuators.

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