Software Requirements Specification
CS308 Project

Greenhouse Temperature Regulation

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1 Introduction

This SRS document covers our project - Greenhouse Temperature Regulation done as a part of the CS 308 lab. The main aim of the project is the **regulation of the temperature of the model greenhouse by introducing a shade over the plant and using PC fan for ventilation**.

1.1 Definitions, Acronyms and Abbreviations

1) FB5 / bot - Firebird version 5

2) Greenhouse trough - The mini greenhouse model that we use in the project. We grow a small plant in it and demonstrate the working of our project by providing a shade for this plant.

3) Sensor - Sensor indicates a temperature sensor throughout the document. A temperature sensor is a device used to measure the temperature of a medium. In our case, the medium is the air around the plant.

4) Curtain / plant shade - green messy cloth with 50% granularity (allows 50% light to come in) which will act as a curtain and provide shade from sunlight to the plant.

5) Closing / opening the shade - Closing means removing the shade over the plant and opening means adding the shade.

6) Fan - PC Fan

1.2 References

http://www.ces.ncsu.edu/depts/hort/consumer/weather/tempeffect-plants.html

http://www.aces.uiuc.edu/vista/html_pubs/hydro/require.html

2 Overall Description

Project Idea:

Our project deals with temperature regulation in a greenhouse. The temperature regulation in our case is achieved by

a) Appropriate exposure of the plants to sunlight

We aim to build a shade over the greenhouse which automatically opens when the temperature in the greenhouse reaches a particular level (lets say this threshold temperature is T_1). This shade blocks the sunlight coming on the plants, thus reducing the temperature. The shade is removed when the temperature again falls below a particular level, thus maintaining the required temperature.

b) Using a cooling fan

We use a PC fan for further cooling of the green house. When the temperature gets higher than a higher threshold temperature T_2 ($T_2 > T_1$), the cooling fan starts to provide ventilation to the green house. It gets switched off when the temperature again falls below T_2. This helps in maintaining the temperature of the greenhouse when the shade alone is unable to bring down the temperature.

These two methods together ensure that the temperature of the greenhouse remain within the user specified range. We work on a greenhouse trough for the sake of demonstration of the project.

Inputs:

The temperature requirements T_1 and T_2 for the plant are the inputs for this system and is given by the user.

Design:

a) The mini greenhouse model is a plant trough.

b) The plant shade we are using is a green messy cloth currently installed in the green house.

c) Two motors are used - one to open and another to close the plant shade.

d) A PC fan is used for further cooling of the greenhouse

e) The temperature sensor is placed as close to the plant as possible so as to best approximate the temperature of the plant.

Working:

The project automatically provides shade to the plants in the greenhouse (greenhouse trough in our case) depending on the temperature. If the shade is unable to bring down the temperature, it switches on the cooling fan to further lower the temperature.

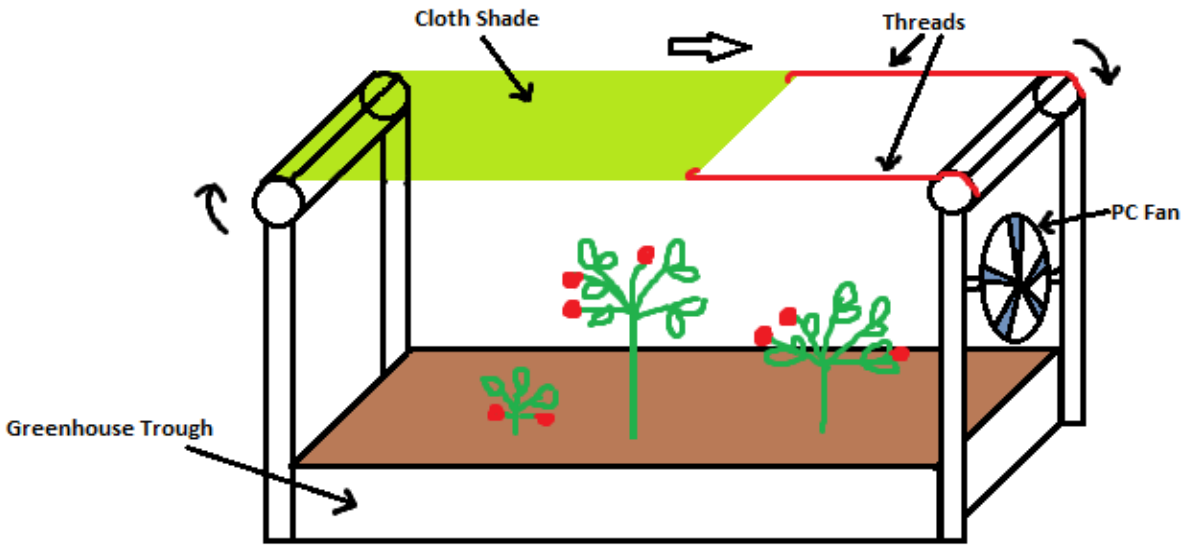
Testing:

The temperature requirements of the plant is provided by the user through the interface provided. According to these temperature requirements, we demonstrate

a) the opening and closing of the plant shade

b) the switching (on and off) of the cooling fan

Design Diagram:



Closing of the plant shade

3 Details

This section gives in details every aspect of our project.

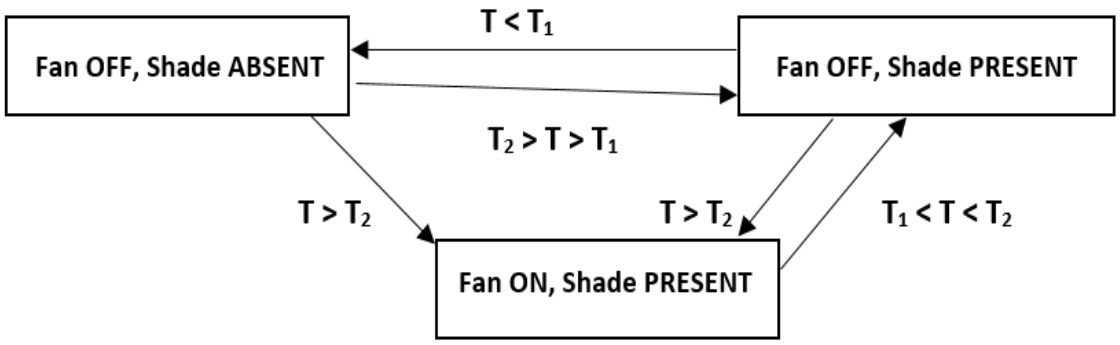
3.1 Functionality

User specifies the temperature requirements of the plant. Temperature sensors takes the reading around the plant and initiates the appropriate movement of the shed. According to the requirements,

a) When the temperature rises above T_1, the shade comes over the plant. When it drops below T_1, it rolls back.

b) When the temperature rises above T_2 ($T_2 > T_1$), the cooling fan is switched on to increase the rate of cooling. When temperature drops below T_2, it is switched off.

The **FSM** for the functionality of our project is shown below:



T : Current Temperature

T_1, T_2 : Threshold Temperatures

3.2 Supportability

1) Naming Conventions throughout the project will be *camelCase* for variable names and *underscore_case* for function names.

2) The front-end for the user inputs will be coded using python. The GUI library to be used is WxPython.

3) The back-end, that is the functionality of the FB5 bot, is governed by C code.

3.3 Design Constraints

We use:

a) The type of cloth, that is its granularity, will be selected as per requirements. We will be using a green messy cloth with 50% granularity - as a shade over the plant also called here as the curtain.

b) Two motors for the opening and closing of shade

For opening the shade, the motor attached to the end with the thread (above in the diagram), starts rolling. As the thread rolls, the curtain unrolls.

For closing the shade, the motor attached to the end with the curtain starts rolling and the curtain rolls onto the end.

c) A PC fan with motor attached which will get switched on/off depending on the temperature.

Constraints:

1) We need to ensure that the plant shade does not in any way interfere with the growth of the plant.

2) Opening and closing mechanism should not take much space and should be easy to implement.

3) The material used for rolling should be easily rollable.

3.4 Testing Strategy

Requirements	Description
Temperature increases from low to medium level: cover the plant by shed to reduce temperature	If the temperature reading by the temperature sensor inside the mini greenhouse gets above T_1, bring the shade on the plant by unfolding the green cloth as per the design specified earlier
Temperature increases from medium to high level: start the PC fan to reduce temperature	If the temperature reading by the temperature sensor inside the mini greenhouse gets above T_2 ($>T_1$), switch on the PC fan for further cooling
Temperature decreases from medium to low level: uncover the plant	If the temperature reading by temperature sensor inside the mini greenhouse goes below T_1, remove the shade on the plant by folding the green cloth as per the design specified earlier
Temperature decreases from high to medium level: stop the PC fan	If the temperature reading by temperature sensor inside the mini greenhouse goes below T_2 ($>T_1$),, then switch off the PC fan

3.5 On-line User Documentation and Help System Requirements

None

3.6 Functional Requirements

3.6.1 Hardware Requirements

1) Greenhouse Trough

2) Firebird bot (FB5)

3) Plastic pipes for the structure around the trough (mini greenhouse model)

4) A green messy cloth with 50% granularity

5) Temperature sensor

6) Threads with high tensile strength

7) 2 motors with low RPM

8) 2 rotating rods

9) 4 gears

3.6.2 Software Requirements

1) Keil uVision4

2) Programming Languages: C, Python

3) The GUI library called WxPython

3.7 Interfaces

3.7.1 User Interfaces

We develop a front-end using python. User gives the temperature requirements to the bot through this interface.

3.7.2 Hardware Interfaces

We use two XBEE Modules, a XBEE USB Converter and a laptop as hardware interfaces to give the inputs to the bot. The bot takes the readings through the temperature sensor which in turn can be conveyed to the user using XBEE Modules.

3.7.3 Software Interfaces

Front-End for the user input is developed using python. The front-end data is transferred to the XBEE Module using X-CTU.

3.7.4 Communications Interfaces

The inputs given by the user is transferred to the bot using serial communication through X-CTU. There are two XBEE Modules, one on the bot XBEE-A and one with the user XBEE-B. The front-end passes the data to the port opened by X-CTU on XBEE-B using XBEE USB Converter which in turn passes it along to XBEE-A on the wireless network.

3.8 Risk Analysis and mitigation

The risks involved in our project include:

1) Accuracy of the temperature sensor: The working of our project depends a lot on the accuracy of the reading given by the temperature sensor. It should approximate the temperature of the plant to the best possible measure. The accuracy will also depend on the location of the sensor.

2) Plant damage or hardware damage: Intervention of the plant with the moving cloth may tear it or the working might get disturbed. The cloth should be of good quality. We will have some separation between this mechanism and plant to overcome this risk.

3) Rigidness of the structure: The structure should not get damaged by wind, rain,etc. Proper covering will be done to avoid this risk.

4) Intervention of the PC fan: The plant in the trough may grow in the direction of the fan and this may lead to damage to the plant. We will avoid this situation by adding a cover between the fan and the plant inside the trough. The plant may also be inclined in the direction opposite to the fan due to the air flow from the fan.