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Entitled

DESIGN AND IMPLEMENTATION OF FUZZY CONTROLLER FOR NON-LINEAR THERMALLY INSULATED MIMO GREENHOUSE BUILDING UTILIZING WEATHER CONDITIONS AND GROUND TEMPERATURE

by

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Abstract

The increased demand of electricity and water consumption for cooling and heating processes together with the continuous increase in earth temperature due to greenhouse gases emission urged the utilization of sustainable, affordable and clean energy resources. Globally, the biggest amount of water is consumed for agricultural purposes. Domestically, in Abu Dhabi Emirate, the agriculture sector consumes over 50% of the supplied water. Part of this consumption is due to the evaporative cooling approach that is typically used in cooling greenhouses. This approach utilizes a large amount of water and energy to maintain the greenhouse temperature within the desired range. Ground Heat-Exchanger is an environmentally-friendly solution used for heating or cooling applications. It is based on seasonal temperature difference between the ground and the ambient which varies with depth. As depth of ground increases, the temperature fluctuation decreases because of the soil high thermal inertia and the time lag in temperature fluctuation between the surface and the ground. The aim of this thesis is to design a control system using fuzzy logic controller to study the feasibility of utilizing weather conditions and soil temperature in cooling or heating processes of a special type of greenhouses. The proposed control system takes a decision of either utilizing the outside weather conditions or using the soil temperature. The study is conducted on a thermally insulated greenhouse system equipped with ground-to-air heat exchanger, actuated windows, fans, and sensors and the proposed controller performance is compared to a conventional ON/OFF controller and logical controller. Results show the proposed control system is capable of maintaining the greenhouse temperature within the desired range for most of the day hours in winter utilizing only the weather and soil temperatures. However, when the temperature is extremely hot, especially in summer, the ground heat exchanger can be only used for pre-cooling with a capability of reducing the ambient temperature of about 6˚C on average. In such extremely hot periods, an auxiliary cooling unit has to be deployed for further cooling. In addition, results reveal that fuzzy controller consumes less power than the ON/OFF and logical controllers when operating the system actuators.

Keywords: Ground Heat Exchanger, GHE, Sustainable Energy, Fuzzy Controller, Greenhouse.