LIGHT INTENSITY BASED FUZZY CONTROLLER FOR SOLAR CONCENTRATORS

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ABSTRACT

The Solar technology offers great potential in terms of supplying the world's energy needs. However, its current contribution to the world is still limited. The main factor is related to high initial cost of building the system and its precise control. This paper will provide a 'Mamdani' fuzzy controller for solar concentrators and make them beneficial to make solar technology affordable and smoothly controllable.

Keywords: *Fuzzy Controller, Solar Concentrator.*

I. INTRODUCTION

Solar concentrator is a device that allows the collection of sunlight from a large area and focusing it on a smaller receiver or exit [1],[2]. A conceptual representation of a solar concentrator used in harnessing the power from the sun to generate electricity is shown in Figure 1. Concentrating solar technologies are in different stages of development; most of them have passed the testing and power production (on a small scale) phases and are being commercialized. [3],[4],[5].

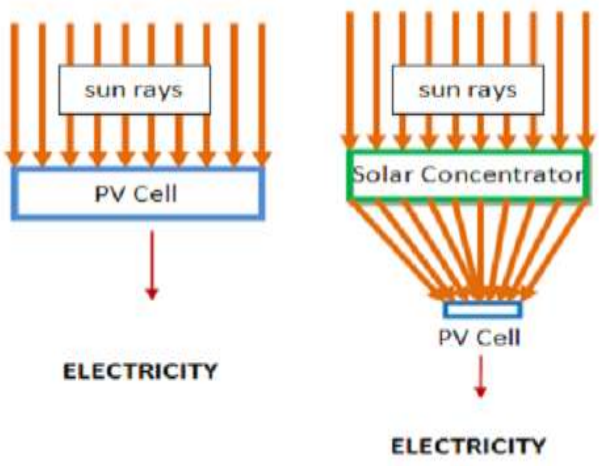


Figure 1: Generating Electricity With and Without Solar Concentrator

A solar concentrator has its own fundamental application to save energy and it can usually be done by conversion of water to steam. Steam has tremendous application in engineering and technological field. It will be a power hungry

system which does the conversion. Here come the pros of solar concentrator as it is based on renewable energy source. Fig-2 elucidates a typical solar concentrator.

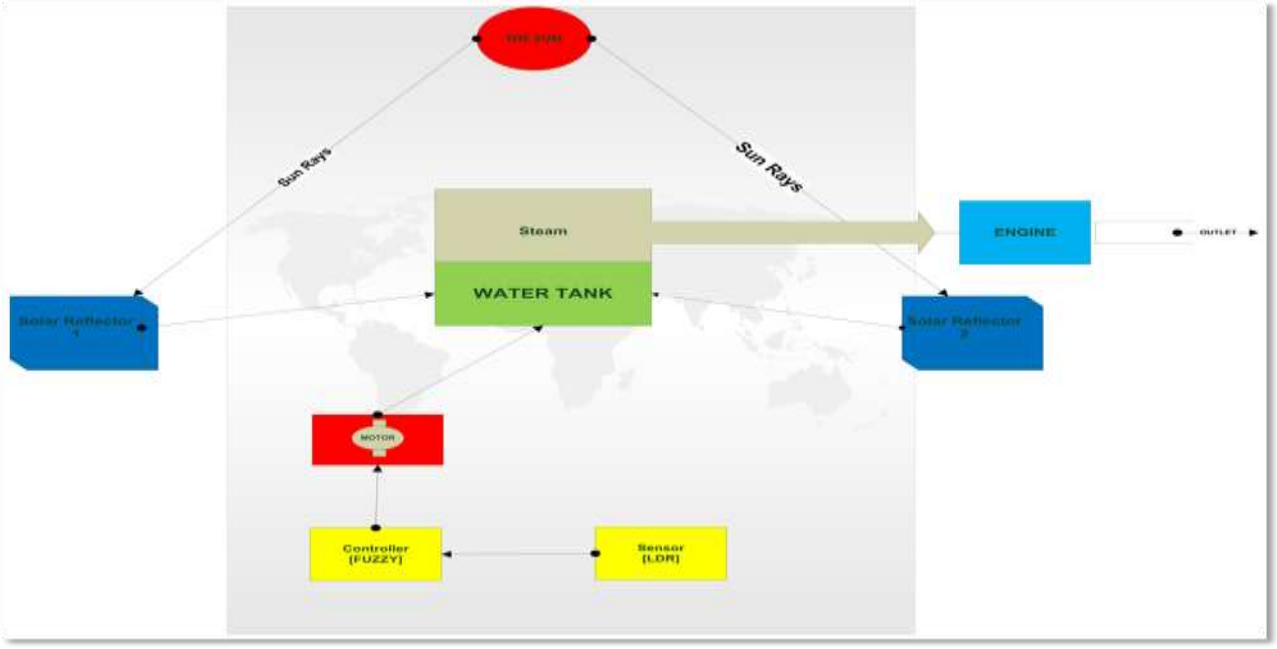


Figure 2: Solar Concentrator application Overview

The entire model (Fig-2) consists of sensors, actuators and controller. Intensity of the sunlight varies time to time so does the temperature of the water tank. This temperature is useful for water to steam conversion but has to be done in controlled manner otherwise mishap might be occurred anytime. If a system has non-linearity a fuzzy controller has to be there [6-8]. It is the most recent technology developed since last decade and has the potential to replace other controllers. [6-10]

In this work we introduced a mamdani model based fuzzy logic controller. It takes input as a function of light intensity and control the motor to compensate the water level in the tank.

III. MEMBERSHIP FUNCTION

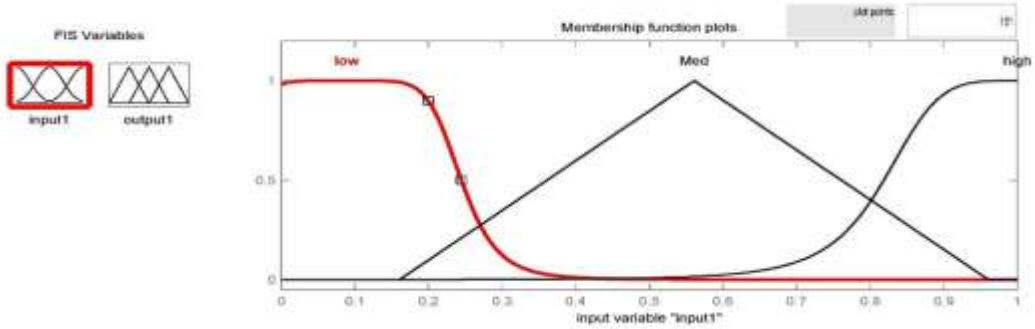


Figure 3: Input Membership Function

Input membership function has been taken as bell shape function (Fig-3) in case of LOW. For MEDIUM membership function a triangular one from 0.16 to 0.96 and HIGH membership function again a bell function maximum at 0.88 has defined. A LDR is used as input sensor for measuring light intensity.

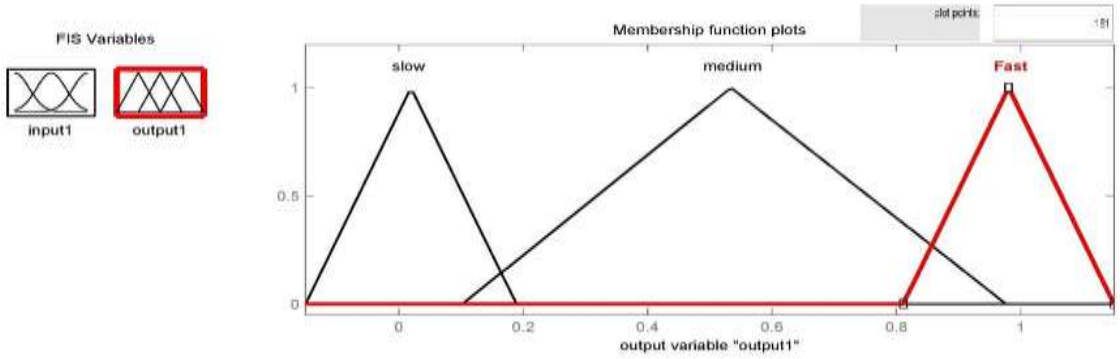


Figure 4: Output Membership Function

In output membership function (Fig-4) slow speed has been defined as triangular function which starts from -0.15, pick at 0.02 and end at 0.189. Other membership functions defined in the following way; slow function [-0.15 0.01957 0.1891], Mid membership function [0.1026 0.5341 0.9761] and Fast membership [0.8109 0.9804 1.15]. BLDC motor is acting as output in this work.

II. RESULTS AND DISCUSSIONS

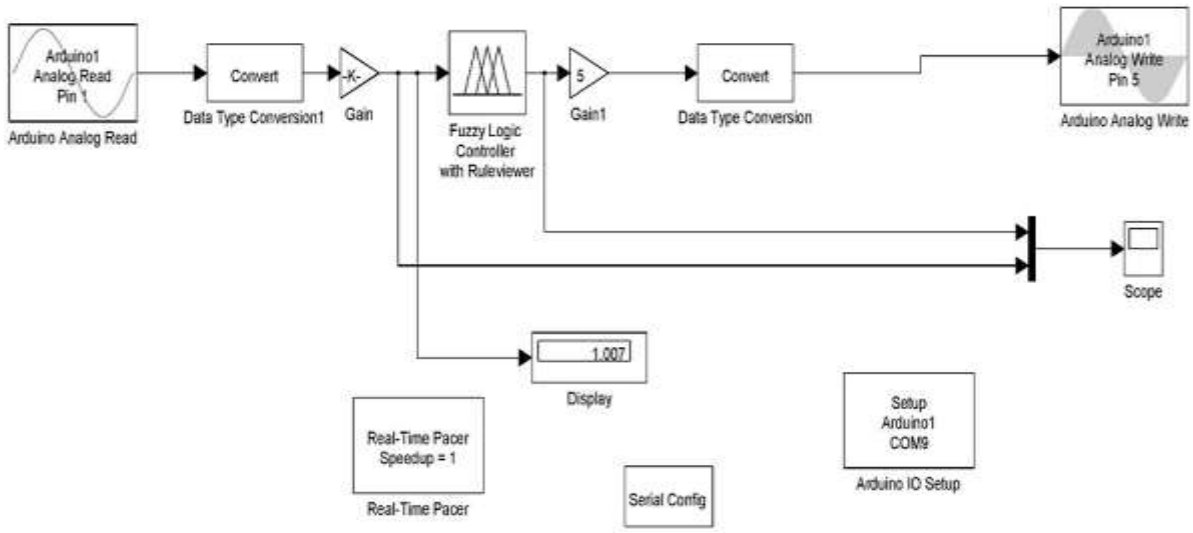
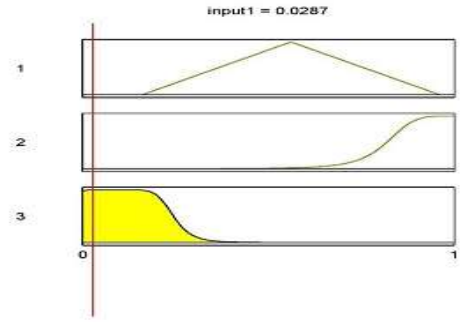


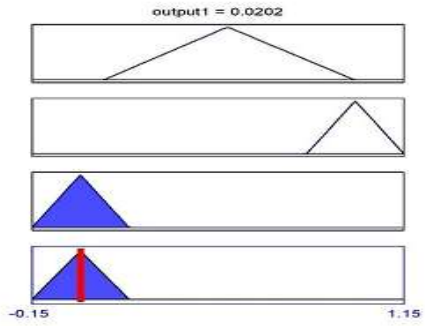
Figure 5: Simulink Model

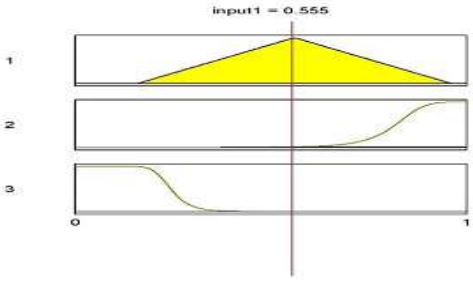
Table 1 describes the result obtained from the hardware set up. It has a good correlation with simulation results. A proposed simulink model in Matlab environment depicts in Fig-5.

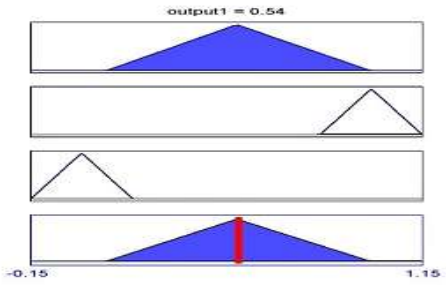
Table 1: Result Summary

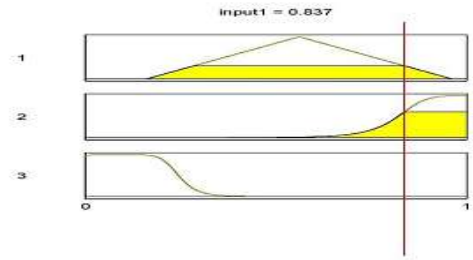
	INPUT	OUTPUT	SPEED
1	LOW	LOW	SLOW
2	MED	MED	Neither too fast nor too slow
3	HIGH	HIGH	FAST
4	TRANSITION STATE	COMPRESSED	Effect of both the Membership Funtion

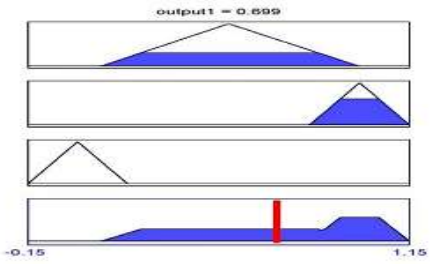












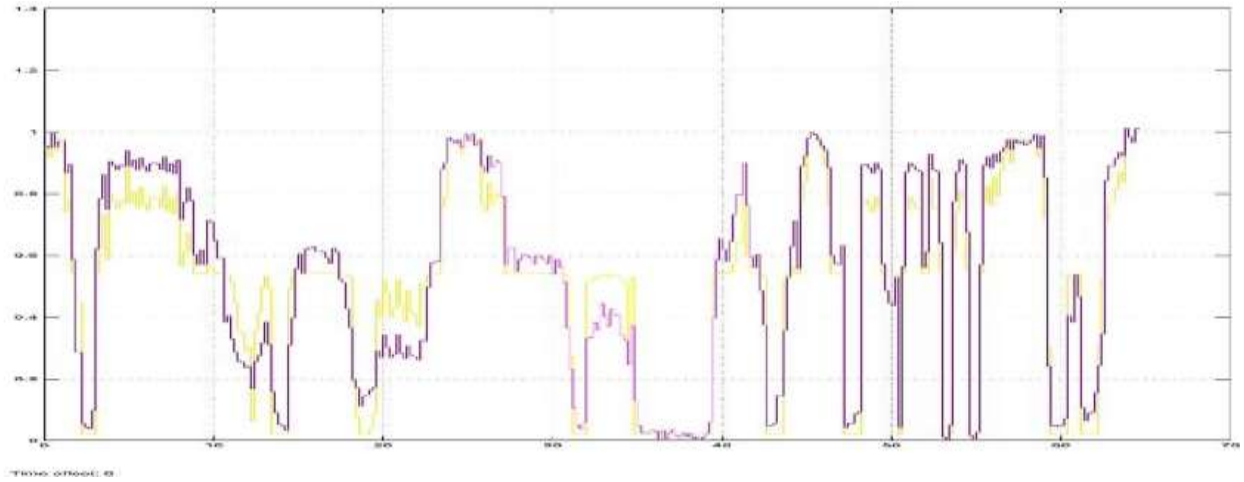


Figure 6: Simulation Result

IV. CONCLUSION

We have successfully implemented this work with hardware set up. Sensors and actuators are operating precisely. Speed of the BLDC motor has controlled exactly according to defined membership functions. By achieving controlled motor speed the water level has monitored. A PLC or microcontroller based system can be fruitful some times in industrial applications but they could not replace non-linearity as our proposed controller did faithfully.

V. ACKNOWLEDGEMENT

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