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Research paper



High Performance of Solar Cooker by Heat Transfer Mode Condition System Using Fuzzy Logic Controller Applications

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Abstract

In this work has been made to predict the effect of several parameters on the productivity to a system by expending fuzzy set technique. A solar cooker has been developed low cost and critically high efficiency produce in Vel Tech Multitech Engineering College at Chennai, Tamilnadu, India. Dissects in thermal performance of cooking system have been produced heat transfer follow in fuzzy logic techniques (Low, Medium, and High). The thermal effect of factor should be developed in fuzzy logic for the system. They should have groups of heat transfer produced in fuzzy logic controller for solar cooker system which had been implemented of system performance discussed. It is to study have induced to give the shortly time for the enhancement of the box solar cooker production.

Keywords: *Solar Cooker, Fuzzy Logic, Solar Thermal internal heat Transfer model, MATLAB fuzzy logic.*

1. Introduction

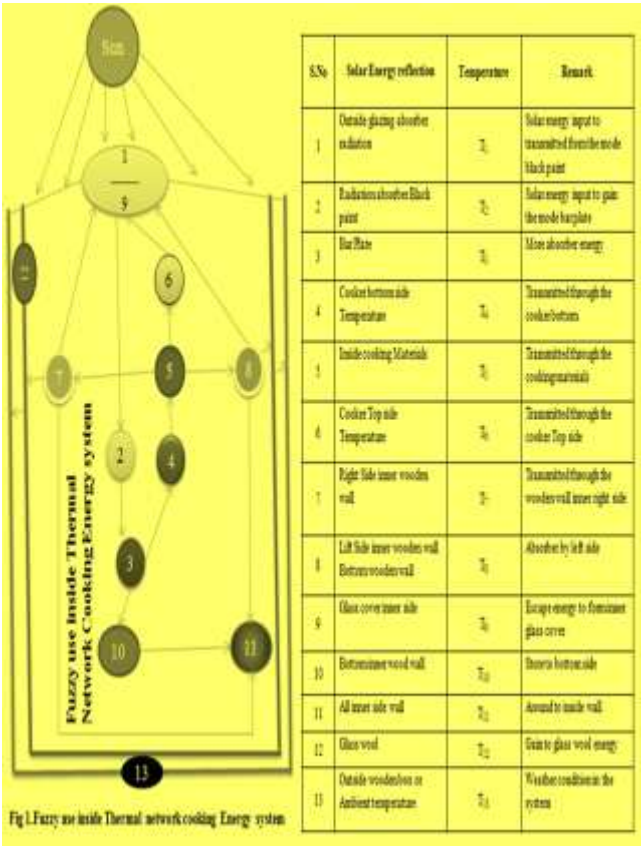
Expert of thermal technology has captured very like that mavens to several turfs of modern eons in produce of applications such as diverse area of science, engineering, business and soil is toward benefit hip establishing health glitches. Many researchers have developed in fuzzy logic methods using different focus on application. Here have used in solar cooker for heat transfer mode analysis of fuzzy logic analysis of Low, Middle, High in between relationship produced in cooking pots. Bansal and Narvey [1] was studied a perfect speed tracking (DC motor) using PID controller. It found that in both precise in fuzzy self-tuning characters of PID controllers for a result obtained with MATLAB. Singhala1 *et. al.,* [2] was developed in temperature control. It was concluded FLC best way in control result in resizing of fuzzy sets, finer tuning of the membership functions. Kahsaya *et.al.,* [3] have produced by box type solar cooker using internal reflector. It final resulted as simulation model discussion for cooker with internal reflector higher and then without reflector lower. Shiau *et.al.,* [4] developed by solar power MPPT algorithms using in fuzzy logic. It was produced in multipurpose controller design defined range for both the sum 180°& 90~270° which that as incorporating of voltage regulation purposes. Boata and Pop [5] was developed in global solar irradiation by Takagi-Sugeno fuzzy algorithms. It found that to be in daily air temperature extremes at input, parameter ordinarily existing aimed at utmost locations and equally meteorological regime the TS classical obtainable now should be effectively every day. Geddam *et.al.,* [6] was produced in box type solar cooker. It found that system reach the temperature of around 100°C is achieved which that the F2 morals on 3.294% cruel qualified blunder is 0.0603 nasty absolute inaccuracy is 0.0156 ordinary blunder and have good agreement between the experimental values.

2. Methodology

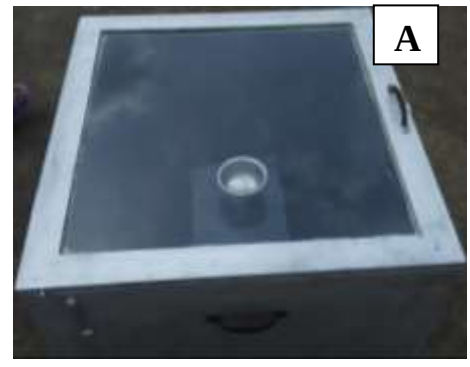
2.1. Experimental Work of a Solar Cooker:

The experimental working on the solar cooker has been developed in during the successive days from the 19/05/2017 and 29/06/2017. Each experiment starts have been worked out in the Research Center of Physics, in Renewable Energy laboratory from 7:30 am to 16:00 pm after which that the place in Vel Tech Multitech Engineering College at Avadi, Chennai, Tamilnadu, India. The experimental work have been produced by with and without PCM, Nanoparticles in mixed of made black paint for a absorb plate in a systems have shown in figure A & B. In this both system is stable to situation near the south appearance. A system have been measured by temperature fixed a thermocouples at different locations like that Glass cover, Par plate, cooker top & bottom Inside cooker boiling materials. Also, ambient temperature and solar radiation have been measured by a thermometer, solar monitor and temperature capacities keep on approved available expending K type thermocouple attached to digital thermometer through variety from – 50 to150^{o}C. Correctness to a thermometer is range of 0.3^{o}C in temperature dimensions amid on 1 to 99^{o}C.

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S.No	Solar Energy reflection	Temperature	Remark
1	Outside glazing absorber radiation	T_1	Solar energy input to transmitted from the inside black paint
2	Radiation absorber Black paint	T_2	Solar energy input to gain the inside hot plate
3	Hot Plate	T_3	More absorber energy
4	Cooker bottom side Temperature	T_4	Transmitted through the cooker bottom
5	Inside cooking Materials	T_5	Transmitted through the cooking materials
6	Cooker Top side Temperature	T_6	Transmitted through the cooker Top side
7	Right Side inner wooden wall	T_7	Transmitted through the wooden wall inner right side
8	Left Side inner wooden wall. Bottom wooden wall	T_8	Absorber by left side
9	Glass cover inner side	T_9	Escape energy to from inner glass cover
10	Bottom inner wood wall	T_{10}	Thermo bottom side
11	All inner side wall	T_{11}	Around to inside wall
12	Glass wool	T_{12}	Goes to glass wool energy
13	Outside wooden box or Ambient temperature	T_{13}	Weather condition in the system



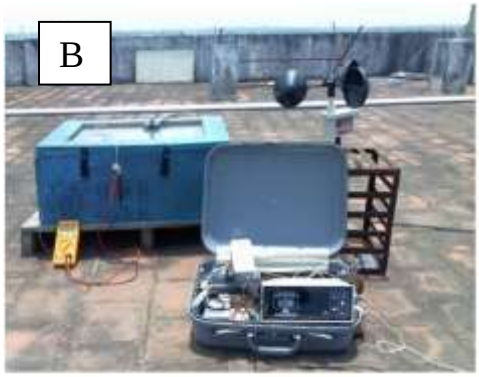


Fig 2: Fuzzy used in thermal network produce in Experimental work of solar cooker (A & B).

A solar cooker have been supposed in instruction beneath
A solar cooker surface area is considered to nodal point with isothermal.
External to cooker reflector is fashioned through diffuse emitters of thermal radiation.
Expansion of cooker is motivation proceeding previous for life thus that steady state temperature at extended.
Solar radiation suitable reflection to absorber plate is zero at position of occurrence.

2.2 Membership Functions

Various forms of membership functions are recycled to fuzzy logic like that triangular, trapezoidal, Gaussian, sigmoid and semi-circular membership function, etc. Mathematical role lingoes are exposed now.
There are many applications developing for math field with very interesting to improve solar thermal method for fuzzy logic techniques. The main applications have been developed in solar cooker box type method. The cooker input control system has been summarized with the following diagram:

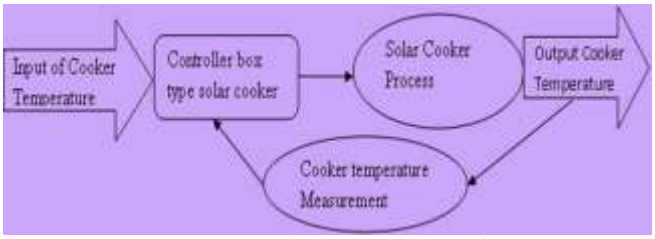


Fig. 3: The main discovery fuzzy set impression of solar cooker.

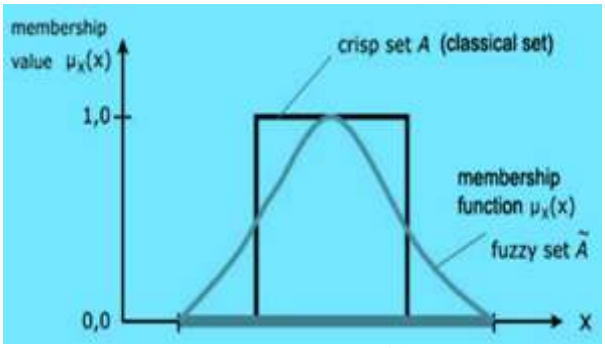


Fig. 4: Solar cooker extension of fuzzy rules.

2.3 Fuzzy Logic Controller of Solar Cooker:

Fuzzification rule of solar cooker:
Heat transfer of cooker is modified in gain and loss form of fuzzy rule. The system form of the temperatures is several values in developing of fuzzy sets in between 0 to 1. The Fuzzification process in variable temperature depend on the member functions have been developed for different range of temperature in a cooker shown fuzzy table of increases (1) and low (0) exponentially. A membership function (MFs) in which NAH, MLTA, MHTA, HTA, NHTA, VHTA, VVHTA, OFM H, N, C, NE, NO, PO, SL, NM and FT represent the fuzzy sets (Very low, Normal Low, Middle Low, Middle High, Hot , Normal hot, Very hot, Very hot, Very Very hot, Stuff Food respectively) associated to each input and output variable of data in system.

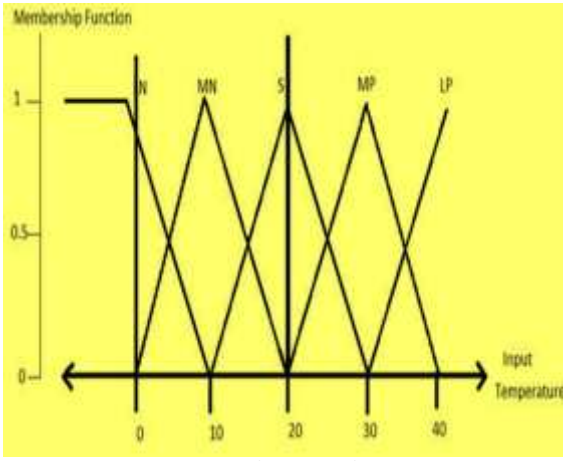


Fig. 5: Membership functions of a Solar cooker.

Table .1: member functions associated to each input and output variable of data in system

S. No.	Solar Cooker Temp. / Target	VLT (10 – 30)	NLT (30 40)	MLT (40 - 50)	MHT (50 - 60)	HT (60 - 70)	NHT (70 - 80)	VHT (80 – 100)	VVHT (100 – 120)	Stuff Food or final materials (120 - above)
1	Very low Temp.	No – Change	NAH	MLTA	MHTA	HTA	NHTA	VHTA	VVHTA	OFM
2	Normal Low Temp	-	No – Change	MLTA	MHTA	HTA	NHTA	VHTA	VVHTA	OFM
3	Middle Low Temp.	-	-	No – Change	MHTA	HTA	NHTA	VHTA	VVHTA	OFM
4	Middle Hot Temp.	-	-	-	No – Change	HTA	NHTA	VHTA	VVHTA	OFM
5	Normal hot Temp.	-	-	-	-	No – Change	NHTA	VHTA	VVHTA	OFM
6	Very hot Temp.	-	-	-	-	-	No – Change	VHTA	VVHTA	OFM
7	Very Very hot Temp.	-	-	-	-	-	-	No – Change	VVHTA	OFM
8	Stuff Food or final materials	-	-	-	-	-	-	-	No – Change	OFM

2.4 Fuzzy Inference Rule of Solar Cooker:

A solar cooker has been modified to fuzzy inference module, rule base, inference heat transfer for defuzzification. Fuzzification is transforms crisp temperature assessment of adaptable hooked going on fuzzy logic. Fuzzy rules form of temperature range built on the fuzzy ethics of altogether variables. Defuzzification has been calculated to assessment of the overall fuzzy harvest of the extrapolation heat transfer organization.

Rule 1: If (solar intensity is high) AND (temperature is low), THEN (yield is High).
Rule 2: If (solar intensity is high) AND (temperature is Normal), THEN (yield is Normal).
Rule 3: If (solar intensity is Normal) AND (temperature is low), THEN (yield is Normal).
Rule 4: If (solar intensity is Normal) AND (temperature is Normal), THEN (yield is Normal).
Rule 5: If (solar intensity is High) AND (temperature is High), THEN (yield is High).
Rule 6: If (solar intensity is Normal) AND (temperature is High), THEN (yield is Low).
Rule 7: If (solar intensity is Low) AND (temperature is low), THEN (yield is Low).
Rule 8: If (solar intensity is Low) AND (temperature is Normal), THEN (yield is Low).
Rule 9: If (solar intensity is Low) AND (temperature is High), THEN (yield is Low).

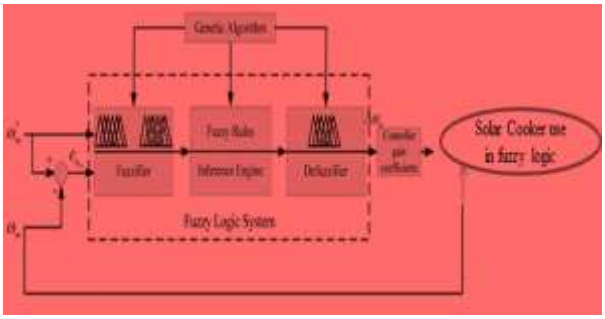


Fig. 6: the Solar Cooker form of fuzzy logic system loop.

2.5 De – Fuzzification form of Solar Cooker Techniques

As a solar cooker have been developed in "MAX of MIN" processes hip Mamdani fuzzy organisms, fuzzy variables is engendered to defuzzification exchange with normalization of heat temperature usual MAX processes vital its place prejudiced regular temperature of a system is applied directly to regions individual through MIN machinists.
The solar cooker has made to more improve the temperature fast working for membership of average over all X. They are used by

$$\frac{\sum X\,\mu_{output}(X)}{\sum \mu_{output}(X)}$$

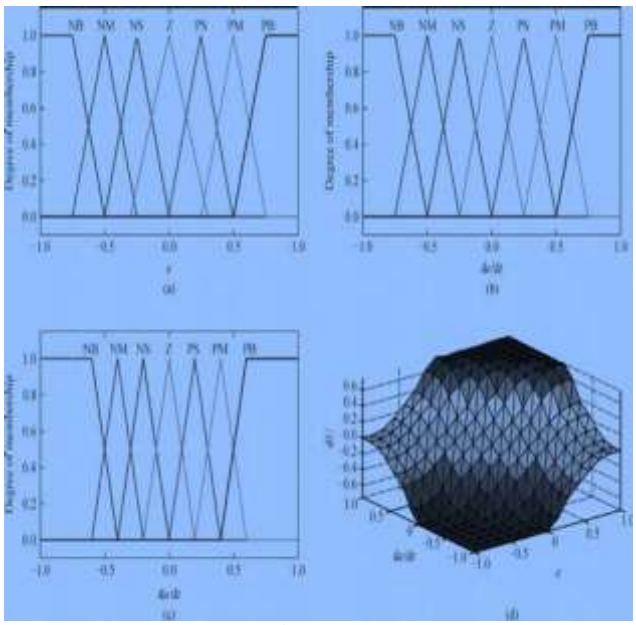


Fig. 7: The main discovery of improves the temperature by system.

3. Result and Discussion

Expertly is aimed domestic help of a cooker progress popular strength through emanating fewer smolder. Through expending fewer fuels, they comfort the affliction of the women and girls who are crease wood, too platefuls keep to forests and cut greenhouse is gas productions. Experimental observations have been carried out in typical one of the day (09' July 2017) in Vel Tech Multitech Dr. RR Dr. SR Engineering College at Avadi in Chennai, Tamil Nadu, India. A solar cooker have been calculated to amid time 8.00 A.M to 17.00 P.M. Mamdhani model has been used to [7,8,9] predict the fast cooking pick time for the same day. The efficiency derived using different values of solar intensity and water temperature are also given in table 1. From the results, three-dimensional graphs were generated between the four variables and depicted in figure 8 and 9 [10, 11]. The relative standard deviation has been found between the experimental and simulation results in order to signify the closeness of the trend. It is observed that there is a reasonable agreement between the simulation and experimental results.

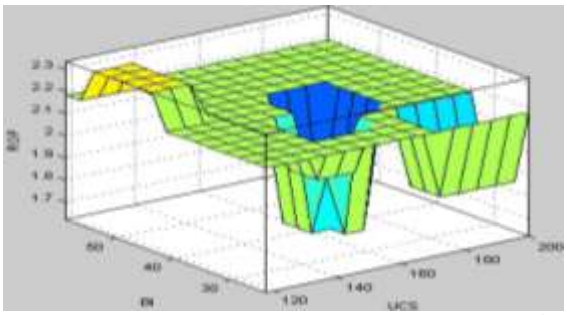


Figure 8: Three-dimensional graphs between hourly variations of different load in Water efficiency.

The solar cooker has been observed for solar intensity at reach to pick time 800 W/ m^2 and ambient temperature is 41°C. They have been developed for a cooker in high energy saving for the system. This system is very well for 3D image produce in MATLAB shown a figure 1. The internal temperature has been developed software new application produce in this cooker. Compare to in this work [12,13,14] higher to Figure 8 & 9 have developed in 3D graph for between hourly variation of water temperature and many absorber energy saving to utilization of a cooker very fasting cooking time is less than making system produce in fuzzy logic techniques. The graph is pick time reach 11 O' clock and then reach water temperature is 98°C.

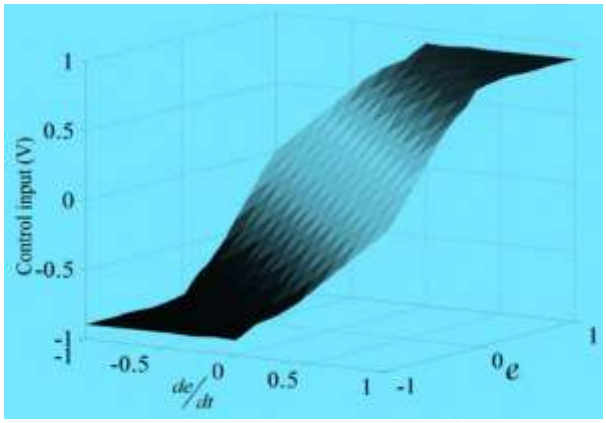


Fig. 9: thermal form of the Solar Cooker efficiency.

4. Conclusion:

The concept of solar cooker inside heat transfer have been produced form of fuzzy logic modeling of cooker results pertaining to the theory is quite impressive. It provides not only a meaningful and powerful values of a cooker representation of measuring uncertainties but also with a meaningful representation of fuzzy concepts expressed in languages. Thus a fuzzy mode of the solar cooker has been defined mathematically by assuming to each possible individual a value representing its grade of membership in the fuzzy set.

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