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# Simulation of Water Level Control in a Tank Using Fuzzy Logic in Matlab.

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**Abstract:**

With the increasing troubles of indecision, imprecision and ambiguity during the modeling of various control system, the fuzzy logic plays the vital role in it. This paper presents a detailed description of simulation of water level control in a tank using fuzzy logic, which clears that fuzzy logic is an different way to represent linguistic and subjective attributes of the real world. In order to improve the efficiency and simplicity of the design process, fuzzy logic can be applied to simulation of water level control in a tank using MATLAB.This paper design a simulation system of fuzzy logic controller for water tank level control by using Fuzzy Logic Toolbox MATLAB.. This proves that fuzzy logic do a fairly good job than other controlling systems.

**Index terms** - fuzzy logic, simulation, water tank.

**Introduction :**

While modern control theory has made modest inroad into practice, fuzzy Logic control has been rapidly gaining popularity among practicing engineers. This increased popularity can be attributed to the fact that fuzzy logic provides a powerful vehicle that allows engineers to incorporate human reasoning in the control algorithm. As opposed to the modern control theory, fuzzy logic design is not based on the mathematical model of the process. The controller designed using fuzzy logic implements human reasoning that has been programmed into fuzzy logic language (membership functions, rules and the rules interpretation)It is interesting to note that the success of fuzzy logic control is largely due to the awareness to its many industrial applications. In many residential areas, combined water tank systems are used. The functioning of these systems are accurate most of
the time, but sometimes the system is unable to detect whether the water level reached the desired level properly or not and thus results in an overflow. Sometimes it is also unable to detect whether the inlet rate of water is proportional to the outlet rate or not and hence cause the water tank empty with much faster rate than it fills up. The solution for these problems is the construction of a new tank, but such schemes are expensive and complex too to extend the system networks
across the wide geographical areas

**REVIEW OF LITERATURE**:

Industrial interests in fuzzylogic control as evidenced by the many publications on the subject in the control literature has created an awareness of its interesting importance by the academic community[1]. Starting in the early 90s,the Applied Research Control Lab at Cleveland State University supported by industry partners,initiated a research program investigating the role of fuzzy logic in industrial control. The primary question at that time was: “What the fuzzy logic control does that the conventional cannot do?”Here we concentrate on fuzzy logic control ( one of the Intelligent Control Technique) as an alternative control strategy to the current proportional – integral – derivative (PID) method widely used in

industry[2]. Nonlinear due to its dependence on the square-root of *H*. Linearizing the model, using Simulink Control Design, simplifies the analysis of this model[3]. The level is sensed by a suitable sensor and converted to a signal acceptable to the controller. The controller compares the level signal to the desired set-point temperature and actuates the control element. The FIS editor window is opened by typing „fuzzy "on command window of the MATLAB. It displays general information about fuzzy inference system. The most common and easy methodology is the Mamdani‟s fuzzy inference method. Membership function editor is used to display and edit all of the membership functions concerned with all input and output variables for the whole fuzzy inference system. Rule editor makes the user to define or modify the rules for the fuzzy logic system.

**WORKING :**

We have defined two Inputs for the Fuzzy Controller. One is Level of the liquid in the Tank denas "level" and the other one is rate of change of liquid in the Tank denoted as "rate". Both these Inare applied to the Rule Editor [6]. According to the Rules written in the Rule Editor the control takes the action and governs the opening of the Valve which is the Output of the controller and denoted by "valve". The Membership Function Editor shares some features with the FIS Editor. In fact, all of the five basic GUI tools have similar menu options, status lines, and **Help** and **Close** buttons. The Membership Function Editor is the tool that lets you display and edit all of the membership functions associated with all of the input and output variables for the entire fuzzy inference system[10-11]. When you open the Membership Function Editor to work on a fuzzy inference system that does not already exist in the workspace, there are not yet any membership functions associated with the variables that you have just defined with the FIS Editor. Use triangular membership function types for the output. First, set the Range (and the Display Range) to (-1 1), to cover the output range. Initially, the *close fast* membership function will have the parameters (-1.0 -0.9 -0.8), the *close low* membership function will be (-0.6 -0.5 -0.4), for the *no change* membership function will be (-0.1 0 0.1), the open slow membership function will be (0.2 0.3 0.4), the open fast membership function will be (0.8 0.9 1.0). Your system should look something

**8.1 Water level control**

In many residential areas, combined water tank systems are used. The functioning of these systems are accurate most of the time, but sometimes the system is unable to detect whether the water level reached the desired level properly or not and thus results in an overflow. Sometimes it is also unable to detect whether the inlet rate of water is proportional to the outlet rate or not and hence cause the water tank empty with much faster rate than it fills up. The solution for these problems is the construction of a new tank, but such schemes are expensive and complex too to extend the system networks across the wide geographical areas. Hence, the fuzzy logic controller is implemented in water tank systems for the controlling of level and rate of water. Figure 6 shows water tank and figure 7 shows water level control in a tank using fuzzy logic controller. This simulink model consists – inputs (level rate), water tank, valve, fuzzy logic controller, outputs(scopes). Figure 8 shows the control response of fuzzy logic controller using following five rules [6], [7], [8], [9]:

- If (level is okay) then (valve is no change).
- If (level is positive) then (valve is open_fast).
- If (level is negative) then (valve is close_fast).
- If (level is okay) and (rate is positive) then (valve is close_slow).
- If (level is okay) and (rate is negative) then (valve is open_slow).

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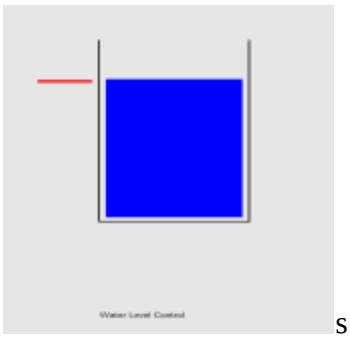
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**Fig 6: Water tank**

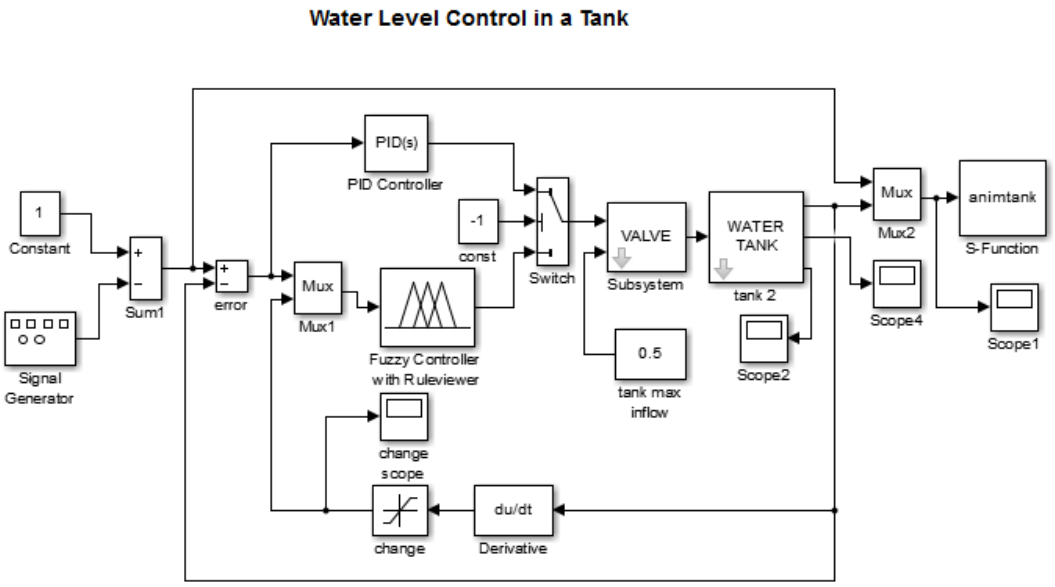


**Fig 7: Water level control in a tank using fuzzy logic Controller**

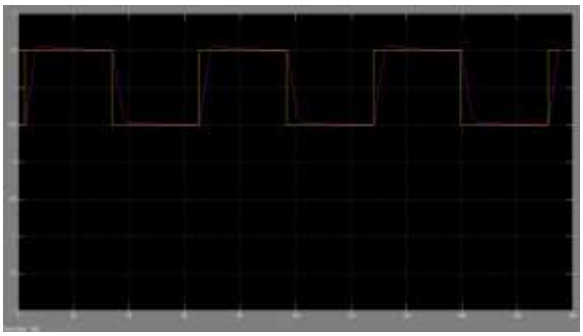

**Fig 8: Control response of fuzzy logic controller**

CONCOLUSION:

Fuzzy Logic provides a completely different, unorthodox way to approach a control problem. This method focuses on what the system should do rather than trying to understand how it works. One can concentrate on

solving the problem rather trying to model the system mathematically, if that is even possible. This almost invariably leads to quicker, cheaper solutions. It is possible to see,
edit and save the designed surface. .. This proves that fuzzy logic do a fairly good job than other controlling systems

## FUTURE SCOPE:

The scope of project is to encode the fuzzy sets, fuzzy rules and procedures. Then perform fuzzy inference into the expert system (Fuzzy Logic Toolbox). In addition, this project also makes the analysis of the variety results that obtained from system. Different numbers of rules that used in the system will give the different result, so the analysis for results will be conducted. Besides that, this system
will be also tested by using different types of methods and membership functions. The purpose is to find the best way to get the result as close as the requirement for stability of the level control for the water tank. The Fuzzy Logic Controller
provides the accurate control of the liquid level in any industrial application.

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