# Project Report on

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# Automation of Domestic Flour Mill Using Fuzzy Logic Control


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# Automation of Domestic Flour Mill Using Fuzzy Logic Control

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***Abstract-*** Automation is one of the emerging technologies in the field of any industrial processes. This report emphasis on the automation of a domestic flour mill using fuzzy logic. As fuzzy logic have various potential functions, this can be utilized in flour mill automation. In this report an idea is proposed for the Range of grinding process as it helps to operate in optimal speed and saving electricity and resources.

## INTRODUCTION

This flour mill is a small scale machine which is used to grind different kinds of wheat and other starchy plant foods. Flour mills can be established at different levels like domestic, commercial, mini and roller flour mill. Milling machinery consist system components of feeding, grinding, separating husk and flour and power handling system. The flour mill processes the wheat to edible wheat flour.

The four main stages of flour production are,
a) Conditioning of wheat feed using multiple hoppers.
b) Quantity of seed
c) Grinding of seeds using chilled cast iron roller blades and
d) Temperature of the grinder during the crushing.

The intermediate goes to purifier machine and rest goes to roller mill for further grinding and separating. The roller mill is generally vertically shaped so that it the material circulates through iron roller blades rather than spinning. Roller mill is placed on a base which consists of a motor for turning the roller blade and has control on its surface. The space between the rotating rollers blades are adjusted to get the consistency as desired by the customer. To separate endosperm of the grain from bran and germ the roller mill which are highly powered are used. Then it is crushed and grinded to fine flour particles. In recent years the domestic floor mill is operated manually. Operating the domestic floor mill is being carried out manually. In this paper a new method is proposed using fuzzy logic for automatic grinding which removes the manual operation and increase the work efficacy.

***Fuzzy logic:*** Fuzzy logic is widely used in machine control. The term "fuzzy" refers to the fact that the logic involved can deal with concepts that cannot be expressed as the "true" or "false" but rather as "partially true". Although alternative approaches such as genetic algorithms and neural networks can perform just as well as fuzzy logic in many cases, fuzzy logic has the advantage that the solution to the problem can be cast in terms that human operators can understand, so that their experience can be used in the design of the controller. This makes it easier to mechanize tasks that are already successfully performed by humans.

***Fuzzy controllers:*** Fuzzy controllers are very simple conceptually. They consist of an input stage, a processing stage, and an output stage. The input stage maps sensor or other inputs, such as switches, thumbwheels, and so on, to the appropriate membership functions and truth values. The processing stage invokes each appropriate rule and generates a result for each, then combines the results of the rules. Finally, the output stage converts the combined result back into a specific control output value.

The most common shape of membership functions is triangular, although trapezoidal and bell curves are also used, but the shape is generally less important than the number of curves and their placement. From three to seven curves are generally appropriate to cover the required range of an input value, or the "universe of discourse" in fuzzy jargon.

As discussed earlier, the processing stage is based on a collection of logic rules in the form of IF-THEN statements, where the IF part is called the "antecedent" and the THEN part is called the "consequent". Typical fuzzy control systems have dozens of rules.

***Example:*** Consider a rule for a motor rotation:

IF (quantity of grain is **"high"**) and (hardness of the grain is **"soft"**) and (temperature is **"cold"**) THEN turn (motor speed is **"average"**)

This rule uses the truth value of the "temperature", "quantity" and "hardness" input, which is some truth value of "cold", "high" and "soft" respectively to generate a result in the fuzzy set for the "motor speed" output, which is some value of "average". This result is used with the results of other rules to finally generate the crisp composite output. Obviously, the greater the truth value of "cold", the higher the truth value of "high", though this does not necessarily mean that the output itself will be set to "high" since this is only one rule among many. In some cases, the membership functions can be modified by "hedges" that are equivalent to adverbs. Common hedges include "low", "near", "close to", "approximately", "very", "slightly", "too", "extremely", and "somewhat". These operations may have precise definitions, though the definitions can vary considerably between different implementations. "Very", for one example, squares membership functions; since the membership values are always less than 1, this narrows the membership function. "Extremely" cubes the values to give greater narrowing, while "somewhat" broadens the function by taking the square root.

In practice, the fuzzy rule sets usually have several antecedents that are combined using fuzzy operators, such as AND, OR, and NOT, though again the definitions tend to vary: AND, in one popular definition, simply uses the minimum weight of all the antecedents, while OR uses the maximum value. There is also a NOT operator that subtracts a membership function from 1 to give the "complementary" function.

There are several ways to define the result of a rule, but one of the most common and simplest is the "max-min" inference method, in which the output membership function is given the truth value generated by the premise.

Rules can be solved in parallel in hardware, or sequentially in software. The results of all the rules that have fired are "defuzzified" to a crisp value by one of several methods. There are dozens, in theory, each with various advantages or drawbacks.

The "centroid" method is very popular, in which the "center of mass" of the result provides the crisp value. Another approach is the "height" method, which takes the value of the biggest contributor. The centroid method favors the rule with the output of greatest area, while the height method obviously favors the rule with the greatest output value.

***Design of Algorithms for Automation of Domestic Flourmill:*** The controller design algorithm is used to design the input stage, processing stage and output stage for automation of domestic flour mill. The controller design algorithm achieves the effective range of grinding with improved control strategy. The algorithm uses four membership function divide over a scale range of 1 to 100, 1 to 10, 1 to 50 and 1 to 1800 for Quality, hardness, temperature and motor speed respectively. Here there are three input variable called "Quality ", " Hardness " and " Temperature " while the output of this proposed algorithm is "Motor speed", the membership function and ranges of variable are explained in the following table.

Table 1: Range of input variable “Quantity” (in gm’s)

| Membership Function | Range |
|---|---|
| POOR | 1-40 |
| AVERAGE | 25-75 |
| GOOD | 60-100 |

Table 2: Range of input variable “Hardness” (in %)

| Membership Function | Range |
|---|---|
| POOR | 1-4 |
| AVERAGE | 3-7 |
| GOOD | 7-10 |

Table 3: Range of input variable “Temperature” (in Celsius(°C))

| Membership Function | Range |
|---|---|
| POOR | 1-25 |
| AVERAGE | 15-40 |
| GOOD | 35-50 |

Table 4: Range of output variable “Motor speed” (in RPM)

| Membership Function | Range |
|---|---|
| POOR | 1-700 |
| AVERAGE | 550-1500 |
| GOOD | 1350-1800 |

Fig. 1: Membership Function for input variable "Quantity"

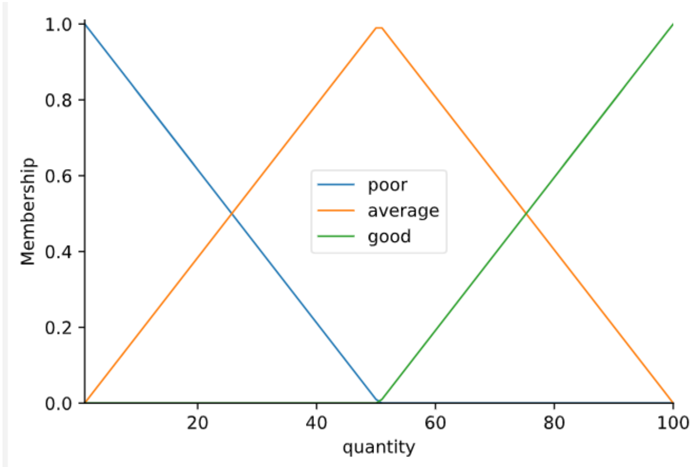



Fig. 2: Membership Function for input variable "Hardness"

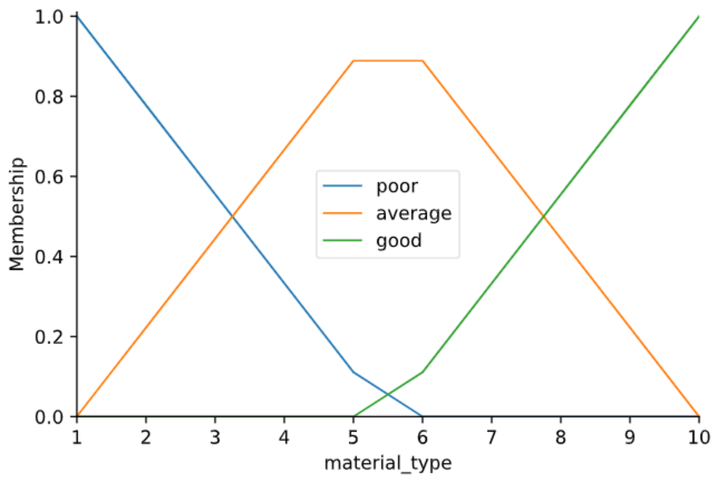



Fig. 3: Membership Function for input variable "Temperature"

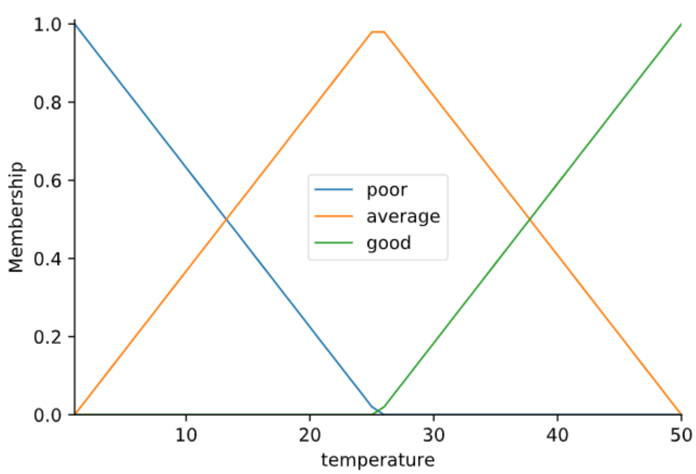
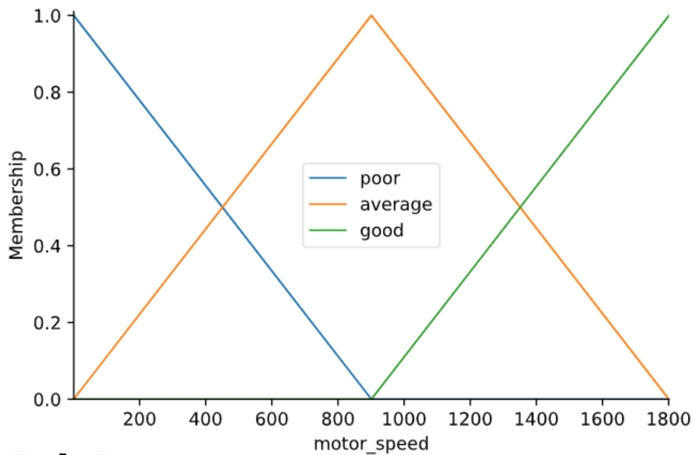


Fig. 4: Membership Function for input variable “Motor speed”



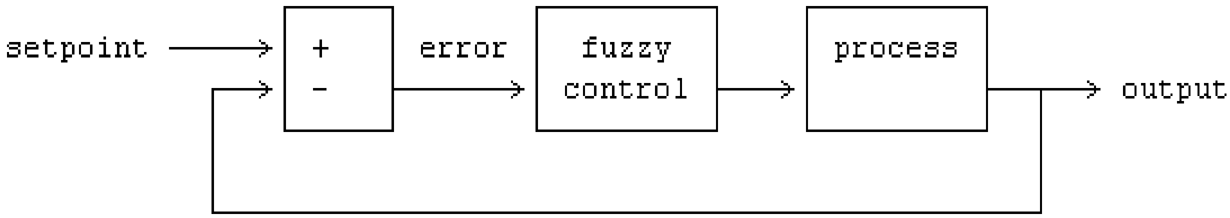

## ***Rule Base:***

Table 1: Range of input variable “Quantity” (in gm’s)

| Quantity | Hardness | Temperature | Motor speed |
|---|---|---|---|
| POOR | POOR | POOR | POOR |
| POOR | POOR | AVERAGE | POOR |
| POOR | POOR | GOOD | POOR |
| POOR | AVERAGE | POOR | POOR |
| POOR | AVERAGE | AVERAGE | AVERAGE |
| POOR | AVERAGE | GOOD | AVERAGE |
| POOR | GOOD | POOR | GOOD |
| POOR | GOOD | AVERAGE | GOOD |
| POOR | GOOD | GOOD | POOR |
| AVERAGE | POOR | POOR | GOOD |
| AVERAGE | POOR | AVERAGE | AVERAGE |
| AVERAGE | POOR | GOOD | POOR |
| AVERAGE | AVERAGE | POOR | AVERAGE |
| AVERAGE | AVERAGE | AVERAGE | AVERAGE |
| AVERAGE | AVERAGE | GOOD | POOR |
| AVERAGE | GOOD | POOR | GOOD |
| AVERAGE | GOOD | AVERAGE | GOOD |
| AVERAGE | GOOD | GOOD | AVERAGE |
| GOOD | POOR | POOR | AVERAGE |
| GOOD | POOR | AVERAGE | AVERAGE |
| GOOD | POOR | GOOD | AVERAGE |
| GOOD | AVERAGE | POOR | GOOD |
| GOOD | AVERAGE | AVERAGE | GOOD |
| GOOD | AVERAGE | GOOD | AVERAGE |
| GOOD | GOOD | POOR | GOOD |
| GOOD | GOOD | AVERAGE | GOOD |
| GOOD | GOOD | GOOD | POOR |

### *Building a fuzzy controller:*

Consider implementing with a microcontroller chip a simple feedback controller:




A fuzzy set is defined for the input error variable "e", and the derived change in error, "delta", as well as the "output", as follows

***Conclusion:*** With the proposed model the automation of flourmill becomes an easier task and the mill operates at safer speed. A person without the knowledge of technical concepts can also use the flourmill. By using Centroid of gravity method the value for "Range" is calculated and from the results shown by the rule viewer it can be verified as well. To illustrate, if the Quantity is 74 (AVERAGE) and Material Type is 4(AVERAGE) and the temperature of grinding is 45(GOOD) so the speed of grinding motor is 805 (AVERAGE). With the proposed model the efficiency of the flourmill can be increased as it is operated on its optimal speed. Further the same can be utilized for various other grinding devices for industrial applications as well.