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Expert System That Calculates How Much Efficiency Can Be Obtained Under Certain Conditions.

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Old Title : Whether air hot balloon can fly or not expert system.

New Title : Expert system that calculates how much efficiency can be obtained under certain conditions.

Project Summary : In this project, an Expert System was designed to show the level of efficiency that students can achieve during their study by evaluating the parameters of temperature and sound intensity in an environment.

Details Of The Expert System : This project was developed using the MATLAB programming language. We created the knowledge base section with the data we collected from the sources mentioned in the references section and the people around us. We created our Rule Base with the Fuzzy Logic method. In the Inference section, we provided meaningful outputs by evaluating the temperature and sound intensity inputs entered by the end-user from the rules we created before, by making use of the Mamdani analysis.

The project was completed by using the MATLAB R2022a version and the "Fuzzy Logic Designer" tool opened by typing command window fuzzy.

With the tables below, you can examine which temperature values are in which categories and how we accept the sound intensity in which ranges.

Temperature(°C)				
Very Cold(VC)	Cold (C)	Normal (N)	Hot (H)	Very Hot (VH)
[-10 -2.5 10]	[0 5 20]	[15 30 40]	[30 40 50]	[40 55 65]

Noise(dB)						
Very Very Quite (VVQ)	Very Quite (VQ)	Quite (Q)	Normal (N)	Loud (L)	Very Loud (VL)	Very Very Loud (VVL)
[0 0 20]	[15 20 30]	[30 40 50]	[45 55 60]	[55 65 70]	[65 75 90]	[75 100 100]

Decibel Volume Level Examples:

• Normal breathing : 0 Decibels • Leaf rustling: 10 Decibels • A house in a quiet place: 30 decibels • Average house : 40 Decibels • Workplace: 50 Decibels

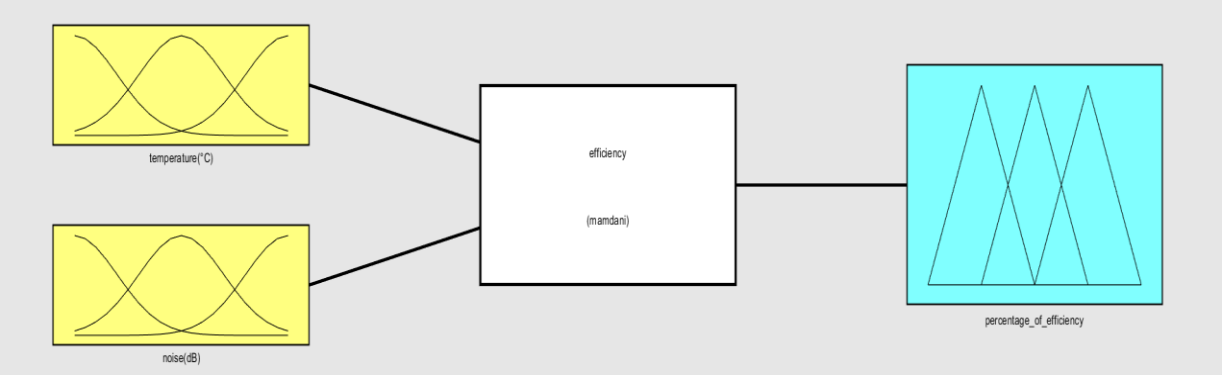
• Two people talking: 60 Decibels • Crowded traffic: 70 Decibels

• Sound that disturbs the ear: 85 Decibels

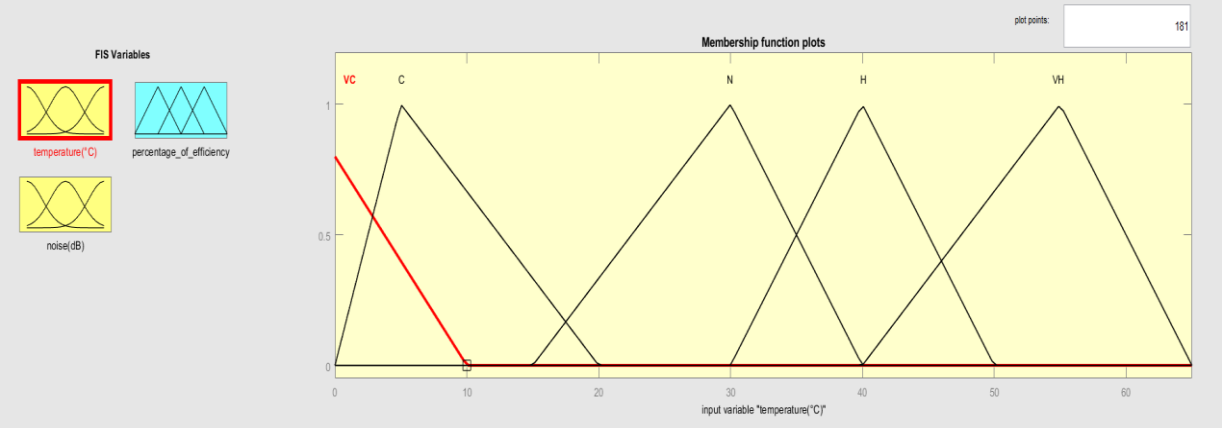
Temperature(°C)						
		VC	**C**	**N**	**H**	**VH**
Noise(dB)	**VVQ**	Very Bad	Bad	Bad	Very Bad	Very Bad
	VQ	Very Bad	Bad	Very Good	Normal	Bad
	Q	Bad	Normal	Very Good	Good	Bad
	N	Bad	Normal	Normal	Normal	Bad
	L	Bad	Normal	Good	Normal	Bad
	VL	Very Bad	Bad	Normal	Bad	Very Bad
	VVL	Very Bad	Very Bad	Bad	Bad	Very Bad

Range of output values				
Very Bad	Bad	Normal	Good	Very Good
[0 0 20]	[10 25 40]	[35 50 65]	[60 75 90]	[85 100 100]

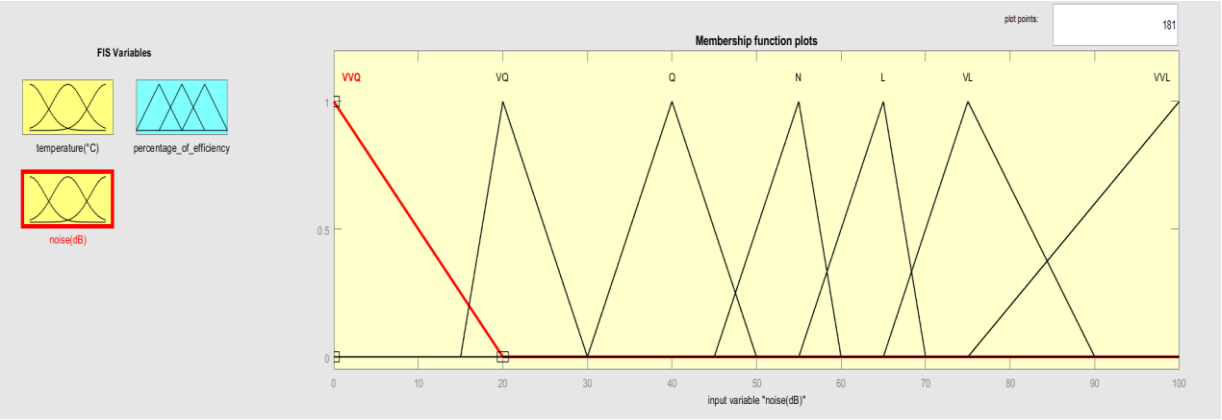
Using the MATLAB program, we analyzed the inputs and outputs we mentioned above with the Fuzzy Logic Mamdani method and visualized them as follows.



Main Structure



Temperature Graph



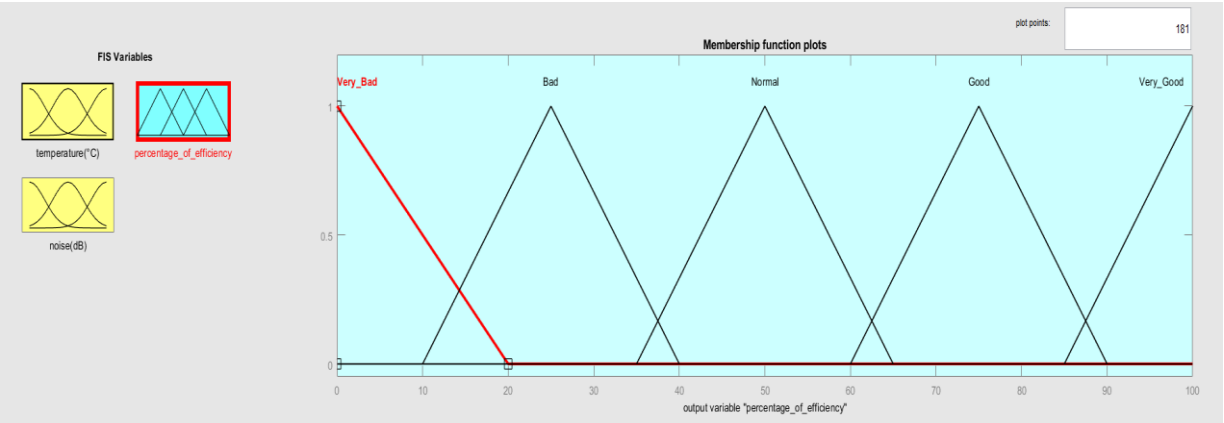
Noise Graph

1. If (temperature(°C) is VC) and (noise(dB) is VVQ) then (percentage_of_efficiency is Very_Bad) (1)
2. If (temperature(°C) is VC) and (noise(dB) is VQ) then (percentage_of_efficiency is Very_Bad) (1)
3. If (temperature(°C) is VC) and (noise(dB) is Q) then (percentage_of_efficiency is Bad) (1)
4. If (temperature(°C) is VC) and (noise(dB) is N) then (percentage_of_efficiency is Bad) (1)
5. If (temperature(°C) is VC) and (noise(dB) is L) then (percentage_of_efficiency is Bad) (1)
6. If (temperature(°C) is VC) and (noise(dB) is VL) then (percentage_of_efficiency is Very_Bad) (1)
7. If (temperature(°C) is VC) and (noise(dB) is VVL) then (percentage_of_efficiency is Very_Bad) (1)
8. If (temperature(°C) is C) and (noise(dB) is VVQ) then (percentage_of_efficiency is Bad) (1)
9. If (temperature(°C) is C) and (noise(dB) is VQ) then (percentage_of_efficiency is Bad) (1)
10. If (temperature(°C) is C) and (noise(dB) is Q) then (percentage_of_efficiency is Normal) (1)
11. If (temperature(°C) is C) and (noise(dB) is N) then (percentage_of_efficiency is Normal) (1)
12. If (temperature(°C) is C) and (noise(dB) is L) then (percentage_of_efficiency is Normal) (1)
13. If (temperature(°C) is C) and (noise(dB) is VL) then (percentage_of_efficiency is Bad) (1)
14. If (temperature(°C) is C) and (noise(dB) is VVL) then (percentage_of_efficiency is Very_Bad) (1)
15. If (temperature(°C) is N) and (noise(dB) is VVQ) then (percentage_of_efficiency is Bad) (1)
16. If (temperature(°C) is N) and (noise(dB) is VQ) then (percentage_of_efficiency is Very_Good) (1)
17. If (temperature(°C) is N) and (noise(dB) is Q) then (percentage_of_efficiency is Very_Good) (1)
18. If (temperature(°C) is N) and (noise(dB) is N) then (percentage_of_efficiency is Normal) (1)
19. If (temperature(°C) is N) and (noise(dB) is L) then (percentage_of_efficiency is Good) (1)
20. If (temperature(°C) is N) and (noise(dB) is VL) then (percentage_of_efficiency is Normal) (1)
21. If (temperature(°C) is N) and (noise(dB) is VVL) then (percentage_of_efficiency is Bad) (1)

22. If (temperature(°C) is H) and (noise(dB) is VVQ) then (percentage_of_efficiency is Very_Bad) (1)
23. If (temperature(°C) is H) and (noise(dB) is VQ) then (percentage_of_efficiency is Normal) (1)
24. If (temperature(°C) is H) and (noise(dB) is Q) then (percentage_of_efficiency is Good) (1)
25. If (temperature(°C) is H) and (noise(dB) is N) then (percentage_of_efficiency is Normal) (1)
26. If (temperature(°C) is H) and (noise(dB) is L) then (percentage_of_efficiency is Normal) (1)
27. If (temperature(°C) is H) and (noise(dB) is VL) then (percentage_of_efficiency is Bad) (1)
28. If (temperature(°C) is H) and (noise(dB) is VVL) then (percentage_of_efficiency is Bad) (1)
29. If (temperature(°C) is VH) and (noise(dB) is VVQ) then (percentage_of_efficiency is Very_Bad) (1)
30. If (temperature(°C) is VH) and (noise(dB) is VQ) then (percentage_of_efficiency is Bad) (1)
31. If (temperature(°C) is VH) and (noise(dB) is Q) then (percentage_of_efficiency is Bad) (1)
32. If (temperature(°C) is VH) and (noise(dB) is N) then (percentage_of_efficiency is Bad) (1)
33. If (temperature(°C) is VH) and (noise(dB) is L) then (percentage_of_efficiency is Bad) (1)
34. If (temperature(°C) is VH) and (noise(dB) is VL) then (percentage_of_efficiency is Very_Bad) (1)
35. If (temperature(°C) is VH) and (noise(dB) is VVL) then (percentage_of_efficiency is Very_Bad) (1)

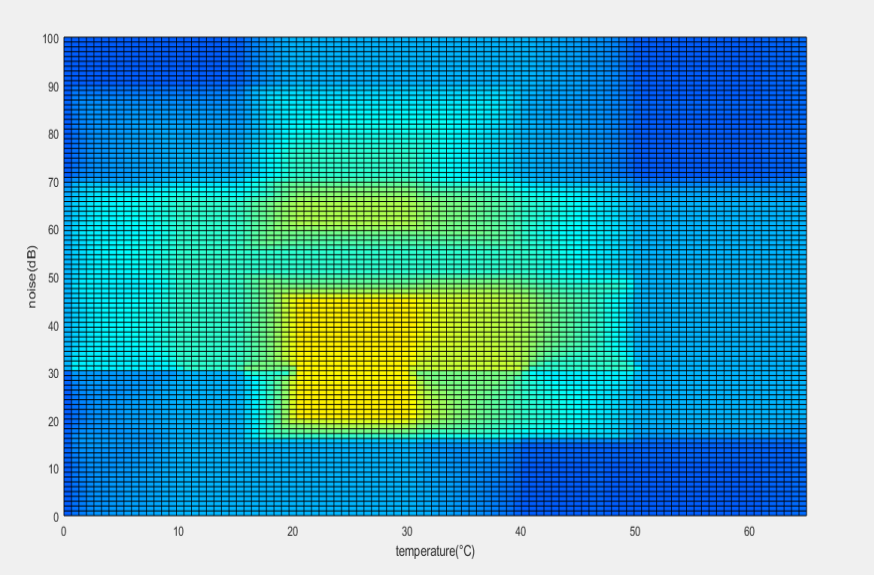
Rules

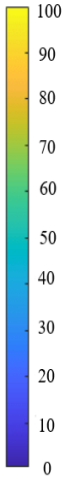
Using the above Inputs and Rules, the following Output graph was obtained.



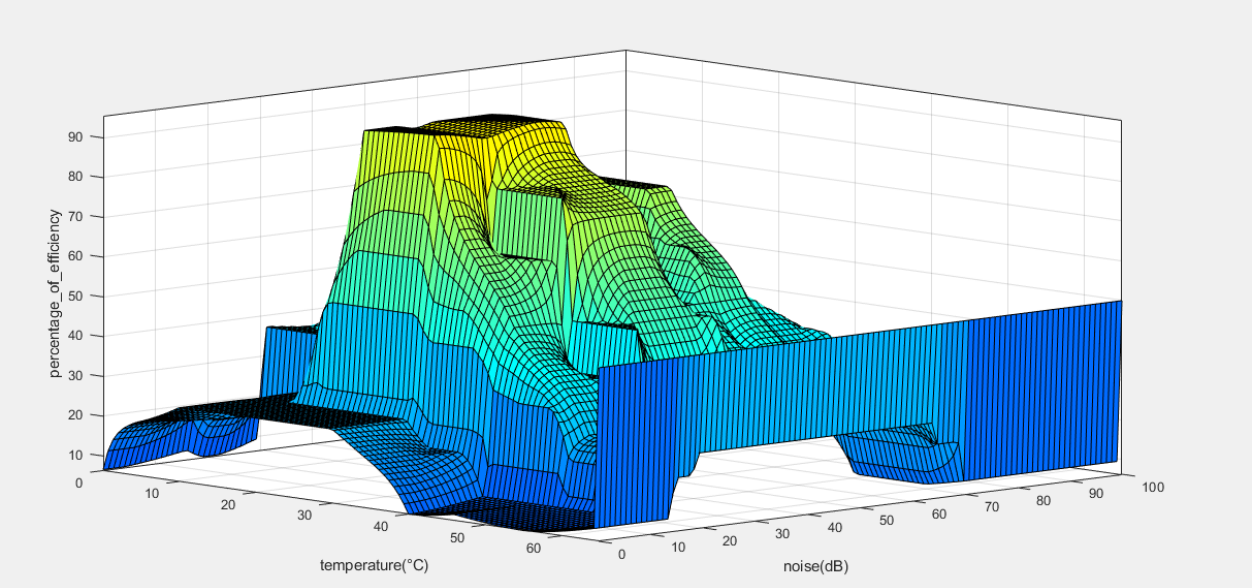
Output Graph

Yellow areas in Surface 2D and 3D are the most achievable with 85% - 100% grade in the Very Good category, light orange and light green areas have good efficiency with 60% - 90% in the Good category, light blue and light green areas 35% - 65% level in the Normal category indicates the medium level of efficiency, the light blue areas indicate the low level of efficiency that can be obtained in the range of 10% - 40% in the Bad category, the dark blue areas indicate the lowest level of working efficiency that can be obtained at the 0 - 20% levels in the Very Bad category.





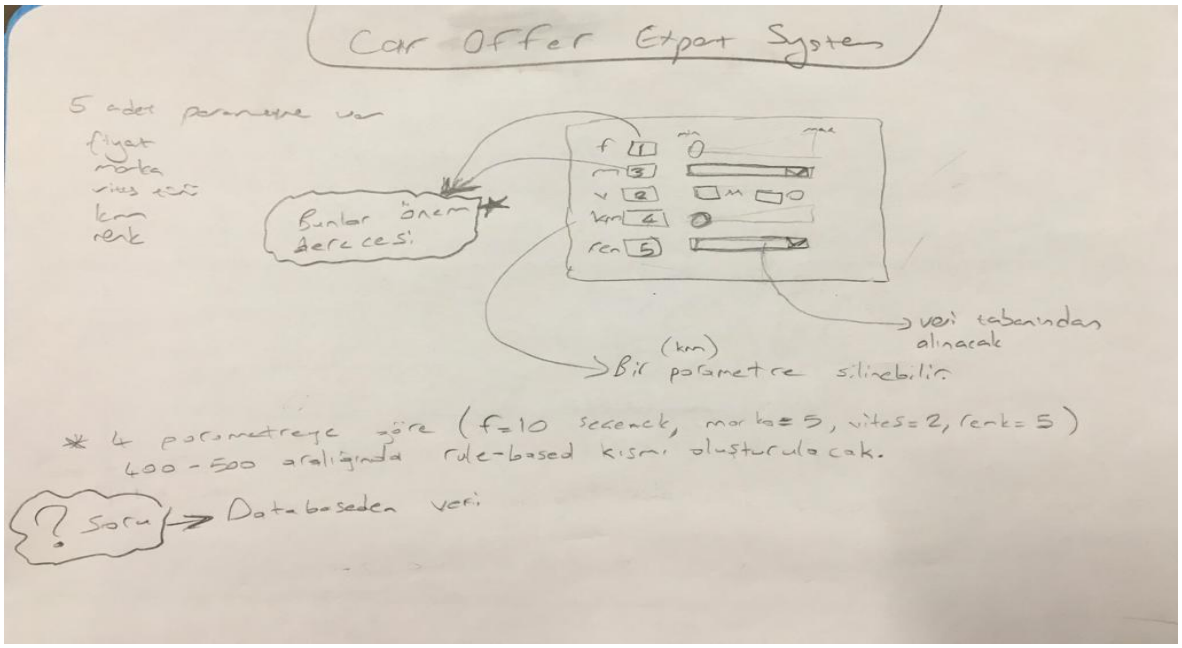
Surface 2D degree of suitability



Surface 3D

Failures and Conclusion

Since the project assignment was given, we have tried many projects. The first and the one we spent the most time on, the "Hot Air Balloon" project, ended in failure. The biggest reason for this was that we did not get the feedback we wanted from the companies we contacted to create the knowledge base. So we decided to create the knowledge base part ourselves, but we could not handle the input values such as temperature, air pressure, wind intensity in a consistent way and extract meaningful data from them. These data were not compatible with real conditions and situations. Since the reliability of the Expert System we would create from here would be weak, we started to think about another project. Our second project was the "Car Offer Expert System". Here we thought long and hard about many components and made comments. We were thinking of taking the inputs of Price, Brand, Gear Type, Color, Mileage and ranking them according to the user's priority level. We were aiming to recommend the most suitable cars to the user according to the ranking and the inputs entered. However, after consulting with our teacher, we realized that the inference system part could not be created in this project. The biggest reason for this was that we would take the data we would receive from an online car sales website and present it to the user after passing it through a certain sql query. Due to the reasons mentioned above, we started to think about a new project and decided to do a project called "Whether To Study Or Not In The Specific Conditions", the details of which can be found in the document.



Failure of “Car Offer Expert Sytem”

References

- https://www.mathworks.com/help/matlab/ref/surf.html

- https://www.mathworks.com/help/matlab/surface-and-mesh-plots-1.html

- https://cdn.bartin.edu.tr/cevre/d2a58cf6-55c1-42ad-b4dc-e05c5446656e/3.-hafta-.pptx