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Intelligent Computing for the Internet of Things

Report: Project 1.2

Intro:

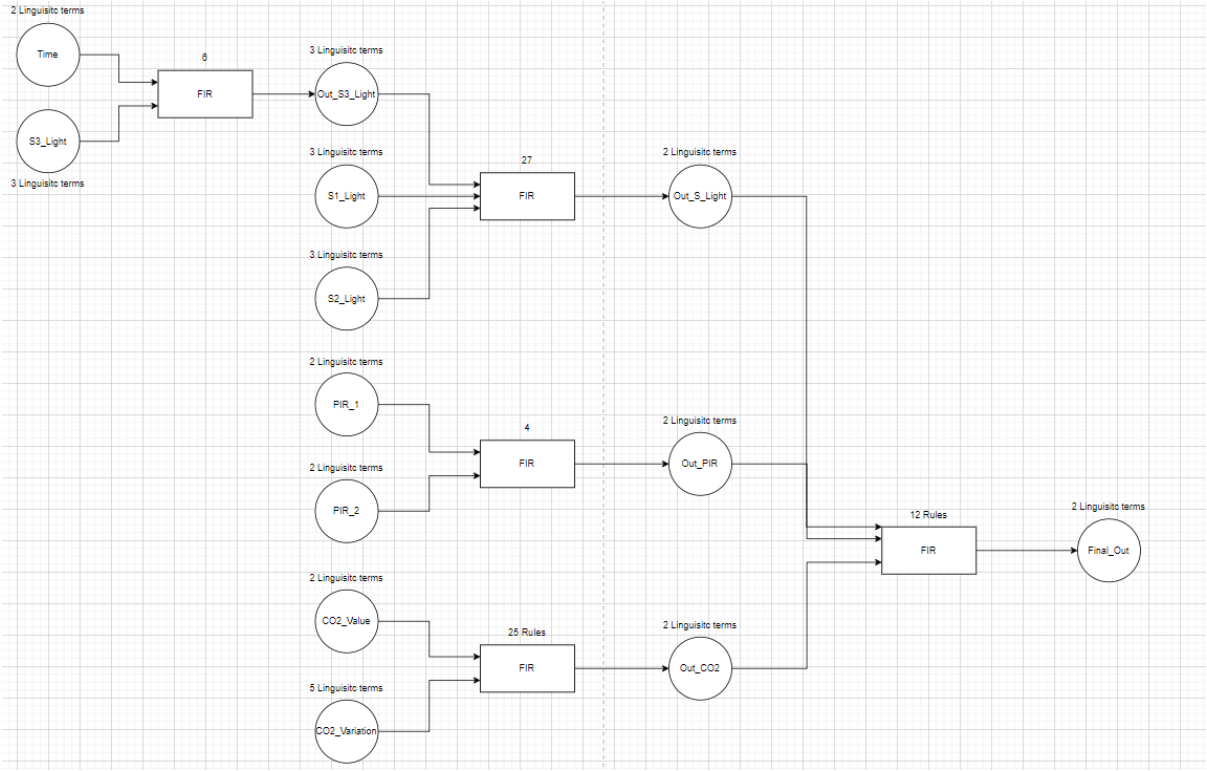
Before starting I am going to explain what has been done and what hasn't. The fuzzy system and all its rules have been made and work. We get a confusion matrix, the precision, recall and F1 of the "3 or more persons in the room". However, because of time constraints we were not able to create the neural network to be able to compare to our fuzzy system. The TestMe file also does not exist as it simply the same file as main.py.

Let's move on to our work on the data set and which columns we kept and which we removed. Firstly, there are three columns that we removed because we did not think they were

necessary for our fuzzy system. These were the temperature sensors that we thought had values way to close to each other and without much variability. This meant that it was difficult to determine or to divide them into our linguistic terms.

Then, another column that we thought about removing but we kept was the CO2 column. Initially we didn't see how we could use this column as the values changed very slowly and were not very useful to each 30 seconds that represented the time between each line of our dataset. However, after a little reflection and reading the statement in more detail we decided that we could create a new column in our dataset that represented the variation of the CO2 in the last 5 minutes. Later we will see in more detail how we created this column.

Our Diagram:



Above we have the diagram we created to organize our ideas and see how we were going to join columns to create our fuzzy system. As we can see we created a fuzzy that had for output the time of day and the light sensor number three because this one was closer to the window and could be affected by the light of the day. Then we joined all light sensors and got an output that based on the lights turned on gave us a prediction on how many people were inside the room. Keep in mind that this diagram was the first diagram we created and so the number above the fuzzy systems do not represent the final number of rules or the number of linguistic terms each input has.

Initially we had three linguistic terms for the light sensors but after working a little on the project we decided to only have "on" and "off" as linguistic terms. This allowed us to have easier rules for our fuzzy system of the lights.

For the PIRs it was easy to do because they have already binary values. The only problem was that they could only let us know if there were people in the room and we assumed that if the two sensors were turned on there were at least two people in the room. This is why we have the output as crowded (image bellow) even though we are not sure if there are 2 or more people in the room with these sensors.

Out PIR		PIR1	
		0	1
PIR2	0	empty	empty
	1	empty	crowded

For the CO2 part of our fuzzy system as we have talked previously, we created a new column representing the variation of the CO2 in the room. The variation we created is a formula we created and probably something that is not perfect in any way. The content of this column is a value between 0 and 4 that respectively correspond to “very slow”, “slow”, “medium”, “fast”, “very fast”. We can see bellow on the table how the rules we created work.

Out CO2		CO2 Var				
		very slow	slow	medium	fast	very fast
CO2 Val	low	empty	empty	empty	empty	crowded
	medium	empty	empty	empty	crowded	crowded
	high	empty	empty	empty	crowded	crowded

Final words:

```
Confusion Matrix [[7992  459  710  473]
 [   4    9  174  308]
 [   0    0    0    0]
 [   0    0    0    0]]
Macro-Precision:  0.2546826297764267
Macro-Recall:  0.21193594655292808
Macro-F1:  0.231332000996602
```

Above we can see the values we get from comparing our fuzzy systems result to the “Persons” column which we altered to have 1 when the value is 3 and 0 when the value is 1 or 2. Clearly these values are not good and don’t even come close to the predictions we did in the past project. This could be due to multiple factors. Firstly, we might have lost information by dividing our project into various fuzzy systems. Secondly, we use a triangular membership function that could not be the best function as a trapezoid could be better. Finally, these errors could be due to errors on the rules we created that could be too vague or not enough.