SMART MATTRESS SYSTEM

Applied Artificial Intelligence System Project-2

Username: **Cyclops**

Domain : Fuzzy Logic - Control Systems

INDEX

Abstract:

Smart Mattress is a fuzzy logic control system that has internal temperature control system as well as automated recliner system that changes the bed's posture based on how sleepy is the person.

Features:

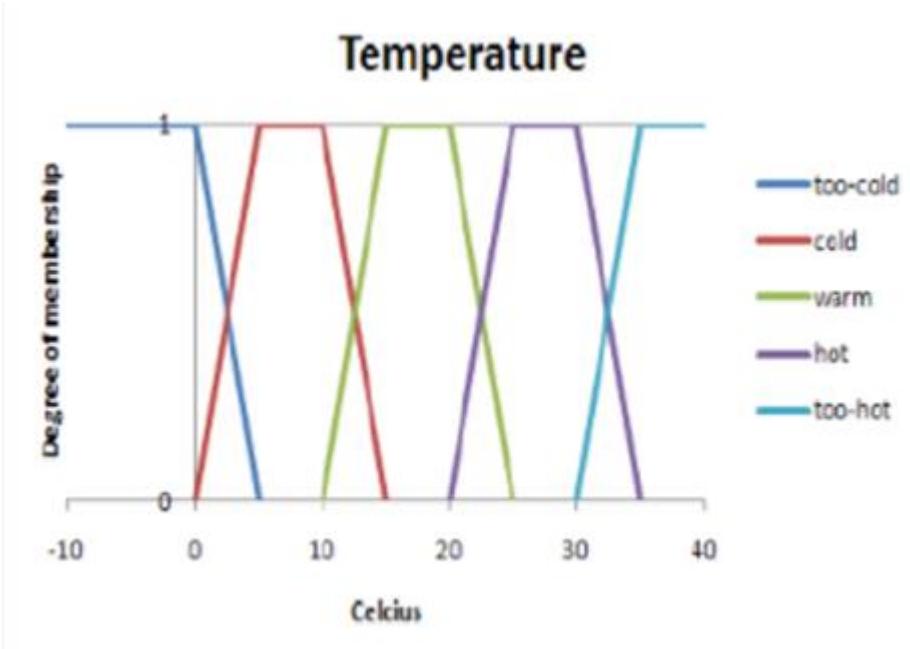
- The system has intelligent control system that senses the current pressure on the mattress and starts the temperature control only when the user is lying down based on pressure readings of the sensor.
- System calculated the mean pressure of the person when lying down based on height and weight of the person. It uses body surface area calculations to compute the pressure exerted by the body when lying down
- It is capable of controlling the temperature of mattress based on the outside temperature eg. If the current temperature is hot then system calibrates to decrease the temperature to move the temperature towards a normal range
- The mattress has an intelligent posture system that changes its position based on the sleepiness of the person.
- It takes input as current temperature, height , weight and sleepiness of person to compute the change in temperature and correct posture .

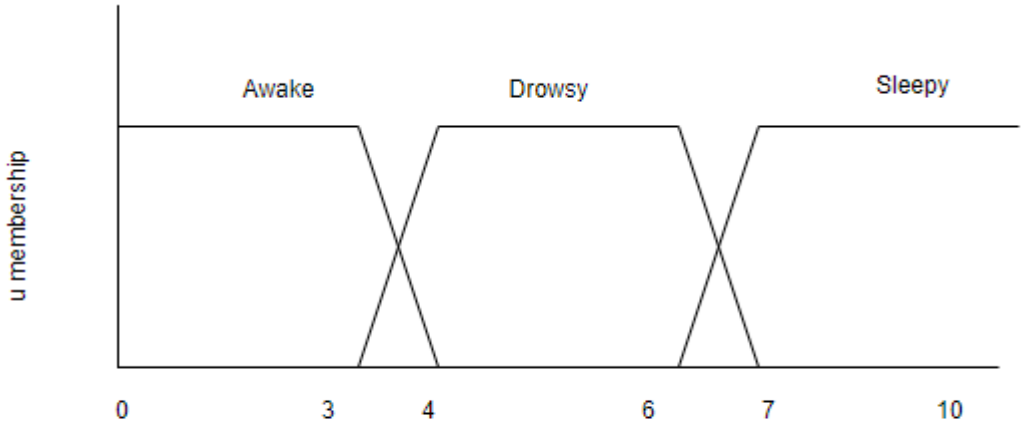
Function and Rule Description:

#	Function/ Rule	Name	Description	References and links
1.	Rule	welcome	To give welcome banner to the user	
2.	Rule	ask-question-by-id	to ask a question and assert it answer to the answer template	
3.	Rule	request-height, weight, temperature, sleepy value	To ask specific questions from the user	
4.	Function	is-type	It performs validation on the input	
5.	Function	ask-user	It reads the answer provided the validation succeeds otherwise again request for correct input	
6.	Function	convert-to-m	it converts the foot input to m	
7.	Function	bsa	Function to calculate body surface area	BSA wiki Ground pressure
8.	Function	pressure	Function to calculate pressure on the mattress	
9.	Rule	init	Main Function that contains all the fuzzy sets for calculations	
10.	Rule	pressure_true	Checks if there is a fuzzy match between the current pressure and the calculated ground pressure of the person lying down	
11.	Rule	too-cold	if fuzzy match temp->too-cold then increase hot change by “HB” and cold change by “Z”	
12.	Rule	cold_n_too-cold	if fuzzy match temp->cold & too-cold then increase hot change by “HM” and cold change by “Z”	
13.	Rule	cold	if fuzzy match temp->cold then increase hot change by “HS” and cold change by “Z”	
14.	Rule	warm_n_cold	if fuzzy match temp->warm & cold then increase hot change by “HS” and cold change by “Z”	
15.	Rule	warm	if fuzzy match temp->warm then increase hot change by “Z” and cold change by “Z”	

16.	Rule	warm_n_hot	if fuzzy match temp->warm & hot then increase cold change by “CS” and hot change by “Z”	
17.	Rule	hot	if fuzzy match temp->hot then increase cold change by “CM” and hot change by “Z”	
18.	Rule	hot_n_too-hot	if fuzzy match temp->hot & too-hot then increase cold change by “CM” and hot change by “Z”	
19.	Rule	too-hot	if fuzzy match temp->hot & too-hot then increase cold change by “CB” and hot change by “Z”	
20.	Rule	awake	if awake current angle < =180 then change angle by “CN”	Sleep scale
21.	Rule	drowsy	if drowsy and current angle < =180 then change angle by “CZ”	
22.	Rule	sleepy	if sleepy and current angle >=120 then change angle by “CP”	
23.	Rule	defuzzify	deffuzify the change of change temperature to finally compute the crisp value	
24.	Rule	defuzzify sleep	deffuzify the change of change sleep to finally compute the crisp value	

Fuzzy Sets





Sleep Fuzzy Set

Usage Manual

Instructions

Extract the project mattress and load the project in the Eclipse and then load fuzzyJ-2.0 file in your java reference library in eclipse. It contains the JAR file for fuzzy extension. Then run the filemattress.clp from eclipse.

Validation and Assumptions

- Weight is assumed to be in kgs and system accepts numerical value only.
- Height is assumed to be in numeric and in inches, for the calculations related to BSA (body surface area) .
- System takes only three values 1, 2 and 3 for sleepy
- System takes temperature within the range of -35.0 to 100.0 Celcius.
- System has asserted the current value of pressure as 400 that I have assumed will be given by the sensor
- System has assumed the current angle of the system as 150 which it has assumed to be coming from the sensor

Future Score

- In future the the bed will take sleep index value based on the brain wave of user or estimate based on PERCLOS (Percentage eye openness tracking).

Sample Runs

Run #1

It accepts all the input from the user (like name, height, weight , sleepiness etc)so no assert command is required.

```
Jess, the Rule Engine for the Java Platform
Copyright (C) 2008 Sandia Corporation
Jess Version 7.1p2 11/5/2008

This copy of Jess will expire in 1817 day(s).


 Please and enter your name Cyclpos

************************************************************

Hello Cyclpos.
Welcome to Smart Mattress control system
Just enter your details
So that Mattress can be customised based on your prefernces
The process will take less than 5min for caibration


*******************************************************

What is your height
Please enter height in inches (1 foot = 12 inches) 70
 Current temperature readings
Please enter current temperature readings (-35 to 100)45
How sleepy are you feeling
1.Awake  2.Drowsy  3.Sleepy 1

Please enter your weight (in kgs) 65
pressure matched
-----------------------------------------
-----------------------------------------

Mattress calibrated based on your readings.
 Following are the calibration of readings based on the outside temperature
 and your current posture that is based on pressure calculated on mattress

Hot Change 0.0
Cold change -3.5355339059327378

-----------------------------------------
-----------------------------------------

Angle Change of Mattress-2.5
```

Run #2

```
Jess, the Rule Engine for the Java Platform
Copyright (C) 2008 Sandia Corporation
Jess Version 7.1p2 11/5/2008

This copy of Jess will expire in 1817 day(s).


 Please and enter your name Swatcats

************************************************************

Hello Swatcats.
Welcome to Smart Mattress control system
Just enter your details
So that Mattress can be customised based on your prefernces
The process will take less than 5min for caibration


*********************************************************

What is your height
Please enter height in inches (1 foot = 12 inches) 74
 Current temperature readings
Please enter current temperature readings (-35 to 100)45
How sleepy are you feeling
1.Awake  2.Drowsy  3.Sleepy 2

Please enter your weight (in kgs) 78
pressure matched
-------------------------------------------
-------------------------------------------

Mattress calibrated based on your readings.
 Following are the calibration of readings based on the outside temperature
 and your current posture that is based on pressure calculated on mattress

Hot Change 0.0
Cold change -3.5355339059327378

-------------------------------------------
-------------------------------------------

Angle Change of Mattress2.5
```

Test Cases:

Test cases are supposed to be input values to the system only

- Name: Wolverine
  Height: 70
  Weight: 96
  Temperature: 45
  Sleepiness: 2

- Name: Thunderbird
  Height: 65
  Weight: 100
  Temperature: 25
  Sleepiness: 1

- Name: Goku
  Height: 80
  Weight: 100
  Temperature: 90
  Sleepiness: 2

- Name: Knightingale
  Height: 80
  Weight: 100
  Temperature: 90
  Sleepiness: 2

- Name: Tweety
  Height: 45
  Weight: 100
  Temperature: 90
  Sleepiness: 2

References:

- https://www.researchgate.net/publication/260232896_Temperature_Control_using_Fuzzy_Logic
- https://www.seeingmachines.com/technology/
- http://halls.md/formula-body-surface-area-bsa/
- https://en.wikipedia.org/wiki/Body_surface_area#Calculation
- https://en.wikipedia.org/wiki/Ground_pressure
- Sleep : https://en.wikipedia.org/wiki/Multiple_Sleep_Latency_Test
- Sleepiness scale : http://healthysleep.med.harvard.edu/narcolepsy/diagnosing-narcolepsy/epworth-sleepiness-scale
- http://www.ergoneers.com/faq/index.php?action=artikel&cat=3&id=154&artlang=en