

## **AI Activity: 5**

**Paper title: Fuzzy Logic Controller Design for Intelligent Robots**

### **Part A: Paper Summary:**

The paper is based on the controllability of a six-legged robot with the fuzzy logic controller at the helm deciding its course of action within a complex environment. In this era of Industry 4.0 when the dependency on autonomous tasks keeps on increasing, it is preferable if robots possess higher intelligence which increases their adaptability in any kind of environment. This six-legged robot had ultrasonic sensors attached all around which increased its sensory awareness and followed an 8-bit signal transmission protocol for low latency. For any kind of robot, Navigation and Obstacle avoidance are vital functions that boost the intelligence factor. Fuzzy logic is used to perform fuzzification, fuzzy inference and defuzzification to make sharp decisions that form the basis of a robot's behaviour to navigate and avoid obstacles within the path. Fuzzy logic is also a better option when we have to process inaccurate input signals which are in the case of uncertain environments. The precise changes made in certain scenarios like how much a robot actually rotate to avoid the obstacle is vital. The multilegged robots fall under the category of bionic robots that mimics the behaviour of living creatures such as insects. Here, the robot was training using Fuzzy logic to achieve functions such as Obstacle avoidance and Wall following. In the former case, when the distance is not so considerable it selects the appropriate right or left turn while in the latter case, the sensors sense the nearest wall and try to walk along the boundaries of the desired wall. The six-legged robot was tested under 3 varied scenarios namely – Obstacle avoidance, Dead End with Three Surrounding Walls & Wall Following - Obstacle Avoidance. The max-min operation was used in the fuzzy inference while the centre-of-gravity method was adopted in fuzzification. The robot completed the desired paths keeping in mind that obstacle avoidance takes precedence over wall following. These three scenarios examined the bionic abilities displayed by the robot in complex environments. In the future, the robot can have additional capabilities enhancing intelligence by using more varied sensors.

**Part B: Recommendation:** According to your interest, discuss one AI application based on fuzzy logic controller design with reference to above paper.

The Fuzzy logic application can be used successfully in firefighting. The six-legged robot when made fireproof can be used to explore extreme hot conditions quickly for discovering any person stuck within a building. The logic can be used to provide an algorithm such that the robot enters those areas which are insanely hot and less hot regions take less priority. This way, life can be saved without any kind of delay. Using Fuzzification, we can break down the element of heat into Very cold, Cold, very hot and more with suitable values assigned. If the average temperature within a region turns out to be 60 degree C, the robot uses fuzzification to derive the correct fuzzy inference after defuzzification. The temperature of 60 degrees could be given a value of 0.6 within the category of Medium Hot. The

knowledge base can be covered by a dataset that shows what kind of temperatures are much fatal during a fire outbreak in enclosed structures. Then the Inference Engine will prioritize the regions using its IF-THEN conditions. The robot must also be tested in complex scenarios like when the quantity of people trapped is more in a region. More the number of lives concentrated within an area, higher is the priority. This kind of help would be vital to firemen who then will be able to make better use of its intelligence. Since the inside of a burning building would be rugged, the robot would be able to make complete use of its legs.

HIGH	HIGH (2)	MED (3)	LOW
MED (4)	MED (5)	LOW (6)	MED
LOW (7)	LOW (8)	LOW (9)	HIGH
COLD WARM HOT			TEMPERTURE

Fuzzy Associative Matrix (FAM)