CONTAINMENT CATEGORIZATION

ABSTRACT

In language the spatial arrangement and configuration of various objects are captured by prepositions. Though there are not so many prepositions but understanding it will hold the key to understanding spatial cognitions in humans. In this work we focus on containment of a object with respect to a container and which involve the prepositions “in” and ”out” . A experimental approach has been taken and a groundwork for the computational model has been laid.

INTRODUCTION

The understanding of spatial relation is absolutely crucial for the humans to perform many tasks. The spatial relation in language translates to language. We try to understand the spatial relations by studying containment. Containment consists of a trajector and a container with a few spatial prepositions such as “in” or “out”. Also in this work we try to develop a computational model based on **visibility** of the object with respect to the container. But first we perform many experiments to understand how the humans perceive containment in different situations.

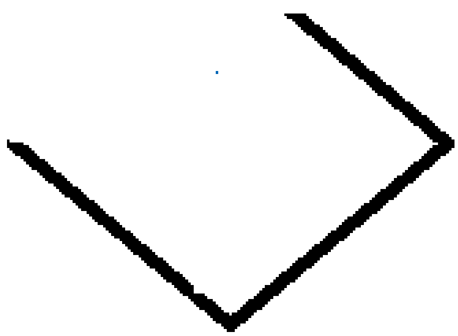
EXPERIMENT

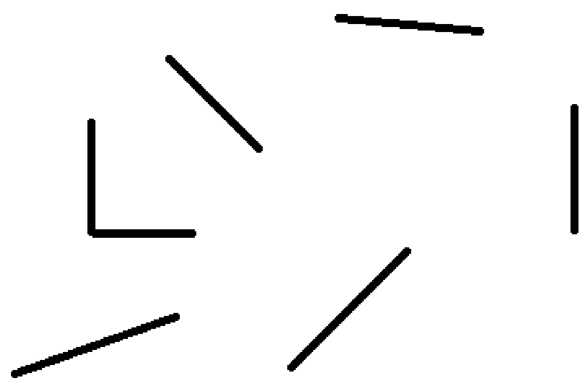
AIM:

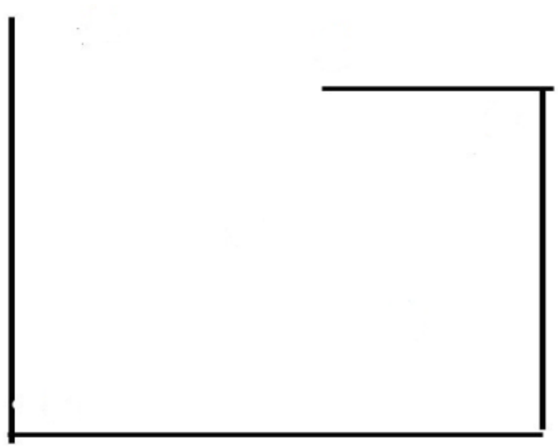
The aim of the experiment is to get a data on the human perception of containment.

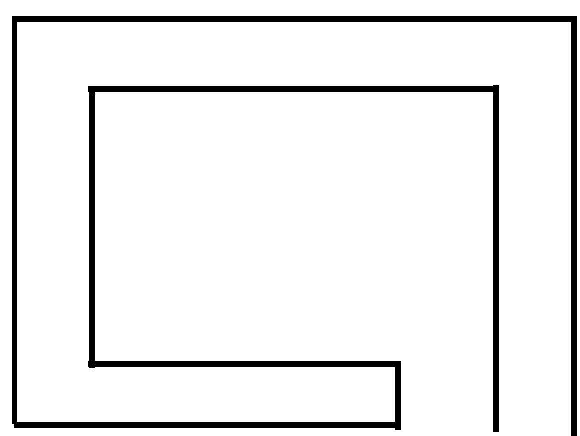
SETUP:

The experiments involved different type of containers and the trajectors placed on random configurations with respect to the container. The containers which were experimented upon are given below.









The details of the human subjects involved in different containers are given below:

Container1: 11 human subjects of age group 8-14.

Container2: 13 human subjects of age group 8-14.

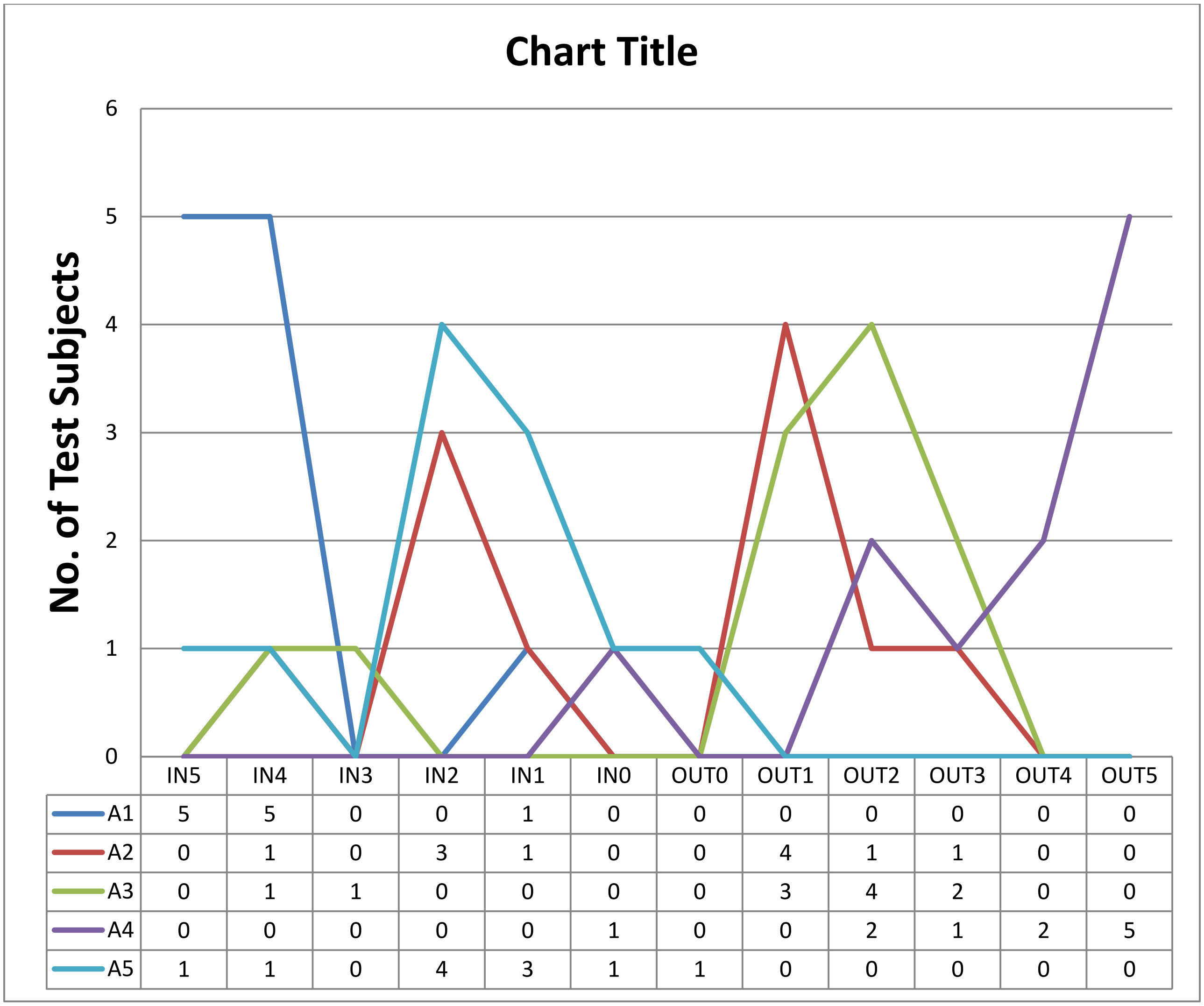
Container3: 36 human subjects of age group 20-22.

Container4: 36 human subjects of age group 20-22.

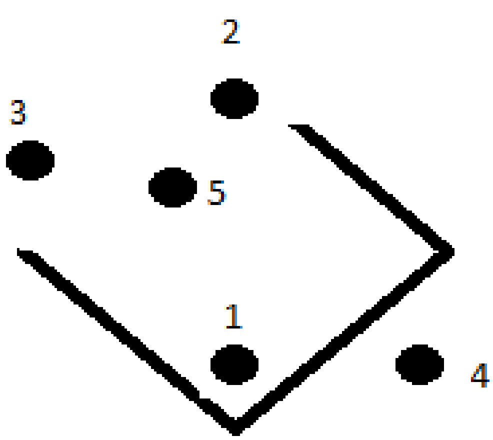
PROCEDURE:

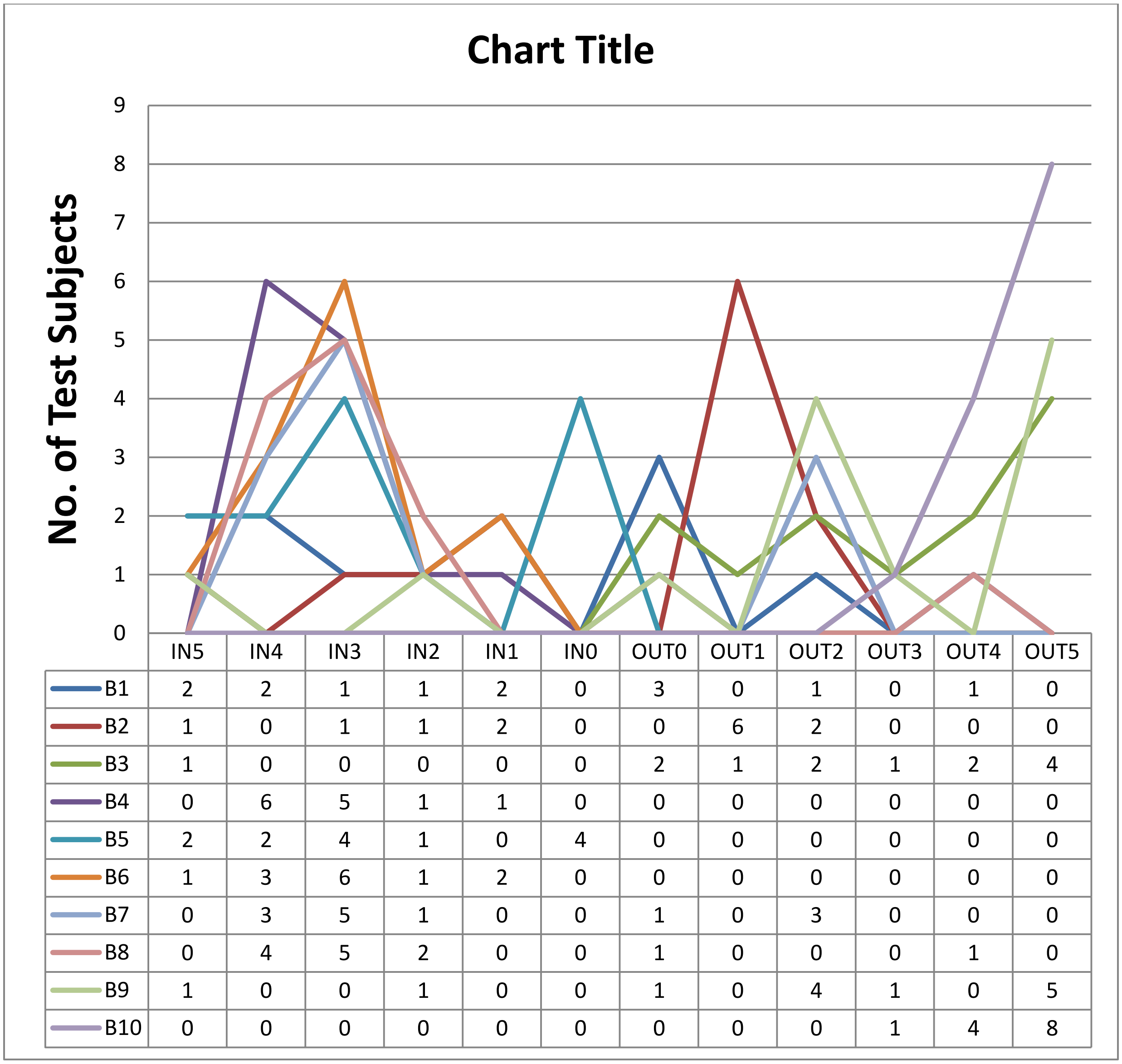
The subjects were shown the image and were then asked to categorize the image on the basis of the position of trajector with respect to the container. They were asked to grade the Inness and outness of the object on a scale of 0-5(5 being innermost and also if object is out then outermost).

RESULTS:

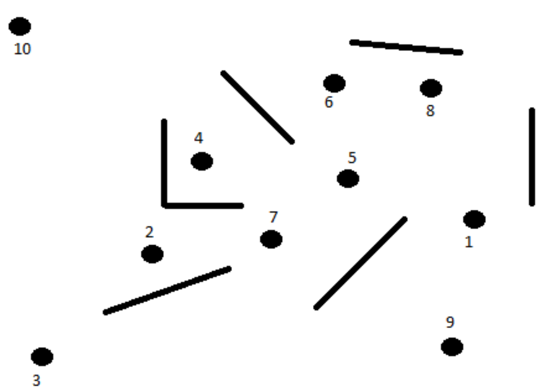


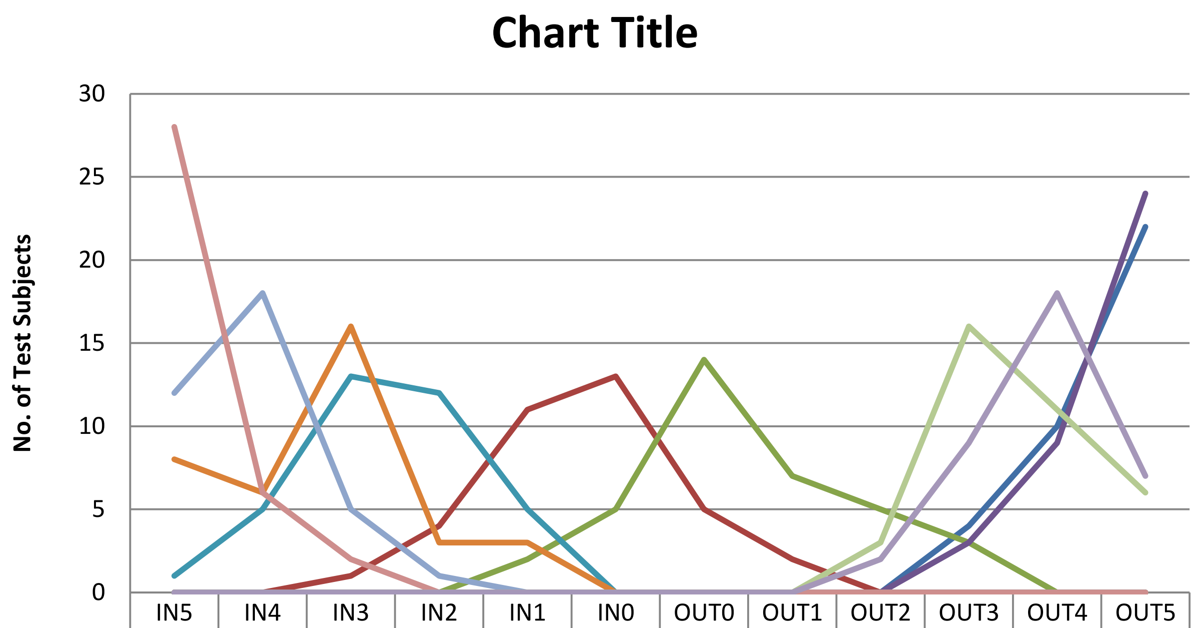
	IN5	IN4	IN3	IN2	IN1	IN0	OUT0	OUT1	OUT2	OUT3	OUT4	OUT5
A1	5	5	0	0	1	0	0	0	0	0	0	0
A2	0	1	0	3	1	0	0	4	1	1	0	0
A3	0	1	1	0	0	0	0	3	4	2	0	0
A4	0	0	0	0	0	1	0	0	2	1	2	5
A5	1	1	0	4	3	1	1	0	0	0	0	0



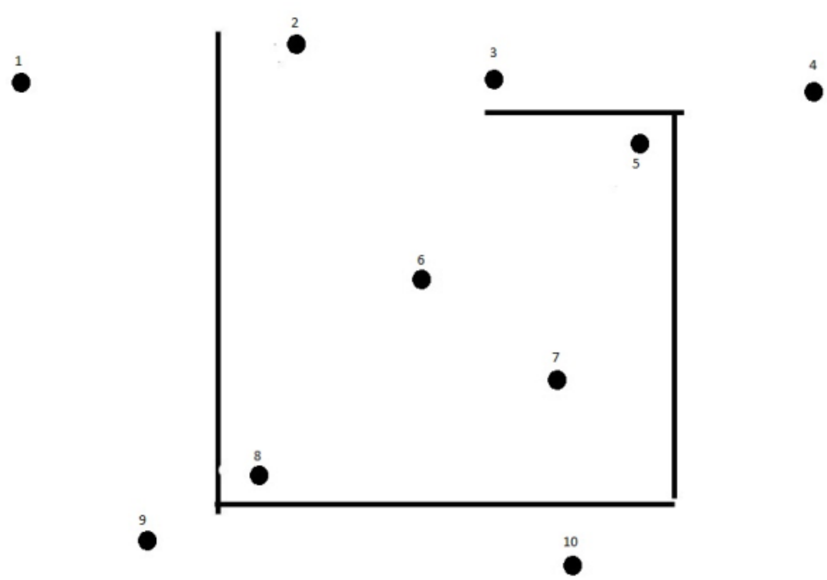


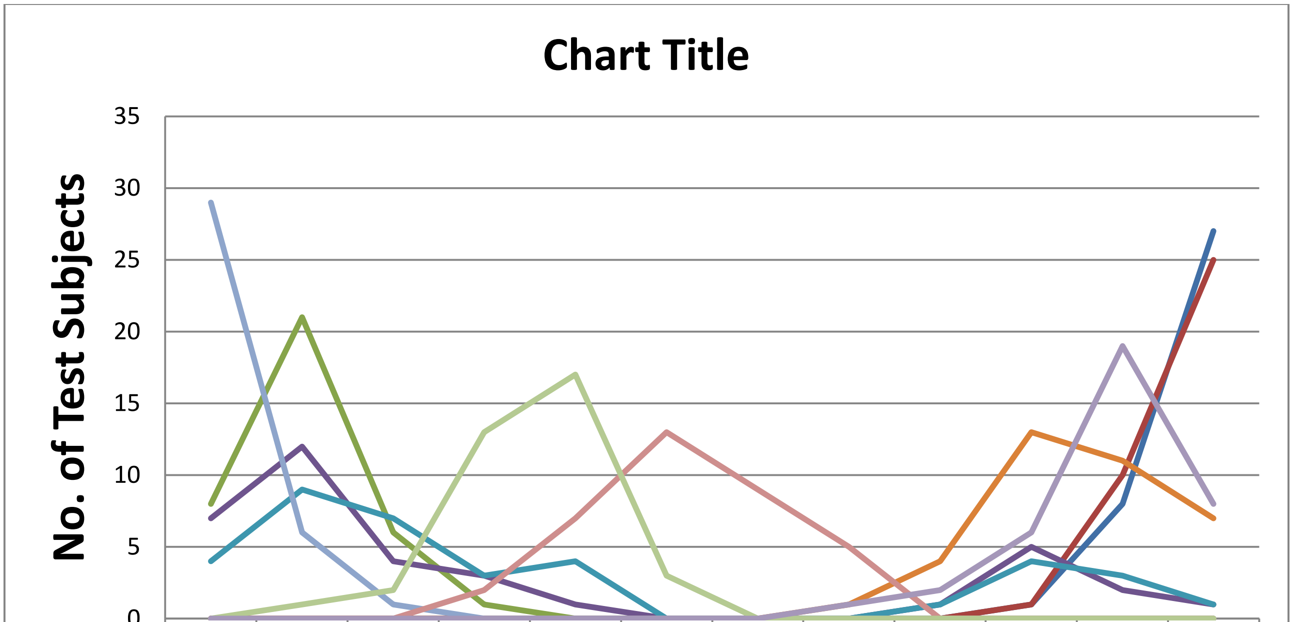
	IN5	IN4	IN3	IN2	IN1	IN0	OUT0	OUT1	OUT2	OUT3	OUT4	OUT5
B1	2	2	1	1	2	0	3	0	1	0	1	0
B2	1	0	1	1	2	0	0	6	2	0	0	0
B3	1	0	0	0	0	0	2	1	2	1	2	4
B4	0	6	5	1	1	0	0	0	0	0	0	0
B5	2	2	4	1	0	4	0	0	0	0	0	0
B6	1	3	6	1	2	0	0	0	0	0	0	0
B7	0	3	5	1	0	0	1	0	3	0	0	0
B8	0	4	5	2	0	0	1	0	0	0	1	0
B9	1	0	0	1	0	0	1	0	4	1	0	5
B10	0	0	0	0	0	0	0	0	0	1	4	8



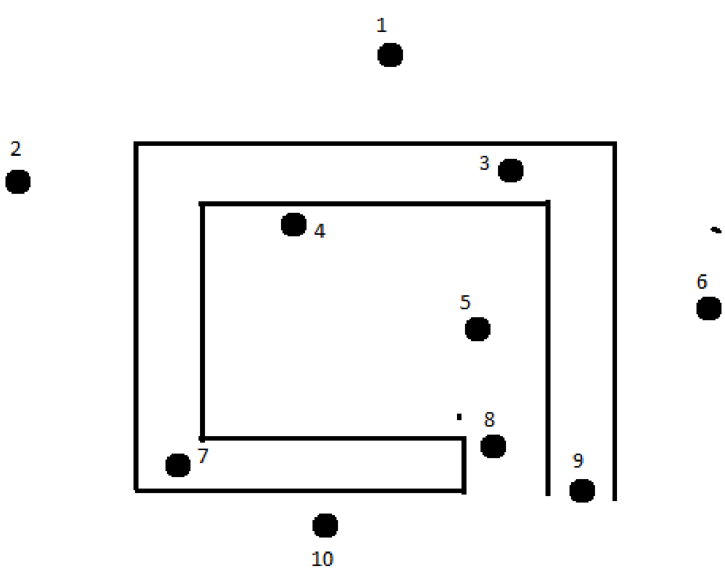


	IN5	IN4	IN3	IN2	IN1	IN0	OUT0	OUT1	OUT2	OUT3	OUT4	OUT5
C1	0	0	0	0	0	0	0	0	0	4	10	22
C2	0	0	1	4	11	13	5	2	0	0	0	0
C3	0	0	0	0	2	5	14	7	5	3	0	0
C4	0	0	0	0	0	0	0	0	0	3	9	24
C5	1	5	13	12	5	0	0	0	0	0	0	0
C6	8	6	16	3	3	0	0	0	0	0	0	0
C7	12	18	5	1	0	0	0	0	0	0	0	0
C8	28	6	2	0	0	0	0	0	0	0	0	0
C9	0	0	0	0	0	0	0	0	3	16	11	6
C10	0	0	0	0	0	0	0	0	2	9	18	7





	IN5	IN4	IN3	IN2	IN1	IN0	OUT0	OUT1	OUT2	OUT3	OUT4	OUT5
D1	0	0	0	0	0	0	0	0	0	1	8	27
D2	0	0	0	0	0	0	0	0	0	1	10	25
D3	8	21	6	1	0	0	0	0	0	0	0	0
D4	7	12	4	3	1	0	0	0	1	5	2	1
D5	4	9	7	3	4	0	0	0	1	4	3	1
D6	0	0	0	0	0	0	0	1	4	13	11	7
D7	29	6	1	0	0	0	0	0	0	0	0	0
D8	0	0	0	2	7	13	9	5	0	0	0	0
D9	0	1	2	13	17	3	0	0	0	0	0	0
D10	0	0	0	0	0	0	0	1	2	6	19	8



COMPUTATIONAL MODEL

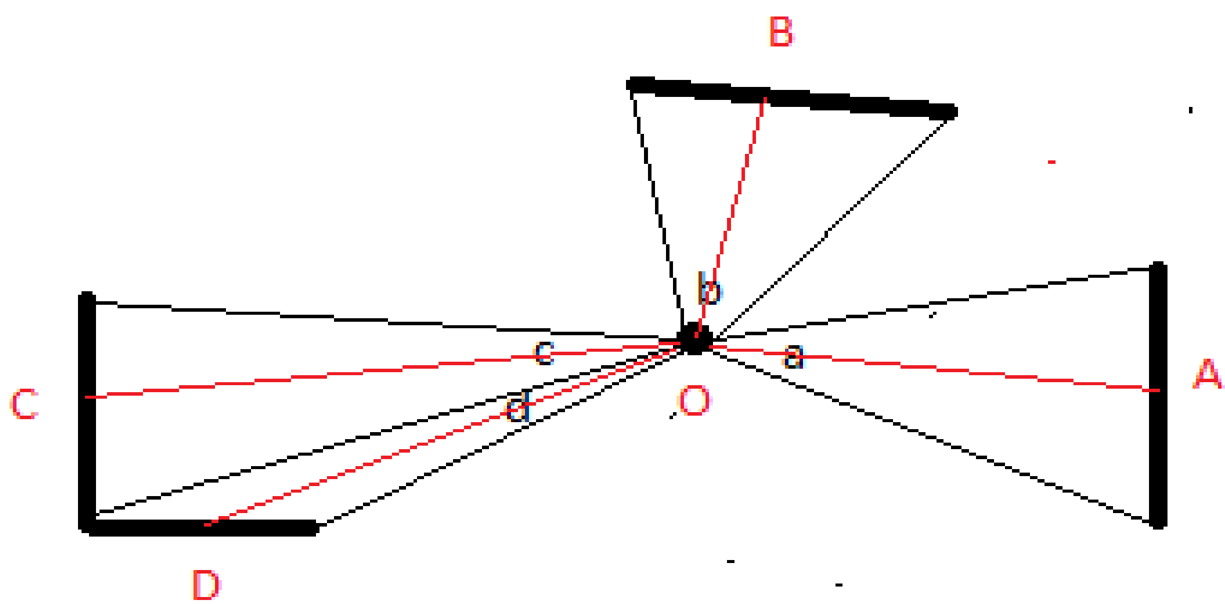
In the computational model we use the following concepts which are shown in the figure below:

Closed Angle

Open Angle

Closing Factor

Scaling factor – to normalize f(distance)



Containment Ratio = Open Angle / Closing Factor

Closed angle = $\Sigma\alpha_i$

Open angle = $360^o - \Sigma\alpha_i$

Closing Factor = $\Sigma f(d_i)*\alpha_i$ / S.F.

S.F. = $\Sigma f(d_i)$ / N

The computational model is based on visibility ie the openness or closeness of a object wrt the lines. It is very clear that more the containment raio the more ubound and free or “out” the object will become.

Conclusion

From the psychological experiments, it is observed that every human perceive spatial prepositions such as containment very differently. Also in case of children this perception varies over a large range whereas in adults the range is comparatively smaller.

Future Work

Our present computational model is very primitive, further work has to be done in the development of reliable visible feature vectors and in development of large human perception databases so that the computational model can be properly trained.

References

1. Mukerjee A. et. al.; Grounded perceptual schemas: developmental acquisition of spatial concepts, ProceedingSC'06 Proceedings of the 2006 international conference on Spatial Cognition V: reasoning, action, interaction
2. Kenny R. Coventry. 1999. Function, geometry and spatial prepositions: Three experiments. Spatial Cognition and Computation, 1:145–154.
3. Wikipedia.org