

Roomba Analysis

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Abstract.

The purpose of the experiment is to evaluate the efficacy of two unique algorithms that determine the movement of a virtual Roomba vacuum. The algorithms are tested in rooms of varying size and configuration for a fixed period of time. The algorithm that vacuums more of the virtual room on average is determined the most effective.

1 Introduction

1.1 Problem

It is uncertain which movement algorithm is more effective. To determine the superior algorithm, the algorithms will b

1.2 Strategies

The virtual Roomba vacuums are limited to eight directions: north, east, south, west, northeast, northwest, southeast, and southwest.

Strategy 1

The first strategy detects whether the Roomba has encountered a wall and redirects the Roomba depending on its previous direction of travel.

If the Roomba encounters a wall when traveling north and a wall is touching the Roomba's right side, the Roomba redirects southwest. If there is no wall touching the Roomba's right side, the Roomba redirects southeast.

If the Roomba encounters a wall when traveling south and a wall is touching the Roomba's right side, the Roomba redirects northeast. If there is no wall touching the Roomba's right side, the Roomba redirect southwest.

If the Roomba encounters a wall when traveling east or west, the Roomba redirects in a random direction.

If the Roomba encounters a wall when traveling northeast or southeast, the Roomba redirects east.

If the Roomba encounters a wall when traveling northwest or southwest, the Roomba redirects west.

Strategy 2

The second strategy detects whether the Roomba has encountered a wall and redirects the Roomba depending on its previous direction of travel in a way that is different than strategy one.

If the Roomba encounters a wall when traveling north or south, the Roomba redirects in a random direction.

If the Roomba encounters a wall when traveling east and a wall is touching the Roomba's right side, the Roomba redirects northwest. If there is no wall touching the Roomba's right side, the Roomba redirects southwest.

If the Roomba encounters a wall when traveling west and a wall is touching the Roomba's right side, the Roomba redirects southeast. If there is no wall touching the Roomba's right side, the Roomba redirect northeast.

If the Roomba encounters a wall when traveling northeast or northwest, the Roomba redirects south.

If the Roomba encounters a wall when traveling southeast or southwest, the Roomba redirects north.

2 Methods

The algorithms are evaluated in four rooms of distinct configuration, two of dimensions 800x600 (considered a "large" room) and the remaining two of dimensions 400x300 (considered a "small" room).

The algorithms underwent five trials in each room; thus each algorithm underwent twenty trials in total respectively. Each trial spanned the duration of 10800 frames at 60 frames per second.

The average percentage of the room that was cleaned by the Roomba was calculated for each algorithm using the formula:

$$\bar{x} = \frac{\sum_{n=1}^N x_n}{N}$$

Where \bar{x} is the average, the numerator is the sum of all percentages (% of room that was cleaned), and the denominator is the total number of percentages.

Number of Trials Performed Per Room

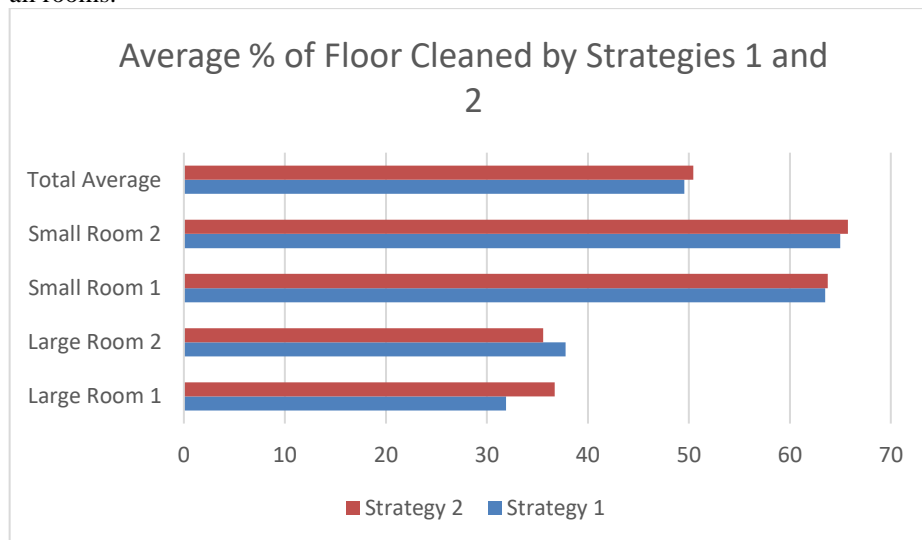
	Strategy 1	Strategy 2
Large Room 1 (Trials)	5	5
Large Room 2 (Trials)	5	5
Small Room 1 (Trials)	5	5
Small Room 2 (Trials)	5	5
Total (Trials)	20	20

3 Results

Percentage of Room Cleaned in each Trial

	Strategy 1					Strategy 2				
Large Room 1 (% Clean)	28.31	29.94	38.35	34.67	28.18	35.33	40.80	32.28	39.21	36.02
Large Room 2 (% Clean)	34.73	33.23	41.29	34.46	45.32	38.93	41.24	31.29	32.55	33.88
Small Room 1 (% Clean)	67.55	59.11	61.98	65.91	62.89	66.95	60.98	58.75	68.56	63.50
Small Room 2 (% Clean)	61.23	58.73	69.27	70.33	65.42	62.54	65.31	67.40	68.13	65.43
Average (% Clean)	49.55					50.45				

The table above indicates the percentage of the floor that was cleaned for each trial. The “Average” rows indicates the percentage of the floor that was cleaned across all rooms.



The chart above shows the average percentage of the floor that was cleaned in each room across five trials for each room. The red and blue bars indicate the averages for Strategy 2 and 1 respectively. The “Total Average” column indicates the average percentage of the floor that was cleaned across all rooms.

4 Conclusion

According to the method pre-defined for determining the more effective algorithm, Strategy 2 is the more effective method; The average percentages for Strategy 1 and Strategy 2 were 49.55% and 50.45% respectively. Although the average for Strategy 2 was greater than that of Strategy 1's, the percentages are not different enough to differentiate the two strategies efficacy.

It can be reasonably deduced that Strategy 1 and Strategy 2 are relatively equal in terms of effectiveness such that their algorithms are very similar. Thus it is not surprising that the two strategies performed at similar levels of effectiveness.