

All Weather Orienteering

Terrain Information (Speed) -

Summer:

openLand = 20

roughMeadow = 12

easyMovementForest = 18

slowRunForest = 16

walkForest = 14

paveRoad = 22

footPath = 24

A* Algorithm

- Map of Open Coordinates which are visited but not expanded
- Map of Closed Coordinates which are visited and expanded
- Priority Queue to store $f(n)$ for each coordinate and get the lowest $f(n)$

The algorithm checks the neighbor 4 coordinates and calculates $f(n)$ for each of them. If the neighbor coordinate is not in the Open Map and not in Closed Map, then calculate the $f(n)$ and add the coordinate in the Open Map. These values are added to the Priority Queue. The current coordinate is expanded and thus added to the Closed Map. The 4 neighboring pixels are visited but not expanded, thus are added to the Open Map. The next coordinate with the lowest $f(n)$ is picked from the Priority Queue.

If the neighbor coordinate is already in the closed map then the neighbor coordinate is skipped. If the coordinate is present in the Open Map and not in the Closed Map, then the value of the current $f(n)$ is compared with the previous $f(n)$ for the respective coordinate. The value with the lower $f(n)$ is mapped to that respective coordinate.

The algorithm continues till the destination is reached.

Cost Function -

The cost of the path is calculated on the basis of time.

Time = Distance / Speed

- $f(n) = g(n) + h(n)$

Heuristic Function

- $h(n)$ -

$$\text{Time} = (\sqrt{\Delta x^2 + \Delta y^2 + \Delta z^2}) / \text{speed}$$

Δx - Difference between the width of 2 coordinates

Δy - Difference between the height of 2 coordinates

Δz - Difference between the elevation of 2 coordinates

Cost

- $g(n)$ -

Longitudinal Distance -

Time = (Height / 2) / Speed for Current Coordinate + (Height / 2) / Speed for Neighbor Coordinate

Latitudinal Distance -

Time = (Width / 2) / Speed for Current Coordinate + (Width / 2) / Speed for Neighbor Coordinate

As the path varies for the same start coordinates and destination coordinates for different seasons depending on the time, the cost function computes the minimum time according to the different seasons.

Seasons -

Fall

If the Current Coordinate is in the Easy Movement Forest, then the speed of the current and the adjacent pixels is reduced as the leaves will fall and it will be difficult to follow the path. Speeds of only the current pixel and adjacent pixel are reduced if passing through Easy Movement Forest.

openLand = 18

roughMeadow = 11

easyMovementForest = 10

slowRunForest = 14

walkForest = 10

pavedRoad = 21

footPath = 20

For Winter and Spring -

Edges of the water are computed all at once and stored in a map.

BFS Algorithm for Winter:

- BFS is used to freeze the water to 7 pixels from the water edges.
- Pick the first water edge coordinate from the map and consider it as the first layer. All the neighboring coordinates to the parent coordinate would be the second layer.
- Considering each water edge pixel as a parent, compute the children till seven layers.
- If reached till seven layers or the neighbor coordinate is not water then break and pick the next water edge coordinate and continue the process

Speed to walk on the ice:
ice - 14

BFS Algorithm for Spring:

- BFS is used to spread the mud on land to 15 pixels from the water edges.
- Pick the first water edge coordinate from the map and consider it as the zeroth layer. All the neighboring coordinates to the parent coordinate would be the second layer.
- Considering each water edge pixel as a parent, compute the children till fifteen layers.
- If reached till fifteen layers or the neighbor coordinate is water or out of bounds or the elevation is more than 1 meter then break and pick the next water edge coordinate and continue the process

Speed to walk in mud -
mud - 6

Algorithm for Human Consumable Output -

All the checkpoint coordinates from the start coordinate to the destination coordinate that is in the path are displayed on the map. The path through from the start coordinate till the destination coordinate is computed for the minimum time and displayed on the map. The total path length is displayed.