e-Yantra Robotics Competition Plus
(eYRC+ Pilot)
Team ID: eYRC+#2447

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Scope of the Task (7)

1. Describe the algorithm used for solving path planning in this task.

<Teams should write in their own words a description of algorithms used in this task.
You can also draw some diagrams/figures, flowcharts to illustrate the algorithm used.
Answer format: Text
Word-limit: 100 words>

- Generate the grid map of the current image
  - Initialize zero filled 10x10 grid_map
  - process image to get the pixel coordinates (X,Y) of the Centre of cell nodes
  - grid_map[y][x]=1 if img[Y][X]==black color,
  - start=(xs,ys), finish=(xe,ye) for img[Y][X] == blue and yellow color
  - return grid_map

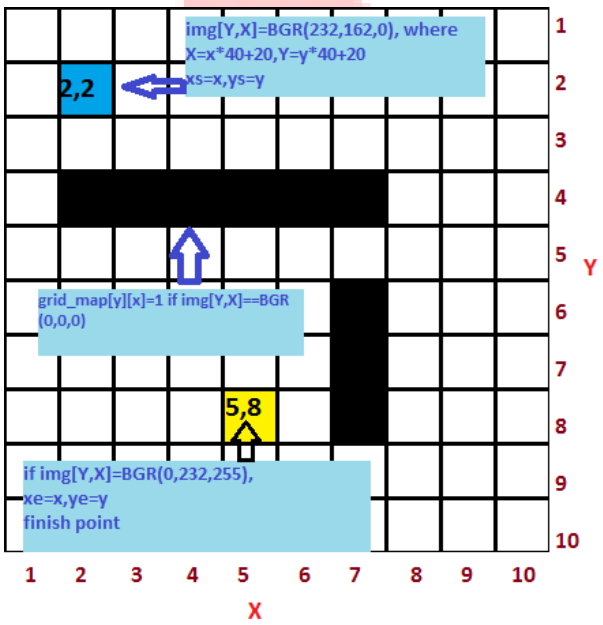


Figure1.1 showing coordinates description and pixel color detection

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	1	1	1	1	1	1	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

Figure1.2 showing grid_map representation

- Compute shortest path
  - Create priority queue which stores each visited cell's minimum cost and its coordinates.
  - Repeat rest steps until current node==finish node
  - visit each neighbor of current cell except obstacles
  - if neighbor's visiting cost is less or not visited previously then push it into heapq along with its new minimum cost
  - Link parent node to neighbor node.
  - Pop first element from heapq
  - if element equals finish node, return route cost and path

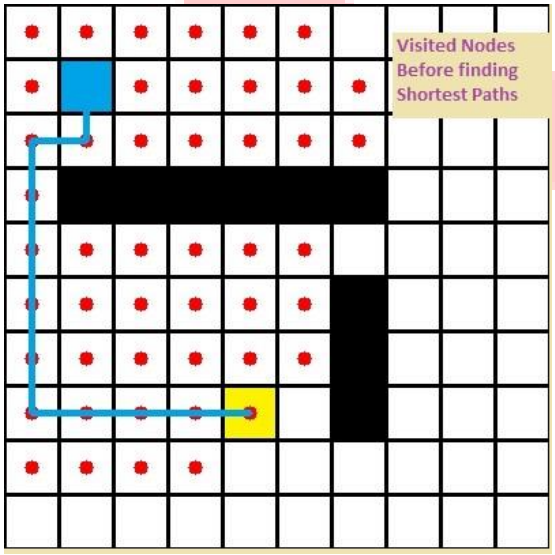
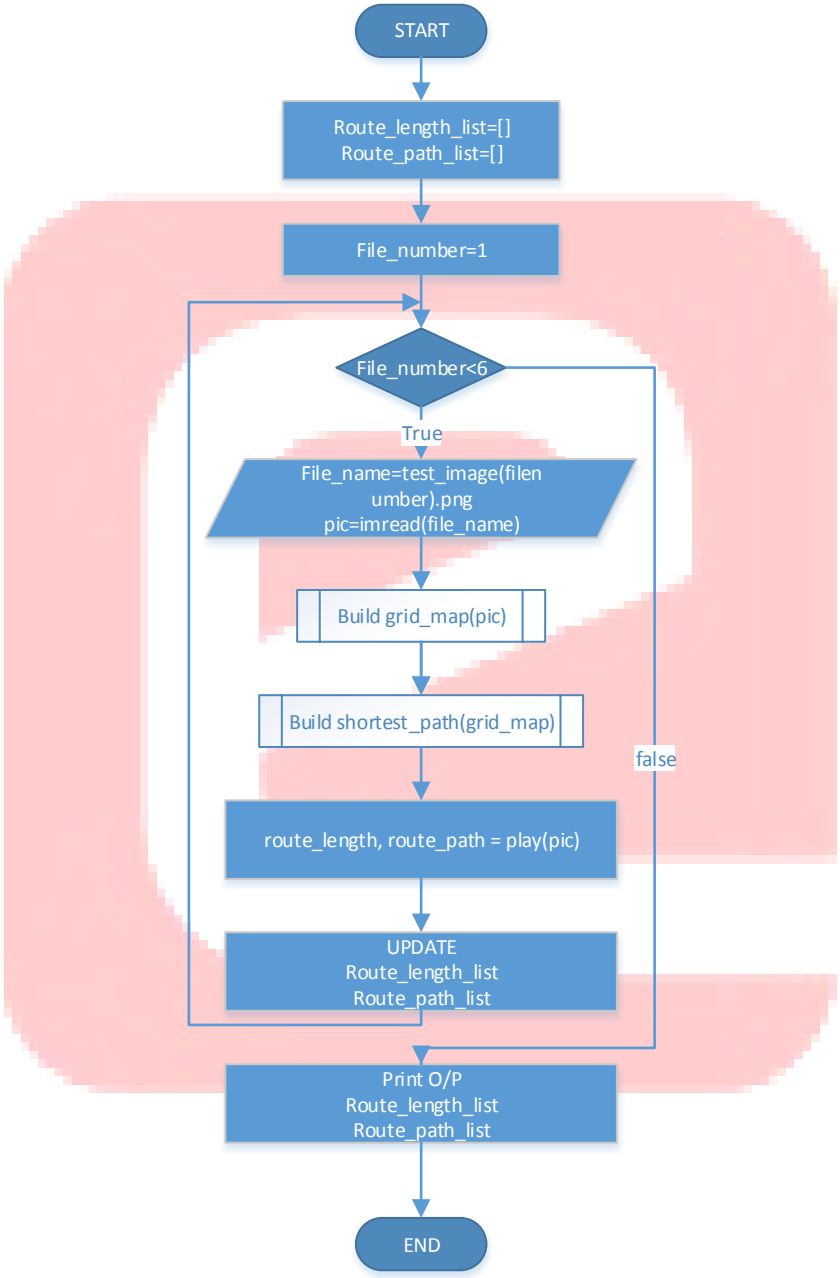


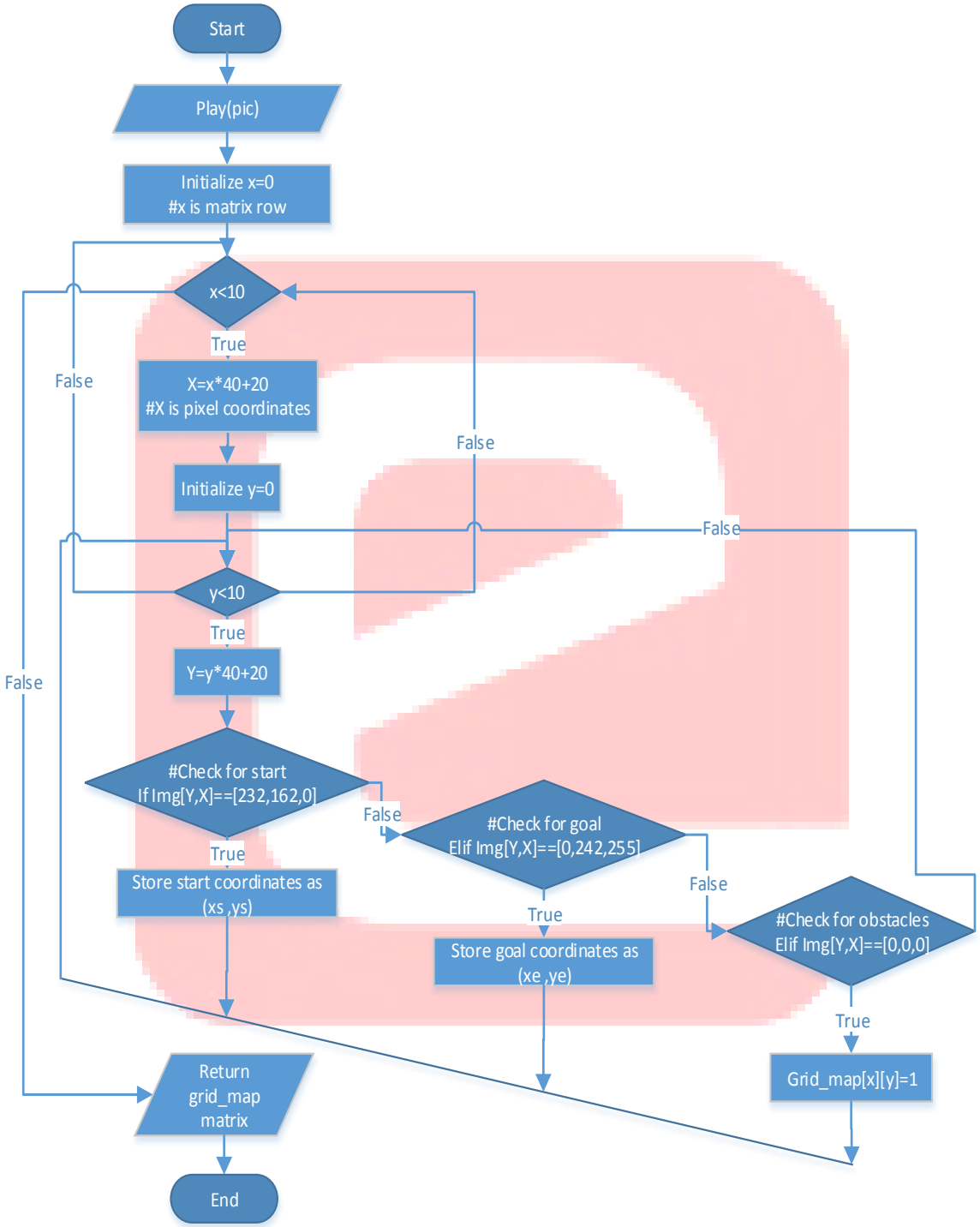
Figure 2.1 : visited nodes highlighted by red dots and shortest path shown as blue zig-zag line

Flow chart of above stated algorithm

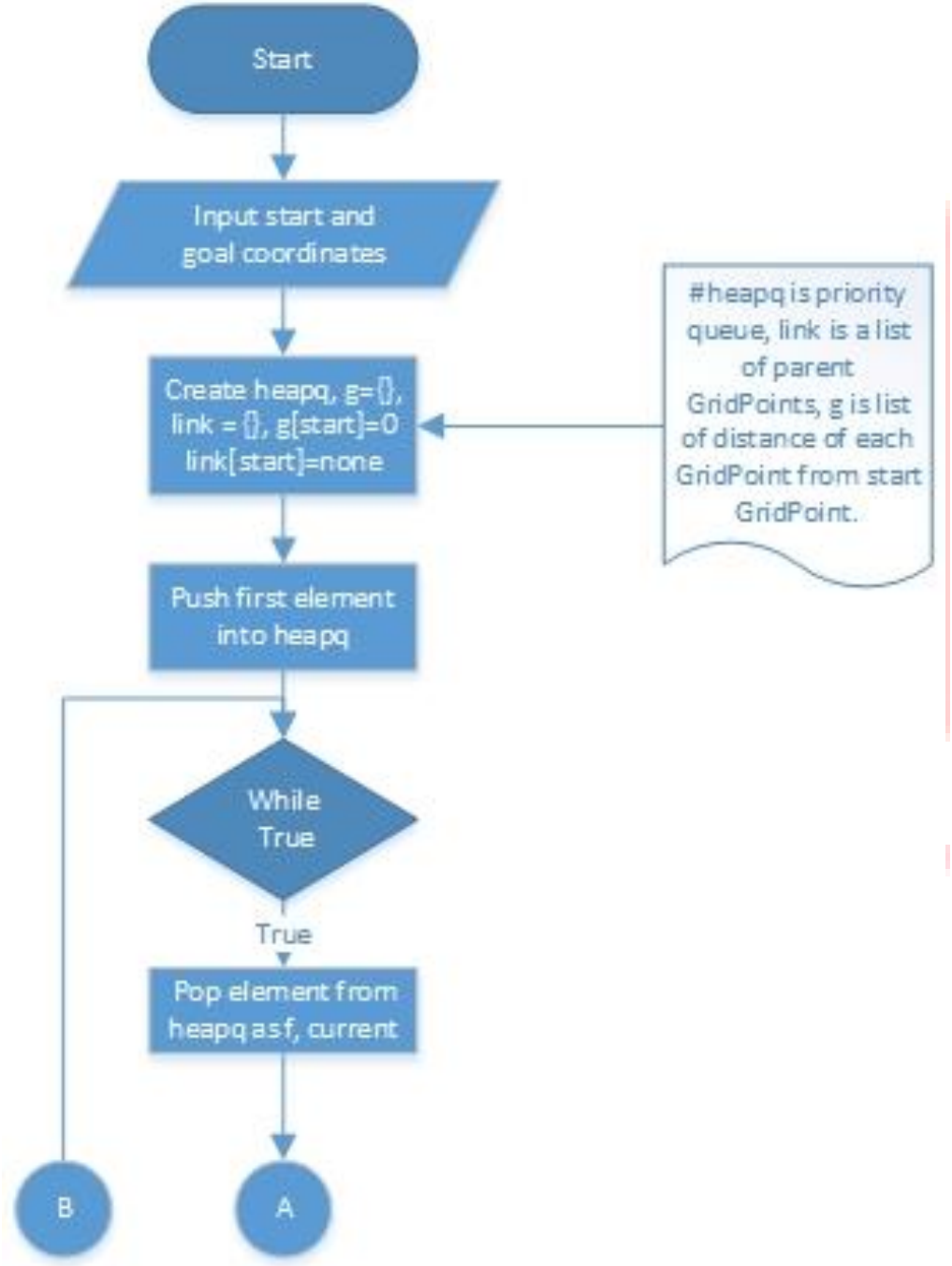
1- Algorithm overview

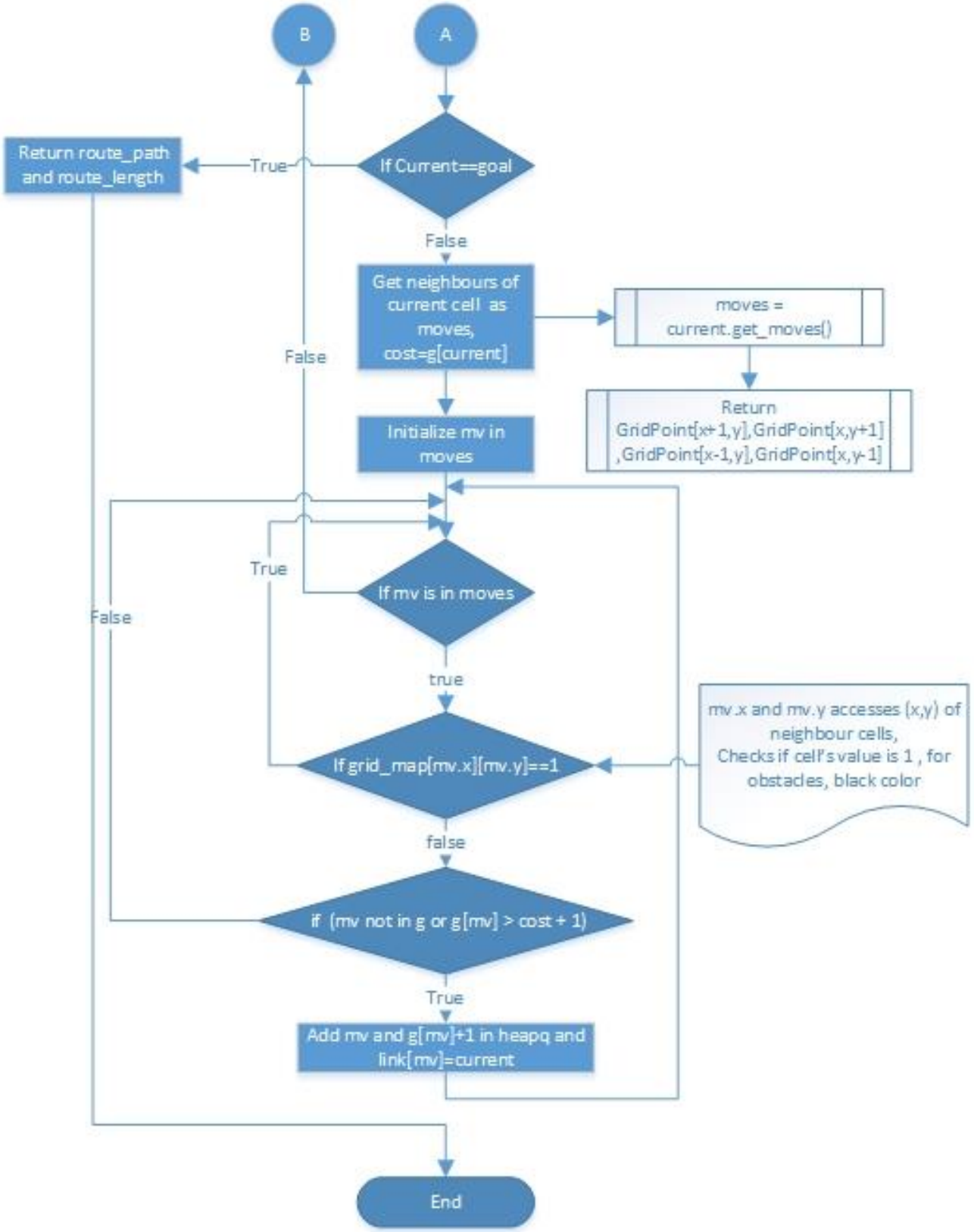


2- grid_map generator overview



3- shortest-path generator overview




B
A
Return route_path and route_length
True
If Current==goal
False
Get neighbours of current cell as moves, cost=g[current]
moves = current.get_moves()
Return GridPoint[x+1,y],GridPoint[x,y+1] ,GridPoint[x-1,y],GridPoint[x,y-1]
False
Initialize mv in moves
True
If mv is in moves
False
true
mv.x and mv.y accesses (x,y) of neighbour cells, Checks if cell's value is 1 , for obstacles, black color
If grid_map[mv.x][mv.y]==1
false
if (mv not in g or g[mv] > cost + 1)
True
Add mv and g[mv]+1 in heapq and link[mv]=current
End

Camera and Image Processing (3)

Write down the answers to the following questions. For this part use first image (*test_image1.png*) in *"Task2_Practice/test_images"* folder.

2. What is the resolution (size) of the test image?

   Answer to question 2

   - 400*400 pixels

3. What is the position of the Start point and the End point in the grid in the test image? (Please refer to the *Task2_Description.pdf* for the definitions of Start point and End point and answer in (x,y) form, where the x-axis is oriented from left to right and the y-axis is oriented from top to bottom)

   Answer to question 3

   - Position of start point: (2,2)
   - Position of end point: (5,8)

4. Draw four shortest paths from the Start point to the End point (you may draw it manually if you desire). An example is shown below:

   Answer to question 4

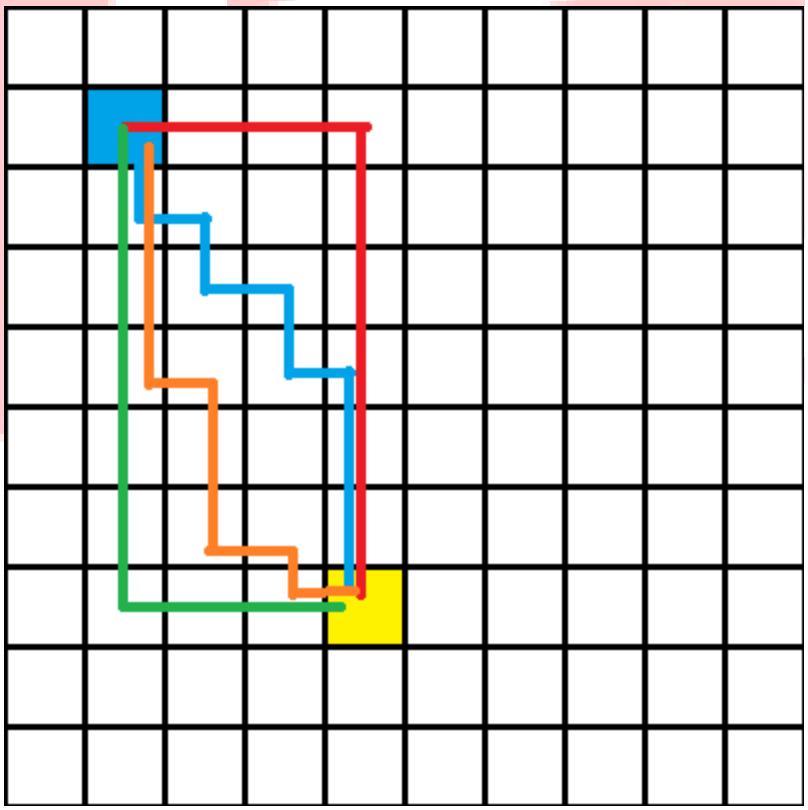


Figure: test_image1.png solution with four shortest paths drawn

<

Answer format:

- Answer to question 2 in bulleted form
- Answer to question 3 in bulleted form
- Image pasted for question 4

>

Software used (10)

Write down the answers to the following questions. For this part use first image in *"Task2_Practice/test_images"* folder.

5. Write a function in python to open the image and return an image with a grid of **n** equally spaced horizontal and vertical red lines(RGB values (255, 0, 0)). You are required to write a function *draw_grid(filename,n)* which takes two arguments:
   a. filename: color image
   b. n: number(integer datatype) of equally spaced horizontal and vertical lines

Output of program should be the image with the specified red grid drawn on it.

<Answer format:

Use the snippet given below by adding your code after the comment: `#add your code here.` Inline comments are mandatory to explain the code>

```
def draw_grid(filename,n):
    '''
    filename-- input color image stored as file
    n-- integer from 1 to 10
    returns img-- the image with the red grid (having specified number of
    lines) drawn on it
    '''
    img=cv2.imread(filename) ##getting input image
    line_width=400/(n-1)##width between 2 consecutive parallel lines
    for x in range(0, n): ##drawing lines
        X=x*line_width
        for y in range(0,n):
            Y=y*line_width
            ##vertical lines
            cv2.line(img,(Y,X),(Y,400),(0,0,255), 2)#lines in red color
            ##horizontal lines
            cv2.line(img,(X,Y),(400,Y),(0,0,255), 2)#lines in red color

    return(img)
```

6. Write a function `space_map(img)` in python to detect the layout of the grid as shown in the test image (Figure 1) below. Function `space_map(img)` takes a test image as input and returns a 10x10 matrix called "`grid_map`" of integers with values either 0 or 1. Each square must be identified as either navigable space(`0`), or obstacle(`1`). The Start and End points are considered as obstacles for this question. An example is shown in Figure 2 below.

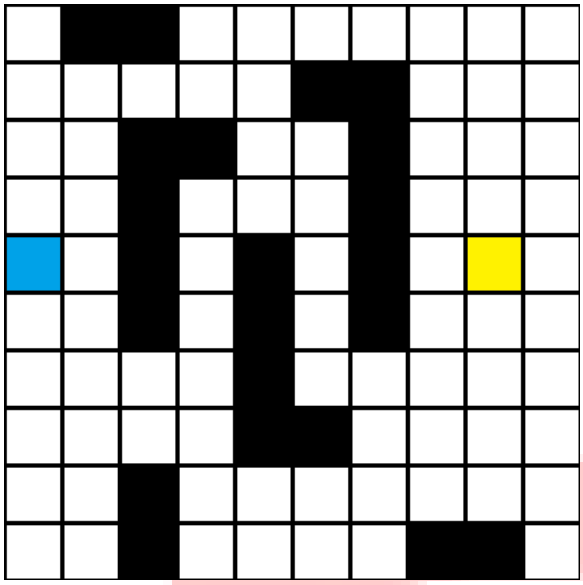


Figure 1: Example Test Image

```
>>>
grid_map =
[[0, 1, 1, 0, 0, 0, 0, 0, 0, 0],
[0, 0, 0, 0, 0, 1, 1, 0, 0, 0],
[0, 0, 1, 1, 0, 0, 1, 0, 0, 0],
[0, 0, 1, 0, 0, 0, 1, 0, 0, 0],
[1, 0, 1, 0, 1, 0, 1, 0, 1, 0],
[0, 0, 1, 0, 1, 0, 1, 0, 0, 0],
[0, 0, 0, 0, 1, 0, 0, 0, 0, 0],
[0, 0, 0, 0, 1, 1, 0, 0, 0, 0],
[0, 0, 1, 0, 0, 0, 0, 0, 0, 0],
[0, 0, 1, 0, 0, 0, 0, 1, 1, 0]]
>>>
```

Figure 2: Example output

<Answer format:
Use the snippet given below by adding your code after the comment: `#add your code here.`
Inline comments are mandatory to explain the code>

```
def space_map(img):
    '''
    img-- input color image stored as file
    result— output grid_map
    '''
    grid_map= [ [ 0 for i in range(10) ] for j in range(10) ]# initializing
    #zero filled 10x10 matrix
    for x in range(0, 10):
        X=x*40+20
        for y in range(0,10):
            Y=y*40+20
            #img[Y,X] is pixel at the center of each cell
            if img[Y,X,0]!=255 or img[Y,X,1]!=255 or img[Y,X,2]!=255:
    #detecting obstacle, if pixel color is not white then mark it as obstacle
                grid_map[y][x]=1 #marking obstacles with value 1
            continue
    return grid_map
```