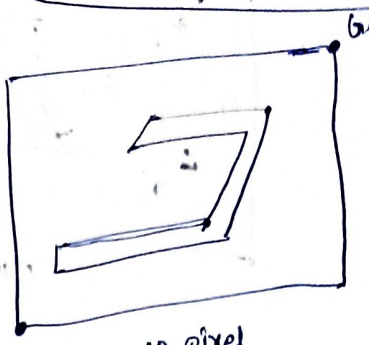
Yousuf
Roll no: 2120702

(1)

for determining the time taken by robot with sensing radius of 1 pixel at a given time to cover all the empty space. we will follow the Morse decomposition. we send a line "L" through the environment & look for critical points as connectivity of 'L' changes in free space at critical points.

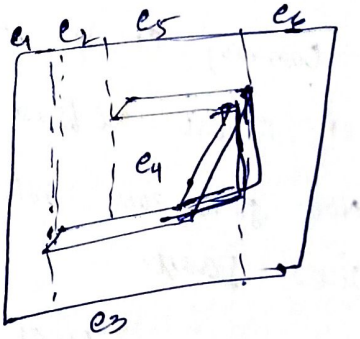


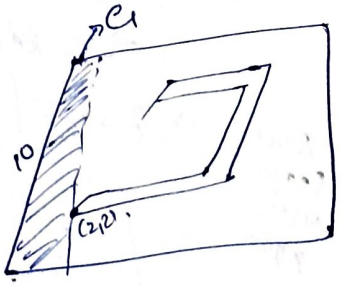
following are the cells and critical points we get & as we get the critical points we start covering the environment.

Let us assume Robot takes '1' step in '1' second. It covers 1 pixel per step.

After started passing line L it covers the cells & detect critical points.

(1) We choose upper cell to cover when ever there is a split in a free space due to obstacle

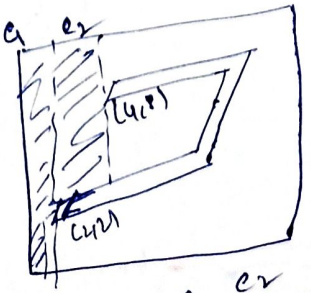




Debth graph

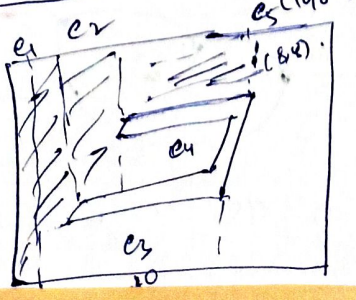
to cover e_1

⇒ 10+8
⇒ 18 sec.



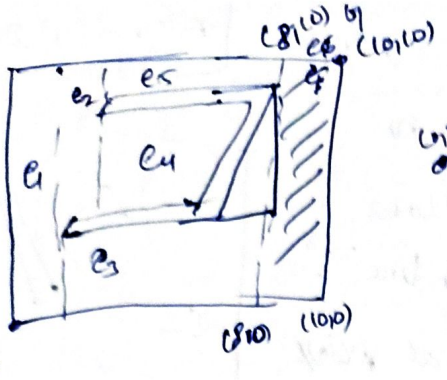
Cover e_2

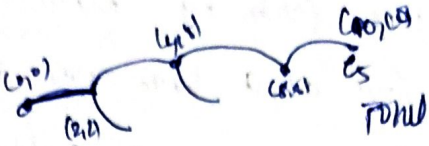
⇒ 8+2
⇒ 10 sec.
total $e_1 + e_2$ ⇒ 28 sec.



Cover e_3

$e_3 = 8$
total = 36 sec



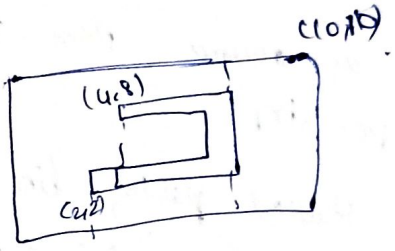


Now we look for the critical point which is uncovered left in Rebb graph.

So e_3 & e_4 are uncovered & these critical points are e_3 (4,2) & e_4 (4,8).

Now using tangent bug algorithm we traverse to critical points one by one & cover the remaining cells

Currently it is at (10,10) so we traverse to nearest one i.e (4,8)



Now go to each critical point & cover those area parts.

For (10,10) to (4,8) using bug tangent algorithm $\Rightarrow 2\sqrt{10} = 2 \times 3.16 \simeq 6$ →①

Now after reaching (4,8) critical point & go for e_4 coverage ⇒ 15 sec + 6 → 21 sec

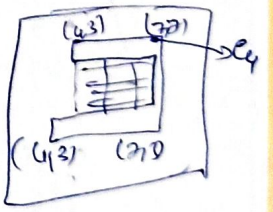
Moving on to (4,8) to (4,2) using bug tangent algorithm

Total step required now ⇒ 77 sec (56 + 21 = 77)

Total step = 6 steps = 6 secs

Total steps to cover e_3 = 6 + 12

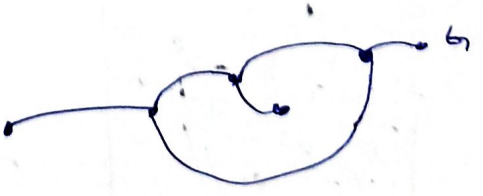
⇒ 18 sec



Total time taken until now = 77 + 18

= 95 sec

Rebb graph,



Time required to cover is 95 secs.