INTERDISCIPLINARY CYBER PHYSICAL SYSTEMS

ADVISORY FRAMEWORK TO INTERCONNECT DISTRIBUTED WATER BODIES TARGETING AGRICULTURE FARMS

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Outline of the presentation

Introduction

- Water scarcity is threatening the sustainability of livelihoods
- Flexible yet optimum water distribution is the need of hour
- Zobhana Jala Sambaddha (ZJS),a novel advisory framework , provides an automated solution.
- It includes image processing based data abstraction from the Satellite Image.
- This provides multipath solution between any source and destination points.

Motivation

01

Uneven distribution of water resources.

02

Water levels are being pulled down by 1 to 3 meters per year.

03

Manual pipe-laying is time-consuming and expensive.

04

A real time framework helps better utilization of distributed water bodies.

How will the Research be helpful?

In India, most of the water bodies are distributed.

With increasing urbanization, growing population there is a significant variation in the water table within a District, Taluka and even at Village level.

We need to frame them into a network of water bodies in order to ensure optimal water utilization.

Literature Survey

Based on [1], a grid(matrix) is considered.

Initial and the final cell is chosen and "weight" is applied to the grid.

Following [2], the configuration phase is divided into multiscale grids

Feasible paths are found using Genetic Algorithm.

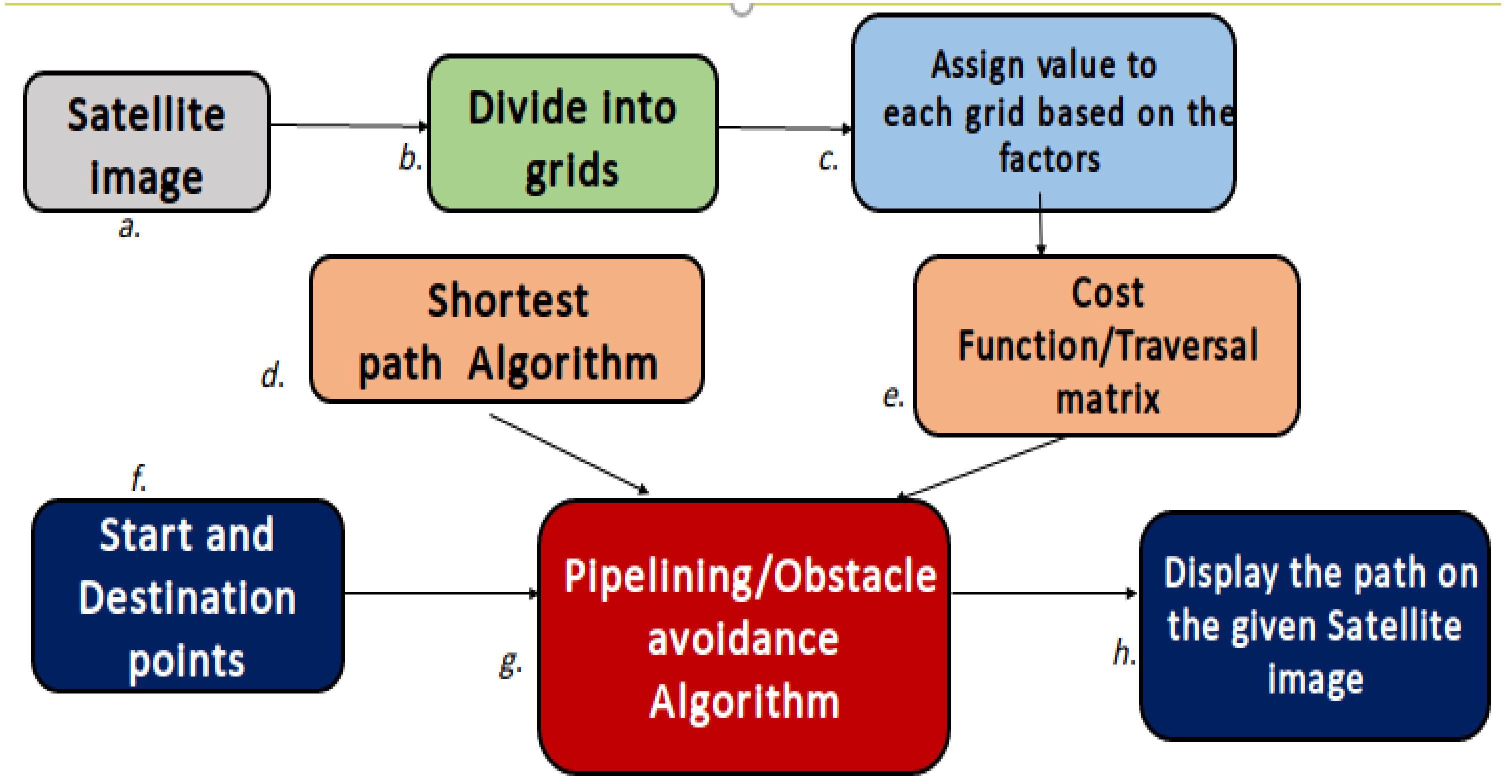
According to [3], the image is captured

Converted to gray scale image

Obstacle detection is done.

Based on [4], A digital terrain elevation map is used, over which the path planning result is shown.

Block Diagram of Framework
Zobhana Jala Sambaddha (ZJS)



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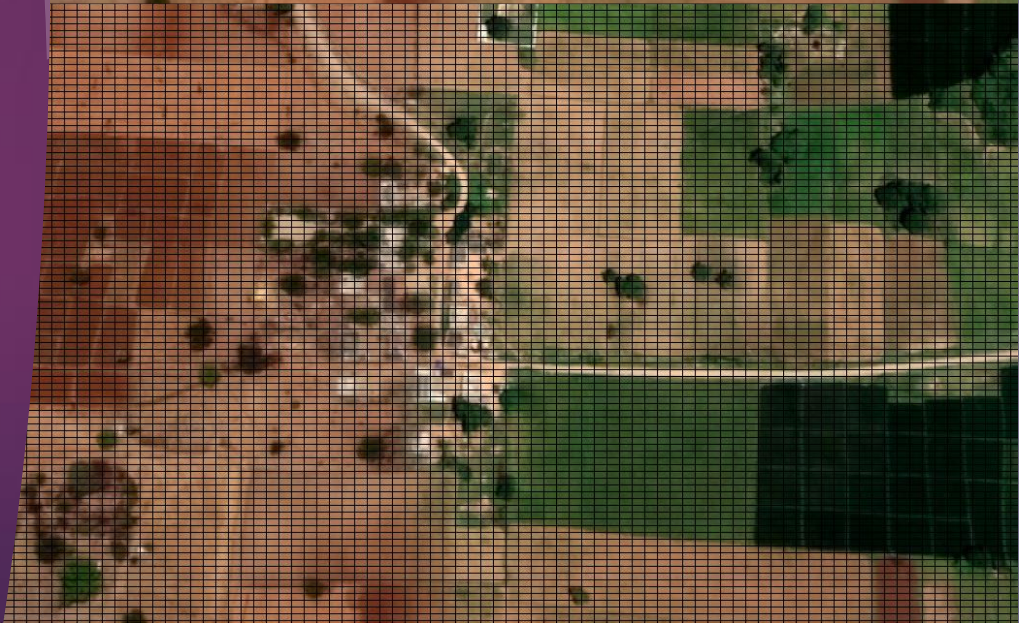
Zobhana Jala Sambaddha (ZJS)



A. Partition of the Satellite Image into Grids

- A satellite image of the target village is divided into grids.
- Trade-off between performance and computation cost

B. Assigning Cost Value to each Grid

The Grids on the image are allocated a cost value determined from the cost function;

Cost function is governed by several atttributes.

4	1	3
2	6	8
1	3	5

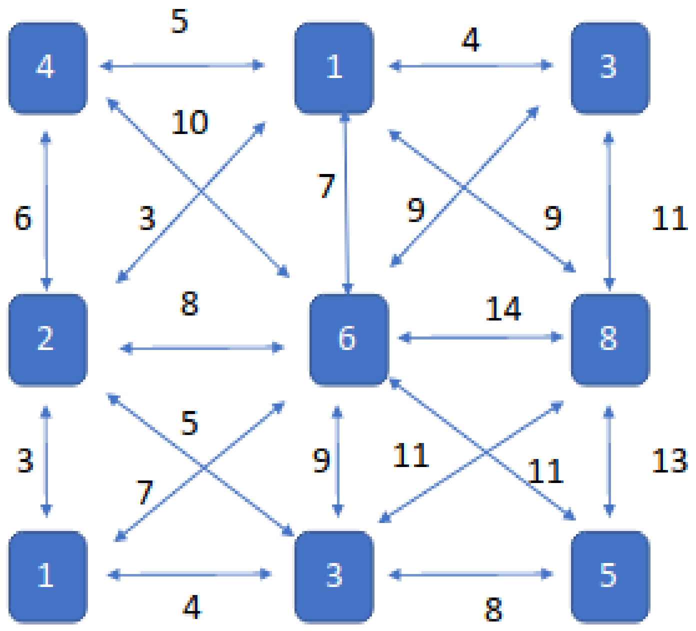
C. Construction of Graph

Construct Matrix of cells. corresponding to grids on the Image.

- Cell padding .
- Construct Graph from matrix.
- Each cell is made into a node having 8 adjacent nodes.
- Constant Edge length
- node(i,j) =node(j,i) = value(i)+value(j).

Input Source(1,1), Destination-(3,3)

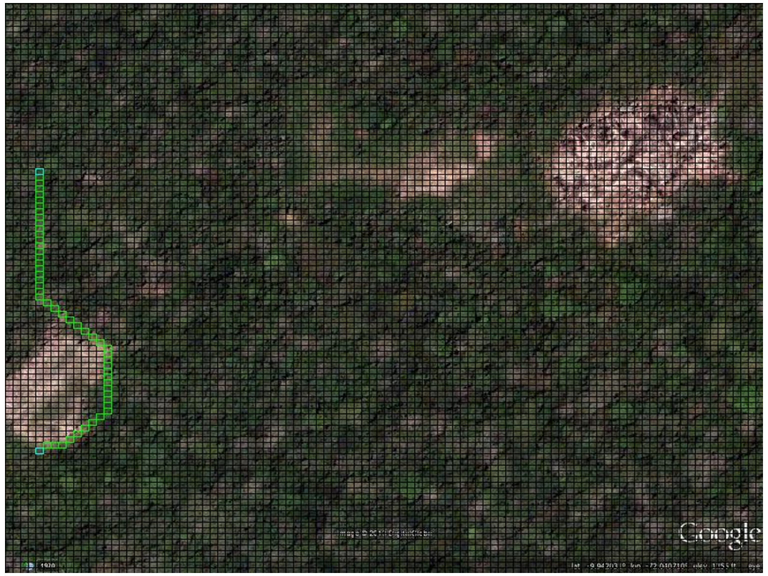
Path : (1,1) -> (2,2) -> (3,3) , Cost:21



Results

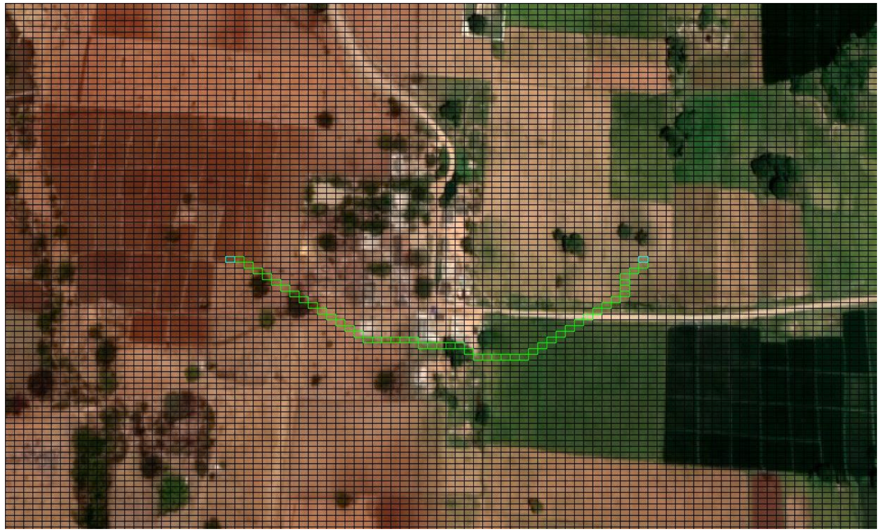
Case 1 : Greenery along with few patches of Rocky Terrain

1. A simple case of greenery and rocky terrain.
2. The value of G in RGB channel is inversely proportional to intensity of green area.
3. The Average value of G within a grid is considered as the cost value.



Case 2: Village-level

1. Rural area comprising of a combination of fields, plain land, soil roads, buildings etc.
2. green fields, plain land treated as region of interest (RoI).
3. buildings is considered as the obstacle region



Case 3: Semi-Urban level

1. Semi-urban area with buildings, green patches and roads.
2. Multiple sets of source and destination connecting multiple water bodies

Observations

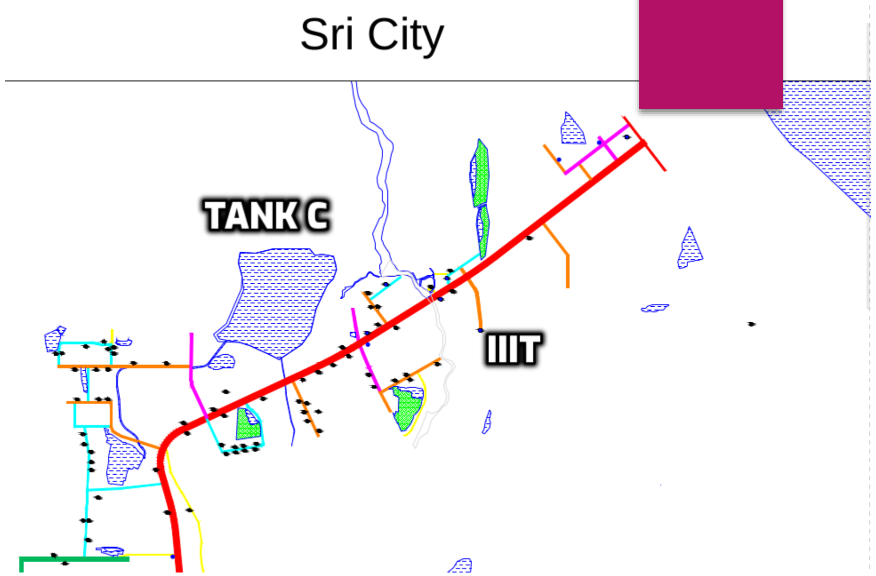
Straight path: The route distance is calculated using four standard directions of left, right, top, bottom,

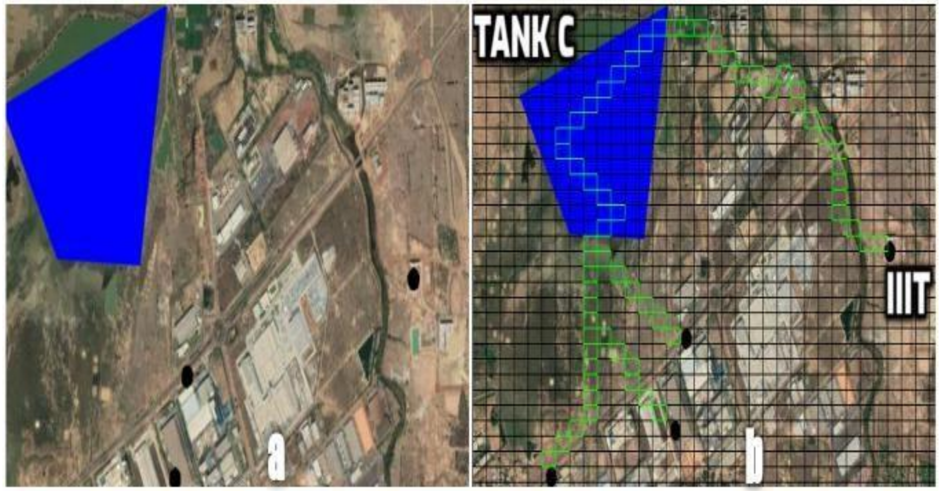
Unconstrained path: The shortest path from given source and destination. The route savings reduction when compared to Straight path is 45%.

Constrained path: The ZJS algorithm results in a constrained path by avoiding obstacles.

The route savings reduction from Straight path to constrained is **36% and 16.6% increment** from unconstrained path to constrained path.

Real Time Implementation on SriCity reduction up to 36%





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Challenges

Selection of grid size in the algorithm.

Maintaining Adaptive thresholds.

Unavailability of satellite images in public domain.

Future Work

Revise	Revise the model considering more technical and non-technical factors.
Test	Test the above model for more cases of satellite images like urban cities, diverese terrains.
Automate	Automate the selection of proper grid size.

Conclusion

This Research primarly deals with finding path to the lay the pipeline between water bodies in an economical manner.

The performance of the route laying mechanism is analyzed in real-world - SriCity.

Reduces pipe-laying infrastructure by up to 36%

Unavailbility of satellite images in public domain has been a challenge.

Future scope includes revise, test and automate the model for diverse scenarios.

References

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THANK YOU

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