



PLUMBER PUZZLE GAME

Submission by:

GROUP - 3

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To Professor -

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ACKNOWLEDGEMENT

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CONTEXT

- Clean tap water is not a given in the world. Across the world, in major cities and small towns, drinking water is contaminated by industry, aging infrastructure, and government oversight. To majorly focus on the piping infrastructure problem, the game is designed with awareness in mind
- This puzzle game is all about transporting water from source to the destination by connecting the pipes correctly and avoiding the wrong routes. When the player progresses through the levels, the project aids in the education of others about the importance of water safety. The player must complete three levels in order to win the game. Each level has a different level of difficulty. Furthermore, when the person attempts to play the game, they face several obstacles.
- During this procedure, the player will learn about different barriers that might lead to faulty infrastructure. This information will aid the player in conserving water in future, as well as having fun when playing the game by encountering problems and overcoming them in order to win. This project is implemented by using Python modules like 'pygame', 'tkinter' and PyCharm interface.

INTRODUCTION

The Plumber Puzzle Game's main purpose is to promote water conservation. To play the game, the player must finish levels in which he acts as a plumber entrusted with connecting pipes to prevent damage or leaks. This is a fun and interesting puzzle game that allows players to enhance their problem-solving, perception, and speed skills while having a wonderful time. It supports people of various ages, genders, and backgrounds in their educational endeavors. The game is separated into four sections: first, an organized coordinate grid; second, pipe mapping to correct grid areas; third, tile rotation and state saving; and fourth, matrix matching of the Active Layout to the player's layout. To build a full pipeline, Player must move the various pipes and join them together. To make the uppermost pipe link with the lowermost pipe, you must rotate the pipes. If the Active arrangement matches the Players layout, the Player wins the game and becomes a brilliant plumber. If the Player fails to align pipes according to the Active condition, the Player loses the game and must repeat the process in order to know about water and avoid difficulties in the future.

PROBLEM FORMULATION

Competing demands for water in many sections of the country put a strain on local and regional water supplies. Water was wasted in large quantities in California as a result of improper outlaying of connected pipes in the subsurface layer, as well as other concerns. It not only conserves water, but it also maintains waste management by lowering the amount of toxins, rodents, any waste, pipe material, and pipe damage caused by rust and dust that is struck through the pipes to be cleaned for the clear flow of water for continued consumption. People are the primary cause of the water shortages that ordinary people are experiencing. People can enhance their knowledge and speed at a given ability by practicing it; this game can be a great instrument to encourage brain growth of specific life skills, as water is the most necessary for human survival. This game is really beneficial to all types of people. Children, in particular, develop the behavior of water conservation in their young minds.

This thought led to the development of the Plumber Puzzle Game, which is one of the ways for people to conserve water safety rules by playing through each level and encountering a variety of obstacles and hurdles to overcome in order to win the game. If they win, they will have seen a variety of different perspectives on how water safety is exploited and will have solved the game in the process.

ALIGNMENT WITH KEEN FRAMEWORKS (3 CS)

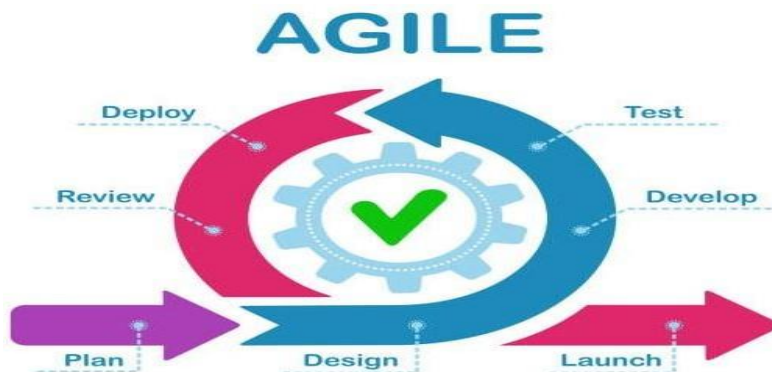
Curiosity: The project will be a puzzle game about planning a grid of pipe placements to get water from a source to an exit while avoiding pollution, dry wells, and all sorts of obstacles. The subtext will be embedded with the game play loop so that the entire experience is a holistic and entertaining game.

Connections: The game will use python, tkinter and pygame as a solution to creation of the game. Other assets will be made with art programs like Adobe Photoshop. The game will be made from scratch as to practice coding in python and learning the pygame libraries.

Creating-Value: The project will connect with concurrent water issues in the U.S and the greater world. Our water retention and scarcity message will connect to the idea that we should design better infrastructure to keep pure water within our area of usage. The game can show some ways in which we can conserve the water as themes and dialog.

METHODOLOGY

For successful outcome of a project, project management is: "The best Software methodology is definitely taken by the group or team to perform particular tasks." Here, we followed Agile Methodology for deployment.



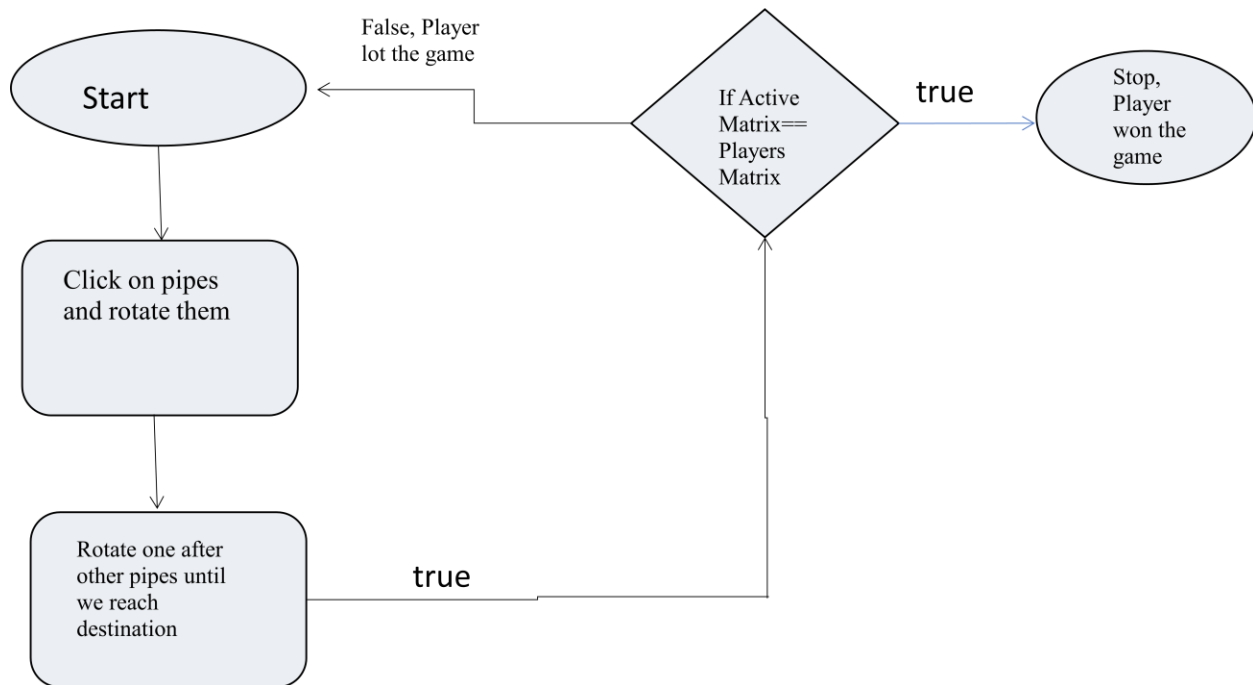
- **Requirements:**

The following are the requirements or tasks that must be performed in order for the project to succeed or be completed: We as a group came up with the idea of creating an interactive game with pipes that could be played by everyone, regardless of age, and would aid in learning. This was the first and most important criterion. To do so, we'll need PyCharm IDE for software development, as well as tkinter and PYGAME Interface for the menu section, as well as the essential packages. The requirements were gathered by the entire team.

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- **Design:**

Our game was developed from scratch with all the grid arrangements and mapping with few steps. Develop GUI using Python Tkinter, PYCHARM Interface. Import libraries for making the game interactive.



Flowchart of the whole process from the view of Player

Development:

Development has mainly categorized into 4 different parts.

- First, the pipe objects are initialized with a dictionary containing their type and their default rotational value.

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- Next, the objects are created in sprite windows with the defined dictionary values, and a mirror dictionary is also used to compare the current game state to the winning solution
- The player can rotate pipes to create a path from the top left to the bottom right, making sure every route is closed.
- These rotations are recorded, and compared to the solution every time and if the solution equals the current game state, it is considered a “Win”
- 3 Main things must work for the game to function
- Organized Coordinate grid
- Mapping of correct pipes to grid spaces
- Rotatability of tiles, and saving the state
- Matrix matching of the Active Matrix and the Players Matrix

Organized Co-ordinate Grid:

```
#Coordinate system, (IE battleship) for the pipe grid, utilizes pixel measurements of 50 increment
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

```
coords = {'A1': (25, 50), 'A2': (25, 100), 'A3': (25, 150), 'A4': (25, 200), 'A5': (25, 250), 'A6': (25, 300),
          'A7': (25, 350),
```

```
level1_pipes = {
    'A1': {straight_pipe, 180}, 'A2': {curve_pipe, 0}, 'A3': {curve_pipe, 270}, 'A4': {t_pipe, 90},
    'A5': {curve_pipe, 0}, 'A6': {straight_pipe, 90},
    'A7': {t_pipe, 180}, 'B1': {straight_pipe, 90}, 'B2': {straight_pipe, 0}, 'B3': {curve_pipe, 180},
    'B4': {straight_pipe, 90}, 'B5': {t_pipe, 270}, 'B6': {curve_pipe, 0},
    'B7': {straight_pipe, 0}, 'C1': {curve_pipe, 0}, 'C2': {curve_pipe, 180}, 'C3': {straight_pipe, 180},
```

Output:



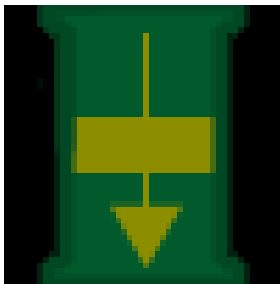
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The Execution of the Tiles mapped to Co-ordinates according to a particular certain angle.

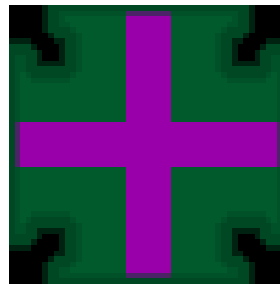
This grid and tile map functions help in mapping coordinates with tiles, and allowing mouse collisions

- The tiles are in both columns and rows within spacing of 50 pixels from each other.
- The grid is alphanumeric, one number and letter (i.e, A1, A2, A3)
- This allows organized level design without having repeat spaces or double numbers to parse
- Assigning these tiles to specific placements is paramount in creating levels, each grid space is occupied by a tile type stored within the level dictionaries.

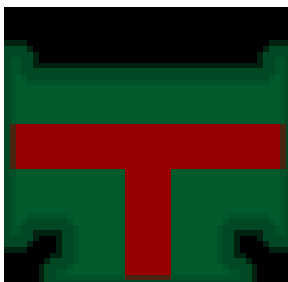
Rotation of Pipe Images:



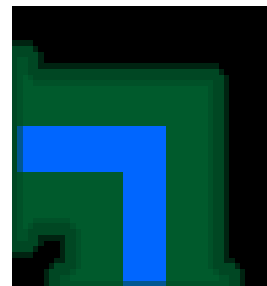
Straight Pipe



Plus Pipe



T-Pipe



C- Pipe

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- Each pipe undergoes rotation in for the proper alignment through the tile while rotation happens
- This Image rotation function is the main function which rotates the tile 90 degrees once the user clicks on a pipe.
- All the pipes pass through the function once a user clicks on the pipe.
- The modified pipe would be restored in the grid, along with its corresponding degree value once it has been rotated
- Pygame must copy and rotate the copied sprite, because of graphical rendering shortcomings
- Once a pipe passes 270 and goes to 360, its rotation is reset back to 0 so it may continue to rotate between fixed values
- Without a reset, the degrees would continue to climb past 360 and become much harder to check

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	A	B	C	D
1	TP- 0	TP- 90	TP- 180	TP- 270
2	CP- 0	CP- 90	CP- 180	C-270
3	SP- 0	SP- 90	SP- 180	CSP- 270
4	PP- 1	PP- 1	PP- 1	PP-1

SP = Straight
 CP = Curved
 TP = T-Pipe
 PP = Plus pipe

Comparison of Player Grid and Original Grid:


	A	B	C	D
1	SP-0	SP-90	TP-180	SP-O
2	CP-90	PP-270	CP-O	CP-90
3	TP-90	SP-90	SP-O	CP-180
4	CP-180	SP-O	CP-90	SP-O

Consider these are the winning conditions:

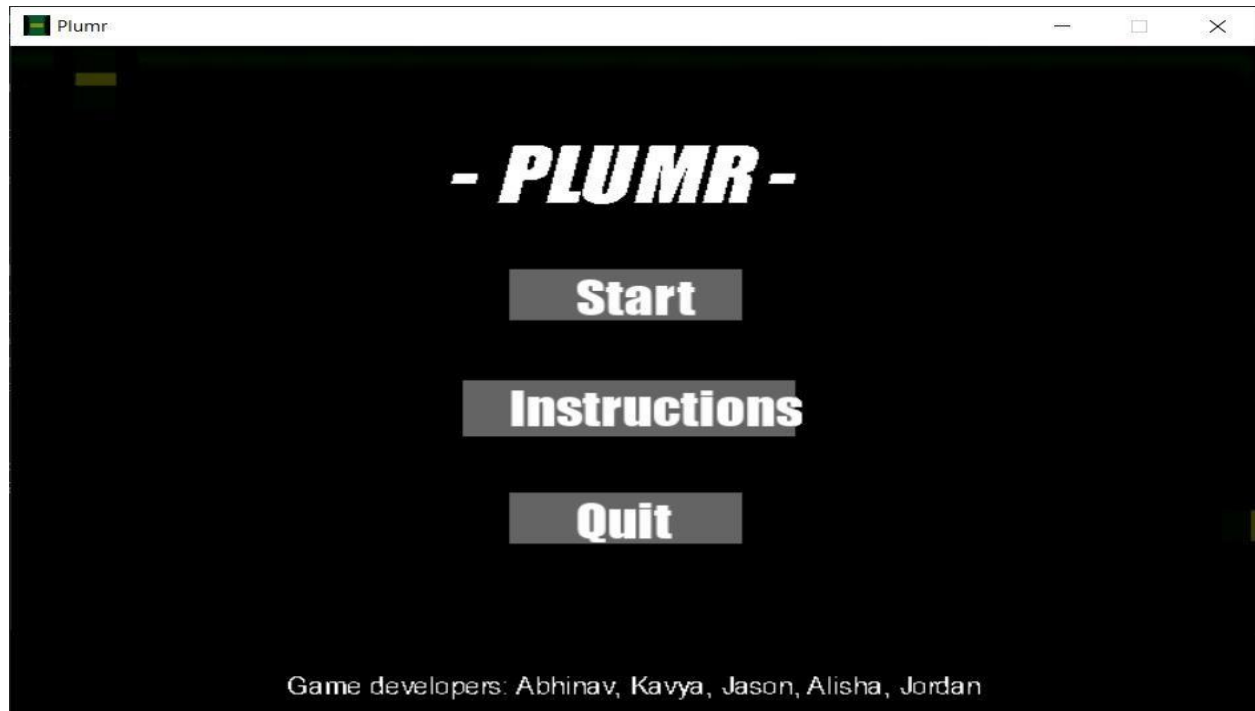
```
(A,1)=0
(A,2)=180
(B,2)=0
(B,3)=0
(B,4)=0
(C,4)=0
(D,4)=90
```

Once player aligns pipes from start to finish, then the coordinates of the game state dictionary match the solution matrix

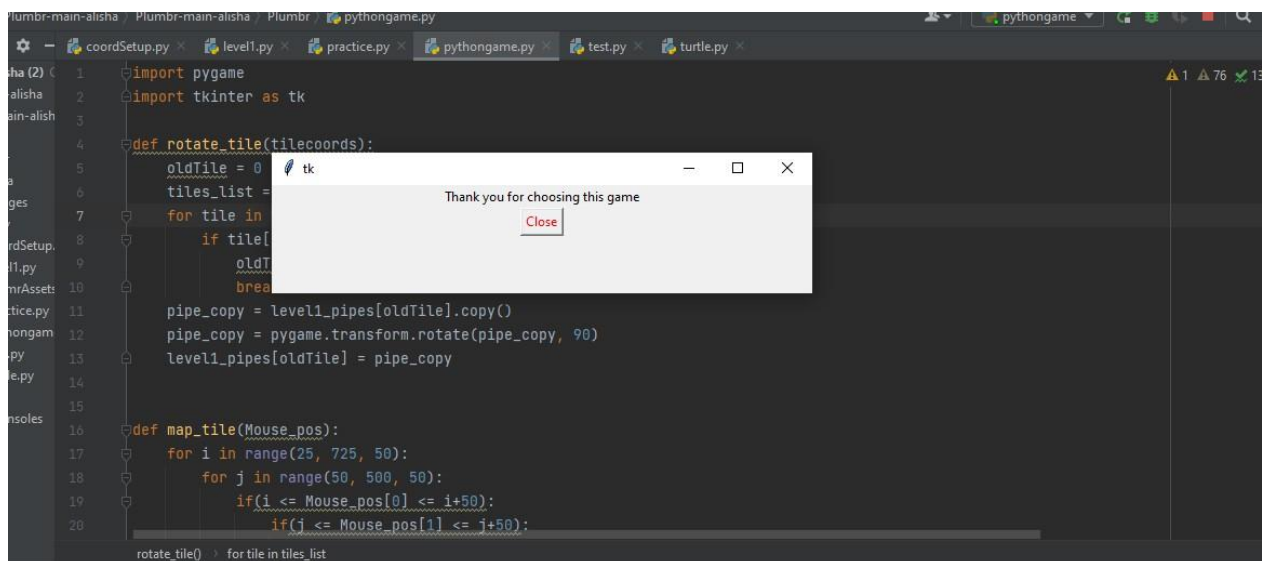
State(0,1) = Solution(1,0)

State(1,0) = Solution(1,0) -----  Correct

User-Interface for Menu and the Start page:



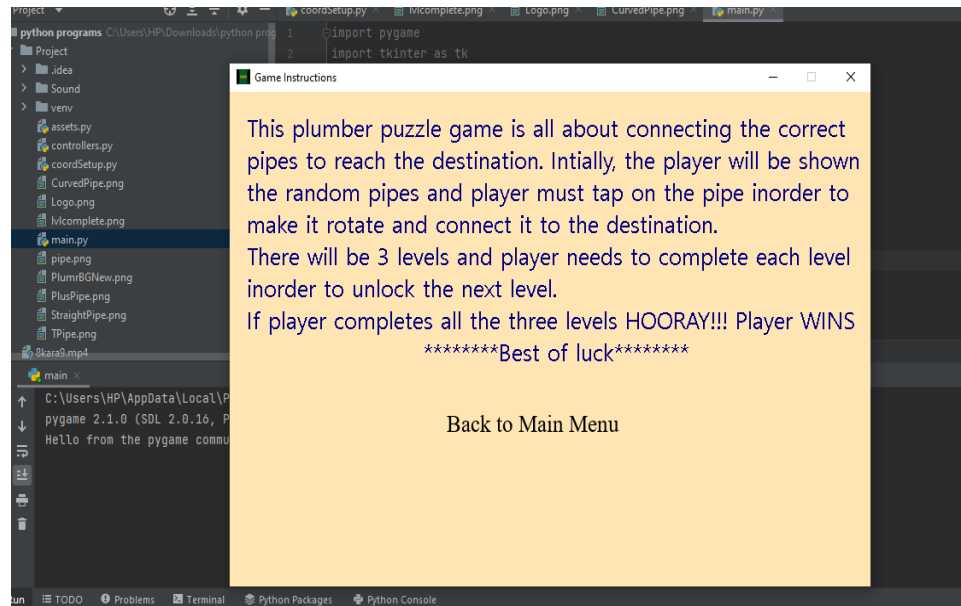
Once Player starts playing the game, they come across these following options of Start, Instructions and Quit.

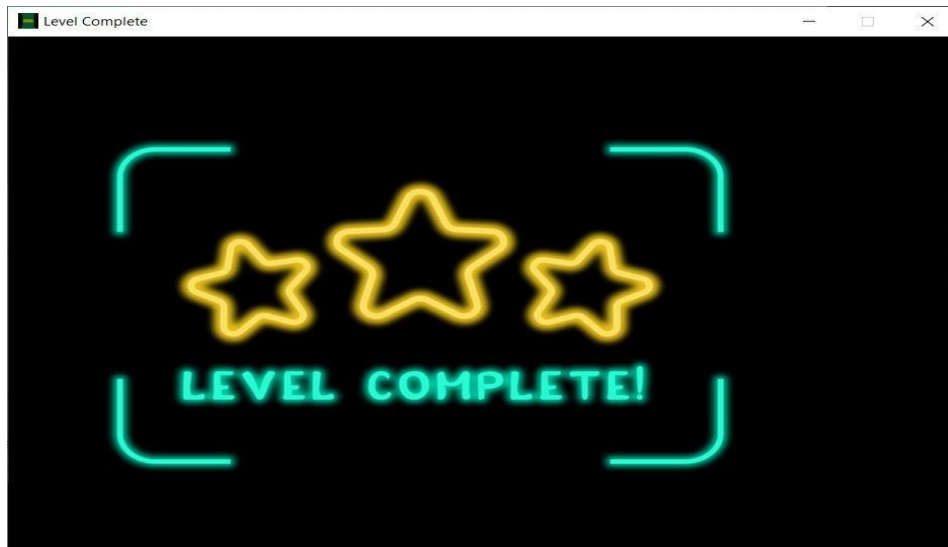


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The following pop-up appears once the player quits from the game.

The below screenshot shows the instructions, If the player wanted to know or go through the game before playing.





This is the output appears after the player completes fixing all his pipes in correct order, this is the output displayed once Player is done with his game.

Testing:

After the successful outcome of the Game, we performed Manual Testing to make sure if everything was working fine. This was the simple test not as the Automatic test and moreover Its low-cost. We could try implementing the Automation testing in near future.

Deployment:

The game's execution begins with Pygame.py, which contains the setting of Co-ordinates as well as three initialization processes: Mapping tiles, Rotating, and Initialization. We'd use any gadget to make sure the game functions smoothly in every situation.

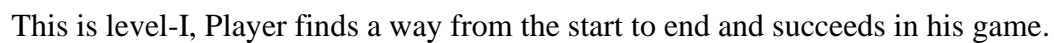
We choose the agile development methodology because it allows for the delivery of apps in numerous iterations, allowing coders to troubleshoot and adjust the code as needed. This aids

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in increasing productivity, discovering flaws and debugging them in order to correct the code and find a solution at an early stage.

Communication would be problem in real-time, this would be said as drawback and Time-commitment for the team is most important factor as the code needs to be iterated for various test cases and would need to provide solution within the iteration of approval.

We came up with the solution of Level-I, Where Player starts his game from the source pipe, and rotates pipes in a particular angle tilting to 90 degrees, in this process Player needs to set the pipes in such that he is paving a way from the source pipe to destination in a proper way. If Player aligns them properly, He would be winning the Game and allowed to be unlocked to play other levels of game.



level 2

This has almost all the pipes we used in designing the game, which has multiple routes of success, choosing the correct route makes the player win the game.

Limitations:

- Intersection of Pygame interface and Tkinter.
- Bugs caused by Pygame window rotations
- Creating advanced logic for handling win and game state
- Designing assets for each part of the game
- Level design with only 1 proper solution

Future Works:

- Advanced levels could be implemented using other data structures
- Multiple paths could be added and increase complexity.
- Implement obstacles
- User interface can be optimized, Animations can be added for water flow from initial to final point.
- Multiple levels to be added, Streamline a design tool

CONCLUSION

We have implemented a game environment for a player to contribute himself as a Plumber in water conservation in undergrounds in this game Plumber Puzzle Game. We have designed three levels for its implementation and have succeeded in those levels, and we will implement more levels in the near future. To improve the game's atmosphere, we added advanced features like PYCHARM Interface, Tkinter, and a few other libraries. Our game's main features are the directions and the ease with which the player may progress from one level to the next without difficulty. This makes the game more exciting and enjoyable to play.

REFERENCES

- [1] <https://www.pygame.org/tags/all>
- [2] <https://docs.python.org/3/library/tkinter.html>