A Project Report on

An aesthetic 2d game with an astute AI using unity framework and its quality evaluation

Submitted in partial fulfillment of the requirements for the award
of the degree of

Bachelor of Engineering

in

Computer Engineering

by

Gouresh Khochare(16102015)
Tejas Deshmukh(16102002)
Preet Gandhi(15102056)

Under the Guidance of

Prof.Sofiya Mujawar

Department of Computer Engineering
A.P. Shah Institute of Technology
G.B.Road,Kasarvadavli, Thane(W), Mumbai-400615
UNIVERSITY OF MUMBAI

Academic Year 2019-2020

Approval Sheet

This Project Report entitled ***"An aesthetic 2d game with an astute AI using unity framework and its quality evaluation"*** Submitted by ***"Gouresh Khochare" (16102015), "Tejas Deshmukh" (16102002), "Preet Gandhi" (15102056)*** is approved for the partial fulfillment of the requirenment for the award of the degree of ***Bachelor of Engineering*** in ***Computer*** from ***University of Mumbai***.

Prof.Sofiya Mujawar
Guide

Prof. Sachin Malve
Head Department of Computer Engineering

Place:A.P.Shah Institute of Technology, Thane
Date:

CERTIFICATE

This is to certify that the project entitled ***"An aesthetic 2d game with an astute AI using unity framework and its quality evaluation"*** submitted by ***"Gouresh Khochare" (16102015), "Tejas Deshmukh" (16102002), "Preet Gandhi" (15102056)*** for the partial fulfillment of the requirement for award of a degree ***Bachelor of Engineering*** in ***Computer***,to the University of Mumbai,is a bonafide work carried out during academic year 2019-2020.

Prof.Sofiya Mujawar
Guide

Prof. Sachin Malve
Head Department of Computer Engineering

Principal

External Examiner(s)

1.

2.

Place:A.P.Shah Institute of Technology, Thane
Date:

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, We have adequately cited and referenced the original sources. We also declare that We have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

_____

(Signature)

_____

(Gouresh Khochare (16102015))
(Tejas Deshmukh (16102002))
(Preet Gandhi (15102056)

Date:

Abstract

This proposed system provides an insight into the entire process of developing a 2d indie game using unity framework. It would include the process of creating 2d pixel art assets , as well as normal assets using adobe photoshop, adobe illustrator and blender ; outputting sprite sheets which are used in the animations of the game characters and objects. It would also include a brief on shortest path-finding A* AI algorithm which would be implemented as the enemy chasing the player character to attack via the shortest path in real time. Unity physics components concepts such as colliders, raycasting , etc would also be implemented. After the game completion , to test the quality of the game , a brief questionnaire would be prepared to get the feedback from all age groups on the basis of which statistical analysis of the game will be done which would result in the rating of the game's feel, theme and environment and would provide an area for the improvement of the same. Also, quality evaluation would be carried out to ensure a superlative, placid graphics design and gameplay.

Contents

Chapter 1

Introduction

Basically it is a2D game that will be developed using unity software.Unity is a game development platform for 2D and 3D game development.Also here we are using $A*$ shortest path finding algorithm that will detect the minimum distance between enemy and player and allow enemy to use shortest path for attacking player.Also difficulty of level increases by adding more enemies and giving time constraints limits for each level to complete.If player passes the level within time limit then score increased.According to their sores ,they get their ranks.

We are setting player's behaviours and various attributes of speeds here i.e.angular ,linear speed.Also camera setting are done where camera gets zoom in,when player stops and gets zoom out,when player is moving.Animations of coins will get add into the sample scene and when we collect coins, our score gets incremented.When higher level approaches, difficulty of jumping also getting high.

So here,we are basically implementing battle ground between player and enemies and adding level of complexities according to game levels.

Chapter 2

Literature Review

2.1 Literature Review

IEEE Paper's Orientation Authors

1] Measuring Quality of an Indie Game developed using Unity framework
- This paper provides an insight into the entire process of developing an indie game by means of Unity framework. Special attention will be devoted to core game mechanics, such as colliders, physics components, and ray casting. With an aim to determine to what extent introduced indie game has met particular dimensions of quality, an empirical study was carried out. Data was gathered from the representative sample of gamers using post-use questionnaire. Outcomes of data analysis are presented and discussed.

Authors-Mateo Bosnjak and Tihomir Orehovacki

2] Reaserching on AI path-finding algorithm in game development
-Path-finding is a basic topic which AI in real-time game. This paper for the characteristics of path-finding in the games and based on analysis and research the classical AI path-finding algorithm introduces a research on two-tiered algorithm based on Uniform block which to improve quality that searching shortest path in two points. At last, the experimental results illustrate the effectiveness of the proposed algorithm.

Author-Yanyan Cao

3] Drawing Chemical Equipment with Adobe Illustrator, Part 3 Gradients, Retouching, and More Objects
-Adobe Illustrator CS3 provides sufficient tools that let chemistry textbook and laboratory manual authors create complex drawings and publish their own original material. In this final tutorial, the author describes how to fine tune an illustration.

Author-Daniel Tofan

4] Character design as bridging tools of Ideological message in game.
—The development of gaming applications around the world, growing so fast, so does in Indonesia. This sparked the game makers in this country to be more creatively, create different variants of the game, and spoiling the game consumers which increasingly growing, rapidly. Character is not just a "Visual Form" but at the same time, also a representation of an ideological, who designed, that is able to communicate more intimately and intense through specific visual language. Character, consciously or unconsciously, have basic roles as an ambassador of the message and the idea that is being built by the makers of the game.

Authors-Tubagus Zufri,Dodi Hilman and Wahyudi Pratama.

Chapter 3

Project conception and initiation

3.1 Objective

There are two main components here i.e. player and enemy.Enemy is fetching player by using $A*$ shortest path finding algorithm and level of complexity increases by increasing enemies and reducing time for overcome that level.

3.2 Problem Defination

Enemy is trying to attack player using $A*$ shortest path finding algorithm and also number of enemies are depend upon the level of complexity.Time constraints are given for each level to proceed to the next level.

3.3 Technology Stack

3.3.1 Unity Game Engine

Unity is a cross-platform game engine developed by Unity Technologies. The engine can be used to create three-dimensional, two-dimensional , virtual reality, and augmented reality games , as well as simulations and other experiences.

3.3.2 Adobe Photo-shop

It is a raster graphics editor developed and published by Adobe Inc. This is used for creating the pixel arts in the project.

3.3.3 Adobe Illustrator

It is a vector graphic editor developed and marketed by Adobe Ic.

3.3.4 c#

It is an object-oriented programming language provided by Microsoft that runs on .Net Framework.

3.4 Benefits to the society

1. It is a stress buster for the people.
2. It indulges the minds into different zones which helps relieving stress.
3. Opens up the logical thinking part of the minds via puzzles.
4. It boosts up the thinking process.
5. It improves brains puzzle solving abilities.
6. Hand-eye co-ordination. Gaming can benefit the individuals co-ordination in different sectors.
7. Helps achieving a sense of accomplishment.
8. Being able to social with and relate to other players.

3.5 Benefits to the environment

In an indirect context or perspective, the game application may be a simulation of a quagmire. For example, a life threatening situation can be simulated, like a terrorist attack. User may be asked to make his way through such critical situations.

3.6 Applications

3.6.1 Learning aid in a software engineering

Students learn software architecture by developing a computer game. Games have been used in schools for many years to help children learn skills in math, language, geography, science, and other domains in an interesting and motivating way. Research shows that integrating can be beneficial for games within a classroom with children academic achievement, motivation, and classroom dynamics. There is also evidence that the teaching methods based on educational games are not only attractive to schoolchildren, but also to university students. There have been conducted researches on games concept and game development used in higher education before, for example, but we believe there is an untapped potential that needs to be explored. Games can provide teachers in higher education with teaching aids that can promote more active students, provide alternative teaching methods to improve variation, and enable social learning through many player learning games. It also promotes student participation.

3.6.2 Entertainment

Games are played for entertainment, sometimes for achievement or reward as well. They can be played alone, in teams, or online; by amateurs or by professionals. The players may have an audience of non-players, such as when people are entertained by watching a chess championship. On the other hand, players in a game may constitute their own audience as they take their turn to play. Often, part of the entertainment for children playing a game is deciding who is part of their audience and who is a player.

Chapter 4

Project Design

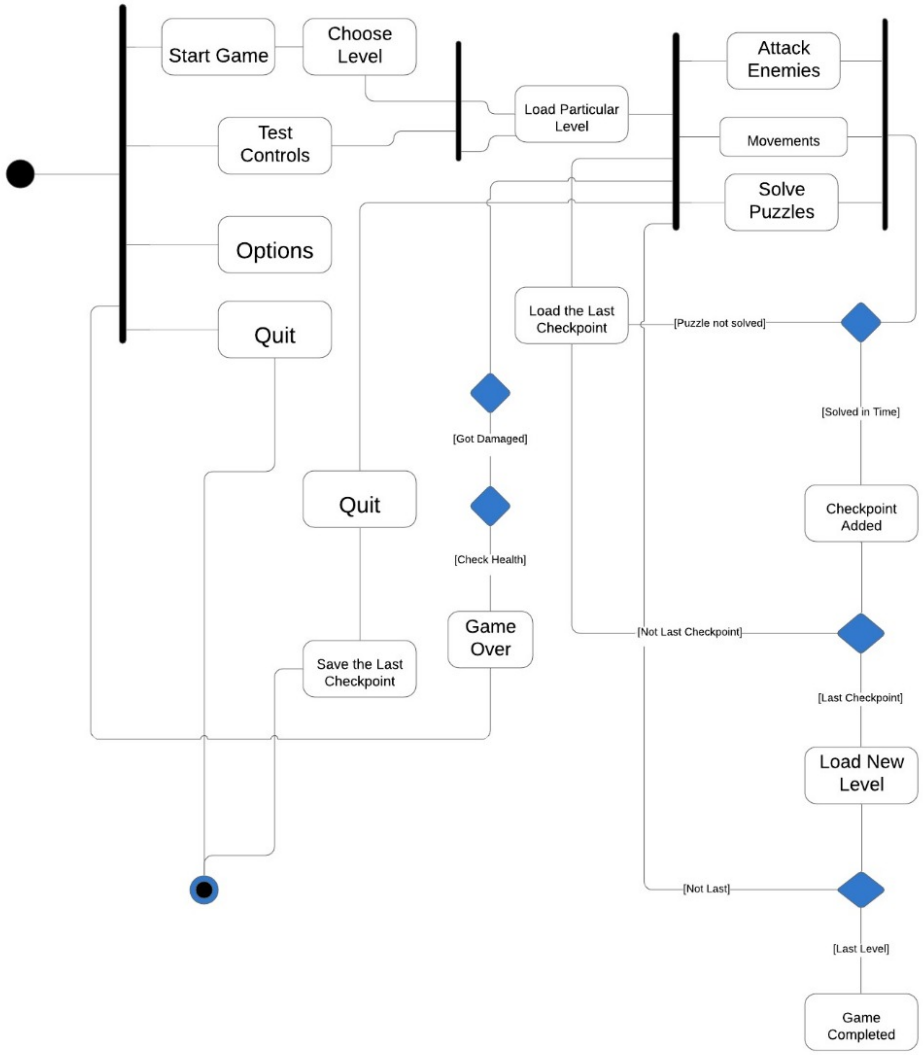
4.1 Proposed System

This proposed system provides an insight into the entire process of developing a $2D$ indie game using unity framework. It would include the process of creating $2D$ pixel art assets , as well as normal assets using adobe photo-shop, adobe illustrator and blender outputting sprite sheets which are used in the animations of the game characters and objects. Also we are designing various tiles for the game and these graphics is implemented in background and foreground. We are setting the behavior of player in such a way that he can free to move everywhere but not able cross any obstacle. It would also include a brief on shortest path-finding $A*$ AI algorithm which would be implemented as the enemy chasing the player character to attack via the shortest path in real time. Layers of player and enemies are setting different here so that when enemy collides with player ,it should get detected. Unity is actually a real development platform. The basic logic of running, walking, jumping and climbing of the player character would be implemented first. Then comes the game assets, puzzles and enemies. The character will be given a health and die system. Also, a score script will be written which catches the level to which the character has advanced, also being able to remember the checkpoints as it goes along. Game will be having different levels, with each level with an increasing complexity. Lots of levels which contains collecting coins , enemies attack and time constraints to required to succeed the respective level are implementing here. After the game completion , to test the quality of the game , a brief questionnaire would be prepared to get the feedback from all age groups on the basis of which statistical analysis of the game will be done which would result in the rating of the game's feel, theme and environment and would provide an area for the improvement of the same. Also, quality evaluation would be carried out to ensure a superlative, placid graphics design and game.

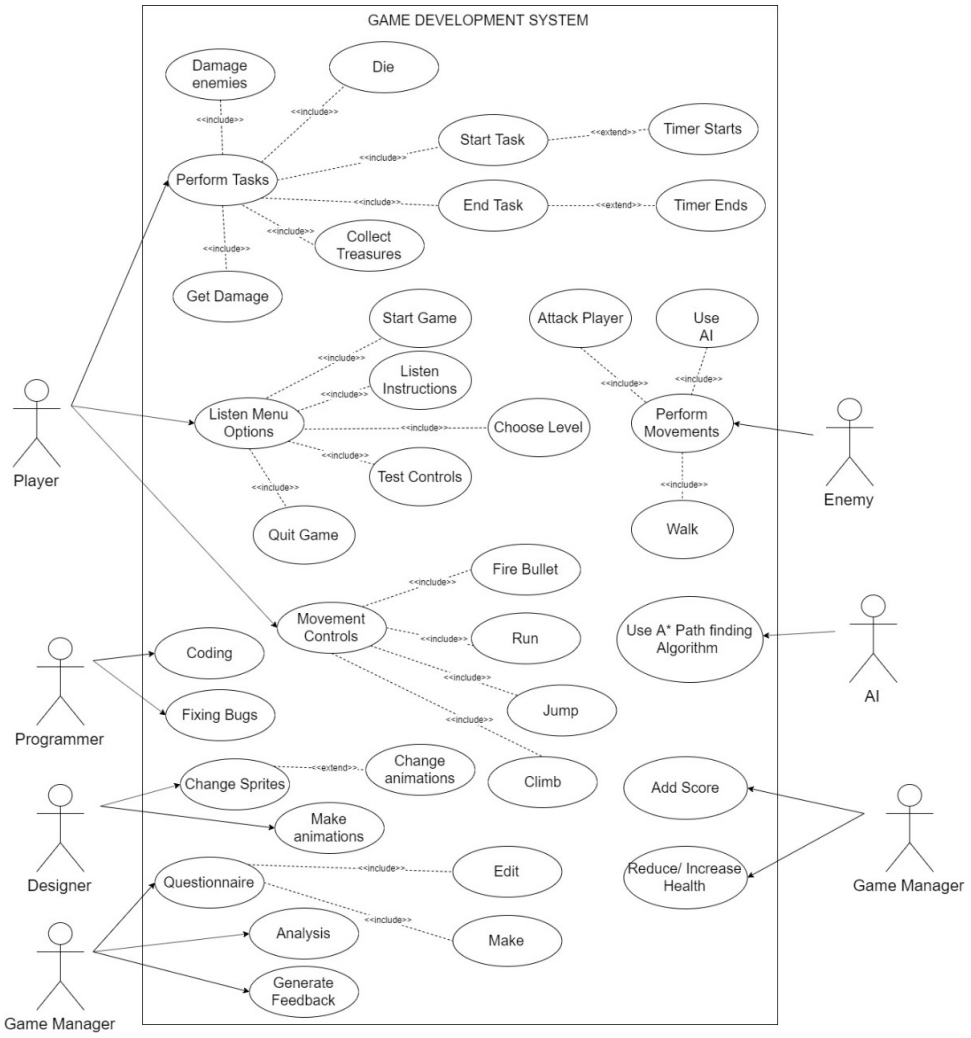
4.2 Design(Flow of Modules)

With the help of adobe photo-shop, different frames of pixel art characters performing different actions will be created and merged together in a file called as a sprite sheet. It is a normal *.png* or *.jpeg* file, with different frames. Also, original music will be made with the help of online audio tools and/or mic. These are the asset creations that will be used in unity, the game engine. The asset logic will be written in C# programming language integrated with the unity framework. The sprite sheet created will also be given a meaning by splitting it up and creating an animation by using the unity features. The animations will be attached to the scripts and objects thus outputting a game. Unity $2D$ physics engine helps with the physics concepts like gravity, translation, rotation, etc. Other than that, there are different kinds of trigger events that could be used for helping with the coding logic. Some maths functions will be used as well, and instant of the objects can also be done dynamically. Player can solve puzzles, attack enemies, score and also instantiate projectile objects i.e. bullets which are of the damage dealing type. The AI script will be then written which will help the AI enemies find the shortest path to the player. After the game logic has been implemented, different levels with different complexities could be designed by using Tile Map feature. Finally, the game can be deployed in PC or android. After that, testing is done and the game will be ready for the release.

4.3 Activity Diagram



4.4 Use Case Diagram

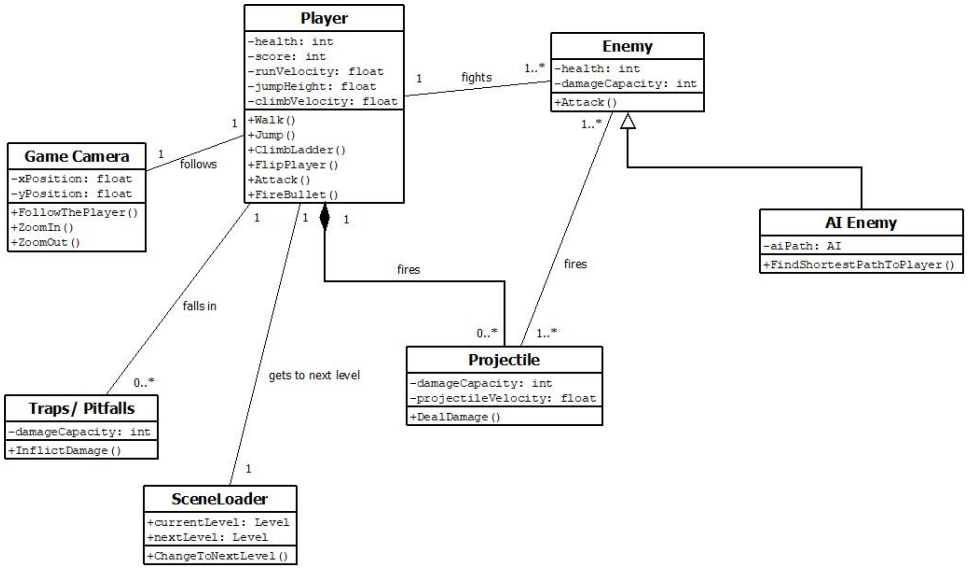


4.5 Description of use case

Here our main factors was player and enemies but along with them there are programmers ,designers and game manager who develops the game, calculating scores and decides game complexity. Role of player describes he can perform various tasks . First he starts the task(entering into game) and timer gets set. After that, he can damage enemies by shooting bullets towards them and also he can take damage when he gets shot by bullets from enemies. Also he can collect treasures to increase the score. After that if he wants he can end the game and timer will get stop at that point. If his health reduces to zero, he dies. In game menu options ,he has various choices of selecting game levels ,also he can see instructions for game and edit the test controls over there. He has various move controls of fire bullets,running, jumping and climbing. Programmer role is that he can code various levels here and also he can fix bugs and improve the efficiency of game. Designer can make various animations and can change sprites and animations to make the game more effective. Making and editing Questionnaires by taking the opinions from group of peoples is done by game manager. He can also does analysis of game and generate feedback for to know more about game performance. On other side we have enemies who can perform operations like walking

towards players and attack players by using AI which gives shortest path towards player. AI using $A*$ algorithm for detecting shortest path from enemy to player. Game manager at back-end calculating score by using time constraints and treasures collected by player. He can increase health of player if player takes booster and if player gets shot by enemies bullet then he reduces health of player. These is how use case diagram works.

4.6 Activity Diagram



4.7 Modules

4.7.1 Implementing the basic Player and Enemy Movements

Different scripts are to be written for different kinds of objects. For eg, a script named Player-Movement.cs should be written in order to control the basic player movements. We can run, jump, climb, fire, etc. The player can instantiate a projectile. As soon as its instantiated, a Projectile.cs will start running on that projectile object. Apart from the player, the Enemy.cs script has to be written and given to the enemy object. Even enemy can fire projectiles. The Camera.cs could be written to control the camera movements which follows the player or Cine-machine could be used which is a component of Unity. Script or component, the output will be the same. There would be other objects and their respective scripts too. Basically, this module focuses on the basic movements and the logic associated with it.

4.7.2 Implementing the $A*$ AI Shortest path finding algorithm on the enemy

Some enemies would be given AI path.cs script which is nothing but AI. With the help of this script, they can find the shortest path to our player and can attack the player.

4.7.3 Designing of various puzzles

Various puzzles in the game such as taking the keys and unlocking the doors would be designed in this phase. This would form the theme of the game. With the core base logic designed, with minor changes different puzzles could be made.

4.7.4 Designing of the respective sprites

To implement the coding of the designed puzzles, first their respective pixel arts should be made. Also, the logic that would have been also implemented for player, enemy, etc objects, those pixel arts would be designed by using adobe photo-shop and applying the same in the unity framework.

4.7.5 Implementing the puzzles

Designed puzzles will be given the logic and will be put together with the animation sprites. This will include writing additional scripts, one for each of the puzzle deciding the sequence of puzzles and which puzzle to be put in which of the levels. All those decisions and coding will be included in this module.

4.7.6 Implementing Health, Score, Die system

The Player would lose health when it falls into the pitfalls or traps or when attacked by an enemy. It could even die and kill other enemies, with everyone having their own damaging capacity. Also, the score could be affected by collection of some treasures such as coins, diamonds, etc. The score would also be affected by the killing of the enemies. Likewise, the logic of health, score and die system as well as their respective animations and particle effects with the help of Particle System component of the unity game engine will be the scope of this particular module.

4.7.7 Making original music track and sounds

Online audio tools will be used for creating an original music track to give the game the feel that its made for. Entertainment and a sense of accomplishment, happiness is the target of this game and animations and sounds plays a very vital role in all of this. Also, different sounds such as the key picking sound, door unlocking sound would be made by using a mic. The future scope of this could also include recording a narrator in order to guide the player in the adventure.

4.7.8 Fixing any bugs

The other additional coding includes the fixing of the bugs. Even the basic movements like walk, jump, etc has a lot of bugs and that would be the target for this module.

4.7.9 Preparing the Questionnaire and getting feedback

To test the game, different age group people will be given this game to play and an overall feedback of the same will be taken from them by given them a set of questions. These

questions would be prepared in this module and after getting the feedback, analysis of the same will be done. That is the scope of this module.

4.7.10 Any improvements

Based on the feedback, the game will be tried to improve. This is an ongoing process and with each feedback, the game will become more and more robust with logic and animations, thus making an aesthetic 2D game for entertainment.

4.8 AI Algorithm

The A* pathfinding algorithm is an exhaustive search algorithm which is guaranteed to find the shortest path between two points. The basic assumption is that the search area is tiled (e.g. square tile) and that the animat moves from the center of one tile to the center of the next tile.

1. Add the starting square to the open list.
2. Repeat the following:
   (a) Look for the lowest F cost square on the open list. We refer to this as the current square.
   (b) Switch it to the closed list
   (c) For each square adjacent to this current square If it is not walkable or if it is on the closed list, ignore it. If it is not on the open list, add it to the open list. Make the current square the parent of this square. Record the F, G, and H costs of the square. If it is on the open list already, check to see if this path to that square is better, using G cost as the measure. If so, change the parent of the square to the current square, and recalculate the G and F scores of the square.
   (d) Stop when you: Add the target square to the closed list, in which case the path has been found or Fail to find the target square, and the open list is empty. In this case, there is no path.
3. Save the path. Working backwards from the target square, go from each square to its parent square until you reach the starting square.

Chapter 5

Future Scope

5.1 Scope

The aesthetic $2D$ game will be made with the help of Unity game engine framework. The basic logic of running, walking, jumping and climbing of the player character would be implemented first. Then comes the game assets, puzzles and enemies. The character will be given a health and die system. Also, a score script will be written which catches the level to which the character has advanced, also being able to remember the checkpoints as it goes along. Game will be having different levels, with each level with an increasing complexity. $A*$ path finding algorithm will be written and the scripts will be attached to the enemy objects. By traversing the nodes, the enemies will be able to find the shortest path to the player character to attack, also by avoiding the obstacles in between. Finally, a questionnaire will be made that will ensure the quality evaluation of the game. Any enhancements, corrections, bug fixes will be considered at the end of the beta project.

Appendices

5.2 Appendices

For making 2D games we are using unity game development platform.Version of our unity is 2018 3.14 f1 .

5.2.1 Features of unity 2018 3.14 f1

1]2D: Fixed sprites referencing both the original Sprite assets and Sprite Atlas resulting in increased memory usage.
2]Android: Adds the ability to opt-out from stopping gradle daemons upon editor exit.
3]Android: Fixed UI mask on older PowerVR devices.
4]Animation: Fixed crash when state has "too many" scripts attached.
5]Animation: Fixed editor crashing on GfxDevice::ApplyBlendShape when playing animation preview.
6]Editor: Fixed cloth component attached to an object disabling the Transform tools.

5.2.2 How to install unity

You can install unity or unity hub from https://unity.com this website.It is free game development platform.

5.2.3 Requirement Specifications

Processor: Intel Core i7-3770 @ 3.4 GHz or AMDFX-8350 @ 4.0 GHz or better.
RAM: 8GB.
Video Card: NVIDIA GeForce GTX 780 or AMDRadeon R9 290X (3 GB VRAM)

Acknowledgement

We have great pleasure in presenting the report on An aesthetic 2d game with an astute AI using unity framework and its quality evaluation. We take this opportunity to express our sincere thanks towards our guide **Prof.Sofiya Mujawar**, Department of Computers, APSIT thane for providing the technical guidelines and suggestions regarding line of work. We would like to express our gratitude towards his constant encouragement, support and guidance through the development of project.

We thank **Prof. Sachin Malve** Head of Department,Computer, APSIT for his encouragement during progress meeting and providing guidelines to write this report.

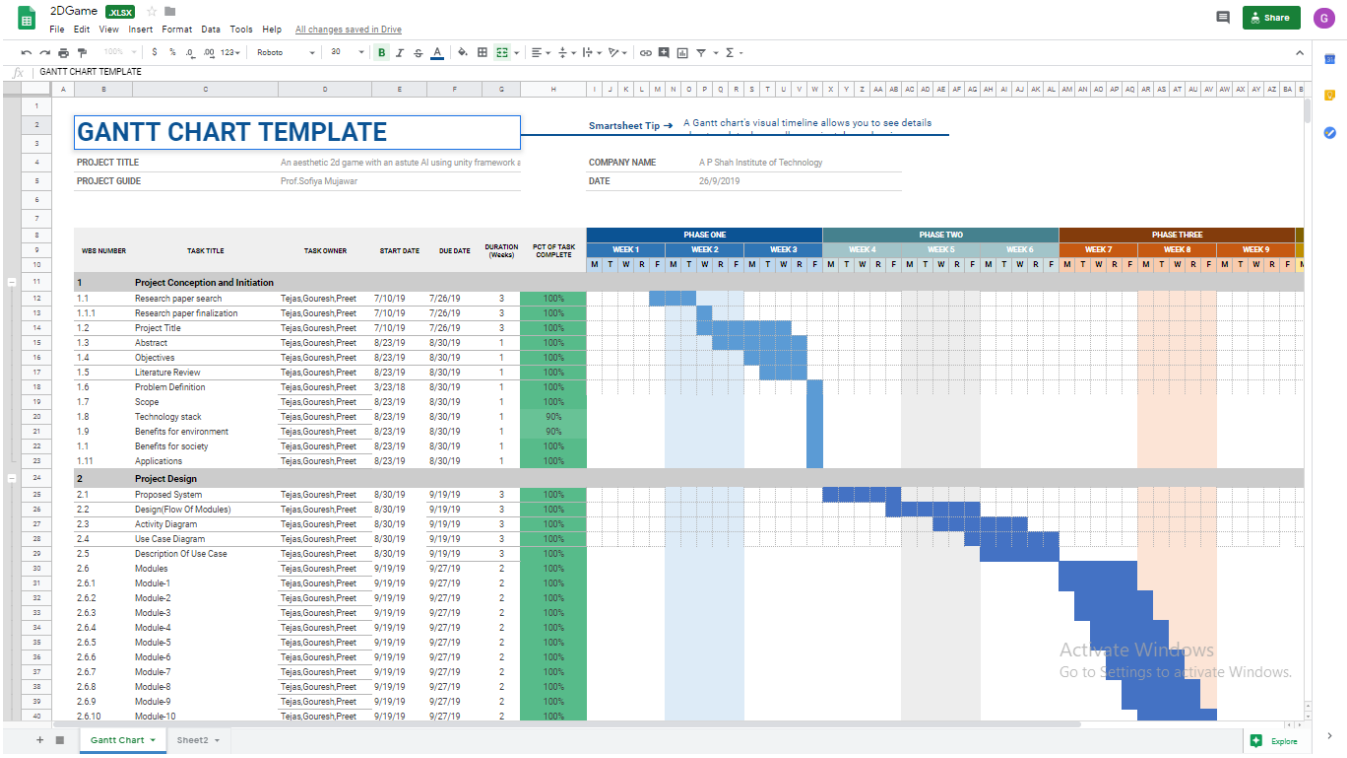
We also thank the entire staff of APSIT for their invaluable help rendered during the course of this work. We wish to express our deep gratitude towards all our colleagues of APSIT for their encouragement.

Gouresh Khochare:
Student ID1:16102015

Tejas Deshmukh:
Student ID2:16102002

Preet Gandhi:
Student ID3:15102056

Gantt Chart



Analysis of gantt chart: So in initial stages we did research on project papers and we found them in duration of 10/7/19 to 26/7/19 also we decided our project title in this duration.Abstract, Objectives, Literature review Scope and other technology stack we are described in our second phase from 23/8/19 to 30/8/19.In third phase from 30/8/19 to 19/9/19, we finalized our use case diagram and activity diagram with respect to proposed system.In last phase of designing, we divide our modules into 10 parts that consists of basic player movements ,enemy movements,implementing of AI shortest path algorithm using A*, puzzles and also any improvements if needed.These is longest phase and we cover it from 19/9/19 to 31/1/20.