Version 1.1 2024/25

University of Staffordshire

Forest Fortress

Technical Design Document

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Contents

Project Introduction

This project is about making a tower defence game inspired by games like TD5 and kingdom rush but, I wanted to make my own little spin on the game, so the user can use potions in the world to add they own little spin.

Project Goals

By the end of the project I want to have a short demo of a tower defence game were the player has to think about placing towers and manged there money and potions to win the game. I also want to add a star system to add to the reliability of the game as well.

Main goals

- Have a demo of a game with a win and lose state
- Have basic enemies that spawn in and go on the right path
- Have a tower system and also a upgrade system for those towers
- Have a wave system that controls the amount of enemies
- Have a money system in the game that the player must look out for.

Smaller goals

- Have a star system for reliability
- Have more then 1 tower in the game
- Have more then 1 enemy in the game
- Try my best to make the game look nice (And not just blocks)
- Try and get 3 potions in and working quite well

Challenges and Risks

The main challenge I see is the AI, as I have not messed with Ai that much they will be a lot of unknowns and figuring out how it all works, but I think I can do it to a good standard.

I also see some of the more advanced systems in the project (Like the upgrade system) could cause some issues. But again I think my skill is good enough to do well.

Finally I think building the game will come with some issues as I have never done it by myself before I think it could cause some problems but again I think I will be able to figure it out and get a build of the game.

Hardware Requirements

For the hardware requirements I have made some tables to showcase the hardware recommended for unreal engine 5, also I have made a table of the hardware which I made the Game on (University Pc)

Table showcasing Recommended hardware for unreal Engine 5

Recommended hardware (Unreal engine 5)			
Operating system	**Processor**	**Video Ram**	**Graphics card**
Windows 10	Quad-core intel	8 Gb of ram	DirectX 11
Windows 11	Or Amd 2.5 Ghz or faster	N/A	Or 12 Compataible card

Table showcasing Hardware in University Pc

Hardware (University Pc)			
Operating system	**Processor**	**Video Ram**	**Graphics card**
Windows 11	11th gen i7-11700	32GB of Ram	RTX 3080

Platforms

Target Platform

The target platform I am aiming for is Pc because I wanted to just use mouse inputs when making this game (Little task I made for myself) Also it made the most sense to make it for pc because tower defence games play the best on Pc.

Engine Specific Specifications and Limitations

When it comes to unreal Engine Specifications, I made a quick chart showcasing what will be Needed to run this project, Look below.

Recommended hardware (Unreal engine 5)			
Operating system	**Processor**	**Video Ram**	**Graphics card**
Windows 10	Quad-core intel	8 Gb of ram	DirectX 11
Windows 11	Or Amd 2.5 Ghz or faster	N/A	Or 12 Compataible card

Then when it comes to Limitations, I would say the main thing I will need to look out for would be Ram on computers because UE5 eats up Ram quite a lot also with the environment that I want to make with the level as well, I have got to make sure that I thinking of optimisation of my code.

Then again with Optimisation of my code should help make this not a big issue, I also think the University Pcs are quite good so I do not see Ram being a big problem if I can make my code the best it can be.

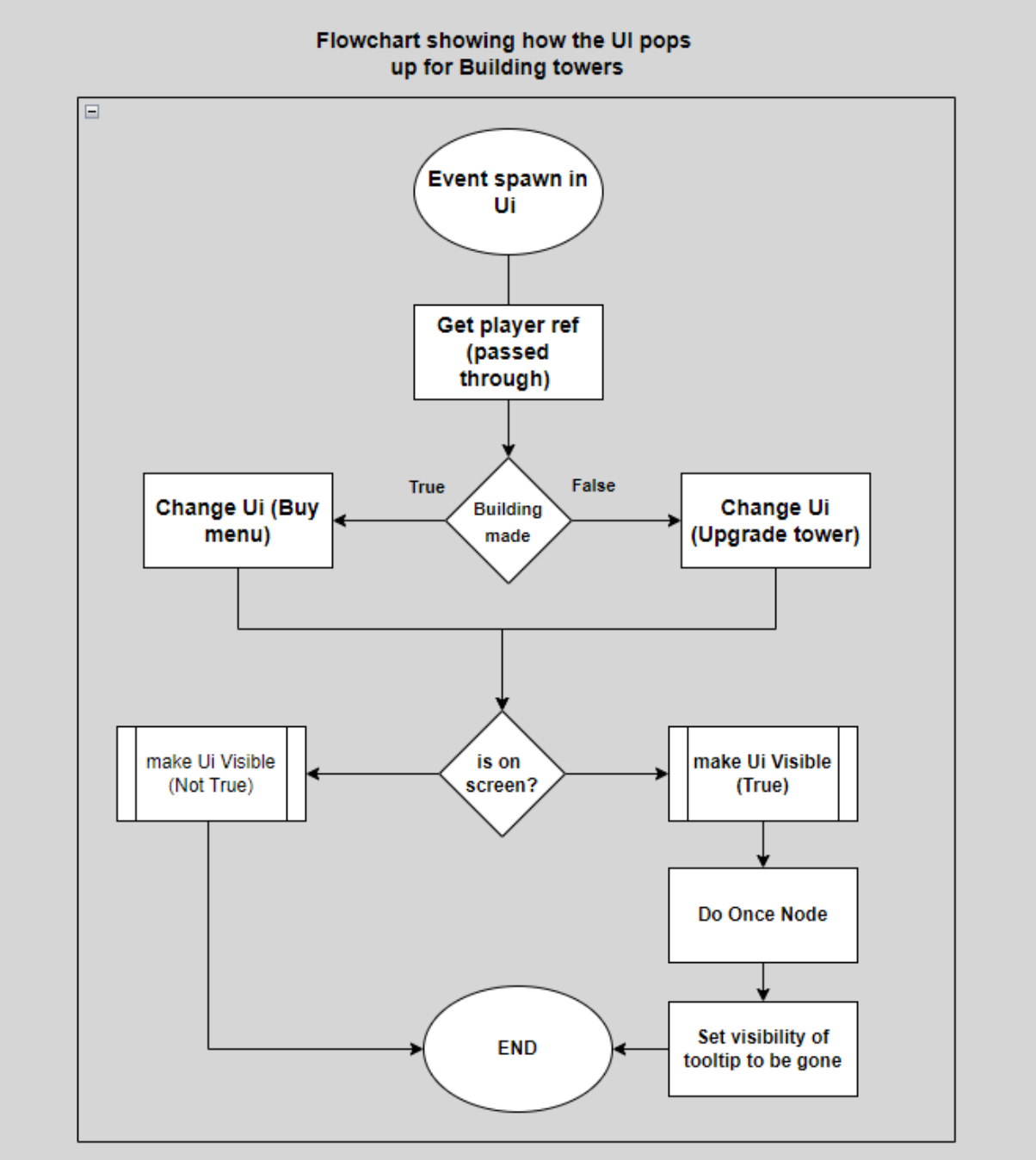
Engine Summary

The Engine version the Project will be using 5.4.4 and they are no new Plugins in the project only the one that comes preinstalled into a UE5 and using the Top down Template

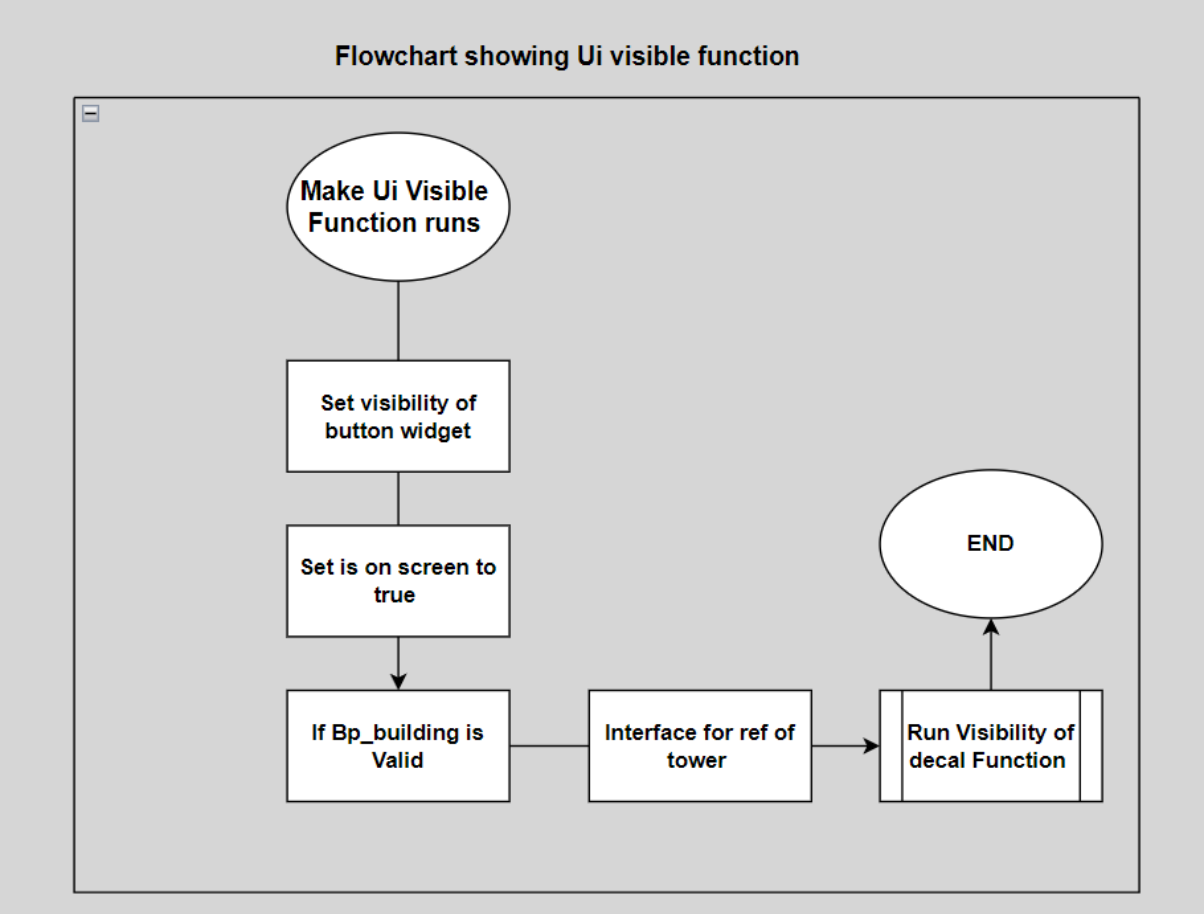
Systems and Diagrams

Flowcharts for BP_Buiding_spawn

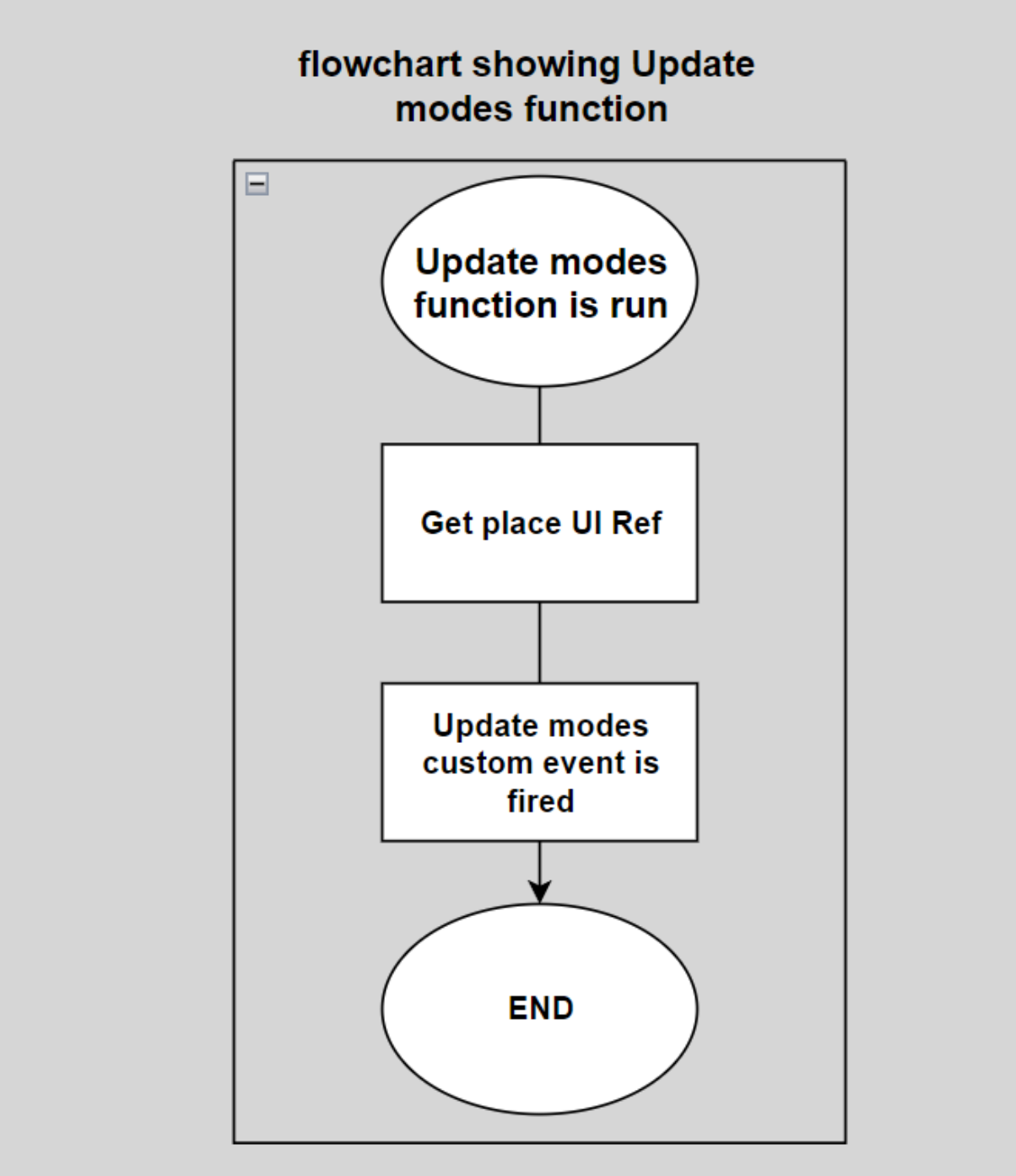
Flowchart showing how the Ui Pops up on Building towers



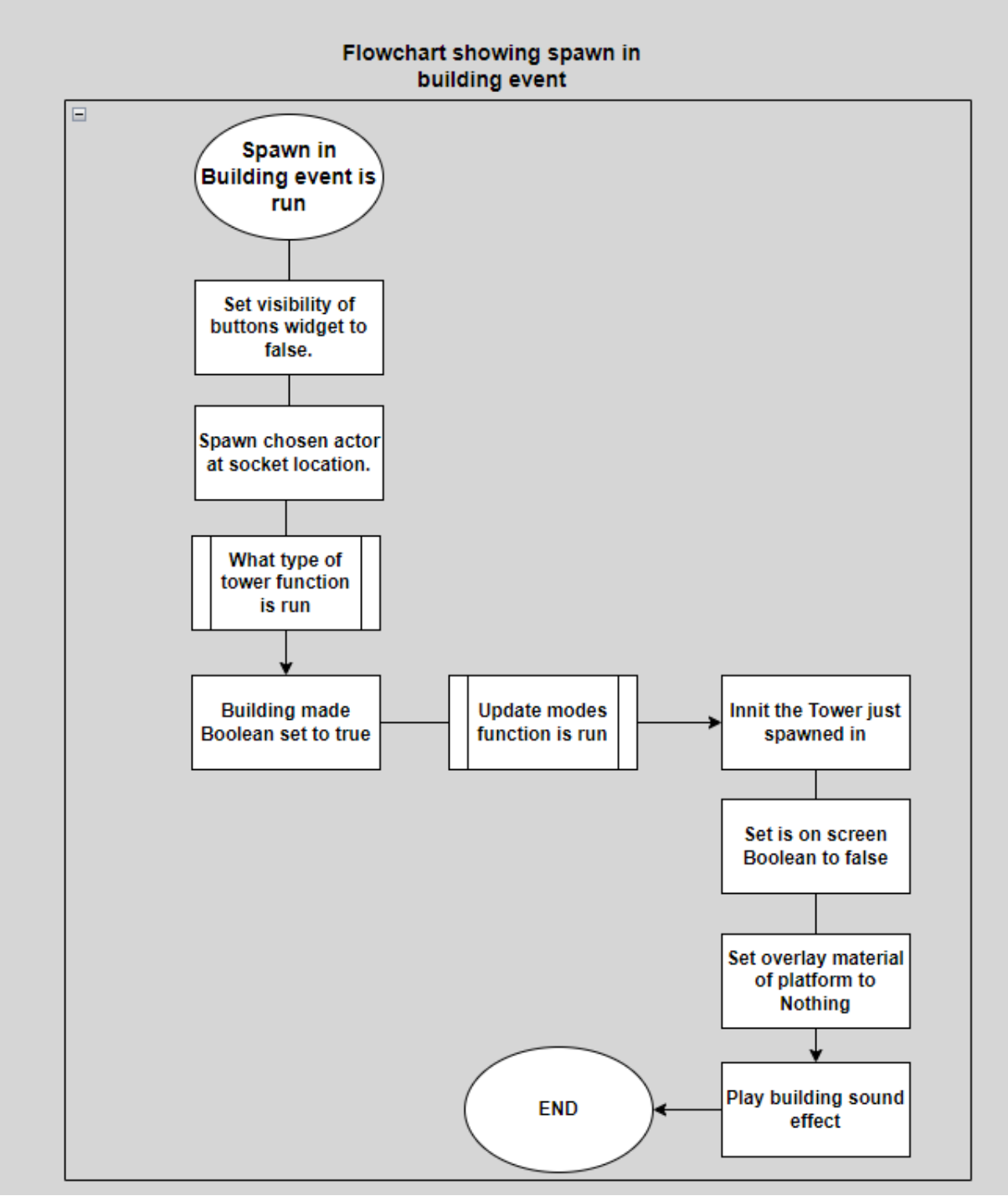
Flowchart showing how UI visible Function works



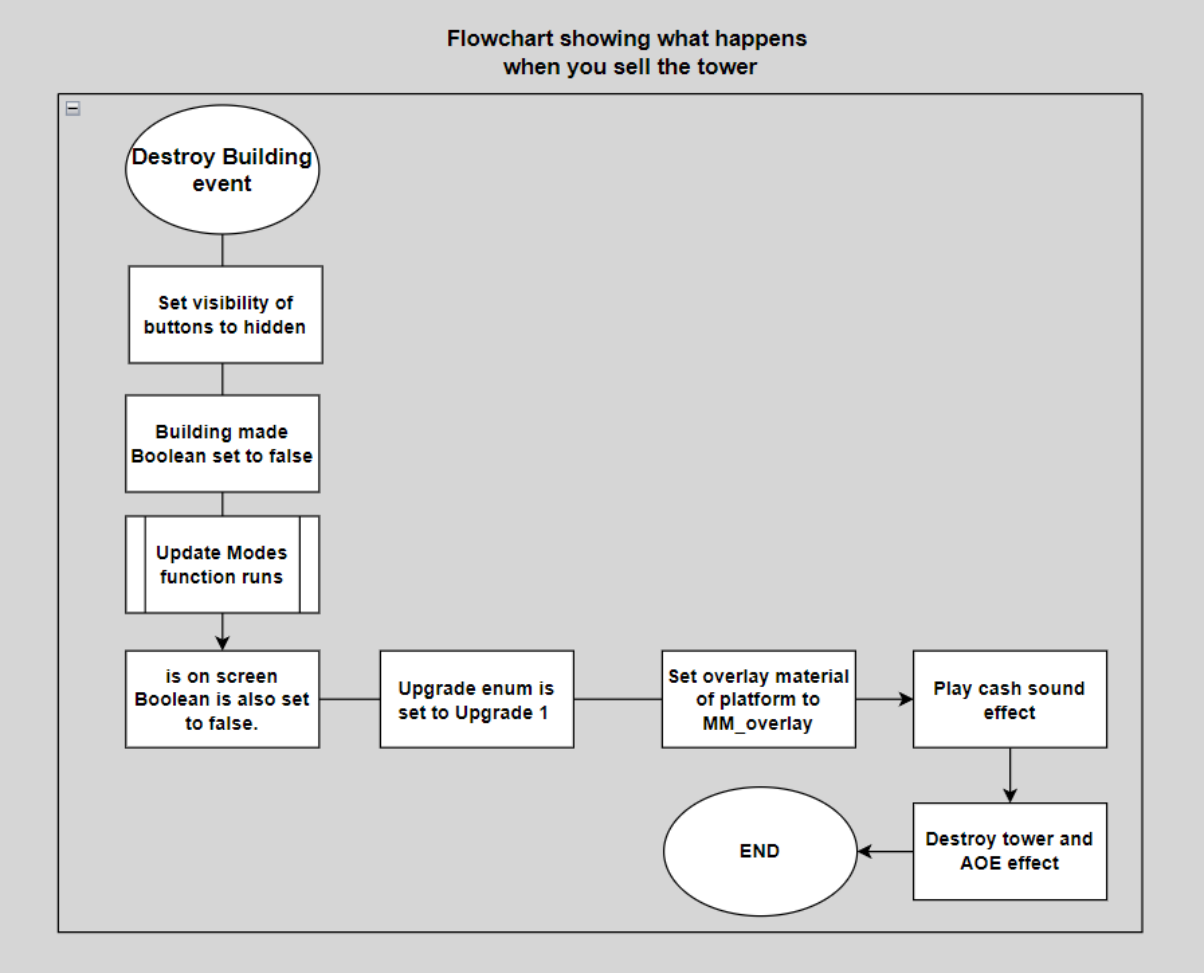
Flowchart showing how Update modes function works



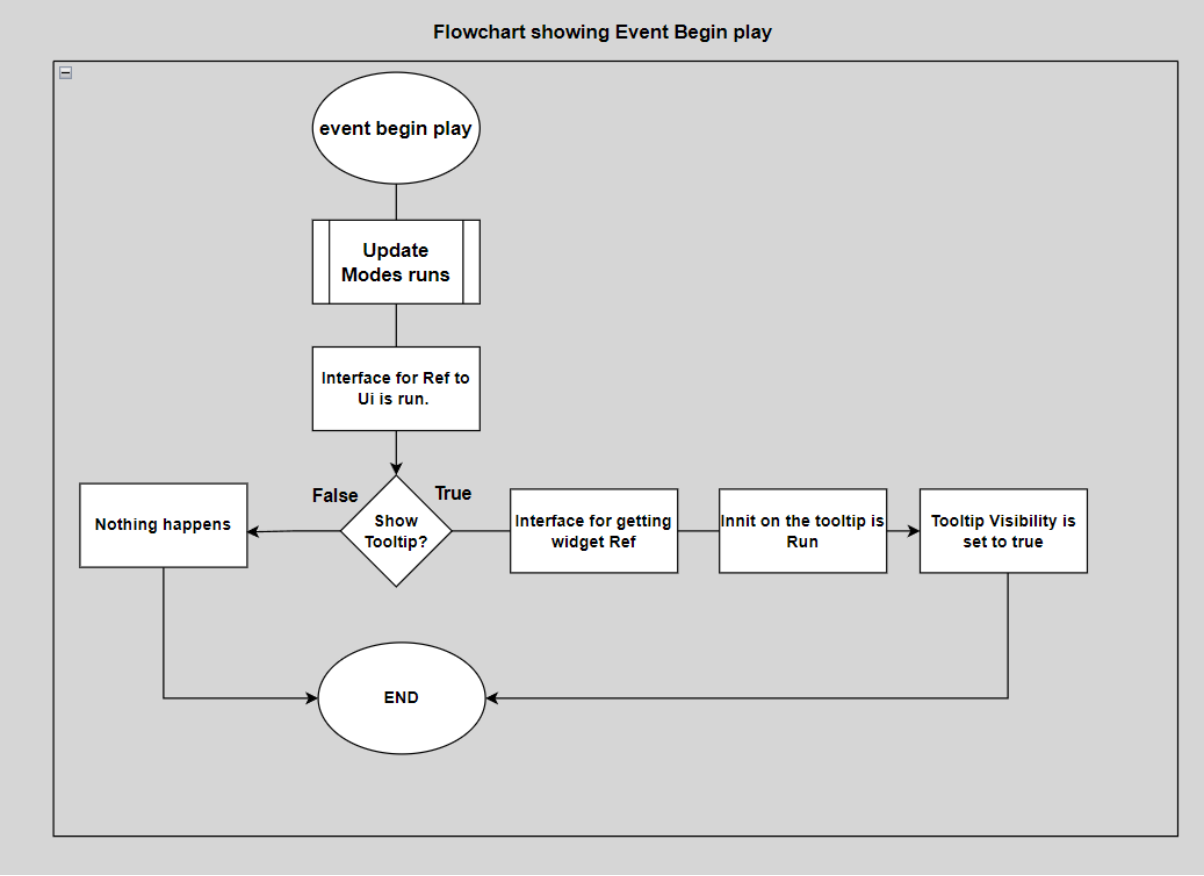
Flowchart showing spawn in building event



Flowchart showing what happens when you sell a tower

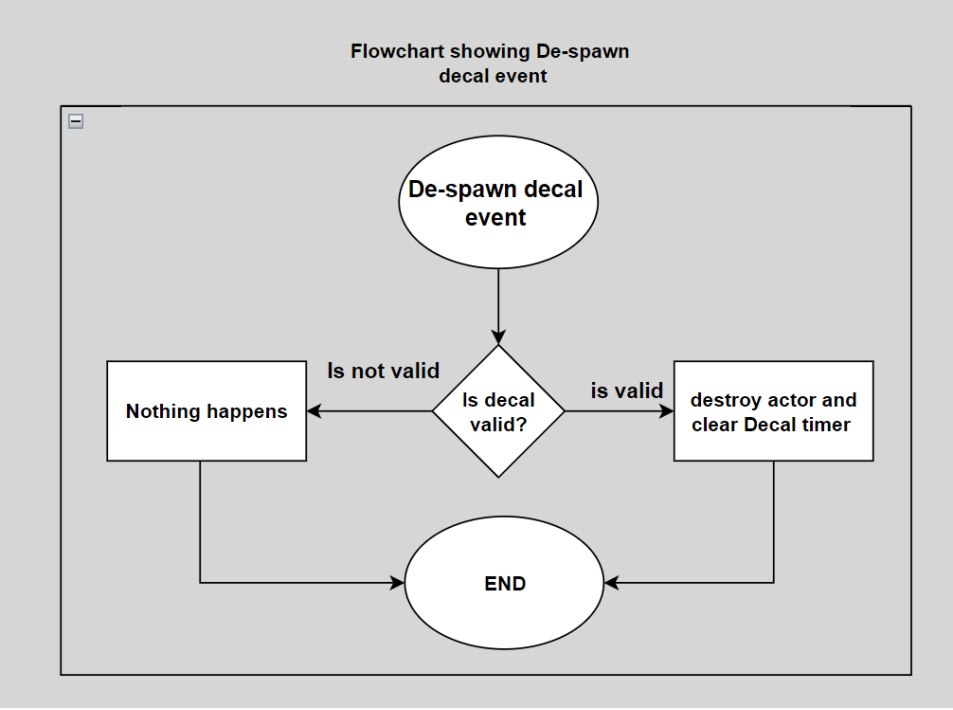


Flowchart showing what happens on event begin play

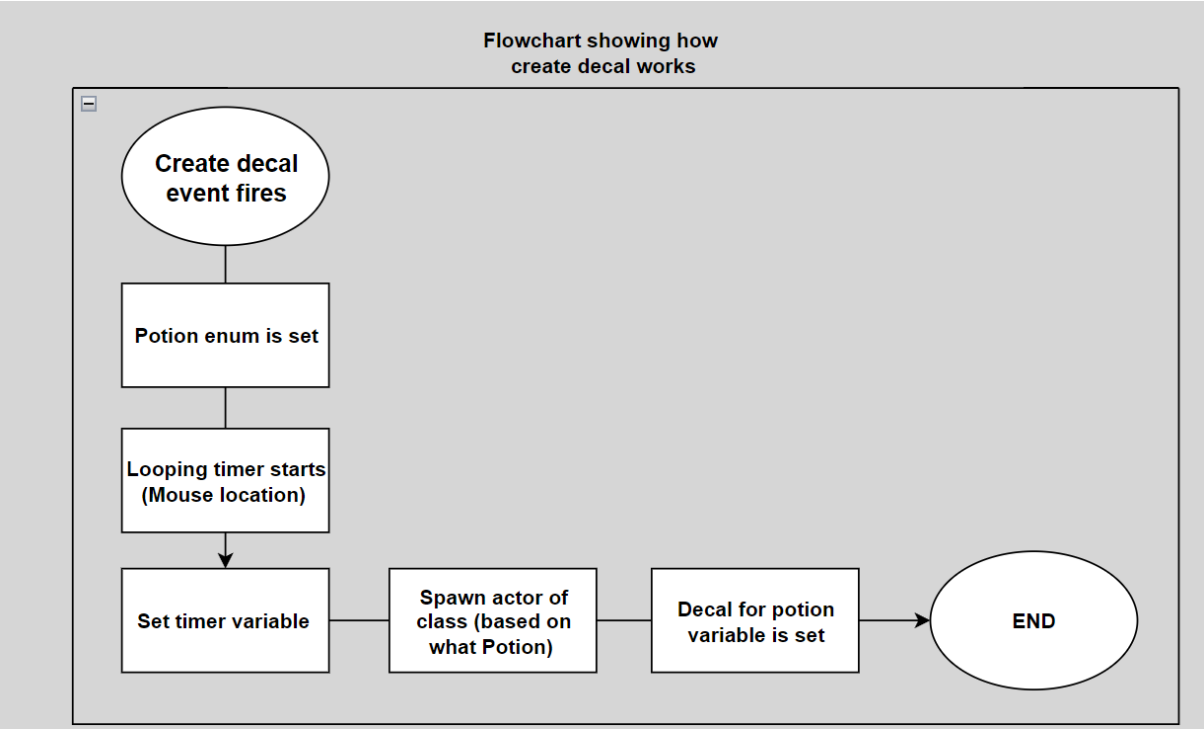


Flowcharts for player character

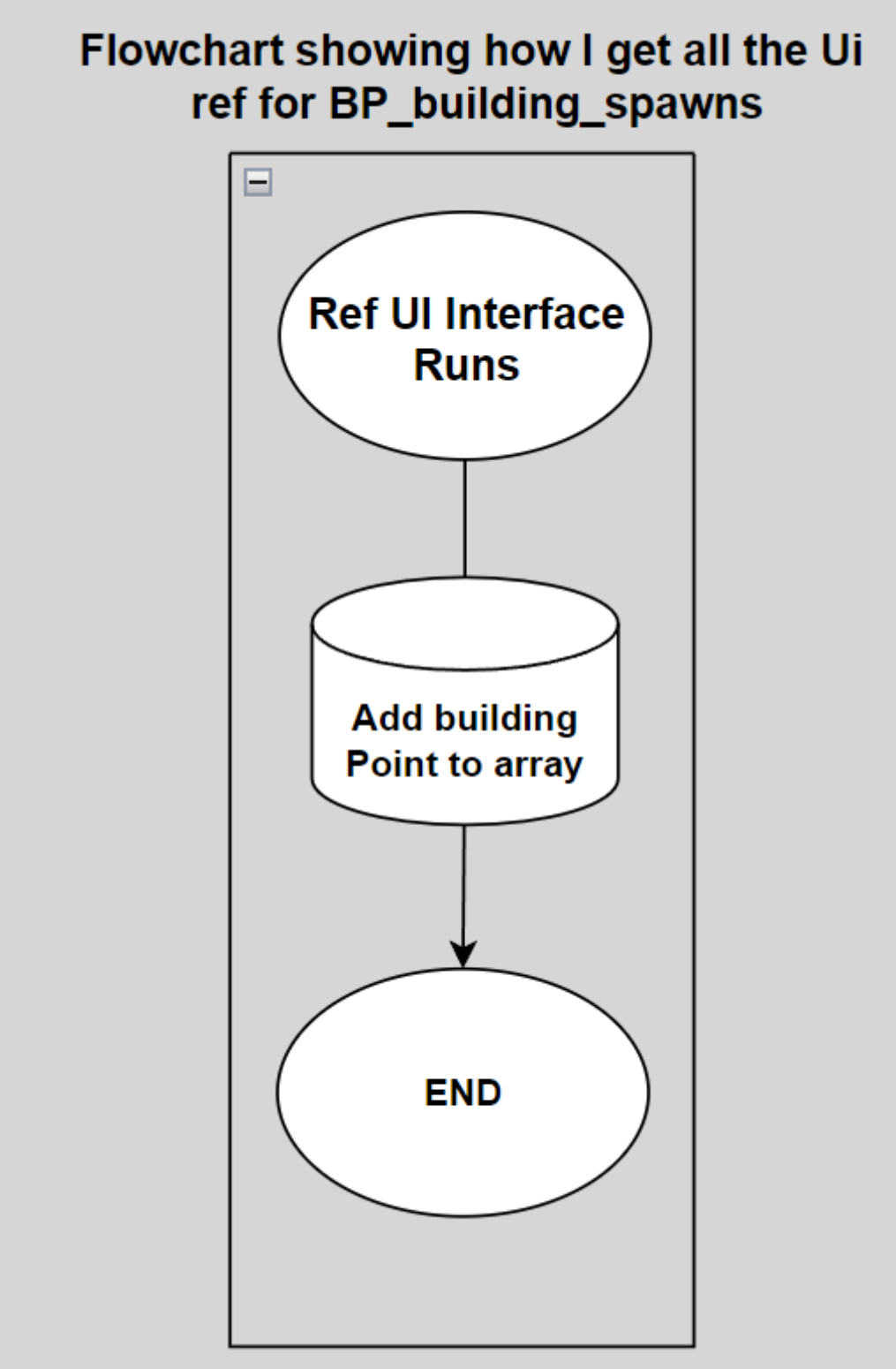
Flowchart showing De-spawn Decal



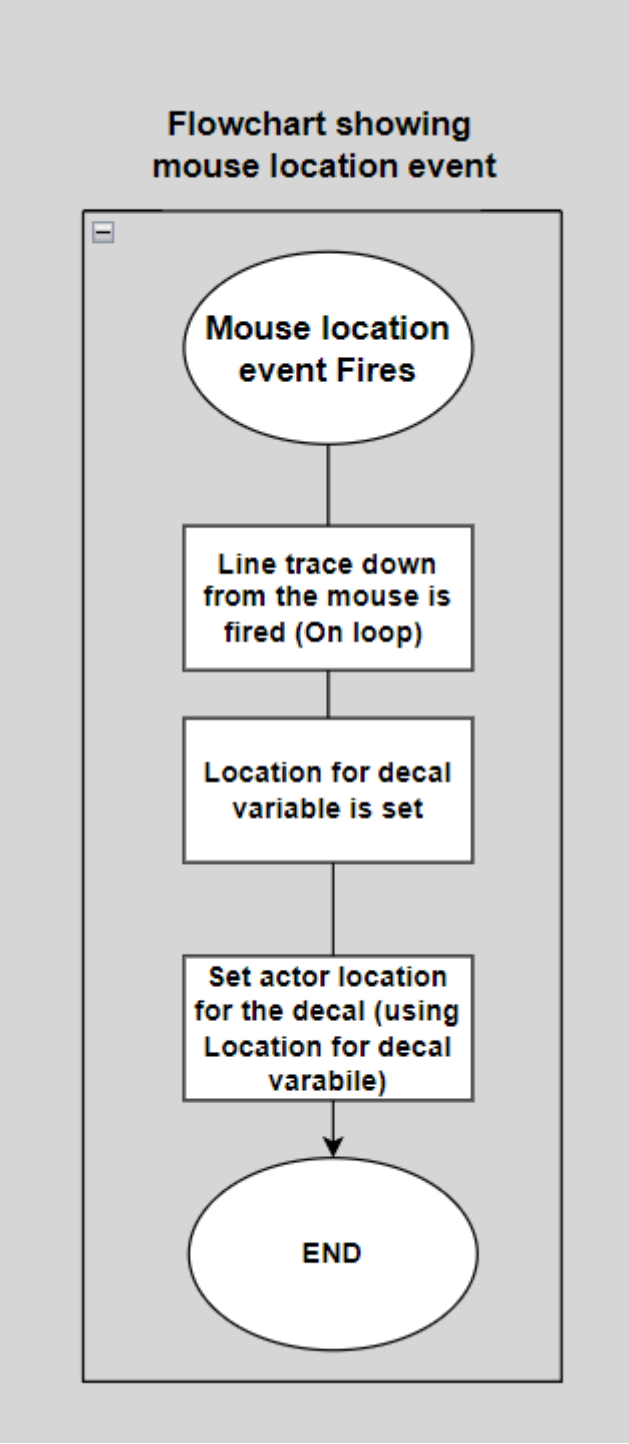
Flowchart showing how to create decal



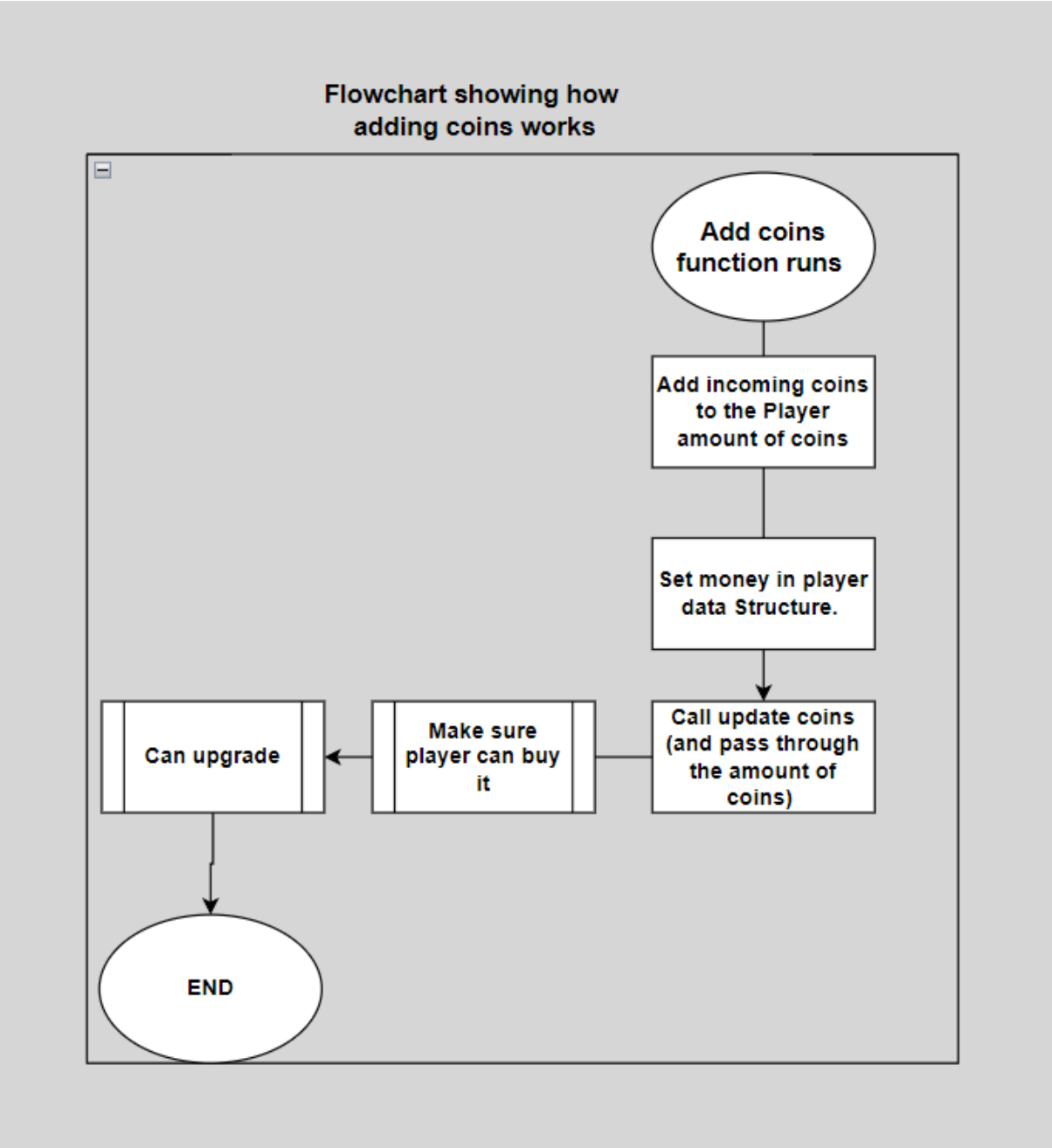
Flowchart showing how to get all Ui refs from UI_building spawns



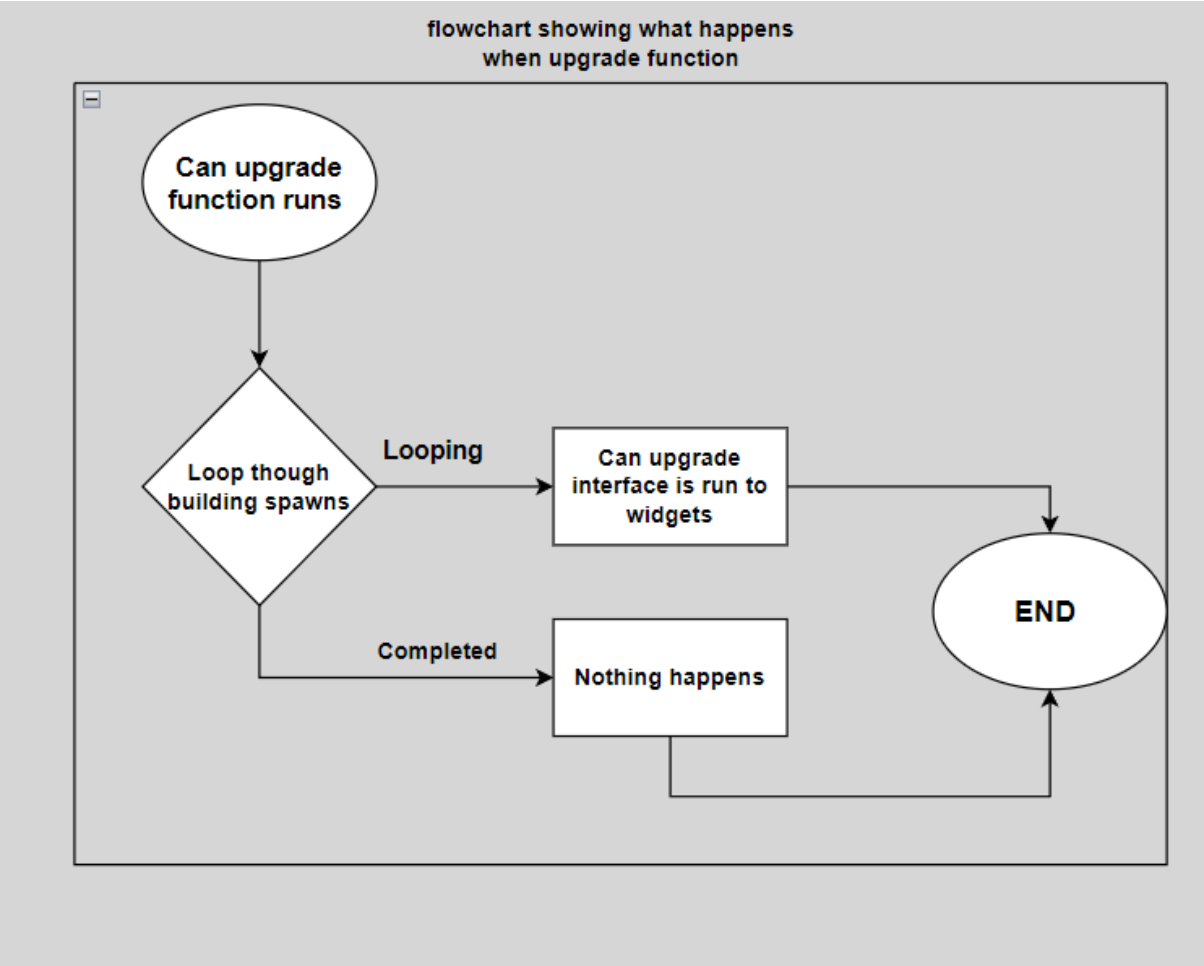
Flowchart showing how mouse location event works



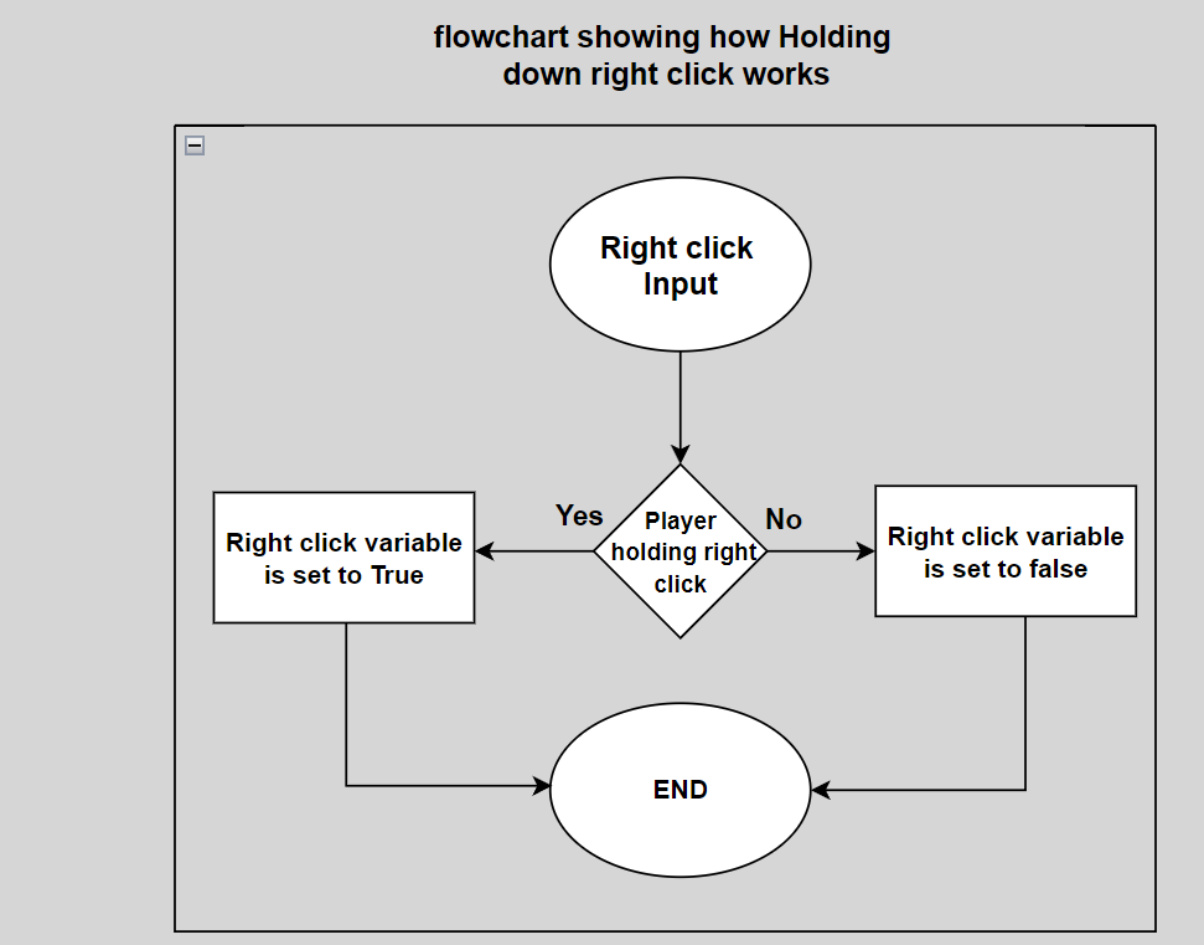
Flowchart showing how adding coins works



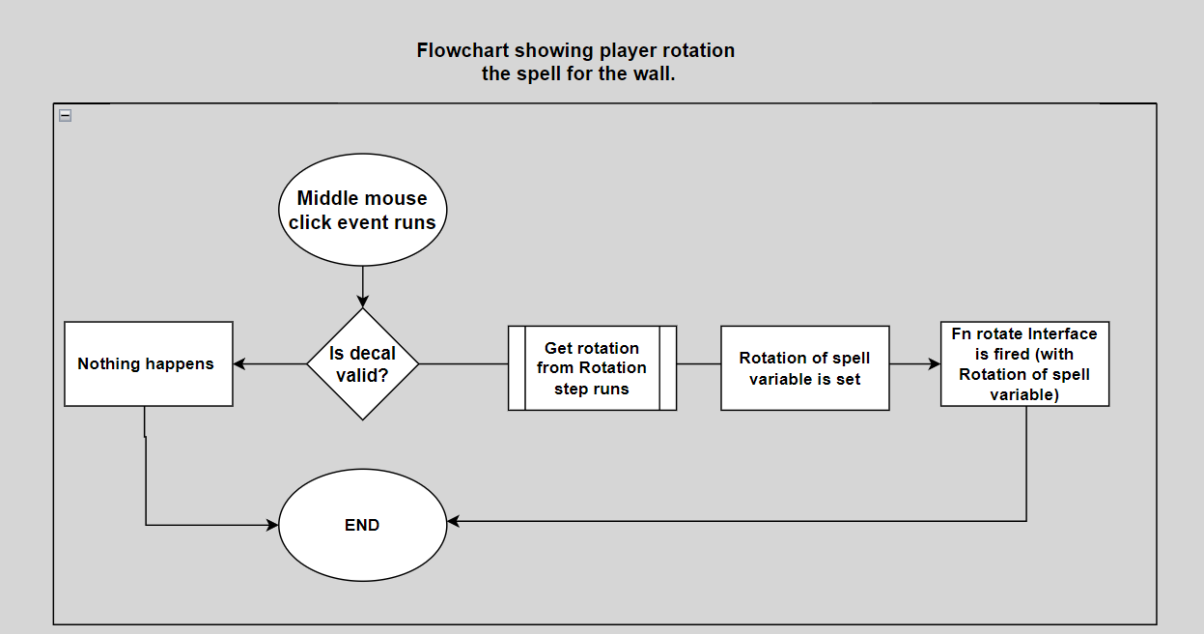
Flowchart showing how upgrade function works



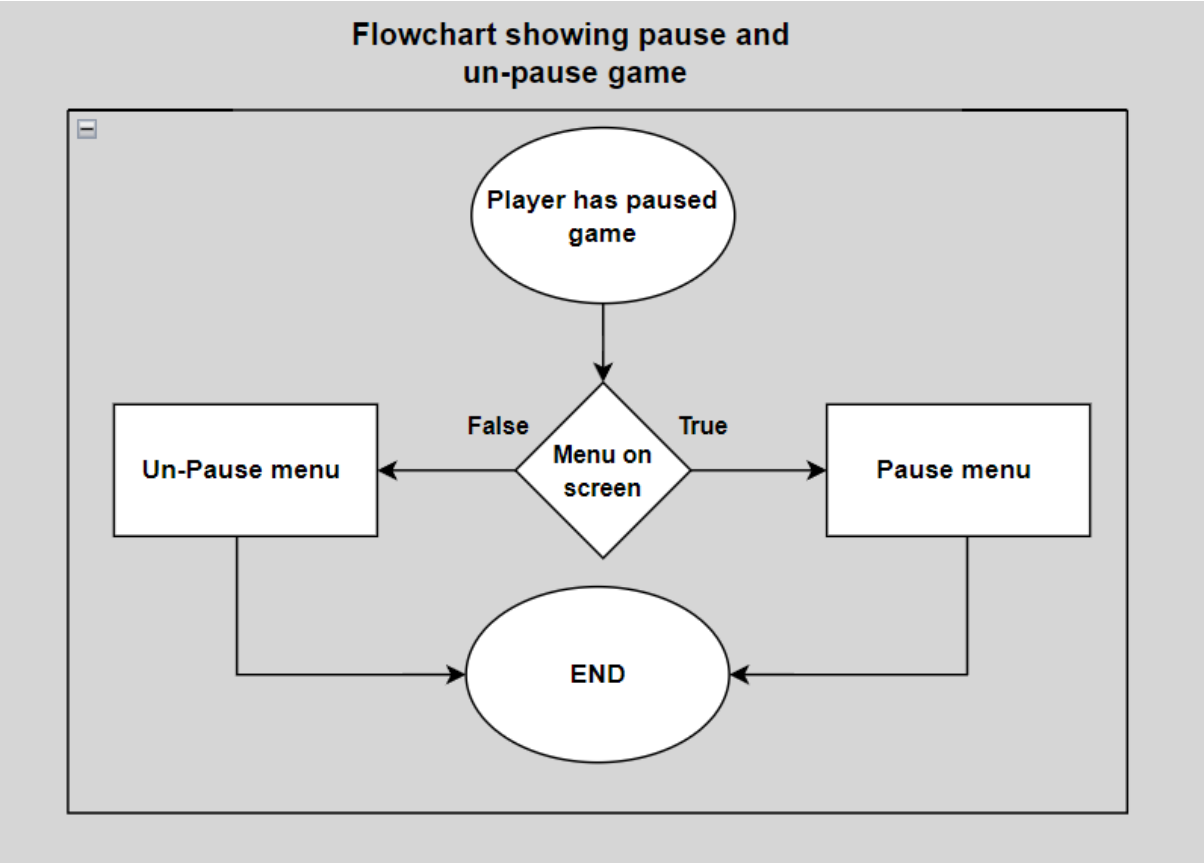
Flowchart showing how holding down right click works



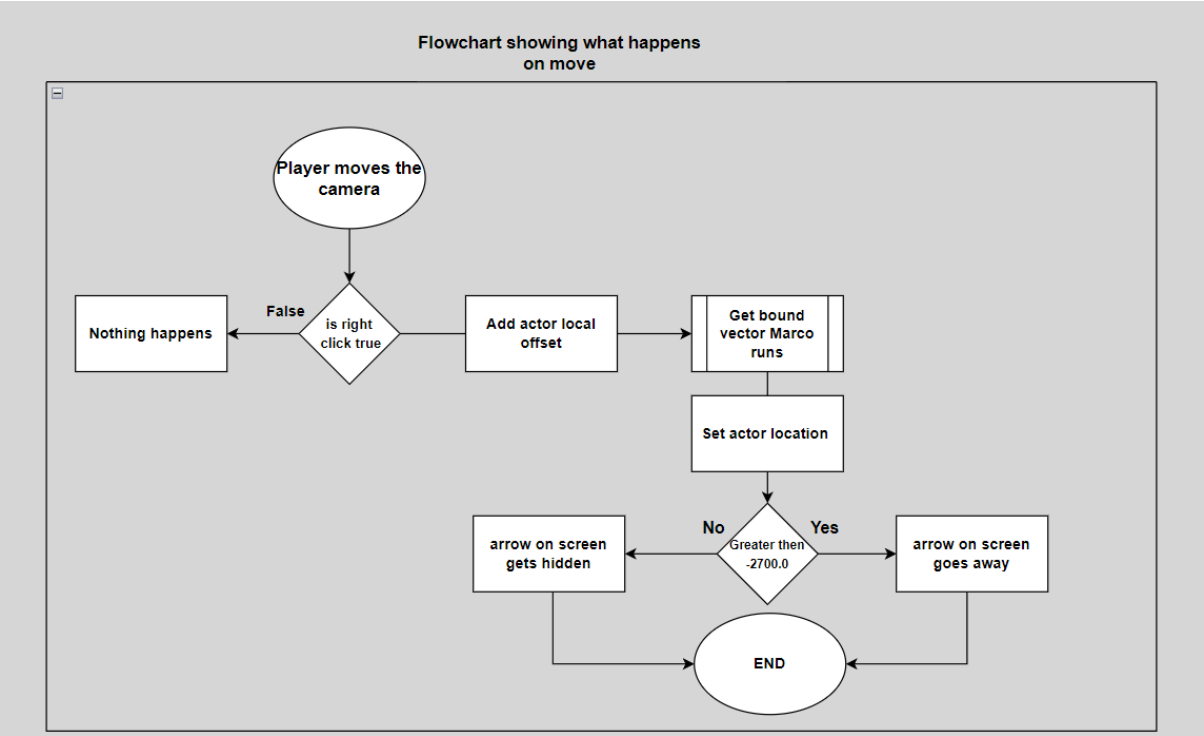
Flowchart showing how player rotation for wall spell works



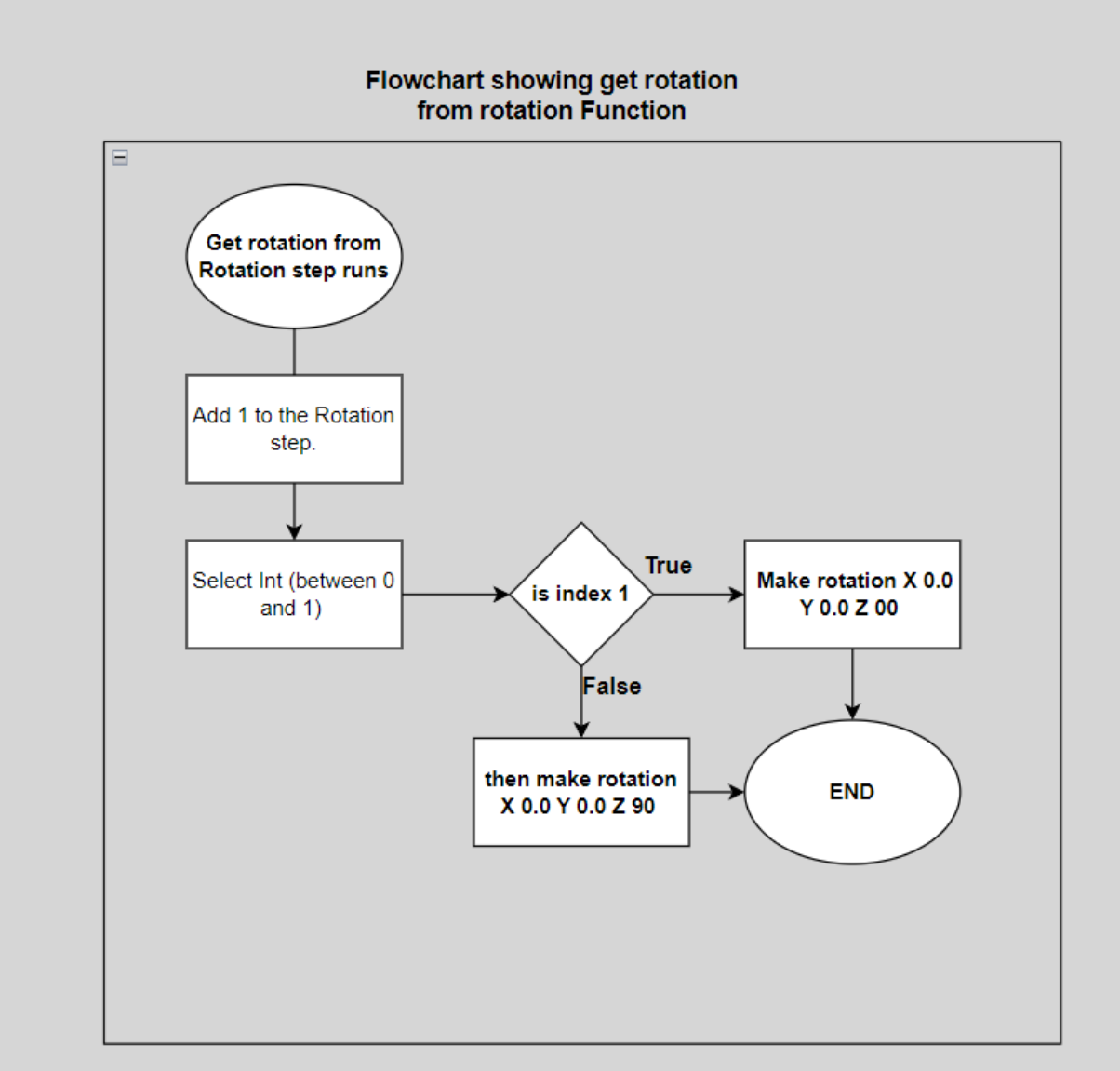
Flowchart showing how Un-pause game works



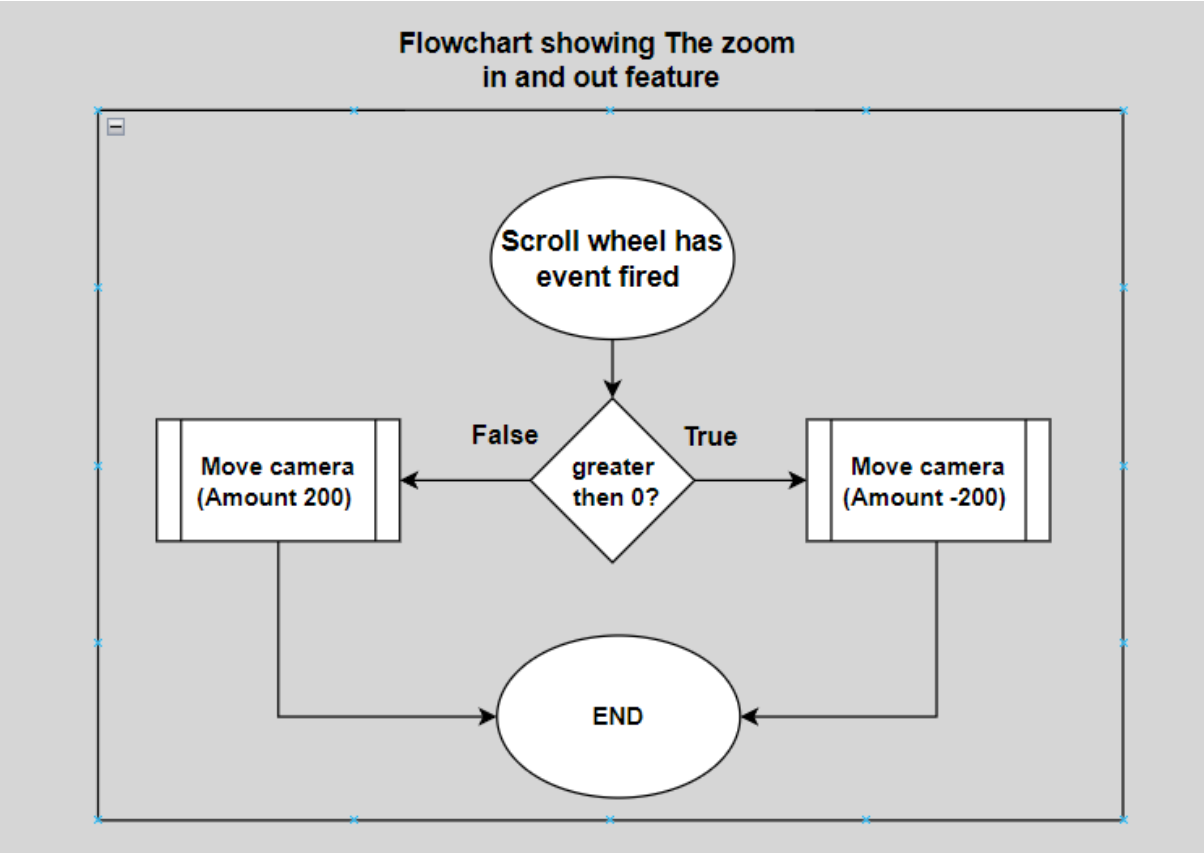
Flowchart showing what happens on move



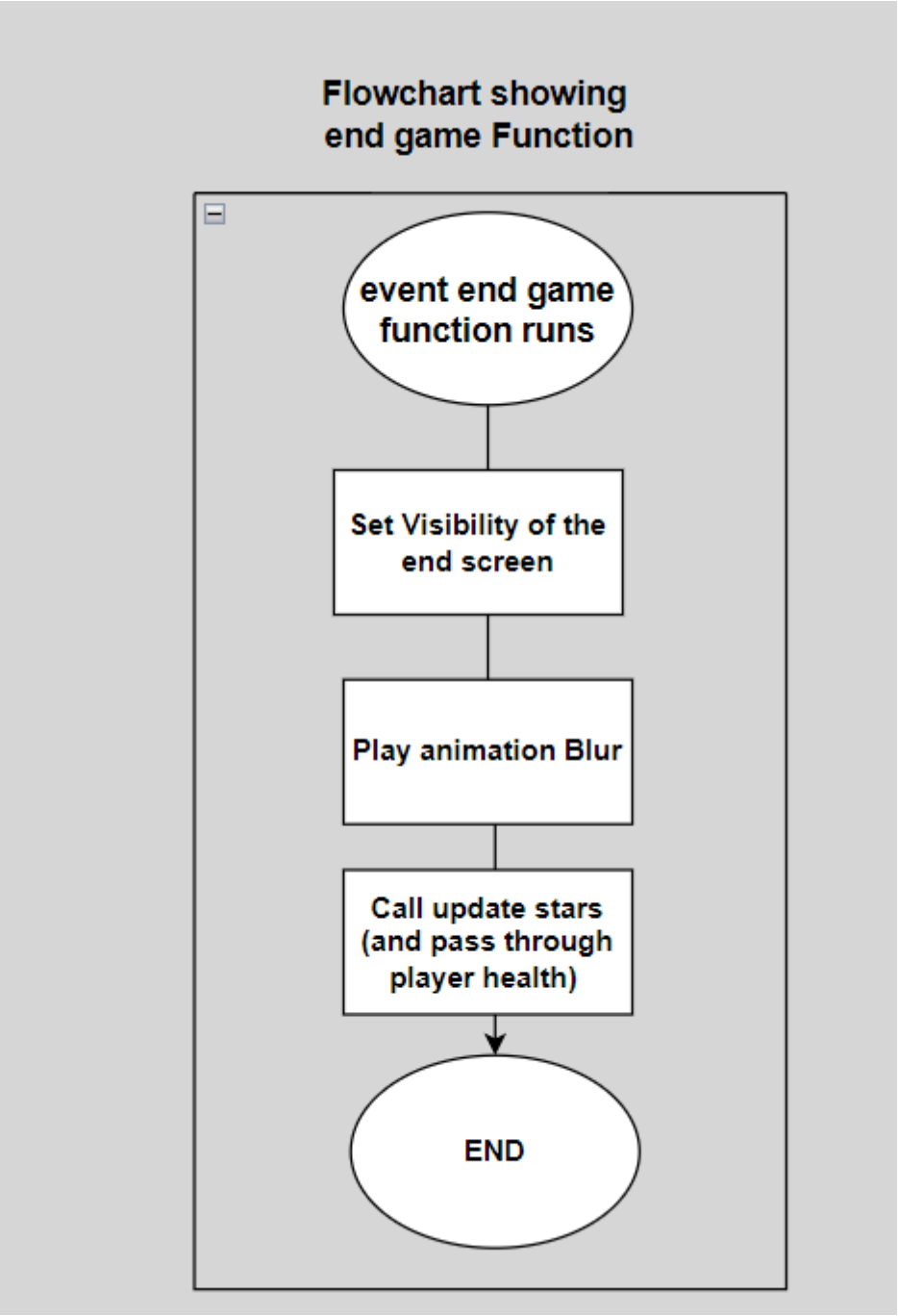
Flowchart showing how get rotation from rotation function works



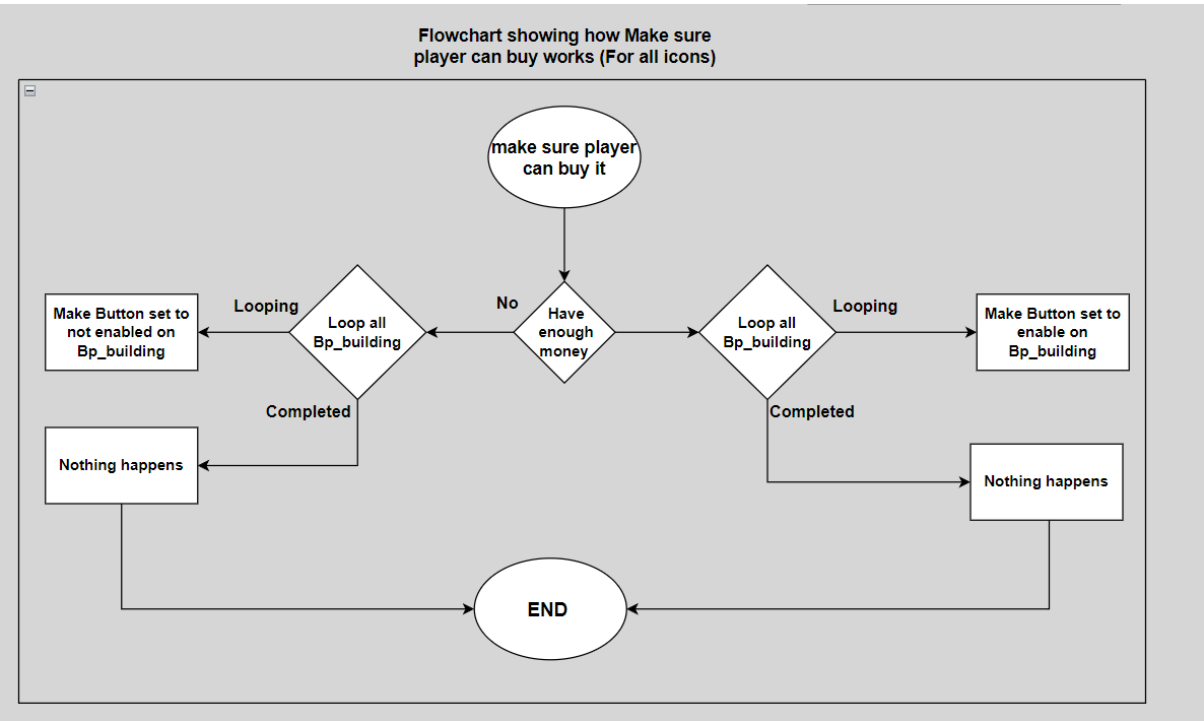
Flowchart showing the zoom in and out feature works



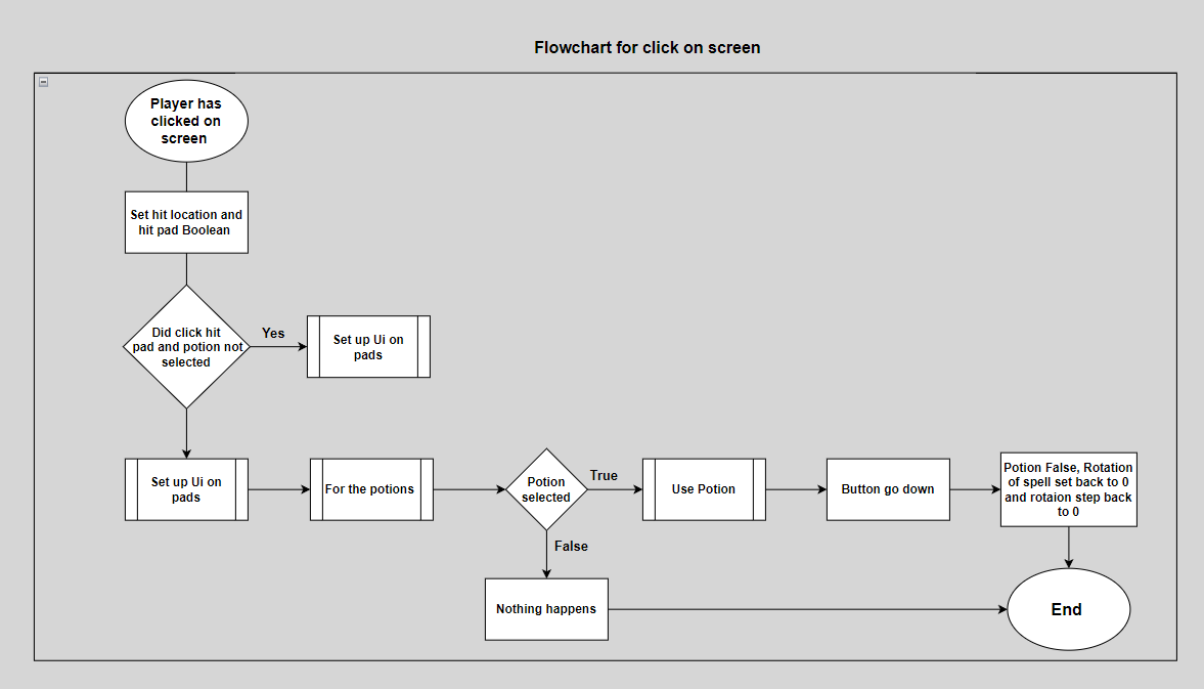
Flowchart showing end game function



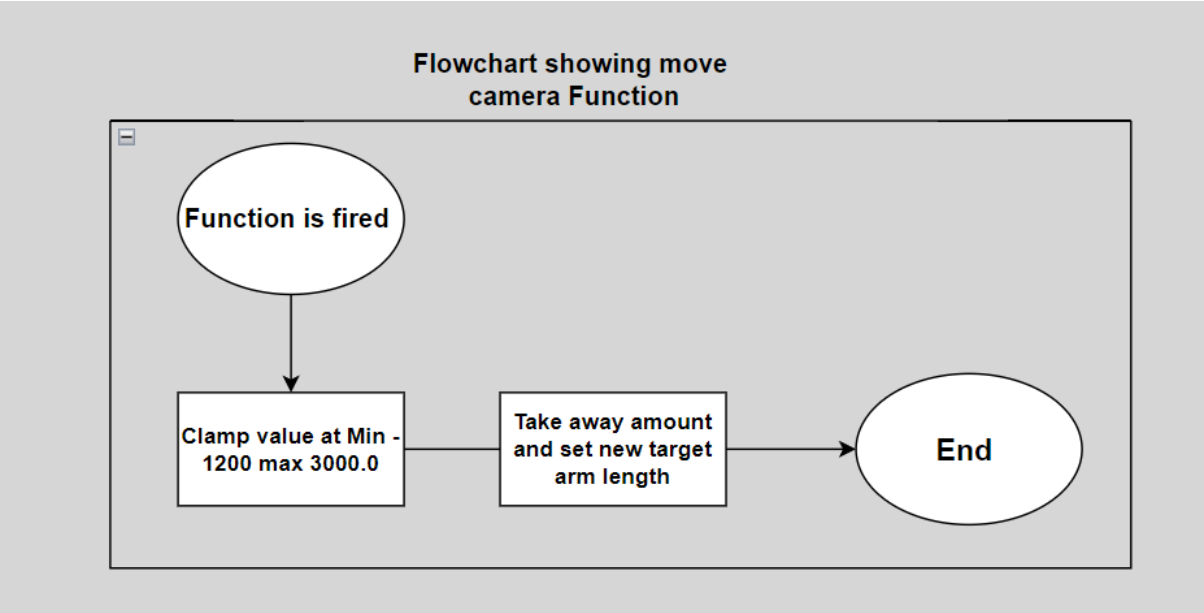
Flowchart showing make sure player can but works (for all icons)



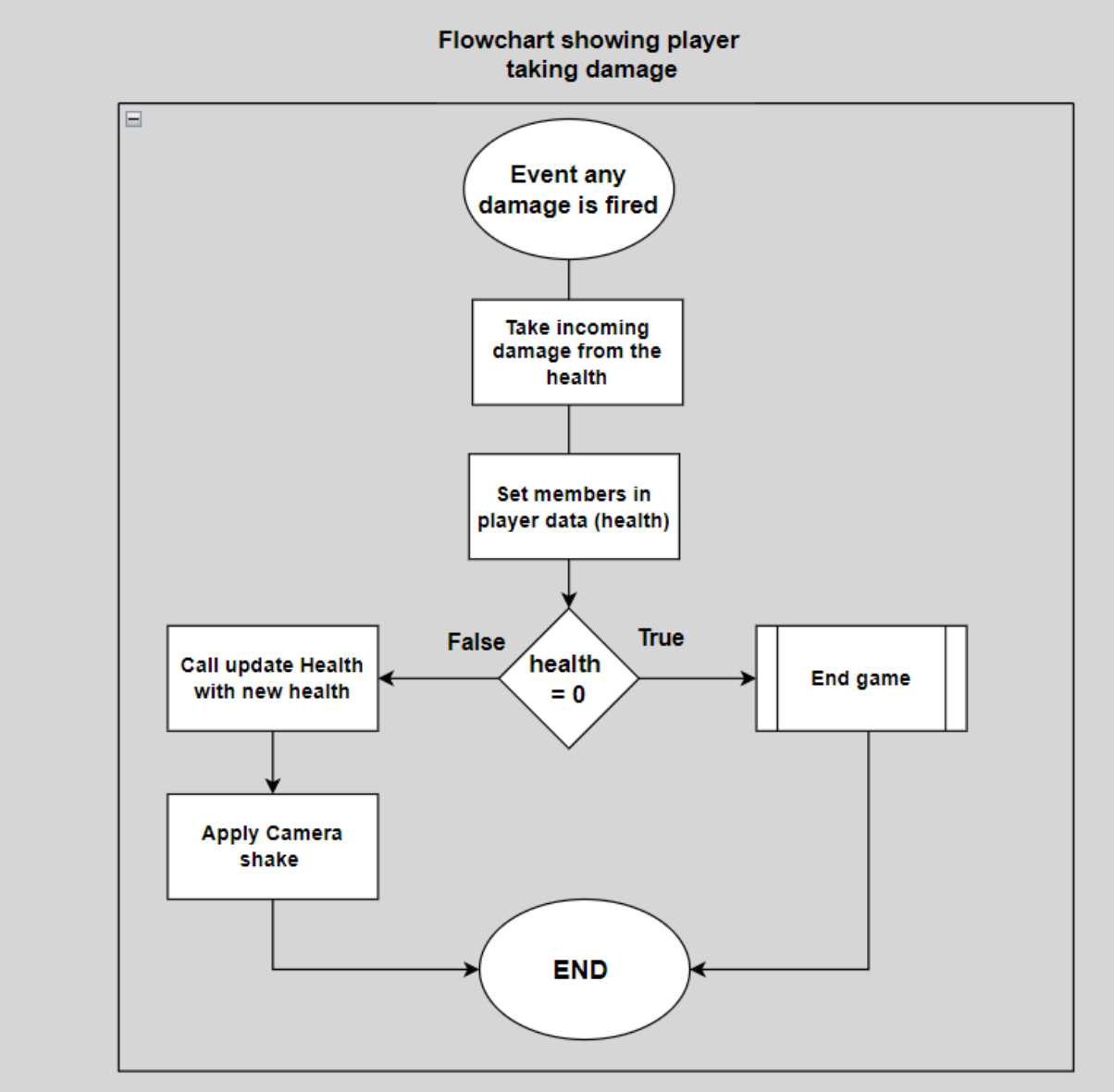
Flowchart showing click on the screen works



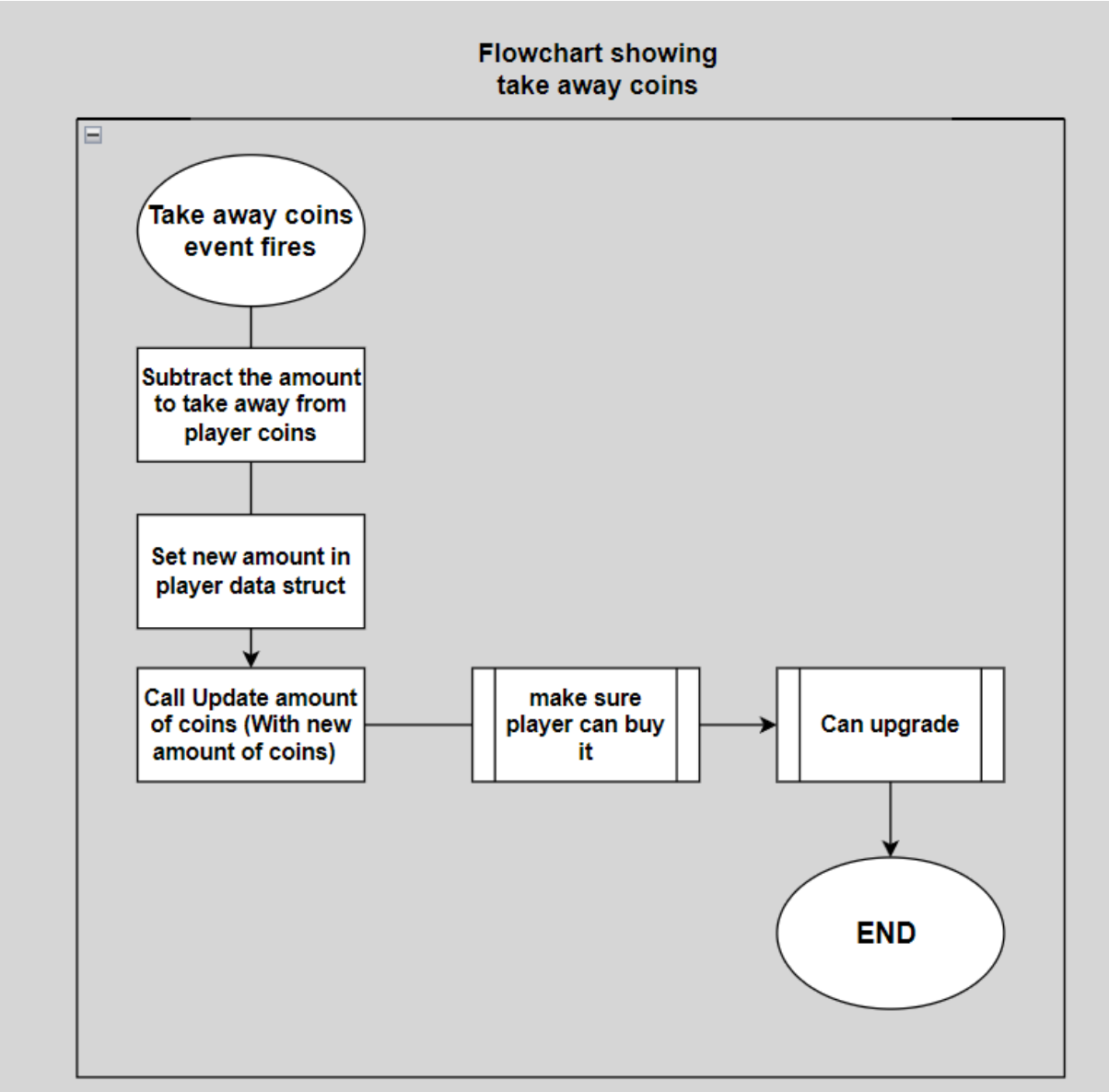
Flowchart showing move camera function



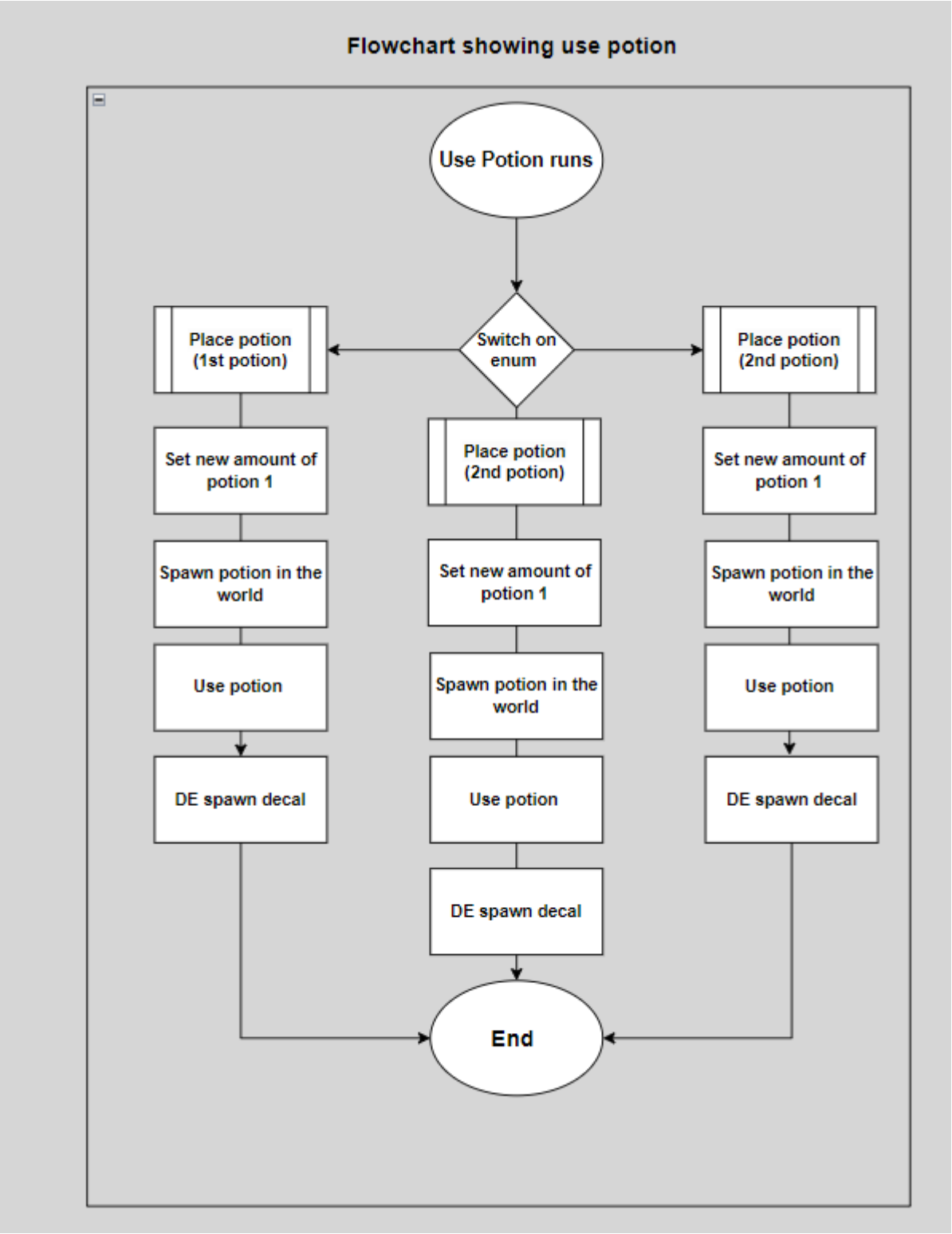
Flowchart showing player taking damage



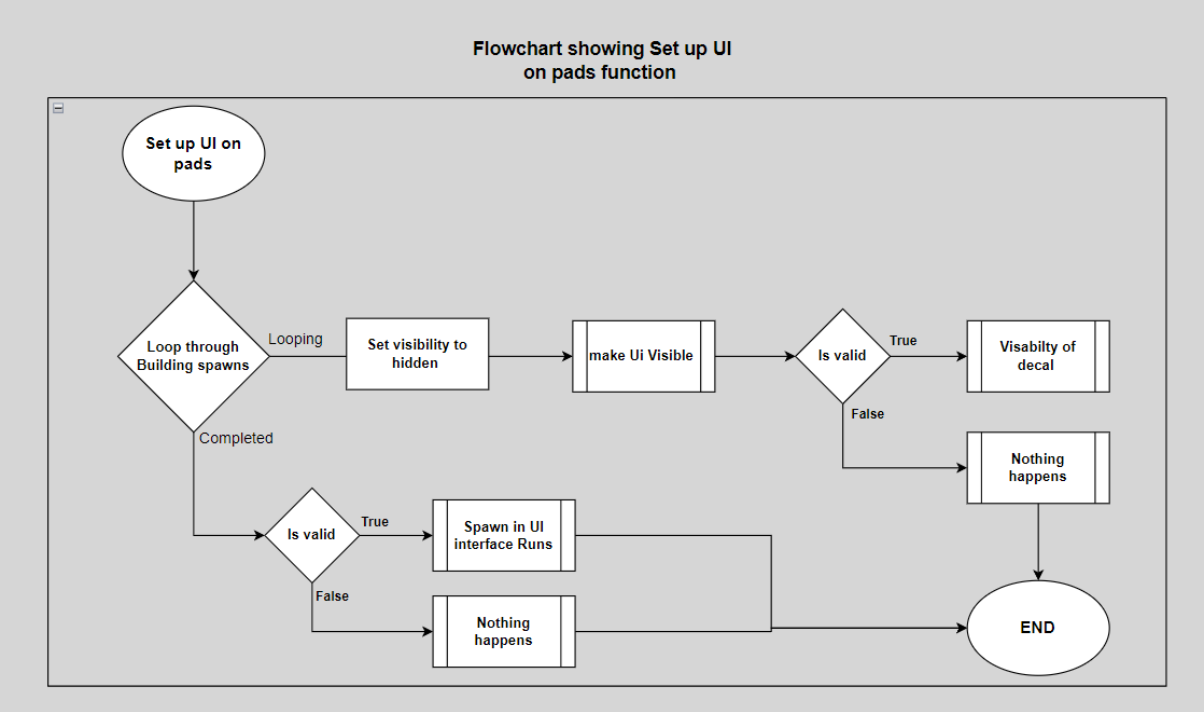
Flowchart showing take away coins works



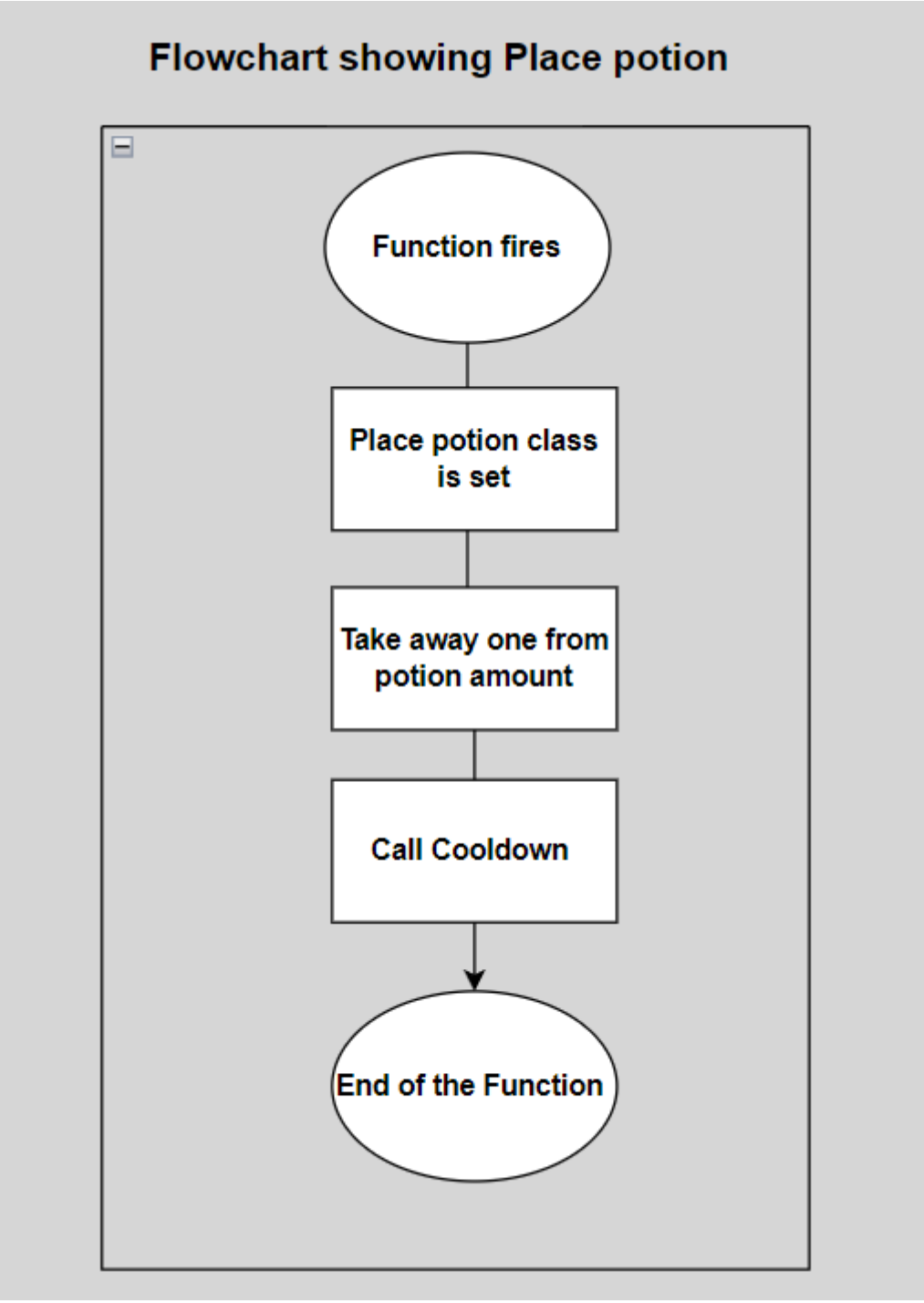
Flowchart showing use potion



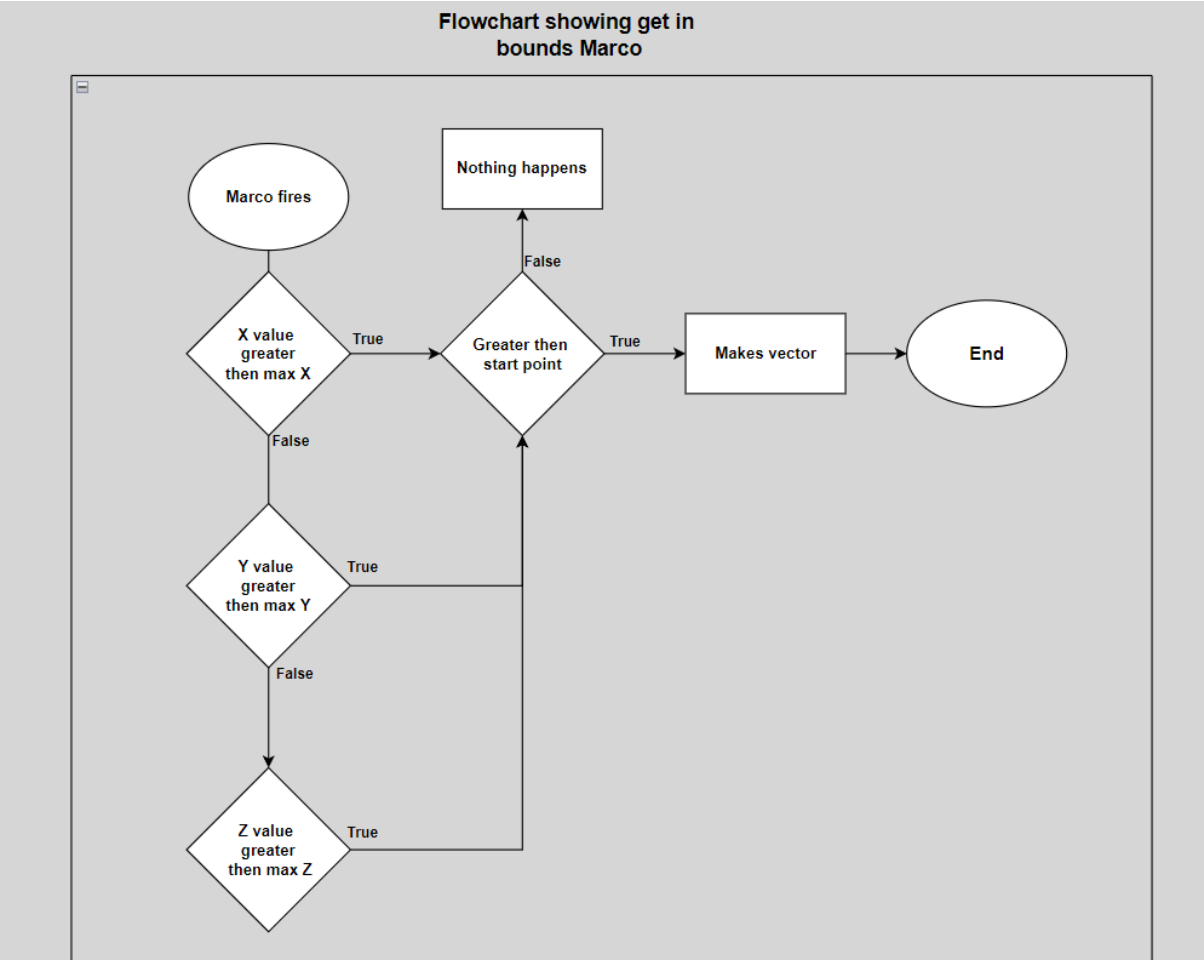
Flowchart showing set up Ui on pads function



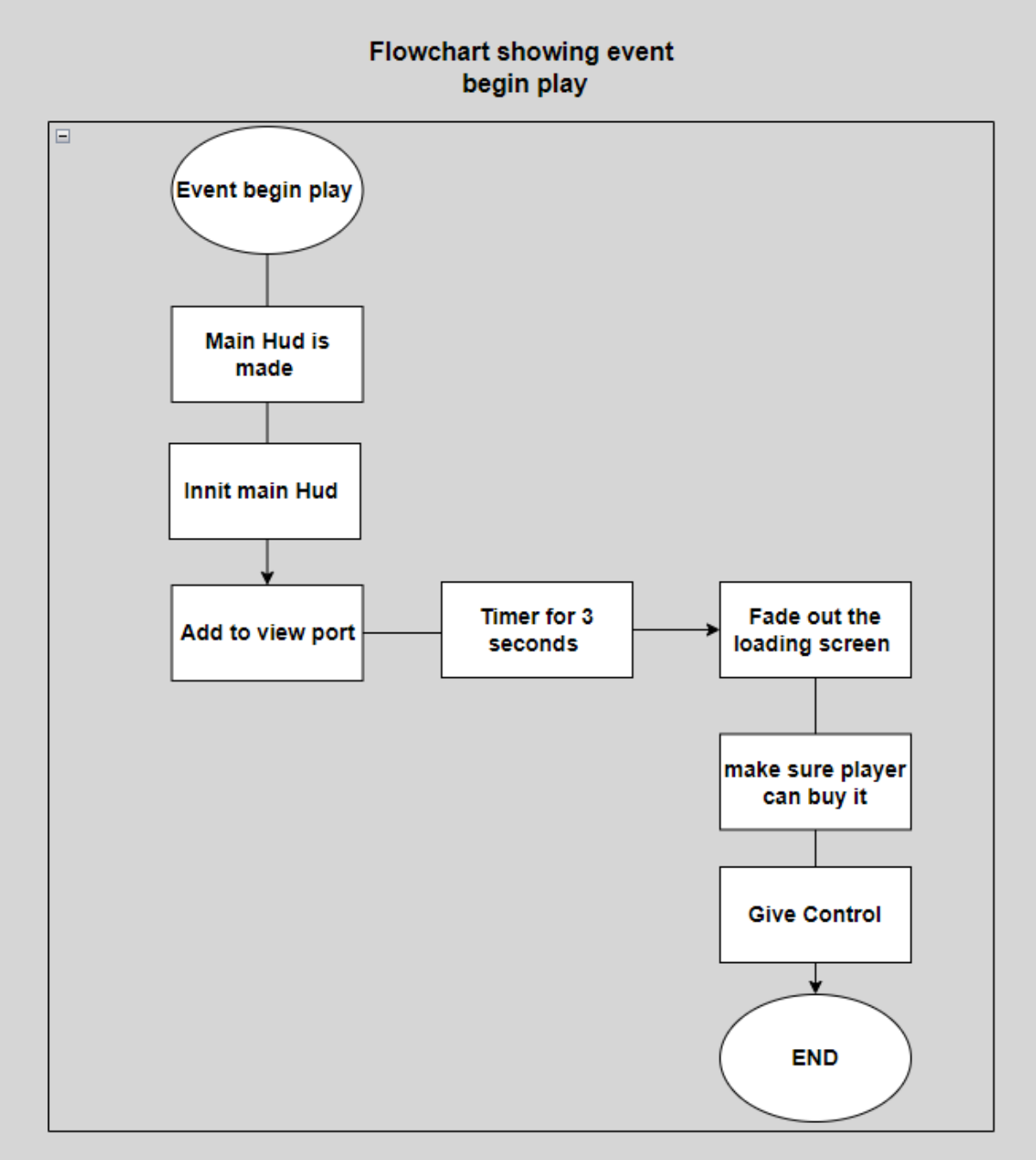
Flowchart showing place potion Code



Flowchart showing get in bounds macro

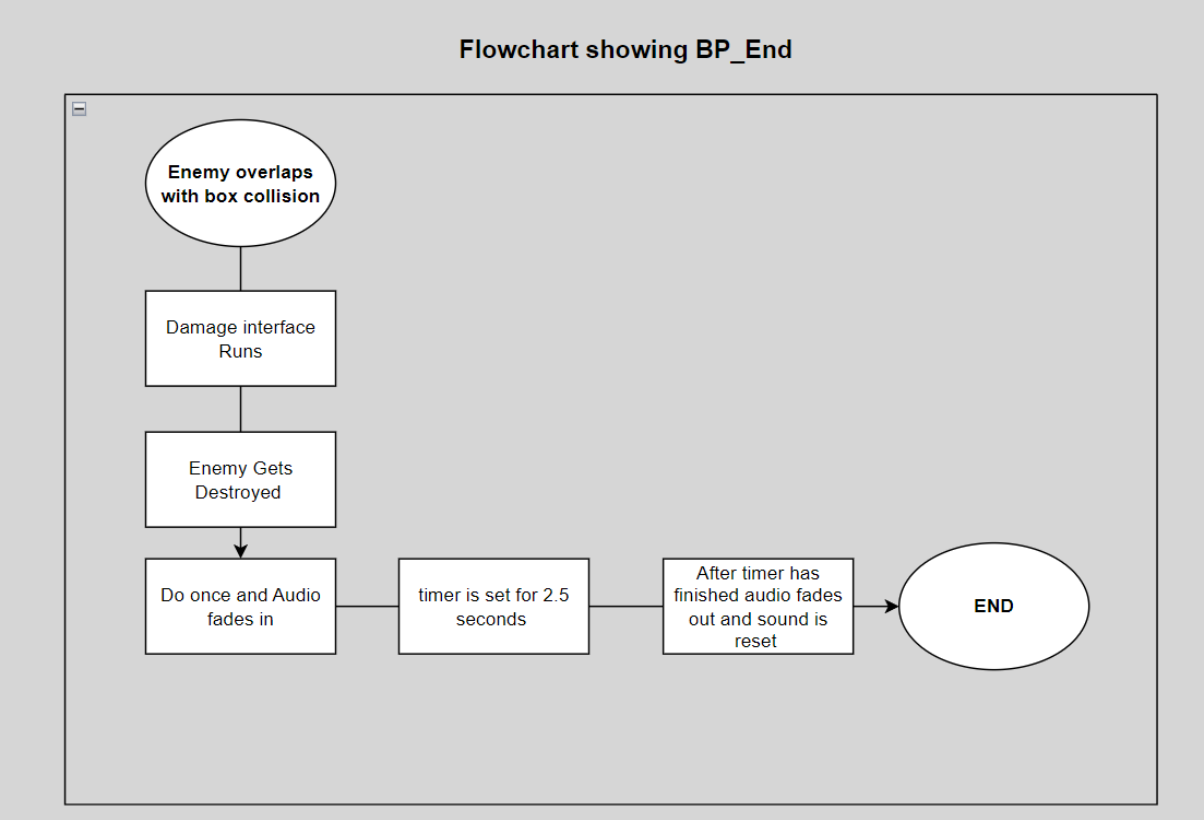


Flowchart showing event begin play



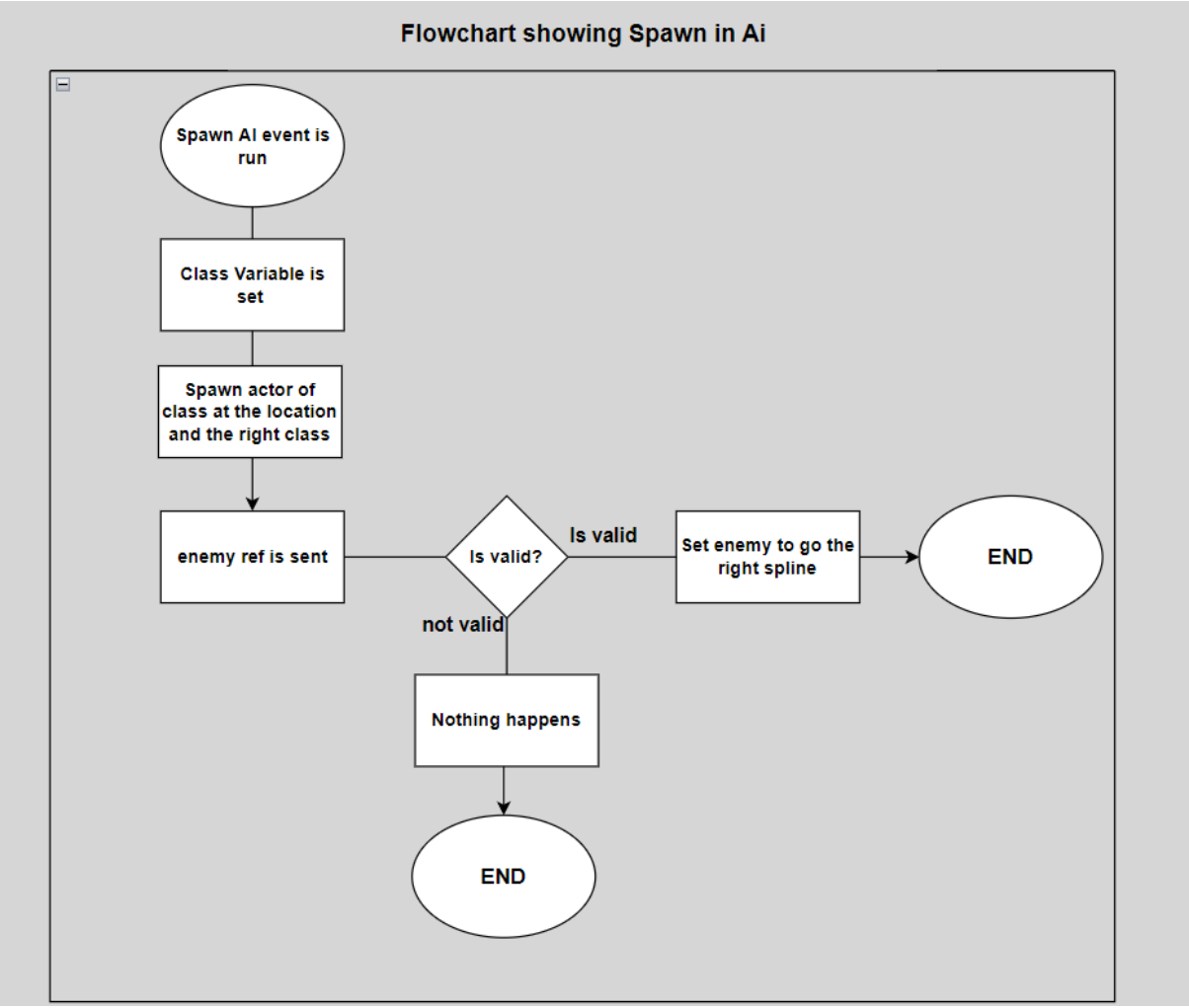
All flowcharts for BP_end

Flowchart showing BP_end

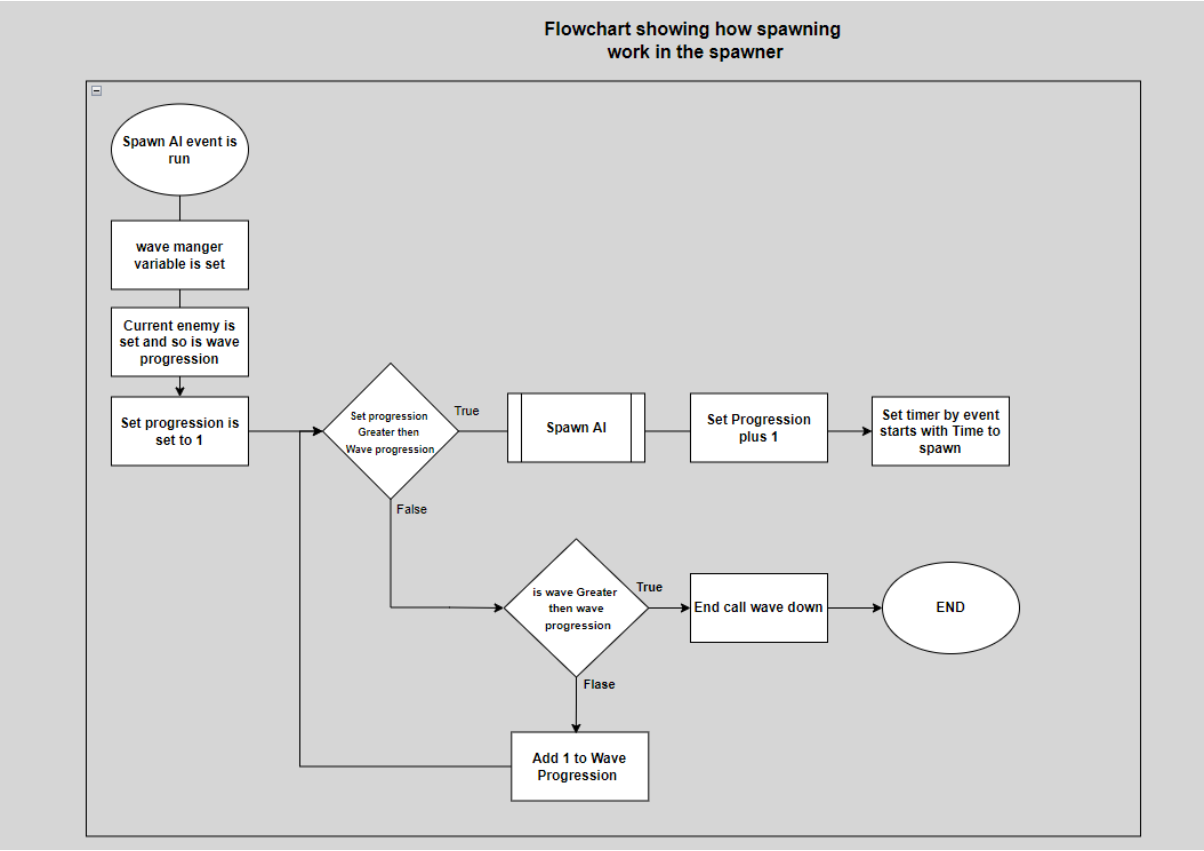


All flowcharts for Ai spawner

Flowchart showing spawn in Ai

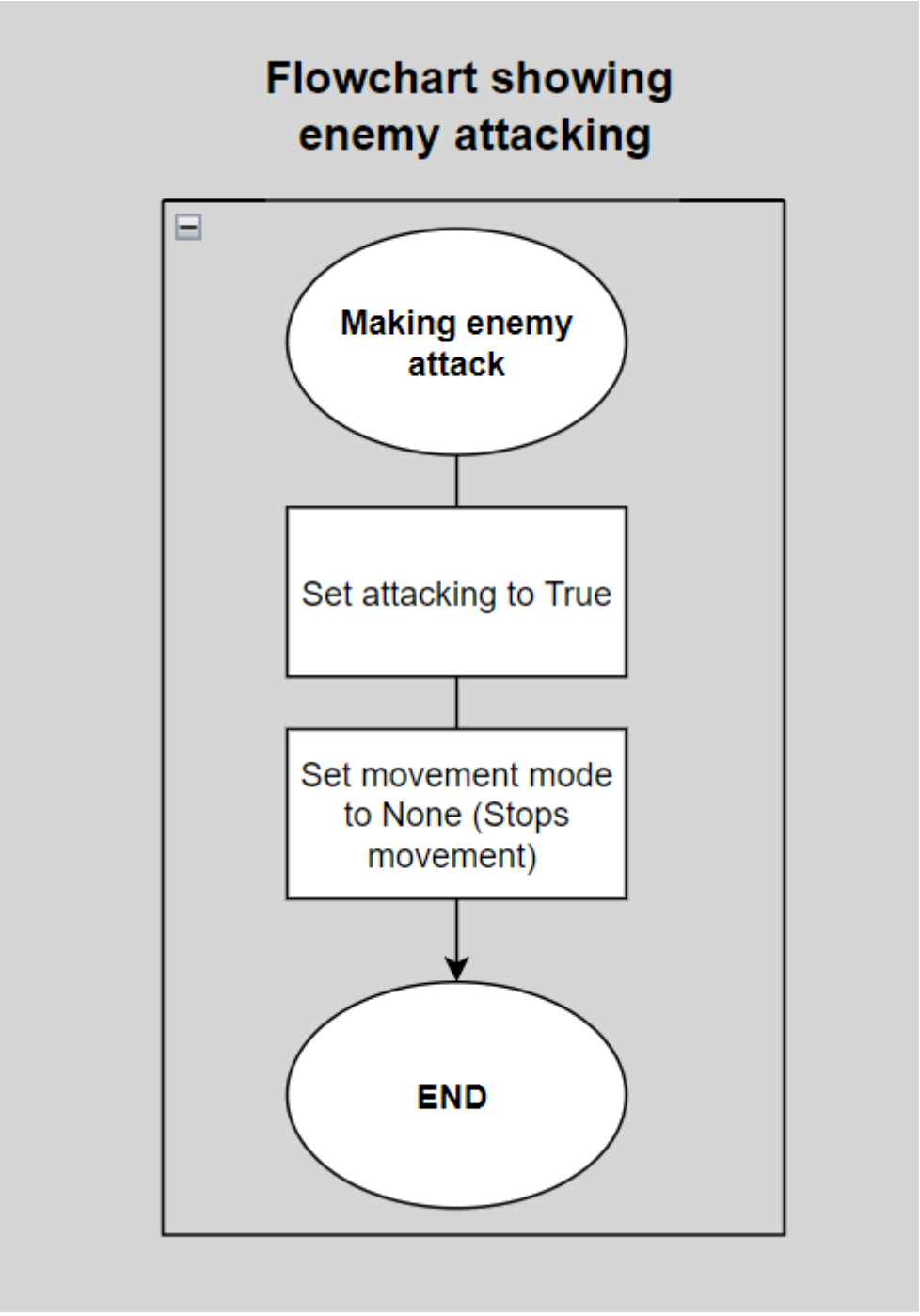


Flowchart showing how spawning works in the spawner

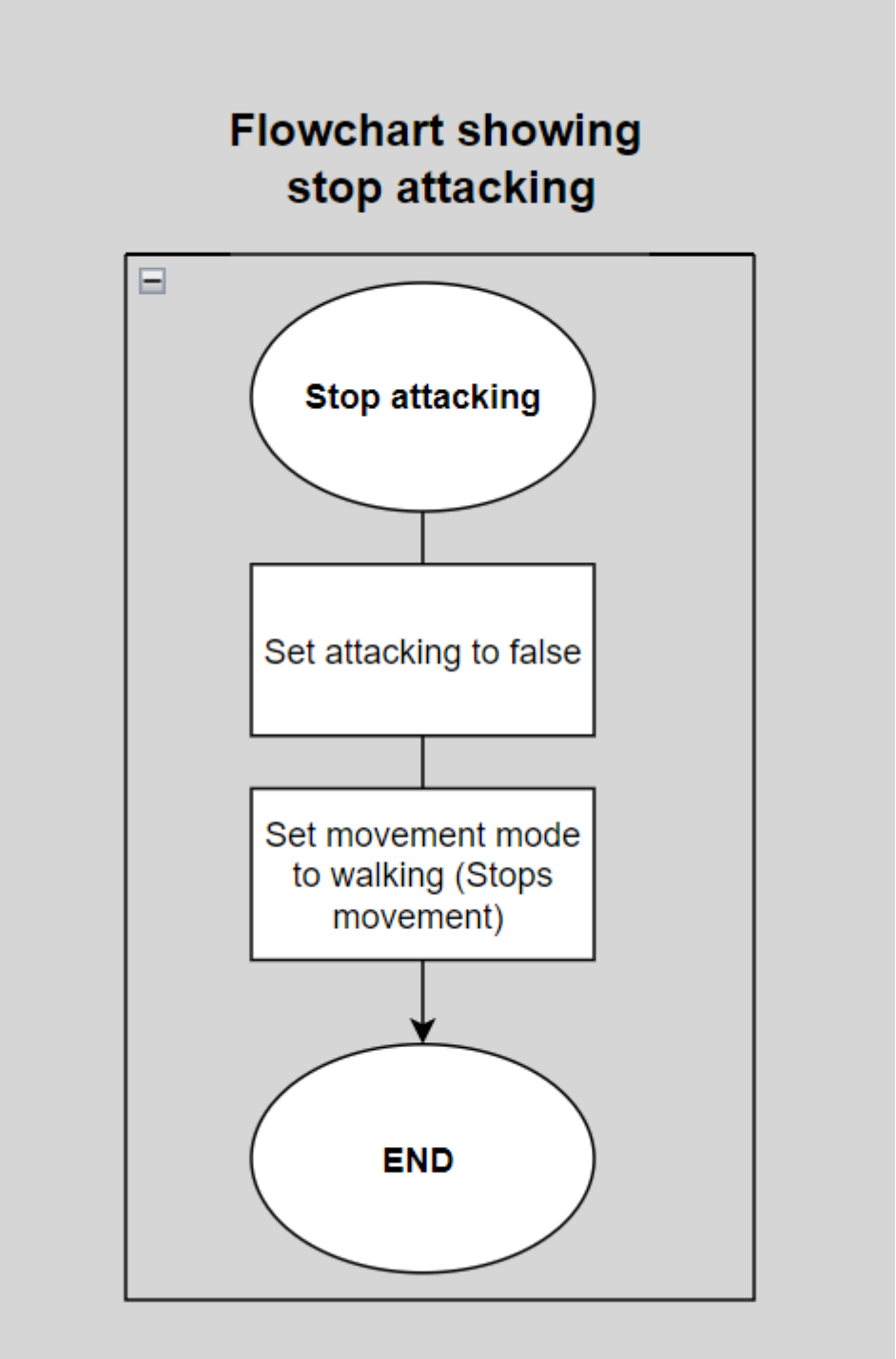


All flowchart showing Enemy code

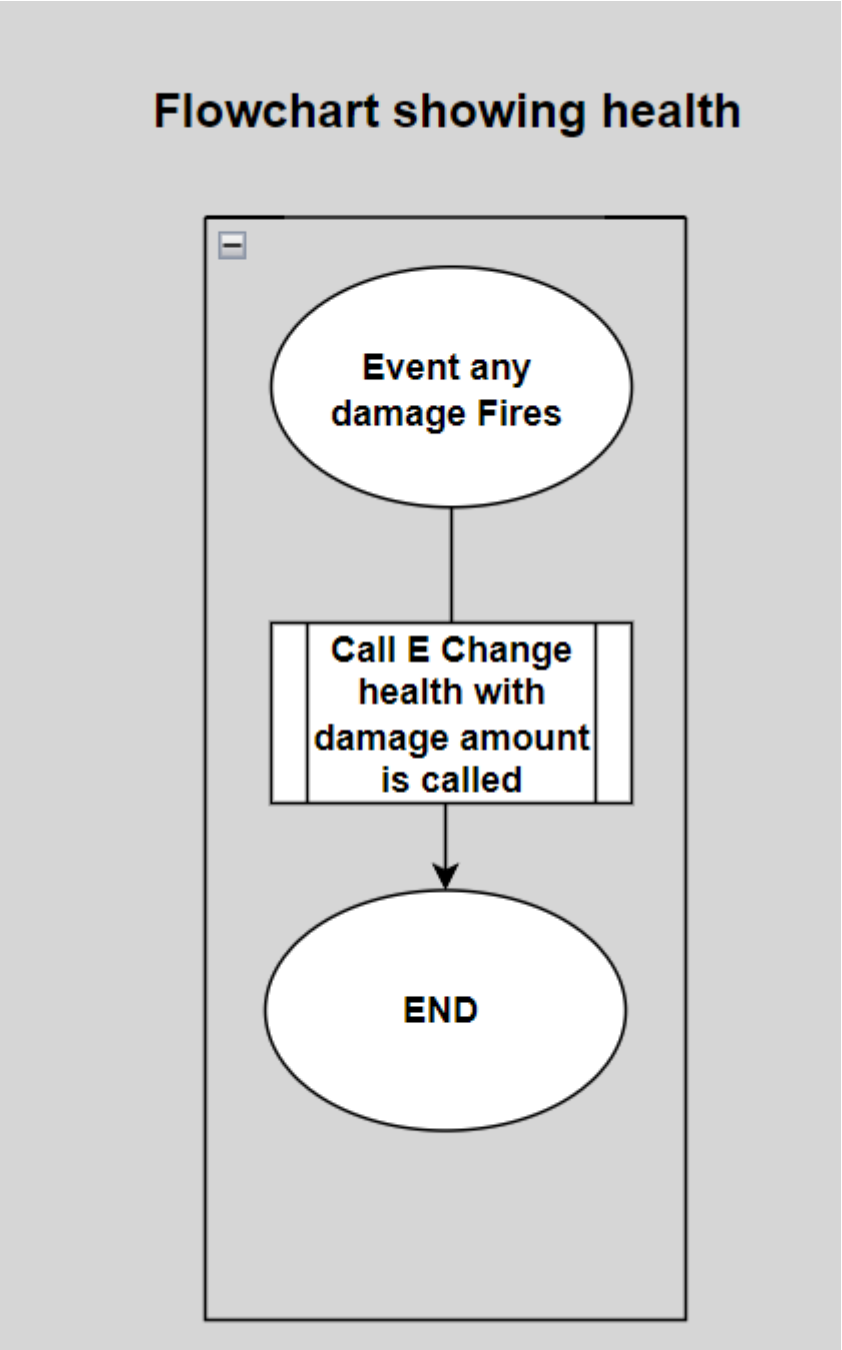
Flowchart showing enemy attack



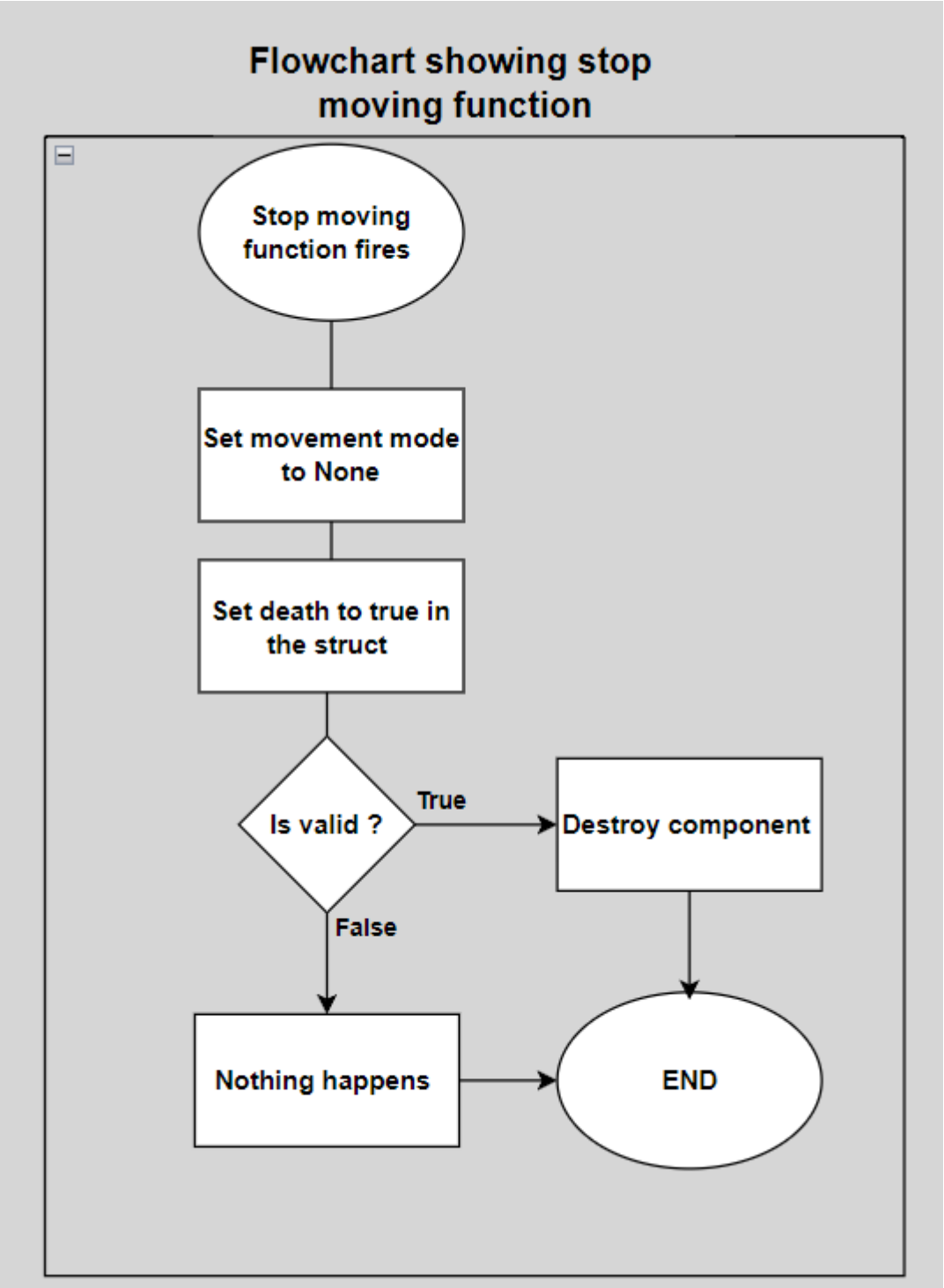
Flowchart showing stop attacking



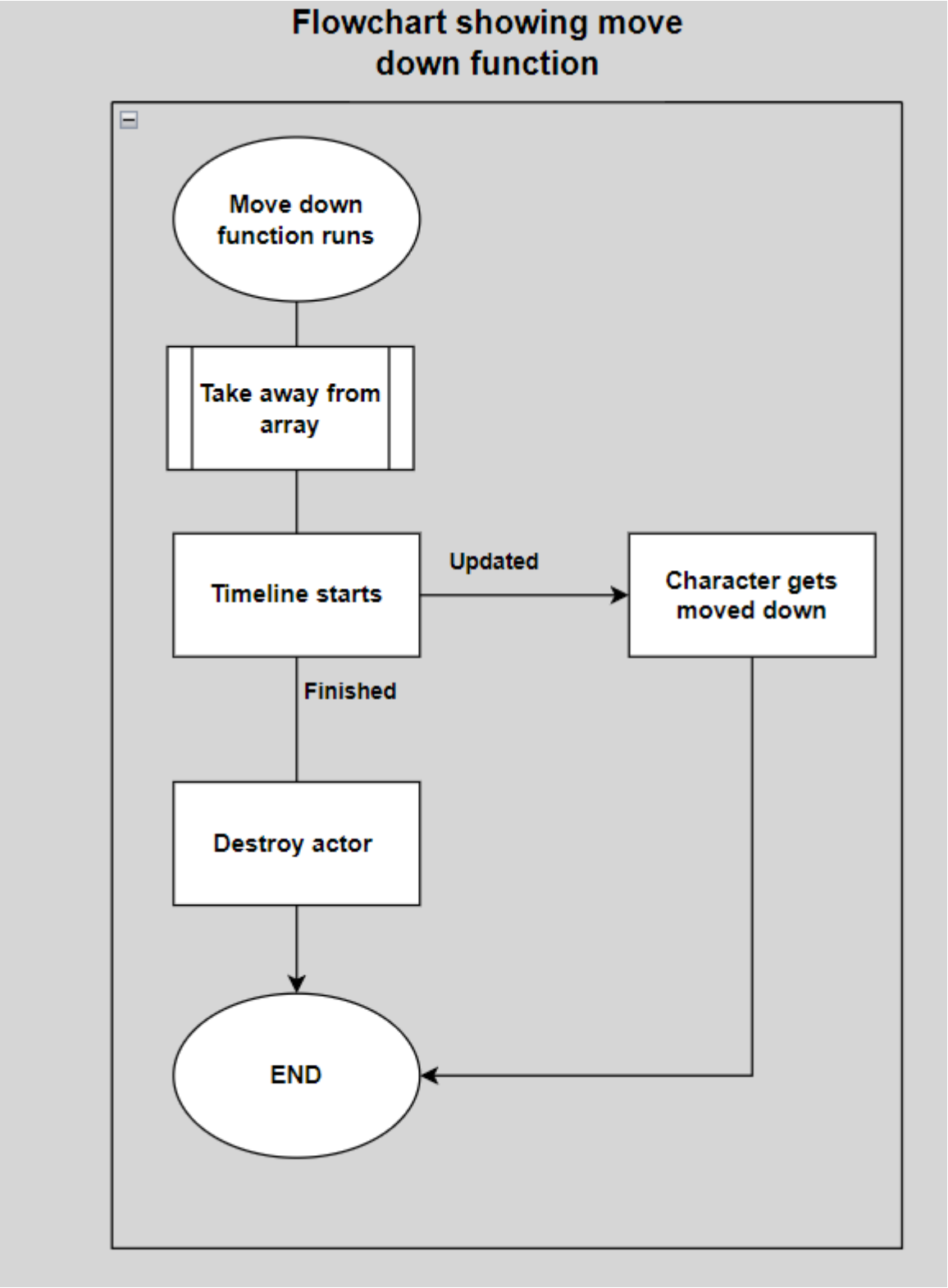
Flowchart showing enemy health



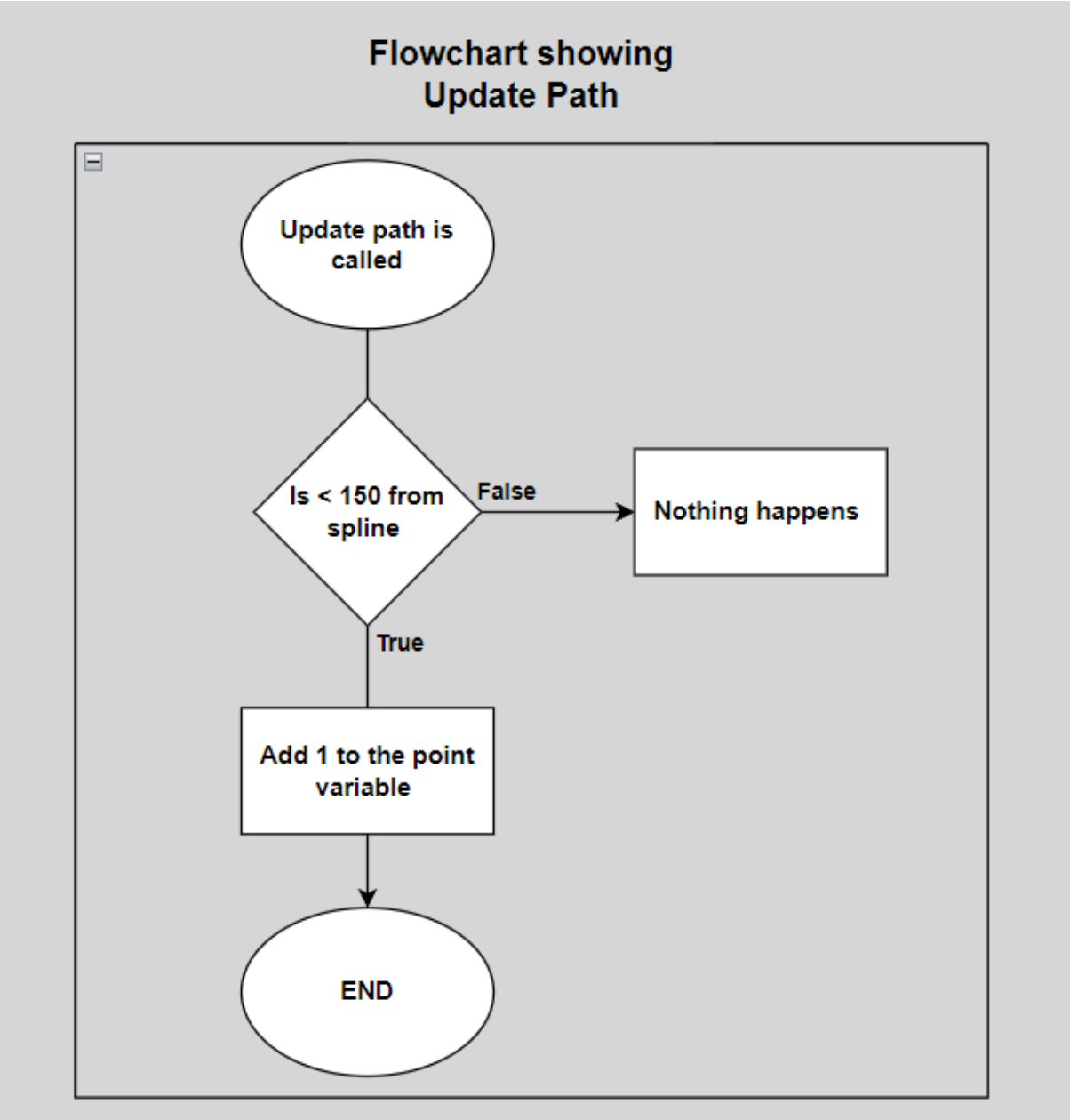
Flowchart showing moving function



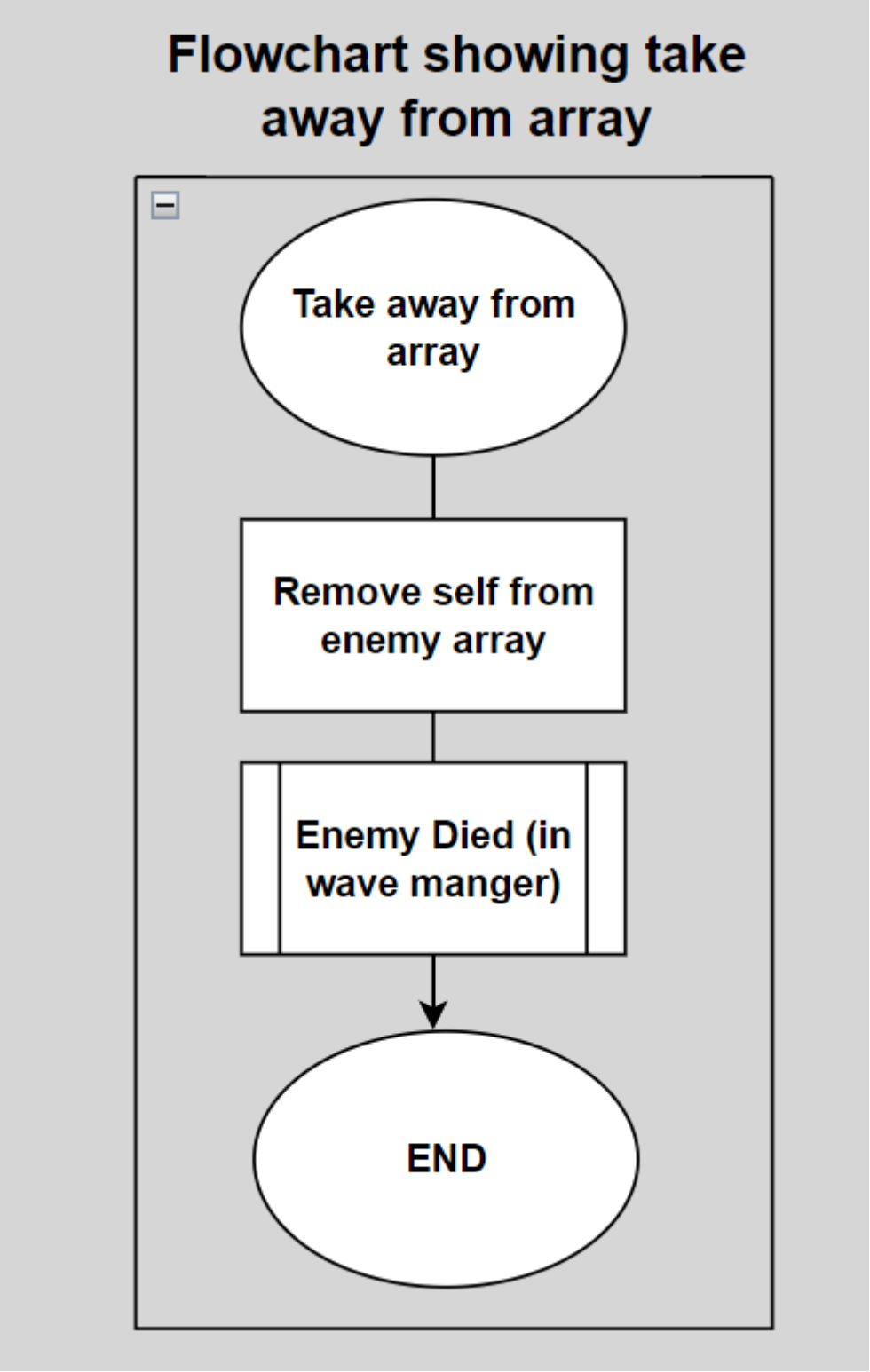
Flowchart showing move down into ground function



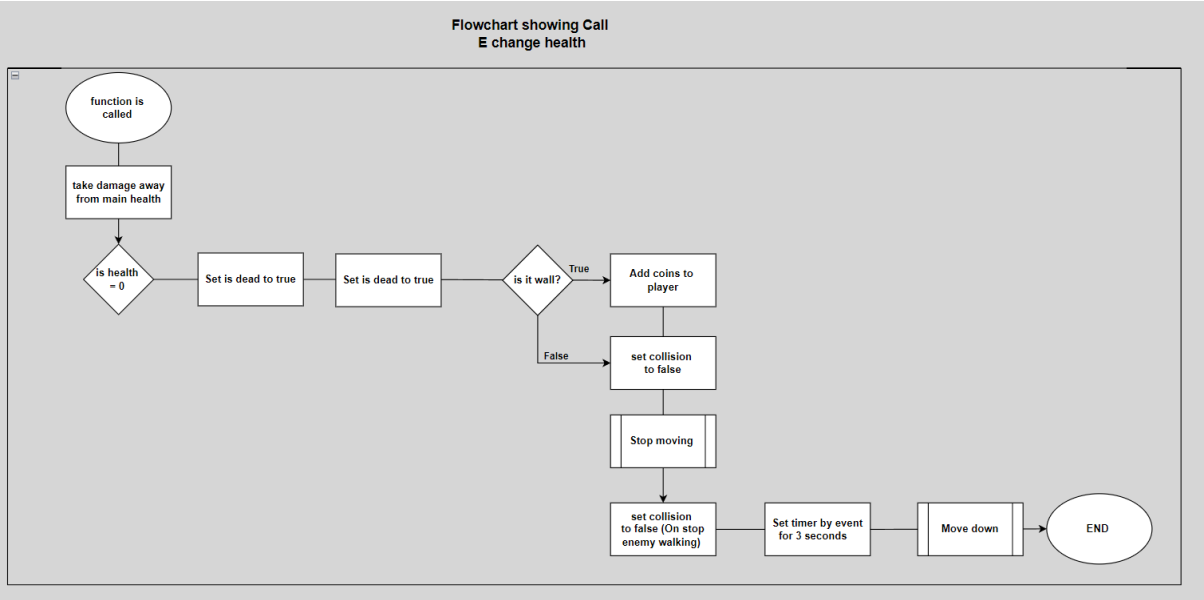
Flowchart showing update path



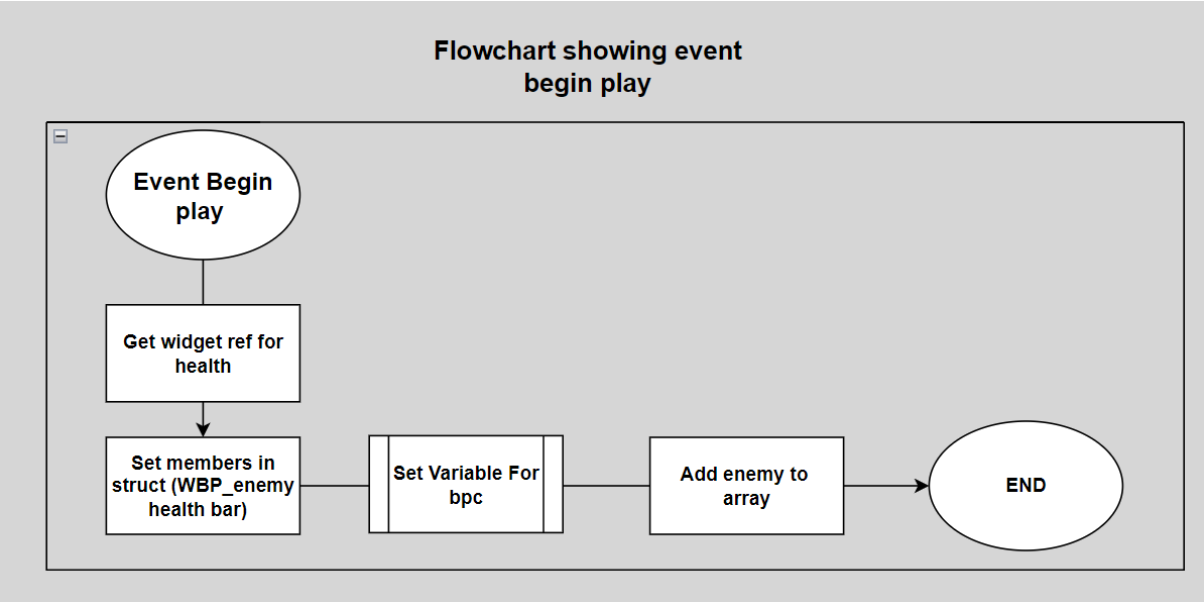
Flowchart showing take away from array



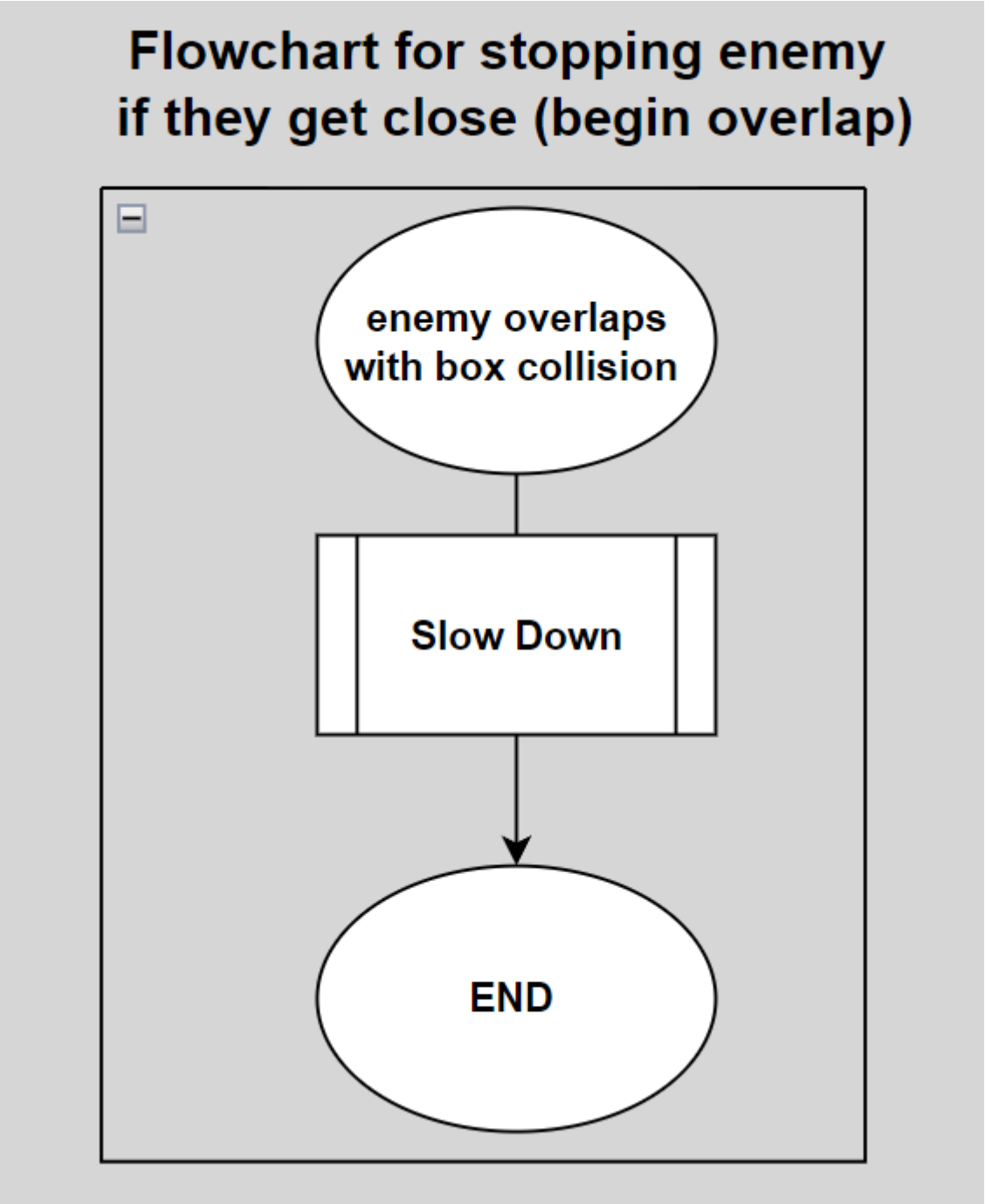
Flowchart showing E_change health



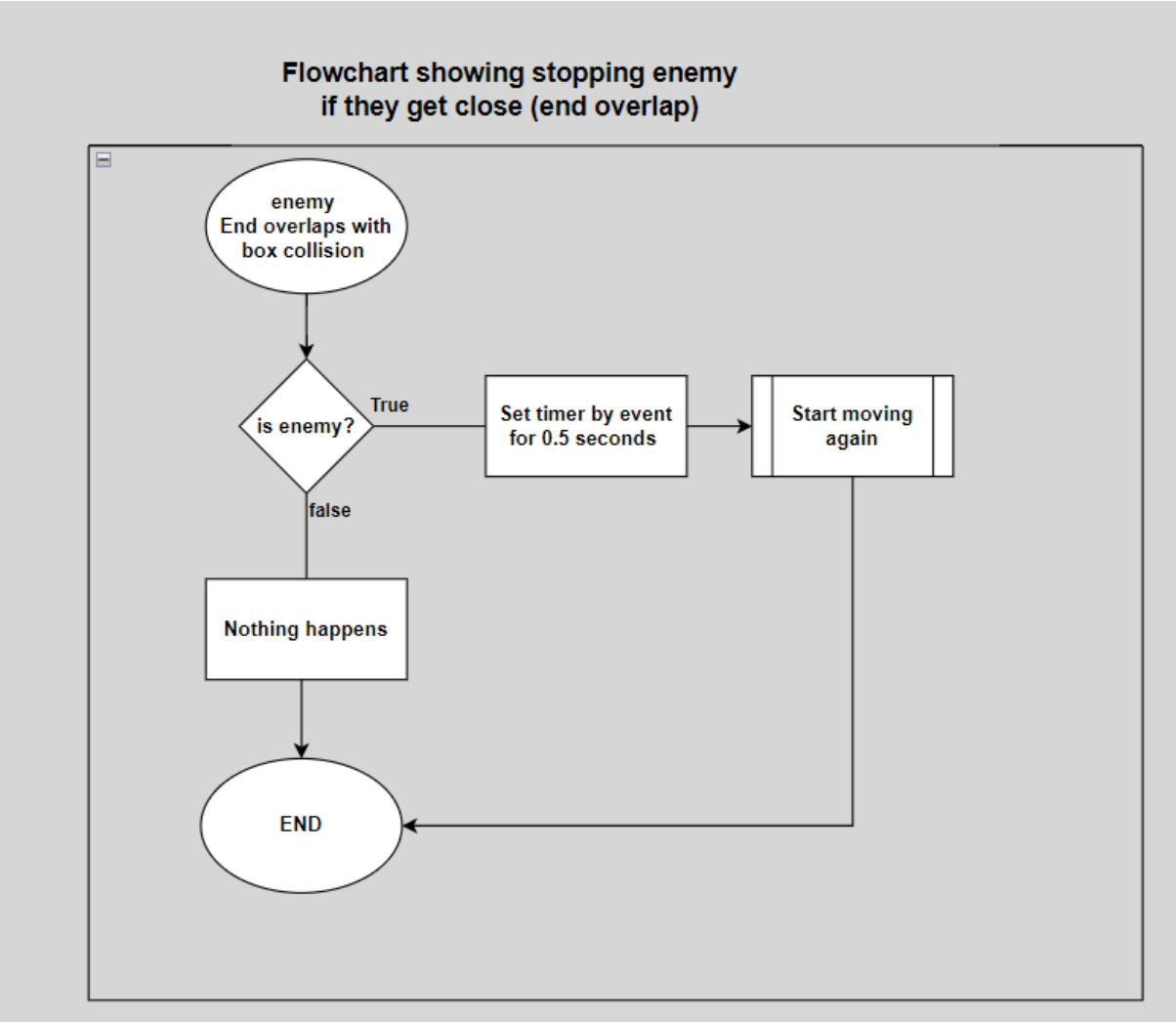
Flowchart showing Event begin play



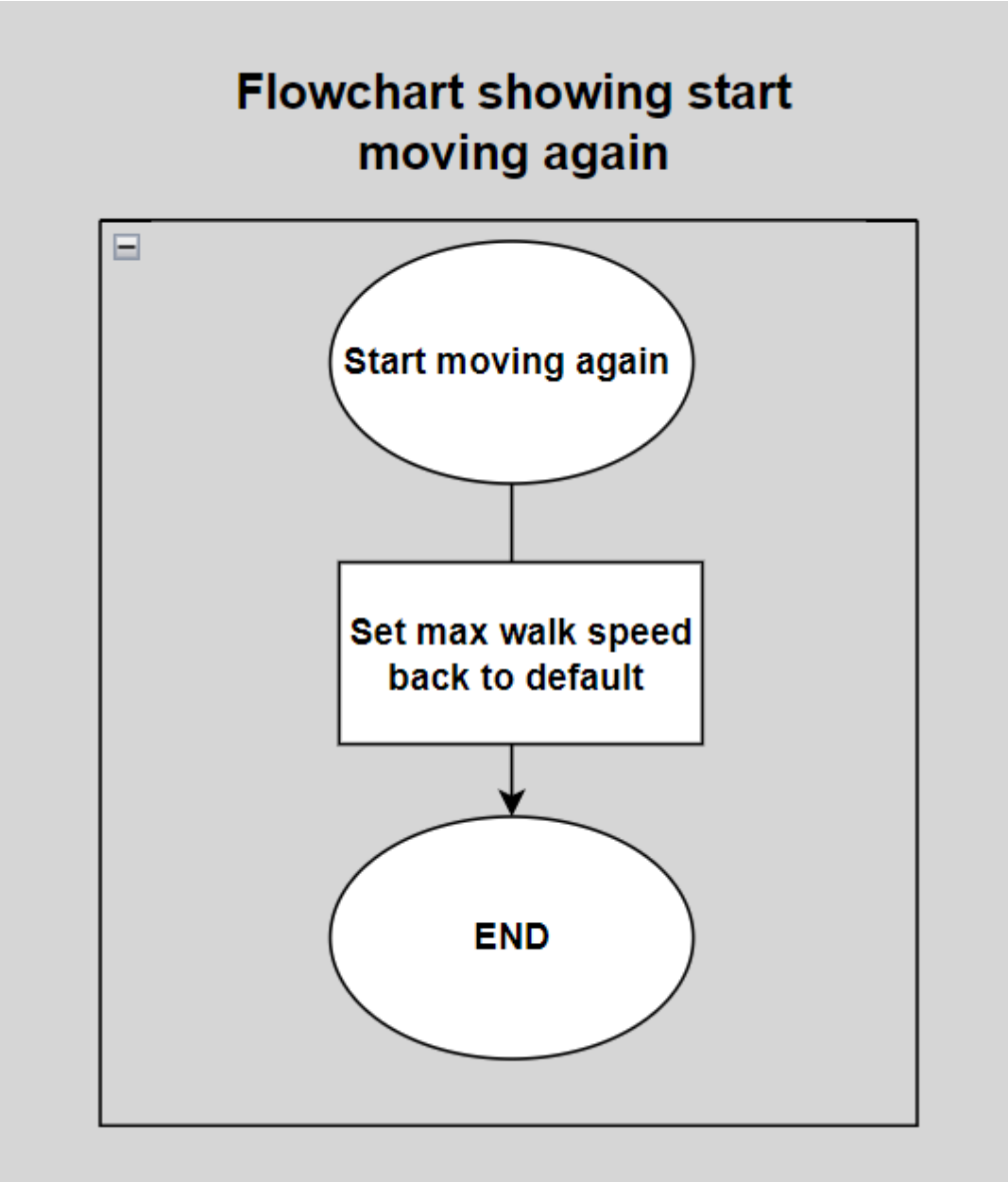
Flowchart showing stopping enemy begin overlap



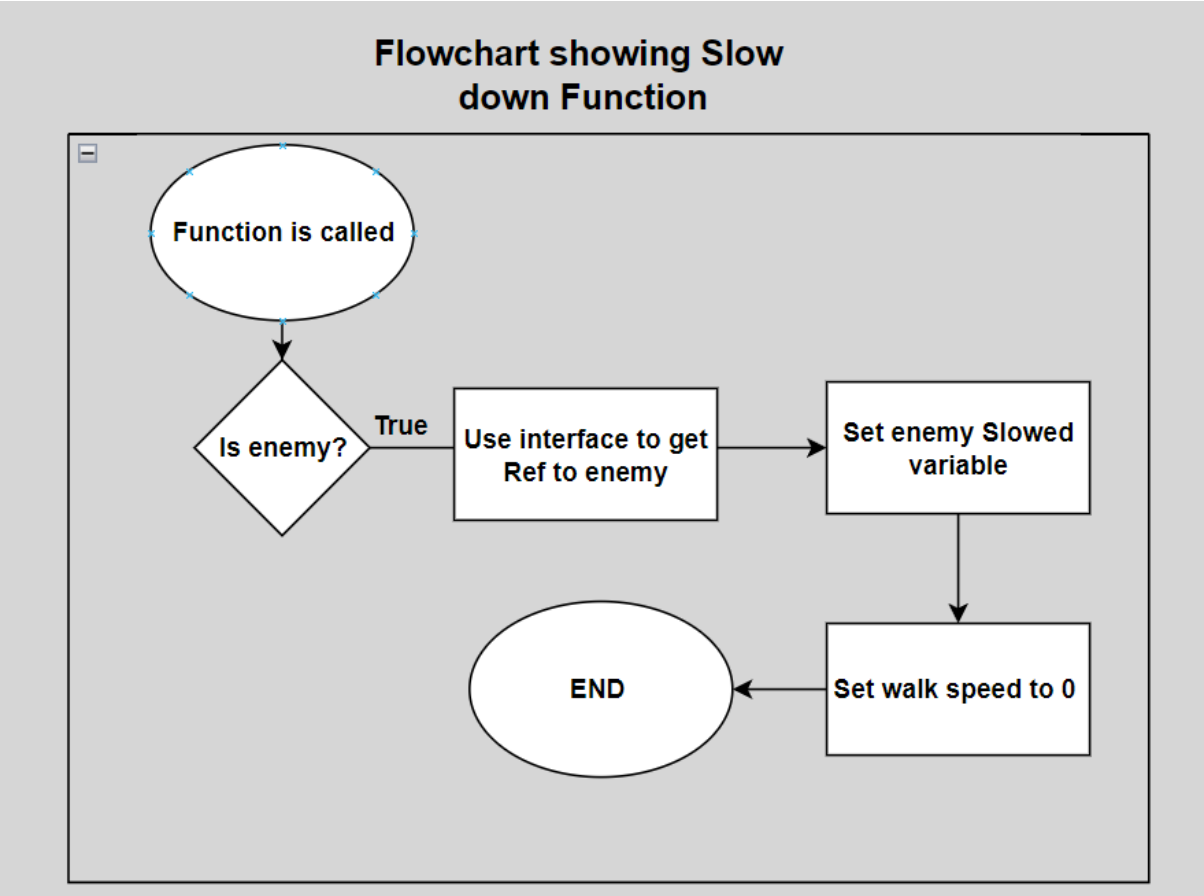
Flowchart showing Stopping enemy (end overlap)



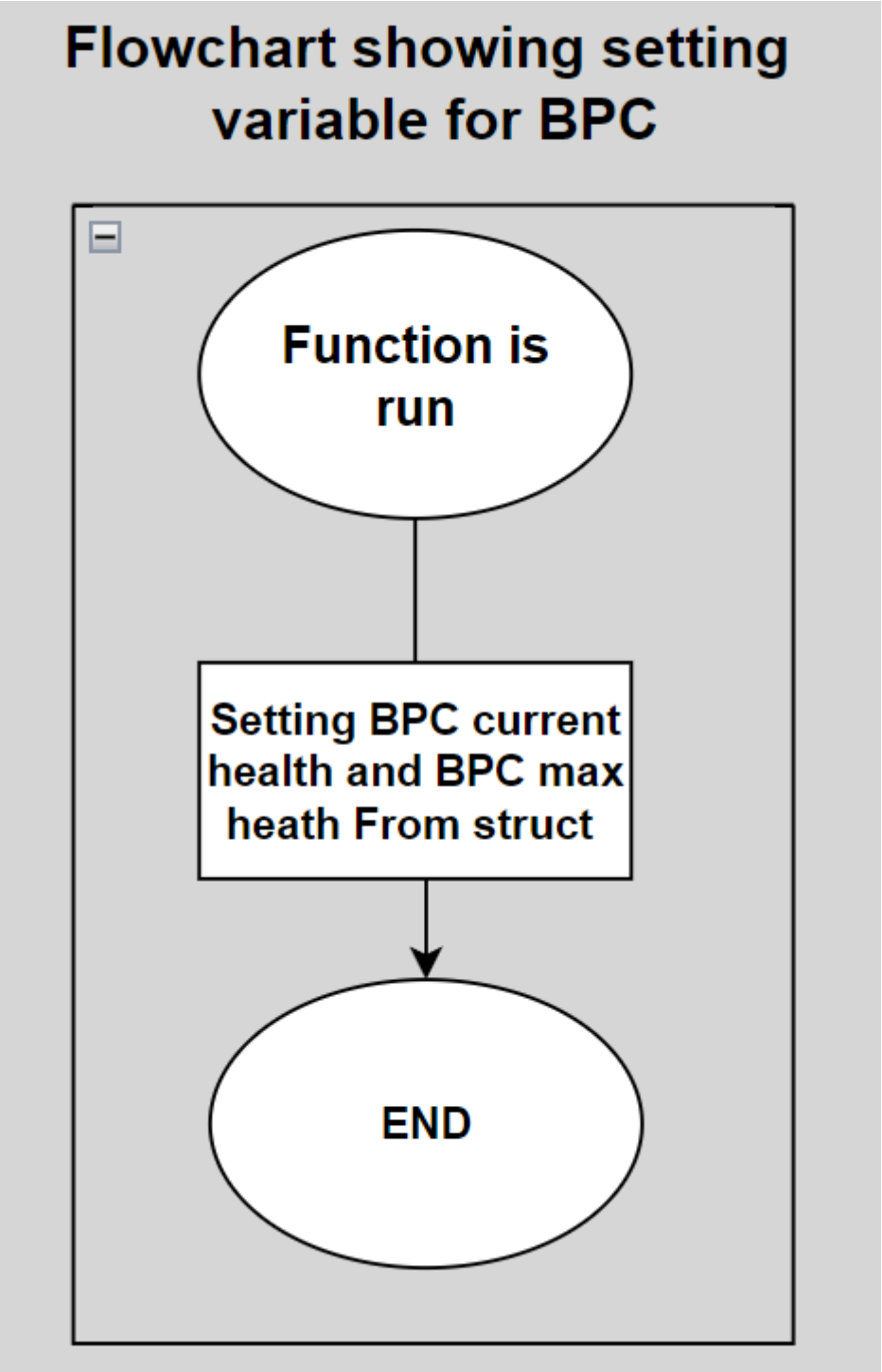
Flowchart showing start moving again



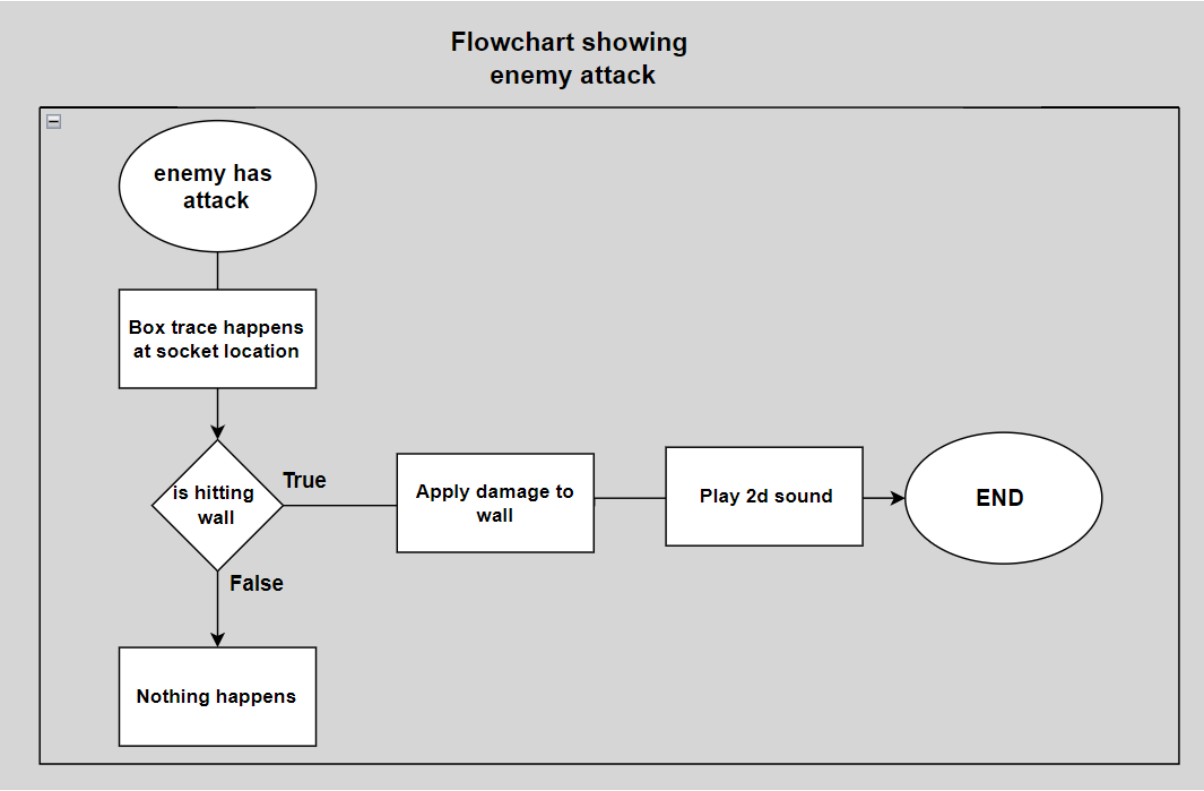
Flowchart showing slow down function



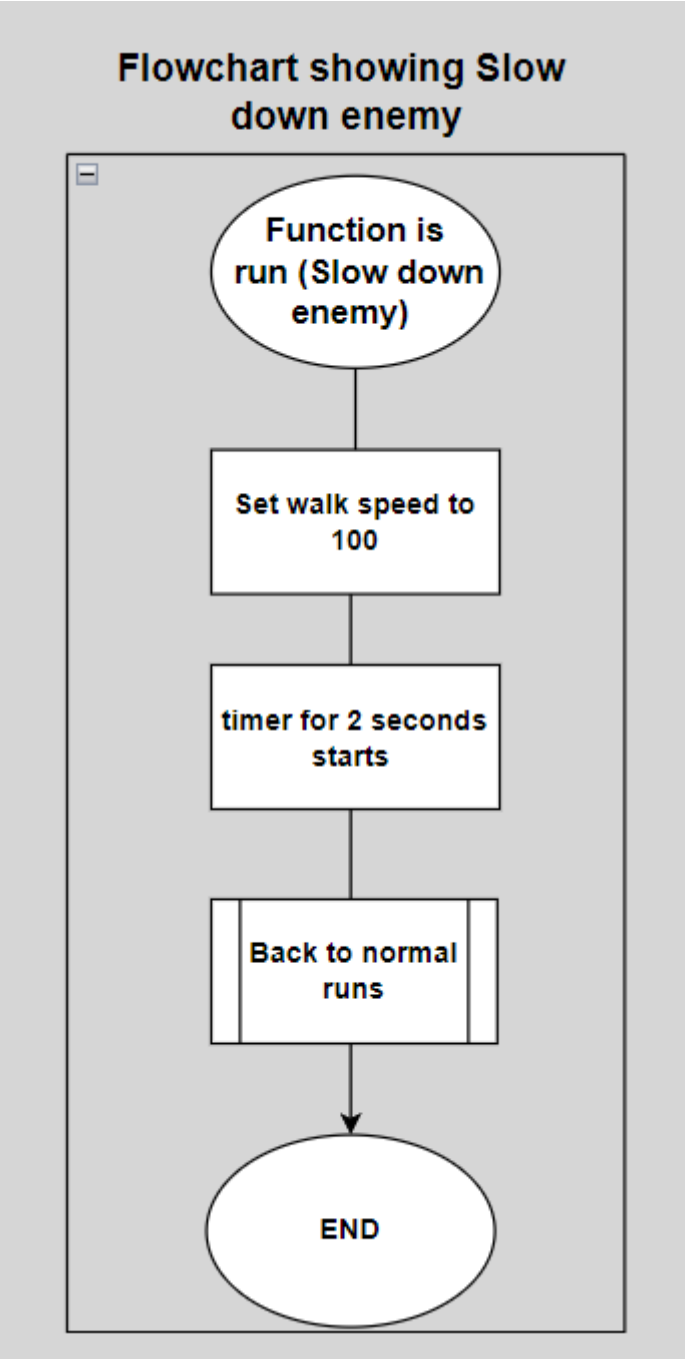
Flowchart showing Setting variable for BPC



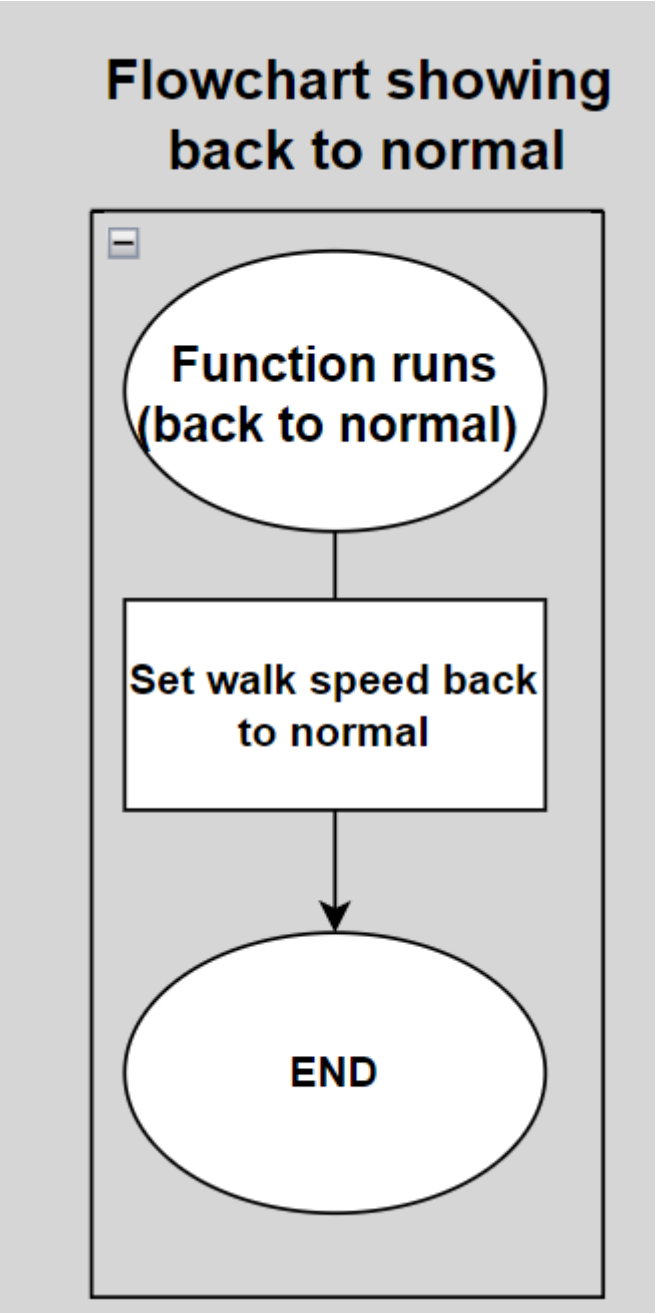
Flowchart showing enemy attack



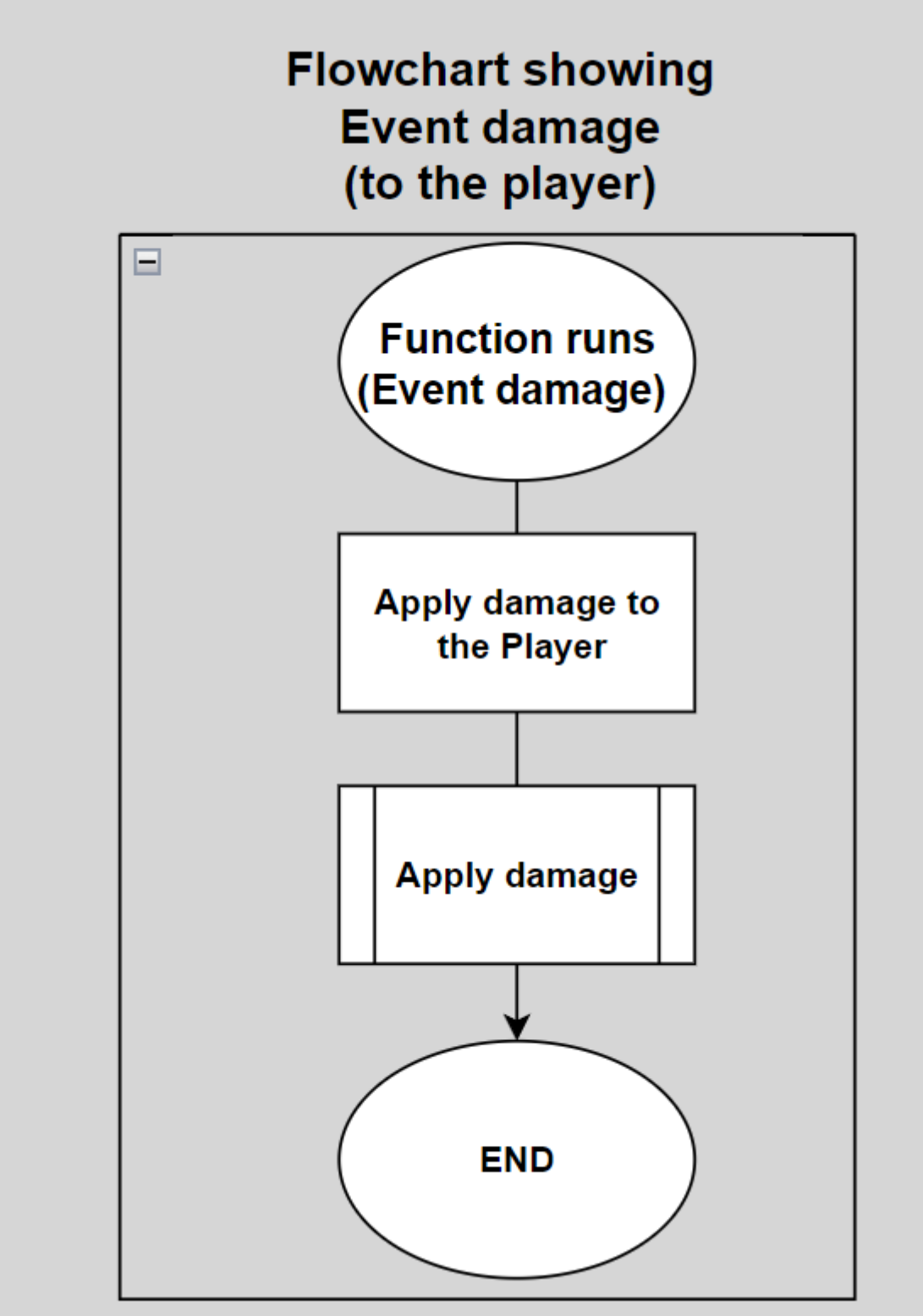
Flowchart showing slow down enemy



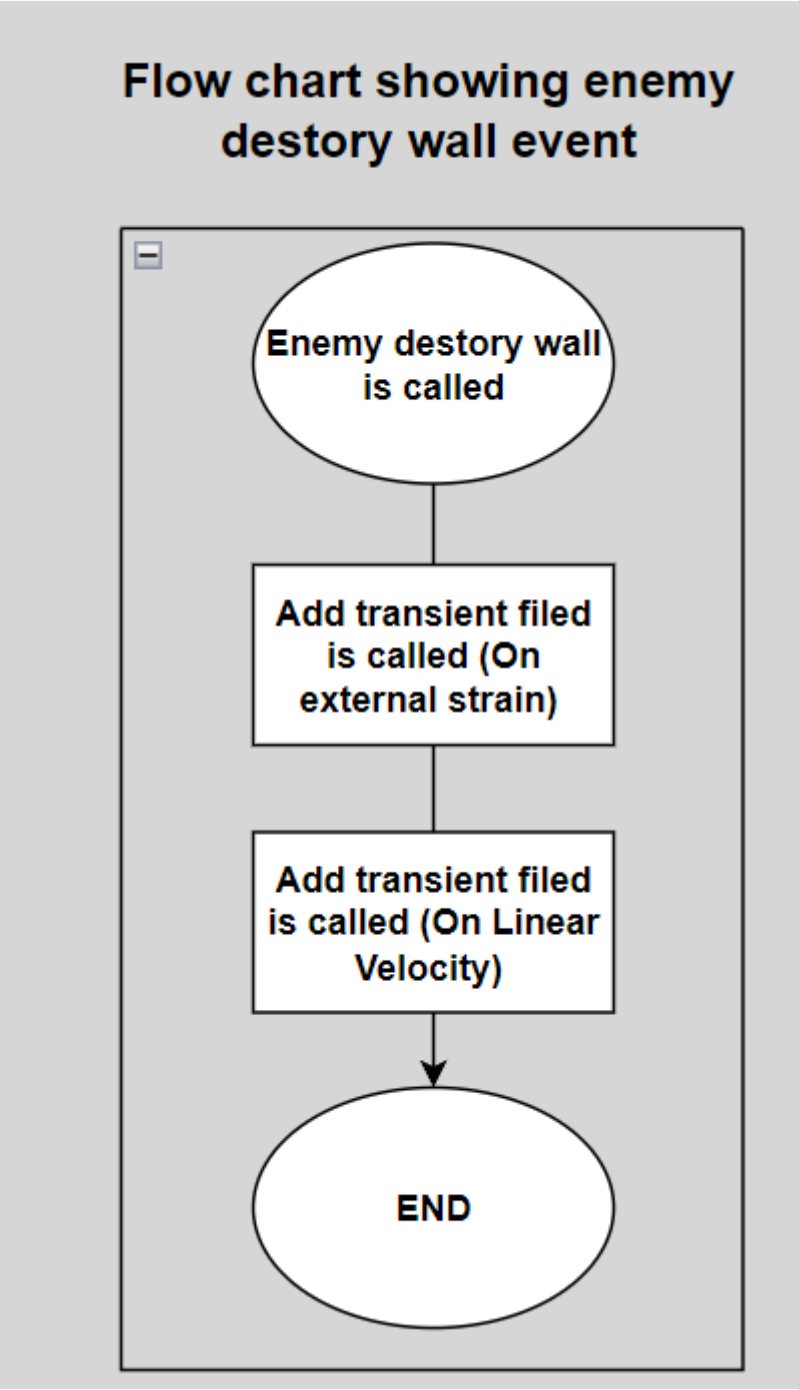
Flowchart showing back to normal



Flowchart showing Event any damage

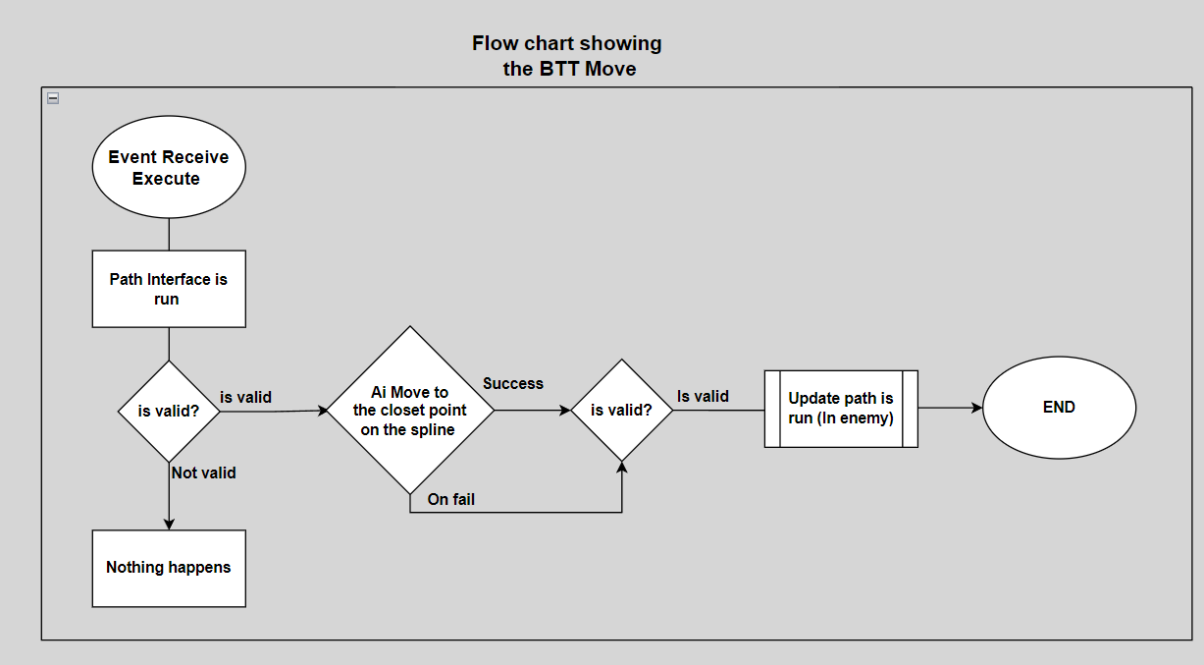


flowchart showing Enemy destroy wall event

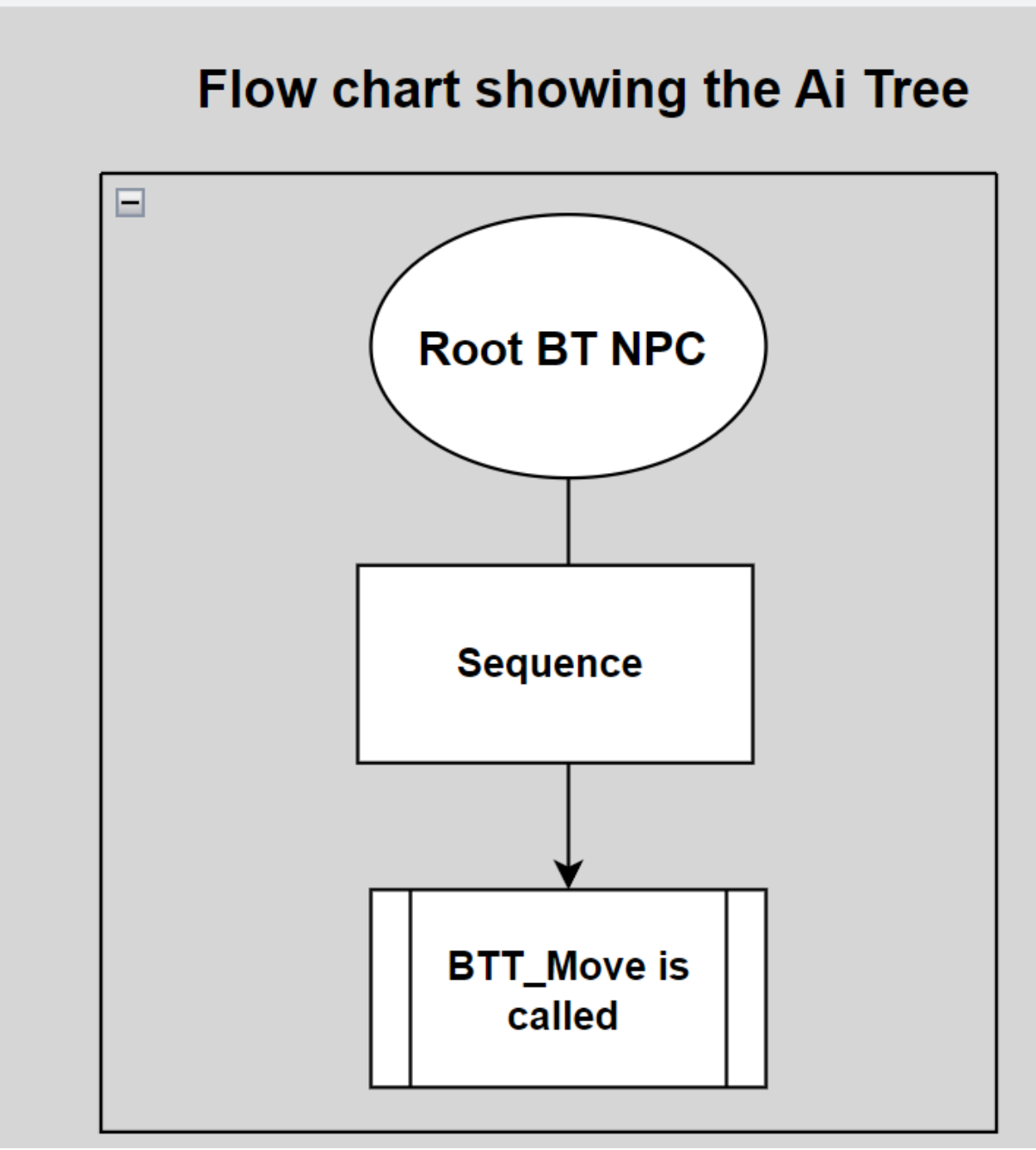


All flowcharts showing AI for enemy

Flowchart showing BTT move

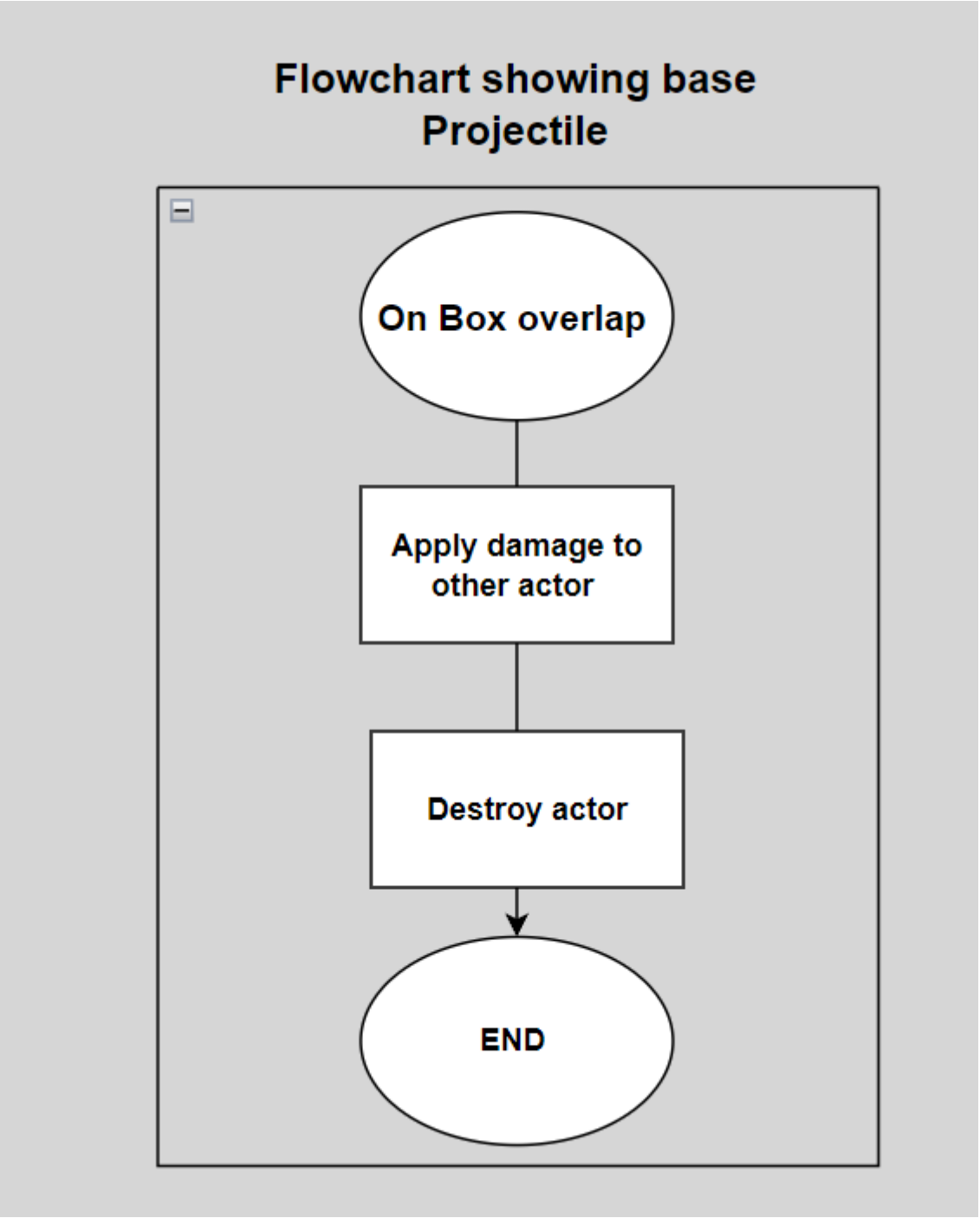


Flowchart showing the AI Tree



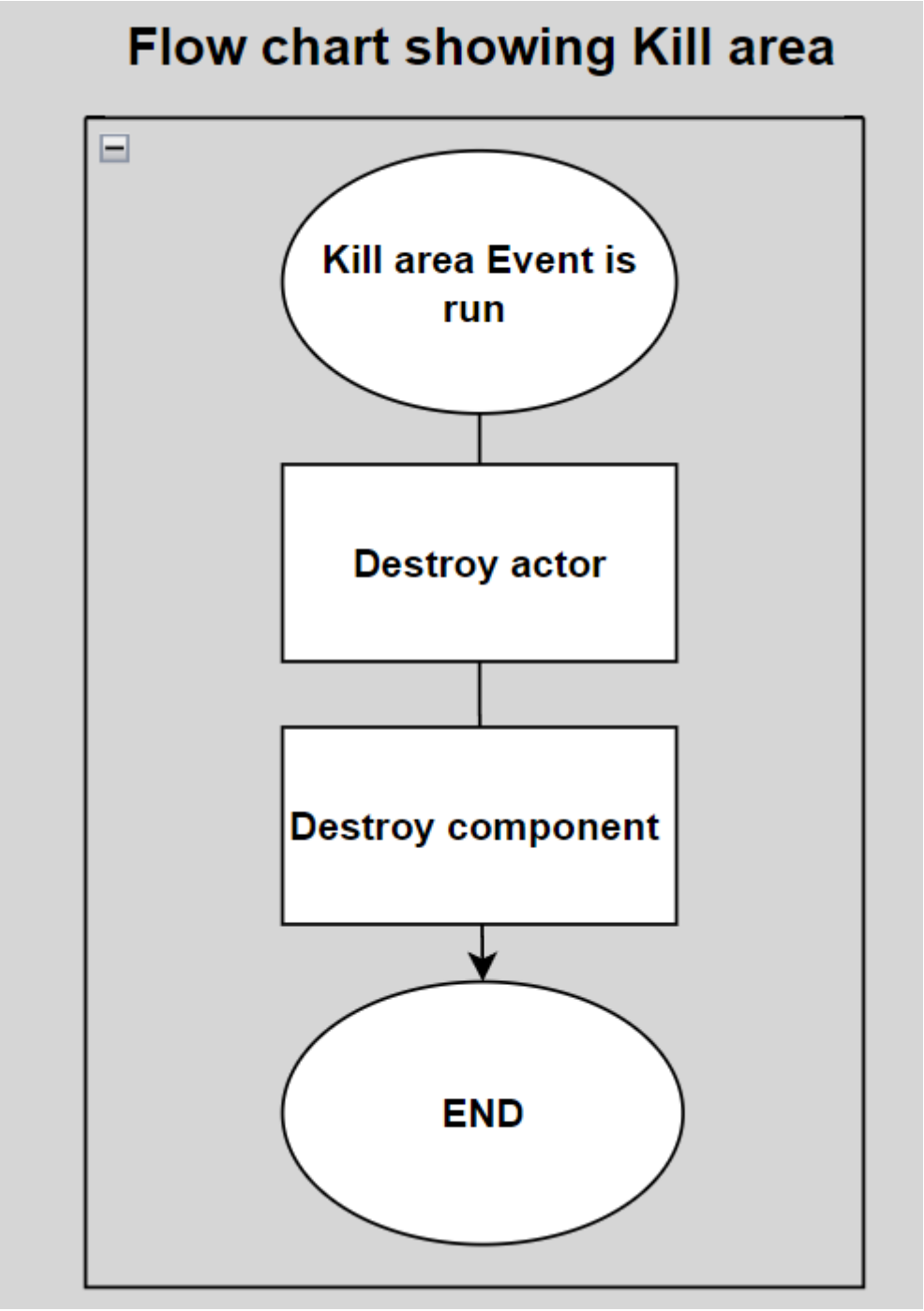
All flowchart showing Code in Projectile

Flowchart showing base projectile

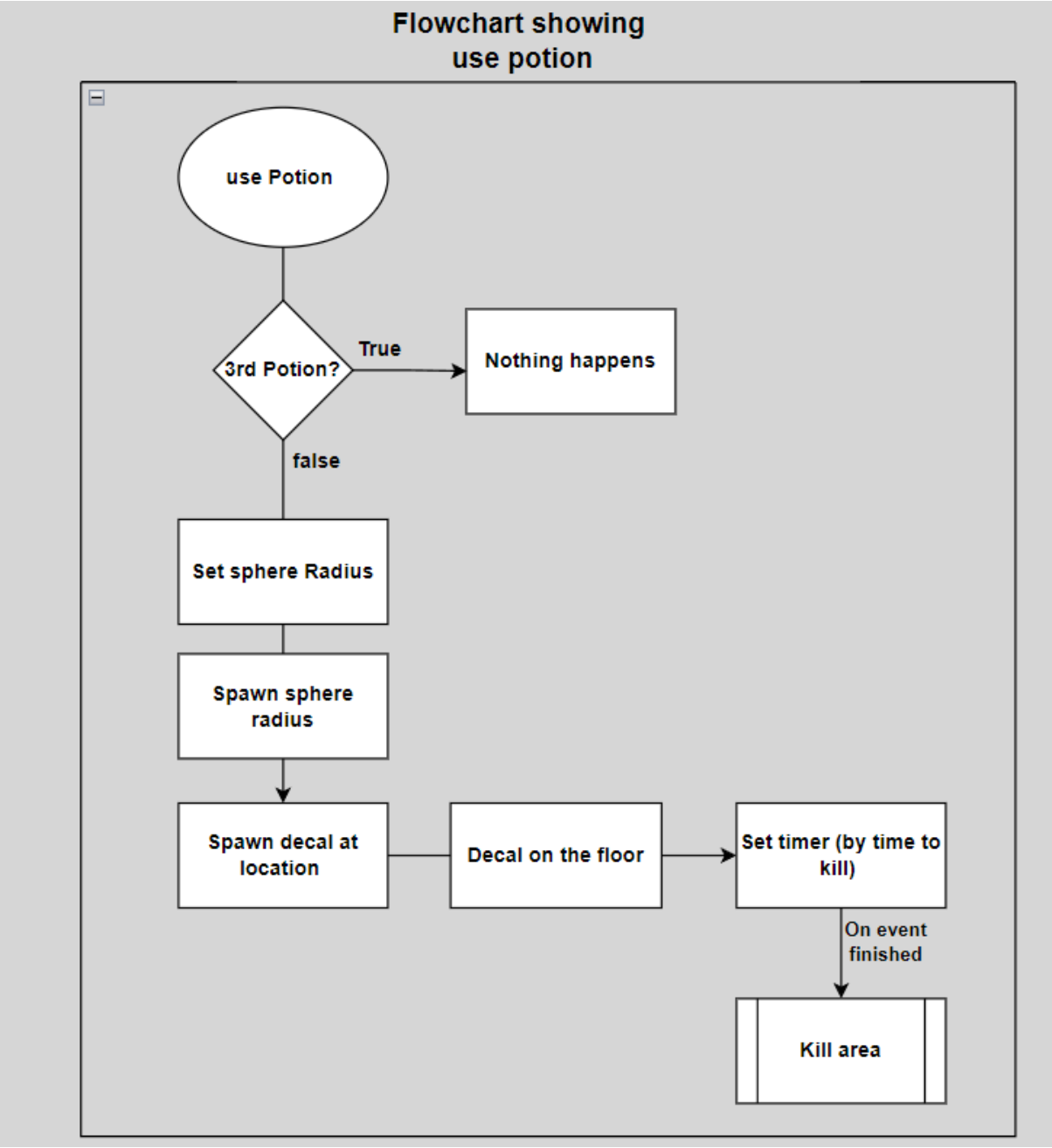


All flowchart for base potion

Flowchart showing Kill area

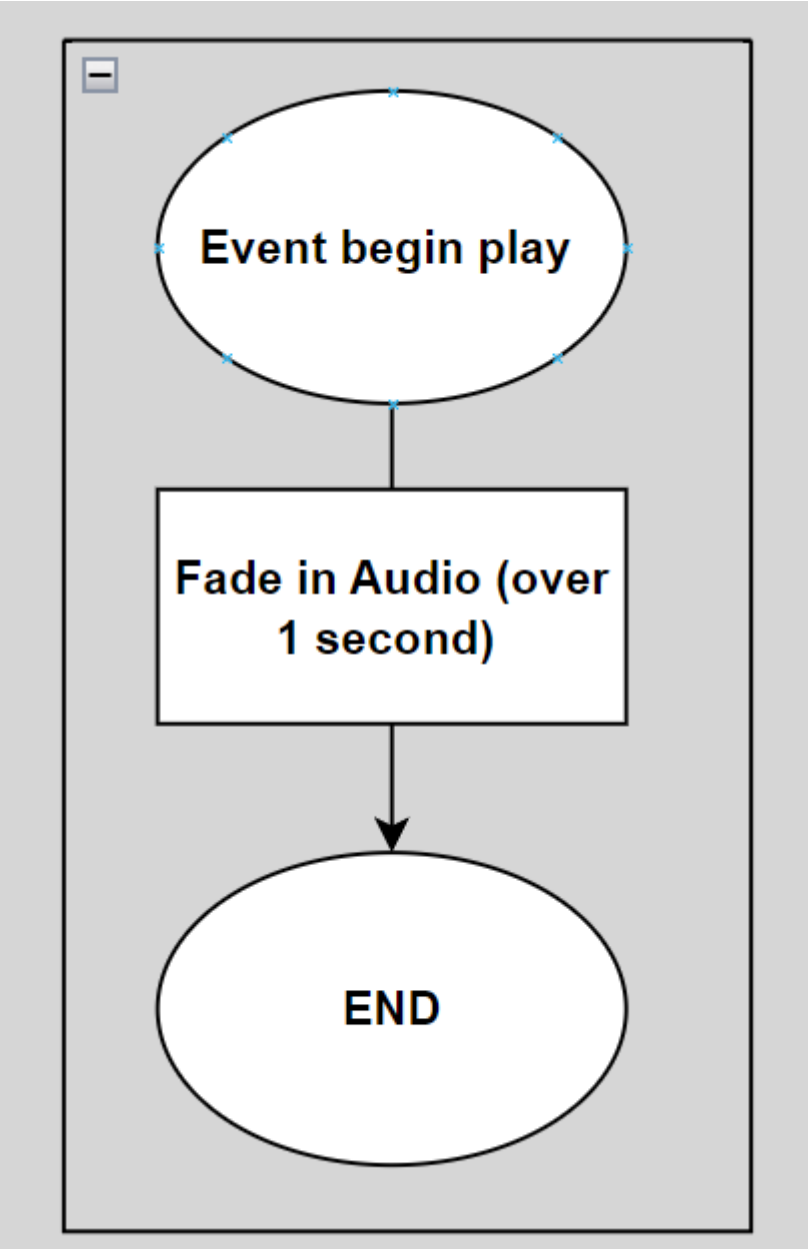


Flowchart showing use potion

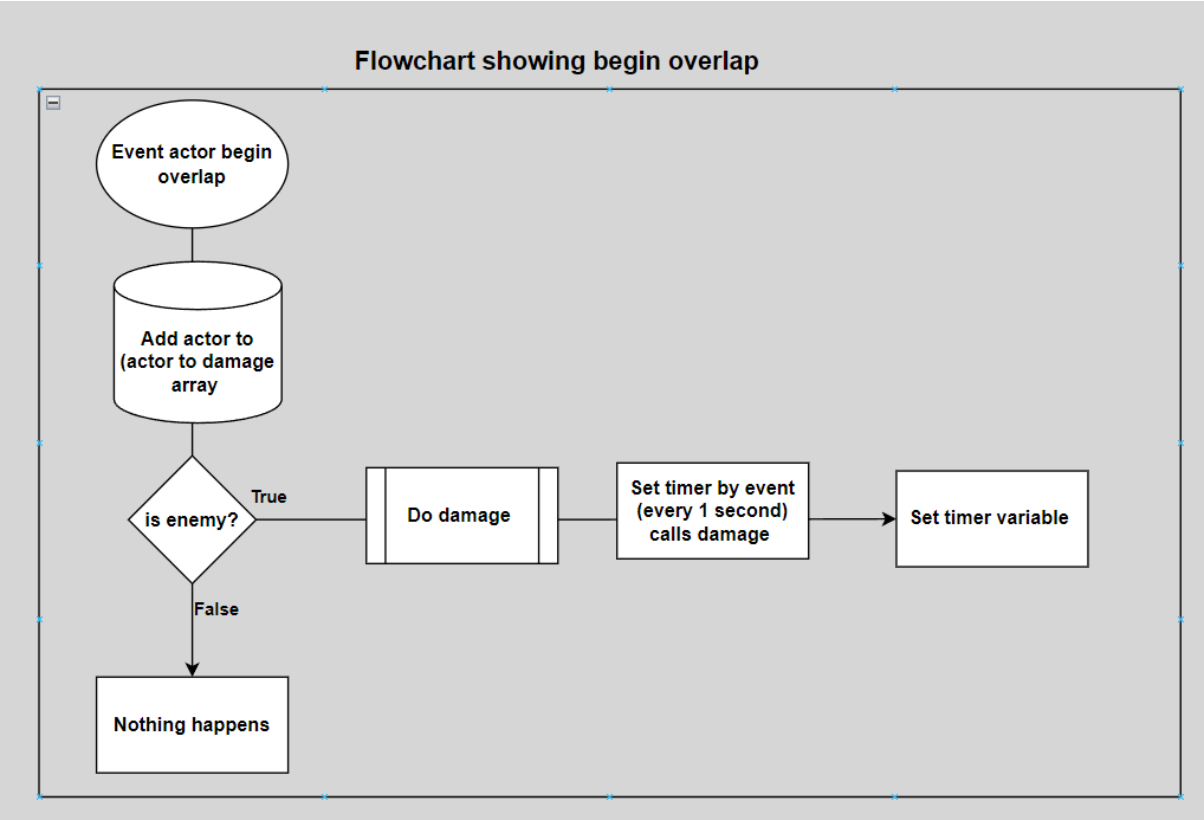


All flowcharts for potion 1

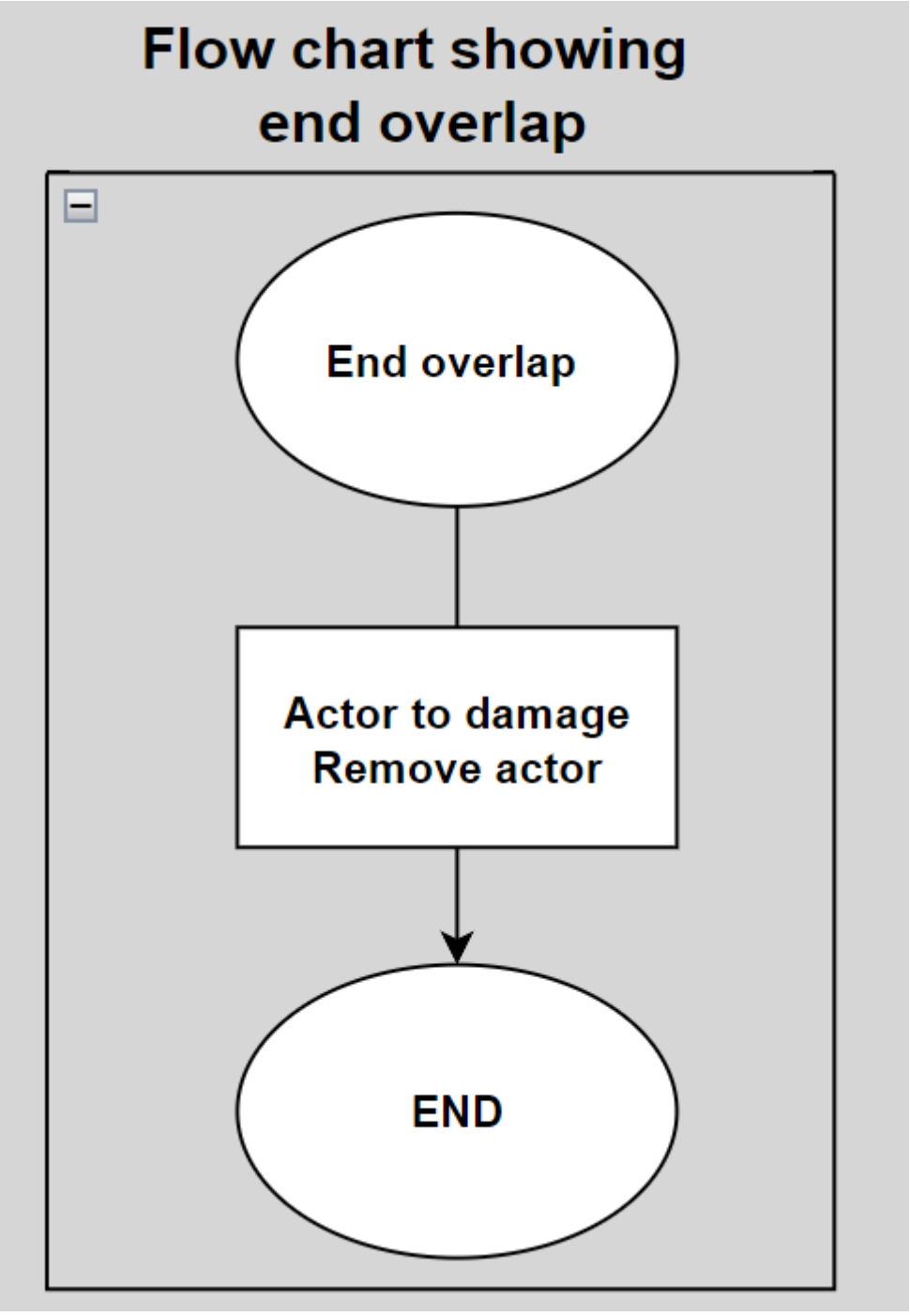
Flowchart showing Event begin play



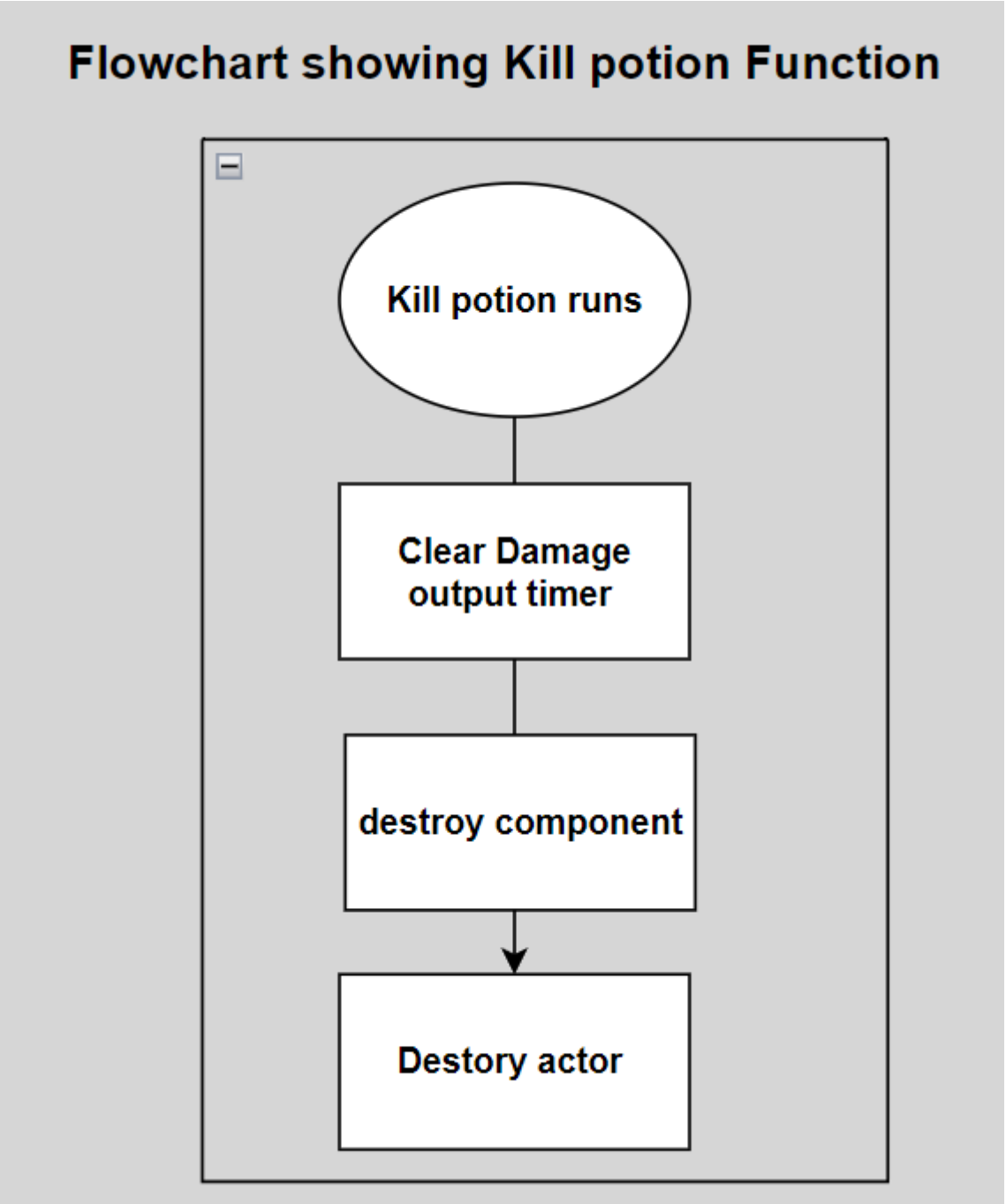
Flowchart showing begin overlap



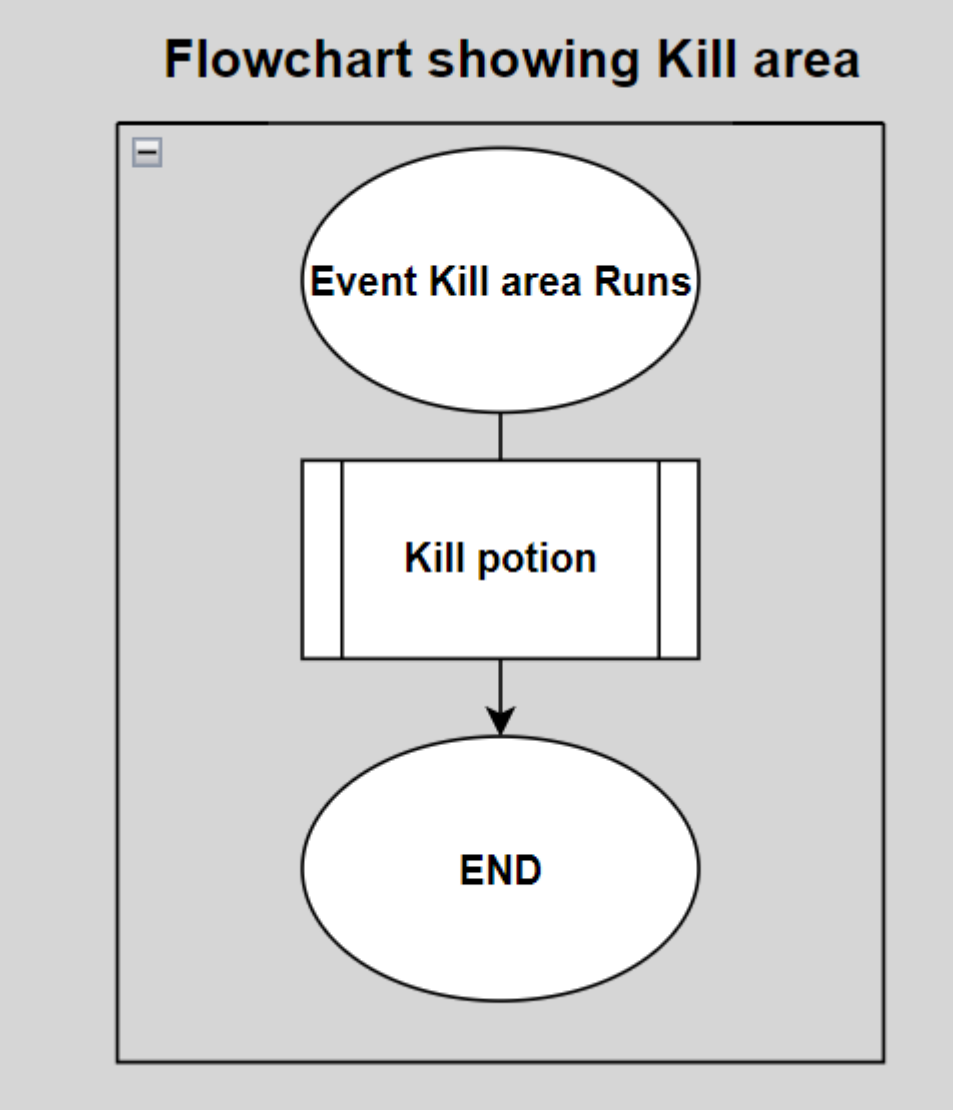
Flowchart showing end overlap



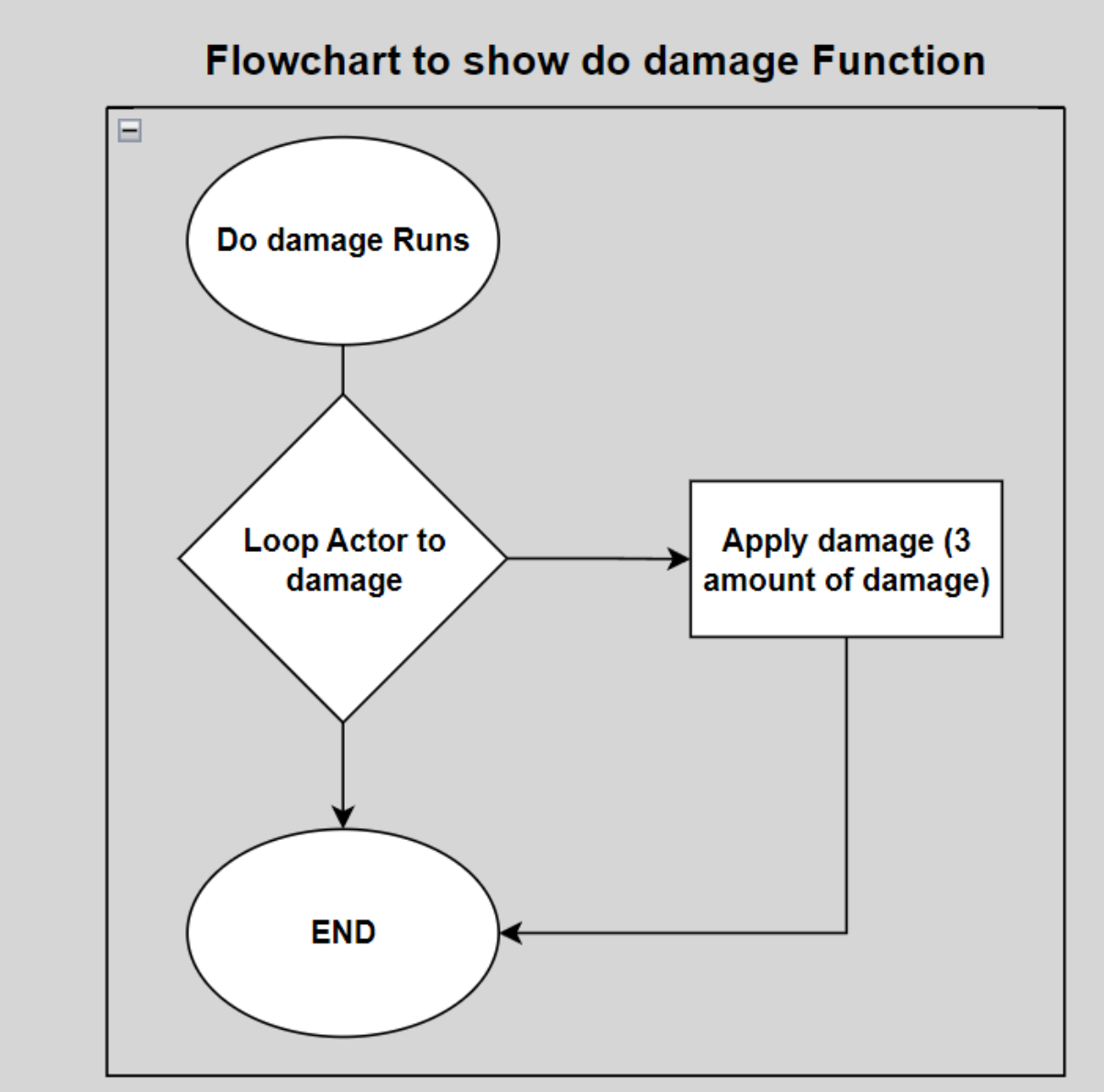
Flowchart showing kill potion Function



Flowchart showing kill area

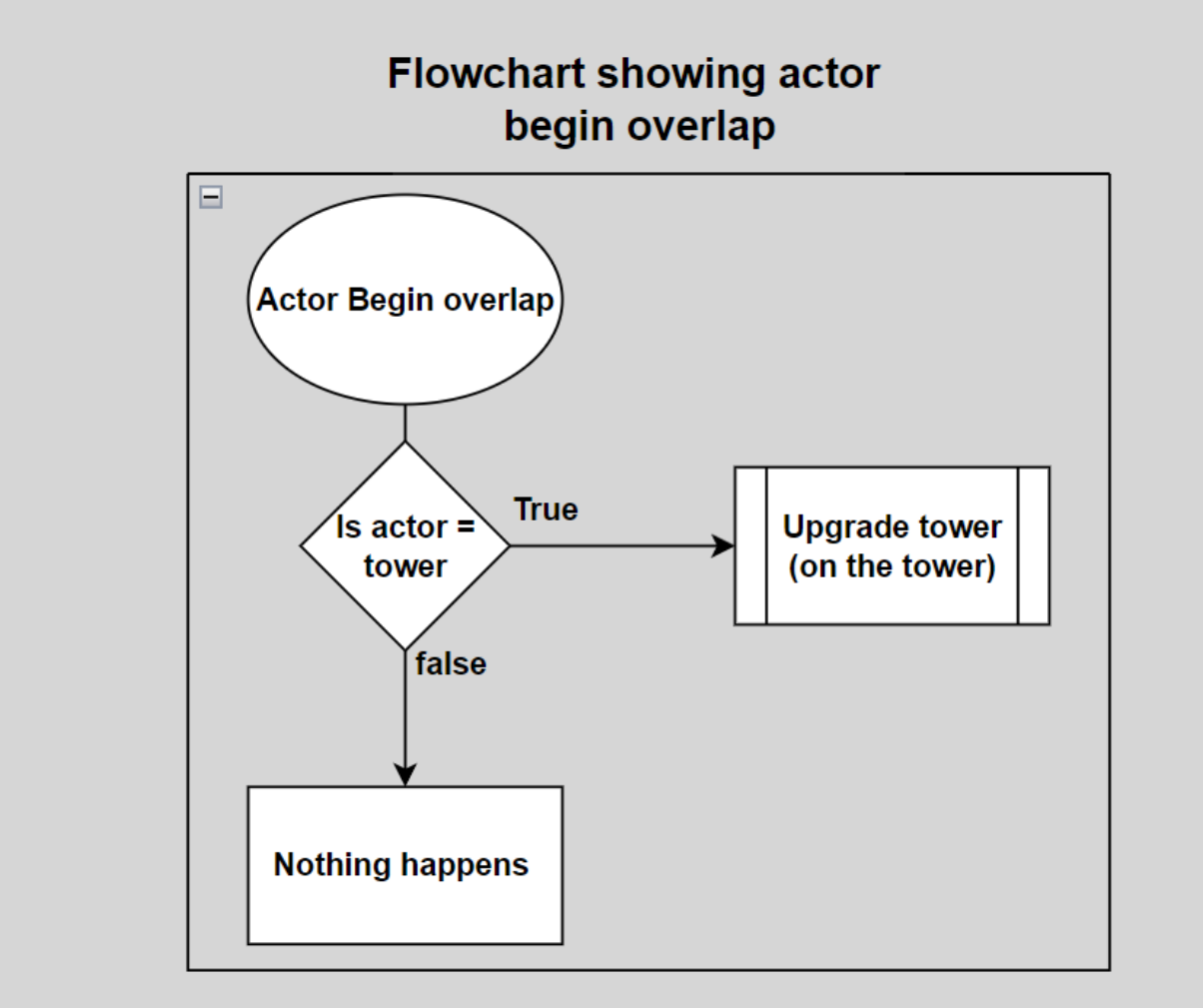


Flowchart showing to do damage function



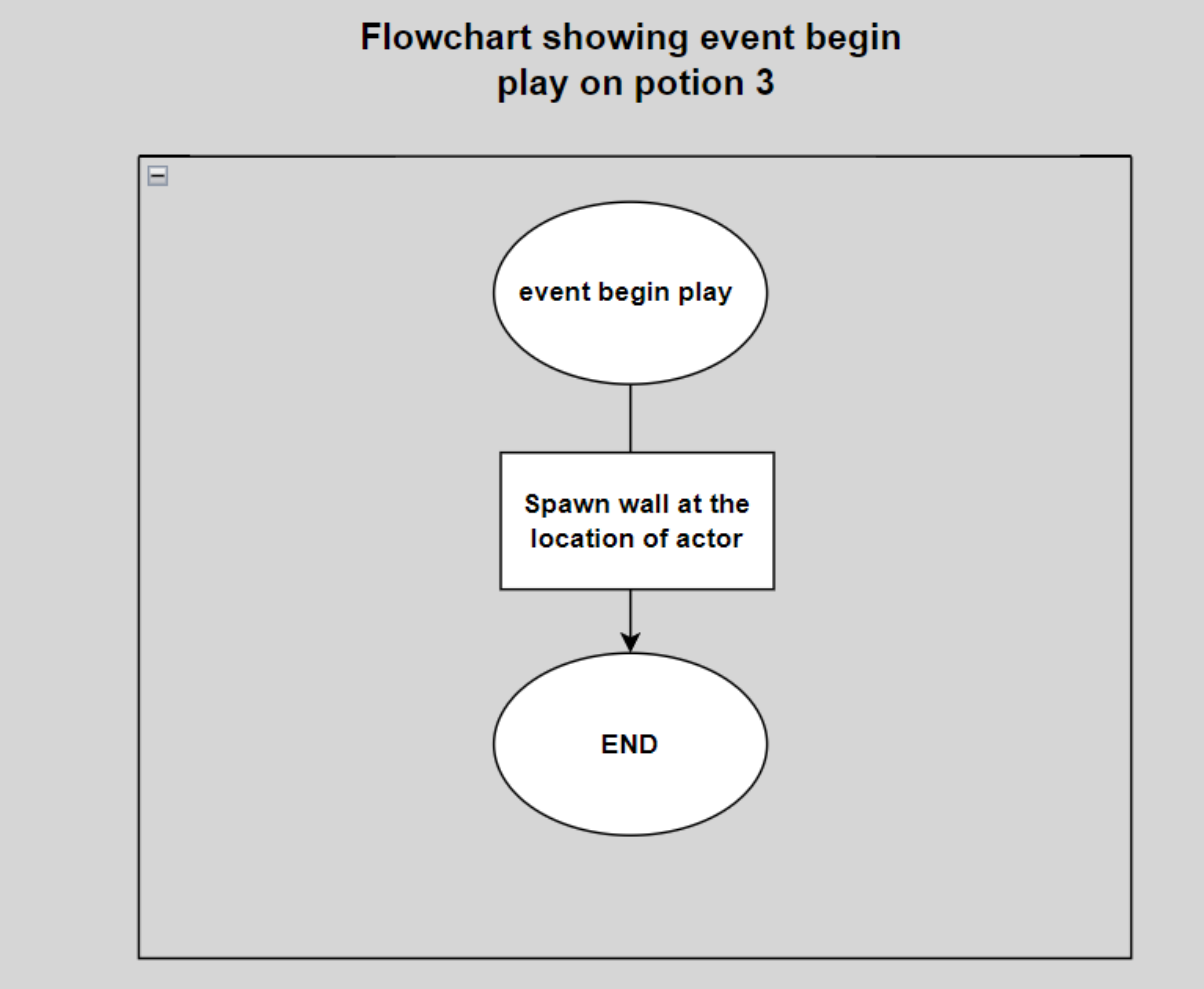
All flowcharts for potion 2

Flowcharts showing actor begin play



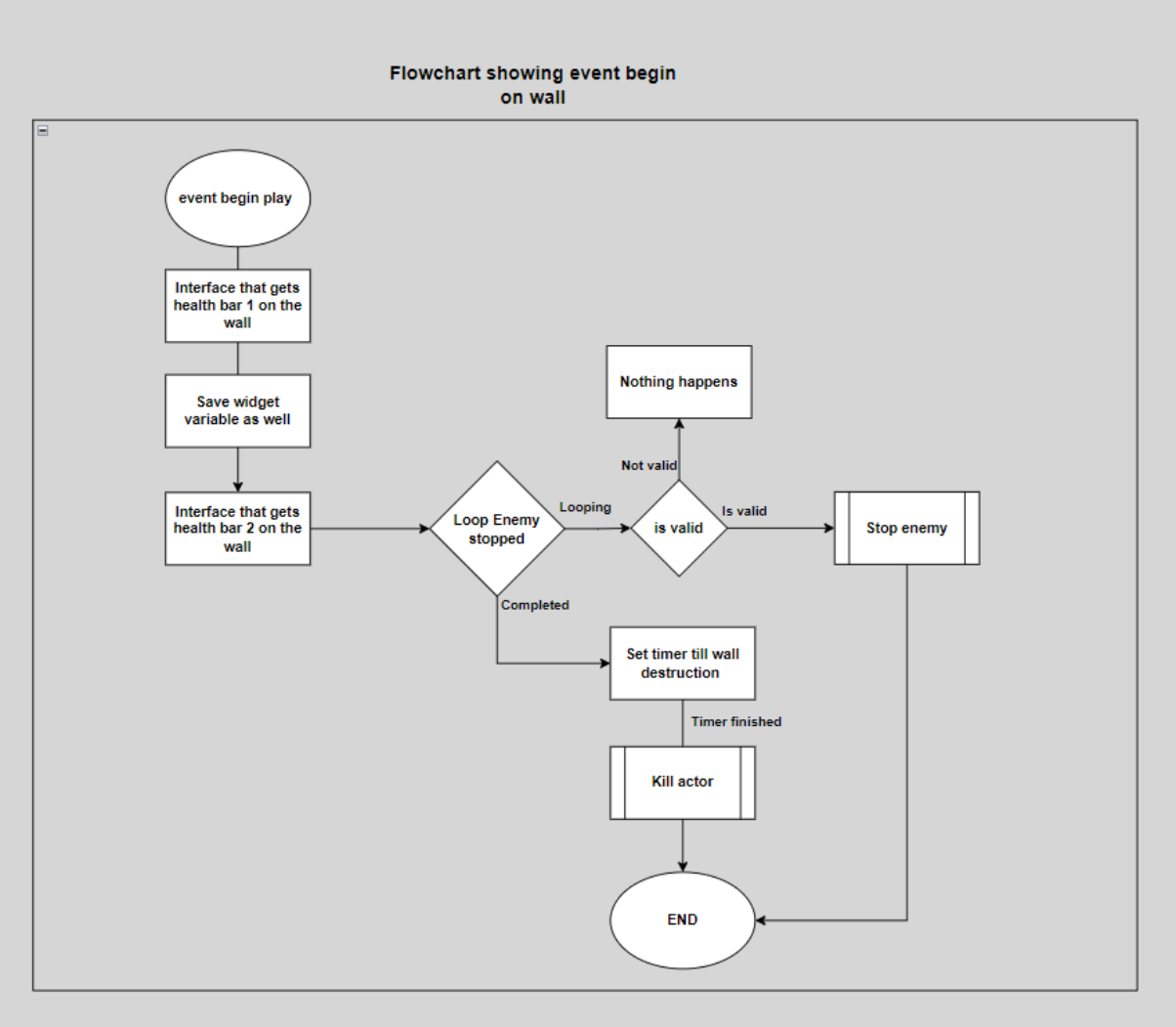
All flowcharts for potion 3

Flowchart showing Event begin play on potion 3

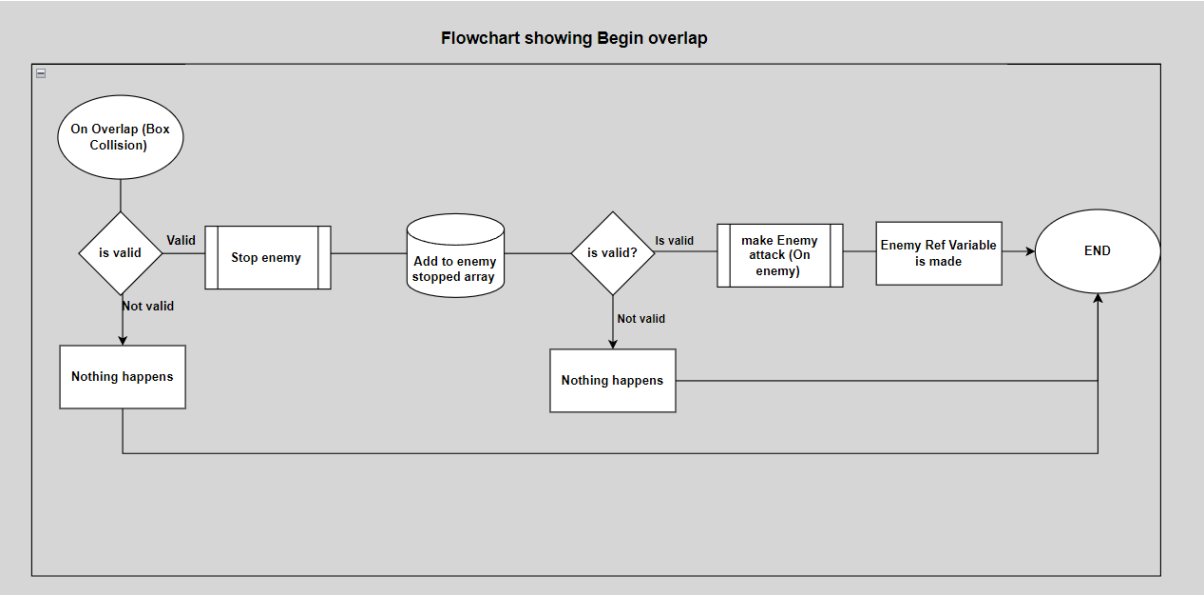


All flowcharts for Wall Potion

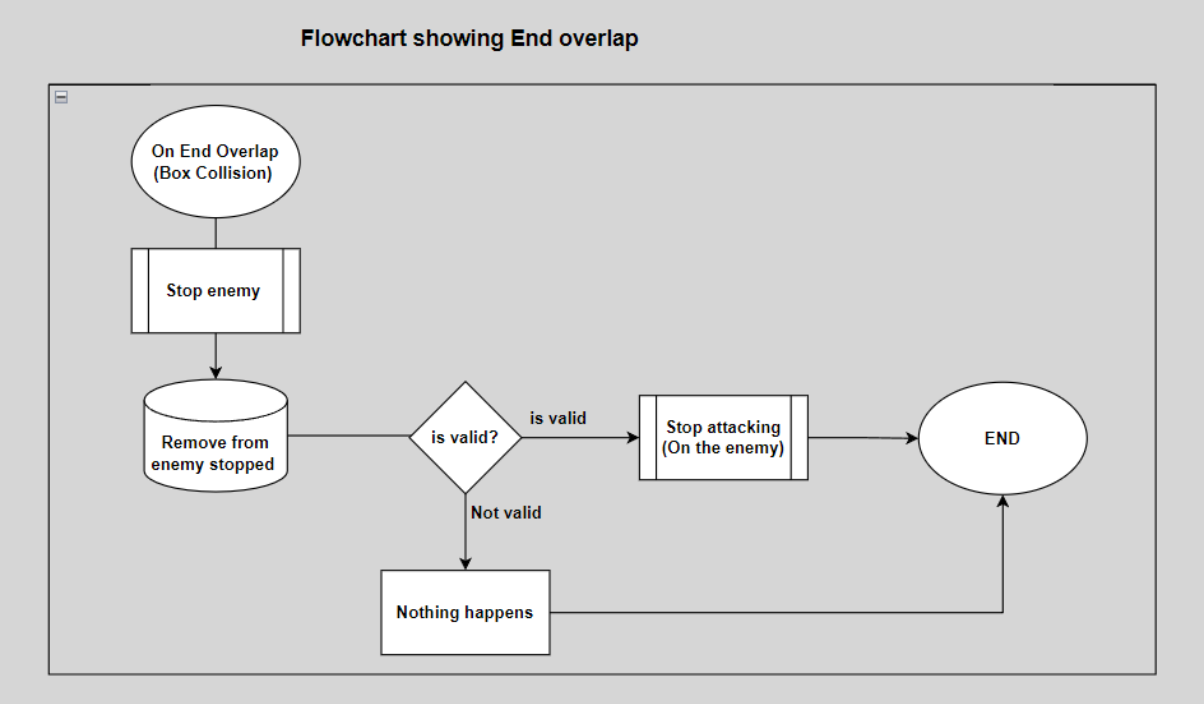
Flowchart showing event begin play



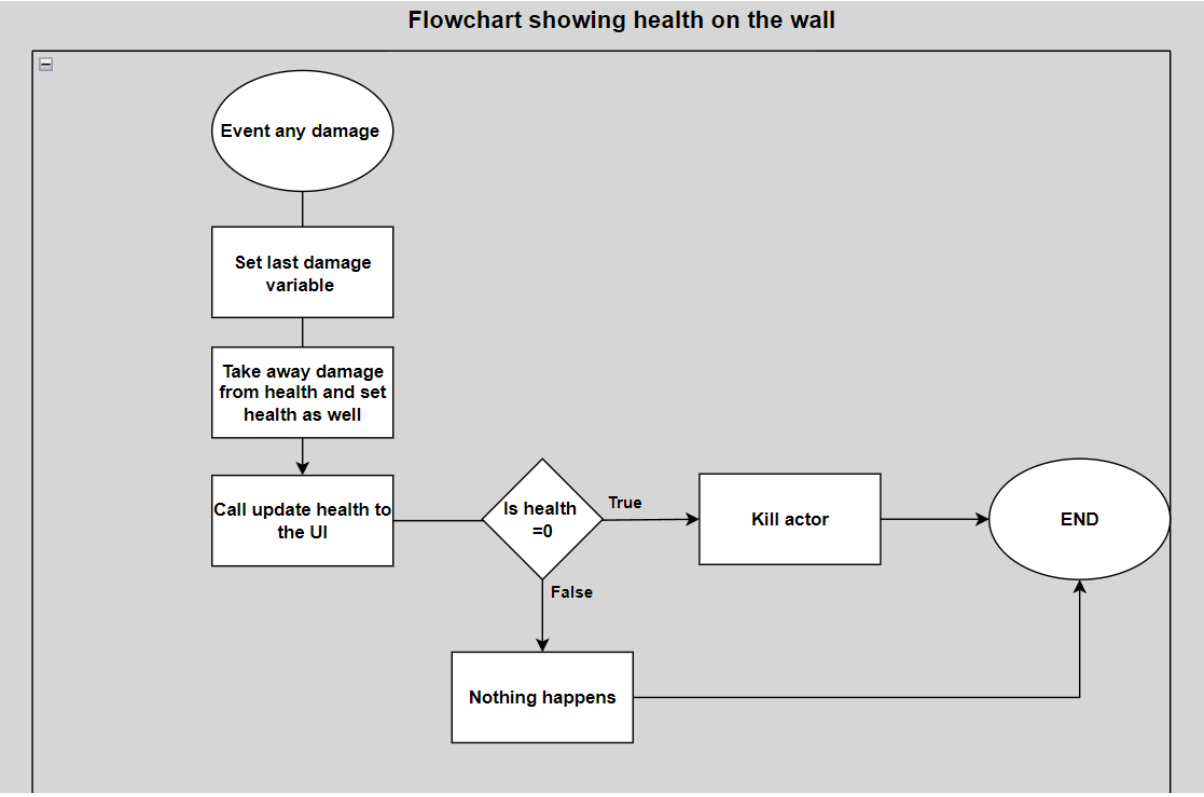
Flowchart showing begin overlap



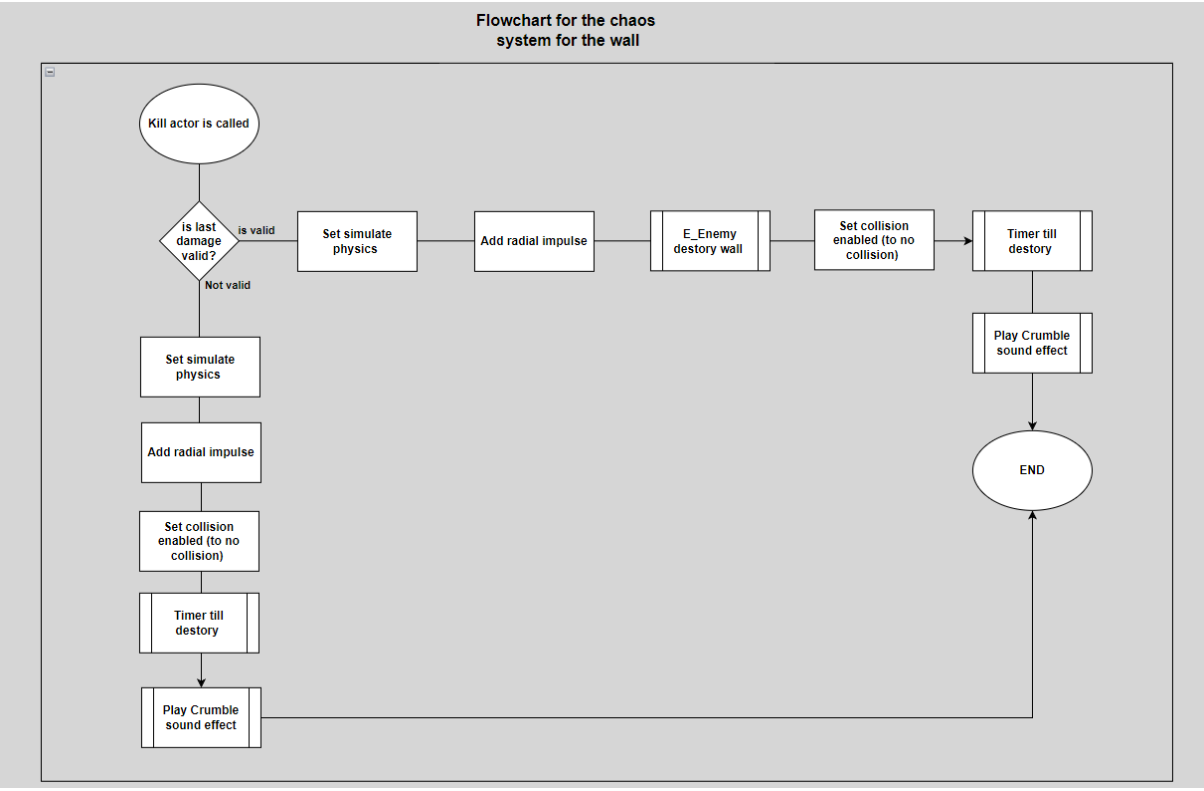
Flowchart showing end overlap



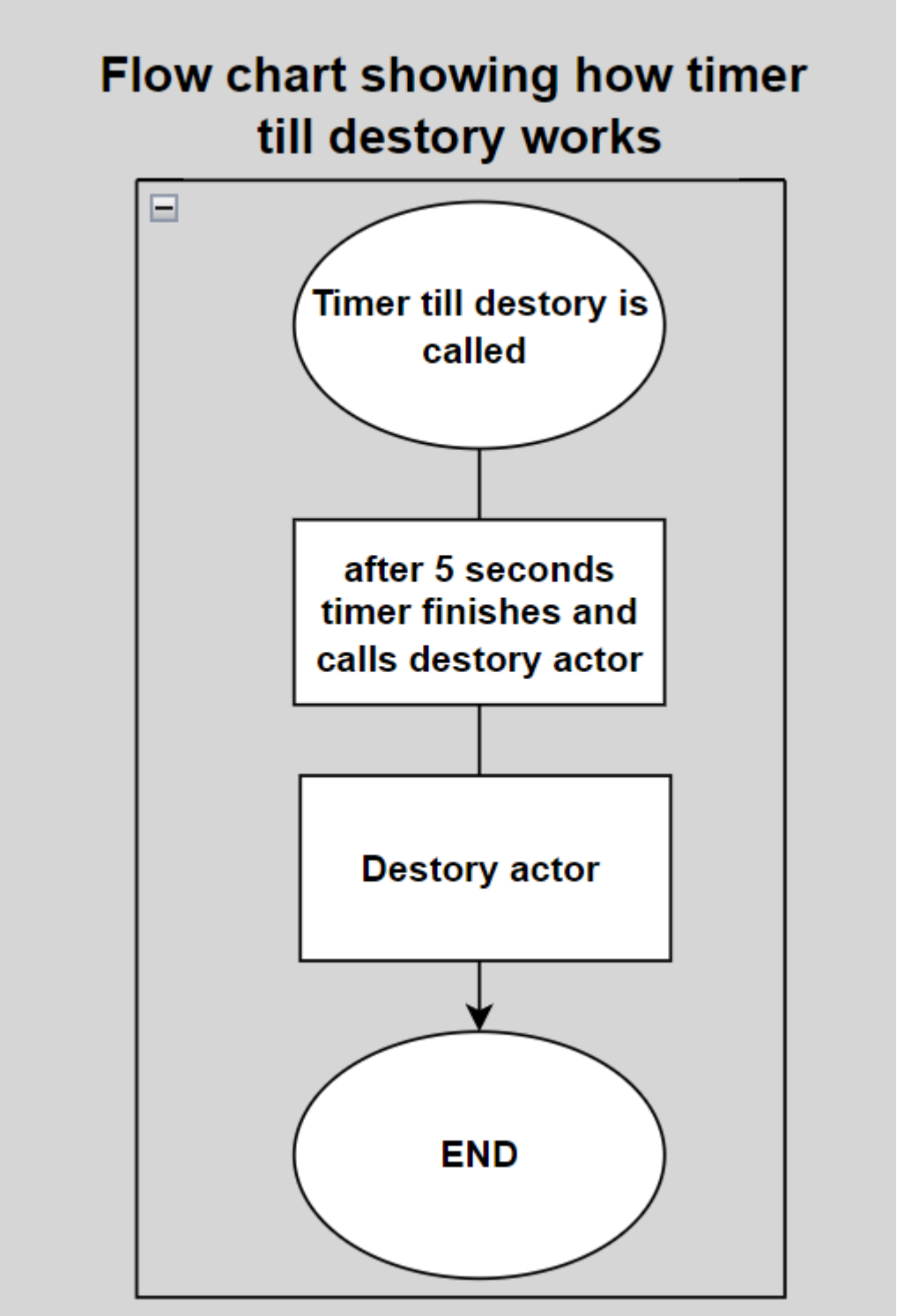
Flowchart showing health widget on the wall



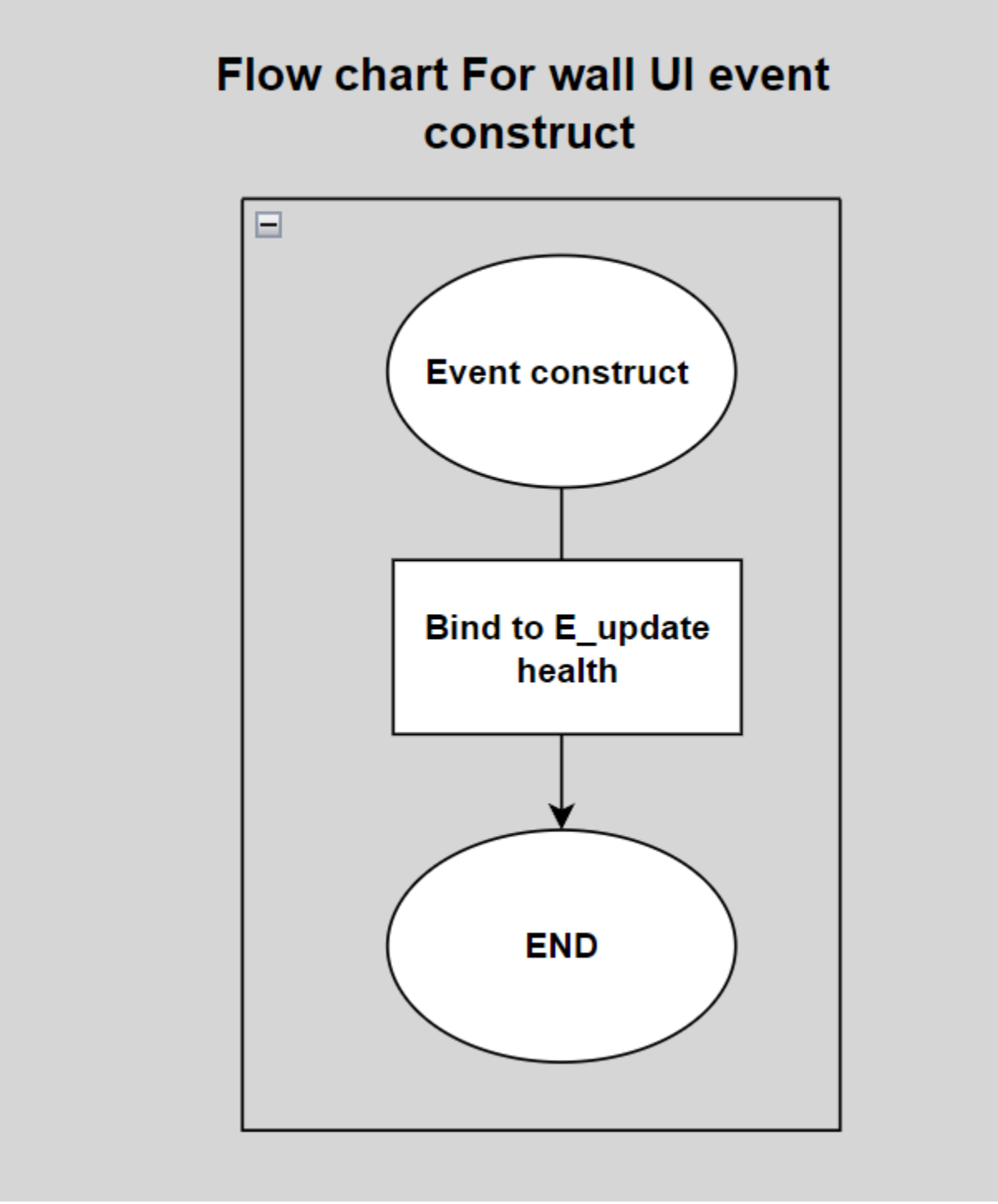
Flowchart showing chaos system for the wall



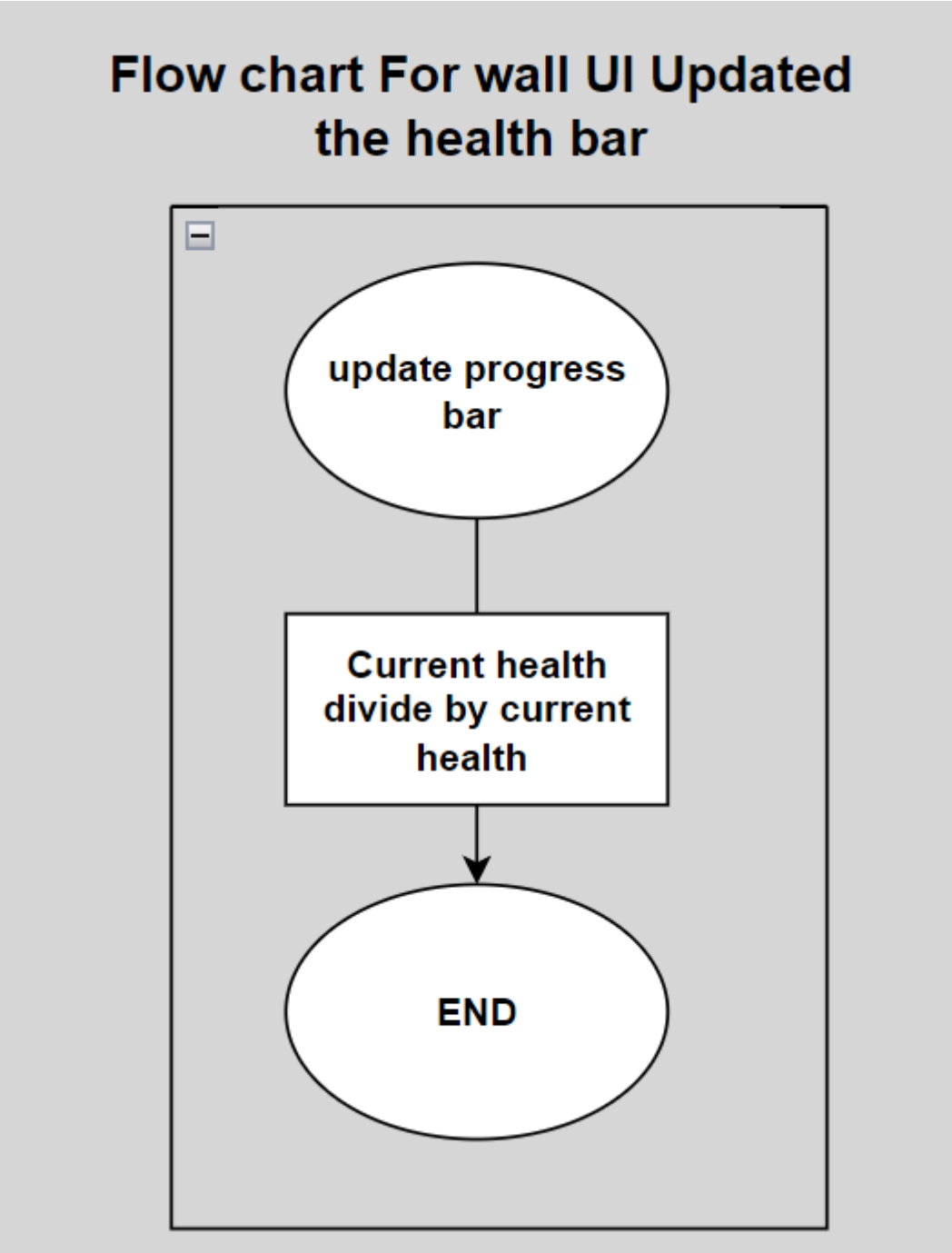
Flowchart showing timer till destroy wall



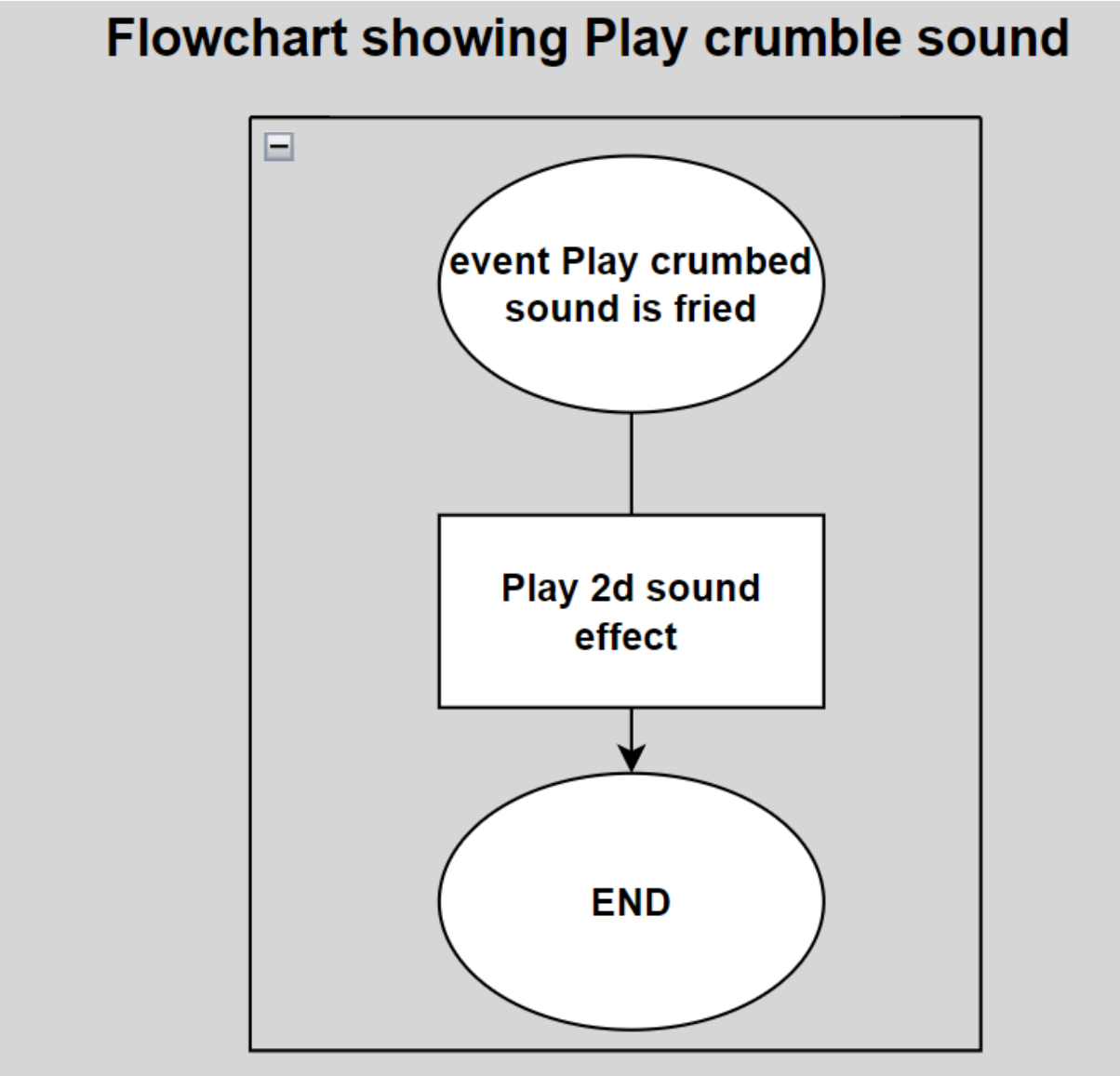
Flowchart showing wall Ui event construct



Flowchart showing health widget on wall updated

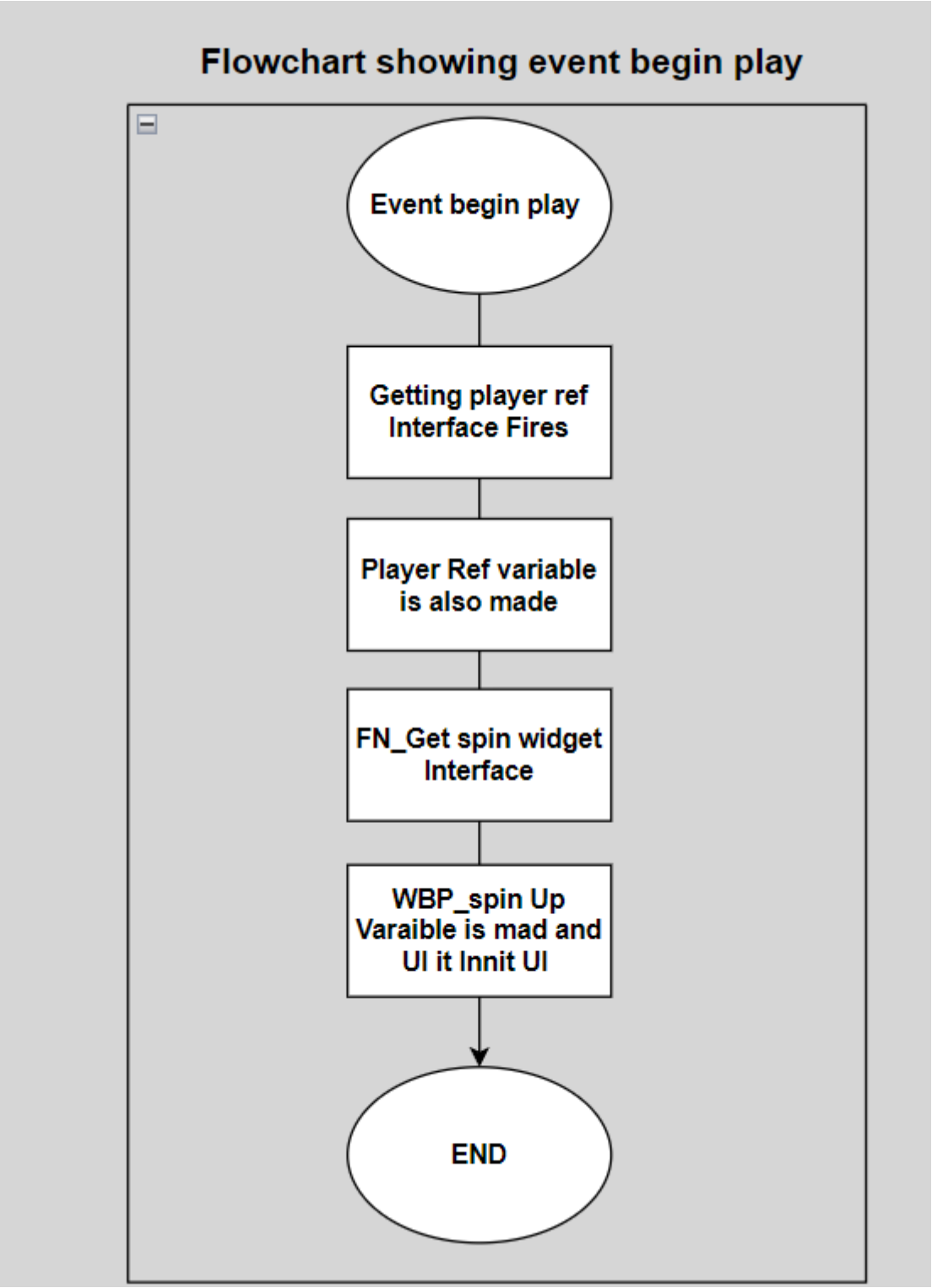


Flowchart showing play crumble sound

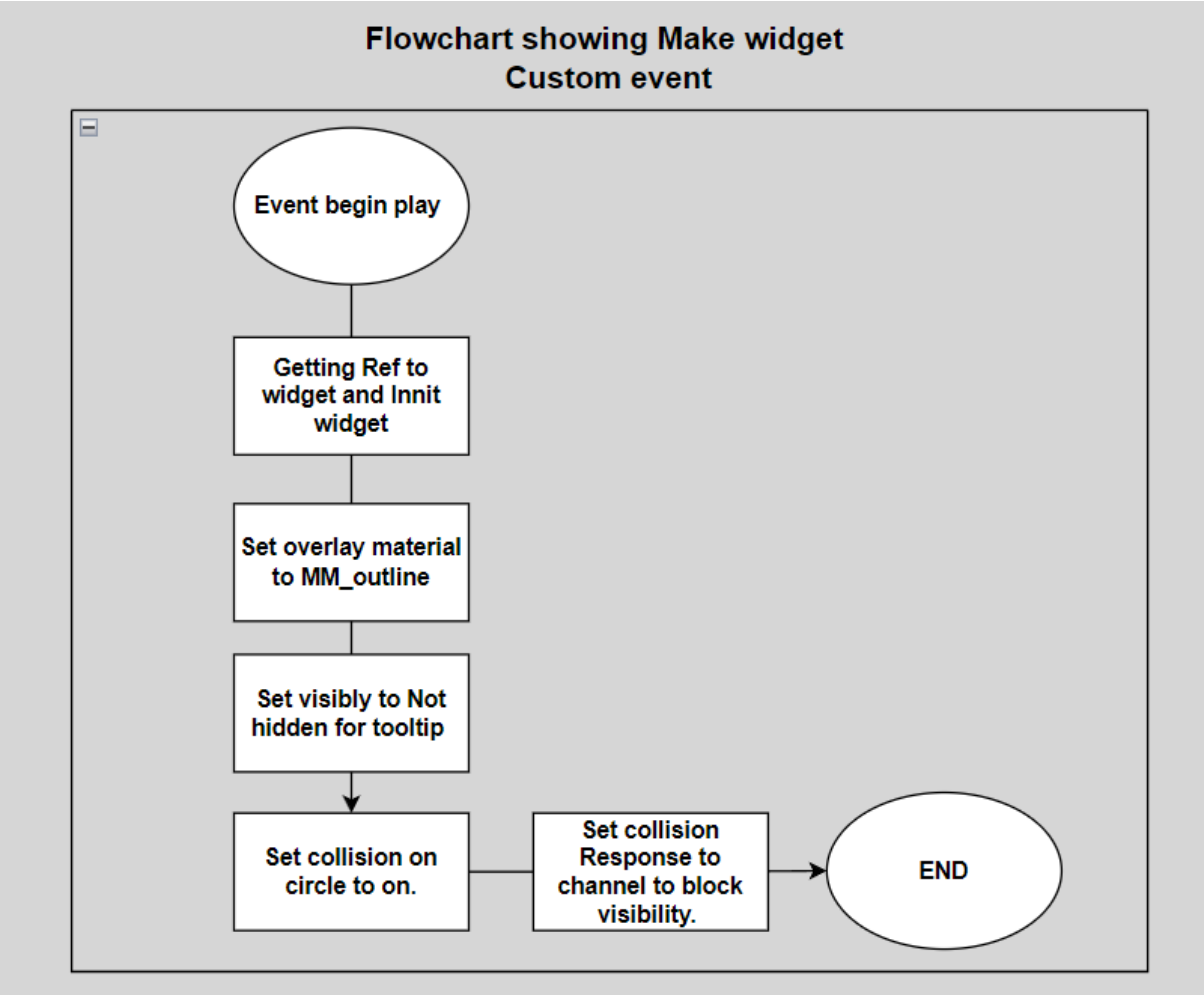


All Flowchart for wheel spin

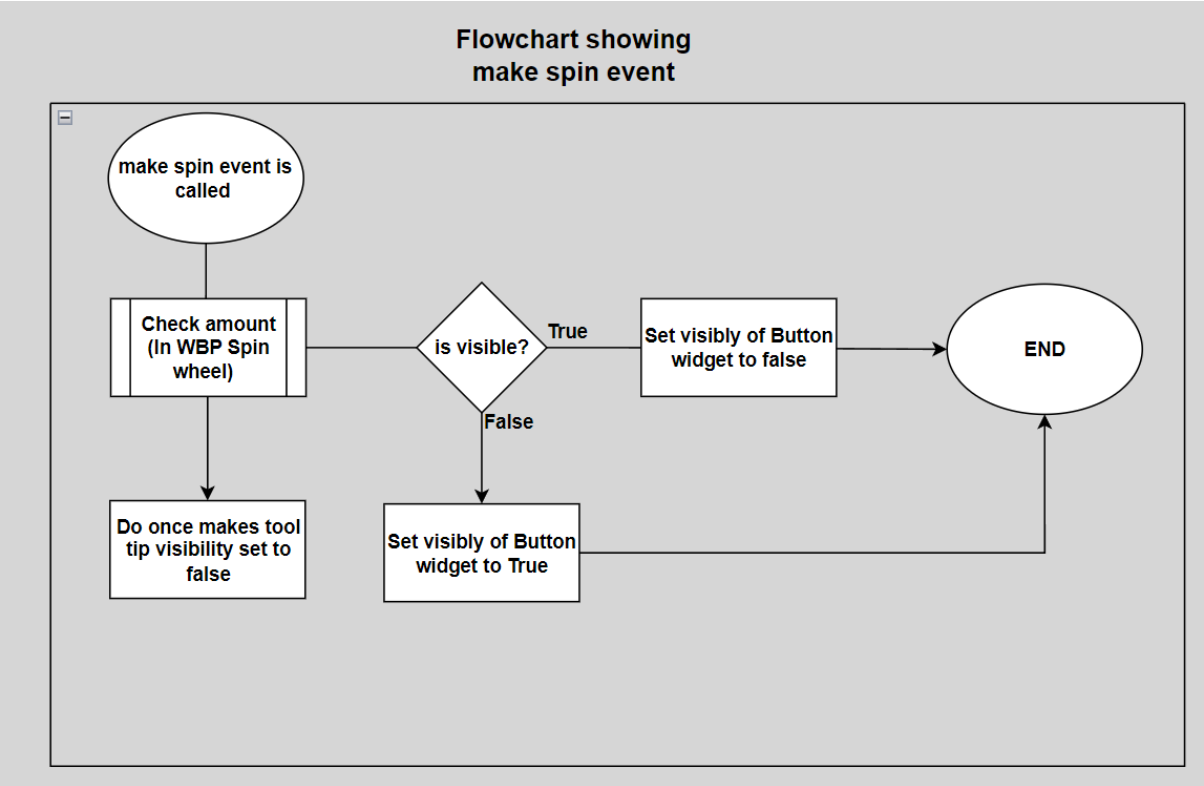
Flowchart showing event begin play



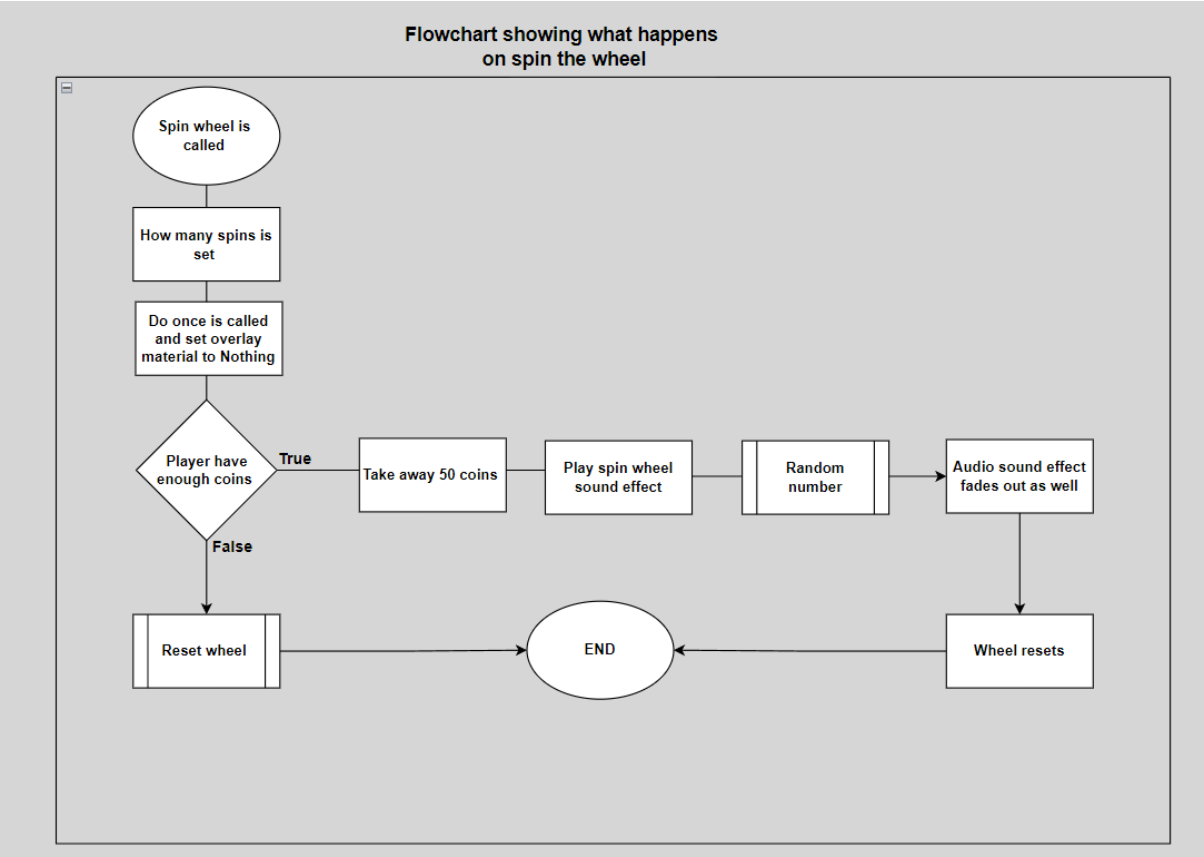
Flowchart showing make widget custom event



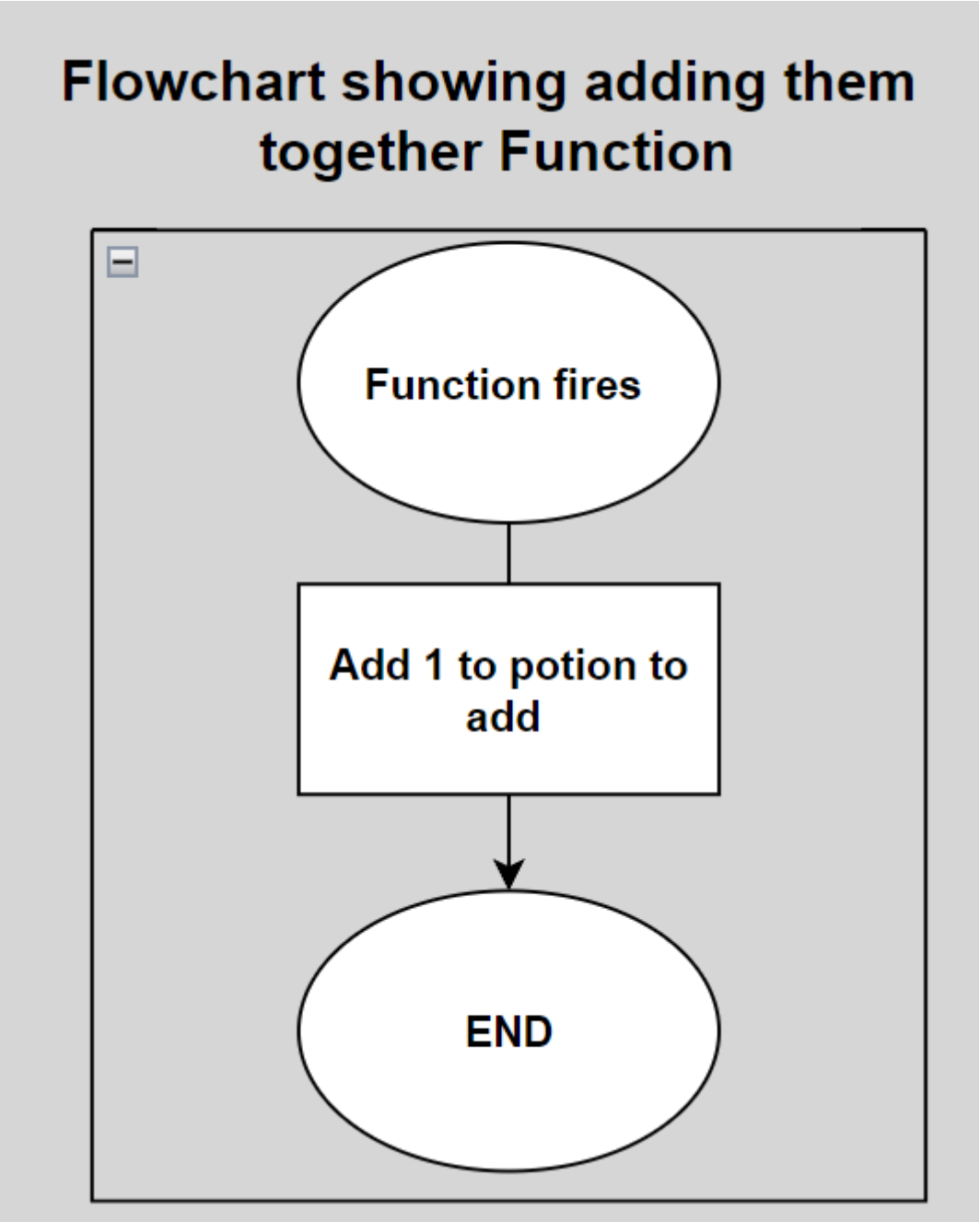
Flowchart showing make wheel spin



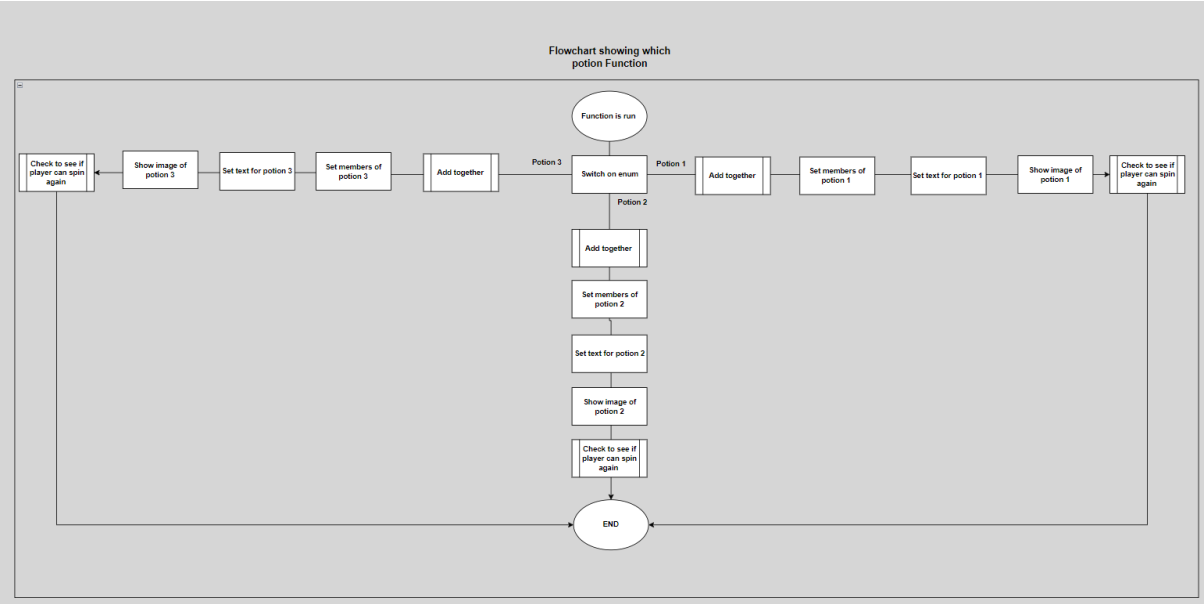
Flowchart showing what happens when spin the wheel



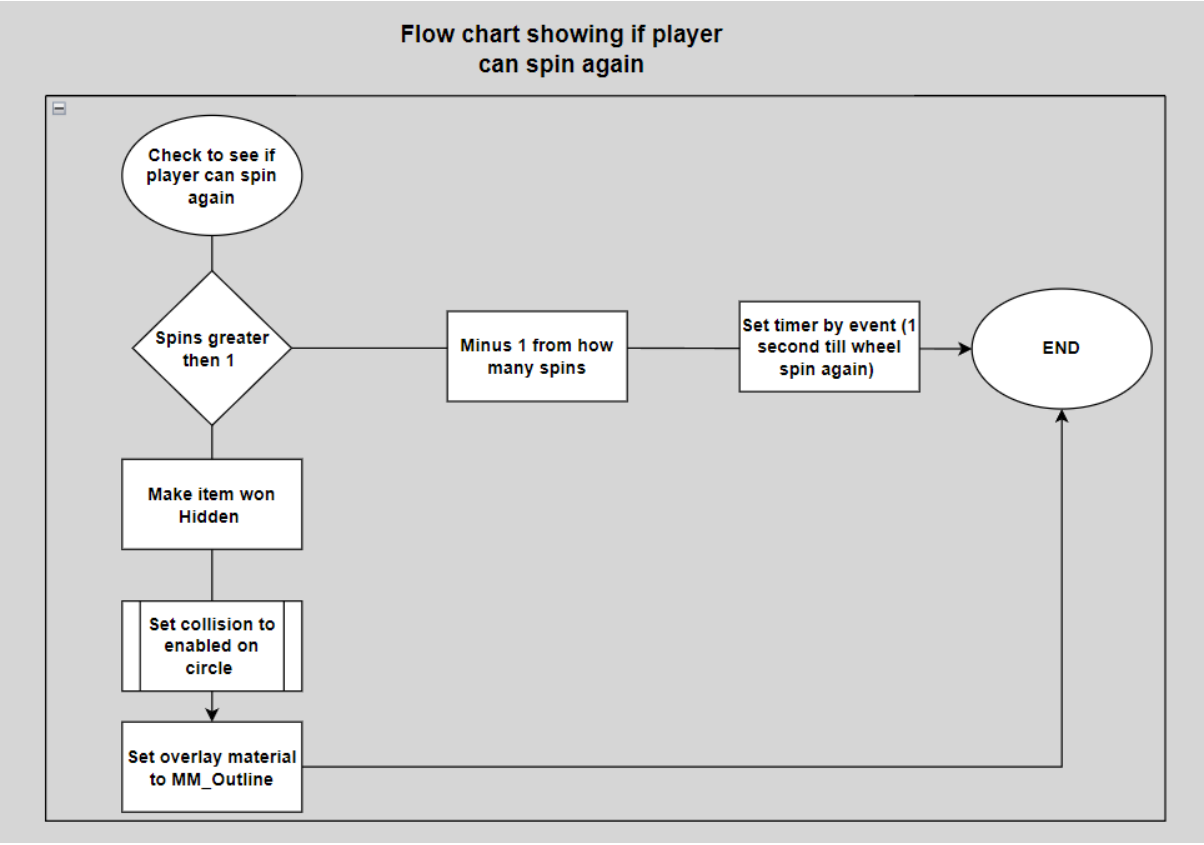
Flowchart showing adding them together in function



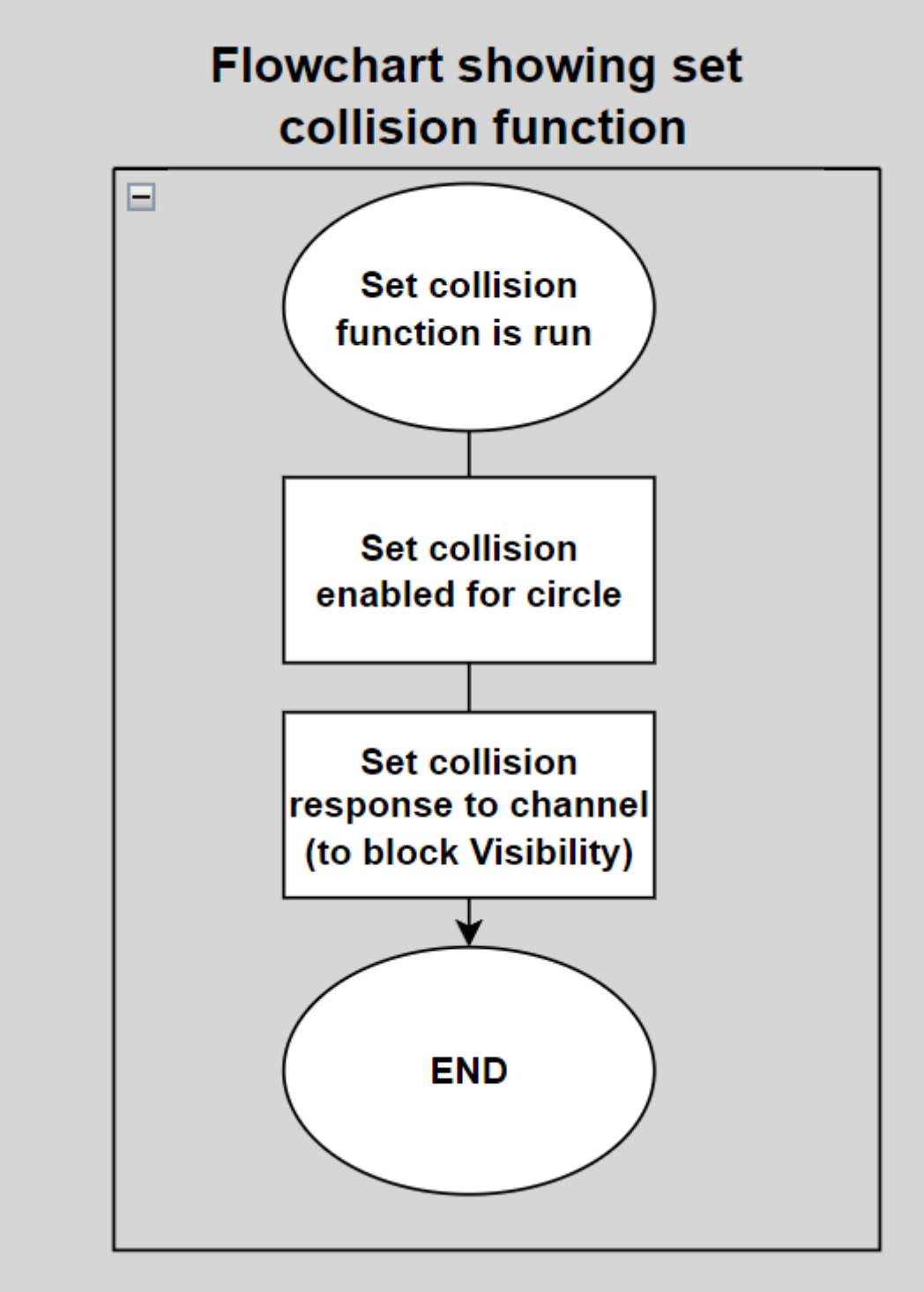
Flowchart showing Which potion to get Function



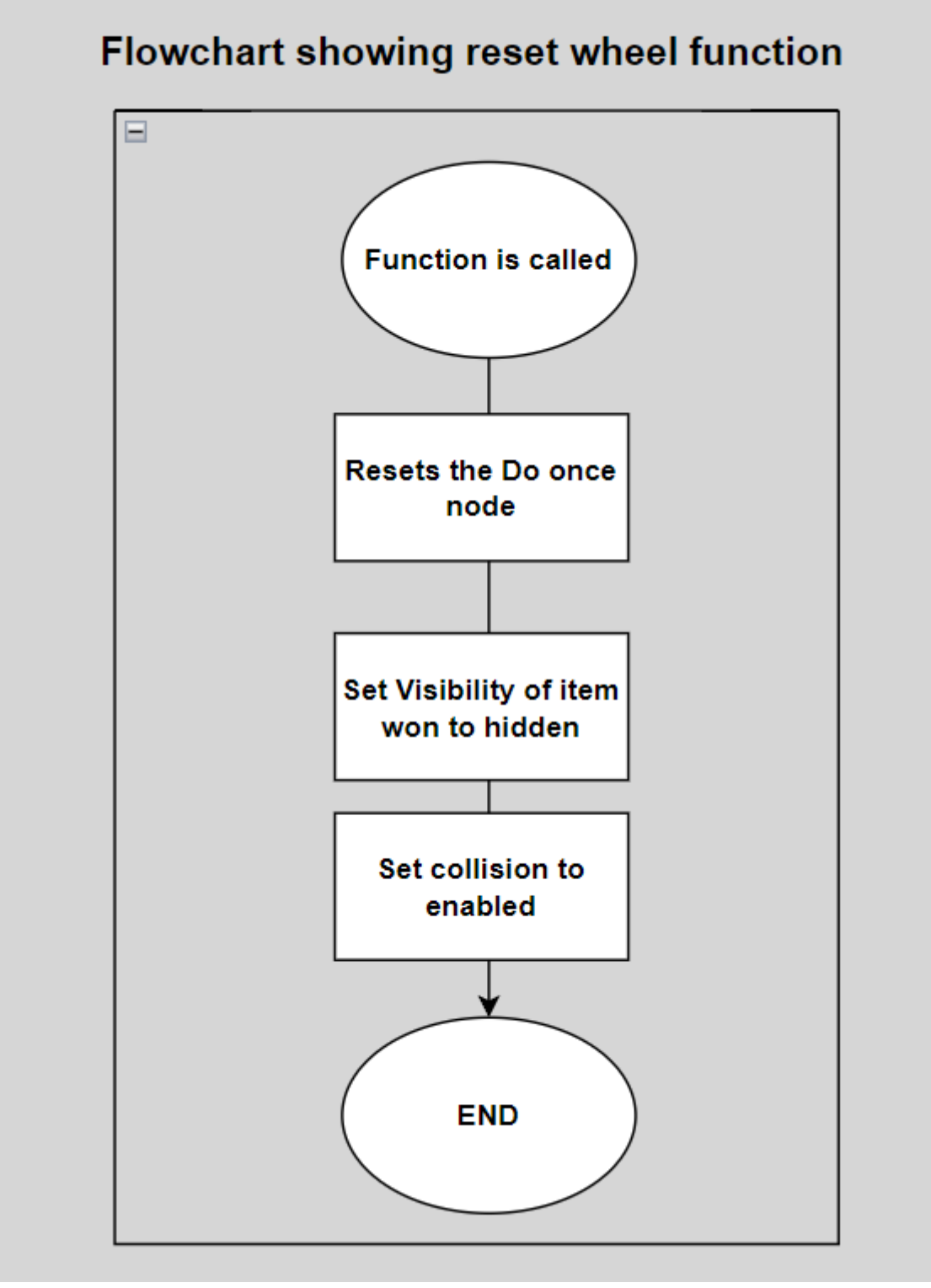
flowchart showing if player can spin again



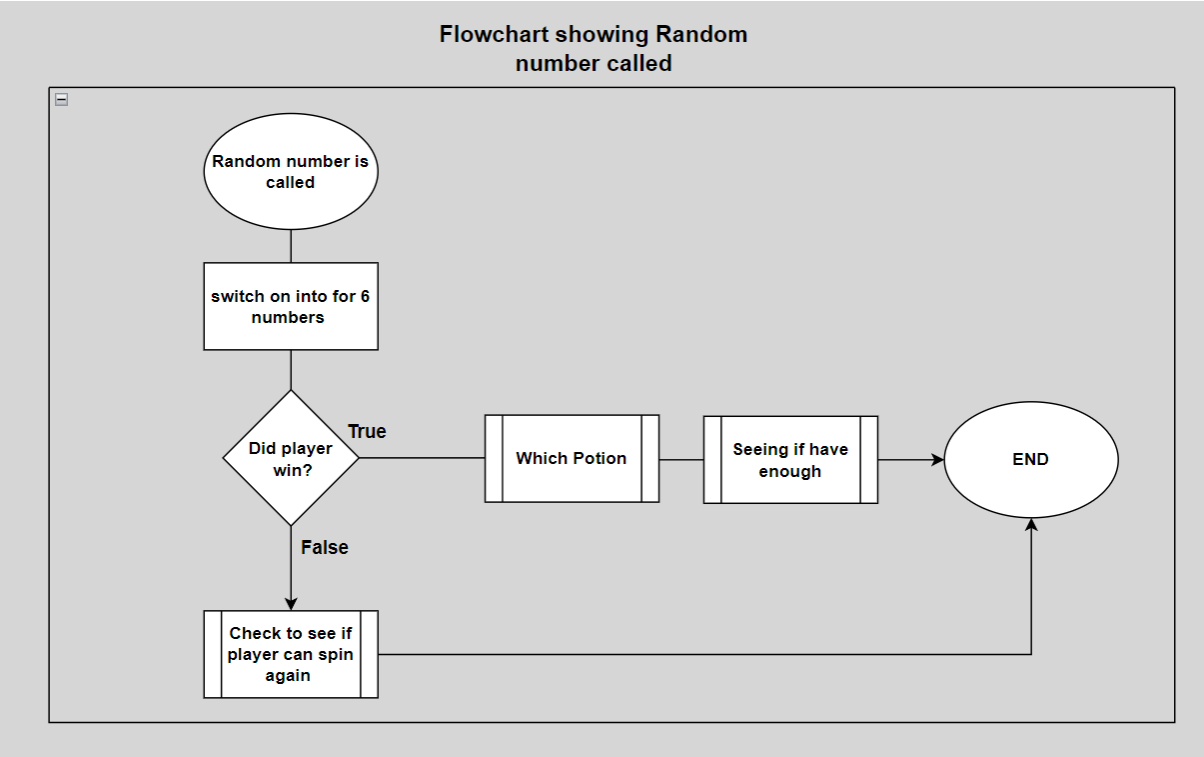
Flowchart showing Collision Function



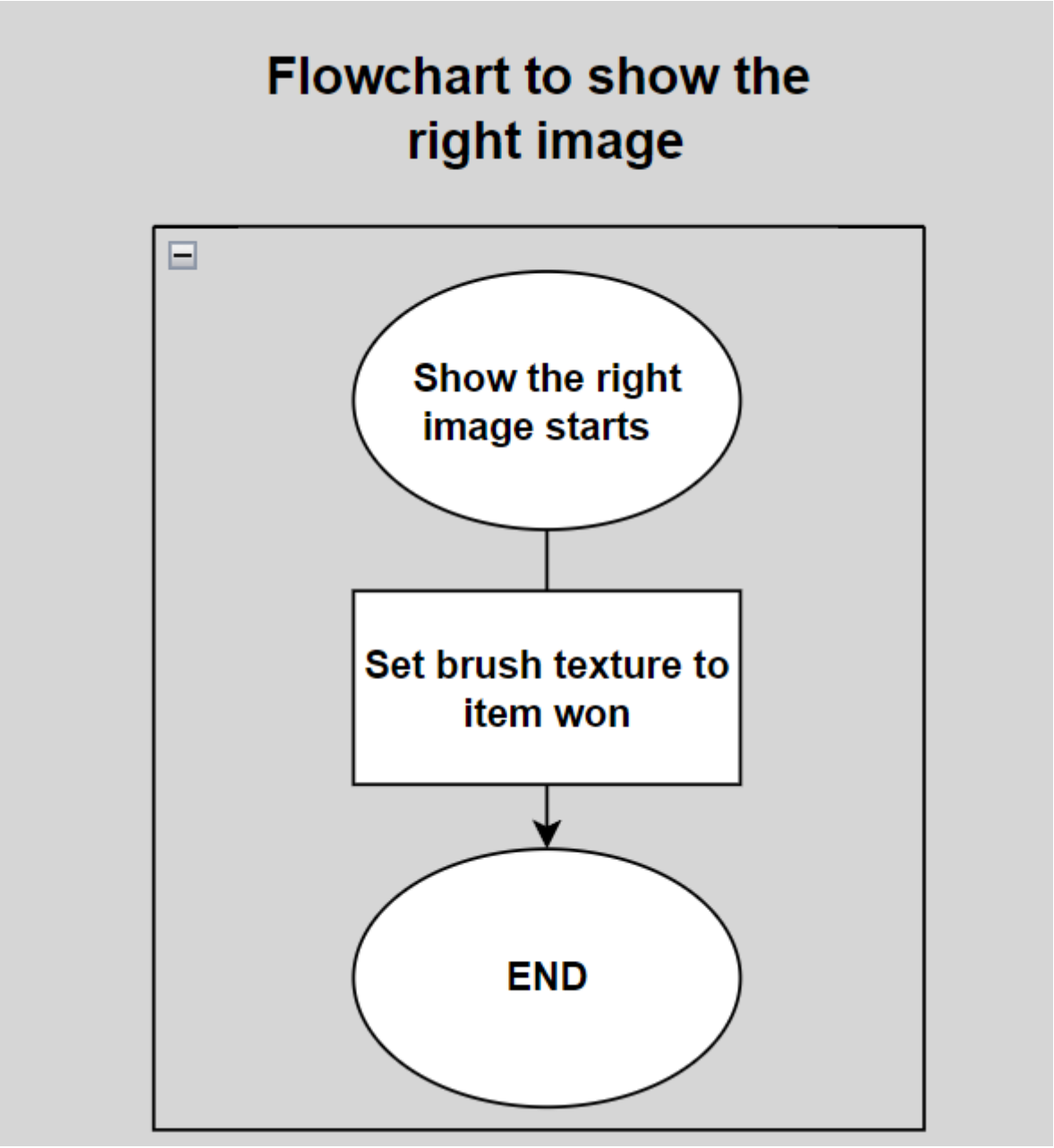
Flowchart showing Reset wheel function



Flowchart showing random number called

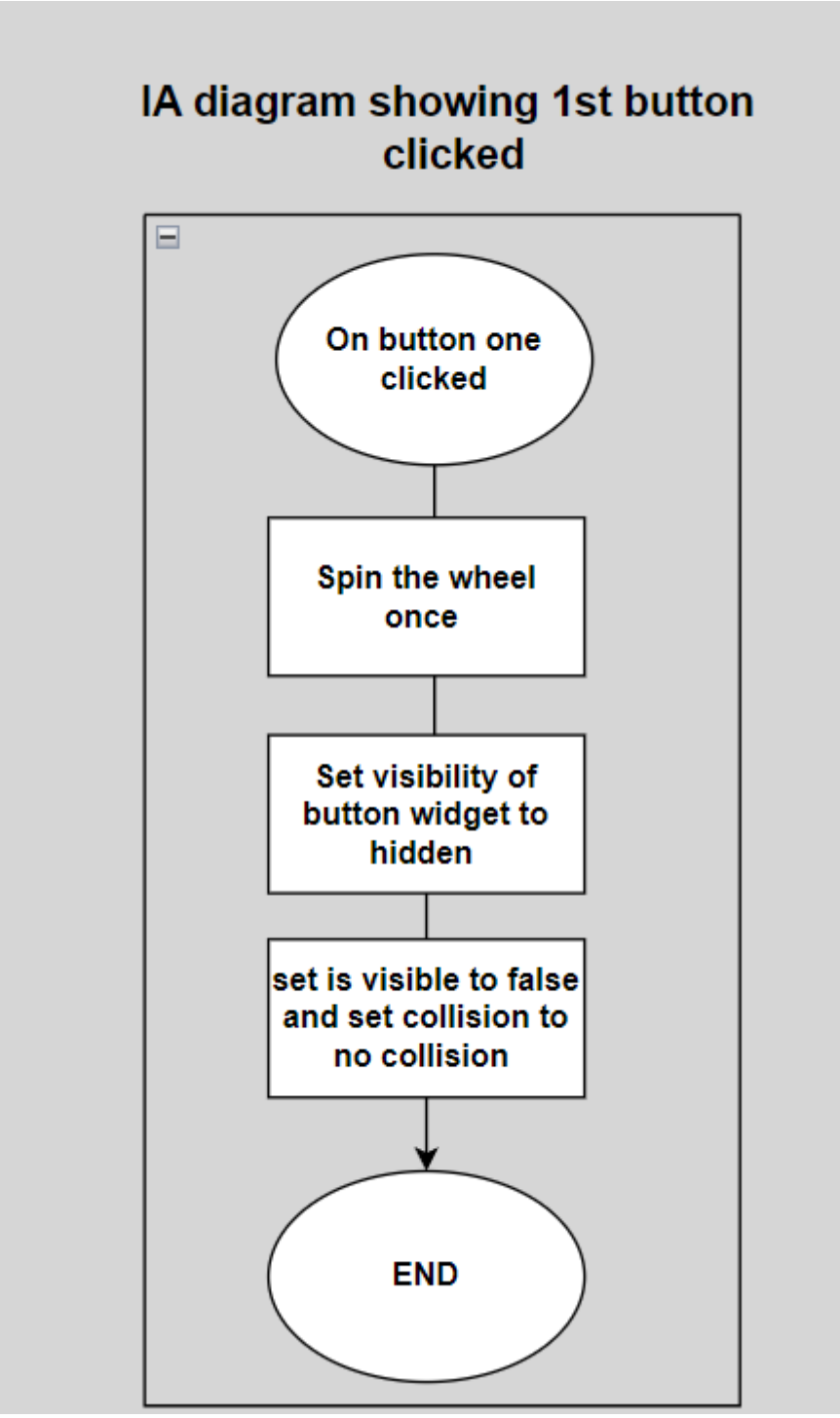


Flowchart showing to show the right image

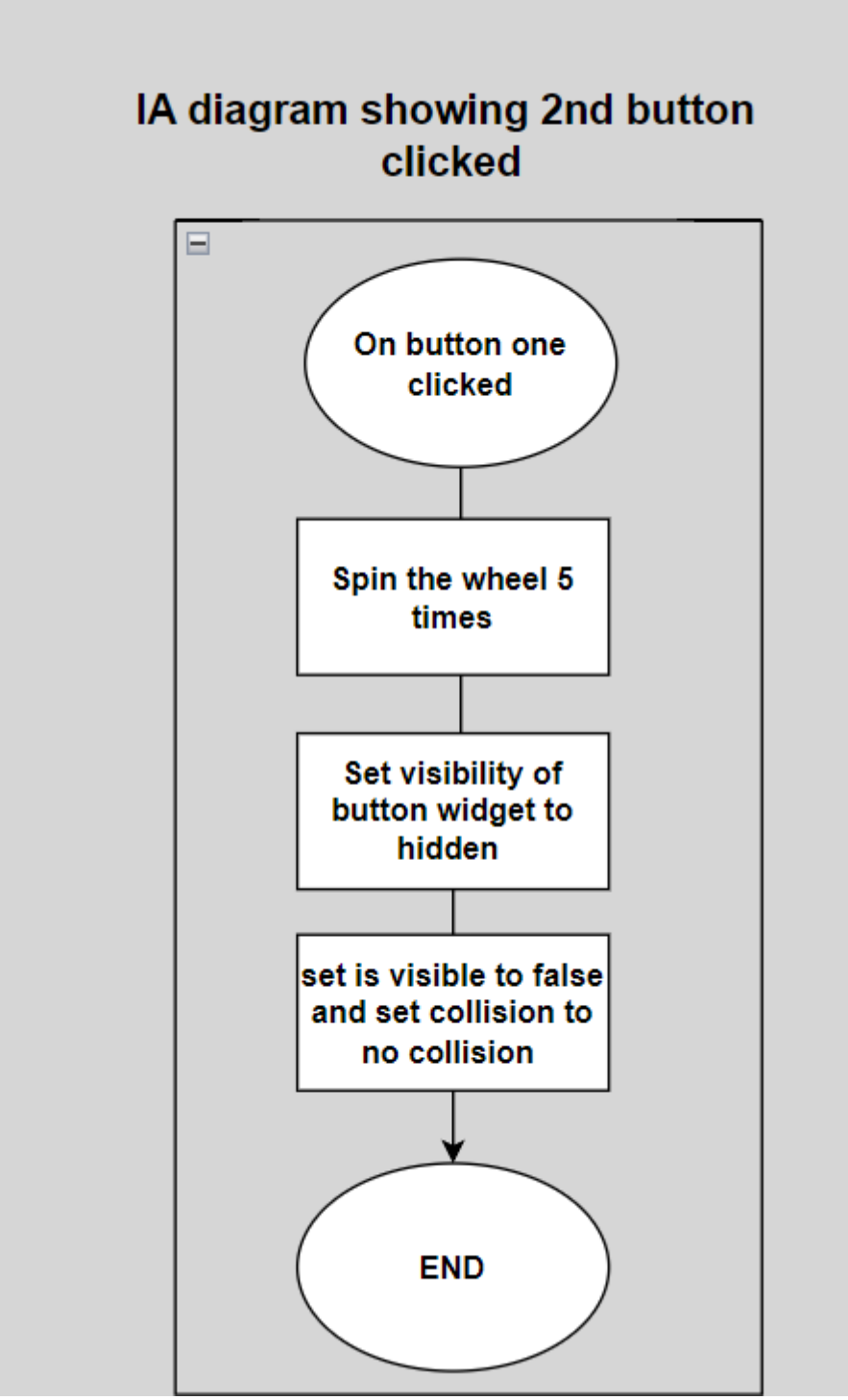


All flowchart and IA diagrams showing wheel spin Ui

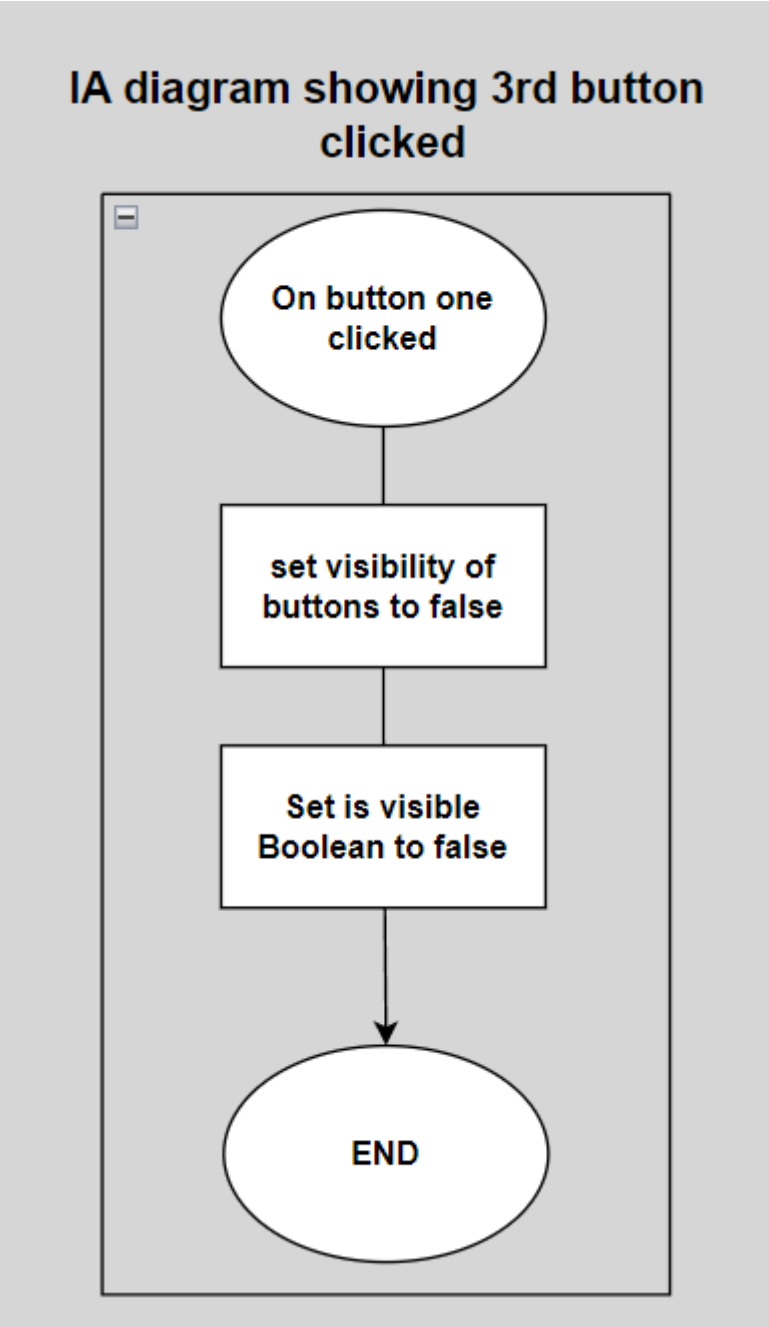
IA Diagram showing 1st button clicked



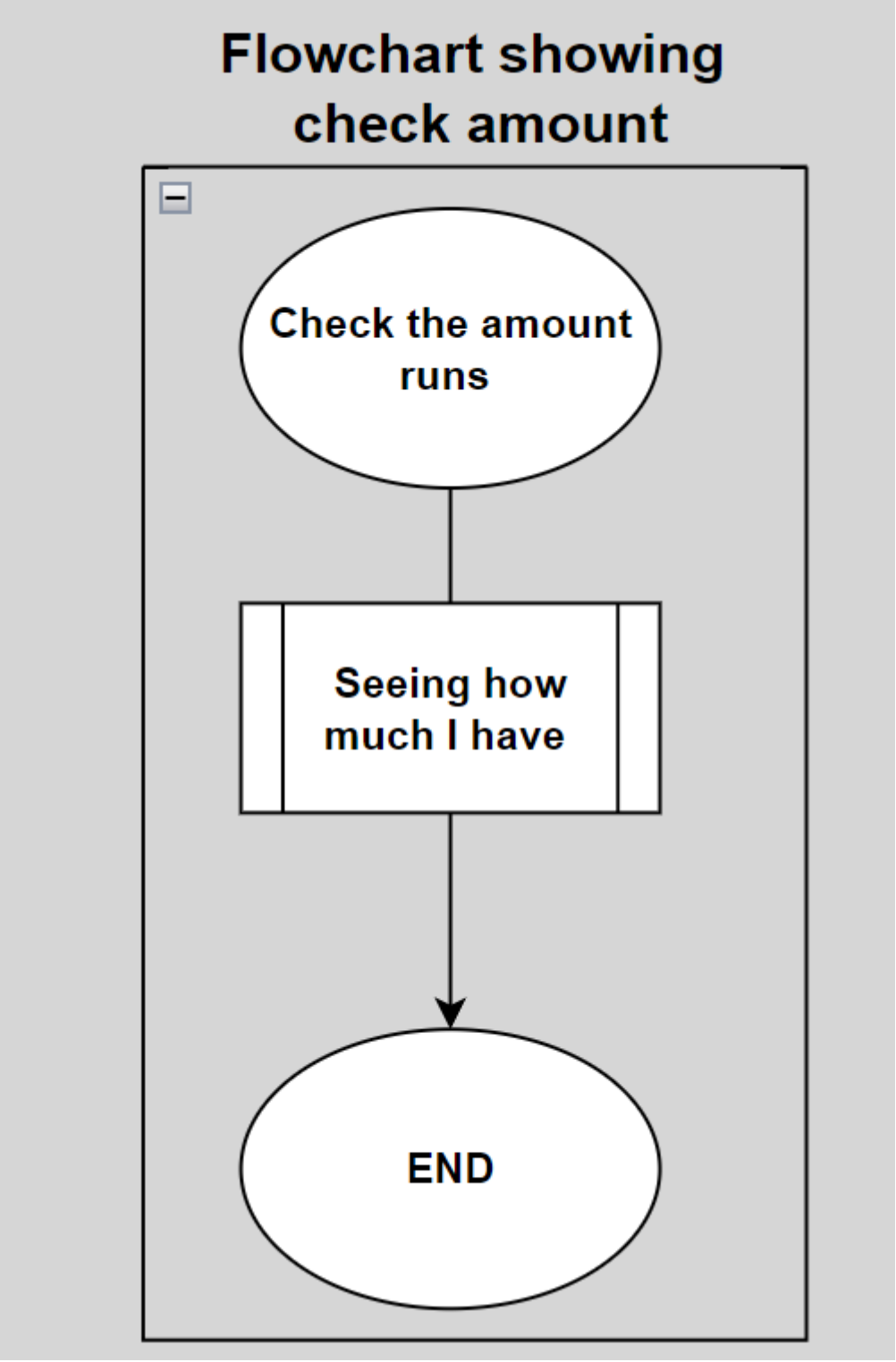
IA diagram showing 2nd button clicked



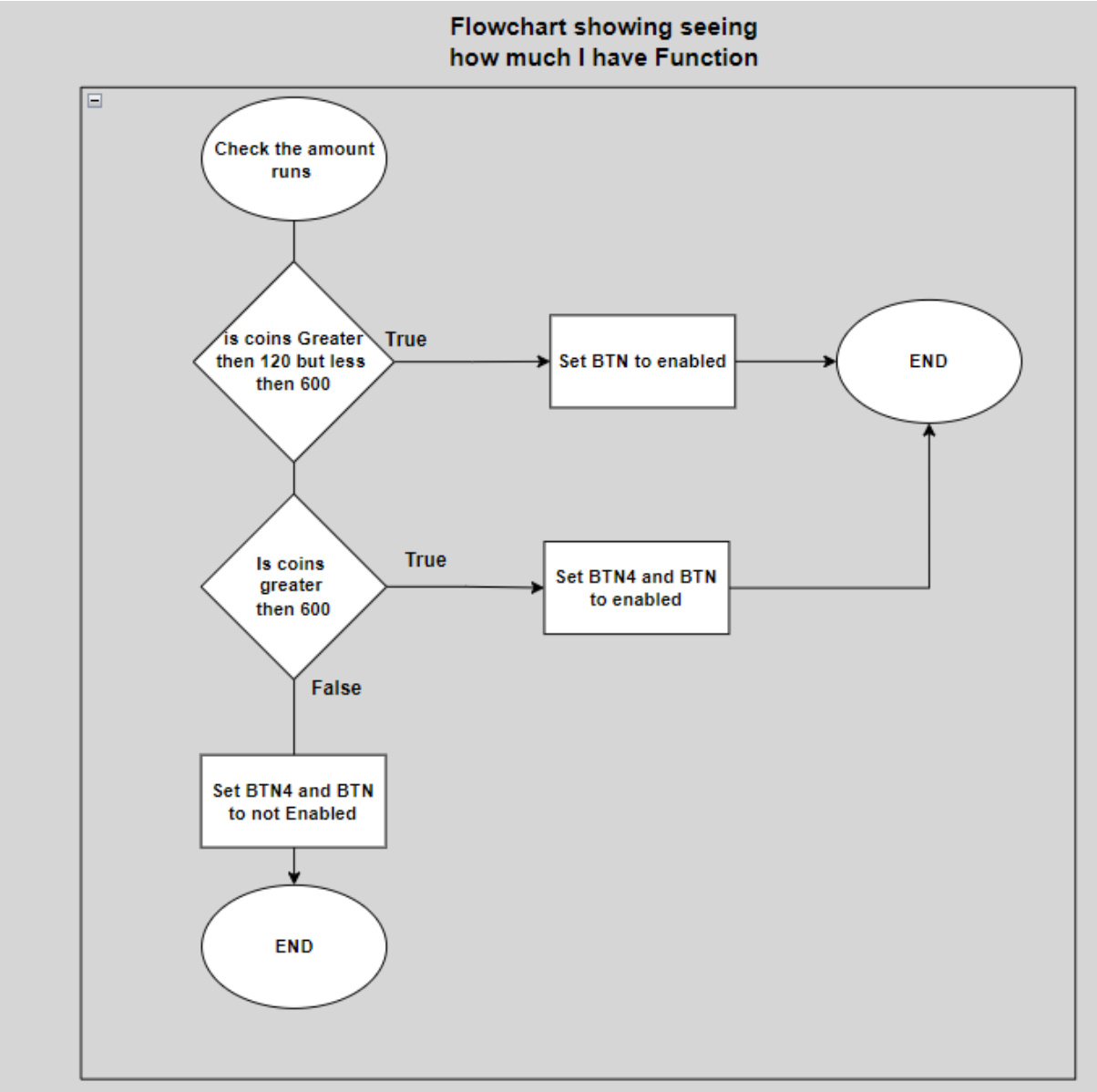
IA Diagram showing 3rd button clicked



Flowchart showing check amount

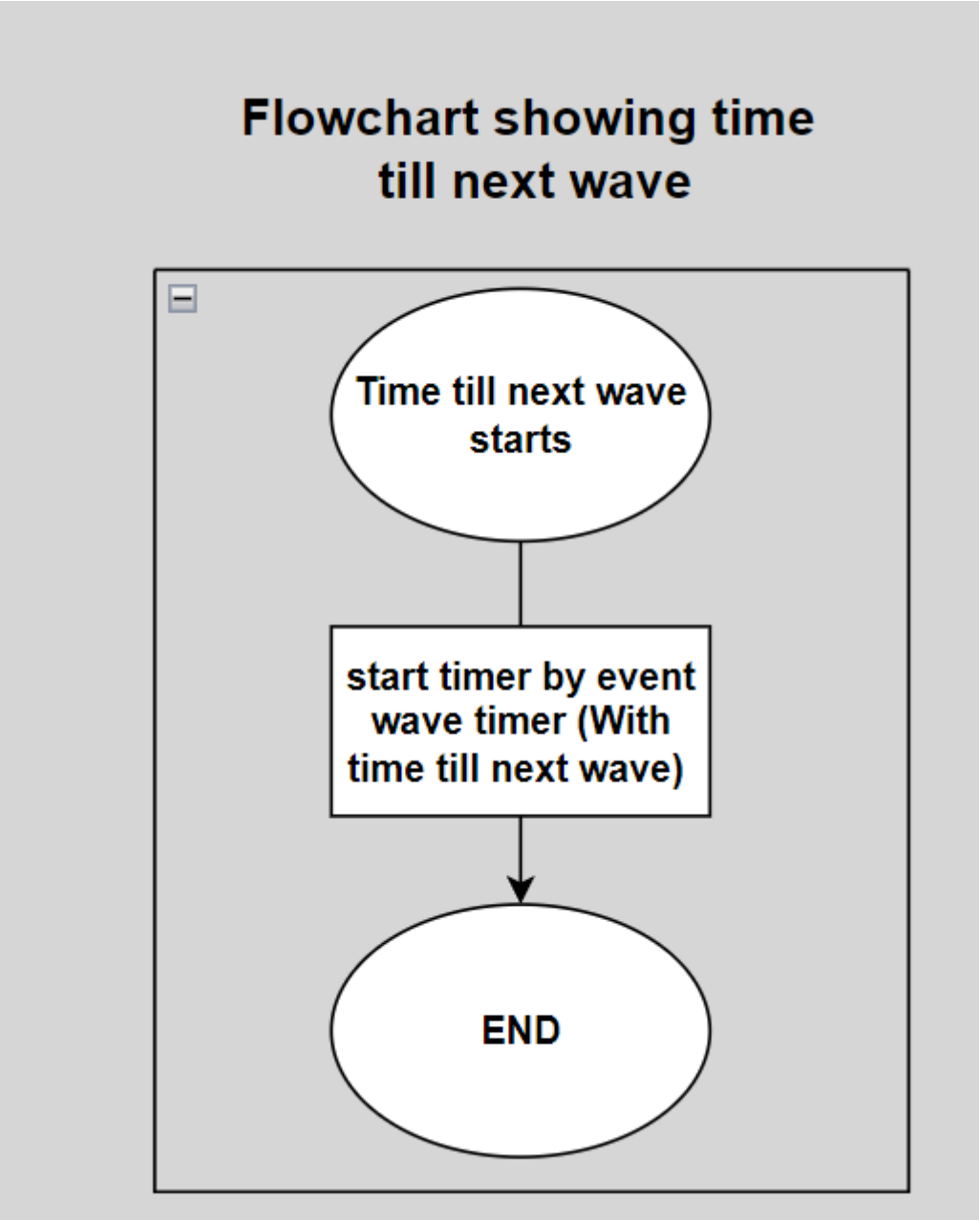


Flowchart showing how much I have function

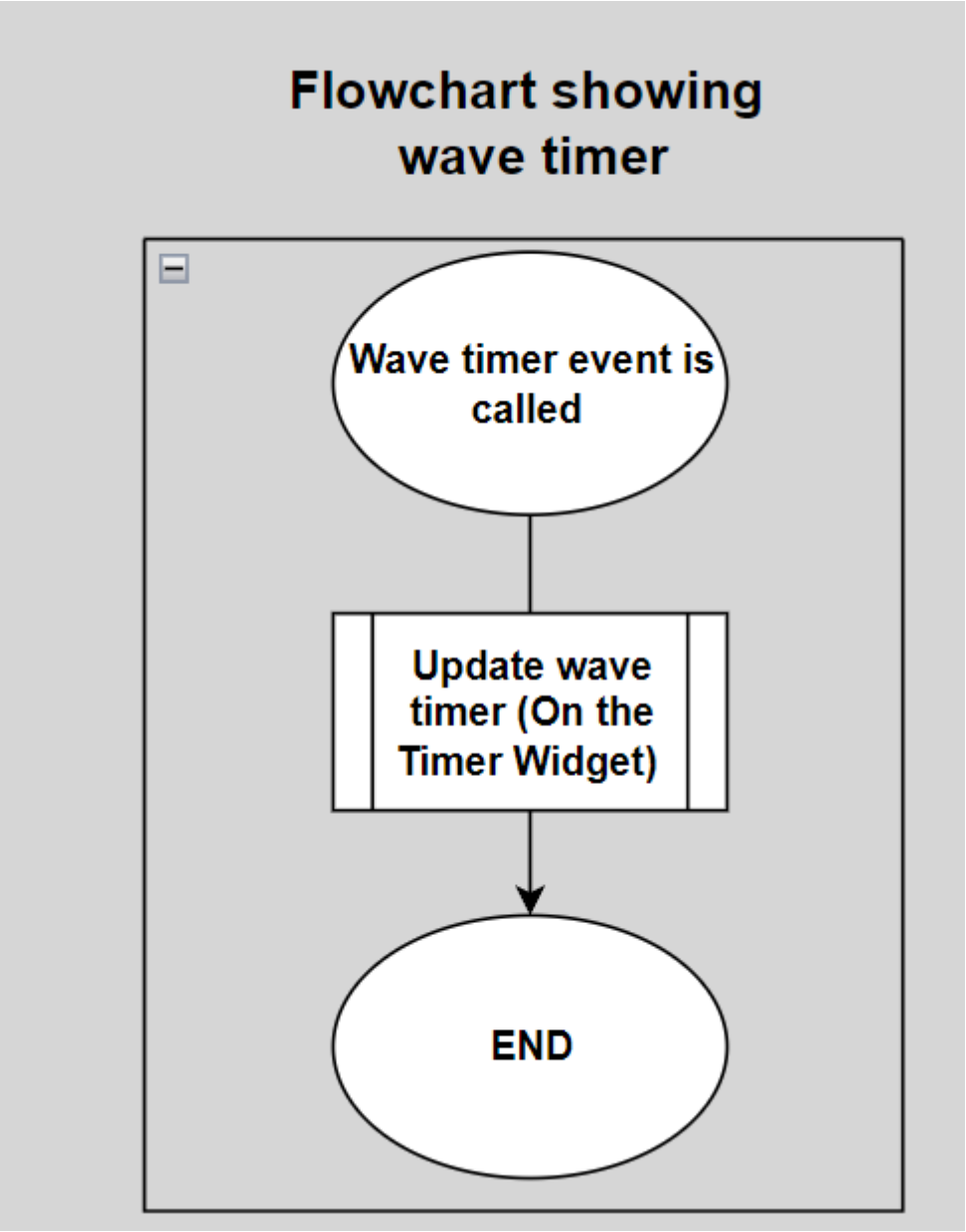


All flowcharts for the wave manger code

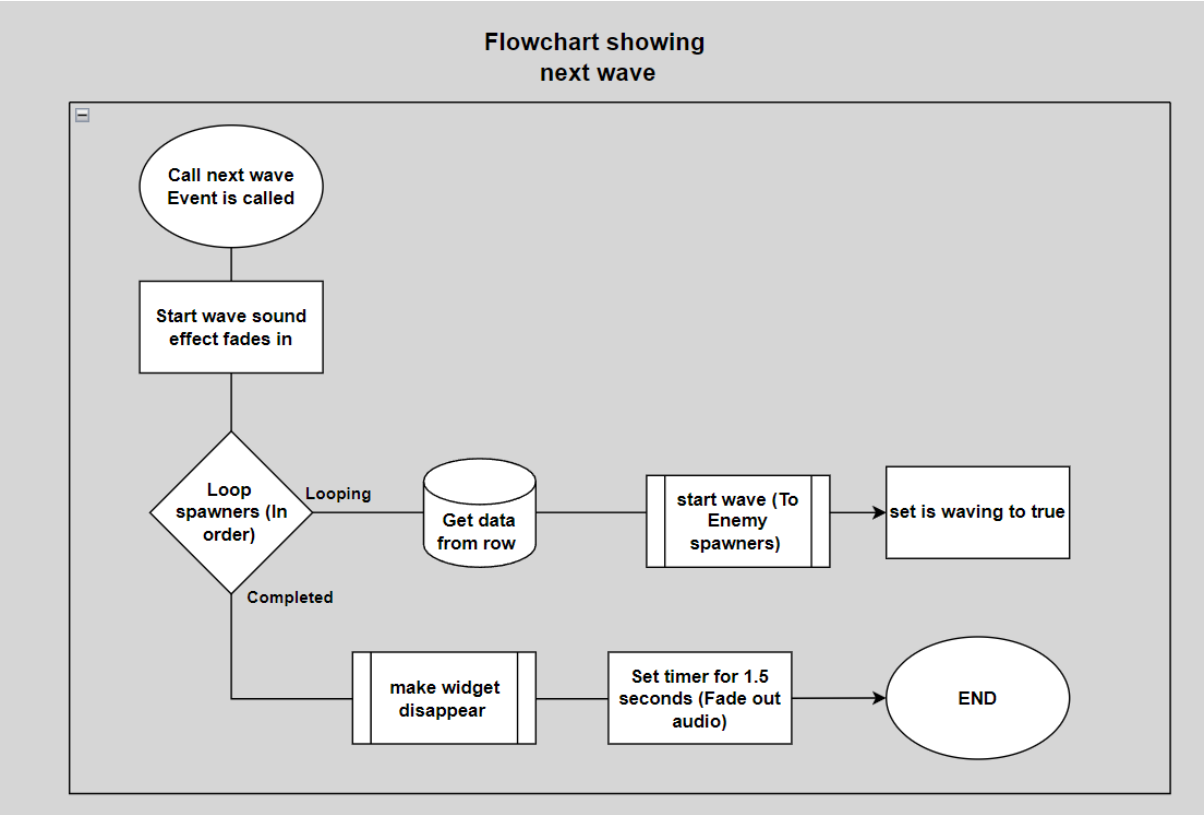
Flowchart showing time till next wave



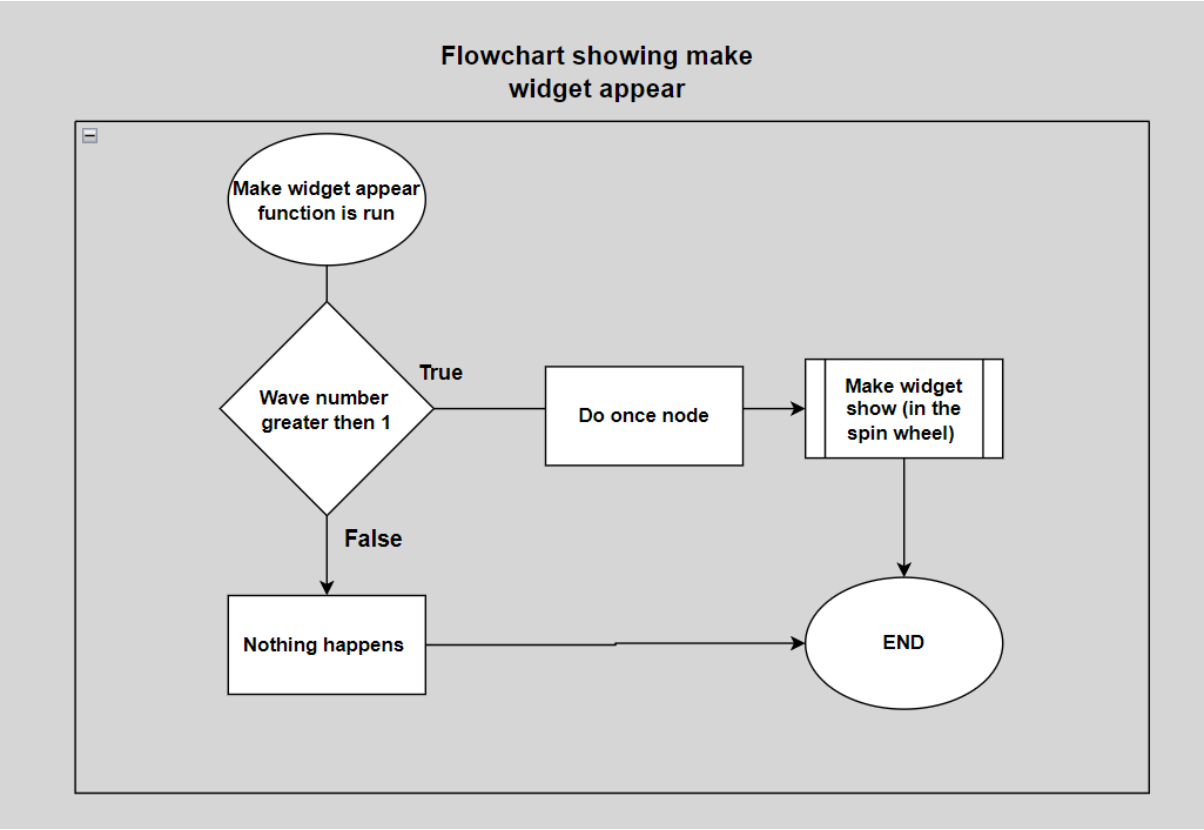
Flowchart showing wave timer



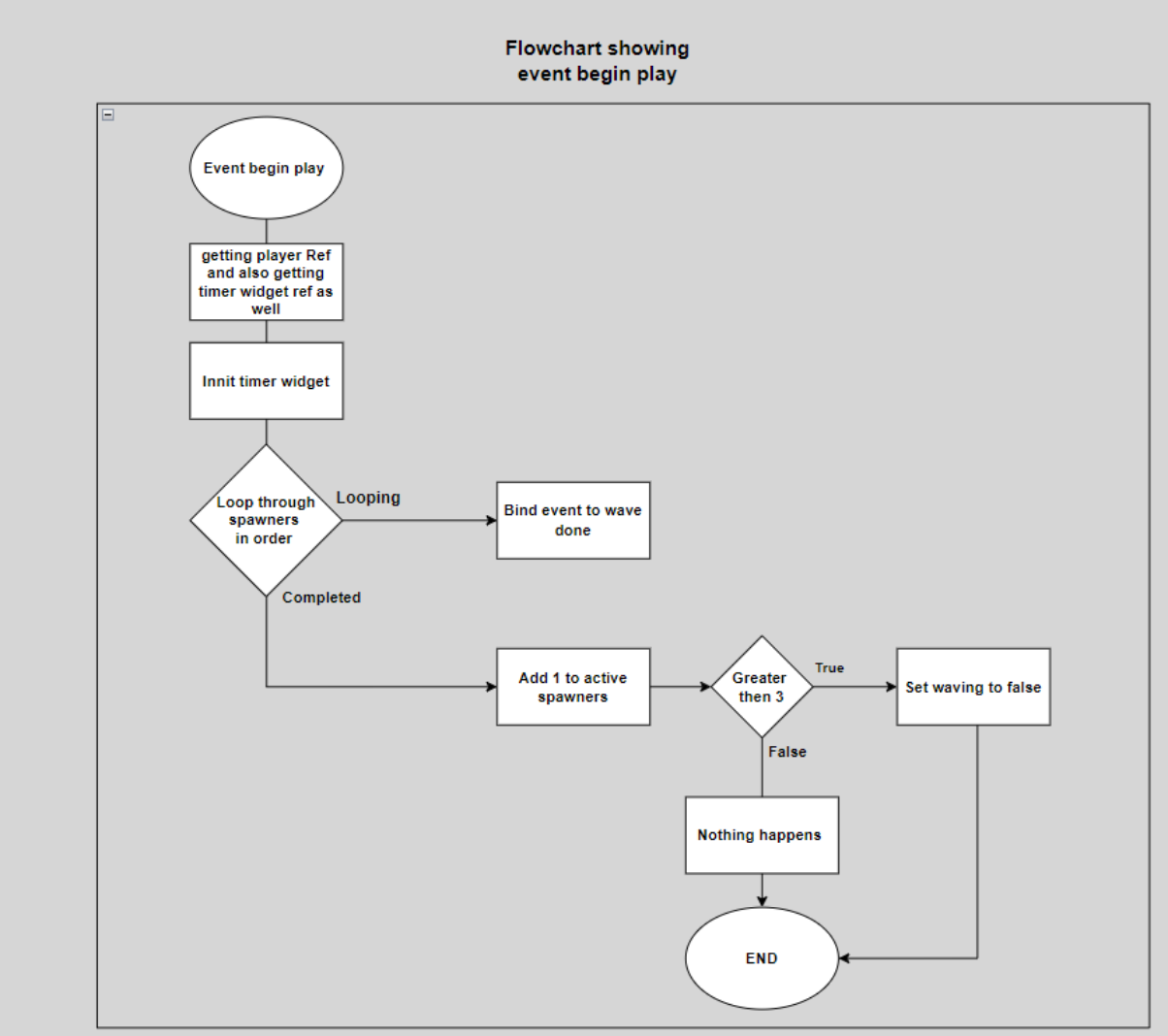
Flowchart showing next wave



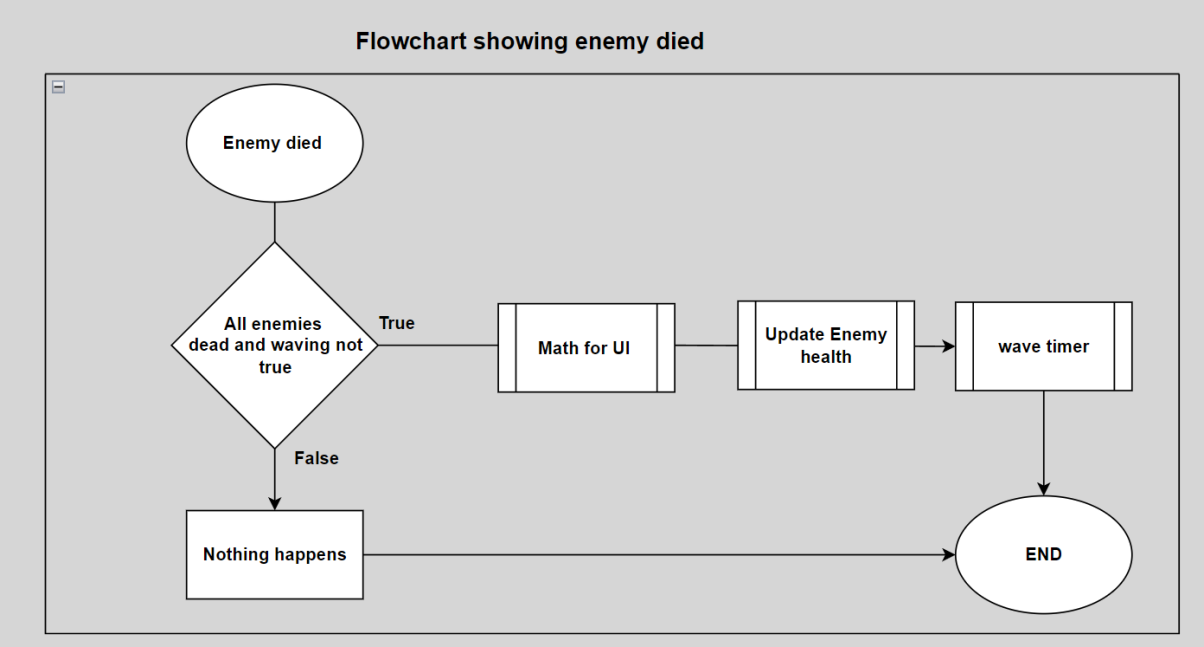
Flowchart showing make widget appear



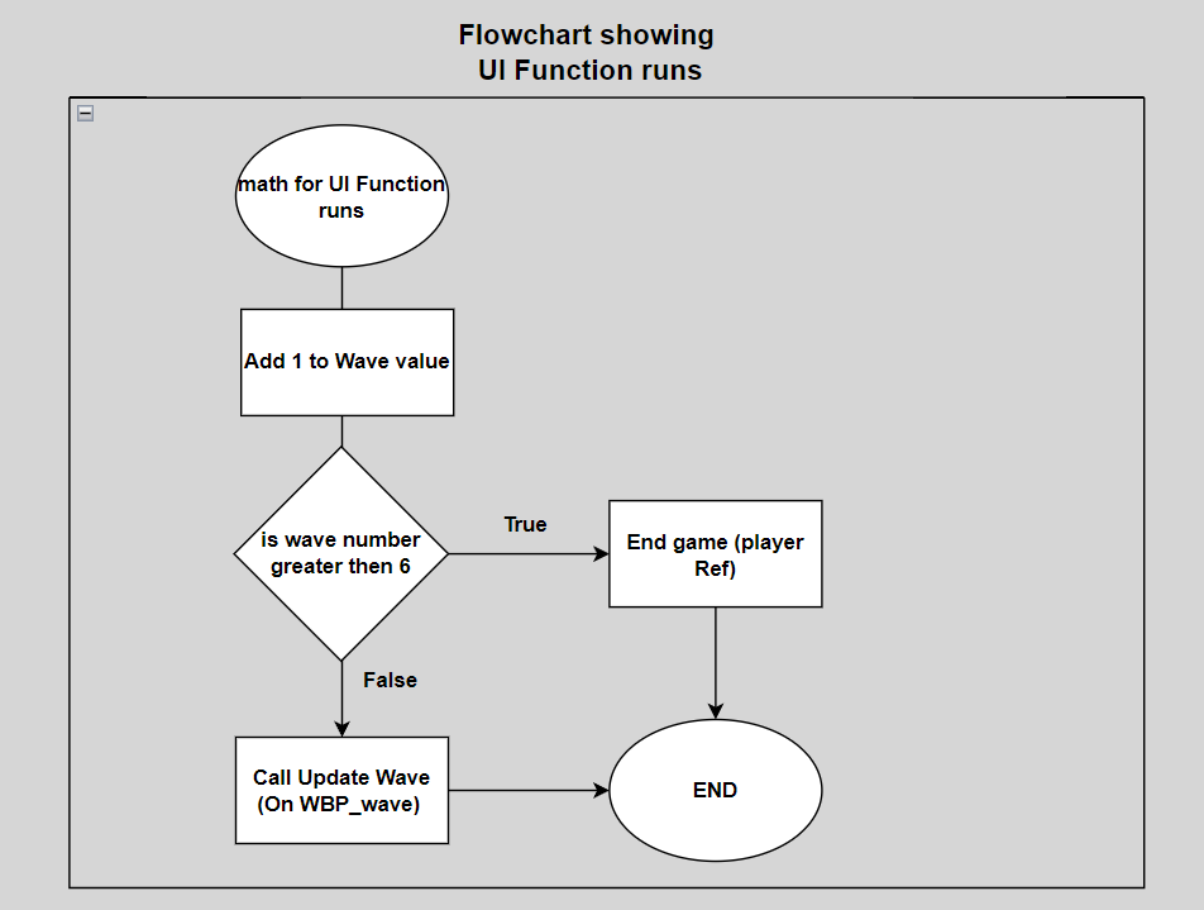
Flowchart showing event begin play



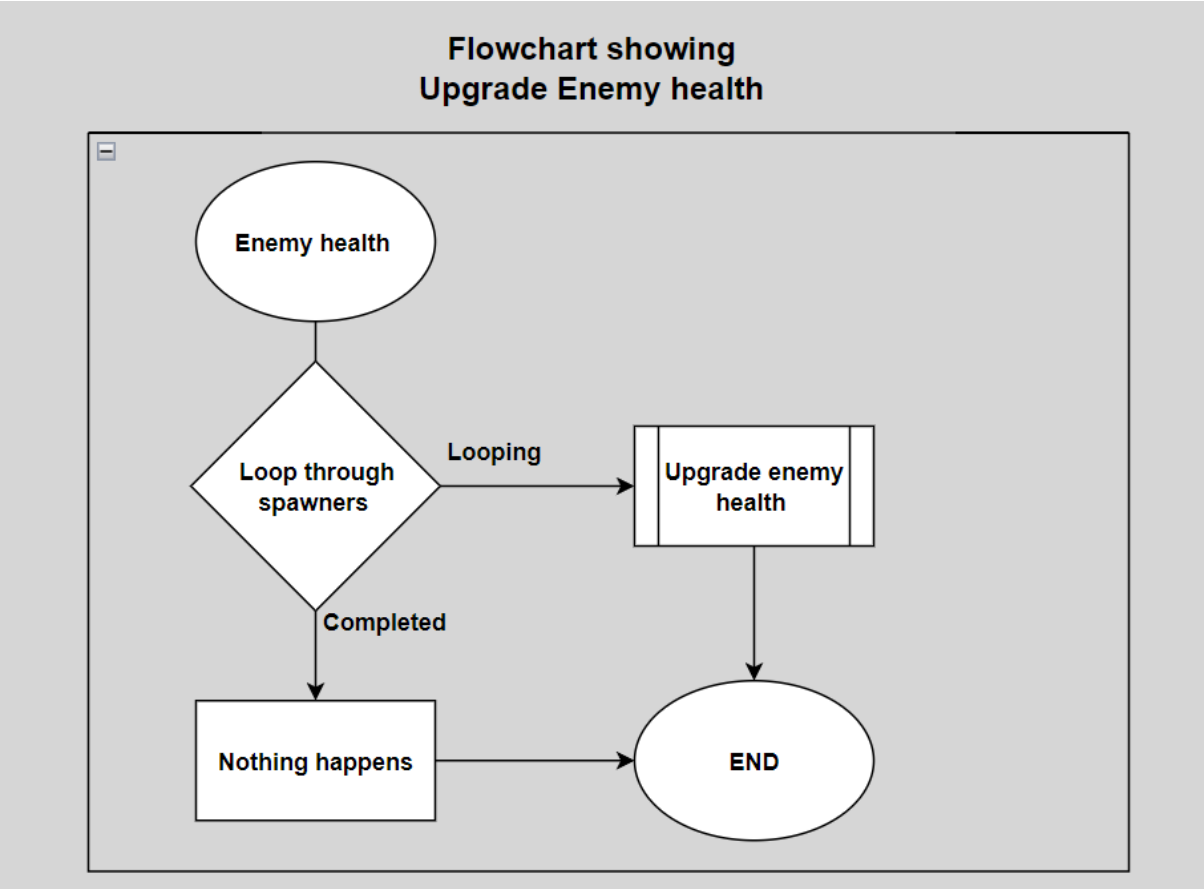
flowchart showing enemy died



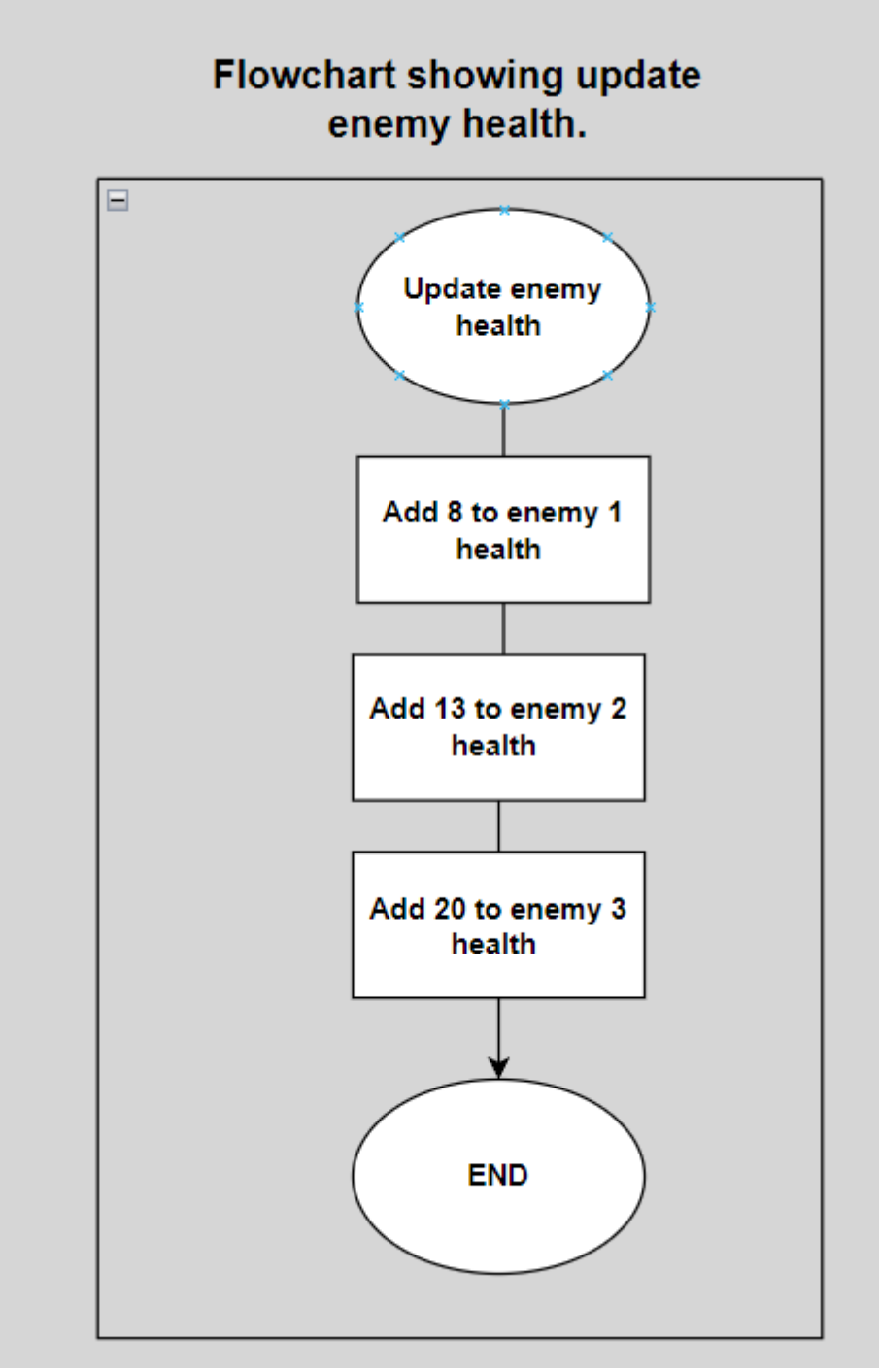
flowchart showing Ui Function runs



Flowchart showing Upgrade enemy health over waves

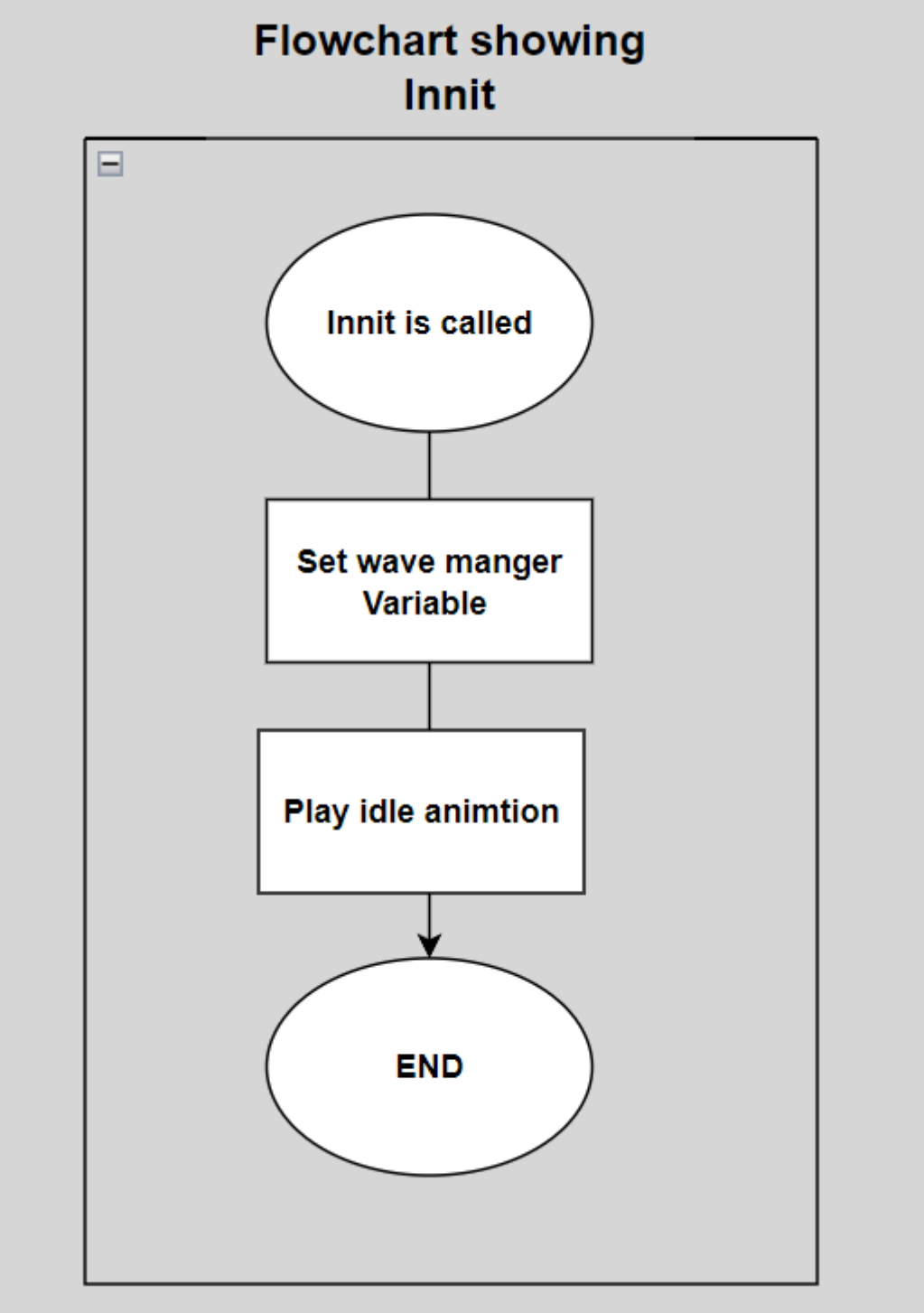


flowchart showing Upgrade enemy health function

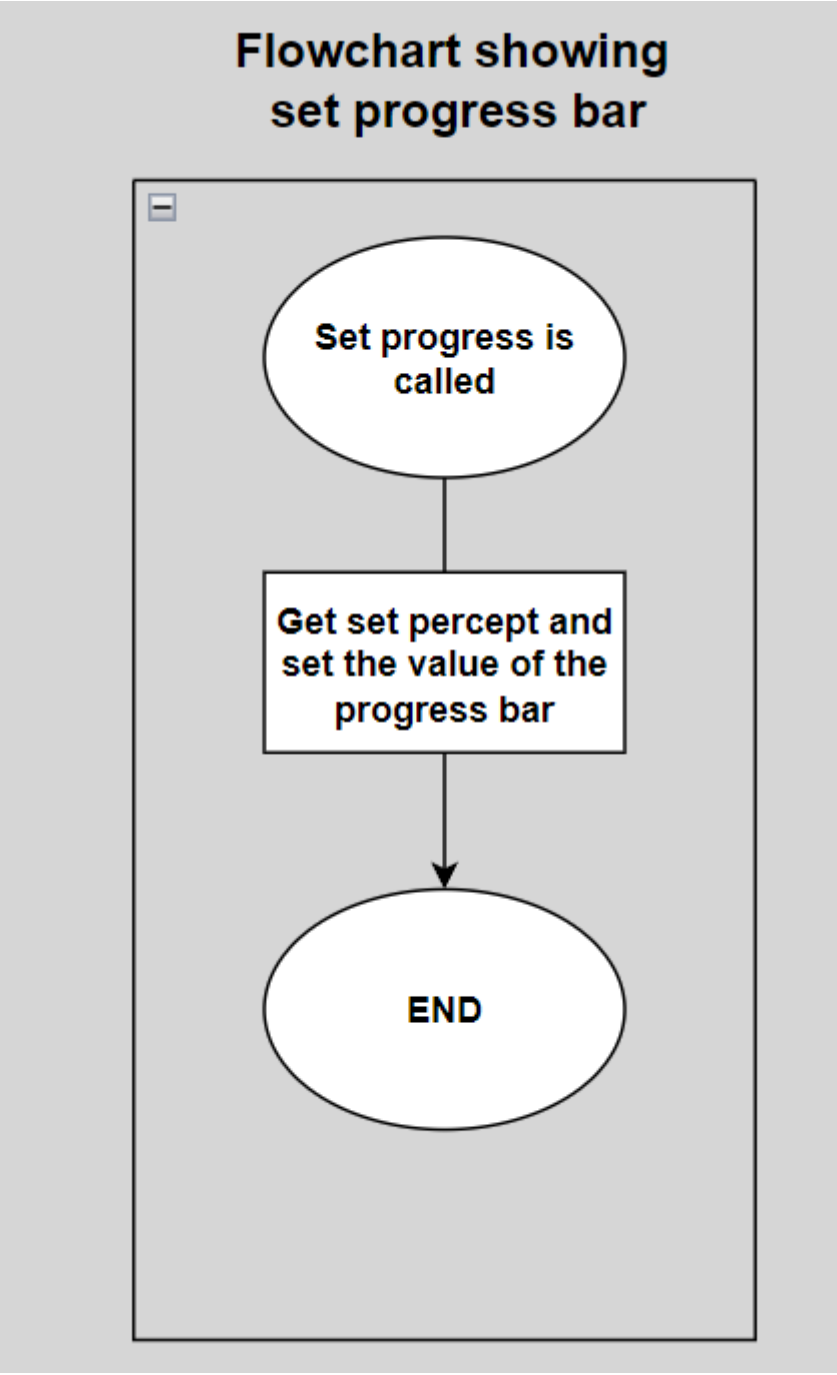


All Flowchart and IA diagrams for wave manger UI

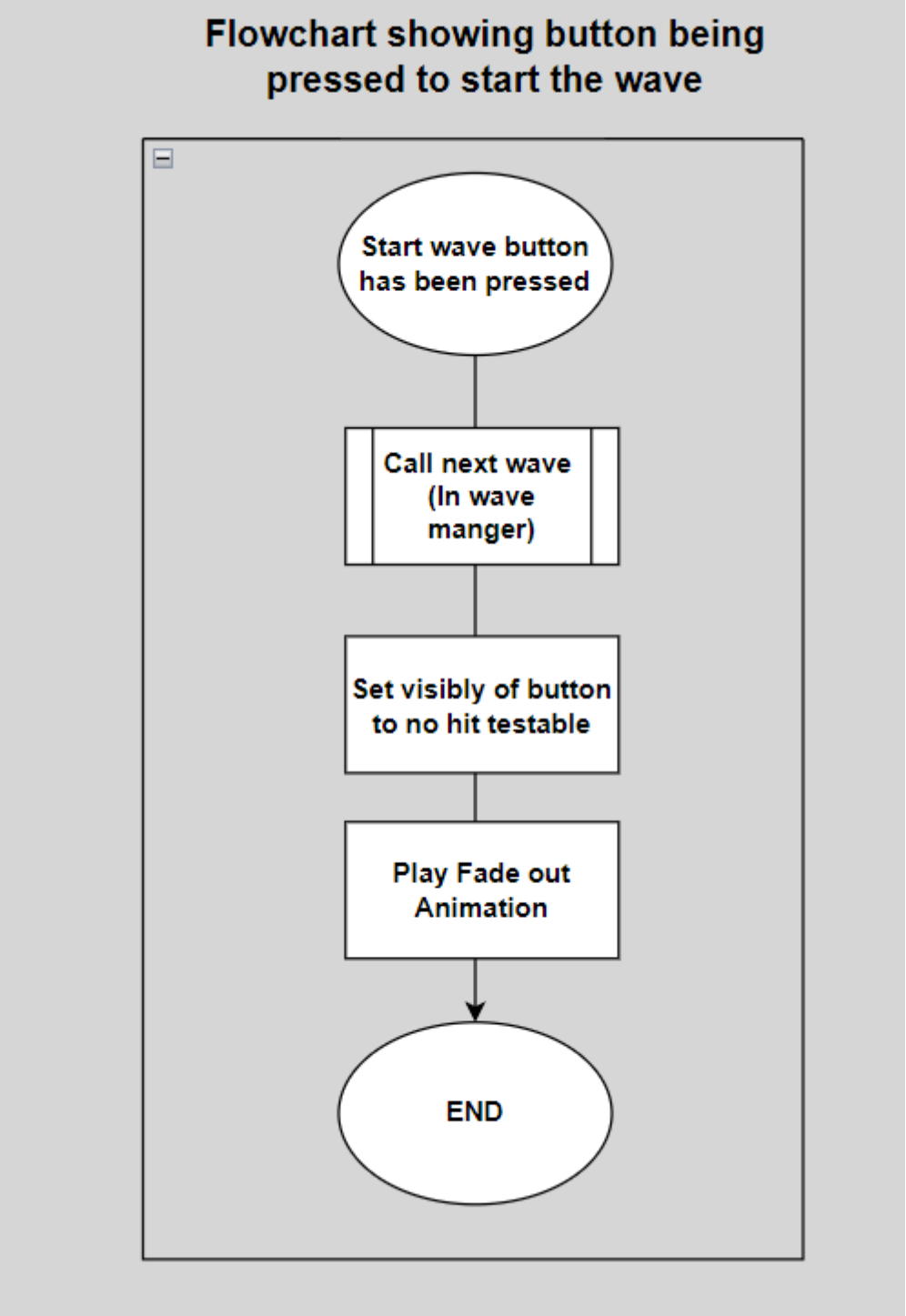
Flowchart showing Innit



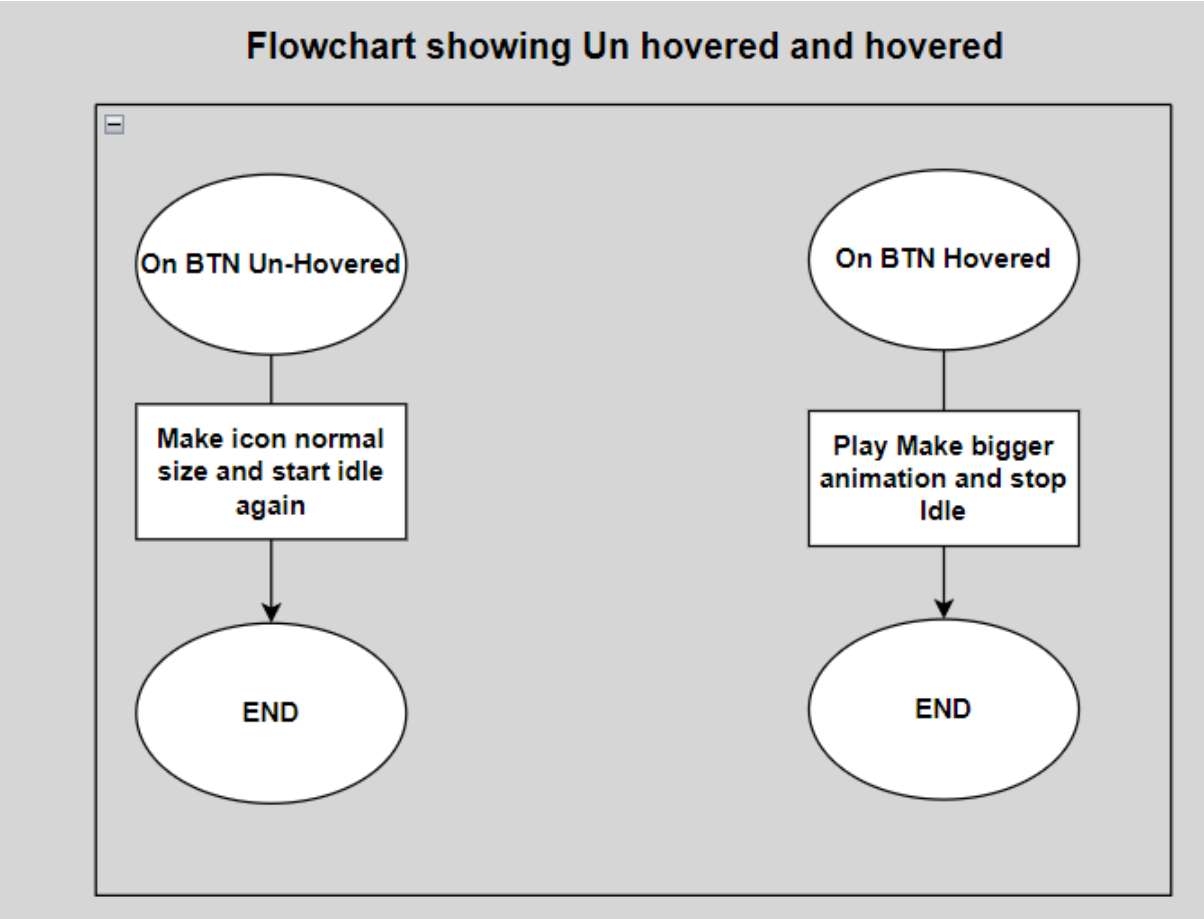
Flowchart showing set progress bar



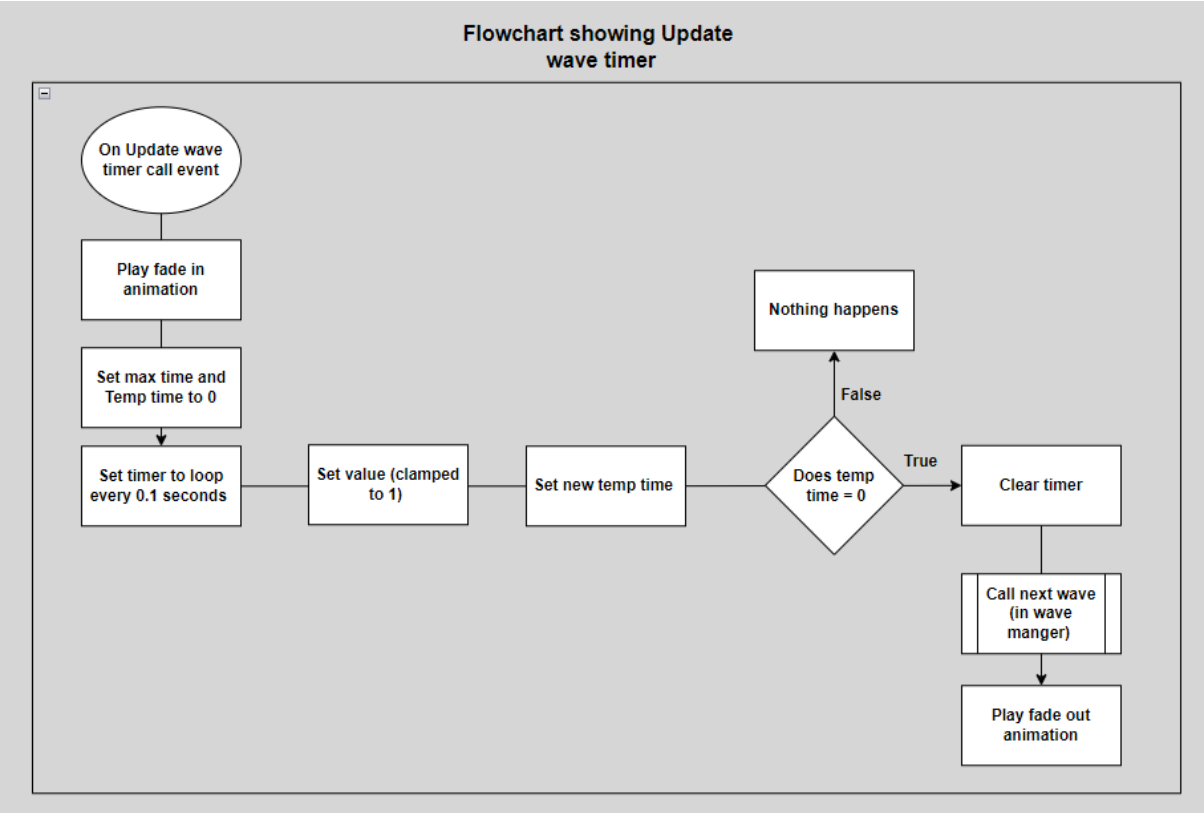
IA diagram showing start Wave button been pressed



Flowchart showing Un hover and hover animations

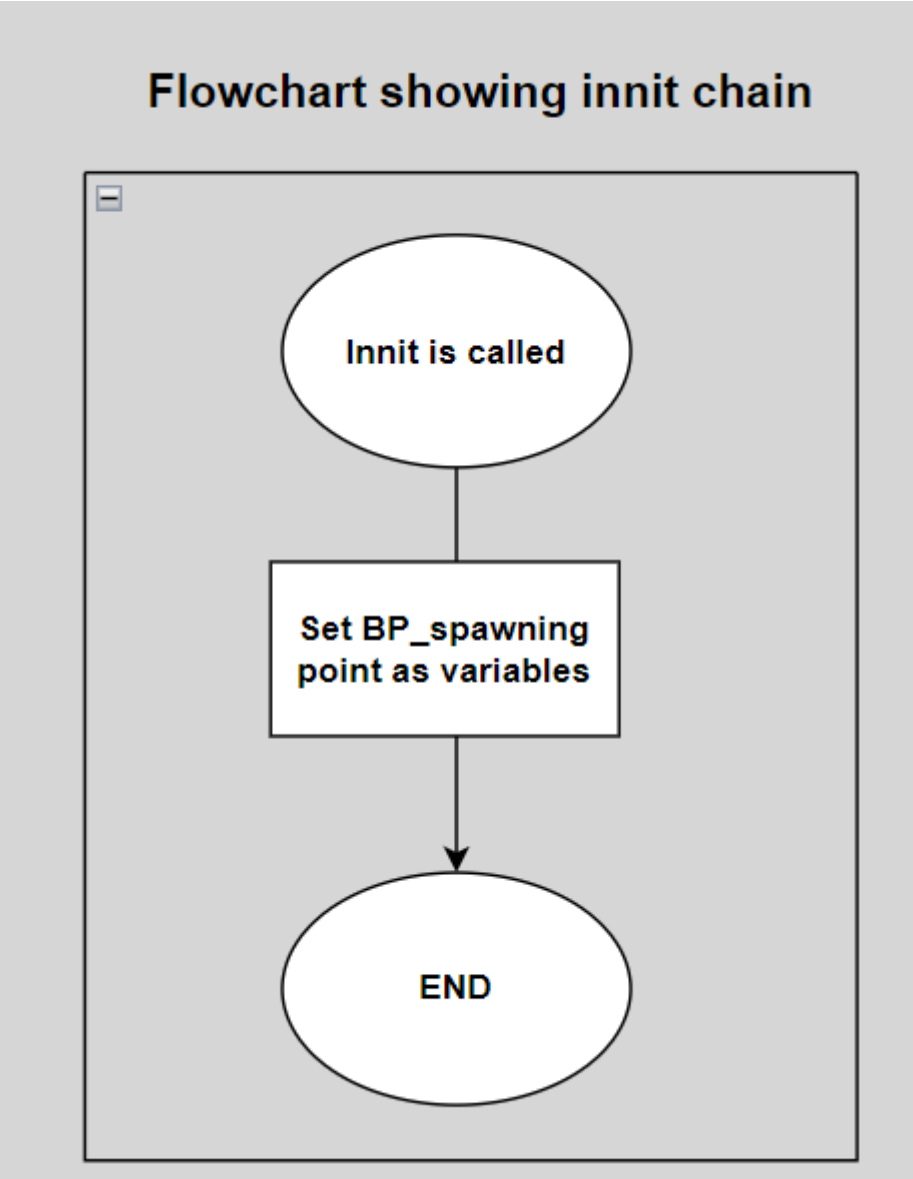


Flowchart showing update wave timer

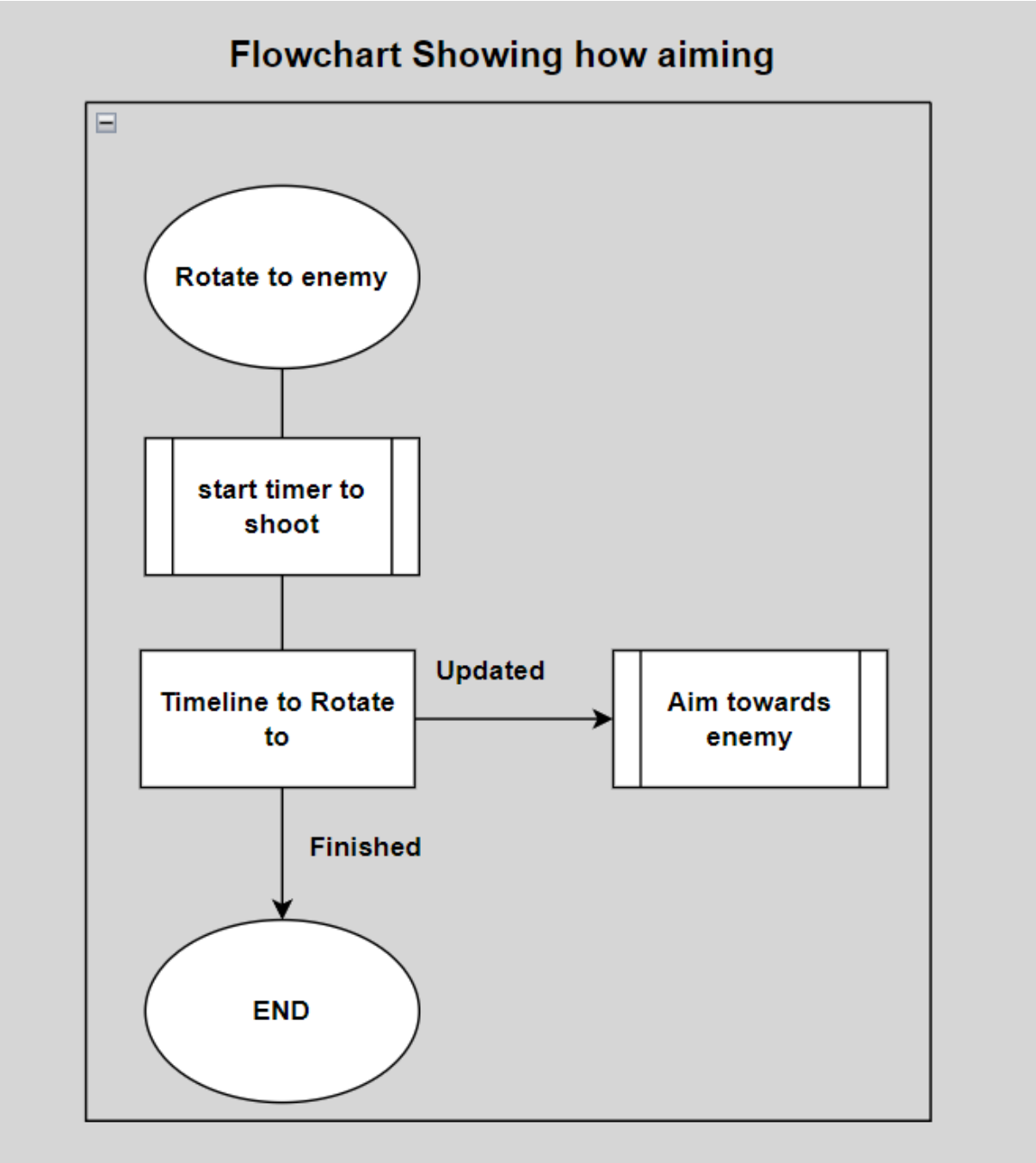


All Flowchart For base tower

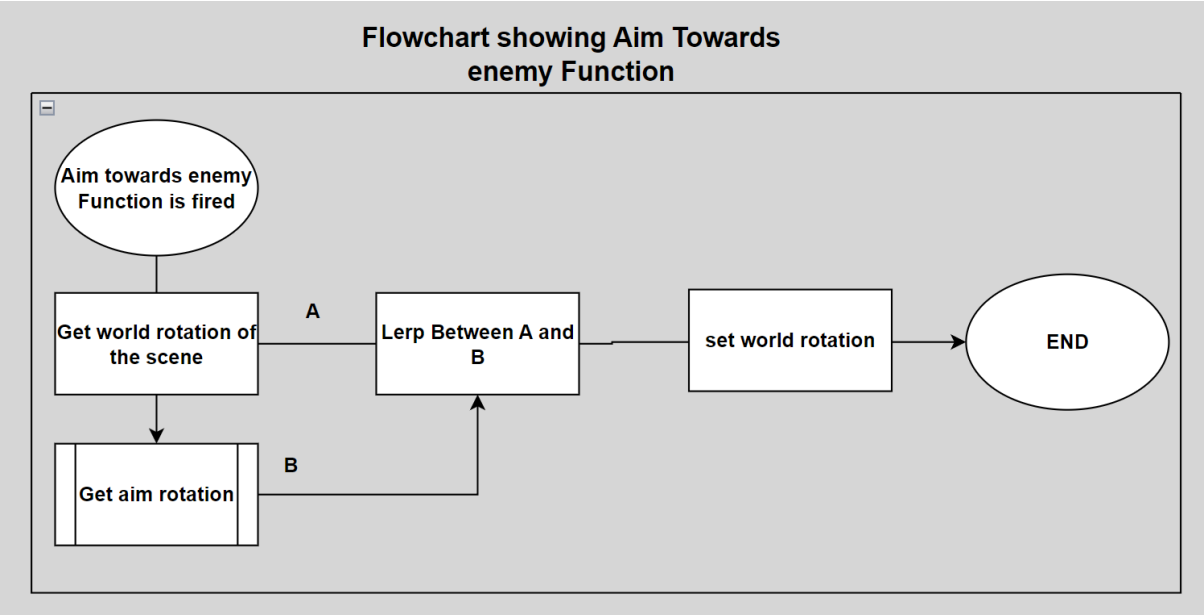
Flowchart showing innit



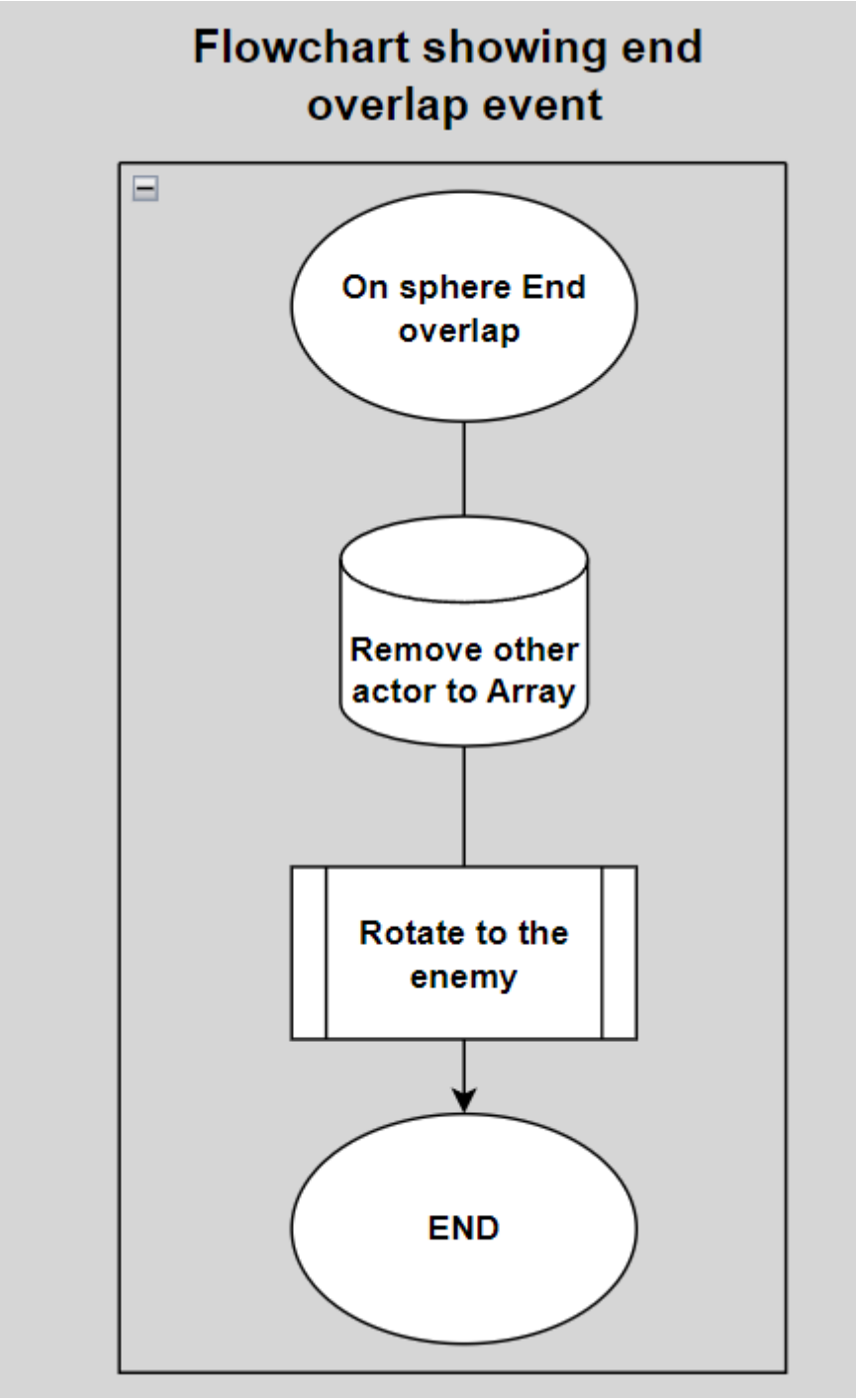
Flowchart showing how aiming works



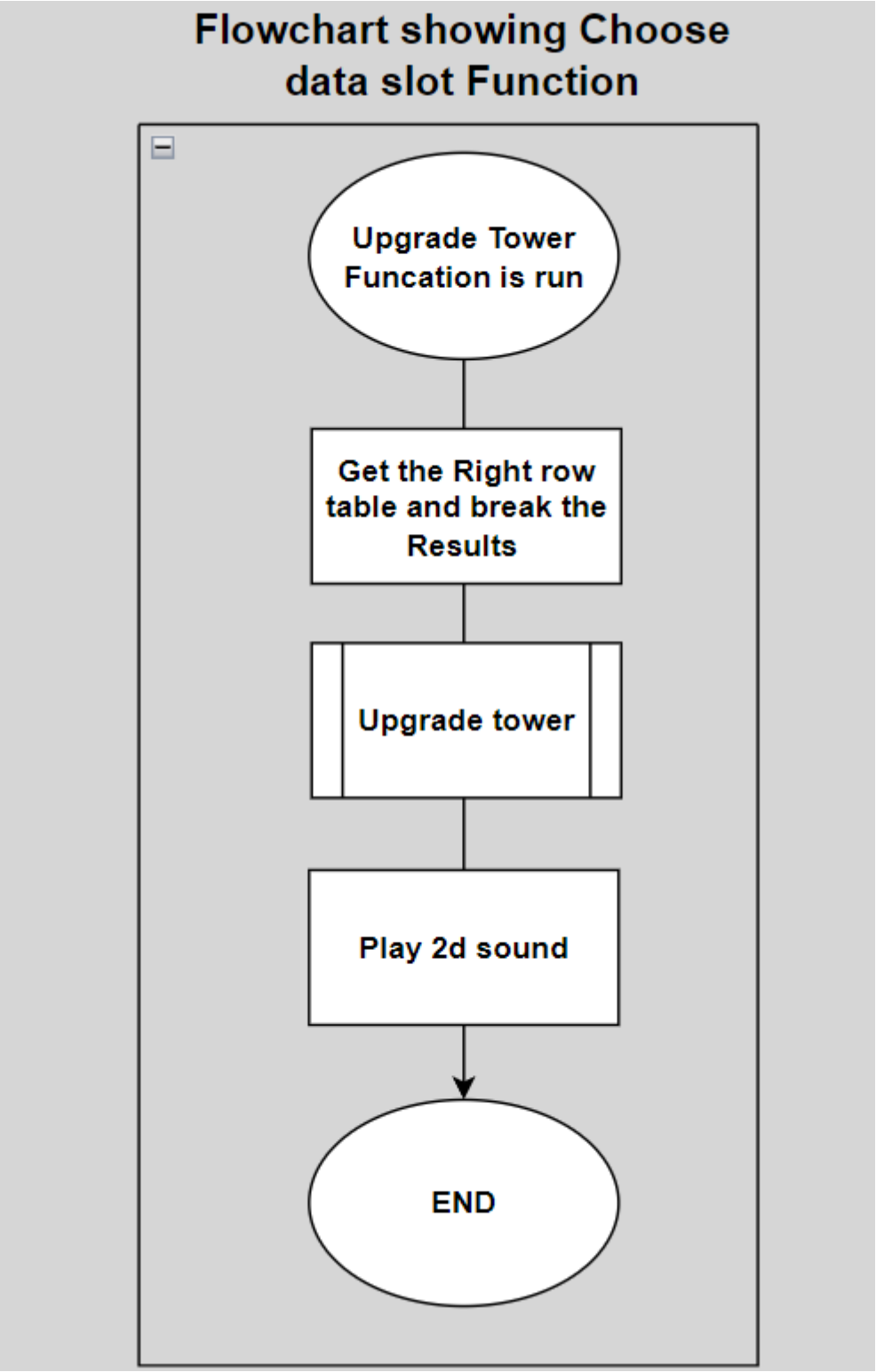
Flowchart showing aim towards enemy function



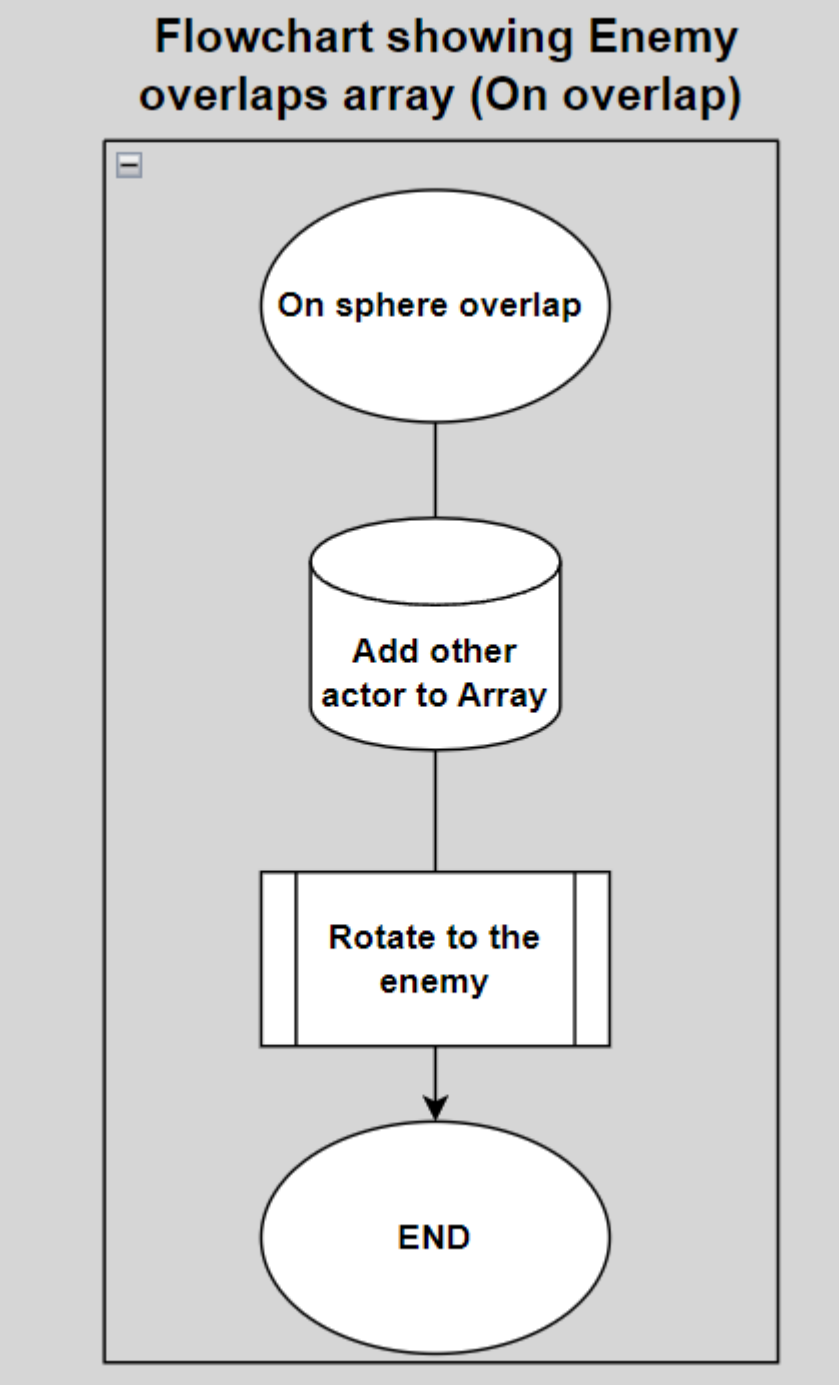
Flowchart showing end overlap event



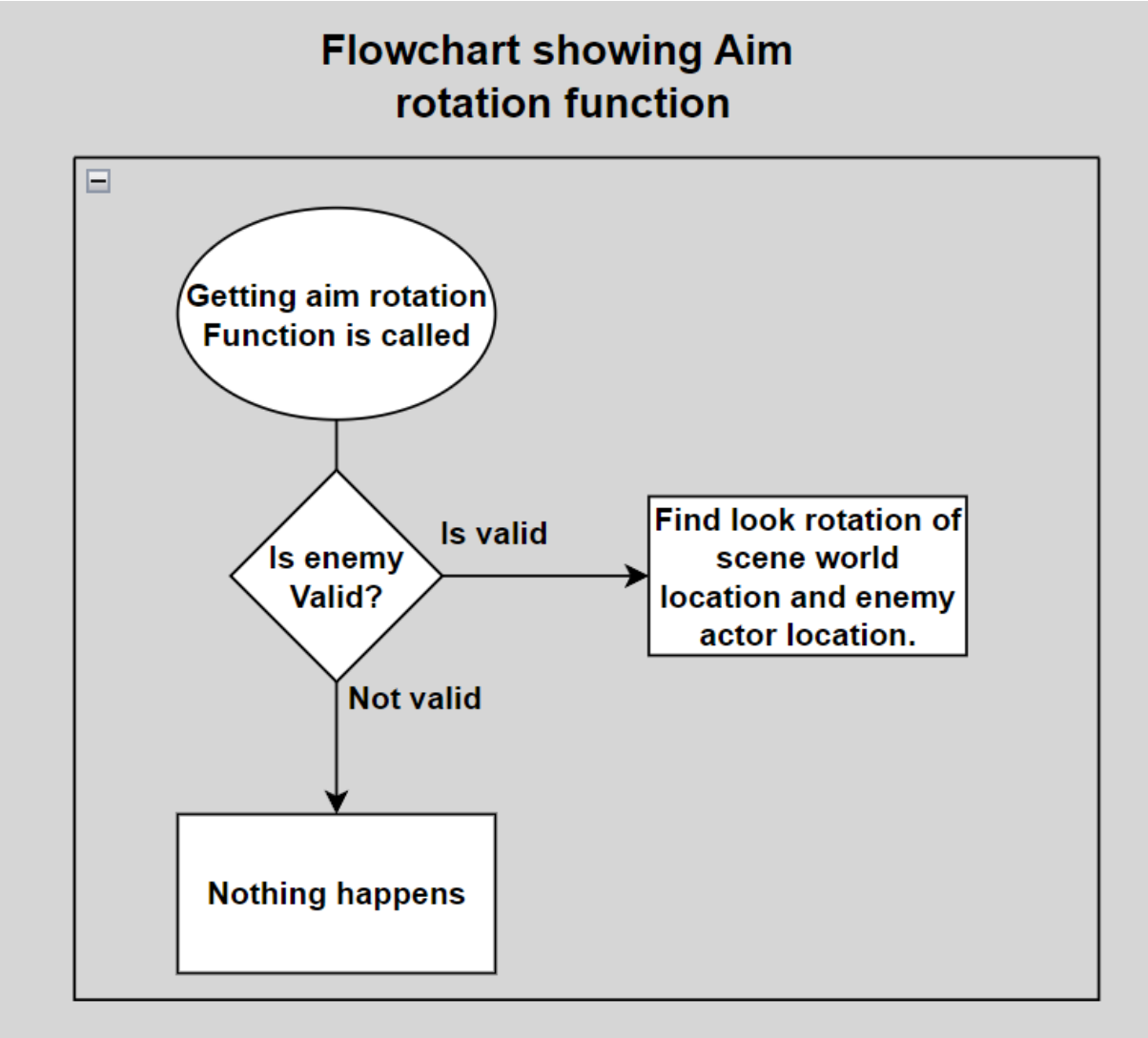
Flowchart showing Data slot function



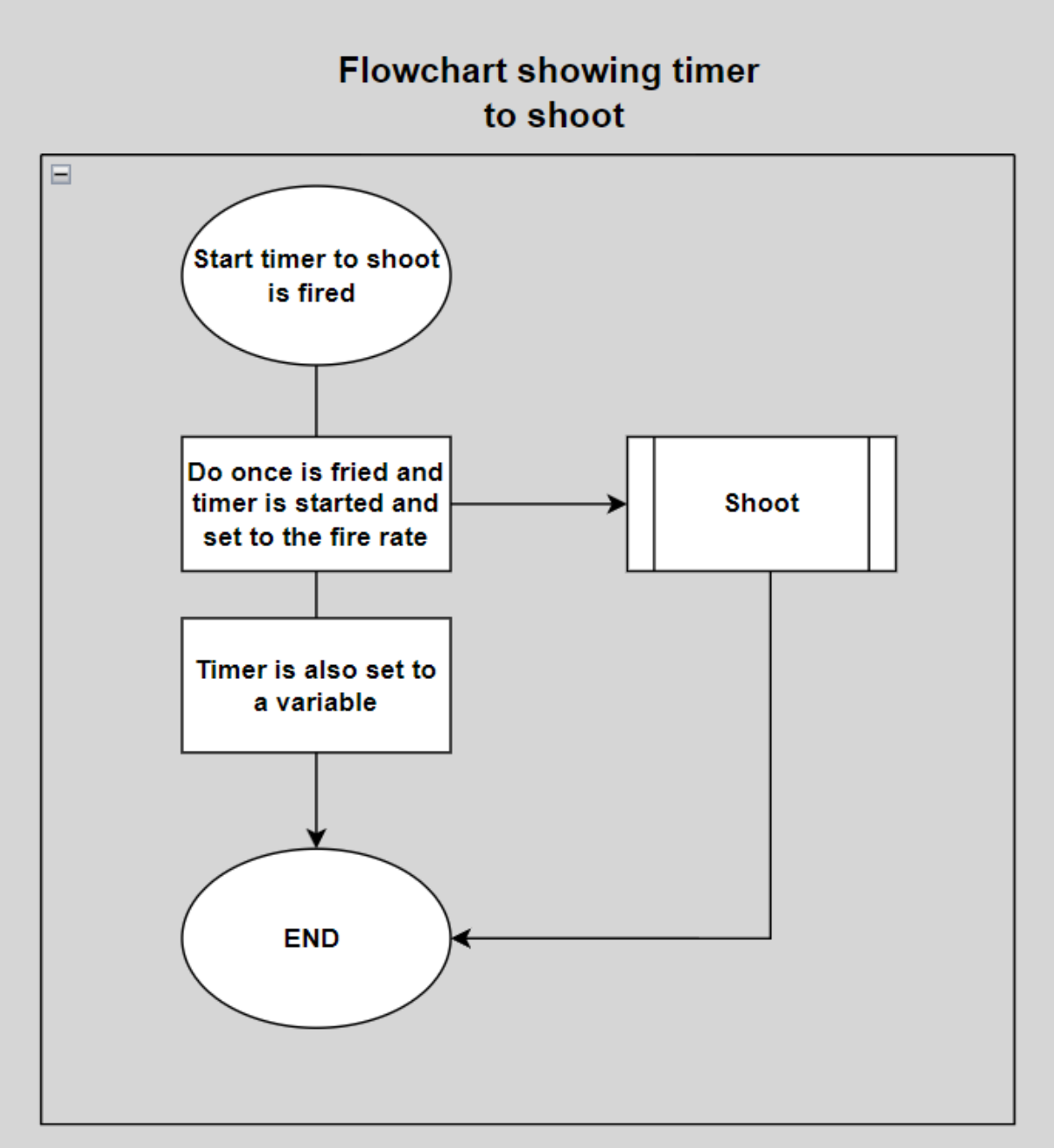
Flowchart showing adding enemy to array (On overlap)



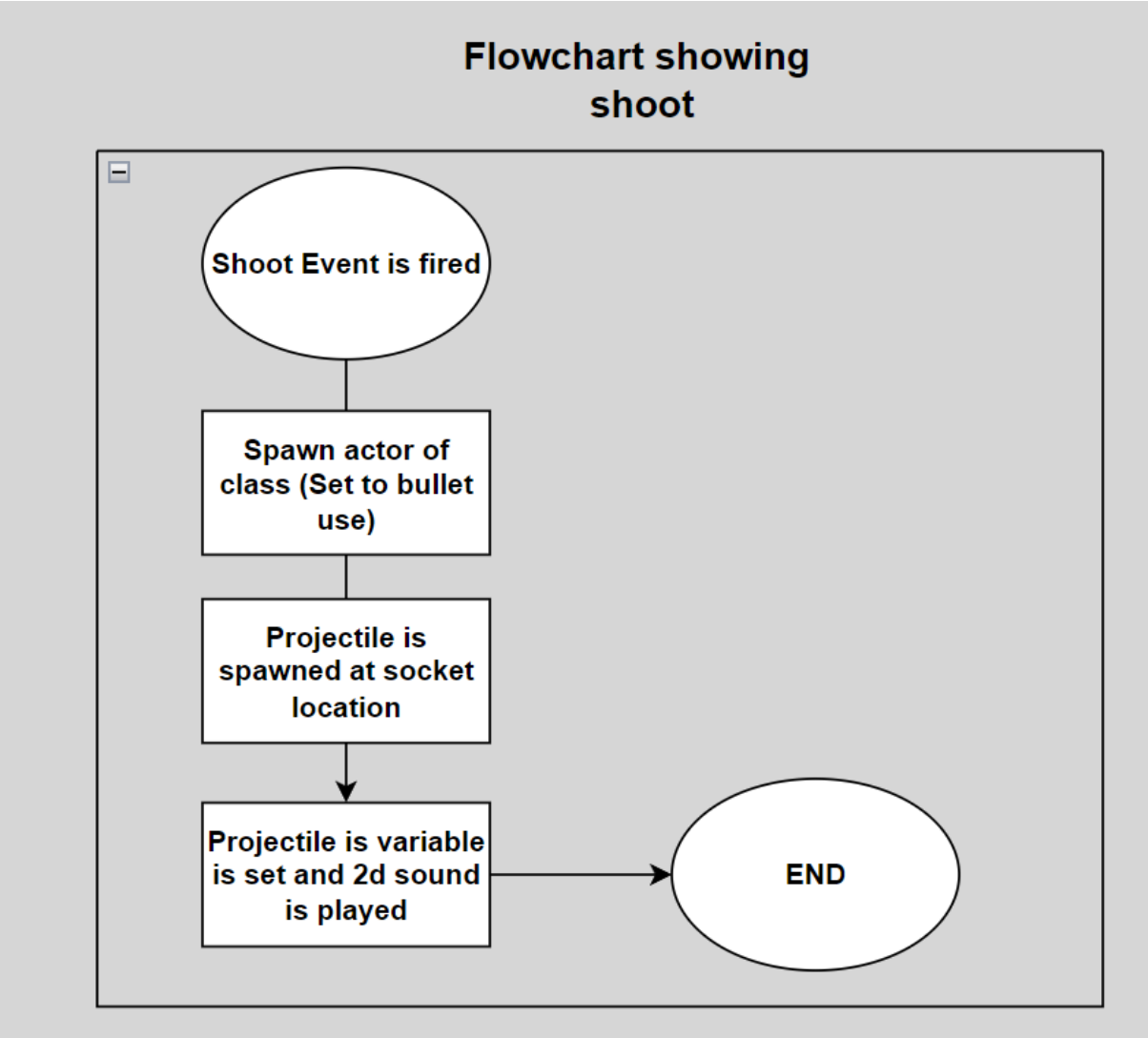
Flowchart showing Aim rotation function



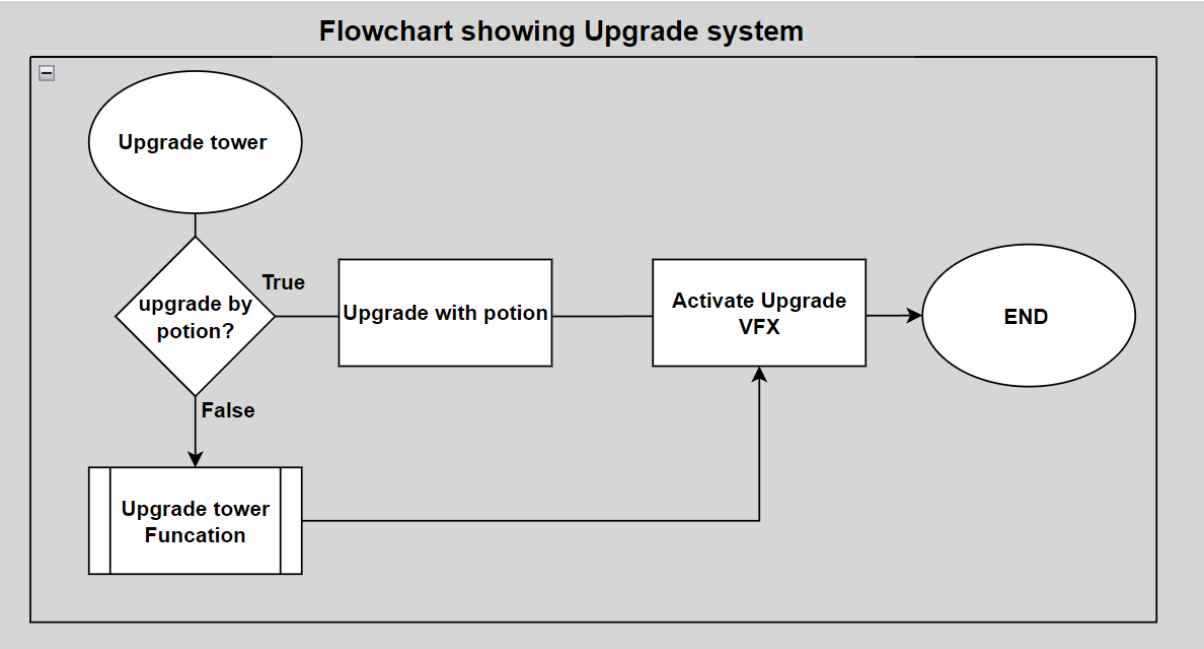
Flowchart showing Timer to shoot



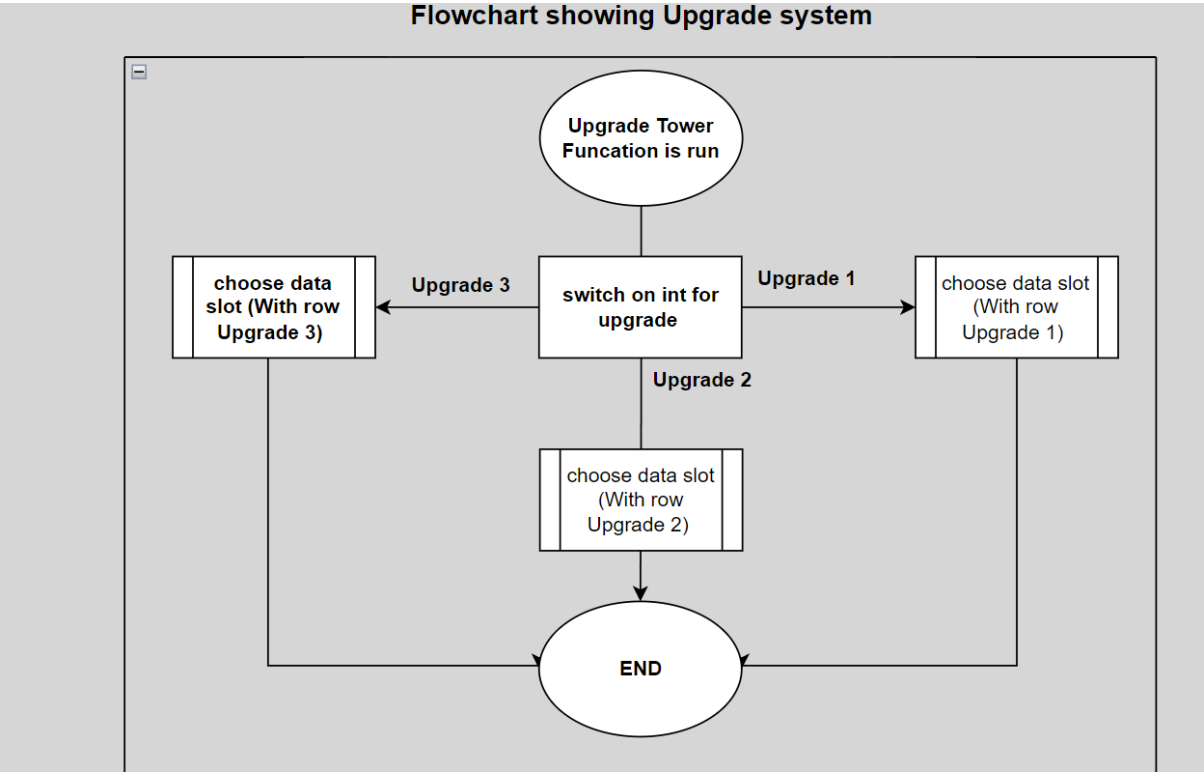
Flowchart showing Shoot function



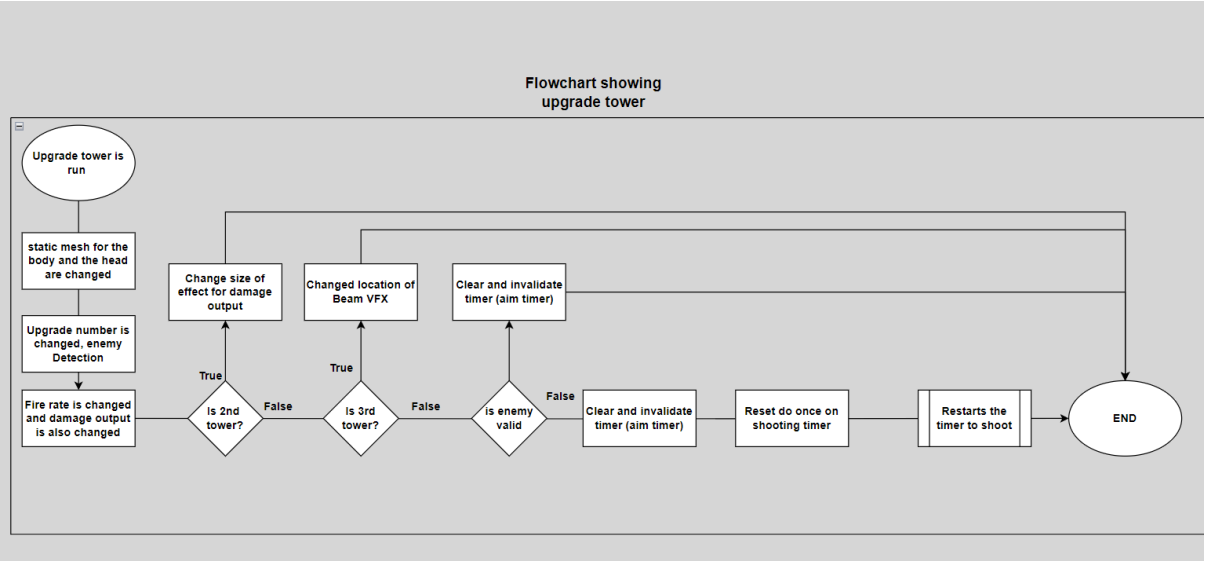
Flowchart showing Upgrade system



Flowchart showing upgrade system Function

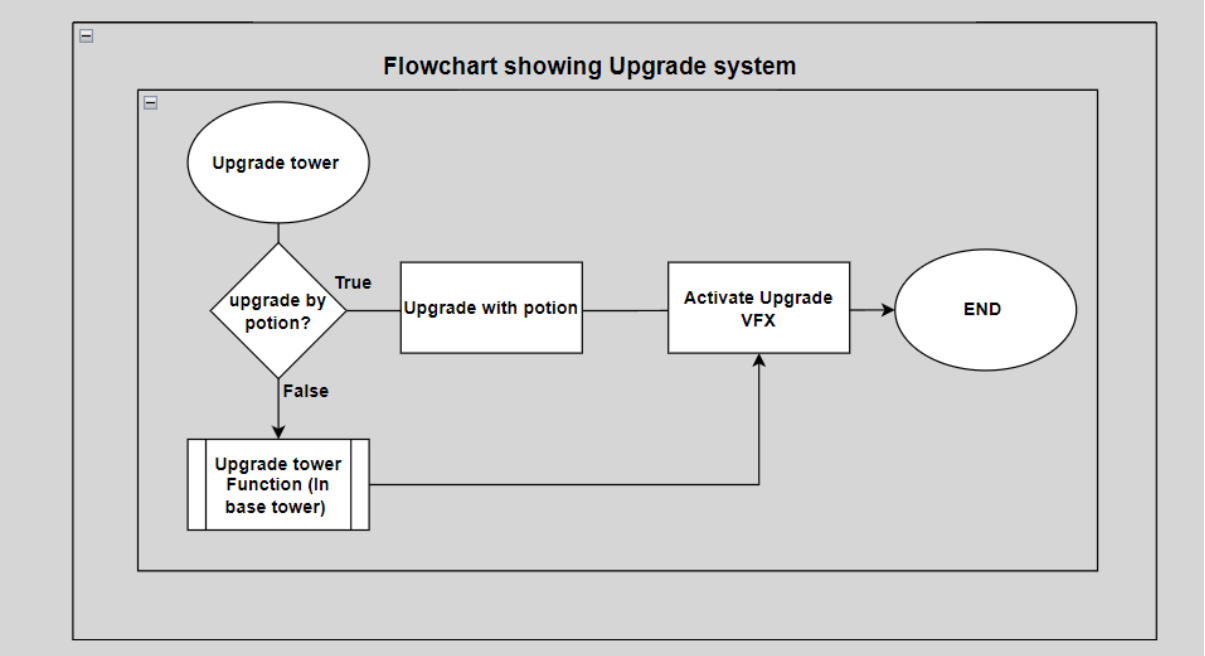


Flowchart showing Upgrade tower event



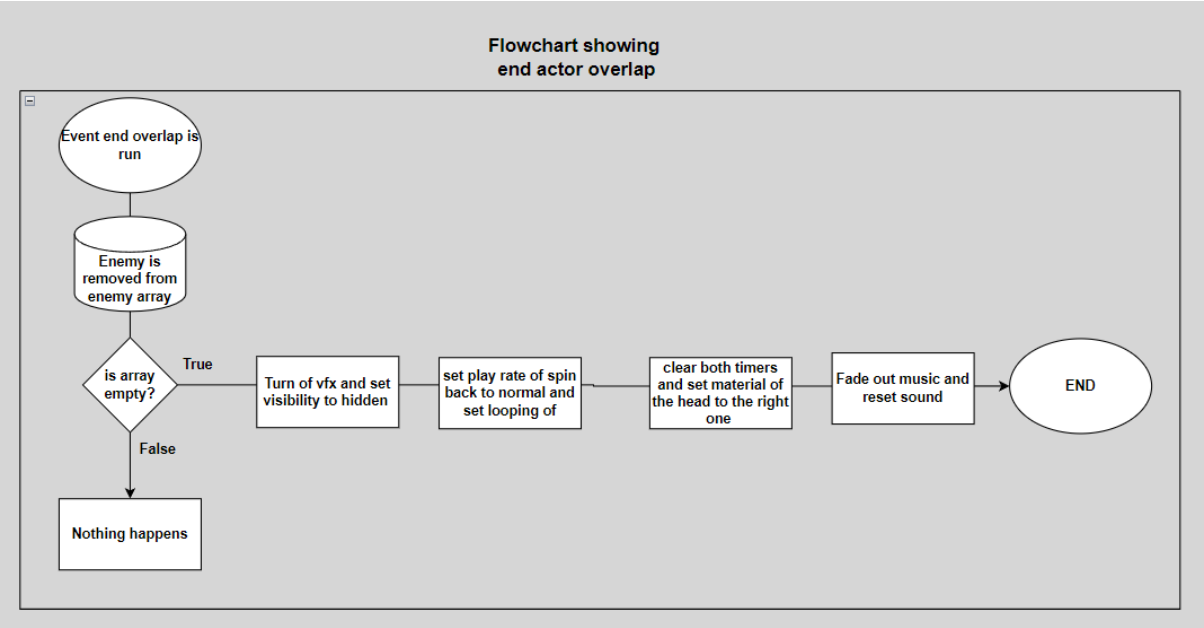
All flowcharts for Tower 2

Flowchart showing Upgrade tower (Tower 2)

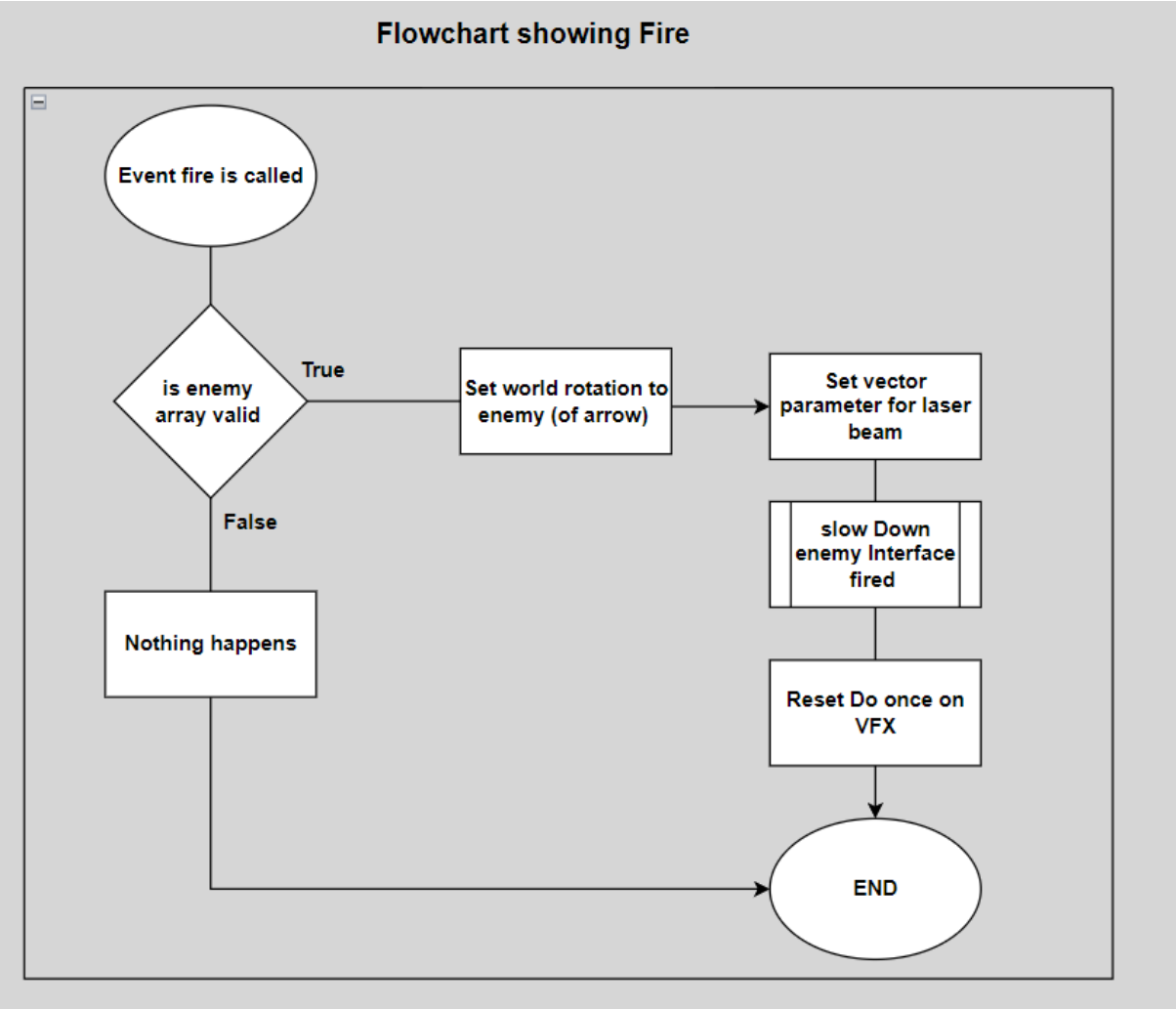


All flowcharts showing Tower 3

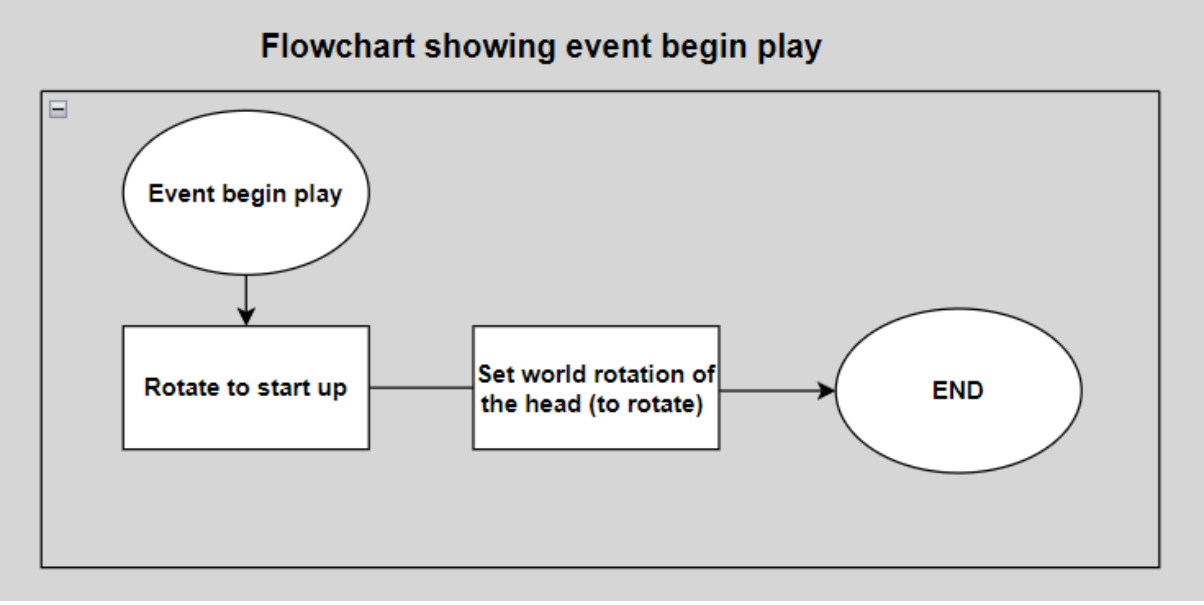
Flowchart showing End overlap



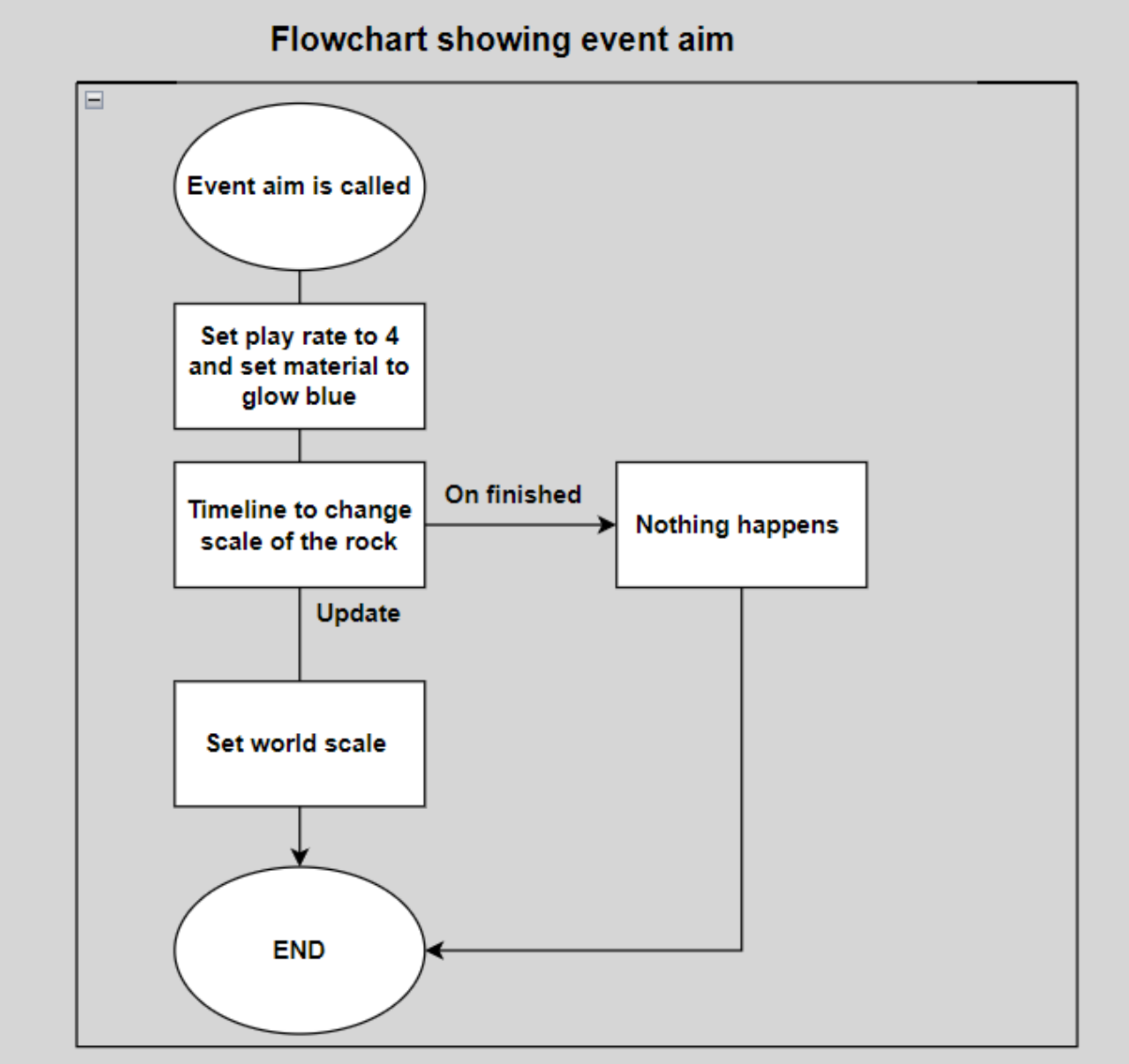
Flowchart showing event fire



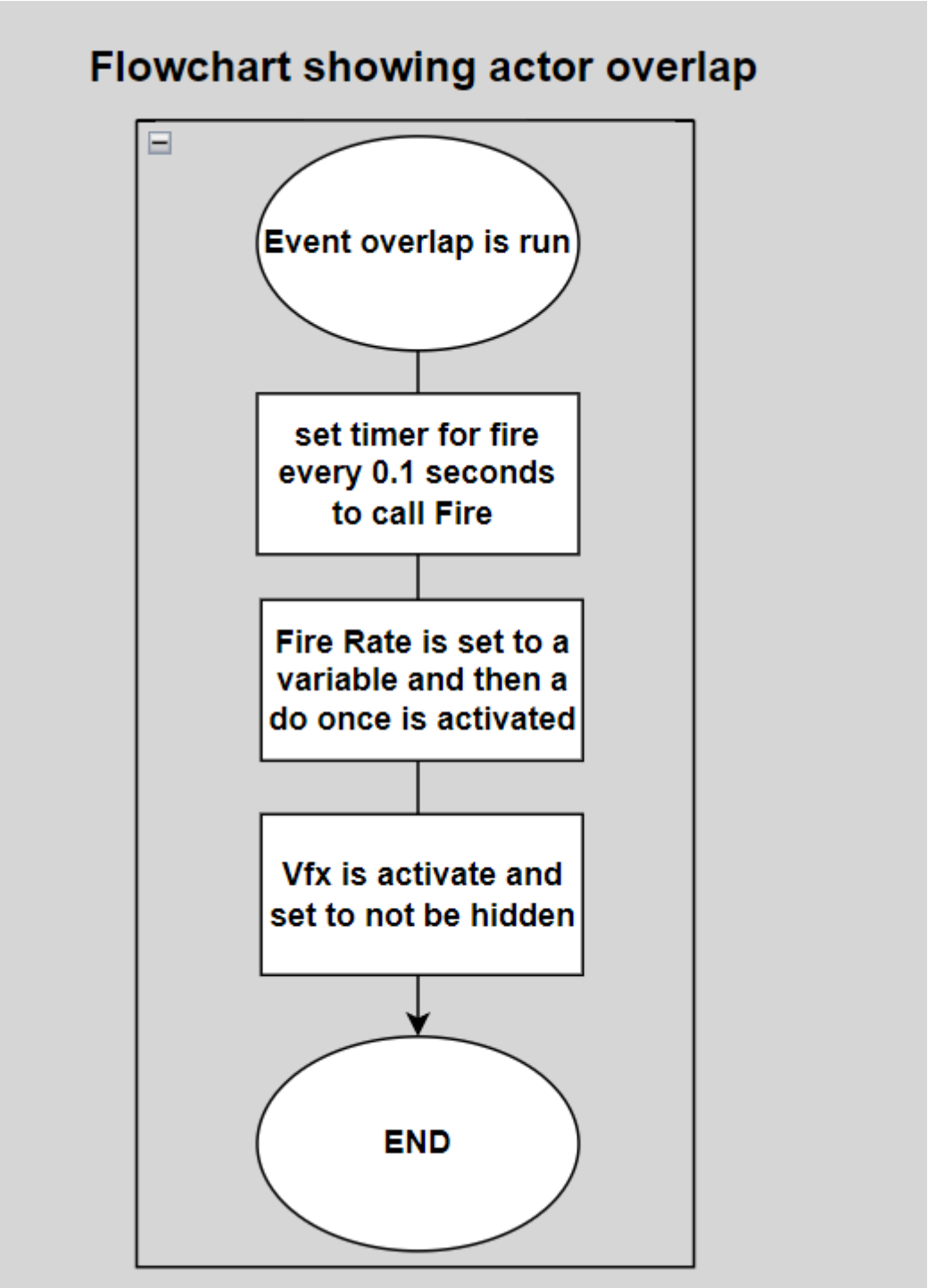
Flowchart showing event begin play



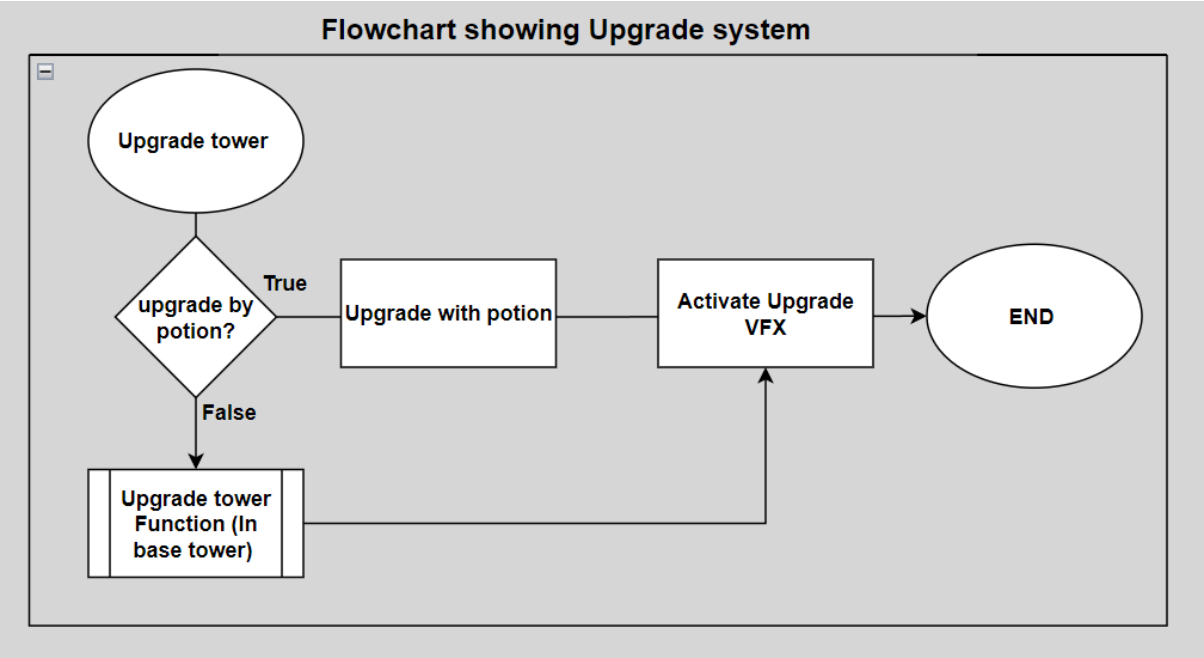
flowchart showing Aim event



Flowchart showing actor overlap

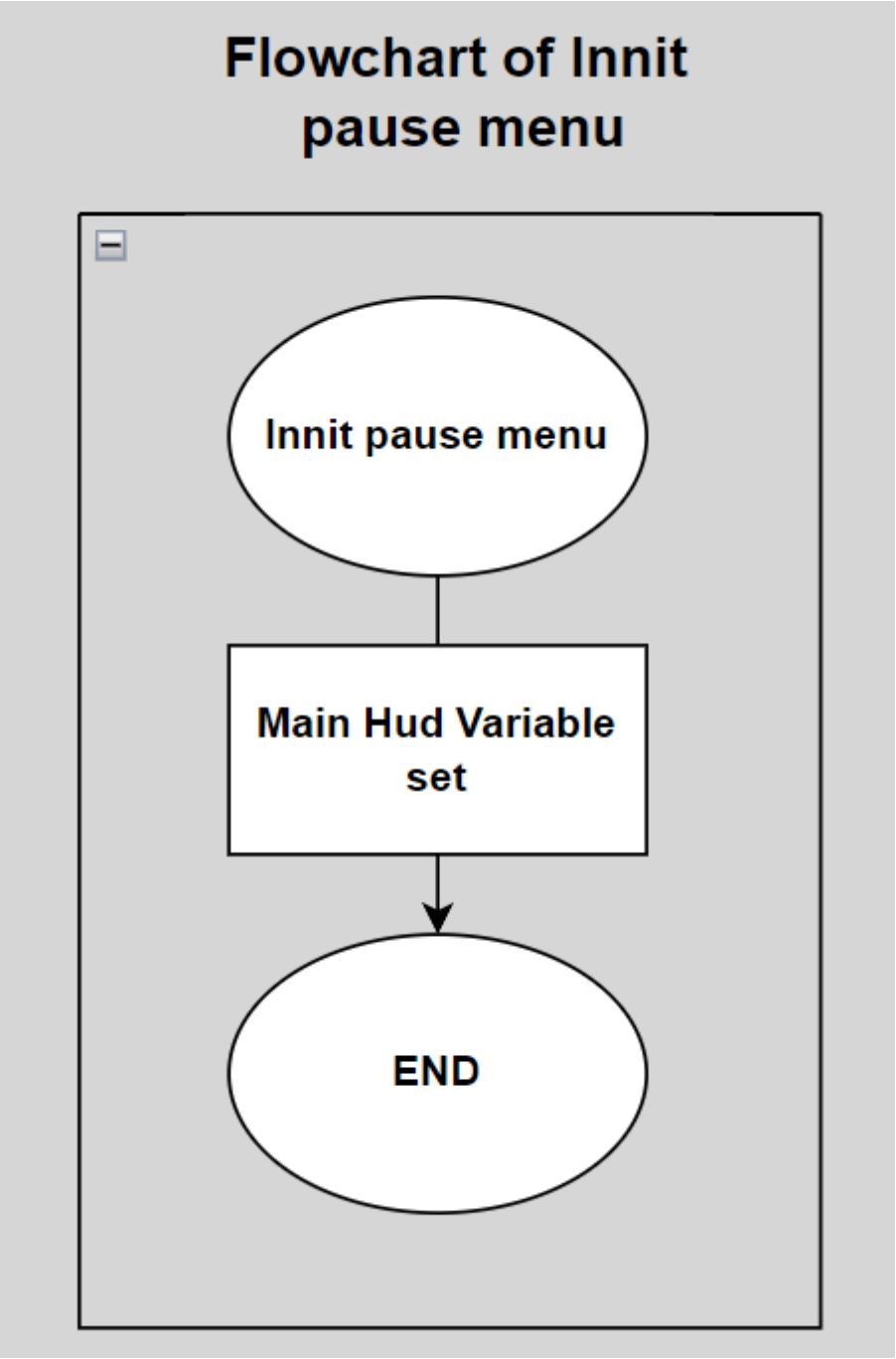


Flowchart showing Upgrade system

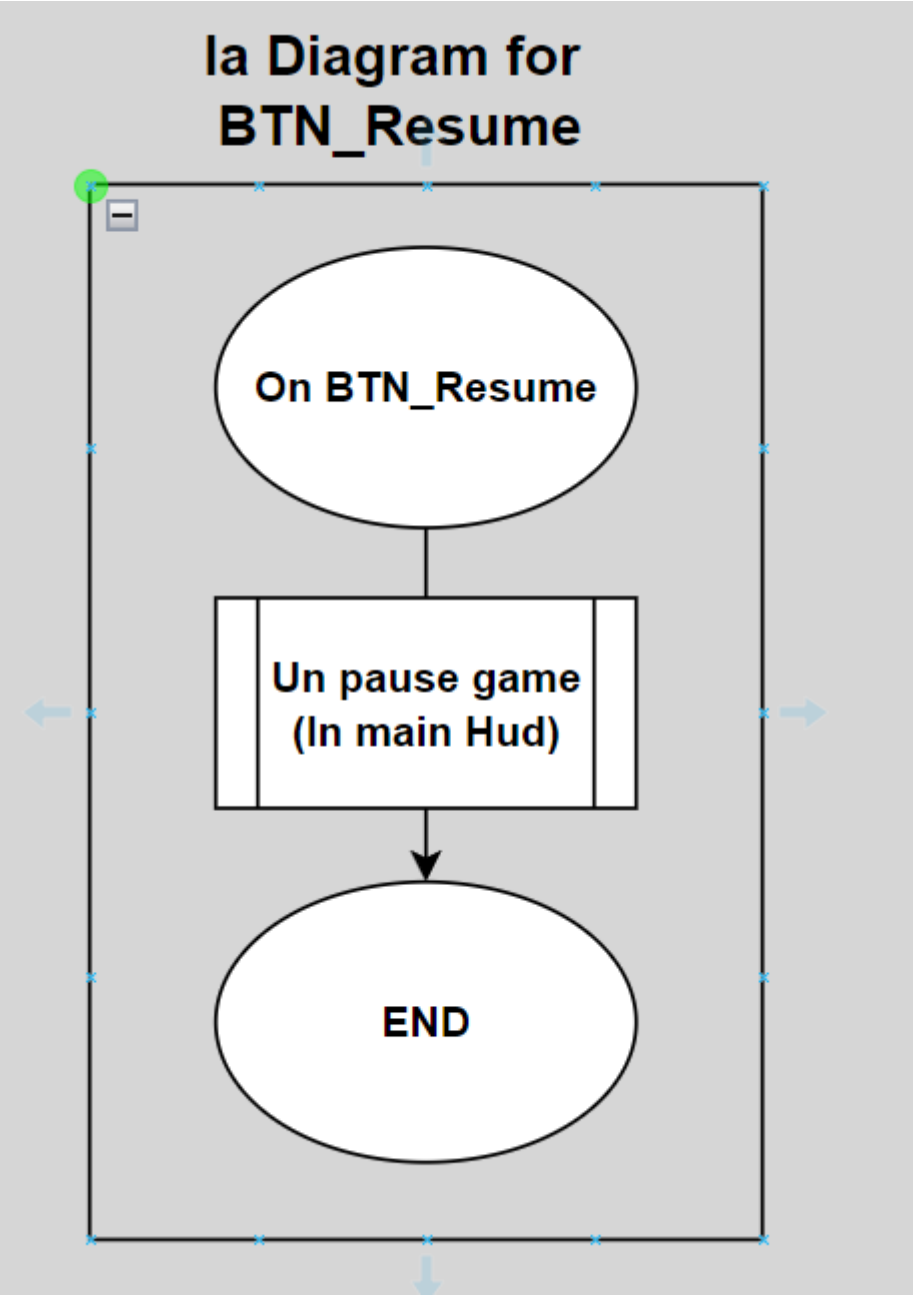


All Flowcharts and IA diagrams for pause menu

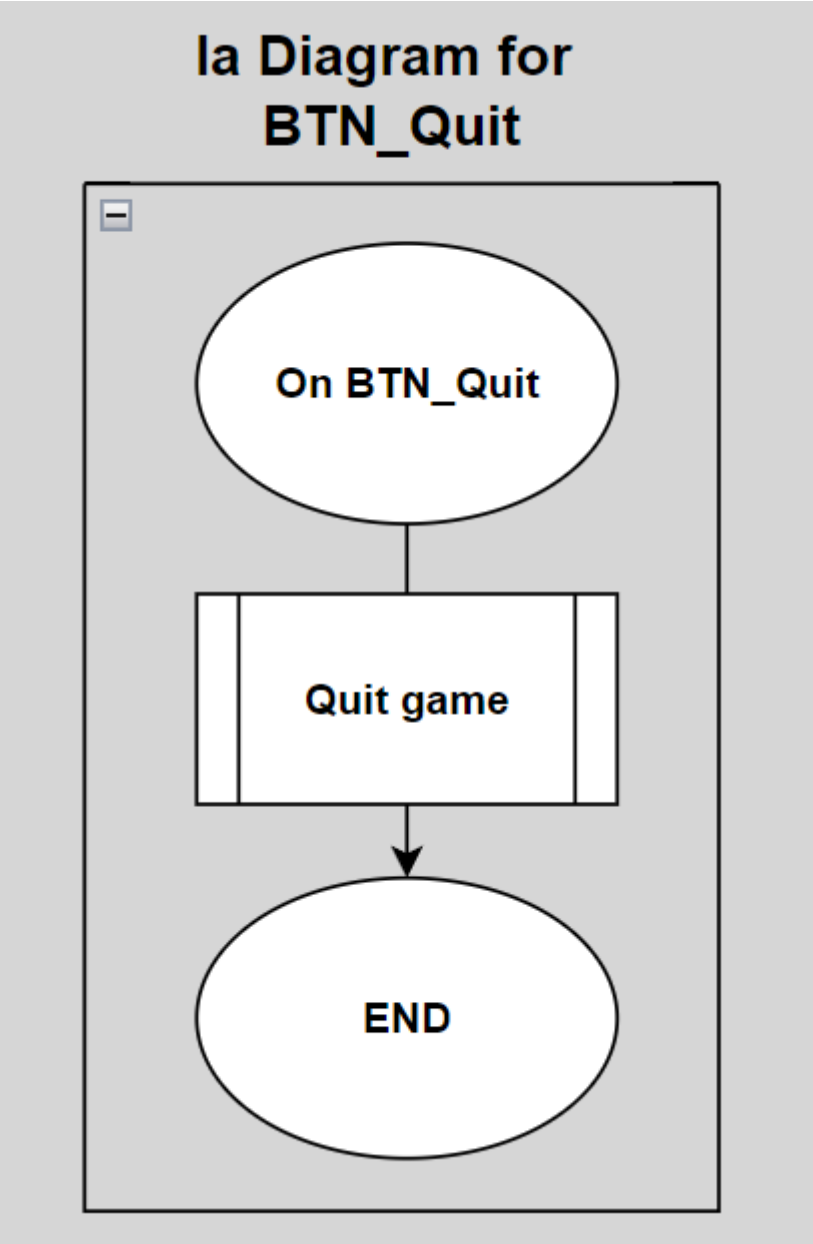
Flowchart showing Innit



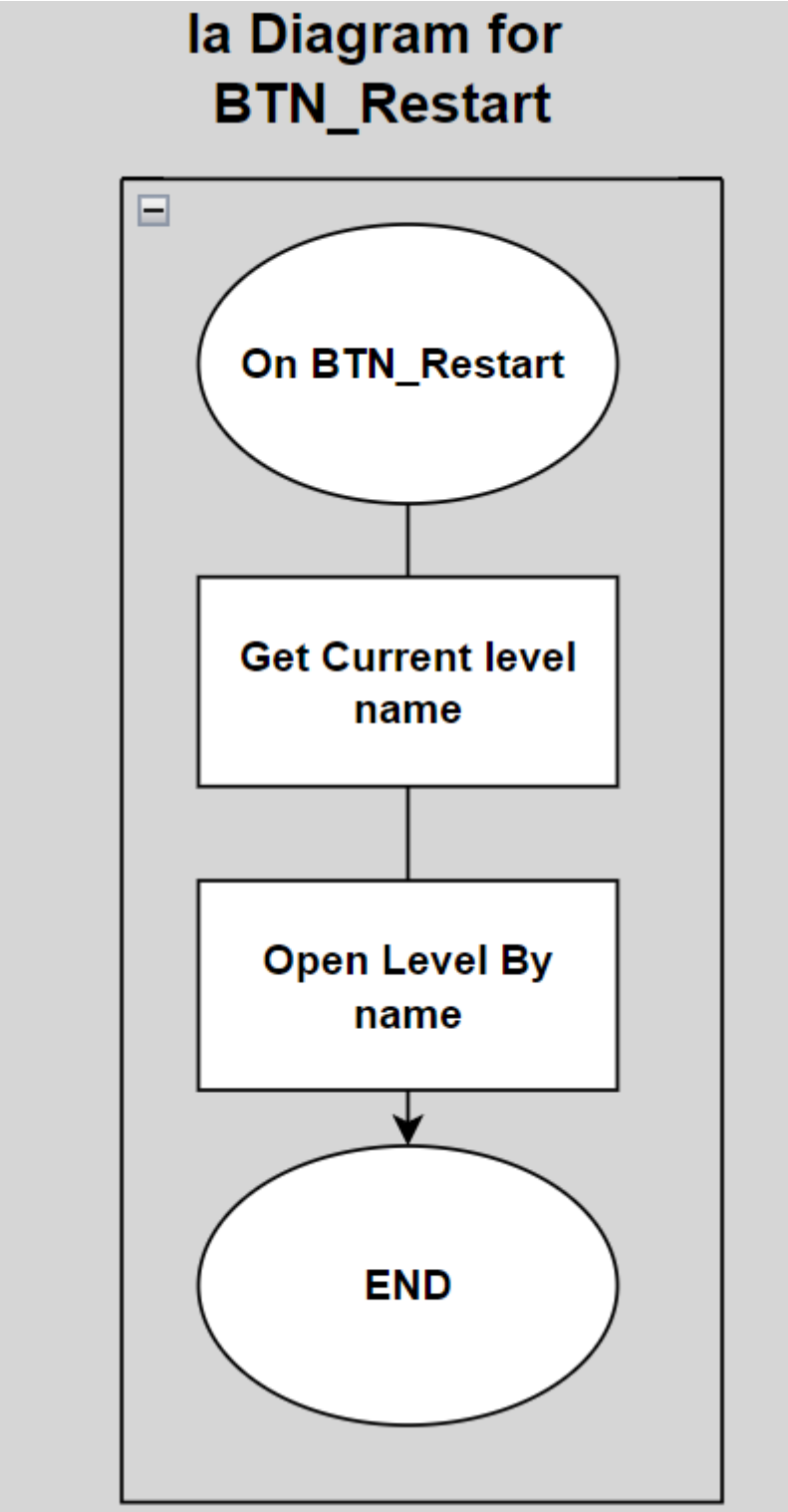
Ia Diagram for BTN_resume



IA Diagram for BTN Quit

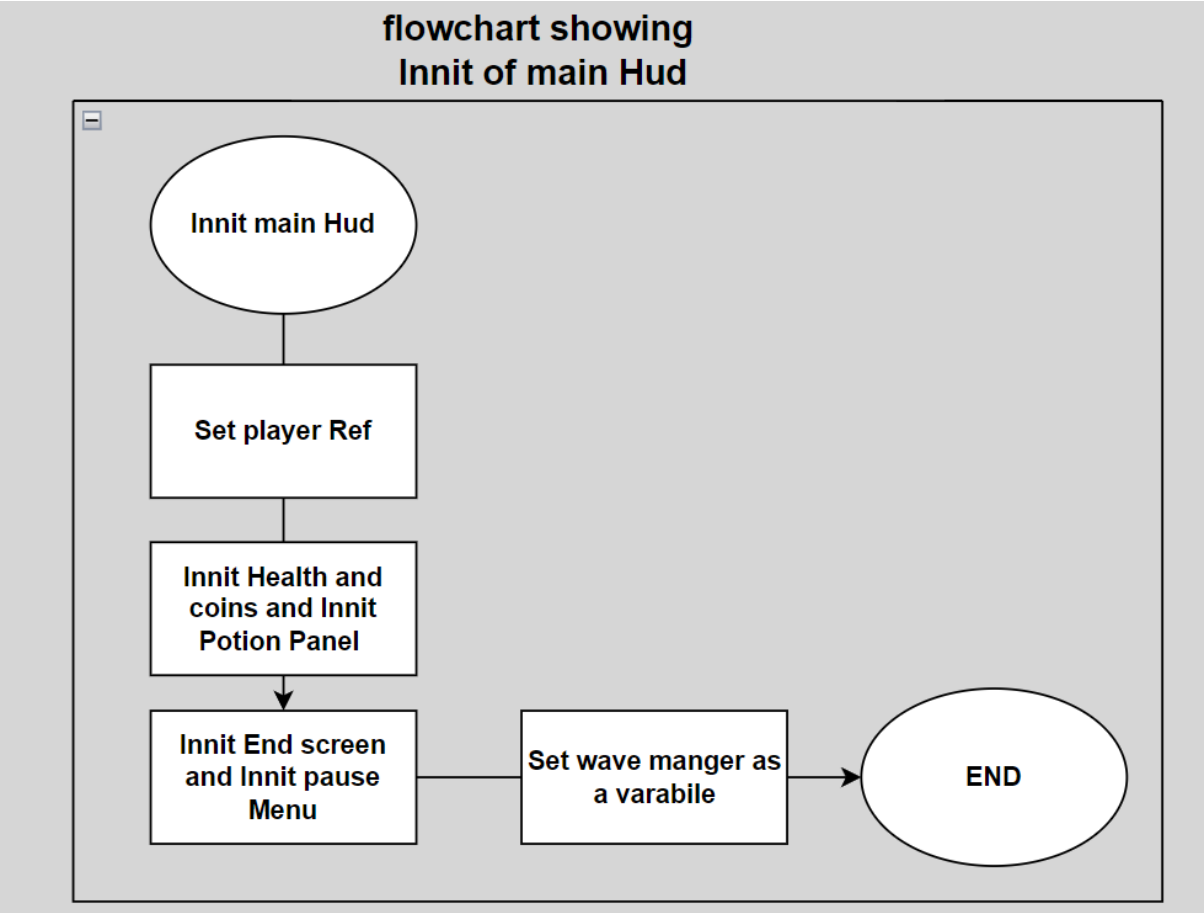


Ia Diagram for BTN Reset

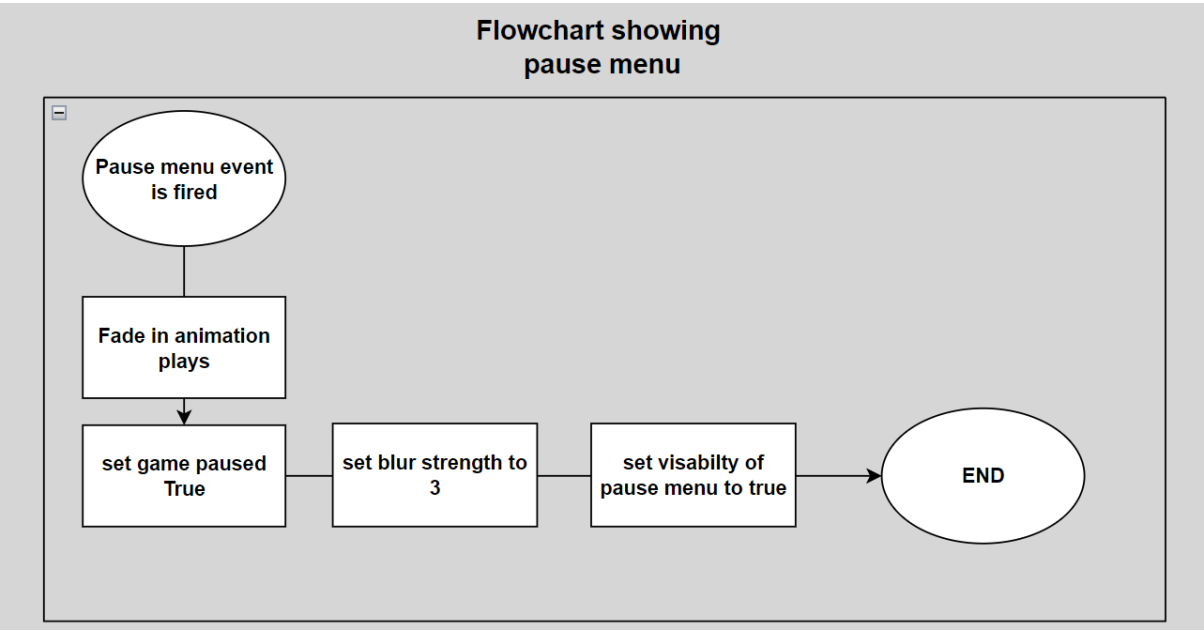


All IA Diagram and Flowcharts for main menu

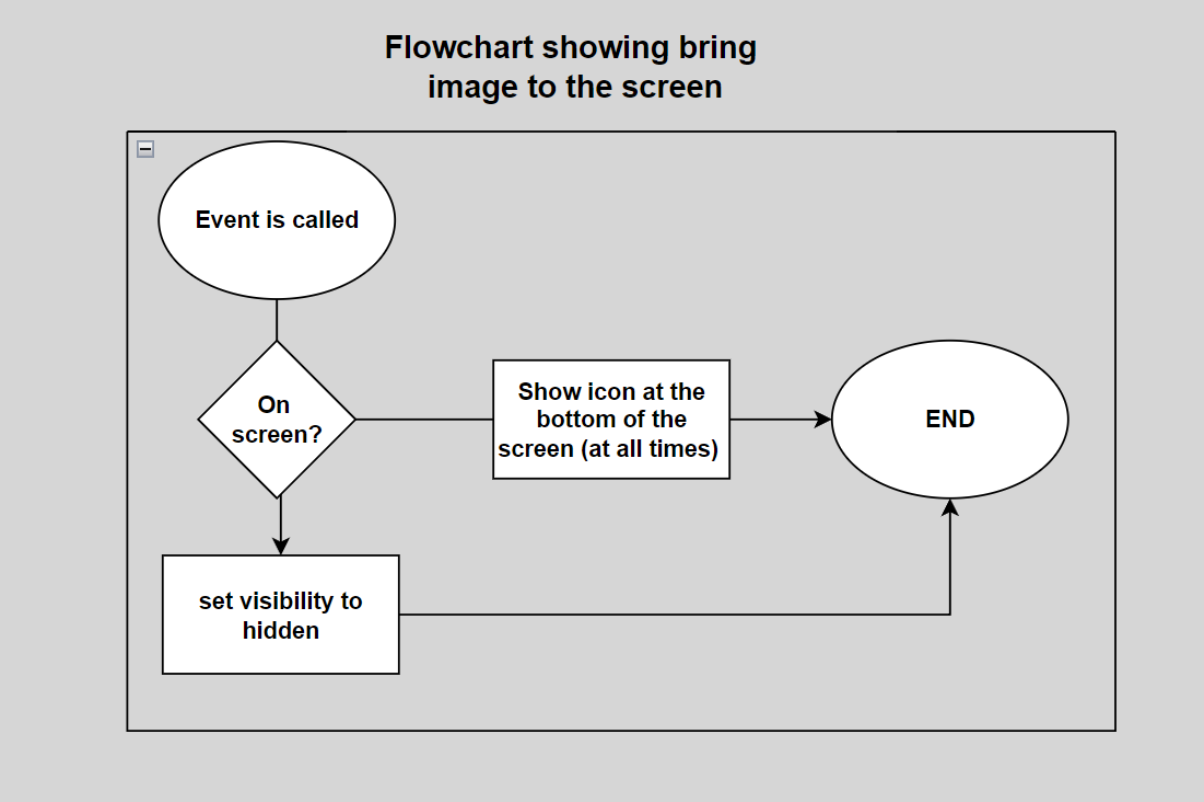
Innit main Hud



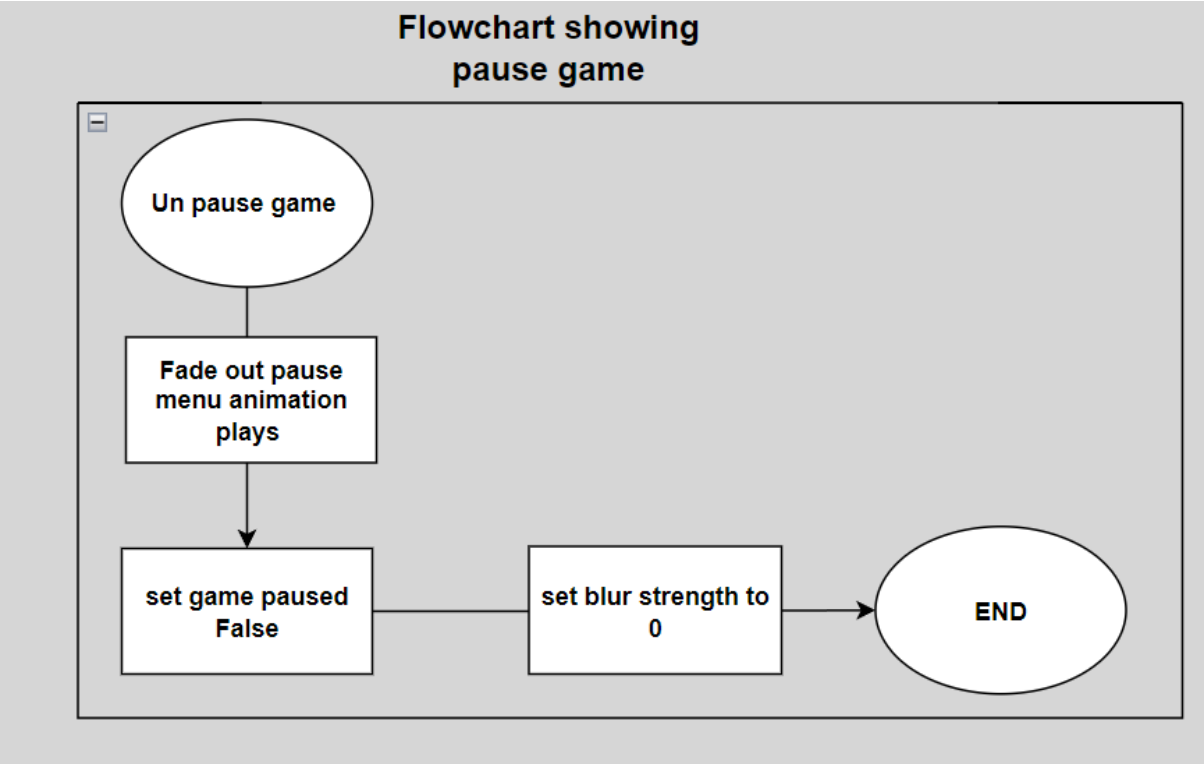
Flowcharts showing pause menu



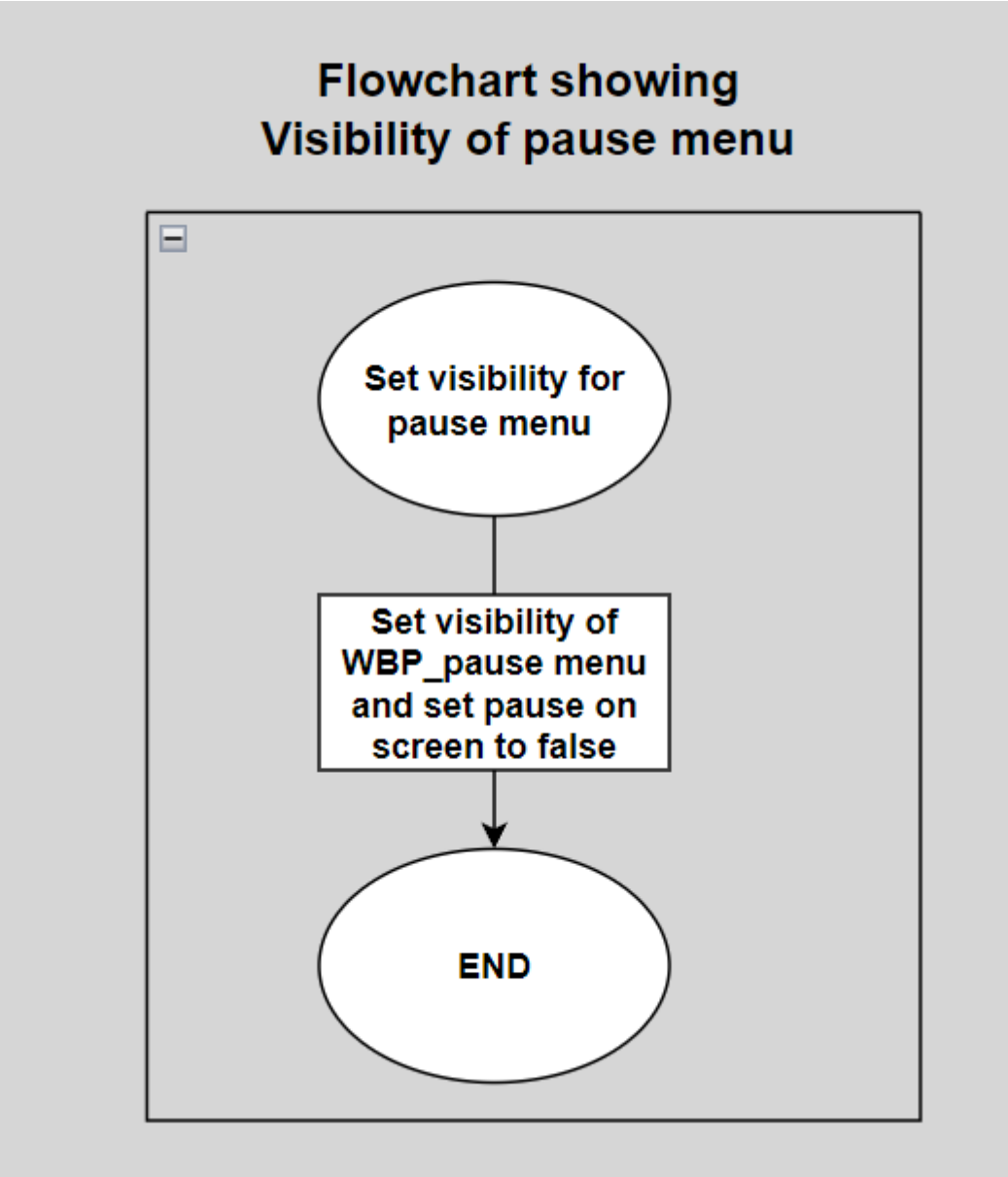
Flowcharts showing Brin image to the screen



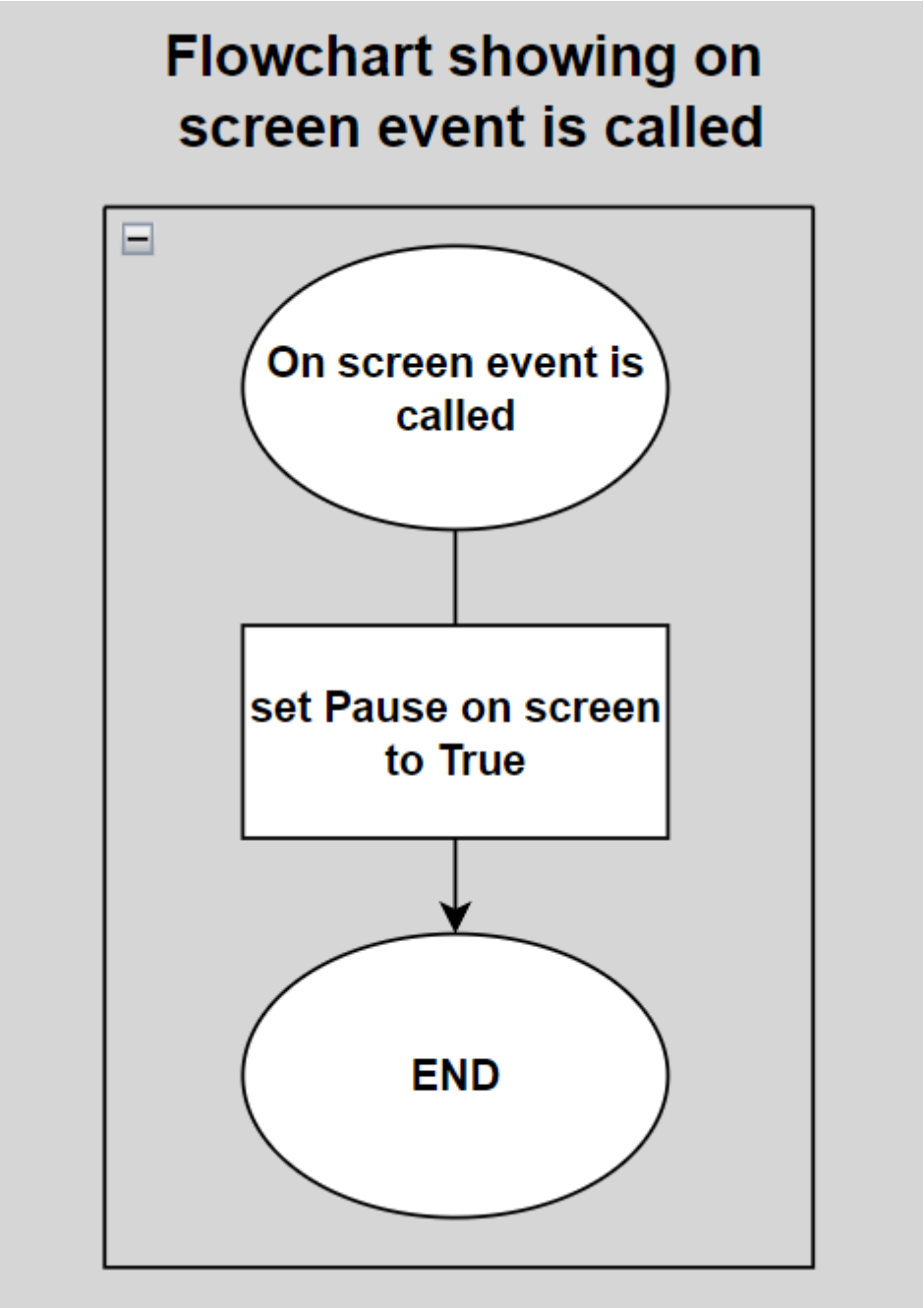
Flowcharts showing Pause menu



Flowcharts showing Visibility of pause menu

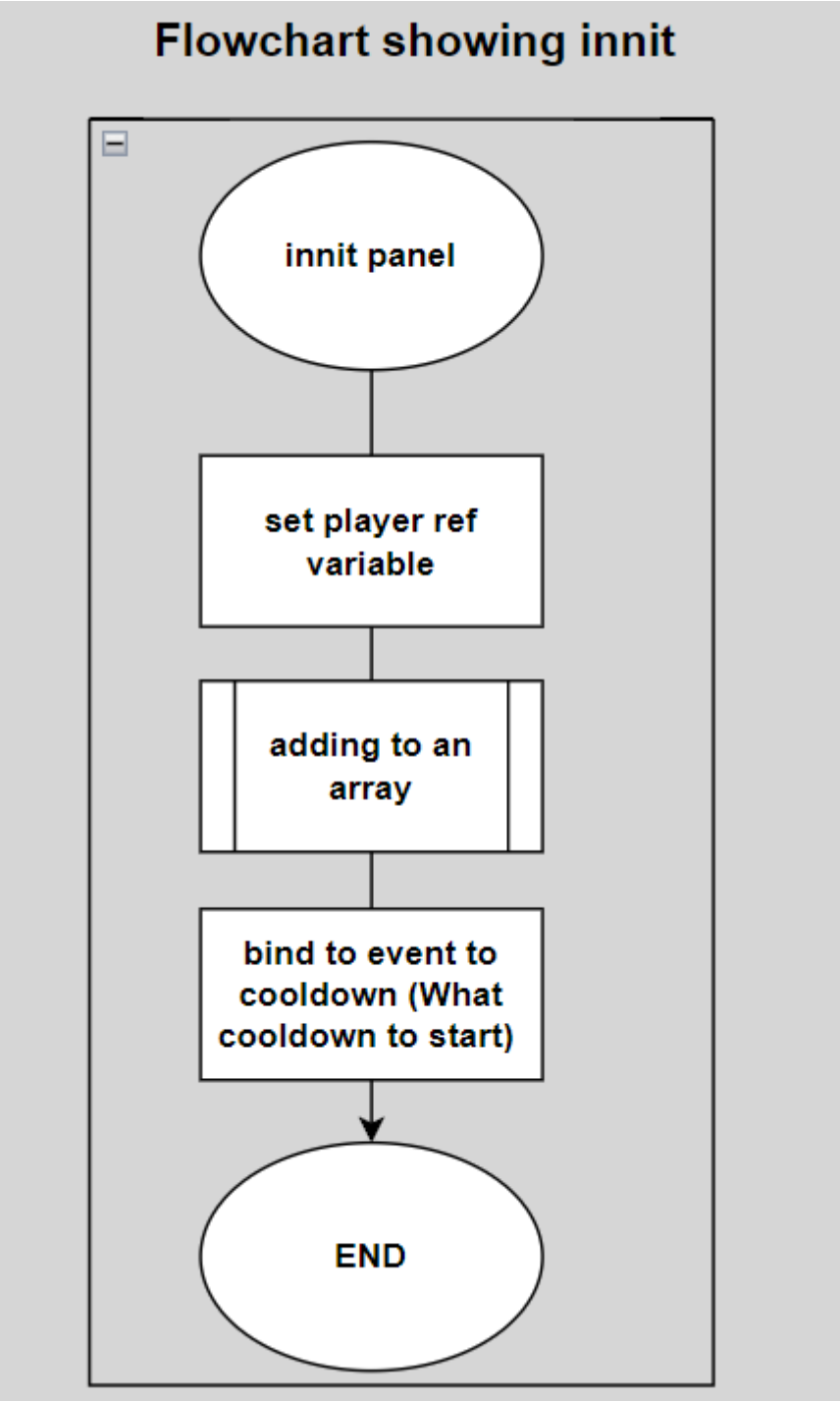


Flowcharts showing on screen event is called

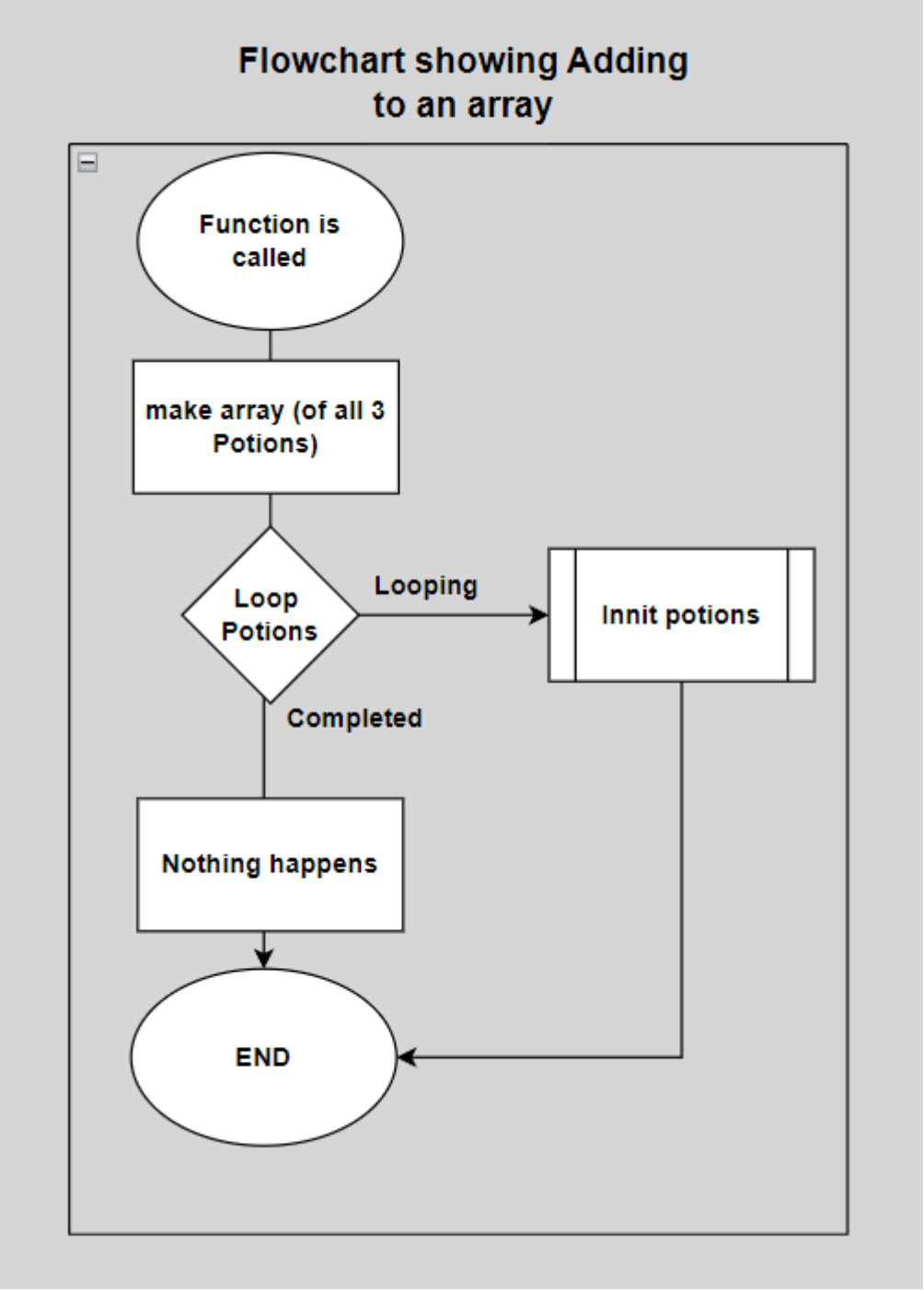


All Flowcharts and IA diagrams for potion panel

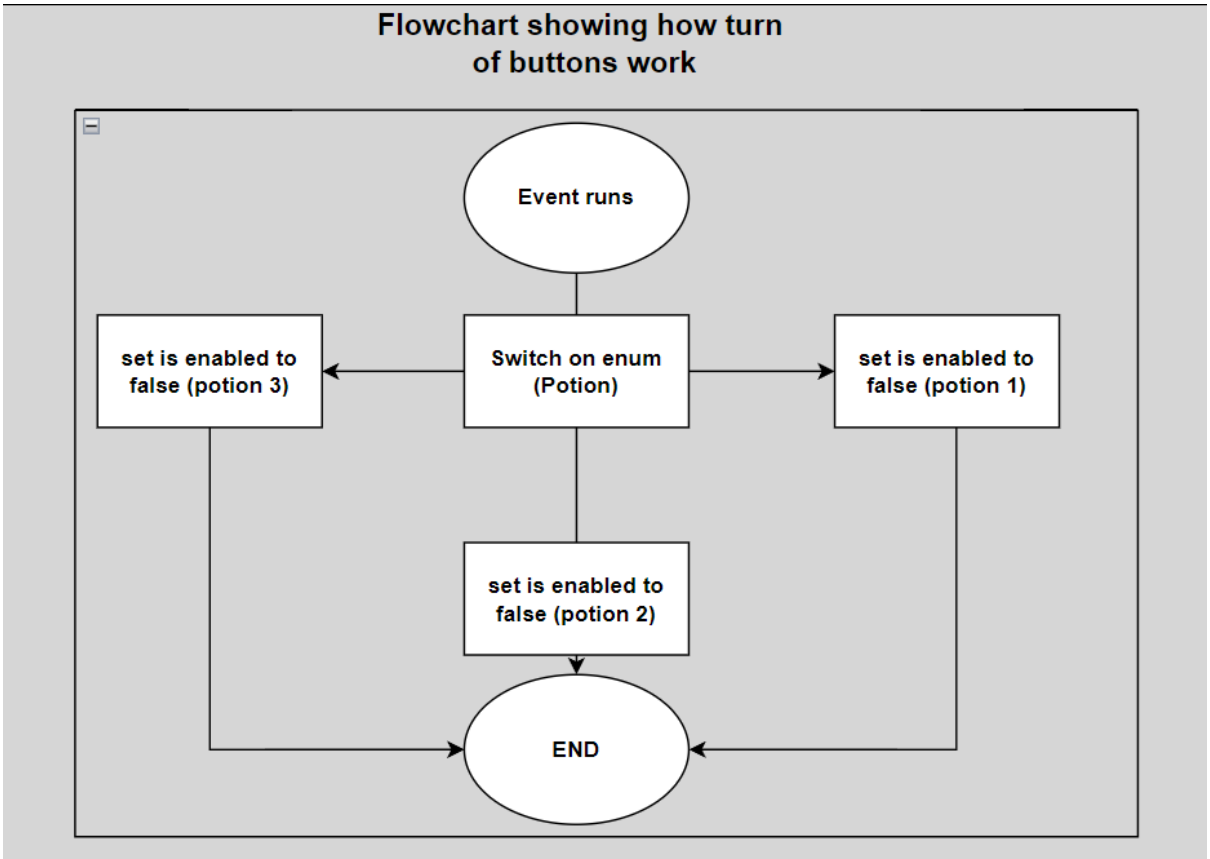
Flowcharts showing Innit



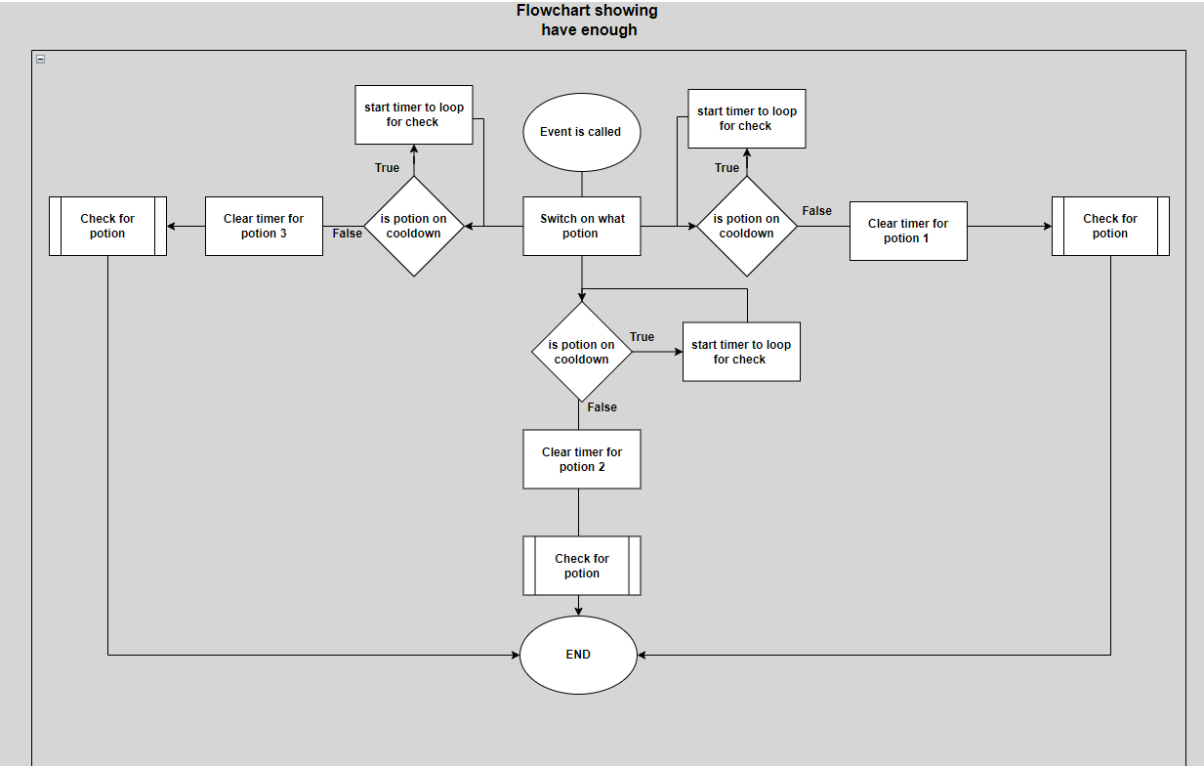
Flowcharts showing adding to an array



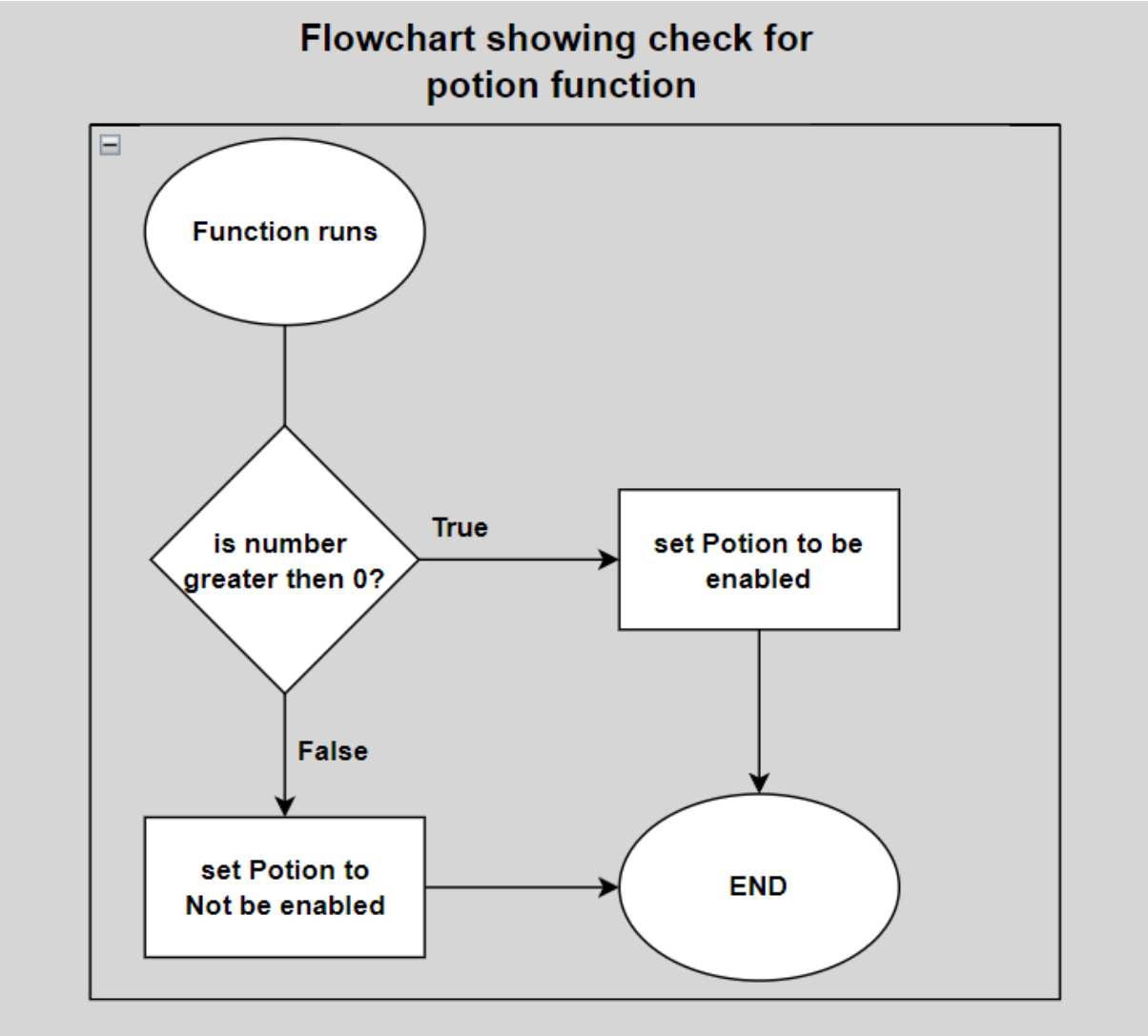
Flowcharts showing How turn of buttons work



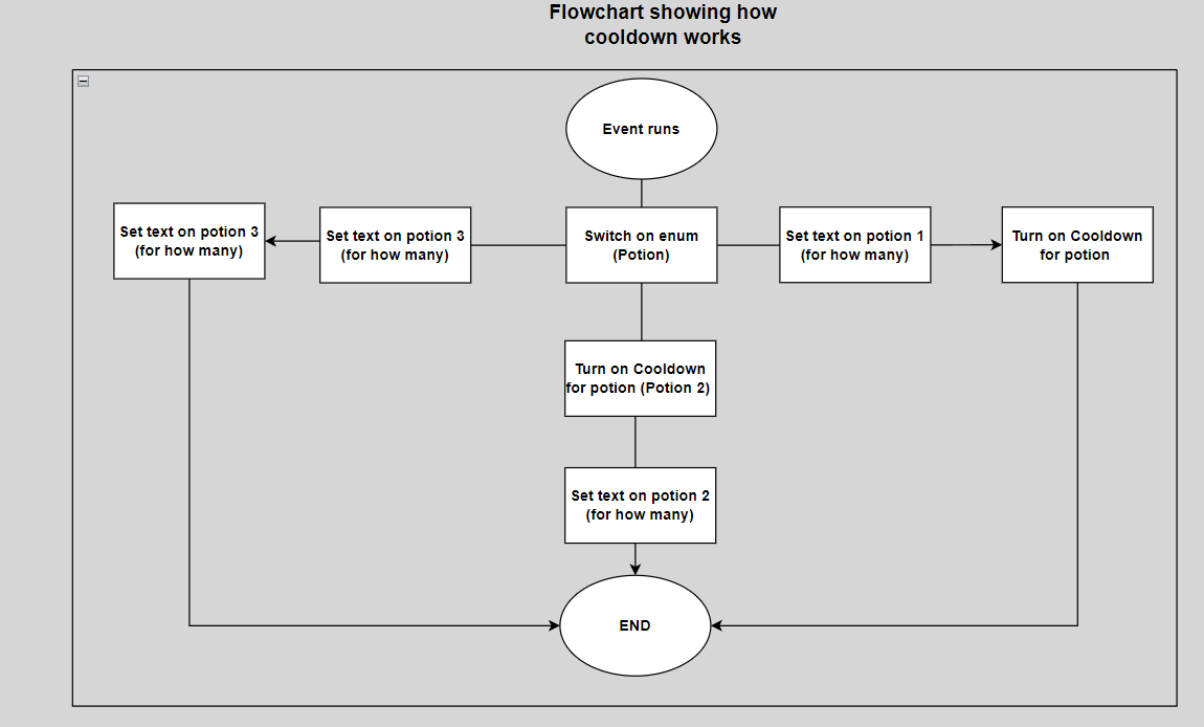
Flowcharts showing have enough function


Flowchart showing have enough
start timer to loop for check
Event is called
start timer to loop for check
True
True
Check for potion
Clear timer for potion 3
False
is potion on cooldown
Switch on what potion
is potion on cooldown
False
Clear timer for potion 1
Check for potion
is potion on cooldown
True
start timer to loop for check
False
Clear timer for potion 2
Check for potion
END

Flowcharts showing check for potion function

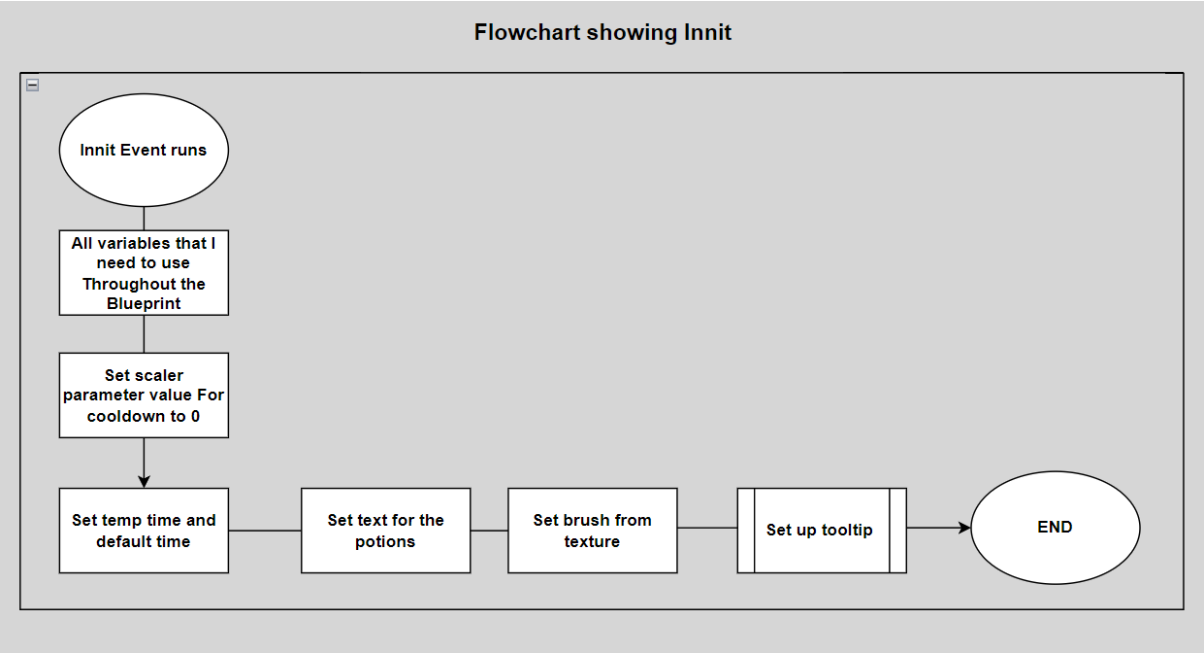


Flowcharts showing how cooldown works

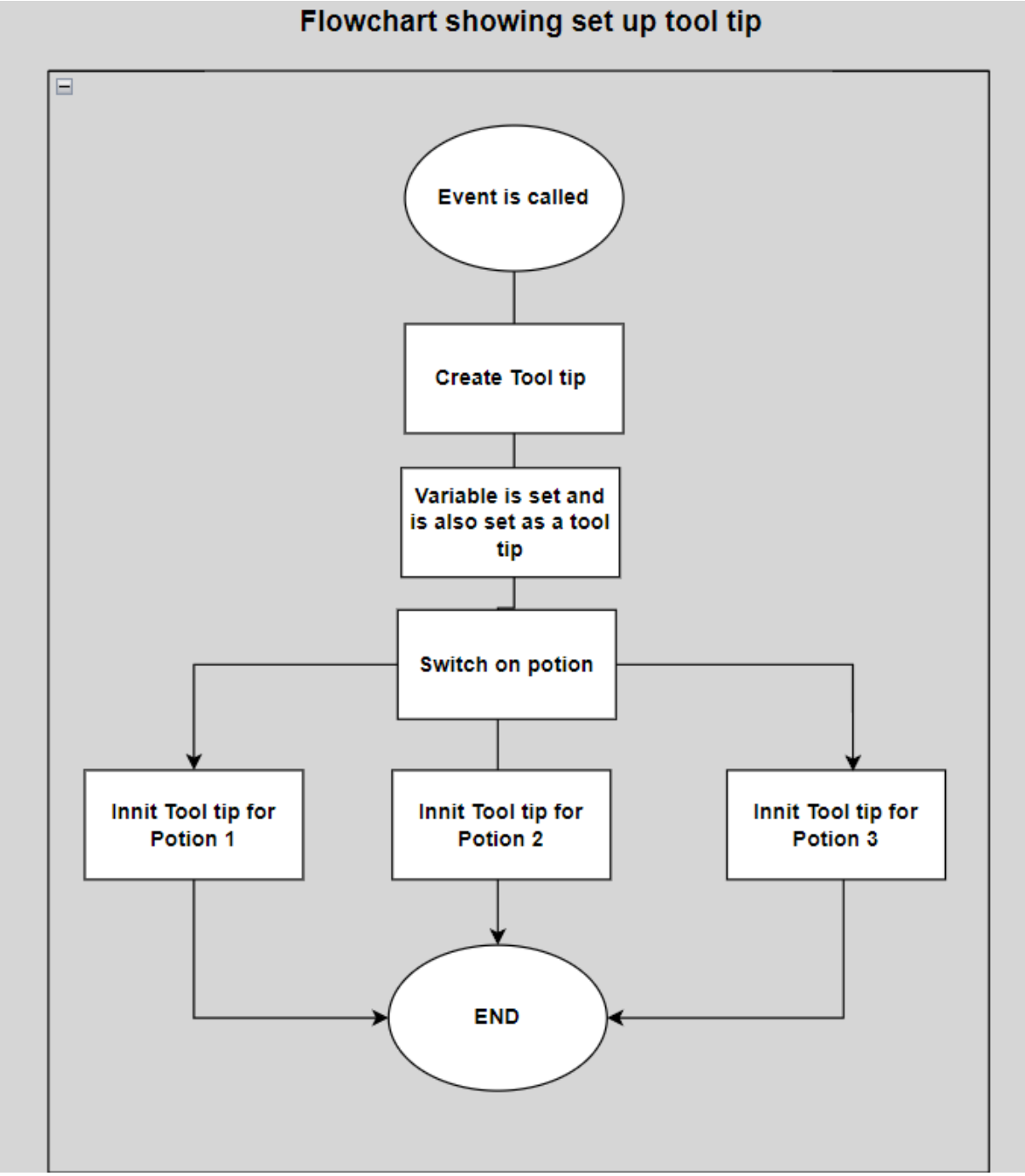


All Flowcharts and IA diagrams for potions

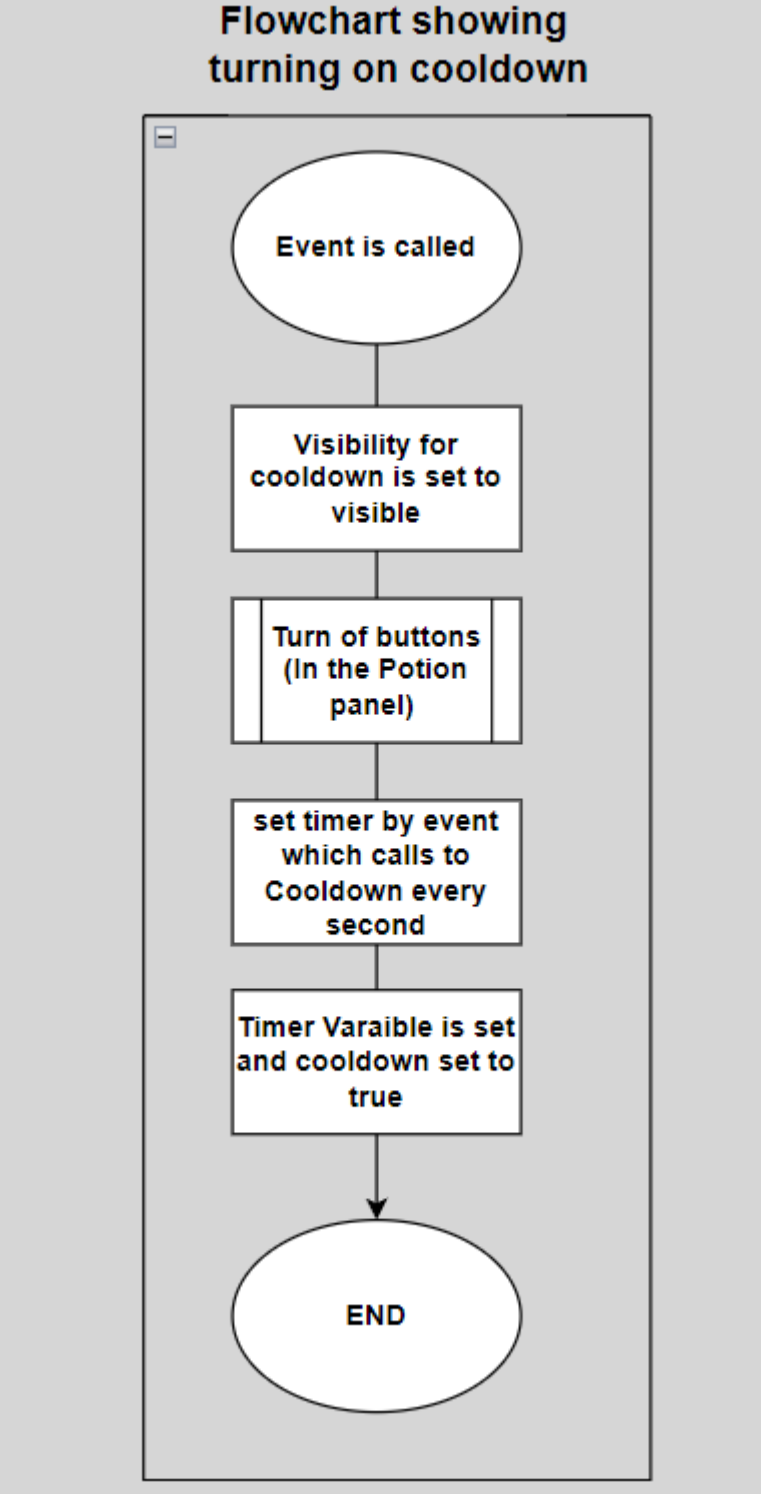
Flowchart showing Innit



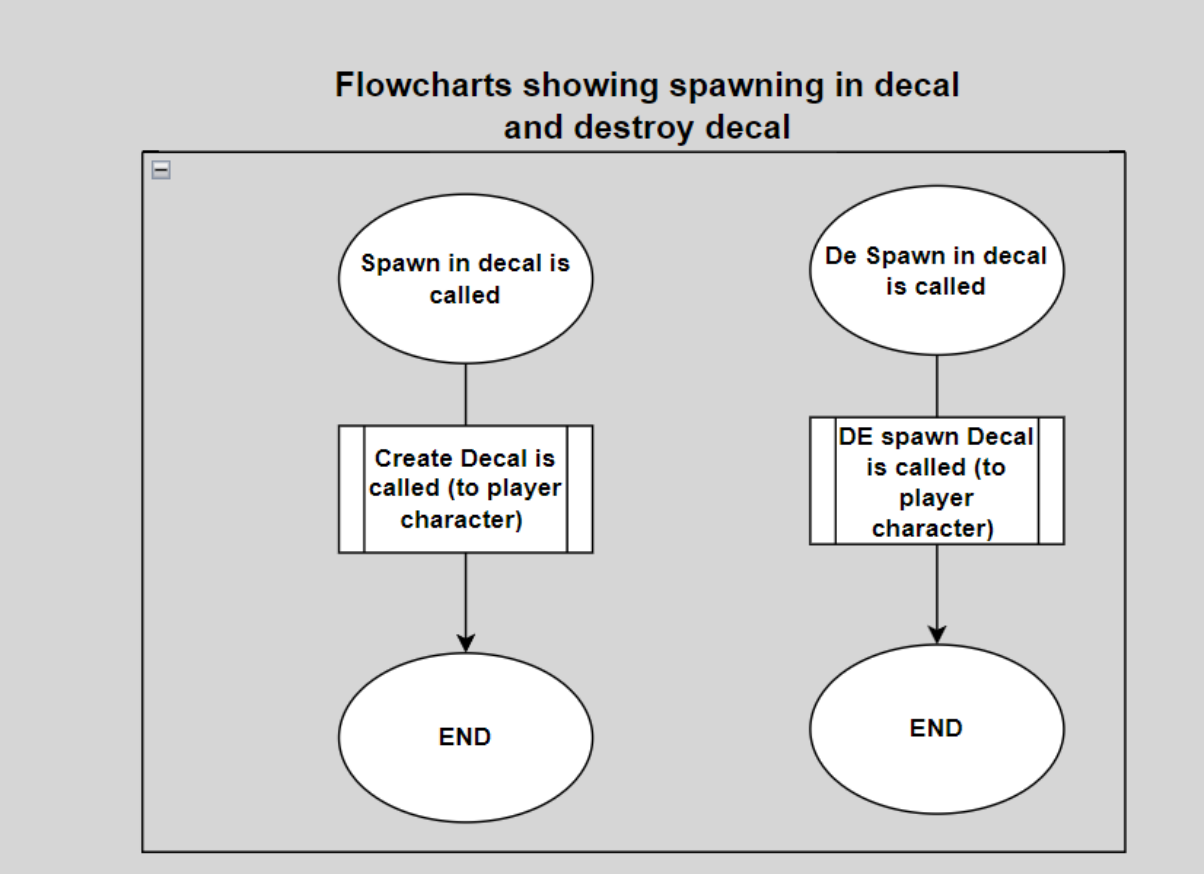
Flowchart showing set up tool tip



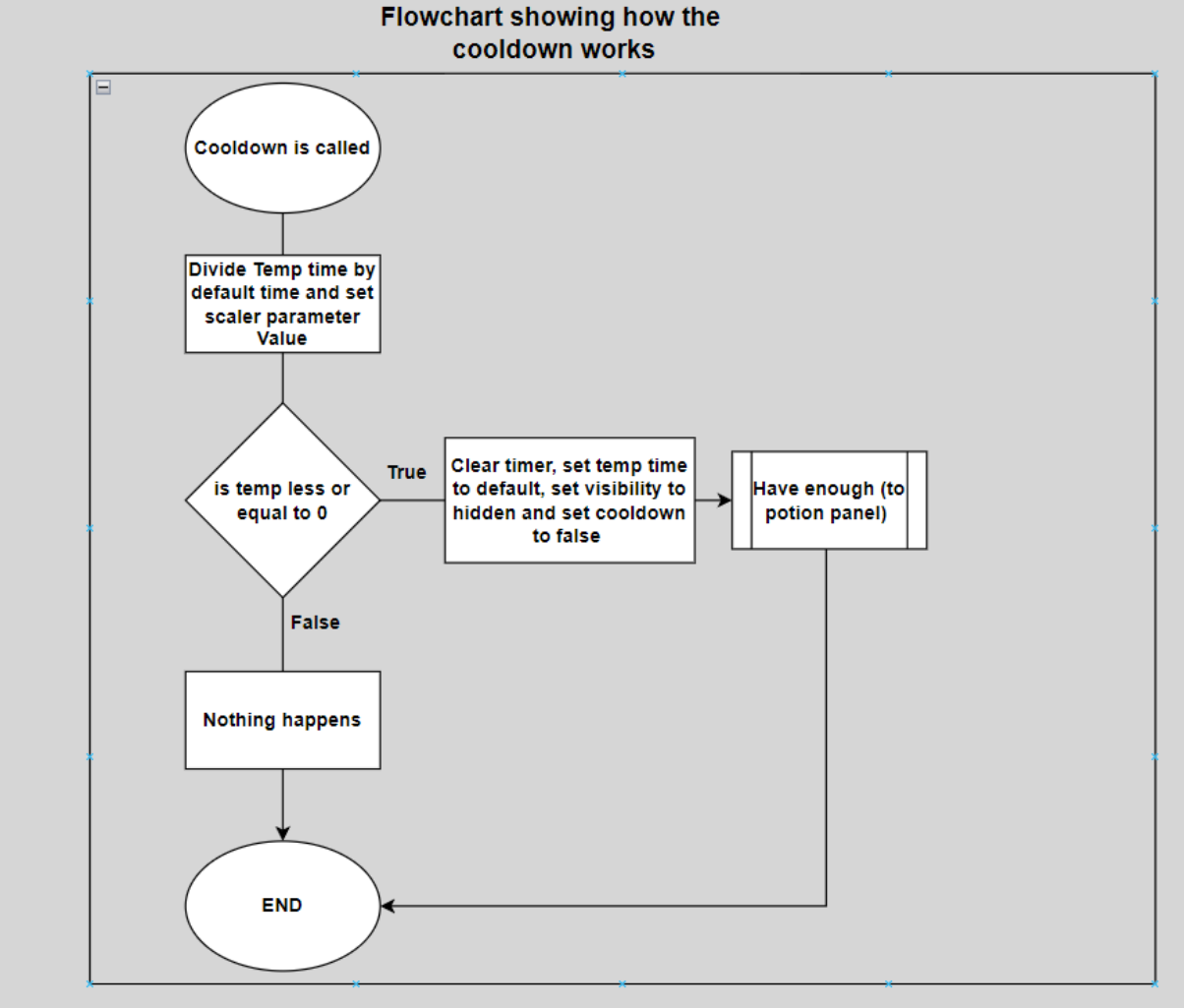
Flowchart showing Turning on cooldown



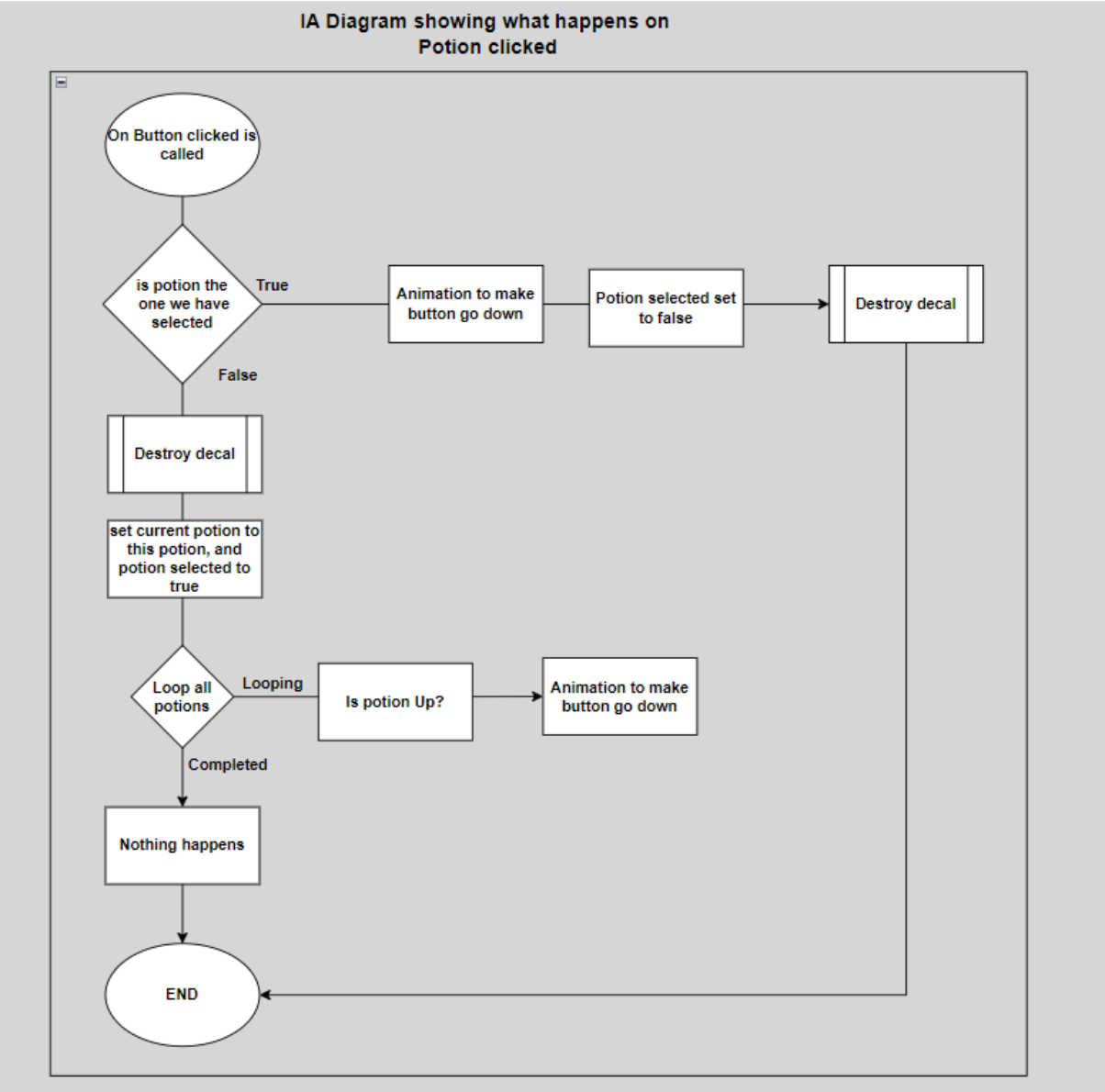
Flowchart showing spawning in decal and destroy decal



Flowchart showing how cooldown works

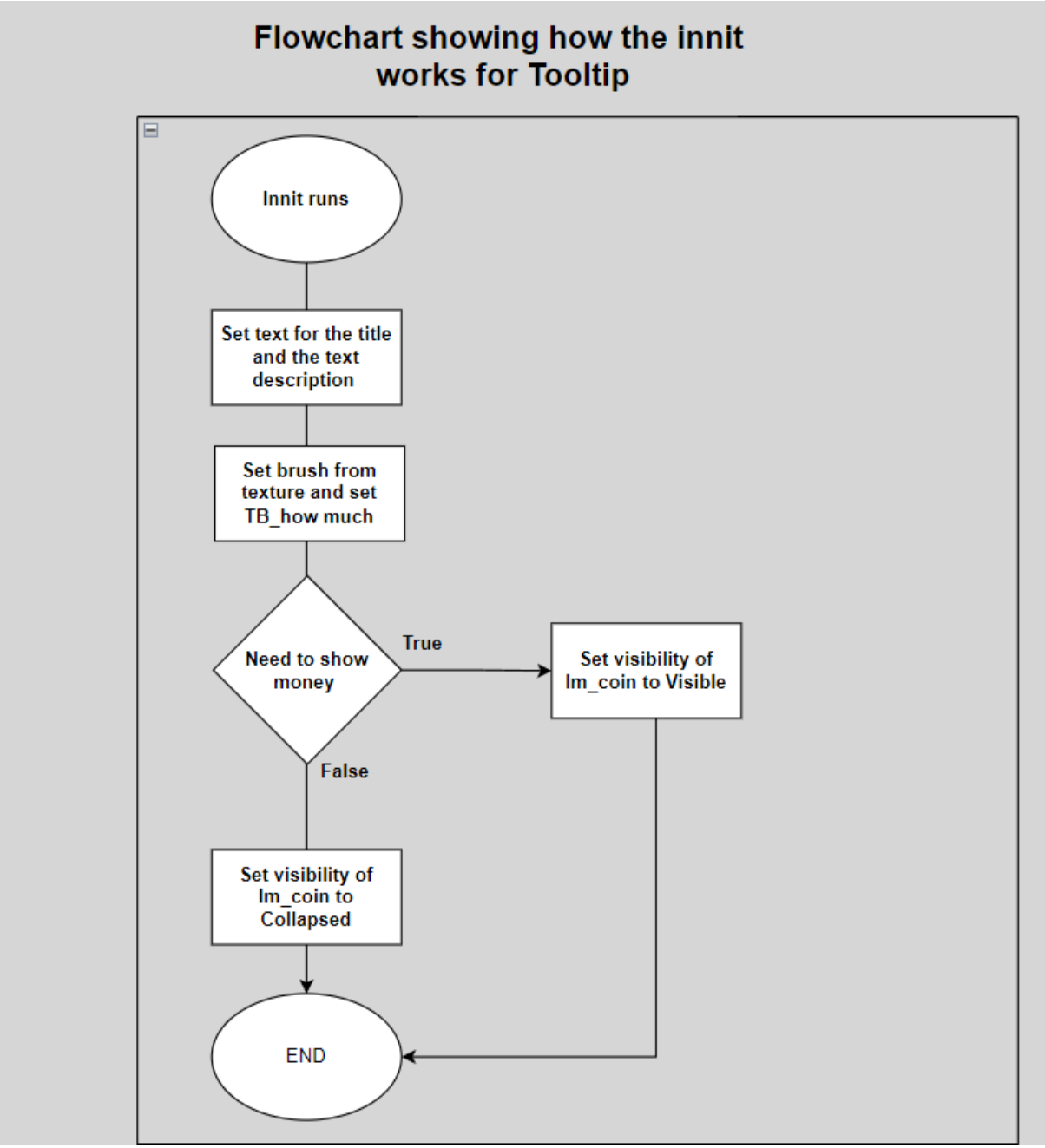


IA Diagram showing what happens when potion clicked



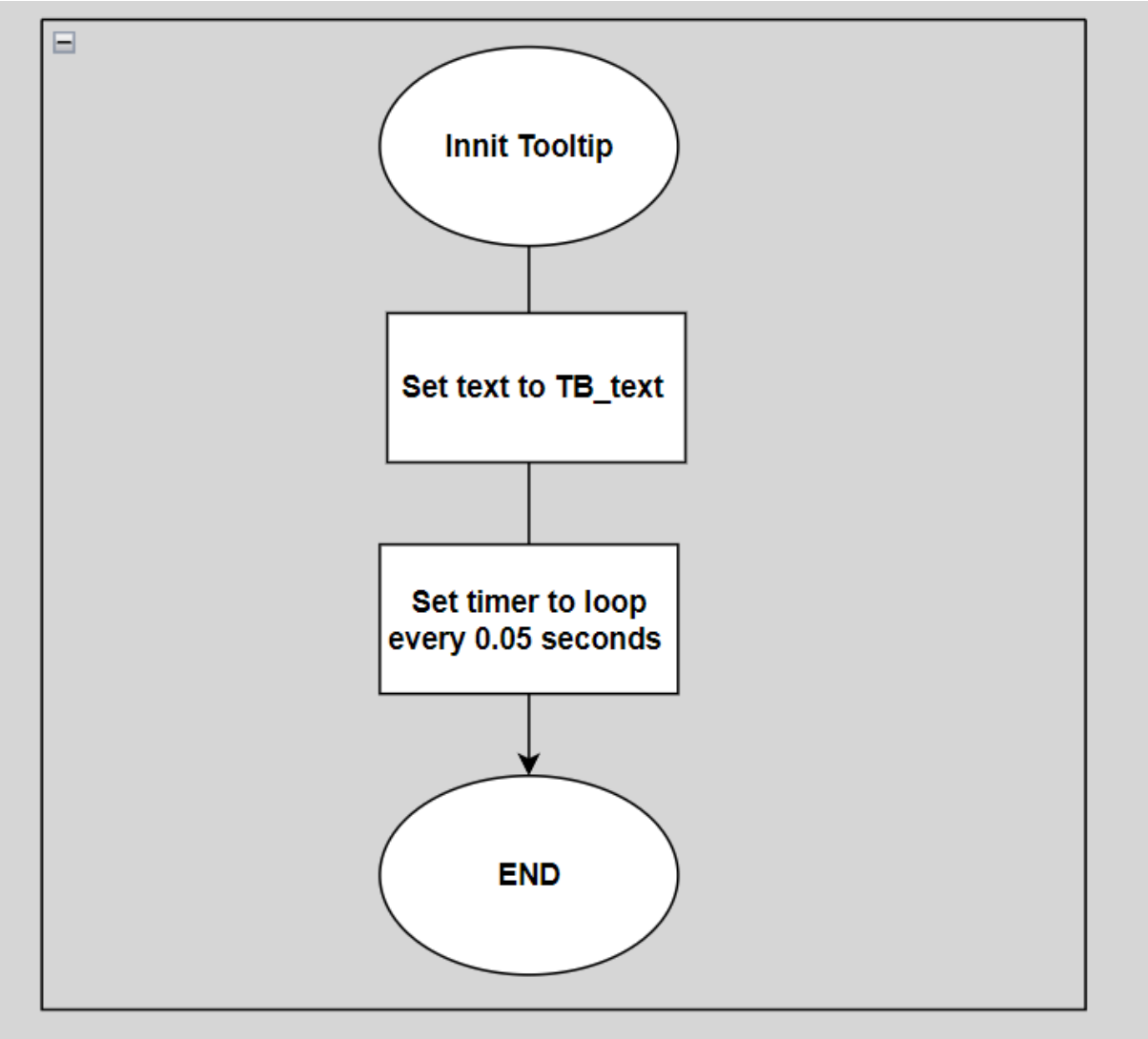
All Flowchart for Tooltip

Flowchart showing how innit works for tooltip



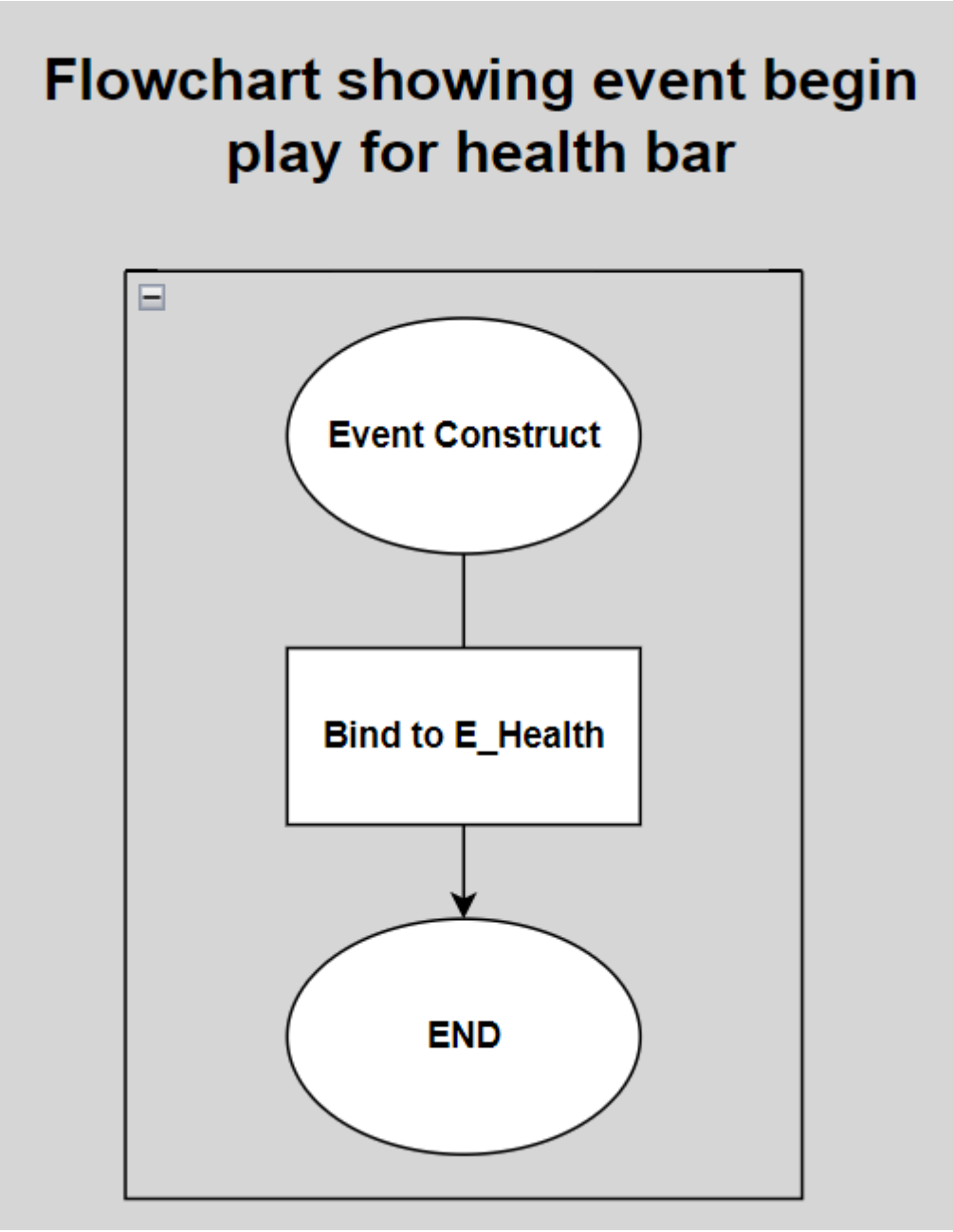
All Flowcharts for WBP_Build here

Flowchart showing innit WBP_Build here

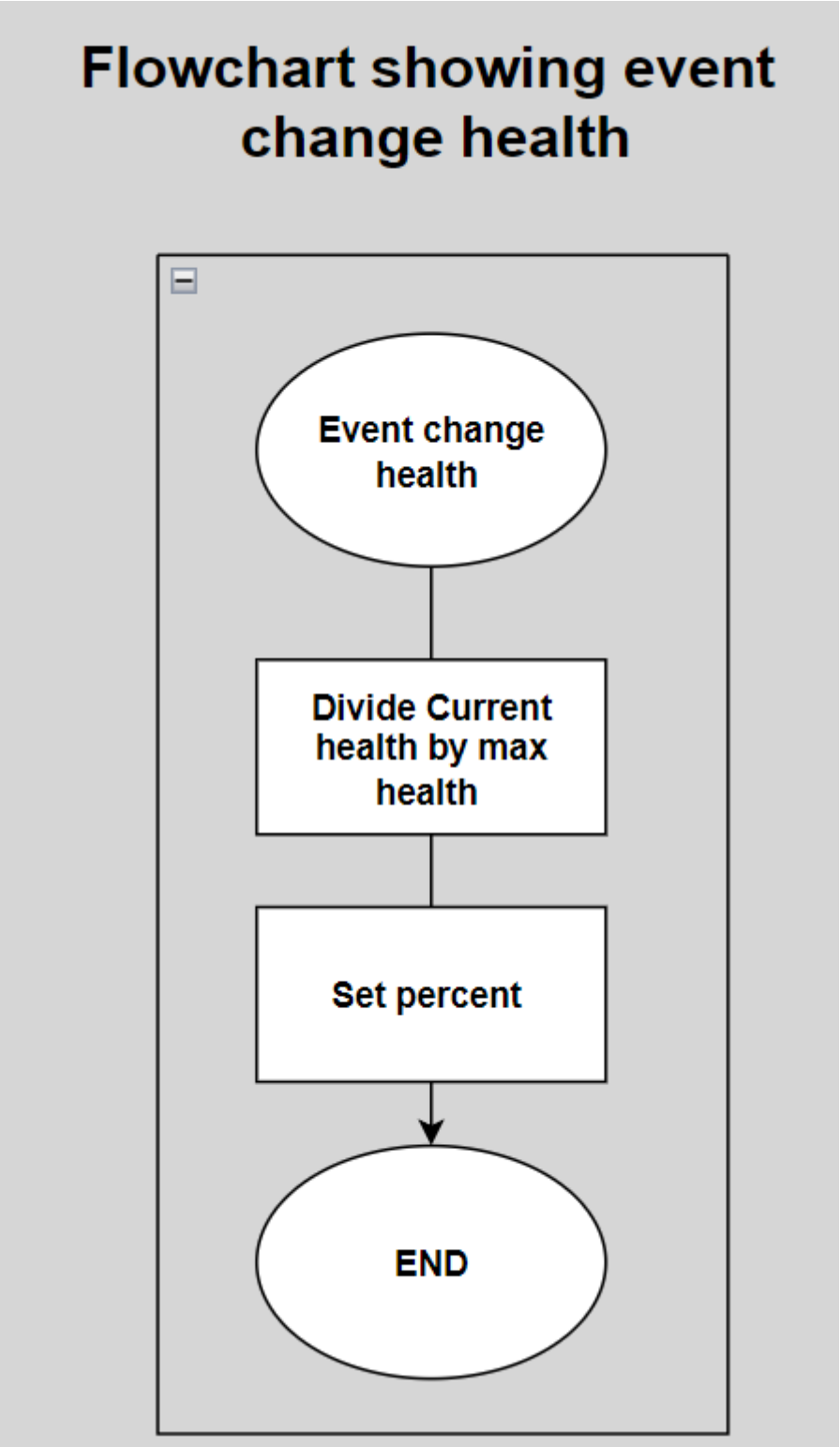


All Flowchart for enemy Health bar

Flowchart showing event begin play for health bar

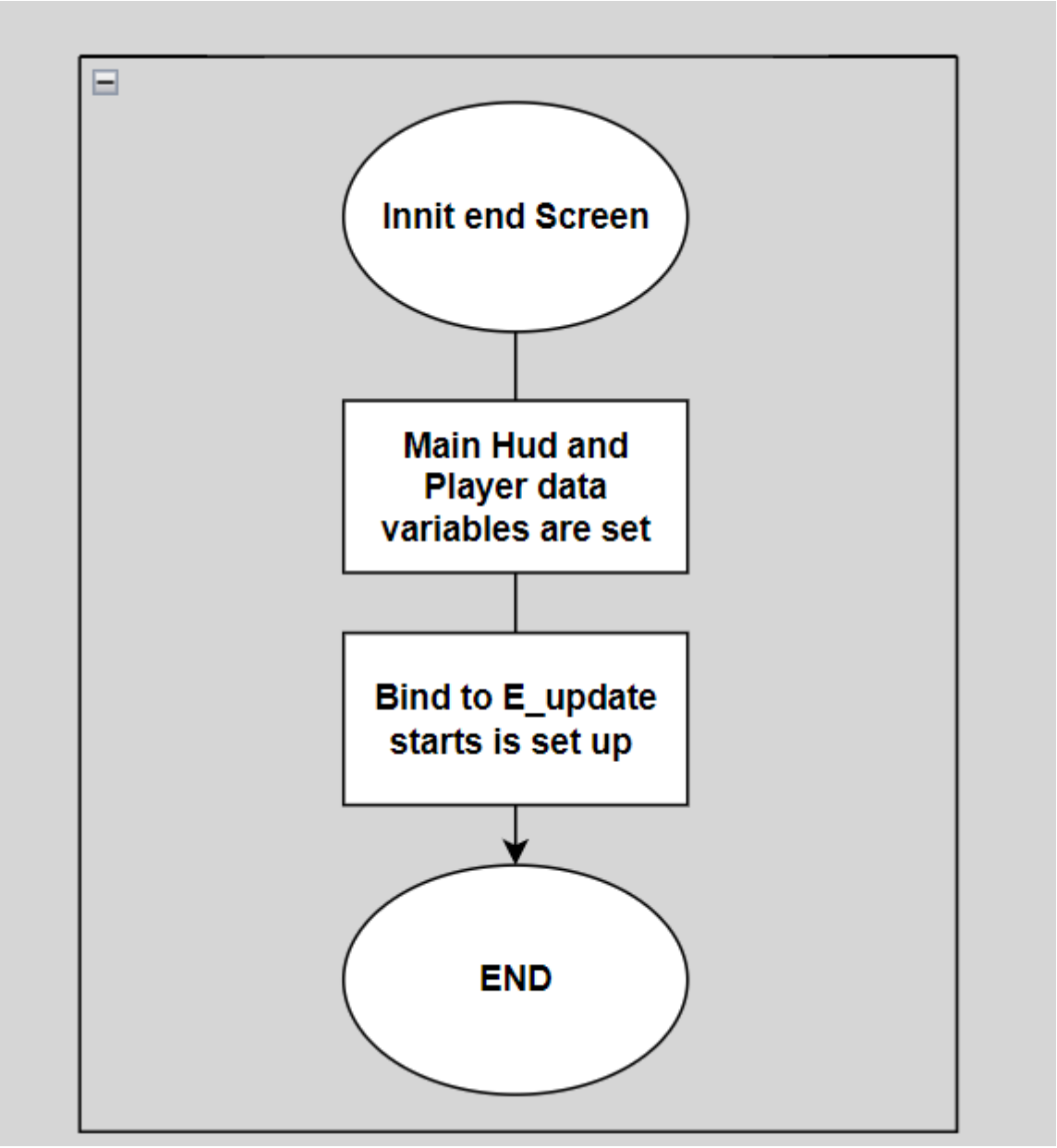


Flowchart showing change health event

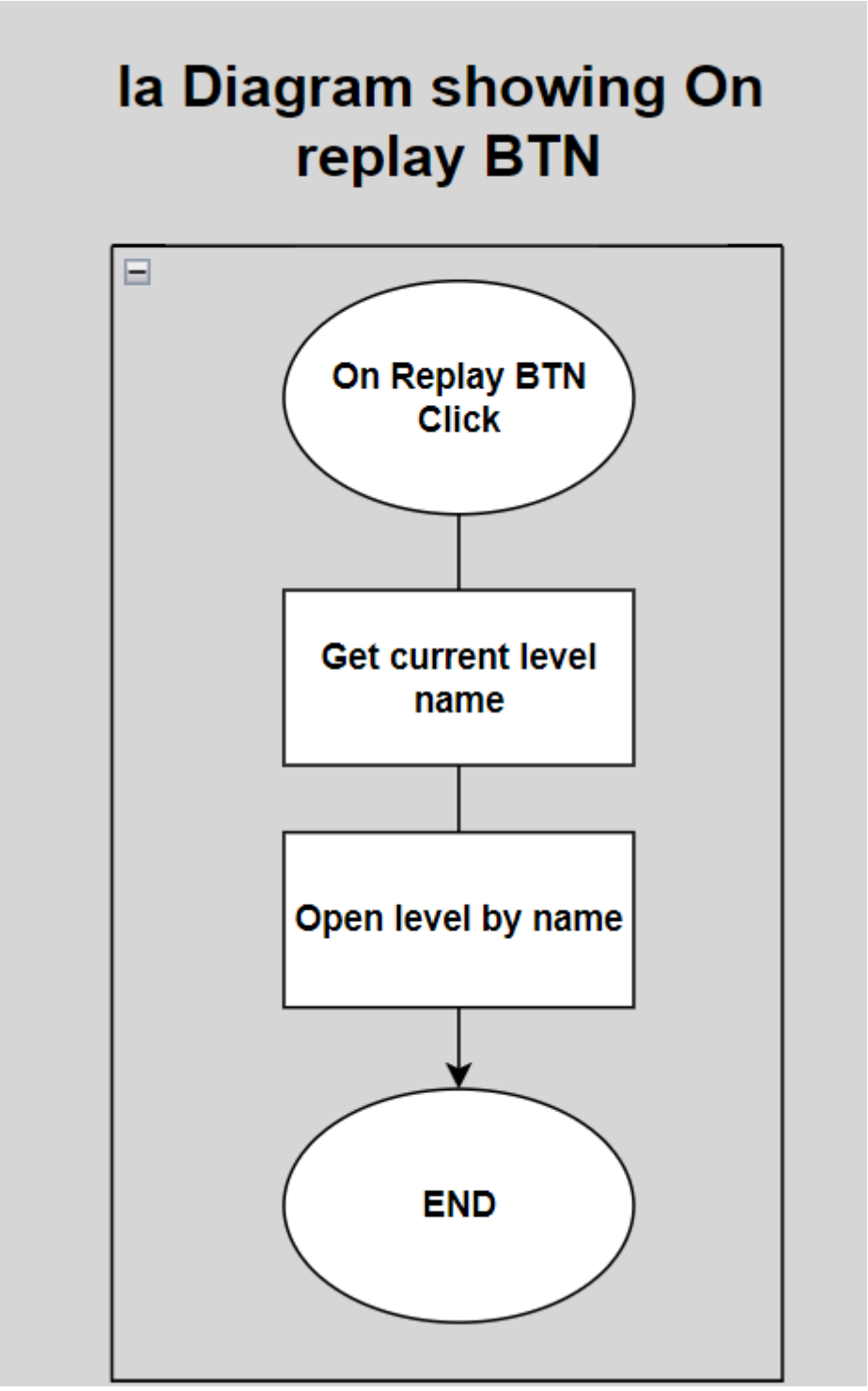


All Flowchart showing WBP_end screen

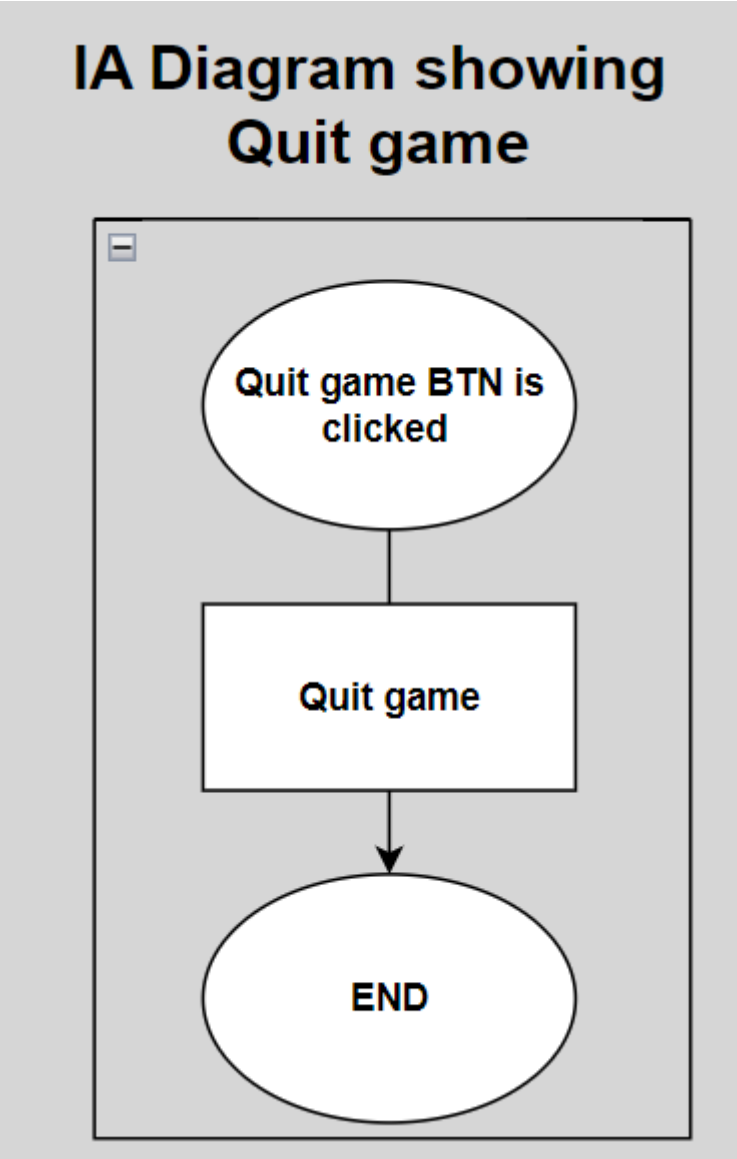
Flowchart showing Innit end Screen



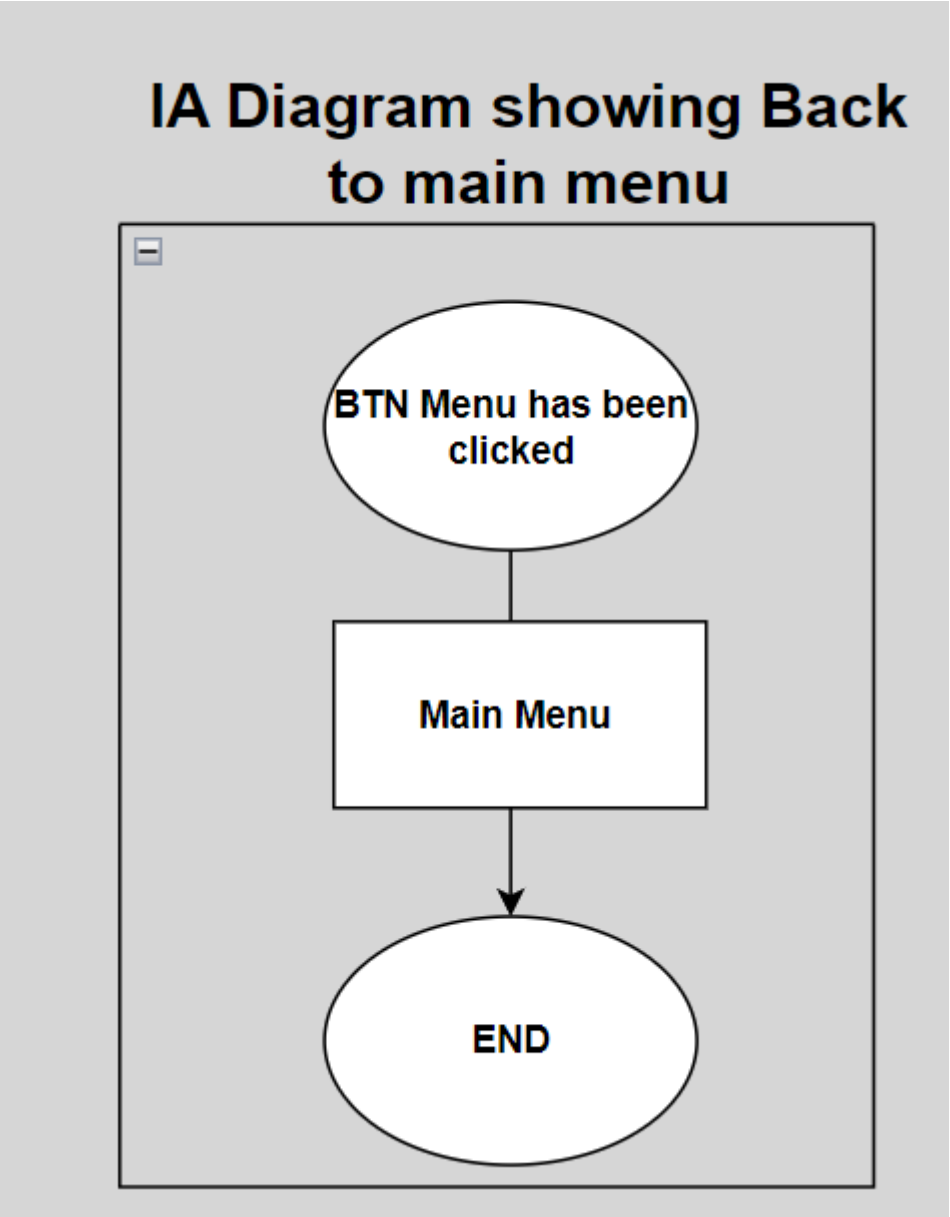
IA Diagram showing Replay BTN



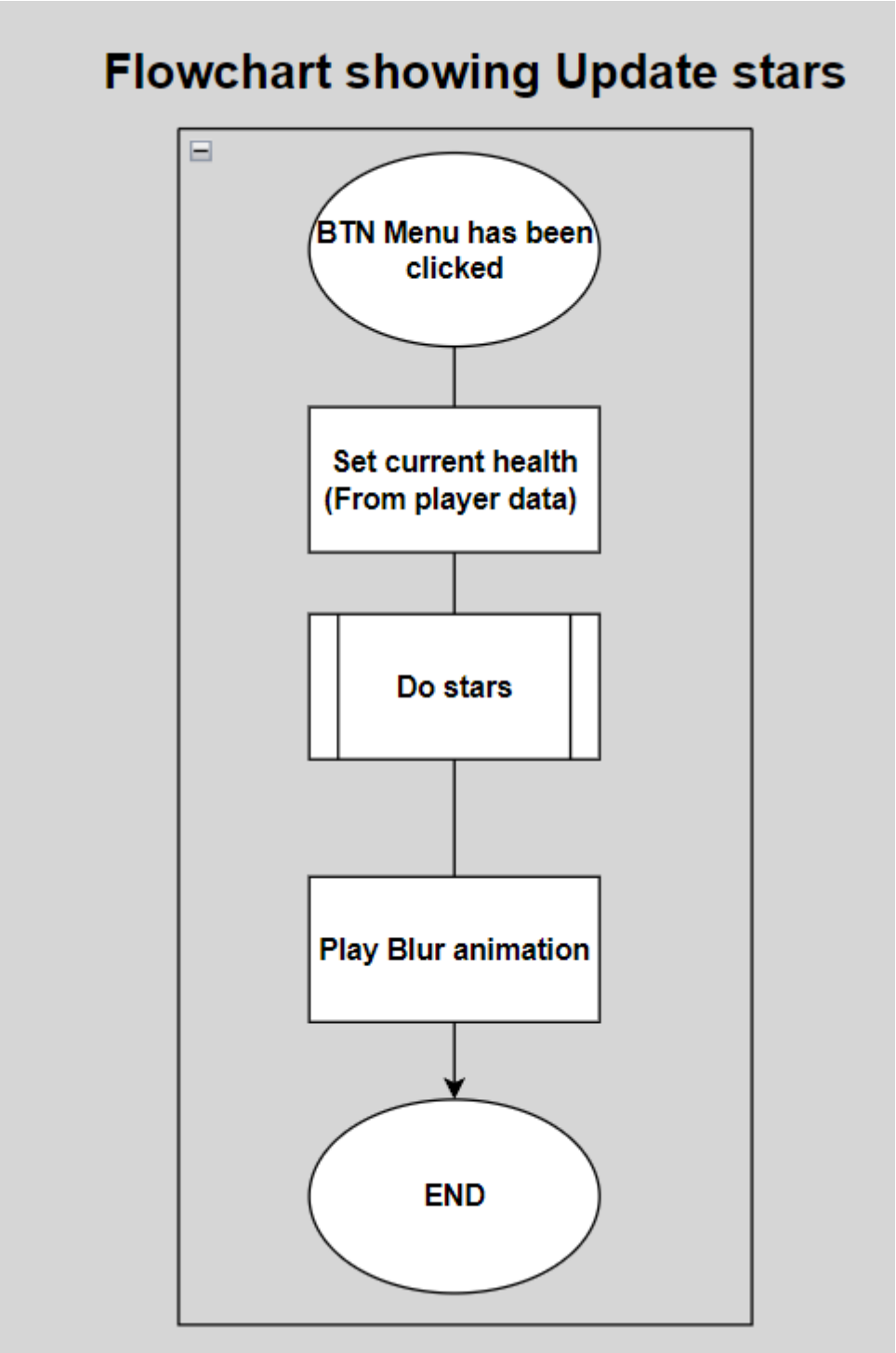
IA Diagram showing Quit game



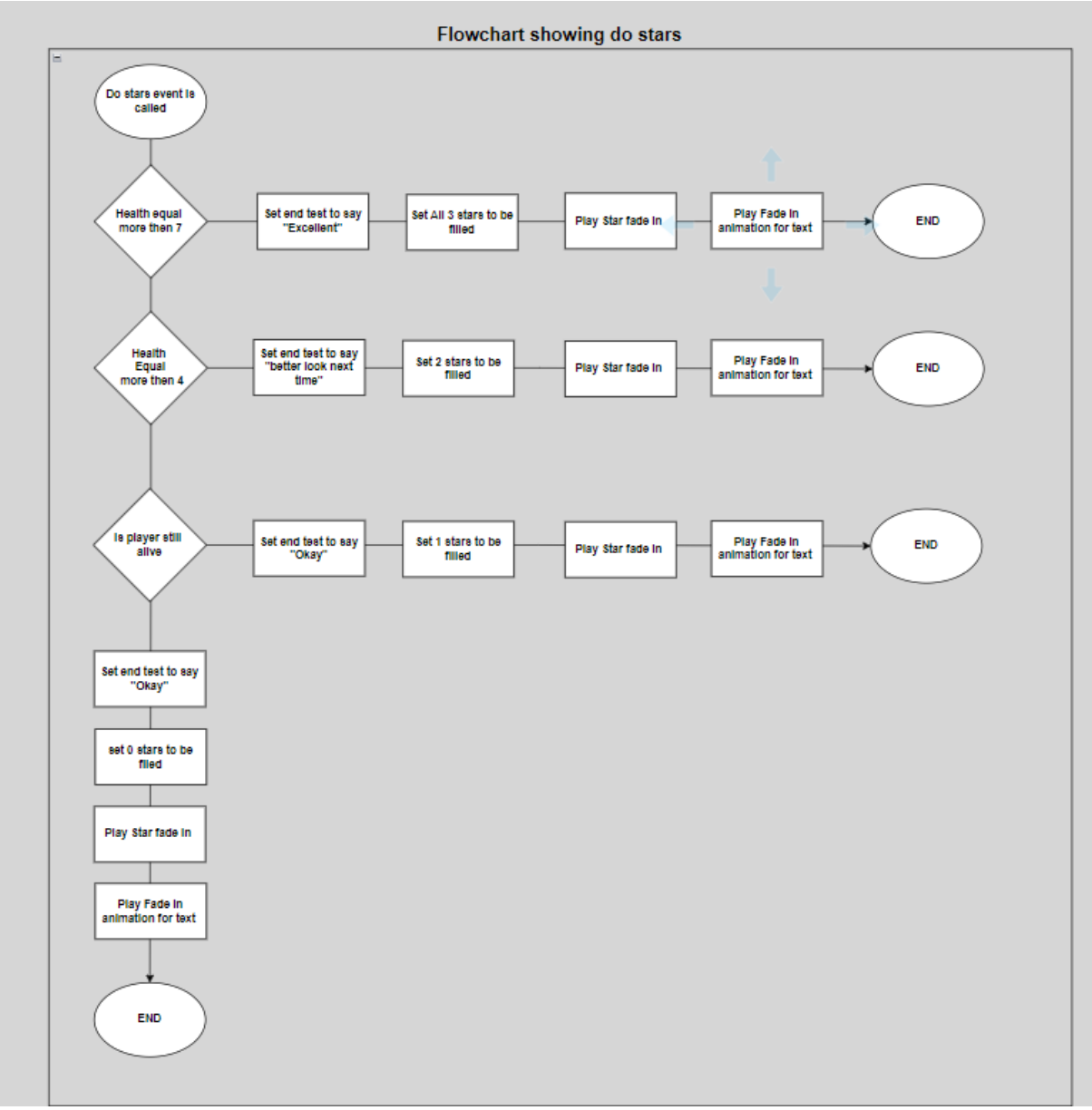
IA Diagram showing Main Menu



Flowchart showing Update stars

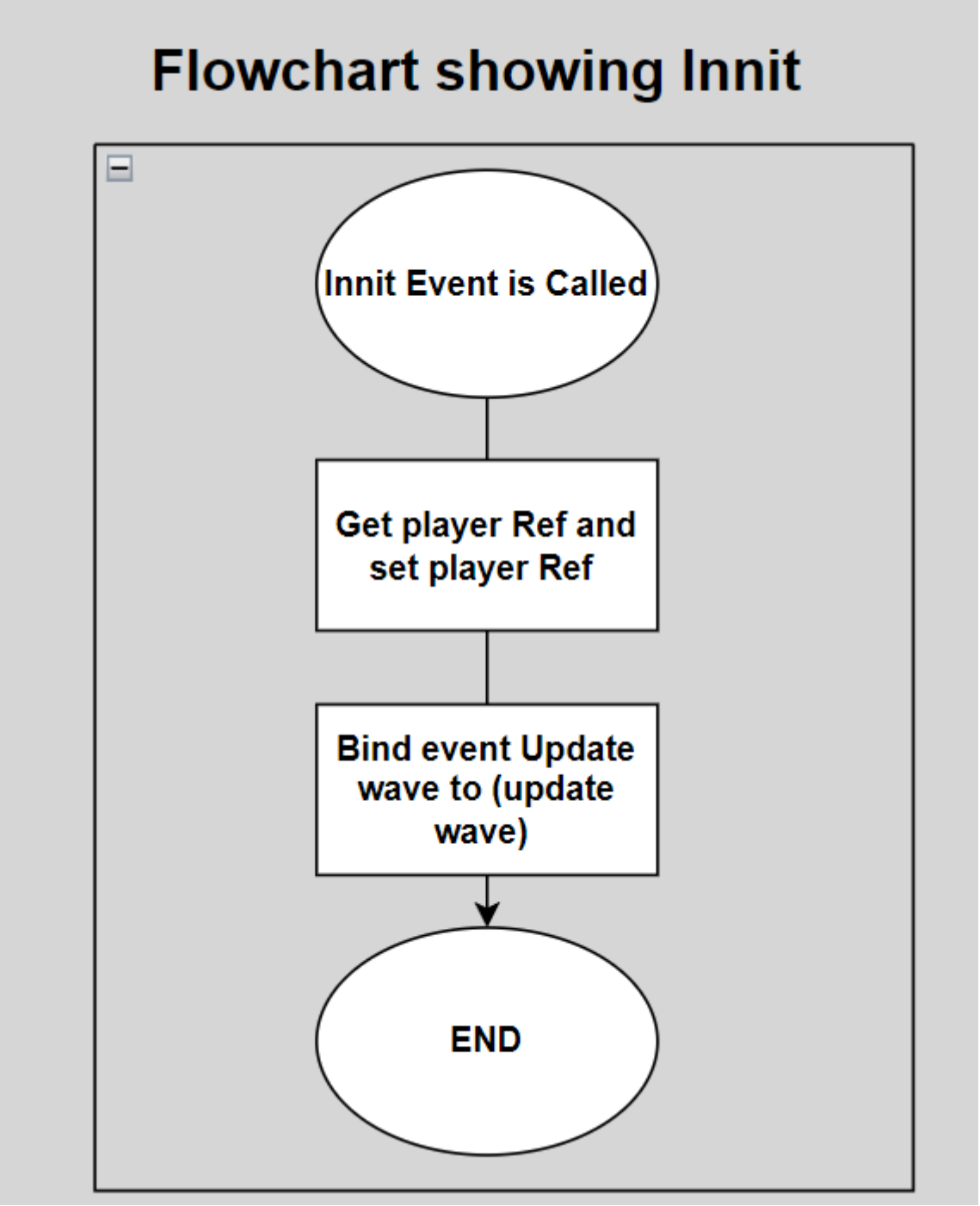


Flowchart showing do stars function

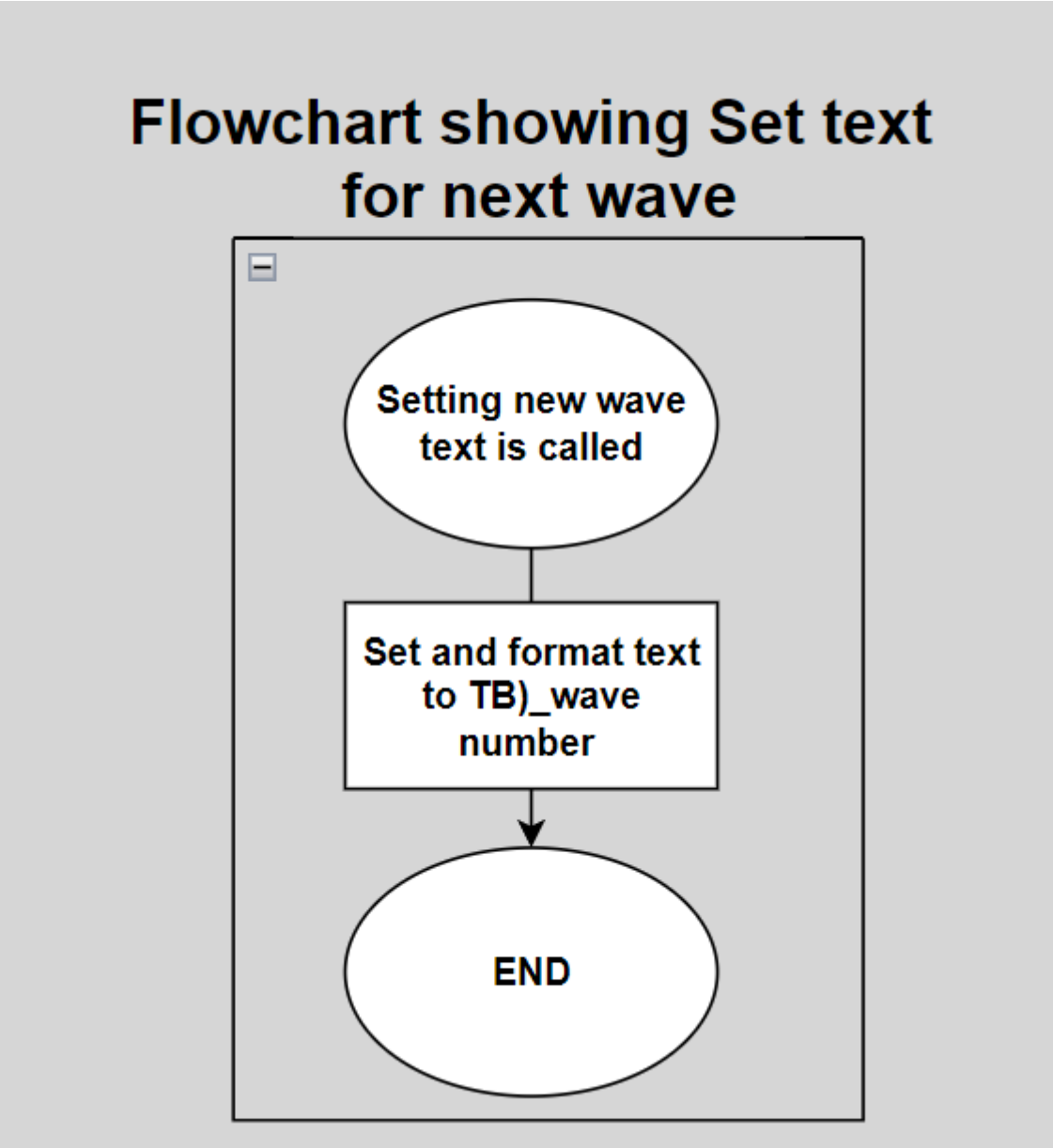


All Flowcharts for WBP wave

Flowchart showing Innit

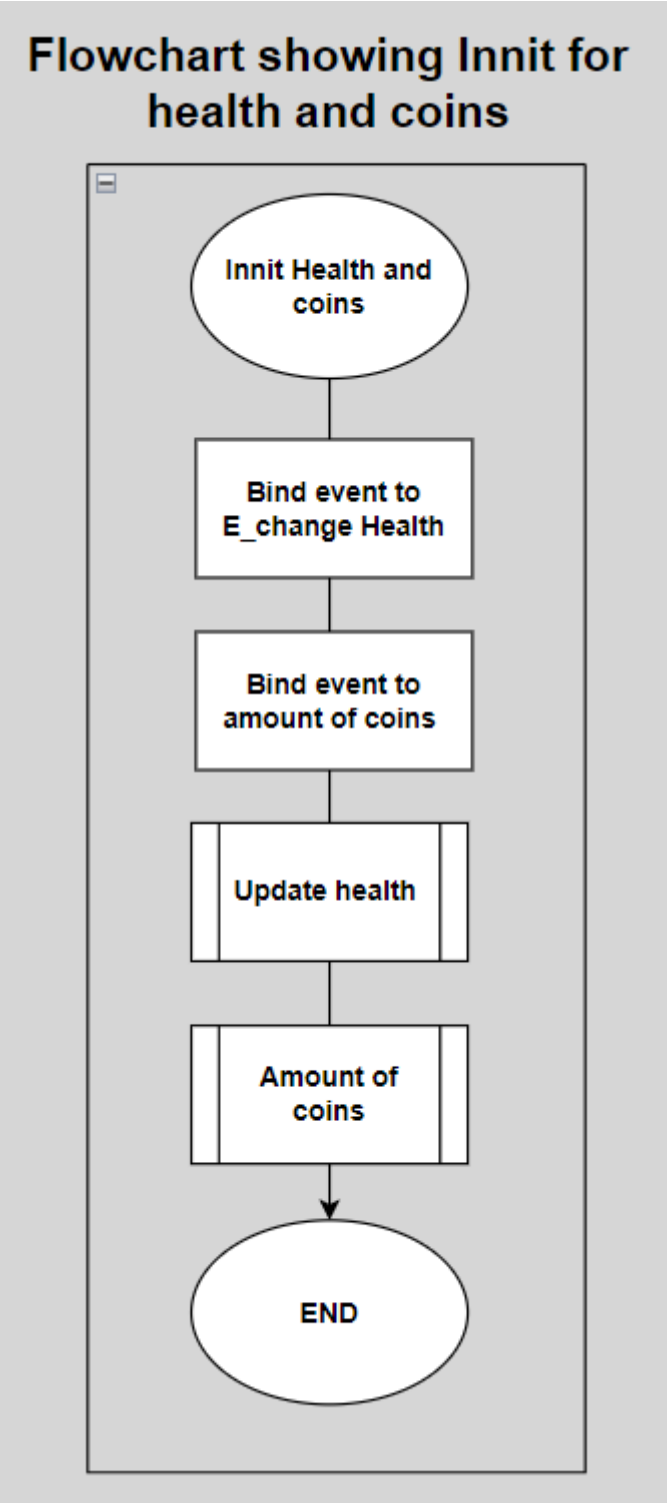


Flowchart showing Set text for next wave

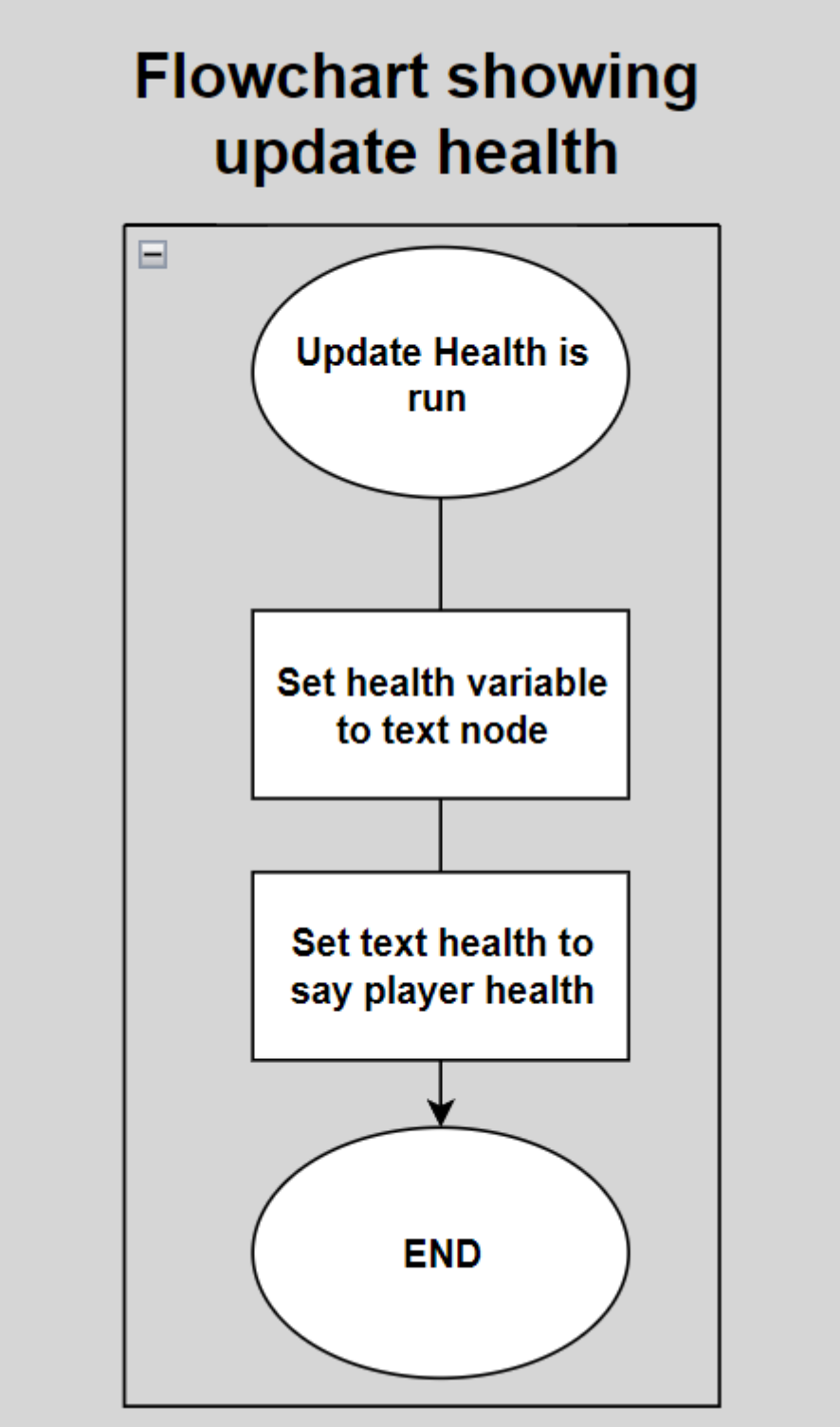


All Flowcharts for WBP_health and coins

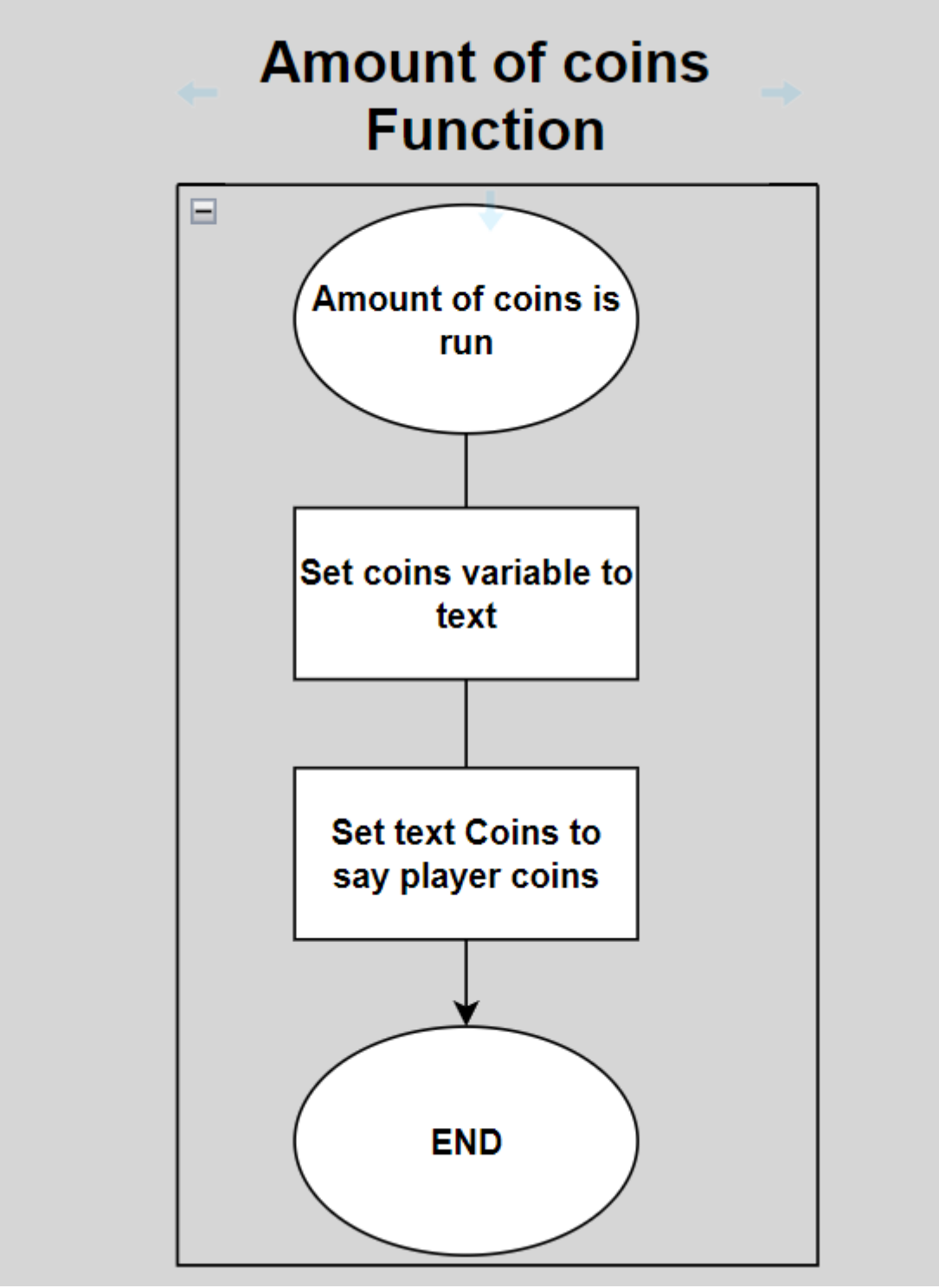
Flowchart showing Innit for health and coins



Flowchart showing Update health

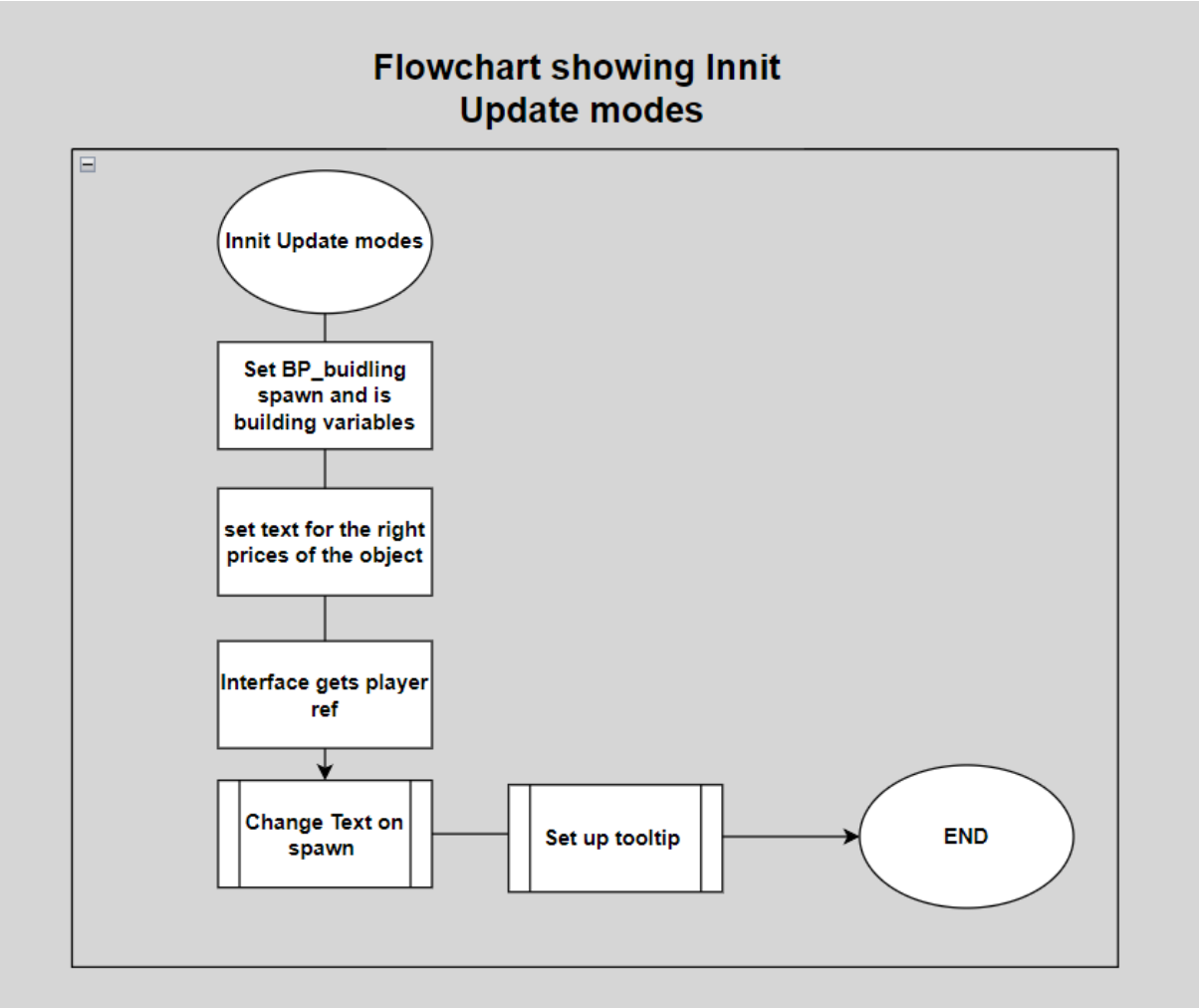


Amount of coins function

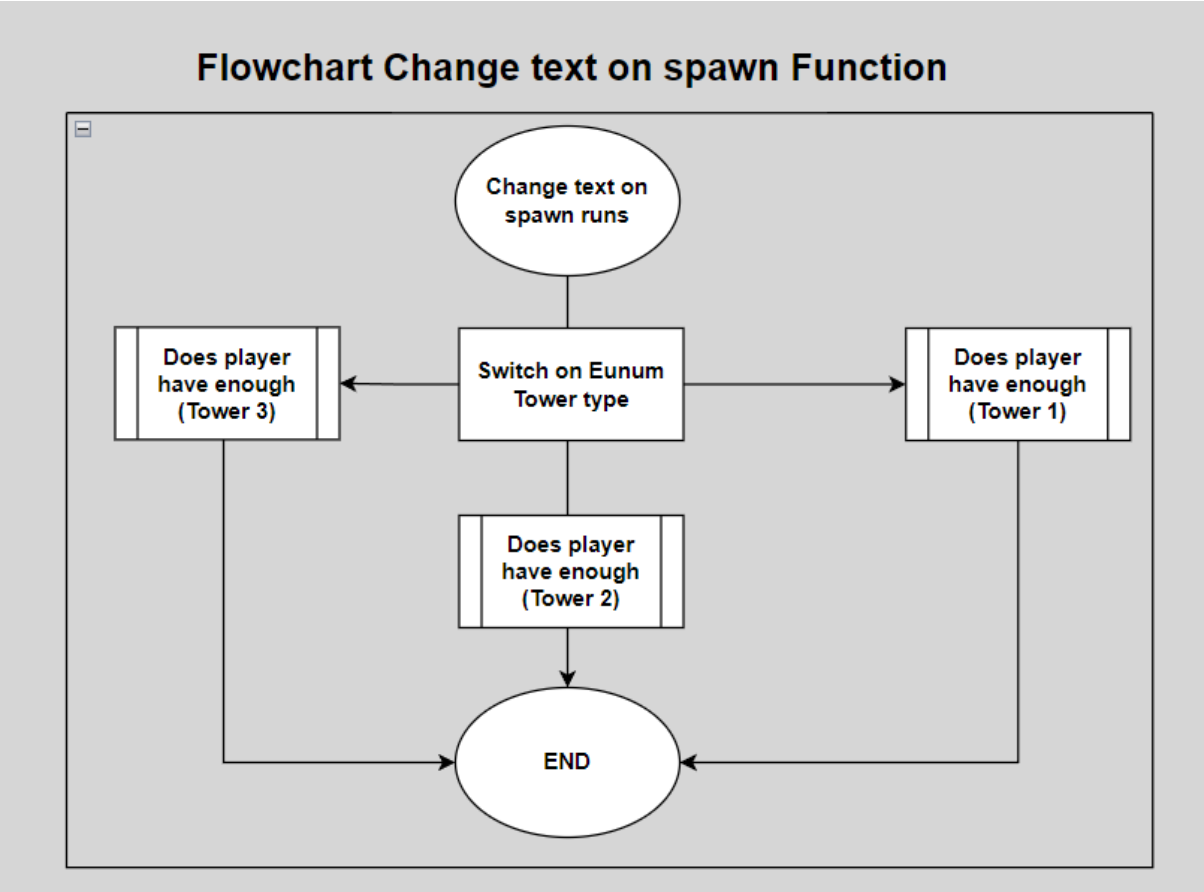


All Flowchart showing WBP_place UI

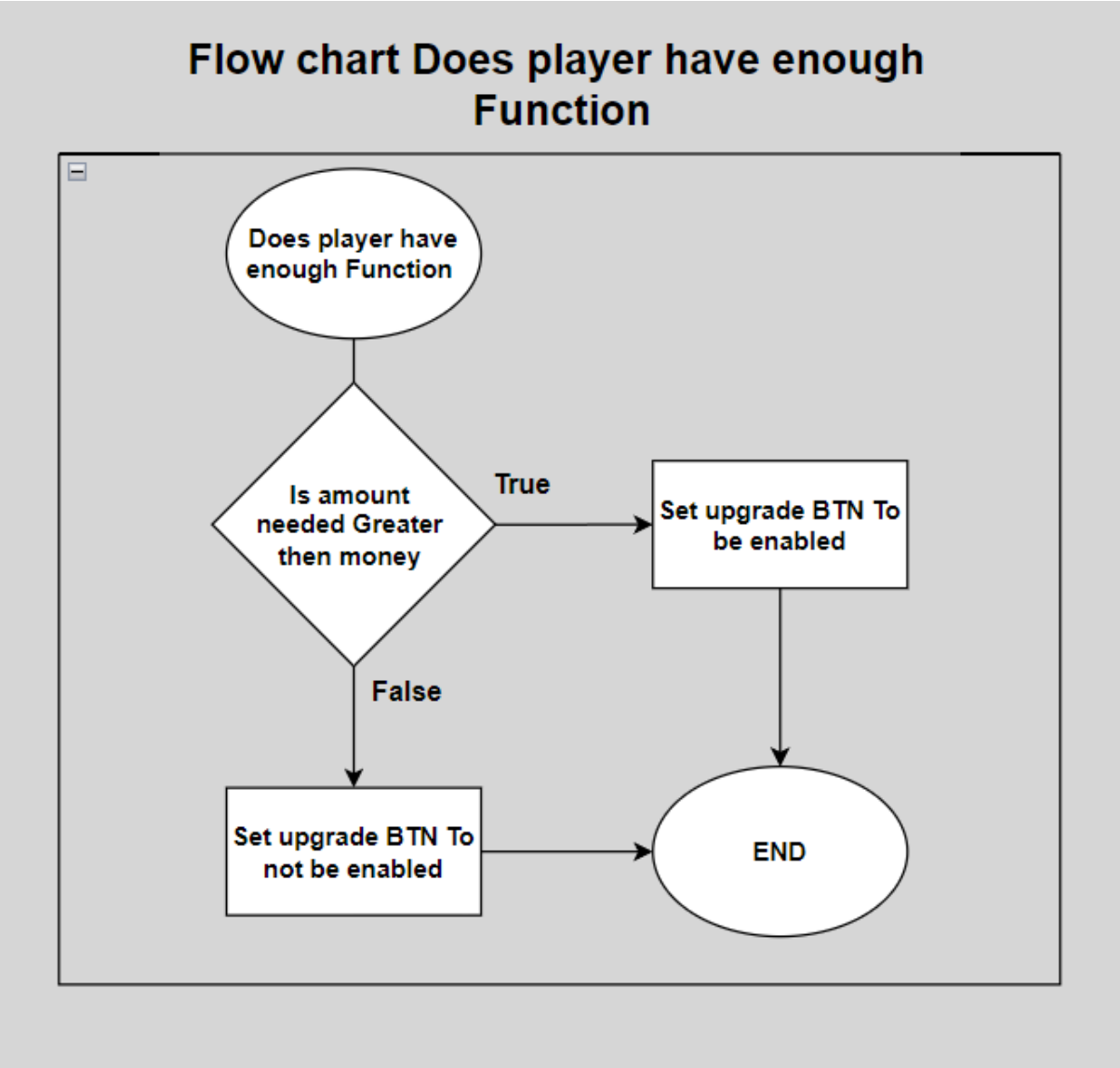
Flowchart showing Update modes



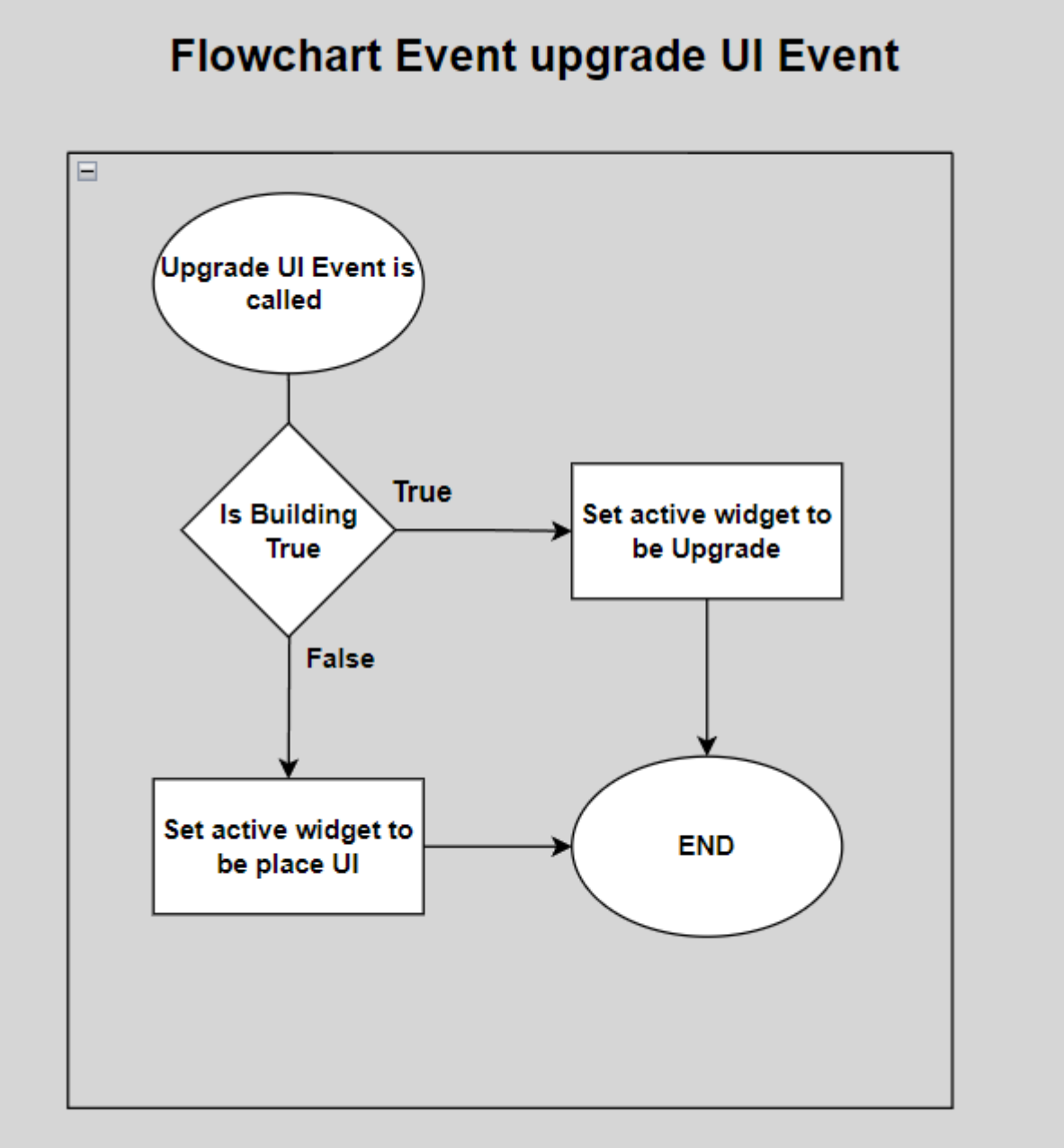
Flowchart showing Change text on spawn function



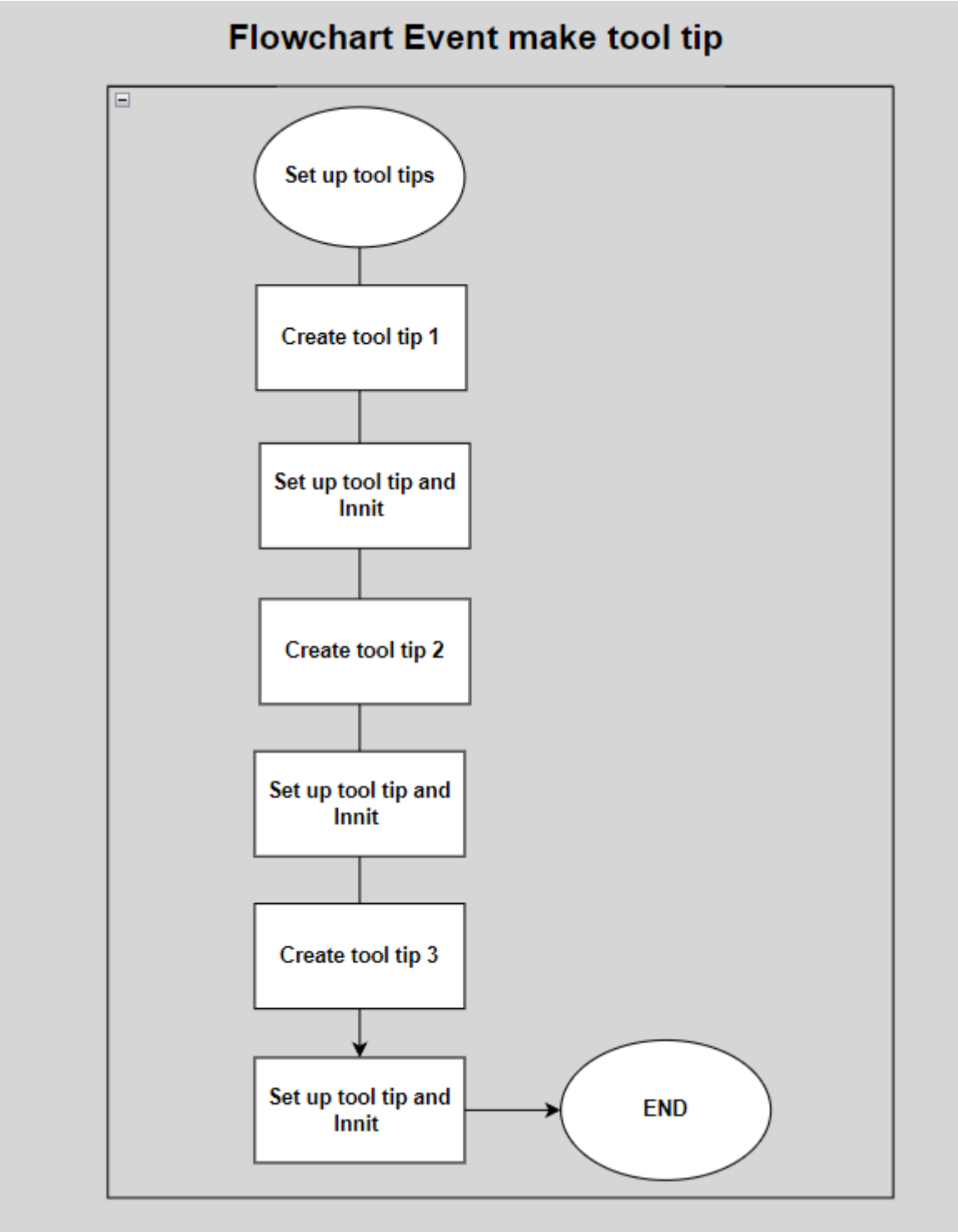
Flowchart showing Does player have enough



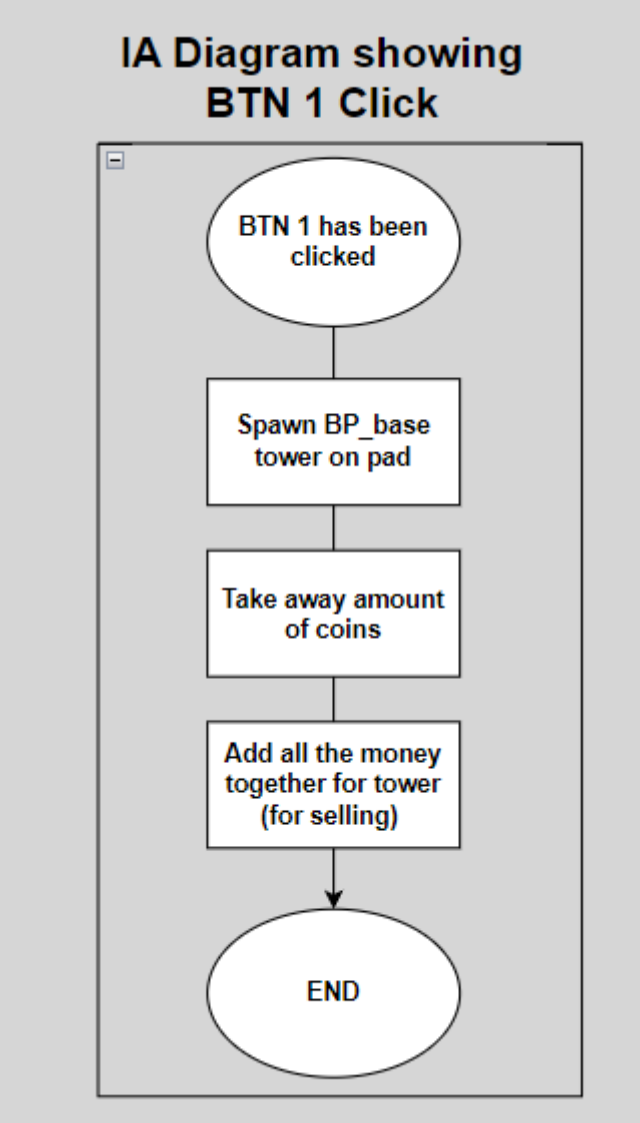
Flowchart showing Event Upgrade UI



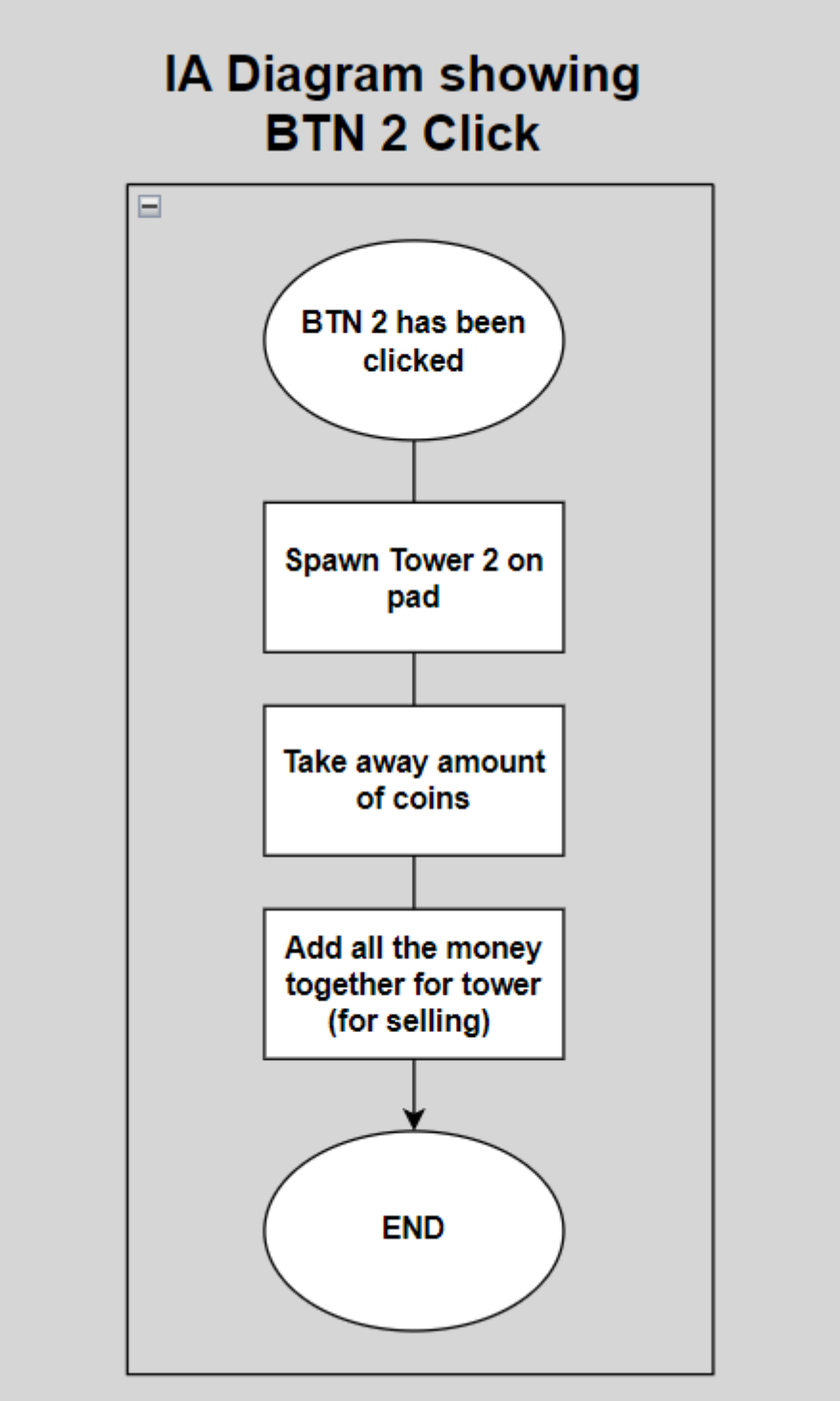
Flowchart showing Make tool tip



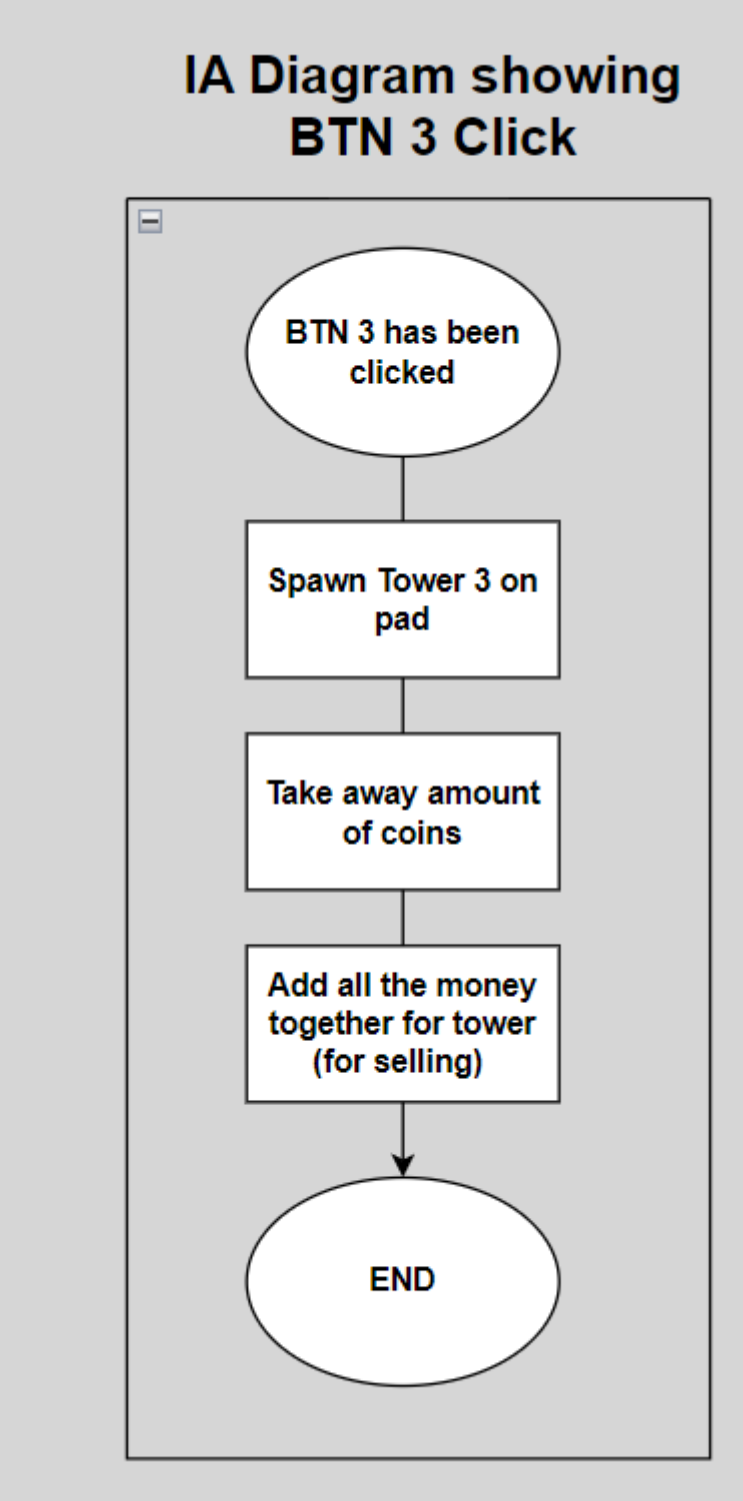
IA diagrams for BTN Click



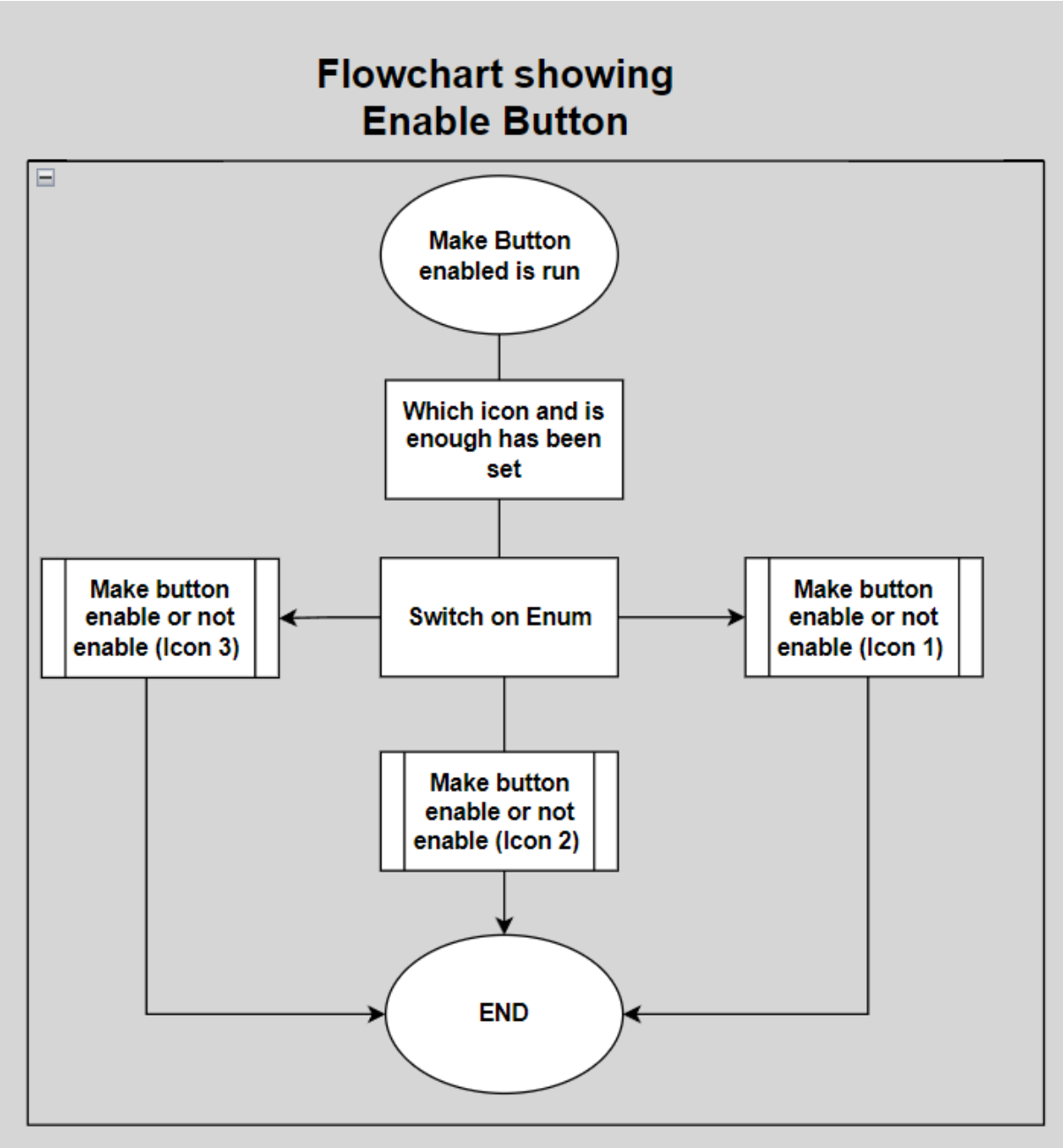
IA diagrams for BTN Click 2



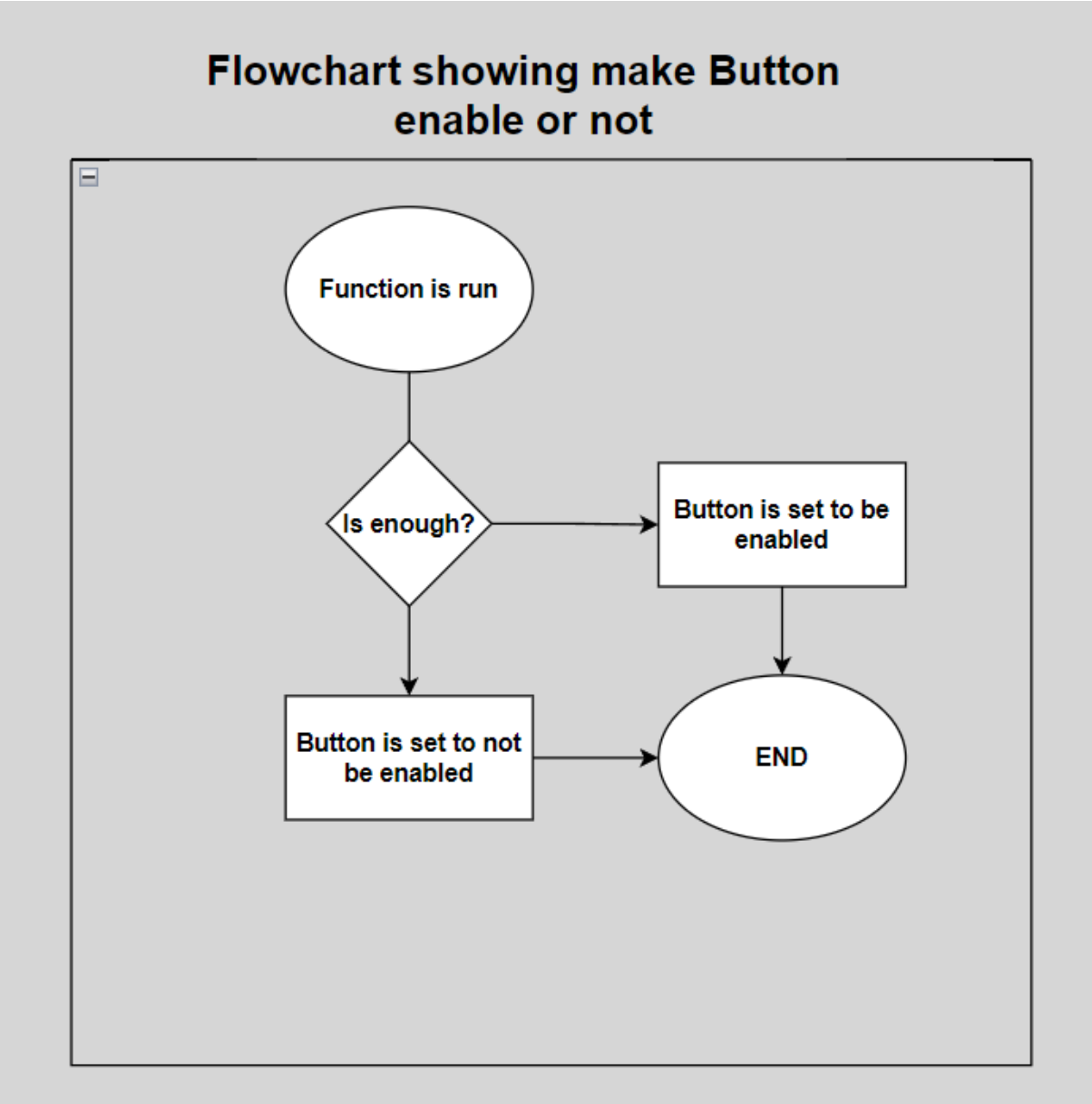
IA diagrams for BTN Click 3



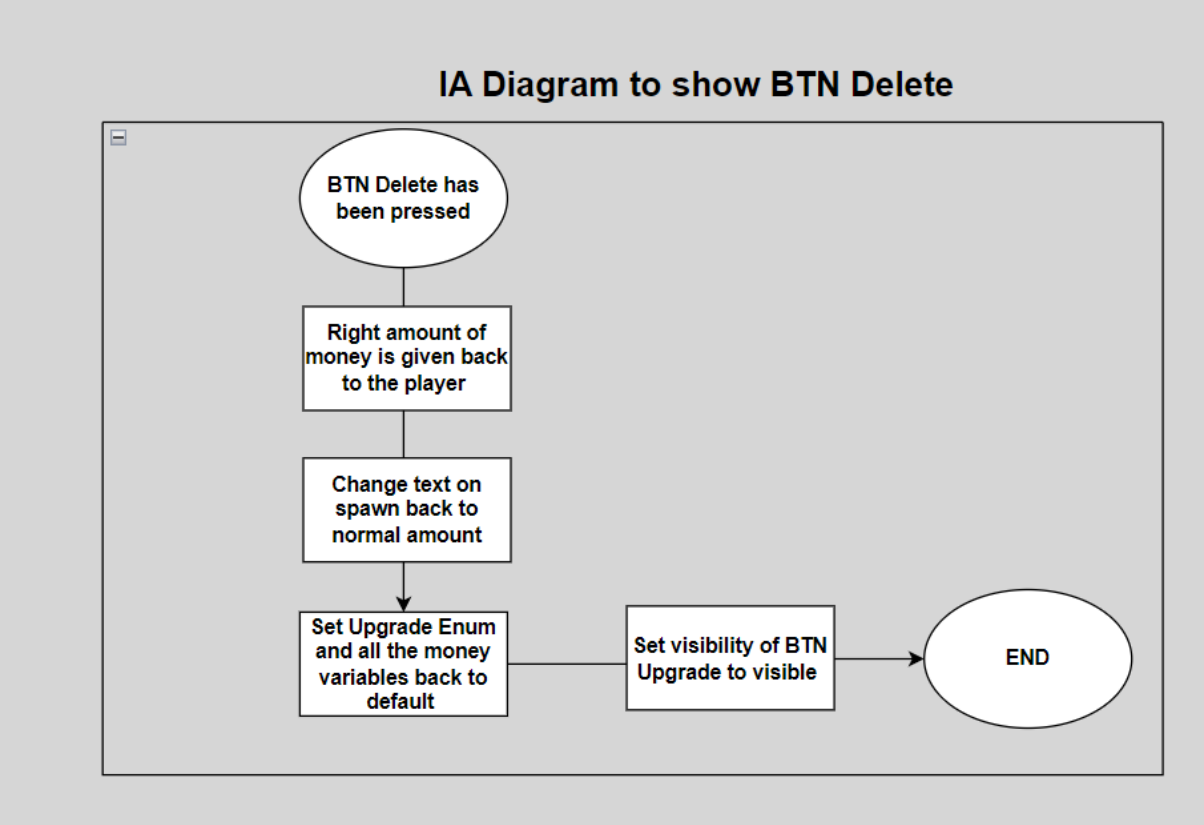
Flowchart showing Enable button



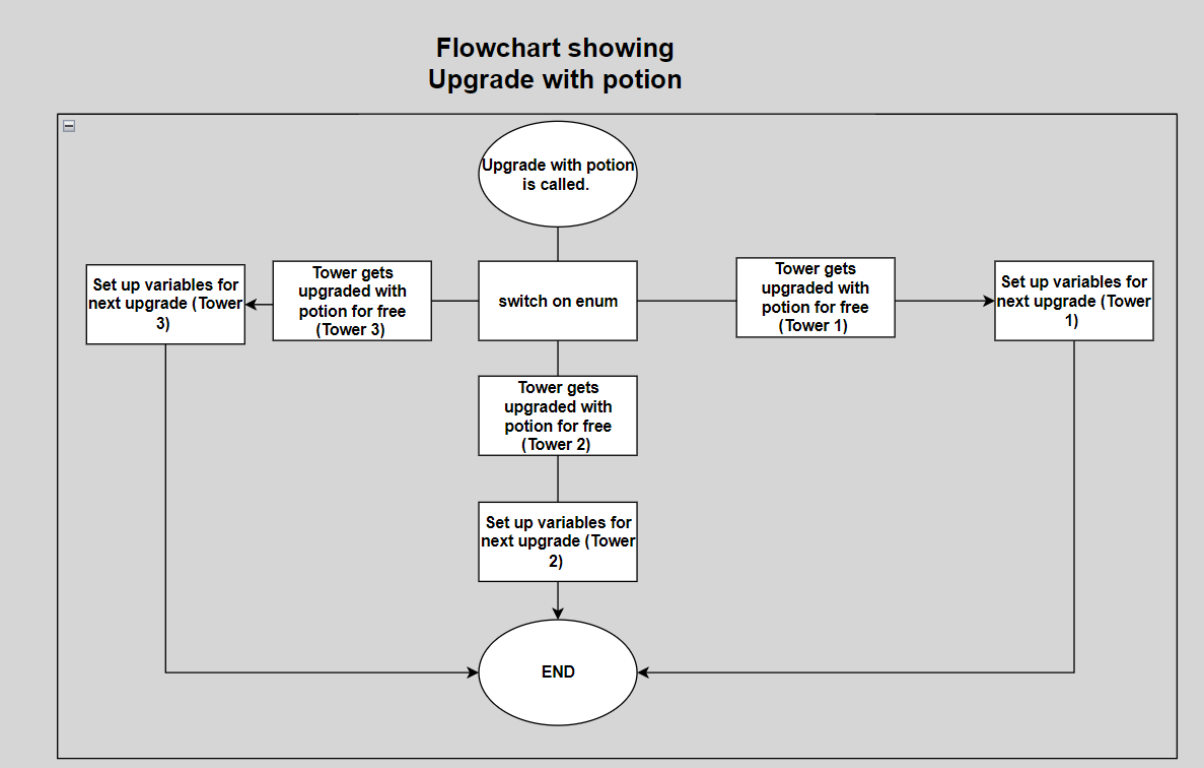
Flowchart showing Make Button enable or not



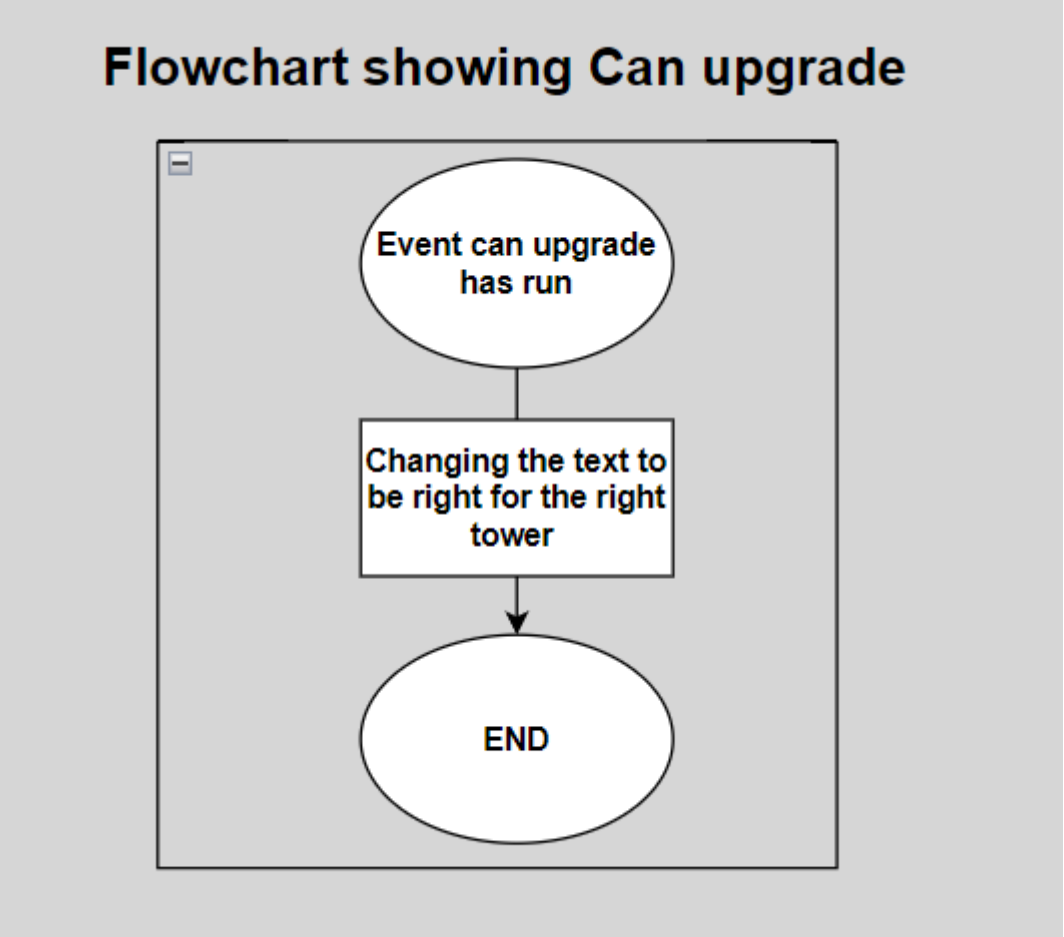
IA Diagram to show BTN Delete



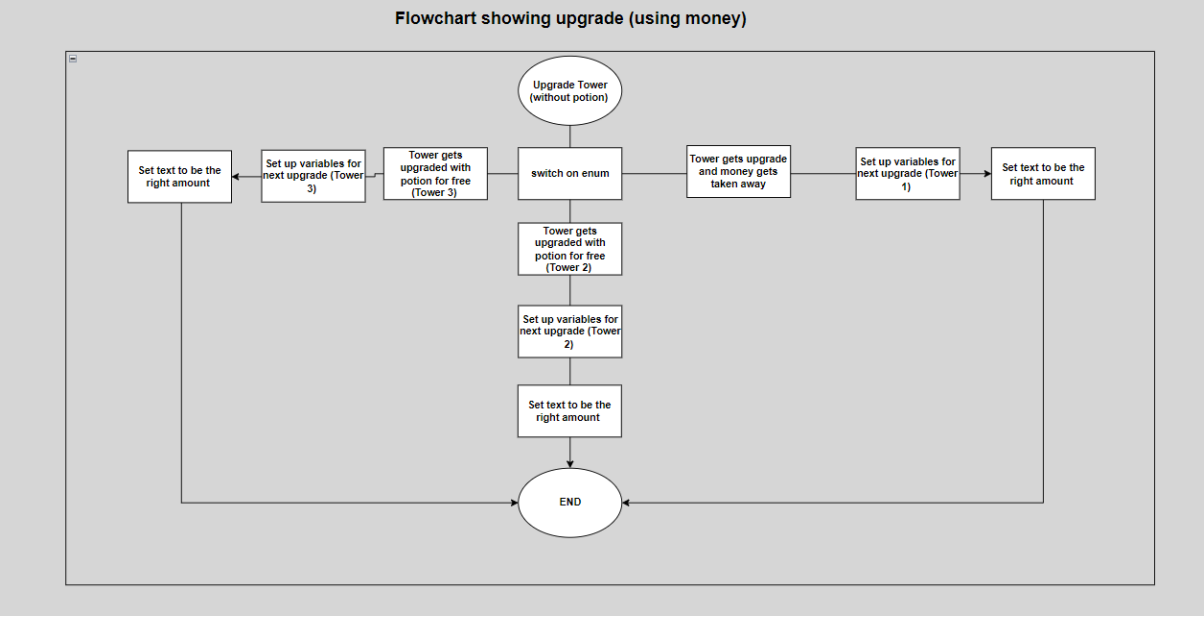
flowchart showing Upgrade With potions



Flowchart showing can upgrade



Flowchart showing upgrade with money



Tables for Structs and data tables

Table for wave system

Below is a table showing each wave and how many enemies are in each wave (This helped me keep track on how much I was spawning in the game)

	Enemy 1	Enemy 2	Enemy 3
Wave 1	3	0	0
Wave 2	5	2	0
Wave 3	6	4	0
Wave 4	2	2	1
Wave 5	5	4	1
Wave 6	7	8	3
Wave 7	12	9	6

Table for Upgrade system

Below is a table showing what happens on each upgrade for the towers in the game (again I made this to help me see what each upgrade does to each tower)

	Body	Head	Upgrade	Socket name	Detect radius	Fire rate	Rotation speed	Upgrade price 1	Upgrade price 2	Upgrade price 3	Damage output
T1_UP1	T1Body1	T1Head1	Upgrade1	Turret2	700	1.2	1.3	120	200	250	5
T1_UP2	T1Body2	T1Head2	Upgrade2	Turret3	800	0.9	1.6	0	0	0	8
T1_UP3	T1Body3	T1Head3	Upgrade3	Turret4	900	0.6	2.0	0	0	0	11
T2_UP1	T2Body1	T2Head1	Upgrade1	Turret2	700	1.0	1.3	180	240	290	5
T2_UP2	T2Body2	T2Head2	Upgrade2	Turret3	800	0.7	1.6	0	0	0	8
T2_UP3	T2Body3	T2Head3	Upgrade3	Turret4	900	0.6	2.0	0	0	0	15
T3_UP1	T3Body1	T3Head1	Upgrade1	Turret2	800	0.01	0	230	280	330	0
T3_UP2	T3Body2	T3Head2	Upgrade2	Turret3	1000	0.01	0	0	0	0	0
T3_UP3	T3Body3	T3Head3	Upgrade3	Turret4	1200	0.01	0	0	0	0	0

Table for player stats

This table just shows the stats of the player when they start the game (I went with 700 coins due to feedback on the game)

	Player data
Health	10
Coins	700
Potion 1	0
Potion 2	0
Potion 3	0

Table showing Cooldown for each potion

This table shows each cooldown for each potion, again I made this so I Remember what each potion radius is and what the cooldown.

	Cooldown	Effect radius
Potion 1	5	32
Potion 2	10	32
Potion 3	20	32

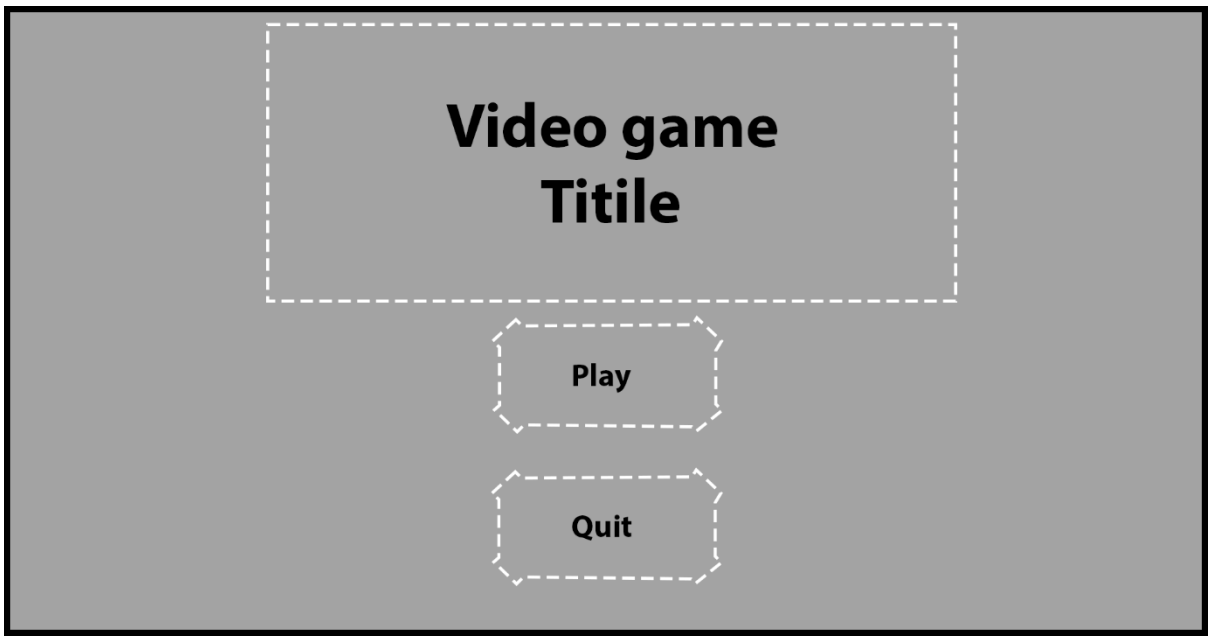
Table showing Enemy Data

This last table shows the enemy data (Again this just help me get a feel for how the enemies will play when in the game)

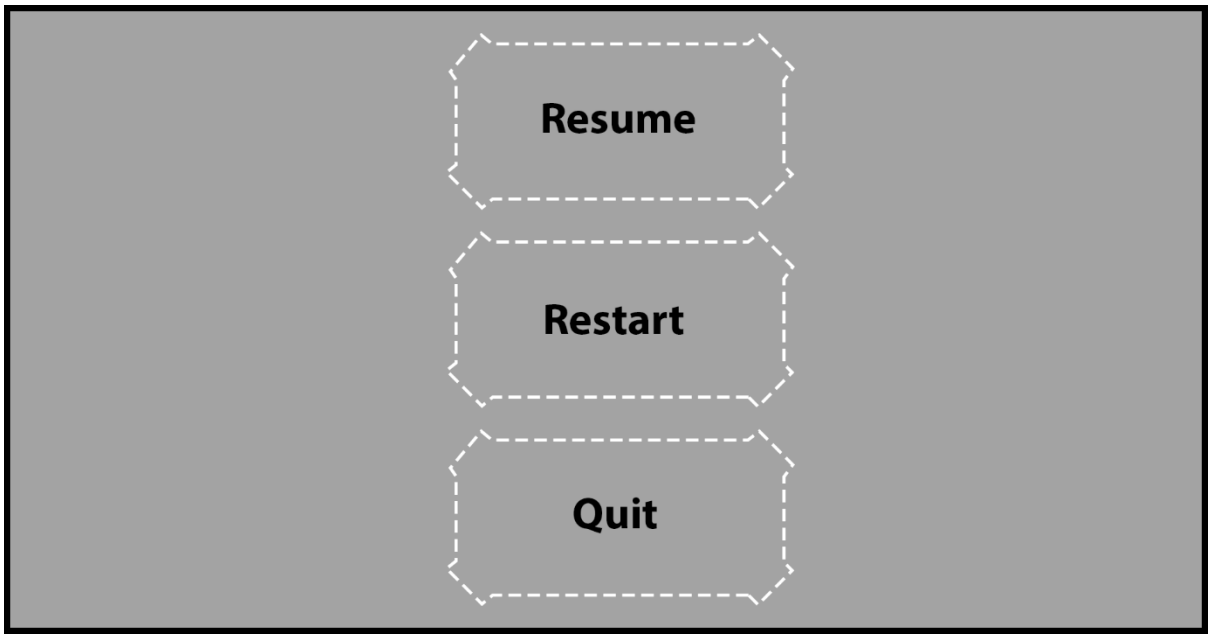
	Health	Speed
Enemy 1	25	200
Enemy 2	35	200
Enemy 3	70	150

UI wireframes

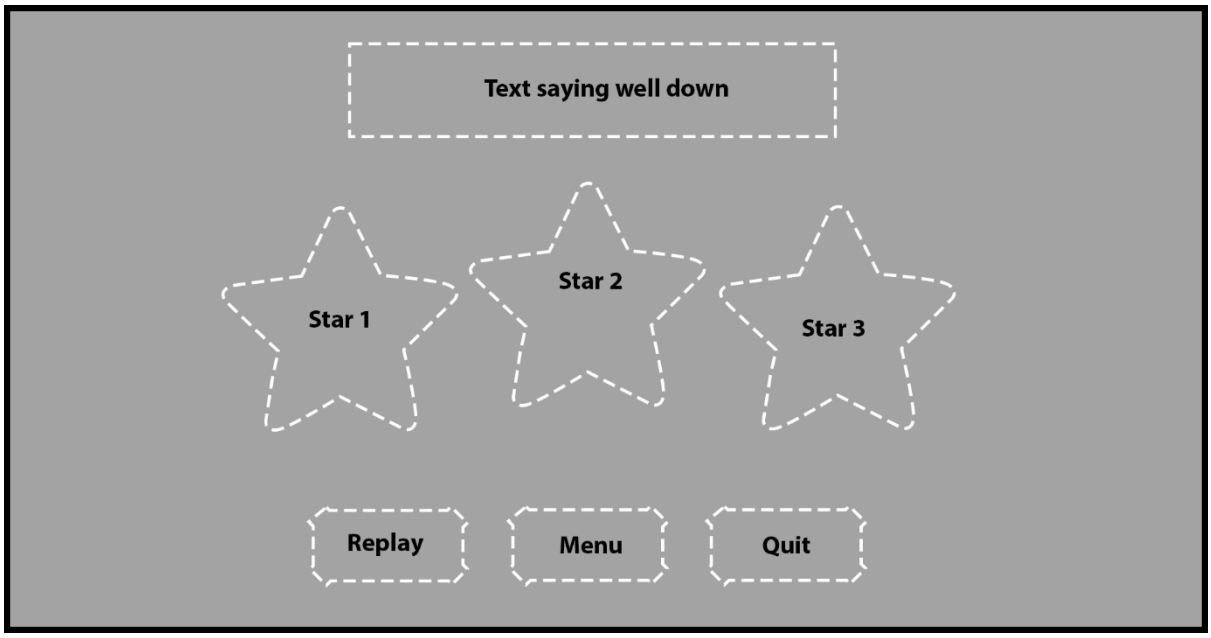
Wireframe 1 Main Hud



Wireframe 2 Pause menu



Wireframe 3 End screen



Wireframe 4 Main HUD

Mechanical Diagrams

Place tower Mechanic diagram

Below is a diagram showing how the place tower works in the game

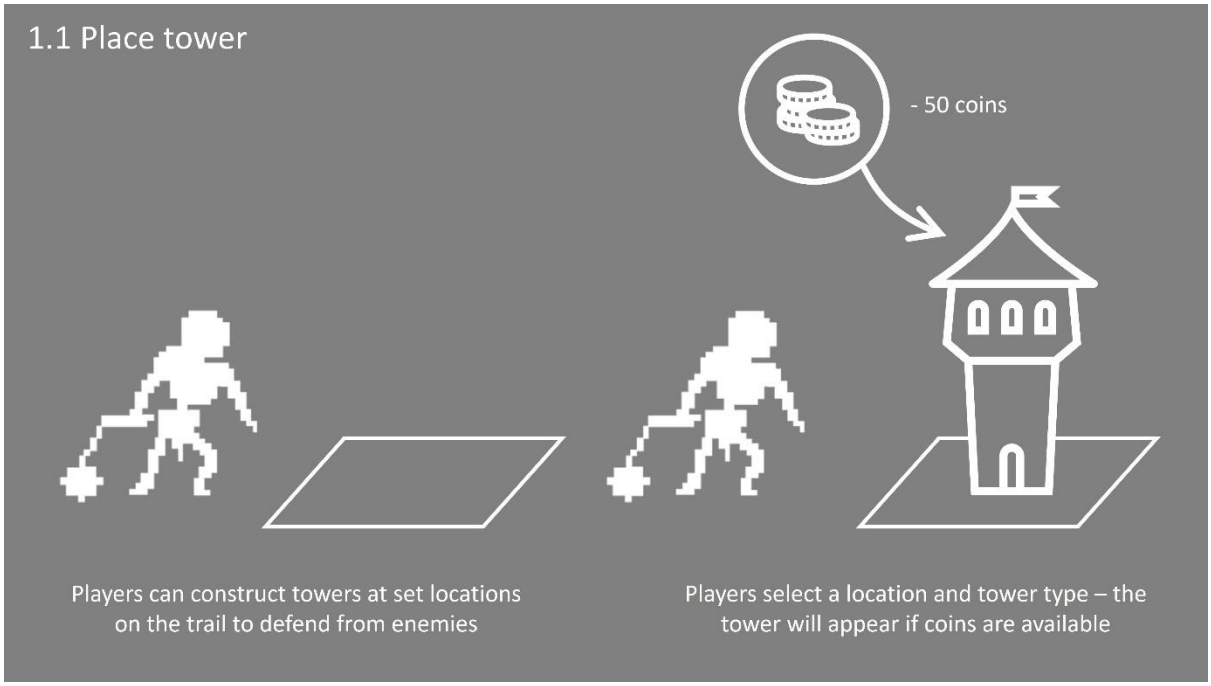


Diagram showing Crossbow tower

Below is a diagram showing how the crossbow tower works in the game

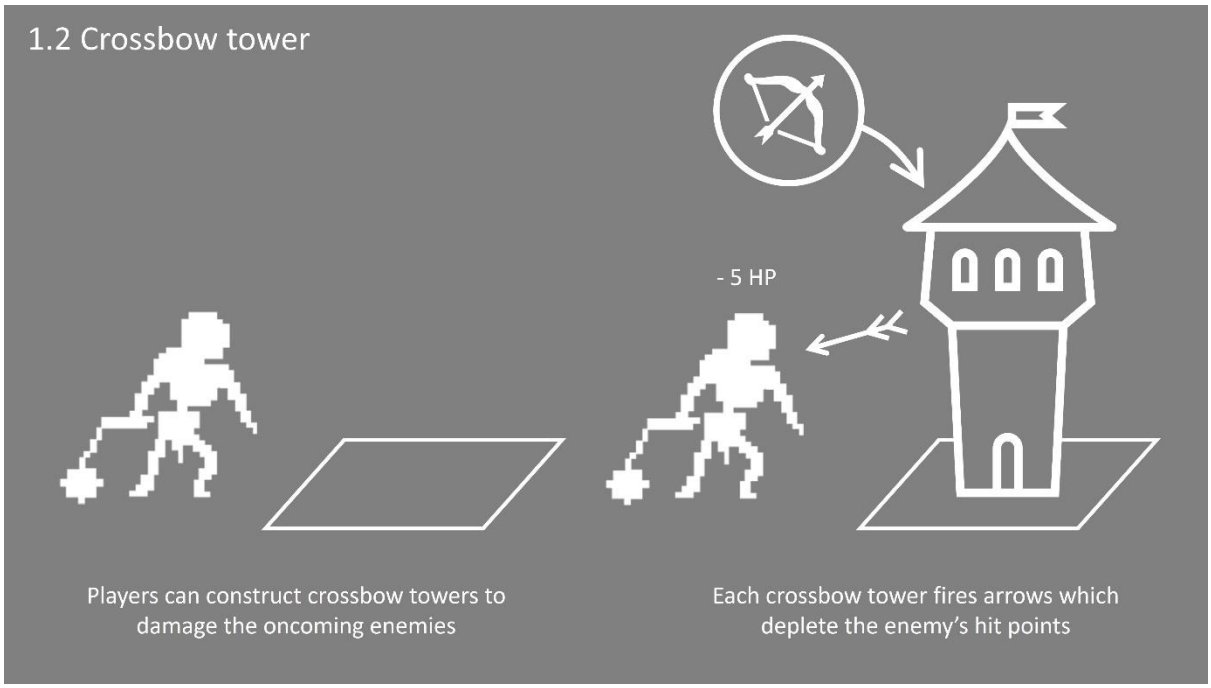


Diagram showing cannon tower

Below is a diagram showing how the cannon tower works in the game

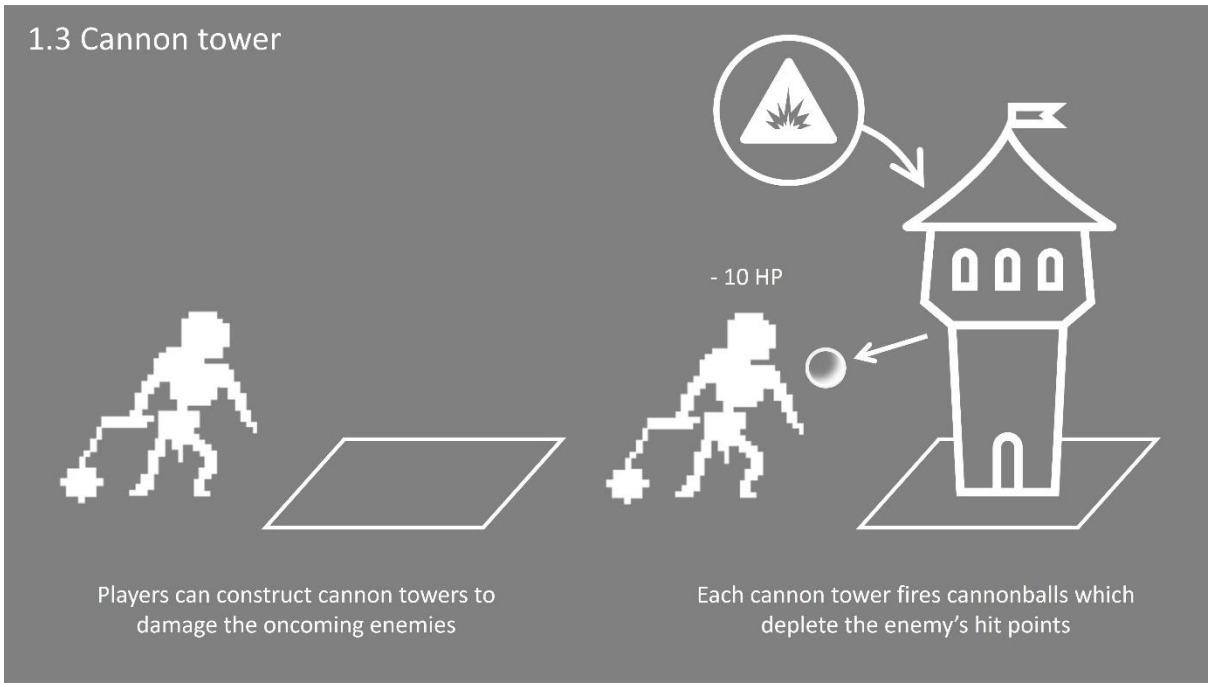


Diagram showing mage tower

Below is a diagram showing how the mage towers work in the game

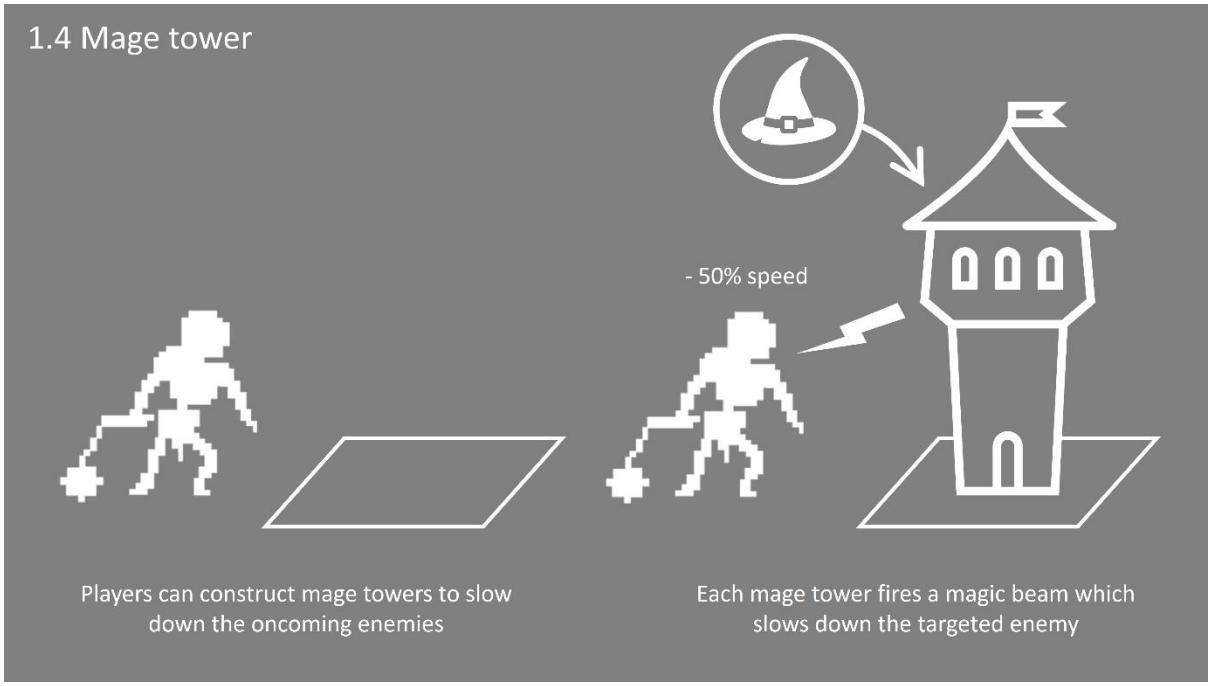


Diagram showing upgrade system

Below is a diagram showing how the Upgrade tower system works in the game

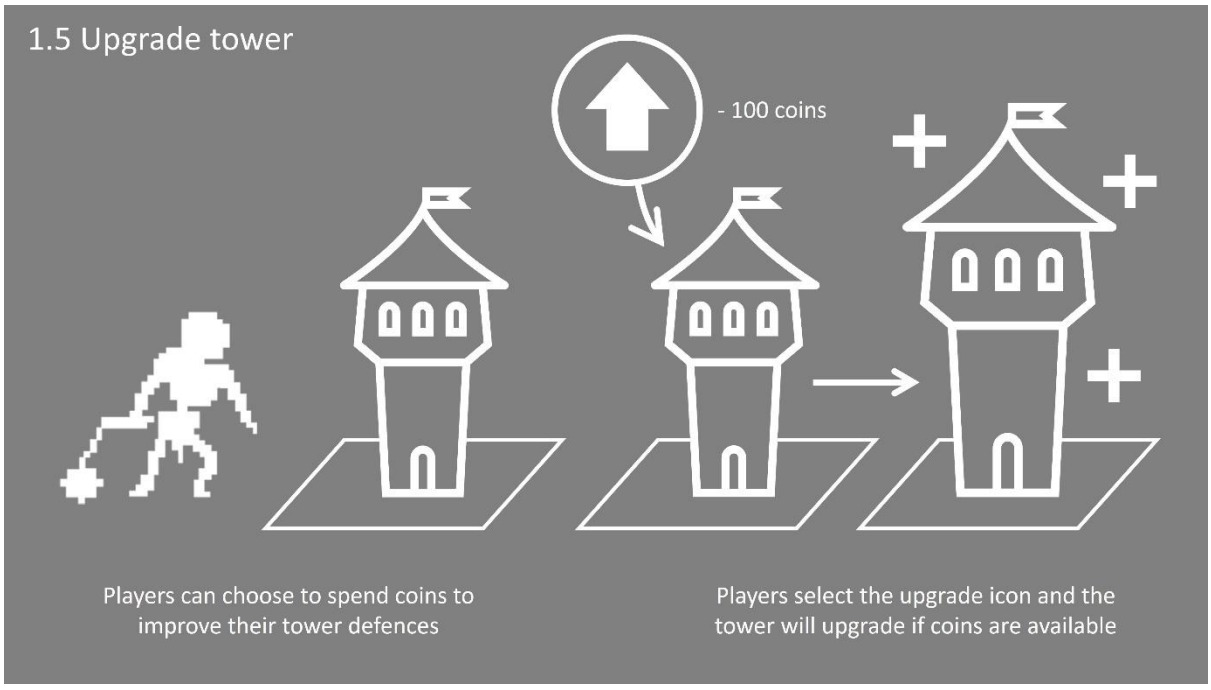


Diagram showing selling tower

Below is a diagram showing how selling tower works in the game

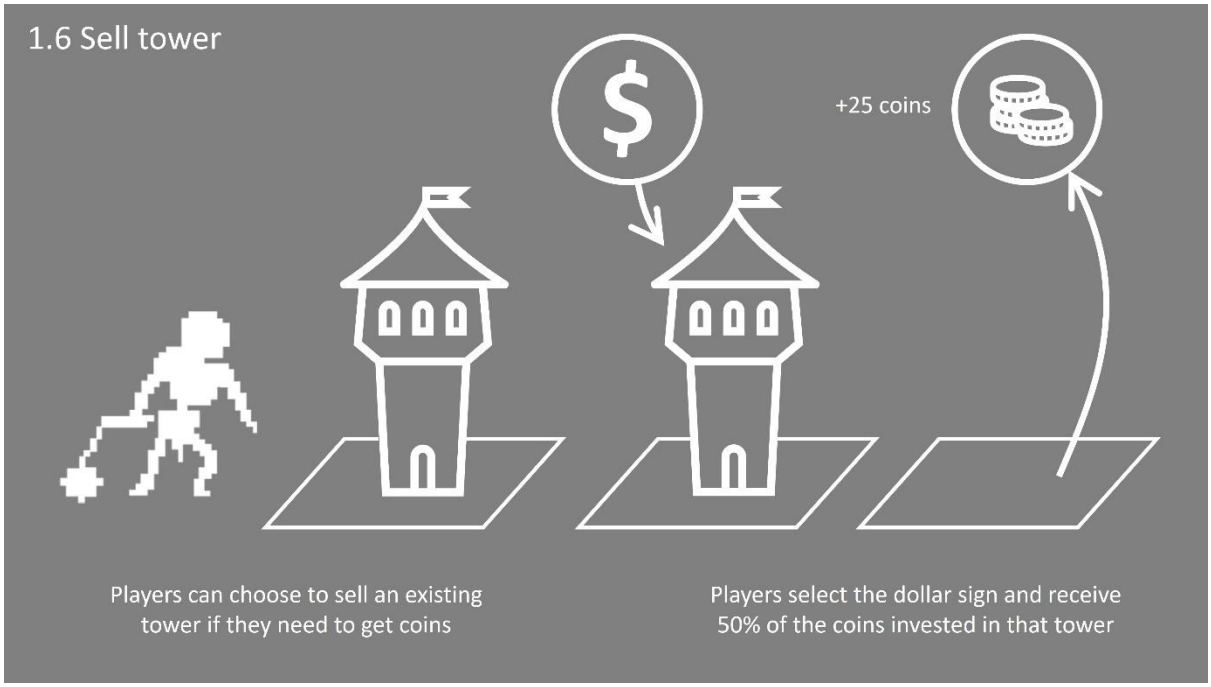


Diagram showing how potion wheel works

Below is a diagram showing how the random potion wheel works in the game

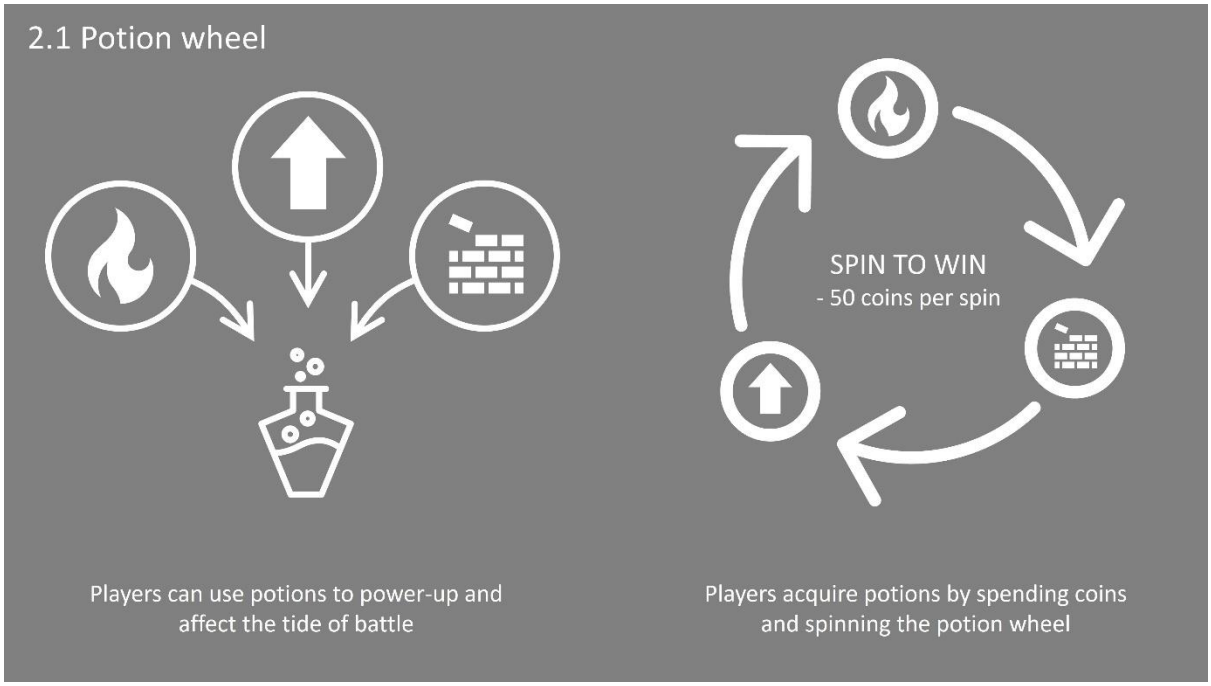


Diagram showing how Fire potion works

Below is a diagram showing how the fire potion works in the game

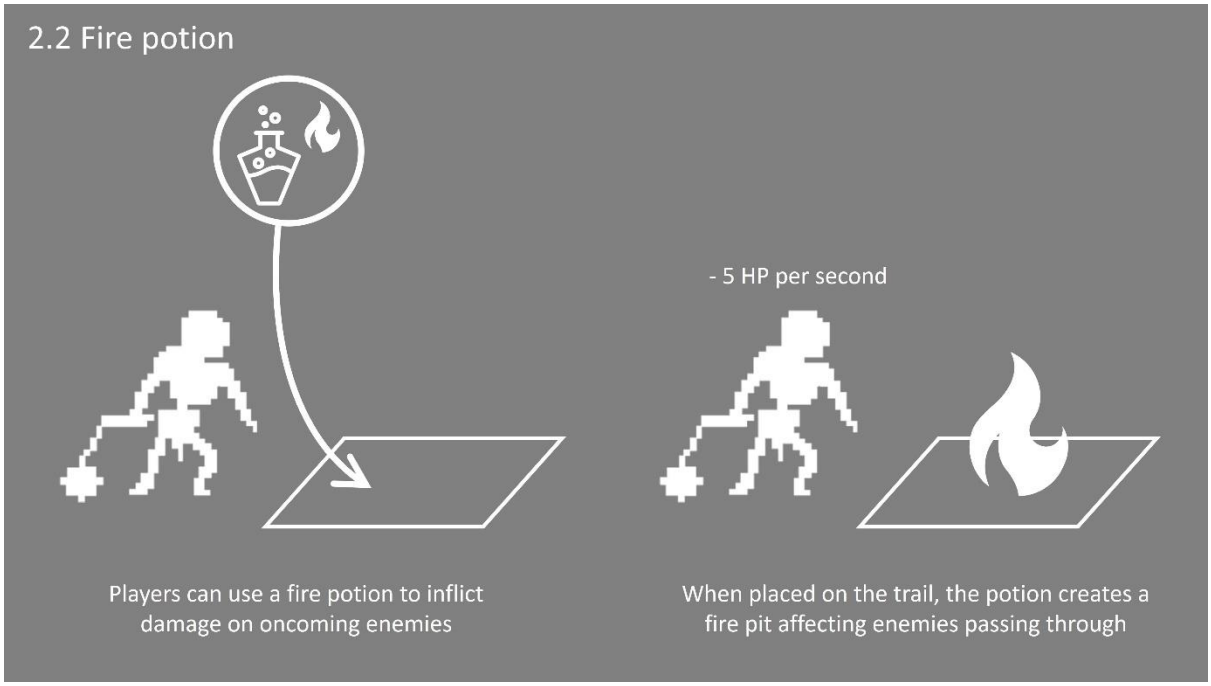
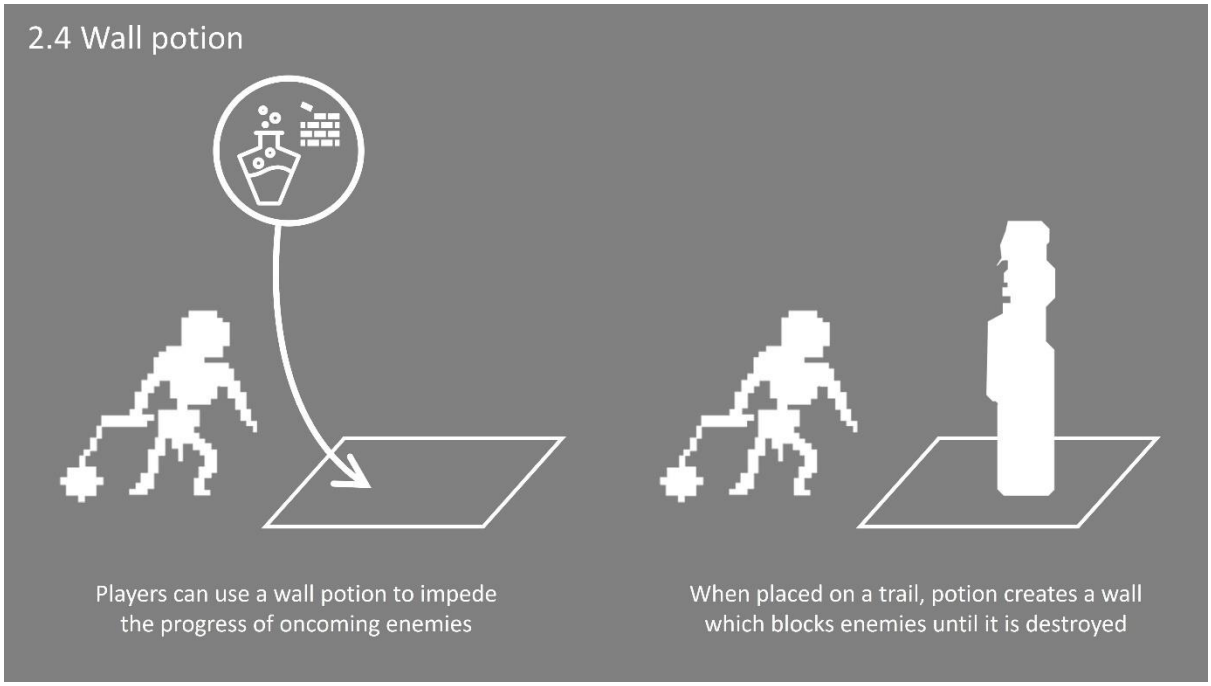


Diagram showing how the wall potion works

below is a diagram showing how the wall potion works in the game



Class Inheritance diagrams

Diagram showing Tower inheritance

Below you will see a diagram showing how I used inheritance when it comes to the towers that the player can place

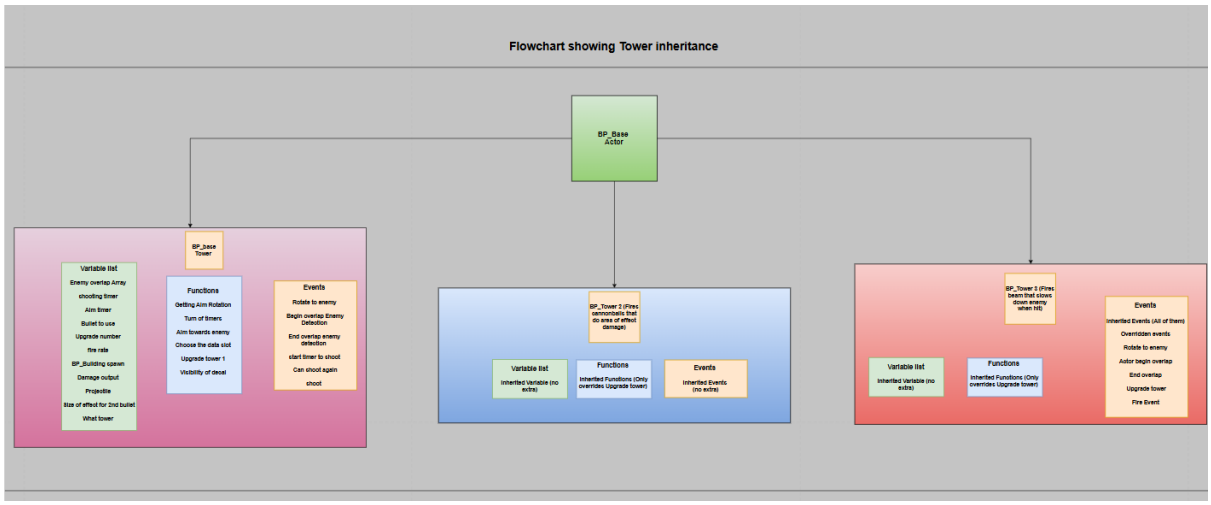
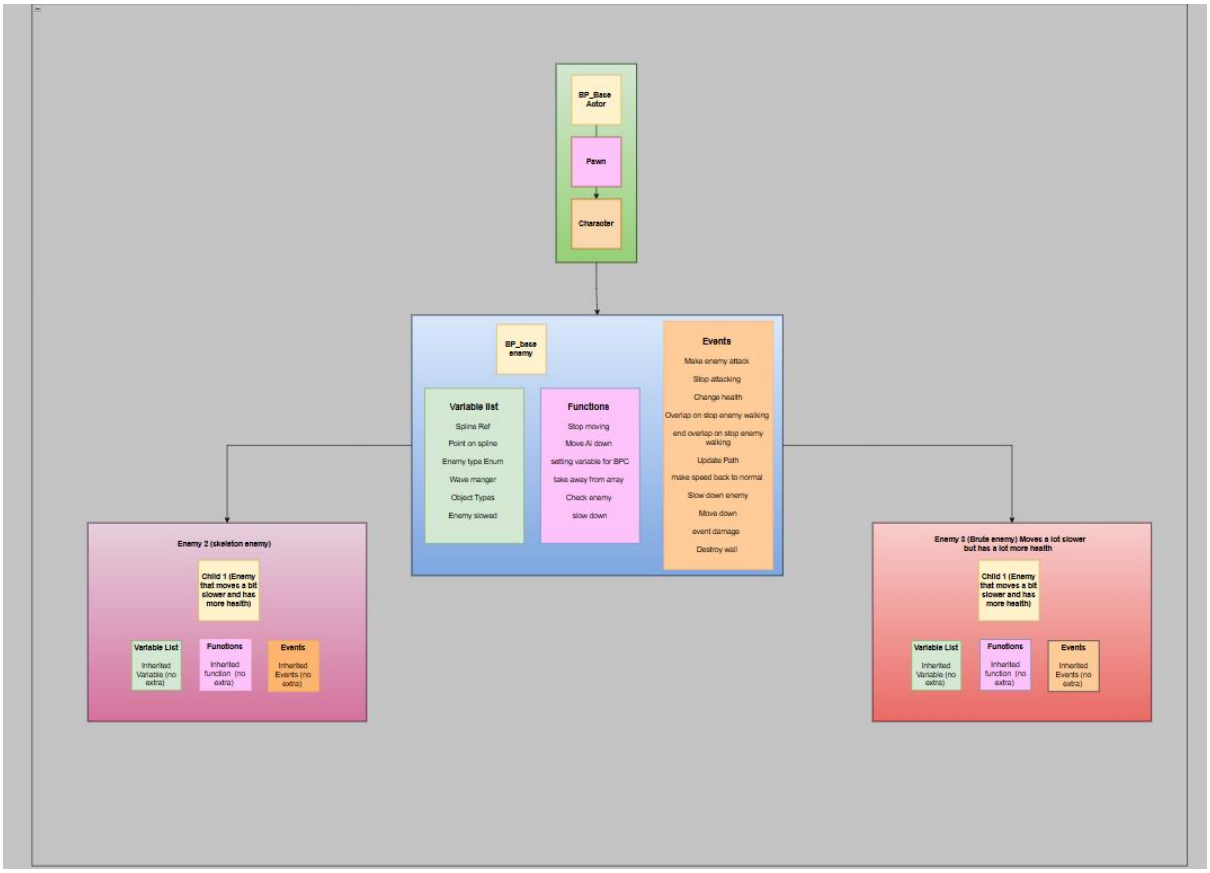


Diagram showing enemy Inheritance

Below you will see a diagram showing how I used inheritance when it comes to the Enemies in the game (And how it made my life a lot easier)



Coding Standards

Programming Standards

When it comes to the naming conventions, I am using Unreal engines Recommended assets names conventions some examples of this are

- Blueprints = BP_
- Actor component = AC_

- Static mesh = Sm_
- Material instance = MI
- Texture = T_

  Here is a link to a table with all the naming conventions that I will be using in this project (just basic Unreal engine 5 coding standards)

  Link to Ue5 Coding standards

  https://dev.epicgames.com/documentation/en-us/unreal-engine/recommended-asset-naming-conventions-in-unreal-engine-projects?application_version=5.3

Style Guide

When comes to best practices I will be making sure my code is readable and I am using comments as well (Look below), But my focus is just trying to keep it neat and readable by keeping it neat and commenting on all parts of the code, it makes it easer to read and come back to in the long run.

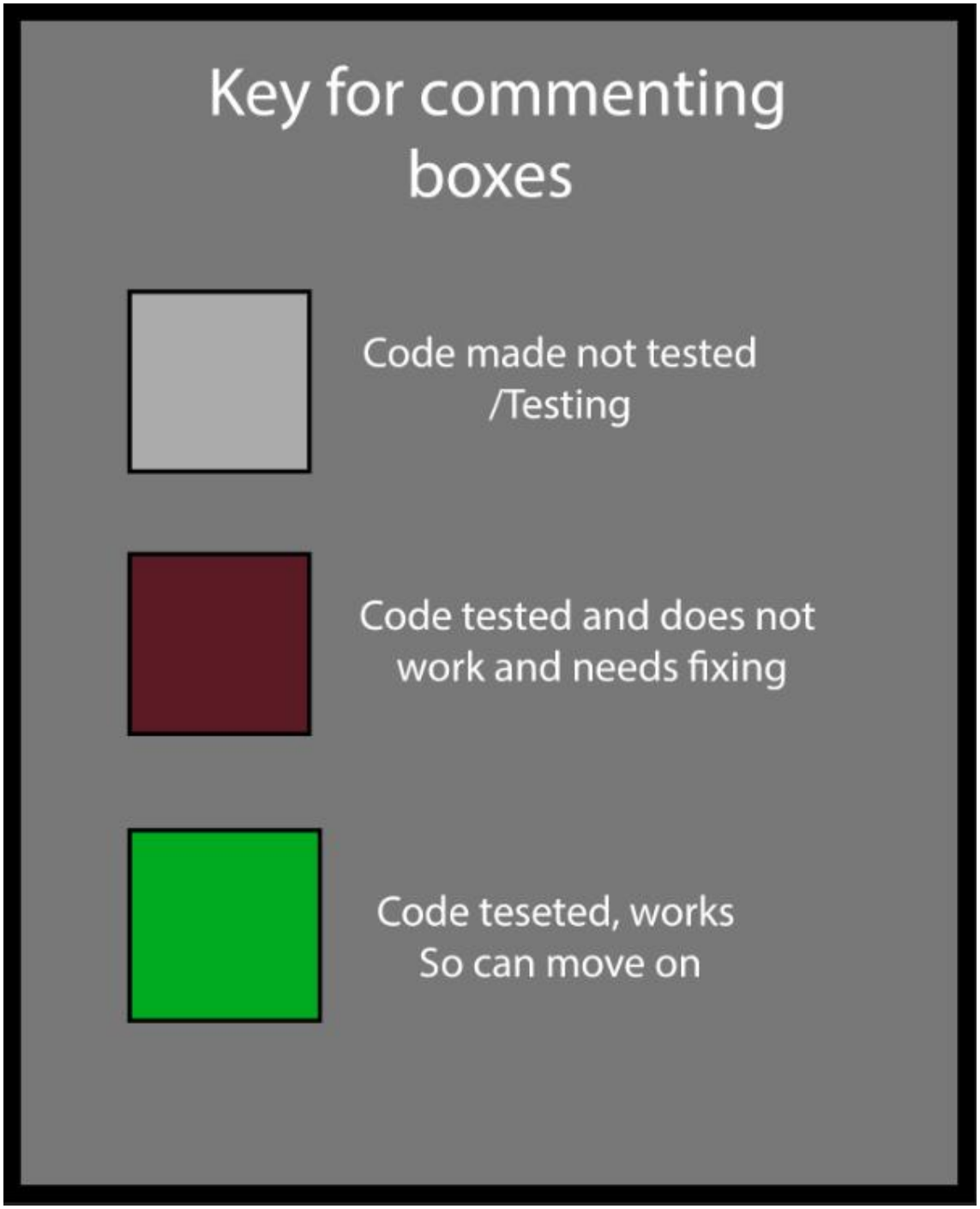
Also when it comes to prefix I am using unreal Engine official documentation when making my tools link below to table (and examples above as well)

Link to UE5 Coding standards

https://dev.epicgames.com/documentation/en-us/unreal-engine/recommended-asset-naming-conventions-in-unreal-engine-projects?application_version=5.3

Commenting Rules

I will be commenting all my work and if it is red that means the code does not work, if the comment is white then I am testing the code and if it green that means it works and is done. (simple Tabe Below)



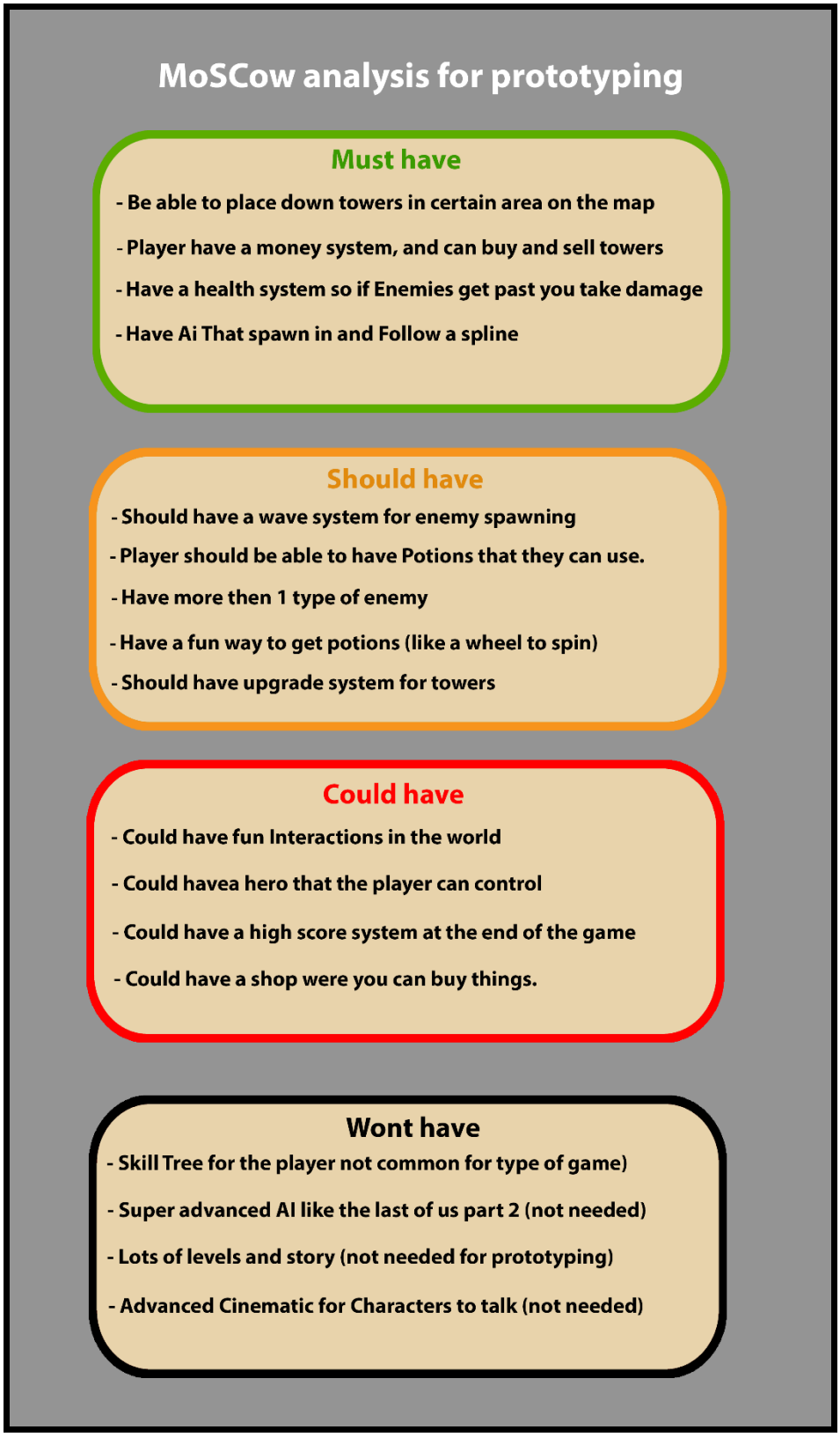
Production Overview

Moscow

Moscow review for the project

Below you can see a quick Moscow review of the project, I think I can get most of this in and working by the end of the project (But I like to

challenge myself sometimes) That is why some of it sound out of scope but I have a good idea that I can get the main gameplay loop in



Timeline

For the timeline I have made a simple Gannt chart for my prototype game, this is very simple but should provide a good idea on when I want each Milestone done for throughout the module/project. (8 weeks)