

3. Analysis model – version 1

3.1 Object catalogue

3.1.1 Asteroids

Asteroid is one of the main entities in the game. These Asteroids objects are full of minerals/resource object which are located at the mantle/core of them. There is countless asteroid object spread throughout the asteroid belt object. They are mapped at different location in asteroid belt. It mainly interacts with settler, robot and gate objects. Settler can travel to one of the Asteroid and drill through it to reach its core where all the material/resource is at. Settler can choose to build Gate object in the Asteroid to interconnect it to another nearby asteroid. Gate object stays at said Asteroid object and use to teleport to another asteroid. Robot can also travel to these asteroid and plunder them. While they can drill to core, they can't really collect any resources.

Responsibility:

Asteroids are responsible for managing different kind of other asteroids. They have 3 states i.e., normal, perihelion and aphelion. Which ultimately decide what kind of asteroid it's going to be. They also have to have random depth to their core. For some Asteroid more drilling is required while for some less is required.

3.1.2 Hollow Asteroid

Hollow Asteroid also play a vital role in game. The core of the hollow asteroid like its name is hollow. While it doesn't contain any resource, it can be filled with the resource/mineral object. It is one of the two different asteroid that is mapped in the Asteroid belt. If settler is in the hollow asteroid, an option hide can be used actively to hide inside it. The Sunstrom object affect all the object at a random time. If Settler is inside hollow asteroid, they can be saved from damage caused by the SunStrom Object. Same can be said for the robot too. It will also have an option to hide inside the hollow asteroid so if its hidden when Sunstrom Objects hits the all objects, it would be saved.

Responsibility:

Hollow asteroid is mostly responsible for saving resources inside it since settler can only carry 10 resource unit/object. It plays a crucial part in keeping the settler and robot from exploding when the sunstrom hits.

3.1.3 Radioactive Asteroid

Radioactive is the most dangerous asteroid as it can explode in case its state is perihelion. Digging to its core will result it in exploding. While it's extremely risky, it also has one of the important resource type object uranium. It interacts with robot, settler and gate as same as asteroid. Settler can drill it to its core if its state is aphelion and extract mineral object. While Robot can drill to its core regardless of its state. It can drill to core without to risk of getting exploded, in case the asteroid is at perihelion state and explodes the robot will be thrown to the nearest asteroid instead of getting destroyed.

Responsibility:

Radioactive Asteroids are responsible for keeping the one of important mineral object uranium inside it. With help of uranium a robot could be build.

3.1.4 Asteroid Belt

Asteroid belt is like a container which contains all the objects mapped inside it. Asteroids are spread throughout the asteroid belt. It also interacts with settler, robot, gate and spaceship. Settler travels inside the Asteroid belt field from one Asteroid object to another Asteroid object. Same can be said for the robot. It's also inside the asteroid belt container travelling through it. Gate is also contained inside asteroid belt field in any of the asteroids. When settler acquire all the minerals needed to build spaceship and build it. It will also get created inside the asteroid belt.

Responsibility:

Asteroid Belt is basically representing the map of the game. It is responsible for making and managing all the entities. It can add something and when something is destroyed it is also responsible for removing it.

3.1.5 Minerals

Minerals are the objects that are contained inside the asteroid. They consist of the materials like Water, Ice, Iron, Carbon, Uranium. They play a major role in the game. They are related to majority of the objects in the game. Asteroids are the one that affect the state of the material objects most. For instance, if the material object inside the asteroid is Ice or water and the Asteroid is in Perihelion state then these materials will melt and vanish i.e., no material will be left inside the core. Settler collect these materials through asteroids. When all kind of materials are collected by settler, they are used to make space station object. If settler have collected certain material, they can be used to make another object like robot and gate.

Responsibility:

There could only be same type mineral that can be inside asteroids and mineral class make sure that it stays that way.

3.1.6 Game

Game object is used to manage the start and ending of the game. It doesn't interact with many other objects. But other objects interaction ends up triggering it. In case a settler dies it'll result in the game being over thus game object will be used. But in case the settler collected all the mineral objects and survived to build the space station, it will result in player winning the game and thus game object will be used to showcase that. At the start of the game, game object is the one that is used to start the game.

Responsibility:

Its sole purpose is to manage start and end the game. It contains main menu. Where we can start the game.

3.1.7 Settler

Settler is the main entity that is controlled by player. It can perform various functions like moving to a nearby asteroid object using Travel method. It can drill on said asteroid using Drill method. It can mine out the material/resource object from the asteroid using mine method. Though Settler can only store 10 materials on them. If they collect all the different required material object, they can use build method to build a spaceship which will result in game ending. In case Settler have enough resource object they can use build method to build a robot which can perform some task similar to it. It can also make a Teleportation gate in an asteroid to another one by consuming enough material object as price. In case Sunstrom Object hits the Settler object, it dies and game ends. But if Settler is on a hollow asteroid object it'll have an additional option hide by using that they can hide inside hollow asteroid and save themselves. In case Settler is on Radioactive asteroid and its state is perihelion then if settler dig to its core, it'll result in asteroid exploding and killing settler.

Responsibility:

Settler is responsible for collecting material object through drilling and mining which are its feature. It's also responsible for building other entities like robot, gate etc. throughout the game.

3.1.8 Robot

A Robot object can come into play in the game if settler have enough resources to build one. Robot can perform tasks similar to that of settler. It can travel to neighbouring asteroids at random and it can drill them to their core but it can't collect the resources within them. Also, during sunstrom it can hide inside a hollow asteroid to save itself but if sunstrom hits it, robot get destroyed. Robot can also dig on radioactive asteroid without worries as even if radioactive asteroid which is at perihelion state explodes it will not destroy robot but throw it to neighbouring asteroid. Robot can also use gate object to travel from one asteroid to another.

Responsibility:

Robot is responsible for travel to neighbouring asteroids and drilling them to their core. It makes easy for settler to come and collect material as robot can't collect material.

3.1.9 Gate

Gate's most prominent feature is that it can be used to teleport from one asteroid to another asteroid which it has been interconnected with. Gate object can only be made when settler have enough resources and it use certain material object to build the Gate. Gate object can also be used by the robot. It'll transfer it to neighbouring asteroid like settler can. Though if a Gate is built on a radioactive asteroid and settler or robot drill to its core and it turns out to be a radioactive asteroid at perihelion state which will result it in exploding and destroying the Gate. SunStrom object can also destroy gate object when it hits it.

Responsibility:

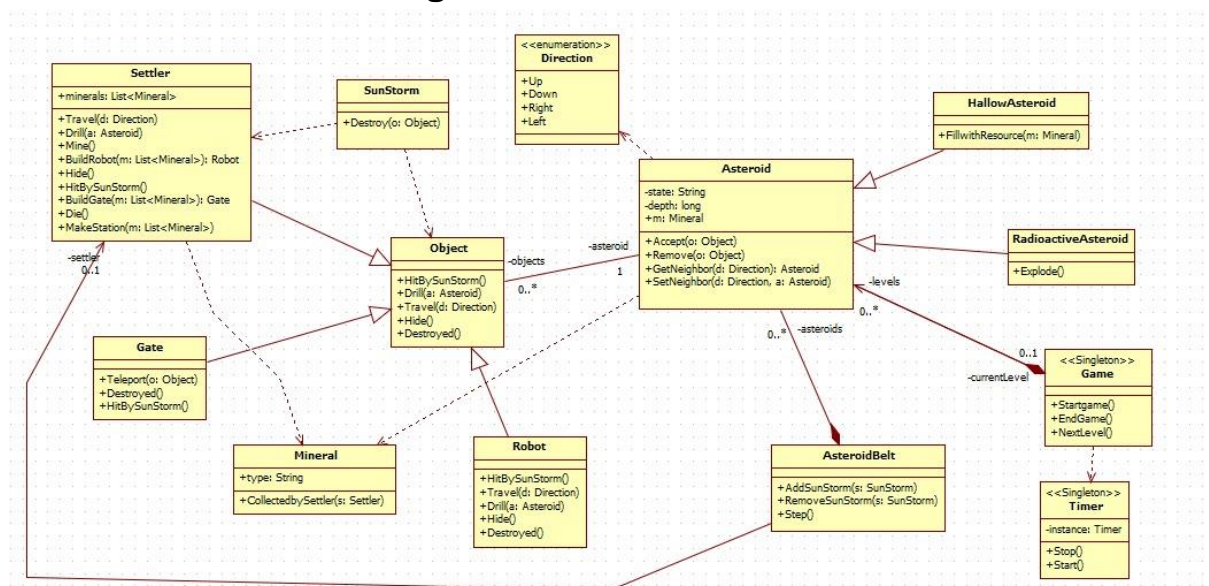
Gate is responsible for teleporting the settler and the robot from one asteroid to the other one which is interconnected by the said gate.

3.1.10 SunStrom

SunStrom is a phenomenon that occur at random time during the game. As soon as a sunstrom object is initialize to run through the asteroid belt field, settler gets informed. SunStrom destroys everything in its path. If Settler is not hiding and it get struck by sunStrom object it'll die and that will make the game object to end the game. Same goes for Robot entity. If it gets hit by the SunStrom it'll explode. Gate objects built throughout the asteroids also get destroyed in case they are hit with the SunStrom in the asteroid belt.

Responsibility:

SunStrom is responsible for removing/destroying different entities throughout the asteroid belt. It occurs at random time and it vanishes after certain time.



- **Mine()**: This method defines that the settler can mine i.e., he/she can extract valuable minerals from the core of the asteroid. This method is only possible if the asteroid has been complete drilled through.
- **BuildRobot(m: List<Mineral>): Robot**: This method can be used if the settler wants to build the robots if settler has enough resources to build one. If the settler doesn't have enough resources/minerals to build the robots then this method won't work.
- **Hide()**: This method is going to be used by settler if he/she wants to hide in an asteroid but one condition for the settler to hide in asteroid is that the asteroid must be hollow otherwise, settler won't be able to perform this function.
- **HitBySunstorm()**: This method defines that the settler can get hit by the sunstorm if it doesn't hide in the hollow asteroid.
- **BuildGate(m: List <Mineral>):Gate** : This function allows the settler to build teleportation gate and just like to bold robots, a settler need specific number of resources to bold these gates. This method is related to the both settlers and robots as they both are permitted to use these gates.
- **Die()** : This function can occur when the settler dies and the game ends. There could be multiple reason for this function occur which will be explained in the further classes.
- **MakeStation(m:List<Mineral>)** : This function indirectly means that the player has won the game and the condition which will be put in this method would be that if the settler has successfully built the space station.

3.3.2 Gate

- **Responsibility**

This class represents all the features and methods of the teleportation-gates. These gates are built by players if he/she has enough minerals to build these gates. These gates are used by settlers and robots. The main purpose of teleportation gates is to transport the settler and robot from one asteroid to another asteroid which is interconnected by the said gate.

- **Super classes**

Object

- **Methods**

- **Teleport (o:Object)**: This method describes when and on which asteroid the settler or robot is going to be teleported. The settler can either be teleported to the radioactive active asteroid or otherwise. The type of asteroid is unknown to the player i.e., the player won't be able to know if the type of the asteroid is hollow or radioactive unless and until it does the drilling.

- **Destroyed():** This method describes when the gate will be destroyed. If the settler or robot uses teleportation gates and gets teleported to a radioactive asteroid and if by chance the settler starts drilling the radioactive asteroid then this can cause destruction of the gate.
- **HitBySunStorm():** This method will explain that the gates can be destroyed by sun storm also.

3.3.3 Mineral

- **Responsibility**

This class is responsible for all the resources and minerals present in a game. The minerals can be radioactive and non-radioactive. It depends on the settler which asteroid it wants to mine. The non-radioactive minerals can be used by settlers to build spaceship, robots or teleportation gates. This class will make sure that if the asteroid contains mineral such as water or ice and if that asteroid is at perihelion then the resources would melt/sublimate.

- **Attributes**

- **Type: String :** This attribute is going to tell which type of minerals are we going to use in the game.

- **Methods**

- **CollectedbySettler(s:Settler):** This method tells that which type of resources and how many units of that resources the settler has collected. This method will contain a counter which will make sure about this. The result of this counter will be shown on the game screen which would be helpful for the player to keep in mind how many resources he still have to drill and mine. The more the resources, the more the counter, the more the score.

3.3.4 SunStorm

- **Responsibility**

The responsibility of this class is to make sure that sun storm occurs during the course of the game at any moment. A settler can survive the sun storm if it hides in a hollow asteroid. The sun storm can occur at any random moment and can vanish after a certain time. Sun storm can be the cause of the death of the player if it is not hiding which can lead to the failure of the game. Sun storm can destroy settlers, robots and teleportation gates.

- **Interfaces**

none

- **Methods**

- **Destroy(o: Object):** This method describes the functionality of the sun storm i.e., it is going to Destroy every object that comes in its ways. The object can be settler or robot or even a teleportation gate.

3.3.5 Robot

- **Responsibility**

The responsibility of this class is to perform the functionalities almost similar to that of the settler. The robots can be built by settler if it has enough resources to build one. The robot class can be considered helpful for the settler as it can help the settlers to perform different functions which can lead to the winning of the game. It can make the players job a little bit easy.

- **Super classes**

Object

- **Interfaces**

none

- **Methods**

- **HitBySunStorm():** The method defines that when the robot is going to get damages. It can get damaged when it gets hit by the sun storm
- **Travel():** The robot can travel from asteroid to asteroid within the space in search for resources to help the player. Robots are controlled by the program internally and it will be defined in this method that where and when the robot is going to travel
- **Drill(a: Asteroid) :** This class defines that a robot can drill the asteroid in searching for resources. If the robot finds any resource useful for the settler then it can send signal/message to the settler so it can come and collect the resources as robots are unable to collect the resources.
- **Hide():** This method defines that the robot can hide inside the hollow asteroid to escape from the sun storm. This method is possible only if the asteroid is hollow. If the asteroid isn't hollow then the option for hiding won't appear.
- **Destroyed ():** The robot can get destroyed if it gets hit by the sun storm. This can cause serious damage to the robot and can often lead to its destruction.

3.3.6 Timer

- **Responsibility**

Timer class provides a method call that is used by a thread to schedule a task, such as running a block of code after some regular instant of time. Each task may be scheduled to run once or for a repeated number of executions. Each timer object is associated with a background thread that is responsible for the execution of all the tasks of a timer object.

- **Interfaces**

None

- **Methods**

- **Stop():** This method tell that at what time the events going to stop such as explosion of asteroid or the occurrence of the sun storm
- **Start():** Its opposite to the stop method. The sun storm and the explosion of asteroid can occur suddenly as programmed.

3.3.7 Asteroid

- **Responsibility**

Asteroid is like a planet containing several minerals/resources which are located at the mantle and are to be mined by the player. Asteroid is one of key classes in the game since it contains the attributes and functions which handle travelling and mining processes. There are unlimited asteroid objects which are freely distributed throughout the asteroid belt. Its interaction is mostly with settler, robot and gate objects. Asteroids can be drilled by Settler and Robot in order to collect the minerals/resources at the mantle. Asteroid can perform several functions which will be explained in the ongoing parts.

- **Super classes**

None

- **Interfaces**

Timer

- **Attributes**

- **state:** string - This attribute shows the type of asteroid which can be either perihelion or aphelion
- **depth:** long – It shows the depth of the asteroid that should be drilled to reach the core
- **Mineral:** It tell which mineral would be contained by asteroid. It can be radioactive mineral as well

- **Methods**

- **void Accept (Object o):** this method accepts a new object such as settler, robot and gate to the asteroid

- **void Remove(Object o):** Once an object leaves the asteroid or explodes, this methods removes it from the asteroid
- **Asteroid GetNeighbour(Direction d):** Player wants to know neighbours around while planning to move Settler from one asteroid to another. So, this method returns Asteroid according to a chosen direction
- **void SetNeighbour(Direction d, Asteroid a):** When it comes to add a new asteroid to the game, this method sets it as neighbour according to its location in the asteroid belt

3.3.8 Object

- **Responsibility**

Object is a superclass for Settler, Robot and Gate thus it contains common features like hiding, drilling etc. All interactions between the child classes and Asteroid are handled through Object class. All the features will be discussed in detail in the next part.

- **Super classes**

None

- **Interfaces**

None

- **Attributes**

None

- **Methods**

- **void HitBySunStorm():** This method defines that when the object is going to get damages. It can get damaged when it gets hit by the sun storm
- **void Drill(Asteroid a):** This method defines that an object which can be either Settler or Robot, can drill the asteroid in order to find resources.
- **void Travel(Direction d):** This method defines that the object can travel from one asteroid to another. It is carried out according to the chosen direction.
- **void Hide():** This method which is available only in the presence of hollow asteroid, defines that the object can hide inside the hollow asteroid to escape from the sun storm.
- **void Destroyed():** Once the settler or robot drill a radioactive asteroid and reach to its core, the object will be destroyed. Thus, this method determines when the destruction will happen.

3.3.9 AsteroidBelt

- **Responsibility**

Asteroidbelt contains all the asteroids located inside it, thus settler, robot, gate and all other objects are in it too. Asteroids are mapped throughout the asteroid belt which allows settlers to travels between asteroids according to a chosen direction. Once all the minerals are collected and spaceship is ready to be built, it will be constructed inside the asteroid belt. Asteroid belt also handles sunstroms which will be explained later.

- **Superclasses**

None

- **Interfaces**

None

- **Attributes**

None

- **Methods**

- **void AddSunStorm (SunStrom s):** This method creates a Sun Storm and add it to one of Asteroids which then will be able to destroy all objects there.
- **void RemoveSunStorm(SunStorm s):** Once the sun storm happens in an asteroid, this methods removes the sun storm from both the asteroid and asteroid belt.
- **Step():** It tell that at which step of the moment, the sun storm is going to occur .

3.3.10 Direction

- **Responsibility**

The primary feature of this class is to help to map asteroids in Asteroid belt and settlers to travel from one asteroid to another. The directions can be chosen by the player to move the settler. There four different directions which will be explained in the upcoming part.

- **Super classes**

None

- **Interfaces**

None

- **Attributes**

Up: it defines that the asteroid will be on the upper (North) part

Down: it defines that the asteroid will be on the bottom (South) part

Right: it defines that the asteroid will be on the right (East) part

Left: it defines that the asteroid will be on the left (West) part

- **Methods**
None

3.3.11 Game

- **Responsibility**

This is the most essential class as it controls all the game from the player side. However, Game class doesn't interact with all the objects. It can start the game, monitor whether the game ends and provide menu bar to the player to have a certain control over the game. At the start of the game, game class plays initializer role that is used to start the game.

- **Super classes**
None

- **Interfaces**
Timer

- **Attributes**
None

- **Methods**

void StartGame(): this a method which starts the game by calling all necessary methods such as triggering tick() method.

void EndGame(): Once the settler dies by explosion or sun storm destruction, it results in the game being over which is handled by this method. It stops all the ongoing processes and release the data to ensure that the game is in start state.

void NextLevel(): This method defines that when the player succeeds to built the spaceship and wants to continue with the next level

3.3.12 Hollow Asteroid

- **Responsibility**

This class determines whether the asteroid is hollow or filled with resources whether useful or radioactive. The user and robot both can hide inside the hollow asteroid.

- **Super classes**
Asteroid

- **Interfaces**
Timer

- **Attributes**
None

- **Methods**

FillwithResources(m:Minerals): The user can carry only 10 units of resources. If the user has more resources then it can store it inside the hollow asteroid which will be completely safe from the dangers lurking in the belt.

3.3.13 Radioactive asteroid

- **Responsibility**

This class is responsible that when and where the radioactive asteroid would be available. Of course, this information would be unknown to the user. It will also define the time a which the radioactive asteroid can explode.

- **Super classes**

Asteroid

- **Interfaces**

Timer

- **Attributes**

None

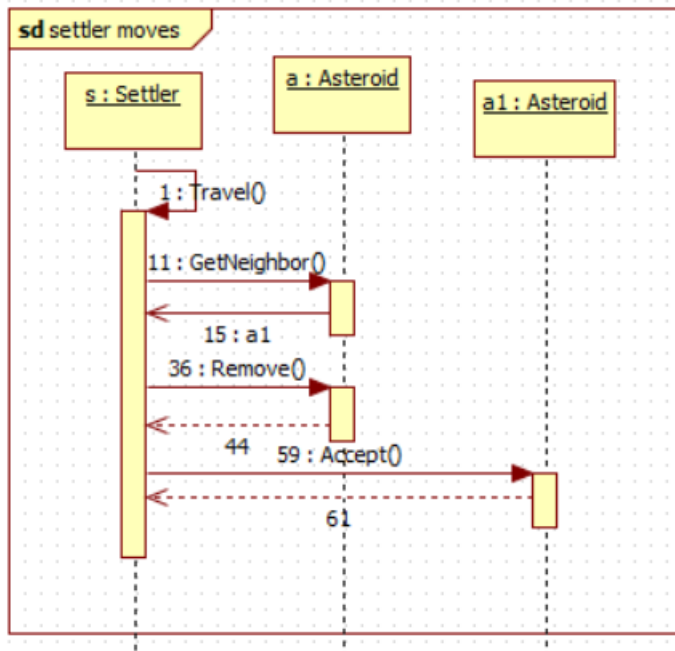
- **Methods**

Explode(): This will tell when and where the radioactive asteroid is going to explode. The programmer is going to set the condition. This will seem to the player that the explosion occurred suddenly

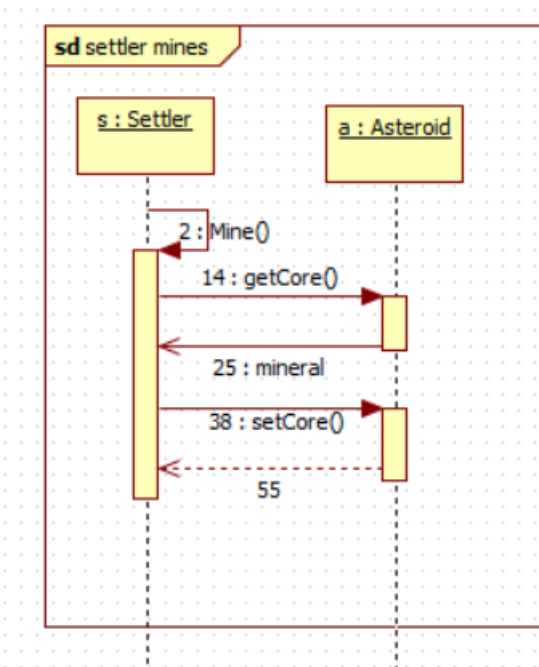
Sequence diagrams

Remark: it was not possible to draw „gate” messages due to error in software, so I draw them as self-message

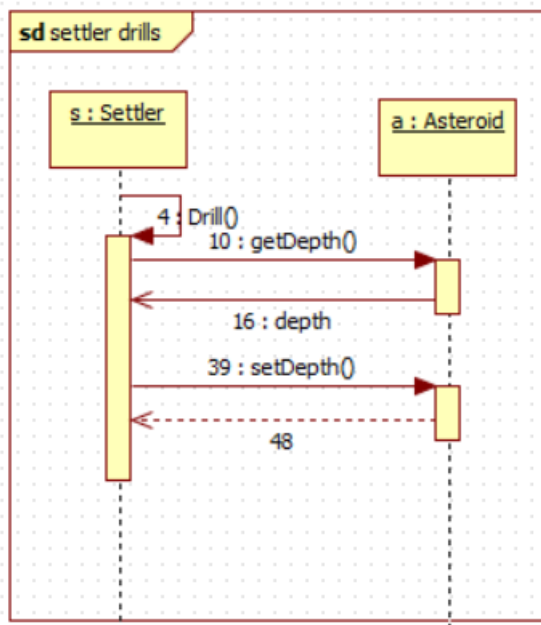
3.4.1 Settler moves:



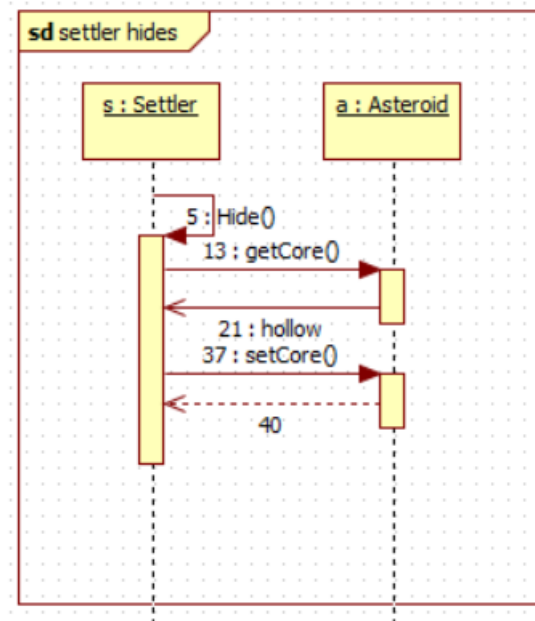
3.4.2 Settler mines:



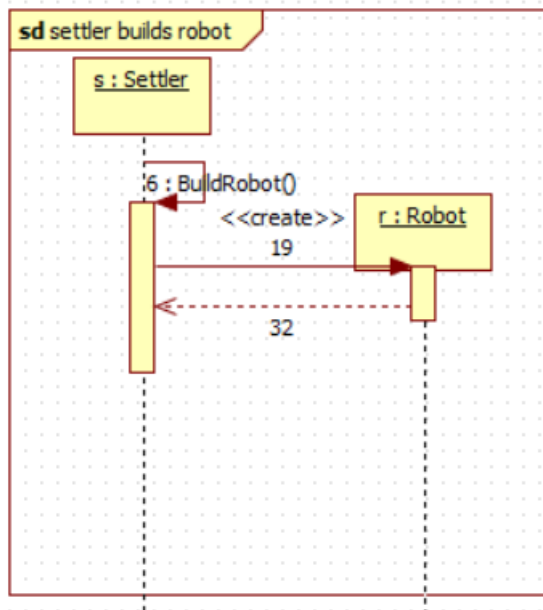
3.4.3 Settler drills:



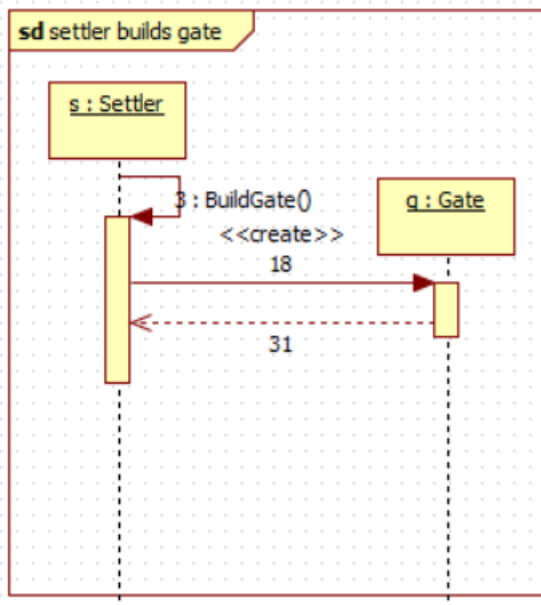
3.4.4 Settler hides:



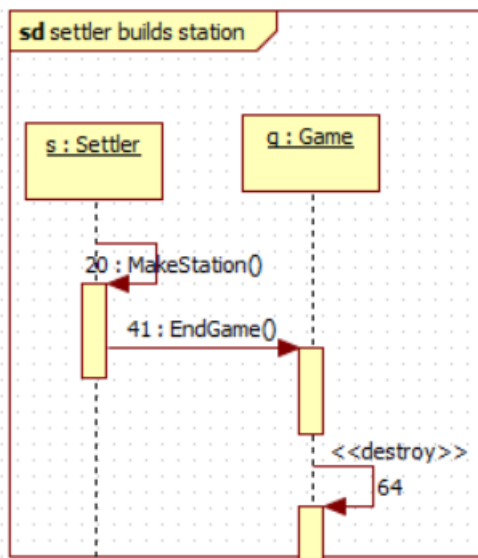
3.4.5 Settler builds robots:



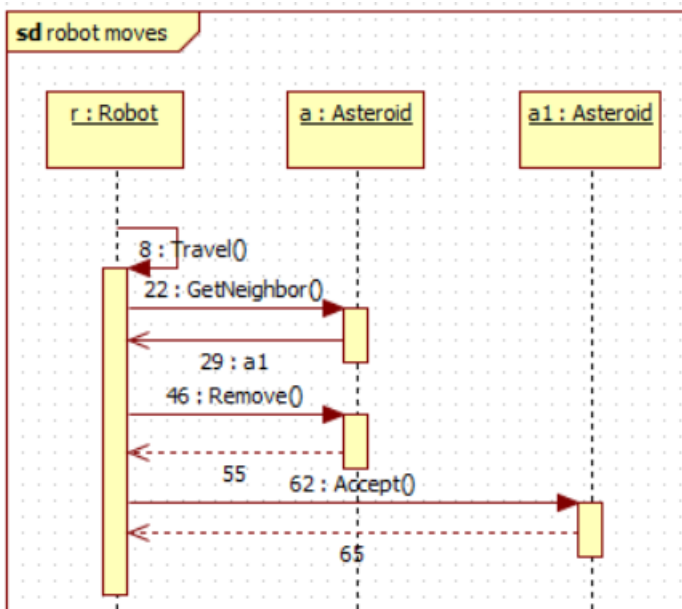
3.4.6 Settler build gates:



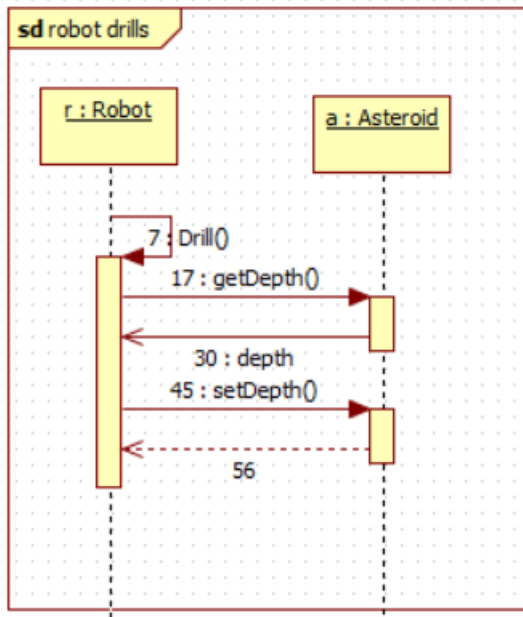
3.4.7 Settler builds station:



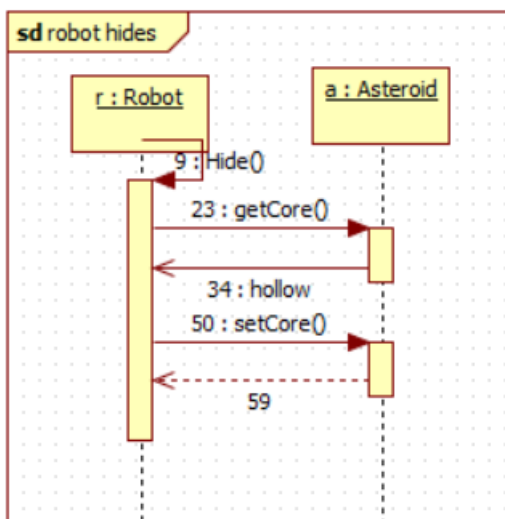
3.4.8 Robot moves:



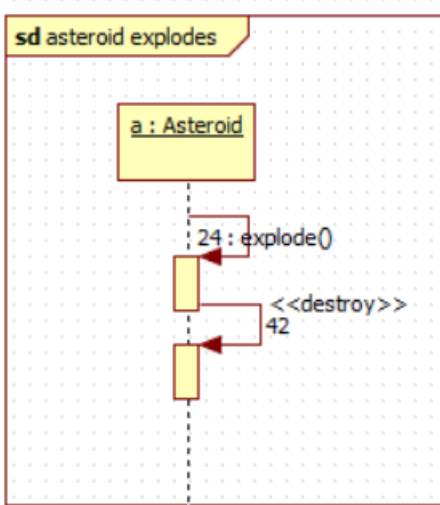
3.4.9 Robot drills:



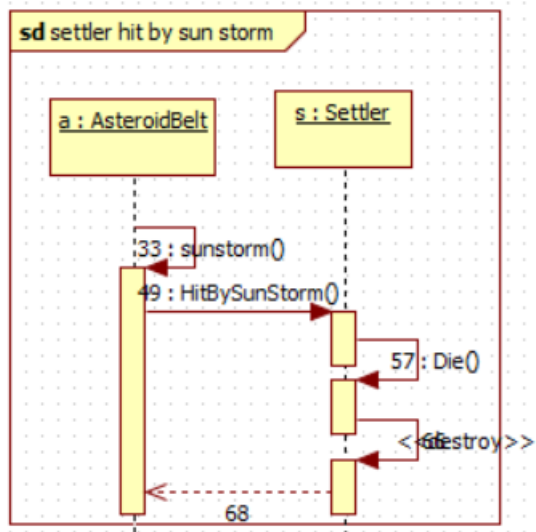
3.4.10 Robot hides:



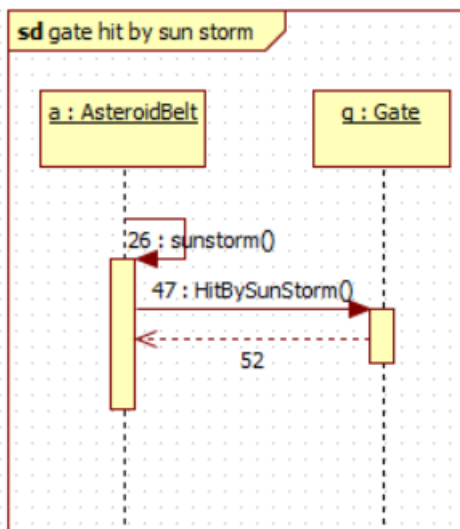
3.4.11 Asteroid explodes:



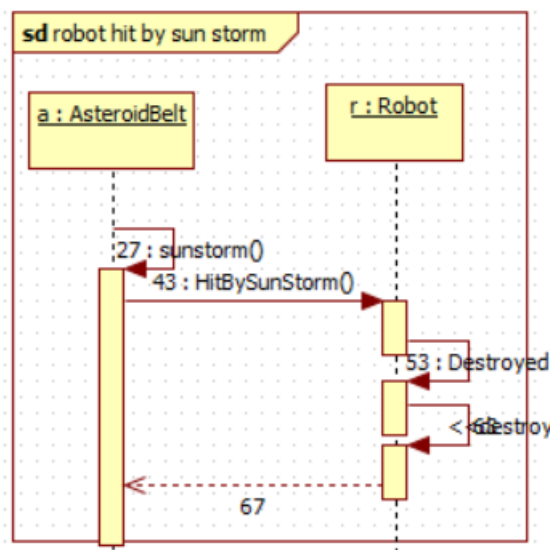
3.4.12 Settler hit by sun storm:



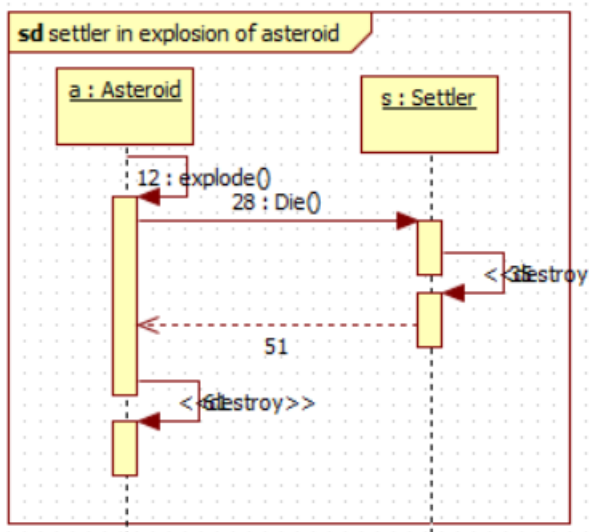
3.4.13 Gate hit by sun storm:



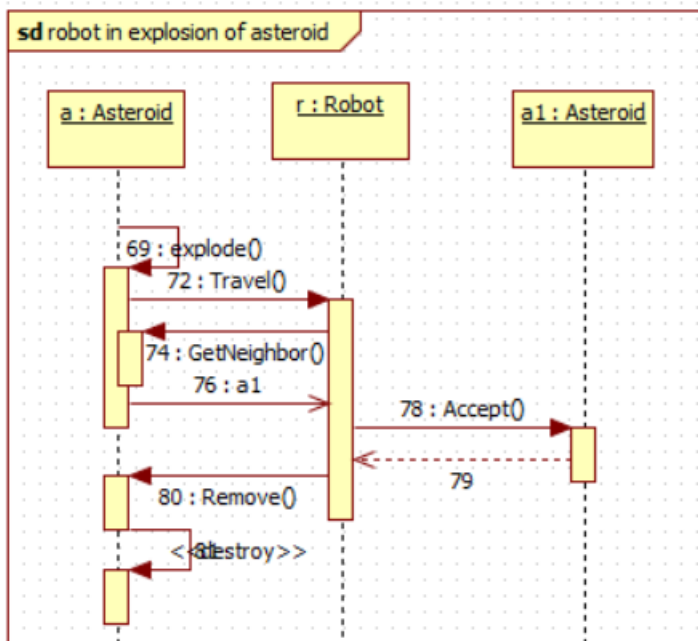
3.4.14 Robot hit by sun storm:



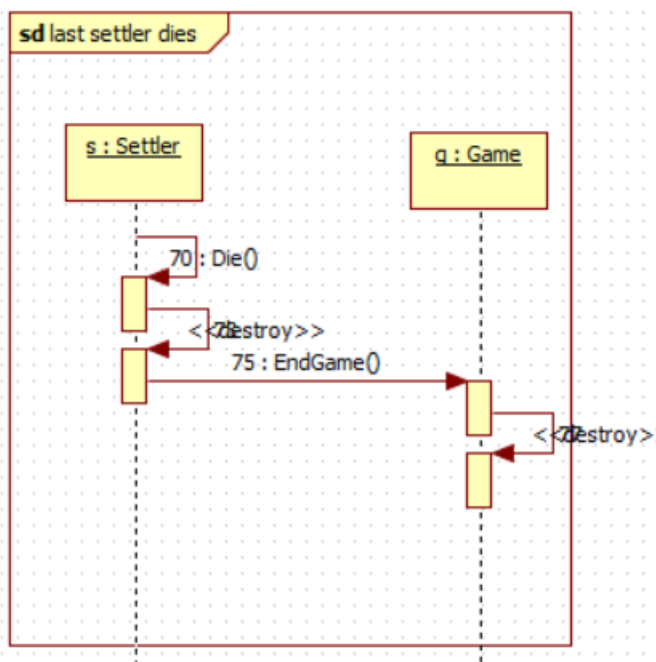
3.4.15 Settler in explosion of asteroid:



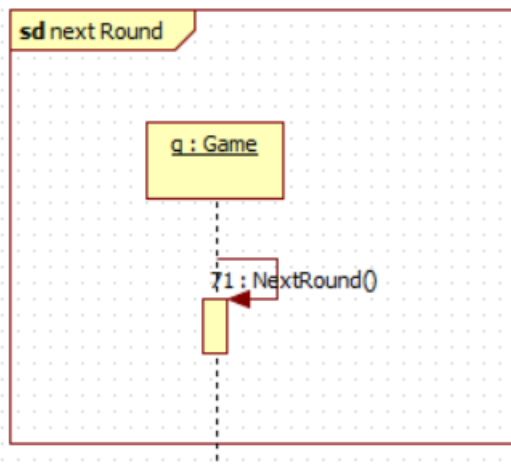
3.4.16 Robot in explosion of asteroid:



3.4.17 Last Settler dies:

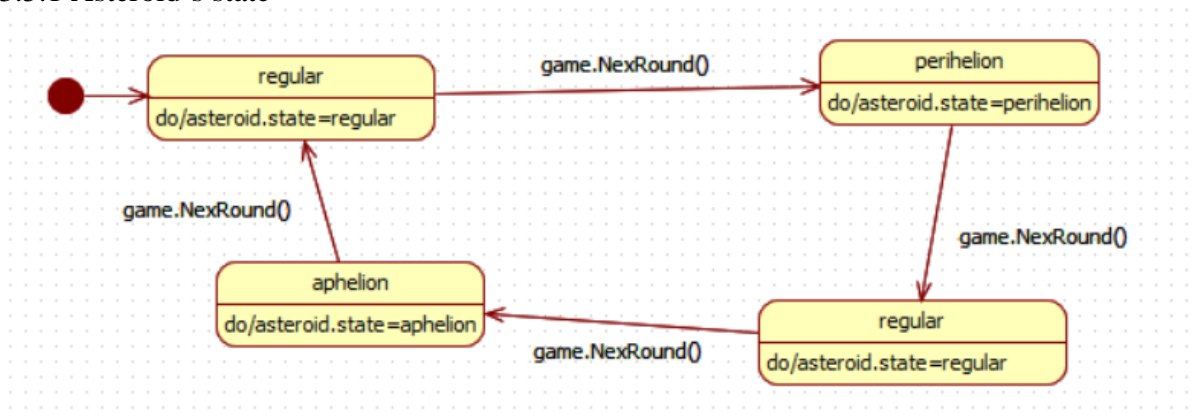


3.4.18 Next Round:



3.4 State-charts

3.5.1 Asteroid's state



3.5 Protocol

Start (date & time)	Duration (hours)	Performer(s) name	Activity description
25.02.2021	1 hour 22 min	Gurdeep Singh, Areeba T. Shoaib, Salahov Kamal, Ali Madatov, Subhan	Discussing and Assigning Tasks, brainstorming methods,
26.02.2021.17:00	2 hour	Gurdeep Singh	3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6
27.02.2021.13:00	1 hour	Gurdeep Singh	3.1.7, 3.1.8, 3.1.9, 3.1.10
28.02.2021. 13:00	3 hours	Areeba T. Shoaib	3.3.1, 3.3.2, 3.3.3, 3.3.4, 3.3.5, 3.3.6, 3.3.12, 3.3.13
28.02.2021 18:00	3 hours	Salahov Kamal	3.4 , 3.5
28.02.2021. 13:00	3 hours	Subhan	3.2
1.03.2021, 12:00	3 hours	Ali Madatov	3.3.7, 3.3.8, 3.3.9,3.3.10, 3.3.11