# Flowchart Graph's Implementation of Enemy AI in a Turn-based RPG

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***Abstract* — This paper explain about the implementation of graph in the decision making of many types of enemy AI (Artificial Intelligence) in a turn-based RPG (role playing game) game system.**

**With the turn based system used, the enemy should have some kind of decision making in order to act in the battle for each turn. Therefore, the AI will be implemented on these purpose. These AI will be used to decide the enemy's behavior.**

***Index Terms*—Artificial Intelligence, Flowchart Graph, Role playing game, Turn based.**

## I. INTRODUCTION

Role playing system (RPG) is a popular video game system that has been played by more than million people around the world. This system game, as its name, is about playing as the certain character in certain plotted time, place, and situation, such as stone age with large dinosaur around, middle age, the World War II, the nowadays, the future with futuristic technology, even in the unknown time. The setting is that the player plays a character or a party goes through a story while slaying enemy or monster around and upgrading the character.

Picture 1: Example of RPG game (Ragnarok Online)

Beside, RPG, there are several video game types with different system. The other types are

- Action
  An action game requires players to use quick reflexes, accuracy, and timing to overcome obstacles. It is perhaps the most basic of gaming genres, and certainly one of the broadest. Action games tend to have game play with emphasis on combat. There are many subgenres of action games, such as fighting games and first-person shooters.


Picture 2: Fighting action game (Street Fighter)

- Shooter
  A shooter game focuses primarily on combat involving projectile weapons, such as guns and missiles. They can be divided into first-person and third-person shooters, depending on the camera perspective.

Picture 3: Shooter game (Counter strike)

- Adventure
  Adventure games are not defined by story or content. Rather, adventure describes a manner of game play without reflex challenges or action. They normally require the player to solve various

puzzles by interacting with people or the environment, most often in a non-confrontational way. It is considered a "purist" genre and tends to exclude anything which includes action elements beyond a mini game.

Picture 4 : Adventure game (Downfall)

- Simulation
  Simulation video games are a diverse super-category of games, generally designed to closely simulate aspects of a real or fictional reality.


Picture 5: Simulation Game (The Sims)

- Strategy
  Strategy video games focus on game play requiring careful and skillful thinking and planning in order to achieve victory. Strategy video games generally take one of four archetypal forms, depending on whether the game is turn-based or real-time and whether the game's focus is upon strategy or military tactics.[1]


Picture 6: Strategy Game (Advance War)

On this paper, the RPG system used will be specified to the turn based system. This system means that the battle in this system is based on turn, for player and the enemy.


Picture 7: Turn based RPG Example (Lunar Legend)

In turn-based games, game flow is partitioned into well-defined and visible parts, called turns. A player of a turn-based game is allowed a period of analysis (sometimes bounded, sometimes unbounded) before committing to a game action, ensuring a separation between the game flow and the thinking process, which in turn presumably leads to more optimal choices. Once every player has taken his or her turn, that round of play is over, and any special shared processing is done. This is followed by the next round of play. In games where the game flow unit is time, turns may represent such things as years, months, weeks or days.

Turn-based games come in two main forms depending on whether, within a turn, players play simultaneously or take their turns in sequence. The former games fall under the category of simultaneously-executed games (also called phase-based or "We-Go"), with Diplomacy being a notable example of this style of game. The latter games fall into player-alternated games (also called "I-Go-You-Go", or "IGOUGO" for short), and are further subdivided into (A) ranked, (B) round-robin start and (C) random—the difference being the order under which players start within a turn: (A) the first player being the same every time, (B) the first player selection policy is round-robin, and (C) the first player is randomly selected. Some games also base the order of play on an "initiative" score that may in part be based on other, outside factors as well as

dice rolls.[2]

With the turn based system used, the enemy should have some kind of decision making in order to act in the battle for each turn. Therefore, the AI will be implemented on these purpose. These AI will be used to decide the enemy's behavior.

## II. ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is the intelligence of machines and the branch of computer science that aims to create it.

The field was founded on the claim that a central property of humans, intelligence—the sapience of Homo sapiens—can be so precisely described that it can be simulated by a machine. This raises philosophical issues about the nature of the mind and the ethics of creating artificial beings, issues which have been addressed by myth, fiction and philosophy since antiquity. Artificial intelligence has been the subject of optimism, but has also suffered setbacks and, today, has become an essential part of the technology industry, providing the heavy lifting for many of the most difficult problems in computer science.

AI research is highly technical and specialized, deeply divided into subfields that often fail to communicate with each other. Subfields have grown up around particular institutions, the work of individual researchers, the solution of specific problems, longstanding differences of opinion about how AI should be done and the application of widely differing tools.

The central problems of AI include such traits as reasoning, knowledge, planning, learning, communication, perception and the ability to move and manipulate objects. These abilities make AI the most powerful use in many technologies, and the one we will discuss here is in video games technology. [3]

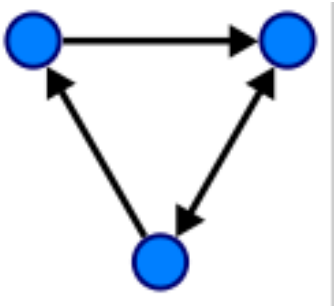
These abilities mentioned above can make AI becoming other "players" in many games. It means that the real player will be able to interact to these other "players" in the game without having the other real players involved and the game can go on. In an RPG game, AI can be use to play as other characters, such as NPC (Non-Player Character) and monsters. And in their role, they will use AI's ability in decision making. This ability can be constructed in many ways. And one of it is by using graph.

## III. THE USING OF GRAPH

### *A. Flowchart Graph*

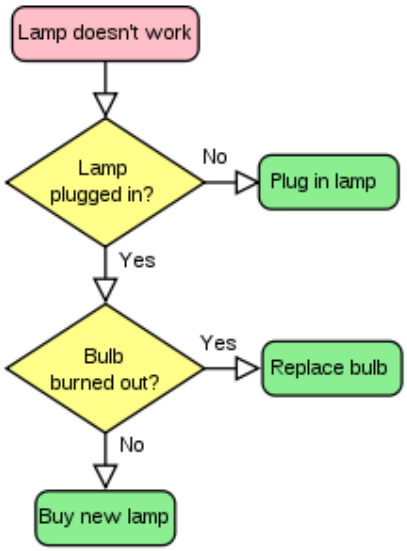
In mathematics, a graph is an abstract representation of a set of objects where some pairs of the objects are connected by links. The interconnected objects are represented by mathematical abstractions called vertices, and the links that connect some pairs of vertices are called edges. Vertices are also called nodes or points, and edges are also called lines. Graphs are the basic subject studied by graph theory. Typically, a graph is depicted in diagrammatic form as a set of dots for the vertices, joined by lines or curves for the edges.

The edges may be directed (asymmetric) or undirected (symmetric). For example, if the vertices represent people at a party, and there is an edge between two people if they shake hands, then this is an undirected graph, because if person A shook hands with person B, then person B also shook hands with person A. On the other hand, if the vertices represent people at a party, and there is an edge from person A to person B when person A knows of person B, then this graph is directed, because knowing of someone is not necessarily a symmetric relation (that is, one person knowing of another person does not necessarily imply the reverse; for example, many fans may know of a celebrity, but the celebrity is unlikely to know of all their fans). This latter type of graph is called a directed graph and the edges are called directed edges or arcs; in contrast, a graph where the edges are not directed is called undirected.[4]



Picture 8: Directed graph

One kind of use of the graph is a flowchart. A flowchart is a graph used to do decision making based modeled in a certain graph. A flowchart is a type of diagram that represents an algorithm or process, showing the steps as boxes of various kinds, and their order by connecting these with arrows.




Picture 9: Example of a flowchart

This diagrammatic representation can give a step-by-step solution to a given problem. Process operations are represented in these boxes, and arrows connecting them represent flow of control. Data flows are not typically represented in a flowchart, in contrast with data flow diagrams; rather, they are implied by the sequencing of operations. Flowcharts are used in analyzing, designing, documenting or managing a process or program in various fields.[5]

### *B. Turn based decision modeling*

In the decision making of AI, we will use a directed graph. The reason is because the changing variable and condition will make the statement and next condition changed in one way to another condition within a turn of battle. Mainly, most of decision will be taken within a turn.

The game system can be modeled here. The battle section of the game will use a turn battle system. The battle is between a character and an enemy monster. Each character and monsters have some variable representing their statuses, such as health and focus (manna). Health variable represents the health of each character. If they reach zero, the character faints. While the focus represents the ability to use special move/skill.

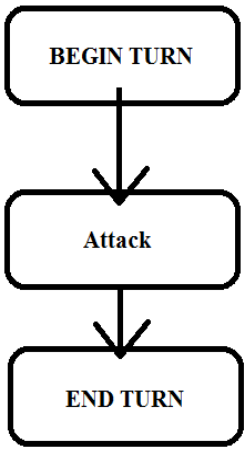
Most of each decision will take a turn, but sometimes it gets more than one turn due to several condition. One of example is when the character is being stunned. The character will skip turn until the "stunned" status is removed. Also, every character in battle (player and monster) may have some other status, such as poisoned, regenerate, berserk, confuse, and so on. These statuses can affect the battle in many ways, instant or continues for each turn, such as player health, focus, speed, strength, and so on.

And then, the player will be given some decision to choose. the decision for the player in one turn is given as below:

Choose decision:

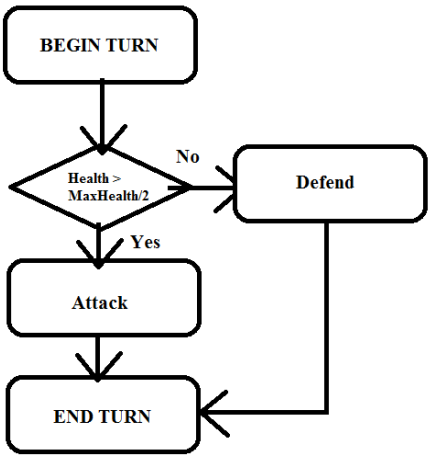
- Attack (Give damage your opponent using your weapon)
- Wait/Defend (Do nothing, but cut half the damage your opponent did to you)
- Use Skill/Magic (Use your special move/skill/the use your focus)
- Use Item (Use the item from your inventory)
- Flee (Attempt to run away from the battlefield)

To take a good decision in a turn, there must be some tactics used. For example, if the player has a low health, he should use item or skill to heal, instead of keep attacking. Another example, if the enemy is far too strong, the player should flee away. This also happen to the enemy. They should do some decision makings in taking a turn. A simple decision making can be seen below.




Picture 10: Simple Behavior

In this decision making above, the enemy always does attack in each turn it takes until it faints. This kind of decision making doesn't check any condition. Another a little more complex decision making can be seen below.

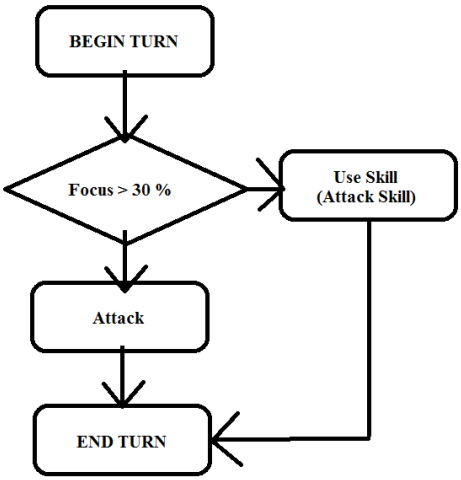



Picture 11: behavior with condition checking

As seen above, this kind of decision making checks the condition of its health then make a turn decision based on that status. This can also be done, not only based on the character's health, but also other conditions, such as character's focus and condition, allies and opponent's status, even the terrain of where the battle occurred and events in-battle.

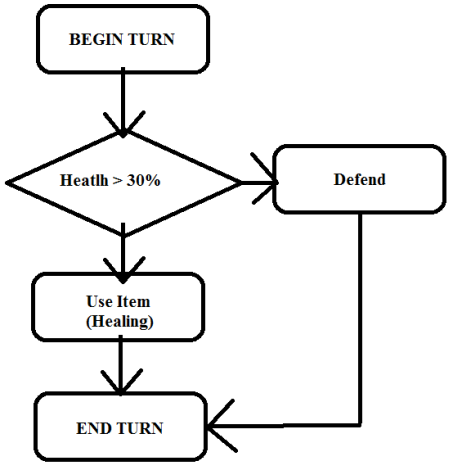
The different decision making will make different behavior. Thus, we will be able to make much different kind of characters and monsters with different behavior. Some of the behaviors depending on decision making are,

- Offensive. This kind of behavior tends to attack than defend itself, using all skill to attack. This behavior often used by weak enemies or the one with high strength.



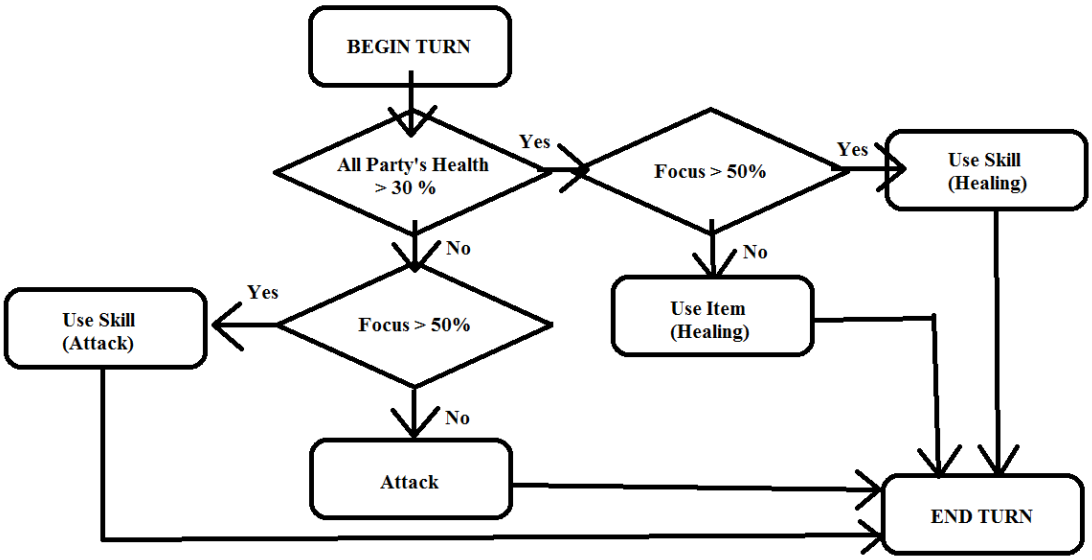

Picture 12: Example of Offensive Behavior

- Defensive. Opposite of offensive one, this kind of behavior makes it tends to defend itself than to attack, making it become a hard to defeat one. Defensive behavior is well-suited with the enemy with high defense.




Picture 13: Example of Defensive Behavior

- Complex. This behavior is more complex than just attacking and defending. It involves more condition checking.




Picture 14: Example of Complex Behavior

The behavior of the enemy also can be altered through the setting of difficulty. This difficulty can affect the behavior as well. We can make an enemy less attacking in easy mode and attack brutally in hard mode. It is up to the favor of maker of the game.

## V. CONCLUSION

In fact, graph once again has been found very useful to represent any information or our thinking. It is a powerful

and friendly way especially in modeling. It can represent the way of how an AI doing a decision making. The example application of graph here is only a small use of how graph is very useful.

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