Towards automated team composition in MOBA games based on players' personality: an intelligent approach

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***Abstract*—MOBA game matches usually work on 10 players divided into two teams fighting for resources with the main goal of destroying the enemy base. Because it is a team game, we can find similarities with traditional sports such as football and volleyball, in which players who have complementary behavioral traits (in addition to their skills in the sport) will get better results. To analyze the personality traits of League of Legends and Dota players, we apply the popular Big-5 framework and propose a new game personality classification as well. Considering personality data in a team composition issue, there is a complex problem that involves several variables, creating a propitious domain to use search-based algorithms. This paper proposes an automated team composition approach on MOBA games by combining the player's roles and their personality traits via a Genetic Algorithm. Thus, a fitness function was developed to search for appropriate teams that contemplate expected roles according to personality traits. Finally, this study reports empirical results of the proposed approach considering its effectiveness and efficiency. The results obtained show that the approach was extremely useful for this context, reaching 100% evaluation.**

***Keywords*-MOBA games, team composition, personality traits, genetic algorithm.**

I. Introduction

Multiplayer Online Battle Arena (MOBA) is a category of real-time strategy games that there has been a growing interest by players and game researchers due to mainly a huge community of players. MOBA's are cooperative games in which to win, teams must eliminate the whole enemy team, fight to resources, or control a specific base of the opposing team. This game category implements common aspects present in sports such as football, volleyball, and basketball, which are cooperation and competitiveness.

Typically, MOBA games are combat-based and it consists of two teams competing against each other. This game category has been gaining so much popularity that different genres have emerged within the MOBA category such as Overwatch and Valorant that are categorized as MOBA-FPS[1]. In this paper, we focus on Defense of the Ancients (Dota) and League of Legends (LoL) since they are similar and have the same elements, both games have a team of 5 players, a map composed of 3 paths and the main goal is to destroy the opponent base.

The major difference between MOBA and other types of games is a set of roles assumed by the players like in a role-playing game (RPG). Thus, a team must be composed of 5 different roles that are complementary in combat, often this is the key to victory in Dota and LoL. The roles may vary slightly in different seasons of the games, but the basic roles are: *i)* Off-lane; *ii)* Jungler; *iii)* Mid-lane; *iv)* Carry and, *v)* Support. In general, the roles have a relationship with cooperation, strategy, skills, and also, studies shown that personality in real life also influences this choice [1] [2].

Social aspects, personality traits, and, human behavioral dynamics have become essential to ensure that teams have an acceptable performance. According to Aydin Atay [1] a player personality can affect entertainment, involvement, motivation, communication, and teamwork. In Psychology, there is a framework named the Big-5, it is known as one of the main models in this area. The Big-5 framework [3] provides five factors in which many personality traits and characteristics fit.

According to Goldberg [3] the five factors can be laid out as follows: 1) Openness to Experience; 2) Conscientiousness; 3) Extroversion; 4) Agreeableness; and 5) Neuroticism. These personality traits have been applied in domains such as the work environment, universities, and also associated with roles in MOBAs. Although great efforts have been devoted to creating an automated strategy to find the dream team, it is a very complex problem since involves different variables as skills, experience, and especially a human factor.

The problem consists of identifying an adequate team T=$\{p_1, p_2, p_3, p_4, p_5\}$ (where p_n is a player) that satisfies constraints of roles R=$\{offlane, jungler, midlane, carry, support\}$ and maximizes the number of players with high skills and experience. Additionally, finding a team with specific personality traits considering real factors and the behavior into the game.

In this paper, we introduce a novel automated approach,

[1]Merging MOBA with First-Person Shooters

called MOBA-Int, to compose teams addressing technical and social aspects in MOBA games. The approach uses a genetic algorithm guides by a fitness function based on player experience and personality traits. Our approach extends the study conducted by Costa et al. [4] which is the current state-of-the-art application of meta-heuristics in team composition for MOBA. The difference from the previous work is that herein we aim to find adequate teams composed of real people and not the best team of characters.

This paper is organized as follows: Section II reports the proposed approach and some related work. Section III reports research design of experiments conducted. Section IV analyzes the results obtained and discusses of the proposed approach. Finally, Section V makes the concluding remarks and future directions are discussed.

II. MOBA-Int Approach

In this section, we outline the details of our approach named MOBA-Int, aiming to automating and optimizing the creation of MOBA teams regarding two groups of aspects: 1) MOBA skills and big-five model personalities and 2) MOBA skills and in-game personalities.

As shown in Fig. 1, our approach employs players' ranking and personalities attributes into a function to evaluate the generated teams considering the aimed personalities. The process consists of three sequential steps: *(1)* Data Preparation; *(2)* Team Composition; and *(3)* Adequate Team.

A. Step 1: Data preparation

The process starts from a database composed of LoL and Dota players. The database is composed of 147 samples that represent the players, each one with 6 attributes as shown in Table I.

TABLE I
A snippet from players database.

ID	Nickname	Ranking	Role	Big-5	GP
0	Cartana	0.5	Jungler	Neuroticism (Neu)	Str
1	Fgomes	0.6	Carry	Openness to Experience (Ope)	Ind
2	jujubatus	0.6	Off-lane	Extroversion (Ext)	Ind
3	Embaixador	0.8	Mid-lane	Conscientiousness (Con)	Agg
4	jax	0.4	Support	Agreeableness (Agr)	Col

The first column displays an identifier of the player; the nicknames are listed in the second column. In the third column is indicated the ranking (an in-game performance evaluation present in MOBA games), where the value is 1.0 if the player has the highest ranking in the database. The fourth column includes which role the player plays. The fifth and sixth columns represent the personalities of individuals. The fifth column is the player personality according to the Big-5 framework (Big-5), and the last attribute in the sixth column (GP) indicates the game personality of each individual. To achieve more consistent results, the database was normalized and the players of the two games were unified and used as one group during the experiments.

Overall, the problem in team composition consists of identifying a set of players that maximize the evaluation of their attributes respecting the necessary roles in the formation. For instance, one Off lane, one Jungler, one Mid lane, one Carry, and one Support.

B. Step 2: Team Composition

The usage of genetic algorithm to generate team compositions can be summarized in three main steps: *(i)* initialization; *(ii)* individuals evaluation; and *(iii)* evolution of them.

An individual is composed of genes, in which each gene includes a player according to MOBA roles and following this sequence: Off-lane, Jungler, Mid-lane, Carry, and Support. In the first step (initialization) the GA starts by selecting random individuals for the initial population, each individual represents a candidate team composition to solve the problem.

In the second step (evaluation), the GA is executed guided by a fitness function according to the needs to achieve an appropriate team. In this study were created two fitness functions that combine ranking and personalities to quantify their adequacy.

Those fitness functions can be seen in the Expression 1. We induced the algorithm finding those teams through bonuses, i.e., for each player with the wanted personality for that role, we reward that team with 10% of its fitness value. This strategy does not prevent the algorithm to search teams without those personalities, since a prohibition can result in not acceptable solutions. On the other hand, the constraint applied is described in 2, where each MOBA role must be filled to a team to be considerate adequate.

Maximize

$$\sum_{i=1}^{n} ranking_n * bonus \tag{1}$$

subject to

$$role = \{offlane, jungler, mid, carry, support\} \tag{2}$$

where, n is the number of players in a team (5), and $ranking_n$ is the ranking of each one of the players. *Bonus* is a beneficial factor inserted to generate teams with the wanted personalities.

The last step (evolution) initiates the process of evolution and improvement of the genetic algorithm through genetic operators. These steps are performed until AG finds the best solution or achieves the maximum number of generations.

C. Step 3: Adequate Team

The last step is the output of the MOBA-Int Approach consists of an adequate MOBA team composition generated based on ranking skills, Big-5 personality traits framework, and Game Personalities. It is important to highlight that an adequate team should have one player on each role, and fit the goal personalities (whether it from the Big-5 or in-game). Fig. 2(a) and Fig. 2(b) presents the teams generated by the

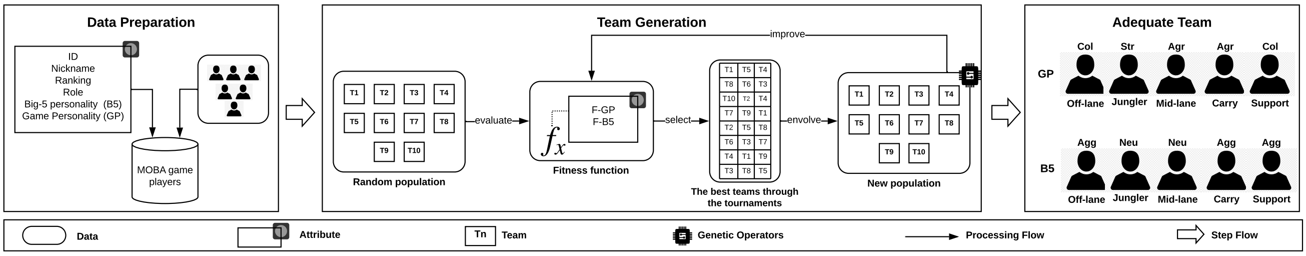

Fig. 1. MOBA-Int approach for team composition.

approach using Game Personalities and Big-5 Framework, respectively. The Game Personalities roles were defined based on 147 answers obtained through a survey conducted. It is worth mentioning that the faces presented do not represent real people. For this, we use an artificial intelligence tool to generate fake people connecting them to each sample in our players' database. However, the nicknames are real and provided for the players that answered the survey.

(a) Game Personalities

(b) Big-5 Personality Framework.

Fig. 2. Personality Traits used on the MOBA-Int approach.

III. Experimental study

We conducted a controlled experiment to determine if the proposed approach is effective in composing a team based on their personalities, and the guidelines recommended by Wohlin et. al [5] were used.

The experiment's goal is to analyze and evaluate the effectiveness of the MOBA-Int approach for supporting MOBA games team composition by combing player's personalities with their roles. We are interested in measuring the effectiveness in terms of the fitness value and efficiency in terms of computational cost in time. The experiments were performed through a laptop with Intel Core i7 2.4GHz CPU, 8GB memory in the Linux Ubuntu operating system.

For achieving the goal, we raise the following Research Questions (RQs):

RQ_1**: How effective is the MOBA-Int approach for MOBA game teams' composition?** The effectiveness of the approach was measured using the fitness value for composing a team. The fitness value of the MOBA-Int approach using two different fitness functions is compared with a random composition. The fitness function was based on the personalities and roles of players. We also performed this experiment 50 times and computed the average fitness value.

RQ_2**: How efficient is the MOBA-Int approach for MOBA game team's generation?** The efficiency of the MOBA-Int approach was measured using the time for generating MOBA game teams. We also performed this experiment 50 times and computed the time average. The time was computed in seconds.

The evaluation of our approach was carried out two independent experiments (E = e_1; e_2) for a team composition using the GA and random composition. The first experiment (e_1) was performed to evaluate the GP fitness function ($F - GP$), while the second Big-5 fitness function ($F - B5$). For both experiments we used six variables: *(i)* Gene = 5; *(ii)* Population = 10; *(iii)* Selection method = tournament; *(iv)* Mutation Rate = 0.2; *(v)* Generations = 100; and *(vi)*Fitness functions (F) = $F - GP$ and $F - B5$.

To answer the RQs, we carried out the experiments in five steps: (1) Generating different teams (T) as experimental subjects; (2) Evaluating each team was based on responses of participants from the conducted survey, i.e it was mapped in the $F - GP$ and $F - B5$ fitness functions; (3) Computing the fitness value for each team obtained from the MOBA-Int approach and random composition; (4) Comparison between the MOBA-Int approach and random composition for MOBA team composition; and (5) Computing the time in seconds for each team obtained from the MOBA-Int approach.

IV. Results and Discussion

In order to answer $RQ1$ of experiment, Fig. 3 shows the fitness value on average obtained by MOBA-Int trough $F - GP$ and $F - B5$ fitness functions. As the results show, it was observed that the fitness value achieved an improvement over the 100 generations. We noted the increase from 0 to 0.8 value is high since there are many good solutions in our dataset, thus, even the population is started randomly, it is possible to obtain regular teams. Despite this, the optimization curve is continuous and there is no evidence of premature convergence for a local maximum.

The average fitness value achieved by MOBA-Int (GA) using $F - GP$ fitness function is 98% and the random generation is 63%. While the average fitness value achieved

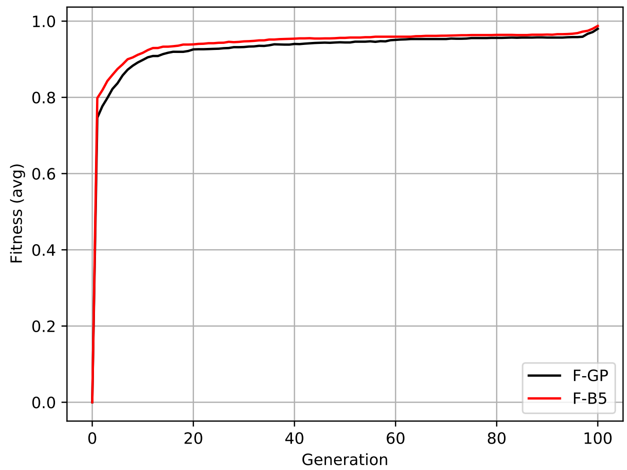

Fig. 3. Fitness value achieved by the MOBA-Int approach using $F - GP$ and $F - B5$ fitness functions.

by MOBA-Int (GA) using $F - B5$ fitness function is 99% and the random generation is 65%.

Analyzing Fig. 4, it is possible to notice that the mean of fitness value achieved by $F - GP$ (e_1) and $F - B5$ (e_2) are more efficient in all experiment repetitions compared with random composition. Of 50 repetitions with both fitness functions, half of them achieved 100% fitness value. In contrast, for random composition, no repetition obtained fitness value greater than 70%.

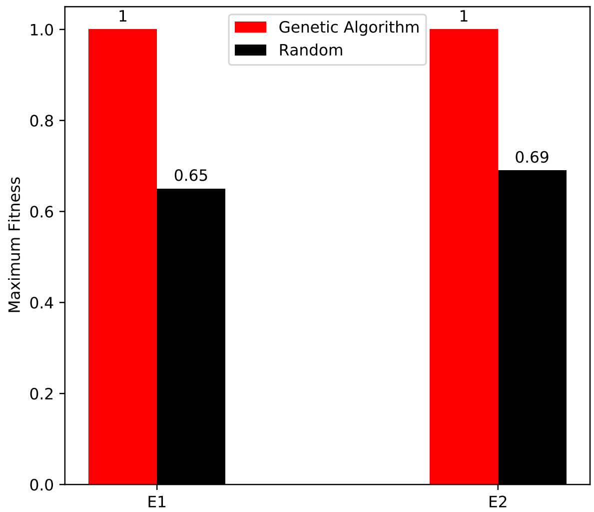

Fig. 4. Maximum Fitness value obtained for MOBA-Int (GA) and random composition using $F - GP$ (e_1) and $F - B5$ (e_2) fitness functions.

To answer the RQ_2, the time average of MOBA-Int using both fitness function were computed. The results reveal that the MOBA-Int (GA) using $F - GP$, on average, obtained the time of 10 seconds, while the $F - B5$ the time was 12 seconds for team composition.

Overall, an approach to find adequate teams for games using search-based algorithms can be very efficient, mainly when there is a search space containing several good solutions. However, the more constraints there are, the more difficult it is to find a feasible solution. In this study, we achieve excellent results due to various good teams combination and we design the problem of personalities team composition with only a constraint. It is worth mentioning, we considered the personality as a bonus factor for the GA to decrease the complexity of the activity.

V. Conclusion

This paper presents MOBA-Int, an automated approach for MOBA team composition that considers individual skills with personality traits. Our approach employs a GA by a fitness function combining skills i.e., experience and rank with real personalities and game personalities. Firstly, a survey was conducted to analyze important information to configure an ideal team. The survey considered questions about, personalities, roles, and adequate players' behaviors. Next, the responses were examined and we associated the game personalities with roles according to the conducted survey. Finally, we develop a genetic algorithm to automate the problem of team composition in MOBAs.

An empirical study was conducted to measure the effectiveness of team composition and answer the Research Questions. Based on our experiment, we find that the proposed approach produces effective teams able to fulfill the criteria defined in fitness functions. The results indicate that the approach is promising to support team composition based on different factors, besides, creates new opportunities for researches and tools for this context.

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