Personal Artificial Intelligence Coach For 'League Of Legends'

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Abstract

Personal AI Coach(PAIC) is a decision support system and artificial intelligence that is designed for people to create better decisions and performances. A PAIC learns how players performed in the past and obtain their game data to compare it with current data to suggest feedback to the user to increase their performance. This research focuses on how PAIC supports casual and inexperienced players to rank up in "League of Legends(LOL)" by using game data. The primary focuses are "What is the impact of Personal Artificial Intelligence Coach for casual/inexperienced users in League of Legends?", "Which factors from past/current game data increase win probability?", "What are the winning factors in 3 different phases?" and "What feedback/advises are required to improve players' performance before/during/after the game?". The implemented system uses a machine learning algorithm to let users obtain knowledge of winning factors. It is verified by usability and system testing to increase its reliability and usability. The web-based user interface allows potential users to access the system easily. This paper establishes the main foundation for the creation of an efficient PAIC to deepen the ability of inexperienced players in LoL

Keywords

Esports, League of Legends, rank system, Decision support system, Personal Artificial Intelligence Coach, causal/inexperienced player, decision making, and machine learning.

1 Introduction

A Personal AI Coach(PAIC) is one of the Decision Support Systems(DSS) to support individual choices to increase their performance. DSS is helpful for the user by supporting the decision-making process in many domains. Especially sports is a highly competitive domain and players get pressured to make decisions at every moment.

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Esports has become a highly competitive domain similar to traditional sports [17]. In similar points of view, esports players also make decisions that determine the outcome of victory or defeat directly like in traditional sports. Therefore quick decision-making through high-quality recognition of the situation is irreplaceable during highly competitive matches. However, inexperienced players faced difficulties making decisions due to a lack of knowledge and experience. PAIC can guide individuals by analyzing player performance and giving feedback to users to support individual decision-making. This research focuses on "How Personal Artificial Intelligence supports inexperienced users to climb up their rank level". League of Legends has more than 140 champions. It requires various kinds of strategies for users to win the game. PAIC can help users, especially inexperienced users. From the op. gg which is one of the biggest statistical game data websites, only 3.72 percent of people above Diamond ranks and 15.2 percent of users above Platinum ranks. It means under the Platinum ranks, many inexperienced players want to climb up their ranks. PAIC monitors their performance from the past to recent matches and finds winning factors that increase win probability during the game and gives feedback to the user. Users can reflect on their performance and make better decisions after getting feedback from PAIC.

1.1 Background

This background section provides background information about League of Legends games, advantages, and disadvantages for personal artificial intelligence coaches, requirements, and reasons why personal artificial intelligence is needed.

1.1.1 League of Legends

According to the description on Riot Games' official website, League of Legends is one of the multiplayer online battle arena (MOBA) games [1]. In the official esports, the "Summoners' Rift" is used as an official map. Rank system also used "Summoners' Rift" map. The "Summoners' Rift"contains various objectives such as drakes, Baron Nashor, turrets, and inhibitors, each offering distinct advantages to the teams. Moreover, players should take the creep minion(CS) to get experience (Exp) and gold to make stronger their champion during the Lane phase. After/during the Lane phase, if once the nexus is destroyed, the team whose nexus is destroyed loses the game, regardless of their neutral advantage.

In “Summoners’ Rift” total 10 players play the game. Each team comprises players assigned to different roles: top, jungle, mid, bottom, and support. Top-lane players typically choose sturdy and tank champions that can defend the front line and target the enemy's strongest champion. Jungle players focus on hunting neutral monsters and assisting the team. Mid-lane players prefer champions with high burst damage and are responsible for dealing significant damage in fights. Bottom-lane players are the primary attackers and require early-game protection to gather resources and experience in order to carry the team to victory. Support players specialize in supporting the bottom-lane players and controlling the team's vision.These factors, along with their complex interactions, give rise to numerous tactics and strategies in League of Legends tournaments.

1.2 Problem statements

Esports has been proliferating in past years according to tremendous growth in video games (D. Himmelstein 2017). The League of Legends is one of the world's most popular online video games. During the 2022 League of Legends world championship finals, the audience almost reached 5.15 million concurrent viewers during the final match. In this popular game, there is a rank system for the League of Legends players [14]. Players can get rank depending on their performance and they can rank up or demote their rank. Over 10 million players play rank matches to climb up the rank ladder[15]. However, many players stay at the same rank since climbing the rank ladder is too competitive and difficult. In LoL, there is a support system. However, from the survey of 30 players, 26 of them feel there is no support system or it is useless. This research will indicate a problem with the current support system in LoL and suggest a new support system which is PAIC to support players to rank up their tier.

1.3 Research questions

This research focuses on the difficulties of casual/inexperienced players when they play the rank system in LoL with a lack of knowledge. The main research question(MQ) is “What is the impact of a Personal Artificial Intelligence Coach for casual/inexperienced users in League of Legends?”.
Sub-research questions are the following:
RQ1. Which factors from past/current game data increase win probability?
RQ2. What are the winning factors in 3 different phases?
RQ3. What feedback/advice is required to improve players’ performance before/during/after the game?

2 Framework

This part of the essay shows the framework for PAIC. The theoretical framework section will discuss the current support system for LoL and suggest the initial design of PAIC.

2.1 Current support system

Even LoL is one of the most popular video games around the world. There is not much research about supporting information to increase user performance in LoL. Some researchers suggest or analyze the factors to increase the winning probability but most of the research focuses on psychological or team cooperation factors. For instance, Monge and Brien (2022) analyze personal behavior factors in LoL. Kim and her team (2017) show the team cooperation factors to analyze player performance in LoL. As appose to current research, PAIC focuses on individual performance instead of suggesting psychological or external factors. In the current LoL system, there are support systems to support the players.

Firstly, there is a rune recommend system during the champion selection phase. In Figure 8 Appendix L, there is a decision-supporting system to select runes depending on the champion and role. It provides 3 recommended runes and summoner spells to players which are most top 3 selections from all users. This support system can support users by giving current popular information about rune and summoner spells. However, this support system can affect to user performance since it frequently changed depending on the number of total user selections. Therefore, some users can get unsuitable rune or summoner spell selections. Moreover, players can depend on this system when they choose the rune and summoner spells without their thinking and understanding the rune and summoner spells.

Secondly, there is a data outcome dashboard about the finished match. In Figure 9 Appendix N, it shows the in-game data during the game. There are much data in the dashboard. However, players hard to find the data they want to see, and difficult to classify the data since the dashboard is complicated due to lots of data. Moreover, some players do not know which data is important and have a strong impact on the result since it only provides statistical data without feedback.

2.2 Performance Factors

In LoL, many factors influence the game results. To support the user by making PAIC, understanding the game factors is essential. In this section, the paper provides the important factors depending on the 3 different phases which are the champion selection phase, lane phase, and team fight phase based on the interview with expert players (Appendix H and I).

2.2.1 Champion selection phase

Before play start to play the game, players need to select their champion among 163 champions. Not only for the champion but also players need to select their rune and summoner spell depending on the role and champion. In this phase, it is important to select a “counter pick” depending on the opponent's champion.

According to Inzitari, Lyons, and Islam (2022), the counter-pick meaning is the champion combinations that show more stronger or highly competitive champions during or after the lane phase. There are no significant win probability has occurred but some pairs show noticeable win probability[21]. Moreover, from the interview [Appendix H and I], two expert players said it is important to find the most skillful champion and role since skillful and suitable can give more effect on the game positively. However, there is a lack of information in the current support system to find a suitable role and champion.

2.2.2 Lane phase

Laning phase is the period to get experience and gold to become stronger. During the Laning phase, players need to separate into their areas depending on the role and get Creep Minion(CS) or jungle monsters[22]. From the interview [Appendix H and I], expert players mention the importance of vision and the worth of death. During the laning phase, the interruption of CS or experience by opponents' jungle or other role players which called "ganking" or "roaming". To avoid these interruptions, it is important to take vision to predict opponents' actions and move to avoid "ganking" or "roaming". Moreover, worth death during the laning phase is death which causes an extra loss in experience or gold due to death. It means due to the death.

2.2.3 team fight phase

After the lane phase, players group up and fight with an opponent to destroy the nexus. Changing phase laning to team fight is a difficult strategical decision. If one team transits the lane phase to the team fight phase without proper itemization or experience, it leads the team to an irreversible outcome[22]. During the team fight, each team should get a neutral advantage to go forward to win the game. Each team should get Drake, Baron Nash, or get the turret to get extra buff or golds. In this period, the worth death can become occur. According to Maymin(2021), worthless death and smart kills can increase the win probability and during a team fight. The smart kill or worthless are occur when neutral damage difference is applied. At the same point, worth death can cause the extra disadvantage to get neutral objects. It can directly affect the game outcome. Two expert players commonly mention the importance of vision score[Appendix H and I]. They argue that it is important to take vision to avoid worth death and get a tactical advantage.

2.3 COFI Models

This section provides the creation model for PAIC. Based on this model, PAIC will be created. In 2022, Rezwana, and Maher suggested COFI models for collaboration between AI and humans. COFI shows the effective design of a framework to create a human and AI interaction system. Figure 1 in Appendix A shows the COFI model suitable for PAIC. The following factors describe the factors that should be considered.

COFI Model factors	How PAIC reflects
Collaboration Style	In any collaborative endeavor, effective communication plays a crucial role by fostering co-regulation among collaborators and supporting the AI agent in its decision-making process during creative tasks [11].
Participation Style	1) Parallel Participation: AI interacts with user input simultaneously 2) Taking turns Participation: AI works after the developer of PAIC implements the code
Task Distribution	"Task Divided" PAIC -AI: collects and analyzes data to give feedback -Developer: works on creating an algorithm, codes to maintain/develop PAIC
Timing of Initiative	Checking the initiative plan: PAIC guides the user to the feedback, statistical result based on the initial plan from developer
Mimicry	PAIC is a coaching system that mimics the human coach to maximize player performance
Communication Style	Interaction between human & AI: In any collaborative endeavor, effective communication plays a crucial role by fostering co-regulation among collaborators and supporting the AI agent in its decision-making process during creative tasks [11].
Human-to-AI communication	Human sends input to AI: user and developer send inputs/changes by using buttons (in the interface) or text directly to AI.
AI-to-Human communication	AI delivers output to users/developers: AI uses a user interface to deliver the outcome of algorithms

Table 1. COFI models factors and reflection of PAIC

2.3.1 Interaction with the Shared Product

Interaction with the shared product shows the "Creative Process" and "Creative Product" factors of the shared product in COFI. PAIC shows "Generate", "Define", and "Evaluate" actions in the creative process. PAIC generates a database and feedback for the user. As a definer, it defines the winning factors by using machine learning. As an evaluator, it evaluates player performance data and statistical data to find winning factors.
PAIC contributes in "Extend" and "Refine" ways. PAIC extends the database by requesting data from Riot API to increase the accuracy and reliability of the feedback. Moreover, PAIC also refines the data from the database and Riot API to find the factors

which increase the win probability for the user. The contribution similarity between AI and developer is highly similar since the developer contributes to making all of the algorithms that AI needs to process and AI contributes to all of the other statistical work and user interactions.

3 Methodology

In this section, the paper provides the methodology information to answer all of the research questions. All of the LoL data is from the Riot Developer Portal[5] by using API keys. All data from the Riot API will be saved into sqlite database to get and analyse user data. To increase the reliability and get more information, this research interviews two expert players who are joint “BlueShell” which is an esports team in the University of Twente and professional players who played as professional players in Portugal, Germany, and Italy LoL leagues and get Challenger tier 2022 seasons and GrandMaster in the 2023 season. In the interview, they mentioned valuable factors in three different phases. From the interview, we can find the information about important factors for each phases.

The algorithm in PAIC use the Python code to make efficient algorithm. All algorithm is based on the machine learning. Machine learning is the computational education method to improve the performance of the system[13]. In PAIC, machine learning is used to investigate the factors that influenced outcome of the game. PAIC used supervised machine learning. Supervised machine learning entails creating algorithms that use provided instances to predict the outcomes of future instances, resulting in the generation of general patterns and hypotheses. The primary objective of supervised machine learning classification algorithms is to categorize data by leveraging prior information [7]. PAIC get “victory” output as a expected outcome and try to find the factors that leads to expected outcome. In Figure 2 Appendix B, it shows the process of PAIC. There are 3 big phase to give feedback to user.

Firstly, data collection phase is the process to get data from Riot API and database. From the Riot API, PAIC can extract much data. PAIC focus on the match data which can extract by using “/lor/match/v1/matches/by-puuid/{puuid}/ids” api requests. Moreover, PAIC also can get user data by “/lol/summoner/v4/summoners/by-name/{summonerName}” or “/lol/summoner/v4/summoners/by-puuid/{encryptedPUUID}”. By using these command, PAIC can get specific user details or match data to analyse and gives feedback.

Secondly, data analyse phase is the actually machine learning process to find the winning factors. During that process, PAIC get data from data collection phase and start to learn the wining factors which caused expected outcome “victory”. PAIC uses past data and current data and indicate the wining factors from much data. Moreover, PAIC learns the factors depending on the timeline and it can indicate the important factors that can directly effect to result. In that process RQ1 and RQ2 can be answered.

Final phase is feedback phase. In feedback phase, PAIC gives the feedback to the user by using result of the data analyse outcome. Most of feedbacks are based on the interview from expert players [Appendix H and I]. After PAIC find that some factors are under the win standard, it mention about the week points to users. PAIC provides two different feedback pages. From the data analyse page, it gives the feedback with in-game factor analyse which are important during lane and team fight page. In champion and role data page, it provide the overview of the role and champions and user can easy to find suitable role and champion during champion selection page. In feedback phase, RQ3 can be answered.

4 System development

This section focuses on how the PAIC system is developed. The demo version of PACI can find via this link: https://www.figma.com/proto/3hext7o9UJ0yFb2pDA2lvs/Untitled?type=design&node-id=1-10&scaling=min-zoom&page-id=0%3A1&starting-point-node-id=1%3A14&mode=design

4.1 Background data for development

Before developing the PAIC system it is necessary to set requirements and get information to answer the research questions. Most of the information that supports development comes from the interviews and Riot API.

4.1.1 Requirements

Based on Framework and Methodology in section 2 and 3, we need to consider the non-functional and functional requirements to create PAIC.

Non-functional requirements

For the non-functional requirements, it is necessary to increase the usability, flexibility, performance, interoperability, and security of the system [12]. To cover these factors, PAIC needs to consider the following requirements

1. PAIC system never accesses personal information without any access.
2. PAIC system should work constantly with any users.
3. The data in PAIC needs to be reliable and never invade human freedom.
4. The data API key needs to be replaceable.

Functional requirements

There are requirements that the system should take functionally. PAIC should consider the following requirements

1. As a user, I want to search for my summoner id on the user interface.
2. As a user, I want to view my feedback depending on my role.
3. As a user, I want to view my feedback depending on changes in vision score.
4. As a user, I want to see my progression of tier changes from the past 10 matches.
5. As a user, I want to see the win probability depending on the opponent's champion.
6. As a developer, I want to update my API keys.
7. As a developer, I want to delete data from the database.
8. As a user, I want to view my total match history

4.2 Web interface

PAIC is web based application. It use HTML as an interface base. To connect with HTML and Python, PAIC use the Django framework to connect each other. In HTML, bootstrap is used to increase the usability. When user gives input into the HTML application, HTML send the “REQUEST” message to Python by using Django system. When Python get “REQUEST” message, it run the algorithms to get data or feedback and send HTML message with “SEND” HTML header and feedback data on HTML body. After HTML get data from the Python, it send “GET” message to Python and shows the result to the users. Due to the time limitation of the research, the real-time feedback during the game is not available. There are three different pages in user interface.

When web-based applications start to run, the application asks the user to enter the “summoner name ” on the top of the website (Figure 4 Appendix D). After the user input, the summoner name, PAIC starts to analyze data by using machine learning and guide to the data analysis page which shows the feedbacks and statistical outcome for lane and team fight phase[Figure 5 Appendix E]. In data analysis page user can see the changes of current tier and factors that PAIC considered as a winning factors. At the bottom of the application, user can see the summary of the statistical result and feedback. Moreover, in champion and role data page, usre can see the win rate about the all of the roles and champion depending on the role [Figure 6 Appednix F]. It support user to find suitable role and champion.

4.3 Machine Learning

After collecting matched data from the specific user, PAIC started to use machine learning to find the winning factors to increase the win probability. In the beginning, PAIC collects expert players’ data from the leaderboard data. After that PAIC started to compare the statistical factors to the players to find the winning factors. When this process is finished, PAIC takes the past 100 matches from user data and analyzes factors. In Figure 10 Appendix O, shows the machine learning results. First figure shows the outcome from comparison with expert players. It shows the comparison with expert players and figure out which factors player need to improve to catch up the expert players. Second figure shows the win probability depending on number of wards. PAIC learn itself about relationship between win and number of wards and save it as a winning factors. There are other winning factors which PAIC was found. The result is summarized below

Vision score	Expert users and players who get a higher win rate get a higher vision score.
Worth death	influences the extra disadvantage (ex: death near Drake, giving the shutdown gold to the opponent)
Suitable role	shows higher win probability
Counter pick	Show a higher win rate when against a specific champion
Suitable champion	Suitable champion shows a higher win rate.

Table 2. Machine learning factors

4.4 Feedback process

Based on machine learning, PAIC learns the factors that make an effect on the result of victory. After finding the factor, PAIC gives feedback to the user depending on the factors. For instance in Figure 5 Appendix E, if a user shows a lower vision score than expected vision score, PAIC gives feedback to the user “Care about taking vision, buy more control ward next time!”. If PAIC find the increasement of the worth death, it analyse the reason of the death and advise to user. For instance, if worth death is over the average death, PAIC indicate the reason like “In which phase the worth death are often occur” or “Which factors related to the vision score”. After find the related reason of the death, PAIC gives feedback like “Try to take vision to avoid worth death near the object!”.

Moreover, users can see statistical feedback about the champion and role selection (Figure 6 Appendix F). Figure 6 Appendix F shows the win probability and total match results depending on roles. The PAIC classifies the match data depending on the role of the player and determines the win probability. In addition, when PAIC classifies the match data from the players, it also classifies the champions depending on win probability with a specific role. PAIC shows the top 6 win rate of the champions and top-6 difficult opponent champions which have the lowest win rate. During the champion selection phase, the user is available to see these statistical data about the champion selection. This statistical feedback supports users pick more suitable champions and roles more efficiently. All of the algorithms are made from Python code and use the if statement to compare the data with winning factors. An example of a demo version can be found at: “https://www.figma.com/file/3hext7o9UJ0yFb2pDA2lvs/Untitled?type=design&node-id=0%3A1&mode=design&t=lNlphRgAv1xjBez6-1”.

5. Evaluation

The main research question is “What is the impact of a Personal Artificial Intelligence Coach for casual/inexperienced users in League of Legends?”. To prove it, PAIC used a system and usability test with two participants. Based on the result of system and usability testing the main purpose of the testing can be answered.

1) How did the winning factors change during the 10 matches?

2) How does PAIC increase player performance?

3) Does the user interface guide the user fluently?

5.1 System testing

For the system testing, two participants played the LoL with two different conditions. One participant uses PAIC but the other participant does not use PAIC. Both participants start playing matches at the same rank level(Gold 1). The results of systems testing show different results on two different users (Figure 3 Appendix C). During the system testing, Participant 1 (P1) who uses PAIC shows improvements after 4 matches. At the end of the testing, he successfully climbs up the rank level Gold 1 to Platinum 4. However, Participant 2 (P2) shows consistent rank levels and did not show any improvements in their rank.

From the result of P1, with PAIC, there were meaningful changes. Figure 7 Appendix G shows the changes in vision score before and after using PAIC. Before using PAIC, the overall vision score was recorded at 22.4. However, after using PAIC, it shows an increase, and the overall score was recorded at 26.6. From the interview of P1 (Appendix K), he feels that the frequency of death from ganking, and death near objects decreased. In Table 3, there are multiple data for the death before P1 used PAIC. From Table 3, P1 recorded 4.12 deaths per game during the lane phase. It means that except for solo kills, P1 got ganking or roaming from opponents whose role is different from P1 and recorded death at 2.25 per game. Moreover, after the lane phase, P1 recorded 6.54 deaths per game near Drake and Nash which makes it disadvantageous for the team to get buff and gold from Nash or Drake.

Solo death during lane phase	1.87 per game
Death during lane phase	4.12 per game
Death near objects	6.54 per game

Table 3 Death per game before using PAIC

After P1 uses PAIC, the number of deaths per game is decreased. The number of deaths due to ganking or roaming decreased to 1.16 per game. P1 avoids 1.09 ganking for roaming after using the vision score. In addition, the number of deaths near objects decreased from 6.54 to 4.67. From the interview after testing, P1 said after getting feedback from PAIC, he tries to take more vision than past on purpose. As a result, P1 can identify opponents’ movements and avoid death.

Solo death during lane phase	1.88 per game
Death during lane phase	3.04 per game
Death near objects	4.67 per game

Table 4 Death per game after using PAIC

Moreover, P1 said that the champion data page (Figure 6 Appendix F) helps him to select the main role and champions by providing objective data. He can view the highest win rate role and champions and it supports him to find suitable roles and champions. However, data for win probability against opponents’ champions (Figure 6 Appendix F), does not show an impact on user performance. From the interview, P1 said he can ban the champion which P1 has the worst win probability when against, but he did not feel much effect about this data.

5.2 Usability testing

Usability tests focus on the checking user interface. The focus during usability testing is 1) Does the user interface show the correct graph to the user?, 2) Does the user interface guide the user fluently?, and 3) Does the user interface show correct feedback to the user? The usability testing uses a Google Forms survey with participants after using PAIC (Appendix J).

5.2.1 Visualization objects

To check visualization, testing questions ask about user experience to check the visualization of the contents of PAIC. In the data analysis page (Figure 5 Appendix E), 91.7% of participants experienced all or most of the graphs and user details shown properly and 8.3% of participants have visible issues due to the Riot API key expired or no data for solo rank match of specific user name. In the role and champion data page (Figure 6 Appendix F), 91.7% of participants can see the images of the role and champion properly but 8.3% of participants have small visual issues due to the Riot API key expired. Overall, the visualization of PAIC shows proper objects to the user but still needs small implements about handling no-data of solo rank history and the Riot API key expired.

5.2.2 Usability

Usability testing needs to test how fluently the PAIC user interface guides the user. For transferring the initial page (Figure 4 Appendix D) to the data analysis page (Figure 5 Appendix E), most users experience fluent page switching without any delay (66.7% of users) but some participants experienced page errors due to the Riot API key expired error. Moreover, the overall usability score from the participants is 4.08 out of a maximum of 5. However, still need to implement the Riot API key expired issue.

5.2.3 Feedback

To give effective feedback to users, it is important to check the readability of feedback. From the survey, 8.3% of participants answered that they cannot find the feedback but 75% of participants answered easy to find, and 16.7% of users can find feedback but takes time. When users find the feedback, 83.3% of users read and understand the feedback clearly. To increase the effectiveness of feedback, the feedback part should be more visible and more clear to understand.

6 Discussion and Conclusion

Based on data science, this research makes the framework and development of PAIC which is one of the DSS models. This section summarizes the conclusion and discussion of the PAIC system.

The main motivation for PAIC is to support the casual/inexperienced users who faced difficulties to rank up their LoL tier. Even though there are DSS systems in current days, only 4 percent of the players reach above the Diamond tiers[16]. This research suggests that the new DSS model with AI increases efficiency during decision-making.

To make PAIC, it is necessary to recognize the difficulties of the casual/inexperienced player. In the interview with the expert players, they mentioned difficulties when they were casual/inexperienced players. Moreover, they mentioned valuable factors which have an impact on winning the game during 3 different phases. Firstly, choosing a suitable champion depends on the opponent's champion and the player's skill level during the champion selection phase. Secondly, avoiding worth death which causes extra disadvantages in gold and exp. Lastly, taking vision during/before the team fights phase. Taking vision causes an advantage for a team fight, it can cause valuable kills which makes it easier to get objects. Machine learning also figures out similar winning factors from the data and based on that PAIC shows graphs or provides feedback to players. This PAIC improves the positive impact on decision-making by using system testing.

For future work for PAIC, focus on the development of the general PAIC algorithm. It means PAIC tries to find more winning factors and get data for all tiers and makes more reliable feedback. Especially for data about win probability depending on the opponent champion, it will be implemented by providing win probability depending on the users' champion and opponents' champion. In addition, to avoid the Riot API key expiration issue, PAIC will use multiple API keys by using a dictionary or list function in Python. Moreover, the design of the user interface will be re-designed since it shows much data at the same time and it can cause confusion to the user. To increase visuality and accessibility to the user, the direction mark or description of the UI will be added. Lastly, PAIC will focus on real-time feedback to the user. By using application-based programs, PAIC utilizes an overlay function to monitor the players' performance directly and give feedback in real-time.

In conclusion, there are many players stocked into lower rank levels in LoL. PAIC can become an alternative to support casual/inexperienced players to reach the higher rank level by using its data analysis, data saving, and feedback systems. However, there should be more system tests and experiments required to increase the reliability of the PAIC. This research suggests the starting point of the model of PAIC to relieve difficulties for LoL players and it can be developed in further research.

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Appendix

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Appendix A.

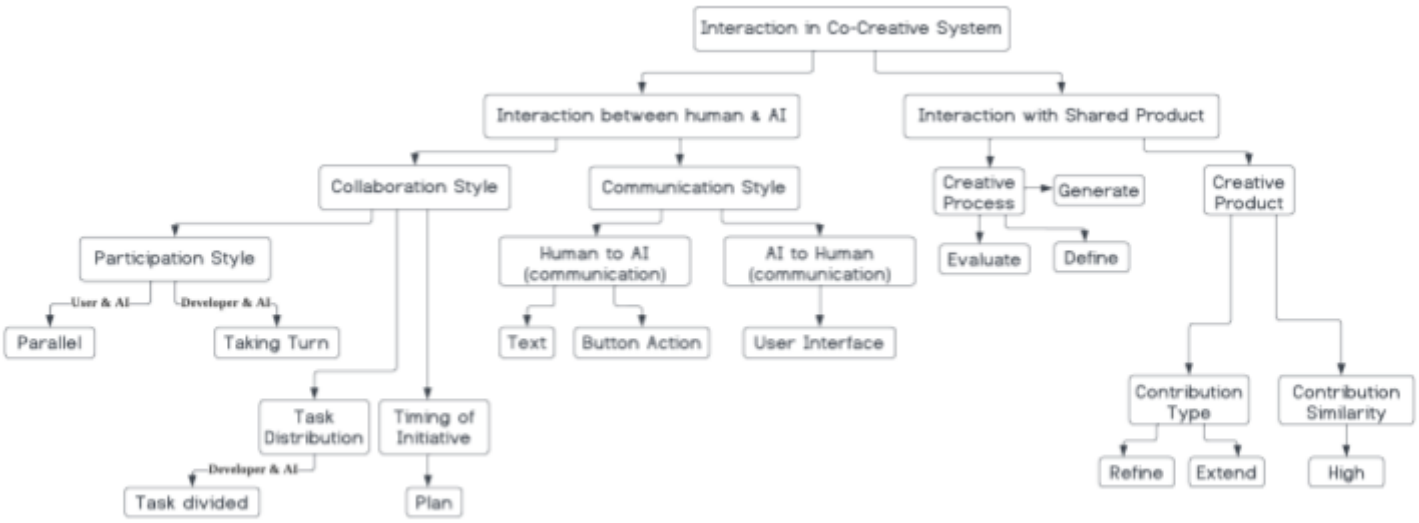


Figure 1. COFI model description

Appendix B.

Figure 2. Logic of how the PAIC processes

Appendix C.

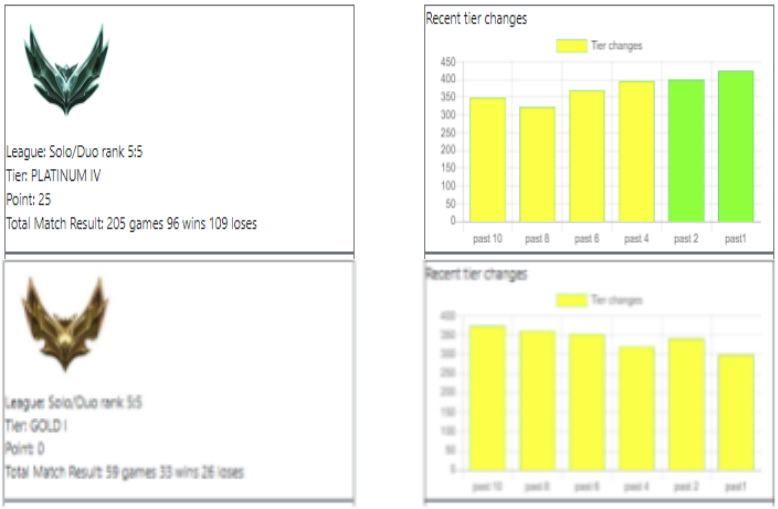


Figure 3. Change of rank tier of two participants (green: user with PAIC, yellow: user without PAIC)

Appendix D.

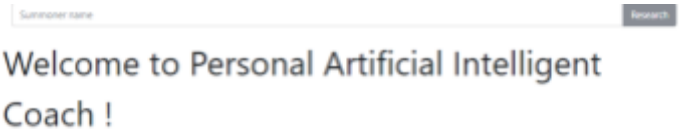


Figure 4. Start page of PAIC

Appendix E.

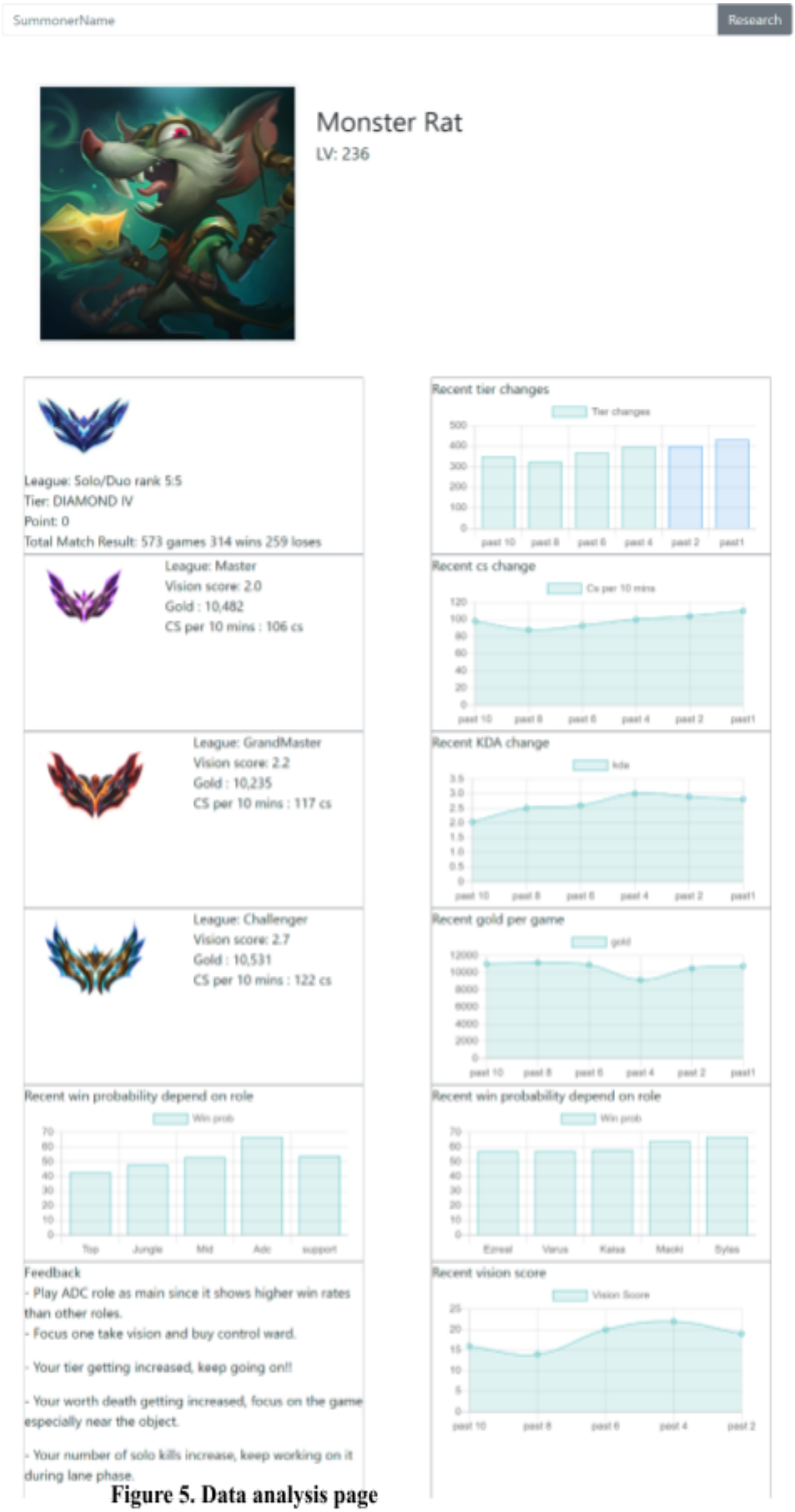


Figure 5. Data analysis page

Appendix F.

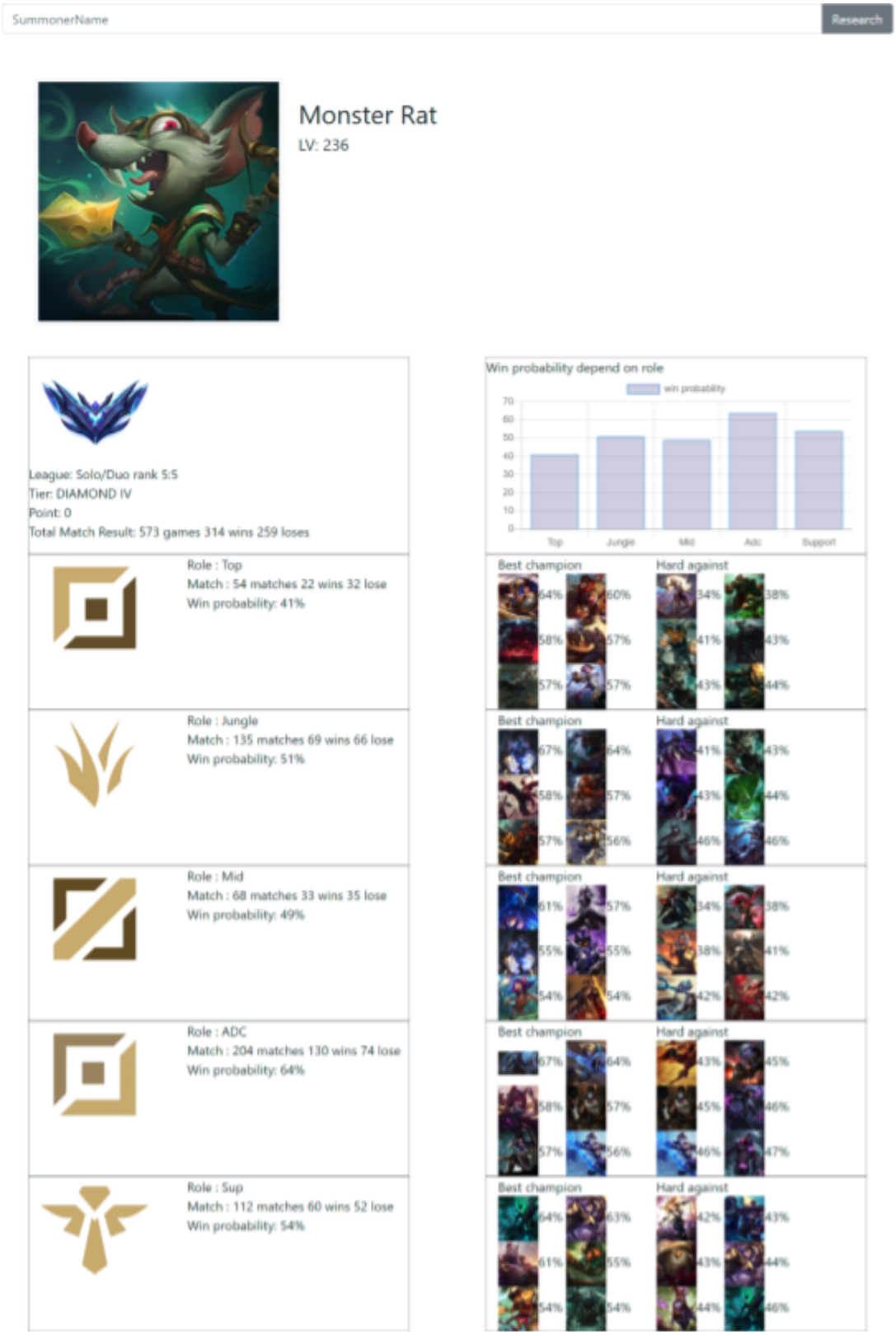


Figure 6. Role and champion data page

Appendix G.

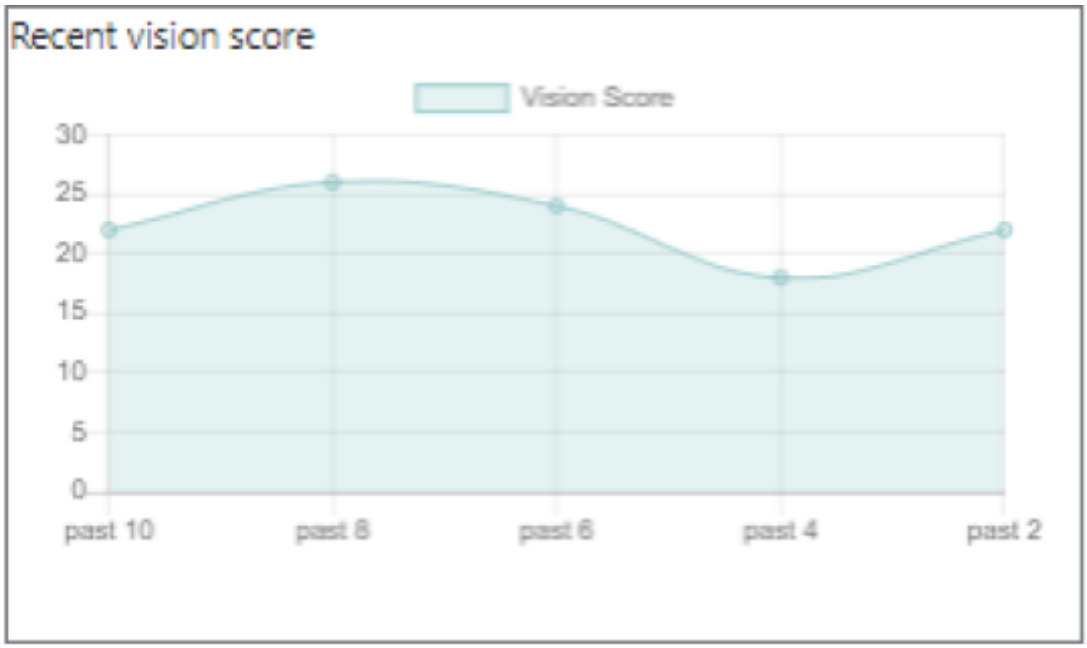


Figure 7. Change of Vision Score(Past~Present) without PAIC

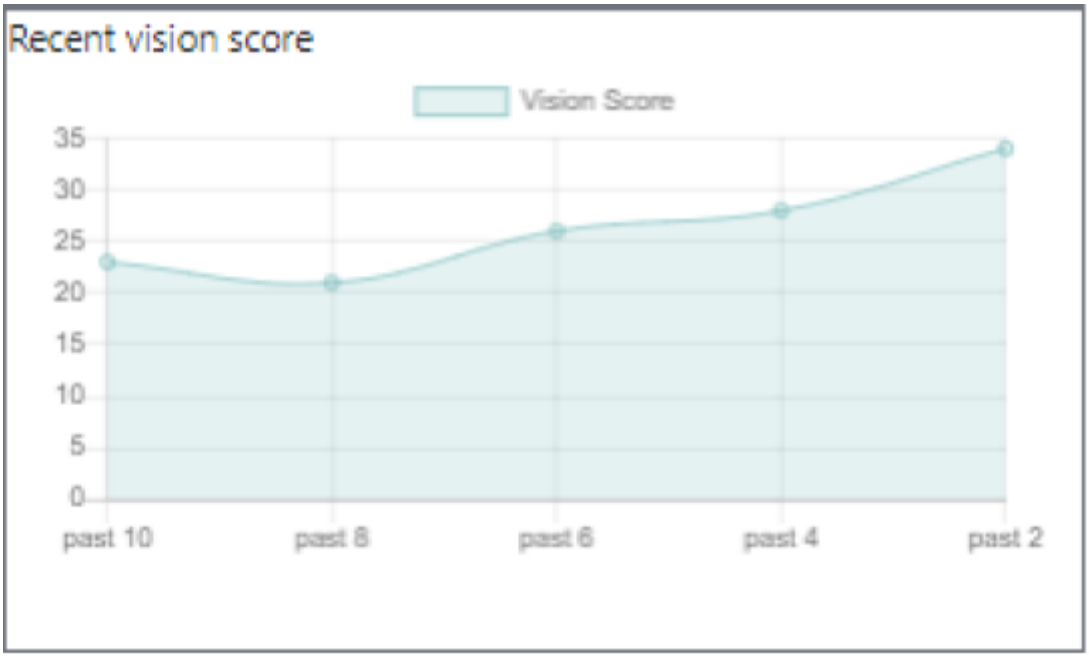


Figure 7. Change of Vision Score (Past~Present) with PAIC

Appendix H.

Participant 1.
Gender: Male
Age: 23

Interview Questions	Interview Answers
1. What is your last and current rank season tier?	In the 2022 season, my top rate tier was Challenger 1200 points and my current tier is GrandMaster 863 points.
2. Have you experienced professional LoL tournaments or matches?	I was a player at Potrual and Germany LoL league team. Currently, I am joining into Italy LoL team.
3. Which factors should be considered during the champion selection phase?	The most important thing is to select the most skillful champion or trendy champion. Moreover, when your opponent picks a champion first, it is important to pick a “counter” champion.
3-1. What is the meaning of “counter” in LoL?	Counter-champion means there is an invisible unfavorable relationship between champions due to the combination of skills, abilities, and roles of a champion. Therefore, to take advantage when against an opponent, it is important to know which champions are counter-champions for the opponent.
4. Which factors should be considered during the champion lane phase?	To get gold and exp, taking CS is important at the lane phase. Moreover, the vision is also important. Due to the ganking or roaming from another lane, sometimes the player is dead due to unpredictable help from the opponent’s side. It can cause delays in farming the gold and exp. Therefore, it is important to take vision during the lane phase.
5. Which factors should be considered during the champion team fight phase?	During team fights, most players fight to destroy the tower and take objects. To win the fight, it is important to take an advantageous position. To take an advantageous position, taking and controlling the vision are essential factors. Due to the vision, the player can be dead or kill an opponent and it makes advantage to take objects or Nexus.
6. What were the difficulties when you were a casual/inexperienced player?	When I was an inexperienced player, it was difficult to find a suitable champion and role. At that time I played lots of time with unsuitable roles and champions and my rank tier was constant.

Appendix I.

Participant 2.
Gender: Male
Age: 24

Interview Questions	Interview Answers
1. What is your last and current rank season tier?	In the 2022 season, my top rate tier was Diamond 2 57 points and my current tier is Diamond 4 98 points
2. Have you experienced professional LoL tournaments or matches?	I was a member of “Blueshell” which is an esports team at the University of Twente and participate national LoL student championship in 2021-2022.
3. Which factors should be considered during the champion selection phase?	Finding the most suitable champion is important and needs to consider the opponents’ champion combination.
4. Which factors should be considered during the champion lane phase?	Vision and CS are the most important. The reason is CS gives gold and exp and makes champion stronger and vision help to avoid ganking from the opponent jungler.
5. Which factors should be considered during the champion team fight phase?	To take vision and take an advantageous position is most important to get objects or team fight.
6. What were the difficulties when you were a casual/inexperienced player?	The most difficult thing is the lack of acknowledgment. When I am an inexperienced player, I did not know which factors are important and direct effect to result. I think that is my difficulty.

Appendix J.

The questions of the survey for usability testing can see in blew link
https://forms.gle/k613oFpRrmUGikHLA

The result of the survey for usability testing can see in blew link
https://docs.google.com/spreadsheets/d/1lE2elCA9znXoHmUrTcto8K_cqnrHhA762iAO3nz4duE/edit?usp=sharing

Appendix K.

Participant 3.
Gender: Male
Age: 21

Interview Questions	Interview Answers
1. What is your last and current rank season tier?	In the 2022 season, my top rate tier was Gold 2 34 points and my current tier is Platinum 4 34 points
2. What were the difficulties when you play LoL before using PAIC?	I thought I have enough skills and play the best role for me. Moreover, I thought the reason I cannot rank up before was just I am unlucky for the random matching for the team.
3. Is PAIC helpful to increase your tier?	Yes, It gave me objective data resources and feedback. It supports me in noticing my weakness during the game.
4. After using PAIC, did you feel any differences during the game?	During the game, I try to focus on my vision control during the line phase and team fight phase. I am not sure but I feel that my death was decreased since I can notice the opponent's movements. I think PAIC help me to avoid death from ganking or roaming from other lane and near objects.
5. The champion and role pages were helpful to find a suitable role or champion?	I used to play the Top or Mid role before using PAIC. When I use PAIC, I can see that the win probability when I play Jungle is way higher than other roles and I feel Jungle is my real suitable role.
6. Is there any drawbacks to PAIC?	At the beginning of using PAIC, it looks slightly confusing since it provides much data analysis. If there is some guideline to explain data graphs, it will be helpful to understand..

Appendix L

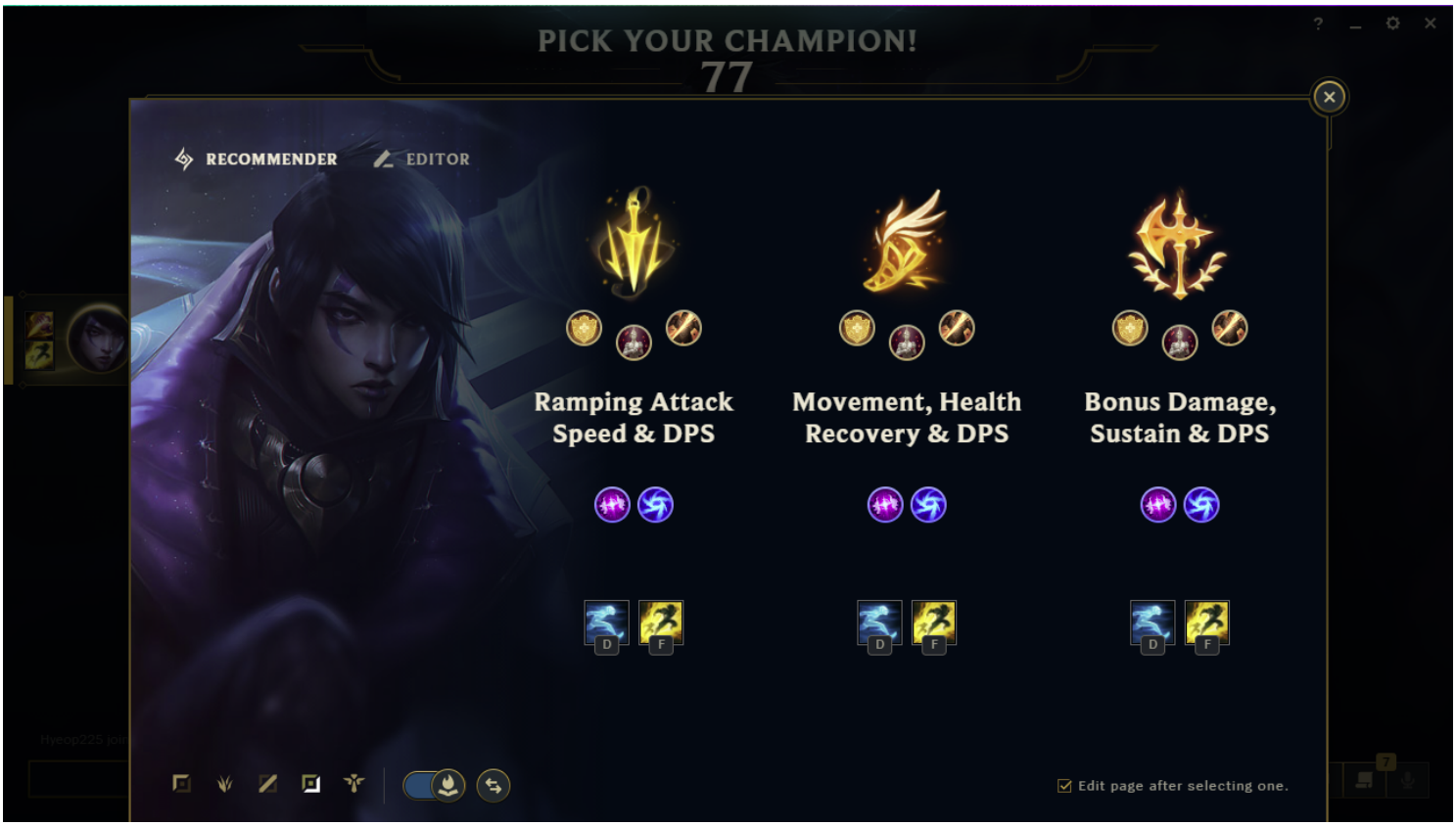
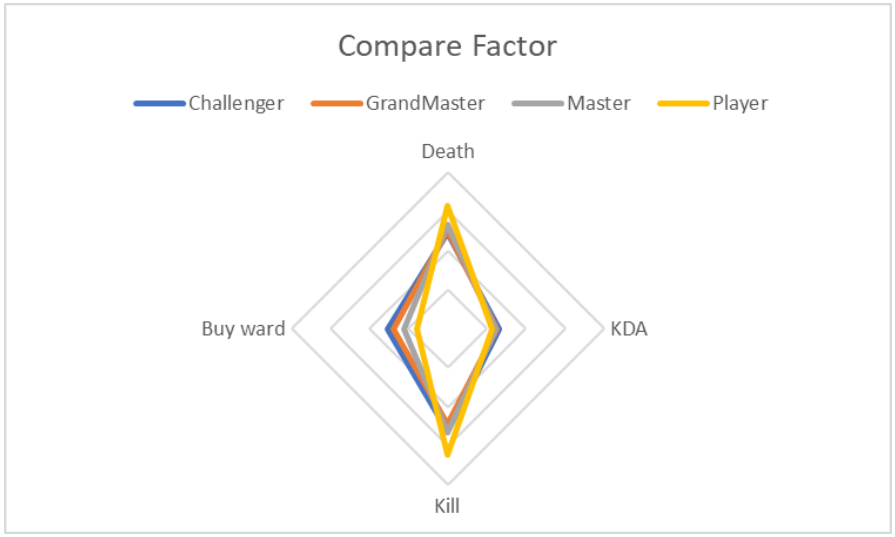


Figure 8. Supporting system in champion selection

Appendix N

Figure 9. Supporting system after the game.

Appendix O



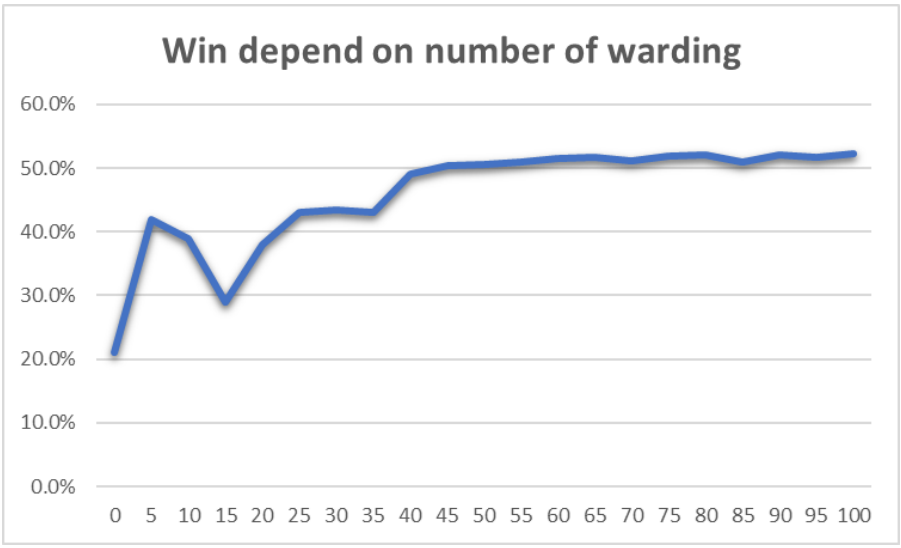


Figure 10 machine learning result