İSTANBUL TECHNICAL UNIVERSITY
FACULTY OF COMPUTER AND INFORMATICS

ADAPTIVE HR GAME

Graduation Project Interim Report

Recep C. Babaoğlu
150130112

Department: Computer Engineering
Division: Computer Engineering

Advisor : Assist. Prof. Dr. Ayşe TOSUN

September 2019

Statement of Authenticity

I hereby declare that in this study

1. all the content influenced from external references are cited clearly and in detail,
2. and all the remaining sections, especially the theoretical studies and implemented software/hardware that constitute the fundamental essence of this study is originated by my/our individual authenticity.

İstanbul, September 2019

Recep Can Babaoğlu

ADAPTIVE HR GAME

(SUMMARY)

After 1850 as a result of globalization of the industrial revolution, different types of professions arose. It has become necessary to find the right person in the right position as soon as possible. In the last decade, with the development of communication technology, connections have been established between employers and candidates easier. It has become a tough task to find suitable employees for organizations and the companies. The human resources has become important. Although the human resources process has been implemented with different names in many places in the past, it can be accepted that it started to develop rapidly in the 1980s.

The human resources and human resources management includes many sub-fields and professions. In the presented project, problems experienced during the recruitment process of the human resources unit will be identified and will be worked on. In the recruitment process, the human resources department applies many different interview techniques. The interview phase consists of several steps and varies according to the profession. Nowadays, the classical method is widely used. In the classical method, multiple answer tests are applied on the candidate. The test questions are determined according to the traits to be measured. These tests are performed physically. After the assessments, the results are evaluated according to some scales. In this method, applicant is aware of the fact that he is in the interview. The applicant may mislead the assessments. He/she could hesitate to give real answers and can try to choose right answers instead of his real answers. In addition, the applicability of the classical method has decreased in today's technology. Web based classic testing has become preferred. The web based and mobile based applications also uses same old method. Another disadvantage of the classical method is that range of the test is limited. Because of the measurement interval limited to question set, number of questions in the assessment is too much. If the applicant give an answer which around the bounds, asking same question is useless and waste of time. As a result of need of dynamic question set, adaptive test method has been developed and started to be used.

The project presented in the report, the problems experienced during the recruitment process of the human resources have been identified and a project will be presented to improve them. In the project to be implemented will be put forward with the help of computer science and psychology. A game will be developed to focus on traits that can be measurable with the game. Experience based traits will be tested in the game. Risk-taking behavior, behavior under pressure, speed of process, selective attention are the features to be tested via game. The advantage of the assessment with the game is to be able to get results without revealing the real purpose and the subject. Candidate cannot mislead the test easily. The game will also be designed to be an application of the adaptive test method. In this way, if the user gives answers out off the test limits, the test can also measure them and it shorten the test time by reducing the need for additional questions.

UYARLANABİLİR İK OYUNU

(ÖZET)

Endüstri devriminden sonra farklı meslek türleri ortaya çıkmış bunun sonucu olarak kalifiye iş gücüne ihtiyaç artmıştır. Doğru kişiyi doğru pozisyona en kısa zamanda yerleştirmek gerekli hale gelmiştir. Son yıllarda iletişim teknolojinin gelişmesi ile iş verenlerin ve adayların birbirine ulaşması oldukça kolaylaşmıştır. Bu durumun sonucu olarak uygun çalışan bulmak şirketler ve organizasyonlar için başlı başına bir uğraş halini almıştır. Dolayısıyla, insan kaynakları biriminin önem kazanması da bu tarihlere denk gelmektedir. Bu süresin geçmişte birçok yerde farklı isimlerle uygulanmasına rağmen hızla gelişmeye başlaması 1980'ler kabul edilir. İnsan kaynakları ve insan kaynakları yönetimi birimi bünyesinde birçok alt alanı içerir, birçok meslek grubuyla da birlikte çalışır.

Geçmişten günümüze işe alım sürecinde insan kaynakları birimi farklı bir çok mülakat tekniği uygulamaktadır. Mülakat aşaması birçok adımdan oluşmaktadır ve pozisyona göre farklılıklar göstermektedir. Günümüzde yaygın olarak klasik yönteme başvurulmaktadır. Klasik yöntemde adayın düşünüldüğü pozisyona uygun olarak adayda ölçülmek istenilen özelliklerle ilgili çoktan seçmeli testler uygulanmaktadır. Bu testler fiziksel olarak gerçeklenmektedir. Testin sonrasında sonuçları belirli ölçeklere göre değerlendirilmektedir. Bu yöntem adayın testin sonuçlarını yanıltmasına açıktır. Adayın mülakatta olduğunun bilincinde olarak soruları cevaplaması gerçek cevaplarını verdiği konusunda tereddüt oluşturmaktadır. Ayrıca günümüz teknolojisinde klasik yöntemin uygulanabilirliği düşmüştür. Yerini web tabanlı klasik test sistemi almaya başlamıştır. Web tabanlı sistemde ve mobil uygulamalarla da test soruları ile analizler yapılmaya çalışılmaktadır. Klasik yöntemin zayıf olduğu bir diğer alan ise testlerin ölçüm aralığının soru seti ile sınırlı olması ve çok fazla soru içermesidir. Eğer aday sınırda bir cevap verdiyse benzer sorular sormak zaman kaybı olmaktadır. Bunun üzerine yapılan araştırmalar sonucunda uyarlanabilir test yöntemi geliştirilmiştir, yaygın olmasa da kullanılmaya başlanmıştır.

Raporda sunulan projede işe alım sürecinde insan kaynakları biriminin uyguladığı yöntemlerdeki sorunlar tespit edilmiştir ve gerçeklenecek projede bilgisayar bilimlerinin öncülüğünde psikoloji alanından yardım alınarak bir çözüm ortaya koyulacaktır. Eski ve alışılagelmiş yöntemler yerine teknolojinin getirdiği yeniliklerden yararlanarak dinamik bir yöntem geliştirilecektir. Test için bir oyun geliştirilip kullanıcının oyun ile ölçülebilecek özelliklerine odaklanılacaktır. Bu özellikler seçilirken deneyim tabanlı olması temel alınmıştır. Risk alma durumu, baskı altında çalışma durumu, işlem hızı, odaklanma gücü oyun ile test edilecek özelliklerdir. Mobil oyun ile testi uygulamanın getirisi adaya gerçek amacımızı ve test ettiğimiz konuyu belli etmeden sonuçlara ulaşabilecek olmaktır. Adayın testi yanıltması zorlaşacaktır. Ayrıca oyun uyarlanabilir test yönteminin de bir benzeri olarak tasarlanacaktır. Kullanıcının verdiği cevaplara göre sıradaki sorunun belirlenmesi oyuna eklenecektir. Bu sayede eğer kullanıcı testin sınırlarında cevaplar veriyorsa test bunları da ölçebilmektedir ve fazladan soru sormaktan kurtararak test süresini kısaltacaktır.

Contents

1 Introduction and Problem Definition

The history of Human Resources Management dates back to BC. The earlier known applications are the pricing systems in Hammurabi laws, the first division of labor and expertise in the Chinese in the 1600s, etc. Scientifically the most significant historical development in the importance of human resources was the Industrial Revolution (18th century) that began with the invention of James Watt's Steam Machine in 1768 [1]. Human resource has changed in name various times throughout history. The name change was mainly due to the change in social and economic activities throughout history. The word of human resources began to be used instead of the older concepts such as personnel management in the 1980s. Human resource management is the scientific approach to the effective management of people in an organization, it focuses on policies and systems to maximize employee performance [2]. Basically, it is management of human capital. The human resource management departments responsible for many subdivisions which are employee recruitment and staffing, compensation and benefits, training, labor and employee relations, organization development etc.

The companies which want to survive in business life knows that it can only be achieved when they have the perfectly combine the employees. Therefore, the recruitment process is become utmost important part. According to Edwin B. Flippo, “Recruitment is the process of searching the candidates for employment and stimulating them to apply for jobs in the organization” [3]. As a result of complexity of personnel recruitment, companies start to get professional help from HR experts. The human resources department has begun to conduct tests to find the appropriate employee. According to the needs of companies and requirements many types of tests have been developed and used.

There have been wide variations in recruitment and selection practices considering an organization’s strategy. The practices have been consisted of different steps (Figure 1.1). In the given figure 1.1, candidate interview step is main concern of the project.

Figure 1.1: Recruitment Process

The candidate interviews differs from each other in terms of test types. The test types are varied because the desired traits differ for occupational positions. Also, assessment types differ from each other in terms of application form. One of the common form of the assessment is classical methods.

Today, classical method is widely used in interviews. The classical method can be defined as a hard copy assessments answered by applicant. In the classical method, most of the question consist of multiple answer question. Some web-based applications and a few mobile applications have been developed instead of classic method. Most of them just changed the platform of the classical method, not the form. Also, one downside of the

classical method is that applicant may try to mislead the result. Because of the possible cheating in classical method, a new approach become necessary. In addition to downsides of the classical approach, question set is predefined. The same set of questions is applied to everyone over and over again. Some modern approaches have been applied an adaptive method to can calibrate question set. The adaptive assessments decrease the application time and increase the precision.

In the project a new approach will be developed to improve downsides of the old studies. Firstly, the project will be an experience based game which focus on traits can measurable with game. The game will be figure out risk taking behavior, behavior under time pressure, speed of processing and selective attention. The advantage of the assessment with the game is to be able to get results without revealing the real purpose and the subject. Candidate cannot mislead the test easily. The risk taking behavior will be understood by evaluating user decisions. The user behavior under time pressure will be observed by using limited time in the game. The speed of processing and selective attention will be monitored using Stroop Effect method. Also game will be adaptive according the user decisions next stages will be rearranged. The adaptive game allows to understand the limit/boundary points.

2 Literature Survey

There are many relevant studies on human resources assessments methods but none of them directly address an adaptive human resources assessment as a game.
A few studies focus on game based assessment. According to Ohr, by using game based talent assessment, companies can easily hire appropriate employers [4]. An Athens based human resources tech startup Owiwi, proved that game based assessments are best way to hire and candidates give positive feedback. Companies who have tried the Owiwi get remarkable results. It brings 50% time reduction, 47% number of interviews reduction. But one downside is that it is a story based game, candidates can easily mislead the answers. Although it reduces wasting time in hiring process, misleading is a common problem which needs to be fixed. Therefore, the proposed project focused the experience based game instead of story based game. In the story based games, the user act as in a multiple choice test. In the experience based games there is a flow, the user cannot realize background logic easily.
There are various experience based assessments methods but most of them not practicable as a game. Few of them are appropriate the game flow. Risk taking, decision making under pressure, speed of process and selective attention are practicable in a game.
Firstly, the risk taking behavior of the applicant, can be measured by evaluating their decisions. The frequently used measurements of decision making in psychology are the Iowa Gambling Test (IGT), the Balloon Analogue Risk Task (BART) and the Columbia Card Task (CCT) [5]. The IGT and the CCT are card games, their flow are not suitable for a progressive game. They have different kind of flow it is not suitable expected experience based game story. However, the BART has a proper flow for an experience based game assessment. The BART is a computerized test, candidates can make different decisions then get different amount of points. Test consist of 20 low, 20 medium and 20 hard different risky stages. The candidate try to get maximize the point by pumping balloons [6]. Also, the BART approach is suitable for a mobile game. The risk taking part of the game have inspired by BART.
Secondly, the Stroop Effect tests are another suitable method. The Stroop Effect measures applicant's speed of processing and selective attention. It is a common method for recruitment process. Basically, in the Stroop Effect assessment, applicant try to say the printed word colors instead of meaning of the word [7]. There are several different version of the method. The basic version which is the color naming version is suitable for the project. According to the selective attention theory, naming the color of the words harder than reading the text. It requires more focus and to give more attention. The speed of processing theory mentions that reading speed of the word more than the naming the color of the word. Lack of correlation between reading and naming speed, makes the test harder.
The Stroop Effect test will be adapted to mobile game. In the game, there will be different colored and different named balls user will try to find the right color which typed in front of the ball instead of background color of the ball. The optimized color set will be implemented after the comparing participant reactions.

Lastly, the project is going to designed as an adaptable game. In other words, the game is going to be an application of dynamic test method. In literature, there is an appropriate method which is named as Computerized Adaptive Test (CAT). The CAT is a difficulty level adjustable test which mostly applied to students. If the user give wrong answer, computer ask easier questions. So according to knowledge base of the applicant, computer sets appropriate next questions. The CAT has many advantages. For example it reduces 50% test time, increases motivation of the applicant by asking related questions, increases security, decreases labor cost and increases accuracy. When it combined with Item Response Theory (IRT) it became more effective. Different questions sets estimates different characteristic levels using IRT [8]. Its basic logic applicable to a mobile game. when designing the next stage of the game, CAT based approach brings many advantages. In the game expected benefits are increased accuracy and much more user motivation.

3 Novel Aspects and Technological Contributions

In this section consists of brief summary of the technical contributions which are novel aspect of project. There are many human resource assessments applications types and methods in literature. Most of them are physically in the form of question and answer. Besides, there are some software application web based tests and games. But, the approach will be implemented in the project is new considering the common implementation of HR assessment. The HR assessments try to figure out some main personal traits. In the project the application try to figure out some main personal traits as usual. But, the assessment method of application differs from older approaches. In the project a game will be implemented. Also, there are many game approach in literature. The method in the game differs from common question-answer based games. User will play a game and the result will be evaluated according to their behavior in the game. The assessment will be experience based. Also, the assessment application will be a mobile game. In addition stages in the game will be designed as adaptive. When experience based game approach and adaptive approach combined, the project will be unique.

4 System Requirements

In this section functional and non functional requirements of the systems will be listed. Functional requirements will be examined in following subsection 4.1 Use Cases, but main non-functional features of the project are listed here:

- Reliability: Response time should be short.
- Performance: 50 FPS should be provided.
- Usability: Software should be user friendly, end user satisfaction is important.
- Maintainability: Make future maintenance easier.
- Documentation: User guides and tutorial should be prepared.
- Security: The saved user data should be secure.

4.1 Use Cases

Use Case #1: Game stages
Scope: Start to test
Primary Actor: User
Preconditions:
• Program must be downloaded.
• User has already run the program.
• User information must be taken from the user.
• Tutorial stage must be completed.
• Start stage must be chosen.
Basic Flow:
1. User selects the stage button which is on the main menu.
2. Then application starts the stages.
3. User plays the stages.
4. Game updates the score label.
5. The game prompt some information messages between stages.
6. Game section terminated.
7. Result scene should be opened.
Extensions:
2.-3.-4 -5.
   1. If the user touches the pause button on the screen.
   2. Game prompt a message “paused the game”.
   3. Game does nothing.
   4. Game waits for touch to resume button.

Use Case #2: Tutorial stage
Scope: Teaches user how to play
Primary Actor: User
Preconditions:
- Program must be downloaded.
- User has already run the program.
- User information must be taken from the user.
- Tutorial stage must be chosen.

Basic Flow:
1. User selects the tutorial button which is on the top of main menu.
2. Then application open the tutorial stage.
3. User reads tutorial infos and warnings.
4. Then tutorial stage starts.
5. User catches balls.
6. Game updates the score label.
7. The game prompt some information messages considering ball types.
8. Tutorial section terminated.
9. Main menu scene will be opened.

Extensions:
5. a
    1. If the user does not catch the ball.
    2. Game prompt a message “ be-careful you miss the ball ”.
    3. Game starts to throw balls again.

Use Case #3: Exit game
Scope: Close the game
Primary Actor: User
Preconditions:
- Program must be downloaded.
- User has already run the program.

Basic Flow:
1. User selects the exit button which is on the main menu.
2. Then application closed.

Use Case #4: Result
Scope: Check the result
Primary Actor: User
Preconditions:
- Program must be downloaded.
- User has already run the program.
- Stages will be completed.

Basic Flow:
1. User selects the result button which is on the main menu.
2. Then shows the result from stages.
3. Then user clicks the close result button.
4. Game scene turn back to main menu scene.

5 Project Plan

Project plan contains resource requirements, work breakdown, work assignment and time plan of the project.

5.1 Project Resources

Required software and hardware resources for the project are listed below.

- A software development laptop with at least 8GB RAM (MacBook Pro with macOS Mojave preferred).
- A smartphone with iOS 12.0 (or later) OS. (Iphone 7 with iOS 12.4 preferred).
- Xcode 10.0 GM release or later GM releases for development on iOS 12.4. (Xcode 10.3 GM preferred.)
- A software language Swift 2 or later. (Swift 4 preferred.)
- A framework with physics motor. (SpriteKit preferred).
- Game assets

5.2 Work Breakdown and Work Assignment

Work Breakdown Structure where enlist main tasks and subtasks is given in Figure 5.1 below.

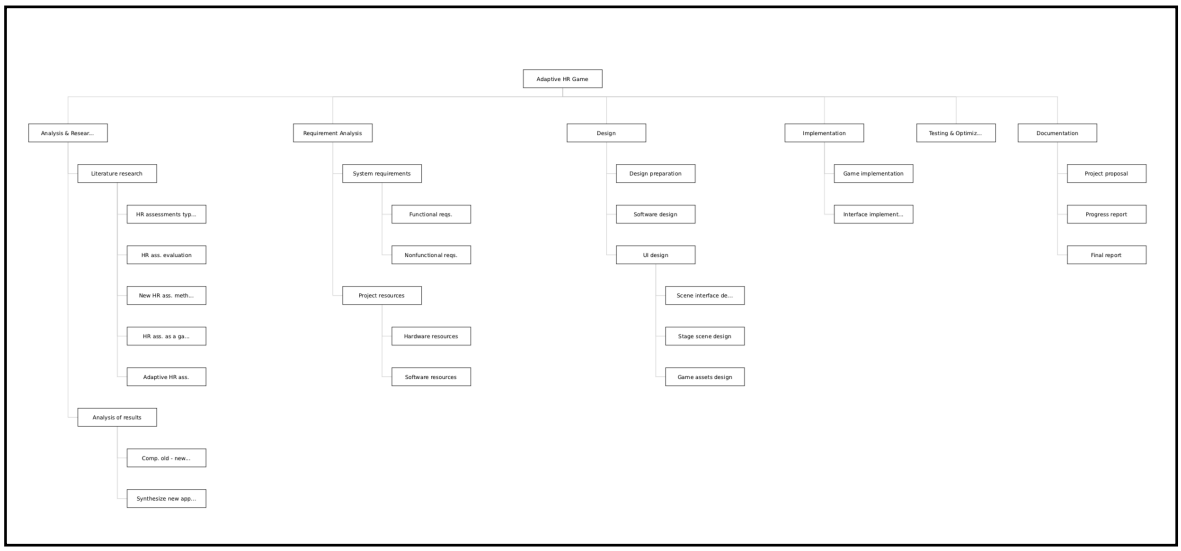

Figure 5.1: Work Breakdown Structure in tree format

1. Analysis & Research
    1.1 Literature research
        1.1.1 HR assessments types
        1.1.2 HR assessments evaluation
        1.1.3 New HR assessments methods
        1.1.4 HR assessments as a game
        1.1.5 Adaptive HR assessments
    1.2 Analysis of results
        1.2.1 Comparison between old and new approaches
        1.2.2 Synthesize new approach
2. Requirement Analysis
    2.1 System requirements
        2.1.1 Functional requirements
        2.1.2 Nonfunctional requirements
    2.2 Determine the required project resources
        2.2.1 Hardware resources
        2.2.2 Software resources
3. Design
    2.1 Design preparation
    2.2 Software design
    2.3 User interface design
        2.3.1 Start and end scene interface design
        2.3.2 Stage design
        2.3.3 Game assets design
4. Implementation
    4.1 Game implementation
    4.2 Interface implementation

5. Testing & Optimization
6. Documentation
    6.0 Project proposal
    6.1 Progress report
    6.2 Final report

5.3 Time Plan

GANTT diagram based on the tasks in the Section 5.2 Work breakdown is presented in Figure 5.2.

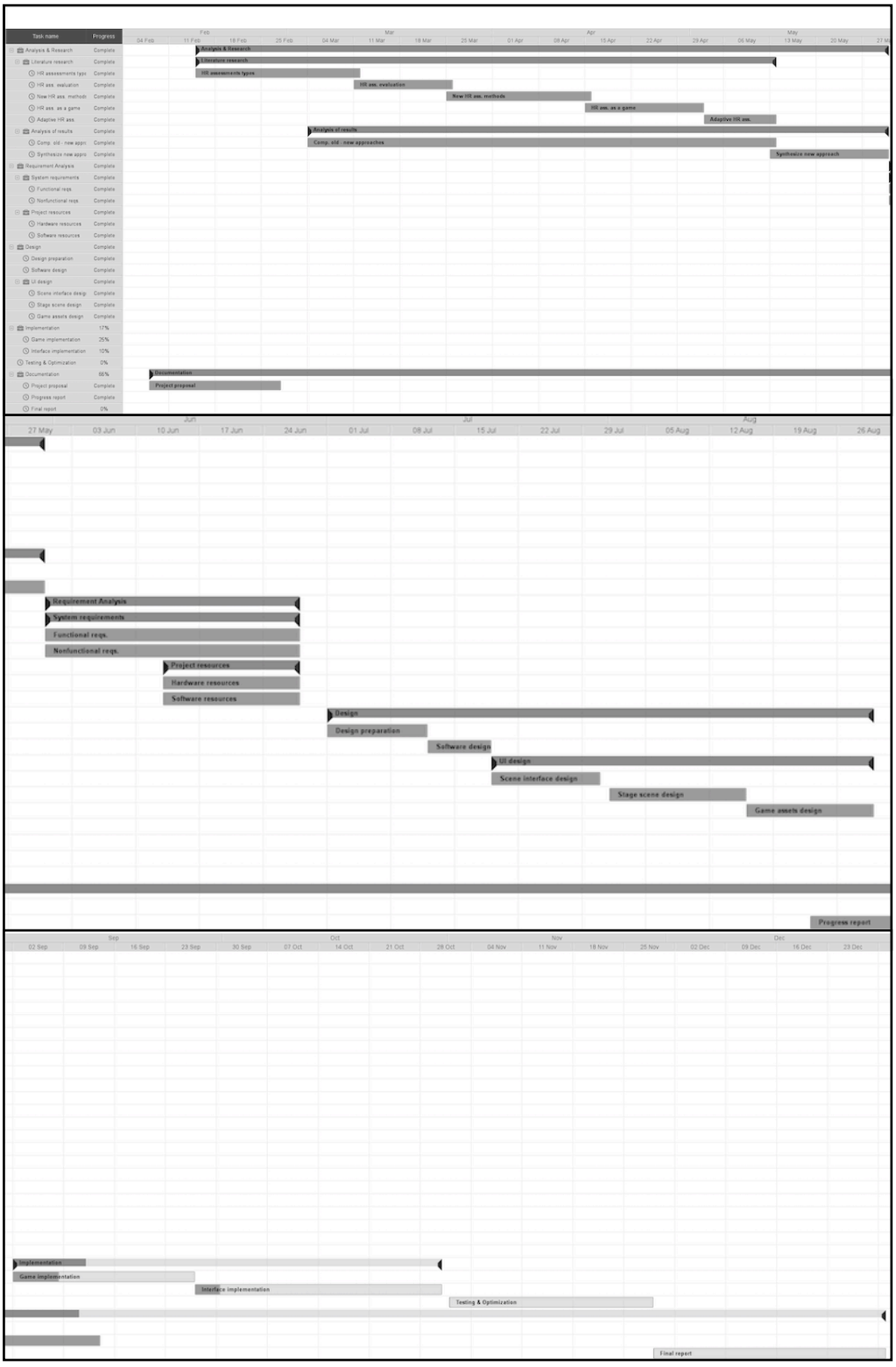

Figure 5.2: GANTT diagram of the project

6 Goals and Evaluation Criteria

In this section project goals will be enlisted. In the project main goal is implementing a game. At the end of the project, the game will be consist of a tutorial and 3 stages. Also a menu scene and result scene should be added the game. The game should be tested on people and approved by the psychologist. If time remains, the game will be adaptive.

1. Game should be at least 50 FPS.
2. Each useless node in the game should be removed to increase performance.
3. No bugs.
4. At least one psychologist will check the test set.
5. At least 20 people will take the test game.

7 References

[1] F. Chukwunonso, "The Development of Human Resource Management from a Historical Perspective and Its Implications for the Human Resource Manager", in Strategic Human Resource Management at Tertiary Level. Rivers Publisher, 87-101 Jan. 2013, [Online]. Available: https://www.researchgate.net/publication/234017585_the_development_of_human_resource_management_from_a_historical_perspective_and_its_implications_for_the_human_resource_manager

[2] A. Al Adresi, M. R Darun, "Determining relationship between strategic human resource management practices and organizational commitment," International Journal of Engineering Business Management, Nov. 22, 2017, [Online]. DOI: https://doi.org/10.1177/1847979017731669

[3] B. Raghavendra, B. Sai Charitha, K. R. Rajitha, "Recruitment and Selection: Recent Development of Recruitment and Selection," International Journal of Science Technology and Management, Vol 6(1), Jan. 01, 2017, pp. 420-427. [Online]. Available: http://www.ijstm.com/images/short_pdf/1484306666_D510ijstm.pdf

[4] T. Ohr, "Talent platform Owiwi gamifies to assess applicant soft skills", June 2018, [Online]. Available: https://www.eu-startups.com/2018/06/try-the-game-based-talent-platform-owiwi-to-assess-the-soft-skills-your-applicants-sponsored/

[5] M. T. Buelow, A. L. Blaine, "The assessment of risky decision making: A factor analysis of performance on the Iowa Gambling Task, Balloon Analogue Risk Task, and Columbia Card Task", Psychological Assessment, Vol. 27(3), 2015, pp. 777-785. Available: DOI: 10.1037/a0038622

[6] T. L. White, C. W. Lejuez, H. Witt, "Test-Retest Characteristics of the Balloon Analogue Risk Task (BART)", Dec, 2015, Vol. 16(6), pp. 565-570. Available: DOI: 10.1037/a0014083

[7] C. M. MacLeod, "The Stroop Effect", Encyclopedia of Color Science and Technology, New York, 2015, pp 1-6. [Online]. DOI: 10.1007/978-3-642-27851-8_67-1, Available: http://imbs.uci.edu/~kjameson/ECST/MacLeod_TheStroopEffect.pdf

[8] A. M. Hol, C. M. Vorst, G. J. Mellenbergh, "Computerized Adaptive Testing of Personality Traits", Journal of Psychology, Vol. 216(1) 2008, pp 12-21. [Online]. DOI: 10.1027/0044-3409.216.1.12