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**Information Technology, Automation and Robotics**

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## **INTERACTIVE ENTERTAINMENT APPLICATION GENERATION SYSTEM**

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**Abstract:** *Today, the computer game industry is one of the most promising and important areas of the software development and media entertainment segment. It is based on the creation, promotion and subsequent sale of computer games*

*The purpose of this work is to develop an interactive entertainment application - a game - in the genre of "quest" and "visual novel", which will be called "Project AVE". In the process of creating this software product, all the necessary functional components were developed. This application is designed for leisure organization.*

*The object of research is actually a software product, a computer game, which is designed to organize the leisure of the end users - players.*

*The subject of research is mathematical models and methods of processing the data received from end users, software modules that organize the interaction of the developed software product with players, as well as information technology related to the organization of leisure of end users.*

*The software implementation was performed using the methods of RenPy development environment and Python programming language. The program consists of 12 main software modules, the coordinated work of which ensures the correct display of the game and the gameplay. 33 global variables were used for the program code.*

**Keywords:** *computer game, entertainment application, visual novel, leisure organization, gameplay.*

### **I. INTRODUCTION**

The key to the well-being of any country is a strong economy. It has long been considered a full-fledged science [1]. The computer game industry [2] is currently one of the leading sectors of the economy. It is based on the creation, promotion and subsequent sale of computer games, and was the beginning of an entire era of virtual entertainment. This industry originated in 1948 in the United States, but the most noticeable impetus for its further development occurred in the 1970s, and in a very short time this area has become one of the leading industries. In particular, the US profit from the sale of computer games in 2007 amounted to 9.5 billion dollars. The labor market also owes the emergence of a large number of new positions in the field of computer games – from tester to game designer (head of the game creation process), which, in turn, has contributed to the emergence of new niches for employees and employers.

The term "computer game" or "video game" (a noticeable tendency to use the designation "computer game" to address games designed to run on a personal

computer) is used in relation to specialized programs, interactive entertainment applications (app) – games [3]. In turn, the main purpose of the games is to organize the leisure of end users.

Among the notable achievements of the computer game industry is the introduction of new, more powerful components for personal computers (such as more powerful videocards). Modern personal computers owe their power to the development of the virtual entertainment industry and the evolution of approaches and computer game development technology.

The development of computer games is the process of creating them directly (but not implementing and further promoting them to the masses – this is usually done by the publisher). Both a large number of people working in a large firm and a small team of several people can take part in the development. There are also cases when the development of a commercially successful game was mostly done by only one person.

The task of this research is to design and develop an interactive entertainment application (app) – a game – in the genre of "quest" [4] and "visual novel" [5], which will be called "Project AVE". In the process of creating this software product, all the necessary functional components were developed. This application is designed for leisure organization. The object of research is the project product "Project AVE", a computer game designed to organize the leisure of end users – players.

The subject of research is mathematical models and methods of processing the data received from end users – players, software modules that organize the interaction of the developed software product with players, as well as information technology related to the organization of leisure of end users.

## **II. SUBJECT INDUSTRY ANALYSIS**

Video game (computer game) – is an entertainment application (app), a program whose main purpose is to organize the gameplay, to establish interaction between end users - "players" - within the game, as well as between the player and the program. The game process is a component of the game that is responsible for the interactive interaction between the game and the player [6]. It dictates the conditions and rules, within which the player interacts with the game world, how the game world itself will respond to the actions of the end user, determines the relationship between the player and the game.

The basis of the gameplay of video games in the genre of "visual novel" is a demonstration of the story (plot) of the game through text and visual inserts. Interaction between the user and the program is also provided through such actions of the player as the choice of appropriate actions, such as responses in dialogues with non-game characters [7]. One of the prominent representatives of this genre is the computer game "Doki Doki Literature Club!" [8].

The software that is developed – is an interactive entertainment application "Project AVE", a computer game in the genre of "quest" [4] and a "visual novel". The

basis of the game process [6] of video games in the genre of "quest" (or "adventure game") is the solution of certain tasks by the user (player). One of the prominent representatives of this genre is the computer game "Edna & Harvey: The Breakout" [9]. You can see an example of a tyFigital game in the genre of "visual novel" on the figure 1.



Figure 1 – Gameplay of the game in the genre of "visual novel"

Gaming process (or gameplay) of "Project AVE" includes:

- controlling by the player one of the game character thanks to what movement on game space is carried out;
- reading text inserts by the player to understand the plot and to have an idea of the construction of the world in the game;
- the player's choice of certain actions of the game character - first of all, the choice of phrases in the dialogues.

A game character is a specific object of the game that is controlled by the end user or player [10]. It is the control process that separates game characters from non-game characters (NPCs). Non-Player Characters are those game characters that a player cannot control under normal conditions. Usually, they play a background role and can also take part in the scenario of the game itself [7].

Figure 2 shows a UML diagram of the project activity. It describes the basic actions available to the user in "Project AVE". Yes, the player can make settings not only from the main menu, but also from the pause in the main game, as well as save the current process, with its subsequent loading - this will allow him to return to the place in the game where he stopped last time.

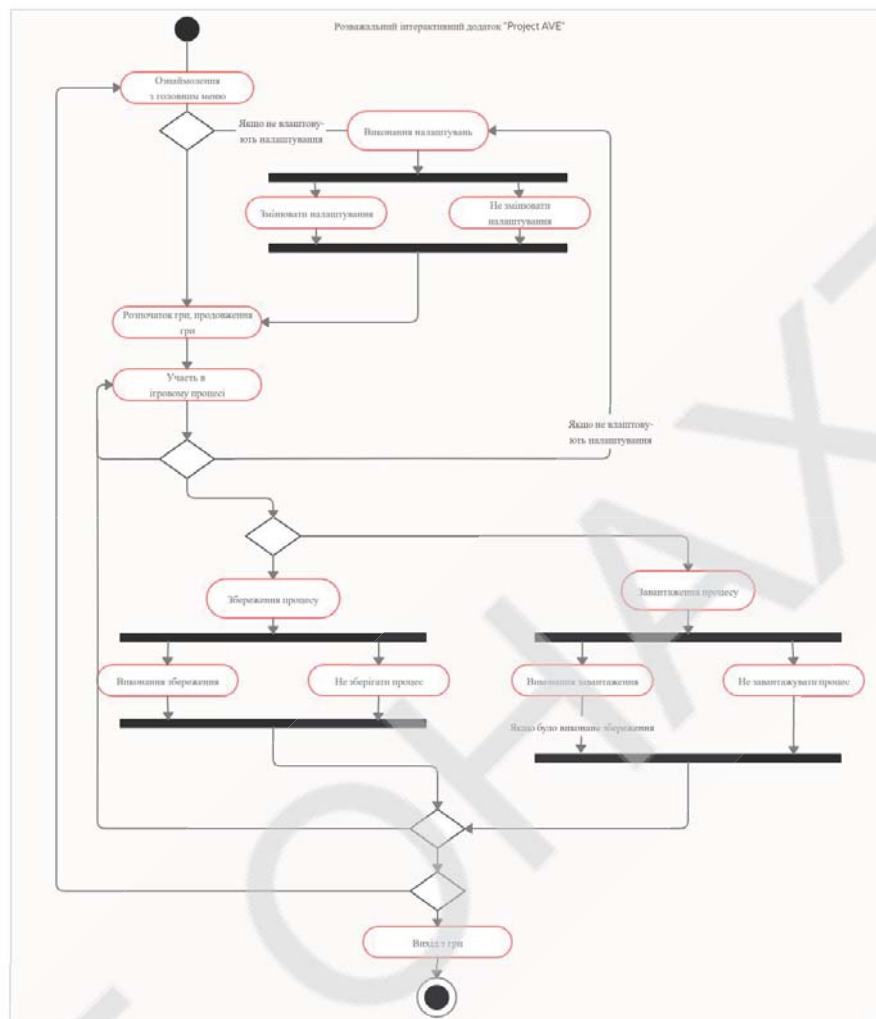


Figure 2 – Diagram of an activity of the end user of the interactive entertainment application "Project AVE"

The actors of the interaction process were identified, as well as what actions are available for each of them within this system.

The end user / player is the target audience of this software product [11]. He can (but is not obliged to) change the settings in the game to his liking, control the game character, explore the game space, but does not have direct access to the source code of the game, ie can not affect it globally, for software security. The interface of an entertaining interactive application is a set of protocols for organizing the interaction of the software product and the end user [12]. Its main purpose is visual and textual interaction, coordination and orientation of the user / player in the game space. Game space (or game process, gameplay [6]) – is a visual representation of the program, the content of the game, in which the main process takes place and realizes the main purpose of any game – the organization of leisure end users. The game space is programmed for appropriate actions, in relation to the user's reactions, and can not act at its discretion or change according to the user's preferences. However,

certain actions of the player affect the state of the playing space. You can see the diagram of use cases on figure 3.

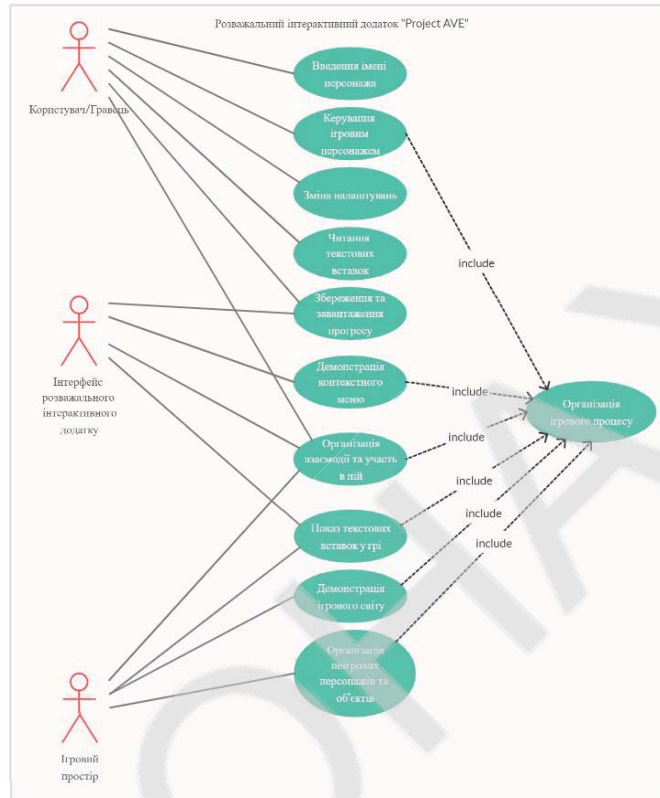


Figure 3 – Diagram of use cases

The organization of the game process is the main purpose of all development and its components; "Leisure organizations of end users".

The main input used by the interactive entertainment application "Project AVE" is the user-entered name of the game character that is used during the game, as well as the player's choices in the game during dialogues with non-game characters or during certain events. The engine used to create Project AVE, Ren'Py [13], uses a system of variables to "remember" the choices made by the player and the data he enters, and outputs the corresponding output data to obtain the necessary information. The main output data demonstrated by "Project AVE" are the fields – text inserts – which through the given text convey to the player the story (plot) [16] of the entertainment application "Project AVE". It should be noted that the user can see all the text outputs of the program only if he selects all available in "Project AVE" options and actions, because the game script does not provide output of all text inserts in order. Another type of such data is graphical. These are images (or "sprites" [15] in the computer games terminology) that show current events in the plot of the game, characters and more.

### III. SOFTWARE IMPLEMENTATION

Figure 4 shows a block diagram illustrating the basic algorithm of user interaction and the interactive entertainment application "Project AVE".

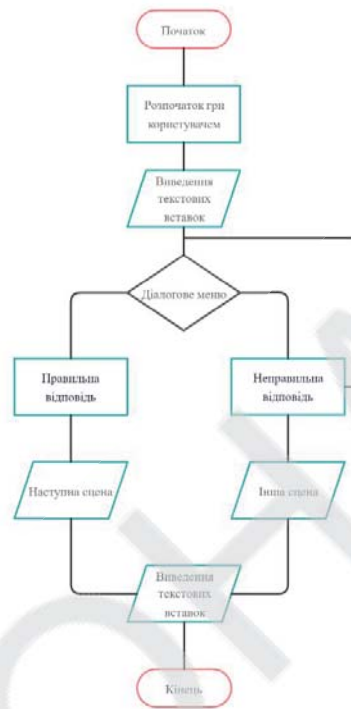


Figure 4 – Block diagram of the gameplay of the application "Project AVE"

Based on the above block diagram of the figure 4, we can draw the following conclusions about the gameplay of "Project AVE". The first thing the user (player) sees after launching the entertainment application is the main menu. After starting the game, the user can see a large number of text fields displayed by the program. At certain points in time, the user will be given the opportunity to influence the further history (plot) of the game, through choices and answers in the dialog menus. Next, according to the script, the player can not go if certain conditions are not met - basically, it is the output of certain text fields by the program, and the user can achieve this if he selects the necessary options in the dialog menus. In case the player has made a wrong action, some events in the game will be inaccessible to him in the subsequent scene of the game space. If everything was done correctly according to the script, the transition to the next scene will take place. The program code provides for the impossibility of the user to go to the next scene, if the necessary conditions have not been met.

Even before writing the program code of the interactive entertainment application "Project AVE", the story (plot) of the game itself was written for further use. There were also pre-specified options for answers and actions of the player and the corresponding various text outputs of the program.

In addition to the text part, sprites [15] – the two-dimensional images – were drawn in advance for further use in an interactive entertainment application, in order to graphically reproduce the events of the story (plot) of the game. These images were created using the graphic editors "Paint.NET" [18] and "Adobe Photoshop CS6" [19].

"Project AVE" was developed by means of the game engine Ren'Py, full name – "Ren'Py Visual Novel Engine" [13]. This engine is a free specialized software environment, the main purpose of which is to create computer games of specific genres - interactive books, visual novels, life simulators or dates [5], in which the display of text and the appropriate response from end users is the central tool program interaction with the player. Ren'Py was developed in 2004 by a programmer with the call sign PyTom, using the Python programming language [20].

A module in programming is a certain functionally complete part of the program. In other words, a module in a program is the part of the general code that is responsible for a particular separate function.

Most of the Project AVE software modules were created using the internal constructions of the Ren'Py engine, while the more complex software functions – initialization and storage of global variables, the use of software (Boolean) logic – are implemented using the Python language.

We can separate the following software modules of the interactive entertainment application "Project AVE":

- main game menu, which can be seen at startup (screen main menu);
- navigation (context) menu that the user can use during the game process (screen navigation);
- parts of the game space in which the plot of the game (label);
- dialog menus, which are the main opportunity for the user to influence the course of the plot in the game (menu);
- information window in which the user can read information about the developer, engine and software version (screen about);
- help window, in which the user can see the configuration of the control keys (screen help);
- this module is responsible for calling the process of loading game progress (screen load);
- this module is responsible for calling the process of saving the game process (screen save);
- history window, which displays all text inserts that the player saw during the game process (screen history);
- creation of non-game characters (Character);
- this module is responsible for displaying text inserts during the game (screen say (who, what));
- styles that are responsible for the appearance of other software modules (style).

The main element of the display of the game space, with images, characters, text and user interface, in games written by the Ren'Py engine are the so-called scenes ("scene"), which, in turn, are a component of more complex objects called "Label". [21]. In general, the purpose of this command is to display a certain image, which will be the general "background" of the scene for a while until the transition to the next scene.

An example of the Ren'Py code for Project AVE, which is designed to create a game space with the label command, is shown in Figure 5.

```
label first_scene:
    show screen mySecondScreen with fade
    scene branch_back_simple with fade:
        size (640, 640), xalign (0.5)
    pause 1.0
    show sprite_hero_back1 with dissolve:
        size (160, 220), xalign (0.35), yalign (0.8), xpos (0.35),
        ypos (0.8), im.Flip("sprite_hero_back1.png", horizontal="True")
    pause 0.5
    show screen mainHeroIdle
```

Figure 5 – Example of using the command "label"

Parts of the program code for creating some game objects using the Ren'Py "label" command to display the game space are shown in Figure 6.

```
label splashscreen:
    scene fill black first with dissolve
    pause 1.0
    return

label start:
    scene fill black first with fade
    pause 0.5
    mainhero "где... где это я?"
    mainhero "кто я?.."

label main_name:
    $ mainhero = renpy.input("Введите имя:")
    if mainhero == "":
        "Меня точно как-то зовут!"
        jump main_name
    else:
        mainhero "Так... кажется, меня зовут [mainhero]."
    pause 1.0

label first_scene:
    show screen mySecondScreen with fade
    scene branch_back_simple with fade:
        size (640, 640), xalign (0.5)
    pause 1.0
    show sprite_hero_back1 with dissolve:
        size (160, 220), xalign (0.35), yalign (0.8), xpos (0.35),
        ypos (0.8), im.Flip("sprite_hero_back1.png", horizontal="True")
    pause 0.5
    show screen mainHeroIdle

label inventoryfirstscreen:
    hide screen mainHeroIdle
    scene interface_1 with fade:
        size (640, 640), xalign (0.5)
    pause 1.0

label second_scene:
    show screen mySecondScreen with fade
    scene branch_back_simple with fade:
        size (640, 640), xalign (0.5)
    pause 1.0
    show sprite_hero_back1 with dissolve:
        size (160, 220), xalign (0.35), yalign (0.8), xpos (0.35),
        ypos (0.8), im.Flip("sprite_hero_back1.png", horizontal="True")
    pause 0.5

label bum_scene:
    scene branch_back_garbage with fade:
        size (640, 640), xalign (0.5)
    show sprite_hero_back1 with dissolve:
        size (160, 220), xalign (0.35), yalign (0.8), xpos (0.35),
        ypos (0.8), im.Flip("sprite_hero_back1.png", horizontal="True")
    show sprite_bum_back1 with dissolve:
        xpos (0.51), ypos (0.25)
    pause 0.5

label bum_dialogue1:
    show screen mainHeroIdle
    show screen bumIdle
    menu:
label option1_1:
label option1_2:
label option1_3:
label option1_4:
label option1_5:
label option1_6:
label option1_7:
label game_choice1:
    menu:
        "Предложить ему сыграть в загадки":
            $ choice1_5 = "1"
            jump option1_41
        "Предложить ему сыграть в слова":
            $ choice1_5 = "2"
            jump option1_42
        "Предложить ему сыграть в кости":
            $ choice1_5 = "3"
            jump option1_43
        "Отказаться от этой затеи (на три пункта назад)":
            $ choice1_5 = "4"
            jump bum_dialogue2

label cafe_dialogue_start:
    $ naruaanswers1 = 0
    $ muffieanswers1 = 0
    $ teidanswers1 = 0
    scene back_inside_door with fade:
        size (640, 640), xalign (0.5)
    show sprite_hero_back1 with dissolve:
        size (160, 220), xalign (0.5), yalign (0.8), xpos (0.5),
        ypos (0.8), im.Flip("sprite_hero_back1.png", horizontal="True")
    pause 0.5
```

Figure 6 – Fragments of software modules using the command "label"

Variables [22] in programming and computer science are objects that have a name and meaning. Common variables are variables that are declared at the beginning of the program code, for further use or change or assignment of value anywhere in the code.

In the Ren'Py engine, there is a "define" command to declare a common variable, which is preferably written before the "scene start" command, which in turn is responsible for the initial scene of the game.

Figure 7 lists the common variables that were used in the following program code.

Most of the common variables use a logical data type, and take the value "True" or "False", depending on the actions and program processes provided by the program code.

```
7 define mainhero = Character("", color = "#66CDAA")
8 define bum = Character("Бездомный", color = "#808000")
9 define naru1 = Character("Официантка", color = "#F08080")
10 define naru2 = Character("Нару", color = "#F08080")
11 define muffie1 = Character("Продавщица", color = "#FF7F50")
12 define muffie2 = Character("Мафи", color = "#FF7F50")
13 define teid1 = Character("Посудомойщик", color = "#20B2AA")
14 define teid2 = Character("Тэйд", color = "#20B2AA")
15 define voice1 = Character("Голос", color = "#FF0000")
16 define knownaru = False
17 define knowmuffie = False
18 define knowteid = False
19 default choicenu1_1 = False
20 default choicenu1_2 = False
21 default choicenu1_3 = False
22 default choicenu1_4 = False
23 default choicenu12_1 = False
24 default choicenu12_2 = False
25 default choicemuffie1_1 = False
26 default choicemuffie1_2 = False
27 default choicemuffie1_3 = False
28 default choicemuffie1_4 = False
29 default choicemuffie12_1 = False
30 default choicemuffie12_2 = False
31 default choiceteid1_1 = False
32 default choiceteid1_2 = False
33 default choiceteid1_3 = False
34 default choiceteid1_4 = False
35 default choiceteid12_1 = False
36 default choiceteid12_2 = False
37 default naru_clear1 = False
38 default muffie_clear1 = False
39 default teid_clear1 = False
40 default lavka1 = False
```

Figure 7 – List of common variables

#### **IV. USER MANUAL**

The main task of the user manual is to provide the end users (players in this case) with the necessary information to work independently with a software product or automated system.

For stable launch and subsequent operation of the application, the computer must have the following configuration:

- 1.5 GHz processor for 2 cores (the manufacturer does not matter), preferably better;
- RAM capacity - not less than 1 GB;
- Video memory capacity - not less than 256 MB;
- wide display with a resolution of at least 1280 × 720, with an aspect ratio of 16: 9, for correct display;
- any sound card;
- amount of free hard disk space - not less than 1 GB;
- keyboard;
- computer mouse

The main requirement for the software for the correct launch of the interactive entertainment application "Project AVE" is the Microsoft Windows operating system installed on the computer - preferably Windows 10 × 64.

After installing the interactive entertainment application, you need to start the game using the executable file (with .exe resolution), or the appropriate shortcut (a small icon on the desktop).

The first thing the user (player) will see is the main game menu window. It can be seen on the figure 8.

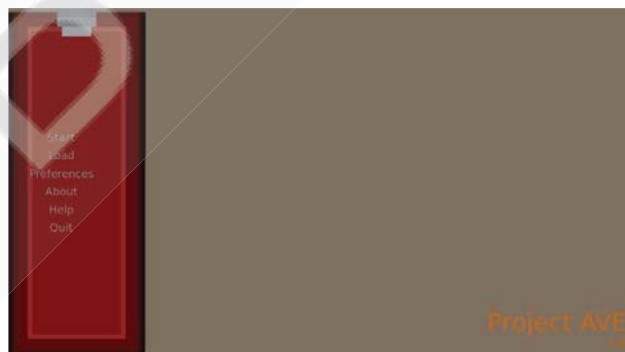


Figure 8 – Window of the main menu of the application

The player can start the game immediately by pressing the left mouse button (or the Enter key on the keyboard) with the "Start" button. In the same way the user chooses all other options in the main menu. Navigate the main menu by using the arrow keys on the keyboard or by moving the computer mouse cursor.

The next option after "Start" is "Load", which will open a window with saves (English "save states" [23]). Here the player can see the previously saved game process and download it to continue the game from the desired location. The "Preferences" button of the main menu is responsible for opening the options window. You can see it on the figure 9.



Figure 9 – Options window in the main menu

The "About" option is responsible for displaying the information window – it contains brief information about this game. The "Help" option shows a help window – information on the configuration (assignment) of the keys to perform the appropriate actions in the game. The last button – "Quit" – is responsible for closing the game window, in fact, for exiting the game application "Project AVE".

By pressing the "Start" button, the user will start a new game, regardless of whether he saved his process in the game application before - if so, the player will be able to download it using the "Load" option. The game will start with a black screen and several text boxes. The entire plot of the game will be transmitted to the user through similar text inserts, as well as through changing images and the appearance of new game characters on the screen. After the player reads the text from the output window, you must press the Enter key, Space (space), or the left mouse button to go to the next text insert. At certain points – particularly on the third screen after the start of the game – the player is required to enter a name, which will then be used to identify the game character played by the user. You can enter a name in any language supported by Ren'Py. If the user has left this field blank, the program will warn him that the line with the name must be filled.

In the future, the user needs attention to the text that displays the game, because in this entertainment application it is the main means of acquainting the player with the history (plot) of the game (Figure 10).

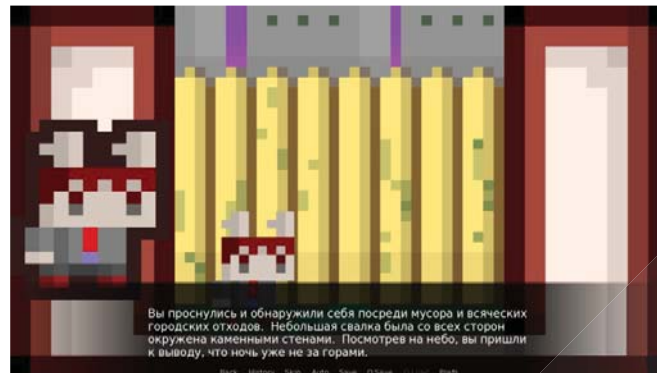


Figure 10 – Demonstration of text output from the game

The basis of the game process (gameplay) of the entertainment application "Project AVE" is the ability of the user to influence the course of the plot in this game, using a menu system with a set of actions and answers in dialogues between the characters of the game. On the figure 11 you can see one of the first such menus.



Figure 11 – Demonstration of the menu during the dialogue in the game

The choice of player in the menu data affects the subsequent story. You can only see some texts and events by selecting a specific option. The interactive application "Project AVE" will respond to any option selected by the player, and if the selected choice was incorrect, the game will return the user to the menu with options to choose another. You can't choose some options if you don't take these steps first. At the bottom of the screen there is a navigation menu, which allows you to download ("Load" button) and save ("Save" button) the gameplay, read history ("History" button), automatically switch dialogs ("Skip" and "Auto"), and open the options menu ("Prefs" button).

## V. CONCLUSIONS

As a result of the research, RenPy engine and Python language developed an interactive entertainment application "Project AVE" – a software product, the main purpose of which is to organize the leisure of end users (players), presented in the form of a computer game.

The following issues were also considered:

- the analysis of the subject area is carried out, the main features of the developed software product are marked, the available analogues are given, taking into account their advantages and disadvantages;
- marked input and output data required for the operation of the program;
- the general structure of the interactive entertaining application is developed;
- described the algorithm of the program and the general functions it performs;
- the main program elements - modules - with the description of actions and functions for which they are responsible in the code are allocated;
- were created UML diagrams of activities, uses, classes, sequences, states, with a description of their components;
- a detailed user guide manual, with a description of all the main windows of the program and the features that are available to the user in each of them.

Figure 12 shows the part of the source code of the “Project AVE”:

```
label-option2_1:¶
.....scene-back_inside_2 with fade:¶
.....size (640, 640), xalign(0.5)¶
.....show-sprite_naru_back1 with dissolve:¶
.....size (160, 220), xalign (0.3), yalign (0.75), im.Flip("sprite_naru_back1.png", horizontal="True")¶
.....pause 0.5¶
.....show-sprite_hero_back1 with dissolve:¶
.....size (160, 220), xalign (0.7), yalign (0.75)¶
....." {size=4} You come to the table, which the waitress is rubbing so hard, and greet her, as if instantly remembering
the correct greeting in these places.¶
.....Quickly quitting her job, she straightened up and folded her arms behind her back, turned to you, smiling. size}"¶
....."She ... probably didn't expect to see you here!¶
.....She smiled absolutely charmingly - naturally and so truly that your soul suddenly felt calmer at once; you almost
forgot that you forgot everything.¶
....." {size=5} The girl was about the same height as you, wore the work uniform of the institution (by the way, in your
opinion, quite prestigious for such a not particularly remarkable cafe) - and, for some reason, a man's: a dark red vest
over a white shirt, and strict black trousers. {/size}"¶
.....naru1 "Oh, hello again, [mainhero]! Is everything I can do for you?"¶
label-naru_dialogue1:¶
.....menu:¶
....."Ask if she knows you":¶
.....$ naruanswers1 += 1¶
.....$ choicenaru_1 = True¶
.....if knownaru == True:¶
....."You decided to ask the waitress what she knows about you.¶
.....It's not for nothing that you have a name badge in your pocket with the name of this establishment."¶
.....naru2 "(uncomprehending) What in the world? You are our HR manager, [mainhero]."¶
....."And she added in a whisper, leaning forward a little:¶
.....naru2 "Say, are the check came again?"¶
.....jump naru_dialogue1¶
.....if knownaru == False:¶
....."You decided to ask the waitress what she knows about you.¶
.....It's not for nothing that you have a name badge in your pocket with the name of this establishment."¶
.....naru2 "(uncomprehending) What in the world? You are our HR manager, [mainhero]."¶
....."And she added in a whisper, leaning forward a little:¶
.....naru2 "Say, are the check came again?"¶
.....jump naru_dialogue1¶
....."You wants to know her name"¶
.....$ naruanswers1 += 1¶
.....$ knownaru = True¶
.....$ choicenaru_2 = True¶
....."Even when you were so close, you couldn't read the waitress's name badge.¶
.....You ask her what her name is."¶
....."The girl's smile did not disappear from her face, but now she began to look strained, and her gaze turned sad."¶
.....naru1 "It's nothing... We are here... yes, not all are so easy to remember. You are here, nevertheless, not so
straight for long... My name is Naru."¶
....."The name seemed unfamiliar to you."
```

Figure 12 – Part of the source code of the program

## VI. REFERENCES

1. Економіка [Електронний ресурс] // Режим доступу <https://uk.wikipedia.org/wiki/Економіка>
2. Индустрия компьютерных игр [Електронний ресурс] // Режим доступу [https://ru.wikipedia.org/wiki/Индустрия\\_компьютерных\\_игр](https://ru.wikipedia.org/wiki/Индустрия_компьютерных_игр)
3. Відеогра [Електронний ресурс] // Режим доступу <https://uk.wikipedia.org/wiki/Відеогра>
4. Пригодницька відеогра [Електронний ресурс] // Режим доступу [https://uk.wikipedia.org/wiki/Пригодницька\\_відеогра](https://uk.wikipedia.org/wiki/Пригодницька_відеогра)
5. Візуальна новела [Електронний ресурс] // Режим доступу [https://uk.wikipedia.org/wiki/Візуальна\\_новела](https://uk.wikipedia.org/wiki/Візуальна_новела)
6. Ігровий процес [Електронний ресурс] // Режим доступу [https://uk.wikipedia.org/wiki/Ігровий\\_процес](https://uk.wikipedia.org/wiki/Ігровий_процес)
7. Неігровий персонаж [Електронний ресурс] // Режим доступу [https://uk.wikipedia.org/wiki/Неігровий\\_персонаж](https://uk.wikipedia.org/wiki/Неігровий_персонаж)
8. Doki Doki Literature Club! [Електронний ресурс] // Режим доступу [https://uk.wikipedia.org/wiki/Doki\\_Doki\\_Literature\\_Club!](https://uk.wikipedia.org/wiki/Doki_Doki_Literature_Club!)
9. Edna & Harvey: The Breakout [Електронний ресурс] // Режим доступу [https://ru.wikipedia.org/wiki/Edna\\_%26\\_Harvey:\\_The\\_Breakout](https://ru.wikipedia.org/wiki/Edna_%26_Harvey:_The_Breakout)
10. Протагоніст [Електронний ресурс] // Режим доступу <https://uk.wikipedia.org/wiki/Протагоніст>
11. Геймер [Електронний ресурс] // Режим доступу <https://uk.wikipedia.org/wiki/Геймер>
12. Інтерфейс користувача [Електронний ресурс] // Режим доступу [https://uk.wikipedia.org/wiki/Інтерфейс\\_користувача](https://uk.wikipedia.org/wiki/Інтерфейс_користувача)
13. Ren'Py [Електронний ресурс] // Режим доступу <https://en.wikipedia.org/wiki/Ren%27Py>
14. Сценарій [Електронний ресурс] // Режим доступу <https://ru.wikipedia.org/wiki/Сценарий>
15. Спрайт (комп'ютерна графіка) [Електронний ресурс] // Режим доступу [https://uk.wikipedia.org/wiki/Спрайт\\_\(комп%27ютерна\\_графіка\)](https://uk.wikipedia.org/wiki/Спрайт_(комп%27ютерна_графіка))
16. Сюжет [Електронний ресурс] // Режим доступу <https://ru.wikipedia.org/wiki/Сюжет>
17. Комп'ютерна графіка [Електронний ресурс] // Режим доступу [https://uk.wikipedia.org/wiki/Комп%27ютерна\\_графіка](https://uk.wikipedia.org/wiki/Комп%27ютерна_графіка)
18. Paint.NET [Електронний ресурс] // Режим доступу <https://uk.wikipedia.org/wiki/Paint.NET>
19. Adobe Photoshop [Електронний ресурс] // Режим доступу [https://uk.wikipedia.org/wiki/Adobe\\_Photoshop](https://uk.wikipedia.org/wiki/Adobe_Photoshop)
20. Python [Електронний ресурс] // Режим доступу <https://ru.wikipedia.org/wiki/Python>

21. Ren'Py Documentation: Displaying images [Електронний ресурс] // Режим доступу  
[https://www.renpy.org/doc/html/displaying\\_images.html](https://www.renpy.org/doc/html/displaying_images.html)
22. Змінна (програмування) [Електронний ресурс] // Режим доступу  
[https://uk.wikipedia.org/wiki/Змінна\\_\(програмування\)](https://uk.wikipedia.org/wiki/Змінна_(програмування))
23. Saved game [Електронний ресурс] // Режим доступу  
[https://en.wikipedia.org/wiki/Saved\\_game#Save\\_states](https://en.wikipedia.org/wiki/Saved_game#Save_states)

## ARTIFICIAL INTELLIGENCE

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*The toFig of this work is artificial intelligence, what it represents, its development throughout the years, and its use in everyday life. The main purpose is to show the value of artificial intelligence to the world, and to put into perspective the way AI has been developed and utilized with the creation and evolution of intelligent machines. Artificial intelligence has had a substantial influence on people's lives, however many people still believe that AI will one day lead to more bad than it will ever do good to the world. The main goal of this paper, is to learn and explore the world of artificial intelligence, and perhaps help readers dive deeper in order to learn new and exciting things.*

*Keywords: intelligence, learning, reasoning, problem solving, perception, algorithm, application, development*

### I. INTRODUCTION

Artificial Intelligence (AI), is intelligence demonstrated by machines, unlike the natural intelligence displayed by humans and animals, which involves consciousness and emotionality. It is commonly referred to as the simulation of human intelligence in machines that are programmed to think and mimic the actions of humans. The main characteristic of artificial intelligence is its ability to rationalize and take actions which have the highest probability to achieve a certain goal.

There is a specific distinction between two different types of AI. 'Strong AI' usually refers to AGI (Artificial General Intelligence), whereas attempts to emulate 'natural' intelligence are referred to as ABI (Artificial Biological Intelligence). As machines become more and more advanced, many of the tasks linked with thinking and reasoning are no longer associated with artificial intelligence. This is a phenomenon known as the 'AI effect'. Still, despite these advances in machines and

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