



Bilkent University

Department of Computer Engineering

Senior Design Project

Project Name: TurnTheTables

High Level Design Report

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Project Analysis Report

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1.Introduction

In today's society, bullying has become a serious problem for everyone. Many educators and parents attach importance to a power imbalance among children having the potential to exhibit unwanted behavior while interacting with others. Since, personality formation takes place in school ages. Whereas there are some policies to address physical bullying, a number of children are under expression of psychological bullying. Both, kids who are bullied and kids who bully others struggle with negative short term and long term problems in their daily lives. The bullied victim can experience negative social and mental health issues including depression, anxiety disorders, social isolation, low self-esteem, feeling of shame and school avoidance [1][2]. There are also significant effects on the bully such as substance abuse, poor school performance and having difficulty in social relationships. The 2017 Youth Risk Behavior Surveillance System (Centers for Disease Control and Prevention) indicates that, nationwide, 19% of students in grades 9–12 report being bullied on school property in the 12 months preceding the survey [3]. Without proper treatment, the victims will continue to face such behavioral and psychological problems and potentially get worse, even engaging suicidal behaviors.

In attempt to come up with an efficient way of bully prevention, our application will propose a more interactive and strategic way of dealing with such a problematic social issue instead of standard methods. For our target group, we aim to comprise the infrastructure of how they can stand against bullying, defend themselves or receive professional support. With the advantage of various scenarios pointing to the interaction between children in a representative manner, our game will not only discourage school-aged children from violent behaviour but also encourage them to stop bullying by giving positive messages subconsciously.

In this report, a brief description of the project will be provided. Then, insight about the constraints surrounding implementation, economic, social, sustainability, ethical and time issues regarding the application will be given. Afterwards, the professional and ethical responsibilities the project brings along will be listed. Finally, all information about the functional and nonfunctional requirements of our application will be included in detail.

1.1 Purpose of The System

The proposed system is an educational game designed to teach children how to behave and defend themselves against bullying. The main functionality of the game is to provide a child-friendly 3D gameplay to children where they interact with different characters and face various scenarios in which they directly/indirectly face bullying and are educated on how to confront such situations. The application will present the user with various scenarios, based on the recommendations of psychologists, where the main character is bullied or witnesses bullying and consequently the user will get various options, so as to react to that situation. In such situations the child will be encouraged and advised to step forward to stand against bullying, and consequently if the child does so, (s)he will be applauded, whereas, if (s)he does not, then they will be discouraged.

1.2 Design Goals

1.2.1 User Friendly

TurnTheTables addresses children going to primary school because studies show that bullying starts when children start comprehending the meaning of gaining power which mostly starts at the age of seven or eight [5]. Since the game is directed to children at small ages, the game must be comprehensible by them. So the vocabulary used in the game will be chosen appropriately. Also There will be voiceover for the dialogues in the game in case the child does not know how to read.

1.2.2 Ethical Issues

All scenarios will be created according to the psychological research conducted and following the guidance of the instructors of Bilkent and Hacettepe Universities' psychology departments. The images drawn by the user will not be used or shared with any 3rd party application. The psychological analyses of the images drawn by the child will only be sent to the parent's email address which was entered at the set up of the game and will not be used for any other purposes.

The game can be saved and then can be re-loaded. Therefore, the user's actions and analysis will also be stored. We will not use online database systems to store user data. In order to preserve privacy of the player, the data will be stored on the player's device.

1.2.3 Performance

When starting the game, a page which asks for the user to draw how she or he feels will be popped and the game will expect the user to draw a drawing. This image will be analysed by the machine learning system we will develop for the game and the result of this analysis will be mailed to the parents. This analysis will contain the psychological condition of the child. If the analysis is not accurate, the parents will be misinformed about their child's health condition. Thus the machine learning algorithm must give accurate results.

1.3 Definitions, Acronyms, and Abbreviations

TurnTheTables: The name of the psychological game which will educate children on how to stand against bullying.

Bully: The game characters in the game which display bullying kind of behaviour.

Main Character: The game character which the player controls in the game.

2. Proposed Software Architecture

Software architecture is the process of converting the software characteristics into a structured solution that meets the functional and nonfunctional requirements of the overall project. This structure aims to propose a solution for qualifying the characteristics of a software such as performance, ethical issues and user-friendly. In this section, the software architecture of TurnTheTables will be indicated by focusing on design goals and their trade-offs.

2.1 Overview

In the following subsections, the software architecture design of this project is described in detail. Firstly, the subsystems and their components of our proposed system are shown with diagrams including the classes within each layer. Then, hardware/software mapping of the system is presented in order to explain how diverse parts of the system will be correlated with different hardware devices. Afterwards, all information about keeping a local data for certain games are provided in persistent data management subsection. This part is followed by access control and security, indicating how the security of our system is managed as well as the access boundaries of the users. In global software control, the general flow of our system and the behavior of our system related to the user input. Lastly, boundary section describes the initialization, termination and the behavior of this system in case of any exception occurrence.

2.2 Subsystem Decomposition

Our system is built on top of a Model-View-Controller architecture model. We have decomposed our system into three subsystems; GameObjects (Model), GameViewManager (View), GameController (Controller). The GameObjects subsystem is responsible for maintaining the domain knowledge and is responsible for the initialization all the game objects. The GameController subsystem is responsible for initializing the control, constructing the game layout, rule checking and realizing the processing throughout the game play. It is dependent on GameObjects. The GameViewManager subsystem is responsible for the interface of the game and managing the sequence of interactions with the user. It is dependent on the GameController to provide information to keep updating the view of the game.

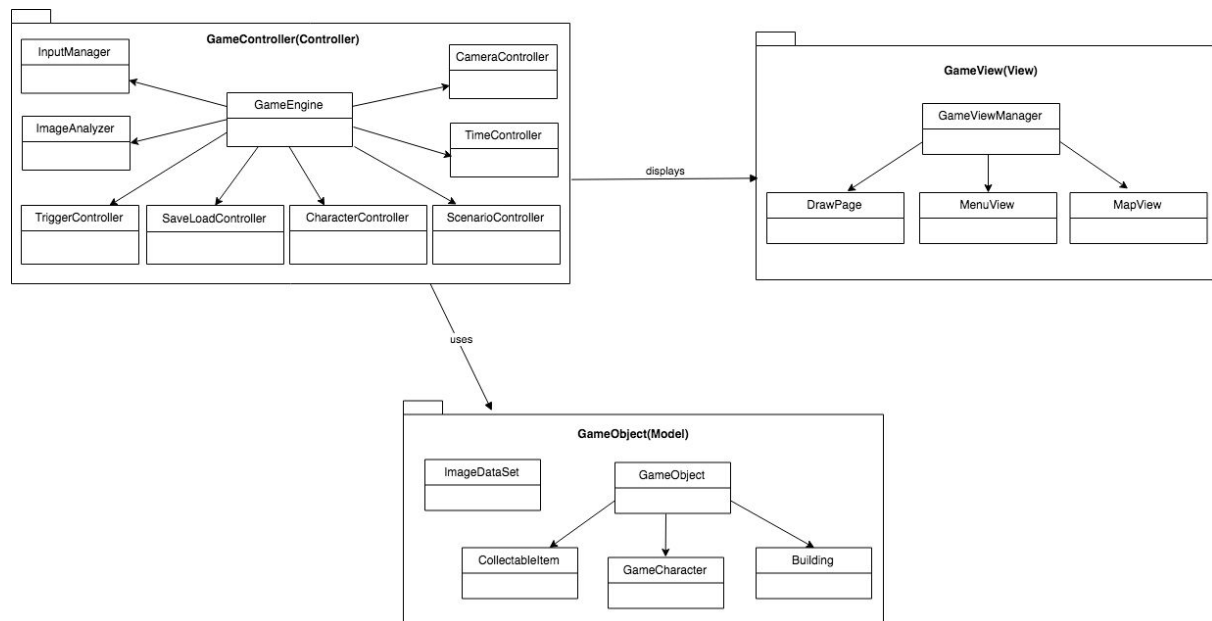


Figure 1: Subsystem Decomposition

2.3 Hardware/Software Mapping

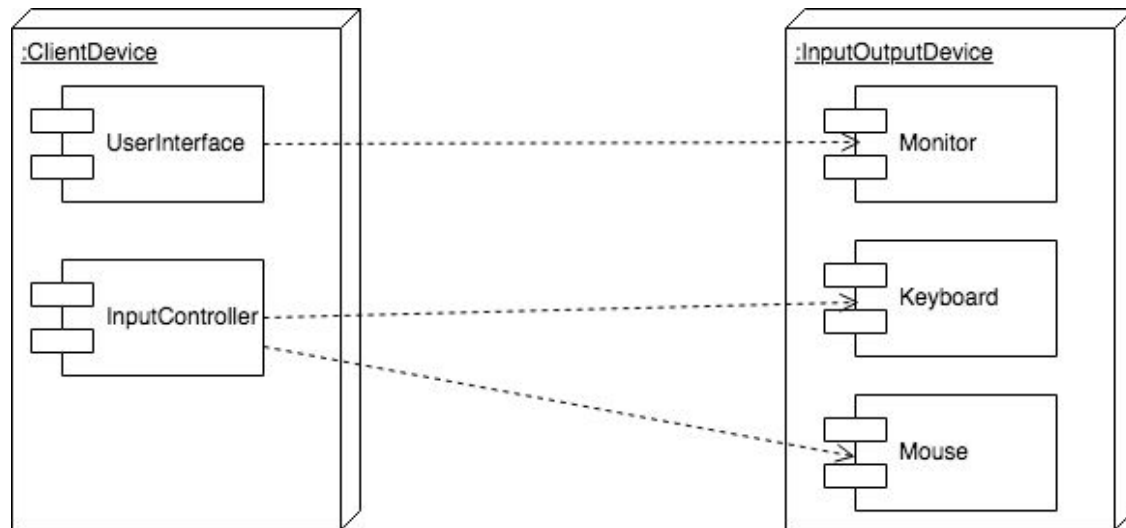


Figure 2: Hardware/Software Mapping

The communication between client device and Input / Output devices comprises the basis for hardware and software mapping of the project. As shown above, Input Controller in the client device takes the responsibility of handling each input type that is accepted by the game then, sent to keyboard or mouse in the IO Device.

2.4 Persistent Data Management

In terms of data management, there is no need for keeping online properties since this game is an offline single player game. For each save game operation, there will be a local database to store necessary data. The functionality of local database has to work for the personal computer that runs the game. With the advantage of Unity3D using serialization which enables to convert data structures and object state into a format that can be reconstructed later, both saving and loading the game can be managed easily.

2.5 Access Control and Security

Since there is no mechanism for multiple profiles for different users, there are no authentication issues and can be accessed by everyone. The state of the gameplay is saved locally, and the personal data regarding the psychological analysis of a child will also be saved locally, but will not be accessible through the game, it will only be received by the child's guardians periodically. Therefore, no security measures are taken as such for hiding data.

2.6 Global Software Control

Our software has an event-driven system, thus a change of states will control the flow of the game. From the beginning of the game, the user will come across different scenarios where

she/he will be asked to perform an action which will change the course of game. For each scenario, there will be different options, each option may lead to a different state of the game.

2.7 Boundary Conditions

There will be three boundary conditions which are Initialization, Termination and Failure.

a. Initialization

The game will start with the menu screen where the user will be able to initialise the game with a previously saved game state or with a new game. Either option will direct the user to the image drawing screen where the user will be prompted to draw a picture of how she or he is feeling today. After drawing a picture the user will be directed to the main game screen where the user could wander around the campus, complete tasks and interact with other characters.

b. Termination

The user could pause the game and could exit to the main menu screen or could directly press the X button on the top right of the screen and shut the game. Either way, the progress made by the player will be automatically saved by TurnTheTables (A save option will not be made available for the user because every decision made by the user is a representation of the child's psychological state and these decisions will accumulate to teach the child's subconscious).

c. Failure

If some unexpected failure causes the game to forcefully shut down, the game progress will still be saved, since the game will be having an auto-save mechanism.

3. Subsystem Services

The Subsystem architecture for TurnTheTables will be a Model View Controller (MVC) subsystem. There are mainly three subsystems which are GameController, GameObject and GameView. These components are explained in detail below:

3.1 GameController (Controller)

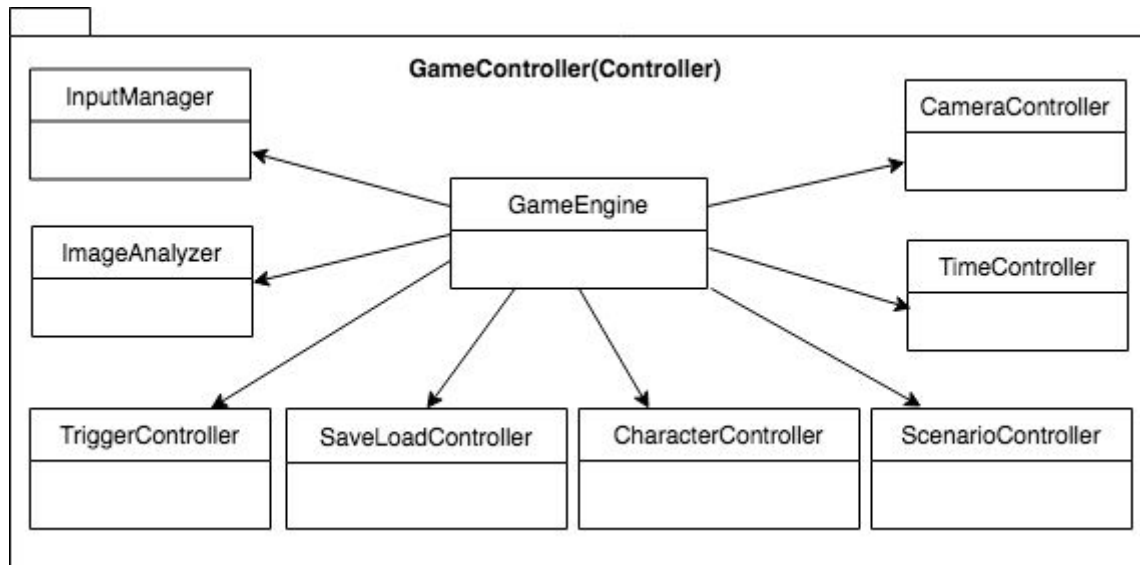


Figure 3: Game Controller

The GameController subsystem consists of the Controller subsystems, and thus is responsible from the main control mechanism of the game. The GameEngine is the main subsystem in which all the controllers are handled. InputManager is responsible from accepting inputs from the keyboard and mouse. ImageAnalyzer is responsible from detecting the depression level of the child by analyzing the images drawn by the child. Throughout the game there will be specific triggers to enable the game to switch to different stages and these triggers will be controlled by the TriggerController. SaveLoadController is responsible from the saving and loading mechanism of the game. The main character's control mechanism is handled by the CharacterController. There will be different scenarios according to the decisions the user makes. These flow of these scenarios will be controlled by the ScenarioController. The time in the game will be controlled by the TimeController. Finally, the CameraController will be responsible from the camera's movement.

3.2 GameObject (Model)

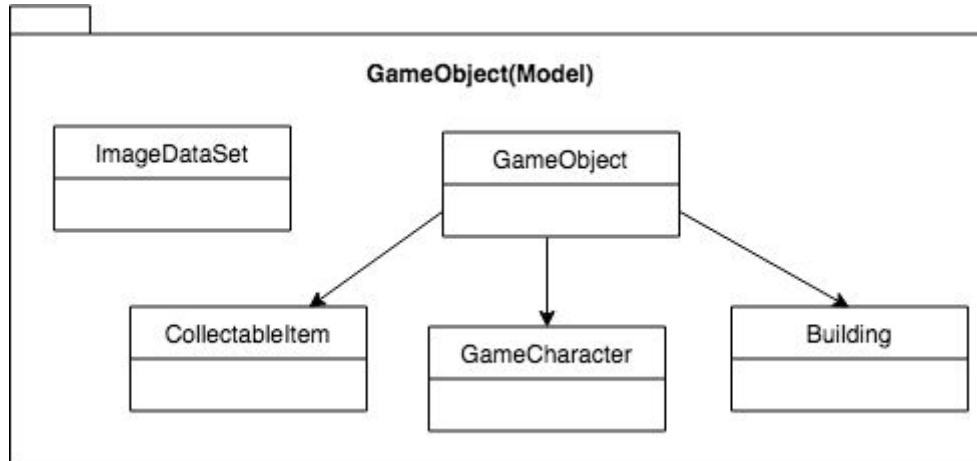


Figure 4: Game Object

The GameObject Subsystem consists of the Game entities. GameObject subsystem is the main subsystem which represents all of the game objects in the game. GameObject subsystem divides into three different subsystems which are CollectableItem, GameCharacter and Building. The CollectableItem represents the objects that could be collectable by the main character, in other words these are the objects that could be added to the inventory. GameCharacter represents all kind of characters throughout the game including the main character controlled by the user. Building represents the buildings in the game. The ImageDataSet is the data set we will be using for the machine learning mechanism for the subsystem to identify the depression of the child.

3.3 GameView (View)

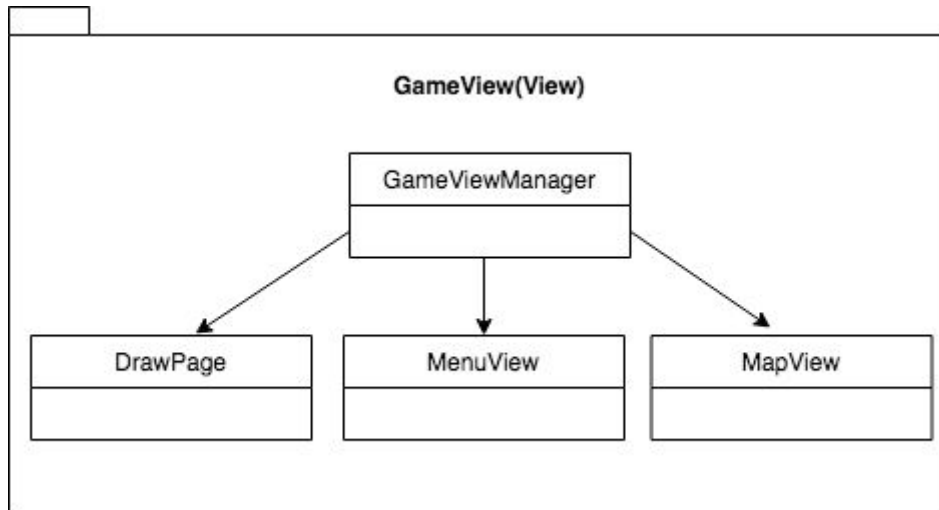


Figure 5: Game View

The GameView subsystem is responsible for displaying the graphical interface to the user. GameViewManger is responsible for handling the main control of the displaying mechanism. It is divided into three subsystems. The DrawPage represents the page that will be opened to prompt the user to draw a picture about how she feels at the moment. The MenuView represents the Menu screen of the game and the MapView represents the screen in which the main character wanders around the school campus.

4. References

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