CID: CAN IT DRIVE

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Introduction

The testing of this project was challenging. As this is a research project, the project itself is constantly evolving, with modules being added, modified and removed at an almost daily basis. Additionally, the project suffered a massive setback. Due to an accident in the RZ-11 lab, some of the installations on the development PCs were lost, which cost time to set up and reinstall. The testing plan was modified according to the changes in the project, the changing circumstances faced by the team, and the feedback received from the project advisors about the test plan. The testing could not be as thorough as we would have liked, but we still categorize it as successful as we deduced the core competencies and capabilities of our project.

The testing was done on modules, scripts and mods of the project that are near finalized, and will not change significantly in the final version. Due to these self-imposed restrictions on what parts of the projects can or cannot be tested, the decision making module and navigator modules, and their sub modules were not tested.

Due to the nature of the project, testing was split into 2 parts:

1. Testing system modules and scripts
2. Testing GTA V mods

Custom scripts were developed to test system modules and scripts. For the testing of GTA V mods, we did not develop and scripts, as it did not apply. Instead we tested the mods in game, and manually performed the tests.

The 3 types of testing performed are:

1. Unit testing
2. Integration testing
3. Performance testing

For unit testing, the units selected were either singular modules and scripts that are designed to perform one task, or a collection of smaller sub-modules and scripts, that collectively work together to produce a desired output. For integration testing, we took a big bang approach. If the testing produced undesired results and fails, then we will proceed with a bottom-up approach to integration testing to isolate and detect the problem areas. For performance testing, we only tested a subset of the finalized parts of our project. This is because we are not concerned with the overall performance of the project, but we still want to identify any possible bottlenecks in the system that can affect the overall functionality of the system.

We also identify the expected result and the actual result for each test perform. If we feel that the expected result will not be pass for the test, then we will detail why we think the test will fail. If the actual result is a fail, then we will detail the identified cause of the failure.

We do not perform security testing as it is not applicable to our project. We do not perform Alpha/Beta testing as our project is a research oriented project and we do not intend to release for general users, such testing is not applicable to our project.

Test Items

Unit Testing

System Modules and Scripts

Unit Name	Participants	Unit Details	Test Details	Pass/Fail Criteria	Expected Results	Actual Results
Network Communication script	Daniyal Selani	This script is responsible for sending and receiving data between modules that are located on 2 different computing nodes on the same network. The module is also responsible for encoding and decoding the messages.	The script on the master pc is given a test data frame to send to the slave pc. The slave pc returns a test data array.	The script on the master pc encodes and sends a data frame. The unit on the slave pc receives, decodes and displays the data frame. The slave pc encodes a response, sends it to the master pc, and the master pc decodes it. If no errors are raised, the test is a pass	The test is a pass	The test is a pass.
Data capture module	Daniyal Selani	This module is responsible for capturing and transforming frames from the game GTA V to the proper dimensions that are needed as input to the different modules of the system.	The module will be required to capture a certain region of the screen, which is of dimension (1280, 720, 3). The module will display the captured region in the following dimensions: 1. (480, 270, 3) 2. (340, 191, 1) 3. (160, 120, 1)	The module passes the test if it captures and displays screen-captured frames correctly without any distortion and/or corruption.	The test is a pass	The test is a pass.
Gameplay recording script	Daniyal Selani	This script records gameplay of GTA V for training models. It records screen capture and the corresponding action taken by user. The script records gameplay and stores it as a ".npy" file.	The script will be required to record GTA V gameplay (frame capture of the frame and corresponding key input from the user). The captured gameplay will be played back and inspected.	The script passes the test if the recorded gameplay can be played back successfully without any distortion or corruption and no saved files are overwritten.	The test is a pass	The test is a pass.
Data extraction module	Daniyal Selani	This module is responsible for extracting relevant information from the input frames from GTA V.	The module is composed of multiple smaller models that perform different computer vision and processing tasks on the input frame. Since these models work together to extract information from the data to describe the state of the environment, it shall be tested it as a single unit. The module will be fed prerecorded gameplay screen capture, and the module will output extracted information of each frame in a json file.	The module passes the test if the module produces the correct output in the form of a json file and it contains the following information: 1.Number of objects in a frame 2. Object classes 3. Confidence level of object prediction 4. Object location In frame 5. Area of bounding box of object 5. Lane/Path of the car in the frame 6. Location of lane/path 6. Segmented area of the lane/path 7. If any object is present in the area of the lane/path	The test is a pass	The test is a pass.

Control module	Daniyal Selani	This module takes output from the system as input, and acts as an actuator to control the car in the game based on the input.	The module will be provided a prerecorded set of control outputs as inputs. The module will be required to translate those inputs into in game actions.	The module passes the test if it can successfully read the inputs and translate them into in game movements.	The test is a pass	The test is a pass.

GTA V Mods

Unit Name	Participants	Unit Details	Test Details	Pass/Fail Criteria	Expected Results	Actual Results
Community Script Hook V .NET 2.10.9	Mahmoud Hamraa	This mod allows the use of GTA V script native functions in custom *.asi plugins written in any .NET language in game	The game is loaded with test mods, such as Enhanced Native trainer, Native UI, NFS Gauge and Map Editor, to see if it supports them in game	The mod passes the test if the test mods load on the screen when they are toggled by pressing activation key without crashing the game	The test is a pass	The test is a pass
Enhanced Native Trainer(ENT) Update 40	Mahmoud Hamraa	This mod allows environmental control of the game. Such as controlling the weather, traffic, time and spawning various vehicles	This mod is loaded in game and observed to see whether it successfully controls the weather, traffic, time and spawning of various vehicles	The mod passes the test if the mentioned tasks are performed without crashing the game.	The test is a pass	The test is a pass
NativeUI 1.9.1	Mahmoud Hamraa	This mod is responsible for building and displaying other game mods in game.	This mod is loaded in game and observed to see whether it successfully loads the menus of other mods in the game. Such as the menu for Enhanced Native Trainer, Map Editor and NFS Gauge.	This mod passes if it successfully displays the menus for other mods used in the game without crashing or lagging caused	The test is a pass	The test is a pass
NFS gauge - RPM Gear Speedometer & Timer 2.63.2	Mahmoud Hamraa	This mod is responsible for measuring the speed of the car being driven in game.	This mod is loaded in game and observed to see if it can successfully provide details about the speed of the car in control.	This mod passes if it successfully displays the speed of the car being driven in a consistent manner and without affecting the performance of the game or crashing it	The test is a pass	The test is a pass
Map Editor 2.13	Mahmoud Hamraa	This mod allows for the creation of custom roads, buildings, infrastructure and spawning NPCs	This mod is loaded in game and observed to see if it can successfully spawn objects needed to create roads, buildings, infrastructure and spawning NPCs	This mod passes if it successfully performs the tasks mentioned without crashing or lagging caused in the game	The test is a pass	The test is a pass

Integration Testing

System Modules and Scripts

Participant	Test Objective	Test details	Pass/Fail Criteria	Expected Result	Actual Result
Daniyal Selani	Check the interactions between the modules and scripts listed below: 1. Data capture module 2.Control module 3. Inter network communication module. Determine that the system can function on multiple computing nodes using the modules listed above, by determining if the game can be run on the master PC, and be controlled by the slave PC.	Send a captured frame from GTA V, from the master PC to the slave PC. Display frame on slave pc. Record control inputs for frame. Send input to master pc, translate input to in game controls and control game movement. Perform this task on a continuous loop	Test will be a pass if all the scripts and modules listed can perform the listed task without crashing. Additionally, if any if there any interruption in the network the system should not crash	The test is a pass	The test is a pass

GTA V Mods

Participant	Test Objective	Test details	Pass/Fail Criteria	Expected Result	Actual Result
Mahmoud Hamraa	Verify that all mods listed in unit testing, and their features work and interact together successfully.	The following actions are carried out: a custom created circuit is loaded using Map Editor. The time and weather are controlled and a vehicle is spawned on the custom created circuit using ENT. The NFS gauge is displayed when a car is driven on the circuit and shows the speed as the car is driving. Lastly, all the menus of the mods are displayed successfully	This test passes if all the following actions can be carried out successfully without any lag or crashing the game.	The test is a pass	The test is a pass

Performance Testing

System Modules and Scripts

Participant	Test Objective	Test details	Pass/Fail Criteria	Expected Results	Actual Results
Daniyal Selani	Verify round trip time for sending frame and receiving control inputs to and from master and slave PC is < 50 MS	Round trip time is defined as the time taken for the network communication to encode, send message, decode message, encode response, and decode response. The data sent will be a data frame of size ~ 65,000 bytes (near max load capacity for single UDP packet). Dimensions of frame (340, 191, 1). The response will be an array of control inputs of size 9. The test will be performed 10 times to ensure accuracy	Test will be considered a pass if the average round trip time calculated after 10 trails is < 50 MS	The test is a pass	The test is a pass
Daniyal Selani	Verify frame rate of screen capture module is >20 fps (frames per second)	Frame rate is defined as the number of frames the module can capture and resize into the correct dimensions per second. The frame captured will be of dimension (1280, 720. 3). The frame will be resized to dimension (340 191, 1). The test will be performed 10 times to ensure accuracy. The instantaneous frame rate at each trial will be recorded. Instantaneous frame rate is calculated as : (1/time taken to perform task)	Test will be considered a pass if the average instantaneous frame rate after 10 trials is > 20 fps	The test is a pass	The test is a pass

Summary of Tests Passed

We had a 100% pass rate for our testing. This is because the system architecture's design requires that certain modules and scripts be ready and fully functional, before the more complex modules can be implemented. Therefore, the modules that were tested performed as expected. Additionally, we are working on the 3rd iteration of our system. We have already fixed and patched many of the issues that were present in the previous versions. We are also aware of the limitations of our system and so the pass/fail criteria were set in the context of this knowledge.

Most of the testing done, focused on the functionality of the modules and scripts. We want to highlight the core competencies and capabilities of our system so far, so that we can better design the remaining modules and scripts.

Resources

- https://www.gta5-mods.com/scripts/nfsgauge-rpm-gear-speedometer
- https://www.gta5-mods.com/scripts/map-editor
- https://www.gta5-mods.com/scripts/enhanced-native-trainer
- https://github.com/Guad/NativeUI/releases/
- https://www.gta5-mods.com/tools/script-hook-v
- https://www.gta5-mods.com/tools/scripthookv-net
- https://github.com/Sentdex/pygta5