A platform to test and automation on gesture and motion controls of play station 4 using robotic arm

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Abstract. Gesture and motion play an important role in computer games. This paper reveals about automation testing for gesture and motion-based interaction on play station4 and to provide a single automation test setup for multiple devices of same family. Generally, play station 4 gesture controls are tested manually by using move motion controller which leads to tedious effort of building a gesture and motion test. The proposed system provides low cost and effective automation test solution for gesture and motion-controlled devices. The created platform ‘TAGMED’ – Test Automation for Gesture and Motion Enabled Devices, a test automation tool to provide automation testing through the gesture and motion input simulation to play station4 gaming consoles. The automation test solution has robotic arm tweaked to handle PS4 MOVE controller and simulate gesture input on testing device, the platform captures the corresponding output, compares the captured output with the expected output and provides the report. This helps in bringing better accuracy of recognition, repeatability and defect less testing.

1. Introduction
Gesture and Motion enabled devices are increasingly becoming available to consumers. The gesture and motion-controlled interfaces are greatly used for all types of people like young age, elder people and disabled people [1-3]. Users could control tiny music players with subtle shoulder movements. The users could look at upcoming appointments on a watch display without touching the watch or dialing a mobile phone with a wave of the hand. Users could control tiny music players with subtle shoulder movements. The users could look at upcoming appointments on a watch display without touching the watch or dialing a mobile phone with a wave of the hand. But the motion and gesture recognition
devices are tested manually which leads to more of effort, less reliability and high investment in human [4]. Gesture and motion-controlled devices, their application functionalities and outputs are tested manually which increases cost and long time to market.

PS4, introduced by Sony, is a game console. PS4 is a high-end version of the console. Gesture and motion control acts as an interaction to real-world with video games [5]. It makes sense to players. The players can swing the move motion controller like he would move his arm when playing cricket or tennis game. Before coming to the customer, the move motion controller with PS4 are tested by manually without any software or hardware which takes long time to market, high cost and non-reliability. Already we have discussed about automation and manual testing on gesture and motion devices [6]. The PS4 move motion controller is having in-built motion sensor which is used to navigate on menu of PS4 and it will be tested by manually.

The application of play station4 is tested manually by tester using move motion controller. Visually to view the changes of PS4, the HDMI out pin of PS4 is connected to HDMI input pin of TV. The tester has to note the screen changes when the move motion controller is waived towards PS4, the display changes are verified with the expected output and the results are observed by visual matching and has to record the observations. Up pages, down pages and its contents are tested. There are 12 applications are tested in down pages such as play station store, whats new, capture gallery, live from play station, the playroom, Tv & video, media player, share factory, installed game 1, installed game 2, internet browser and library. Likewise, in up pages 10 applications are tested such as notifications, friends, communities, events, messages, party, profile, trophies, settings and power. In up and down pages of PS4, we are testing the motion function of each application not deeply in applications function. This testing leads to time consuming and defect leakage. Non-repeatability and inconsistency will take place in manual testing. Manual testing is replaced by automation testing to reduce time and cost. Automation testing stabilizes and improves repeatability of testing and provides high test execution speed. This research work provides an automation testing tool for gesture and motion enabled devices.

It’s sparkling to see Gesture and motion-controlled applications and devices, in home automation, industrial automation, etc., [7-8]. The applications of Gesture and motion-controlled devices in games [9] are as follows:

- **EYE TOY (Sony)** - Interacting as personalized gamer with Sony play station games.
- **Wii Nintendo** - Wireless and motion sensitive remote with game console.
- **XBOX live vision** - Interacting as personalized gamer with Microsoft’s XBOX-360, XBOX ONE games.

These applications, their functionalities and outputs are tested manually with huge time and high effort investment. The proposed TAGMED - Test Automation for Gesture and Motion Enabled Device, is a novel automation testing solution for gesture and motion
enabled devices. TAGMED application is created using .NET C# and PowerShell automation tool. It enables test automation using black box method [10] through required hardware and software interfaces. Using TAGMED platform, we can test and automate the applications, functionalities and outputs of gesture and motion-controlled devices with less time and effortless investment.

TAGMED simulates motion inputs using robotic arm which is tweaked with PS4 move motion controller to simulate motion signal to the PS4 [11-12]. The corresponding output of the PS4 is captured and compared with the predefined output and a report is generated. Test cases are executed repeatedly on single device to produce exact output. The main goal of automation is to reduce time and increase speed of testing.

2. Used tools

2.1. Hardware tools used

- Play Station 4
  It is the target device under test, where its gesture and motion application are the target to be tested.
- Play Station Move Motion Controller
  It is a wireless electronic hardware, which used the Bluetooth communication to send the motion signals to the PS4.
- Aver Media Capture Card
  It is used to stream the video content from the gaming consoles. The capture card captures the HDMI output from the PS4 and sends to the automation test PC through USD communication.
- Relay control
  The relay control is used to control ON and OFF of the toggle (T) button of PS4 move motion controller.

2.2. Software tools used

- Windows PowerShell IDE
  It is the heart of this automation solution which is used to create automation test scripts and as test execution engine.
- TAGMED Application
  The TAGMED Application GUI developed using .Net C# to control PS4 and Image comparison.
- Robotic Arm Application
  Robotic arm application is used to control the robotic arm for gesture input simulation. The 6DOF robotic arm is used. The gesture and motion inputs are simulated by sending the gesture sequences like left to right, move up, etc. to the robotic arm through serial communication are stored in this platform.
- Image capture application
It is an open source C# application which is used to connect to the Aver Media capture card connected to the PS4 and capture the images from capture card whenever required for testing at the same time saving the captured image in predefined location of automation PC.

- **Microsoft Word**
  Used to generate the report and capture the automated test execution result along with the objective evidence like images captured during automation.

### 3. PS4 Automation testing

#### 3.1. Automation script

Automation script is the bridge between all the entities used for in solution; it controls the entire hardware and software tools used in this solution. Test cases are converted to automation test script and the automation testing starts from the automation script. When the automation starts, the script automatically opens the TAGMED and Robotic arm application to access the controls available in the application. Depending upon the test case, the script triggers the TAGMED application to send the gesture or motion input to the robot arm which is tweaked with PS4 move motion controller which holds the simulator remote controller of the PS4, which will move the robotic arm over the PS4. Once the robotic arm with move motion controller motion is generated, PS4 changes from current stage to new stage. Then the script sends the capture command to the snapshot maker to capture the output from PS4. Further the script compares the captured output with the expected output and generates the report. The Figure 1 shows about the block diagram of PS4 testing with TAGMED application.

![Figure 1 Block diagram of automation testing of PS4.](image)

#### 3.2. TAGMED Application
Study of previous research work on Gesture test automation from mobiles, explains about TAGMED application. Subsequently, this paper directly explains about the automation with the PS4.

![Figure 2](image2.png)

**Figure 2** the automation test setup for PS4 game console

The Figure 2 shows the automation test setup for PS4 game console. In this test setup, the TV is used only to visually see the content of PS4 while automation. The relay pin is connected to toggle button of PS4 and to control move motion controller programmatically during automation. The tweaked move motion controller is placed on robotic arm which is 6 degrees of freedom to produce simulation towards Play station.

![Figure 3](image3.png)

**Figure 3** the GUI of TAGMED application

The Figure 3 shows the GUI of TAGMED application, which controls the PS4 game
console. TAGMED application’s Android Device section has been discussed in our previous paper TAGMED for mobile gesture application testing [6], Android Device section not used for this PS4 gesture testing. The Image section is used to compare the image captured from the PS4 with the corresponding golden reference. The reference images of testing application are stored in our automation PC. The automation script sends click events to the TAGMED application open the captured image from the PS4 is displayed on the left image box. The reference image to which the captured image is compared with is opened on the right image box from predefined location. On the compare button click event, the TAGEMD application compares the captured image with its corresponding reference image using pixel by pixel comparison logic and displays the result in the output box, the mismatched pixel count is displayed in the Mismatched Pixel Text box. The Tol text box is used to provide the tolerance for the error during the image comparison.

3.3. Working 
Pre-requisites:
- Turn ON move motion controller by relay control and Pair with PS4.
- The Image capture application snapshot maker should be connected to the capture card to capture the image from PS4
- The reference images of PS4 should be available in the PC for comparison with the captured image from the PS4 during automation.
- The robotic arm sequences left, right, down and up sequences should be stored in the PC, which will be accessed by the automation script during the automation. The robotic arm with move motion controller and PS4 should be fixed on a fixed fixture, so that the robotic arm can wave towards PS4.

3.4. Automation process
The automation starts from PowerShell script, which opens TAGMED application, first. Automation testing of gesture and motion applications sequence starts with PS4 down page. Automation script sends the capture command to capture the down page of PS4 and place in the capture image section by the following steps.

i. From PS4, the image is captured by aver media capture card and transmitted to snapshot maker application in the automation PC.
ii. The snapshot maker application stores the captured image in the predefined location and the same is loaded in the captured image section by script command.

The reference image is loaded in the reference image section by browse button and it will be compared with the captured image by compare button from TAGMED application. The result box displays the result both it is pass or fail and the same will be updated in the report file. The output box shows about any error in execution.

Then the script opens the up sequence from the robotic arm application platform. Robotic arm swings to upward direction, again the PS4 display changes from down page to up page. The images in the up page is captured and loaded in the captured image section by
the script command and the result is produced by comparison logic. By calling left and right sequences of robotic arm application, we can test back and forth application which is available in up page of PS4. This methodology is implemented to test ‘up’, ‘left’ and ‘right’ motion control of PS4 console.

Next, the script opens down sequence from robotic arm application, the robotic arm swings to down direction again. PS4 displays changes to down page. The comparison process takes place with reference and captured image and the report is updated based on result. By calling left and right sequences of robotic arm application, we can test back and forth application which is available in the down page of PS4. This methodology is implemented to test ‘down’, ‘left’ and ‘right’ motion control of PS4 console. Finally, the result is produced and the report is stored in the test PC in the predefined location and the script execution is stopped.

4. Results and discussion

Table 1 clearly shows the general report for testing of some of the gesture and motion application of Samsung series mobile phone. While automation testing is performed, the comparison output is not matched to 100%, due to time change in captured image of testing application. This will be solved by introducing the tolerance value about 0.1%. The main theme of TAGMED is testing and automation on gesture and motion application and not on image. Therefore, TAGMED is verified as an automation tool for testing of gesture and motion application of play station 4 and move motion controller. Based on test report, the manufacturer can easily test applications of gesture and motion enabled devices. The test automation developed for PS4 gesture and motion application testing was successful in its operation and the results are achieved as expected. During the test automation execution, script triggered the Robotic arm to generate up to down, down to up, right to left and left to right wave simulation input to the PS4. The PS4 recognized the gesture input generated by the robotic arm and changed its displays accordingly, the report is generated.

| Test Case ID | Test Procedure | Expected Behaviour | Observed Behaviour | Result |
|--------------|----------------|--------------------|--------------------|--------|
| PS4_001      | Open down page | PS4 should open down page | PS4 down page is opened. 1980 pixels are mismatch. | Pass   |

Table 1. Test Report

Test Machine: TEST-PC
Execution start: Monday, April 27, 2019 10:10:15 AM

Down page testing:
### Up page testing:

| Test Case ID | Test Procedure | Expected Behaviour | Observed Behaviour | Result |
|--------------|----------------|--------------------|--------------------|--------|
| PS4_002      | Swipe the robotic arm to up side | PS4 should move from down page to up Page | PS4 Up page is opened. 1875 pixels are mismatch | Pass |

### Right motion testing:

| Test Case ID | Test Procedure | Expected Behaviour | Observed Behaviour | Result |
|--------------|----------------|--------------------|--------------------|--------|
| PS4_003      | Swipe the robotic arm to right | PS4 down page Should move to next position from first position. | PS4 cursor moved to next position. 1896 pixels are mismatch | Pass |
TAGMED greatly reduces time and effort investment required for testing the gesture and motion enabled application by 50%. It eludes human error, provides high test coverage and repeatability. The Table 1 shows the actual report generated by the TAGMED test automation application to test the gesture and motion application of PS4 console for its up, down, left and right gesture. From test report, the observed outputs are having mismatch pixels but the result is ‘pass’. It means the mismatch pixels are within the tolerance value. The result of test case id ‘PS4_004’ is ‘fail’, it means the captured image is not same with reference image. To debug this problem, we have to repeat the testing until the result is passing. In automation testing, repeatability of testing process is easiest one. To do repeatability testing, we have to start the execution process until the expected outcomes. If the problem exists after repeating the execution, then we have to debug any error in software itself. Debugging of software problem is also possible one in automation testing. The problem exists even after debugging of software problem, it states that the problem is with the hardware device, the motion function of move motion controller is not functioning.
and that particular testing device is not delivered to customer.

5. Conclusions

Based on the test report we can conclude that the test carried out on PS4 console with move motion controller by test automation set up gives expected output. Most of the commercial devices, health care equipment like MYO arm band in physiotherapy and industries in the field of automotive are having gesture and motion-based applications and its usage are increasing day by day. But till now testing is done only by manually. TAGMED was developed to reduce defects in manual testing. Automated testing is significantly faster than a manual approach. Automated testing helps to find more bugs compare to a human tester. It increases productivity and time to market by fast and accuracy in results. Reuse of testing is possible by recording the whole process of automation. Automation testing is a one-time investment for software, tools and for domain skilled person. So, it reduces cost of project also. Therefore, the automation testing has an edge over conventional manual testing.

Acknowledgement

This work has been financed by Department of Science and Technology- Government of India, Women Scientist Scheme A under Grant SR/WOS-A/ET-1073/2014.

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