

Survey on PACS and Tools that are Efficient for Automation Testing PACS

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Abstract— Computer application in health care or computer aided health care is the mostly concentrated domain. PACS (Picture Archiving and Communication System) is one such application that helps in retrieving, storing, maintaining and manipulating the DICOM images, patient and hospital details. In this paper the focus is on the health care, PACS, tools and technologies used for automation testing of the PACS product, how automation would be helpful to radiologists as the end users.

Key words: PACS, DICOM

I. INTRODUCTION

The development of computer applications that helps the doctors or the radiologists is important because it helps indirectly the patients. The patients are getting benefit out of this because the radiologists can reach the patients at any time from any place.

The innovation in the computer applications, the features available out of the application and innovation in the usage of tools to develop the applications for the support of health care takes an important position in improving lives of public.

One such application that support health care is PACS (Picture Archiving and Communication System). The product is the worldwide enterprise system that helps to fetch, store, maintain, communicate, transfer, edit, and modify the patient data where the data is imagery data.

The innovation in the development of PACS and the usage of the efficient tools to test the PACS would save time and produces quality PACS.

The innovation in the development of PACS should meet the expectation of the radiologists like the product should be web based, low cost, should be available in mobile phones, should allow to acquire the data from modalities of different hospitals, should allow the transfer of imagery data between different organizations.

The usage of efficient tools to test that is Automation test the PACS would help to save time and effort spent on manual testing. The automation testing is in demand in the present situation to test the products that deal with the digital images huge volume of the digital imagery data which has the complex calculations involved. Finally the automation testing that is testing through scripts help to increase the quality of the product.

II. HEALTH CARE AND INNOVATION IN HEALTH CARE

A. Challenges and limitations

One may face challenges in developing a computer application to a health care system. The challenge that could occur in the path of developing an application to the support of health care is the synchronization of data. The synchronization should be achieved with the data present in

the server that maintains the patient and hospital imagery data and the data that are present in real time in real world.

Similar to challenges there are certain limitations of computer performance. There are four general orders of limitations.

Among that first order limitation is due to the storage problem of voluminous data. This limitation can be classified as economical problem rather than storage.

Second order limitation may occur due to the error in the developed software. Third order limitation may be because of one may not find how much and what information to be abstracted from the end users. Fourth order limitation is one on which the third order depends. Fourth order limitation depends on the review or the requirement information provided by the doctors as what kind of application do they require and the limitation here is that feasible to convert to the form of software.

III. PACS

At the most basic level, the benefits of digital images and PACS is that it eliminates manual, chemically based, and highly redundant processing and handling of film and paper envelopes. PACS helps in capturing, storing, modifying the digital medical images which are in the DICOM format.

A. Architecture

The architecture used for the PACS is a basic one like two tier client server architecture. Initially one box is used for to carry out both server and client roles. Later on one box acts as server and other acts as client. Now a days the server role is carried by more than two units, one may store images, one for infrastructure management, one for processing the database, one for controlling the different servers and so on.

B. Components of PACS

The various hardware and software components that compose PACS. Work station monitors are one among hardware components. This helps radiologists to view the images and information on the monitor screen with the required resolution and settings.

Storage is the other component that helps in storage of information like hospital, patient details and the DICOM images. Network is the other hardware component that helps in sharing the information among different hospital system or with patients can share the information with the radiologists wherever he/she may be.

Software components comprises of RIS, HIS, DICOM images. HIS (Hospital information system) comprises of information regarding the hospital administrative department like information of payment, about radiologists hospital business transactions etc. RIS (Radiology information system) consists of information regarding patients that can help a radiologist to analyze or

diagnose the patient problems. Information may be patients unique ID, name, address, sex, problems, notes on the problems etc. DICOM images are standard format used to store the medical images which is got by the hospitals.

C. PACS Applications

PACS is used to store the above mentioned software components in the hardware components and used to fetch whenever they are required. Radiologists can modify as and when he/ she diagnose the patients problem. The reports once stored can be cached for future use, can be exported to different destination etc.

The images can be hung in different angles, direction, monitor layout, different monitors (virtual). Different protocols are designed and implemented to hang the images in different angles, direction etc. Hanging in different forms helps the radiologists to view the images as he/she wants if he /she had the physical report with them.

D. Security of PACS

Security is a common issue that can be faced in any field or domain. So one possible solution in the domain of PACS is that to assign the privileges and roles to the user while creating a user so that he/she cannot do any illegal activities.

IV. AUTOMATION

Automation is a process which trains the system in such a way that it does not require human intervention any more for the functioning of the automated system.

There are different types of automation systems. The incorporation of the measurement system into the digitized computer then the system is semi-automated system. This system gives the feeling of radiologist next to the patient. This type of system can analyze the signals and output on various output devices.

Other system is fully automated system, where in the system is trained in such a way that the system can not only analyzing and displaying signals, but can perform all kinds of activities without any human intervention. The radiologist need not be present at the spot or hospital he/she can be anywhere else and can just monitor the ongoing processing. Thus the automated system improves the quality of the treatment given to the patients even though the radiologists are not present at the hospital. Automating a system to the fullest is the golden target.

A. Automation Framework and Tools

A framework is required to automate any system irrespective of its domain. Framework provides the control ID for the various buttons, check boxes, radio buttons, group boxes, combo boxes etc. One can develop functions on the various elements that the interface has using the control id. Selenium is one such frame work which helps in providing control ids and this helps to automate system as web based one Automation testing a PACS uses some of the tools like Test-driven. Net as debugger and NUnit, Test Runner as testing tool. Below is the description and usage of each tool.

NUnit is a framework used for testing. The testing which uses this framework is unit testing. The frame work is free source.

Nunit takes output generated by the Testdriven.net as input and produce the result in the form of XML.

The NUnit tools contains the following concepts
“SetUp” Attribute: This attribute is found inside an attribute of nunit called “TestFixture” which contains the set of common functions that should be executed before any test method is executed.

In case of any error in the SetUp, it throws an exception and the test method is not run. The error is reported in the XML.

“SetUpFixture” Attribute: Attribute “SetUpFixture” is used to name or highlight the class. That class should which has only one SetUp and TearDown with in it.

“TearDown” Attribute: “TearDown” attribute is found within attribute “TestFixture”. This attribute has a set of functions commonly executed after the execution of individual method highlighted by attribute “Test”.

Method under “TearDown” attribute is executed only when the method (s) under the attribute “SetUp” is run with no error. TearDown would not be executed if the error or exception is thrown by SetUp.

“Test” Attribute: The “Test” attribute is made use to name or highlight the class that consists the code to achieve the functionalities of the system that s to be automated.

Before NUnit 2.5, the template of the test method was:

```
public void Name_of_theMethod()
```

And NUnit 2.5, has a template:

```
public static void Name_of_theMethod ()
```

1) *TestFixtureAttribute (NUnit 2.0 / 2.5)*

This is the attribute that marks a class that contains tests and, optionally, setup or teardown methods.

2) *TestDriven.Net*

The above mentioned process is a procedure of software development. Initially a developer codes a test case that describes a necessary feature.

Programmers apply the concept for the purpose of enhancing and compiling earlier developed code.

3) *TestDriven.Net usage*

TestDriven .Net takes application map as an input and gives .dll file. Application Map is the xml file it has all information needed to compile the script.

4) *TestRunner*

TestRunner being a system used for testing Selenium tests. The testing would be periodically carried out.

TestRunner is a piece of implementation used for Continuous Integration. This allows a software to be maintained in good quality.

5) *TestRunner Usage*

“TestRunner” gets suite ticket as input and outputs XML, which contains results of the test scripts. Suite ticket contains all the necessary information like debug folder path, server IP address and bitmap paths etc. to help generating the run results. Test results contain test steps, expected output, actual output and the status of the result at each step.

B. Automation and Virtualization

A question may raise that how to come to a conclusion that the automated system works fine in the client environment, in this case hospital environment. The answer is to make use of the virtualization. Virtualization helps to imitate the hospital environment. Virtualizing the servers, virtualizing the clients, virtualizing the monitor systems.

V. DISCUSSION, CONCLUSION AND FUTURE WORK

In the present paper the discussions are made on the Health care domain, its challenges and limitations. Discussion on the PACS and the architecture, its components, and general application. Discussion on the automation systems in general, automation frame work, virtualization and security issues.

Innovation in the technologies used in the health care like PACS can improve many lives. Automating the PACS can improve the quality of the PACS.

One can find one or more windows application for PACS and which are qualified by automation. But fully automated system is still a golden target. The web based PACS application with qualification by automation is still in its infancy stage which can be taken as future work.

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