Spacecraft Checkout Test Data Retrieval and Playback Software

Preeti Patil[1]
School of Computing And Information Technology,
REVA University, Bangalore.

SunilKumar S Manvi[2]
School of Computing And Information Technology,
REVA University, Bangalore.

Sheena Jose[3]
Spacecraft Checkout Group, ISRO Satellite Centre, Old Airport Road, Bangalore, India.

***ABSTRACT*-ACSS is a set of software products, developed for the automation of Spacecraft Checkout operations. ACSS runs on Checkout servers which are on LINUX platform. Various software packages of Checkout Software are used to test the spacecraft during spacecraft Integration. The tests on the spacecraft are conducted in a pre-defined sequence. These tests generate huge amount of Error free Test files which are archived in a various files.**

The proposed project system shall be to develop software to analyze the test history of a particular spacecraft during Checkout. It shall stitch the data available in multiple files and generate a timeline of the events. System will provide the users with a timeline of the tests conducted and the detail set of commands issued to the spacecraft which affects on telemetry. Software can also playback the test history by retrieving the data. This software shall thus be used to validate the next generation of ACSS.

***Keywords*-Automated Checkout Software System (ACSS), Spacecraft Checkout, Spacecraft Integration.**

I. INTRODUCTION

Ongoing ISRO programmers expect 6 to 8 spacecraft per year and with this ever increasing number and complexity of spacecrafts, there is a need to quickly, efficiently and accurately test the spacecraft from integration to launch phase. The way to fulfill this need is to improve the spacecraft checkout operations efficiently and cost effectively. The health of the spacecraft is calculated through telemetry, telecommand and ground systems parameters. ACSS is a set of software products which is designed with the prime objective of providing functionality to test and to automate the spacecraft checkout operations. In existing system, all these subsystem test data are manually observed and compared. All these manual activities are automated in the new system to support automatic checkout activities for spacecraft systems. The proposed software is used to accurately process summary files from the different subsystems ,validate and retrieve test data for all subsystems of spacecraft based on the time and different parameters without any typographical errors in real-time[1]. The new software system namely Test Data Retrieval and playback software integrates administrator and general user that provides an Integrated Development Environment (IDE) having a user friendly GUI (Graphical User Interface) for the analysis of test data files which is ready for execution by the software.

A. Spacecraft Checkout

The objective of Spacecraft Checkout is to evaluate the functional performance of the integrated spacecraft and to check all sub-system operational modes and redundancies. The main tasks of checkout are to provide controlled access to the spacecraft to provide means for assessing the overall performance of the integrated spacecraft, to simulate the different sub-systems & to evaluate the performance of various onboard subsystems.

B. Spacecraft Integration

The main objective of the spacecraft integration is combining all the parts of the sub-systems to make the spacecraft functional activities to work effectively.

C. Automation

Spacecraft system is unique, expensive, low volume procurements, often required sufficient amount of hand touch labor. Further they must complete the spacecraft mission ready and perform in highly adverse environment. Spacecraft systems typically spend large amount of resources for testing component of hardware and software system[2]. This assembly, integration and testing is time consuming task. With the ever increasing in number and complexity of spacecrafts, there is a need to quickly, efficiently and accurately test the spacecraft. The way to fulfill this need is to improve automation activities in hardware and software components for efficient and cost effective checkout operations.

II. SYSTEM OVERVIEW

The proposed software system consisting of various sub-system summary files which contains test data. It is used to process and test all the command history of any spacecraft. Broadly, the system carries out analysis and test data retrieval of the any sub-system summary file. The sub modules and their interfaces between the summary file and database files are carried out in the GUI Design part. Here, for any spacecraft multiple sub-system summary file test data are shown below in overall system architecture diagram.

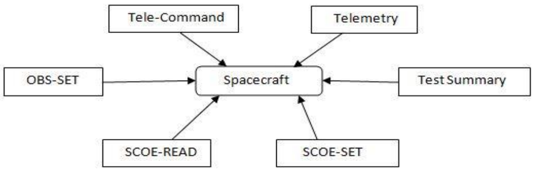


Figure 1.Multiple sub-system of spacecraft

II. SYSTEM ARCHITECTURE

The proposed system is designed as 3-tier client-server architecture, where server component handles administrators test data configuration, upload and view. On the other hand, client component handles general user which is used for the display of all summary file data based on different time format[3]. The database layer acts as intermediate to both client and server components to provide the required data inputs and storing of test data.

A. **Administrator**

Administrators are the one who are having the authority to develop the software and modify the existing data. Software system can be build according to the administrator requirement. If the new administrator wants store for different spacecraft, then he has the authority to create new spacecraft name in the database and he can create all the tables however he wants. The test data which has retrieved during spacecraft integration and testing are loading into the database based on the requirement.

Administrator performs following operations.

- Creates new database and all tables in the database.
- Configures the test data into the existing database.
- Upload the test data files into the database.
- View the test data based on the summary files.

B. Database system

It is one of the major layers in system's architecture which can be configured to any summary file of spacecraft by selecting the relevant parameters in database. DBMS helps the checkout team to define privileges and authenticity to take care of data security and integrity from various users and systems.

It performs following operations.

- storing user login.
- storing satellites name.

· Loading of Spacecraft and ACSS summary file test data.

· Loading of mnemonics.

· Archival of raw and processed test results data.

C. **General User Retrieval of test results**

After completion of all tests on any sub system, test results are stored in archived test files. Complete test data and other database summary details are saved into database in real time. All Reports will be displayed based on the parameters in the console window which is compatible to any platform (Windows/Linux). The retrieval operation will be used for generation and display of archived reports in off-line. During archival or retrieval, the following key parameters are considered to retrieve the test data.

- Satellite Name
- Summary file Name
- Mnemonics
- Archival Date
- Start Time
- End Time

The above mentioned key parameters shall be used as filters for quick retrieval of stored reports.

III. IMPLEMENTATION

Test data, which contains the command history of different subsystems, are stored in the file which is retrieved when spacecraft undergoes integration and testing. The data files are generated from the different subsystems which undergoes different testing are stored in different files of different format. All the files are loaded into the database based on different subsystem tables. After storing into database, the test data has been retrieving based on the date, time and parameters associated in the different subsystem summary files of the spacecraft.

The main implementation of this software system is to design GUI based software application. When the user logins to the system, user data is stored into the database for future reference. The user has to select or create new spacecraft name for which he wants to insert or modify the test data into the database. If the logged in user is an administrator, then he can configure the file path, upload the test data files and store the file content into the database. If the logged in user is general user, then he can only view or playback the data based on date, time and mnemonic parameters from all subsystem summary file at a time. In the existing system, the telemetry data is transmitted over the socket to data acquisition system, but in the proposed system, transmitted data is play backed based on the timeline of event[4]. Here, the flow of GUI design for any spacecraft sub-system is shown in the following system flowchart diagram.

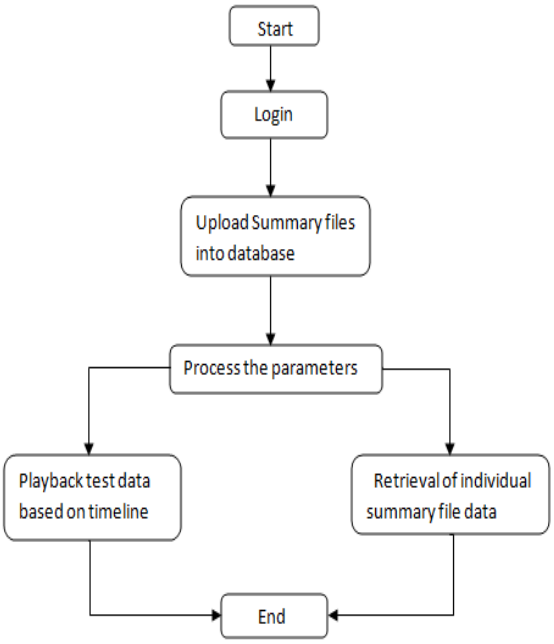

Start
Login
Upload Summary files into database
Process the parameters
Playback test data based on timeline
Retrieval of individual summary file data
End

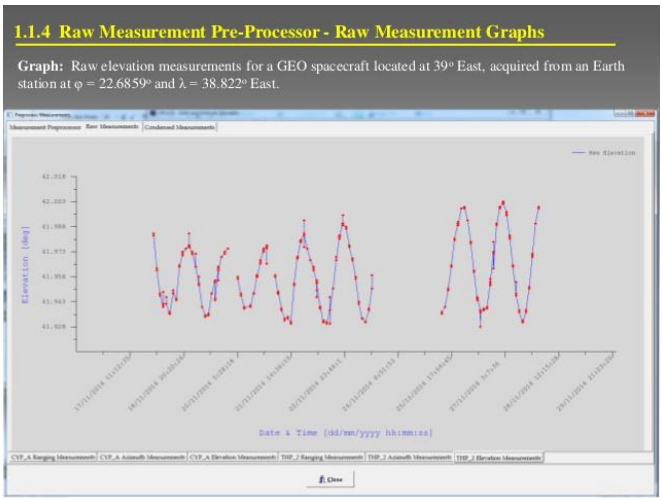
Figure 2: Design of the spacecraft test data retrieval

IV. RESULTS AND DISCUSSION

Test data Retrieval and Playback software provides analysis of the test history based on the timeline of the summary files. Administrators are allowed to add and modify the content of the test data which are stored in the database. General users are allowed to view the test data based on date, time and mnemonics as parameters from the database. This has improved the standard of test data files processing, retrieval which reduces the time taken for retrieval and human errors as well[5].

A. Experimental setup -This software has been developed using Net beans and Java Language on UNIX/LINUX platform with compiler that supports both. Test data files which are retrieved during the spacecraft testing, are stored in the database and interfaced with MySQL database through JDBC connection.

B. Comparison –This software has provided an efficient and improved version in retrieving the test data in generalizing the content of all subsystem summary files test data based on different parameters. The time taken for comparing and testing a spacecraft has reduced down at the ratio 4:1.Testdata of the different spacecraft compared based on different parameters are show in the below diagram.


1.1.4 Raw Measurement Pre-Processor - Raw Measurement Graphs

Graph: Raw elevation measurements for a GEO spacecraft located at 39° East, acquired from an Earth station at φ = 22.6859° and λ = 38.822° East.

Measurement Preprocessor
Raw Measurements
Condensed Measurements
Raw Elevation
42.018
42.003
41.988
41.973
41.958
41.943
41.928
Elevation [deg]
Date & Time [dd/mm/yyyy hh:mm:ss]
CYP_A Ranging Measurements
CYP_A Azimuth Measurements
CYP_A Elevation Measurements
THP_2 Ranging Measurements
THP_2 Azimuth Measurements
THP_2 Elevation Measurements
Close

Figure 3: Comparisons of different spacecraft testdata

IV. CONCLUSION & FUTURE WORK

This proposed model is used to retrieve and playback the test data based on timeline, which increases the efficiency and overall performance of the checkout software system. It combines the multiple test data files in the form of text files and stores into a database. General user can playback the test data based on timeline. If in case any unexpected error occurs, then the proposed system can be used to analyze and retrieve the test data history of particular spacecraft. Due to all these features one can save the time and efforts in manual retrieving of the test history of spacecraft.

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ACRONYMS

GUI	Graphical User Interface.
JDBC	Java Database Connectivity.
IDE	Integrated Development Environment
TC	Tele-command
TM	Telemetry

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