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Development of Web Directory of Aerospace Testing Facilities in India

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ABSTRACT

The paper is an outcome of a major research project funded by the Aeronautics Research and Development Board (AR&DB), DRDO. The primary intent of this project is to create a web-based database of testing facilities in aerospace and to facilitate sophisticated searchable database on WWW platform. The output of the project report can be treated as a working catalogue to provide narrative information describing each facility, its testing capabilities, unique characteristics, location, organisation, key persons, etc. Usage of the database is divided into passive and active. It enables to identify specific data requirements needed to quantify the status of the country's technological maturation from which an assessment can be made for research, development and testing of future aerospace vehicles. It also helps in designing standard operating procedure for providing Aerospace Test facilities existing in DRDO labs to the private sector (including under 'Make in India' initiative) on payment basis.

Keywords: Aerospace, testing facilities, web–directory, DRDO, India

1. INTRODUCTION

"Today, in the wake of advanced technology platforms and means of operations, Aerospace Science and Technology is the most influencing factor. It imbues our Nation significantly with strength, not only for economic development, but also for comprehensive security standards."[1] Many aerospace testing facilities have been established in India by research & development institutions, national laboratories and academic institutions. There has been tremendous growth in India's space programme giving an impetus to development of ancillary industries in the country for meeting the aerospace requirements.

Over the few years, there have been many expansions, enhancements and upgrades of existing aerospace facilities or newly established aerospace facilities. There is considerable potential in Indian entrepreneurs, industries/R&D organisations to participate 'Make in India' programme to create huge market for mutual benefit with overseas aircraft industries and systems, components and material manufacturers through technology tie-ups, collaborations and joint ventures. These facilities are used for civil, space as well as military applications.

In recent years, 'web-based information system expectations of users have increased many folds.'[2] Aerospace testing facilities information is not available on public domain and accessed only at specific institutional websites and which have meagre such information. Further, it is very difficult to find the relevant information relating to aerospace tests and in the process great deal of useful information is likely to be missed. Hence, the present project explored aerospace testing facilities information in semantic web environment where information has evolved after several reviews in the field. This project also identified major problems in obtaining aerospace testing facilities information. Therefore, it was the need of the hour to develop a web-based database on Aerospace Testing Facilities in India (hereafter called ATFI) across various research and development organisations and premier academic, research, private institutions engaged in teaching, training and research in aerospace.

2. SCOPE AND OBJECTIVES

The main objectives of the study are to:

(i) Design and build a web-based database on aerospace testing facilities available in profiled indian institutions using a suitable RDBMS with facilities for updating, modification, indexing and searching facilities;

(ii) Create a value-added Union List of Aerospace Testing facilities, and

(iii) Design an end-user interface for browsing, navigating through and searching with particula emphasis on the common web portal for all resources existing in ATFI.

The study is confined to ten major aerospace labs/institutions in India, such as: (i) Birla Institute of Technology (BIT), (ii) Council of Scientific and Industrial Research (CSIR), (iii) Defence Research & Development Organisation (DRDO), (iv) Electronics Corporation of India Limited (ECIL), (v) Hindustan

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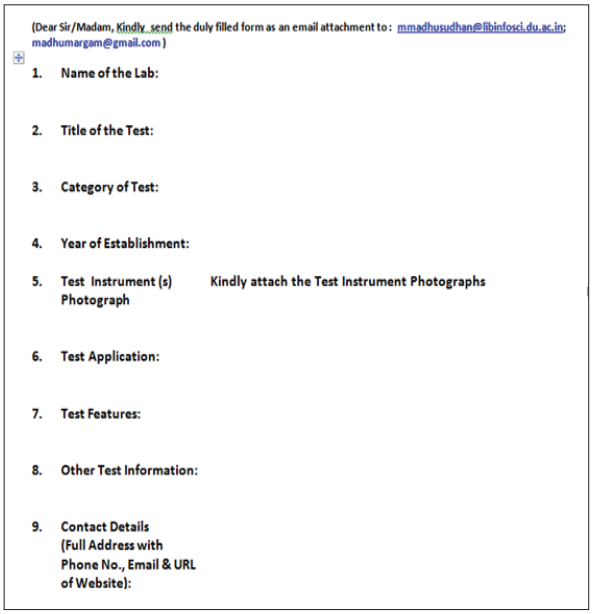
Aeronautics Limited (HAL), (vi) The Indian Institute of Science (IISc), (vii) Indian Institutes of Technology (IITs), such as: IIT-Kanpur, IIT-Kharagpur, IIT-Madras (Chennai), (viii) Vikram Sarabhai Space Centre (VSSC) and Indian Institute of Space Science & Technology (IISST) of Indian Space Research Organisation (ISRO), (ix) Madras Institute of Technology (MIT), and (x) Other aerospace labs/institutions.

3. METHODOLOGY

The system analysis and design method was followed to develop ATFI web directory with the help of specially designed 'Data Capturing Form' (Fig.1). All the participating labs under the study were visited in person and interactions with the authorities of aerospace testing facilities was done and data was structured, validated and then incorporated in the ATFI web directory and authorised users also contribute the ATFI data. The ATFI web directory was developed using state-of-the web technologies, and mobile technologies with mobile app.


(Dear Sir/Madam, Kindly send the duly filled form as an email attachment to : mmadhusudhan@libinfosci.du.ac.in; madhumargam@gmail.com)

1. Name of the Lab:
2. Title of the Test:
3. Category of Test:
4. Year of Establishment:
5. Test Instrument (s) Photograph — Kindly attach the Test Instrument Photographs
6. Test Application:
7. Test Features:
8. Other Test Information:
9. Contact Details (Full Address with Phone No., Email & URL of Website):

Figure 1. Data capturing form.

4. ARCHITECTURE OF ATFI

The architecture of ATFI project web portal is in five layers (Fig. 2). Each layer has its own role in the functioning and is depending on other and collectively functions in retrieving the results of ATFI.

Figure 2 reveals that the different layers are to manage records and full text contents. System uses the relational database management system (RDBMS) with the help of MySQL to store data. The functionality of system backup and contribution of contents by the users also comes under the purview of this layer. Network layer in the system perpetually connects the users and source institutions. Presentation layer helps in display of the retrieved aerospace testing results as per organisation, laboratory, category, and place. The results can be filtered

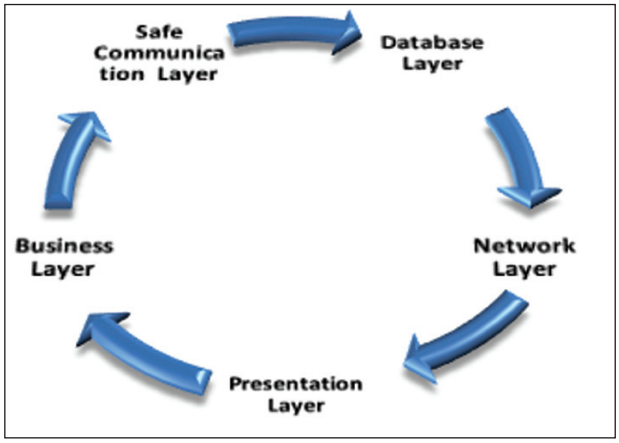


Figure 2. Layers of ATFI.

further using the session filtering. Business layer combines a number of operations of the system. This layer helps to perform several operations and facilitates the users to get the latest news, video tutorial, FAQ for online help. 'Safe communication layer' ensures the safety of data. This layer is an industry standard to safely communicate and safely exchange information."[1]

4.1 Functionalities of ATFI

The ATFI Web portal's architecture includes various functionalities such as: (i) User Registration (Join), (ii) Aerospace Testing Facility Submission (Contribute), (iii) User Approval Process, and (iv) Editing testing facilities, and (v) Rejection of testing facilities (Delete) (Fig. 3).

4.2 Designing of ATFI Web Portal

Designing of ATFI Project web portal is using a hybrid approach and using both commercial and open source tools, such as: Linux Centos platform and the database runs on MySQL, an open source, multi-threaded and robust structured query language database server with web application on Apache Server, with a total capacity of about 1024 GB with extendable storage. Backups are stored on-site server with different formats like .SQL, .XLS and .DOC.

The following tools and languages are used for designing ATFI web portal: Dreamweaver, Cascading style sheets (CSS), Adobe Photoshop, Adobe Flash, JAVA programming language, Hypertext Preprocessor (PHP), Asynchronous JavaScript and XML (AJAX), mobile app, and Web 2.0 tools

5. DEVELOPMENT OF ATFI WEB DIRECTORY

To achieve the objectives, a web-based database of ATFI was developed and integrated in the web portal (http://atfi.dlis.du.ac.in) (Fig. 4). Figure 4 shows the home page of ATFI. The ATFI home page header contains the links of join, contribute, aerospace testing facilities search, etc. To start a search, user may click on "search" or "browse". The contribute page on the header empower users to submit records in ATFI. Single type of prescribed

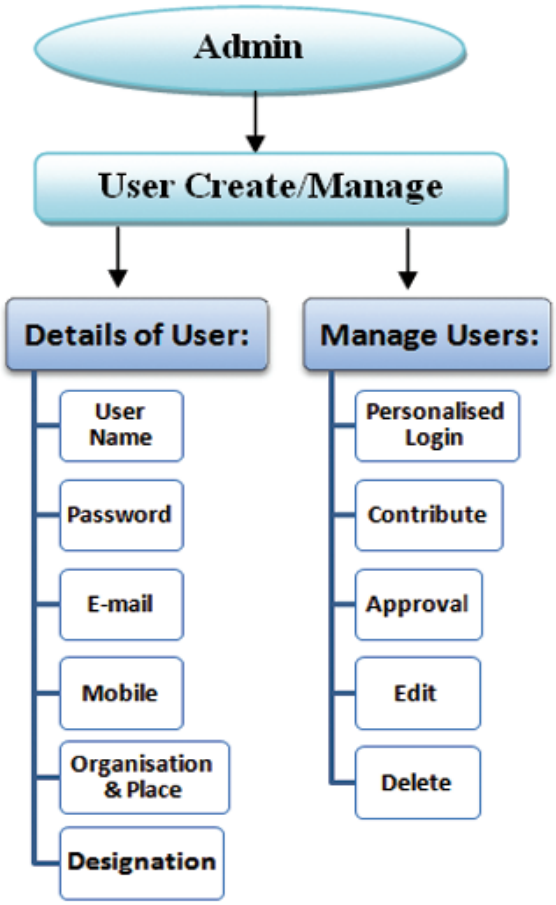


Figure 3. User creation and managing data in ATFI.

records can be submitted in ATFI. In addition, online help such as, FAQ, query submission form, and video tutorial are listed for effective use of ATFI sources and its services. User can login into ATFI link that is provided.

"The primary intent of ATFI web portal is to provide sophisticated searchable database of Aerospace Testing facilities across India. These details are complemented by relevant photographs of the facilities. This web portal has many dynamic features to facilitate easy navigation, mobile view with total responsiveness, tab view and many other collaborative features"[1] aesthetically designed and visually appealing punch lines for sliders with reliable page headings, faster page loadings, easy to use navigation that helped to achieve the desired tasks. Mobile app is provided for easy access to smart mobile phones or mobile devices.

5.1 Uses of ATFI Web Directory

The ATFI web directory has the following uses:

(i) To serve as a significant reference and statistical information tool for finding narrative information related to features of aerospace test facility, location, organisation, institutions, key persons, etc.

(ii) The passive usage that involves simple acquisition of information, such as for the purpose of studying expert knowledge.

(iii) The active use involving photographs and other material information being made available to the user to assist in other research works, educational or other activities.

(iv) The institutional profile and instruments used in the aerospace testing are by-products of this research project and it may be used as a guide/catalogue for future up-dating of the contents of the web-based database.

(v) To help in creation of a Union catalogue of aerospace testing facilities in India.

(vi) To help in designing standard operating procedure for providing Aerospace Test facilities existing in DRDO labs to the private sector (including under 'Make in India' initiative) on payment basis.

(vii) To identify specific data requirements needed to quantify the status of the country's technological

Figure 4. Homepage of ATFI (http://atfi.dlis.du.ac.in).

maturation from which an assessment can be made for research, development and testing of future aerospace vehicles.

(viii) To act as web interface to scientists to find aerospace test facilities according to his/her areas of interest.

(ix) To act as an evaluation tool to appraise the performance of Aerospace test facilities, not only within DRDO labs, but also other Aerospace organisations in India.

5.2 Classification of Aerospace Testing Facilities

Each aerospace category has various sub-categories, which are specified in the database and special care has been taken in categorization of these facilities for easy navigation, searching and browsing. These are broadly categorised and included, as: (i) Aerodynamic , (ii) Aircraft Components, (iii) Antenna, (iv) Avionics and Instrumentation, (v) Dynamics and Vibration, (vi) Electrical and Electromagnetic, (vii) Engine, (viii) Environmental, (ix) Flight Mechanics & Simulation, (x) Life Cycle, (xi) Materials, (xii) Operator Training, (xiii) Performance Evaluation, (xix) Structural and Fatigue, (xv) Turbomachinary, (xvi) Wind Tunnel, and (xvii) Other Testing facilities.

5.3 Search and Browse Features of ATFI

The ATFI web portal offers powerful searching capabilities to enable user to find the exact information he/she needs on mobile technology. The advanced search engine offers flexibility and precision. User can use the basic search box located at the bottom of the screen for Keyword search which includes search of all of the information in the ATFI database. In addition, there are four search forms available to suit the user particular searching needs: (i) Organisation, (ii) Laboratory, (iii) Category, and (iv) Place Search. Search page is depicted in Fig. 5.

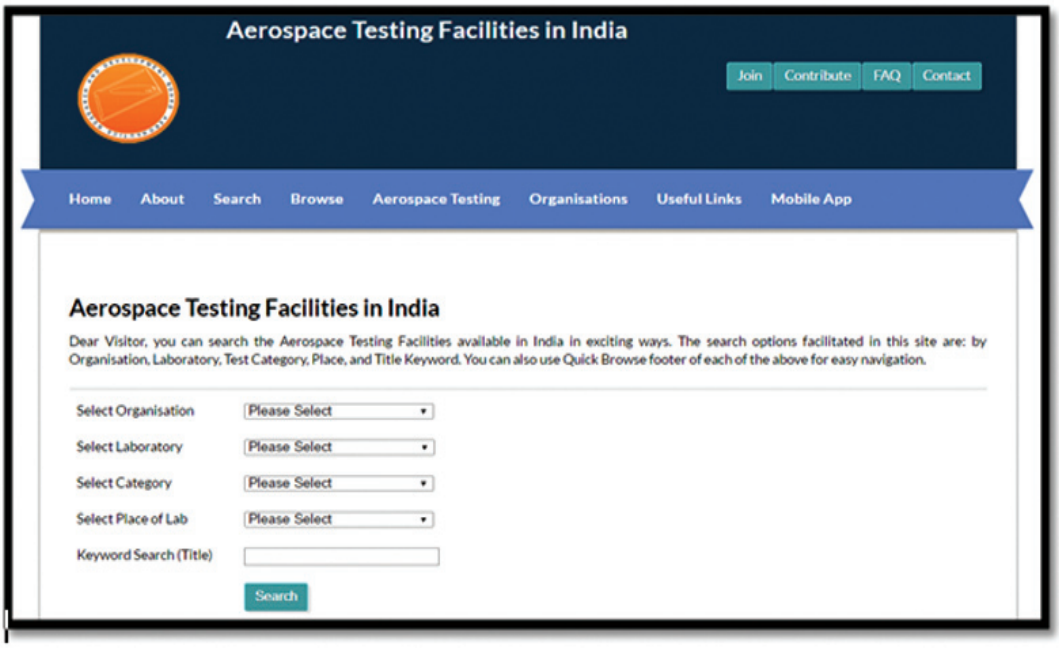


Figure 5. Search page of ATFI (http://atfi.dlis.du.ac.in/search.php)

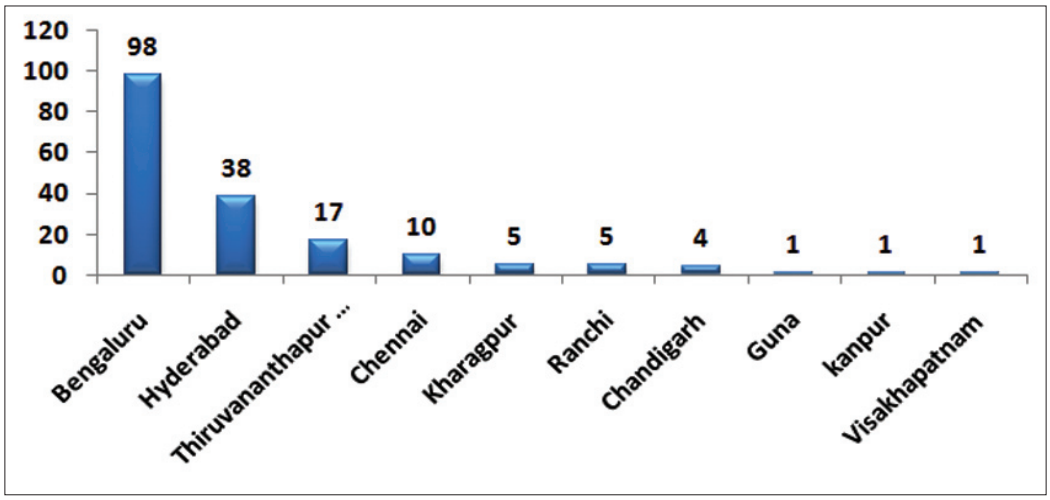


Figure 6. Aerospace testing facilities in India-by place.

The browse facility in ATFI web portal allows user to narrow down search based on specific fields of the ATFI database. It allows the user to search for a term or number within a particular data field of the testing facility or search a limited portion of the ATFI database, rather than the entire summary of every ATFI database. Browse facility is provided in ATFI web portal in exciting ways such as by Place, Organisation, Laboratory, and Test Category. Figure 6 presents the aerospace testing facilities by place in India.

Figure 7 depicts the organisation-wise aerospace testing facilities. Figure 8 presents the category-wise aerospace testing facilities included in this web-portal.

5.4 Search Results

After conducting a search, the ATFI Web portal will display matched search results or 'hit list'. Twenty hits are displayed per page and subsequent results will be displayed in the next page(s). User has to Click on 'Page#1,2,3,4' shown in blue colour and available on top and bottom of each search results page (Fig. 9).

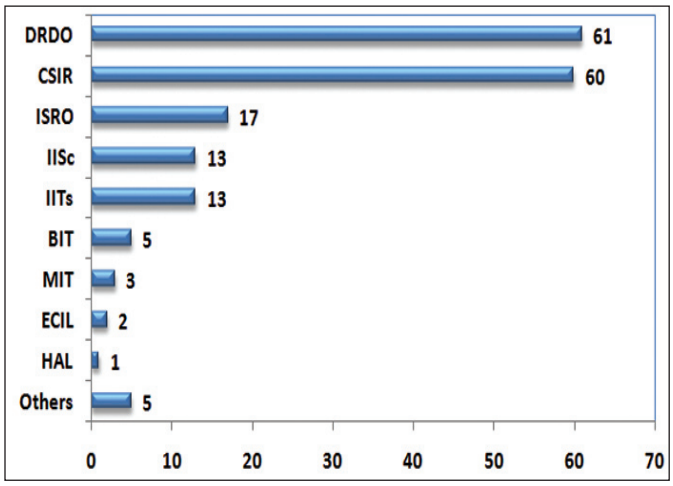


Figure 7. Aerospace testing facilities in India-by organisation.

5.5 Print/Save as PDF/E-mail

The search results page has provisions for print or save as PDF file or email facilities, which are very useful for users and print and save option button has been provided bottom of the search results page. Interestingly, a special user defined customization of results page provision has been embedded, i.e., images or any field may be removed while printing or saving the search results page including change of font face (Fig. 10).

5.6 Video Tutorial

Keeping of respondents' preference and its popularity, online video tutorial has been provided for effective searching, browsing, and salient features in this web portal (Fig. 11).

5.7 Dynamic Index Page

The innovative feature ATFI web portal is dynamic index page (http://atfi.dlis.du.ac.in/ aeroat.php) wherein all the existing aerospace testing facilities and future added testing facilities are indexed automatically in real time and a click away from full details of each aerospace test facility.

5.8 Frequently Asked Questions (FAQ) Page

The 'FAQ is an online document that poses a series of common questions and answers on a specific topic.'[3] The AFTI has a specially designed FAQ page (http://atfi.dlis.du.ac.in/ faq.php) to help the visitors 'as a way to answer questions'[3] about the aerospace testing facilities/ services and improve the access of AFTI web portal-and also save with petty or repetitive phone calls and email from the users.

5.9 Contact and Feedback Form

The most exciting and useful feature of this web portal is the implementation of Feedback Form (http://atfi.dlis.du.ac.in/contact.php) integrated with Contact details. The 'suggestions should be an integral part of the web portal development, especially in the initial stages

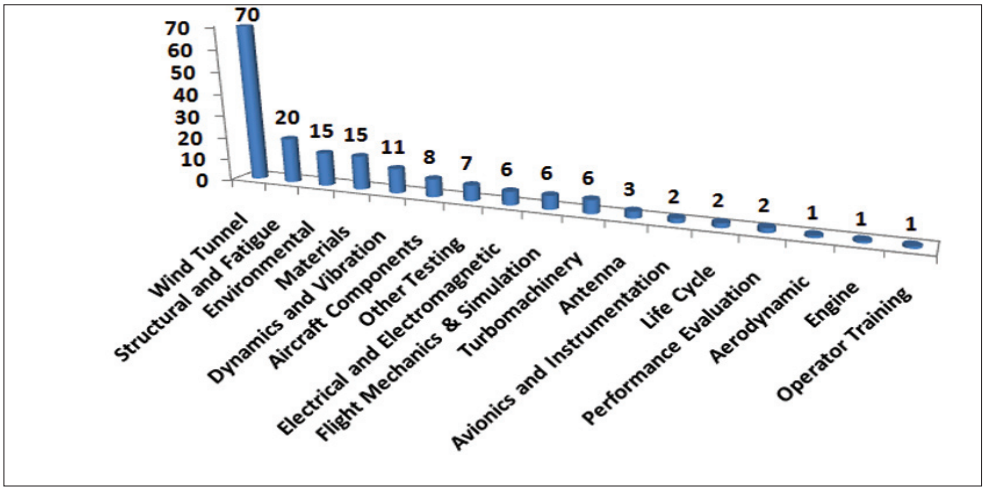


Figure 8. Aerospace testing facilities in India-by category.

Figure 9. Search results on 'DRDO' organisation.

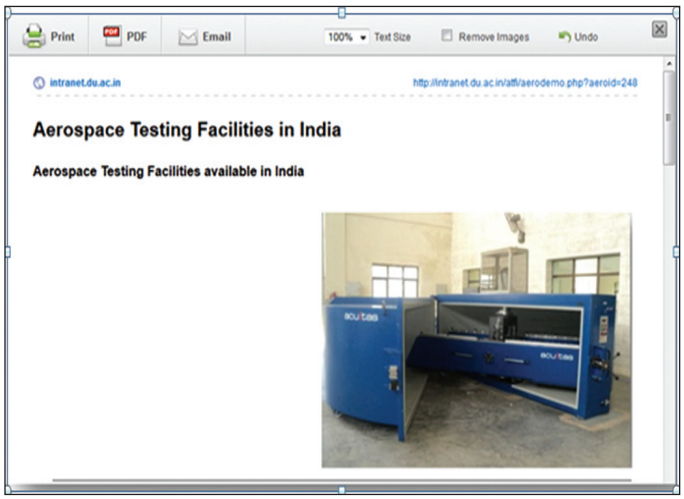


Figure 10. Snapshot of customisation of search results page.

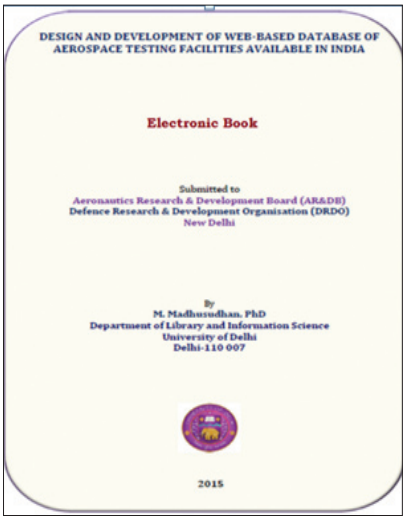


Figure 12. Electronic book facility (http://atfi.dlis.du.ac.in/ATF.php).

Figure 11. Multimedia tutorial page (http://atfi.dlis.du.ac.in/tutorials.php)

as it helps in correcting the design, as the suggestions are the views and reactions of the end users'[4] are to be taken into account for their views, suggestions and comments.

5.10 Electronic Book

The electronic book facility also provided using sophisticated e-book tool as an alternative mode of access for the convenience of users to access all the aerospace testing facilities existing in ATFI web portal (Fig.12).

5.11 Mode of Access

The ATFI web portal was developed using interactive responsiveness (Fig. 13) that makes web portal accessible with: (i) Automatic Customised Display, (ii) Any type of Mobile Device, (iii) Any type of Tab, and (iv) Any size of Desktop.

Figure 13. Snapshot of mobile view with total responsiveness of ATFI web portal (http://www.responsinator.com/?url=http://atfi.dlis.du.ac.in).

5.12 Security Aspects

The ATFI portal has many security features (Fig. 14) to ensure safety of information, such as (i) CAPTCHA, (ii) Email Address, (iii) Mobile Number, (iv) IP Address, and (v) Unique Record ID and Password. Further, it is compatible with OWASP standards (2014) with reference to Web Application Audit (Open Web Application Security Project) and free from any other known vulnerabilities.

6. CONCLUSIONS

'Web-based information systems deliver varied contents to a large number of heterogeneous user groups. The integration between interface and the back-end becomes more complex.'[2] This web-based directory is a compilation of all aerospace testing facilities in India and "ensures to provide a collaborative environment to address all needs of Aerospace industry testing facilities"[1]. It is one of the primary information resource consolidation work and would help in building a knowledge-base of testing facilities in aerospace to all those who are in need. It could be seen as an initial effort towards, taking stock of the availability of testing facilities in aerospace which has to main objectives to bring them to the knowledge of potential users, to enhance their utility and also to supplement building web-based database. It is also a source of online information, for Indian business/entrepreneurs and for overseas organisations who wish to diversify aerospace field, expand their operations, manufacture aircraft items under joint venture/co-operation agreements, collaborate with Indian firms and R&D institutions and relocate their business to take advantage of such opportunities in India. Further, it will enable "to identify specific data requirements needed to quantify the status of the country's technological maturation from which an assessment can be made for research, development and testing of future aerospace vehicles"[1].

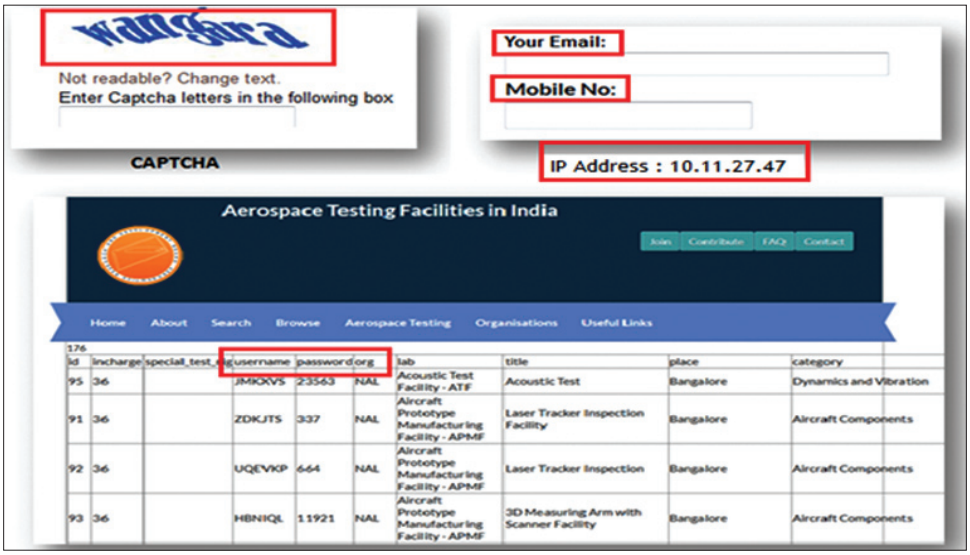


Figure 14. Snapshots of security aspects in ATFI web portal.

The information presented in this web-directory is based on survey conducted by correspondence, on-site visits to all the participating labs/institutions, personal observation of respective web portals and other published literature in conference proceedings and leaflets of various organisations. The contents of the ATFI web portal is beneficial to Aerospace institutions/labs, scientists, faculty members, research scholars, and students. Interestingly, it works automatically and authenticates the user ID and password, no maintenance required, robust web and mobile integrated technologies, user driven facilities (contribute, edit and delete records) are embedded. It is compatible with OWASP standards (2014) and free from any other known vulnerability. The major limitation of the project was the permission issues and non-receipt of some aerospace test images.

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