

“Identification of Interactivity Level and Interactivity Type of a Learning Material”

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ABSTRACT:- The Metadata for educational resources helps to understand the details of learning object used on a website. From the IEEE Learning Object Metadata there are various metadata which we can extract automatically. Still there are metadata like interactivity type, interactivity level and Learning Path for which automatic extraction is not identified. This research paper shows automatic extraction of interactivity type and interactivity level of a webpage. Interactivity type and level will help students to study as per their learning convenience and interest.

KEYWORDS:- Web-based learning, Learning material, e-Learning, Interactivity level, Interactivity type, Learning object, Learning Object Metadata

I. INTRODUCTION

The objective is automatic extraction of interactivity type and interactivity level from a webpage. Interactivity type and interactivity level are educational category metadata describes in IEEE learning object metadata model. Generally webpage have three types of interactivity: 1) Expositive interactivity 2) Active interactivity 3) Mixed interactivity. And three types of interactivity level. 1) Low 2) Medium 3) High. Metadata for educational resources helps to understand the details of learning object used in a website. Each student has different grasping power and has different choices for studying. Same way for teachers, it's difficult to find best suitable material with respect to the students' pre knowledge and interest. Interactivity type and level will be helpful for a students and teachers for finding suitable learning object as per their needs.

Learning Object

A learning object is "a collection of content items, practice items, and assessment items that are combined based on a single learning objective".

Learning objects go by many names, including content objects, chunks, educational objects, information objects, intelligent objects, and knowledge bits, knowledge objects, learning components, media objects, and reusable curriculum components, reusable information objects, and reusable learning objects, testable reusable units of cognition, training components, and units of learning.

Examples of Learning object

The best way to understand what a learning object is, and why they matter, is to look at examples. Following are some examples of learning objects:

- Electronic calculators
- Animations
- Tutorials
- Text entries
- Bibliographies
- Audio clips
- Video clips
- Quizzes
- Photographs
- Illustrations
- Diagrams
- Graphs and charts
- Maps
- Assessments

Learning Object Metadata

Metadata is data that describes other data. It summarizes basic information about data, which can make finding and working with particular instances of data easier.

Learning Object Metadata (LOM) is a metadata standard to describe educational resources. LOM is a data model, usually encoded in XML, used to describe a learning object and similar digital resources used to support learning. It is nothing but a description of a learning object.

Metadata standards

It is recommended that the learning objects should be associated with some common metadata standard.

Some metadata standards are listed below:

- IEEE LOM, <http://ltsc.ieee.org/wg12/index.html>
- DCMI, <http://dublincore.org/>
- IMS, <http://www.imsglobal.org/>
- SCORM, <http://www.adlnet.gov/scorm/index.cfm>
- CanCore, <http://www.cancore.ca/>
- ADL, <http://www.adlnet.org>

We are going to focus on IEEE LOM.

IEEE Schematic representation of the hierarchy of elements in the LOM data model

The LOM comprises a hierarchy of elements shown in figure. At the first level there are nine categories, each of which contains sub-elements; these sub-elements may be simple elements that hold data, or may themselves be aggregate elements, which contain further sub-elements. The semantics of an element are determined by its context: they are affected by the parent or container element in the hierarchy and by other elements in the same container.

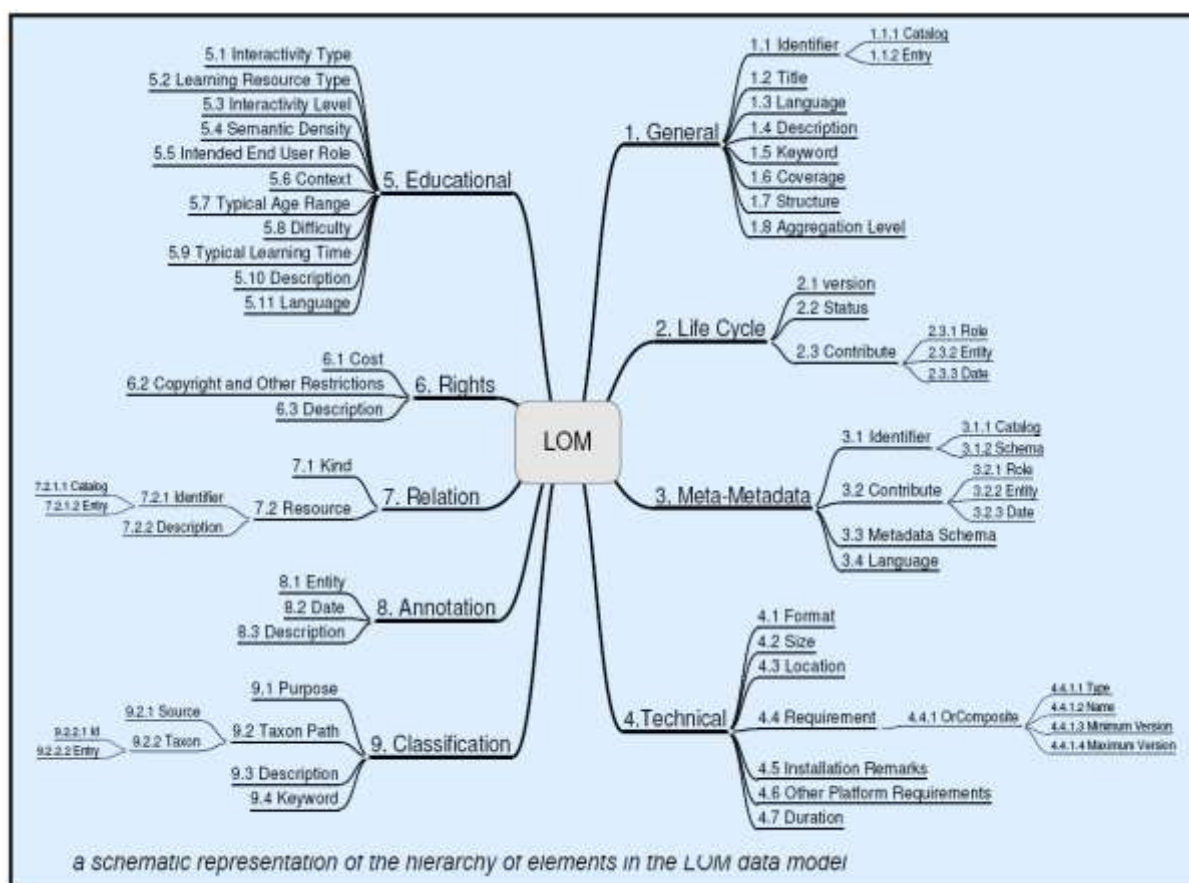


Fig.1: IEEE Schematic representation of the hierarchy of elements in the LOM data model

Categories of metadata

There are nine categories of IEEE LOM. They are described below.

Table I: Categories of IEEE LOM

Metadata category	Description of contents
1. General	Descriptive information of the learning object as a whole, such as: identifier, title, language, description, keyword, coverage, structure, aggregation level.
2. Life-cycle	Elements related to the creation or revision history of the learning object as well as information about those who have contributed to the development, creation, revision of the learning object.
3. Meta-metadata	Information regarding the creation of the metadata record.
4. Technical	The category consists of elements that describe the technical characteristics of the learning object such as the format, size, location and technical requirements.
5. Educational	The educational category aggregates elements regarding pedagogical and educational information about the use of a learning object. Such elements include: Interactivity type, Learning resource type, Interactivity level, Semantic density, Audience or Intended end user role, Context, Typical age range, Difficulty, Typical learning time, Description, Language.
6. Rights	The rights category includes information regarding the intellectual property rights and conditions of use of the learning object.
7. Relation	The relation category presents information about the relationship of the described learning object with other objects.
8. Annotation	The annotation category provides a comment regarding the use of learning objects.
9. Classification	The classification category classifies the content of the learning object based on an appropriate classification system.

We are going to focus on education category of LOM. It is discussed in the next topic.

Elements of learning object metadata of education category

There are following elements of learning object metadata of education category.

Table II: Elements of LOM of education category

Element	Description
Interactivity Type (IEEE 1484.12.1-2002)	<ul style="list-style-type: none"> • Active: Active learning (e.g., learning by doing) is supported by content that directly induces productive action by the learner. • Expositive: Expositive learning (e.g., passive learning) occurs when the learner's job mainly consists of absorbing the content exposed to them. • Mixed: A blend of active and expositive interactivity types.
Learning Resource Type (IEEE best practice)	exercise, simulation, questionnaire, diagram, figure, graph, index, slide, table, narrative text, exam, experiment, problem statement, self assessment, lecture
Interactivity Level (IEEE 1484.12.1-2002 but meaningful only in community practice)	very low, low, medium, high, very high
Semantic Density (IEEE 1484.12.1-2002 but meaningful only in community practice)	very low, low, medium, high, very high
Intended End User Role (IEEE 1484.12.1-2002)	<ul style="list-style-type: none"> • Teacher • student • author • learner • Manager

Context (IEEE 1484.12.1-2002)	<ul style="list-style-type: none"> • School • higher education • training • Other
Typical Age Range	(range)
Difficulty (IEEE 1484.12.1-2002 but meaningful only in a context of a community)	<ul style="list-style-type: none"> • very easy • easy • medium • difficult • very difficult
Typical learning time	open text element
Description	open text element
Language	standardized def.

II. PROBLEM STATEMENT

Millions of E-learning websites and learning materials are available on a world wide web. It becomes a very tedious task for e-learners to find proper suitable website or learning materials from all the options available. The metadata holding content data such as authors, titles, subject, keywords, granularity are already extracted. It is required to know the interactivity type and level of webpage to minimize the learning time of e-learner.

III. PROPOSED MODEL

E Learning interactivity is defined as the “dialogue” between learners and eLearning tools through which learners become engaged and involved in the eLearning process. It is a key element of the actual eLearning course design process, and it has proven to be a practice that adds outstanding value to your eLearning course. It involves forms of action or reaction on learners’ behalf, in order for them to achieve results or reach a conclusion. eLearning interactions may include multiple choice quizzes, tests, eLearning scenarios, simulations, animation videos etc, that help learners to deepen their understanding of the subject matter through experimentation, dealing with unpredicted circumstances, or even learning from their mistakes.

The eLearning Interactivity Type& Level:

The eLearning interactivity types are defined based on the extent of interactivity in the eLearning process. With this in mind, there are Three main eLearning interactivity Types:

- **Active:** Active learning (e.g., learning by doing) is supported by content that directly induces productive action by the learner. Learners have great control over their eLearning experience, as they are required to fully interact with the eLearning content and give feedback. This level may include: interactive games, simulated job performance exercises, customized audio or videos, avatars, stories and scenarios, as well as multimedia. Interactivity level of active e-learning is generally high.
- **Expositive (Passive):** Expositive learning (e.g., passive learning) occurs when the learner's job mainly consists of absorbing the content exposed to them. Learners are not required to interact with eLearning resources and the eLearning process is strictly linear. This level may include: simple images and graphics, simple video and audio, test questions, etc. Interactivity level of Expositive e-learning is generally Low.
- **Mixed:** A blend of active and expositive interactivity types. Learners may have some control over their eLearning experience, as they are required to make simple interactions with the eLearning material. This level may include: animations, clickable menus, drag and drop interactions, and multimedia. Interactivity level of mixed e-learning is generally moderate.

Proposed Model

Fig.3 is showing proposed model used for finding interactivity of a webpage available on a world wide web. Input of our proposed model is URL of a webpage for which we will get its interactivity type and level as an output.

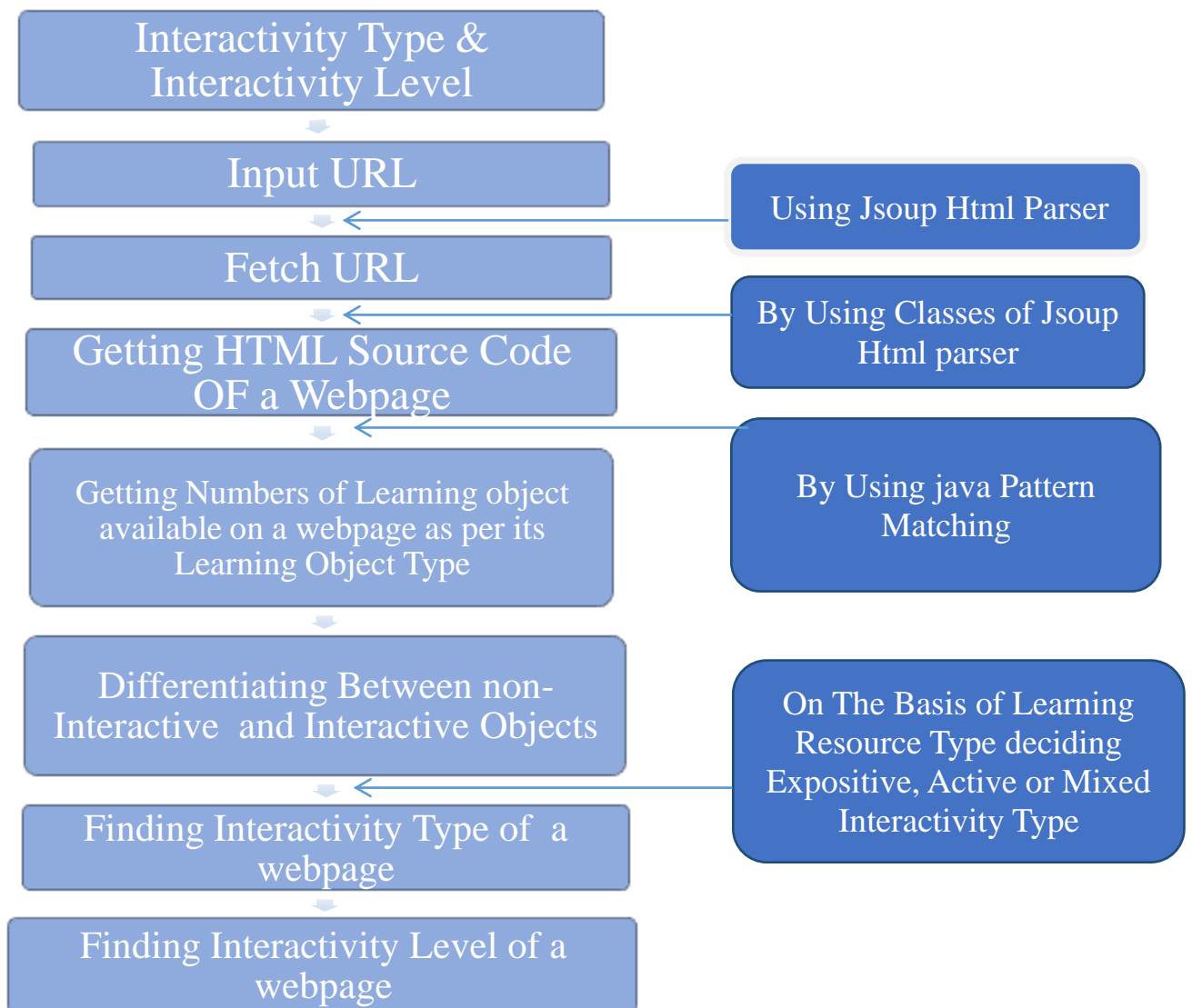


Fig.3: Proposed Model for finding interactivity type and interactivity level

Model Description

As shown in a figure, finding an interactivity type of a webpage is seven step processes.

Step1: For finding interactivity type of webpage. We have taken URL of a page as an input for which we want result. We have taken WebPages which are using http or https protocol.

Step 2: URL contains link of the webpage. jsoup’s “connect” class helps to fetch that URL.

Step 3: Each webpage has source code. Using jsoup’s “html parser”, we got source code of the fetched URL.

Step 4: Using Java pattern matcher, we have found learning objects available in a webpage using objects’ extensions.

For example, it will help us to identify images with .png extension, images with .jpg extension etc. Using this, we can find out total numbers of images available on a webpage.

Step 5: After getting all the objects available in a webpage, we have differentiated between non-interactive and interactive learning objects and make a count of it. We consider learning objects type to decide its interactivity type and level.

Table III: Interactivity by learning resource type

Learning Resource Type	Interactivity Type	Interactivity Level
TABLE	MIXED	MEDIUM
TEXT	EXPOSITIVE	VERY LOW
SLIDE	EXPOSITIVE	LOW
SIMULATION	ACTIVE	VERY HIGH
AUDIO LECTURE	EXPOSITIVE	VERY LOW
VEDIO LECTURE	EXPOSITIVE	LOW
FIGURE	EXPOSITIVE	VERY LOW
CONFERENCE LECTURE	MIXED	MEDIUM
GRAPHICS/DIAGRAM	EXPOSITIVE	VERY LOW

Step 6: Once we got numbers of total learning objects, non-interactive learning objects and interactive learning objects available on a webpage we can decide interactivity type of a webpage.

Step 7: After deciding the interactivity type of a website, we can know whether webpage is less interactive or more interactive. This way interactivity level can be found out.

IV. EXPERIMENTS CONDUCTED

To analyze our model, we have taken different WebPages as an input and we have analyzed results.

List of WebPages

Table IV shows list of WebPages. We have tested and we got interactivity type and level for those WebPages.

Table IV: List of WebPages

Sr No	Webpage	Non Interactive Object	Interactive Objects	Interactivity Type	Interactivity Level
1	http://home.ku.edu.tr/~daksen/mgis410/downloadsClassNotes.html	105	6	Active	High
2	http://home.ku.edu.tr/~daksen/mgis410/downloadsMiscellaneousFiles.html	46	0	Expositive	Low
3	http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-660j-introduction-to-lean-six-sigma-methods-january-iap-2012/lecture-videos/lean-thinking-part-1/	21	1	Expositive	Low
4	http://ocw.mit.edu/courses/biology/7-013-introductory-biology-spring-2006/audio-lectures/3-biochemistry-1/	22	3	Expositive	Low
5	http://www.animations.physics.unsw.edu.au/	5	0	Expositive	Low
6	http://faraday.physics.utoronto.ca/IYearLab/Intros/StandingWaves/Flash/reflect.html	1	3	Expositive	Low
7	http://www.eummena.org/index.php/map.html	7	0	Expositive	Low
8	http://www.learnerstv.com/presentation/presentationcategory.php?cat=Medical	64	2	Expositive	Low
9	http://web2.0calc.com/	5	22	Active	High
10	http://www.math-tests.com/Factors-Test/factors-test.html	2	3	Expositive	Low
11	http://www.tutorialspoint.com/java/java_online_quiz.htm	7	13	Active	High
12	http://partsim.com/simulator	10	13	Active	High

13	http://www.online-calculator.com/	5	5	Mixed	Moderate
14	http://www.indiabix.com/online-test/general-knowledge-test/82	13	87	Active	High
15	http://www.onlinequizportal.com/play_now_mode/Challenge.html	11	1	Expositive	Low
16	http://www.webmath.com/nsolve.html	18	16	Active	High
17	https://www.univie.ac.at/moe/onlinewerkzeuge.html	31	13	Active	High
18	https://msdn.microsoft.com/en-us/library/ms524741(v=vs.90).aspx	25	4	Expositive	Low
19	http://www.phdcc.com/dynamic-cd/dvdoc/aspdoc.asp	6	6	Mixed	Moderate
20	http://php.net/manual/en/features.commandline.options.php	13	2	Expositive	Low
21	http://www.theworld.com/web/help/dynamic-pages.shtml	11	0	Expositive	Low

V. RESULT ANALYSIS

We have tested interactivity type and level of many WebPages. Some of those are shown in following figures.

- <http://www.theworld.com/web/help/dynamic-pages.shtml>
We have taken this URL as an input and we have found that this webpage has total 11 objects. In which, there are 11 less interactive objects and there are none interactive objects. So the interactivity type of a webpage is Expositive and its interactivity level is Low.

```

C:\Program Files\Microsoft Windows\WinSxS\x-wwww.exe (14-11)
Enter URL => http://www.theworld.com/web/help/dynamic-pages.shtml
page contains 0 .ppt object
page contains 7 .doc object
page contains 0 .pdf object
page contains 0 xls object
page contains 0 .mp3 object
page contains 0 .mp4 object
page contains 4 .avi object
page contains 0 .swf object
page contains 0 timer object
page contains 0 type="text" object
page contains 0 type="textarea" object
page contains 0 type="password" object
page contains 0 type="submit" object
page contains 0 type="radio" object
page contains 0 type="checkbox" object
page contains 0 type="button" object
page contains 0 type="date" object
page contains 0 type="color" object
page contains 0 type="range" object
page contains 0 type="month" object
page contains 0 type="week" object
page contains 0 type="time" object
page contains 0 type="datetime" object
page contains 0 type="email" object
page contains 0 type="search" object
page contains 0 type="url" object
total objects on a page:11
less Interactive Objects on a page:11
Interactive Objects on a page:0
Interactivity Type:Expositive
Interactivity Level:Low
    
```

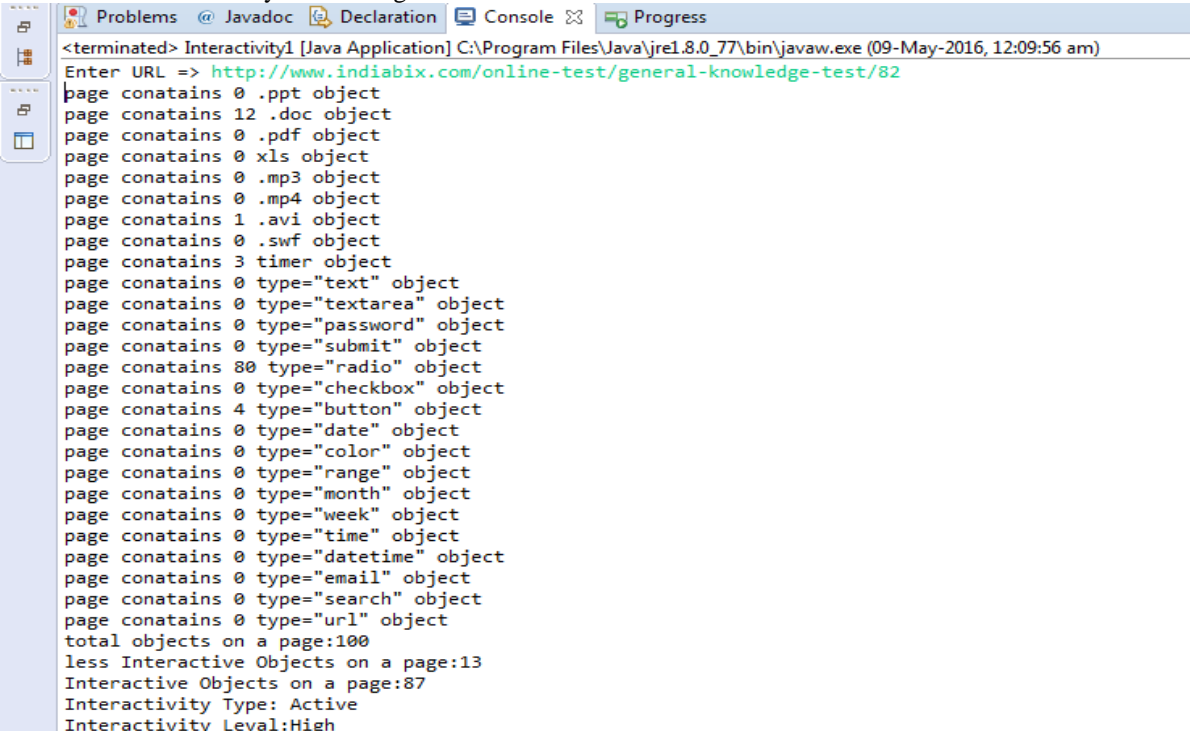
Fig.4: The Webpage which has Expositive Interactivity type and Low Interactivity level

- <http://www.phdcc.com/dynamic-cd/dvdoc/aspdoc.asp>
We have taken this URL as an input and we have found that this webpage has total 12 objects. In which, there are 6 less interactive objects and there are 6 interactive objects. So the interactivity type of a webpage is Mixed and its interactivity level is Moderate.

```
Enter URL => http://www.phdcc.com/dynamic-cd/dcddoc/aspdoc.asp
page conatains 0 .ppt object
page conatains 5 .doc object
page conatains 0 .pdf object
page conatains 0 xls object
page conatains 0 .mp3 object
page conatains 0 .mp4 object
page conatains 1 .avi object
page conatains 0 .swf object
page conatains 0 timer object
page conatains 3 type="text" object
page conatains 0 type="textarea" object
page conatains 0 type="password" object
page conatains 3 type="submit" object
page conatains 0 type="radio" object
page conatains 0 type="checkbox" object
page conatains 0 type="button" object
page conatains 0 type="date" object
page conatains 0 type="color" object
page conatains 0 type="range" object
page conatains 0 type="month" object
page conatains 0 type="week" object
page conatains 0 type="time" object
page conatains 0 type="datetime" object
page conatains 0 type="email" object
page conatains 0 type="search" object
page conatains 0 type="url" object
total objects on a page:12
less Interactive Objects on a page:6
Interactive Objects on a page:6
Interactivity Type: Mixed
Interactivity Level:Moderate
```

Fig.5: The Webpage which has Mixed Interactivity type and Moderate Interactivity level

- <http://www.indiabix.com/online-test/general-knowledge-test/82>
We have taken this URL as an input and we have found that this webpage has total 100 objects. In which, there are 13 less interactive objects and there are 87 interactive objects. So the interactivity type of a webpage is Active and its interactivity level is High.



```
<terminated> Interactivity1 [Java Application] C:\Program Files\Java\jre1.8.0_77\bin\javaw.exe (09-May-2016, 12:09:56 am)
Enter URL => http://www.indiabix.com/online-test/general-knowledge-test/82
page conatains 0 .ppt object
page conatains 12 .doc object
page conatains 0 .pdf object
page conatains 0 xls object
page conatains 0 .mp3 object
page conatains 0 .mp4 object
page conatains 1 .avi object
page conatains 0 .swf object
page conatains 3 timer object
page conatains 0 type="text" object
page conatains 0 type="textarea" object
page conatains 0 type="password" object
page conatains 0 type="submit" object
page conatains 80 type="radio" object
page conatains 0 type="checkbox" object
page conatains 4 type="button" object
page conatains 0 type="date" object
page conatains 0 type="color" object
page conatains 0 type="range" object
page conatains 0 type="month" object
page conatains 0 type="week" object
page conatains 0 type="time" object
page conatains 0 type="datetime" object
page conatains 0 type="email" object
page conatains 0 type="search" object
page conatains 0 type="url" object
total objects on a page:100
less Interactive Objects on a page:13
Interactive Objects on a page:87
Interactivity Type: Active
Interactivity Level:High
```

Fig.6: The Webpage which has Active Interactivity type and High Interactivity level

VI. CONCLUSION

In this research, we have differentiated non interactive and interactive objects available on a webpage and as per these we have extracted interactivity type and level of a webpage.

VII. FUTURE SCOPE

For finding Interactivity type we have taken WebPages which are using http or https protocol as an input. Further work can be done for parsing WebPages, which are using protocols other protocols. We have taken only WebPages and found the interactivity type and level of that WebPages. More work can also be done by taking whole website as an input and interactivity type and level of a website can be find out.

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