**A Novel Approach for Implementing WebSocket Protocol in E-Learning**

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***ABSTRACT***

***WebSocket protocol is a two way (bi-directional) communication protocol over single TCP connection which provide handshake by long-polling method, interpreted by HTTP servers and it allows interaction between a browser and a website (server) to pass messages back and forth while the connection remaining open. In this paper, we highlighted the implementation of WebSocket protocol in e-learning and smart-classes. At present e-learning has become the most highlighted topic by using WebSocket protocol and other technologies like mean Stack, we can provide simultaneous access to what students are learning in classes just a click away.***

***Keywords***

***WebSocket Protocol, ws & wss, E-learning, Long Polling, HTTP, Smart Class***

# INTRODUCTION

The WebSocket Protocol enables two-way communication between clients to a remote host server. The protocol consists of an opening hand shake followed by basic message framing, layered over TCP [3]. The goal of this technology is to provide a mechanism for browser-based applications that need two-way communication with servers that does not rely on opening multiple HTTP connections. The WebSocket protocol was standardized by the IETF as RFC 6455 in 2011[2].

It can be used by any client or server application. The WebSocket Protocol is an independent TCP-based protocol. Its only relationship to HTTP is that its handshake is interpreted by HTTP servers as an Upgrade request [4].

So, WebSocket protocol can be used in e-learning based applications as this technology will be able to give access to the content simultaneously by pushing it from the server to all the devices that are connected over that network. Learners can get instant demonstration of the material that they are trying to grasp by just connected themselves to the host server.

E-learning allows us to learn anywhere and usually at any time, as long as you have properly configured devices that have network connectivity.

# HISTORY

# Before full-duplex communication was attained by using Comet channels through port 80 of HTTP. But this method is difficult to implement as well as it is inefficient for small messages because of TCP handshake and HTTP header overhead. Use of HTTP and other protocols results in problems like [2, 3]:

# For each client, server was forced to use different number of TCP connections, the first one for sending information to client and each time for incoming message, a new connection was created.

# Each client-to-server message carries HTTP header which results in high overhead of wire protocol.

# And client-side script is compelled is to maintain mapping between outgoing and incoming connections to track replies.

# A simpler solution is to use TCP connection for traffic in both directions that is what Web Socket protocol provides which aims to solve these problems without compromising security assumptions of the web. It is combined with WebSocket API, and it provides an alternative to HTTP polling for two-way communication from client browser to remote-place.

# WEBSOCKET PROTOCOL AND E-LEARNING

The WebSocket protocol facilitates live-content and the development of various real time applications. This is done by facilitating a standardized way to send content from server to the browser without being solicited by the client and allowing back and forth message passing while keeping the connection open. In this way bi- directional conversation can take place between a browser-server.

The communications are done over port number 80 (TCP) [2], this provides the benefit for those environments which block non web Internet contents using a firewall. This allows web socket protocol to be used on every browser like Chrome, IE, Mozilla Firefox, Opera and Safari. The protocol has no overhead compared to HTTP. This protocol defines two new URI schemes, *ws* and *wss*, for un-encrypted and encrypted connections, respectively. The *ws* (Web-Socket) URI scheme is similar to the HTTP URI scheme and use TCP/IP without encryption. The *wss* (Web-Socket-Secure) URI scheme identifies protected traffic over that connection via Transport Layer Security (TLS). The TLS connection provides data confidentiality, integrity, and endpoint authentication over TCP connection.

HTML5 combined with WebSocket protocol brings a new level to real time communication in web-browser. On the daily basis new products are evolving to stay connect permanently to web. And all this is possible because of WebSocket technology. It is replacing other older browsers-server communication technologies [17].

E-learning can be CD-ROM, Network, Intranet or Internet based. It can be a very rich learning experience that includes audio, video, virtual environments and animations and enhance the level of training which is better than what you might experience in a crowded classroom.

E-Learning is very visible and it provides a better learning experience that other traditional methods and by the use WebSocket protocol students can access the live demonstration of the lessons on their electronic devices like Tablet, Computer, Mobile, etc [10].

E-learning has blossomed over the recent years and has become a most popular method of learning. E-learning allows us to learn from anywhere and at anytime from a properly configured Personal computer or Cell phones.

*Smart classroom is an application of E-Learning*,Smart class is an advanced technology implementation for schools, which provides learning tools using latest media presentations like *Rich multi-media*material for student learning, *3D and 2D multimedia*modules and this make learning more *interactive* and *interesting* [9].

# IMPLEMENTATION OF WEBSOCKET PROTOCOL

# According to Internet Engineering Task Force (IETF) standard document, WebSocket protocol is used to provide a process for web applications that need twoway communications. WebSocket does not use HTTP hacks or open multiple connection by using <*iframe*> or *XMLHttpRequest* and long-polling. The simple steps to establish and use WebSocket protocol are:

* A socket-connection is established between the client & server using HTTP for the initial handshake.
* Jump from HTTP to a socket-based protocol.
* Communicate through bi-directional messages (send messages back-and-forth).
* Independently message are sent because it is not based on request-response model
* Both sides can initiate the data-transmission that enables the real server-side push and disconnects whenever they want.

1. *Protocol Handshake[2]*

The initial step is similar to HTTP request-response as described in above checkpoints so that servers allow HTTP as well as WebSocket connections on the same port, to establish a WebSocket connection firstly client sends a Web-socket handshake request for which the server reply by a WebSocket handshake response, as shown below:

*Client request:*

GET /chat HTTP/1.1

Host: server.example.com

Upgrade: websocket

Connection: Upgrade

Sec-WebSocket-Key: x4JRIGbJI1EzLkh9GBhBVw==

Sec-WebSocket-Protocol: chat, superchat

Sec-WebSocket-Version: 13

Origin: <http://example.com>

*Server response:*

HTTP/1.1 101 Switching Protocols

Upgrade: websocket

Connection: Upgrade

Sec-WebSocket-Accept: HSmrc0sMlYUkAGmm5OPpG2HaGWk=

Sec-WebSocket-Protocol: chat

Now here HTTP connection is replaced by WebSocket connection over the TCP/IP connection. Websocket uses same ports 80 and 443 (HTTPS) by default.

1. **OUR PROPOSED IDEA**

In this paper, we have proposed to use *WebSocket protocol in E-learning technology*. Learners (students) can get simultaneous access to the digital data like videos, lecture presentations by creating a WebSocket two-way communication network between the teacher’s system and their system. So that they can grasp the topic better and have a good interaction with the guide or teacher. As well as learners can clarify the topic on the spot. Therefore we can implement WebSocket protocol in *SMART* classes as a whole we can apply this networking protocol to enhance our quality of Learning.

1. **ADVANTAGES AND APPLICATIONS OF WEBSOCKET PROTOCOL**
2. *Various advantages of WebSocket Protocol are[1, 5]:*

* No HTTP header overhead thus performance increased
* Faster access/Direct Access to resources
* *Uses Full-Duplex Communication Model for the web:* WebSocket provides communication between the client and server on both directions simultaneously. WebSockets can be used where long-term, two-way communication is required.
* *Push model-* this model is based on publish-subscribe-distribute paradigm. It allows administrators to conserve network bandwidth and CPU-time on the management station.
* ***TLS (Transport Layer Security)-I***t is more secure version of SSL.
* *Easy to use API:*TheWebSocket API is simple and requires very less code. WebSocket promote App Development as it saves time, saves money and saves money. By using this protocol faster online games, real time displays of stock, instant social network notifications and weather information etc., can be developed.
* *WebSocket are faster than HTTP:*The currently used HTTP protocol is slow as browser and must request documents from a server and wait until the server sent a web-page to display. Using WebSocket, we can send and receive our data simultaneously using text, binary-arrays or blobs.
* *WebSocket saves bandwidth* because request to the server is not sent to receive information [13].
* WebSocket is used for developing *WebRTC*–based applications. *WebRTC* is used to create applications that do browser-2-browser interactions and WebSocket is a good protocol used for this [13].

1. *WebSocket has various applications as follows [6]-*

* Live trading and sports notifications
* Live-collaborative-writing
* Medical equipment controlling over the Web
* Chat-application
* Online-games with multiplayer feature
* Real-time social streaming

1. **ADVANTAGES OF E-LEARNING [1, 8]**

* *Scalable and Efficient*
* *Lower costs*[7]
* *More effective learning*[7]
* *Capacity and Consistency -* E-learning targets a large number of audiences. Any number of Learners can take benefit from the same lecture.
* *Higher Learning Retention –*E**-**learning has high retention-rate and has various learning styles. We can also refresh or update the coursework according to our convenience.
* *E-learning saves time and money -* This includes reduction in the amount of time and expense in student travel and it is convenient. It reduces the cost incurred in regular classroom training.
* *E-learning is faster -* E-learning delivers very fast as compared to the older way of classroom-based training. Graphics representations such as line drawings, charts, photographs, animations and videos can boost learning [7].
* *Mobile-* E-learning can be done on various electronic devices like laptops, ipads or iphones. E-learning provides mobile learning and it can be accessed anywhere whether we are on the train or on a plane where there is a network connection.
* E-learning helps in building self-knowledge and self-confidence as student feels confident after successfullycompleting online or computer-based courses.
* E-learning can accommodate different learning styles and supports learning with a variety of media.
* E-learning helps in saving trees through saving paper. E-learning provides online content and provides alternatives to paper through tools like email, PDF manuals, synchronous classrooms etc [11, 12].

1. **RECOMMENDED TECHNOLOGIES FOR IMPLEMENTATION OF WEB SOCKET IN E-LEARNING**
2. *MongoDB database*: It is an open-source document database that provides high performance, high availability, and automatic scaling. And it can be act as the Back end of proposed Application’s implementation.

A record in MongoDB is a document, which is a data structure composed of field and value pairs. MongoDB documents are similar to JSON objects. The values of fields may include other documents, arrays, and arrays of documents. The advantages of using documents are:

* + - Documents (i.e. objects) correspond to native data types in many programming languages.
    - Embedded documents and arrays reduce need for expensive joins.
    - Dynamic schema supports fluent polymorphism.

1. *HTML5 WebSockets:*  WebSocket is sometimes called as HTML5 WebSocket API, although both are used independently and have different specifications [18]. The HTML5 WebSockets specification defines an API that enables web pages to use the WebSockets protocol for two-way communication with a remote host [16]. ***WebSocket*** is an evolving project that is part of the new HTML5 set of standards for web communication. HTML5 Security Cheat Sheet defines the web application deployment using WebSockets [19]. From a purely client side perspective any application written for HTML5/WebSocket can be ported on any platform that runs an HTML5 compliant browser (e.g. computers with different OS, tablets and Smartphone) [14].
2. **LIMITATION OF OUR PROPOSED IDEA**

As we are using WebSocket protocol it has some disadvantages like [5]:

1. The applications that are viewed in old browsers that do not stick up for HTML5, those browsers are unable to use WebSockets. Browser must be fully HTML5 compatible to use WebSockets.
2. WebSockets do not use caching.

Also our application will require high speed internet connection because it will perform simultaneous access of content to learners’ devices.

# FUTURE SCOPE

E learning has rapidly evolved from a thing of the future to a practical approach towards education. With the rise of virtual reality technology and augment reality solutions, experimental subjects, skill-based learning and military training will come to depend more heavily on e-learning solutions. Various education technology providers are also hinting towards the rise of mobile learning solutions (also known as mlearning) as the advanced stage of education technology in future. Government has taken many initiatives to bloom e-learning. The vast growth of technologies has led to more and more elearning based programmes which would increase overall Future Growth of 17.4% over the period FY2013-FY’2018[15]. As more people adopting e-learning this will lead to increasing the overall growth of world’s e-learning market in future. Various Schools and institutes are shifting towards smart classes and e-learning concept as it enhances the mental growth of students.

1. **CONCLUSION**

This Paper defines about meaning of E-learning and WebSocket protocol and also describes implementation and advantages of WebSocket protocol. In this paper we have presented an idea of implementing WebSocket protocol in E-learning and recommended some technologies to implement this thought. The evolution of WebSocket protocol marks the starting journey of Living real web. It is the major upgrade in web-communication history. It gives us chance to devise new products based on this which will stay permanently live (connected) to the web. [17] As WebSockets provide full-duplex communication thus this can be used in e-learning to increase the quality of learning. By this learners’ can get simultaneous access to the material so that they can get topic at higher pace. Students can able to maintain higher concentration as well as enjoy the class too. Also Students can maintain a copy of the same in any media like pdf, ppt, docx, audio, video, etc. The e-Learning has several competitive blessings during a variety of areas like accessibility, flexibility, technology and convenience. However, academic sources on-line have utterly revolutionized the approach towards tutorial education in class and school. Dependency on the net based mostly learning has tremendously increased in recent years.

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