Evolution of World Wide Web: Journey From Web 1.0 to Web 4.0

Article · March 2015

2 authors, including:

Bijoy Chhetri
Centre for Computers and Communication Technology (CCCT)
10 PUBLICATIONS **91** CITATIONS

Some of the authors of this publication are also working on these related projects:

Community College Implementation View project

2021 publications View project

Evolution of World Wide Web: Journey From Web 1.0 to Web 4.0

[1]**Pranay Kujur,** [2]**Bijoy Chhetri**

[1,2]Dept. of Computer Science and Engg. Sikkim Manipal Institute of Technology, India

Abstract

The fast lane toward the development of Web is coined to be as an outright phenomenon in the today's society with incorporated use of modern innovative technology and redefining the way of organizing, communicating and collaborating with individual which in terms lead us to mixture of spectacular successes and failures. The purpose of this paper is to understand and conceptualize the evolution of Web from the scratch to the upcoming trends in the field of Web Technology.

Keywords

Web 1.0, Web 2.0, Web 3.0, Web 4.0, characteristics, Limitation, Architecture.

I. Introduction

In today's era Web Technology can be easily defined by the user in different descriptive way. But matter in fact many user are quite unknown to the information that from where the WWW was coined first. As this paper state the evolution of Web so it is important to initiate the story from the beginning where it was stated first.

Web was introduced by Tim Burners-Lee inlate 1989 [9-10]. He view of the capabilities of the World Wide Web was expressed by three innovations, typically associated with three phases: namely, the Web of documents (Web 1.0), the Webof people (Web 2.0) and the Web of data (the still-to-be-realisedWeb 3.0) [11].Through its life cycle, the World Wide Web has been through various phases of development. Going by the trend of constantevolution, the Web is now slowly but surely transiting to more data centric phase in the context of Web version 3.0 [7].

This paper is structured in such a way that, classifying obtaining nature of Web 1.0 and projecting prospective characteristics of Web 2.0with added different dimensions of the Web 3.0 semantic frameworks, whilst its scope is directed to explore a stronger appreciation into architectural foundations of the next generation of Web 4.0 of Web applications. This paper would attempt to build a user centric view of the composition of featuresthatwould be expected to be incorporated in future generations of Web technology. In sum, the paperpresents a holistic view of the World Wide Web.

II. World Wide Web

The World Wide Web is a system of interlinked hypertext documents accessed via the Internet [21]. With a web browser, one can view web pages thatmay contain text, images, videos, andother multimedia and navigate between them via hyperlinks.On March 12, 1989,Tim Berners- Lee, a British computer scientist and former CERN employee, wrote aproposal for what would eventually become the World Wide Web [1]. The 1989 proposal was meant for a more effective CERN communication system but Berners- Lee eventually realised the concept could be implementedthroughout the world.Berners- Lee and Belgian computer scientist Robert Cailliau proposed in 1990 to use hypertext "to link and access information of various kinds as a web of nodes in which the user can browse atwill" [22]. In these ways the first web service was designed and tested and latterly confined as Word Wide Web.

III. Web 1.0

Web 1.0 was first implementation of the web and it lasted from 1989 to 2005. It was define as web of information connections. According to the innovator of World Wide Web, Tim Berners-Lee considers the Web as "read-only" Web [1]. It provides very little interaction where consumer can exchange the information together but it was not possible to interact with the website. The role of the web was very passive in nature.

Web 1.0 was referred as the first generation of World Wide Web which was basically defined as

"It is an information space in which the items of interest referred to as resources are identified by global identifier called as Uniform Resources Identifiers (URIs)".

First generation Web was era static pagesand content delivery purpose only. In other words, the

early web allowed us to search for information and read it. There was very little in the way of user interaction or content contribution.

A. Charateristics

Web 1.0 Technologies includes core web protocols: HTML, HTTP and URI. The major characteristics of Web 1.0 are as follow:
1. They have read only content.
2. Establish an online presence and make their information available to anyone at any time.
3. It includes static web pages and use basic Hypertext Mark-up Language.

B. Limitation

The major limitations of Web 1.0 are as follow:
1. The Web 1.0 pages can only be understood by humans (web readers) they do not have machine compatible content.
2. The web master is solely responsible for updating users and managing the content of website.
3. Lack of Dynamic representation i.e., to acquire only static information, no web console were available to performing dynamic events.

IV. Web 2.0

Web 2.0 is the second generation of web. It was defined by Dale Dougherty in 2004 as a read-write web [1].The concept began with a conference brainstorming session between O'Reillyand Media live International. The technologies ofweb 2.0 allow assembling and managing large global crowds with common interests in social interactions.

Tim O'Reilly defines web 2.0 on his websiteas follows [8]: "Web 2.0 is the business revolution in the computer industry caused by the move to the internet as platform, and an attempt to understand the rules for success on that new platform. Chief among those rules is this: Build applications that harness network effects to get better the more people use them."

Web 2.0 facilitates major properties like participatory, collaborative, and distributed practices which enable formal and in-formal spheres ofdaily activities on going on web. In other terms it resemble major distinct characteristics of Web 2.0

include "relationship" technologies, participatory media and a social digital technology which in term can also defined as the wisdom web. People-centric web and participative web is taken into concern and which facilities readingand writing on the web which makes the web transaction bi-directional.

Web 2.0 is a web as a platform where users can leave many of thecontrols they have used in web 2.0. In other words, the user of web2.0 has more interaction with less control. Web 2.0 is not only a new version of web 1.0 but it also implies to flexible web design, creative reuse, updates, collaborative content creation and modification in web 2.0 that should be considered as one of the outstanding feature of the web 2.0 is to support collaborationand to help gather collective intelligence rather Web 1.0.
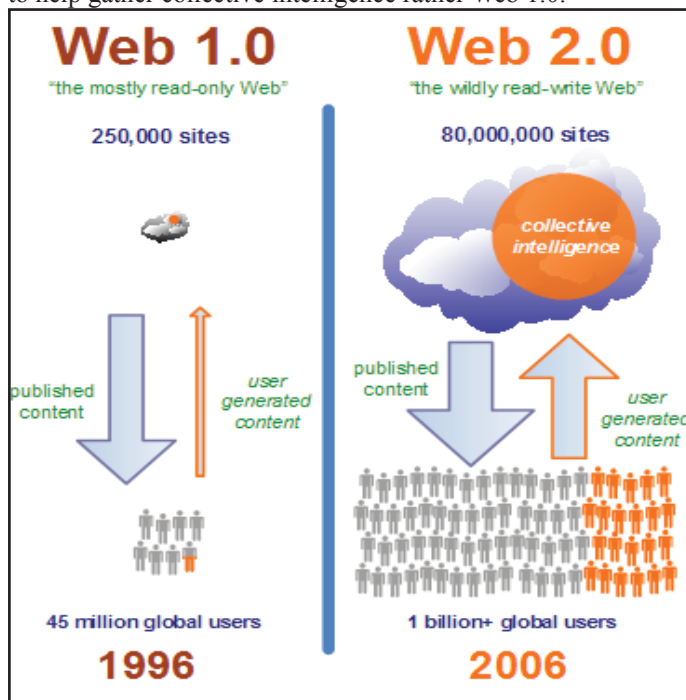

Fig. 1: Comparison Web1.0 & Web 2.0 [28]

A. Charateristics

Web 2.0 is instead a label coined by Tim O'Reilly and associates to reference the transition of the World Wide Web to a new phase of use and service development [17]. The categorization can be used to elaborate on the understanding of Web 2.0 achieved through varied definitions.

1. Technology Centric Definition

Web has become a platform with software above the level of a single device. Technology that is associated with blogs, wikis, podcasts, RSS feeds etc.

2. Business Centric Definitions

A way of architecting software and businesses.The business revolution in the computer industry caused by the move to internet as platform and an attempt to understand the rulesfor success on that of new platform.

3. User Centric Definitions

The Social Web is often used to characterize sites that consist of communities.It is all about content management and new ways of communication and interaction between users.Web applications that facilitate collective knowledge production, social networking and increases user to user information exchange.

B. Limitation

Sometimes it may happen that if the new technology meets expectations of the mass user at large, there may be a chance that these technologies may face lot of consequences from external environment which may supress or limit the flow of technology in presenting results which might not be feasible andmay lead to degrade the performance of the technology as a whole.

1. Constant iteration cycle of Change and Updates to services [11].
2. Ethical issues concerning build and usage of Web 2.0 [11].
3. Interconnectivity and knowledge sharing between platforms across community boundaries are still limited [12] [15].

V. Web 3.0

Web 3.0 is one of modern and evolutionary topics associated with the following initiatives of Web 2.0. Web 3.0 was first coined by John Markoff of the New York Times and he suggested web 3.0 as third generation of the web in 2006 [18]. Web 3.0 can be also stated as "executable Web". The basic idea of web 3.0 is to define structure data and link them in order to more effective discovery, automation, integration, and reuse across various applications [6].It is able toimprove data management, support accessibility of mobile internet, simulate creativity and innovation, encourage factor of globalization phenomena, enhance customers' satisfaction and help toorganize collaboration in social web.

Web 3.0 is also known as semantic web. Semantic web was thought up by Tim Berners-Lee, inventor of the World Wide Web [1]. There is a dedicated team at the World Wide Web consortium (W3C) working to improve, extend and standardize the system, languages, publications and toolshave already been developed [3].Web 3.0 is a web where the concept of website or webpage disappears, where data isn't owned butinstead shared, where services show different views for the same web or the same data. Thoseservices can be applications (like browsers, virtual worlds or anything else), devices or other, andhave to be focused on context and personalization, and both will be reached by using verticalsearch [13].

Web3.0 supports world wide database and web oriented architecture which in earlier stage was described as a web of document. It deals mainly with static HTML documents, but dynamically rendered pages and alternative formats should follow the same conceptual layout standards whenever possible and links are between documents or part of them.The web of documents was designed for humanConsumption in which primary objects are documents and links are between documents (or parts of them). Semantics of content and links are implicit and the degree of structure between objects is fairly low [19]. Fig. 2 represents the structure of web of documents in simple [19].
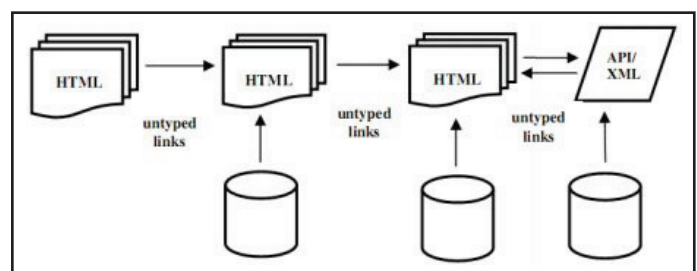

Fig. 2: Web of Document [20].

The proponents of the Web of Data envision much of the world's data being interrelated and openly accessible to the general public. This vision is analogous in many ways to the Web of Documents

of common knowledge, but instead of making documents and media openly accessible, the focus is on making data openly accessible, the Web of Data hosts a variety of data sets that include encyclopaedic facts, drug and protein data, metadata on music, books and scholarly articles, social network representations, geospatial information, and many other types of information in some ways like a global database that most its features are included Semantics of content and links are explicit and the degree of structurebetween objects is high based on RDF model. In fig. 3, the structure of web of data is shown simplicity [14].
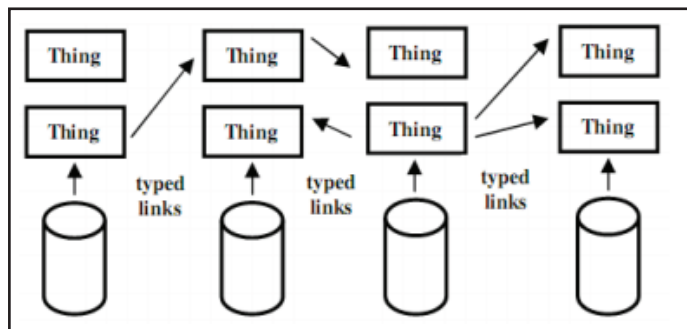

Fig. 3 Web of Data[20].

A. Semantic Web

The Semantic Web is a collaborative movement led by internationalstandards body the World Wide Web Consortium. According to the W3C [4],
"The Semantic Web provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries".

The main purpose of the Semantic Web is driving the evolution of the current Web by enabling users to find, share and combine in formation more easily. The Semantic Web, as originally envisioned, is a system that enables machines to "understand" and respond tocomplex human requests based on their meaning. Such an "understanding"requires that the relevant informationsources be semantically structured.

Tim Berners- Lee originally expressed the Semantic Web as follows [2]:
"If HTML and the Web made all the online documents look like one huge book, RDF, schema, and inference languages will make all the data in the world look like one huge database".

Tim Berners-Lee proposed a layered architecture for semantic web that often represented using a diagram, with many variations since.
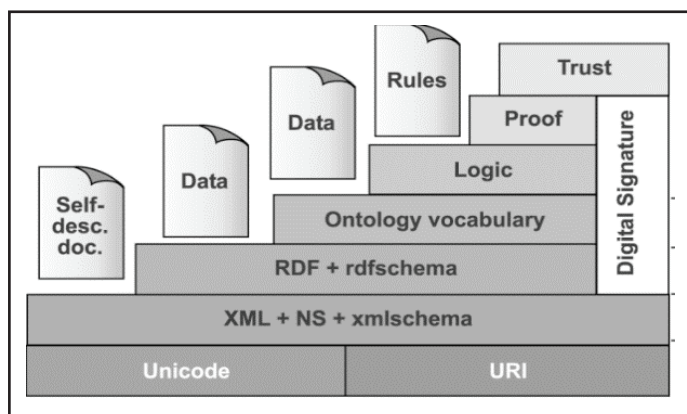

Fig. 4: Semantic Web Layered Architecture [5]

The development of the Semantic Web proceeds in steps, each step buildinga layer on top of another.Figure 4shows the "layer cake" of the SemanticWeb which describes the main layers of the SemanticWeb design and vision [5].

1. Unicode and URI

Unicode is used to represent of any character uniquely whatever this character was written by any language and Uniform Resource Identifier (URI) is unique identifiers for resources of all. The functionality of Unicode and URI could be described as the provision of a unique identification mechanism within the language stack for the semantic web [20].

2. XML

It is a language that lets one write structured Web documents with a user-defined vocabulary. XML is particularly suitable for sending documents across the Web. XML has no built-in mechanism to convey the meaning of the user's new tags to other users.

3. RDF

Resource Description Framework is a basic data model, like the entity-relationship model, for writing simple statements about Web objects (resources). A scheme for defining information on the Web. RDF provides the technology for expressing the meaning of terms and concepts in a form that computers can readily process.

4. RDF Schema

It provides a predefined, basic type system for RDF models. RDF Schema provides modeling primitives for organizing Web objects into hierarchies. Key primitives are classes and properties, subclass and sub property relationships, and domain and range restrictions.

5. Ontology

The ontology layer described properties and the relation between properties and different. Ontology can be defined as a collection of terms used to describe a specific domain with the ability of inference.

6. Logic Layer

It is used to enhance the ontology language further and to allow the writing of application-specific declarative knowledge.

7. Proof Layer

It involves the actual deductive process as well as the representation of proofs in Web languages (from lower levels) and proof validation.

8. Trust Layer

It will emerge through the use of digital signatures and other kinds of knowledge based on recommendations by trusted agents or on rating and certification agencies and consumer bodies.

Semantic web is not limited to publish data on the web.It is about making links to connect relateddata. Berners-Lee introduced a set of rules have become known as the Linked Data principles to publish and connect data on the web in 2007 [16]:
- Use URIs as names for things
- Use HTTP URIs to look up those names
- Provide useful information, using the standards (RDF) by look up a URI
- Include links to other URIs to discover more things

Data providers can add their data to a single global data space by publishing data on the webaccording to the Linked Data principles.

B. Characteristics
The major characteristics of Web 3.0 as marked by Nova Spivackare [18]:
1. SaaS Business Model.
2. Open Source Software Platform.
3. Distributed Database –or what called as "The World Wide Database".
4. Web Personalization.
5. Resource Pooling
6. Intelligent Web.

C. Challenges
Semantic Web faces several challenging issue like:

1. Vastness
The World Wide Web contains many billions of pages. Redundancy in Data may occur which has not yet been able to eliminate all semantically duplicated terms.

2. Vagueness
This arises from the vagueness of user queries, of concepts represented by content providers, of matching query terms to provider terms and of trying to combine different knowledge bases withoverlapping but subtly different concepts.

3. Inconsistency
These are logical contradictionswhich will inevitably arise during the development of large ontologies, and when ontologies from separate sources are combined.

4. Deceit
This is when the producer of the information is intentionally misleading the consumer of the information.

VI. Comparision
The main difference between Web 1.0, Web 2.0and Web 3.0 is that web 1.0 is consider as read-only web targets on content creativity of producer web 2.0 targets on content creativity of users and producers while web 3.0 targets on linked data sets. The very few comparative differences between Web 1.0, Web 2.0 and Web 3.0 are given below:

Table 1: Comparison of Web 1.0, Web 2.0 and Web 3.0

WEB 1.0	WEB 2.0	WEB 3.0
1996 – 2004	2004 -2016	2016+
The Hypertext Web	The Social Web	The Semantic Web
Tim Berners Lee	Tim O'Reilly, Dale Dougherty	Tim Berners Lee
Read Only	Read and Write Web	Executable Web
Millions of User	Billions of User	Trillions+ of Users
Echo System	Participation and Interaction	Understanding self
One Directional	Bi-Directional	Multi-user Virtual environment

Companies Publish Content	People Publish Content	People build application though which people interact and publish content.
Static content.	Dynamic content.	Web 3.0 is curiously undefined. AI and 3D,The web learning
Personal Websites	Blog and Social Profile	SemiBlog, Haystack.
Message Board	Community portals	Semantic Forums
Buddy List, Address Book	Online Social networks.	Semantic Social Information

VII. Web 4.0 and Future Web
Web 4.0 can be considered as an Ultra-Intelligent Electronic Agent, symbiotic web and Ubiquitous web [25]. Interaction between humans and machines in symbiosis was motive behind of the symbiotic web. Powerful as human brain, progress in the development of telecommunications, advancement on nanotechnology in the world and controlledinterfaces using web 4.0. In simple words, machines would be clever on reading the contents of the web, and react in the form of executing anddeciding what to execute first to load the websites fast with superior quality and performance and build more commanding interfaces [24].
Web 4.0 will be read write concurrency web [23]. It ensures global transparency, governance, distribution, participation, collaboration into key communities such as industry, political, social and other communities. WebOS will be such as a middleware in which will start functioning like an operating system [26].WebOS will be parallel to the human brain and implies a massive web of highly intelligent interactions [27].

VIII. Conclusion
This paper provided an overview from the evolution of the web. Web 1.0, web 2.0, web 3.0 and web 4.0 were described as four generations of the web. The characteristics of the generations are introduced and compared. It is concluded web as an information space has had much progresssince 1989 and it is moving toward using artificialintelligent techniques to be as a massive web of highly intelligent interactions in close future.

References
[1] Tim Berners-Lee,"The World Wide Web: A very short personal history", [Online] Available: http://www.w3.org/People/Berners-Lee/ShortHistory.html, 1998.
[2] Berners-Lee, Tim; Fischetti, Mark,"Weaving the Web", Harper San Francisco, chapter 12, 1999.
[3] Sean B, Palmer,"The Semantic Web: An Introduction", [Online] Available: http://www.infomesh.net/2001/swintro/, 2001.
[4] W3C Semantic Web Activity "[Online] Available: http://www.w3.org/2001/sw/", World Wide Web Consortium, 2001.
[5] Jane, Greenberg, Stuart, Sutton, D. Grant, Campbell, "Metadata: A Fundamental Component of the Semantic Web", Bulletin of the American Society for Information Science and Technology, Vol. 29, Issue 4, pp. 16–18, 2003.
[6] Ossi, Nykänen,"Semantic Web: Definition", [Online] Available: http://www.w3c.tut.fi/talks/2003/0331umediaon/slide6-0.html, 2003.

[7] Motta, E., Sabou, M,"Next Generation Semantic Web Applications", Heidelberg, Springer-Verlag Berlin, pp. 24-29, 2006.

[8] O'Reilly, Definition of Web 2.0. [Online] Available: http://radar.oreilly.com/archives/2006/12/web-20-compact-definition-tryi.html, 2006.

[9] Brian, Getting,"Basic Definitions: Web 1.0, Web 2.0, Web 3.0", 2007, [Online] Available: http://www.practicalecommerce.com/articles/464-Basic-Definitions-Web-1-0-Web-2-0-Web-3-0

[10] Maged, N. KamelBoulos, Steve, Wheeler,"The emerging Web 2.0 social software: an enabling suite of sociable technologies in health and health care education", Health Information and Libraries Journal, pp. 2 -23, 2007

[11] Anderson, P.,"All That Glisters Is Not Gold' -- Web 2.0 And The Librarian", Journal of Librarianship and Information Science, 39 (4), pp. 195–198, 2007.

[12] Abel, F., Frank, M., Henze, N., Krause, D., Plappert, D., Siehndel, P.,"Group Me! - Where Semantic Web meets Web 2.0", 2007.

[13] Mind Booster, Noori,"What is Web 3.0?", [Online] Available: http://mindboosternoori.blogspot.com/2007/08/what-is-web-30.html, 2007.

[14] Tim, Berners-Lee, Christian, Bizer, Tom, Heath & Kingsley, Idehen,"Linked Data on the Web", 17th International World Wide Web Conference, 2008.

[15] Chan, C. K., Lee, Y. C., Lin, V.,"Harnessing Web 2.0 for Collaborative Learning", Springerlink, 2009.

[16] Christian, Bizer, Tom, Heath & Tim, Berners-Lee, "Linked Data - The Story So Far", Journal Semantic Web and Information Systems, 2009.

[17] Harrisom, T. M., Barthel, B.,"Wielding new media in Web 2.0: exploring the history of engagement with the collaborative construction of media products", New media & Society, 11(1&2), pp. 155–178, 2009.

[18] Nova Spivack,"Web 3.0: The Third Generation Web is Coming" [Online] Available: http://lifeboat.com/ex/web.3.0, 2011.

[19] SarehAghaei, Mohammad Ali Nematbakhshand HadiKhosraviFarsani,"Evolution of the World Wide Web: From Web 1.0 to Web 4.0",Computer Engineering Department, University of Isfahan, Isfahan, Iran, International Journal of Web & Semantic Technology (IJWesT) Vol. 3, No. 1, pp. 1-10, 2012.

[20] Patel et al., International Journal of Advanced Research in Computer Science and Software Engineering 3(10), pp. 410-417, 2013.

[21] W3C,"World Wide Web Consortium", [Online] Available: http://www.w3.org.

[22] World Wide Web: Proposal for a HyperText Project ([Online] Available: http://www.w3.org/Proposal.html).

[23] "Web 4.0 - A New Web Technology", [Online] Available: http://website-quality.blogspot.com/2010/01/web-40-new-webtechnology.html/,Hemnath (2010)

[24] On2broker: Lessons Learned from Applying AI to the Web Dieter Fensel, Jürgen Angele, Stefan Decker, Michael Erdmann, Hans-Peter Schnurr, Rudi Studer and Andreas Witt Institute AIFB, University of Karlsruhe, D -76128 Karlsruhe, Germany dfe@aifb.uni-karlsruhe.de, [Online] Available: http://www.aifb.uni-karlsruhe.de/~dfe.

[25] Jonathan Fowler, Elizabeth Rodd (2013) Web 4.0: The Ultra-Intelligent Electronic Agent is [Online] Available: http://bigthink.com/big-think-tv/web-40-the-ultra-intelligent-electronic-agent-is-coming.

[26] Ron, Callari,"Web 4.0,Trip Down the Rabbit Hole or Brave New World?", [Online] Available: http://www.zmogo.com/web/web-40trip-down-the-rabbit-hole-or-brave-new-world/.

[27] Dan, Farber (2007), "From semantic Web (3.0) to the WebOS (4.0)", [Online] Available: http://www.zdnet.com/blog/btl/from-semantic-web-30-to-the-webos-40/4499/.

[28] Flat Word Business,"Web 1.0 vs Web 2.0 vs Web 3.0 vs Web 4.0 – A bird's eye on the evolution and definition" [Online] Available: http://flatworldbusiness.wordpress.com/flat-education/previously/web-1-0-vs-web-2-0-vs-web-3-0-a-bird-eye-on-the-definition/.

Pranay Kujur received his B.Tech degree in computer Science and Technology from Government College of Engg. And Textile Technology, Berhampore, West Bengal, India in 2013. He is currently pursuing M.Tech in Computer Science and Technology from Sikkim Manipal Institute of Technology, Sikkim. His research interests include Wireless Sensor Networks, Internet of Things, Security and Web Technology.

Bijoy Chhetri received his B.E degree in Computer Science and Engineering from Visvesvaraya Technological University, Karnataka India in 2002. He is working as Sr. Lecturer in Centre for Computers and Communication Technology, Sikkim. He is currently pursuing M.Tech in Computer Science and Technology from Sikkim Manipal Institute of Technology, Sikkim. He has a combined teaching and industrial experience of 13 years. .His research interests include Network Security, Artificial Intelligence and Web Technology.