Usability of Web Browsers for Multi-touch Platforms

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Chapter 1: Introduction

1.0 Background

Multi-touch interface is an improvement within the existing touch screen technology, which allows the user to operate the electronic visual display with finger gestures. This Multi-touch interface is designed by using multi-touch technologies, which also is multi-finger and multi-user interface. It means that users can sort and rearrange the pictures or document by proper zoom in/out options; this can be done by simply dragging the picture with the finger tips [1]. This concept is generally based on a multi-touch display that innovate existing technology and applies reengineering to it and manages whole things by using just the finger tips. Another task for the designer is to provide easy access for the user in manipulating the document such as rotating the shape of an article, saving or reordering the same articles in a particular folder, accessing maps in the 3D view with proper Zoom-in and Zoom-out options.

This great advancement helps the user to manage their pictures, documents and files by moving the fingers on the screen. Multi-touch screens also provide the manipulation of photos like rotating, enlarging, zooming in/out and emailing them simply by touching the surface of the web interface [2]. Hence in future, Multi-touch interface can be a great advancement in the field of computers.

The Web browser is the software program that communicates with web server via some internet protocol such as HTTP, FTP protocol that translates information and image data into well formatted display. Software application that runs behind the graphical display understands the software code and presents the information to user as per their requirement.

This Dissertation is basically deals with the implementation of Mozilla Firefox Web Browser Plugin for Multi-touch interface, which is design to perform browser navigation controls and other window controls by just touching the interface. The whole idea behind this dissertation is to perform browser task more easily, time saving with just finger tips. Apart from time consuming, this Plugin enhance human computer interaction and perform browser task. But most important, this Plugin works on Firefox web browser which runs over Multi-touch platform.

This Plugin basically works with touch gestures that controls the touch movement and perform certain actions, in order to operate navigation controls, window controls and other miscellaneous options.

Firefox Extension/Plugin is basically a Internet Application, which is similar like user interface with runs under Mozilla Component framework, which is commonly known as Firefox web browser. Firefox Plugin can be implemented by using XML graphical user interface language (XUL) which is develop by Mozilla with open source tool which use (XPCOM) framework to create variety extensions, add-ons, themes, Plugins and lot more web applications. Generally XUL is similar like XML, used for designing user interface in support with JavaScript [51].

1.1 Problem Statement

Touch screen is the great advancement to the existing computer market because of its features. It is used to accept input from the touch sense. Previously the web browsers used to accept the input from normal input devices such as keyboard, mouse, and other pointing devices which is working under normal Screen. When we considered the browser under multi-touch interface, it accepts the input from user's finger. Because of certain reasons user face problems while providing the input to the browser which runs under Multi-touch platform.

Web browser performs well under multi touch, but however it does have some hassle to perform the task smoothly as it accepts the input from user's finger such as Selecting links, Scrolling web page and selecting text. Apart from this, screen size is also the problematic issues with multi-touch browser interface. The three basic issue with web browser under multi-touch are; user targets the finger to select the desired link but the touch area of the finger is larger than the display pixel, because of this user unable to specify the proper point of contact with the display [52]. Secondly, during scrolling the web page to view the content, text is also selected. Another issue is with browser which runs on small size multi-touch display, here user unable to select the desired links, images or text because of the small size display, every time they has to zoom the document and then perform certain task as per the need.

1.2 Purpose of Study

The basic concept behind this dissertation is to get the knowledge of multi-touch interface and its usage. My research primarily aims to get information about touch gesture and its usage, which runs under Firefox browser and to understand touch gesture functionality, examine the existing issues, finally eliminating the issues by implementing Firefox Plugin and provide suitable user friendly gesture.

1.3 Project Objective

From the above mentioned purpose of study, this dissertation finalized with the following objectives:

➢ To research, the existing Multi-touch interface in the market and understand its touch gestures.

➢ To research, critically review different web browser for multi-touch platform and its usage.

➢ To understand the browser support for specific Multi-touch interfaces, such as No support, Standard support, Tailored support.

➢ To find out the basic issues with touch gesture that runs under Firefox browser.

➢ To find out Popular web browser activities, that enhanced the existing touch gestures functionality.

➢ To evaluate, gesture justification and understand the concept with single, dual, Multi-touch interface.

➢ Finally, Eliminate the existing problem by implementing Firefox Plugin that overcome the issue and provide user friendly touch gesture.

1.4 Organization of Project Report

Chapter 1: Introduction and background

This chapter describes the basic introduction of Multi-touch interfaces, gives the overview of web browser, Firefox Plugin and presents the brief introduction of this dissertation. Apart from this it specify problem of statement, purpose of study, and project objective and approach.

Chapter 2: Literature Review

This chapter explain in details about the background of mulit-touch interface in relates with three different categories such as Monitor/Laptops, Handheld devices, and Special devices including Microsoft surface computer, Diamond touch and etc., Apart from this it also explain in detail about the browser support for the above mention devices and its popular web browser activities.

Chapter 3: Requirement and analysis

This chapter describe the basic requirement for the application and it also explains in detail about the problem statement of the existing market. It also describe the overview of waterfall model to understand the steps of software development life cycle. And finally it provides the basic software and hardware requirement for this application to run on Firefox web browser.

Chapter 4: Design

This will explain the overall design of the web browser and its popular activities perform by the user. This part is explain with the help of Tree view architecture of web browser.

Chapter 5: Implementation and Testing

Chapter 6: Result and Future work

Chapter 7: Conclusion

Chapter 2: Literature Review

2.1 Background of Multi-touch Technology

Multi-touch technology started in 1982 at the University of Toronto. The first human-input multi-touch system was developed by the Input Research Group of this university. Initially this system mainly contains a glass panel with a camera behind the glass. Whenever the glass is pressed by a finger or several fingers, the camera would detect the action on to the surface/glass as one or more black spots generate on the white background. Once it gets spotted it will request the data as input depending on the size of the dot which is due to the pressure applied on the glass, will send the response back to the glass. To some extent this system also acts as pressure-sensitive device [5].

"In 1983, Bell Labs at Murray Hill published a comprehensive discussion of touch-screen based interfaces. In 1984, Bell Labs engineered a touch screen that could change images with more than one hand. In 1985, the University of Toronto group including Bill Buxton developed a multi-touch tablet that used capacitance rather than bulky camera-based optical sensing systems". [5]

In the beginning of twenty-first century various companies adopts multi-touch technology and applied this innovative technology to their existing product in order to expand there business. In the year 2007 multi-touch technology gets great exposure to the market when Microsoft released its Microsoft Surface Computer and Apple released its iPhone.

2.2 Companies that manufacture multi-touch devices

Brand Name	Product Name
HCI	Multi-Touch Table, Multi-Touch Wall, Multi-Touch Screen, Multi-Touch Frame, Multi-Touch Company
3M	M2256PW with ten-finger support
Acer	Acer Aspire 1820PT & 5738PG
Apple	iPhone, iPad, iPod Touch, MacBook, MacBook Air, MacBook Pro, Magic Mouse
Asus	EEE PC T91MT & T101MT
Circle Twelve	Diamond-Touch
Dell	Latitude XT & XT2, Studio 17
Google	Nexus One
Hewlett-Packard	HP Touch-smart
HTC	HTC Magic, HTC Hero, HTC HD2
Lenovo	X200 & T400
Microsoft	Surface, Zune HD
Sony	VAIO L Series All-in-one desktops
Displax	16 fingers, also airflow detection
Perceptive Pixel, Inc	Multi-touch collaboration wall and multi-touch workstation

2.3 Softwares that support Multi-touch interface

Many recent operating systems support multi-touch, including Mac OS X, Windows 7, Windows Vista, Windows XP Tablet PC Edition, Linux Ubuntu (since version 7.10), Google's Android, Palm's webOS and Xandros.

2.4 Different types of Multi-touch Interfaces

The following chart is a list of Multi-touch laptops and monitors that use multi-touch technology built into their screen, rather than, or in addition too, the track pad or mouse. Apart from that, the chart specifies one field by Browser Support; it mainly specifies browser support for that device.

2.4.1 Monitors/Laptops Devices

Table shows the Multi-touch Monitors/Laptops Interface

Brand Name	Model	Form Factor	Operating System	Touch Points/ Browser Support	Screen Size	Resolution	Price	Ref
3M	3M Multi-Touch Display	Monitor	Windows 7	10 / (SS)	19 inch	1440 × 900	£935.00	[6]
Acer	T230H	Monitor	N/A	5 / (SS)	23 inch	1920 × 1080	£ 406.10	[7]
Dell	SX2210T	Monitor	Windows 7	10 / (SS)	21.5inch	1920 x 1080	£398.99	[8]
Acer	Aspire AS5738PG	All in one Desktop	Windows 7	2 / (SS)	15.6 inch	1366 × 768	£516.50	[10][39]
Acer	Aspire Z5610-U9072	All in one Desktop	Windows 7	2 / (SS)	23 inch	1920 × 1080	£589.99	[11]
Acer	Aspire 1820PT	Ultra-thin Tablet	Windows 7 Home Premium	5 / (SS)	11.6 inch	1366 × 768	£1,032	[12]
Gateway	One ZX6800-01	All-in-One Desktop	Windows 7	2 / (SS)	23 inch	1920 × 1080	£568.99	[13]
HP	Touch-Smart 300	All-in-One Desktop	Windows 7	2 / (SS)	20 inch	720p	£580.99	[14]
HP	Touch-Smart 9100	All-in-One Desktop	Windows 7	2 / (SS)	23 inch	1920 × 1080	£839.50	[15]
Sony	L Series	Desktop	Windows 7	2 / (SS)	24 inch	1920 × 1080	£839.50	[16]
Dell	Latitude XT2	Tablet PC	Windows Vista, 7	10 / (SS)	12.1 inch	1280 x 800	£1,410	[17]
Toshiba	Satellite U505	Touch Laptop	Windows 7	2 / (SS)	13.3 inch	1280x800	£615.99	[18]
Toshiba	Satellite M505	Touch Laptop	Windows 7	2 / (SS)	14 inch	1280x800	£677.77	[19]

2.4.2 Special Devices

Brand Name - Ref	Model	Form Factor	Operating System	Touch Points / Browser support	Screen Size	Resolution	Price	Ref
Microsoft	Surface	Surface Computer	Window Xp, Vista, 7	52 (NS)	30 inch	1024 x 768	£8,100 £9,680	[9]
Perceptive Pixel, Inc	Multi-Touch Collaboration Wall / Multi-Touch Workstation	Touch Wall	Vista, Windows 7	Unlimited Touch points / (TS)	95 inch	1920x1080	-	[29]
Circle Twelve Inc.	Diamond Touch DT107	Touch Computer table	Windows (2000, XP), Linux driver available on request	Multi-touch / (TS)	32 or 42 inch	2752 x 2064	£ 6,580.45	[30] [31] [32]
Music Technology Group	Reactable	Music Projector	N/A	Multi-touch / N/A	37.4 inch by diameter	640x80	£ 15,138 (Probably)	[33] [34]
Northrop Grumman	Gesture Table	Touch table	Microsoft Window	Multi-touch / (TS)	84 inch	1280 x 720	-	[35] [36]
Microsoft	Touch Light	Imaging touch screen and 3D display	N/A	Dual touch / (NS)		-	£ 39,584	[37]
MIT Media Lab	SixthSense	Wearable gestural interface device	N/A	(SS)	N/A	N/A	£ 230.00	[38]

2.4.3 Handheld Devices

Brand Name	Model	Suitable Browser	Operating System	Touch Points/ Browser Support	Screen Size	Resolution	Price	Ref
Apple	iPhone 3Gs / 32Gb	WebKit-based Safari	Apple's iPhone OS 3.0	Dual Touch / (SS)	3.5 inch	480x260	£450.00	[20]
Google	Nexus One	Safari, Firefox, Opera mini/ Dolphin	Android Mobile Technology Platform 2.1 (Eclair)	Single with Safari - Dual with Dolphin / Both Supports (SS +TS)	3.7 inch	480x800	£333	[21]
Acer	beTouch E200	I.E 6	Windows Mobile 6.5 Professional	1 / (NS)	3.0 inch	240x400	£250	[22]
Acer	neoTouch S200	I.E 6/ Opera mobile	Windows Mobile 6.5 Professional	1 / (NS)	3.8 inch	480x800	£330	[23]
Toshiba	TG01	WAP 2.0/xHTML, HTML (IE)	Windows Mobile 6.1 Professional	Single Touch / (NS)	4.1 inch	480x800	£390	[24]
E-TEN	Glofiish V900	PocketIE	Windows Mobile 6.1 Professional	(NS)	2.8 inch	480 x 640	£464.50	[25]
HTC	HD2	Opera Mobile	Windows Mobile 6.5 Professional	Dual Touch / (SS)	4.3 inch	480x800	£469.99	[26]
HTC	Hero	Dolphin	Android	Dual Touch / (TS)	4.3 inch	320x480	£315.99	[28]
Sony Ericsson	Satio	Opera mini	Symbian	1 / (NS)	3.5 inch	360x640	£384.99	[27]

## 2.5 Existing Web Browsers for Multi-touch Interface

A Web browser is a software application used for accessing or publishing information over to the Internet (World Wide Web), this information is identified by Uniform Resource Locator. Nowadays Multi-touch is a great improvement in the existing computer field which uses touch screen technology to operate screen with finger gestures. In order to operate web Browser over these multi-touch platform, it should have a unique features to deal with. There are some browsers in the existing market which support multi-touch platforms like Dolphin Multi-touch Web Browser for Android OS, Firefox, Internet explorer 7, Google Chrome for Windows 7, Motorola Droid and Cyanogen web browser for Google Nexus one. These browsers have unique browser controls with the help of which users can access internet via Multi-touch interface without any difficulty.

Browser support for multi-touch interface mainly depends on the Operating system it can be categorized into three types

a) **No Support (NS):** It specifies that there is no Multi-touch support facilities existing for this device, it only has single touch support.
b) **Standard Support (SS):** It specifies that a particular browser provides features such as Zoom in, Zoom out, Scroll Up/Down, Rotate Images or interface/screen etc [38]. These controls can be operated with finger gestures for example, with moving two fingers away from each other for Zoom-in and closed to each other for Zoom-out as shown in figure(1) and for rotate, holding two fingers moving clockwise and anti-clockwise to rotate the subject in the same direction as finger gestures moves which is shown in figure (2). For scroll up, moving finger gesture upwards for scroll up and downwards for scroll down as shown in figure(3). For selection, tapping is done with single finger in order to select a particular link onto the browser as shown in figure (4).
c) **Tailored Support (TS):** It specifies that this particular browser provides special Controls with the help of finger gestures in addition to standard support, which provides the features such as Back, Forward, Bookmarks, Scroll Up, Scroll Down with hand tool gesture. The dolphin browser is one of the examples for tailored support which provide the series of menus like Multiple Windows, Home, Refresh, gesture creator, cache clear option and many more..

Figure (1): It shows Zoom-in and Zoom-out with two finger gestures.
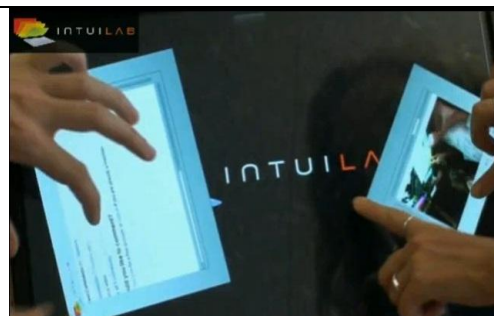
Figure (2): It shows Rotate option by

	moving two fingers in clockwise direction to rotate the subject in clockwise and vice versa.
Figure (3): For scroll up, moving finger gesture upwards for scroll up and downwards for scroll down.	**Figure (4):** For selection, tapping is done with single finger in order to select a particular link.

2.5.1 Browser controls for Multi-touch Monitors / Laptops

Generally Browser controls for multi-touch is similar like normal browser controls such as BACK, FORWARD, CLICK SELECTION etc, but these controls work with multi-touch gestures. Basically browser controls for multi-touch normally work with finger gestures for selection purpose. In the case of Multi-touch clicking the interface is the same as normal mouse click with computers. But here it works with finger gestures tapping it with click. This particular selection is tapped by single finger as shown in figure (5). Another way of clicking for precise selection user can use the Zoom-in and tap the single finger gesture as shown in figure (6), Here the

Zoom-in of the interface is done with dual finger gesture and it works similar to magnifier.

Figure (5)

Figure (6)

Apart from these functions, these browsers also support scrolling Up/Down with the help of two finger doing up/down Vertical slide gesture as shown in figure(7) where the two fingers' horizontal slide gesture operates the back and forward control shown in figure (8).
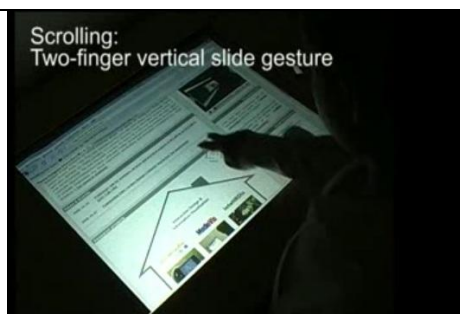

Figure (7): Scrolling Up/Down with the help of two fingers up/down Vertical slide gesture.
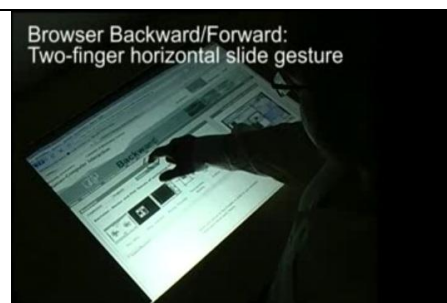

Figure (8): Two fingers horizontal slide gesture, for back and forward control.

2.5.2 Browser controls for Multi-touch Special Devices

Multi-touch is an improvement to the touch screen technology, which provides unique features and it's quite functional, which provides multiple finger gestures to user that send a complex commands to the Visual display. There are some special devices that support multi-touch technology such as *Microsoft Surface, Perceptive pixel computing, Mitsubishi Diamond touch, Reactable, Gesture table, Sixth sense, Touch table, etc*. But it is not compulsory that all these special devices should support multi-touch web browser. Though browser is not multi-touch its functionality mainly depends on Operating system and makes its multi-touch by using its own in-build features for touch gestures, which can be fulfilled by browser extensions such as Add-ons, and Plugins.

In order to explain the Browser controls for Multi-touch special devices following devices need to be consider

> ➢ Preceptive pixel
> ➢ Diamond touch
> ➢ Microsoft Surface computer

2.5.2.1 Preceptive pixel Browser controls

Multi-touch technology is also known as Human-computer interaction, because it's an interaction of users and computers by using different peripherals such as Keyboard, Mouse and the latest touch gestures [43]. *Perceptive pixel* is the best example for the human computer interaction with multi-touch gestures. It provides most advanced multi-touch solutions to the world with unlimited gestures. It develops interfaces that look out to unique features and bringing people closer to their content and eliminating the hurdle between user and computer [44]. It supports Multi-touch web browser which can access to get information from the internet. It has same browser controls as normal browser does, but as its runs under multi-touch platform it can also be access with touch gestures with some addition of unique Plugins and Add-ons. It has normal controls such as Back, Forward, Zoom-in, Zoom-out, Tap selection, Scroll Up/Down, etc. But this multi-touch browser can be considered under tailored support as discuss above in section 1.4.

2.5.2.2 Diamond touch Browser controls

It has unique features while using browser through windows. It is unique because the user can use his hand as a mouse. The one finger is like a left mouse click button and its used for selections, and fist is like scroller as shown in below figure(9). In the case of multi-touch interface, there is a difference between normal mouse and multi-touch gestures. As it will works with touch gestures, such as a single touch finger tapped, which is for Right click of mouse, while double tap is for holding the interface, and working as scroll Up/Down, and two fingers together for Zoom-in/Zoom-out which is shown in below figure(10). Sometimes browsers can't work properly with single finger gestures, for this issue it has an enhanced feature like by putting two fingers on to the interface, which makes mouse floats between two fingers and creates hand tool on interface with the help of which user can avoid selection issue, as shown in figure (11). Also, while holding a single tap for selection and user have other options, like copy, paste, etc and tapping again once for selection. Another great feature of diamond touch is that while using the interface you can capture the whole screen with just a single touch. It works the following way: user can drag fist across the table it will recognize the screen, will capture the whole screen and will launch multi-user interface with which user can do the modification with the captured screen and for saving just tap the fist to view the touch gesture saving options as shown below in figures(12)(13)(14) respectively[45].
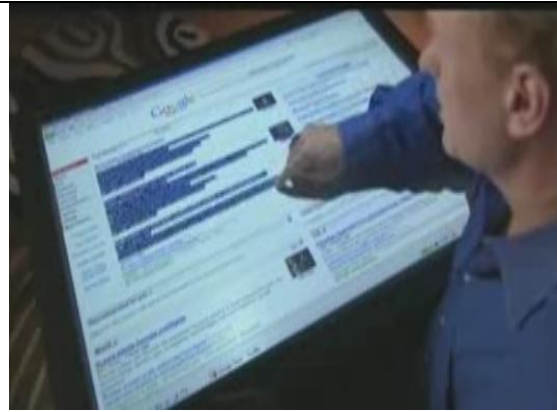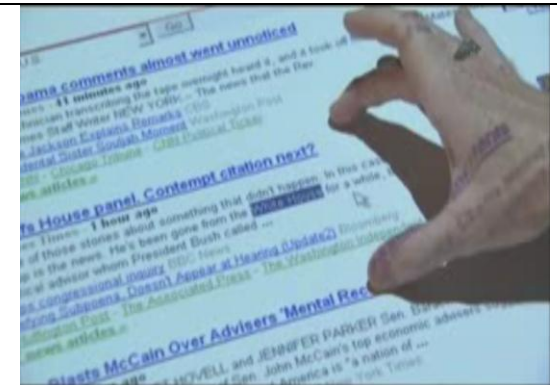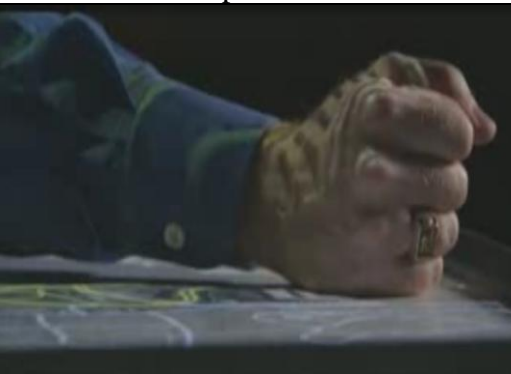
Figure (9): Single touch tap for selection	Figure(10): Fist tapped for scroll Up/Down
Figure(11): Two fingers to avoid selection issue	Figure(12): Drag fist across the table to captured the screen
Figure(13): Modified the captured screen and works multi-user as well	Figure(14):Saving just by tapping the fist

2.5.3 Browser controls for Multi-touch Handheld Devices

Multi-touch handheld devices mainly include Smart phones or PDA's, but here we will mainly focus on the mobile devices which support Multi-touch web browser. The browsers which already exist in the market and support multi-touch functionality for handheld devices are the Dolphin browser, the Firefox, the Internet Explorer and the Cyanogen. Among all of these the Dolphin browser is particularly rich in multi-touch features, because it can create its own multi-touch gestures. The interface of this browser is much cleaner than normal desktop browsers.

2.5.3.1 Overview of the Dolphin Browser

The **multi-touch capabilities** of the Dolphin browser are a great addition. That makes many Apple and (non-Apple) converted Android users. This browser falls into the tailored support category, because its features are unique and quite functional. The Touch gestures is the most innovative and functional aspect of the Dolphin browser. These gestures can be accessed either by Hit menu or long screen press. The Dolphin browser provides a border around the screen and a hand cursor that includes a series of navigation buttons such as Home, New tag, Refresh, etc. in the top left corner. It also provides a navigation buttons such as Back, Forward, Home, Thumbnail views of open web pages and setting menu. It also have URL bar with the reload, stop, and add webpage to bookmark buttons.

User can customize 23 commands themselves, because it provides a menu at the bottom left of interface. It's like a palette that allows the user to set his or her own touch gestures in various stoke motions, -such as drew letter M for page bookmarked and letter B for back to the previous web page, Letter S for Stop, Letter N for New tab etc [40].

Another extremely great feature provided by the Dolphin browser is the "clear the cache and exit" option. In order to do so, long press the back button. This will protect your personal information by clearing the history and saved information on to your phone or SD card [41]. Apart from this it has one more unique feature to "Select Text", which can be done by selecting the option from the menu such as select text, It will select the text and copy it to clipboard as shown in the figure above [42].

2.5.3.1 Pros/Cons for the Dolphin Browser

Pros:

- ➢ Enables Multi-touch with all standard support such as Zoom-in, Zoom-out, scroll etc.
- ➢ Works with Touch Gestures
- ➢ Visual bookmarks
- ➢ It allows Tabbed Browsing
- ➢ Scrolling left/right is possible in open windows
- ➢ Highly functional start page
- ➢ Save cache/history to SD card and can delete data with just one touch gesture
- ➢ Long press 'back' button to clear cache and exit

Cons:

- ➢ Slower than Stock Browser
- ➢ Ads!
- ➢ No double tap zoom (double tap toggles tab view)
- ➢ Bulky/ugly tabs
- ➢ No location detection

2.6 A Summary Table for the Most Popular Gestures Related to Web Browsers

Gestures related to Firefox, Chrome Web Browser		
No	**Gesture Name**	**Action perform**
1	Selection	Tapping with Single finger
2	Precise Selection	Zoom-in and tapping with single finger
3	Zoom-in	Moving two fingers away from each other
4	Zoom-out	Moving two fingers closed to each other
5	Right click option	Holding finger onto the interface
6	Rotate image	Moving two fingers in clockwise direction to rotate the subject in clockwise and vice versa
7	Scroll Up/Down	Moving finger gesture upwards for scroll up and downwards for scroll down.
8	Previous page(Back)	Two fingers slide horizontal in backward direction
9	Next page(Forward)	Two fingers slide horizontal in forward direction
Gestures related to Dolphin Web Browser		
No	**Gesture Name**	**Action perform**
1	Scrolling	Moving finger gesture in any direction to scroll the page irrespective of direction(Right, Left, Top, Bottom)
2	Zoom-in	Moving two fingers away from each other
3	Zoom-out	Moving two fingers closed to each other
4	Tab Browsing	Moving single finger horizontally back and front to switched between windows
5	clear the cache and exit option	Long press the back button
6	Open New Tab	Double tapping the window to open new tab
User defined gestures for dolphin browser		
7	Letter B	Write letter B with hand tool in browser to navigate back to previous page
8	Letter S	Stopping loading the page
9	Letter M	For bookmarking
10	Letter C	Closing the active tab

2.7 What is Web Browser

A Web browser is the software program that communicates with a web server via an internet protocol, such as HTTP, or FTP protocol that translates information and image data into well formatted display. Software application that runs over through the internet which understands the backend code in and translate the coding for graphical display. Browser functions mainly involved presenting, traversing, retrieving information from the World Wide Web. Where each web page describes its own application, such as email client, video application, news feeds, etc., [46].

The most popular web browsers are the Microsoft Internet Explorer, followed by the open-source Firefox browser and its upcoming relatives such as Netscape 6.0, Apple Safari that runs on Apple Macintoshes operating system, Opera, Flocks social

networking browser, The Lynx browser, which is most frequently used text only browser, and last but not least the latest and fastest Google Chrome[47].

2.7.1 Features of Web Browser

All major web browsers allow the user to access information from the internet at the same time via the same browser window with a multiple tab or a different window. Apart from this major browsers also include pop-up blockers to prevent unwanted windows opening from "popping up" without the user's permission [48]. Other important features of web browsers are web page bookmarks so that user can quickly access these pages in the future. Bookmarks are also called "Favorites" in the Internet Explorer.

Most browsers contain the features listed below. Some of these may be presented as buttons (or icons) in a toolbar. If you don't find a button, you will find it as a menu item within File, Edit, View, History, Bookmarks, Tools, or Help. You can usually customize the toolbar to include any or all of these features:

- ➢ Address bar
- ➢ Forward/Back button
- ➢ Refresh or Reload button
- ➢ Stop button
- ➢ Home button
- ➢ Search field

2.7.2 Popular Activities of Web Browsers

Here is a list of popular web browser activities performed online by internet users such as sending emails, playing games, or downloading music, etc.,

S.no	List of Popular activities while browsing
1	Type the link in the address bar
2	Typing User id, Password
3	Login to email account
4	Make login, pwd as remember
5	Send or read email
6	Scroll Up/Down the web page to access the information
7	Use a search engine to find information
8	Use Back and Forward Button to navigate between web pages
9	Save web page as Bookmark
10	Search for a map or driving directions
11	Refresh the web page if necessary
12	Look for info on a hobby or interest
13	Open multiple windows or multiple tab to access information simultaneously
14	Check the weather

15	Surf the Web for fun
16	Watch a video clip or listen to an audio clip and save on home computer
17	Watch a video on a video-sharing site like YouTube or GoogleVideo
18	Manage Browser Add-ons
19	Make the web pages as Bookmarks
20	Delete surfing History
21	Get news
22	Buy a product
23	Visit a local, state, or federal government website
24	Buy or make a reservation for travel
25	Do any online banking
26	Upload documents or files over to web sites
27	Get info online about a college, university, or other school you or a family member might attend
28	Download other files such as games, videos, or pictures
29	Send instant messages
30	Install Missing Plug-ins for flash files etc.
31	Download computer programs from the Internet
32	Download music files to your computer
33	Upload photos to a website so you can share them with others online
34	Look for information on Wikipedia, if needed copy/paste the text over through the web
35	Send or receive text messages using a cell phone
36	Play online games
37	Listen to music online at a website
38	Read someone else's online journal, web log, or blog
39	Log on to the internet using a wireless device
40	Categorize or tag online content like a photo, news story, or blog post
41	Search for info about someone you know or might meet
42	Share files from own computer with others
43	Download video files to your computer
44	Download screensavers from the Internet
45	Chat in a chat room or in an online discussion
46	Download computer games from the Internet
47	Create content for the Internet
48	View live images online of a remote location or person, using a webcam
49	Use an online social networking sites like MySpace, Face book, or Friendster
50	Make a phone call online

List of popular browser activities and their touch gestures

S.no	List of Popular activities while browsing	Touch gestures
1	Type the link in the address bar	Single touch
2	Typing User id, Password	Hold the finger for authentication (like Scanning)
3	Scroll Up/Down the web page to access the information	Swiping two fingers in vertical direction(Hold finger on to the screen and move other finger Up/Down to scroll the page)
4	Use Back and Forward Button to navigate between web pages	Swiping two fingers in horizontal direction(Hold finger on to the screen and move other finger Left/Right to scroll the page)
5	Open navigation links	Touch the URLs to generate Pie around the finger
6	Selection of text	Hold and move the single finger to select the text.
6	Copy and Paste	When finished with a selection gesture Your automatically provided with the option for copy and paste
9	Save web page as Bookmark	\/ used for bookmarked
10	Load Home Page	Just draw /\ for home page
11	Stop Browsing	Put two fingers on the screen and leave them for 'X' Seconds
12	Refresh the web page if necessary	Draw the same symbol for
16	Zoom in	Pinch two fingers apart
17	Zoom out	Pinch two fingers together
19	Rotate	Hold the frame and rotate in any direction

2.8 Gesture Justification

Recently, computer technology is more advanced and uses multi-touch interface to avoid complexity and provide to several benefits over traditional normal desktop displays. One of the most noticeable benefits of multi-touch interface while interacting the interface through directly touching; this it is more "natural" and "attractive" than working with any other pointing devices like a mouse[49]. The usefulness of this part of the dissertation in short is to evaluated and provide the useful information about touch gestures plug-in for Firefox browser. It describes the development of multi-touch gestures and also compare with the previous gestures. At the same time, we analyse the similarities between gestures and describe how they interacting with interface.

Mozilla Firefox has thousands of plug-in related to different categories some of which works with pointing gesture such as Fire gestures, Dragit, Quickdrag and etc,.

The multi-touch functionality of the Firefox browser is depends on the functionality of the system itself. Previously, it supported indirect touch but now it works with gestures. However, the only aim to support two point indirect touch gesture rather than multi-touch direct gesture is that it's easy to use and anyone play with it. As for the technological viewpoint – bimanual input is easy to work with and is inexpensive especially compared to Multi-touch direct gesture technology. From the human physiological viewpoint – Multi-touch direct gesture is more supportive than indirect mouse gesture because the "naturalness" and "attractiveness" of touch-based hand gestures provides a new opportunity for human versus computer interaction with, - hand-based gestures such as zoom-in/out, scrolling option, selecting the text etc,. It works well with just a single touch, there is no need to hold the mouse in one hand and click the particular button to perform a certain task. Furthermore, previously Firefox used multi-touch mouse gestures and it worked well with that solution too. But the touch gestures which we provide are more advanced in nature and work as the user needs them to.

Examples to Justified the Gesture with a Single Touch and a Multi-touch Gesture

2.8.1 Experimenting with single touch gestures

While using the single touch gesture with one hand, a user can just click the interface for selecting the text, and open the links, or the images etc,. These set of actions with single touch are not so natural, they work similarly to a mouse click.Single touch gestures don't work with pinching zoom-in/out, but the interface can be zoomed-in/out by double tapping the interface with a single touch.

2.8.2 Experimenting with multi-touch gesture

Multi-touch gestures works with dual touch senses, where a user can move the object in a natural and an attractive way. They used to play with the actions such as zoom-in, zoom-out, left rotation, right rotation, moving the fingertip to forward and backward to reload the page to previous and to next tab.

2.8.3 Advance(Future) Implementation of Multi-touch gestures

a) One handed instruction set with multi-touch gesture for small size devices

When the user touches something on screen by using a thumb and a forefinger, namely it has two touch points; zoom-in and zoom-out instructions are achieved. If the user don't move in the state that the thumb and the forefinger are touched, no reactions will occur. But if the distance between the two fingers is decreasing, the zoom-out instruction is achieved. On the other hand, when the distance between the of two fingers increase, the zoom-in instruction is executed. Both left-rotation and right-rotation instructions are controlled by using the thumb and the forefinger. This time, moving the index finger indicates the rotation amount and direction, while the thumb is fixed as a principal axis. as shown in the figure below.

(a) Pointing or Click (b) Move (c) Zoom-In (d) Zoom-Out (f) Left-Rotation (e) Right-Rotation
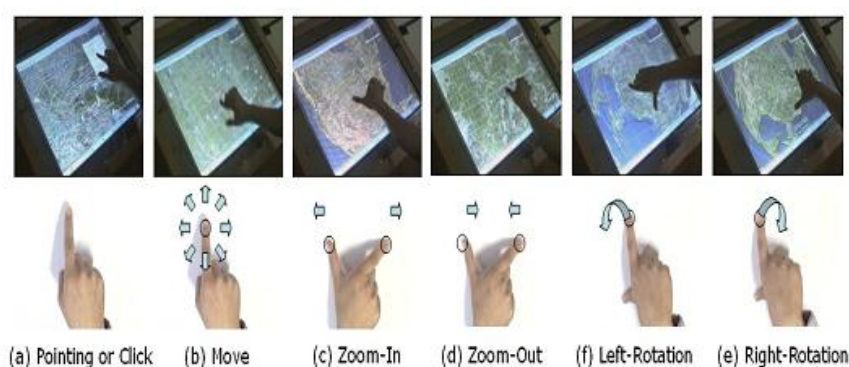
Figure: One handed instruction set with multi-touch gesture for small size devices (a) Pointing or Click: single point touch. (b) Move: move to arbitrary direction. (c) Zoom-In (d) Zoom-Out (e) Right-Rotation: the thumb is fixed. (f) Left-Rotation: the thumb is fixed.

b) Two handed or advanced technique

In the case of using both hands, other instructions: zoom-in, zoom-out, scroll-up, scroll-down, rotate, forward and backward of the web page depend on the number of fingertips that contact the screen. We can implement user friendly gestures that can operate easily and work well fine with no huge efforts. Like the zoom-in function:user can just make a spot with one finger of both hands, which when they move away from one another, zoom-in instruction is executed, and in the opposite case (hands move towards each other), zoom-out instruction is achieved. Also the user can execute scroll-up and scroll-down instruction. For the instruction to be executed, the user just holds one finger

and scrolls the other finger over to the page to activate the scroll up command as shown in figure below [50].
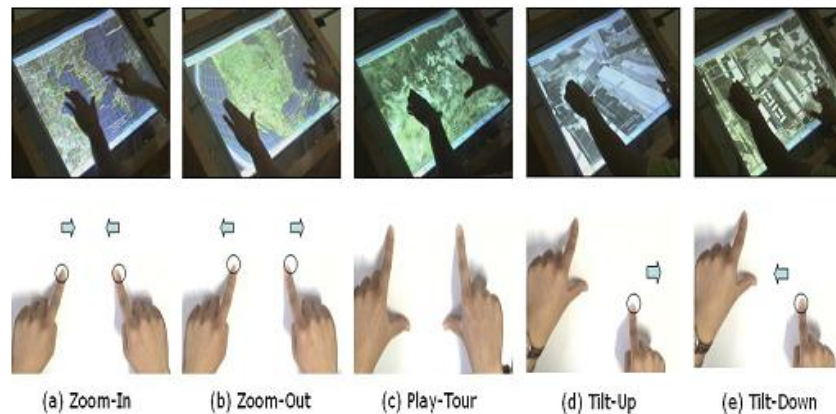

Figure: Two handed instruction set. (a) Zoom-In (b) Zoom-Out (c) Play-Tour: both hands are fixed for a few seconds. (d) Tilt-Up: fingers of left hand are fixed. (e) Tilt-Down: fingers of left hand are fixed.

Chapter 3: Requirement Analysis

This phase of the project describes the overall objectives in detail and it also explains what the basic requirements involves during the project and how to analyze these steps to get the final outcome. This part basically explains step by step approach to breakdown the existing problem into manageable steps and completes the task. This is the building block for the project and can be explained by considering software development life cycle model like waterfall model.

Any project management is truly based on system development life cycle conceptual model that mainly describe certain number of steps since from initial project study till the completion of application [54]. Waterfall model is basically a software development process which consists of sequence of steps such as requirements analysis, design, implementation, testing, installation and maintenance.
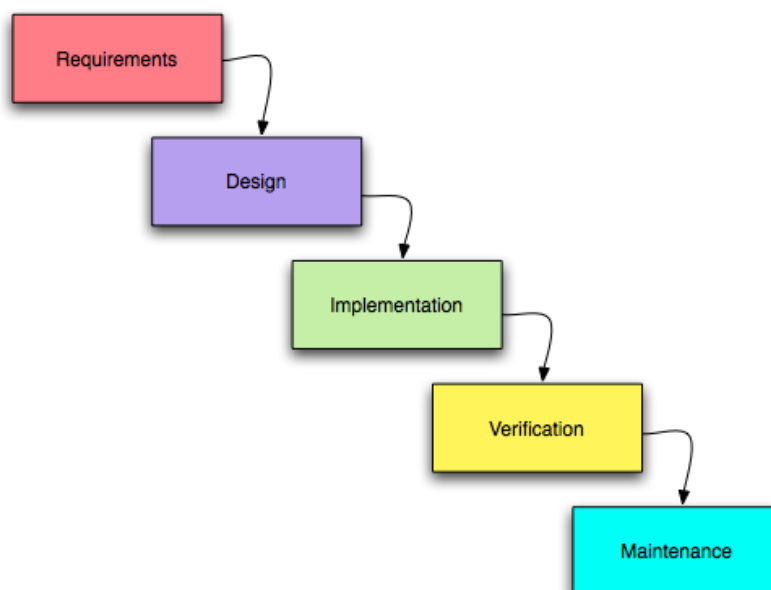
(Source : http://alicomputerservices.com/ComputerTech/wp-content/uploads/2008/10/waterfall_model.png)

This model generally explains the set of steps to build a software application. Initially it deals with requirement phase, the responsibility of this phase is to get the complete idea behind the project and to know what the basic requirements are, the result of this phase is then transfers to design phase, this phase is responsible to design the complete software blueprint, and design is basically a plan for software implementation. Once it's accomplished the result is forward to coding phase, here the entire blueprint is transformed to coding and the result is accomplished in the form of software application, it might be desktop application or web application. The result of the phase is then followed by Testing and maintenance. Where the application is tested and if any bug appears, it is again transferred to implementing phase to rectify the bugs and finally it is launched to fulfil the user requirement.

The Primary intension of this dissertation is to build a Firefox browser Plugin, which is build to perform action on multi-touch interface. To fulfil this, the basic requirement is to have the complete knowledge about existing multi-touch interfaces and critically review the different web browser and what are the touch gesture actions they can perform on surface. Another next is to understand the browser support for different Multi-touch interfaces and determine its basic issue in relating to Firefox browser. Once its achieved, determine popular web browser activities and find out what are the options perform on the surface. Finally, passed these set of requirements to design phase for designing and for further implementation.

The basic software and hardware requirement for building Firefox Plugin are:

3.1 Hardware Requirements

Monitor Resolution	:	800 x 600 at 24-bit true color
Monitor Display	:	Multi-touch
System Make	:	Intel Pentium – IV
Processor	:	P-IV 2.4 GHZ
Memory	:	256 MB
Hard Disk	:	40 GB

3.2 Software Requirements

Web Tools	:	XUL, JavaScript, HTML, CSS
Software	:	Net beans IDE / Notepad++
Operating System	:	Windows Vista / Windows 7
Browser	:	Mozilla FireFox
Browser version	:	3.0.1 – 3.6.4

Chapter 4: Design

4.1 Tree view for popular browser activities
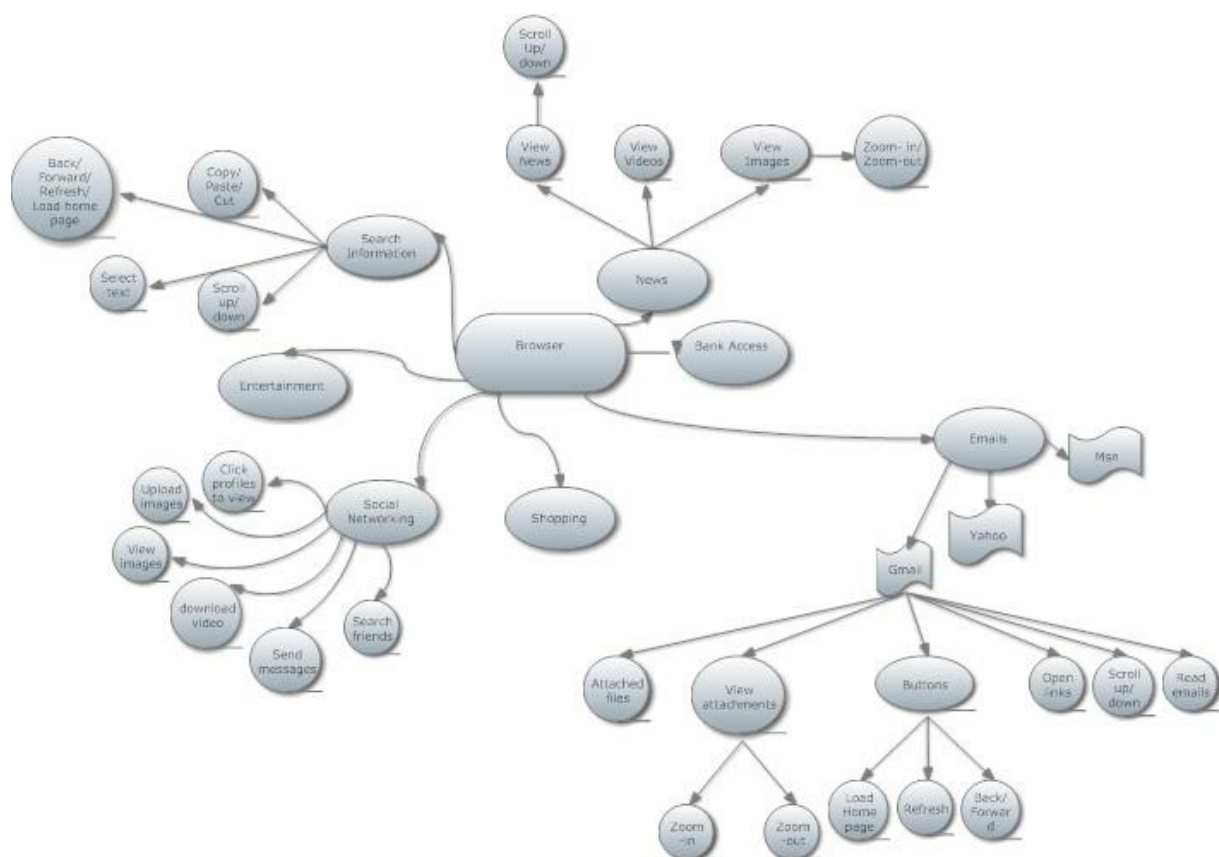
4.2 Description for popular web browser activities

The above tree primarily describes the popular web browser activities that can be done with any web browser. It mainly specifies symbols such as Circles, Oval, Curve rectangle and Flag, each of these symbols specify particular activity perform by browser.

The junction point of this tree specifies the curve rectangle which denotes the particular web browser from which all nodes generates. It will mainly create the Oval symbols which specify the tasks performed by the user of the web browser such as browsing the internet for Entertainment, Shopping, Access Emails accounts, Social Networking sites, View News, Search information and etc,. The leaf nodes are represented by the circles which specify the particular browser activities performed by users to complete the above tasks such as Browsing, or surfing the internet. These browser activities can be consider as multi-touch gestures that can perform to complete the above tasks.

These leaf nodes mainly describes popular web browser activities listed below

- ➢ Zoom-in/out
- ➢ Scroll Up/Down
- ➢ Back/Forward page
- ➢ Open links

➢ View Images
➢ Upload images
➢ Download images
➢ Rotate object
➢ Attached files
➢ Select text
➢ Copy/Paste Text
➢ Rotate Object
➢ Load home page
➢ Refresh web page

Chapter 5: Implementation, Testing and Evaluation

5.1 Project Implementation

This part of the dissertation is mainly deals with the implementation of Firefox Plugin, which is design and implements to work with touch gestures. Basically this Plugin is implemented by using graphical user interface language created by Mozilla and JavaScript. This language is created to develop Mozilla application is basically known as XUL (Xml graphical user interface language), it much similar like XML. So Overall, XUL is used for developing user interface.

What is XUL?

XUL (pronounced as "zool"), this is created to develop Mozilla application which help the browser to work easier and faster. It's basically a XML language, all the features of XML works fine in XUL as well. Apart from this other languages such as "XHTML", "MathML" and "SVG" can be easily place in it.

The graphical user interface ("GUI") of the Plugin is develop by using XUL with data from data repository and it supplied the data to interface by using RDF file. RDF file is the Installation file for the Mozilla Plugin. By Using XUL file user can develop Firefox extension such as forms, toolbars, menus, themes and browser's display. This overall features of Firefox Plugin is basically called as Overlay [53].

To developed a Firefox Plugin, user need XUL file in associated with some scripts such as JavaScript or VB Script. XUL file is save with .xul extension.

How to Handle XUL file?

XUL is handled in the same way like other language such as "HTML" and other languages. Basically this XUL file is place in the content directory, this directory is loaded into the URL or browser address bar to provide the user interface. The Mozilla engine accept this directory and load the content in the form of HTML page and if needed accepts "CSS" file and transformed whole data in the form of object on to the interface. CSS is normally a style sheet which applies graphical style to interface.

Mozilla provides a set of methods to installed content; all the installation files are placed in chrome system. This is commonly known as chrome:// URL. There is no file extension for the Mozilla extensions, but there are some new file extensions to Extensions files such as .rdf, .xul, .js, .menifest, .dtd, .css, etc.,

What is Firefox Package ?

Firefox package is the directory which is provide with Mozilla and located in chrome folder, this directory is mainly responsible to hold all the files which is needed for installing browser extension. The Package basically contain chrome folder, chorme.menifest and install.rdf. Apart from this, content folder may also contain three more directory such as content, locale, skin. Each directory is responsible to its relevant files, which is helpful in installing browser extension [53].

Different types of chrome package are:

Content: It mainly deals with windows and scripts. The window basically content elements used for designing user interface. They are in the form of XUL files, Javascripts. XUL files must save with .xul file extension. Content package can hold more than one XUL file, but the main user interface xul file must have same name as package name.

Skin: This package is used for holding Cascading Style sheets, images, data files and application themes.

Locale: This package is responsible for holding the text files that describe all the interface text, this is stored separately and can be in any language format.

Example for Package:

```
content
    browser
        browser.xul
        browser.js
        -- other browser XUL and JS files goes here --
        bookmarks
            -- bookmarks files go here --
        preferences
            -- preferences files go here --
    .
    .
    .
```
(Source: Mozilla developer centre)

Package Installation

To execute Mozilla extension, user needs to understand package installation. Mozilla package installation is much simpler when compare to other package installation method such as "Dotnet", "Java", "Jquery" and "dojo" etc., But different installation methods provided by the mozilla to install different extensions, over you need to create "install.rdf", "chrome.menifest" and content package, once these three files are

created "ZIP" them to one directory. The whole extension is packed in one "ZIP" file and this "ZIP" file with the file extension "XPI". "XPI" is the short description for the installation file, which is used as install component for mozilla. Once "XPI" file is crated just with drag and drop this .xpi file to Firefox browser. This leads the chrome engine to perform execution and install the extension [53].

```xml
The basic layout of an Install Manifest is like so:

<?xml version="1.0"?>

<RDF xmlns="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
     xmlns:em="http://www.mozilla.org/2004/em-rdf#">
  <Description about="urn:mozilla:install-manifest">
    <!-- properties -->
  </Description>
</RDF>
```

(Source: Mozilla developer centre)

5.2 Testing

5.3 Critical Evaluation of multi-touch platforms for web browsers

With the introduction of multi-touch interfaces, an innovative way of human-computer interaction has been introduced. In general multi-touch interface is broadly classified into three categories such as monitors/laptops, Special devices, and handheld devices. This section will focus on the critical evaluation of multi-touch interfaces for web browser. For evaluating the multi-touch interfaces for web browser. The first thing need to consider for evaluating the multi-touch for web browsers is performance. One of the most important question arise, Is multi-touch interfaces perform the common task and at what extent they are replacing existing input devices.

Before we begin the evaluation of multi-touch interfaces for web browsers, we formulate the following assumption:

1. The performance of multi-touch interfaces depends on the size and the resolution of interface.
2. Some tasks on a multi-touch device are faster than with a mouse.
3. Multi-touch devices allow users to complete the task faster than normal devices do.

In the above section we have categorized multi-touch interfaces into three different sections such as multi-touch monitors/laptops, Special devices, and handheld devices. Hence we need to evaluate the multi-touch interfaces for web browsers separately for the above three categories.

Evaluation of multi-touch interfaces for web browser is mainly depends on the size, resolution, and touch sense. Initially we will evaluate the advantages and disadvantages of multi-touch monitor/laptop devices for web browser.

5.3.1 The Advantages and disadvantages of Multi-touch devices (Monitor/Laptop) for Web Browsers

Advantages:

An important advantage in this category is to supports perfect Zoom-in, Zoom-out because the display is user-friendly in size (not too small not too big). But zoom-in and zoom out also works with resolution if the display is having the good resolution then it works perfectly, it will zoom the document or picture. Another advantage is the function *"Scroll Up/Down"*. If the length of the web page is larger than the window size, then with the help of a touch gesture the user can scroll the web page easily. It works with just single click in the browser by holding the finger and scrolling up/down to scroll the web page, there is no issue for doing so. Hence scroll up/down works fine with multi-touch. Apart from these *"Right click"* works with touch gesture, in order to perform right click options user must have to hold the touch finger for a second to display the right click option, once it displays the option the browser needs to perform the task just by using the finger gestures.

Disadvantages:

The main disadvantage is the selection of the hyper link or navigation, while navigation selection it will open all the links whichever comes in touch sense. In order to rectify the issue user first zooms-in on the navigation link which he wants to open and then click on the link to open it. This is the existing solution for the opening the hyper links. Another disadvantage is with scrolling the page up/down for which user touches and in the meantime the touch sense opens the hyper links coming in-between, or sometimes moves the page back to the previous window.

5.3.2 The Advantages and disadvantages of Multi-touch (Special Devices) for Web Browsers

Advantages:

The basic advantage in this category is that, it is user friendly because the display is much enough in size to perform certain action such as Zoom-in/out, Scroll Up/Down, Twisting page Back/Forward, Shifting between tabs. There is no issue regarding Zoom-in/out to view the text and images perfectly. If zoom-in needed, it works fine because its resolution is enough to do extent zoom-in, no matter it will zooming the document or picture. Another advantage is *"Multi way scrolling"*. If the length of the web page is larger then the window size, then with the help of touch gesture user can scroll the web page easily. Apart from scrolling the web page up and down, with the help of touch gesture user can move the web page Up, Down, Left, Right. It works with just a single click on surface. Therefore, scroll up/down works fine with multi-touch functionality in the browser. Another advantage is *"Right click"* works with touch gesture, once the user wants to perform right click option on the surface, he just needs to hold the finger for a while then will show the list of options in the circular way to perform a specific task. Last but not the least, the problem of opening the web page in other categories is rectified with the size of the screen, so that the user can easily open the hyper link with a single click , without any need for zooming-in and clicking.

Disadvantages:

> ➢ Expensive to buy
> ➢ Takes large space to set-up interface

5.3.3 Advantages/Disadvantages of multi-touch handheld devices for web browser

Advantages:

> ➢ Enabled with Multi-touch with all standard support such as Zoom-in, Zoom-out, scroll etc.
> ➢ Works with Touch Gestures
> ➢ Visual bookmarks
> ➢ It allows Tabbed Browsing
> ➢ User can create user-defined touch gestures such as assign some letters to perform a certain task. (Example: Write Letter B over surface to redirect the web page to previous one)
> ➢ Scrolling left/right is possible in open windows
> ➢ Highly functional start page
> ➢ Save cache/history to SD card and can delete just with touch gesture
> ➢ Long press 'back' button to clear cache and exit

Disadvantages:

> ➢ Slower than desktop Browser
> ➢ Zoom-in is needed every time to view the document or images
> ➢ Small in size, problem in opening the web links
> ➢ Text get dull while zoom-in
> ➢ Open the web link with Zoom-in and the click, because small size
> ➢ Ads!
> ➢ No double tap zoom (double tap toggles tab view)
> ➢ Bulky/ugly tabs
> ➢ No location detection

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