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# International Journal of Fuzzy Logic And Design

**Aims and Scope**

The International Journal of Fuzzy Logic and Design aims to provide a forum for scientists, engineers, and practitioners to present their latest research results, ideas, developments and applications in the field of computer architectures, information technology, and mobile technologies. Original unpublished manuscripts are solicited in the following areas including but not limited to:

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# International Journal of Fuzzy Logic And Design

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## Contents

# Z39.50: Ins and Outs

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## ABSTRACT

*The term Z39.50, although appears to be a typical technical word full of mystery, is actually not a completely new word in the library literature especially in the context of library information systems and resource sharing. Z39.50 is a rare protocol that goes beyond codifying mechanism and moves into the area of standardising shared semantic knowledge. This paper discuss about what Z39.50 is all about and how we as librarians can exploit it for our own benefit.*

**Keywords: Z39.50, Protocol, Information Retrieval, Client/Server**

## 1. INTRODUCTION

Z39.50, formally known as NISO/ANSI (National Information Standards Organisations /American National Standard Institute) Z39.50-1995 Information Retrieval: Application Service Definition and Protocol specification is the American National Standard for information storage, search and retrieval. (Koganuramath, Mallikarjun, & Kademani, 2001). It is an International Standard for Communication between computer systems basically in library and information system environment which is becoming increasingly necessary to the future development and deployment of computer linked library systems. It is a network application standard that enables different hardware and use different software to interoperate and work together seamlessly for the purpose of information retrieval. It's a NISO Standard that defines specification for protocols to promote communication between different networked systems for information retrieval. It enables information seekers to search unlike systems on a network or even on the internet through the use of a single user interface as the main purpose of Z39.50 is to reduce the complexities and difficulties of searching and retrieving information and thus making it easier to use the wealth of information which is scattered all over. And the best part is the user need not to know how the other systems on network work. (NISO, 2002)

**Versions and History:**

It grew out of the LSP: Linked System Project in 1980 to standardise searching of the major bibliographic databases of OCLC, LOC(Library of Congress), WLN (Washington Library Network) and Research libraries information network of the Research Library Group (RLG). At the time, the primary application was to support shared cataloguing using a logical national bibliographic database constructed from this small number of bibliographic utilities rather than to offer end users a common view of large numbers of autonomously managed databases.

**Version 1-1988**

The protocol developed was moved to NISO and was further developed into Z39.50 information retrieval standard, which was later approved as a NISO standard in 1988.Library of Congress is the maintenance agency and Registration Authority of Z39.50. Z39.50 Implementation Group (ZIG) assumed a primary role in the development of version 2 and 3.

This version had its root in the OSI efforts of the 1980s and within the OSI model, it is an application layer protocol.

**-Version 2-1992**

This version formalised the structure of information to be exchanged based on the ISO standard data description language and encoding rules known as ANSI and BER.

**-Version 3-1995**

This version moved to the TCP/IP Environment. It is a compatible superset of 1992 and is the current version of standard which builds on and includes version 2.It supports simple to highly complex applications.

The current version is formally known as "ANSI/NISO Z39.50-1995 Information Retrieval: Application Service Definition and Protocol Specification".

The ISO approved two Information retrieval standards in 1993- ISO10162 and ISO0163-1.In 1998 ISO adopted Z39.50 protocols and issued ISO 23950 Information Documentation – Information retrieval,

withdrawing the two previous standards. The convergence of Z39.50 and ISO23590 has resulted in global standard with extensive support for multiple languages and character sets. (Lynch, 1977)
Apprehensions about Z39.50

- It is still under development
- Not widely used
- It is too complex to implement
- It is not required any more as we have web
- It does not work

But...

- It's a fairly matured standard
- Widely implemented for LIS work
- Supports non-bibliographic information
- Supports interoperability across databases
- Supports maintenance of centralised union catalogue

**The Basic Concept**

This standard defines a client-server based service and protocol and a standard way for two computers to communicate for the purpose of recovery of information. It specifies procedures and formats for a client to SEARCH a database provided by or available with a server, RETRIEVE database records and perform related information retrieval functions. Specifically, Z39.50 supports information retrieval in a distributed, client and server environment where a computer operating as a client submits a search request (query) to another computer acting as an information server. Software on the server performs the search on one or more databases and creates a set of records that meet the criteria of the search request as a result. The server returns records from the resulting set to the client for processing. The power of z39.50 is that it separates the user interface on the client side from the information servers, search engines and databases; Z39.50 provides a consistent view of information from a wide variety of sources and offers client implementers the capability to integrate information from a range of databases and servers. (Koganuramath, Mallikarjun, & Kademani, 2001)

The Z39.50 standard was developed to overcome the problems associated with multiple databases searching such as having to know the unique menus, command language, and search procedures of each system accessed. Z39.50 simplifies the search process by making it possible for a searcher to use the

familiar user interface of the local system to search both the local library catalogue as well as any remote database system that support the standard.Z39.50 makes it easier to use the wealth of information resources on the Internet. When using Z39.50 enabled systems, a user in one system can search for electronic information in another system without having to know how that system works. Z39.50 gives different networks the ability to act like one network. By allowing different networks to act like one Z39.50 gives the user the ability to search different databases using one interface. Z39.50 protocol does this by separating the user interface from all of the information servers, databases, and search engines it uses (Pandian & Karisiddappa, 2004)

**Significant features of z39.50**

1. It does not require the searcher to be familiar with the details of the standard.
2. The origin module within the searcher's system is responsible for establishing the connection to the target system, formatting the query according to the z39.50 standard, interpreting the results in a format familiar to the searchers, keeping track of results etc.
3. Z39.50 eliminates the need for expertise in the use of a large number of dissimilar systems. (Koganuramath, Mallikarjun, & Kademani, 2001)

**Current Problems In Internet Information Retrieval: Z39.50 As Rescuer**

- There is only a little meta-information about the internet information sources
- There a lot of search syntax available
- There are lot of user interfaces, and
- Presentation of information(records) is not effective
- Z39.50 has the capability to solve the problems mentioned above. (Koganuramath, Mallikarjun, & Kademani, 2001)

**Basic Structure of Z39.50**

The basic function of Z39.50 is to negotiate a connection between the client and server on two systems, execute a search, and return the formatted results to the user's screen.

ORIGIN: In a Z39.50 session, the Z39.50 client software that initiates a request for the user is known as origin.

TARGET: The Z39.50 software system that responds to the origin's request is called the target. (NISO, 2002)

Queries can be sent to multiple databases simultaneously and hence there can be more than one server/target, although user will normally send query from one client/origin at any given point of time. (Miller,1999)

When executing a Z39.50 search, the user specifies search terms that will be used to match against access points in the database. The user's query identifies information, or **attributes**, about those search terms that specify how that term is to be treated when used in the search. There are several different types of attributes:

**Use** attributes indicate database access points— searchable fields or indexes that can be specified in the search. For example, a search for an author's name or a publication title would be specified by use attributes.

**Relation** attributes are descriptors that specify characteristics such as less than, greater than, or equal to. A search for books published during or later than 1996 would use relation attributes in the query.

Other attributes that control queries include truncation or omitting of characters in search terms and the structure of the query itself. In Z39.50 implementations, attributes belong to published attribute sets, which define characteristics of searches for given types of information. An example is the registered "bib-1" attributes set, which specifies a standard way that searches for bibliographic information will be executed. (Pandian & Karisiddappa, 2004)

**Facilities and Services**

Z39.50 groups together protocol devices that supports certain tasks (eg. compromising session, facilitating a search, and asking retrieval records) into facilities.(NISO, 2002)
Facilities consist of 11 elements:

- Initialisation
- Search
- Retrieval
- Result-set-delete
- Sort
- Browse
- Access control
- Accounting / resource control
- Explain
- Extended services
- Termination

Each one of the above elements are further divided into services which ease action between the origin and the target, and Z39.50 applications select those services which will accomplish their function.(Miller, 1999)

| Facility | Service |
|---|---|
| Initialization | Init |
| Search | Search |
| Retrieval | Present<br>Segment |
| Result-set-delete | Delete |
| Browse | Scan |
| Sort | Sort |
| Access Control | Access-control |
| Accounting/ Resource Control | Resource-control<br>Trigger-resource-control<br>Resource-report |
| Explain | *uses the Services of* Search *and* Retrieval |
| Extended Services | Extended-services |
| Termination | Close |

Table 1 :Facilities and Services (Miller, 1999)

**Initialization**

It's the first step in the process of inquiry in which origin and target get known to each other and settle to a set of rules for handling the queries. Systems which require passwords will also exchange authentication here. (Miller, 1999)Thus, it allows the origin and the target to negotiate and start a Z39.50 search session called as Z- Association. The set of rules to which origin an target settles to include sharing information about the version of the protocol being used by client and server, default character set, size and limits on records to be transferred, and other Z39.50 features eg. Sorting, browsing and deleting result sets. (NISO,2002)

**Search**

This is the heart of all service as it where the majority of work is done. It capacitates the origin to submit queries to the target which may range from simple to complex (using Boolean- AND, OR, NOT, truncation,>, < and other advanced search techniques). (Miller, 1999)The user formulates a search

query from the vocabulary provided by the service using an interface format familiar to the user. The search term provided by the user which could be a word, phrase or exact title is characterised by attributes whose value tells the server how to treat that term.Z39.50 supports multiple search results and also combines the results of these searches when required.(NISO, 2002)

What comes back?

- Full bibliographic records
- Brief bibliographic records
- Circulation information
- Holdings information
- Combinations. (McCallum)

**Present**

This is the delivery and display part of the results to the user. The user may ask to display the whole search result or some part of it like top ten records or so and also the format (record syntax) in which the result should be displayed. For e.g. one user can out of 100 results ask to display first 20 results and in the Dublin core format, while the other user can ask to display top 10 results out of 200 search results and in USMARC format.

The record syntaxes used by Z39.50 could be

- MARC (machine readable re cataloguing), USMARC, UKMARC, DANMARC, AUSMARC depending upon the place of vendor and the key market.
- SUTRS-Simple Unstructured Text Record Syntax
- Raw ASCII text file
- Dublin Core Metadata Format
- XML(eXtensible Markup Language)
- GRS-1 Generalised Record Syntax(Miller,2002)

Other features supported by facility protocol are:

-**Sort** the results as specified by the user

-**Delete** search results, either entirely or for specified records.

-**Scan** (browse) through index lists of items such as subject terms, titles, author names, and other database fields.

-**Access Control** through authentication and passwords.

-**Resource Control and termination** of Z39.50 search sessions by the client or server.

-**Explain**, which allows the client to exchange information with the server about what type of server the client is querying and what the client must do to communicate successfully with that server in a Z39.50 session

-**Extended Services**, which define operations the client may request of the server, such as saving a search for later re-use or running a search query on a periodic schedule. (NISO, 2002)

**Working**

1 Z39.50 operates in a client-server environment, acting as a common language that all Z39.50 enabled systems can understand.

2 It is a language that bridges the many languages and dialects those information systems 'speak'. For Z39.50 communication and interoperation to take place , both the client and the server must be able to speak the Z39.50 language. Most Z39.50implementations use the standard TCP/IP Protocol to connect to the systems and Z39.50- complaint software to translate between them for search and retrieval. To the users this all happens behind the scenes, they simply see their familiar search and display interface.

3 To achieve the interoperability, Z39.50 standardises the messages that clients and servers use for communication regardless of what underlying softwares systems or platforms are used.Z39.50 supports open systems i.e. it is non-proprietary or vendor independent.

4 A client system that implements the Z39.50 protocol allows communication with diverse servers, and a server system that implements the protocol is searchable by clients developed by different vendors.

5 Without having to know how the server works the user performs the search through Z39.50 interface on the client.

6 Z39.50 governs how the client translates the search into a standard format for sending to the server.

7 After receiving the search, the server uses Z39.50 rules to translate the search into a standard format recognised by the local database, performs the search, and returns the results to the user's client.

8 The client's user interface software processes the results returned via Z39.50 with the goal of displaying them as closely as possible to the way records are displayed in the user's local system.[6]

9 The following chart shows the working of Z39.50.(NISO, 2002)

**Few Advantages of Z39.50**

- ❖ It does not require the searcher to be familiar with the details of the standard.
- ❖ The origin module within the searcher's system is responsible for establishing the connection to the target system, formatting the query according to the Z39.50 standard, interpreting the results in a format familiar to the searchers, keeping track of results, etc.
- ❖ It eliminates the need for expertise that requires database searching, such as cataloguing, acquisitions and inter library loan.
- ❖ Because the search interfaces of different systems are transparent, users no longer need to master how to use each database.
- ❖ Easier access to electronic resources reduces user's time spent in searching for relevant information.
- ❖ Greatest benefit is the seamless access to multiples, diverse database through a single interface. (BiblioTech Review, 2001)

**Applications and Services Of Z39.50 In Libraries**

Originally Z39.50 was designed to help with searching very large bibliographic databases like those of OZLC and the Library of Congress. Today, Z39.50 is used for wide range of library functions that involves database searching, from cataloguing to interlibrary loans to reference. With the rapid growth of internet the Z39.50 has become widely accepted as a solution to the challenge of retrieving multimedia information including texts, images, digitized documents etc. It is being used to access for example museum data, govt. information, geospatial data, etc. It can also be used to search online

databases and CD-ROMS that the vendors develop according to a variety of design schemes. Users can search all databases with a single Z39.50 client even though each uses a different hardware and software configurations, shares different types of data and has different internal search logic. With the help of Z39.50 information systems (or libraries) can retain their uniqueness while providing a uniform interface to information seekers. Libraries can adopt a single standardised interface fir their patrons to access the library's catalogue, purchased CD-ROMS, subscriptions to online databases, and internet resources. Data from a variety of sources can be extracted to a common format for offline use or import into a local database. (Pandian & Karisiddappa, 2004)It is widely used in library environment, library consortia and like and is often incorporated into Integrated Library Systems and Personal Bibliographic Reference Software.it also encourage resource sharing and concept of consortia on a large scale. The services of library are now becoming 'Z39.50-enabled' in the same way as they became 'web-enables' but the process have been slow and still on the run, however, this will be long lasting.

Following are the services which are benefitted by the protocol:

**OPACs**:

Web gateways allows OPAC to be available through web and endowing OPACs with Z39.50 will help the user to access the catalogues of the library located in any corner of the world or just simply of the local one.

**Cataloguing:**

(a) Bibliographic record sourcing

With the help of Z39.50 searching, retrieving and downloading of bibliographic records has become easy and effective. Thus, libraries with the help of this protocol can search multiple databases and compare the records and hence save the time and cost due to duplicate cataloguing.

(b) Union Catalogue

Union catalogues - combined catalogues of several libraries - have been a valuable tool for decades among the libraries but it is expensive and difficult to maintain. Using Z39.50 enabled catalogues and OPACs, a “virtual” union catalogue can be assembled without any changes to the individual organisation's methods and procedures. A user may sit at an OPAC screen and search several catalogues

simultaneously as if they were one. Useful material and its location can be displayed with no additional work by library management apart from set-up of Z-clients. Ad-hoc groupings of libraries can be assembled to suit the needs of the users without any technical or administrative fuss. Colleges or companies suddenly merged or taken over, co-operative degrees, stock sharing schemes any scenario where it might be useful to have a consolidated view of library and information resources is simple to set up and administer.

**Inter Library Loan:**

Now since the Z39.50 makes union catalogue 'virtual' its direct impact would be on ILL as it would allow user to identify the location of the item he wants. The extended service feature of Z39.50 would help the user to arrange for the delivery or that particular item including account verification and billing.

**CD-ROMs Access**

Despite the steady migration of CD-ROM information providers to Web based services, CD networks will be a feature of library services for some time. There remains the practical problem in using the networkable state of CD-ROMs as there is need to understand each different software interface and having to search each database separately. Using Z39.50, it would be possible to search each database using a single familiar interface and, additionally, several databases at the same time. Z 39.50 also solves the problems of being able to use different clients e.g. Macs, UNIX Workstations - even dumb terminals could be used. The SilverPlatter ERL technology actually provides similar facilities - but it is a proprietary standard and of limited application outside the CD-ROM area.

**SDI Service:**

Version 3 of Z39.50 allows the user to specify search statements to be saved and run at intervals. Thus the user may for instance identify useful libraries and information resources and set up SDI profiles using a single interface. Searches can be automatically run when required and the results downloaded from the database to a specified destination e.g. fax or e-mail. Z39.50 makes the much-vaunted Push Technology seem Stone Age in comparison.

**Web Searching and Filtering:**

Searching the Web is frustrating for some of the very reasons that Z39.50 was developed i.e. many

different search engines and user interfaces. By adding an optional Z39.50 interface to Search Engines, much of the frustration and time wasting could be avoided.

The much-discussed topic of filtering unwanted areas of Web content could be attacked through an extended service. Each library could set their own filter parameters on the Z39.50 client used to access the major Search Engines.

Given the rapid development and constant vying for competitive edge in the Web Search Engine arena Z39.50 server technology has probably a low priority. As the benefits of Z39.50 begin to be appreciated by professionals, however, it will only need one Search Engine to add the feature and there will be an avalanche of followers.

**Database Updates**

Another task type that may be used as an extended service is updating a database. Thus a Z-client may for example retrieve a record from a database, edit it and then send it back to update the database.

GeoCAT product from Geac illustrates this function nicely since it may be used as a standard tool with either the ADVANCE or PLUS Library Management systems.

**Commercial Information Database**

Library catalogues are only a fraction of the searchable information available. There are hundreds of commercially available information service providers like Dialog, Lexis Nexis, FT Profile etc. These services allow very complex search statements and Z39.50 (version 3) contains equivalent search statements including proximity searching, term highlighting, image retrieval, individual chapter retrieval, specification of variant forms for downloading e.g. Word, Word Perfect etc. Accounting and authorisation controls are also built in. Again, by using Z39.50 protocols, the complexity of searching disparate databases can be reduced. (BiblioTech Review, 2001)

**Z39.50 Products and Systems:**

Z39.50 can be incorporated into all sorts of products and systems only a few of which are currently being exploited. Z39.50 can be implemented on any computer system and so opens the way for true "interworking". Thus a Mac Z-client can access a UNIX and a Windows NT based system simultaneously and seamlessly.

**OPACs**

Integrated into a Library Management System (LMS), a Z39.50 OPAC allows users to search the local library catalogue and also to select from a set of library defined external library catalogues. This is the commonest use for a Z-client. OPAC Z-clients can be on the desktop, on a local private LMS server or publicly available over the Internet. They can be built as Windows, UNIX, Java or Web clients Independent of the systems that they are accessing.

**Cataloguing And Other Clients**

A cataloguing client normally communicates with the database in an LMS via a proprietary piece of software and/or SQL. Geac's GeoCAT is the only example so far of a Z-client being used for catalogue update purposes. It works with Geac's Advance and Plus but could work with other systems in theory. By using a Z-client, it is possible to:

- use one cataloguing tool against several databases from different vendors
- update two databases at once
- catalogue items remotely over the Internet e.g. to catalogue collections before they are physically transferred
- Notify a bibliographic utility that a record has been used rather than just viewed for accounting purposes.

Geac have also built extended services for accessing patron records so a user may request, look at account information, place ILLs etc. from a Web Z-client. Here the use of a Z-client is not apparent to the user but it has paid dividends to Geac since they have only one client to maintain against ADVANCE and PLUS.

**Personal Bibliographic Tools**

Several personal or standalone Z39.50 clients are available as desktop tools for librarians and researchers whose local LMS does not have a Z39.50 capability. BookWhere, SLS PC Browser and ZNavigator are good examples.

**Z-Technology Packages**

The first companies with Z-products were the large system suppliers like Ameritech, DRA, Innovative,

Geac etc. They provided both Z-clients and Z-server packages with their systems and so if you run one of the big systems you are “in the club” as far as bibliographic records are concerned. But what about libraries with systems that don't have Z39.50 or with special collections not on their main library system? One answer is to load a separate copy of your catalogue on a specialist Z-server database engine and buy a Z-client OPAC to view your own and any other databases. Combinations of Z-client and Z-server software are being marketed as “Z-Technology” packages now. They typically provide Z-server, database engine with loading and indexing routines, PC Z-clients and Web Z-clients. OCLC's Site Search is a good example of such technology.(BiblioTech Review, 2001)

**Z39.50 Globally**

Z39.50 is recognized worldwide as the international standard for networked information search and retrieval. The convergence of Z39.50 and ISO 23950 has resulted in a global standard with extensive support for multiple languages and character sets.In North America and internationally, many library software vendors, bibliographic utilities, commercial sector, and government organizations have adopted Z39.50 functionality in their products. Some 67 organizations have registered as official Z39.50 implementers. Likewise, the number of independent developers of Z39.50 client and server software products and Z39.50 solutions for information and metadata management is growing.

The broad range of accessible information includes:

- · Bibliographic data
- · Government information
- · Scientific and technical data
- · Geospatial data
- · Thesauri and other taxonomies
- · Digital library collections
- · Arts and humanities data
- · Museum information

Certainly, libraries have been central to the spread of Z39.50 technologies to provide access to databases and catalogues. Increasingly, large-scale applications of Z39.50 functionality support access to information for users of entire library networks and consortia. (NISO, 2002).

**Z39.50 Client and Server Software on the Web**

There are several of z39.50 Client/Server softwares on the web. Many are available as free downloads, where as some on evaluation.

Following are few such available types of software:

- Z Navigation: a z39.50 Client software is designed to run on Windows 3.11 and Windows 95 PCS
- http://www.sbu.ac.uk/~litc/caselib/software.html [1.6 MB]
- Book where Database: Free evaluation version.
- http://www.bookwhere.com [2963 KB]
- UFO/Fiat Lux: Windows 95/NT z39.50 client
- http://sun3.lib.uci.edu/~toyofuku/fiat_lux.htm
- A Search Module for Apache: Implements z39.50 search from within the
- Apache HTTP Server
- http://igsmtl.er.usgs.gov/apache/mod_search.html
- EndNote 3.0 - first z39.50 Mac Client (does Windows, too)
- http://www.niles.com/
- Netscape for Windows z39.50 plug-in (Alpha version)
- http://www.markkelly.com/z3950/ciir.htm
- SIRSI VIZION Pro : offers access to a seriof z39.50 clients and servers
- http://www.sirsi.com/Vizion/viziontoc.html
- Isite: CNIDR,Center for Networked Information Discovery and Retrieval
- http://www.cnidr.org/ir/isite.html (Koganuramath, Mallikarjun, & Kademani, 2001)

**13 Z39.50 in India**

As compared to the global counterpart Indian libraries and universities are yet in the process of fully exploiting and implementing this protocol. Some examples are:

a) N-LARN

It stands for NMEICT Project on Library Automation and Resource Sharing. This Z39.50 server provides bibliographic data for academic libraries in India.Its reliability is 67% as found on IRSpy

b) Vikram Sarabhai Library, IIM Ahmedabad. (Kumar)

## 14 Limitations of Z39.50

- Lack of agreed structure for representation of local holdings and availability data which is crucial to the completion of most end user searches i.e. user wants to know not that a remote library has a copy of given item in its catalogue but whether the item itself is available and at which location.
- Loss of branding so that the originator cannot guarantee acknowledgement on the end-users display. This could make Z39.50 approach unacceptable to some commercial companies.
- Complexity and thus high overheads to use.(Joshi, 2003)

## Conclusion

Z39.50 is an open protocol standard that represents the culmination of two decades of thinking and debate about how information retrieval functions can be modelled, standardised, and implemented in a distributed environments, and importantly it has been tested through substantial deployment experience.[13]it is unquestionably true that in spite of quirks and limitations Z39.50 turns out to be an effective model which can handle numerous and simultaneous queries on a widely distributed networked systems which is also the need of the hour as there is a mushroom growth in the number of databases and information resources. Thus, it is important for every person related to library system to understand the whole picture of this mischievous protocol and start implementing it on a larger scale.

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# Fuzzy Method For The Selection of Suitable Feed Stock For The Production of Biodiesel

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## ABSTRACT

*Investigations are being carried out on different non edible seed oils with different production methods e.g.; different processes, different molar ratios, different catalysts, different reaction time and different temperature, throughout the world. Vegetable oils are important substitutes for diesel fuel, as their properties are comparable to diesel fuel and also they are renewable in nature. In this paper, we propose a fuzzy based method for the selection of the suitable feed stock oil out of some feed stock oils researched so far in India. This method is based on the relations between different parameters and feed stocks available to obtain biodiesel, using intuitionistic fuzzy sets. For this purpose, we develop a hypothetical case study with assigned degree of membership and degree of non-membership based on the relation between the feed stocks, their properties and constraint like their availability in different zones of India.*

***Keywords: Fuzzy Set, fuzzy relations, Intuitionistic fuzzy sets (IFS), non edible oil, feed stock, biodiesel***

## 1. INTRODUCTION

Use of biodiesel is being promoted to take care of rapidly depleting reserves of fossil fuels and increasing pollution level. In country like India, where the choice is to be made between food and fuel, the non edible oils are best suited for the production of biodiesel as compared to edible oils. Every feed stock has its pros & cons and unique characteristic. In this paper, we propose a mathematical model for the selection of a feedstock for production of biodiesel based on the set of available feedstock related options. In this paper, Thumba ($F1$), Moringa Oleifera ($F2$), Jatropha ($F3$), Mahua ($F4$), Sal ($F5$) and Karanja ($F6$) are chosen to find out the feasibility as promising resource for production of biodiesel in different parts of India. Adlassnig [1], Ahn[2] and Yao[3] elaborated fuzzy relation between sets.

For a fixed set $X$, IFS of $A$ is defined as:

$A = \{< x, \mu_A(x), \nu_A(x) > | x \in X\}$

Where $\mu_A(x): X \to [0,1]$ *and* $\nu_A(x): X \to [0,1]$ define the degree of membership and degree of non-membership of the element $x \in X$ to the set $A$.

For every $x \in X$, $0 \le \mu_A(x) + \nu_A(x) \le 1$ and the amount $\pi_A(x) = 1 - \mu_A(x) - \nu_A(x)$ is called the intuitionistic index or hesitation index, which may require to membership value, non-membership value or both. Let $A$ be an IFS of the set $X$ and let $R$ be an IF relation from $X \to Y$, then Max-min-max composition $B$ of IFS $X$ with the IF relation R ($X \to Y$) is defined as $B = RoA$ with membership and non-membership function.

Let $F = \{f_1, f_2, ....., f_m\}; P = \{p_1, p_2, ....., p_n\}; C = \{c_1, c_2, ....., c_q\};$ be the finite set of feed stock, parameters and constraints respectively.

According to Kumar [4, 5], two fuzzy relations (FR), $Q$ and $R$ are defined as:

$Q = \{< (f,p), \mu_Q(f,p), \nu_Q(f,p) > | (f,p) \in F \times P\}\}$

$R = \{< (p,c), \mu_R(p,c), \nu_R(p,c) > | (p,c) \in P \times C\}$

Where $\mu_Q(f,p)$ indicate the degree to which the parameter p appear in feedstock f and $\nu_Q(f,p)$ indicate the degree to which the parameter $p$ does not appears in feedstock $f$. Similarly $\mu_R(p,c)$ indicate the degree to which parameter $p$ confirm the constraints $c$ and $\nu_R(p,c)$ indicate the degree to which the parameters $p$ does not confirms the constaints $c$.

The composition $T$ of IFRs $R$ and $Q$ ($T = R \circ Q$) describe the state of feedstock $f_i$ in terms of the undertaken for the process from $StoC$ given by membership and non-membership as:

$\mu_T(f_i, c) = \max_{i \in I} \{\min [\mu_Q(f_i, p), \mu_R(p, c)]\}$ *and*

$\nu_T(p_i, c) = \min_{i \in I} \{\max [\nu_Q(f_i, p), \nu_R(p, c)]\}; \quad \forall f_i \in F$ *and* $c \in C$

We can estimate the labels of parameters of different feed- --stocks using the information obtained from the chart of given case study. From $Q$ and $R$, one may compute new measure of IFR $T$ for which, in general, the parameteteric labels of feedstock $f$ for any constraint $c$ such that the following is to be satisfied:

(i) $F_T = \mu_T - \nu_T \cdot \pi_T$ is greatest and (ii) The equality $T = R \circ Q$ is retained.

This new measure of $T$ will translate the higher degrees of association and lower degree of non-association of property as well as lower degrees of intuitionistic index to the processing.

If there is almost equal values for different processing in $T$ is obtained, we consider the case for which intuitionistic index is least.

## 2. CASE STUDY

To see the application of the method, let us frame a hypothetical case study:

Let $F = \{f_1, f_2, f_3, f_4, f_5, f_6\}$ be the set of feed stocks and $P = \{P_1, P_2, P_3, P_4, P_5\}$ be the set of available parameters of different feed stocks.

Suppose the IFR $Q(S \to I)$ is given by (hypothetically):

| $Q$ | $P_1$ | | $P_2$ | | $P_3$ | | $P_4$ | | $P_5$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| Feedstock | $\mu_Q$ | $\nu_Q$ | $\mu_Q$ | $\nu_Q$ | $\mu_Q$ | $\nu_Q$ | $\mu_Q$ | $\nu_Q$ | $\mu_Q$ | $\nu_Q$ |
| $F_1$ | 0.8 | 0.1 | 0.6 | 0.1 | 0.2 | 0.8 | 0.6 | 0.1 | 0.1 | 0.6 |
| $F_2$ | 0.0 | 0.8 | 0.4 | 0.4 | 0.6 | 0.1 | 0.1 | 0.7 | 0.1 | 0.8 |
| $F_3$ | 0.8 | 0.1 | 0.8 | 0.1 | 0.0 | 0.6 | 0.2 | 0.7 | 0.0 | 0.5 |
| $F_4$ | 0.6 | 0.1 | 0.5 | 0.4 | 0.3 | 0.4 | 0.7 | 0.2 | 0.3 | 0.4 |
| $F_5$ | 0.6 | 0.1 | 0.2 | 0.8 | 0.6 | 0.1 | 0.1 | 0.6 | 0.8 | 0.1 |
| $F_6$ | 0.2 | 0.8 | 0.6 | 0.1 | 0.1 | 0.6 | 0.8 | 0.1 | 0.6 | 0.1 |

Let the Constraints $C = \left\{ \begin{matrix} EasternIndia, Western, NorthernIndia, \\ SouthernIndia, CentralIndia \end{matrix} \right\}$ be the set of options available for their availability.

Suppose the IFR $R(P \to C)$ is given by (hypothetically):

Table 1:

| $R$ | EI | | WI | | NI | | SI | | CI | |
|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | $\mu_R$ | $\nu_R$ | $\mu_R$ | $\nu_R$ | $\mu_R$ | $\nu_R$ | $\mu_R$ | $\nu_R$ | $\mu_R$ | $\nu_R$ |
| $P_1$ | 0.4 | 0.0 | 0.7 | 0.0 | 0.3 | 0.3 | 0.1 | 0.7 | 0.1 | 0.8 |
| $P_2$ | 0.3 | 0.5 | 0.2 | 0.6 | 0.6 | 0.1 | 0.2 | 0.4 | 0.0 | 0.8 |
| $P_3$ | 0.1 | 0.7 | 0.0 | 0.9 | 0.2 | 0.7 | 0.8 | 0.0 | 0.2 | 0.8 |
| $P_4$ | 0.4 | 0.3 | 0.7 | 0.0 | 0.2 | 0.6 | 0.2 | 0.7 | 0.2 | 0.8 |
| $P_5$ | 0.1 | 0.7 | 0.1 | 0.8 | 0.1 | 0.9 | 0.2 | 0.7 | 0.8 | 0.1 |

The Composition $T = R \circ Q$ is follows as:

Table 2:

| $T$ | EI | | WI | | NI | | SI | | CI | |
|---|---|---|---|---|---|---|---|---|---|---|
| Feedstock | $\mu_T$ | $\nu_T$ | $\mu_T$ | $\nu_T$ | $\mu_T$ | $\nu_T$ | $\mu_T$ | $\nu_T$ | $\mu_T$ | $\nu_T$ |
| $F_1$ | 0.4 | 0.1 | 0.7 | 0.1 | 0.6 | 0.1 | 0.2 | 0.4 | 0.2 | 0.6 |
| $F_2$ | 0.3 | 0.3 | 0.2 | 0.6 | 0.4 | 0.4 | 0.6 | 0.4 | 0.2 | 0.8 |
| $F_3$ | 0.4 | 0.1 | 0.7 | 0.1 | 0.6 | 0.1 | 0.2 | 0.4 | 0.2 | 0.5 |
| $F_4$ | 0.4 | 0.1 | 0.7 | 0.1 | 0.5 | 0.3 | 0.3 | 0.4 | 0.3 | 0.4 |
| $F_5$ | 0.4 | 0.1 | 0.6 | 0.1 | 0.3 | 0.3 | 0.2 | 0.1 | 0.2 | 0.1 |
| $F_6$ | 0.4 | 0.3 | 0.7 | 0.1 | 0.6 | 0.1 | 0.2 | 0.4 | 0.6 | 0.1 |

Now, we calculate $S_T$ :

Table 3:

| $F_T$ | EI | WI | NI | SI | CI |
|---|---|---|---|---|---|
| $F_1$ | 0.35 | 0.68 | 0.57 | 0.04 | 0.08 |
| $F_2$ | 0.18 | 0.08 | 0.32 | 0.6 | 0.2 |
| $F_3$ | 0.35 | 0.68 | 0.57 | 0.04 | 0.05 |
| $F_4$ | 0.35 | 0.68 | 0.44 | 0.18 | 0.18 |
| $F_5$ | 0.35 | 0.57 | 0.18 | 0.13 | 0.13 |
| $F_6$ | 0.31 | 0.68 | 0.57 | 0.04 | 0.57 |

From the table, we conclude that feedstock $f_1, f_3, f_4, f_5 and\ f_6$ are suitable for Western India [7-9] and feedstock $f_2$ [6] is suitable for Southern India for production of biodiesel.

## 3. CONCLUSION.

In this paper, we use generalized concept of fuzzy set theory. A study for selecting and promoting the feedstock selection in different zones of India has been made with IFS theory. IFS method is an efficient tool for decision making problem. A fuzzy base feedstock selection for biodiesel production is being made which may prove to be an optimized selection.

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# A Fuzzy Based Methodology For User's Perception Evaluation of Low Floor Buses For Bhopal City

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## ABSTRACT

*For the market oriented economy, the success or failure of any enterprise relies heavily on the user's satisfaction. Similarly in the Public Transport Services, by assigning different weights for different attributes like fare, frequency, speed, comfort, network coverage, safety, bus stop locations, security, passenger's information system, staff behavior etc., one can know the user's satisfaction after collecting the data of user's perception with the help of questionnaire based survey in public transport. Some cities have a very high share of public transport due to a well developed and long existing network for public transport. For example, Madrid has an all-inclusive public transport system including metro lines, trams and buses. But in most of the Indian cities, the user's satisfaction is neglected many a times by the public transport service providers. However, to improve the quality of service, the attributes which affect the users have to be acknowledged. This study focuses on the development of methodology for qualitative assessment of low floor bus service in mid-sized Indian cities like Bhopal.*

## 1. INTRODUCTION

Public Transport includes all multiple occupancy vehicle services designed to transport customers on primarily local routes and then after on regional routes. It is also a shared commuter's transportation system which is offered for use by the common public, as different from a variety of other modes like cab, carpooling, traveler buses or hired buses which are not used by common public due to prior reservation. From a city mobility point of view, public transport is far more efficient than private vehicles in terms of the consumption of energy and street space it uses. Suppose if we take an example of bus, it consumes only 2.5 times extra space than a car with the carrying capacity of 40 passengers. Also, from the fuel point of view, the same bus consumes about 3 times excess fuel as any four wheeler like car (Rachel, 2011). Therefore it is assumed that Public Transport is the backbone of any transport system

due to their important role as private modes cannot afford by everyone. Recognition and study of such factors that influence the commuter's opinion for the overall quality of service is vital. Some major cities in India prefer the modern generation and improved public transport system to the current conventional public transport system. Major cities like Delhi, Ahmedabad, Pune, Mumbai have adopted the low floor buses because of their higher carrying capacity, improved design, safe and user friendly mode. Mid-sized cities like Indore, Lucknow and Bhopal have also incorporated the low floor buses for the users due to their high efficacy.

## LITERATURE REVIEW

Today we have numerous technological developments coming up every other day to evaluate the user's perception. One such development in this area is Fuzzy Logic. Probability and Fuzziness manage ambiguity about information. But in some circumstances, both these theories should be combined in order to get a better understanding of reality. Fuzzy logic provides a fixed method to get a definite conclusion linked with unclear, uncertain, imprecise, noisy, or absent input detail. **Imam (2014)** investigated the extent of customer satisfaction and level of service for the users of public transport services in Amman. For this study the survey questionnaire was based on the eighteen travel attributes. At the survey time, every respondent was asked to rate their perception with each item on a specified scale ranging from 1 to 10; where 1 is extremely unsatisfied and 10 is extremely satisfied. Similarly, they were also asked to rate the importance of every attributes on the Likert Scale with the ratings from 1 "Not important" to 5 "Very important". The results showed that the users of buses are the most satisfied, followed by the user's jitneys, and minibuses, respectively. But, the overall satisfaction level reflects that users are not generally fully satisfied with the available public transport systems in the Amman, since even the highest score of (101/180) translates to merely 56%. **Ayanda et al. (2014)** explained that the study of level of service and user's satisfaction in public transport is vital because it affects society and is also very necessary for the happiness of any country. This research study was conducted in Johannesburg, South Africa and around 902 users were selected using the commuter intercept survey. This study work disclosed that younger people are much attracted towards public transport in comparison to other age people. **Shalini et al. (2013)** selected the Jaipur city for their research work related with the quality of service of existing public transport system in the city. Nineteen attributes have been chosen judiciously for the survey in order to assess the level-of-service of existing public transport system of Jaipur city. In this paper, quality of transit service was evaluated using the fuzzy, AHP and Fuzzy AHP approaches. The results obtained by AHP and Fuzzy-AHP were found to be between 8 % and 13.7%. **Umoh et.al (2013)** to improve the sales, trustworthiness, robustness and profitability all these researchers, developed a fuzzy- based decision support framework and applied that model for customer loyalty and relationship management.

They used the fuzzy logic approach for the analysis of customer loyalty and relationship management. They collected the data from the supermarket of Jane and Juliet located in Nigeria. The outcomes suggested many new ideas to the companies like improvement in the customer equity, launching of loyalty programs, maximizing the customers' value and, this way, the companies' profit could become in many folds. **Priya et al. (2013)** suggested a methodology for finding the market value of product manufactured by Cadbury Company using fuzzy logic technique. The parameters which have been taken in this study to find out the market value of Cadbury product are Price, Quality, Brand Loyalty, Flavor and packaging. All these variables are different in nature and contribute to market value of Cadbury product. **Melike et al. (2013)** conducted their study on very famous city of Istanbul. It is one of the most important and largest cities of Turkey with a population of 14.4 million. They concluded in their work that to increase the use of public transport, service quality and level of service of public transport system should be on upper side. This study suggested that to have higher customer satisfaction, providing Istanbul Card process should be made easier, the distance between buses and stops should be decreased, the security/safety in vehicles and at bus stations should be improved and finally finding of lost property should be facilitated for all public transportation companies. **Dhote et al. (2012)** applied standard 22-items of SERVQUAL and these items were distributed into 5-factor dimension of SERVQUAL-tangible, reliability, responsiveness, assurance, empathy by knowing patient expectation and observation of service in the reputed hospital. In this study, a fuzzy reasoning approach has been applied to determine the service quality and help in the quality assessment of hospital services. The approach proposed in this work is very handy to know the status of service without any complex mathematics. Fuzzy reasoning approach can be further utilized to do this service quality check in online fashion. The proposed approach will help hospitals as well as researchers to benchmark the procedure to determine service quality in hospitals. **Cheng et al. (2011)** suggested an evaluation approach on assessing the service quality and level of service in the Taiwan's hotel industry based on the TOPSIS Technique. TOPSIS technique is referred as Order Performance by Similarity to Ideal Solution (TOPSIS). Customers and employees are the two group used as the part of this study. TOPSIS method is very useful to know the importance of weights for the evaluation criteria and also useful to synthesize the ratings of the studied hotels in fuzzy environment. The study result obtains a crisp overall performance value for each hotel to make a final comparison between the perceptions of the two research groups.

## METHODOLOGY

The principal focus of this study will be related to level of service of public transport user's perception. For developing a fuzzy based methodology to assess public transport user's perception through the proposed study consists of the following steps

i. Develop a method using fuzzy logic for evaluation of user perception.

ii. Apply the method to the data collected for the study area.

iii. Analysis of data using fuzzy logic to get the level of service of public transport service from user's perspective.

iv. Defuzzification of Final output to get Crisp Value.

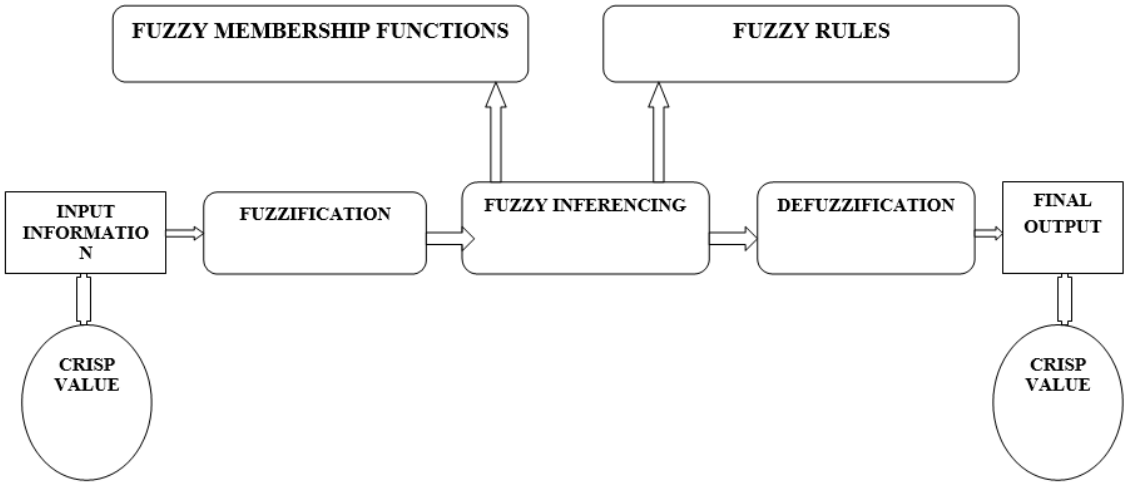


Figure 1.1 Methodology for User's perception evaluation of low floor buses

## CONCLUSION

Most of the cities of world are facing the problem of high accident rate and in most of the cases; the victims are two wheeler and four wheeler users. This situation can be avoided by promoting the use of public transport. Public transport also helps to avoid some other traffic related problems like congestion, air and noise pollution, delays, use of non-renewable energy sources etc. Higher level of service in public bus transport not only keep customer to continue using public bus transport to fulfill their travel demand but also attract potential customer. Fuzzy logic technique can be handy in many areas tied to public transport user perception including the evaluation of the service quality, other transportation services. This article sought to develop a comprehensive fuzzy based approach to assess the public transport user's perception that would consider the distinctive characteristics of the individual who use public transport services. The fuzzy technique **that might** be **fitly** applied to the study of public transport user perception has been **elected** from **several** fuzzy approaches. After adopting this method detailed procedures and guiding principle for using fuzzy sets to analyze public transport user's perception were developed based on this recommended approach.

# Study of Password Cracking Methodologies

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## ABSTRACT

*Abstract - In this paper, various password attacks are analysed and their comparisons are made on the basis of the text type entered which is may be a number string, plaintext password containing all characters. In this experiment, Cain&Abel is used as a password cracker tool to demonstrate the three types of password attacks commonly used by attacker nowadays: Dictionary attack, Brute force attack and Rainbow table attack. Cain&Abel is used as a password cracker tool because it is covering several features of hacking tools into a single application such as penetration testing to find the security vulnerability in the system with all hashing techniques such as MD5 (Message Digest), SHA – 1(Secure Hash Algorithm), SHA – 2 (predecessor of Secure Hash Algorithm-1) etc. It is observed with the experiment that time complexity to crack the password in Rainbow table is better and easy as compared to other existing contemporary methodologies.*

***Keywords – Brute force attack, Dictionary attack, Rainbow table attack, Hashing algorithms.***

## 1. INTRODUCTION

Cyber-crime encompasses any criminal act dealing with computers and networks (called hacking). Additionally, it also includes traditional crimes conducted through the Internet such as Internet fraud, identity theft and credit card account thefts wherein password cracking is one of the loopholes of cyber-crime **[1]**.

Password cracking can be defined as a process of attempting to guess or crack password and attempting to gain access to a system, also be defined as "a process for recovery of password from data that are stored into the system." Therefore, password cracking is an approach which uses in repetition order to try and guess the password. Moreover, the purpose of password cracking might be help user to recover a

forgotten password, gain unauthorized access to a system, or perform preventive measure by system administrator to check for password strength **[2]**. Identity authentication or access control through password is still a widely method of ensuring system security, despite the increased use of alternative techniques such as graphical password, smart card and biometrics.In order to force users to create strong password, system administrator policies often enforce several complex rules intended to force users into creating strong password **[3]**. Under such rules, users may be required to use numeric or special character, have to enter password of a minimum length and avoid word found in a dictionary. In this manner, methods of password cracking can be paraphrase as a test for password guessing, because we do not know if the proper method/test is going to be efficient.

**Classification of Password attacks.** There are three types of password cracking methods on which study is performed: **Brute force attack, Dictionary attack, Rainbow table attack.**

**Brute force.** These attacks are popular because the most input text only covers a fraction of the total words and character is tried until the password is broken not using any input dictionary of human generated words. According to **[4]** there are four types of attacks such as **pure brute force attack, letter frequency analysis, markov models and targeted brute force attack with the help of brute force.** The description of each of them is described below as:

**i) Pure brute force attack** does not use outside probability information that is not found inherently in the key space being searched.

**ii) Letter frequency analysis attack**is an attempt to use the frequency of characters appearing in a training set to increase the effectiveness of brute force attacks and password cracking probability for effective results.

**iii) Markov models** in password cracking is a way to represent the join probability of different characters appearing together.

**iv) Targeted brute force attacks** can comprise letter frequency analysis and Markov models, but applies outside logic to these attacks. For e.g. performing letter frequency analysis attacks, but use a different character set for each character position.

**Dictionary attack.**A file of words is run against database of user password **[5]**, and if it contains a simple dictionary word cracked easily The attackers use a dictionary word lists **[6]**

which comprises of dictionary words, that used as a target toattack the suspect password. The attacker then uses colander rule **[7]** which states that “capitalization the first letter, adding three digits to the end, changing the letter 'a' to '@' etc.” to further match the target password. So, success of dictionary attack depends on both input dictionary and colander rules. Attacker first tries with little input dictionaries, then using much larger input dictionaries to crack the password.

**Rainbow table attack.**In a standard offline password cracking attack, the attacker possess a password hash instead of the password string and its attempt to crack the password string gets unsuccessful because attacker does not possess hash value of the password string. So for implementing this method new strategies have been used referred as Rainbow table **[8]** which maintains the table of the hash values. Rainbow table defined as ”a precomputed table for reversing cryptographic hash functions”, usually for cracking password hashes, in which table **[9]** is used in recovering a plaintext password up to a certain length consisting of a limited set of characters. Rainbow tables always specific to the hash function such as MD5 tables can crack only MD5 hash and it includes various hashing techniques **[10]** like LM (LAN Manager) hash, MD5 (Message Digest) hash, SHA (Secure Hash function). The important concept used in the rainbow table is index value “a value that is stored in the rainbow table at the particular index and ranges from 0 to (key max-1)” which makes it a very efficient compression algorithm for hash look – up tables.

## II. METHODOLOGIES

The various methodologies used for password cracking are brute force attack, dictionary attack and rainbow table. Now, the algorithms on which they work and their basics are described below.

## 2. BRUTE FORCE ATTACK

Brute force works for both online and offline accounts, now how it work for both online and offline is explained below. Brute force works on the concept of the string matching, thecharacter is matched until the password is cracked and comparisons made with the help of various algorithms which are used in brute force.

### Brute force and its basics.

A brute force algorithm proceeds in a simple way, with requirement of huge number of steps. An attacker has an encrypted file — say, you're Last Pass or Kee Pass password database **[11]** and file

encryption key that unlocks the password. To decrypt the password, attacker begins to try every single possible password and see if that results in a decrypted file. Attacker can also use a computer program to increasing the speed of brute-force encryption with the help of computer hardware which is capable of doing more calculations per second.

**No Brute Force for Web – Services.** Applying Brute Force for online and offline accounts are somewhat different. For example, if an attacker wants to brute-force to Gmail account, he start to try every single and possible combinations of password to get easy access to account — but Google will quickly cut him off after a few failed login attempts Gmail will show CATPCHA image (image file of slightly distorted alphanumeric characters) **[12]** to verify user aren't valid one. They'll likely stop your login attempts completely if you managed to continue for long enough. Even after entering the password successfully Gmail asked you to enter the CATPCHA image also only after that attacker can successfully login to targeted account.Services that provide access to accounts will throttle access attempts and ban IP addresses that attempt to log in so many times. Thus, an attack against an online service wouldn't work too well because every combinations of passwords can be made before attack.

**Brute force for Offline – services.** For offline service attack attackers have easy access to the encrypted data, and then there is no way to prevent him from trying a large number of passwords in a short period of time. An attacker snagged an encrypted file from targeted computer or managed to compromise an online service and download such encrypted files. The attacker now has the encrypted data on their own hardware and can try as many passwords.

## 2.1 EXISTING BRUTE FORCE ALGORITHMS

Various algorithms have been developed by many researchers **[6][7][8] [13]**, few of them are studied and described below:

**A. Random password generation**. According to **[13],** random password generation is a method in which randomly words are created with the help of keyboard. Assuming any password, like "security" it is easy to crack, then assuming longer password, like 20 letters which is hard to remember. What if considering a random password that is easy to remember? An easy way to get a random password of any length: enter the letters from all top rows i.e. from "q" to "p", next row, from "a" to "l" and from "z" to "b" through keyboard for e.g. “qwertyuiopasdfghjklzxcvbsecurity”. If the attackers trying to crack the word “qwertyuiopasdfghjklzxcvbsecurity” he will try each and every combination of word which need more time and leisure, in this way it provides the vulnerability.**B. BFM Calculator (Brute Force Method)**. Brute force method calculator **[2]** is used in determining the guess numbers during a password cracking.

One brute force algorithm also proposed by Weir et. al. **[14]** which presented a novel password cracking technique that determines the guess numbers for a brute force cracking algorithm based on **Markov theory [15] [16]** which stated that "it is a stochastic process (random process) in which the probability distribution of the current state is conditionally independent of the path of past states, a characteristic called the Markov-property" for e.g. Assume an alphabet {A, B, C} and a three character-minimum configuration. If training data set **[4]** shows that A is the most likely starting character, B is the character most likely to follow A, and C is the character most likely to follow B, the first guess is ABA, & continuing the process in same manner.

**C. Brute force string matching.** As, explained in **[17],** a brute force string matching problems stated "that compare the entered string with the pattern entered, till the word found matches with the text entered." In, this algorithm two inputs taken **pattern** which contains a string of m characters to be searched for and **text** composed of a long string of n characters to be searched in. The algorithm starts with aligning the pattern at the beginning of the text then each character of the pattern is compared to the corresponding character, moving from left to right, until all characters are found to be match, or a mismatch is detected. While the pattern is not found and the text is not yet exhausted, the pattern is realigned to one position to the right and again compared using the same methodology **[17]** used as described above, the string entered and compared with the text if word found then successfully string cracked. For e.g. considering the pattern "tanvi" and text "tanvi fond of songs", now comparing the each word of the text with pattern, as text matches with the pattern the comparison stopped.

Table I. Comparisons of the brute force algorithm

| **Characteristic factor** | **Random password generation** | **BFM (Brute force method) Calculator** | **Brute force String matching** |
|---|---|---|---|
| **Methodology** | Randomly generated keywords. | Password cracking on the basis of guesses. | Comparison of text and pattern. |
| **Training data set** | Combination of strings, numbers and special characters | 12,000 plaintext passwords | Combination of strings and patterns |
| **Time Complexity** | O $(mn)$ | For , kth character $(k-1)N^{L-1}$ incorrect guesses | O $(n^2)$ |

**Advantages of Brute force algorithm.** A straightforward approach usually based directly on the word comparisons with the following advantages: Firstly, chance of actually finding a password is high since attack uses so many possible combinations with no requirement of setup installations.

**Disadvantages of Brute force Algorithm.** With many advantages brute force algorithm is often the least desirable choice because of the more number of comparisons that will be involved which requires much hardware intensive as, due to lot of processing power because of more number of comparisons. Secondly, much requirement of comparisons takes more leisure and time.

## 3. DICTIONARY ATTACK

A dictionary attack is a technique or method used to breach the computer security of a password-protected machine or server. A dictionary attack attempts to defeat an authentication mechanism by systematically entering each word in a dictionary as a password or trying to determine the decryption key of an encrypted image or a document so as to possibly try to crack the password **[4]**.Dictionary attacks are often successful because many users and businesses use ordinary words as passwords. These ordinary words are easily found in a dictionary, such as an English dictionary.

### 3.1 DICTIONARY ATTACK HASHING ALGORITHM

In dictionary attack the knowledge of hashed passwords and their storage in plaintext form required for security purposes. The hash value of any string, number or special characters entered might be look like something as e.g. :49f68a5c8493ec2c0bf489821c21fc3b. During account login on a website the password entered is hashed and stored in a database, then at the time of login again into the same account the password entered is compared to hashed password stored in the database associated with your user name. The pseudo-code **[18]** for password and username might look something like this.

```
$passwd= md5($_POST['passwd']);

if ($uname == $username and $passwd == $password);
```

The description of pseudo code of dictionary attack with the help of functions used in the Java is described below as:

```
import hashlib
wlist = raw_input('common-passwords.txt')
#common-passwords is the downloaded dictionary
contains the user password database#
file = open(wlist,'r')
wlst = file.read()
file.close()
dictionary = wlst.split()
npt = raw_input('md5: ')
x=0
# compare the hash value of password string and
dictionary word list
while (x<len(dictionary)):
hsh = hashlib.md5(dictionary[x])
if (hsh.hexdigest()==npt):
print 'hash: ' + dictionary[x] ;
break;
x += 1;
```

## 4. RAINBOW TABLE ATTACK

Rainbow Tables **[8]** are basically huge sets of pre computed tables **[9]** filled with hash values that are pre-matched to possible plaintext passwords by reversing the hash function for the determination of the plaintext password. The use of Rainbow Tables allow to crack the passwords in a very short amount of time, however the trade-off is that it takes a lot of storage (sometimes Terabytes) to hold the Rainbow Tables.

### 4.1 RAINBOW TABLE HASHING ALGORITHM

Sometimes it is advisable not to use MD5((Message Digest function) and all hashing techniques **[19]** which is used in the rainbow table as they are outdated password hashing algorithms, instead of hashing techniques **[19]** use cryptographic "**Salt**" (commonly known as random word in dictionary attack) in your password hashing routine. After adding the cryptographic salt (which is a random data used as an additional input to a one – way function that hashes a password or paraphrase). The cryptographic "Salt" or random word increase the vulnerability of the rainbow table by making them secure.

```
Import hashlib
wlist = raw_input(md5_numeric#4-
6_0_2x40000000_oxid#000.rt') [9]
file = open(wlist,'r')
wlst = file.read()
file.close()
npt = raw_input('md5: ')
x=0
while (x<len(dictionary)):
hsh = hashlib.md5(dictionary[x])
if (hsh.hexdigest()==npt)
{
print 'hash: ' + dictionary[x];
}
else
break;
x+=1;
```

The pseudo code proposed in **[19]** is as follows which is coded with the help of python programming language described below:

**Advantages of Rainbow table attack.** The rainbow table attack comprises the following advantages with storage feature of rainbow table: Firstly, Rainbow tables are often used for network security attacks and the password stored in the rainbow table stored in the form of hash values rather than as plaintext password for ensuring the security.

D**isadvantages of Rainbow table attack.** Extended password length and complexity may help a bit, but for rainbow table to generate its hash value is a difficult task due to the requirement of lot of resources

## III. DEMONSTRATION OF BRUTE FORCE, DICTIONARY AND RAINBOW TABLE ATTACKS USING CAIN&ABEL

Cain&Abel is a password attacker tool with the following features described below is:

I) Cain & Abel crack **[20]** various hashed passwords using methods such as Dictionary attack, Brute force attack and Rainbow table attack/ cryptanalysis attack.

II) It is also a password recovery tool for Microsoft Windows such as it can recover many passwords i.e. network packet sniffing, cracking various hashed by using methods such as Dictionary attack, Brute force attack and Rainbow table attack/ cryptanalysis attack.

Now, by using Cain&Abel, the procedure of brute force attack, dictionary attack and rainbow table attack:

**A.** The following figure gives the brute force attack demonstration of Brute force attack using Cain&Abel. The password is cracked by selecting the appropriate field of predefined based on the type of text entered if number string then 0123456789 entered.

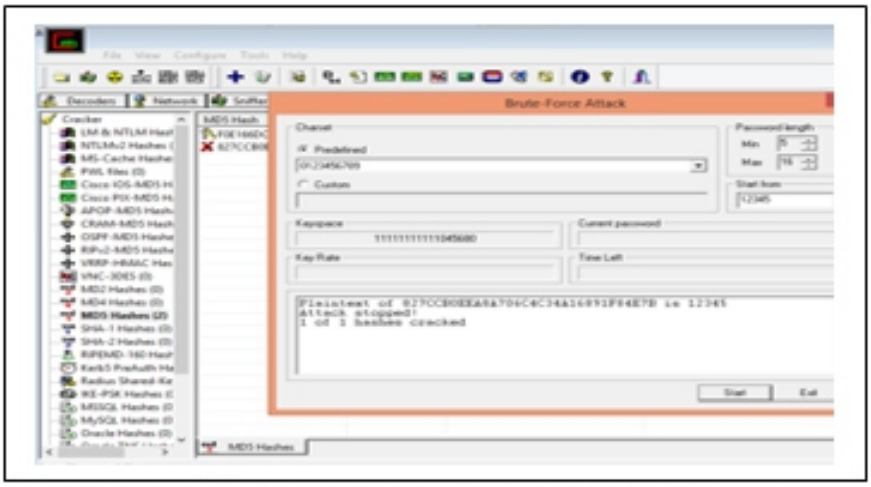


Fig1. Brute force attack demonstration using Cain&Abel

**B.** For, dictionary attack the dictionary is downloaded' ”common-passwords.txt' which comprises of the password database. Here also the hash value generated using hash calculator and it is cracked.

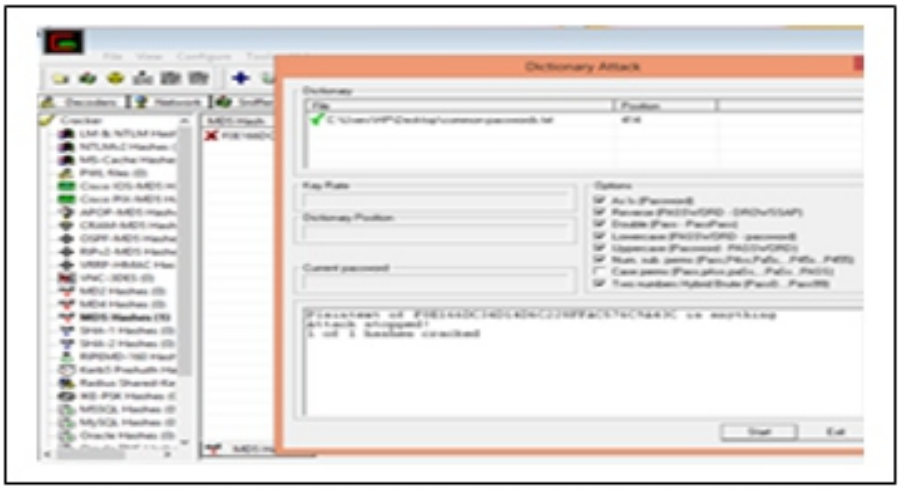


Fig2. Dictionary attack demonstration using Cain&Abel

**C.** Similarly, given below is the demonstration of dictionary attack using Cain&Abel. The password entered here is number string whose hash value is computed using hash calculator. Here, the rainbow table **[9]** is created using WINRTGEN **[21]** and then successfully password cracked.

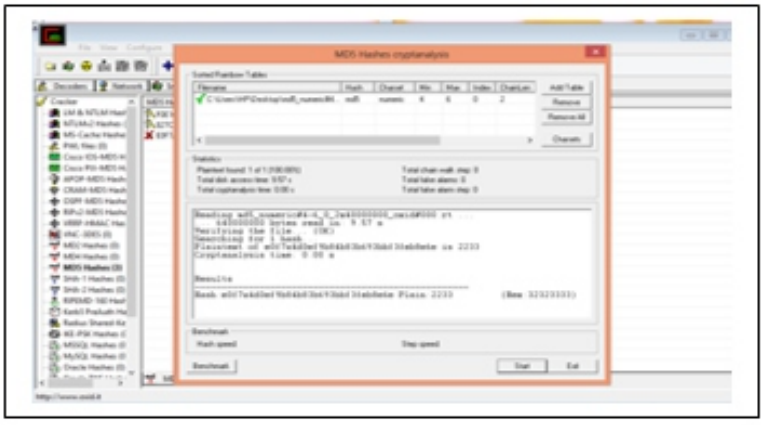

Fig3. Rainbow table attack demonstration using Cain&Abel

## IV. DIFFERENCE BETWEEN BRUTE FORCE, DICTIONARY ATTACK AND RAINBOW TABLE ATTACK

Here, the difference between the brute force attack, dictionary attack and rainbow table attack on the basis of the study made and observations with the advantages and disadvantages of each and every methodology. The characteristic factors use as the basis of the difference is attack/description, time complexity with the advantages and disadvantages of each and every methodology.

Table II. Difference between brute force, dictionary and rainbow table attack

| FEATURE | DICTIONARY ATTACK | BRUTE FORCE ATTACK | RAINBOW TABLE ATTACK |
|---|---|---|---|
| **Attack/ Description** | Password cracking from pre – defined dictionaries (common-word.txt ) | All possible combination comparisons. | Use of pre – calculated table which contains cryptographic hash functions |
| **Time-required** | Low variance, if word is available in dictionary | High variance due to length of the cracked password | Once table is created, constant time to crack the password |
| **Advantage** | Speedy | Good for short and common passwords | Pre-calculated table contains hash values. |
| **Disadvantage** | Finds only those words belong to dictionary. | Not suitable for long string passwords | Require tables which increase complexity for first time. |

## V. CONCLUSION AND FUTURE WORK

Indeed, there are several methodologies and techniques conducted by attackers, in online and offline for password cracking. That is the reason it is required for user to create password with required password strength and several password composition policies. By way of illustration, this paper introduced the usage of password cracking tool, method and approaches that can be perform in guessing the passwords. First, it is try to crack the passwords using brute force attack with the help of various brute force algorithms on the available training set and then by dictionary attack on "**common-passwords.txt"** which is downloaded file. On, the rainbow table attack it is required to download the rainbow table which may be downloaded or created. The observation occur after conduction the experiment, the most popular technique used by attackers nowadays, is Rainbow table technique for cracking the password because it can crack 14 – character alphanumeric passwords in about 160 seconds. The final aim is to measure the time complexity of the brute force attack, dictionary attack and rainbow table attack. Also, for rainbow table attack, the way rainbow table generated and its disk storage can be analysed for future work.

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# Intuitionistic Fuzzy B-Ideal on B-Algebras

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## ABSTRACT

*In this paper, we introduce the concept of intuitionistic fuzzy B-ideals in B-algebra. Homomorphism and anti-homomorphism functions are satisfied while applying the intuitionistic fuzzy B-ideal concept. Intuitionistic Fuzzy B-ideal is also applied in Cartesian product.*

***Keywords: B-algebra, B-ideals, Fuzzy B-ideals, Intuitionistic fuzzy B-ideals, Homomorphism, Anti-homomorphism, Cartesian product.***

## 1. INTRODUCTION

After the introduction of fuzzy subsets by L.A.Zadeh[7], several researchers explored on the generalization of the notion of fuzzy subset J. R. Cho and H. S. Kim[4] discussed relations between B-algebras and other topics, especially quasi-groups. H. K. Park and H.S.Kin[5] introduced the notion of Quadratic B-algebras. Sun ShinAhn and KeumseongBang[3] have discussed the fuzzy sub algebra in B-algebra. C. Yamini and S. Kailasavalli[1] introduced the notion of Fuzzy B-ideals. Atanassov[6] introduced the concept of intuitionistic fuzzy sets, which is a significant extension of fuzzy set theory by Zadeh. JiayinPeng[2] introduced the notion of Intuitionistic fuzzy B-algebras. In this paper we introduce the Intuitionistic fuzzy B-ideals and investigate how to deal with the homomorphism, anti-homomorphism, Cartesian product of Intuitionistic fuzzy B-ideals and strongest intuitionistic fuzzy relation.

## 2. PRELIMINARIES

In this section we give some basic definitions and preliminaries of B-algebras and introduce intuitionistic fuzzy B-ideals.

**Definition 2.1:** A B-algebra is a non-empty set X with a constant 0 and a binary operation „*" satisfying the following axioms:

(i) $x * x = 0$

(ii) $x * 0 = x$

(iii) $(x * y) * z = x * (z * (0 * y)), for\ all\ x, y, z \in X$

For brevity we also call X a B-algebra. In X we can define a binary relation "≤" by $x \leq y$ if and only if $x * y = 0$.

**Definition 2.2:** A non-empty subset $I$ of a B-algebra X is called a sub algebra of X if $x * y \in I$ for any $x, y \in I$.

**Definition 2.3:** Let $\alpha$ be a fuzzy set in a B-algebra. Then $\alpha$ is called a fuzzy sub algebra of X if $\alpha\ x * y \geq \alpha\ x \wedge \alpha\ y\ for\ all\ x, y \in X$.

**Definition 2.4:** An intuitionistic fuzzy set $S = \{< x, \alpha_S\ x, \beta_S\ x\ >/x \in X\}$ of X is said to be an intuitionistic fuzzy B-algebra if it satisfies

$$\alpha_S(x * y) \geq \alpha_S\ x\ \wedge \alpha_S(y)$$

$$\beta_S(x * y) \leq \beta_S\ x\ \vee \beta_S(y)$$

**Definition 2.5:** A non-empty subset I of a B-algebra X is called a B-ideal of X if it satisfies for $x, y, z \in X$

(i) $0 \in I$

(ii) $x * y \in I and\ z * x\ \in I$ implies $y * z \in I$

**Definition 2.6:** Let $(X, *, 0)$ be a B-algebra, a fuzzy set $\alpha$ in X is called a fuzzy B-ideal of X if it satisfies the following axioms

(i) $\alpha(0) \geq \alpha(x)$

(ii) $\alpha\ y * z \geq \alpha\ x * y \wedge \alpha\ z * x, for\ all\ x, y, z \in X$

| * | 0 | 1 | 2 |
|---|---|---|---|
| 0 | 0 | 2 | 1 |
| 1 | 1 | 0 | 2 |
| 2 | 2 | 1 | 0 |

The fuzzy set $\alpha$ given by $\alpha\ 0 = 0.8$, $\alpha\ 1 = 0.5$, $\alpha\ 2 = 0.2$ is a fuzzy B-ideal.

**Definition 2.7:** An intuitionistic fuzzy set S of a B-algebra X is said to be an intuitionistic fuzzy B-ideal if it satisfies the following conditions

(i) $\alpha_S(0) \geq \alpha_S(x)$

(ii) $\beta_S(0) \leq \beta_S(x)$

(iii) $\alpha_S\ y * z \geq \alpha_S\ x * y \wedge \alpha_S\ z * x$

(iv) $\beta_S\ y * z \leq \beta_S\ x * y \vee \beta_S\ z * x$, $for\ all\ x, y, z \in X$

| * | 0 | 1 | 2 |
|---|---|---|---|
| 0 | 0 | 2 | 1 |
| 1 | 1 | 0 | 2 |
| 2 | 2 | 1 | 0 |

The intuitionistic fuzzy subset S given by $\alpha_S\ 0 = 0.9$, $\alpha_S\ 1 = 0.6$, $\alpha_S\ 2 = 0.3$ and $\beta_S\ 0 = 0.1$, $\beta_S\ 1 = 0.4$, $\beta_S\ 2 = 0.7$ is an intuitionistic fuzzy B-ideal.

## 3. HOMOMORPHISM AND ANTI HOMOMORPHISM OF B-ALGEBRA

**Definition 3.1:** Let $(X,*, 0)$ and $(Y, \Delta, 0')$ be B-algebras. A mapping $f: X \to Y$ is called a homomorphism if $f\ x * y = f\ x\ \Delta f\ y$, $for\ all\ x, y \in X$

**Definition 3.2:** Let $(X,*, 0)$ and $(Y, \Delta, 0')$ be B-algebras. A mapping $f: X \to Y$ is called a anti homomorphism if $f\ x * y = f\ y\ \Delta f\ x$, $for\ all\ x, y \in X$.

**Definition 3.3:** For any homomorphism $f: X \to Y$ the set $x \in x/f(x) = 0'$ is called the kernel of $f$, denoted by $Ker(f)$ and the set $\{f(x)/x \in X\}$ is called the image of „$f$" denoted by $Im(f)$.

**Definition 3.4:** Let $f: X \to Y$ be a mapping of B-algebras and $\alpha$ be a fuzzy set of Y. The map $\alpha^f$ is the pre-image of $\alpha$ under $f$, if $\alpha^f\ x = \alpha\ f\ x\ for\ all\ x\ in\ X$.

**Definition 3.5:** Let $f: X \to Y$ be a mapping of B-algebras and S be an intuitionistic fuzzy set of Y. The map $S^f$ is the pre-image of S under $f$, if

(i) $\alpha_S^f\ x\ = \alpha_S\ f\ x$

(ii) $\beta_S^f\ x\ = \beta_S\ f\ x\ for\ all\ x\ in X$

**Definition 3.6:** Let $f: X \to X$ be an endomorphism and $\alpha$ be a fuzzy set in X. We define a new fuzzy set in X by $\alpha^f$ in X as $\alpha^f{}_S x\ = \alpha_S\ f\ x\ for\ all\ x\ in X$.

**Definition 3.7:** Let $f: X \to X$ be an endomorphism and S be an intuitionistic fuzzy set in X. We define a new fuzzy set in X by $S^f$ in X as

$$\alpha_S^f\ x\ = \alpha_S\ f\ x$$

$$\beta_S^f\ x\ = \beta_S\ f\ x\ for\ all\ x\ in\ X$$

**Theorem 3.8:** Let $f$ be an endomorphism of a B-algebra X. If S is an intuitionistic fuzzy B-ideal of X, then so $s^f$.

**Proof:**

(i) $\alpha_S^f\ (0) = \alpha_S\ f\ 0$

$\geq\ \alpha_S\ f\ x$

$= \alpha_S^f\ x$

$\Rightarrow \alpha_S'\ 0\ \geq \alpha_S'\ x$

(ii) $\beta_S^f\ (0) = \beta_S\ f\ 0$

$\leq \beta_S\ f\ x$

$= \beta_S^f\ x$

$\Rightarrow \beta_S'\ 0\ \leq \beta_S'\ x$

(iii) $\alpha_S^f\ (y * z) = \alpha_S\ f\ y * z$

$= \alpha_S\ f\ y * f(z)$

$\geq \alpha_S\ f\ x * f\ y \wedge \alpha_S\ f\ z * f(x)$

$= \alpha_S\ f(x * y) \wedge \alpha_S\ f(z * x)$

$= \underset{S}{\alpha'}\ x * y \wedge \underset{S}{\alpha'}\ z * x$

$\Rightarrow \underset{S}{\alpha^f}\ y * z \geq \underset{S}{\alpha^f}\ x * y \wedge \underset{S}{\alpha^f}\ z * x$

(iv) $\beta_S^f\ (y * z) = \beta_S\ f\ y * z$

$= \beta_S\ f\ y * f(z)$

$\leq \beta_S\ f\ x * f\ y \vee \beta_S\ f\ z * f(x)$

$= \beta_S\ f(x * y) \vee \beta_S\ f(z * x)$

$= \underset{S}{\beta'}\ x * y \vee \underset{S}{\beta'}\ z * x$

$\Rightarrow \underset{S}{\beta^f}\ y * z \leq \underset{S}{\beta^f}\ x * y \vee \underset{S}{\beta^f}\ z * x$

Thus, $S^f$ is an intuitionistic fuzzy B-ideal of X.

Hence, the proof.

## 4. CARTESIAN PRODUCT OF INTUITIONISTIC B-IDEALS OF B-ALGEBRA

**Definition 4.1:** Let $S = \{ x, \alpha_S\ x\ , \beta_S\ x\ \ / x \in X\}$ and $T = \{ y, \alpha_T\ x\ , \beta_T\ x\ \ / x \in X\}$ be intuitionistic fuzzy sets of X. A Cartesian product of S and T defined by

$$S\ X\ T = \{ x, y\ , \alpha_{SXT}\ x, y\ , \beta_{SXT}\ x, y\ / x, y \in X\}$$

$$\alpha_{SXT} = \alpha_S\, x \wedge \alpha_T\, x$$

$$\beta_{SXT} = \beta_S\, x \vee \beta_T\, x\,, \text{ where } x, y \in X$$

**Definition 4.2:** An intuitionistic fuzzy relation $R = \{(x, y), \alpha_S\ x, y\ , \beta_S\ x, y\ / x, y \in X\}$ on X is called an Intuitionistic fuzzy relation on S if

$$\alpha^R\ x, y\ \leq \alpha_S\ x\ \wedge\ \alpha_S\ y$$

$$\beta^R\, x, y \geq \beta_S\, x\ \vee \beta_S\, y\ for\ all\ x, y \in X$$

**Definition 4.3:** Let S be an intuitionistic fuzzy set in X. An intuitionistic fuzzy relation R on X is called a strongest intuitionistic fuzzy relation on S if

$$\alpha^R\, x, y = \alpha^R\, x\ \wedge \alpha^R\, y$$

$$\beta^R\, x, y = \beta^R\, x \vee \beta^R\, y\ for\ all\ x, y \in X$$

**Theorem 4.4:** For a subset S of a B-algebra X, let R be the strongest intuitionistic fuzzy relation on X. If S is an intuitionistic fuzzy B-ideal of XxX then

$$\alpha^R\ x, x \leq \alpha^R(0,0)$$

$$\beta^R\ x, x\ \geq \beta^R\ 0,0\ for\ x \in X$$

**Proof**

Given: R is the strongest intuitionistic fuzzy relation of XxX, then

$$\alpha^R\ x, x\ = \alpha\ x \wedge \alpha\ x$$

$$\leq \alpha\ 0 \wedge \alpha(0)$$

$$= \alpha^R\ 0,0$$

$$\Rightarrow \alpha^R\ x, x\ \leq \alpha^R(0,0)$$

$$\beta^R\ x, x = \beta\ x\ \vee \beta\ x$$

$$\geq \beta\ 0 \vee \beta(0)$$

$$= \beta^R\ 0,0$$

$$\Rightarrow \beta^R(x, x) \geq \beta^R(0,0)$$

Hence the proof.

**Theorem 4.5:** Let S and T are intuitionistic fuzzy B-ideals in B-algebra X then SxT is an intuitionistic fuzzy B-ideal in XxX.

**Proof**

For any $x, y \in X \times X$,

$$\alpha_S \times \alpha_T\ (0,0) = \alpha_S\ 0 \wedge \alpha_T\ 0$$

$$\geq \alpha_S\ x \wedge \alpha_T\ x$$

$$= \alpha_S \times \alpha_T\ (x, y)$$

$$\Rightarrow \alpha_S \times \alpha_T\ (0,0) \geq \alpha_S \times \alpha_T\ (x, y)$$

Similarly, we can also prove

$$\beta_S \times \beta_T\ (0,0) \leq \beta_S \times \beta_T\ (x, y)$$

Let $x_1, x_2, y_1, y_2, z_1, z_2 \in X \times X$

Now,

$$\alpha_S \times \beta_S\ y_1, y_2 * z_1, z_2 = \alpha_S \times \beta_S\ y_1 * z_1, y_2 * z_2$$

$$= \alpha_S(y_1 * z_1) \wedge \beta_S(y_2 * z_2)$$

$$\geq \alpha_S\ x_1 * y_1 \wedge \alpha_S\ z_1 * x_1 \wedge \beta_S\ x_2 * y_2 \wedge \beta_S\ z_2 * x_2$$

$$\geq \alpha_S\ x_1 * y_1 \wedge \beta_S\ x_2 * y_2 \wedge \alpha_S\ z_1 * x_1 \wedge \beta_S\ z_2 * x_2$$

$$= \alpha_S \times \beta_S\ x_1 * y_1, x_2 * y_2 \wedge$$

$$\alpha_S \times \beta_S\ z_1 * x_1, z_2 * x_2$$

$$\Rightarrow \alpha_S \times \beta_S\, y_1, y_2 * z_1, z_2$$

$$\geq \alpha_S \times \beta_S\, x_1 * y_1, x_2 * y_2 \wedge \alpha_S \times \beta_S\, z_1 * x_1, z_2 * x_2$$

Similarly, we can also prove

$$\alpha_T \times \beta_T\, y_1, y_2 * z_1, z_2$$

$$\geq \alpha_T \times \beta_T\, x_1 * y_1, x_2 * y_2 \wedge \alpha_T \times \beta_T\, z_1 * x_1, z_2 * x_2$$

Thus, $S \times T$ is an intuitionistic fuzzy B-ideal in $X \times X$.

Hence, the proof.

**Result 4.6:** Let S and T be intuitionistic fuzzy sets of a B-algebra X such that SxT is an intuitionistic fuzzy B-algebra of X. Then,

(i) Either $\alpha_S\, x \leq \alpha_S(0)$ or $\alpha_T\, x \leq \alpha_T(0)$ for all $x \in X$

(ii) Either $\beta_S\, x \geq \beta_S(0)$ or $\beta_T\, x \geq \beta_T(0)$ for all $x \in X$

(iii) If $\alpha_S\, x \leq \alpha_S(0)$ for all $x \in X$, then $\alpha_S\, x \leq \alpha_T(0)$ or $\alpha_T\, x \leq \alpha_T(0)$

(iv) If $\beta_S\, x \geq \beta_S(0)$ for all $x \in X$, then $\beta_S\, x \geq \beta_T(0)$ or $\beta_T\, x \geq \beta_T(0)$

(v) If $\alpha_T\, x \leq \alpha_T(0)$ for all $x \in X$, then $\alpha_S\, x \leq \alpha_S(0)$ or $\alpha_T\, x \leq \alpha_S(0)$

(vi) If $\beta_T\, x \geq \beta_T(0)$ for all $x \in X$, then $\beta_S\, x \geq \beta_S(0)$ or $\beta_T\, x \geq \beta_S(0)$

**Theorem 4.7:** If S and T are the intuitionistic fuzzy sets in B-algebra X such that SxT is an intuitionistic fuzzy B-ideal of XxX then either S or T is an intuitionistic fuzzy B-ideal of X.

**Proof**

Since, $\alpha_S\, x \leq \alpha_S(0)$ or $\alpha_T\, x \leq \alpha_T(0)$

Let $\alpha_S\, x \leq \alpha_S(0)$

And also, If $\alpha_S\, x \leq \alpha_S(0)$ for all $x \in X$, then $\alpha_S\, x \leq \alpha_T(0)$ or $\alpha_T\, x \leq \alpha_T(0)$

Let''s take, $\alpha_S\, x \leq \alpha_T(0)$

$$\alpha_S\, x = \alpha_S(x) \wedge \alpha_T(0)$$

$$= \alpha_S \times \alpha_T\, x, 0$$

$$\alpha_S\, y * z = \alpha_S\, y * z \wedge \alpha_T(0)$$

$$= \alpha_S \times \alpha_T\, y * z, 0$$

$$= \alpha_S \times \alpha_T \quad y, 0 \; * \; z, 0$$

$$\geq \alpha_S \times \alpha_T\, x, 0 * y, 0 \wedge (\alpha_S \times \alpha_T\, z, 0 * x, 0$$

$$\geq \alpha_S \times \alpha_T\, x * y, 0 * 0 \wedge \alpha_S \times \alpha_T\, z * x, 0 * 0$$

$$= \alpha_S(x * y) \wedge \alpha_S(z * x)$$

$$\Rightarrow \alpha_S\, y * z \geq \alpha_S(x * y) \wedge \alpha_S(z * x)$$

Similarly,

We can prove $\beta_S\, y * z \leq \beta_S(x * y) \vee \beta_S(z * x)$

Hence, S is an intuitionistic fuzzy ideal of X.

Now let's prove T is an intuitionistic fuzzy ideal of X.

Assume, $\alpha_T\, x \leq \alpha_S(0)$

Then,

$$\alpha_T \; x \quad = \alpha_S(0) \wedge \alpha_T(x)$$

$$= \alpha_S \times \alpha_T\; 0, x$$

$$\alpha_T\, y * z \; = \alpha_S\, 0 \; \wedge \alpha_T(y * z)$$

$$= \alpha_S \times \alpha_T\, 0, y * z$$

$$= \alpha_S \times \alpha_T \quad 0, y \; * \; 0, z$$

$$\geq \alpha_S \times \alpha_T\, 0, x * 0, y \wedge (\alpha_S \times \alpha_T\, 0, z * 0, x$$

$$\geq \alpha_S \times \alpha_T\, 0 * 0, x * y \wedge \alpha_S \times \alpha_T\, 0 * 0, z * x$$

$$\geq \alpha_S \times \alpha_T\ 0, x * y \wedge \alpha_S \times \alpha_T\ 0, z * x$$

$$= \alpha_T(x * y) \wedge \alpha_T(z * x)$$

$$\Rightarrow \alpha_T\ y * z \geq \alpha_T(x * y) \wedge \alpha_T(z * x)$$

Similarly, we can also prove, $\beta_T\ y * z \leq \beta_T(x * y) \vee \beta_T(z * x)$

Thus, B is an intuitionistic fuzzy B-ideal of X.

Hence the proof.

**Theorem 4.8:** Let S be an Intuitionistic fuzzy set in a B-algebra X and $S^R$ be the strongest fuzzy relation on X. Then S is an intuitionistic fuzzy B – ideal of X if and only if $S^R$ is an intuitionistic fuzzy B-ideal of XxX.

**Proof**

Suppose that S is an intuitionistic fuzzy B-ideal of X.

Then

$$\alpha_S^R\ 0,0 = \alpha_S(0) \wedge \alpha_S(0)$$

$$\geq \alpha_S(x) \wedge \alpha_S(y)$$

$$= \alpha_S^R\ x, y$$

$$\Rightarrow \alpha_S^R\ 0,0 \geq \alpha_S^R\ x, y\ , for\ all\ (x, y) \in X \times X$$

Now, for any $x_1, x_2, y_1, y_2, (z_1, z_2) \in X \times X$

$$\alpha_S^R\ y_1 * z_1, y_2 * z_2 = \alpha_S^R(y_1 * z_1) \wedge \alpha_S^R(y_2 * z_2)$$

$$\geq\ \alpha_S\ x_1 * y_1\ \wedge \alpha_S\ z_1 * x_1\ \ \wedge\ \ \alpha_S\ \ x_2 * y_2\ \wedge \alpha_S\ \ z_2 *\ \ x_2$$

$$\geq\ \alpha_S\ x_1 * y_1\ \wedge \alpha_S\ \ x_2 * y_2\ \ \wedge\ \ \alpha_S\ \ z_1 * x_1\ \wedge \alpha_S\ \ z_2 *\ \ x_2$$

$$= \alpha_S^R(x_1 * y_1, x_2 * y_2) \wedge \alpha_S^R\ z_1 * x_1, z_2 * x_2$$

$$\Rightarrow \alpha_S^R\ y_1 * z_1, y_2 * z_2 \geq \alpha_S^R(x_1 * y_1, x_2 * y_2) \wedge \alpha_S^R\ z_1 * x_1, z_2 * x_2$$

Similarly, we can also prove

$$\beta_S^{\sim} \cup \mu \leq \beta_S^{\sim} x, y$$

$$\beta_S^{\sim} y_1 * z_1, y_2 * z_2 \leq \beta_S^{\sim} (x_1 * y_1, x_2 * y_2) \vee \beta_S^{\sim} z_1 * x_1, z_2 * x_2$$

Thus,$S^R$ is an intuitionistic fuzzy B-ideal of XxX.

Conversely,

Suppose that $S^R$ is an intuitionistic fuzzy B-ideal of XxX.

We know that,

$$\alpha_S\, 0 \geq \alpha_S(x)$$

$$\beta_S\, 0 \leq \beta_S\, x \; for\; all\; x \in X$$

Now, let $x_1, x_2, y_1, y_2, (z_1, z_2) \in X \times X$

Then,

$$\alpha_S\, y_1 * z_1 \wedge \alpha_S\, y_2 * z_2 = \alpha^R\, y_1 * z_1, y_2 * z_2$$

$$\geq \alpha_S^{\sim} x_1, x_2 * y_1, y_2 \wedge \alpha_S^{\sim} z_1, z_2 * x_1, x_2$$

$$= \alpha_S^R x_1, y_1, x_2, y_2 \wedge \alpha^R z_1, x_1, z_2, x_2$$

$$= \alpha_S\, x_1, y_1 \wedge \alpha_S\, x_2, y_2 \wedge \alpha_S\, z_1, y_1 \wedge \alpha_S\, z_2, y_2$$

In particular, if we take, $x_2 = y_2 = z_2 = 0$

Then, $\alpha_S\, y_1 * z_1 \geq \alpha_S\, x_1, y_1 \wedge \alpha_S\, z_1, x_1$

Similarly, we can also prove

$$\beta_S\, y_1 * z_1 \leq \beta_S\, x_1, y_1 \vee \beta_S\, z_1, x_1$$

Thus, S is an intuitionistic fuzzy B-ideal of X.

Hence the proof.

## 5. CONCLUSION

In this paper we have discussed about Intuitionistic Fuzzy B-Ideals, Homomorphism, Anti Homomorphism and Cartesian product of Intuitionistic Fuzzy B-Ideals.

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