BARCODE TECHNOLOGY AND ITS APPLICATION IN NEPALESE LIBRARIES

A thesis submitted to the

Central Department of Library and Information Science in partial fulfillment of the requirement for the Master Degree in Library and Information Science

Submitted by

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LETTER OF RECOMMENDATION

This is to certify that Mr. Amod Rijal has prepared this dissertation entitled "BARCODE TECHNOLOGY AND ITS APPLICATION IN NEPALESE LIBRARIES", under my supervision and guidance. I recommend this dissertation for final approval and acceptance.

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LETTER OF ACCEPTANCE

The thesis here to attached, entitled " **BARCODE TECHNOLOGY AND ITS APPLICATION IN NEPALESE LIBRARIES**", Prepared by Mr. Amod Rijal in partial fulfillment of the requirements for the MASTER'S DEGREE OF LIBRARY AND INFORMATION SCIENCE is hereby accepted and approved.

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ACKNOWLEDGMENT

First of all, I have no words that can adequately carry my sincere aptitude to **Mr. Rudra Prasad Dulal** who as my teacher as well as research guide has provided me with all sorts of basic ideas and techniques essential for carrying out this research work from very beginning to the end and enabled me to present this dissertation in this form.

As this is the result of combined efforts of all, 8o, I take this opportunity of expressing thanks and deep sense of gratitude to all colleagues and experts who have aided me directly and indirectly during my research. In this regard, I am deeply indebted to my Head of Department **Dr. Madhusudan Karki** and respected teacher **Mr. Bhim Dhoj Shrestha** for providing various suggestions and support to carry out this work. Similarly, I am highly thankful to all the respected teachers of this department **Dr. Mohan Raj Pradhan, Mr. Bishnu Prasad Aryal** and Former head of the Department **Mrs. Nirmala Shrestha. Late Leela Dahal,** simple and ideal person of LIS profession is sadly missed for always. Their helpful suggestions and inspiration are notable. I would like to thank all the staffs of library and Information Science Department for their kind co-operation and consistent support.

I acknowledge with sincere thanks and express gratefulness to all the following Librarians for taking responsibility in providing me the correct data and information of their Libraries. **Mr.Bishnu Prasad Aryal,** Assistant Librarian of Public Youth Campus Library.**Mr.Jagadish Chandra Aryal,** Librarian of social science Baha Library. **Mr.Prakash Thapa,** Library Director of the American Library. **Mr.Prem Raj Adhikari,** Library officer of Kathmandu University Education and management. **Mr. Binayak Adhikari,** Library Officer of Kathmandu Valley Public Library (KVPL). **Mrs. Sarita Bhattarai,** Deputy Administrator of Nepal College of Information Technology (NCIT). **Mr. Yubaraj Pangeni,** Library Office of Ministry Of General Administration. **Mr. Ramesh Parajuli,** Librarian of GEMS Institute of Higher Education. **Mrs. Min Kumari Dallakoti,** Librarian of Ullens School Senior Library. **Mr. Purna Lal Shrestha,** Deputy Librarian of Amrit Science Campus.

I always admire **Mr. Bishnu Prasad Aryal** for his vision and encouragement and devoting his valuable time in this research. I also wish to express my appreciation to **Mr. Bishow Raj Gautam, Mrs. Anita Bhandari, Mr. Mahesh Khanal, Mr. Pravash Pokherel, Mr. Om Nath Khatiwada, Mr. Ram Prasad Sharma, Mr. Ramesh Parajuli and Mr. Sangram Chaudhary.**

My dearest wife **Mrs. Priti Dhakal (Rijal)** deserves the highest appreciation for her help and assistance she rendered me in several ways. Last but not least, I am really grateful to all my department friends, juniors and seniors and special thanks to **Mr. Shubodh Neupane, Mr. Kedar Ghimire and Mr. Gokul Shrestha** who have motivated me and given me confidence to complete this research.

Finally, I apologize for the mistakes if any made knowingly and unknowingly during this research.

Thank you!

26th Dec. 2010

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ABSTRACT

The thesis entitled **'BARCODE TECHNOLOGY AND ITS APPLICATION IN NEPALESE LIBRARIES'** in general based upon an indispensable part of library automation in all types of library. The thesis has included major aspects necessary for the effective library management and organization in the field of barcode technology. The study has introduced the relation between library and barcode technology, along with the definition, history, advantages/disadvantages and types of barcode. Among different types of barcodes, some of the important types are Universal Product Code (UPC). Code 39, CODABAR, EAN-8, EAN-13, CODE 128. Scanners and decoders are essential parts of the barcode technology. So, scanning devices like laser gun, Charged Coupled Device (CCD) plays important role within barcode technology. Different types of barcode labels along with smart barcodes, generic barcode are essential for bar-coding of books and library cards.

The problem of study has included limitation of the performance of barcode technology due to lack of proper human resources as well as insufficient allocation of budget. The lack of knowledge of barcode technology among the library professionals makes the barcode technology a challenging job. The problem of the study is to know the present situation of the barcode technology and its development using different types of software for better services and suggestions necessary for the users and the libraries. Thus, among various library technologies available in computerized library and information centers, barcode technology has its own importance for speed, accuracy and reliability of the data circulation.

The objectives of the study was to know barcode technology and its application in libraries, to identify libraries using barcode technology, to know whether barcode application software in the libraries of Nepal is useful or not and to suggest libraries and libraries personal (staffs) for better services through barcode technology. The study has limited to 10 libraries using barcode system for automation and the data has been collected from 25th August 2008 to 8th March 2009, within 7 months.

In the context of Nepal, limited studies have been carried out on barcode technology in the areas of Library automation. Six related informational literature have been

studied and most of the reviewed literatures were found related to the topics and a great help has received from the reviewed literature.

The study has focused on the barcode technology and its application in the formation of library system. It has found that most of the libraries in the Kathmandu valley are not fully automated; few of them are converting their library system from manual to automation with support of barcode system. The population of the study has included the number of those libraries which were using different software supporting barcode technology. Most of the libraries or information centers are using software such as SOUL, CDS/ISIS, WINISIS, LIBRA, KOHA, ALICE, IAN.

The researcher has used a set of questionnaires including 18 questions based upon the objectives. Those questionnaires were distributed to collect data. Different types of libraries have studied inside and outside Kathmandu valley. Due to the repetition of same library software, only ten libraries of Kathmandu valley have been studied as a sample for the data collection. The selection of the libraries has depended upon the nature, types and easy availability. Out of 10 libraries, 6 are academic libraries, 1 governmental library, 1 public library and 2 special libraries.

It has found that only limited numbers of libraries were using barcode technology. This limited is due to the lack of proper budget, computer infrastructure, networking and professional human resources. The researcher has concluded that the proper implementation of barcode technology take place with the use of suitable barcode system, scanning device of better quality and advanced software. The collected data has shown that the barcode plays a role of a bridge between the users and the libraries. It provides services like circulation, searching, cataloguing, and user management in a better and smart way. The data indicates that all the libraries show positive response on the reduction of total expenditure. As in the modern age of IT, evolution of information could not be controlled, where dissemination of information in a right time is very difficult. So, barcode technology could support a library to function in an appropriate way as a modern technology in the field of automation.

Finally, researcher has recommended that, to provide effective library services to the users, all the libraries should install advanced barcode technology in their automation

system. In spite of having some limitations, this system could provide proper information too the users in a proper time with error free network. The present state of the barcode technology is not at satisfactory level, which could be made better by providing training and knowledge about barcode system to the staffs, users and to all related persons. The library management should improve accuracy and reliable performances like online circulation, reporting, registration, database searching, membership identification with effective security system and all this could be possible only by applying barcode technology. The research study recommends for qualified or well trained library staff and professional for the better image of library. One should be careful and conscious in applying the new technology, so that all the related information could be preserved and disseminate with high speed, accuracy and in the reliable and systematic way.

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CATALOGUE OF THESIS

Main card

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Rijal, Amod
Barcode technology and its application in Nepalese libraries/ Amod Rijal.- Kritipur: Central Department of Library and Information Science, 2011.
01 xi, 91p.: ill.; 30cm
Dissertation: Master degree of Library and Information Science from CDLISc.
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Rijal, Amod
Barcode technology and its application in Nepalese libraries/ Amod Rijal. - Kritipur: Central Department of Library and Information Science, 2011.
01 xi, 91p.: ill.; 30cm
Dissertation: Master degree of Library and Information Science from CDLISc.

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Title added card

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021.5496 Barcode technology and its application in Nepalese libraries
R449b

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LIST OF ACRONYMS

AIM:	Automatic Identification Manufacturers Assoc.
ASCII:	American Standard Code for Information Interchange
Auto ID:	Automatic Identification Technology
BPO:	British Post Office
CCD Scanner:	Charged Coupled Device
CD-ROMs:	Compact Disk Read Only Memory
CDSISIS:	Computerized Documentation Service/Integrated Set of Information Systems
CMOS:	Complementary metal-oxide semiconductor
CP:	Coincidence Point
EAN:	European Article Numbering system
ECC:	Error Checking and Correction Scheme
FIM:	Facing Identification Mark
GEMS:	Graded English Medium School
GPL:	General Public License
HCCB:	High Capacity Color Barcode
IAN:	Information Access Network
ILS:	Integrated Library System
ISBN:	International Standard Book Number
KULibrary:	Kathmandu University Education and Management Library
KVPL:	Kathmandu Valley Public library
LEDs:	Light-Emitting Diodes
MoGA:	Ministry of General Administration
NCIT:	Nepal College of Information Technology
OCR:	Optical Characters Recognition
OPAC:	Online Public Access Catalogue
POSTNET:	Postal Numeric Encoding Technique
PYC:	Public Youth Campus Library
QR Codes:	Quick Response's
SOUL:	Software for University Libraries

TU:	Tribhuvan University
UGPIC:	Universal Grocery Products Identification Code
UPC:	Universal Product Code
USIS:	The United States Information Services
WINSIS:	Windows/Integrated Set of Information System

Chapter I

INTRODUCTION

1.1 Background of the Study

1.1.1 Library and Barcode

Library is the collection of books and other informational materials made available to people for reading, study, or reference. The word *library* comes from *liber*, the Latin word for 'book'. However, library collections have almost always contained a variety of materials. Contemporary libraries maintain collections that include not only printed materials such as manuscripts, books, newspapers, and magazines, but also art reproductions, films, sound and video recordings, maps, photographs, microfiches, CD-ROMs, computer software, online databases, and other media. In addition to maintaining collections within library buildings, modern libraries often feature telecommunications links that provide users with access to information at remote sites. (Prasher, 1991)

The central mission of a library is to collect, organize, preserve, and provide access to knowledge and information. In fulfilling this mission, libraries preserve a valuable record of culture that can be passed down to succeeding generations. Libraries are an essential link in this communication between the past, present, and future. Whether the cultural record is contained in books or in electronic formats, libraries ensure that the record is preserved and made available for later use. Libraries provide people with access to the information they need to work, play, learn, and govern. (Khanna, 1994)

Almost every one is familiar with the zebra-striped labels that have become ubiquitous in our lives, from the supermarket queue to the materials that we buy for our libraries. Barcodes owe their success to the design that allows unique information to the programmed into their strips and then read accurately and quickly by readers and scanners attached to computers. A barcode is series of bars and spaces arranged according to a set of rules that determines how data is to be represented. Different bars and spaces patterns are used to express different symbols. These symbols are readable only by a scanner. In fact, barcode technology is an important identification tool that provides an

accurate and timely support of the data requirement for proper management systems. Libraries use new technologies because the conditions in the general environment that led to the development of the technology are also the conditions in which the library operates.

Understanding and coping with the new technology, the information environment becomes complicated. The demands of new information environments on library and information professionals are not only complex but libraries have also changed from static warehouses of interested documents to dynamic service centers serving professionals as well as non-professionals. Therefore, in libraries, barcode technology is being used to automate the data-capturing process, for stock verification, and in the circulation counter for issue/return of documents. (Islam and Nafiz, 2010)

Barcodes have been an indispensable part of library automation because they serve as a computerized accession number- a unique identifier that links a specific book, journal, compact disc and the like- to the computerized bibliographic record that describe it.

Library automation as we see today is the computerization of library activities and application of information technology in libraries. Library automaton involves total computerization of library activities starting from acquisition to management and circulation to reference services, and library technology involves use of photocopier to microfilm machine and barcode reader to electronic security gate.

Among various library technologies available in computerized library and information centers, barcode technology is one of them. This technology plays a vital role in automating the functions of library. Now a-days we see that black and white strips are known as barcode. Barcode technology embodies a technique that can go hand-in-hand with automation in identifying, locating and tracking all the bewildering data. (Singh, 2000)

1.1.2 Definition

Barcode is not a new technology, as many of us would think. It has been around the late 1940s and saw its first commercial use in 1960 as a method for tracking rail road cars. Since then this automatic method of identification has been found wide acceptance in the grocery and materials handling industries. A number of possibilities exist for using

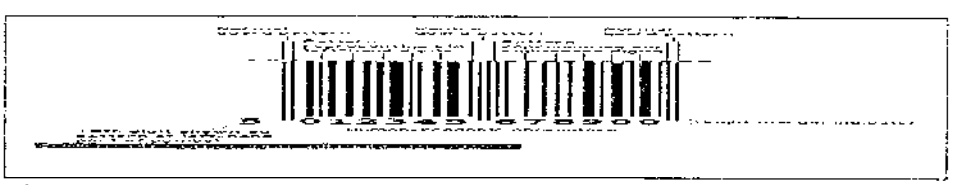
barcode. One such possibility is its use in libraries. The Kentish Town Branch of CAMDEN Public Library was the first library to use the Plessy Light Pen System in 1972. A U.K. firm, SB Electronic Systems, has a bar-coded label. The University of Surrey library a bar-coding method known as '2 of 5' and these labels are 'read' by microprocessor based light-pen terminals. Many American libraries use code-48 which includes alphabetic characters. (Kawatra, 2000)

Structure of a Bar Code

Bar codes provide unique labels for a wide range of products, from groceries to magazines. A complex coding system relates the pattern of widths of the dark and light bars to the number they represent. The number of digits a bar code represents varies; the EAN bar code depicted here is widely used in Europe and represents 13-digit numbers. Bar code patterns can be "read" rapidly by a laser scanner. The number obtained can be used to retrieve such information about the product as its nature, type, and price. The number itself is printed below the bar code. A barcode is a piece of Automatic Identification Technology (Auto ID) that stores real time data. It is a series of vertical bars or a graphical bar pattern which can (depending on the width and pattern) encode numbers and letters in a format which can easily be retrieved and interpreted by a barcode reader.

Barcode can be defined as a self contained message with information encoded in series of black bars of varying breadths and white spaces between every two of them. The bars and spaces represent a series of characters or digits. These are readable only by a scanner which sends a message to the computer that de-codifies the number of the digits. The computer identifies such bars as '0's and '1's (Zeros and Ones) and white blanks as 'off's and 'on's. Therefore, a barcode is a series of '0's and '1's representing characters or digits in such a form as can be identified by computers only. (Kawatra, 2000)

Figure no.1: Structure of barcode



Source: Kawatra, 2000

1.1.3 Barcode History

Beginning with 1932, when an ambitious project was conducted by a small group of students headed by Wallace Flint at the Harvard University Graduate School of Business Administration. The project proposed that costumers select desired merchandise from a catalog by removing corresponding punched cards from the catalog.

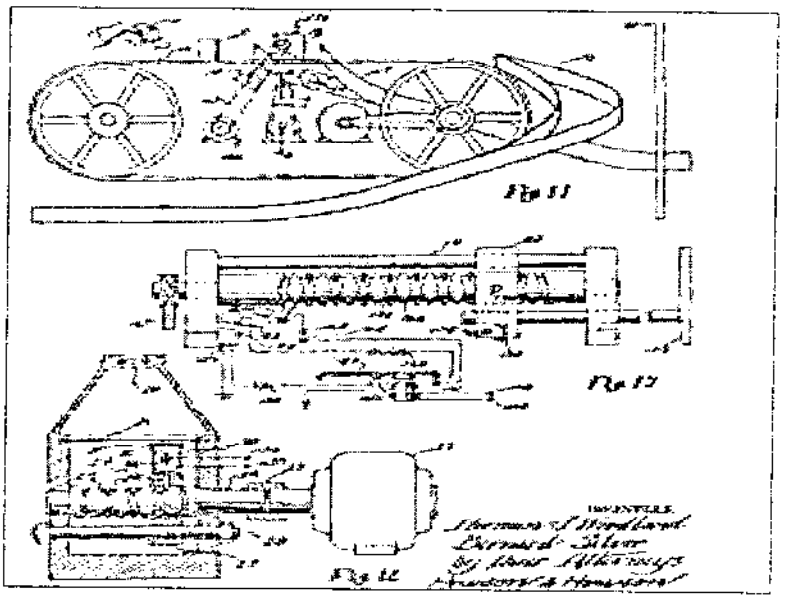
The first patent for a barcode type product (US patent # 2,612,994) was issued to inventors Joseph Woodland, Jordin Johanson and Bernard Silver on October 7, 1952. Its implementation was made possible through the work of Raymond Alexander and Frank Stietz, two engineers with Sylvania (who were also granted a patent), as a result of their work on a system to identify railroad cars using the Automatic Car Identification System. It was not until 1966 that barcodes were put to commercial use and they were not commercially successful until the 1980s.Examine the 1958 patent drawing to the left that depicts the Woodland's and Silver's barcode label and the1958 patent drawing below right of the inventors' barcode scanner technology.

Life is truly black and white when you are dealing with barcodes. Those little lines that grace the backs of our books. boxes and just about everything else have become ubiquitous in our society - so much so that they have become symbols of capitalism, namelessness and government control. Some readers have never known a world without barcodes, and for others it may just seem like that, but the barcode is barely in its middle-age crisis. Officially, the first patent for a barcode was awarded in October 1952 for tracking train cars. It was another 14 years before the barcode caught the eyes of manufactures and put into commercial use. Another 15+ years forward to the 1980s, and barcodes were being slapped on just about everything we buy.

A barcode is a combination of thick and thin lines used to represent a series of numbers. For books, these numbers encode an ISBN, which has become so popular it had to be extended from a 10 to a 13 digit number! But a barcode can encode any value, not just ISBNs. The series of lines represents digits, and the thickness and combination of those lines describe which digit is being encoded. The traditional barcodes you see everyday are sometimes called one-dimensional barcodes. This is because they are scanned, or "read", in only one direction - horizontally. The vertical height of the barcode makes for

easy scanning, but in itself does not add any additional information. The next generation of barcodes is generally referred to as 2D, two-dimensional, barcodes. These new style barcodes get their name from the ability to be read both horizontally and vertically, therefore increasing the density of information that can be encoded in the same amount of space.

Figure no.2: Barcode machine



Source: History of barcode, 2008

In 1948, Bernard Silver was a graduate student at Drexel Institute of Technology in Philadelphia. The local food chain store owner had made an inquiry to the Drexel Institute asking about research into a method of automatically reading product information during checkout. Bernard Silver joined together with fellow graduate student Norman Joseph Woodland to work on a solution. Woodland's first idea was to use ultra-violet light sensitive ink. The team built a working photo type but decided that the system was too unstable and expensive so they went back to the drawing board. On October 20, 1949, Woodland and Silver filed their patent application for the 'Classifying Apparatus and Method', describing their invention as 'article classification...through the medium of identifying patterns'

Barcode was first used commercially in 1966, however, it was soon realized that there would have to be some sort of industry standard set. By 1970, the Universal Grocery

Products Identification Code or UGPIC was written by a company called Logicon Inc. The first company to produce barcode equipment for retail trade use (using UGPIC) was the American company Monarch marking in 1970, and for industrial use, the British company Plessey Telecommunication was also in 1970. The first product to have a barcode included was a packet of Wrigley's Gum. (History of barcode, 2008)

1.1.4 Advantages/ Disadvantages of Barcode

Barcode increase productivity, reduces human errors, decrease costs and improves service and quality. Bar-coding is the most accurate and least expensive way to get data into a computer.

Following are advantages of barcode:

- Improves the relations between the borrower and the staff.
- Saves the time of the borrower and the staff.
- More transactions can be handled.
- Perfect retrieval and entry of records.
- No need of keeping borrower tickets and book cards together. in turn lot of space is saved.
- Minimizes the maintenance efforts.
- Improves the image of the origination.
- Improves information availability.
- Highest degree of reliability.
- Pay back period is also less.
- Barcodes also have high tolerance to water, Dirt, moisture and other foreign materials.
- Positive patron attitude towards library.
- Data integrity.
- Ease of implementation.
- Helps to become more flexible.
- Speed: Automated scanning of items passing on a conveyer belt need not have a human operator. Using a hand- held wand to read barcode symbol on a

small object typically takes two seconds per item. Assuming barcode symbology of 12 characters, the speed of data capture would be six characters per second, three times faster than a skilled key-punched operator.

- Accuracy: Manual data entry tends to be inaccurate with one error for every 100 to 300 keystrokes. With a high-quality barcode system error rates are approximately one for every 300 million characters. The addition of check digit allows the scanner to mathematically determine that the reading is correct.
- Reliability: Barcode technology is easy and reliable to use. One need not have an engineer to operate the system, even in an ordinary library. Attendant in a library can perform the scanning and may require about six minutes of training to learn to operate the system. Also there can be no manipulation of data collected.

Following are disadvantages of barcode:

- Tallying borrower's signature every time at the circulation counter.
- Selecting the distance between the barcode and the Charged Coupled Device (CCD) scanner.
- CCD scanner problems, i.e., hardware problem.
- Scanning problem due to physically damaged label.

Companies and libraries implement barcode systems to track, secure and manage data. These systems offer may cost and quality benefits, including

- Reductions of labor costs with faster data entry.

  Manual method: Observe + Record + Review + Key entry = Database

  Automatic method: Capture = Database
- Error reduction: it is estimated that keyboard entry mistakes result in out of 300 entries, while barcode scanning mistakes result in 1 out of 3 million scans.
- Inventory tracking: Save capital costs, have goods on hands.
- Access to information: Accurate, real-time, when you need it. (Kawatra, 2000)

1.1.5 Types of Barcodes System

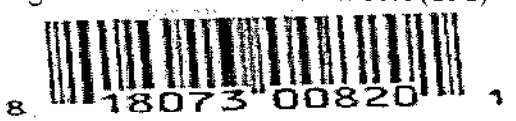
The set of pattern comprising the total character set of a particular barcode is known as its symbology. There are over 40 different systems of barcode. A great deal of time is wasted by committees assigned to choose a corporate standard symbology. It must be however noted, that there is no one symbology that is 'the right one' for the organization. Each one has different advantages and disadvantages. Any modern scanner can automatically recognize and decode all the common symbologies.

Some of the most commonly adopted barcode systems are-

1.1.5.1 Universal Product Code (UPC)

UPC is a common code used in retail trade. Its advantage is standardization in a form that allows many organizations throughout the world to interpret the same data. It uses the space efficiently to record the data. Its disadvantage is that it can only record certain length o0f numbers.

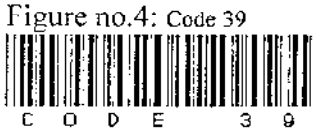
Figure no.3: Universal Product Code (UPC)



1.1.5.2 Code 39

Code 39, also known as code 3 of 9, is the first code examined which is alpha and numeric. The code can be of any length and all the capital letters of alphabet can be encoded as well as numbers and additional characters of - $ / + % * and space. Lower case letters cannot be encoded. Code 39 is always started and finished with an asterisk, known as the start/stop character and its may only be used at the beginning and end of the code.

Figure no.4: Code 39



1.1.5.3 CODABAR

The final commonly used barcode is CODABAR, like code39, it can be of any length but only numeric and some other characters like $ - : /. + can be encoded. Coda bar also uses start/stop characters such as a, b, c and d. It is used in the medical industry especially in blood banks. CODABAR in the most libraries is used on both the books and the member card.

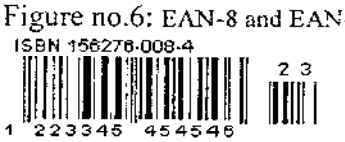
Figure no.5: Coda bar

Coda bar was developed was developed in 1972 by Pitney Bowes, Inc. It is a discrete, self-checking symbology that may encode 16 different characters, plus an additional 4 start/stop characters. This symbology is used by U.S. blood banks, photo labs, and on FedEx air bills. Since Coda bar is self checking, there is no established checksum digit. Should a specific application wish to implement a checksum digit for additional security, it is up to the implementer to define and handle same. However, keep in mind that other applications that read your barcode will interpret your checksum digit as part of the message itself.

1.1.5.4 EAN-8 and EAN-13

EAN or European Article Numbering system (also called JAN in Japan) is a European version of UPC. It uses the same size requirements and a similar encoding scheme as for UPC codes. EAN-8 encodes 8 numeric digits consisting of two country code digits, five data digits and one check digit. B-Coder will accept up to 7 numeric digits for EAN-8. B-Coder will automatically calculate the check digit for you. If you enter less than 7 digits or if you enter any digits other than 0 to 9, B-Coder will display a warning message. If the option "Enable Invalid Message Warnings" in the Preferences menu is not selected and you do not enter 7 digits, B-Coder will left pad short messages with zeros and truncate longer messages so that the total length is 7.

Figure no.6: EAN-8 and EAN-13



Both EAN-8 and EAN-13 support a supplemental two or five digit number to be appended to the main bar code symbol. The supplemental is designed for use on publications and periodicals. Supplemental messages must consist of either two or five numeric digits and will appear as a small additional bar code on the right side of a standard EAN symbol. EAN bar code numbers are assigned to specific products.

EAN-13 is the European version of UPC-A. The difference between EAN-13 and UPC-A is that EAN-13 encodes a 13th digit into the parity pattern of the left six digits of a UPC-A symbol. This 13th digit, combined with the 12th digit, usually represent a country code.EAN-13 has been adopted as the standard in the publishing industry for encoding ISBN numbers on books. An ISBN or Book Land bar code is simply an EAN-13 symbol consisting of the first 9 digits of the ISBN number preceded by the digits 978. The supplemental in an ISBN bar code is the retail price of the book preceded by the digit 5. For example, if your ISBN number is 1-56276-008-4 and the price of the book is $29.95 then you would enter 978156276008 as the bar code message and 52995 for the supplemental.

1.1.5.5 Interleaved 2 of 5

It is very compact. However, it can only record numbers. The code represents number of even length. It is possible to scan only a part of the bar code and book a like a valid result.

Figure no.7: Interleaved 2 of 5

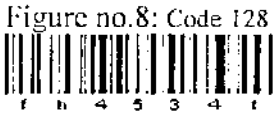
Interleaved 2 of 5 is a high density variable length numeric only symbology that encodes digit pairs in an interleaved manner. The odd position digits are encoded in the bars and the even position digits are encoded in the spaces. Because of this, I 2 of 5 bar codes must consist of an even number of digits. Also, because partial scans of I 2 of 5 bar codes have a slight chance of being decoded as a valid (but shorter) bar code, readers are usually set to read a fixed (even) number of digits when reading I 2 of 5 symbols. The numbers of digits are usually pre-defined for a particular application and all readers used in the application are programmed to only accept 2 of 5 bar codes of the chosen length. Shorter

data can be left padded with zeros to fit the proper length. Interleaved 2 of 5 optionally allows for a weighted modulo 10 check character for special situations where data security is important.

1.1.5.6 Code 128

Code 128 is a variable length, high density, alphanumeric symbology. Code 128 has 106 different bar and space patterns and each pattern can have one of three different meanings, depending on which of three different character sets is employed. Special start characters tell the reader which of the character sets is initially being used and three special shift codes permit changing character sets inside a symbol. One character sets encodes all upper case and ASCII control characters, another encodes all upper and lower case characters and the third set encodes numeric digit pairs 00 through 99. This third character set effectively doubles the code density when printing numeric data.

Figure no.8: Code 128



Code 128 also employs a check digit for data security. In addition to ASCII characters, Code 128 also allows encoding of four special function codes (FNC1 - FNC4). The meaning of function code FNC1 and FNC4 were originally left open for application specific purposes. Recently an agreement was made by the Automatic Identification Manufacturers Assoc. (AIM) and the European Article Numbering Assoc. (EAN) to reserve FNC1 for use in EAN applications. FNC4 remains available for use in closed system applications. FNC2 is used to instruct a bar code reader to concatenate the message in a bar code symbol with the message in the next symbol. FNC3 is used to instruct a bar code reader to perform a reset. When FNC3 is encoded anywhere in a symbol, any data also contained in the symbol is discarded.

1.1.5.7 POSTNET

POSTNET (Postal Numeric Encoding Technique) is a 5, 9 or 11 digit numeric only bar code symbology used by the U.S. Postal Service to encode ZIP Code information for automatic mail sorting by zip code. The bar code may represent a five digit ZIP Code (32

bars), a nine digit ZIP + 4 code (52 bars) or an eleven digit Delivery Point code (62 bars). POSTNET is unlike other bar codes because data is encoded in the height of the bars instead of in the widths of the bars and spaces. Most standard bar code readers cannot decode POSTNET. This symbology was chosen by the Postal Service mainly because it is extremely easy to print on almost any type of printer. POSTNET is a fixed dimension symbology meaning that the height, width and spacing of all bars must fit within exact tolerances. Microsoft Access and Word have built in tools for generating PostNet bar codes. *Postal FIM Patterns.*FIM or Facing Identification Mark patterns are another type of postal bar code used in automated mail processing by the U.S. Postal Service. FIM patterns are used for automatic facing and canceling of mail that does not contain a stamp or meter imprint (business reply mail, penalty mail, etc.). They also provide a means of separating business and courtesy reply mail from other letters. Three FIM patterns are currently in use. FIM-A is used on courtesy reply mail that has been preprinted with PostNET bar codes. FIM-B is used on business reply, penalty and franked (government) mail that are not preprinted with PostNET bar codes. FIM-C is used on business reply, penalty and franked mail that has been preprinted with PostNET bar codes. FIM patterns are placed in the upper right corner along the top edge and two inches in from the right edge of letters and cards.

1.1.5.8 PDF417

PDF417 is a high density 2 dimensional bar code symbology that essentially consists of a stacked set of smaller bar codes. The symbology is capable of encoding the entire (255 character) ASCII set. PDF stands for "Portable Data File" because it can encode as many as 2725 data characters in a single bar code. The complete specification for PDF417 provides many encoding options including data compaction options, error detection and correction options, and variable size and aspect ratio symbols.

Figure no.9: PDF417

The zymology was published by Symbol Technologies, Inc. to fulfill the need for higher density bar codes. The low level structure of a PDF417 symbol consists of an array of

code words (small bar and space patterns) that are grouped together and stacked on top of each other to produce the complete printed symbol. An individual code word consists of a bar and space pattern 17 modules wide. The user may specify the module width, the module height, and the overall aspect ratio (overall height to width ratio) for the complete symbol. A complete PDF417 symbol consists of at least 3 rows of up to 30 code words and may contain up to 90 code word rows per symbol with a maximum of 928 code words per symbol. The code words in a PDF417 symbol are generated using one of three data compaction modes currently defined in the symbology specifications.

1.1.5.9 BPO 4 State Code (British Post Office, Royal Mail Code)

BPO (British Post Office) 4 State Code is a new postal bar code symbology that has been developed by the British Post office for encoding European postcode data similar to the way the U.S. PostNET symbology is used for encoding Zip Code data. At the time of this writing, the BPO 4 State Code has not been officially adopted as the standard for European postal applications however it is anticipated that it will be sanctioned sometime in 1995. The goal of BPO 4 State Code is to provide European countries with a simple and efficient postal bar coding scheme.

Figure no.10: BPO 4 State Code

The U.S. PostNET symbology encodes numeric characters in a pattern of four bars per character with each bar being either tall or short (i.e. two possible "states" for each bar). The U.S. technique thus allows for up to 16 different possible bar patterns for each set of four bars and is adequate for encoding the ten digits zero through nine. Because European postcodes contain both alpha and numeric characters, (thus requiring a minimum of 36 different possible patterns for the characters A-Z and 0 to 9), each character in the BPO 4 State Code is encoded into four bars with each bar having four possible states.

1.1.5.10 DATA MATRIX

Data Matrix is a high density 2 dimensional matrix style bar code. Symbology, that can encode up to 3116 characters from the entire 256 byte ASCII character set. The symbol is

built on a square grid arranged with a finder pattern around the perimeter of the bar code symbol.

Figure no.11: Data Matrix

There are two types of Data Matrix symbols each using a different error checking and correction scheme (ECC). The different types of Data Matrix symbols are identified using the terminology "ECC" followed by a number representing the type of error correction that is used by the encoding software. ECC 000 to ECC 140 are the original type of Data Matrix symbols and are now considered obsolete. The newest version of Data Matrix is called ECC 200 and is recommended for all new Data Matrix applications. The ECC 200 version of Data Matrix uses a much more efficient algorithm for encoding data in a symbol as well as an advanced error checking and correction scheme.

1.1.5.11 MaxiCode

MaxiCode is a fixed size matrix style symbology which is made up of offset rows of hexagonal modules arranged around a unique bulls-eye finder pattern. Each MaxiCode symbol has 884 hexagonal modules arranged in 33 rows with each row containing up to 30 modules. The maximum data capacity for a MaxiCode symbol is 93 alphanumeric characters or 138 Numeric characters. The symbology was designed by United Parcel Service for package tracking applications. The design of the MaxiCode symbology was chosen because it is well suited to high speed, orientation independent scanning.

Figure no.12: MaxiCode

Although the capacity of a MaxiCode symbol is not as high as other matrix style bar code symbologies, it was primarily designed to encode address data which rarely requires

more than about 80 characters. MaxiCode symbols actually encode two separate messages - a Primary message and a Secondary message. The Primary message normally encodes a postal code, a 3 digit country code and a 3 digit class of service number. The Secondary message normally encodes address data and any other required information

1.1.5.12 Aztec Code

Aztec Code is a high density 2 dimensional matrix style bar code symbology, that can encode up to 3750 characters from the entire 256 byte ASCII character set. The symbol is built on a square grid with a bulls-eye pattern at its center. Data is encoded in a series of "layers" that circle around the bulls' eye pattern. Each additional layer completely surrounds the previous layer thus causing the symbol to grow in size as more data is encoded yet the symbol remains square.

Figure no.13: Aztec Code

The smallest element in an Aztec symbol is called a "module" (i.e. a square dot). The module size and the amount of error correction are the only "dimensions" that can be specified for an Aztec symbol and both are user selectable. It is recommended that the module size should range between 15 to 30 mils in order to be readable by most of the scanners that are currently available. The overall size of an Aztec symbol is dependent on the module size, the total amount of encoded data and also on the level of error correction capacity chosen by the user. The smallest Aztec symbol is 15 modules square and can encode up to 14 digits with 40% error correction. The largest symbol is 151 modules square and can encode 3000 characters or 3750 numeric digits with 25% error correction.

1.1.5.13 MSI/PLESSEY

MSI/PLESSEY is a variable length, numeric-only symbology. The symbology is one of the earliest bar code symbologies ever developed and is based on a four bit binary number scheme. Each symbol is framed by a start and a stop pattern and contains a check

character that is calculated from the values of each of the encoded data digits. MSI/Plessey is rarely used in anything other than grocery store shelf marking applications. In fact most modern bar code readers do not provide support for reading MSI/Plessey symbols.

1.1.6 Barcode Dimension

There is a large variety of 2D symbologies. The most common are matrix codes, which feature square or dot-shaped modules arranged on a grid pattern. 2D symbologies also come in a variety of other visual formats. Aside from circular patterns, there are several 2-D symbologies which employ steganography by hiding an array of different sized or shaped modules within a user-specified image. A matrix code, also known as a 2D barcode or simply a 2D code, is a two-dimensional way of representing information. It is similar to a linear (1D) barcode, but has more data representation capability.

There are two dimensional barcode also which can store data in a small area. However, they are too slow to scan. In most application, it is possible to avoid the need for large quantities of data in the barcode and thus avoid the need for two dimensional barcodes. For example, barcode might contain a short identification number which can be linked to a larger body of information in the computer database.

Two dimensional barcodes are replacing older, linear 'strip' codes, as they can store much greater amounts of information. Recently, two dimensional barcodes, which cannot be read by scanning in a single direction but must be processed as a complete image, have become widespread. These use a series of 'modules' (normally black-white spots representing binary information) lay out on a grid, often printed as a square or rectangular matrix. This matrix contains 'finder' elements, so the image recognition system can locate and orient the pattern, and 'timing' information to ensure that the correct grid-spacing is identified.

- QR Codes. These 'quick response' patterns were invented in Japan in 1994 and patented by Denso Wave. However, the coding system has been standardized as ISO/IEC 18004:2006 and the company has promised not to assert its patents. QR codes use a square grid with 21 to 177 modules along each axis. At the lowest

level of error correction, a QR code can store up to 4,296 alphanumeric characters. One review suggests that QR Codes can be slightly faster to detect and decode.

- Aztec code. This public domain coding system (originally created by Honeywell) can store up to 3,067 alphanumeric characters using grids from 15 to 151 units square.
- High Capacity Color Barcode (HCCB). This proprietary format is being marketed as Microsoft Tag. The company says that the format will be free for the duration of the beta (trial) period, but that it reserves the right to charge thereafter. HCCBs use a 5 by 10 grid of colored triangles (storing 105 bits in the 4-colour version) that code for a URL. To extract information, an HCCB reader must decode the data and look up the associated address via a Microsoft server, which will then redirect the user to the required web page. Although a web connection is always required, due to this lookup process HCCBs can 'expire' or be updated to a new URL.
- Shotcode. These are circular, represent 40 data bits and must lookup the underlying URL in a similar way to HCCBs. (Wikipedia, the free encyclopedia,2008)

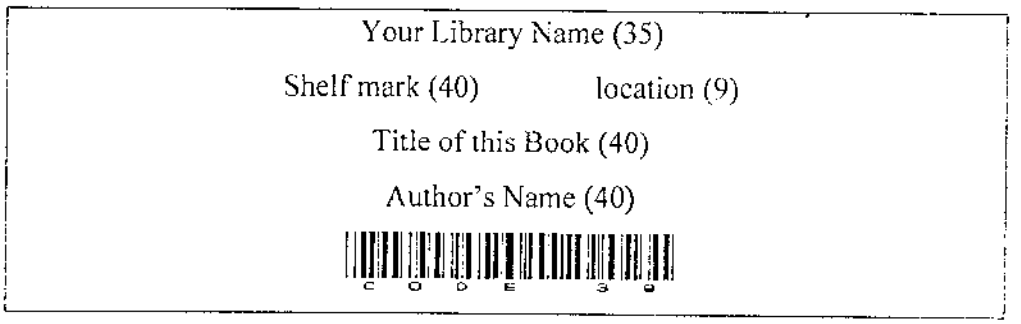
1.1.7 Barcode Labels

Most automated circulation systems require barcode which is incorporated on each book and ticket. In many educational and research institutions co operations between library and administrative departments has led to the introduction of a single card which can serve many purposes for the holder. For example, a card including photograph and a barcode label may be issued to a student/ member on registration. This will serve as a general identification card as well as library ticket. Readers may also be able to use one ticket for borrowing from several libraries if cooperative arrangements have been agreed between libraries. Thus, the advantages of computerized systems in terms of personal convenience may be apparent to readers.

Assigning barcode for first time to all readers can be a significant task in total system implementation programmed and consequently it is an exercise which must be carefully

planned. Depending on local circumstances, however data may be entered and barcodes assigned to each reader when they first borrow books via the new system or alternatively, borrowers' records can be prepared in advance so that the borrower card is ready for distribution to each reader in advance of the time they want to use it. The former method is probably not practical for every busy libraries and the later method has the slight disadvantage that a proportion of cards may be wasted as they may remain unclaimed. Some systems allow a compromise situation where the borrowers' records are prepared in advance but a barcode number is only assigned when the reader applies for registration under new system. The record on the file remains incomplete and therefore unusable until the barcode number is 'wanded' or typed in. (Singh, 2000)

Figure no.14: Barcode label



1.1.8 Bar-Coding Books

Most automated circulated system requires that each item included in the bibliographic file has its own unique barcode number. In integrated library systems, this number may be used as the unique item identifier across all functions. It would normally be assigned on receipt of the item. The barcode label is stuck on the book in a consistent place which has been chosen as the most convenient for issuing purposes and the number is keyed or 'wanded' into the system. Labeling the existing stock is a major task for those libraries automating for the first time or changing from a system which did not require barcode numbers.

The method adopted for the labeling exercise will be dictated by local circumstances and common sense. Some libraries complete the exercise by organizing staff to work systematically along the shelves with the self list file, or classified card catalogue, sticking a label in the book and a matching one on the shelf list or catalogue entry. Data entry has been completed as a separate exercise, with staff working from the labeled

cards rather than the books. Another common method is to combine data entry with labeling. The books to be entered are removed from the shelves and taken to the terminals; thus the books are only handled once. Whatever, method is adopted, the exercise will be time-consuming and allowance should be made for this in the overall implementation plan. Some libraries have alleviated the situation by hiring temporary staff, by closing the libraries for a period of time, or simply by having an 'all available hands on deck' policy on the basis that more people during tedious work for short, intensive periods will be more effective than having smaller numbers working on it with the necessary breaks in between.

When using Barcode Components or Applications for printing, the following is suggested:

- When encoding uppercase and/or lowercase letters, numbers, punctuation, any letter or symbol appearing on the standard U.S. keyboard and lower ASCII functions such as returns and tabs, up to about 40 digits, use Code128. All of ID Automation's barcode components and applications support Code 128 as the default barcode type.
- When encoding several lines of data of any type over 40 characters, it is suggested to use the PDF417 or Data Matrix barcodes.

When using Barcode Fonts, the following is suggested:

- When encoding only numbers, up to about 30 digits, choose Codabar Barcode Fonts. Codabar is the most dense, self-checking (easy-to-use) symbology.
- When encoding uppercase letters, numbers and these symbols (- . $ / + %), up to about 20 digits, choose Code 39 Barcode Fonts. Code 39 is also a dense self-checking (easy-to-use) alpha-numeric symbology.
- When it is necessary to encode uppercase and lowercase letters, numbers, punctuation and ASCII functions such as returns and tabs, up to about 40 digits, use Code 128 Barcode Fonts or the Universal Barcode Fonts.

1.1.9 Smart Bar-Codes

One popular method for labeling and linking the collection utilizes customized or smart, barcodes. Smart barcodes are created by means of computerized processing of the item information already contained in the bibliographic recorded. The item information is then linked to a unique number and a corresponding barcode label is printed that, as suggested below, includes a mix of eye-readable matching points such as shelf mark, location, truncated author and/or title, publication date and edition.

You should consider this method if your collection has already been retrospectively converted and contains the information necessary to create the item record through machine processing. It will be most successful if item information has been entered consistently, if shelf marks are unique, and if database maintenance is up-to date so that barcodes are not created for items that, for example, have been withdrawn from the collection. Libraries using the Dewey decimal classification can still use smart barcode label to identify the item clearly.

- Smart barcodes cost more than generic barcodes initially, both for production of the labels and for the machine processing required to support their use. Common problems in smart bar-coding projects include:
- Items for which no label has been printed- principally duplicate copies, multivolume sets, and items for which there was no information in the database.
- Creating barcode labels for non-existent items.
- Creating barcodes with insufficient identifying information to match them with the item on the shelf.

Because a smart barcode has already been attached to an item in the automated system, any human error that results in attaching the wrong barcode to the wrong item will have very negative implications.

Smart barcode do have advantages, however:

- Materials do not have to be physically transported to workstations to be linked.

- The bar-coding and linking process can be completed in one step, saving personnel costs. (Wikipedia, the free encyclopedia, 2008)

1.1.10 Generic Barcode

For those libraries that have completed retrospective conversion or that do not have sufficient item information in their bibliographic records to make the use of smart barcodes practical, the use of generic or 'dumb' barcodes may be the best approach. Dumb barcodes have no inherent connection to an item and basically consists of a barcode and an eye-readable number that can be attached randomly to materials in the collection. The sample is given below.

Figure no.15: Barcode sample

There are two ways to use dumb barcodes:

- Take the items to be bar-coded and linked to a terminal. Barcode each item, then link the item into the system by matching it with the appropriate bibliographic record, transferring necessary item , information and wanding, scanning or keying the barcode number to complete the process.
- Take the shelf list to the shelves, barcode both the item and the shelf list, and then link the item into the system from the shelf list.

The disadvantages to this method are apparent. Either all items in the collection must be moved to and from workstations or a two-step process of labeling or linking must be adopted, which takes longer and requires more human labor. However, dumb barcodes are less expensive than smart barcodes. (Kawatra, 2000)

1.1.11 Scanners

Linear symbologies are optimized to be read by a laser scanner, which sweeps a beam of light across the barcode in a straight line, reading a slice of a bar code light-dark patterns. In 1990s development of CCD imagers to read bar codes was pioneered by Welch Allyn. Imaging does not require moving parts like a laser scanner does. In 2007, linear imaging is surpassing laser scanning as the preferred scan engine for its performance and

durability. Stacked symbologies are also optimized for laser scanning, with the laser making multiple passes across the barcode.

2D symbologies cannot be read by a laser as there is typically no sweep pattern that can encompass the entire symbol. They must be scanned by a camera capture device.

The earliest and the still the cheapest, bar code scanners are built from a fixed light and a single photo sensor that is mutually "scrubbed' across the bar code.

Barcode scanner can be classified into two categories based on their connection to the computer. The older type is the RS-232 bar code scanner. This type requires special performing for transferring the input data into to the application program. The other type is the USB barcode scanner, which is a more modern and more easily installed device than the RS-232 scanner. Its advantage is that it does not need any code or program for transferring input data into the application program; when you scan the bar code its data is sent to the computer as if it had been typed in the keyboard.

Barcode is the coded information in the form of bars that can be read by the OCR (Optical Characters Recognition). Barcode readers are frequently used to simplify the charging and the discharging of books in the libraries. Barcode act in much the same way as a keyboard. In the same way that depressing a key sends a signal containing a character code to the computer, reading a barcode result in the same kind of signal being sent to the processor. Generally, libraries have found that barcodes provide a convenient way or recording data about books. The barcode in affect acts as a unique identification number which is associated with a record giving appropriate details of individuals books. The barcode can be quickly read into the computer by means of a 'light pen' or a 'wand' which has very small lamp and light sensitive pick up device in its tip. The light is reflected from the barcode and as the wand is moved across the label, the pick up device receives the light from the dark bars than from the spaces between them. The signals received through this process are then converted into a form which can be recognized by the computer. (Singh, 2000)

1.1.11.1 Types of Scanning Devices

- Laser Gun: This looks like a pistol and is held in the hand when the user pulls the trigger, a light beam sweeps across the barcode. It is fast and doesn't

require much of manual dexterity and practice. It is good for low quality barcodes even from the long range-even from a few inches up to 20ft, depending upon the scanner model and barcode quality. Its advantages are-

- It is expensive
- It is more venerable because of precision optics and moving parts.

- Wand: It has the size and shape of a pencil with a lighted bead in the top. The user holds it and draws it across the barcode. The wand makes a small sound when the code is scanned. Its advantages are-
  - It requires manual dexterity and practice.
  - It does not do will with the low quality and curved surfaces.
  - It must be used in contact with the barcodes and scanning from long range is not possible.
- CCD Scanner (Charged Coupled Device): It looks like a vacuum cleaner head, that you put is down over the barcode as though you are going to vacuum it up. It is very inexpensive, but almost as fast and good as laser gun. It is accurate and requires little manual dexterity or practice. Its limitation is that it is of short range scanning capacity. It can scan by contact or up to 3 inches distance depending upon the scanner model.
- In Counter Scanner: This is mounted on the surface of the counter top, looking at barcodes passing over,. It is hand free, fast and accurate. Its advantages are-
  - Expensive
  - No mobility or flexibility.
- On counter Scanner: It is mounted on the counter, facing horizontally instead of vertically. It is also hands free, fast and accurate apart from reducing the risks of strain injuries. Its advantages are-
  - It is expensive.
  - It has no mobility or flexibility.
- Badge Scanner: It is a small box with a slot through which the user slides a badge or card. It is mainly used in time and attendance control system. This scanner requires little practice or manual dexterity apart from being inexpensive. (Kawatra, 2000)

1.1.12 Barcode Decoders

Hand Held Decoders

Hand Held Products is now part of Honeywell. Dedicated to offering products uniquely tailored to markets such as retail, transportation, distribution, warehousing, logistics, and manufacturing, Hand Held offers the industry's best value and backs it up with expert, personalized service from start to finish. By investing in Hand Held products, our customers are able to reduce costs, improve service, and position their companies for future growth.

Symbol Decoders

Symbol Technologies offers a comprehensive range of technologies, products, partnerships and support necessary to provide integrated industry-specific data management systems. The building blocks in this process are Barcode laser scanning, hand-held computers and wireless LANs - the three essential elements needed to transform data into action.

Wasp Decoders

Wasp Bar Code provides a professional line of bar code business products including complete hardware and software suites, TrueType bar code fonts, powerful labeling software, premium bar code scanners, and state-of-the-art developer toolkits intuitive for small business, yet powerful enough to be used by Fortune 500 Companies. (Singh, 2000)

1.2 Statement of Problem

Barcode technology is useful for all types of libraries. It is one of the major aspects necessary for the effective library management and organization. This system helps to save time, human resources and plays important role in automation of library. Few of the libraries in our country have adopted barcode system, but they are limited only within performance like circulation system. There are no records of facts and figures of libraries, library users and librarians regarding the use of automation and its application in libraries. There has been lack of knowledge about barcode technology among the library professionals. No use of barcode technology in library. Among different modern technology, barcode technology could be adopted in the libraries of developed countries. But in case of developing countries there has been lack of proper human resources as well as sufficient budget, barcode technology became a challenging task. Basing upon the problems the major reasons for carrying out the study are as follows-

- Unknown about automation/digitization of library system.
- Less research about barcode technology and its development.
- No consistency usage of software for better services.
- Lack of the supports and suggestions necessary for the users and the librarian.

1.3 Objectives of the Study

The objectives of the study are as follows-

- To know barcode technology and its development.
- To find out the applicability of barcode technology in libraries.
- To know whether barcode application software in the libraries of Nepal is useful or not.
- To suggest libraries and library personnel (staff) for better services through barcode technology.

1.4 Scope and Limitation of the Study

As we know that the library is the social institution based on the five laws. The progressive increase in number of transactions and the information explosion have promoted the introduction of computer technology for automating and improving the efficiency of operations.

This study includes all those following libraries using barcode technologies as-

- The American Library.
- Amrit Science Campus Library.
- Gems Library.
- Kathmandu University of Education and Management Library.(KU)
- Kathmandu Valley Public library. (KVPL)
- Ministry of General Administration.(MoGA)
- Nepal College of Information Technology.(NCIT)
- Public Youth Campus Library.(PYCL)
- Social Science Baha Library.(SSBL)
- Ullens School Senior Library.

This study focuses on the applicability and development of barcode technology in all kinds of libraries within Nepal. On the basis of different types of library software used for barcode technology, the researcher has taken major ten libraries. These libraries can represent the responsibility of all other libraries software of same kind. Data has been collected within 25th August, 2008 to 8th March, 2009, through the questionnaire.

1.5 Significance of the study

The research based on barcode technology has not yet been studied in Nepal. This research is quite new and provides lots of knowledge about barcode and its applicability to all types of libraries, library staffs and users as Nepalese library and information centers are lacking far behind in the field of automation. Also due to the time frame and lack of the proper facility of different factors, the study has the following limitations-

- This study focuses on library automation only through library barcode system.
- This study includes only those libraries which are using barcode technology.

1.6 Definition of the Terms/glossary

Barcode Character

A single group of bars and strips that represents a specific quantity (often one) of numbers, letters, punctuation marks, or other symbols. This is the smallest subset of a bar code symbol that contains data.

Barcode Density

The number of characters that can be represented in a linear unit of measure. This number is often expressed in characters per inch (cpi).

Bar Height/Length

The bar dimension perpendicular to the bar width, also called bar height. Scanning is performed in an axis perpendicular to the bar length.

Bar Width

The thickness of a bar measured from the edge closest to the symbol start character to the trailing of the same bar.

CCD readers

CCD readers use an array of hundreds of tiny light sensors lined up in a row in the head of the reader. Each sensor measures the intensity of the light immediately in front of it. Each individual light sensor in the CCD reader is extremely small and because there are hundreds of sensors lined up in a row, a voltage pattern identical to the pattern in a bar code is generated in the reader by sequentially measuring the voltages across each sensor in the row.

Character

A single group of bars and spaces that represents a specific number (usually one) of numbers, letters, punctuation marks, or other symbols. A graphic shape representing a letter, numeral, or symbol. A letter, digit, or other symbol that is used as part of the organization, control, or representation of data.

Character Alignment

The vertical or horizontal position of characters with respect to a given set of reference lines.

Character Density

Within a liner bar code symbol, the number of data characters per unit length (typically per inch). For a discrete symbology, the character width must include the inter-character gap.

Character font

Refers to the range and variety of data characters available within a given thermal printer model, for example 7 Bitmapped fonts type A,B,C,D,E,F and 1 Scaleable font.

Communication software

Communication software is used to provide remote access to systems and exchange files and messages in text, audio and/or video formats between different computers or user IDs. This includes terminal emulators, file transfer programs, chat and messaging programs, as well as similar functionality integrated within MUDs.

Counter-scanning (CS)

Counter-scanning (CS) is a method for measuring surface topography with a scanning probe microscope enabling correction of raster distortions resulted from drift of the microscope probe relative to the surface being measured. Two surfaces scans, viz. direct scan and counter one are obtained during CS. The counter scan starts in the point where the direct scan ends. This point is called the coincidence point (CP).

Discrete bar code

Each character of the bar code message stands alone, separated by inter-character gaps, and can be red independently from the others.

Guard Bars

Bars that are at both ends and center of a UPC and EAN symbol, that provides reference points for scanning. Guard bars are similar in function to start and stop characters.

Hand-Held Scanner

A hand-held scanning device used as a contact bar code reader or OCR (optical code reader).

High Density

This barcode type has narrow spaces and bars with an "X" dimension that is less than 7.5 miles.

Horizontal Bar Code

A bar code or symbol presented in such a manner that its overall length dimension is parallel to the horizon. The bars are presented in an array that looks like a picket fence.

Laser Scanners

Laser scanners work the same way as pen type readers except that they use a laser beam as the light source and typically employ either a reciprocating mirror or a rotating prism to scan the laser beam back and forth across the bar code. As with the pen type reader, a photodiode is used to measure the intensity of the light reflected back from the bar code.

Pen-type readers

Pen-type readers consist of a light source and a photodiode that are placed next to each other in the tip of a pen or wand. To read a bar code, the tip of the pen moves across the bars in a steady motion. The photodiode measures the intensity of the light reflected back from the light source and generates a waveform that is used to measure the widths of the bars and spaces in the bar code. Dark bars in the bar code absorb light and white spaces reflect light so that the voltage waveform generated by the photo diode is a representation of the bar and space pattern in the bar code. This waveform is decoded by the scanner in a manner similar to the way Morse code dots and dashes are decoded.

REFERENCE

Barcode- wikipedia [online] (cited 2008, September 20). Retrieved from http://www.*the free encyclopedia*.htm.

History of barcode [online] (cited 2008, August 9). Retrieved from http://www.the history of barcode.htm

Kawatra, P.S. (2000). *Textbook of information science*. New Delhi: A.P.H. Publishing Co-operation.

Khanna, J.K. (1994). *Library and Society* (2nd ed.). New Delhi: Ess Ess Publications.

M.S. Islam & Nafiz, Zaman Shuva. (2010). *The International Information & Library Review*. 42(1), 27-33.

Prasher, R.G. (1991). *Information and its communication*. New Delhi: Medallion press.

Singh, Anil (2000). *Application of barcode technology in libraries*. Library Herald. 40(1), 43-47.

Chapter II

REVIEW OF LITERATURE

The topic 'Barcode Technology' is considered as an important aspect for all kinds of libraries. The research and upgrading barcode technology by using modern and sophisticated library software is the necessity of today's system. However, only few numbers of studies have been carried out on the specific topic of library barcode technology in relation to the ones carried out on other topics in the field of library and information science. More specifically, in context of Nepal, very few studies have been carried out on the library barcode technology.

Butters, (2007) have advised that barcodes are often a source of frustration for library users as well as staff. If the barcodes are of poor quality they may not be read by the scanner in the self service equipment. If barcodes are to be found in multiple locations throughout the collections, all of the barcode positions may not be accessible to the scanner in the self service equipment and may also be challenging for the borrower to locate. Consider whether barcode relocation to a fixed position somewhere on the cover of the book is necessary. Experience suggests that the more that is required of the borrower - such as hunting inside the book for the barcode - the less enthusiastic will the self service equipment be received. A project to relocate all barcodes to a common position may deliver rewards in terms of equipment utilization. Many vendors have products specifically designed for the duplication and relocation of barcodes. Consideration should also be given to non-book material. A strategy will be needed for audio tapes, CDs, DVDs, video cassettes and other commonly borrowed non-book items. The accepted wisdom is that if a borrower has multiple items including one item that cannot be processed via self service, the borrower will bring all of their items to a staff member - even if the majority could have been processed via self service.

As according to Butters, a barcode technology must be of good quality. Barcode should not be used only for books but also on non-book materials.

Brian, (2008) has explained the world of barcodes is becoming vastly more interesting in recent times, with 2D barcodes allowing us to represent anything from URLs to invoices, which in turn allows us to connect physical images to applications in all kinds of interesting ways. In this article I will look at the history of barcodes, detail what's available today for creating and reading barcodes, and look at some real-world use cases.

According to the Brian, world of barcode technology is becoming very useful and necessary for coming future, in the field of library.

Kawatra, (2000) has stated that, barcode is not a new technology, as many of us would think. It has been around since the late 1940s and saw its first commercial use in 1960 as a method for tracking railroad cars. He also code that, a number of possibilities exist for using barcode. One such possibility is its use in libraries. The Kentish Town branch of CAMDEN public Library was the first library to use the Plessey light pen system in 1972. A U.K firm SB Electronics System, has a barcode level. The University of Surrey library a bar-coding method known as '2 of 5' and these levels are 'read' by microprocessor based light-pen terminals. Many American libraries use code-48 which includes alphabetic characters.
As according to Kawatra, barcode technology is not new technology, so it can support today's libraries through automation.

Marriott, (1995) outlines research work based on the application of coding theory and information theory to barcode systems design, with the aim of developing a replacement for traditional linear barcodes. The coding device needs to be cheap to print and easy to read but also have the ability to store and retrieve a complete transaction file. The result of this work was PDF417, a symbol which can contain over a kilobyte of binary data or almost 2,000 alphanumeric characters. Describes the key features of PDF417 and gives examples of applications in the automotive industry, supply chain communications and military ID card systems.
As according to Marriott, today linear barcodes are replaced by 2D barcodes. Those advanced barcodes helps libraries to preserve and retrieve complete information without loss of time and human resource.

Zosel and Niels, (2006), have stated that bar codes have provided a reliable, inexpensive form of machine-readable identification, since 1970s. Although bar coding has numerous benefits, its primary function is to error-proof the data-entry process. Studies show that one out of 300 manually keyed entries results in an error, but only one out of 3 million scanned entries using a Code 39 bar code results in an error. Clinical analyzers with embedded bar code readers provide a good example of how bar coding can reduce errors and save time. With an embedded bar code reader, an analyzer can identify each sample, determine what test needs to be performed, and identify the necessary reagent. The entire test is bar code verified, and the information is automatically uploaded to the central laboratory's database. Without the bar code and reader, the information would have to be keyed in manually, which can reduce efficiency and increase errors.

Imager-based bar code readers are emerging as a more-attractive technology compared with laser bar code scanners. Until recently, 2D capable bar coding system was not easy to use and was not cost-effective to implement. Most imagers were too large and expensive to use as a subsystem within a diagnostic instrument. However, new miniature mega pixel imagers can read 2D codes while solving quality and alignment problems for both small portable device sand large-scale instruments.

We are familiar seeing barcode strips in many contexts, especially on consumer goods that use the European Article Number (EAN) system, which is now governed by the GS1 supply chain standards group. These barcodes are linear, in that a reader detects the pattern and (effectively) sweeps across it in the horizontal direction. Tagging systems, including barcodes, are used in many applications, such as identifying boarding passes, numbering concert tickets, uniquely identifying industrial and military goods, tracking items in transit and marking postal items with machine-readable addresses. It is frequently suggested that machine reading considerably reduces error rates, from (typically) 1 in 300 for human input to (at worst) 1 in 15,000 for barcodes.

As according to Zosel and Niels, barcode technology has got numerous benefits over manual process. A barcode technology is error free technology as compared to manually process barcodes.

REFERENCE

Barcode- wikipedia [online] (cited 2008, September 20). Retrieved from http://www.*the free encyclopedia*.htm.

Butters, Alan. (2007). *RFID systems, standards, and privacy within libraries. Electronic Library, 430-439.*

Kawatra, P.S. (2000). *Textbook of information science*. New Delhi: A.P.H. Publishing Co-operation.

Marriott, Mark (1995). *PDF417 portable data files a new dimension in barcodes*. 15 (1).

Zosel, Andrew & Wartenberg, Neils (2006*). Medical Device & Diagnostic Industry*. 32

Suda, Brian (2008). *Connecting the real-world to the virtual*. 16 (1).

Chapter III

FOCUS OF THE STUDY

3.1 Barcode System and Its Application

Barcodes are a pattern of bars and spaces of varying width that represent digits, letters or other punctuation symbols to identify an item or object. Barcode by itself is not a system but an identification tool that provides an accurate and timely support of the data requirement for sophisticated management system. Barcode usages increases accuracy in data collection saves time and improves efficiency in library activities.

Barcode acts in much the same way as a keyboard. In the same way that depressing a key sends a signal containing a character code to the computer, reading a barcode results in the same kind of signal being sent to the processor. The barcode, in effect, acts as a unique control number which is associated with a record giving appropriate details of individual items. While scanning, the light is reflected from the barcode and the pick up optical device receives less light from the dark bars than from the spaces from them. The signals received through this process are then converted into a form which can be recognized by the computer.

The signals can enter the computer in one of the two ways: The barcode scanner can be directly plugged into one of the 'slots' in the back of the system box and special software controls the processes or the barcode signals can enter through the keyboard connection to the computer.

Basic requirement for implementing barcodes in library application

- Online scanner (connected with computer for issue/ return process)
- Off-line scanner (useful when there is no light and also for physical verification, user statistics)
- Decoder (external or inbuilt) which translates the scanned data into ASCII character stream before it is fed into the computer.
- Printer (Dot-matrix, laser, thermal)
- Communication software
- Printing software

- Books/ periodicals (documents) database.
- Laminators (sheets or stickers, laminating roles, membership card pouches, laminating machines etc)
- Membership databases
- Library software and
- Labels

3.2 Barcode Based Circulation System

The automation packages provide the modules for the circulation system. When the transaction such as issuing is to be performed the barcode on the reader's ticket is scanned. Following this the barcode of the document is also scanned. The system links these two barcode numbers. For any follow up such as overdue notices, reservation, extension of loan etc, the record can be retrieved by keeping the barcode number. So also for any enquires such as what are the books borrowed by a particular member, their due dates etc. the membership barcode number can be used. (Kawatra, 2000)

3.3 Code and Symbology

A code is the combination of numbers and characters that represents an entity, such as, a part number. The symbology is the language used to represent the code in machine-readable form. The code represented by a combination of bars and spaces of varying width is called the barcode symbol.

The mapping between messages and barcodes is called a symbology. The specification of a symbology includes the encoding of the single digits/ characters of the message as well as the start and stop markers into bars and spaces, the size of the quiet zone required to be before and after the barcode as well as the computation of a check sum.

Bar codes are like a printed version of the Morse code. Different bar and space patterns are used to represent different characters. Sets of these patterns are grouped together to form a "symbology". There are many types of bar code symbologies each having their own special characteristics and features. Most symbologies were designed to meet the needs of a specific application or industry. For example the UPC symbology was

designed for identifying retail and grocery items and PostNET was designed to encode Zip Codes for the US Postal Service.

Liner symbologies can be classified mainly by two properties-

- Continuous vs. Discrete: Characters in continuous symbologies usually abut with one character ending with the space and the next with a bar, or vice versa. Characters in discrete symbologies begin and end with bars; the inter-character space is ignored, as long as it is not wide enough to look like the code ends.
- Two width Vs. Many widths: Bars and spaces in two width symbologies are wide and narrow; how wide bar is exactly has no significance as long as the symbology requirements for wide bars are adhered to (usually to three times more wide than a narrow bar). Bars and spaces in many- width symbologies are all multiples of a basic width called the module; much such codes use four widths of 1, 2, 3 and 4 modules. (Kawatra,2000)

3.4 Library Software

Library software is application software used in the libraries for the automation of the major function of the library via acquisition. Cataloguing process, catalogue care generation , authority file maintenance, circulation, serial control, online public access catalogue (OPAC),automatic indexing, thesaurus construction, union catalogue, directories, SDI services etc depending upon the features of the software. The modules of the functions of libraries are already programmed and designed in the software and the library has to simply install and used it for proper function.

Large number of library software has been introduced by the librarians and the information scientists all over the world. Examples include CDSISIS/WINSIS, LIBRA, SOUL, IAN, KOHA, ALICE etc.

Following are major barcode software used in Nepalese libraries-

3.4.1 CDSISIS/WINSIS (Computerized Documentation Service / Integrated Set of Information Systems, Windows/Integrated Set of Information System)

CDS/ISIS is a software package for generalized Information Storage and Retrieval systems developed, maintained and disseminated by UNESCO. It was first released in

1985 and since then over 20,000 licenses has been issued by UNESCO and a worldwide network of distributors. It is particularly suited to bibliographical applications and is used for the catalogues of many small and medium-sized libraries. Versions have been produced in Arabic, Chinese, English, French, German, Portuguese, Russian and Spanish amongst other languages. UNESCO makes the software available free for non-commercial purposes, though distributors are allowed to charge for their expenses. CDS/ISIS is an acronym which stands for Computerized Documentation Service / Integrated Set of Information Systems. In 2003 it was stated that, this package is accepted by libraries in the developing countries as standard software for information system development.

The original CDS/ISIS ran on an IBM mainframe and was designed in the mid 1970s under Mr Giampaolo Del Bigio for UNESCO's Computerized Documentation System (CDS). It was based on the internal ISIS (Integrated Set of Information Systems) at the International Labour Organization in Geneva.

In 1985 a version was produced for mini- and microcomputers programmed in Pascal. It ran on an IBM PC under MS-DOS. Winsis, theWindows version, first demonstrated in 1995, may run on a single computer or in a local area network. The *JavaISIS* client/server components allow remote database management over the Internet and are available for Windows, Linux and Macintosh. Micro CDS/ISIS is an advanced non-numerical information storage and retrieval software developed by UNESCO since 1985 to satisfy the need expressed by many institutions, especially in developing countries, to be able to streamline their information processing activities by using modern (and relatively inexpensive) technologies.

The software was originally based on the Mainframe version of CDS/ISIS, started in the late '60s, thus taking advantage of several years of experience acquired in database management software development. Several partners contributed to its development through the years.

From the outset, CDS/ISIS was created as multi-lingual software, providing integrated facilities for the development of local linguistic versions. Thus, although UNESCO distributes only the English, French and Spanish versions of the package, user-developed

versions exist in virtually all languages, including special versions which UNESCO helped in developing, for Arabic, Chinese and Korean.

CDS/ISIS for Windows (Winisis) is 100% compatible with all Windows Operating Systems. However Windows NT/2000/XP users should read the troubleshooting section of the "readme" file installed by the Winisis installation program. In case you get a message similar to: "a device can attached to system is not functioning" "cannot run 16 bit. (UNESCO, 2004)

3.4.2 LIBRA

Libra is library software to organize your stuff: Audio CDs, Movies, Books & Games (for a start). And it does so beautifully, and at an amazing price Based on a real SQL database engine, Libra enables you to browse, sort or search through your items in lightning speed. You can do sophisticated queries too, like show me all the books & DVD's tagged with 'fiction' and' kid's stuff' that are not on loan.

Keep track of what your friends borrowed from you, and never lose a single item again. Libra helps you keep detailed record of each loan and reminds you when it's due. Once you have built your library collection, print out beautiful pages of your collection to create a catalog. The catalog will serve as a master index of all your items, so that you can track & find your items easily.

Export your library to web pages, and upload them to your web host to share with friends & family. Your friends can now browse through your entire collection, and know if you have a title that they need. We spent a great deal of effort in making things look pretty, and if you're running on Windows Vista (not absolutely required), you're in for an eye candy treat. From reflection on book shelves to glowing text on glass windows, we're pushing the limits of beauty on Windows, allowing you to show off your collection with great pride.

Libra comes with import plugging for a number of popular applications, including Microsoft Excel. If you already store your existing data in one of these applications, you can easily import your collection into Libra without re-entering all items. For applications that are not supported currently, keep a lookout in our development forum to see if anyone has implemented the required plunging.

3.4.3 Software for University Libraries (SOUL)

Software for University Libraries (SOUL) is an state-of-the-art integrated library management software designed and developed by the INFLIBNET Centre based on requirements of college and university libraries. It is user-friendly software developed to work under client-server environment. The software is compliant to international standards for bibliographic formats, networking and circulation protocols. After a comprehensive study, discussions and deliberations with the senior professionals of the country, the software was designed to automate all house keeping operations in library. The software is suitable not only for the academic libraries, but also for all types and sizes of libraries, even school libraries. The first version of software i.e. SOUL 1.0 was released during CALIBER 2000. The database of the SOUL 1.0 is designed on MS-SQL and is compatible with MS SQL Server 7.0 or higher. The latest version of the software i.e. SOUL 2.0 will be released by the end of the year 2008.

Following are the strong features of SOUL 2.0

- UNICODE based multilingual support for Indian and foreign languages;
- Compliant to International Standards such as MARC21, AACR-2, MARCXML;
- Client-server based architecture, user-friendly interface that does not require extensive training;
- Supports cataloguing of electronic resources such as e-journals, e-books, virtually any type of material;
- Supports requirements of digital library and facilitate link to full-text articles and other digital objects;
- Support online copy cataloguing from MARC21 supported bibliographic database;
- Provides freedom to users for generating reports of their choice and format along with template and query parameters;
- Supports ground-level practical requirements of the libraries such as stock verification, book bank, vigorous maintenance functions, transaction level enhanced security, etc.;

- Provides facility to send reports through e-mail, allows users to save the reports in various formats such as Word, PDF, Excel, MARCXML, etc.;
- Highly versatile and user-friendly OPAC (On-line Public Access Catalogue) with simple and advanced search. OPAC users can export their search results in to PDF, MS Excel.
- Supports authority files of personal name, corporate body, subject headings and series name;
- Provides simple budgeting system and single window operation for all major circulation functions;
- Strong region-wise support for maintenance through regional coordinators. Strong online and offline support by e-mail, chat and through dedicated telephone line during office hours; and
- Available at an affordable cost with strong institutional support.

One of the major attractions of SOUL is its robust OPAC. The OPAC has simple and advanced search facility with the minimum information of the item by using author, title, corporate body, conference name, subject headings, keywords, class number, series name, accession number or combination of any of two or more information regarding the item. Major functions provided in the module are:

- Simple Search;
- Boolean Search;
- Advanced Boolean Search;
- Displaying and downloading of records in MS Excel, PDF or MARCXML; and
- Search support for the items that are in the acquition process in the library.

3.4.4 Information Access Network (IAN)

Information Access Network (IAN) helps to build library software. One of the best library software, known as LibInfo which is automated library software to run at any environment ranging from a single computer and network. The features of software include all the functions like circulation, cataloguing, report generation, overall statistics, fine generation and bar-coding.

3.4.5 KOHA

Koha is the first open-source Integrated Library System (ILS). In use worldwide, its development is steered by a growing community of libraries collaborating to achieve their technology goals. Koha's impressive feature set continues to evolve and expand to meet the needs of its user base. In use worldwide in libraries of all sizes, Koha is a true enterprise-class ILS with comprehensive functionality including basic or advanced options. Koha includes modules for circulation, cataloging, acquisitions, serials, reserves, patron management, branch relationships, and more. For a comprehensive overview of features visit the Koha feature map.Koha uses a dual database design that utilizes the strengths of the two major industry-standard database types (text-based and RDBMS). This design feature ensures that Koha is scalable enough to meet the transaction load of any library, no matter what the size. Koha is built using library standards and protocols that ensure interoperability between Koha and other systems and technologies, while supporting existing workflows and tools. Koha's OPAC, circ, management and self-checkout interfaces are all based on standards-compliant World Wide Web technologies--XHTML, CSS and JavaScript--making Koha a truly platform-independent solution.

Koha is distributed under the open-source General Public License (GPL). More information on the GPL can be found here. It is an important part of the open-source promise that there is no vendor lock-in: libraries are free to install and use Koha themselves if the have the in-house expertise or to purchase support or development services from the best available source.

3.4.6 ALICE

Alice was developed in Australia and Europe. It is one of the most popular library systems in the world being well established in educational charity, corporate and special libraries. It has been used approximately 90 countries in the world. It is a core module based integrated software. It can handle, enquire, management, circulation and can add other functions of the library according to need. It has the facilities of periodical control, internet and web control.

Following ten different types of libraries are using above explained barcode software. This shows that good and sophisticated software makes barcode technology accurate and reliable.

3.5 The American Library

The United States Information Services (USIS) Library, now known as The American Library of the American Embassy in Kathmandu, was opened on May 30, 1952. The then Prime Minister, Matrika Prasad Koirala, inaugurated the library. Soon afterwards, it gained enormous popularity and became a focal point of social and cultural events in the capital. The American Library Kathmandu is an integral part of the American Center, the Public Affairs Section of the U.S. Embassy, and carries out a variety of activities designed to promote a better understanding of the policies, values, institutions, and culture of the United States.

The American Library is open to all. As in public libraries in the United States, users may take advantage of the books, multimedia facilities, and information services available in the library. Membership registration for a period of 6 months costs NRs. 200 for students and NRs. 300 for service holders and non-students. Renewal charges are NRs. 100 and 150 respectively. Members may check out two books at a time for a period of three weeks, after which a late fee of NRs. 1 per day is charged. The American Library contains approximately 6000 books and 43 DVDs in the fields of international relations, economics, arts and humanities, and U.S. society. In addition, the Library now has 100 famous American movies and 5 online databases, which cover leading journals related to business, social sciences and other fields.

It has started barcode technology from 2004 AD. Books are classified according to the Dewey Decimal Classification System, and are arranged on the shelves in numerical order. Magazines are shelved alphabetically. The collection of 71 periodicals is the most complete selection of American magazines available in Nepal. The library also subscribes to popular newspapers, including The International Herald Tribune and The New York Times. The library offers the use of the Internet for research on America and related subjects. The library charges a nominal cost of NRs. 2 for printouts and NRs. 1 for photocopy service per page. The library is moving towards greater electronic access

of information. Presently, several commercial and government online services are available to assist your research needs.

The American Library is open for all users. The system is semi self-service; after a user finds the resources that they need, they can make copies or print information themselves. Of course, library staffs are happy to help if there are any problems.

3.6 Amrit Science Campus Library

Amrit Science Campus situated in the heart of Kathmandu Valley is the unique science campus of the country. The campus library has been established in the year 1957 AD and barcode technology was introduced from 2009 AD.

It has got collection of around 32,000 including books, periodicals, journals etc. The Campus is a semi-autonomous institution under Institute of Science and Technology with partial decentralization, affiliated to Tribhuvan University.

Some of the finest technical manpower, who are now, involved in different development activities both at home and abroad, were students of Amrit Science Campus The campus offers courses in Physics, Chemistry, Mathematics, Botany, Zoology, Statistics, Computer Science, Environment Science and Microbiology at Bachelor's level. At present, altogether nearly 1900 students are studying at different levels.

3.7 Graded English Medium School (GEMS)

In the year 1984 A.D., Little Flowers' English School was established in Anarmani - 4, Birtamod, Jhapa. Within a very short period of time, the school became a full-fledged high school and acquired unchallenged reputation in the whole of Eastern Nepal. Many education conscious intellectuals of the Terai and Kathmandu valley were so impressed at the success of Little Flowers', Jhapa that they urged the management to start a similar type of school in Kathmandu Valley. And thus 'GEMS' (Graded English Medium School) was established at Sanepa height, Lalitpur in 2041 B. S. (1984 A.D.).

The library was established in the year 2008 AD while barcode technology was started from 2009 AD.The management has been emphasizing quality education since its inception in 1984, and, as a result, it has positioned itself as one of most leading educational institutions in the country today.

It has got collection around 11,000 books including journals, periodicals etc.The Higher Education Building is one of the main academic wings, in which higher level classes like

Plus 2 (Only Science) under the affiliation with Higher Secondary Education Board (HSEB), GCE A' Level under the University of Cambridge, the UK, and the BS/MD (Bachelor of Science leading to Doctor of Medicine) programmed under the affiliation with Angeles University Foundation, the Philippines are being run. In an attempt to become a full-fledged education provider, the management began its higher level programmes in 2008. Plus 2 programmes is one of them, and it has been successfully running since then under the team of qualified and experienced academic administrators and faculty members.

3.8 Kathmandu Unversity Education and Management Library (KULibrary)

KU Library is situated in one of the beautiful hills of Dhulikhel, Kavre, 28 km from Kathmandu surrounded by greenery and magnificent view of the Himalayas in the north, in a pollution free environment, centrally located within the campus and is accessible within a reach of five minutes from each and every department, which was established in 2000AD. It is of three storey building having 10,000 sq ft area in each storey. It is well planned and will be sufficient for future development. Being a research cum teaching university, focus has been given to enrich the reference collection with less priority for text books which on the other hand the students themselves would be able to purchase.

Library automation means automating all the housekeeping operations of the library such as, acquisition, cataloguing, serials control, circulation, OPAC, etc. KU library previously used CDS/ISIS for information storage & retrieval. It was just a computerized catalogue. The technological development and the increasing demand of the users compelled us to think of the library automation, which resulted to purchase Software for University Libraries (SOUL) developed by INFLIBNET Centre, an inter-university centre of UGC of India. It has been installed and used in three different libraries of KU, i.e. Central library, KUMS library and Management & Education library, which made KU library the first academic library to have library automation in Nepalese context. The web-based Online Public Access Catalogue (OPAC) is a remarkable feature of the software by which a user would be able to find out his/her requirements and his status himself online.

The use of Barcode makes the circulation work fast and systematic, which was started from 2004 AD. Periodical section, Technical processing section, Reference section, Stack-cum-reading room, Circulation section, Offices for librarian and assistant librarian, Store are all well designed. They are all equipped with necessary library furniture and equipments designed by the experts. It has got 25 computers connected to the internet and is available to the students from 8 am to 8 pm to help them in their study. The collection has proved to be a best collection in the respective field and is admired by faculty members and researchers within the campus, as well as the outsiders and visitors. The access to online e-resources received through PERI, WHO & FAO further enriched the resources as well as the research activities in KU. Keeping in view the importance of library, the university has given number one priority among the physical facilities provided by the university. The library budget for books & journals is increasing every year. Apart from the recurring budget, the budget for books & journals was NRs. 5.75 lakhs in 1994/95. This budget increased every year and reached to NRs. 31.75 lakhs in 2005/06, which is a substantial amount provided by the University for the Development of the library system in KU.

3.9 Kathmandu Valley Public Library (KVPL)

In 2003 AD, some of the scholars decided to establish the public library and start the library services thinking that, well managed and effective library would have to meet the educational needs of the public. It started its services to all the users from 2005. It is situated at Bhrikutimandap, Kathmandu.

Its collection is around 50,000 volumes of books, documents, reports, journals; historical photographs etc. The library acquires most of the documents through gift and donation, which are donated by individual person and also institutions like British Council, Asia Foundation etc. To organize and manage the library materials, library is using Dewey Decimal Classification Scheme, Sears List of Subject Headings. To create the bibliographic database library is using WINISIS library software and manage about 8,000 entries of database. The library also used ALICE library software along with barcode technology. Also computers are available for online search to all the users.

introduction of the New Education System Plan, the campus boasts an unrivalled position in the history of management education in Nepal.

The PYC Library is as old as the institution itself established in 1973 AD. It is a unique collection of all resources related to general management, travel and tourism, analytical and other subjects related to the BTTM studies. There is the Issue and Reading/Reference Sections separately departmentalized in the PYC library. There is an e-library system and on-line library facilities available to all the faculty members and students of the BTTM. In addition to its own collection of the books, journals, magazines and newspapers, the library works in close consultation with the campus' own computer laboratory.

PYC started barcode technology from 2007 AD. PYC has a glorious tradition of learning where teachers and students have displayed, almost reminiscent of ancient seats of learning, exemplary mutual co-operation, understanding trust and commitment. It is often described by the academia as a TU-constituent campus where political or disruptive activities would hardly affect or pollute its educational environment.

3.13 Social Science Baha Library (SSBL)

The Social Science Baha Library is located at Ramchandra Marga, Battisputali (branching off the Battisputali main road towards Ram Mandir from opposite Hotel Dwarika's). It has been established in 2002 AD. The library is open only to members. Membership can be obtained by filling out an application form. Part of the application form has to be filled out by someone who can vouch for the applicant. The voucher can be the head of the concerned university department, college principal, office head, or any one in a similar capacity.

The library is solely a reading and reference collection. It does not operate on a lending basis. There is a well-lit, comfortable reading room, and access to the shelves is through the attending librarians. The reading room is equipped with computers to provide users with access to in-house and online resources.

Social Science Baha Library started barcode technology from 2009 AD. A nominal annual fee is charged. The rates are different for student, ordinary and institutional members but these are modest and affordable. A one-time membership fee will be charged as well as an annual library fee. These fees will be modest for individual

members, while institutions will be asked to pay slightly higher rates. Provisions have also been made for short-term temporary membership. The library rules provide full details of the fee structure and the different kinds of membership.

It has total collection of around 20,000 and 5000 periodicals. Library hours: 10 am to 5 pm, Sunday to Thursday; 10 am to 2pm, Friday. The library remains closed on Saturdays, selected public holidays, and the first Sunday of the international calendar month.

3.14 Ullens School Senior Library

The Ullens School is a non-profit school situated in Khumaltar, Lalitpur which is one km away from the Kathmandu ring Road.Ullens School is accessible from any part of Kathmandu by any public commute. It was established in 2006 with the aim to provide holistic education to children.

It has collection of around 2500 including journals etc.It aims to provide respect and dignity to children allowing them to achieve their full potential within a multi-faceted learning environment. Ullens School delivers its educational curriculum and philosophy based on Bank Street's Developmental Interactive Approach and Developing Capable Persons in collaboration with Bank Street. It is one of the few schools in Nepal with a total child-centric approach, unlimited internet access, high level of infrastructure, highly trained school staff with education and training from Bank Street School of Education, New York along with volunteers from around the world. The patron of Ullens School is the famous philanthropist Baron Guy Ullens and his wife Myriam Ullens.

REFERENCE

Wikipedia [online] (cited 2010, May 21). Retrieved from http://www.*the free encyclopedia*.htm

Kawatra, P.S. (2000). *Textbook of information science.* New Delhi: A.P.H. Publishing Co-operation.

UNESCO (2004). *CDS/ISIS for windows: reference manual ver.* 1.5. Information Society Division. 2-9.

Chapter IV

RESEARCH METHODOLOGY

Research is a systematic and organized effort to investigate a specific problem that needs a solution. This process of investigation involves a series of well-thought-out activities of gathering, recording, analyzing and interpreting the data with the process of finding answers to the problem.

Research is undertaken not only to solve a problem existing in the work setting, but also to add or contribute to the general body of knowledge in a particular area of interest to the researcher. Research opens new frontiers of knowledge, through which new evidence is discovered. For the study of "Barcode Technology and Its Application in Nepalese Libraries" researcher visited ten different libraries.

4.1 Research Design

Research design is the plan, structure and strategy of investigation conceived so as to obtain answers to research questions and to control variance. It also serves as the framework for the study, guiding the collection and analysis of data, the research instruments to be utilized, and the sampling plan to be followed. First, study area and problem is to be identified and appropriate methodology is chosen according to the research question related to questionnaires are distributed hand to hand to collect data. Those collected data are analysis and presented in tabular and chart form, to obtain the objectives.

4.2 Population

Different types of libraries using barcode technology are chosen for the population of the study. The population of the study is mostly those libraries which use barcode technology. The researcher has taken different barcode using libraries from Katmandu valley and also outside valley but due to the repetition of same library software, only major ten libraries are used as the population for this study which are as follows-

- The American Library.
- Amrit Science Campus Library.
- Gems Library.
- Kathmandu University of Education and Management Library.(KU)
- Kathmandu Valley Public library. (KVPL)
- Ministry of General Administration.(MoGA)
- Nepal College of Information Technology.(NCIT)
- Public Youth Campus Library. (PYCL)
- Social Science Baha Library.(SSBL)
- Ullens School Senior Library.

4.3 Sampling Procedures

It is quite difficult to study each and every unit of the research, thus sampling has been done. Here, the non-probability sampling has been chosen for the study. The strategy in taking sample for the study is according to the types of libraries. Among chosen libraries Public Youth Campus Library (PYCL), Amrit Science Campus Library, Kathmandu University of Education and Management Library (KU), National College of Information Technology (NCIT), Gems Library and Ullens School Senior Library are academic library, Kathmandu Valley Public library (KVPL) is public library; Social Science Baha Library (SSBL) and The American Library are special library, and Ministry of General Administration. (MoGA) is government library. The selected libraries are chosen depending upon the availability of barcode technology only.

4.4 Data Collection Procedure

Collecting data is the connecting link to the world of reality for the researcher. The primary as well as the secondary sources of data is used for the study. The primary data is collected through questionnaire, observation and informal interview relating to the topic while the secondary data is collected through review of past literature, websites and statistics issued by the libraries.

In the process of collecting data from the different libraries all the chief persons related to library are included. Questionnaires are designed with the alternative possible answers,

i.e., structured types so that there is no difficulty for the respondent to find out the answer of the questions. The questionnaires were structured as closed and open ended questions.

4.5 Data Analysis Procedure

The data collected in the form of questionnaire has been edited, coded, tabulated and classified for analysis. The data from respondents has been analyzed manually. The result of the analyzed data has been presented in the different form of tabulation and graphical, diagrammatical presentation. Finally, relating to the findings, conclusions have been drawn.

REFERENCE

Joshi, P.R. (2003). *Research Methodology.* (3rd ed.). Kathmandu: Buddha Academic Publisher & Distributors.

Sharma, P.K. & Chaudhary, A.K. (2003). *Statistical Methods* (2nd ed.). Kathmandu: Khanal Books & Stationary.

Vaidya, Bina (2007). *Library networking and resource sharing in INFOLIB.* 1(1), 27-29.

Wolff, H.K. & Pant, P.R. (2007). *Social Science Research and Thesis Writing.* (4th ed.). Kathmandu: Buddha Academic Publishers & Distributors.

Chapter V

DATA ANALYSIS AND PRESENTATION

The present research work has been entitled as "Barcode Technology and its application in Nepalese Libraries". The main objectives of this research have been included as to know and identify barcode technology, its development and applicability in Nepalese libraries. Data has been collected from different ten libraries through the questionnaire and observation.

Different types of responses were found in accordance with the questionnaire introduced to different libraries. The responses obtained from different questions of the questionnaire are initially presented in the form of the table and then the tabulated data are presented diagrammatically in the form of bar diagram.

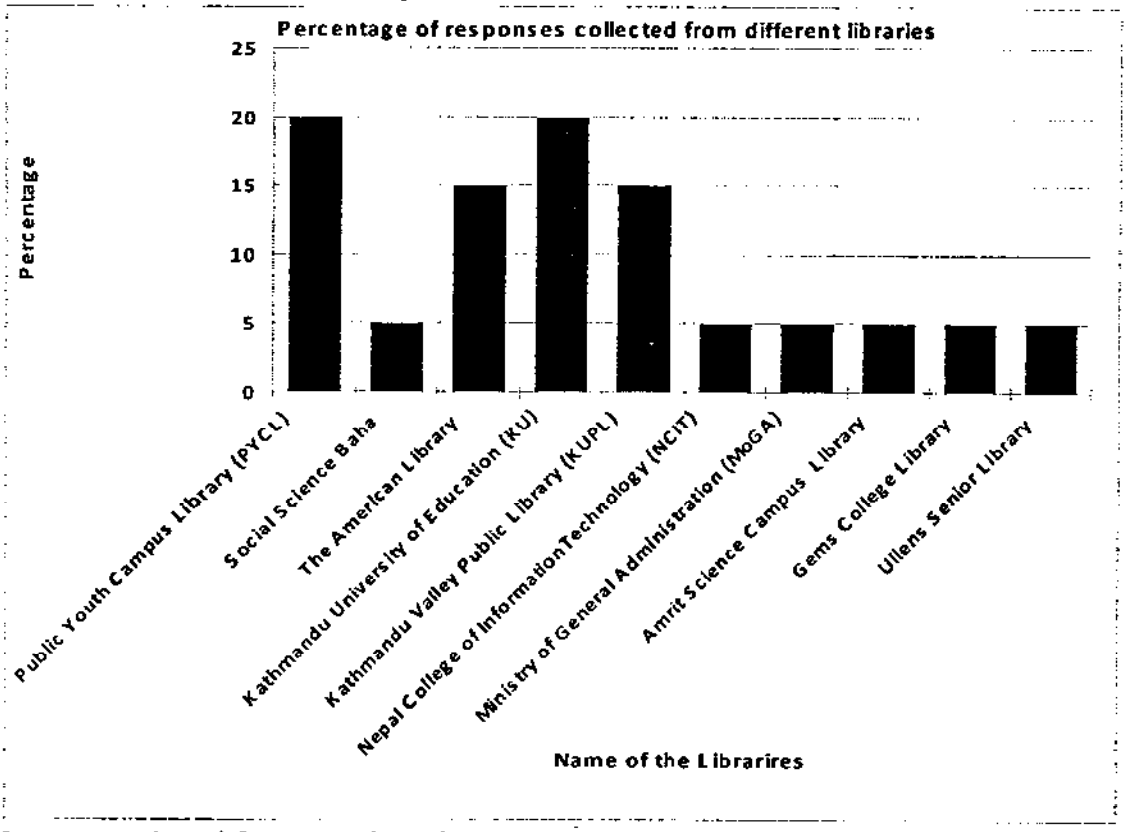
The major libraries used for the data collection in the research study and total number of responses collected from the enumerators are given in the form of the table as well as bar diagram and pie-chart. The individual name of the library is given in necessary tables and figures. The researcher believes that those tables and figures are sufficiently and correctly represented those all responses.

Table no.1: Number of collected responses from libraries

Name of libraries	No. Of collected responses	Percentage
The American Library	3	15
Amrit Science Campus Library	1	5
Gems College Library	1	5
Kathmandu University of Education (KU)	4	20
Kathmandu Valley Public Library (KVPL)	3	15
Ministry of General Administration (MoGA)	1	5
Nepal College of Information Technology (NCIT)	1	5
Public Youth Campus Library (PYCL)	4	20
Social Science Baha(SSBL)	1	5
Ullens Senior Library	1	5
Total:	**20**	**100**

The above table no. 1 clearly represents the amount of collected responses from different libraries and their percentage in total. We have 20 numbers of collected responses from 10 different libraries.

Figure no.16: Percentage of responses collected from different libraries



Source: Analyzed from questionnaire

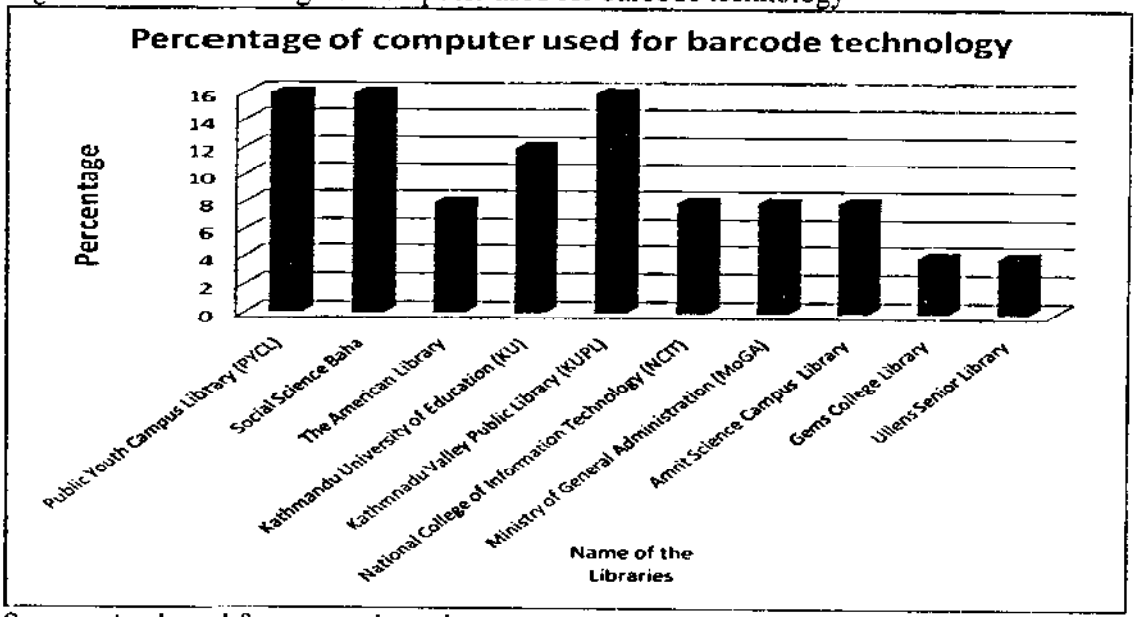
Figure no.17 represents the percentage of the responses collected from each individual library out of total 20 collected responses. Among 20 responses, it is found that the 20% of highest responses from public Youth Campus and KU library while 5% of lowest responses are from Social Science Baha, NCIT, MoGA, GEMS College, Amrit Science College library and Ullens senior library while 15% of responses are from the American Library and KVPL each.

Table no.2: Number of computers used for barcode technology

Name of libraries	No. of computers	Percentage
The American Library	2	8
Amrit Science Campus Library	2	8
Gems College Library	1	4
Kathmandu University of Education (KU)	3	12
Kathmandu Valley Public Library (KVPL)	4	16
Ministry of General Administration (MoGA)	2	8
Nepal College of Information Technology (NCIT)	2	8
Public Youth Campus Library (PYCL)	4	16
Social Science Baha(SSBL)	4	16
Ullens Senior Library	1	4
Total:	**25**	**100**

Table no.2 shows the number of computers used for barcode technology in different libraries. This also shows that computers are very much necessary to run the barcode application, in any library.

Figure no.17: Percentage of computer used for barcode technology



Source: Analyzed from questionnaire

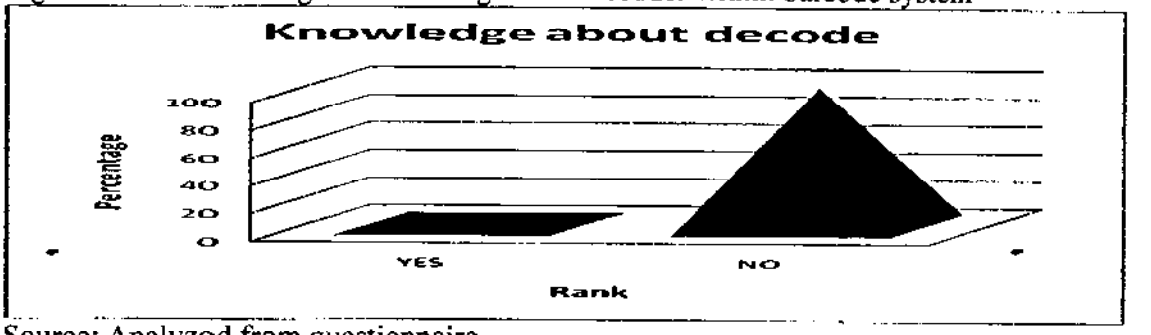
Figure no. 18 shows that the role of computers for thee application of barcode technology in libraries is very much necessary without computers no library can run the barcode application. Here, the highest number of computers, i.e., 4 computers has been used by Public Youth Campus library, Social Science Baha and KVPL each whole least number of computers i.e., 1 by Gems college library and Ullens Senior Library.

Table no.3: Ranking of the barcode system used by different libraries

Table no.7: Knowledge about decoder within barcode system

Knowledge about decoder	No. of response	Percentage
YES	0	0
NO	20	100
Total:	**20**	**100**

Figure no.20: Percentage of knowledge about decoder within barcode system



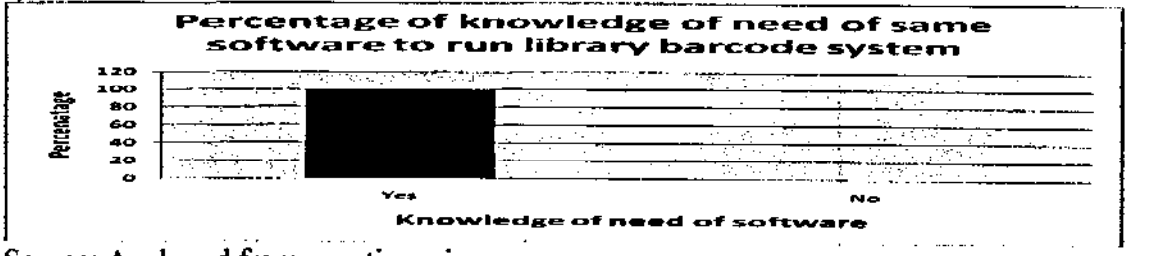
Source: Analyzed from questionnaire

Table no.7 and figure no.21 represents the knowledge about decoder within barcode system. Response shows that all the libraries were unknown of the decoder within barcode system, as 100% respondent gave responses 'NO' while 0% gave "YES".

Table No.8: Knowledge of need of some software to run library barcode system

Knowledge of need of software	No. of response	Percentage
Yes	20	100
No	0	0
Total	**20**	**100**

Figure No.21: Percentage of knowledge of need of same software to run library barcode system



Source: Analyzed from questionnaire

Table no. 8 and figure no. 22, represents the knowledge of need of some software to run library barcode system. Here, the response shows that all the libraries have knowledge of

the need of some software to run library barcode system, because 100% responses say "YES".

Table no.8 (I): Library software used by different libraries

Name of the software	No. of response	Percentage
Libra	3	30
Koha	1	10
IAN	1	10
LMS	1	10
Label Magic	1	10
Open Biblio	1	10
Soul	1	10
Alice	1	10
Total	**10**	**100**

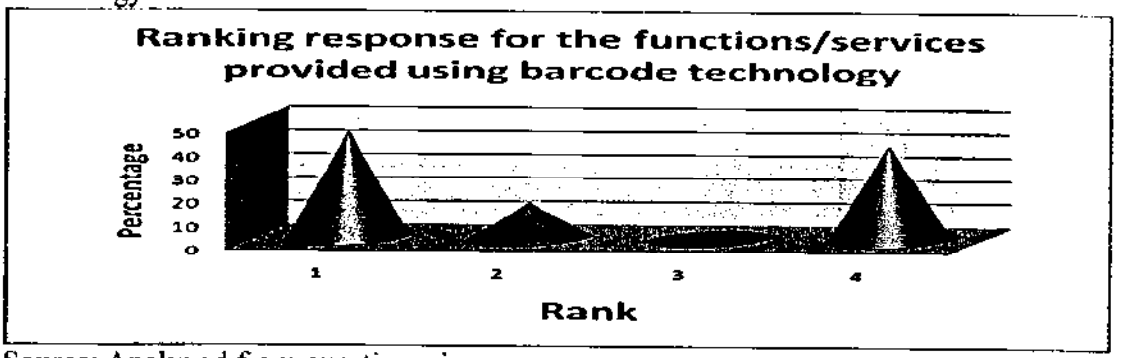
Source: Analyzed from questionnaire

The table no. 8 (I) represents the library software used by different libraries, where the library software called 'Libra' has been used by maximum libraries, i.e., 30%, which other software are less in use.

Table no.9: Ranking the functions/services provided using barcode technology

Rank	Response Number	Percentage
1	3	45
2	3	15
3	0	0
4	8	40
Total	**20**	**100**

Figure no.22: Ranking response for the functions/services provided using barcode technology



Source: Analyzed from questionnaire

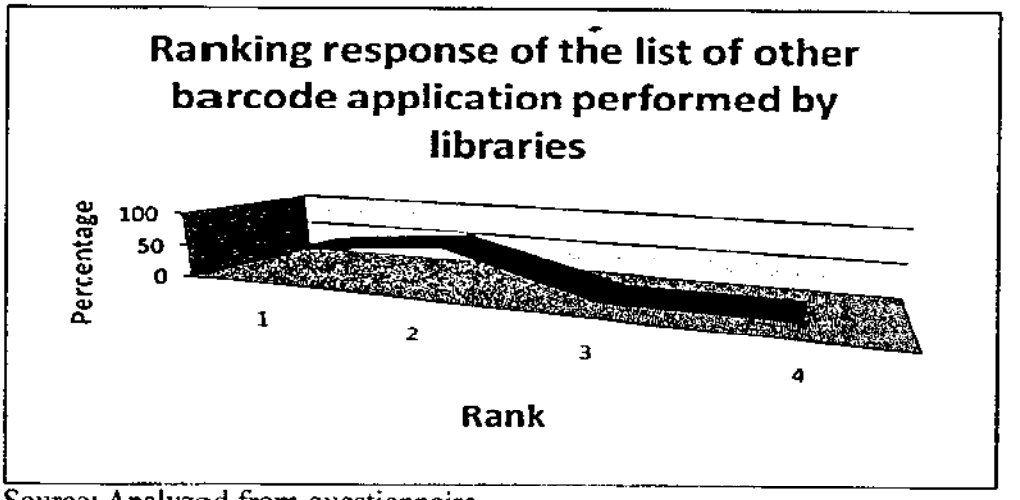
The table no. 9 and figure no. 23 represents the ranking response for the functions/services provided using barcode technology. The bar diagram, clearly shows that the circulation within the library is mostly used or performed frequently. Also, the

function of 'user management' is the lowest, i.e., zero response. Similarly, 'searching and cataloguing' are the functions frequently used as 40% and 15%.

Table no.10: Ranking the list of other barcode application performed by libraries

Rank	Response number	Percentage
1	2	40
2	3	60
3	0	0
4	0	0
Total	**5**	**100**

Figure no.23: Ranking response of the list of other barcode application performed by libraries



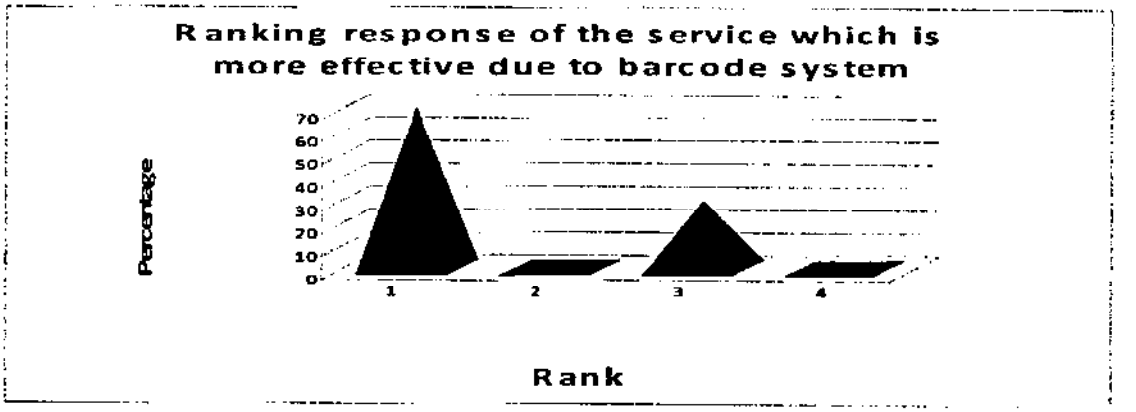
Source: Analyzed from questionnaire

Table no. 10 and figure no. 24 shows the ranking response of the list of other barcode application performed by libraries. Here, according to the bar-diagram, it is clear that 'registration of the periodicals' has been performed maximum times as 50%, followed by 'stock taking' as 40%, while weeding out the collection' and other functions are not performed.

Table no.11: Ranking the service which is more effective due tot barcode system

Rank	Response Number	Percentage
1	7	70
2	0	0
3	3	30
4	0	0
Total	**10**	**100**

Figure no.24: Ranking response of the service which is more effective due to barcode system



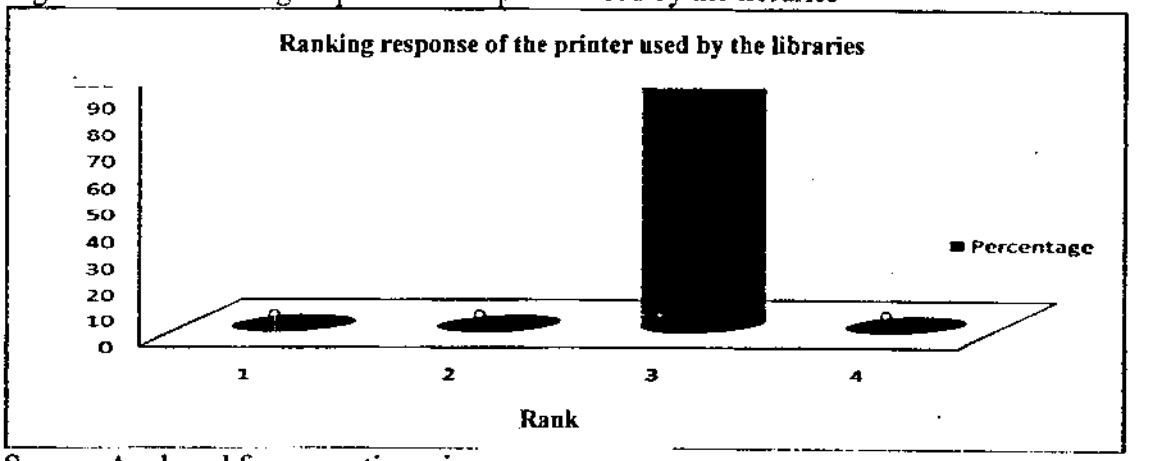
Source: Analyzed from questionnaire

Table no. 11 and figure no. 25, represents the response of the service which is more effective due to barcode system. Here, we can see that the most effective service in 'circulation' having 70% of total response, which is followed by 'user management 'as 30% while' cataloguing and other services, has got 0% response.

Table no.12: Ranking the printer used by the libraries

Rank	Response Number	Percentage
1	0	0
2	0	0
3	20	100
4	0	0
Total	**10**	**100**

Figure no.25: Ranking response of the printer used by the libraries



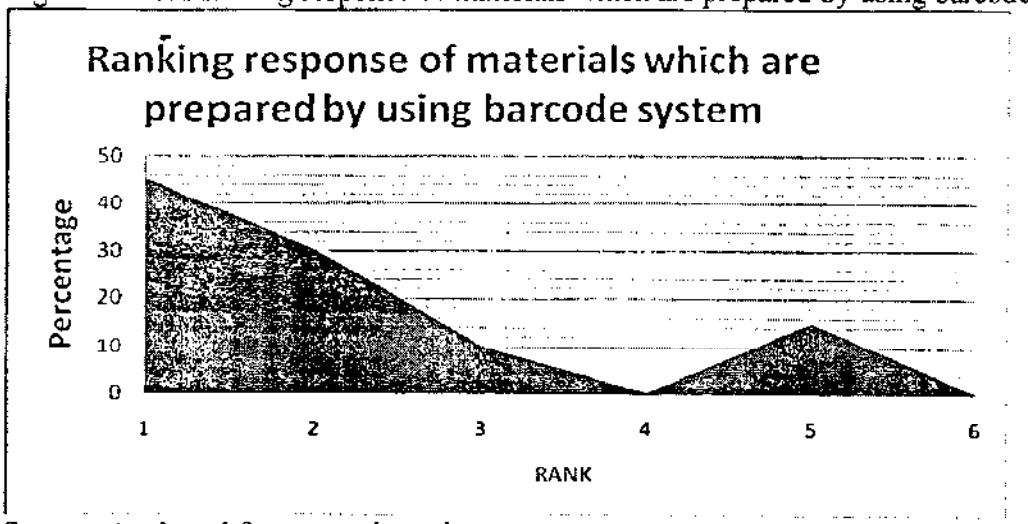
Source: Analyzed from questionnaire

Table no. 12 and figure no. 26, represents the response of the printer used by the libraries. Here, we can see that almost all the libraries used laser printer.

Table no.13: Ranking of materials which are prepared by using barcode system

Rank	Response Number	Percentage
1	9	45
2	6	30
3	2	10
4	0	0
5	3	15
6	0	0
Total	**20**	**100**

Figure no.26: Ranking response of materials which are prepared by using barcode system



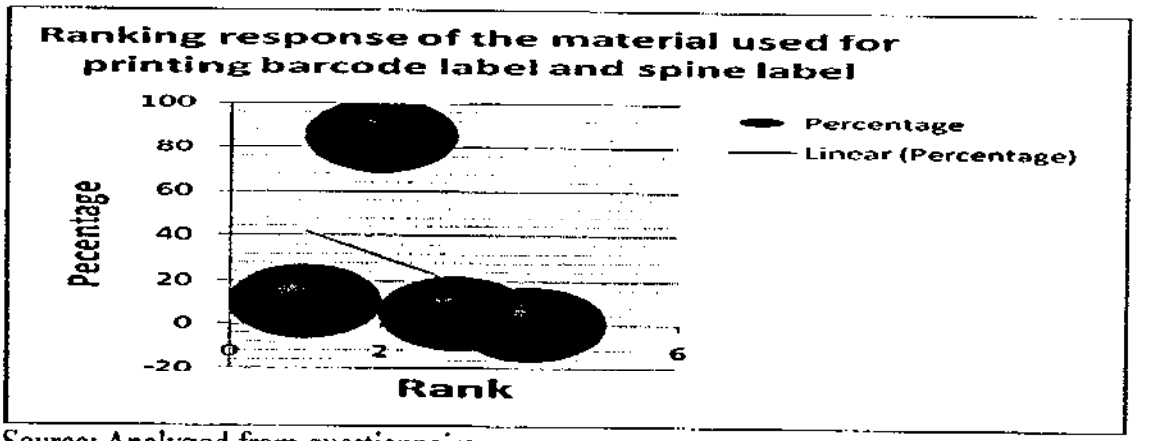
Source: Analyzed from questionnaire

Table no. 13 and Figure no. 27 represents the ranking response of materials which are prepared by using barcode system. Here, the bar diagram shows that the barcode system is used mostly for preparing "ID CARD" as 45% and then 'barcode labels', 'report' and 'spine labels' as 30%, 15% and 10%, respectively. The response for 'circulation slip' is found to be 0%.

Table no.14: Ranking response of the materials used for printing barcode level and spine label

Rank	Response Number	Percentage
1	2	10
2	17	85
3	1	5
4	0	0
Total	**20**	**100**

Figure no.27: Ranking response of the material used for printing barcode label and spine label



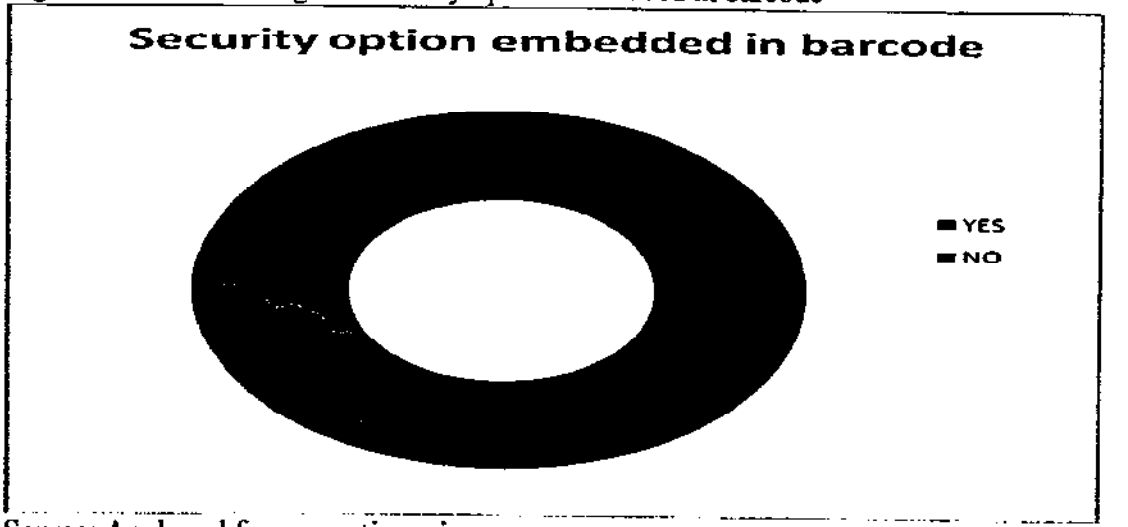
Source: Analyzed from questionnaire

Table no. 14 and figure no.28 represents the ranking responses of the material used for printing barcode label and spine label. Here, the bar-diagram shows that the 'sticker paper' is used mostly for printing barcode and spine label as 85%, while photocopy paper and pre-sheet is also used as 10% and 5% respectively.

Table no.15: Security option embedded in barcode

Security option embedded in barcode	Response Number	Percentage
YES	14	70
NO	6	30
Total	**20**	**100**

Figure no.28: Percentage of security option embedded in barcode



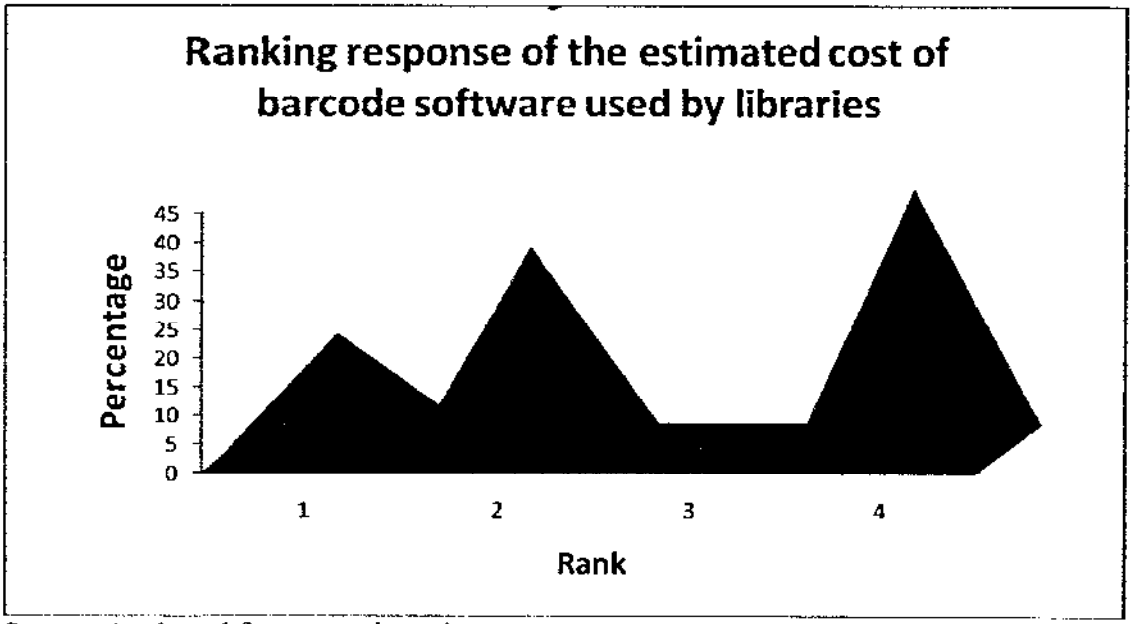
Source: Analyzed from questionnaire

Table no. 15 and figure no. 29 represents security option embedded in barcode. Here, we can include that security is not necessary in all context as 30% responses says "NO".

Table no.16: Ranking the estimated cost of barcode software used by libraries

Rank	Response Number	Percentage
1	4	20
2	7	35
3	0	0
4	9	45
Total	**20**	**100**

Figure no.29: Ranking response of the estimated cost of barcode software used by libraries



Source: Analyzed from questionnaire

Table no. 16 and figure no. 30, represents the ranking responses of the estimated cost of barcode software used by libraries. Here, the bar-diagram shows the variable cost of barcode software ranging from higher cost at NRs. 30,000 – NRs. 40,000 as 45% of total response, while there also found lower cost of NRs. 0 – NRs. 10,000 and NRs. 10,000 – NRs. 20,000 as 20% and 35% of total response. Also no response i.e., 0 is found for the cost range of NRs. 20,000 – NRs. 30,000. Thus we could conclude that the barcode software's of different ranges were being used by different libraries.

Table no.17: Does the barcode technology reduce total amount of expenditure?

Does the barcode technology reduce total amount of expenditure?	Response Number	Percentage
YES	20	100
NO	0	0
Total	**20**	**100**

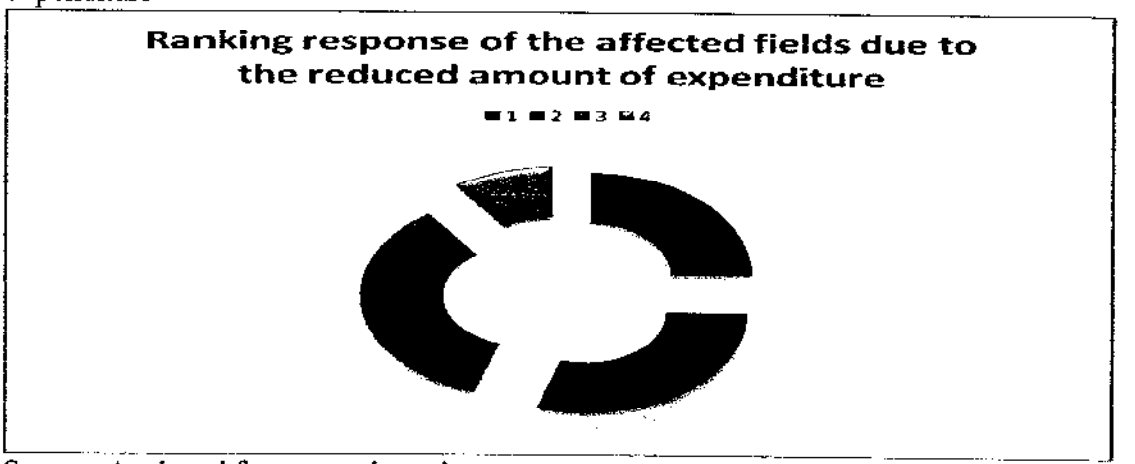
Source: Analyzed from questionnaire

Table no. 17 represents response of the barcode technology reducing total amount of expenditure. Here it shows that the 100% of the response is "YES" which means the barcode technology could reduce the total amount of expenditure.

Table no.18: Ranking of the affected fields due to the reduce amount of expenditure

Rank	Response Number	Percentage
1	5	25
2	6	30
3	7	35
4	2	10
Total	**20**	**100**

Figure no.30: Ranking response of the affected fields due to the reduced amount of expenditure



Source: Analyzed from questionnaire

Table no. 18 and figure no. 31, represents the response of the affected fields due to the reduced amount of expenditure. Here, the bar-diagram shows that all the fields are affected in which 'staffing' has got highest response of 35%, while 'end processing' and 'ID CARD" has got response of 30% and 25% respectively. Also other fields like 'time saving', 'errorless circulation are also affected'.

Chapter VI

SUMMARY, CONCLUSION AND RECOMMENDATION

6.1 Summary

Library is the organization that helps the mankind to collect, organize, preserve and disseminate all kinds of knowledge and information. It's becoming challenging work for the libraries to collect and disseminate the right information in the right time to the right person. So it is very important that right technology should be applied for the preservation of information permanently. Among various libraries barcode technology is the most needed technology as this helps and support for the preservation of information. The manual process in the library has been changed to the automation, due to the help of various technologies developed now-a-days. This automating function of the library has been made more advanced due to the input of barcode technology.

The concept of barcode technology is not new. It has been around from 1940s and from 1972 has been used in the library. This technology helps the librarian and libraries to increase the productivity, reduces human errors, decrease costs and improves service and quality of all types of information. Also the major advantages of the barcode technology are- speed, accuracy and reliability.

The aim of this study is to know about barcode technology and its applicability in Nepalese libraries. During the research, it was found that only limited numbers of libraries were using barcode technology. This limitation is due to the lack of proper budget, computer infrastructure, networking and professional human resources.
Here, the ten different types of libraries using barcode technology have taken as a sample for research. The data are collected from the questionnaire, informal interview and observation, which are presented in tabular and graphical form.

6.2 Conclusion

Barcode technology and its application in libraries of Nepal has revealed that automation of libraries can be made very accurate, reliable and speed. Through the use of barcode technology a library can perform with less error within itself. Though libraries have been practicing the automation, e-library etc in recent decades, has gained momentum due to the application of barcode technology.

Automation of libraries helped to improve the resources of individual libraries, where as networking and barcode technology improves the quality and accuracy of information among the users. Unless the scope is defined and restricted it would be difficult to proceed. Therefore, the study is restricted to ten different libraries having barcode technology.

For the implementation of barcode technology in a library, there is necessary of computer. Without computer no barcode technology can be applicable. So, all the libraries are having more than one computer to run the barcode technology.

The data clearly shows that most of the libraries used Universal Product Code (UPC), Code 39 and EAN 13. Except these three barcode system, no other barcode systems are in use so far within ten selected libraries.

Scanning device is one of the major parts of barcode technology. It is difficult to run the barcode system in any library without scanning device. So, according to the data collected, all the libraries are using only one type of scanning device, i.e., laser gun.

Most of the libraries used scanner having 35 scan/second, while 20% libraries used 270 scan/second, i.e., less number of libraries is using good quality of scanner.

All the libraries have given the negative answers about decoder within barcode system. So this shows that libraries and librarians are quite unknown about functioning of barcode system.

The data shows that all the libraries are known about the need of library software to run the barcode technology, as the respondents have 100% positive answers.

All the libraries must have some sort of library software in order to run barcode technology. Thus, maximum number of libraries use software called "Libra".

The collected data shows that the barcode technology in a library is directly connected to the users and services or functions provided to them. "Circulation" is the function/service mostly performed by the libraries whereas "searching", "cataloguing" are frequently in use but user management is not performed by any library. Similarly in other services performed by the libraries, maximum times are the "registration" of the periodicals.

All the libraries have used barcode technology for the preparation of the different types of materials in a library. Out of those materials "ID CARD" is the mostly prepared by using barcode technology.

Most of the libraries used barcode technology for printing barcode labels and spine labels. Here, it was found that sticker paper is used mostly for printing barcode and spine label.

The different libraries have different opinions about the security option embedded in barcodes. Here, data shows that without security options also barcode can be prepared.

According to the data collected, all the libraries show positive response on the reduction of the total expenditure, saves time of users and staffs, make circulation work more effective and helps to maintain proper space management.

6.3 Recommendations

We can say that the barcode technology can play a significant role in the automation of library management systems in spite of having some limitations of the technology. This technology is an appropriate technology for the management of learning resources and library services. Ensuring uncorrupted and error free network systems and uninterrupted supply of electricity can surpass the limitations of barcode technology. Adequate funds are also required to install and use barcode technology in library. If the library has adequate funds to make the digital library, they should use the barcode technology to provide proper information services to the proper user at the proper time. The present state of the use and application of barcode technologies in the libraries of Nepal is not at a satisfactory level, although the rate of user and staff satisfaction is good. Overall satisfaction and use of barcodes in the libraries of Nepal is limited due to the high initial cost for infrastructure building, preparing and pasting the barcode label for each learning resource, and lack of vendor's support. This study found that most of the libraries are applying barcode technology in the areas of accessioning, cataloguing, membership identification and producing statistical reports. On the basis of findings following recommendations have been made to enrich the field barcode application in Nepalese libraries.

- Libraries should use optimum number of computers for the better implementation of barcode technology.

- Among Universal Product Code (UPC), Code 39 and EAN 13 libraries can use anyone barcode system, which suits their resource.

- Libraries could use 'laser gun' as a scanning device, which is quite effective one and should look for the better quality of laser gun.

- Libraries should use the good quality of scanner which could read 270 scan/seconds. This helps to perform automation process with more speed.

- All the libraries should provide necessary knowledge about barcode and its technology for the library staff. This helps the libraries to obtain complete benefit from barcode system.

- As library software is one of the essentials for the barcode technology, so the libraries and librarians must install advanced library software.

- Librarians should make lots of benefits from barcode technology. Most of the libraries are doing only circulation using barcode but they could perform other functions like searching, reporting, registration etc.

- Library management should improve performance like online circulation, registration and database searching process for better user management system.

- Libraries should use barcode in making of ID-Cards, which helps it to be user friendly.

- Libraries should use 'sticker paper' for better spine label.

- Libraries should embedded security options while preparing barcode, as this helps the library automation made effective and accurate.

- All the libraries must use barcode technology in order to reduce the total amount of expenditure. Though initially it takes investment in this technology but in a long term, it happens to be low costing process.

REFERENCE

Barcode- wikipedia [online] (cited 2008, September 20). Retrieved from http://www.*the free encyclopedia*.htm.

Butters, Alan. (2007). *RFID systems, standards, and privacy within libraries. Electronic Library, 430-439.*

History of barcode [online] (cited 2008, August 9). Retrieved from http://www.the history of barcode.htm

Joshi, P.R. (2003). *Research Methodology.* (3rd ed.). Kathmandu: Buddha Academic Publisher & Distributors.

Kawatra, P.S. (2000). *Textbook of information science.* New Delhi: A.P.H. Publishing Co-operation.

Khanna, J.K. (1994). *Library and Society* (2nd ed.). New Delhi: Ess Ess Publications.

M.S. Islam & Nafiz, Zaman Shuva. (2010). *The International Information & Library Review.* 42(1), 27-33.

Marriott, Mark (1995). *PDF417 portable data files a new dimension in barcodes.* 15 (1).

Prasher, R.G. (1991). *Information and its communication.* New Delhi: Medallion press.

Sharma, P.K. & Chaudhary, A.K. (2003). *Statistical Methods* (2nd ed.). Kathmandu: Khanal Books & Stationary.

Singh, Anil (2000). *Application of barcode technology in libraries.* Library Herald. 40(1), 43-47.

Suda, Brian (2008). *Connecting the real-world to the virtual.* 16 (1).

UNESCO (2004). *CDS/ISIS for windows: reference manual ver.* 1.5. Information Society Division. 2-9.

Vaidya, Bina (2007). *Library networking and resource sharing in INFOLIB.* 1(1), 27-29.

Wikipedia [online] (cited 2010, May 21). Retrieved from http://www.*the free encyclopedia*.htm

Wolff. H.K. & Pant, P.R. (2007). *Social Science Research and Thesis Writing.* (4th ed.). Kathmandu: Buddha Academic Publishers & Distributors.

Zosel, Andrew & Wartenberg, Neils (2006*). Medical Device & Diagnostic Industry.* 32

Annex 1: QUESTIONNAIRE Researcher:Amod Rijal, MLISc

Dear Friends,

I am carrying out research on the topic, **"Barcode Technology and its Application in Nepalese Libraries"** under the guidance of Mr. Rudra Prasad Dulal, within the Central Department of Library and Information Science, TU.

The objectives of my studies are to know and identify barcode technology, its development and applicability in Nepalese libraries. I shall be grateful, if you could provide your valuable time for the necessary information which will be kept confidential and used only for research work.

A. General Information of Librarian

Full Name of Librarian:

Gender: Age:

Name of Library/ Information center:

Designation:

Qualification:

Language competence:

Q1. How many computers you are using for barcode technology?

a. One
b. Two
c. Three
d. More than three

Q2. Name the barcode system you are using?

a. Universal product code
b. Code 39
c. EAN 13
d. Other (specify)

Q3. Which scanning device you are using?

a. Laser gun
b. Charged couple gun
c. In counter
d. Other (specify)

Q4. Which type of scanner do you have?

a. a contact type/ on-line
b. non-contact type/ off-line
c. don't know

Q5. What is the speed of scanner/ second, i.e., read/ second?

a. 35 scan/ sec.
b. 42 scan/sec.
c. 270 scan/ sec.
d. Other (specify)

Q6. Could you say the range of barcode scanner, on the basis of its **width**?

a. Up to 5 cm.
b. Up to 10 cm.
c. Up to 20 cm.
d. More than 20 cm.

Q7. Could you say the range of barcode scanner, on the basis of its **distance**?

a. 0 cm.
b. Up to 10 cm.
c. Up to 25 cm.
d. Up to 50 cm.
e. Up to 100 cm.
f. More than 1 m.

Q8. Do you have any knowledge about decoder within your barcode system?

Yes [ ]
No [ ]

If yes, which type is it?

a. External
b. Internal/ Inbuilt.

Q9. Do you know there is need of some software to run the barcode system?

Yes [ ]
No [ ]

If yes, which library software you are using?

a. CDSISIS/ WINSIS
b. LIBRA
c. SOUL
d. IAN
e. Other (specify)

Q10. Could you list some other activities which you are carrying out through barcode application?

a. Stock-taking
b. Registration of periodicals
c. Weeding out the collection
d. Other(specify)

Q11. Which service is more effective due to barcode system?

a. Circulation
b. Cataloging
c. User management
d. All of above

Q12. Which printer you are using?

a. Dot-matrix
b. Ink-jet
c. Laser
d. Other(specify)

Q13. What sorts of materials are prepared by using barcode system?

a. ID card
b. Barcode labels
c. Spine labels
d. Circulation
e. Other(specify)

Q14. Which material you are using for printing barcode label and spine label?

a. Photocopy paper
b. Sticker paper
c. Pre-sheet
d. Other(specify)

Q15. Is security option embedded in barcode?

Yes [ ]
No [ ]

If yes, which security option is used in barcode?

a. Encoded
b. Adding extra character
c. Eliminating characters
d. Other(specify)

Q16. What is the estimated cost of barcode software you are using? (In NRs.)

a. 0-10000
b. 10000-20000
c. 20000-30000
d. 30000-40000

Q17.Does the barcode technology reduce total amount of expenditure?

Yes [ ]
No [ ]

If yes, please indicate the effected fields below—

a. ID card
b. End processing
c. Staffing
d. Other(specify)

Q18. Do you have any suggestion to improve barcode technology for better services in library? Give reasons.

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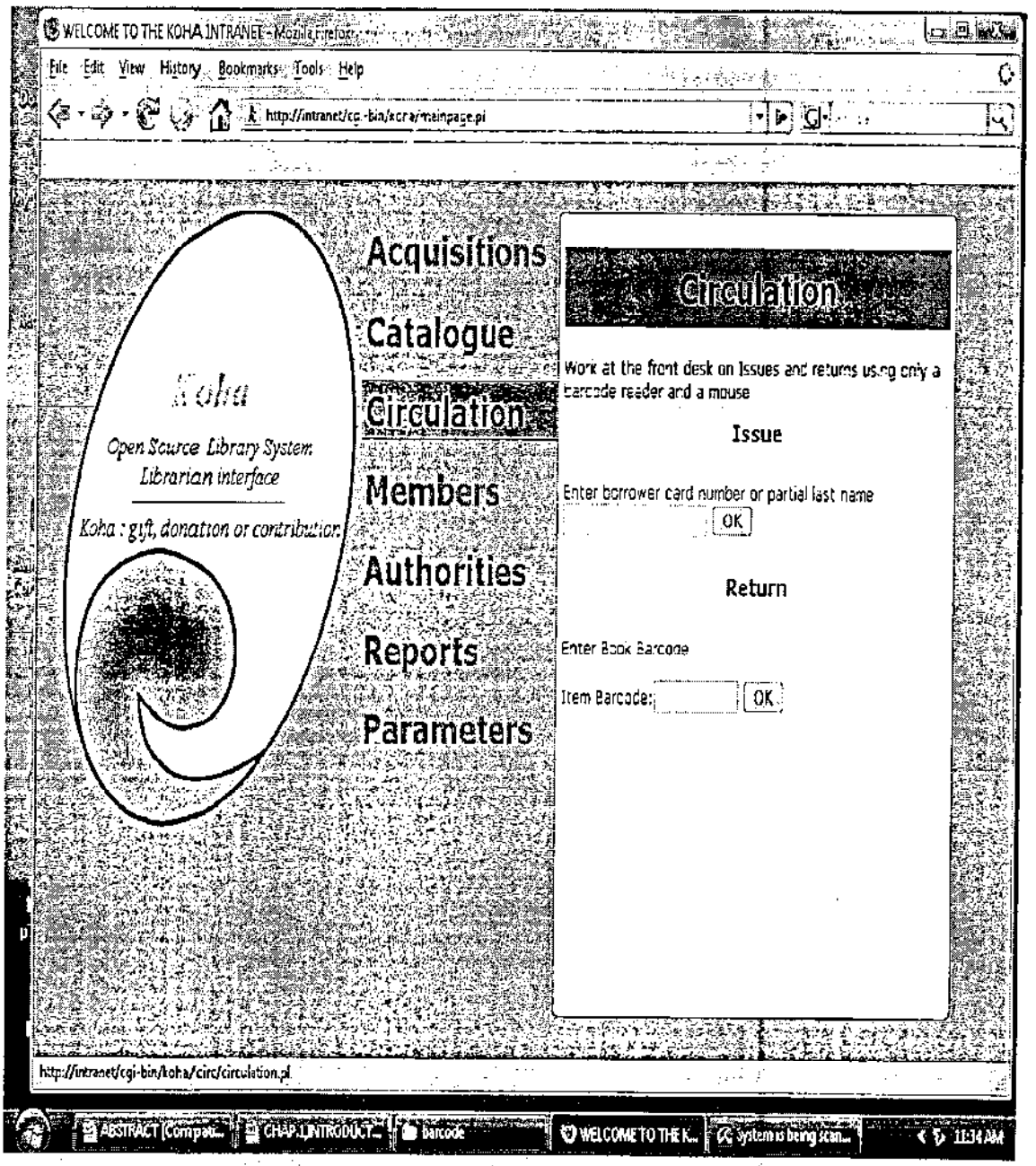
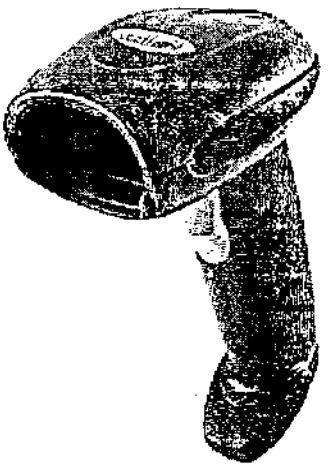
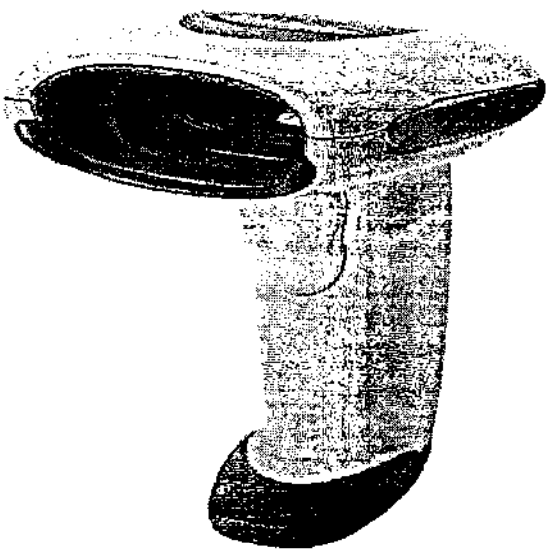
Thank You

Annex 2: Homepage of Koha

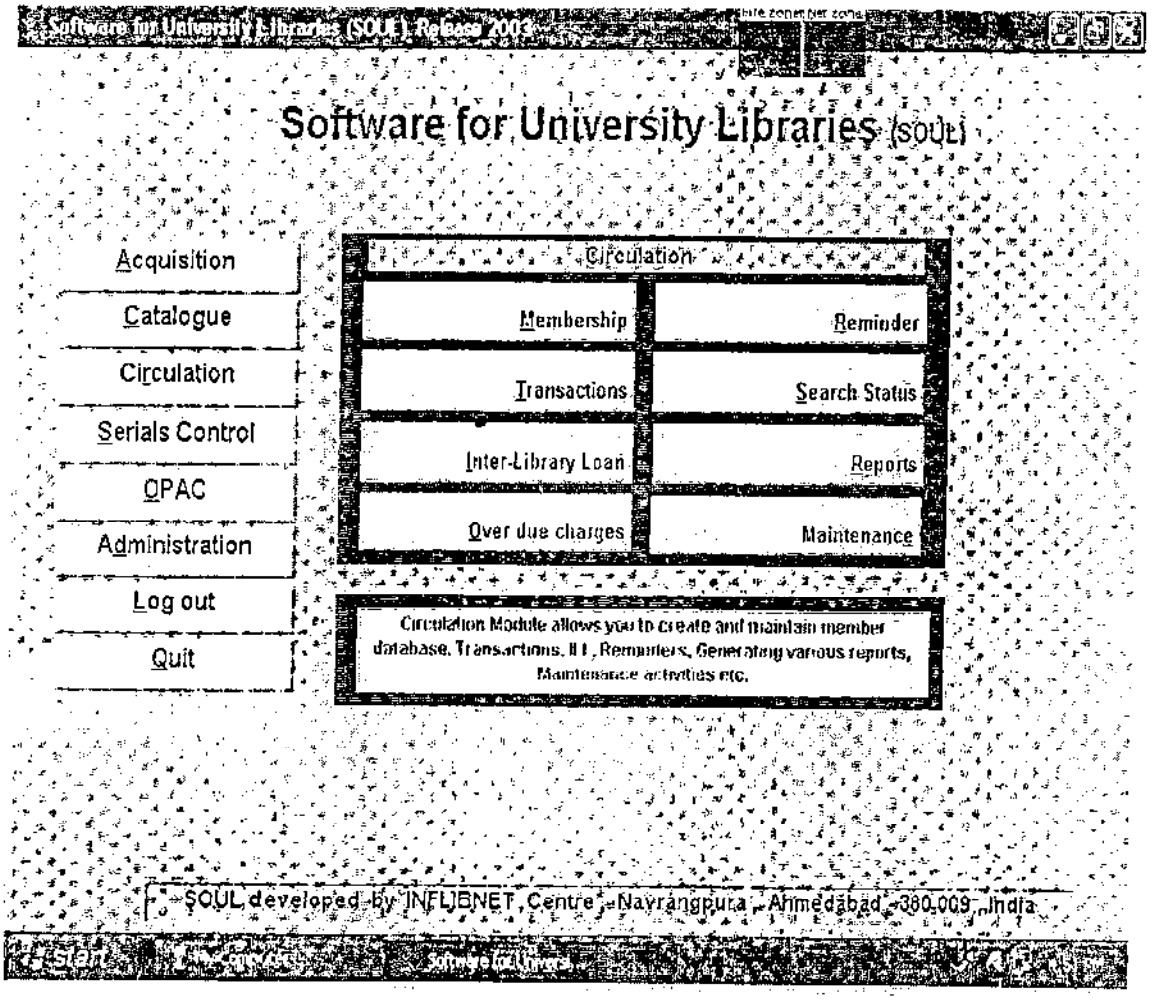


Annex 3: Different types of Barcode Scanners

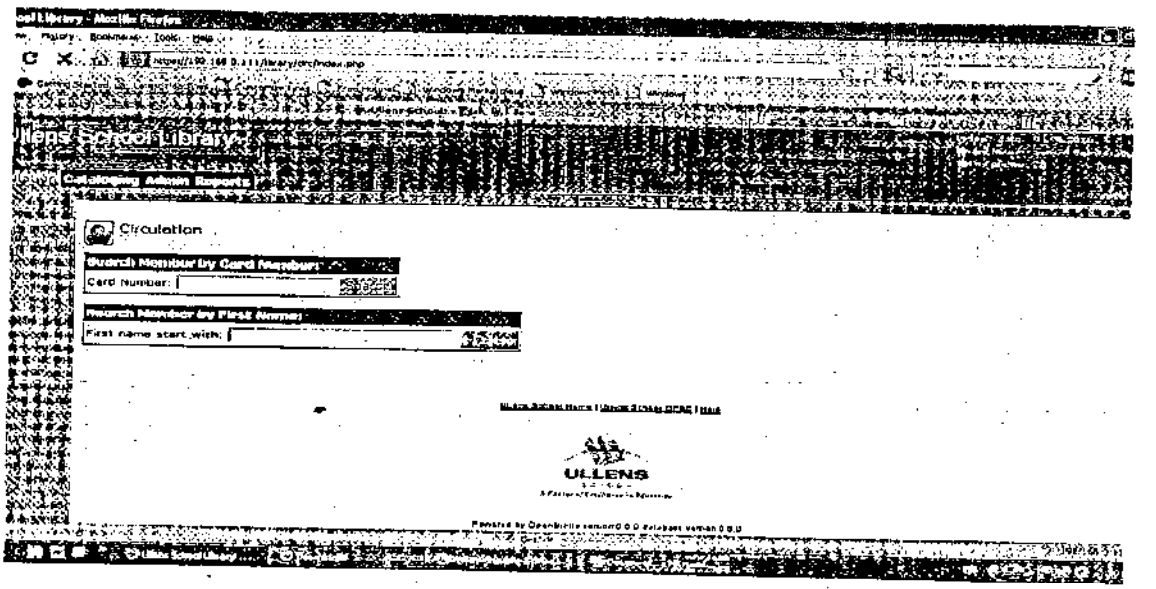


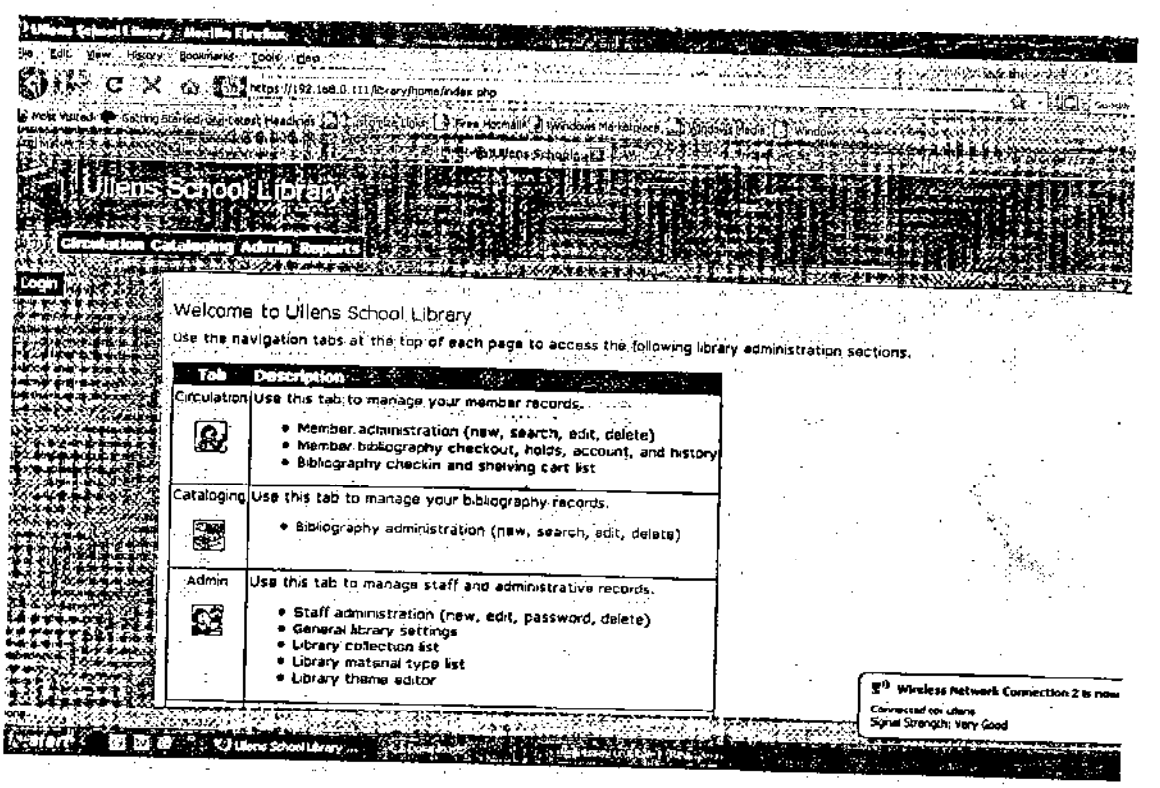


Annex 4: Home Page of SOUL



Annex 5: Home Page of Open B iblio





Annex 6: Sample of Barcode Labels

658.8.AAK-S.100

100

657.45.LIM-A.1022

1022

657.45.SHA-T.1024

1024

420.DOF-M.1000

1000

658.15.PRA-F.1023

1023

659.1.SON-A.1025

1025

657.MUN-C.1001

1001

651.SHR-B.1013

1013

657.45.SHA-P.1026

1026

657.MUN-C.1002

1002

651.SHR-B.1014

1014

657.SHA-E.1027

1027

657.MUN-C.1003

1003

651.SHR-B.1015

1015

657.PRA-B.1028

1028

658.15.SHA-F.1004

1004

651.SHR-B.1016

1016

657.PRA-B.1029

1029

658.15.SHA-F.1005

1005

651.CHA-B.1017

1017

338.9.GHI-E.103

103

657.WAG-A.1020

1020

651.CHA-B.1018

1018

657.45.LIM-A.1021

1021

657.45.SHA-T.1024

1024

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BIO-DATA

Mr. AMOD RIJAL

Personal Profile:

Father's Name:	Govinda pd. Rijal
Mother's name:	Indira devi Rijal
Date of Birth:	18th October 1977
Martial status:	Married
Sex:	Male
Nationality:	Nepali
Religion:	Hindu
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Educational Qualification:

MLISc.	T.U.	2008
Bachelor (1 Year B.Ed.)	T.U.	2005
Bachelor (B.Sc. physics)	T.U.	2003
Intermediate (I.Sc.)	T.U.	1997
S.L.C.	Nepal Board	1993

Trainings: Basic knowledge on MSWord, MS Excel, PowerPoint, PASCAL, CDSISIS, WINISIS and NETWORKING.
6-months advanced computer training.

Experience: Worked as a College Librarian in Kathmandu Don Bosco College from Falgun 2065 to Chaitra 2067.

Worked as a Chief Librarian in Nepal Transition to Peace (NTTP) for 3 months.