ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

SCHOOL OF INFORMATION STUDIES FOR AFRICA

AN APPROACH TO THE INTEGRATION OF EXPERT SYSTEMS AND HYPERMEDIA TECHNOLOGY IN DEVELOPING A PROTOTYPE TOURIST INFORMATION SYSTEM FOR ETHIOPIA

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN INFORMATION SCIENCE

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M. K. E.

Dedicated

To

My beloved
Mother W/o Abebu Zeleke
For your continuous praying,
consistent sympathy and
unending kindness
throughout the
years of my
life

and
My wife Etunat Bayilewot
For your unwavering support
and strong love

Abstract

In Africa, though the potential for tourism is said to be much higher, the number of tourists arrived at the continent and revenue generated from this sector is very low as compared with the other continents. Lack of technical persons to provide relevant and sufficient information to the tourists is one of the main stumbling blocks for development of tourism in Africa.

Ethiopia is no exception to this. There is only one training institute (called CTTI) which has trained 59 tour guides and travel operators; at least 23% of them don't work in the tourism sector. On the other hand the number of tour operators and travel agencies in the country is highly increasing just after 1990 and now they are altogether 109. These tour operators and travel agencies are acting as a tourism information center (TIC) in providing information to the tourists coming to the country.

In Ethiopia, usually the media that are used to promote tourism are guide books, brochures, flyers, and few documentary films. In all these media, the information is organized in a linear way and the user has to search all over the document from beginning to the end until he/she has got the required information. Had the information been organized in such a way that the user can easily branch out from one chunk of information to the other in a meaningful way with all types of media, it would have saved the time of the user and increase also the level of understanding. Hypermedia system, which incorporates textual databases, sound, animation, video, still pictures and other type of media, can support the facilities mentioned above. In a hypermedia system, the information nodes are organized in a non linear way so that the users can easily navigate around the knowledge corpses. Utilities of such databases can be enhanced by developing an expert interface on top of it to provide guidance to the users.

In this study an attempt has been made to develop an integrated expert and hypermedia system to guide tourists planning to visit Ethiopia. The knowledge base for the expert system was acquired from one experienced tour guide and two of his trainees. The acquired knowledge was represented in a hierarchical model and a production rule method was used to map the knowledge base for computer programming. Information for the textual

database and still pictures for the hypermedia system were taken from various guide books and brochures and the recorded sound was taken from the concerned organizations.

KnowledgePro was used as a tool for developing the prototype. The prototype expert and hypermedia components were integrated at three levels. The first was at the start of the system i.e. the user will be asked whether he/she is in need of assistance. If yes expert system will run otherwise the user will be taken to the hypermedia knowledge corpses. The second situation is at the end of the expert systems' suggestion. After the user is advised to visit a particular tourist site, there is an explanation about that selected tourist site using the hypermedia system. The third position where these two systems are integrated is using the two buttons found on each system. One button is labeled as 'Hypermedia' on expert system module and the other button is labeled as 'Expert' on hypermedia system module. Using these two buttons the user can go from one system to the other easily at any time.

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Abreviations

CRS	-	Computers linked accomodation Reservation System
TIS	-	Tourism Information System
TIC	-	Tourism Information Center
CTTI	-	Catering and Tourism Training Institute
ETC	-	Ethiopian Tourism Commission
WTO	-	World Tourism Organisation
EAL	-	Ethiopian Air Lines
NTO	-	National Tour Operation and Travel Agency
ES	-	Expert System
AI	-	Artificial Intelligence
KBS	-	Knowledge Base Systems
ExTISE	-	A prototype Expert System for Tourism Information System of Ethiopia
HyTISE	-	Hypermedia Tourism Information System for Ethiopia
GNP	-	Gross National Product

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CHAPTER ONE

INTRODUCTION

1.0 BACKGROUND

For years, computers have been used in tourism sector like other organizations for payroll, accounts payable, accounts receivable, reports and numerical analysis. Today, however, automation & data processing have moved out of the accounting department and the tourism business organisations can use database, computers linked accommodation reservation system (CRS), and other information to develop a total tourism information system (TIS) to aid in decision making, in marketing, in customer services, or to accomplish a special purpose.

According to Holloway, tourism industry is ideally suited for information technology application. Tourism information centres (TIC) are ones who are largely benefited and assisted on their jobs with the help of IT. The Computer linked accomodation Reservation System (CRS) is just one example of the important role which IT is now coming to play in providing tourist services in TIC (Holloway 1994,234). These centres are important because they frequently provide the initial contact with most tourists who visit a community, and because they have the opportunity and the responsibility for creating the first impressions a tourist will perceive (Mill 1990,97).

In the customer services and in decision making process, different types of expert systems and multimedia technologies have been used in the tourism industry. The potentials to use these

systems are not yet well utilized, especially in developing countries, and will continue to be applied in the future. Witnessing this, Witt and Moutinho (1994,129) stated the case as:

> *Expert systems and artificial intelligence are likely to be included in more systems in the future to assist in the more complex applications and decision processes in the travel industry. Travel counselling lends itself well to this application. Multimedia technologies that permit the use of images in computer systems are already being used to some degree and are likely to become much more prevalent.*

Ethiopia having higher potential of tourist sites can promote its tourism industry using expert systems and hypermedia technologies. In this study the feasibility of using an integrated expert and hypermedia system in developing an information system on tourism in Ethiopia has been studied and a prototype expert hypermedia system has been developed.

1.1 STATEMENT OF THE PROBLEM & JUSTIFICATION

The tourism industry is mainly engaged with the activity of delivering sufficient and relevant information about the scenic spots to the tourists. Tourist firms offer services that depend on the presence of guests, so accurate correspondence between services offered and customer needs is imperative.

The desire of tourists are quite numerous and seeks a knowledge of understanding them well. They need advice for example, on transport, local conditions (weather, currency, health etc), location, and history of the place, and so on. They need also to know pretty good idea how the

particular scenic spot looks like pictorially and even the sounds of some peculiar animal, birds and so on.

Tourist firms are providing such information for their customers using their travel operators and tour guides. These are qualified personnel having a knowledge of tourism and tourists behaviour.

In Ethiopia, though there are no universities or colleges dedicated to graduate a student with a profession of tour guide, there is one training centre established in 1969. This training centre, Catering and Tourism Training Institute of Ethiopia (CTTI), delivers a one year certificate programme for tourist guides and a one year diploma programme for travel operators. So far CTTI has trained 32 tourist guides in two years (1976 & 1982), and 27 travel operators in 1995 (CTTI 1994,8; WTO 1990,1:162). Since the task needs cummulative knowledge and experience, these trained persons would not have contact directly with the tourists just after the graduation, they should first gradually attain adequate experience.

Formerly, with the problem of the socialist economic policy of the country, there were not much private tourist firms. Between 1970's and beginning of 1980's there were 12 private tourist organisations which soon withdrew from the business of the tourism sector at the establishment of a governmental tourist firm called National Tour Operation and Travel Agency (Ayalew, 1992:36-37).

Today as a result of the economic policy and the regulation number 9/1990, private investors are allowed to compete in the tourism business. In 1994 the private tour operators and travel agencies were totally estimated (Kefelegn 1994,59) to be 49 but they are now 109 (Sofian 1997;

Asegedech 1997). This trend shows that the demand to get a qualified tourist guide has increased because they are the core and base for the tourism business sector. However, satisfying the demands to get a professional guidance is difficult and will force the government to incur much costs.

The other problem which is encountered in the tourism industry is the difficulty to present fully the descriptions of touristic sites. Usually tourists are getting such information through reading, watching movie or by retrieving the relevant information from the available databases which are provided by the Tourism Information Centres (TIC). Specially brochures and guide books are prepared for this purpose containing texts and pictures of the scenic spot. But, these materials are not well suited to provide information such as sounds of birds, animals and the fascinating movement of rivers. In addition to this problem, a tourist should read the guide book or brochures from beginning to end to search for his places of interest. This is of course a time consuming and tiresome task. Because of these conditions, tourists are usually saying that (while they were interviewed through the Ethiopian Radio Broadcasting Service e.g. on April/1997) though the tourist sites available in Ethiopia are tremendous, there is a problem in getting information about the specific scenic spots.

An expert hypermedia system, which consists of both an expert system and hypermedia systems' features, can assist to minimize the problems mentioned above. An expert hypermedia is distinguished by the separateness and explicitness - and consequently the examinability, intelligibility and modifiability - of its knowledge base, allowing inferences to be made relating to the subject content of the system and/or the use/operation of the system (Ford 1991,207). The integrated expert systems and hypermedia technology can be designed in two ways. The first one

is to improve the performance and functionality of hypermedia systems. And the second one is to use hypertext and hypermedia methods to improve the quality of the expert system (Barker 1993,175). In this study it is the second one that has been attempted.

Expert systems are suitable to represent the knowledge of an expert person in guiding tourists. Unlike the non-expert system which uses algorithms for the well-structured problems (that can be reduced to a predictable series of steps), an expert system uses heuristics which is appropriate for ill-structured problems (complex or full of uncertainties).

Heuristics are rules of thumb often used by human experts. They can be contrasted with algorithms, which represent procedures which, if remorselessly followed, will eventually produce a solution to a problem. Heuristics are short cuts which, if they manage to produce a solution, are likely to do so in less time and with less processing effort than algorithms (Ford 1991,5).

Expert systems are now being used widely in many organisations where there is a shortage of expertise. It can be applied to the tourism firms too in order to minimize the problem of getting tourist guides. This is so because, the application of expert system technology in tourism can increase productivity by making the experts' knowledge more widely available and reaches the less expert personnel. It can also improve the quality of work by insuring that the task is performed in a consistent manner. Another advantage of an expert system in the tourism sector is that it can contain the knowledge of more than one expert, so that the user benefits from a consensus of opinion.

As mentioned above, the other module of the system in this study is a hypermedia system. Hypermedia is the name given to the collection of technologies and techniques that are needed to create and access non-linear information structure using interactive selection strategies (Barker 1993,43). It can support the use of text, still pictures, moving pictures, sounds and a variety of different styles of human-computer interaction. Some of the earliest applications of this system were for the creation of customer-orientated information services for use in museums and art galleries (Barker 1993,114).

The flexible structuring of knowledge and information in hypermedia enables the users to browse and retrieve the relevant information easily. It has changed the conventional linear representations of texts and pictures, like in a book, to multidimensional view. Hence hypermedia technology is suitable for tourists to navigate around the relevant knowledge corpse with appropriate media instead of reading and/or watching the document in a one dimensional way.

The intention of this study is to experiment the application of integrated expert systems and hypermedia technology on tourist guide. This study, in particular, attempts to design and develop a prototype expert hypermedia system for guiding tourists planning to visit Ethiopia. The reasons to take tourist guide activity for utilizing the expert hypermedia system are:

- the scarcity of the expertise in the sector;
- the task is narrowly and precisely defined, i.e, it is clearly understood and the objective is well defined;

- the tasks can be articulated/described in words and/or still pictures and/or moving pictures and/or sounds rather than just performed;
- willingness of the relevant experts/experienced tour guides to assist in the process of diffusing their own expertise; and
- the task to guide tourists requires cognitive skill.

1.2 OBJECTIVES

1.2.1 General Objective

The general objective of this study was to design and develop a prototype information system containing integrated expert systems and hypermedia technology for guiding tourists planning to visit Ethiopia.

1.2.2 Specific Objectives

The specific objectives of this study were:

- to explore the potential and limitations of applying expert hypermedia system as tourists guide;
- to assess the feasibility of using an expert hypermedia technology on the activity of tourist guide in Ethiopia; and
- to develop a prototype expert hypermedia system to guide tourists planning to visit Ethiopia.

1.3 METHODS

1.3.1 Data Collection Method

1.3.1.1 Interview

To acquire the knowledge of the experts for the domain, interview and planned discussions were conducted with one expert who has several years' experience and knowledge in the domain; he is now working in one of the private tour operator & travel agency called Lift Air Tour and Travel Agency. In addition to this expert, two other experts who were the trainee of the above expert also participated in the knowledge acquisition process (See appendix I for the details of experts profile).

Since the peak seasons for tourists to visit Ethiopia is between January and June, these experts would be very much busy during this time. Therefore, the interview and discussions were conducted from October 1996 to begining of January 1997 (i.e. for three and half months) and altogether 28 contacts were made.

1.3.1.2 Literature review

The other method used to collect data was reviewing various literature published in expert and/or hypermedia systems, written documents about the domain, brochures, guide books, and other related materials that describe the subject matter.

1.3.2 Method of Developing the System

1.3.2.1 Prototyping

Prototyping approach was selected as a method to develop the system out of the other approaches because developing an expert hypermedia system is not a one end activity.

1.3.2.2 Programming tools

There are about three distinct types of programming tools which can be used to build expert hypermedia systems:

i) **Artificial intelligence programming languages (e.g. Prolog & Lisp)**

These are kinds of programming languages where the developer or programmer has to start from scratch to build the system. As it is shown in Table 1.1, it is difficult to understand and develop by non-programmers. It takes extra time to develop an expert and/or hypermedia system as compared with the other programming tools. Experience in the USA shows that it requires at least six months' dedicated practice to become proficient in using the larger LISP systems; therefore, the undoubted programming power is bought at a high price (Beerel 1993,28).

Table 1.1 Comparisons of Programming Languages.

Features	Shells	AI languages	Knowledge engineering environments
Understandable know-how	*		
Access by the expert	*		
Develop. by non-programmers	*		
Attractive user interface	*		*
Sophisticated graphics			*
Low initial cost	*	*	
Runs on standard hardware	*	*	
Fast development	*		*
Handles large systems	*	*	*
Programming flexibility		*	*
Uses nets, frames, etc.			*
Extensive support tools			*
Easy interfacing	*	*	*

(Source: Beerel 1993,31).
Note: The asterisk sign (*) shows the presence of the feature.

ii) Knowledge engineering environments (Toolkits)

These programming tools provide a set of building blocks which aim to cater for the programmer's every need and, hence, are sometimes known as toolkits. Toolkits can be classified between shells and programming languages. They seek to maintain some of the flexibility of languages with the prefabricated approach of shells, by offering a flexible building blocks approach. They offer a range of ready-programmed techniques such as different knowledge representation frameworks, reasoning mechanisms and so on (Ford 1991,236-7), as shown in Table 1.1.

iii) **Shells**

They are special software package designed specifically to help build an expert and/or hypermedia system. It has a generalized dialogue structure and the inference engine in place, and the only missing component is a knowledge base. The shells allow one to concentrate on the development of the knowledge base, rather than the programming procedures. It can enable a system to be built quickly with relatively little programming expertise (see Table 1.1).

There are a number of programming shells which are used to build an expert and/or hypermedia systems. **KnowledgePro** is one of those shells which is dedicated to build both expert and hypermedia systems. It is a knowledge-based hypermedia shell enabling the development of intelligent and expert hypermedia system. It allows the integration of hypermedia navigation facilities with rule-based programming (Ford 1991,207).

In this study KnowledgePro, which is also available here in SISA, has been used as a tool to build a prototype expert hypermedia system.

1.4 SIGNIFICANCE OF THE STUDY

The study's main concern was to design and develop a prototype expert hypermedia system to tourists guide. In this work both tourists and less experts (not experienced tour guides) can be benefited.

Tourists can get information in line with their interests without worrying to find assistance (tourist guide). As it is mentioned, the knowledge of tourist guide is built through several years of experience and learning. With this work, less expert tourist guides can be benefited to attain relevant experience within a short period of time. Moreover, they can be assisted in reducing mundane tasks and be free for more attentive customer services and researches.

The growing numbers of private tourist firms like tour operators and/or travel agencies can also be benefited to settle the problem of having scarce tour guides. In addition to these beneficiaries referred to above, the result of the study could also be used for those interested to develop expert and/or hypermedia systems in related areas.

1.5 SCOPE AND LIMITATIONS

1.5.1 Scope

Emphasis is given to analyze the potential and feasibility of implementing expert hypermedia system to tourism information system. To demonstrate the system, a prototype expert hypermedia system has also been developed.

Commensurate with the above mentioned scope, the approaches used to represent the knowledge of an expert in tourism information system was also studied and analyzed.

1.5.2 Limitations

As it is mentioned earlier, one module or part of the prototype system is the hypermedia system. Hypermedia technologies should practically support textual, graphical (both still pictures & animation), video and sound representation of documents. However, animation, video and sound require high amount of storage space. For instance, in a CD-ROM disc having 650 Mbytes storage capacity, it is possible to store only 30 seconds of video or 18 hours of low-quality sound (Barker 1993,133). This implies that with 16 high density double side diskettes, we can store only one second of video or 27 minutes of sound which is uneconomical and almost impossible task.

To minimize such problems, various types of compression and decompression techniques must be applied. Some of the commercial systems that compress video data, for example, are Intel's Digital Video Interactive (DVI) and Phillips' Compact Disc Interactive (CD-I). Such and other related type of systems are required to compress large amount of data on a certain amount of ratio & decompress it while retrieving.

In SISA, however, equipment like those mentioned above, digital cameras, CD-ROM writer, and so on are not available. Because of this, animation and video are not included in the developed prototype system. However, text, still images and sound media are incorporated to the prototype system for demonstration purposes.

Also, as an academic exercise, emphasis is placed on educational value of the work rather than its contribution to the operational environment. Hence more time and effort was devoted to the knowledge representation and programming aspect. The prototype could not be tested due to lack of time, though a general guidelines for testing has been provided.

1.6 ORGANISATION OF THE THESIS

The thesis is organised into six chapters. Chapter one contains the introductory part of the thesis with the historical background of tourism at the beginning. Justification of the study, objectives and the methods used to carry out the research, and significance of the study have been discussed in this chapter.

Chapter two discusses about the tourism information in Ethiopia. It constitutes the infrastructure of tourism and its impact for economy of Ethiopia including the type of tourism sectors found in Ethiopia.

Chapter three reviews both expert system and hypermedia technologies in relation to their historical background, architecture and application to the business sectors or other organisations.

The approaches used and the knowledge representation of an expert in tourism information system is shown in chapter four.

Chapter five describes the development of the prototype system for both expert and hypermedia, and their integration. System requirements for implementing the system is also discussed here. Conclusion and recommendations drawn from the thesis are stated in chapter six.

CHAPTER TWO

TOURISM INFORMATION IN ETHIOPIA

2.1 HISTORICAL BACKGROUND

Early people tended to stay in one place. Travel was essentially to seek food or to escape danger. The earliest forms of leisure tourism can be traced as far as the Babylonian and Egyptian Empire in the sixth century BC. Later in the third century BC Greek tourists travelled to visit the sites of healing gods.

Romans also contributed for the development of tourism in the world. They introduce their guidebooks (Itinerary) listing hotels with symbols to identify quality in a manner reminiscent of the present day Michelin Guides (Holloway 1994,14).

Following the collapse of the Romans Empire, travel became more dangerous & difficult. However, the advent of railways in 1825 in England and the establishment of the first regular steamship service in Britain and the United States in 1840 have changed the problems on transport and the growth in travel (Mill 1990,7).

In its history, the dynamic change of tourism industry occurred just after World War II when Boeing 707 jet in 1958 was introduced commercially. Hence it is possible to speak of tourism industry on the international scale only after 1950's. Since then, the development of tourism

forms a significant impact on economy, social, cultural and environmental situations of the world.

The effect of tourism on economic aspects are income, employment, balance of payments and investment and development (Mill 1990,87 and Holloway 1994,67).

In addition to the many economic impacts that tourism has on a destination, there are impacts on people - the effect of the interaction between host and guest. There is also an interchange of peoples culture of beliefs, value, attitudes, and behaviours that are shared by a society and which are passed on from one generation to another.

The environment impacts of tourism are considered to be important for less developed countries because it improves the sanitation, sewerage and housing of a country (Mill 1990,91).

The continent of Africa is arguably more suitable for tourism industry because of the potentials they have. In describing this situaion, the tourist newsletter of ETC stated (ETC 1997,2):

> *Despite the poverty of its peoples, Africa is a rich continent. Its natural, cultural and human resources are immence. The tourist resources of Africa are also vast. ... Scientists are of the opinion that "Africa is home to 2/3 of the earth's total animal and plant species, ranging from 250,000 to 300,000." Africa's potential is thus tremendous, but it is largely untapped.*

In Africa, though the potential for tourist sites is said to be much higher as discussed above, the contribution of tourism industry for the countries' GNP is very limited. Especially Sub-Saharan

Africa is not well developed as a destination for international tourists in comparison with other major world regions. In 1991, Sub-Saharan states reporting to the WTO accounted for 9% of the global population, but received only 3.5% of international stayovers (or 15,845,000 of 455,100,000 tourists), and just 1.8% of receipts (or US $4593 millions of US $261,071 millions) (Weaver & Elliott 1996).

As it is described by Weaver & Elliott (1996) the poor performance in tourism is attributable to five major sets of factors broadly associated with Sub-Saharan Africa's status as the least economically developed major world region. These factors are:

1. a negative public image in the market regions (a problem recently exacerbated by the AIDS epidemic and the genocide in Rwanda);
2. foreign exchange constraints which hinder the implementation of services and infrastructure necessary to sustain tourism;
3. a lack of skilled labour (which fosters a reliance on expatriate workers in critical technical and managerial positions);
4. weak institutional frameworks for tourism planning; and
5. chronic political instability.

As it is mentioned above, one of the problems in Africa is the lack of skilled manpower both in technical and managerial positions. Part of the technically skilled labours are those experts who guide or deliver information to tourists coming to their countries.

Ethiopia being a country who has a recorded history of more than thirty centuries, a heritage of anthropological remains, ancient monuments, works of art and an abundance of peculiar animals,

had been visited by several explorers and religious people. During the earliest years the country was taken as a place for relaxation. Some legends in combination with the real history had mentioned some evidences that Ethiopia was chosen as a destination site for recreation and pleasure among the ancient slave-owning kingdoms of the time than other African countries (Ayalew 1992,5).

Various events had contributed for the introduction of tourism in Ethiopia. Most of these events were related to religion in the earlier years. The adoption of Christianity as a state religion in the fourth century AD. by an Ethiopian eunuch of Queen Kandae who has been baptised by the disciple Philip and later the introduction of Muslim religion caused a lot of travellers to come to Ethiopia and visit. Portuguese missionaries and other Europeans who made explorations to the source of the Blue Niles were believed to be the earlier visitors too (Kefelegn 1994,22).

Although some individuals did get a chance to visit Ethiopia because of various reasons, the rest of the world was not fully aware of the tourist nature of Ethiopia because no one went there to report on it until the fifteenth century, when the Italian Pietro Rombulo came to live in Ethiopia, and no coherent report was produced until Francisco Alvarez narrative, which was in 1920 (Ayalew 1992,5). Especially the defeat of Italy by Ethiopia in the battle of Adwa in 1896 has contributed a lot for Ethiopia to be recognised all over the world as a great state.

Tourism in Ethiopia, though dated back many years ago, became as a means of revenue generator for the country only after the World War II. Ayalew (1992,35) describes this as:

> In addition to the other sectors of economic benefit, tourism as an industry was given great attention by Imperial government of Ethiopia, particularly because of the external

influences and the UN development plan, which stimulated the first office creation as Ethiopian Tourism Operation (ETO) in 1961 in Addis Ababa for initial development of the sector. Since then, Ethiopia commenced trading in tourism sector.

Since its establishment in 1961, ETO, now called Ethiopian Tourism Commission (ETC), has taken responsibility to promote, and laid the ground work to expand tourism during 1970's and subsequent years. Specially nowadays tourism is being given a great attention by the current government. The international tourism conference, called the 30th WTO - African Commission Conference, which was held here in Addis Ababa in April/1997, is one of such instances.

2.2 TOURISM INFRASTRUCTURE IN ETHIOPIA

2.2.1 Transportation

Tourism is absolutely dependent upon the level of man and its dynamism, i.e., it is based on changing of permanent residences for other new destinations where people temporarily stay mainly for the purpose of recreational activities. These activities are highly dependent on the means of transportation. Transport is an integrated part of tourism which seeks high amount of investment and technologies. Inadequate transport facilities in a country will certainly affect the development of tourism whatsoever the natural aesthetic value the country has.

Ethiopia, like most of the developing countries, faces problems of transportation. Although are all means of transport exist, namely, land, air, and water (lake) transport they are inadequate and not up to the standard.

2.2.1.1 Land Transport

Land transport is the most suitable means of transport for tourists because it provides a chance of an on-way touring opportunity, if possible by stopping the vehicle easily.

One of the measures of the sufficiency of roads in a particular country is its density in relation to the inhabitants and area. In Ethiopia, the available density of roads is only about 0.9 km per 1000 inhabitants and the density per 100 km^2 is 31 km for all types of roads: both figures are well below the average for Africa, where the weighted means are 2.6 km and 58 km respectively (WTO 1990,122).

However, though the density of roads is low, most of the tourist sites are linked and accessible inside the country with those relatively well constructed road systems. Internally in Ethiopia there are some 4,100 kilometres of asphalt roads with a further 19,000 kilometres of gravel and dry-weather roads (EAL 1996,62).

There are also roads which connect Ethiopia with other African countries thereby promotes an inter-regional tourism. For example, the Moyale Highway connects Addis Ababa with Nairobi, dry weather roads link Addis Ababa with Djibouti, Khartoum and Hargessa in Somalia, and the Gaborone - Cairo High Way connects Ethiopia to the trans-African High Way through Gondar, Bahir Dar, Addis Ababa or in the South through Awasa to Moyale and finally to Kenya (Ayalew 1992,21).

The other means of land transportation which connects Ethiopia with Djibouti is the railway transport which was built at the beginning of the 20th century. This railway has a total length of 781 km which ranges from the Redsea coast of Djibouti to the highlands of Addis Ababa. This railway plays a vital role in the tourism development of Ethiopia, in addition to its importance for import-export activity. However, the railway is old and lacks maintenance since its construction.

2.2.1.2 Air Transport

As the land transport is the main factor to connect tourist sites internally, air transport also has a significant role in connecting countries from various continents. The international, i.e. overseas tourism of the country is absolutely dependent on the means of air transport.

The advantages of air transport can easily be assessed in countries like Ethiopia with large sized and rugged terrain which makes it very expensive and time consuming to reach all regions by road. Therefore, for Ethiopia, like the other developing countries, being located at a great distance from the tourist generating countries of the world such as North America, West Europe, etc, the most indispensable mode of transport for tourist is undoubtedly air transport. According to WTO statistical result, the mode of transport used by tourists coming to Ethiopia from 1990-94 is totally by air transport (WTO 1996,59).

Ethiopian Air Lines (EAL), which is the only air lines owned by the government, is the one which facilitates the air transport for tourists. So far, EAL has an extensive domestic network flying to 43 fields and an additional 21 landing strips (EAL 1996,62). Internationally, it serves some 45-47 cities in Africa, Asia, and Europe, etc., and at the same time, other international air

carriers also support the EAL in its effort of increasing the inflow of tourists to the country, beyond its other economic significance. Hence, airlines such as Lufthansa, British Air Ways, Kenya Air Ways, Alitalia, Air India, Almeyda Air Lines, Interflug Air Lines, etc., are very important (WTO 1990,3:133).

2.2.1.3 Water (Lake) Transport

Water transport has also an impact on the flood of tourists to a destination from distant countries as that of air transport. Specially for those countries who don't have a direct flight to a tourism destination with air transport can use the water transport as an alternative.

Ethiopia, however, became a land locked country just after the succession of Eritrea. But, navigable river and inland water boating is available occasionally distributed in some parts of the country. To mention some, water boating and `Tankwas' made of papyrus provide services for tourists to visit the monarchs found in Lake Tana; to visit the cultural and natural sites of South West region of Ethiopia, the hollowed tree trunk canoes are being used as a means of water transport for tourists.

2.2.3 Hotels

The second organisation in which tourism industry is composed of is hotel. For the development of tourism industry, the availability and quality of hotels to a country is the decisive factor. Hotels are the place for tourists to stay for some days after they visit or travel a long journey. Hence the facilities found inside and hospitality of the waiters in a hotel influences the flood of tourists to a country.

In Ethiopia, there are a lot of chains of hotels located in line with the route of tourist sites. The northern part of the country is served by Ghion hotels, Eastern part by Ras hotels, Western part by Ethiopia hotel and Southern part by Wabishebelle hotels administration (See Table 2.1). There is also a private owned Bekele Mola chain of hotels in the rift valley region. Other than these chains of hotels there is one big hotel, called Hilton hotel, in Addis Ababa and a new Sheraton hotel is about to open soon.

Table 2.1 Distribution of Hotels in Different Regions of the Country.

Hotels	Place
Ethiopia Hotel adm.	Covers the Western parts of Ethiopia and constitute about 10 hotels under it.
The Ghion Hotels adm.	Include the famous Historic Routes to the north & constitute about 17 hotels.
The Filwuha Hotels adm.	It constitutes of all hotels located in spas and thermal recreation areas. There are 3 hotels under it.
Ras Hotels adm.	Covers the Eastern Zone and consists about 12 hotels.
Wabishebelle Hotels adm.	Covers the South region of Ethiopia and comprised of 6 hotels.
Bekele Molla Hotel	Covers the rift valley region. There are about 6 hotels under it.

(Source: ETC 1994,30).

According to the WTO statistical data, Ethiopia has a total number of rooms and bed places (for the year 1990-94) as depicted in the table 2.2 below.

Table 2.2 No. of rooms & beds available in Ethiopia for tourists.

Accommodation	1990	1991	1992	1993	1994
No. of rooms (H & S)*	3090	2783	2661	3218	3440
No. of bed places (H & S)*	5515	4931	4564	5350	5500

*: H & S - Hotels and Similar establishment.
(Source: WTO 1996,59)

2.2.4 Skilled Manpower

The success of tourism in a country will be in part dependent upon an adequate supply of skilled labour, with the right motivation towards employment in the industry.

For a successful tourism industry in Ethiopia, the necessary man power training institute has been decisively recommended since the opening of the tourist office in 1961. The idea created an impression on the Imperial Government of Ethiopia which moved to set up in 1969 a small centre for tourism manpower training in a rented private house. At the beginning, the Catering and Tourism Training Institute (CTTI), was established to train primary-level manpower in order to provide tourists with professional services (Ayalew 1992,53). Since 1969, CTTI have graduated students in the various specialisation's (See Table 2.3).

Table 2.3 No. of Graduate Students from CTTI.

Tourist activities	No. of trained persons	Persons employed in tourist sectors
Front office	204	90
House-keeping	126	38
Catering	223	90
Food preparation	103	41
Food & beverage control	61	25
Supervising staff	82	80
Travel operator	27	NK
Tour guide	32	14
Total	858	378

NK: Not Known.
(Source: WTO 1990,1:162; CTTI 1994,8)

As we see from the above table, the number of students employed in tourist activities is about 45% only (excluding the travel operators). That means even those limited trained persons are not working in the tourism sectors.

Tourist guides are part of the professionals who are highly significant to tourism industry. They are the ones who provides information for visitors on where to go, how to get there, what to see, and what to do to enjoy their visit (Mill 1990,115). Hence they have by now assumed outstanding importance in tourism (WTO 1990, 1:162).

However, as it can be deduced from Table 2.3, the number of tourist guides found in Ethiopia is very small as compared to the available tourism sectors and the increasing number of tourist arrivals.

2.3 CONTRIBUTION OF TOURISM INDUSTRY FOR ECONOMIC DEVELOPMENT

The Ethiopian economy is an underdeveloped economy. The underdeveloped nature of the economy is seen by its low level of productivity, high rate of unemployment, deficit in balance of payment, deterioration in terms of trade, inefficient utilisation of resources, etc.

Therefore, the development of Ethiopian economy highly depends on the efficient utilisation of its natural and cultural resources nature endowed it. To achieve better economic development, the country has to mobilise and exploit its domestic resources. One means of exploiting its resources is to develop tourism.

Tourism has numerous and quite important economic significance to Ethiopia. It helps to earn foreign exchange, creates employment opportunities, contributes to GNP of the country, and expands market for both primary and manufactured goods. It has other economic contributions such as helping to develop secondary industries by investing the foreign exchange earned from tourism, and distribute economic activities among regions.

2.3.1 GNP Share of Tourism

The main contribution of tourism, as discussed above, for the economic growth of a country is its GNP (Gross National Product) share from the total. Some countries have got a remarkable share for their GNP from this "smokeless industry". Tourism has GNP share of 38.1%, for

instance, in Sychelles, 10.88% in Mauritius, 30% in Barbados, and so on (ETC 1992,13; Holloway 1994,25).

In Ethiopia, the part of tourism receipts for the whole GNP of the country is very minimum usually less than 1% but it has a considerable share in relation to the country's total export (Table 2.4).

Table 2.4 GNP share of tourism in Ethiopia.

No.	Variables (in Mn US dollars)	Years				
		1990	1991	1992	1993	1994
1	GNP	6061	8795	9564	8816	6947
2	Tourism receipts	26	20	23	20	23
3	Tourism expenditure	11	7	10	11	NA
4	Balance (2-3)	15	13	13	9	NA
5	Exports (F.O.B)	294	189	169	199	343
6	Tourism receipts as % of exports	8.8	10.6	13.6	10	6.7
7	Tourism receipts as % of GNP	0.43	0.23	0.24	0.23	0.33

NA: the data is Not Available
(Source: Processed from WTO 1996,59).

In a research done by WTO in 1990, Ethiopia was the leading country to have the potential for tourist sites as compared with some of the East African countries such as Kenya, Tanzania, Uganda, Sychelles, Madagascar, Mauritious (WTO 1990,1:219). However as it is shown on Table 2.5 for 1990, Ethiopia has the lowest rank among these East African countries in relation to the tourism receipts and GNP share.

Table 2.5 GNP share of Tourism in 1990 for Some East African Countries.

Countries	International Tourism Receipts (in Mn US $)	Percentage on Receipts in total export (in Mn US $)	Percentage of receipts in GNP
Djibouti	6	42.82	-
Ethiopia	26	5.31	0.42
Kenya	443	42.03	5.26
Madagascar	43	13.43	1.46
Mauritius	264	22.35	10.88
Sychelles	120	30.76	38.10
Tanzania	65	11.07	2.93
Uganda	10	4.00	0.29

(Source: Processed from ETC 1992,2:35).

But, though Ethiopia didn't utilise its resources well in this regard, the number of tourists visiting Ethiopia is improving in the consecutive years since the recognition of tourism as a revenue generator. In 1987, for instance, the number of tourists coming to Ethiopia was 73.1 thousands but in 1993 it increased to 93 thousands which is almost 27.4% increments within these seven years (Table 2.6). However, a lot has to be done by experts working in this industry to have more number of tourists like those of other neighbouring African countries.

Table 2.6 Profile of Tourist Arrivals & Receipts in Ethiopia.

Years	Tourists arrival	Foreign currency revenue[1] (in '000 Birr)
1987	73144	29550
1988	76450	39271
1989	76844	42901
1990	79346	52282
1991	81581[2]	38824
1992	83213[2]	57763
1993	93072[3]	107822

(Source: processed from ETO 1994,13 & 15)

2.3.2 Employment Benefit

Tourism is also important to an economy because it generates employment. Jobs will be created in travel agencies, tour operators and other intermediaries who supply tourist services in both the generating and destination areas.

Ethiopia has also been benefited from tourism industry by creating more jobs for her citizens. More than 6,000 people are working now on some organisations who have a direct relation with tourist services (Table 2.7). The number could rise up if those working on all private hotels, tour operators, travel agencies and other related sectors were included.

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1 1987-1992 excludes:
- NBE foreign currency earning report;
- Revenue from private sectors.

1993 excludes:
- NBE foreign currency earning report. But it includes revenue from private sector.

2 includes 800 tourists (i.e. from Sept. - Dec.) entering Ethiopia via neighboring country.

3 Provisional data

Table 2.7 No. of Employees in the Public Tourism Sectors of Ethiopia.

Name of organisations	1983 EC (1990/91 GC)	1984 EC (1991/92 GC)	1985 EC (1992/93 GC)	1986 EC (1993/94 GC)
ETC	207	204	150	125
ETTE	660	624	573	571
CTTI	65	66	63	63
NTO	309	292	265	245
Hilton hotel	409	414	409	412
Ghion hotel	1511	1579	1440	1412
Ethiopia hotel	879	884	872	797
Wabishebele hotel	681	668	660	655
Ras hotel	1398	1376	1336	1284
Filwuha hotel	591	569	600	585
Total	6710	6676	6368	6149

(Source: ETC 1994,12)

2.3.3 Balance of Payment

The other contribution of tourism to a country's economy is for balance of payment. In a national context, tourism may have a significant influence on a country's balance of payments. International tourists are buying tourist services in another country, and these payments are noted in a country's accounts as invisible (Holloway 1994,75). That means the visitors' expenditures impact on the overall income of GNP and at the same time the pattern of its balance of payment shows the extent to which tourism is contributing to the country's economy.

In Ethiopia, as it is shown on Table 2.4, the contribution of tourism to balance of payment seems immaterial. It decreases from time to time.

2.4 TOUR OPERATORS AND TRAVEL AGENCIES IN ETHIOPIA

Basically tourism industry is composed of two major organisations which are directly involved in the business activities of the sector (Ayalew 1992,35):

1) travel agency and tour operation; and

2) hotel/catering and the related hospitality.

Travel agency and tour operation sectors are part of the tourism industry activities that need expertise in guiding tourists. They are the ones who have a day-to-day contact with tourists and provide relevant information timely and accurately.

In Ethiopia, the business of travel agency and tour operation is run by both government and private organisations.

2.4.1 Government Organisations

National Tour Operation and Travel Agency (NTO), is the only government tour operation & travel agency found in Ethiopia. Formerly, i.e. before 1990, NTO was running its business with less competitors because of the then economic policy. But, as it is shown on

table 2.8, the number of international tourist arrivals hosted by NTO is now decreasing because of the increasing number of private organisations working in the business.

Table 2.8 International tourist arrivals hosted by NTO.

Years	Tourist arrivals	Tourists hosted by NTO	Percentage of tourists arrival hosted by NTO
1987	73,144	3,590	4.9
1988	76,450	4,106	5.4
1989	76,844	4,848	6.3
1990	79,346	2,808	3.5
1991	81,581	1,233	1.6
1992	83,213	1,534	1.8
1993	93,072	2,007	2.2

(Source: ETC 1994,34).

2.4.2 Private Organisations

The number of private tour operators and travel agencies available in Ethiopia is rapidly increasing, from almost zero before 1990 to 36 travel agencies and 13 tour operators in 1994 (Kefelegn 1994,59). This figure has now changed to 69 travel agencies and 40 tour operators where almost all of them to be confined in Addis Ababa (Sofian 1997; Asegedech 1997). The mushrooming of these private organisations will indeed contribute a lot to develop tourism industry for Ethiopia as long as they act as an information centre for tourism information system.

CHAPTER THREE

REVIEW OF EXPERT AND HYPERMEDIA SYSTEMS

3.1 INTRODUCTION

There are various types of information systems which are used in different organisations. An information system is a set of interrelated components working together to collect, retrieve, process, store, and disseminate information for the purpose of facilitating, planning, control, co-ordination, analysis, and decision making in business and other organisations (Laudon & Laudon 1995,5).

One of the information systems which is currently being used is an Expert System (ES). Expert systems arose from a research program that began with the development of the Dendral system in the 1960's, which dealt with the identification of chemical compounds from mass spectrometry data (Parsaye et al 1989,163). Since then they are being used on numerous types of applications.

Many scholars have tried to define what ES mean. The following four definitions are sufficient to indicate the definition and meaning of ES.

i) Expert systems are computer programs that give the appearance of human like reasoning for problems ordinarily requiring expertise (Pedersen 1989,4).

ii) Expert systems are a specialised form of artificial intelligence; they are designed so as to replicate the problem-solving techniques of an expert in a narrow area of specialism, where reasoning is applied rather than calculation (Beerel 1993,9).

iii) Expert system is one which has a larger set of factual and heuristic knowledge acquired from one or more human expert(s) in that field, and is able to achieve the same performance in problem-solving as those experts (Chiang-Choon and Hougjin 1991,67).

iv) An expert system is a program that relies on a body of knowledge to perform a somewhat difficult task usually performed only by a human expert. The principal power of an expert system is derived from the knowledge the system embodies rather than from search algorithms and specific reasoning methods. An expert system successfully deals with problems for which clear algorithmic solutions do not exist (Parsaye & Chingnell 1988, 1).

In describing ES, other two concepts are mostly mentioned. These are Artificial Intelligence (AI), and Knowledge Based System (KBS). The relations and differences of these three concepts are discussed below.

3.2 ARTIFICIAL INTELLIGENCE, KNOWLEDGE BASED SYSTEMS AND EXPERT SYSTEMS

i) Artificial Intelligent (AI) system

It uses at least some heuristic knowledge (not necessarily at an expert level); and/or can make judgments despite uncertain and/or incomplete evidence.

AI software generally falls into one of three categories (Wilson and Burford 1990,275):

- expert systems;

- natural language systems (NLS); and
- simulated neural networks.

ii) Knowledge-based systems (KBS)

Most intelligent (and expert) systems are themselves examples of a broader class-knowledge-based systems.

A knowledge-based system (KBS) need not be an intelligent knowledge-based systems (IKBS). Indeed, many systems which make no use of heuristics, and which perform tasks which do not require the techniques of AI at all, have been built using knowledge-based techniques (Ford 1991,8).

Knowledge based systems include knowledge, often in a fairly generic form. This may be that the system can be used as a general problem solver but cannot really be defined as an expert system as it lacks specific expertise.

iii) Expert systems

ESs are examples of a particular class of computer programs which generally use heuristics to perform tasks previously restricted to human experts.

3.3 CHARACTERISTICS OF ES

An Expert System, like other kinds of information systems, has its own characteristics which make it different from others. Some of these characteristics as mentioned by Beerel (1993,142-3) are:

- The system must be able to reason with domain-specific knowledge that is symbolic as well as numerical;
- The system must use domain-specific methods that are heuristic (plausible) as well as following procedures that are algorithmic (certain);
- The system should be able to explain what it knows & how it arrives at its answers; and
- The system retains flexibility which enables one to maintain & adapt the knowledge readily.

Expert Systems, though they are trying to mimic the cognitive nature of human being, cannot fully substitute an expert in a particular task. Experts are better than an ESs i.e. the knowledge represented in an ES is always a subset of the knowledge of human being who is expert in that particular field (See Figure 3.1). However, ES can improve the quality of work. It can free the expert for more interesting and challenging work, while freeing him or her from many of the familiar, mundane tasks. Even for limited scope of the ES, the software can be a trainee in its sub domain just as an inexperienced new hire would be.

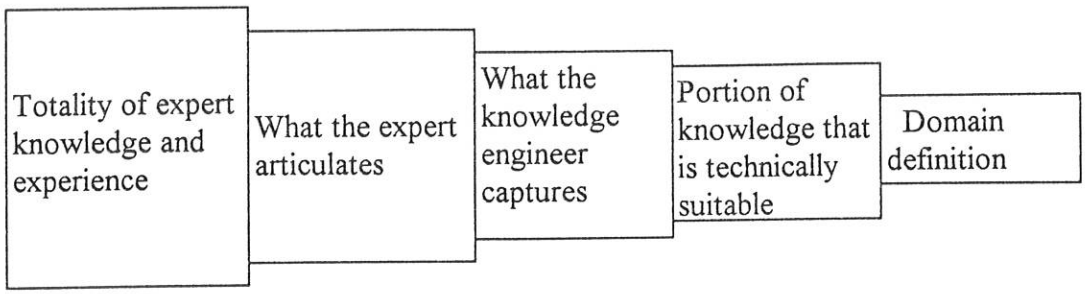


Figure 3.1 Portion of Knowledge Extracted from an Expert

(Source: Pedersen 1989,159-62)

3.4 ES LIFE-CYCLE

In building an ES, one should follow the following six stages to accomplish the task (Parsaye et al 1988,295-97):

i) **Feasibility analysis**

The domain in which the ES is to operate (e.g. medicine, engineering, finance, tourism) and the task which will be performed by the ES (e.g. diagnosis, monitoring, cash-management, guidance) are studied and analysed by the ES builder.

ii) **Conceptual design**

The conceptual structure of the system is defined, along with a specification that describes the way in which the ES will carry out the task.

iii) **Knowledge acquisition**

The knowledge required for performing the task is acquired from a human expert, case histories, reference sources, etc.

iv) **Knowledge representation**

The knowledge is formalised and represented in a symbolic format.

v) **Validation**

User's views, expert opinions, or operational criteria are used to determine whether the ES has achieved an acceptable degree of success.

vi) **Technology transfer and maintenance**

The ES is moved to an operating business or an industrial environment, and its structure and use are gradually modified through maintenance.

3.5 ROLE OF INFORMATION PROFESSIONALS IN BUILDING ES

Information professionals are the core members in building an ES. They can participate in an expert system developer team or do the task by themselves in various ways. Morris and O'Neill (1988) explain these activities as follows:

- As a specialist in information resources providing initial information to the knowledge engineer prior to his discussions with the expert;
- As, a potential knowledge engineer who, as part of his or her job, collects, refines and structures knowledge for use in ESs;

- Collaborating on user studies and user modelling;
- Acting as "an information broker," if and when ESs become widespread;
- Updating and extending the knowledge base of installed systems;
- Helping to bridge the gap between computer and information science; and
- Developing expert systems for client groups.

3.6 MEASURES OF QUALITY FOR AN ES

The quality of an expert system being developed can be measured from two points of view. Sharma et al (1992) describe two dimensions of quality, technical and social factors, by categorising all the subsystems under them as shown in Table 3.1. All the features listed on the first column are grouped under the next column, and the features under the second column are components to those which are on the third column and these in turn are categorised under the last column, the technical and social subsystems.

Table 3.1: Measures of Quality for an ESs.

1	Difficulty	Task selection	Task	The Technical Subsystems
2	Scarcity			
3	Utility			
4	Confidence	Task Performance		
5	Realism			
6	Criticality			
7	Novelty	Work Redesign		
8	Simplification			
9	Interactivity	Input	Technology	
10	Codability			
11	Operativeness	Processing		
12	Speed			
13	Exaustiveness			
14	Inference			
15	Explainability			
16	Augmentation			
17	Specificity	Output		
18	Precision			
19	Presentation			
20	Compatibility	Interface		
21	Documentation			
22	User-Friendliness			
23	Modifiability			
24	Stimulation	Quality of Work	People	The Social Subsystems
25	Relief			
26	Benignity			
27	Managerial Approach	Life-Cycle considerations		
28	Enthusiasm			
29	Inclusion			
30	Expert helpfulness			
31	Bureaucratisation	Organisational fit	Organisation	
32	Education			
33	Adaptiveness			
34	Agreement			
35	Innovation			
36	Performance	Economic benefits		
37	Feasibility			
38	Competitiveness			

(Source: Processed from Sharma and Conrath 1992)

3.7 ARCHITECTURE OF ES

The architecture of an expert system consists of:

1. A knowledge base (or knowledge source) of domain facts and heuristics associated with the problem;
2. An inference procedure (or control structure) for utilising the knowledge base in the solution of the problem;
3. A user interface to interact with the users; and
4. An explanation module to reason out how the system arrives at a particular solution and to explain also the relevancy of some of the questions imposed by the system.

3.7.1 Knowledge Base

The core and brain part of an expert system is its knowledge base. It contains the specific knowledge about the system area of expertise in the form of facts and rules. The rules use the facts in deriving the conclusions. We use facts to refer to either permanent or temporary knowledge. e.g. Carbon is an element. Rules are a straightforward method of representing expertise, and they are frequently used to represent knowledge in expert systems (Parsaye et al 1989,169).

There exist many different methods for representing knowledge in an expert system, such as first-order predicate calculus, frames, semantic networks, and production rules (Saleem and Azad 1992).

The most popular approach to represent the domain knowledge (both facts and heuristics) needed for an expert system is by production rules (also referred to as situation-action rules or if-then rules). One of the chief advantages of this rule based approach is that each rule is usually a nugget of expertise. It can be read in isolation from other rules and make perfect sense. This tends to make creation and maintenance of expert systems much easier for very large systems than a conventional programming approach and they are also suitable to quickly create prototypes to test ideas and prove feasibility.

Frames are also important to represent knowledge in an expert system. A frame is a set of information relating to a particular entity. They are ways of packaging knowledge within a well defined structure. Packages provide modularity, hierarchical organisation, and compactness of expression.

3.7.2 Inference Engine

The other constituent of an expert system which executes the knowledge base is an inference engine. The task of the inference engine is to take the knowledge in the knowledge base and carry out a set of actions that will utilise the knowledge in finding a solution to the problem.

This rule interpreter (inference engine) uses a control strategy for finding the enabled rules and for deciding which of the enabled rules to apply. An inference engine uses mostly two basic control strategies. Various authors describe these two as (Parsaye et al 1989,172; Ford 1991,27; Saleem et al 1992; Walls 1989; and so on): bottom-up (goal driven) approach usually called

backward chaining and top-down (data driven) approach usually called forward chaining. Another approach can also be drawn from these two approaches by combining them.

i) Backward chaining

In backward chaining inference, the system is provided with a specific clause called a goal to prove. To prove a goal, backward chaining inference begins with and focuses on the conclusions of rules. Backward chaining inference proves two-valued goals (true or false) by matching them with the fact base and conclusions of backward rules. That means in a tree-like if-then production rules, we start at the root of the tree and follow the branches toward the leaves until we find facts in the fact base.

ii) Forward chaining

In some senses, forward chaining is the opposite of backward chaining since it focuses on the premises of rules rather than their conclusions. If the clauses in the premise of a forward rule are proved, the conclusion of the rule is added to the fact base. we start from the leaves and work our way toward the root until we find a chain of branches that leads to the top-level goal.

Both the above types of inferences work based on two logical values: true or false. However, there is sometimes a situation where there is no certainly true or false value. In this case there will be multivalued form of logic described by their confidence factors (CF's). This type of inference is termed as inexact inference (Parsaye et al 1989,179).

3.7.3 User Interface

Expert systems are interactive systems. They are designed to help people solve problems and make decisions in bounded, well-defined knowledge domains. The part of this system which interacts with the user is the user interface. It facilitates communication between a user and the expert system during the consultation process. This component questions or presents menu choices to obtain initial and subsequent information from the user, then communicates the result of the consultation to the user.

3.7.4 Explanation Module

A feature which is highly essential to an expert system is the ability to explain its line of reasoning. Generally the explanations provided by expert and intelligent systems are based on a record (or 'trace') of the rules used in the processing of a query.

There are essentially three levels of explanation that can be provided (Beerel 1993,176):

1. Explanation of why a particular question was asked.
2. Showing the user the chain of reasoning that was followed as a consequence of the results of the user consultation
3. Justifying to the user individual steps taken within the chain of reasoning.

3.8 APPLICATION OF ES

Applications of an expert system are too many and are being utilised in different organisations. It can improve efficiency, reduce cost, save manpower, increase flexibility, improve job satisfaction, and relieve pressures on experts, to name but a few benefits (Morris et al 1988).

Generally expert systems are used for diagnosis, instruction, planning, configuration, troubleshooting, monitoring etc. Some of the expert systems that are developed and being implemented are shown in the table 3.2 below.

Table 3.2: Some Applications of ESs.

EXPERT SYSTEM	APPLICATIONS
MYCIN	Diagnosing bacterial infections and prescribing treatments for them.
Dendral	To identify the chemical structure of a substance from its mass-spectrogram.
CATS-1 (Computer assisted Troubleshooting system)	For troubleshooting and diagnosis of malfunctioning diesel locomotive engines.
VM (Ventilator Manager)	To aid in monitoring patients immediately after cardiac surgery.
R1/XCon	To configure and design VAX^{tm} minicomputers at Digital Equipment Corporation (DEC).
Guidon	To teach medical students about infections diseases.
The Prototype Corporate Loan Evaluation System	To assist bank managers & corporate lending advisory staff in the lending decision.
The Expert Fund-Raising System: The General Business Plan Expert System (GBP)	To provide cost-efficient expert advise in the business planning process.
The Expert Approach to Market Planning: The Strategic Market Planner Expert System (SMARTPLAN)	To assist marketing managers in developing 'wiser' marketing plans.
The Marketing Audit Model (MAUD)	To provide a structured and dynamic framework for carrying out a marketing audit of any type of organisation.
The Mergers and Acquisitions Model (MAC)	To guide the user through the critical issues that need to be considered when contemplating the merger and acquisition route to company development.
The Cash Management Tool (CASHMAN)	To assist the user in improving his cash flow and liquidity management.
ANSWERMAN	To refers users to reference books likely to contain the answer to queries in the area of agriculture both on online databases of bibliographic citations and full-text files that can provide answers to queries rather than just references.
Reuters' TIS (Topic Identification System)	It automatically indexes news stories for input to the Country Reports and Textline database products.
EURISKO	To facilitate information access to on-line databases by unskilled users; and to relieve skilled intermediaries of the need for detailed technical knowledge of unfamiliar databases.
RESEARCHER	To analyses patent abstracts; to searches for similarities between different patents; to answers questions, including questions requiring the use of information derived from more than any single abstract; to customises its answers for different types of enquirer.
TOME.SEARCHER	To perform the online searching activities by taking a user's natural language request and translates it into a Boolean search formulation.

(Sources: Beerel 1993,222-248; Parsaye et al 1988,16,313-23; Ford 1991,115-218).

There is also an expert system developed for tourism application in the academic area. It was developed by Kanchanosatha Vinita in 1990 for his MSc. degree at New York Institute of Technology. The system advises tourists planning to visit Thailand.

3.9 HYPERTEXT/HYPERMEDIA SYSTEM: HISTORICAL BACKGROUND

In the research of hypertext and its application, three prominent persons are always cited in different books or journals. These are: Vannever Bush, Douglas Engelbart and Ted Nelson.

3.9.1 Vannever Bush (1945)

Vannever Bush was the science advisor of US President Roosevelt and overseer of all wartime research, including the Manhattan Projects, envisioned, yet never created, and the mechanism (Fiderio 1988). This man was the first to set a foundation for all hypertext systems. In 1945, he developed an idea to change the linear way of the text to multidimensional text. Extrapolating from the technology of his time, Bush described a new kind of devise which was a sort of mechanised file and library. He called it a **memex**. A memex is a device in which an individual stores all his books, record, and communications, and which is mechanised so that it may be consulted with exceeding speed & flexibility (Rayward 1994). At that time it was difficult for him to implement his idea fully because of the insufficiency of the technology of that era. He used microfilm and photocells to store the data.

3.9.2 Douglas Engelbart (1963)

The first researcher influenced by Bush's concepts of associative links and browsing was Douglas Engelbart. His research in the early 1960's centred around using computers to augment human intellect. At that time, he began developing the oN-Line System (NLS) now called **Augment** (Fiderio 1988).

Augment is an on-line work environment. In its original form, it served as a storage receptacle for memos, research notes and documentation; as a communication network, since on-line conferencing was possible; and as a shared work space where researchers could plan and design projects.

Augment stores information in a sophisticated hierarchical structure allowing non hierarchical branching. Since speed was important, Engelbart invented the mouse as an input device. He also came up with the concept of viewing filters. Via filters, it is possible to view a shortened version of the statement or file, which allows to move quickly through a hypertext database, scanning for only pertinent data (Fiderio 1988).

3.9.3 Ted Nelson (1965)

Another prominent person who took Bush's concept a step further just immediately after Douglas Engelbart is Ted Nelson. Nelson envisions hypertext as an on-line network holding the world's literary treasures under one roof (Fiderio 1988). **Xanadu** is his version of the publishing utility of the future. It is the most well known hypertext system. It was Ted Nelson who originally coined the word hypertext to mean non sequential writing (Fiderio, 1988). Xanadu is

supposed to expand the publishing environment that millions of people could use to create, interact & interconnect with linked electronic documents and other forms of hypermedia, such as movies, audio, and graphics. It is designed to run in parallel on many networks of servers.

Xanadu documents consist of native bytes, the original document and inclusions, information originally found in other documents, and hidden pointers. Links are attached to bytes. It is possible to ask the system to know where the bytes came from, and is also possible to see them in their original form. Xanadu is more than just an online reference system. It is also an interactive writing and conferencing environment.

3.10 DEFINITIONS OF HYPERTEXT AND HYPERMEDIA SYSTEMS

Both hypertext and hypermedia use the same principle and components. In many books they are being described interchangeably. In the discussion of hypertext and hypermedia, two main concepts are involved. These are macrotext/macromedia and microtext/micromedia. The former involves broad-based, networked systems involving many users and documents and document types. But the latter is highly focused and is concerned with a single system or document base (Rayward 1994).

Hypertext is a system to manage a collection of textual information that can be accessed nonsequentially. It consists of a network of nodes and logical links between nodes. The variety of nodes and links that can be defined make hypertext a very flexible structure in which information

is provided both by what is stored in each node and by the way the information nodes are linked to each other (Lucarella et al 1993).

Hypermedia has similar meaning with that of hypertext except that in the case of hypermedia the addition of dimension is not only involved on the text as that of the hypertext but also for images and audio. That means hypermedia is an outgrowth of a hypertext. Five major categories of media can be incorporated into a hypermedia application (Berk et al 1991,19) - text, still pictures, moving pictures, sound and other computer programs. .

Hypermedia systems optimise the user-machine interaction by maximising the human cognition process. Information in various forms such as audio, image, and text stimulate multiple perception channels and increase human attention (Ozkarahai, 1995).

In the hypermedia system, the user query to retrieve image or audio can not be performed alone unless it is linked with textual nodes. That means the non-textual nodes should be linked on paths to textual nodes so as to be able to browse upon the users query. Hence hypermedia design requires both hypertext design and multimedia design (Berk et al 1991,67).

Hypermedia is not exactly the same as that of multimedia. This is so because not all multimedia approaches support the kind of linking structures that a hypermedia system has. Hypermedia differs from multimedia on the basis of the depth and richness of information available, and the fact that the user is in control of that information in a hypermedia environment. Generally it can be said that multimedia is a superset of hypermedia and other interactive technology approaches (Hutchings et al 1994).

3.11 ARCHITECTURE OF HYPERTEXT/HYPERMEDIA SYSTEM

3.11.1 Nodes

The fundamental unit of information in a hypertext/hypermedia document is called a node. It is a small portion of the document which covers one concept. A node may fit on a single screen or it can be as small as a word or as large as a whole book. A node could be text display, graphic display, videotape or video disk segment, animated graphics, recorded speech, digitised speech, music, and so on.

The size of nodes is an important design consideration in hypertext/hypermedia system. A given corpus of information can be divided into either a large number of small chunks or a small number of large chunks. The term used to identify this issue is called granularity. Hypermedia structures with a large number of small chunks are called fine-grained; structures with very few large nodes are called coarse-grained. A large number of small nodes can cause disorientation problems. On the other hand, a small number of large nodes can lead to specificity problems when indexing or retrieval tools are used. An optimum size for textual chunks would seem to be about two or three paragraphs (Barker 1993,74).

3.12.2 Links

Link is one part in a hypertext/hypermedia system which is used to interconnect individual nodes and represent the relationships between the nodes. These relationships between nodes can change the type of the hypertext/hypermedia system based on the types of links connecting them.

For a good hypertext/hypermedia programming, links must have two qualities (Frisse 1988): there must be a way to be able to trace or follow them, and secondly they must be able to transport the user quickly from one node to another. Usually one or two keystrokes or the tap of a mouse button is all one needs to transport from one node to the next. The total time required to traverse a link is small, usually only a second or less.

There are about four kinds of link types based on their structure (Frisse 1988; Patterson et al 1994):

i) Node-linked

Here information in any node can be accessed from any other node. The drawback of such a structure is the potential for users to become disoriented or "lost in hyperspace."

ii) Sequential link

The nodes are linked sequentially one after the other. Long essays, for instance, require a sequential ordering.

iii) Structured link

It represents an attempt to present conceptually consistent information more systematically, while still allowing for exploration of related concepts. Nodes of related ideas are presented in groups or sets.

iv) Hierarchical link

Here nodes of general concepts lead to nodes of related and increasingly detailed information.

3.12.3 Buttons

Buttons are the vehicles which activate links. They are a link inserted in the text, highlighted in some manner on the screen, usually in contrast, thus allowing the user to position himself with the cursor in such a way that with one keystroke he can connect with associated nodes. In other words, a button is a visual link in a node (Cornejo 1994,47).

3.12.4 Browsing and Navigation Tools

One of the major problems with hypertext/hypermedia programs is disorientation. It may become difficult for the user to visualise how the information is linked together, and to keep track of where they are. To minimise these problems, there are various navigational tools used: maps, commands, and contents lists & indexes.

Maps are a graphical representation of the links among different nodes (Vernoll 1993). The existence of a map that indicates where one is in the hypertext becomes more and more necessary as the hypertext becomes more complex both in terms of the number of nodes and the density of links (Parsaye et al 1989,271).

The use of commands requires that the user types some specifications as an argument to the command but for many users that is not a large cognitive overhead. In the case of contents lists

and indexes the names of different sections can be displayed as a list organised alphabetically or according to some meaningful scheme. Selecting one of these names causes the relevant section to be displayed. An alphabetical list corresponds to the index in a book except that the mapping between index items and hypertext sections is one to one. A list organised in some other way corresponds to a contents page in a book. However, such devices are only appropriate for directed nomination in small hypertexts. For large hypertexts a search or goto command may be easier to use, even though it involves typing (McAleese et al 1990,22).

3.13 APPLICATIONS IN INFORMATION RETRIEVAL

Hypertext or hypermedia provides a way of representing and managing information in a flexible & non-linear way that is appropriate for many multimedia applications. Instead of passively watching a program on mammals for example, the user can choose his or her own route through the material provided (Jeffcoate 1995).

Hypertext and hypermedia systems vary significantly, depending on the applications and users they address. They are designed for either single user or multi user applications and are most commonly run on workstations, although more and more microcomputer applications are becoming available.

There are about four types of hypertext/hypermedia systems (Fiderio 1988): Problem-resolution systems, Browsing systems, Library or literary-exchange systems, and multi-purpose systems.

3.13.1 Problem-Resolution Systems

Systems designed primarily for problem resolution and network creation feature tools that are used to define and analyse data through structured types of links and nodes. These systems are used to organise elements in unstructured problems and feature commands that permits to create and modify internal links between concepts quickly.

Most importantly, the tools can usually suppress details through viewing filters similar to those in Douglas Engelbart's oN-Line System (NLS) (Fiderio 1988). Such products might be used for systems analysis, idea processing, authoring new applications. Augment and gIBIS (Graphical Issue-Based Information System) are examples of systems designed to be problem-resolution work environments.

3.13.2 Browsing

Hypertext/hypermedia systems created primarily for browsing have fewer user tools for editing or link creation. These systems feature clear, understandable screen displays for presenting information and easy-to-operate browsing commands for perusing it. For example, one of the hypertext systems-Document Examiner, features a clear, book-like user interface and heuristic online string and keyword searches. These features are used to browse through the documentation, sometimes viewing information in several levels of detail.

Another example of these kind of hypertext/hypermedia system is KMS (Knowledge Management System). It uses frames instead of nodes; frames are connected by two kinds of links, hierarchical and cross-referential. To navigate through a network, frames are formatted

with a name, a title, a body, tree items linked to lower-level links, and special command items. CD-ROM is also well suited to store large databases for hypertext/hypermedia browsing systems.

3.13.3 On-Line Libraries

Systems envisioned to support huge on-line libraries, documents, and document creation and critiquing, such as Ted Nelson's Xanadu, are the third major application group of current hypertext/hypermedia systems (Fiderio, 1988). These systems will probably feature complex, multiple structured back-ends, or databases, that can store everything from collaborative notes and research to E-mail, documents, and whole libraries.

These systems are not easy to implement because of the complexity and size of the task. Before such systems are implemented, a standard user interface and a central storage system must be developed. In addition, a network must be maintained in such a way that all links are legitimate, copyrights and royalty issues are addressed, and the systems are fast enough to meet the needs of the general public.

3.13.4 Multi-Purpose Systems

Several well known hypertext/hypermedia products function as general-purpose systems (Fiderio 1988). It is possible to customise these products to fit to the particular application or simply to experiment with hypertext or hypermedia itself. NoteCards, HyperCard, and Guide are three such systems.

3.14 EXPERT HYPERMEDIA SYSTEM

The two systems, expert and hypermedia systems, can be combined together to improve their performances for a particular application.

As has been mentioned in Chapter One section 1.2, the integration of these two systems can be designed in two ways: one is to improve the performance and functionality of hypermedia systems, and the other to use hypertext and hypermedia methods to improve the quality of the expert system.

As it is shown in the diagram below, expert system can be used as an interface to the hypermedia system by representing a particular user's interest in a series of profiles. These are formed by bringing together a collection of rules that describe his or her specific information interests. The rules from which the profiles are constructed form an expert system definition which can be used to guide its owner towards particular sections of a hypermedia knowledge corpus that might be most useful in the context of the problem currently being addressed.

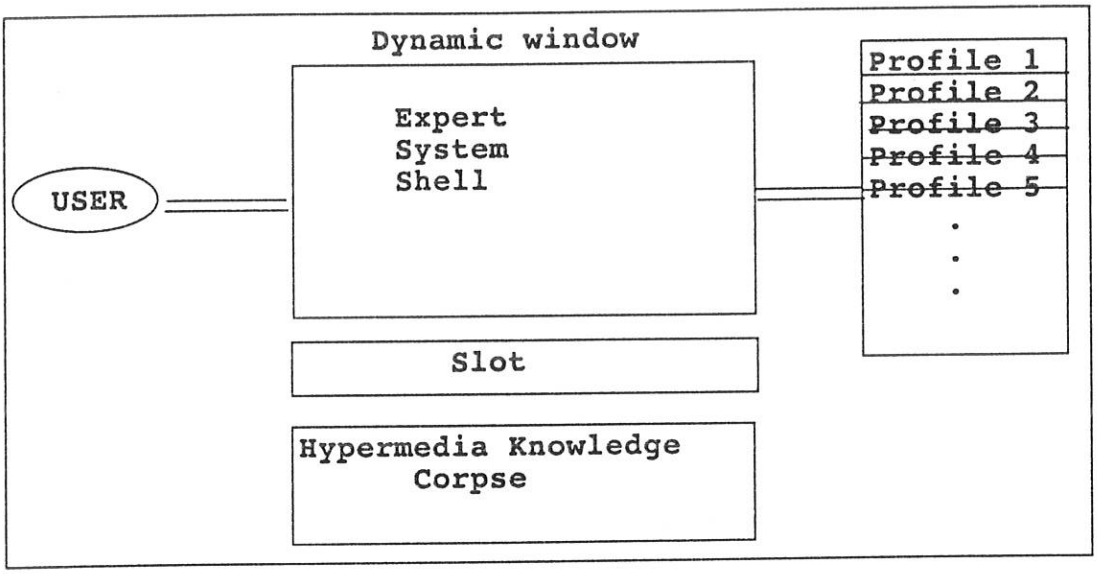


Figure 3.2 Use of an Expert System for Hypermedia profiling

(Source: Barker 1993,176)

To develop an expert hypermedia system various programming languages can be used. One of the programming shells called KnowledgePro is very much suitable to develop an expert hypermedia system. KnowledgePro was used to develop a hypertext expert system for use by aquaculture researchers. It's called Regis and was developed by NAL, the U.S National Agricultural Library, a division of the U.S. Department of Agriculture. Hypertext is combined with the expert system so that users can branch off to get clarifications of key terms when needed (Seyer 1991,135-6). That means the performance of the expert system is strengthened by integrating it with the hypertext system for further explanation.

CHAPTER 4

KNOWLEDGE ACQUISITION FOR THE TOURISM INFORMATION SYSTEM

4.1 INTRODUCTION

One of the stages in the life cycle of ES, as mentioned in Chapter Three; Section 3.4, is knowledge acquisition process. Knowledge acquisition is the general name given to the process of eliciting, acquiring, and representing knowledge consisting of descriptions, relationships, and procedures in a specialized domain of interest (Hengi-Li Yang 1995). Its major functions are to extract knowledge from expert(s), and analyze and formalize the knowledge into some computer understandable forms. It should appropriately represent the knowledge structure to conceptualize the mental model(s) or expert(s) and facilitate inference and explanation capabilities.

The knowledge acquisition process has three stages (Pedersen 1989,164-5):

1. Explanation;
2. Capture; and
3. Organization.

Explanation: It begins with invitation to the expert to explain some aspect of his or her problem-solving behavior. This request asks the expert to translate some experientially acquired knowledge into language. For this study

explanation was carried out by conducting several interviews and discussions with the experts.

Capture: This stage refers to the process of documenting the objects, relations, and actions that make up the knowledge. The capturing stage for the knowledge acquisition of tourism information system in Ethiopia will be discussed shortly in this chapter.

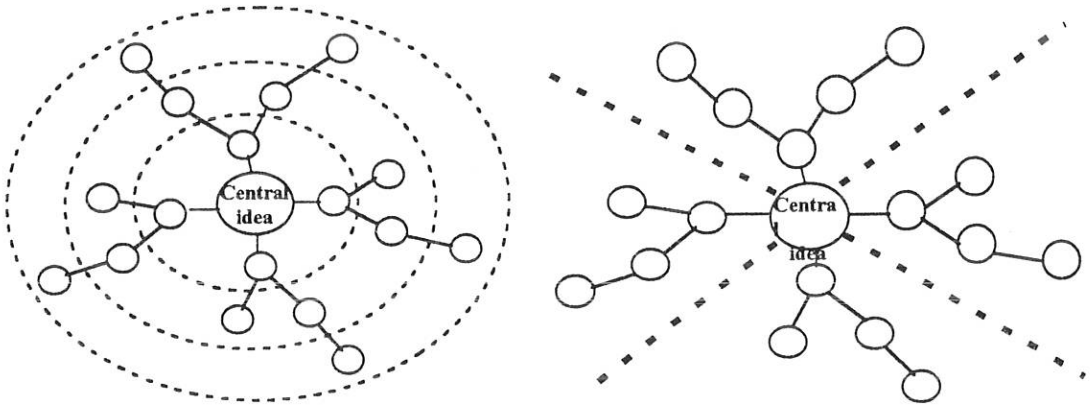
Organization: This stage refers to the process of ordering that knowledge in such a form that it is ready for mapping to rules. This stage for the knowledge acquisition of tourism information system of Ethiopia will be discussed in the next chapter.

4.2 APPROACHES IN ACQUIRING KNOWLEDGE

In the knowledge acquisition process, various methods - interview, discussions, written documents and other related methods were used. Out of these methods interviews and planned discussions with the experts share the highest portion of the time in acquiring knowledge.

As mentioned by Beerel (1993,161), there are two approaches to acquire knowledge while using interviews and discussions. The first is working clock-wise around the central idea, progressively moving outwards towards the more detailed ideas at the edge of the map (See Figure 4.1 a). The second one starts from the central idea and proceeds segment by segment until the final goal is attained (See Figure 4.1 b). This approach is more suitable than the first one because it permits the expert to concentrate on the specific portion of the

knowledge and explain to the knowledge engineer how he or she solves the problem in the domain. For this study the second approach was preferred as a tool to acquire the knowledge of tourist guide.



a) Working outwards **b) Working in segments**

Figure 4.1 Spider web-like representation of the acquired knowledge.

(Source: Beerel 1993,161).

4.3 CAPTURING THE KNOWLEDGE OF A TOURIST GUIDE

While conducting interviews and planned discussions with the expert, each segment of the knowledge was analyzed and documented in a **hierarchical model**. As described by Parsaye and Chignell (1988,37), hierarchies are often used in representing and organizing knowledge in terms of related concepts. Each concept in the hierarchy is related to a higher-level concept, called its parents. The advantage of using hierarchies is that they allow to organize concepts and to express knowledge in a more compact manner. Anything valid for a higher-level concept is generally assumed valid for lower-level versions of that concept.

This avoids the need for repetition in storing information that is actually shared among a related class of concepts.

In relation to the hierarchical representation of data, Sumner (1995) describes the measure of similarities in the clusturing (group) using Dices's coefficient, S_{ij}, as:

$$S_{ij} = \frac{2 / I \, n \, J /}{/I/ + / J/}$$

where / I n J / represents the number of references that documents i and j have in common. S_{ij} ranges from zero to one, with $S_{ij} = 1$ indicating that the reference representations of the two documents are identical and $S_{ij} = 0$ indicating that they are completely different.

Using the above Dice's coefficient, Sumner concluded that as we move down to the hierarchies, the similarity threshold (TS) among the clusters increases (Figure 4.2). That means as TS decreases an increasing number of documents are joined to each cluster, and previously distinct clusters can be connected together.

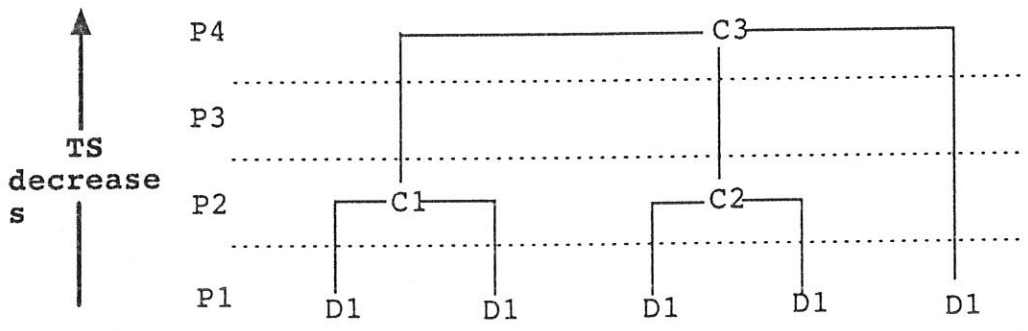


Figure 4.2 A hierarchy and partition (P1 - P4) for documents (D1 - D5) in clusters (C1 - C3).

A similar logic had been used for the knowledge acquisition of an expert system for tourism information system. Starting from the central idea (where the similarity threshold is minimum), clusters having loosened relationships was segregated and placed to the next lower level (partition) forming other clusters and these clusters in turn formed into pieces of clusters until the final tourist destinations reached (or until the similarity threshold raised to maximum).

In this study concepts in the hierarchies are shown inside the elliptical shape whereas the places or destinations to be visited by the tourists are shown inside the boxes. The central idea to begin the process of acquiring knowledge was ***making a tour*** as shown in the figure below (Figure 4.3). The choices to make a tour are two: Sightseeing and Safari tour. The segment analysis of these two will be discussed in the subsequent sections.

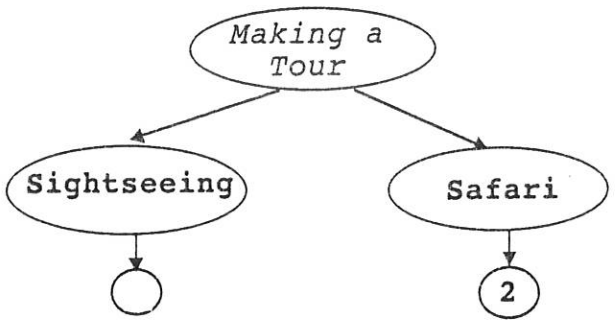


Figure 4.3 Central idea of the acquired knowledge

4.3.1 Sightseeing visit

The portion of the central idea that contains sightseeing visit is the type of tour activity made by tourists by perceiving tourist sites. These sites could be historical, natural, cultural and education & business tour (See Figure 4.4).

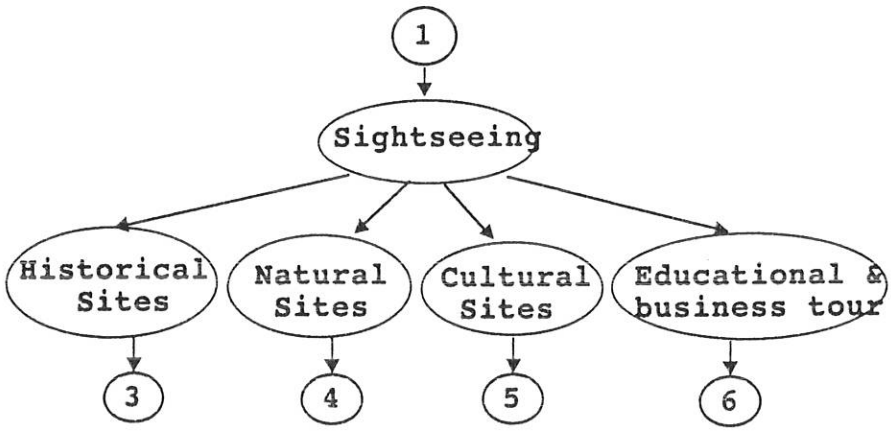


Figure 4.4 Components of sightseeing visit

4.3.1.1 Historical sites

Ethiopia, being well rich in its ancient history, has numerous historical sites. History about the ancient Ethiopian's capital city which consists of history before and after medieval period (i.e. 17th century), and religion history about both Christian and Muslim religion, are the two main parts of this segment.

As it is shown on Figure 4.5, the ancient Ethiopian's capital city before medieval period were Axum, Lalibela and Gorgora, and after 17th century Gonder, Mekelle and Addis

Ababa were also the capital city for Ethiopia where the last one is still a capital city for the country.

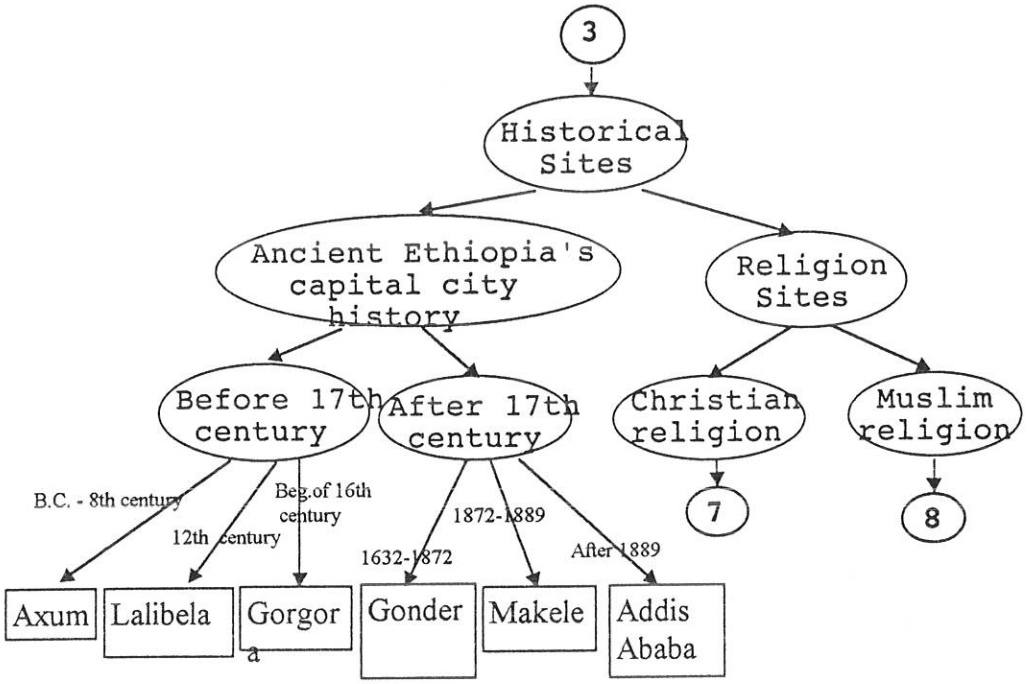


Figure 4.5 Components of Historical Sites

The further hierarchical representation of Christian and Muslim religion is depicted on Figure 4.6 and Figure 4.8 respectively.

Ababa were also the capital city for Ethiopia where the last one is still a capital city for the country.

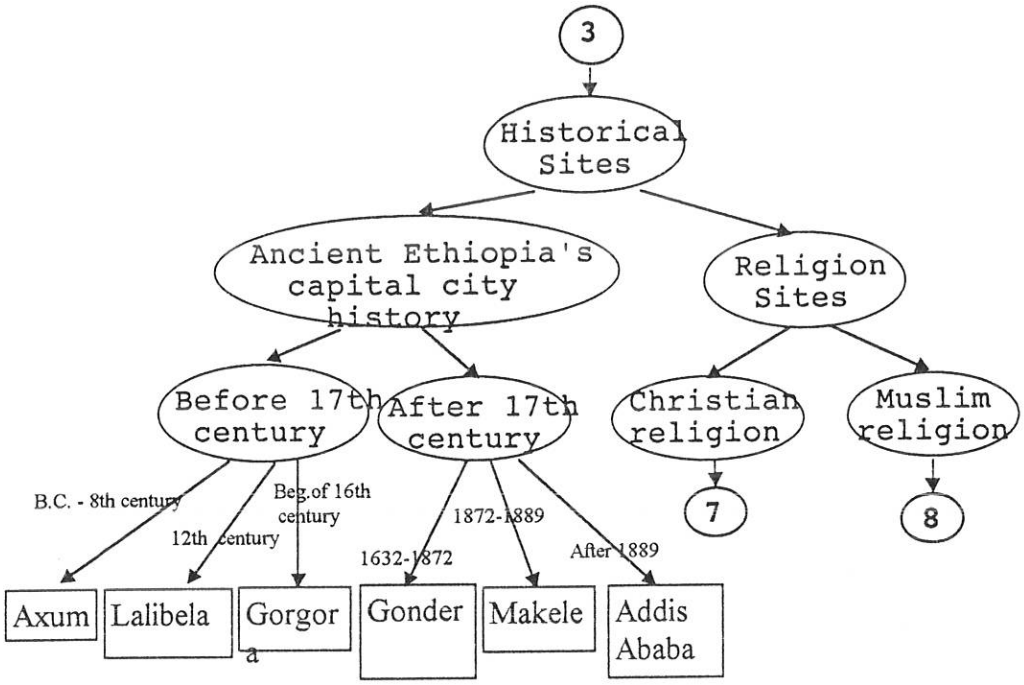


Figure 4.5 Components of Historical Sites

The further hierarchical representation of Christian and Muslim religion is depicted on Figure 4.6 and Figure 4.8 respectively.

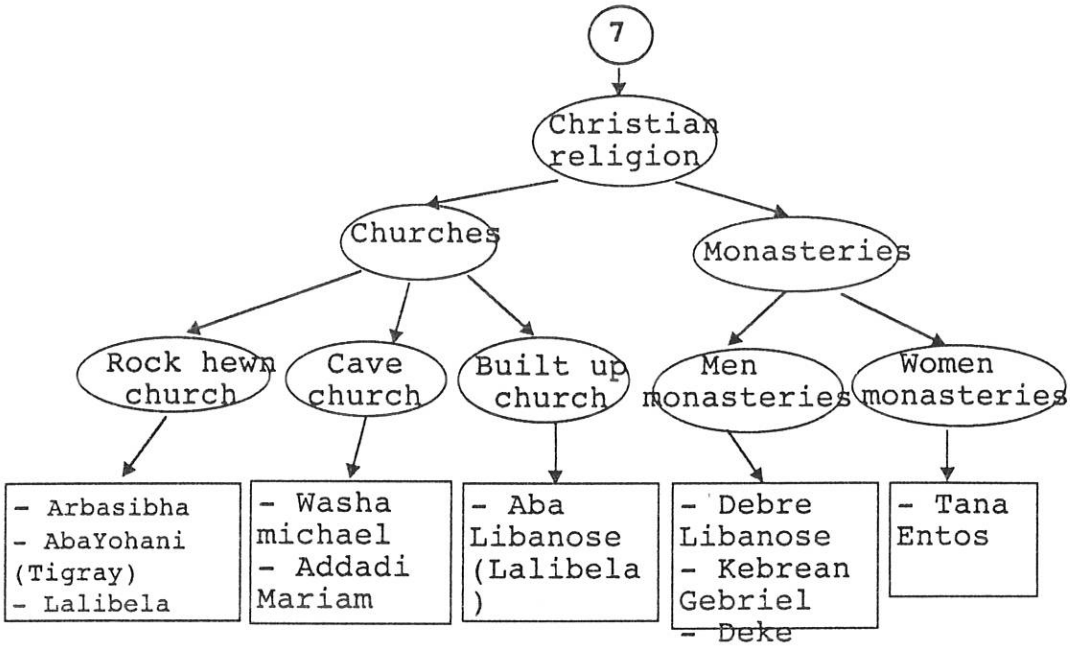


Figure 4.6 Captured knowledge for the religion history of Ethiopia

The possible interest of tourists to know about the Ethiopian Christian religion history are types of churches' buildings and monasteries. Here, as it can be seen from the figure above, for one type of churches or monasteries there are different choices. For instance, for the rock hewn churches those found in Tigray and Wollo are suggested. However, in respect of the tourist interest from the location (distance), weather condition and so on, they are different and have to be further processed in the development of the system to get the unique tourist sites which is more preferable by the tourist based on his/her interest as shown in the following figure.

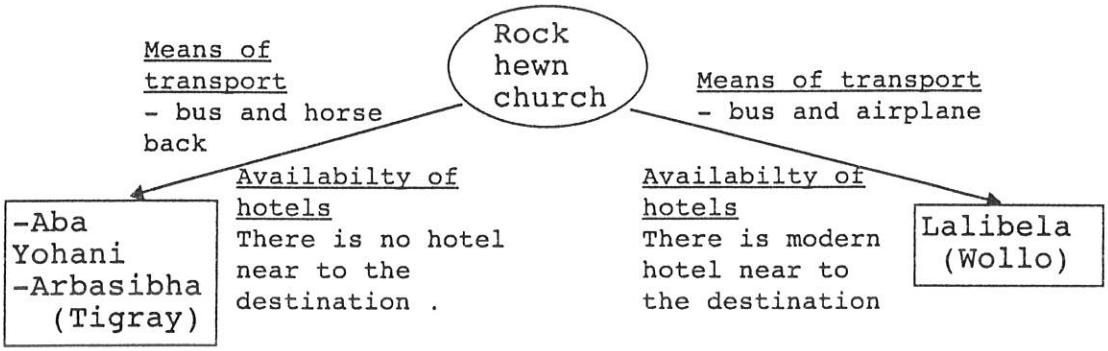


Figure 4.7 Dissimilar properties for various rock hewn church destinations

For the Muslim religion, the area of interest for the tourists are about mosques, shrines and tombs as shown in Figure 4.8.

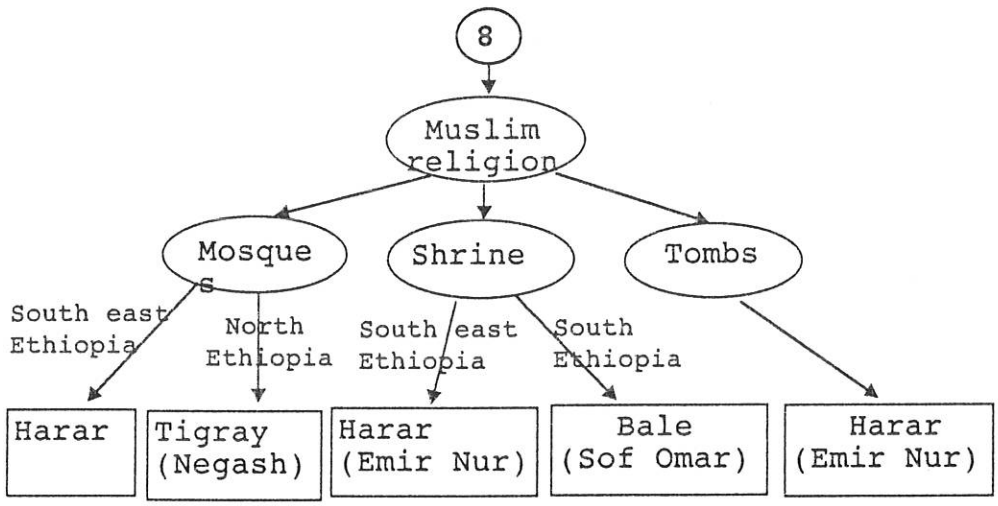


Figure 4.8 Knowledge captured about the Muslim religion of Ethiopia

4.3.1.2 Natural sites

The natural sites found in Ethiopia constitute two types of sites: Topography, and Fauna & Flora (See Figure 4.9).

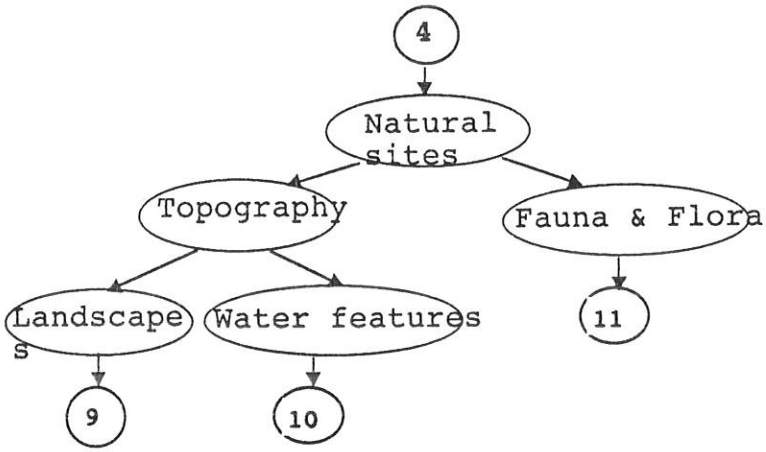


Figure 4.9 Components of Natural sites

The topography describes the landscapes and water features of the country. The type and place of these tourist sites are depicted in Figure 4.10 and 4.11 using the hierarchical model.

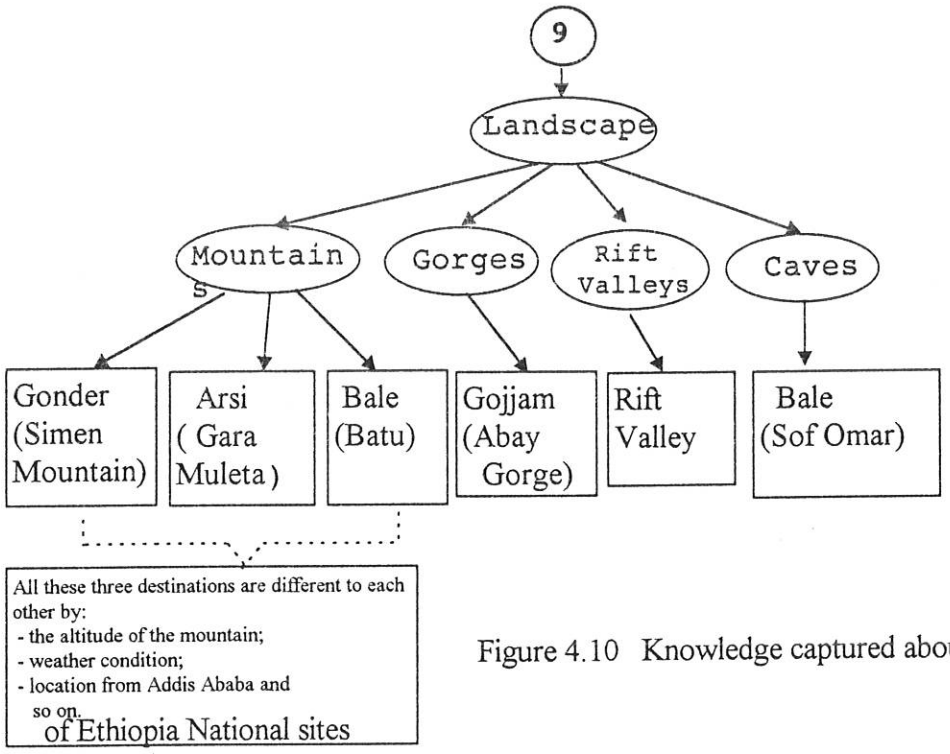


Figure 4.10 Knowledge captured about the Landscape

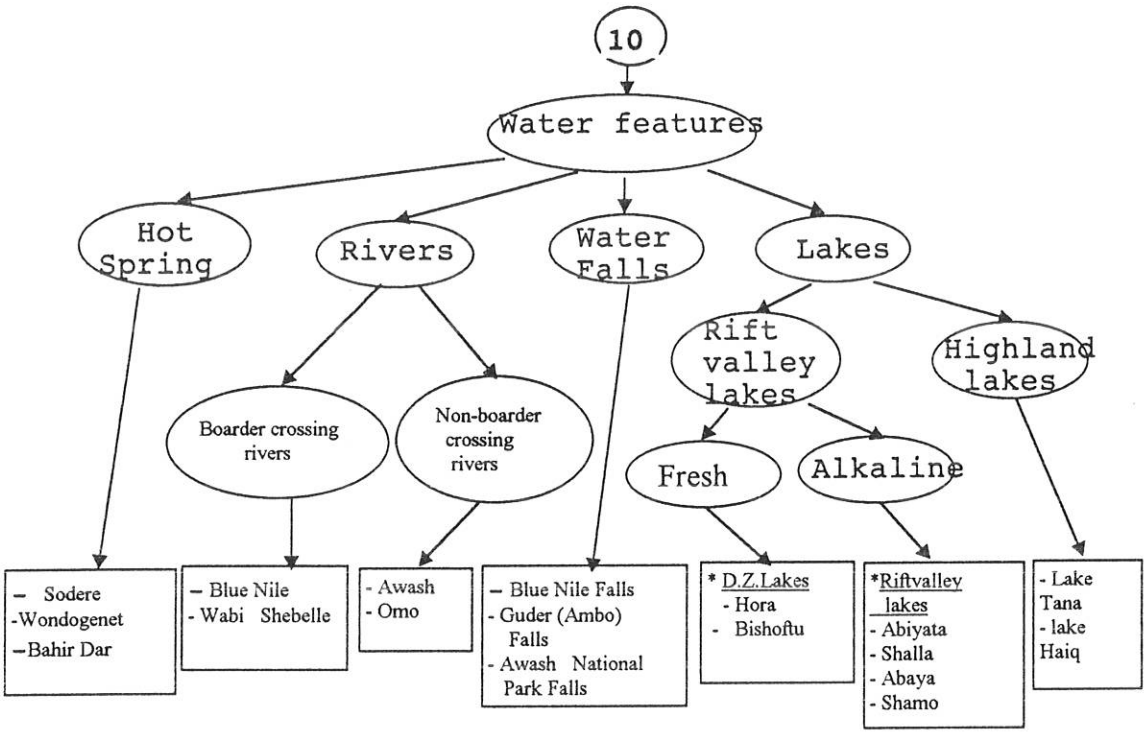


Figure 4.11 Knowledge captured about the Water features of Ethiopia Natural sites

The concept for the natural sites of fauna and flora are captured as shown in figure 4.12 below. In Ethiopia there are about 7 endemic animals, 28 endemic birds and thousands of endemic plants. All these endemic fauna and flora are usually concentrated in the regions where natural forests are found i.e. south and south east of the country except some of the endemic animals found on Simien Mountain located on the north part of the country (Gonder).

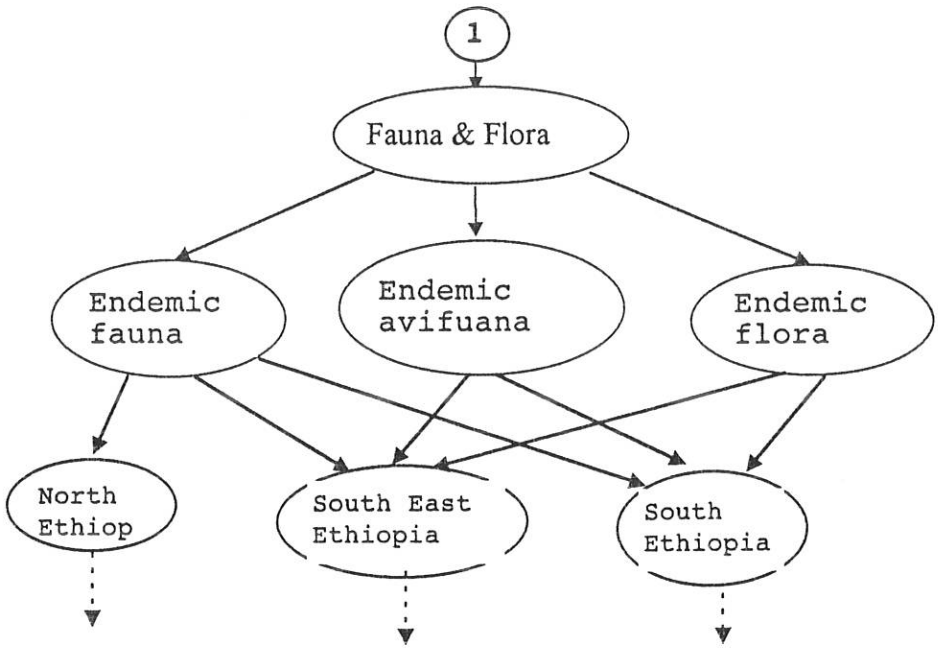


Figure 4.12 Knowledge captured for Fauna and Flora of Natural sites

4.3.1.3 Cultural sites

Ethiopia, having more than 80 different ethnic groups, owns a diverse type of culture. The economic activity, life-style and religion of the people are the core concepts that are drawn by the experts to show the cultural sites found in the country. The following diagrams (i.e. Fig. 4.13 up to Fig. 4.19) show how the knowledge is captured from the experts.

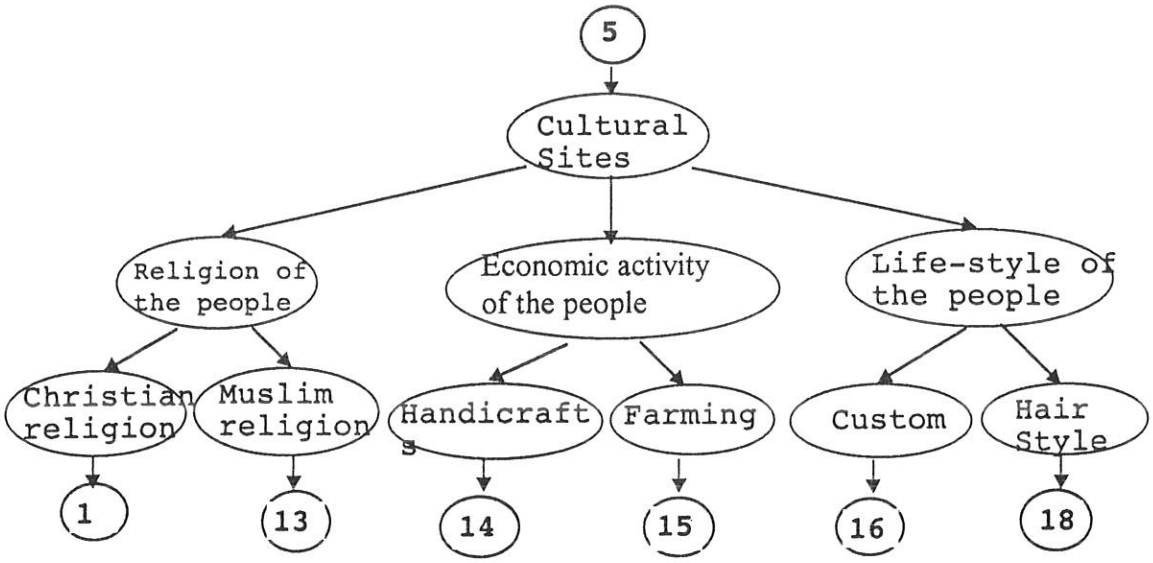


Figure 4.13 Knowledge captured for Cultural sites

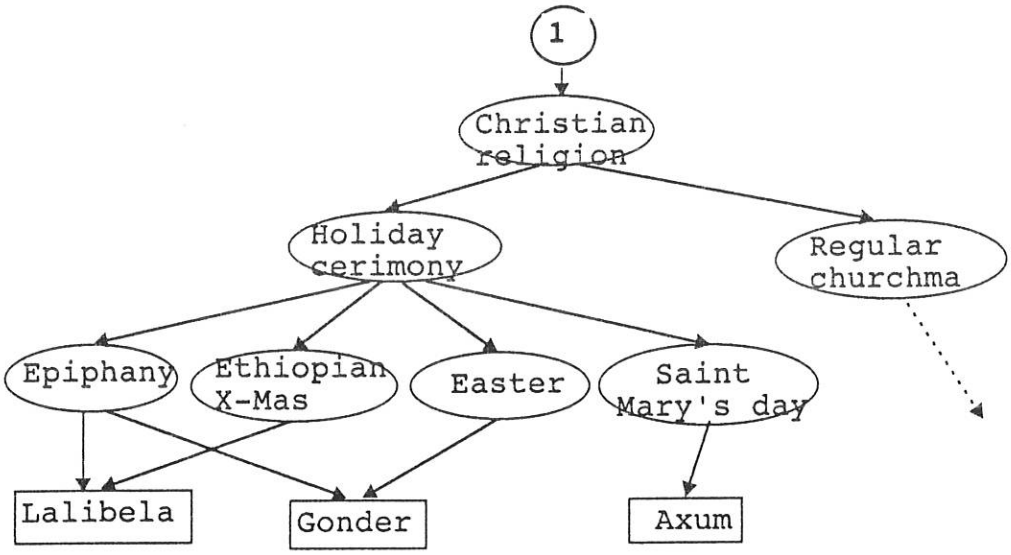


Figure 4.14 Knowledge captured for the Culture of Christian Religion

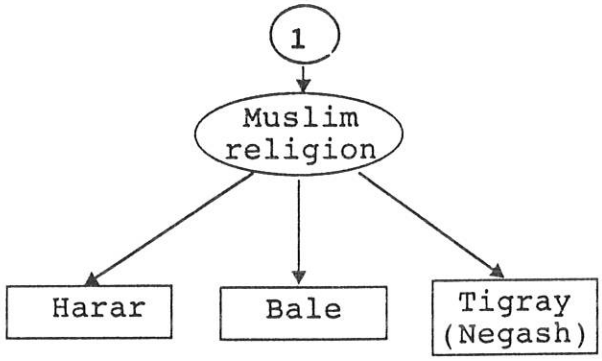


Figure 4.15 Knowledge captured for the Culture of Muslim Religion

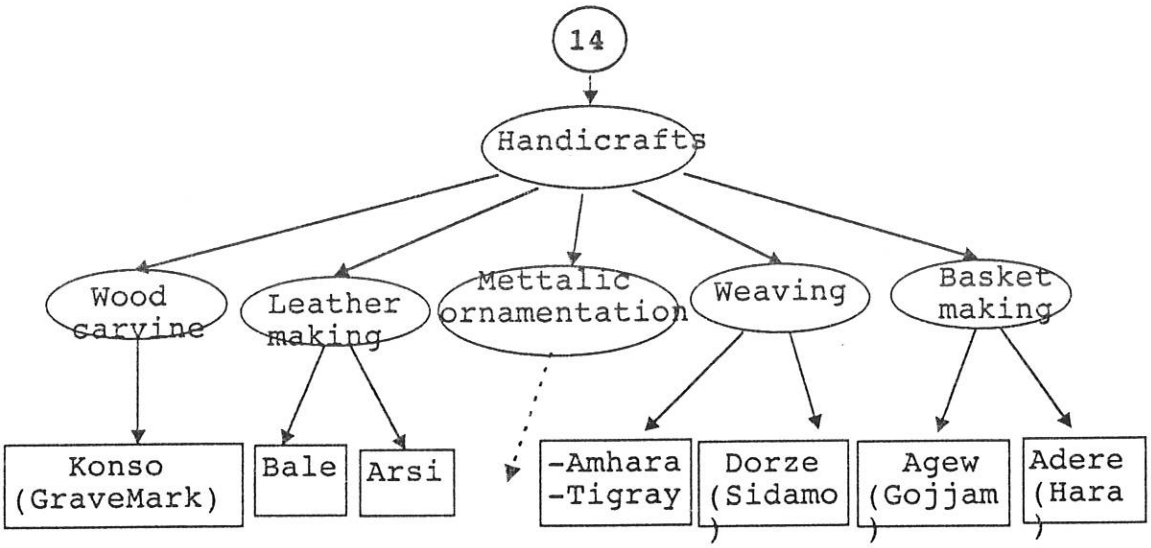


Figure 4.16 Knowledge captured for the Handcrafts activity

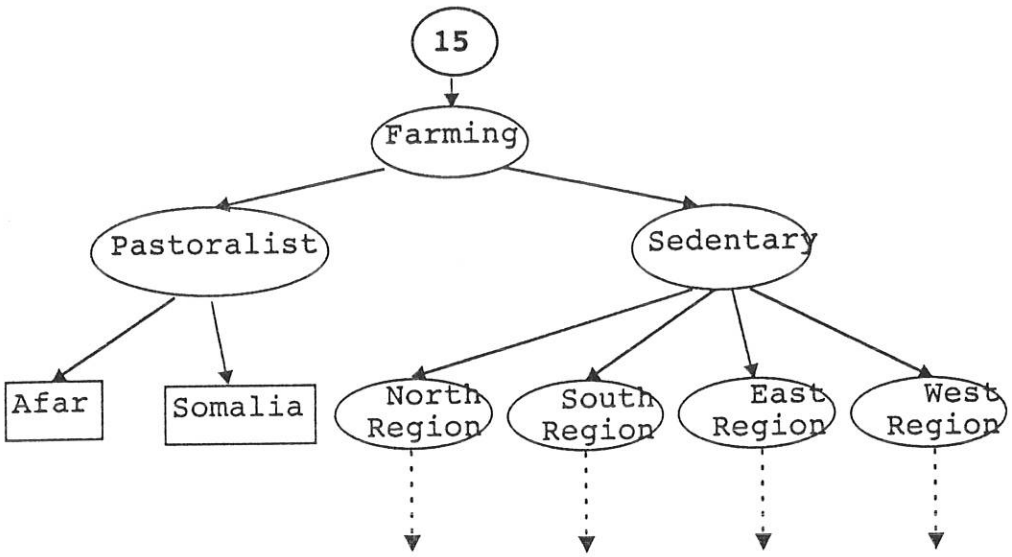


Figure 4.17 Knowledge captured for Farming activity

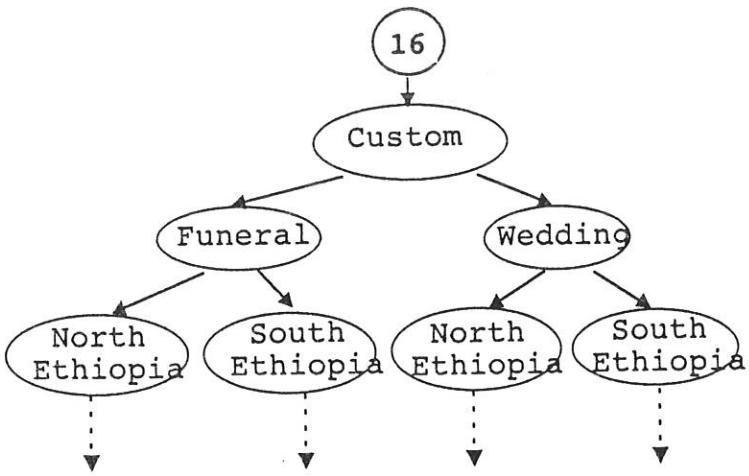


Figure 4.18 Knowledge captured for the Customs of the people

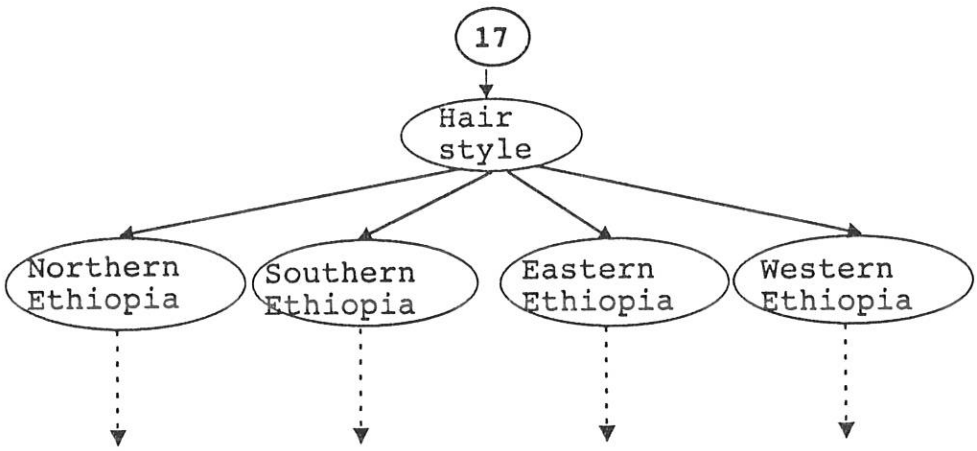


Figure 4.19 Knowledge captured for the Hair style of the people

4.3.1.4 Education and Business tour

The discovery of the oldest man kind skeleton called Lucy at Danakel Depression, the availability of some peculiar animals, birds, plants and other related tourist sites made tourists to come to Ethiopia for academic research (educational purpose). No less tourists are coming to the country for business activity especially after the free market economy policy the country follows lately. To facilitate the interest of tourists in this regard, the knowledge of the experts was captured as depicted on Figure 4.20.

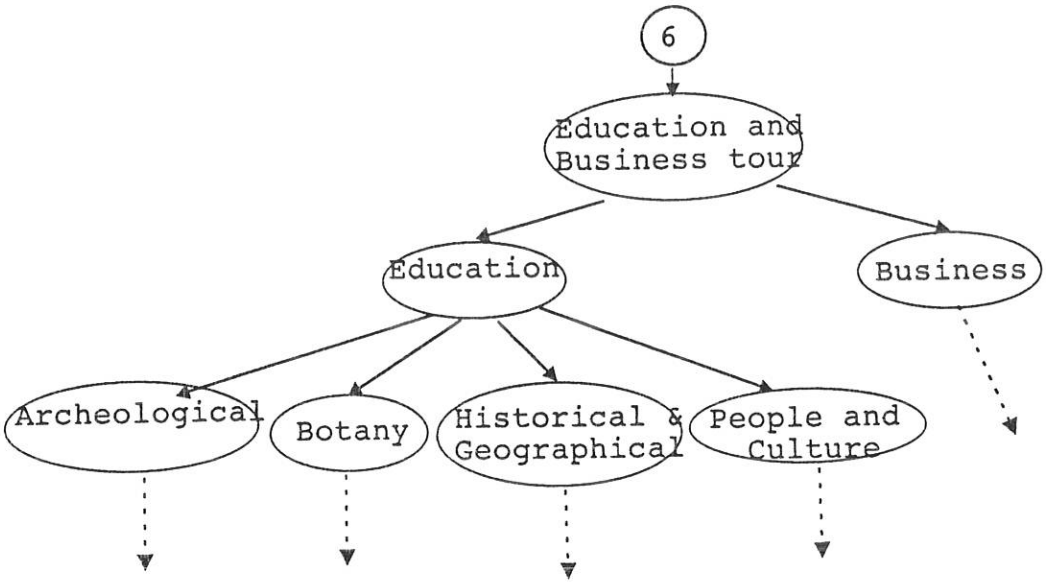


Figure 4.20 Knowledge captured for the Educational and Business Tour

4.3.2 Safari Tour

The other segment of the central idea i.e. making a tour is Safari Tour. Safari tour differs from that of sightseeing because it needs physical exercise or participation of tourists unlike that of sightseeing. Ethiopia receives tourists from abroad to make safari tour in different activities. Those are photo safari, hunting safari, trekking safari, fishing safari and roughting safari as shown in Figure 4.21 below.

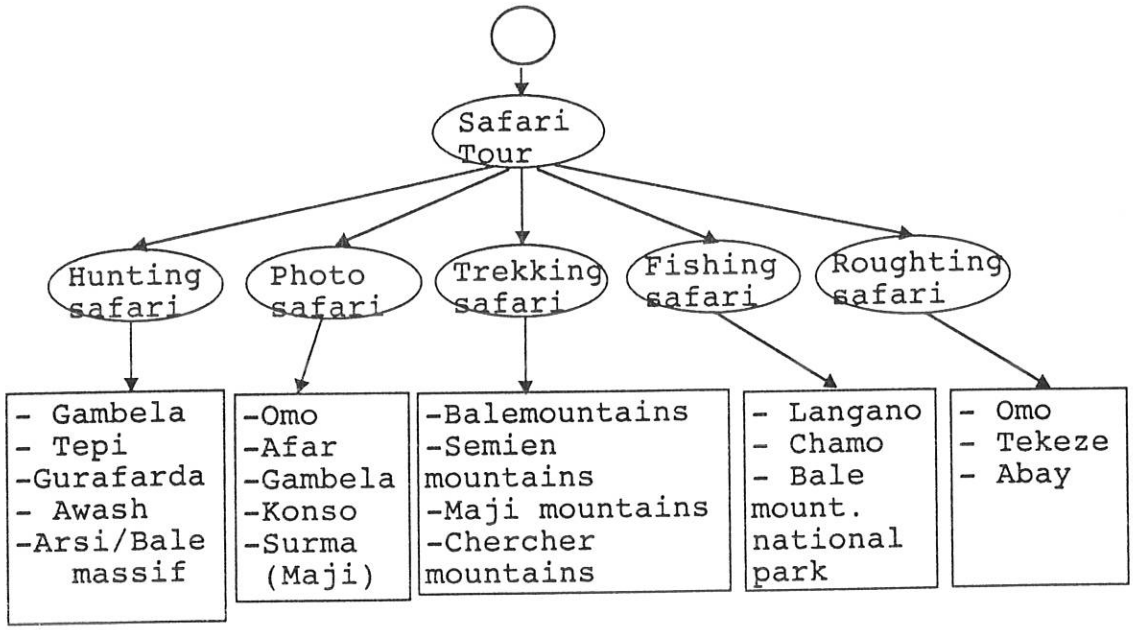


Figure 4.21 The representation of acquired knowledge for Safari Tour

Here in each type of safari tour there are various choices suggested for tourists. However, unlike that of decision support system, an expert system should select a unique tourist sites among the choices based on the interest of tourist that were raised during the dialog made with the computer. To do this all the dissimilar properties among these destinations for a specific safari tour have to be further clustered in the next lower level to get the higher similarity threshold as shown on the following Figure, taking hunting safari as a case.

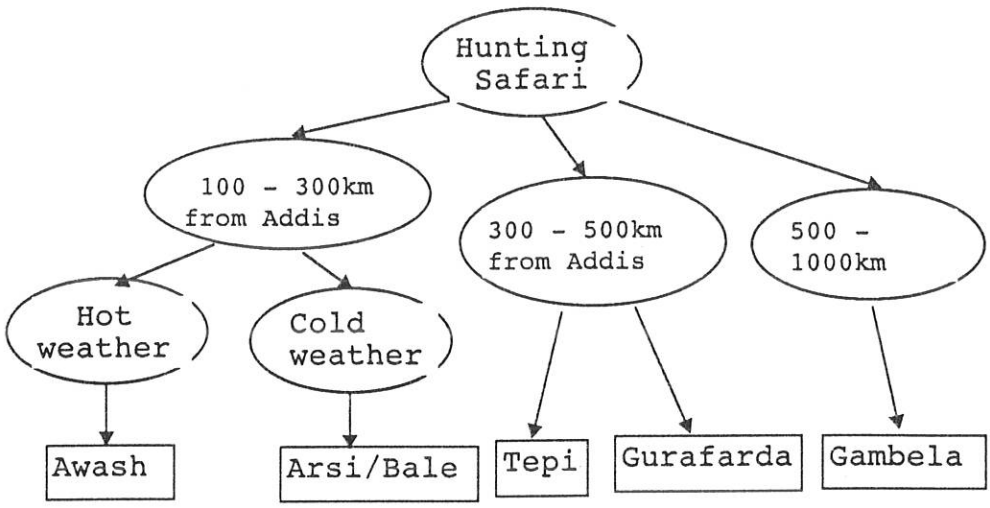


Figure 4.22 Further clustering of destinations for Hunting Safari

Analogously, for the other type of the safari tour the alternatives (choices) suggested above can be further clustered into lower level groups until we get a unique destinations.

CHAPTER FIVE

DEVELOPMENT OF THE PROTOTYPE INTEGRATED EXPERT AND HYPERMEDIA SYSTEM

5.1 INTRODUCTION

After the knowledge of the expert acquired, the next stage in the development of an expert system is the task of knowledge representation as discussed in Chapter Three section 3.4. The structured knowledge captured from the experts have to be mapped to rules so that it is suitable for programming. The knowledge representation for this study i.e. the development of the Prototype Expert System for Tourism Information System of Ethiopia (**ExTISE**) is discussed in this chapter along with its architecture.

The other module i.e. the Hypermedia Tourism Information System for Ethiopia (**HyTISE**) which is incorporated in this study to strengthen the performance of the ExTISE has also been explained in this chapter in section 5.3. Here the type of design techniques that were selected, the how and when incorporation of still images and sounds to the system are discussed. The possibility of integrating these two systems and the system requirements to implement the system are explained in section 5.5.

The prototype expert system that was developed to guide tourists planning to visit Ethiopia (ExTISE) consisted of the knowledge base, an inference engine, the user interface, and an explanation module as shown in Figure 5.1.

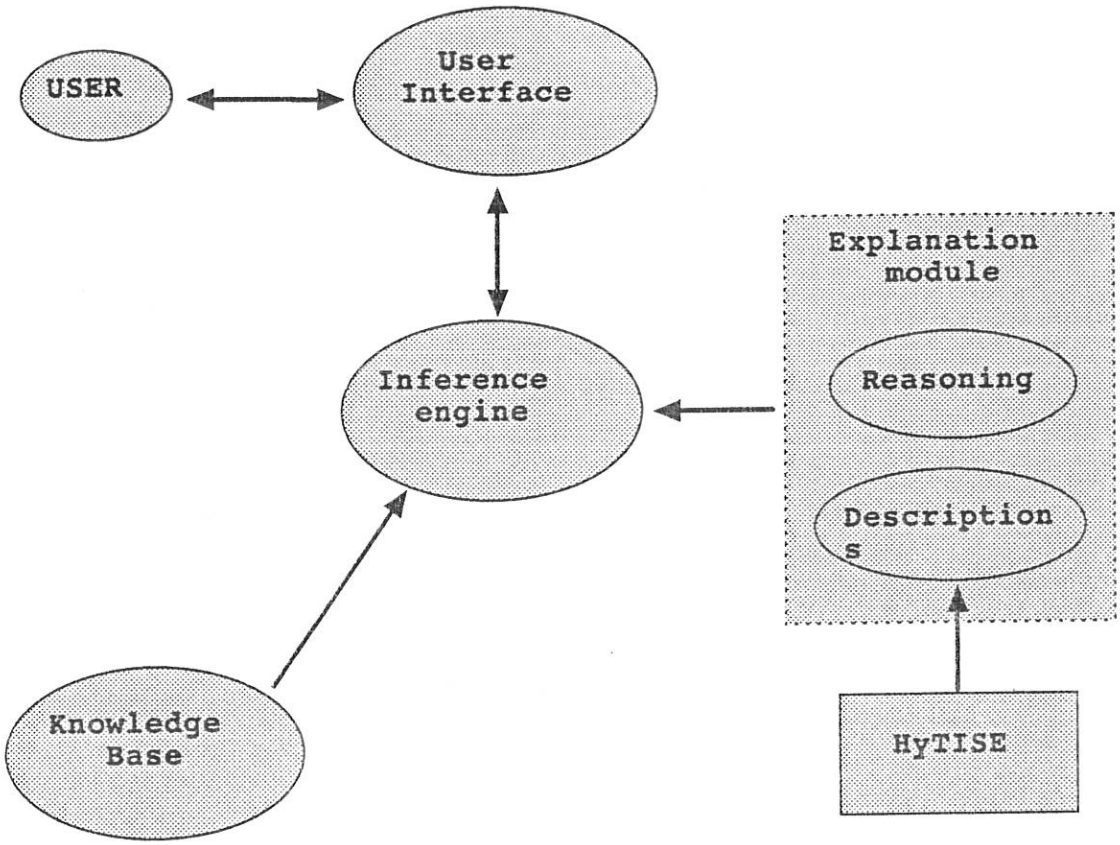


Figure 5.1 Structure of the prototype expert system

5.2 GENERAL FRAMEWORK

The main purpose of developing an expert system is to disseminate expertise i.e. transferring expertise from some expert(s) to a computer and then on to other human non experts (Yang 1995). With ExTISE both tourists (to get relevant information) and less experts (to strengthen their knowledge or share the experience of other high experts) can be the user of the system. That means there are users that totally do not know about the tourist sites available in Ethiopia, and there are also users partially aware of the sites but want to know about the details of the destinations by browsing from the database. Therefore, to facilitate the interest of these two groups, ExTISE was designed to provide options to the user to interact either with the expert or hypermedia system. When the user needs assistance or a tourist guide, the system will proceed to the expert system module and finally suggest the user where to go and visit including the reasoning and explanation of that selected destinations. The execution procedure of ExTISE is described in the screen flow diagram (Figure 5.2) shown below.

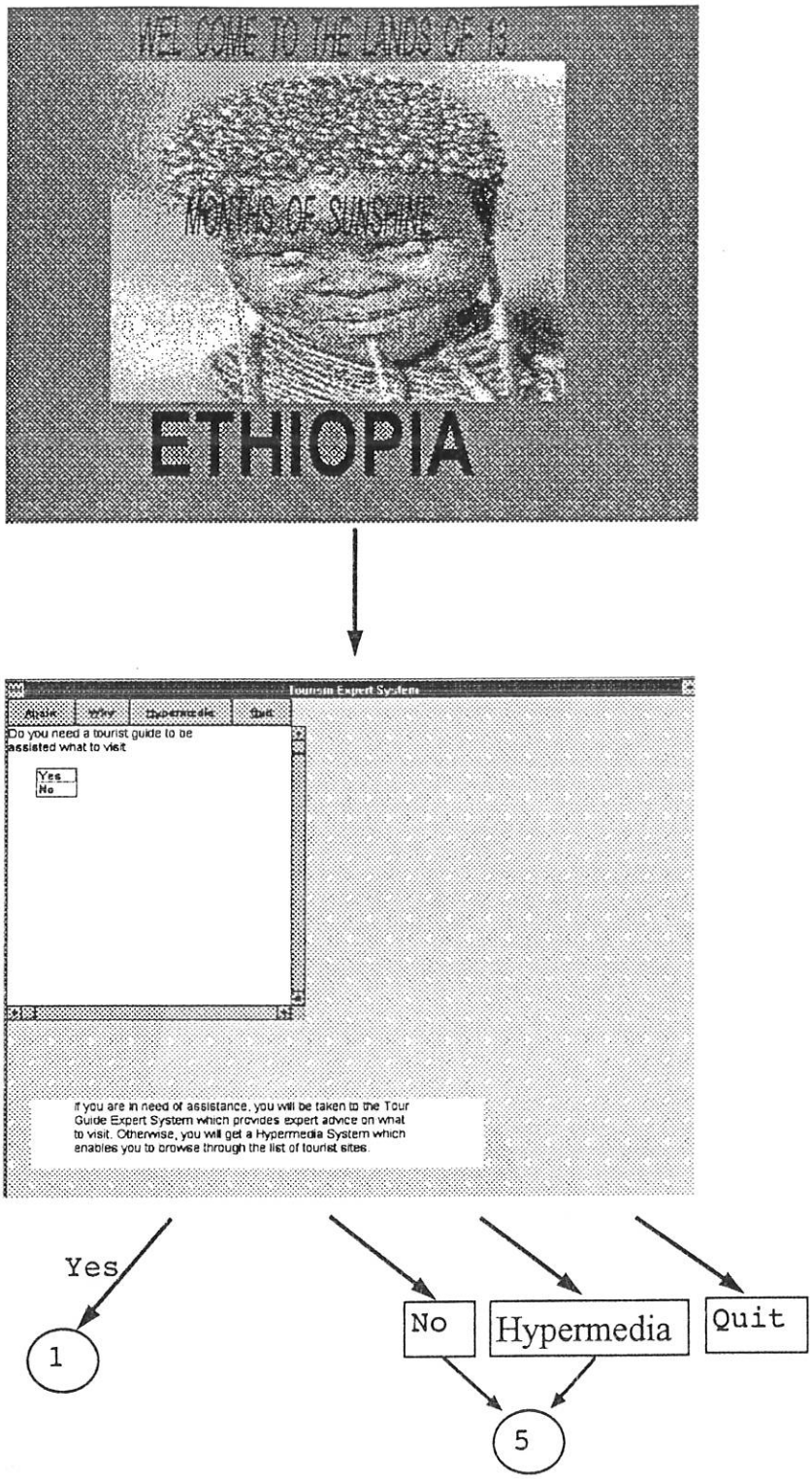


Figure 5.2 Screen Flow Diagram

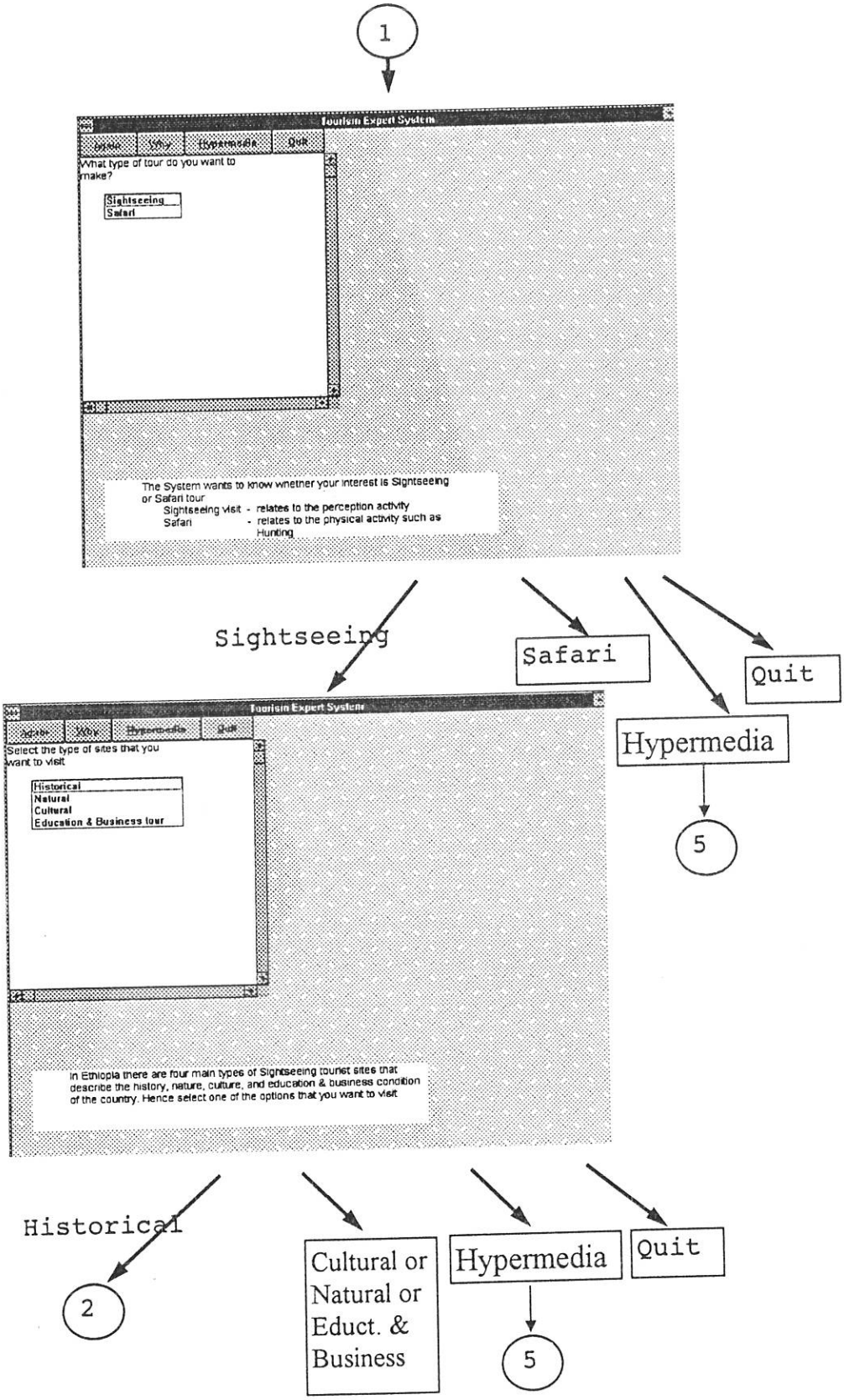


Figure 5.2 Screen Flow Diagram (Contd.)

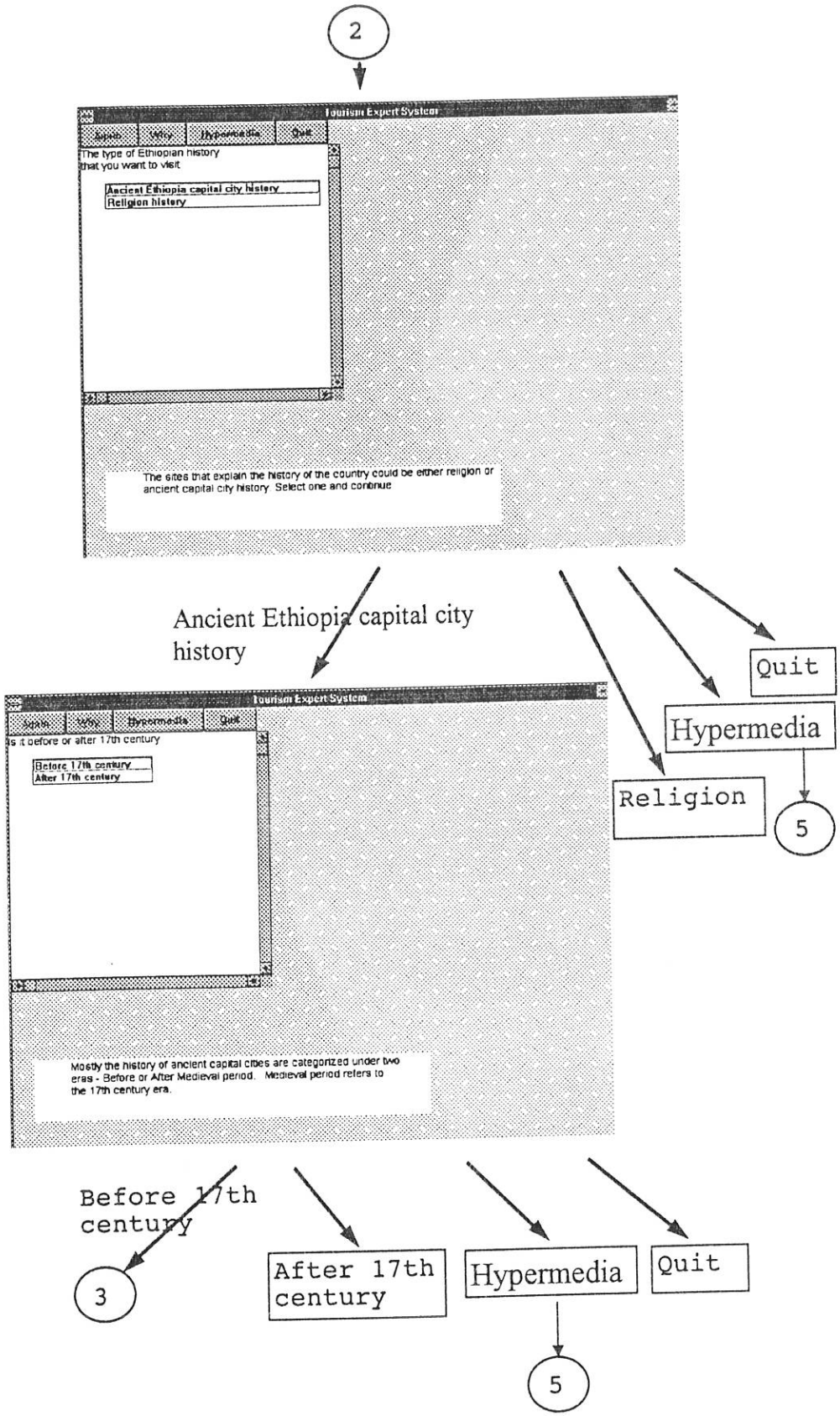


Figure 5.2 Screen Flow Diagram (Contd.)

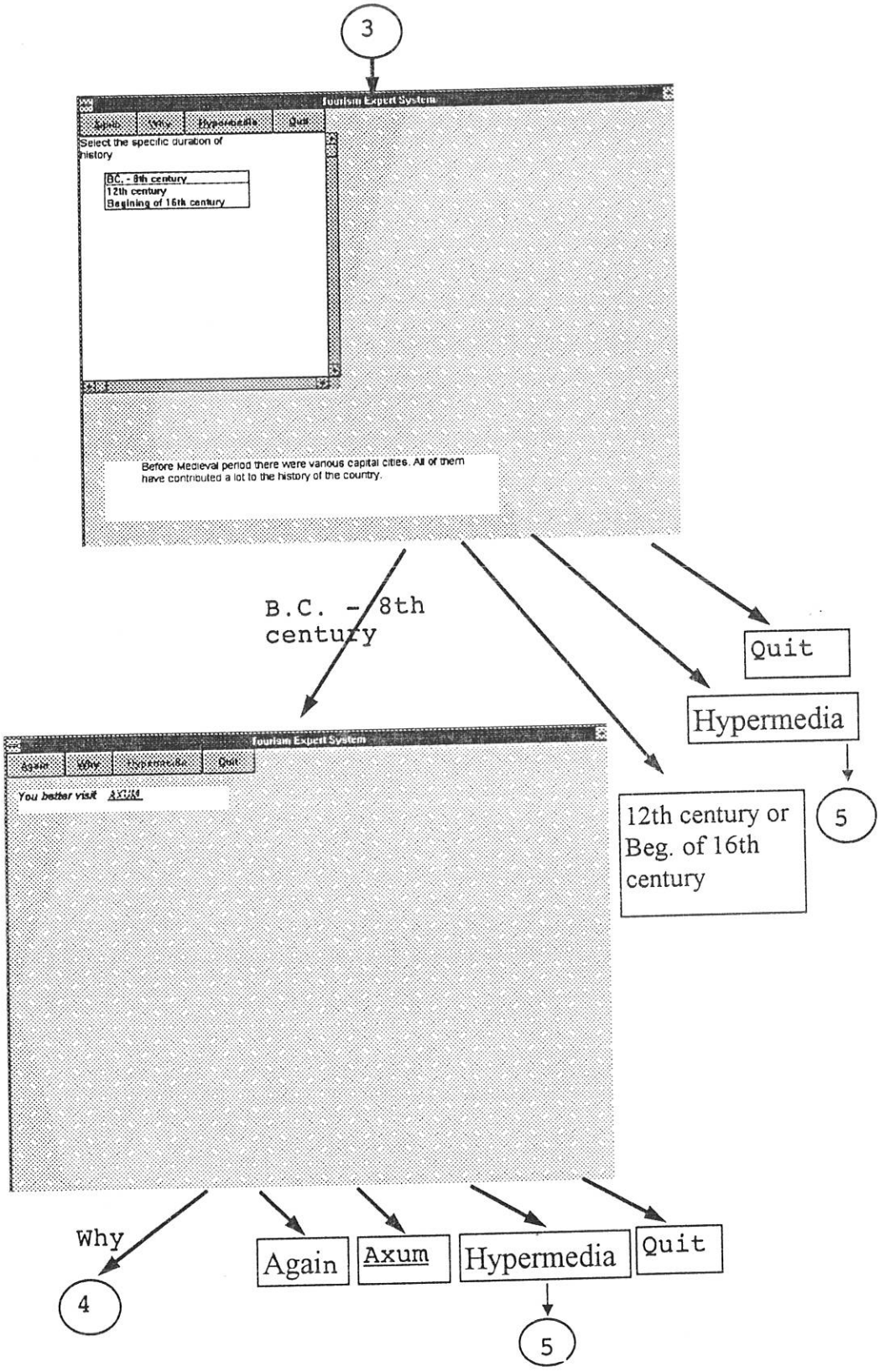


Figure 5.2 Screen Flow Diagram (Contd.)

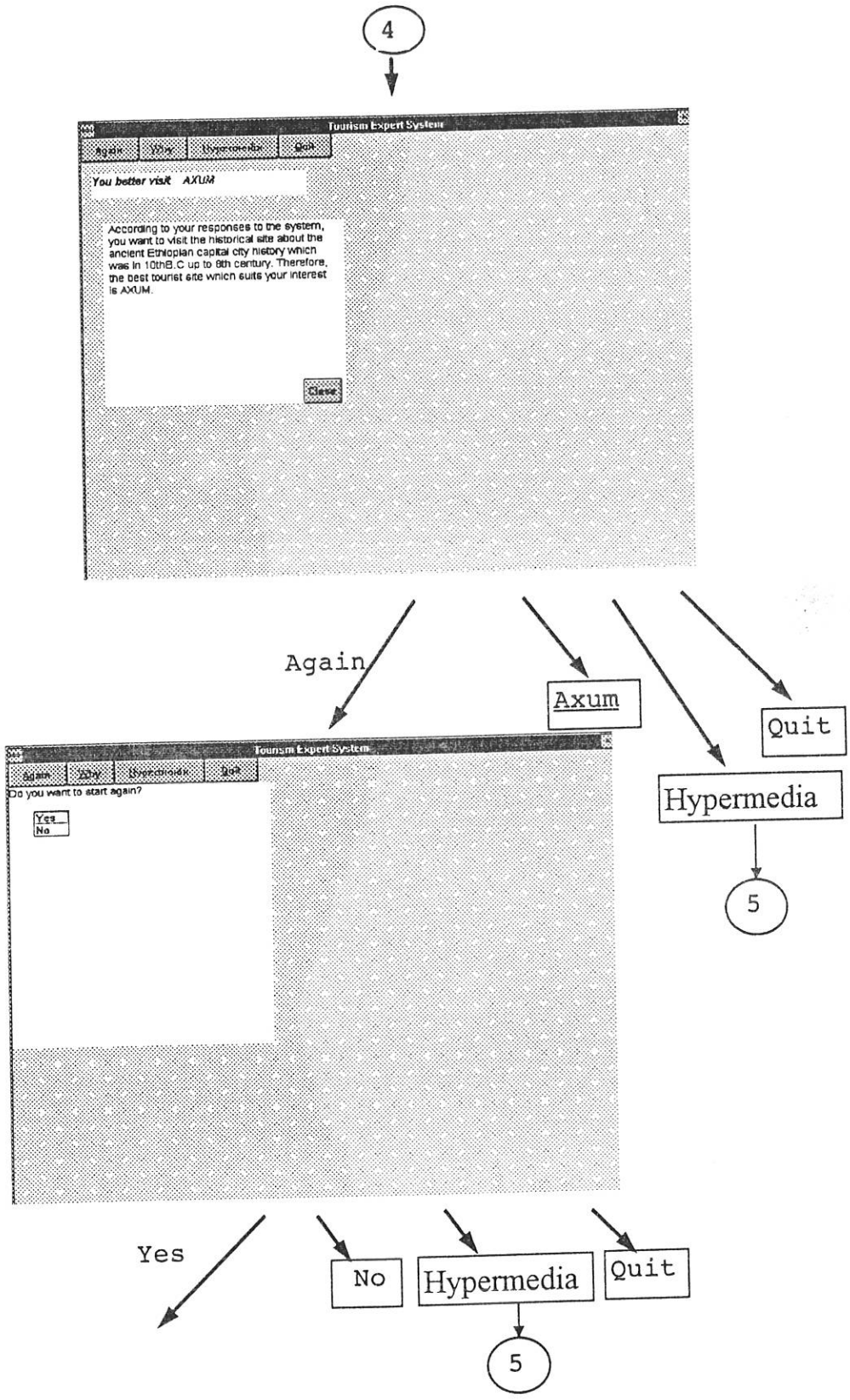


Figure 5.2 Screen Flow Diagram (Contd.)

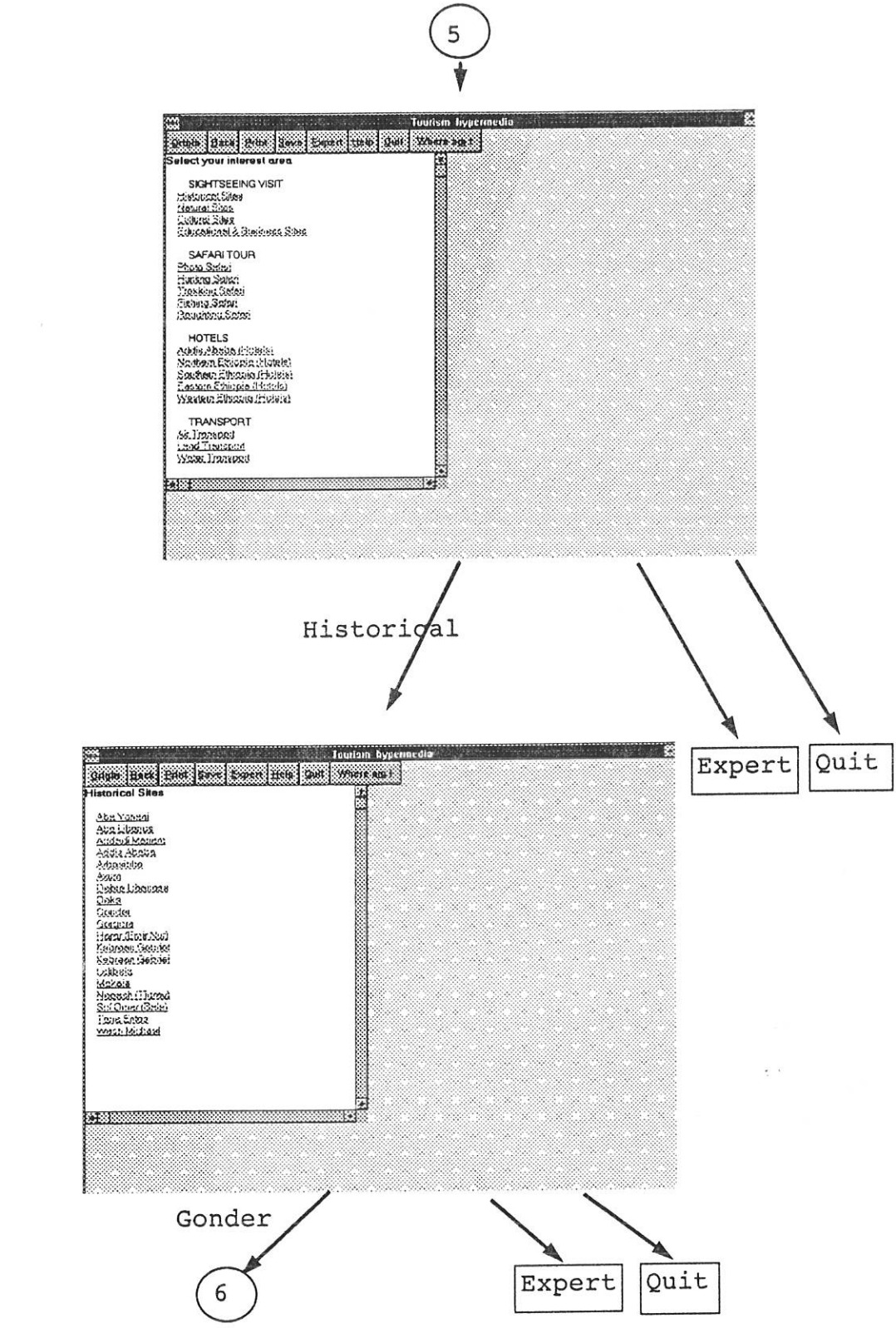


Figure 5.2 Screen Flow Diagram (Contd.)

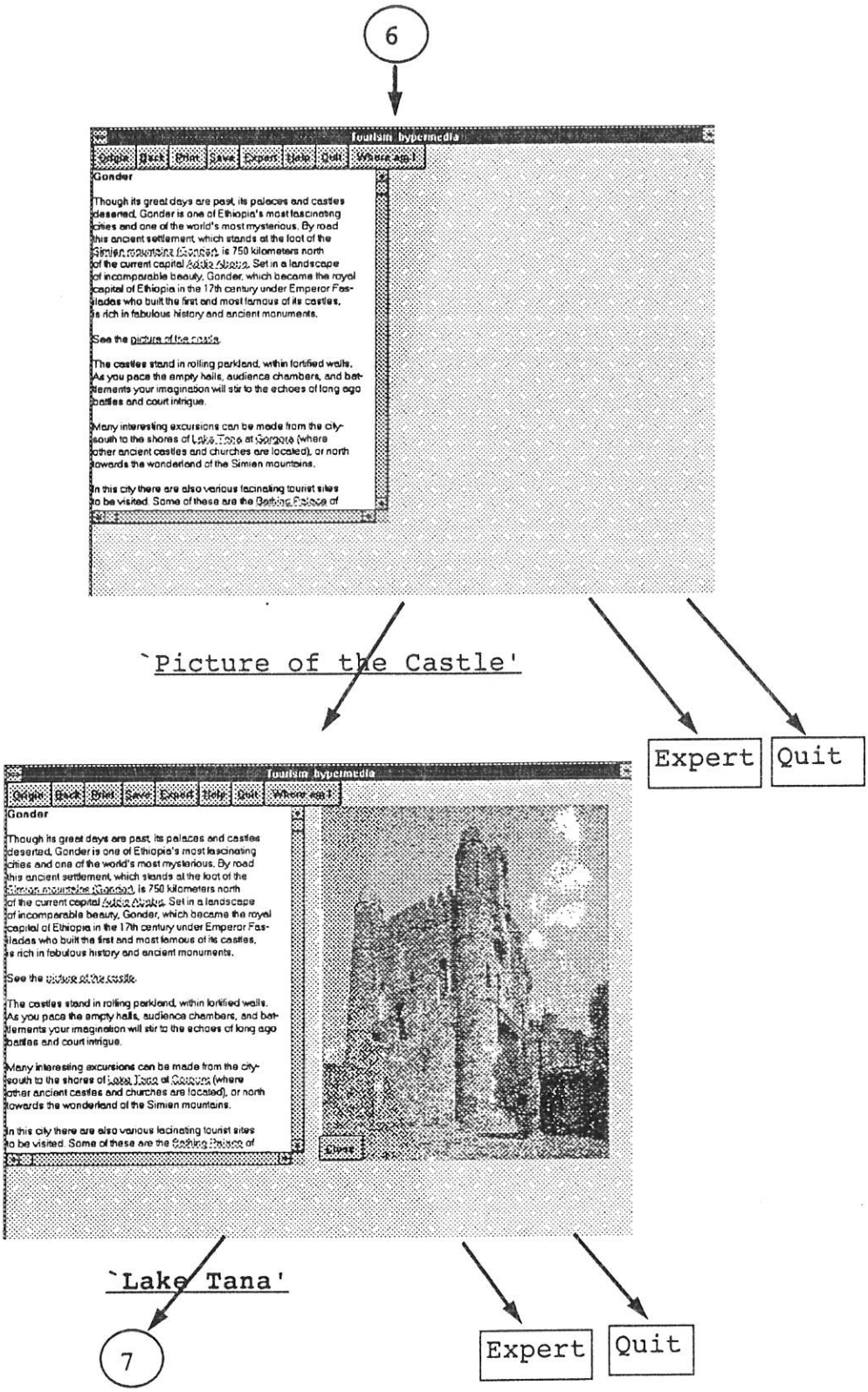


Figure 5.2 Screen Flow Diagram (Contd.)

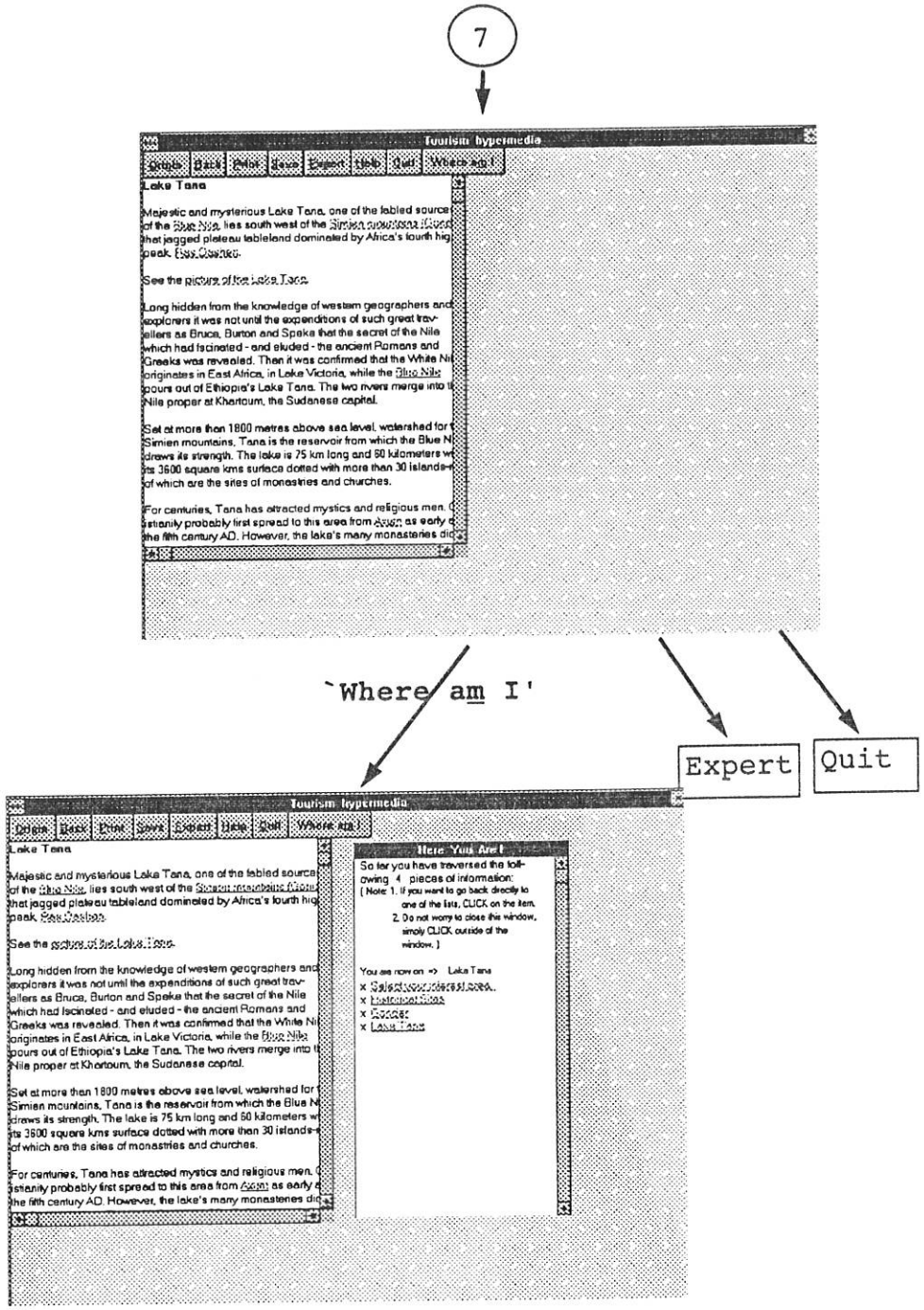


Figure 5.2 Screen Flow Diagram (Contd.)

5.2.1 The Knowledge Base of ExTISE

The knowledge base for ExTISE was represented using production rules (situation-action or if-then rules). These rules are constructed from the acquired knowledge shown in Chapter 4. Each rules contains the knowledge base for one type of tourist site. As an example, some of the rules that construct the knowledge base are:

```
topic site.

    set_number_of_values (site,1).

Rule 1    if ?tour is Sightseeing
              and ?sightseeing is Historical
              and ?history is 'Ancient Ethiopia capital city history'
              and ?time is 'Before 17th century'
              and ?'Before 17th century' is 'BC.-8th century'
              then site is AXUM and message().

Rule 2    if ?tour is Sightseeing
              and ?sightseeing is Historical
              and ?history is 'Ancient Ethiopia capital city history'
              and ?time is 'Before 17th century'
              and ?'Before 17th century' is '12th century'
              then site is LALIBELA and message() .

Rule 3    if ?tour is Sightseeing
              and ?sightseeing is Historical
              and ?history is 'Ancient Ethiopia capital city history'
              and ?time is 'Before 17th century'
              and ?'Before 17th century' is 'Beginning of 16th century'
              then site is GORGORA and message().

Rule 4    if ?tour is Sightseeing
              and ?sightseeing is Historical
              and ?history is 'Ancient Ethiopia capital city history'
              and ?time is 'After 17th century'
              and ?'After 17th century' is '1632 - 1872'
              then site is GONDER and message().

Rule 5    if ?tour is Sightseeing
              and ?sightseeing is Historical
              and ?history is 'Ancient Ethiopia capital city history'
              and ?time is 'After 17th century'
              and ?'After 17th century' is '1872 - 1889'
              then site is MEKELLE and message().

Rule 6    if ?tour is Sightseeing
              and ?sightseeing is Historical
              and ?history is 'Ancient Ethiopia capital city history'
              and ?time is 'After 17th century'
              and ?'After 17th century' is 'After 1889'
```

then site is 'ADDIS ABABA' and message().

Rule 7 if ?tour is Sightseeing
and ?sightseeing is Historical
and ?history is 'Religion history'
and ?'Religion history' is Christian
and ?type is Churches
and ?Churches is 'Rock hewn churches'
then site is 'ARBASIBHA or LALIBELA' and message().

Rule 8 if ?tour is Sightseeing
and ?sightseeing is Historical
and ?history is 'Religion history'
and ?'Religion history' is Christian
and ?type is Churches
and ?Churches is 'Cave churches'
then site is 'WASHA MICHAEL in A.A or ADDADI MARIAM' and message().

Rule 9 if ?tour is Sightseeing
and ?sightseeing is Historical
and ?history is 'Religion history'
and ?'Religion history' is Christian
and ?type is Churches
and ?Churches is 'Built up churches'
then site is 'ABA LIBANOS' and message().

Rule 10 if ?tour is Sightseeing
and ?sightseeing is Historical
and ?history is 'Religion history'
and ?'Religion history' is Christian
and ?type is Monasteries
and ?Monasteries is 'Men monasteries'
then site is 'DEBRE LIBANOSE or KEBREAN GEBIEL or DEKE' and message().

Rule 11 if ?tour is Sightseeing
and ?sightseeing is Historical
and ?history is 'Religion history'
and ?'Religion history' is Christian
and ?type is Monasteries
and ?Monasteries is 'Women monasteries'
then site is 'TANA ENTOS' and message().

Rule 12 if ?tour is Sightseeing
and ?sightseeing is Historical
and ?history is 'Religion history'
and ?'Religion history' is Muslim
and ?Muslim is Mosques
then site is 'HARAR or NEGASH in TIGRAY' and message().

Rule 13 if ?tour is Sightseeing
and ?sightseeing is Historical
and ?history is 'Religion history'
and ?'Religion history' is Muslim
and ?Muslim is Shrines
then site is 'EMIR NUR in HARAR or SOF OMAR in BALE' and message().

```
Rule 14     if ?tour is Sightseeing
               and ?sightseeing is Historical
               and ?history is 'Religion history'
               and ?'Religion history' is Muslim
               and ?Muslim is Tombs
               then site is 'EMIR NUR in HARAR' and message().

Rule 15     if ?tour is Sightseeing
               and ?sightseeing is Natural
                        :
                        :

Rule i      if ?tour is Sightseeing
               and ?sightseeing is Cultural
                        :
                        :

Rule j      if ?tour is Sightseeing
               and ?sightseeing is 'Education & Business tour'
                        :
                        :

Rule k      if ?tour is Safari
                        :
                        :

         end.  (* Site *)
```

In the language of KnowledgePro "?" means "value_of" that is "?tour" means "value_of (tour)", and a "topic" behaves like a class in an Object Oriented programming approach. In all the above rule based system, the rules are fired when the situation part is true. For instance in Rule 1, for the "site" to be "Axum" (i.e. the action part), the following must be true:

```
the value_of  tour                  = sightseeing
the value_of  sightseeing            = historical
the value_of  history               = 'Ancient Ethiopia Capital city history'
the value_of  time                  = 'Before 17th century'
the value_of  'Before 17th century = 'BC. - 8th century'
```

If one of the above equalities holds false, Rule 1 will not be fired and hence another rule which has a true situation part will be searched. To discuss a little more, looking the sample of rules

listed above, if *?tour* is *safari* instead of *sightseeing* then the part of rules (Rule 1 up to j) will be skipped and proceed to the rule base for *safari* (which is after rule k).

The other components of the knowledge base for ExTISE are facts. Facts are related by rules. The facts of the knowledge base are stored in the hypermedia module for explanation. Each time when the rules are fired, facts about that destination which were linked with the database will be displayed to the user.

5.2.2 The Inference Engine of ExTISE

The inference engine of ExTISE is the one which decides which rules to apply and in what order. The order or type of inference used is the backward chaining procedure. That means it starts from the goal (i.e. particular destination) and searches for the rules which proves the goals. Though the searching algorithm of the inference engine is from the KnowledgePro (i.e. where to find the rules, the explanation module and so on) the code used to utilise this facilities is:

```
topic message.
        text ('You better visit', ?site).
end.
```

Hence to find the goal (value_of site), the backward chaining inference will search the rules from the knowledge base based on the responses given by the user during the dialogue session.

5.2.3 The Explanation Module of ExTISE

One of the important parts that has been incorporated to ExTISE is its reasoning procedure to select a particular tourist site to the tourists. Here in this system there are two main explanations:

i) At each step when the system asks questions to the user, there is a window on bottom side of the screen to explain why that question is raised and even to clarify some words which seems to be technical; and.

ii) after a certain rule is fired and the system suggests a particular destination to be visited, the chain of reasoning to come up with the suggested sites will be provided if the user selects the 'Why' button.

5.2.4 The User Interface of ExTISE

The system asks and responds to the user through its user interface components. In this component attempt has been made to make it user friendly or easy to use for users. The screen for the user interface of ExTISE is depicted in Figure 5.3 below.

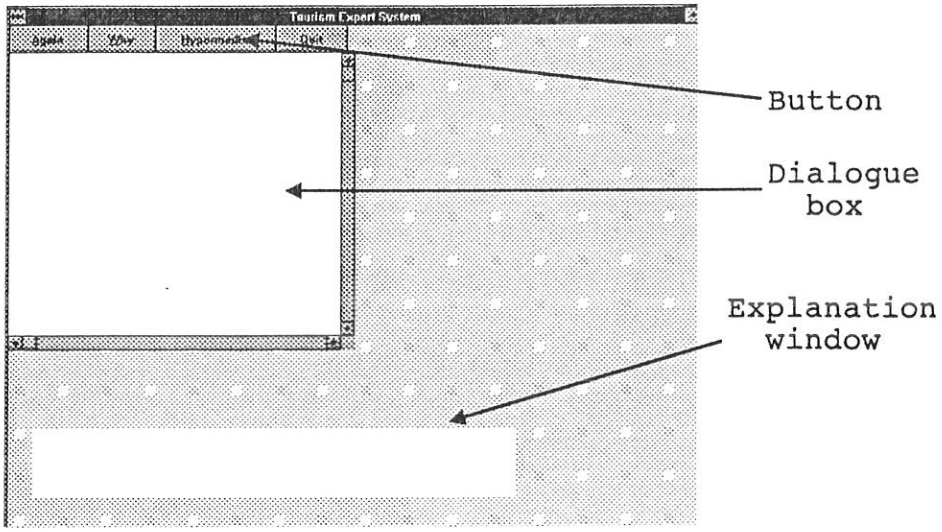


Figure 5.3 Screen for ExTISE

As it is shown in the figure above the user can interact with the computer through the dialogue box. In this box, questions are raised by the system and the user will select his responses from the choices given. Each time when the question comes, there is an explanation on the bottom window. After the user finishes interacting with the system, a selected destination will be provided. If the user selects the button 'Again' the ExTISE will start again from the beginning. When 'Hypermedia' is selected the user will proceed to HyTISE and button 'Quit' is to quit or stop the application.

The other important feature in this user interface component is that it is designed to accept input both from mouse and keyboard. For instance to select button 'Why', it is possible by pressing Alt+W or click the button using the mouse.

5.3 DEVELOPMENT OF THE HyTISE

The hypermedia system which was developed to strengthen the performance of expert system incorporates textual databases, pictures and sound. Texts are organised in a non-linear way with numerous nodes. It is from these text nodes that still picture and sound nodes are linked.

5.3.1 Links and Node Organisations of HyTISE

The nodes are organised in such a way that it minimises granularity problems. That means not to have:

i) few numbers of nodes with large size which leads to the lack of specificity; and

ii) large number of nodes with small size which leads to the problem of disorientation.

In building HyTISE, the nodes are organised in hierarchical link where the conceptual level at the top and the network level at the bottom (See Figure 5.4). Down to the network level, the nodes are connected according to their synonymous i.e. in a particular node there are other hyper link buttons which contains a node having similar concept with the current node. In addition to these type of links, there are also a referential links which refer the user to look into for further information. Mostly these referential links are preceded by the phrase 'See also' or Click here' and are used in this system to link with pictures and sounds of current node, and sometimes to other textual nodes.

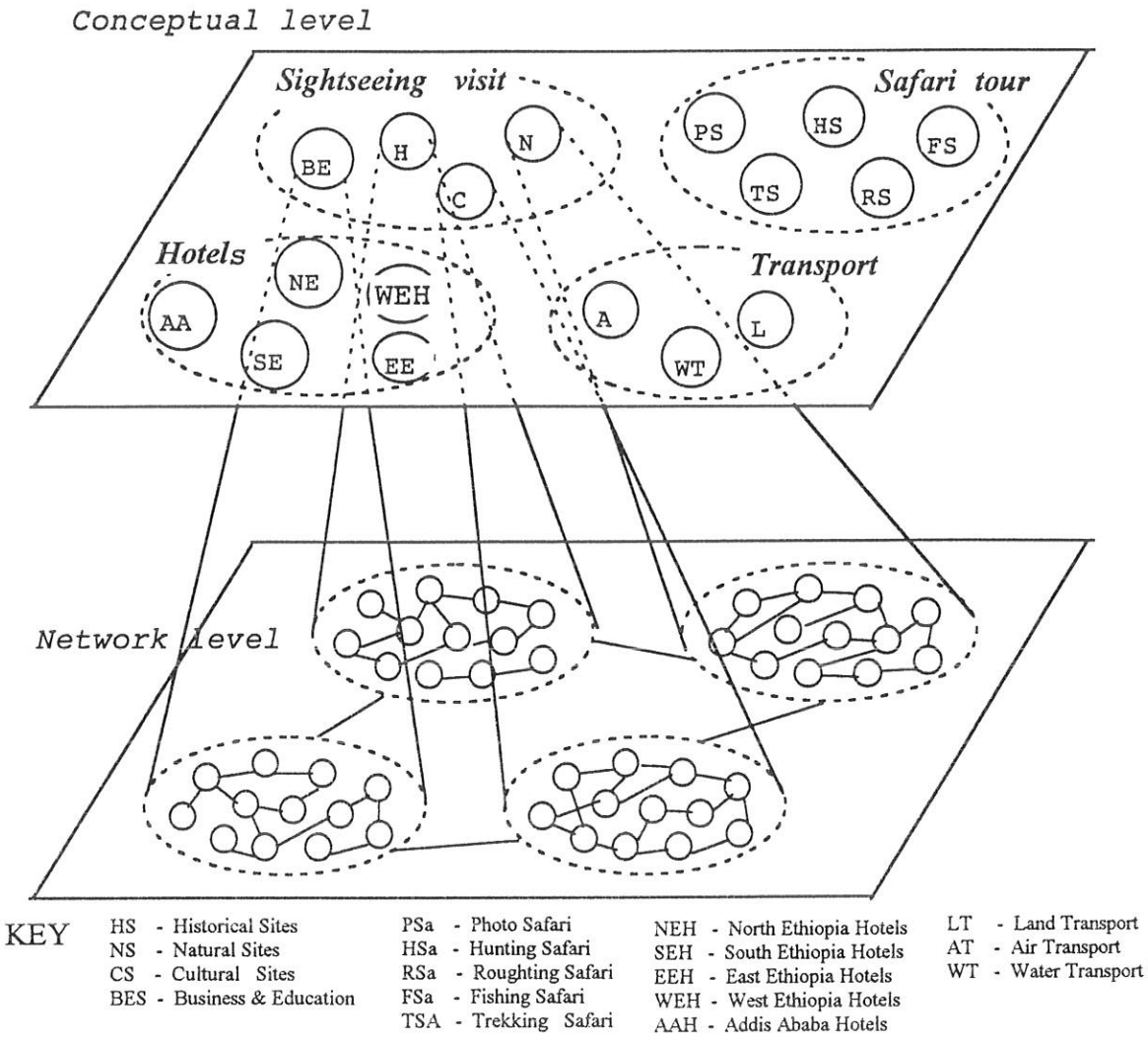


Figure 5.4 The Node structure of HyTISE

In the above figure, all the nodes at the lower level describe the tourist sites available in Ethiopia. The textual description of these sites have a button with green colour to link it with its node. For the picture and sound of the sites (if there are any), the buttons were also indicated in green colour to activate them. Generally the database for texts (which is shown in Appendix II) and pictures were taken from various Guide books and brochures and the sound record was from ETC documentary audio-visual section.

5.3.2 Navigational Tools of HyTISE

One of the problems in hypermedia systems, which is mostly mentioned by different scholars, is disorientation problem. In HyTISE, it has been attempted to minimise such problems by creating buttons as shown in Figure 5.5 below.

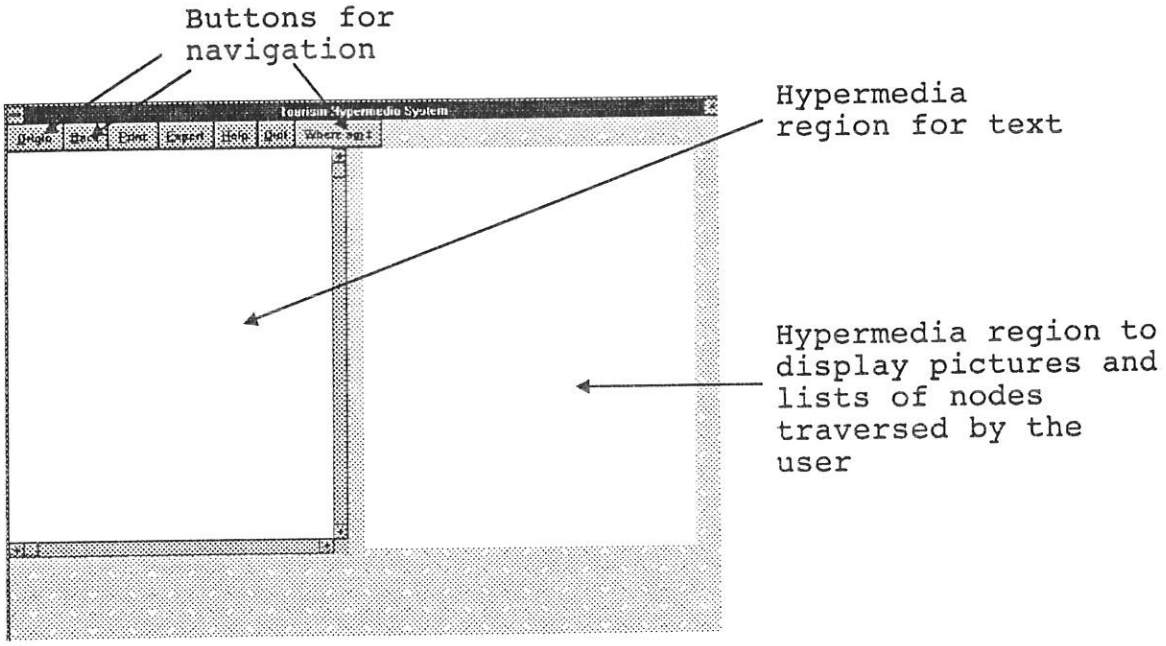


Figure 5.5 The Screen for HyTISE.

The three buttons 'Origin', 'Back' and 'Where am I' are used as a tools for the users to keep track of where he/she is. If 'Origin' button is selected, the user will go directly to the starting position of the HyTISE (i.e. conceptual level). Or if the user selects 'Back' button, the immediate previous screen will appear. The 'Origin' and 'Back' buttons are not enough for the users to keep track of the path. The button 'Where am I' is very important to show the number and lists of pieces of information that was looked by the user and his/her current position. Using the lists provided by

this button, the user can directly go back to any one of the nodes instead of going one step back or to the origin.

5.4 INTEGRATION OF ExTISE AND HyTISE

The two systems, ExTISE & HyTISE, are integrated at various levels. These are:

i) At the start of the system

When the system starts, there is a question (with its explanation at the bottom) as:

Do you need a tourist guide to be assisted what to visit ?

Yes
No

If the user selects 'Yes', ExTISE will start otherwise if 'No' is selected HyTISE will continue.

ii) At the end of ExTISE's suggestion

When the user finishes responding to the questions raised by the system, suggestions where and what to visit will be given by the system. This finally selected destination is shown on the screen with a hypertext region in green colour. If there is a need to have more explanations about that suggested tourist sites, the user can select the hyper region and get the hypermedia system for that selected destination.

iii) There is also the third place where these two systems are integrated. This is so using the 'Hypermedia' and 'Expert' buttons found on ExTISE and HyTISE screen respectively. At

any time when the user wants to go from one system to the other these two buttons are used as a bridge to move on.

5.5 SYSTEM REQUIREMENTS

Any information system, after it is designed and developed, has to be implemented in order to fulfil its objectives. To do so the necessary equipment needed for the system should be stated carefully. However, before implementation the system has to be tested or validated.

5.5.1 Testing

Testing or validation process is one of the stages in expert system. In testing the system, the users have to get a chance to fully interact with the system. In doing so users should be categorised into various groups according to say their awareness about Ethiopia, experiences in using computers and other related things. Based on the feedback coming from the users, the system can easily be modified.

Experts who were not the member of the system developer team, should also be involved in this process. From these group of experts, important ideas, which were probably skipped by the interviewed tourist guides, can be drawn and included to strengthen the system. The experts who were part of the developer team need not be involved in testing. A knowledge engineer who is familiar with the software will have done most of this logical checking by eye as the rules checking for correspondence (Beerel 1993,163).

5.5.2 Hardware Requirements

The system requires a minimum of Intel 386 processor and a coloured monitor with a minimum speed 25 MHz and 4 MB RAM. The system have been also checked for Intel 386 with 16 MHz speed and 2 MB RAM, but it was observed that the system was too slow to make a dialogue with the user and sometimes the computer was unable to display pictures having large space. Hence the above stated minimum speed and RAM are imperative to implement the system. The other main hardware components required for the system are the sound card and speakers which are used to hear the recorded sound from the system.

5.5.3 Software Requirements

The system was developed using KnowledgePro v2.5. This programming shell requires one of the following compilers to get an .EXE file:

- Microsoft c/c++ v7.0;
- Microsoft Visual c++ v1.0 or v1.5;
- Borland c++ v3.1;
- Borland c++ v4.0.

If a Microsoft c v7.0 compiler was used, the system could run from DOS environments directly. Otherwise, if the other compilers were used a DOS based Windows operating software or Windows 95 could be used.

5.5.4 Design of the Database

The non-linear texts which were organised from the guide books and brochures are not full and complete for this prototype. To implement this system, the texts, pictures and sound nodes of all the tourist sites found in Ethiopia have to be organised in a non-linear way and incorporated to the system. This non-linear representation of the database can be prepared manually as shown in the appendix II or using hypertext authoring tools such as SmarText, SGML (Standared General Markup Language), and others.

As mentioned above, the textual databases can easily be taken from guide books and brochures. However, pictures or photographs of the tourist sites have to be scanned, if there are no ready-made digital images, and incorporated to the system. For sound nodes, it can be recorded from the documentary film available in ETC or Wildlife Protection Department of Ministry of Agriculture or other related organisations.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

Ethiopia, as has been discussed in Chapter Two, leads most of the African countries in holding various tourist sites. However, with respect to the amount of receipt from tourism, she is almost at the lower rank among other African countries. There are a number of causes attributable to the problems in attracting more tourists to the country.

Absence of mechanisms for providing the right information to tourists at the right time and lack of technical persons in guiding tourists are part of the problems which hinder the development of the tourism industry in Ethiopia. In fact as it is shown in this study the number of tourist guides graduated from CTTI is much less as compared to the increasing flow of tourists to the country. Even some of those graduate tour guides are not working in tourism sectors.

Tourism industry, in general, is suited to apply information technology (IT) in developing the sector. So far as it is shown in Chapter One, the computers linked accommodation reservation system (CRS), implementation of various databases and other information system were used in tourism information system (TIS). Specially the tourism information centres (TIC) such as private and government tour operators and travel agencies are the ones who are mostly used IT for their financial system, customer service activities and other related tasks.

Ethiopia can also be benefited in minimising the problems mentioned earlier by adopting IT. In fact on the conditions where there is lack of experts and when there is a need of extracting the knowledge of these scarce experts and distribute to others, developing an expert system is quite important and advisable. In addition to this, the way information is delivered to tourists about Ethiopian tourist sites are mostly through guide books, brochures and other printed materials. All the textual databases and pictures found from these materials could be organised in a better way

using hypermedia technologies which is indeed more interactive and incorporates additional media like video, sound and animation.

In this study an attempt was made in designing a prototype integrated expert and hypermedia system which would provide necessary information to tourists. The knowledge base part of the system, i.e. ExTISE, was acquired from three tour guides. The hierarchical model was selected in representing the acquired knowledge and found to be valuable in designing the system.

ExTISE, however, is used only when the user wants to know what to visit and where to go based on the dialogue made with the system. The user couldn't get full information (textual database, pictures, sound, etc.) about a specific tourist site. In this case integrating expert system with hypermedia technology increases the potential for the system to provide sufficient information for the user. One of the advantages of integrating expert system with hypermedia can easily be seen from this study where, after getting a relevant information about what to visit from the expert system (ExTISE), the user has an opportunity in retrieving the relevant information about the selected site in different media using the hypermedia system (HyTISE).

In brief, the integrated expert and hypermedia system is quite applicable and feasible if applied in the field of world tourism industry in general and to Ethiopian tourism in particular.

6.3 RECOMMENDATIONS

This research has enabled the researcher to come up with the following recommendations:

6.3.1 This integrated expert and hypermedia system is a prototype system. This implies that it has to be tested or validated several times before implementation. Apart from it being a prototype, the constituent or components of the knowledge base of ExTISE is a human knowledge. This extracted knowledge is not absolute and constant. It is dynamic and changes from time to time, and from expert to expert. Therefore the system has to be tested with other tourist guides and the acquired knowledge base has to be modified at certain intervals.

6.3.2 As mentioned in some of the chapters, the users of this system are many and ranges from high expert tourist guide to low level expert, and from technically equipped persons in using computers to those who are strange to it, and from those who are familiar with Ethiopian tourist sites to those who are a new comer to the country. The common ability shared to all these diverse type of users is the skill to express or ask their interest freely using their natural language. The integrated ExTISE and HyTISE system didn't incorporate the natural language interface rather the users are bounded to the questions and choices provided by ExTISE irrespective of the way the users speak. Therefore, to strengthen this prototype integrated expert and hypermedia system, a natural language user interface could be included to the system.

One thing that should not be overlooked here is that tourists coming to Ethiopia are not all English speaking people. Considering this, the Ethiopian Tourism Commission (ETC) mostly prepares its guide books and brochures in different languages like French, Arabic, German, and others. In this study the integrated ExTISE and HyTISE system can only be used by those who are an English language speakers. Hence there should be a mechanism to have an option for languages other than English language so that all types of users can use the system.

6.3.3 Users who are in need of information about Ethiopian tourist sites are located all over the world. They need this information before or after they enter in to the country. The following recommended points could be the ways of delivering information to these wide scattered tourists:

- Ethiopia has its own embassies on most part of the world. These embassies can be used as a tourism information centre (TIC) to provide information about Ethiopian tourist sites to the foreigners;

- Nowadays, the best way or means of communication media to address or provide information to many users is the Internet. Ethiopia, has been connected to Internet since February 1997. Hence it is quite important in the future to include this system to Internet by designing a web page of Ethiopian Tourism so that many people can get information from it.

6.3.4 One module of the system in this study is a hypermedia system (i.e. HyTISE). Basically hypermedia system should incorporate various types of media like video, sound, animation, text and others in a non-linear way of representation. However, to incorporate fully all these media, there should be a mechanism to compress and decompress the amount of disk space occupied by them. Hence these compression and decompression techniques or equipment has to be used in order to get a maximum output from this system.

6.3.5 The tourist sites available in Ethiopia are quite numerous and need a large amount of disk space to store them in digital form. Currently CD-ROM is the most suitable disk to store large databases and distribute to wide range of area. Therefore, to store all data about Ethiopian tourist sites, there should be a CD-ROM writer so that it is possible to publish and distribute the system by the concerned organisation like ETC.

6.3.6 As discussed in Chapter Four the model used for the knowledge representation of a tour guide is the hierarchical model. However a further study could be carried out using the other models such as semantic network or others to represent the knowledge of the tour guide.

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Appendices

Appendix 1. Experts (Tour Guides) Profile

No.	Name of the Expert	Educational back-ground	Work experience	Current working place
1.	**Ato Atnafu Bizuneh**	- B.A. in Geography - Diploma in Tour Guide	- 2 years as a teacher in High Schools - 2 years as a teacher at CTTI - 4 years as a Tour Guide at NTO - 6 years as a Branch Manager at NTO - 4 years as a Supervisor at NTO - 2 years as a Division Head at NTO - 2 years as an Operation Manager at Lift Air Tour and Travel Agency	Lift Air Tour and Travel agency
2.	**Ato Yenealem Getachew**	- BSc. in Geology - Diploma in Tour Guide	- 6 monthes as a Tour Guide at Tana Tour Operation - 3 years as a Tour Guide at NTO - 3 months as a Branch Manager at NTO	National Tour Operation and Travel Agency (NTO)
3.	**Ato Dawit Alemayehu**	- Diploma in Marketing and Management - Diploma in Tour Guide	- 3 years as a Tour Guide at NTO	National Tour Operation and Travel Agency (NTO)

Appendix 2. A portion of textual database for HyTISE.

```
(Note:    1. The symbol `//' shows the begining and end of
          a node;    and
          2. The `#m' sign shows the begining and end of
            the hypertext button.)
```

//Select your interest area

SIGHTSEEING VISIT
#mHistorical Sites#m
#mNatural Sites#m
#mCultural Sites#m
#mEducational & Business Sites#m

SAFARI TOUR
#mPhoto Safari#m
#mHunting Safari#m
#mTrekking Safari#m
#mFishing Safari#m
#mRoughting Safari#m

HOTELS
#mAddis Ababa (Hotels)#m
#mNorthern Ethiopia (Hotels)#m
#mSouthern Ethiopia (Hotels)#m
#mEastern Ethiopia (Hotels)#m
#mWestern Ethiopia (Hotels)#m

TRANSPORT
#mAir Transport#m
#mLand Transport#m
#mWater Transport#m

//Historical Sites

#mAba Yohani#m
#mAba Libanos#m
#mAddadi Mariam#m
#mAddis Ababa#m
#mArbasibha#m
#mAxum#m
#mDebre Libanose#m
#mDeke#m
#mGonder#m
#mGorgora#m
#mHarar (Emir Nur)#m
#mKebrean Gebriel#m
#mKebrean Gebriel#m
#mLalibela#m
#mMakale#m

#mNegash (Tigray)#m
#mSof Omar (Bale)#m
#mTana Entos#m
#mWash Michael#m

//Natural Sites

#mA.A. Filwuha#m
#mAbbay#m
#mAbaya#m
#mAbiyata#m
#mAwash Palm Spring#m
#mAwash National Park Falls#m
#mAwash#m
#mBahir Dar#m
#mBatu (Bale)#m
#mBishoftu#m
#mBlue Nile#m
#mGara Muleta (Arsi)#m
#mGuder (Ambo) Falls#m
#mHora#m
#mLake Tana#m
#mLake Haiq#m
#mOmo#m
#mRift valley#m
#mShalla#m
#mShamo#m
#mSimien mountains#m
#mSodere#m
#mSof Omar (Bale)#m
#mTissisat Falls (Abay Falls)#m
#mWabi Shebelle#m
#mWondogenet#m

//Cultural Sites

#mAdere#m
#mAfar#m
#mAgew#m
#mAmhara#m
#mArsi#m
#mAxum#m
#mBale#m
#mDorze (Sidamo)#m
#mGonder#m
#mHarar#m
#mKonso (Grave mark)#m
#mLalibela#m
#mNegash (Tigray)#m
#mOmo#m
#mSomali#m
#mTigray#m

//Educational & Business Sites

#mBale mountains#m

#mDanakel depression#m
#mSimien mountains#m

//Photo Safari

#mAfar#m
#mGambela#m
#mKonso#m
#mOmo#m
#mSurma (Maji)#m

//Hunting Safari

#mArsi/Bale masife#m
#mAwash#m
#mGambela#m
#mGurafarda#m
#mTepi#m

//Trekking Safari

#mBale mountains (Bale)#m
#mChercher mountains#m
#mMaji mountains#m
#mSimien mountains#m

//Fishing Safari

#mBale mountain national park river#m
#mChamo#m
#mLangano#m

//Roughting Safari

#mAbay#m
#mOmo#m
#mTekeze#m

//Addis Ababa (Hotels)

#mAbenet Hotel#m
#mAdda Hotel#m
#mAddis Ketema Hotel#m
#mAirport Motel#m
#mAmba Ras Hotel#m
#mAros Hotel#m
#mAssab Hotel#m
#mAxum Hotel#m
#mBekele Mola Hotels#m
#mBelete Hotel#m
#mBlue Nile Hotel#m
#mCarara Lounge#m
#mCentral Venue Hotel#m
#mDama Hotel#m
#mDessie Hotel#m

#mEthiopia Hotel#m
#mExtreme Hotel#m
#mFairview Hotel#m
#mFasica Hotel#m
#mFilwuha Hotel#m
#mGedera Hotel#m
#mGeshen Hotel#m
#mGhion Hotel#m
#mGuenet Hotel#m
#mGuenete Selam Pention#m
#mHamle 19 Hotal#m
#mHarmbee Hotel#m
#mHara Hotel#m
#mHawi Hotel#m
#mHilton International#m
#mHotel D'Afrique#m
#mIbex Hotel#m
#mKagnew Shaleka Hotel#m
#mKorem Terara Hotel#m
#mLem Hotel#m
#mLido Hotel#m
#mMegenagna Hotel#m
#mMekor Hotel#m
#mMeskel Flower#m
#mMesrak Hotel#m
#mMottera Hotel#m
#mNational Hotel#m
#mNetsanet Goh Hotel#m
#mPlaza Hotel#m
#mRas Hotel#m
#mTaitu Hotel#m
#mTourist Hotel#m
#mVilla Verde#m
#mWabe Shebelle Hotel#m
#mWest Hotel#m
#mWoinhareg Hotel#m
#mYemisrach Hotel#m
#mYordanose Hotel#m
#mZuber Hotel#m

//Northern Ethiopia (Hotels)

#mHotels in Axum#m
#mHotels in Dessie#m
#mHotels in Gishen#m
#mHotels in Gonder#m
#mHotels in Lalibela#m
#mHotels in Makale#m

//Hotels in Axum

#mAxum Hotel#m
#mEzana Hotel#m
#mKaleb Hotel#m
#mYoha Hotel#m

//Hotels in Dessie

#mAmbassel Hotel#m

//Hotels in Gishen

#mGishen Hotel#m

//Hotels in Gonder

#mGoha Hotel#m
#mFogera Hotel#m
#mQuarra Hotel#m
#mTerara Hotel#m

//Hotels in Lalibela

#mRoha Hotel#m
#mSeven Olives Hotel#m

//Hotels in Makale

#mAbraha Atsbaha Hotel#m
#mAdulis Hotel#m
#mAmbassador Hotel#m
#mGreen Hotel#m
#mHarambee hotel#m

//Southern Ethiopia (Hotels)

#mHotels in Ambo#m
#mHotels in Arba Minch#m
#mHotels in Awasa#m
#mHotels in Goba#m
#mHotels in Jimma#m
#mHotels in Lake Langano#m
#mHotels in Meki#m
#mHotels in Moyale#m
#mHotels in Robe#m
#mHotels in Shashemene#m
#mHotels in Sodere#m
#mHotels in Sodo#m
#mHotels in Wendo Guenet#m
#mZiway#m

//Hotels in Ambo

#mAmbo Hotel#m

//Hotels in Arba Minch

#mBekele Mola Hotel#m

//Hotels in Asela

#mAsela Ras Hotel#m

//Hotels in Awasa

#mAwasa Hotel I#m
#mAwasa Hotel II#m

//Hotels in Awash National Park

#mKereyu Lodge#m

//Hotels in Debre Zeit

#mBekele Mola Hotel#m
#mHora Ras Hotel#m

//Hotels in Goba

#mBale Goba Ras Hotel#m

//Hotels in Jimma

#mGibe Hotel#m
#mJimma Ethiopia Hotel#m

//Hotels in Lake Langano

#mBekele Mola Hotel#m
#mLangano Hotel#m

//Hotels in Meki

#mBekele Mola Hotel#m

//Hotels in Moyale

#mBekele Mola Hoyale#m

//Hotels in Nazaret

#mAdama Ras Hotel#m
#mBekele Mola Hotel#m
#mPlaza Hotel#m

//Hotels in Robe

#mBekele Mola Hotel#m

//Hotels in Shashemene

#mBekele Mola Hotel#m

//Hotels in Sodere

#mSodere Resort Hotel#m

//Hotels in Sodo

#mBekele Mola Hotel#m

//Hotels in Wendo Guenet

#mWendo Guenet Hotel#m

//Ziway

#mBekele Mola Hotel#m

//Eastern Ethiopia (Hotels)

#mHotels in Dire Dawa#m
#mHotels in Harar#m
#mHotels in Nazaret#m
#mHotels in Asela#m
#mHotels in Awash National Park#m
#mHotels in Debre Zeit#m

//Hotels in Dire Dawa

#mDire Dawa Ras Hotel#m
#mKara Mara Ras Hotel#m

//Hotels in Harar

#mHarar Ras Hotel#m

//Western Ethiopia (Hotels)

#mHotels in Bahar Dar#m
#mHotels in Welega#m
#mHotels in Gambella#m

//Hotels in Bahar Dar

#mBahar Dar#m
#mTana Hotel#m

//Hotels in Welega

#mWelega Hotel#m

//Hotels in Gambella

#mGambella Hotel#m

//Air Transport

//Land Transport

//Water Transport

//Lake Tana

Majestic and mysterious Lake Tana, one of the fabled sources of the #mBlue Nile#m, lies south-west of the #mSimien mountains#m, that jagged plateau tableland dominated by Africa's fourth highest peak, #mRas Dashen#m.

See the #mpicture of the Lake Tana#m.

Long hidden from the knowledge of western geographers and explorers it was not until the expenditions of such great travellers as Bruce, Burton and Speke that the secret of the Nile which had fscinated - and eluded - the ancient Romans and Greeks was revealed. Then it was confirmed that the White Nile originates in East Africa, in Lake Victoria, while the #mBlue Nile#m pours out of Ethiopia's Lake Tana. The two rivers merge into the Nile proper at Khartoum, the Sudanese capital.

Set at more than 1800 metres above sea level, watershed for the Simien mountains, Tana is the reservoir from which the Blue Nile draws its strength. The lake is 75 km long and 60 kilometers wide, its 3600 square kms surface dotted with more than 30 islands-many of which are the sites of monastries and churches.

For centuries, Tana has attracted mystics and religious men. Christianity probably first spread to this area from #mAxum#m as early as the fifth century AD. However, the lake's many monasteries did not begin to be built until the middle years of the 14th century during the reign of Emperor Amde Tsion. After this time monasteries like #mKebrean Gebriel#m, #mDeke#m, #mEntos#m, #mUra-Kidanemereth#m and others were constructed.
All these regions are the home of the #mAmhara people#m. The pretty market town of #mBahar Dar#m on Tana's southern shore is the ideal center from which to explore the lake and its islands monasteries.

//Blue Nile

Blue Nile starts from #mLake Tana#m which is found in #mBahar Dar#m. As it plunges morethan 2,000 meters in its 800 km course from Ethiopia to the plains of the Sudan it is the Blue Nile which embodies the drama and mystery of the great river of history-beginning its journey with a thundering cascade of 50 meters over the 400 meters wide #mTissisat falls (Abay falls)#m.

Apart from its facinating sightseeing nature, there is also a #mBlue Nile Gorge#m which is formed by this river. This gorge by itself has geological wonder.

//Blue Nile Gorge

The Blue Nile Gorge is one of the interesting gorge found in Ethiopia which is located some 150 kms from #mAddis Ababa#m starting from Dejazmach Belay Zeleke Street (also called the Gojjam Road), which is in the norht-west of the city.

At the begining of the Blue Nile Gorge there is a sheer cliff drops more than 1,000 meters (3,000 feet) into a spectacular gorge formed by the Zega Wodel River, one of the Blue Nile tributaries. At this point, a marker indicates the turn right to the #mDebre Libanose Monastery#m, which is approximately five kms (three miles) from the turnoff along an asphalt road.

//Debre Libanose monastery

Debre Libanose, perched beneath a cliff on the edge of a #mBlue Nile Gorge#m, overlooks a tributary of the #mBlue Nile#m. The original monastic buildings of Debre Libanos have long since disappeared, having been destroyed, it is said, during the wars of #mAhmed Gragn#m. They were replaced by a succession of structures, the latest of which is a spectacular modern church erected after World War II on Emperor Haile Selassie's orders. Note the mosaic figures on the facade.

The church also has beautiful stained glass windows and contains some interesting mural paintings by the well-known Ethiopian artist Afewerk Tekle. To the left of the church is the nuns' residence, built in the 1920's, and

to the right behind the church is a cave containing holy water. Nearby are the huge monks' kitchens, dating from the early 20th century. Although women are not allowed to enter the monastery, they can visit other areas of the compound.

//Tissisat Falls (Abay Falls)

Tissisat Falls is found 30 kilometers downstream from the point where it leaves #mLake Tana#m. The falls are approached on foot from the nearby village which gives them their name-'Tissisat' means 'smoke of fire'. After crossing over a castellated 17th century Portuguese bridge that spans a deep balastic rift, a grassy rise is climbed and then the Falls suddenly appear-breaking the smooth unfaltering flow of the Nile into a boiling cataract and sending it faoming down the gorge below.

See the #mpicture of the falls#m

A constant spray mist cloaks the surrounding cliffs, creating iridescent rainbows. High above raptors circle on the thermals. In the gorge below mettalic blue kingfishers, carmine bee eaters, song birds and swifts dart through the fine droplets of spray before returning to their cliff-ledge perch.

WHEN TO GO
Visit at any time of the year, but the falls are at their best towards the end of Ethiopia's great rainy season (which runs from June to September) and in the month or so following from late September to mid-October. For most of the year the falls are white, but during the rainy season they carry down so much mud
that they become a rich reddish-brown.

//Kebrean Gebriel

Kebrean Gebriel is one of the monastries found in #mLake Tana#m on the island cloaked with lush forest juts out of the water. It can be reached from #mBahar Dar#m after some 30 minutes' cruise by motor launch. It is here that the 17 monks at the 15th century spend their days in meditation, cultivating their gardens. They
live completely self-contained lives where females are forbidden even to land on the island.

//Ura-Kidanemereth

Ura-Kidanemereth, an hour's cruise away from #mBahar Dar#m, is located at Zegie, a mainland peninsula. It's built in the same style and dates from the same era as that of #mKebrean Gebriel#m but sports a conical thatched roof and stores an impressive treasury of ancient illuminated Bibles in the #mGe'ez#m script.

This building is decorated with a number of external and internal frescoes of religious significance. The monks here do not remain in isolation but indeed play an active role in community affairs among the local villagers.

//Bahar Dar

Bahar Dar, 578kms (358 miles) from #mAddis Ababa#m, 183 kms (113 miles) from #mGonder#m and 554 kms (343 miles) from #mAxum#m, is served by road and air, with daily #mEthiopian Airlines#m flights.

Bahar Dar is a capital city for one of Ethiopia's regions - Amhara region. Its colourful markets and several handicrafts and weaving centres-within a few minutes' walk of the main #mhotels in Bahar Dar#m - are all well worth visiting.

//Amhara people

Amhara are a highland people whose language has become the national lingua franca of Ethiopia. Amahara traditional homes, many of which can be seen in the #mLake Tana#m area, consist of a circular wall of thin poles

with cross laced to them, plastered with mud and dung and thatched with 'teff' straw. The conical roof is generally supported by four or five eucalptus poles. Some houses are stone built, but all are without windows, smoke seeping through the tatche. Mainly subsis-tence farmers whose cropes are traded at colourful local markets, the Amhara wear wooly caps and heavy wool rugs under their sheepskin capes.

//Ge'ez

Ge'ez was an official language for Axumites when #mAxum#m was a political center for Ethiopia. It is from this language that the current national language Amharic is derived. Nowadays, though the language is not being spoken by the people, it is a church language for Ethiopian Orthodox religion.

//Axum

Although its very early history is still unknown, Ethiopia legends first recorded in the fourteenth-century Kebre Nagast (Book of Kings) make Axum the capital of the Queen of Sheba in
the tenth century BC. It does seem certain that a high civilization was established here in Axum by immigrants from southern Arabia in the centuries before the Christian era, and by the first century AD - the time of the earliest historical records - Axum was well known to Greek traders as a fine city and also as the centre of a considerable empire. Axum was a place for the birth of a new script called #mGe'ez#m.

GETTING THERE
Axum 1,005 kms (623 miles) from #mAddis Ababa#m, 360 kms (223 miles) from #mGonder#m, 220 kms (136 miles) from #mMakale#M, and 529 kms (328 miles) from #mLalibela#m, can be reached by road or by air on one of #mEthiopian Airlines#m' daily flights to
the town.

WHEN TO GO
Although Axum is worthy of a visit at any time, the town is particularly interesting during the time of church festivals, notably #mEthiopia's Christmas#m (7 January) and #mEpiphany#m (19 January), as well as at the end of November, the festival of #mMaryam Zion#m, to whom the great Church of Saint Mary is dedicated.

WHERE TO STAY
The #mEzana Hotel#m, the #mKaleb Hotel#m, the #mAxum Ghion Hotel#m, and the recently built #mYoha Hotel#m.

TOURIST SITES
Just north of the town square stand a number of famous obelisks, or monolithic stelae, with which Axum is widely identified.

Click here to know about the #mAxum obelisks#m

To the left of of the principal obelisks, in the park of the stalae, one can enter the newly excavated tomb of Ramha, a former king of Axum.

Also of great interest is Axum's Church of Saint Mary of Zion. There are in fact two churches, one old and one new, both located in a spacious walled compound directly opposite the Park of the Stalea. The older, a rectangular battlemented building, was put up in the early seventeenth century by Emperor Fasilidas, the founder of #mGonder#m; the much more modern structure was erected nearby by Emperor Haile Selassie, who opened it in the company
of Queen Elizabeth II of Great Britain in 1965.

//Axum obelisks

In Axum during the ancient times there were seven monolites (obelisks) of granite standing together, but the biggest, which was the largest monolith in the world-measuring over thirty-three meteres (108 feet) and weighing about 500 tonnes - fell at some remote period in the past, and now lies in broken segments on the ground to the right of the standing stalae.

The second largest stela, about twenty-four meters (79 feet) high, had also fallen and was stolen during the Italian Fascist occupation on the personal orders of the Italian dictator Mussolini. It was taken to Rome in 1937. Though eligible for return in accordance with the Italian Peace Treaty of 1947, it has thus far not been repatriated, although Ethiopian scholars and patriots are now campaigning for its return. The third largest stela, which is slightly smaller, measuring twenty-three meters (75 feet), still stands in Axum.

All seven giant stelae are made of single pieces of granite and have identical decoration. Each was erected in the centre of polished limestones.

//Lalibela

Once the thriving and populous capital city of a medieval dynasty, Lalibela is now not much more than a village. It is scarcely visible against a horizon dominated by the 4,200-metre
(13,776-foot) peak of Mount Abune Yosef. But this anonymity is a deceiving camouflage, for it this remote highland settlement some 800 years ago, safe from the prying eyes and plundering hands of hostile interlopers, a noble king fashioned a secret marvel.

See the #mpicture of Lalibela#m.

Formerly known as Roha, it nowbears the name of #mKing Lalibela#m (1181-1221), a member of the Zagwe dynasty.

GETTING THERE
Lalibela, 642 kms (398 miles) from #mAddis Ababa#m, 279 kms (173 miles) from #mMakale#m, and 241 kms (149 miles) from the Wollo regional capital of Dessie, is served by road and by air on daily flights of Ethiopian Airlines - except in the rainy season

WHEN TO GO
Always a place of unparalleled fascination, Lalibela is particularly interesting during religious celebrations, notably those of #mEthiopia's Christmas#m (7 January), #mTimkat#m (19 January), and Easter, when Christians pour into the area from far and near.

WHERE TO STAY
Lalibela has two good modern government hotels, the #mSeven Olives Hotel#m and the more recently built #mRoha Hotel#m, as well as several small, satisfactory private ones.

//King Lalibela

Shortly after his birth at Roha, the future king's mystical life began to unfold. Legend has it that one day his mother saw him lying happily in his cradle surrounded by a dense swarm of bees. Recalling an old Ethiopian belief that the animal world could foretell the advent of important personages, the second si-
ght came upon her and she cried out: 'The bees know that this child will become King'. Accordingly she called her son 'Lalibela,' which means' the bee recognizes his sovereignty'.

Lalibela's older brother, Harby, the incumbent monarch, was naturally disturbed to hear this news and became jealous. As the years passed, he began to fear for the safety of his throne,
decided to eleminate his rival, and unsuccessfully tried to have his brither murdered. Persecutions of one kind or another continued for several years, culminating in a deadly potion that left the young prince in mortal sleep. During the three-day stupor, Lalibela was transported by angels to the first, second, and third heavens, where God ordered him to return to Roha and build churches, the like of which the world had never seen before. The

Almighty, it is said, further told the prince how to design those churches, where to build them, and how to decorate them.

//Makale

Ethiopia's earliest known capital, Yeha, is less than two hours' drive from #mAxum#m through some dramatic high-land scenery. As the birth-place of the country's earliest high civilization, it is well worth visiting. To get there, head east for twenty kms (12 miles) to Adwa. Continue along the main road towards Adigrat
for another twenty-four kms (15 miles) and then turn north on to short dirt track, where you will see the imposing ruins of Yeha's Temple of the Moon about 4 kms (2.5 miles) to the right of the track.

Immediately beside the temple is a modern church dedicated to Abune Aftse, one of the Nine Saints from Syria who founded many important monasteries in northern Ethiopia in the fifth
and sixth centuries.

//Gonder

Though its great days are past, its palaces and castles deserted, Gonder is one of Ethiopia's most fascinating cities and one of the world's most mysterious. By road this ancient settlement, which stands at the foot of the #mSimien mountains#m, is 750 kilometers north of the current capital #mAddis Ababa#m. Set in a landscape of incomparable beauty, Gonder, which became the royal capital of Ethiopia in the 17th century under Emperor Fasiladas who built the first and most famous of its castles, is rich in fabulous history and ancient monuments.

See the #mpicture of the castle#m.

The castles stand in rolling parkland, withinfortified walls. As you pace the empty halls, audience chambers, and battlements your imagination will stir to the echoes of long ago battles and court intrigue.

Many interesting excursions can be made from the city-south to the shores of #mLake Tana#m at #mGorgora#m (where other ancient castles and churches are located), or north towards the wonderland of the Simien mountains.

In this city there are also various facinating tourist sites to be visited. Some of these are the #mBathing Palace#m of Emperor Fasiladas, #mDebre Birhan Selassie#m, #mQwesquam$m.

//Bathing Palace

The Bathing Palace, located beside the Fasiladas castles, stood in a pool filled with water drawn by canal from a nearby river. It could only be reached by draw-bridge. The pool is generally empty today; however, once each year-during the annual #mEpiphany#m, 'Timket', celebrations - it is filled again.

//Debre Birhan Selassie

Debre Birhan Selassie (meaning 'Light of the Trinity'), was constructed during the reign of Iyasu I (1682-1706) - grandson of Emperor Fasiladas. It is located on the north west of the Gonder city which stands on raised ground. Described by a contemporary visitor as a 'stupendous and wondrous edifice' it was, in its heyday, surmounted by a gold cross while its inner walls were 'marvellously painted from top to bottom with innumerable scenes of Biblical Iore and medieval history. Today, though the gold cross is long gone, Debre Birhan Selassie still stands with its interior decorations well preserved.

//Qwesquam

Qwesquam is located in the hills north-west of the Gonder city.

//Harar

Founded in the seventh century AD, Harar is one of Ethiopia's oldest cities. In stark contrast, nearby Dire Dawa is an upstart child of the 20th century which rose to importance as a staging
post on the railway that links #mAddis Ababa#m with the port of Djibouti.

Capital of Hararghe, Ethiopia's largets administrative region (to which it gives its name), the ancient walled city of Harar is situated high in the Ahmar mountains on the eastern wall of the Great Rift Valley and stands sentinel over the vast Danakil Desert to the north, over the cattlerich savannas to the south, and over the fertile lands of the Harar mountains to the east where some of Ethiopia's finest coffee is grown and where citrus orchards blossom with fruit.

After the death of #mAhmed Gragn#m in 1543, Harar became an important Muslim city and considered to be as the fourth most sacred centre of the Islamic world.

//Ahmed Gragn

Ahmed Gragn ('Gragn' - 'the Left Handed') was one of the Muslim leader in Ethiopia in the 16th century who fought against Christian Ethiopian kingdoms starting from #mHarar#m to the west using a jihad (holy war) to disseminate his religion to the country. For 20 years Gragn waxed rich on the plunder of his armies. In 1543, however, he was killed and his forces routed by Emperor Galawdewos who had called in a force of Portuguese mercenaries to help him.

Gragn was succeeded by his nephew, Nur ibn al-Wazir Mujahid, who retreated into Hara and built the stout walls that surround the city to this day.

//Simien mountains

The Simien mountains are hard cores of volcanic outlets from which the surrounding material has eroded away over the centuries - one of the most distinctive characterstics of these highlands,
which constitute one of the major mountain massifs in Africa. The region includes many summits above 4,000 metres (13,000 feet), and culminates in the highest mountain in Africa. It is not a difficult mountain to climb and can be reached by travelling through the park.

GETTING THERE
Debark, the base from which to explore #mSimien Mountains National Park#m, is 850 kms (527 miles) from Addis Ababa, 101 kms (63 miles) from #mGonder#m, and 256 kms (159 miles) from #mAxum#m and can be reached by road through #mBahar Dar#m and Gonder. Visitors can also fly to Gonder on one of #mEthiopian Airlines#m' daily flights and arrange transport from there to Debark, either privately or by bus or taxi.

WHEN TO GO
The best time to visit is the dry season, from December to March. Travel is difficult during the long rainy season between June and September, when several rivers may be flooded and difficult to cross, trails are slippery, and fog frequently obscures the view throughout the day. October, November, and December are the coldest months.

WHERE TO STAY
The nearest hotel accomodation is in Gonder, (See #mHotels in Gonder#m), as hotels in Debark are not geared to foreign tourists, with the possible exception of the Simien Hotel. A small, local hotel, it has a very amiable and cooperative management, excellent food, delicious coffee, cold beers, and is bug free.

//Simien Mountains National Park

Simien Mountains National Park is located in #mSimien Mountains#m with 179 square kilometres (111 square miles) area and lies between 1,900 and 4,430 metres (6,200 and 14,530 feet). It is in the Afro-alpine zone and the temprature regularly falls below freezing at night. Daytime tempratures range from 11.5 to 18 degree centigrades (53 to 64 degree farahniet). The rainfall averages 1,550 mm (60 inches) a year.

See the #map of the park#m.

The topography of this small park is breathtaking. Climbing up from Debark on mules, through extensive farmland, the visiter is unaware of the dramatic scenery about to unfold. The land forms various small plateau areas, and the edges of these plunge dramatically to the lowlands to the north and east. The edges of these gorges from the perfect habitant for the animal that this park was set up to protect - the #mWalia Ibex#m.

Other than Walia Ibex, there are also other endemic animals and birds in this park. Some of these are:

#mGelada Baboon#m;
#mSimien Fox#m;
#mThick-billed Raven#m;
#mBlack-headed Siskin#m;
#mWhite-collared Pigeon#m;
#mWatteled Ibis#m;
#mWhite-billed Starling#m;
#mSpot-breasted Plover#m;
#mWhite-backed Black Tit#m; and others.

//Simien Fox

Though it is named after the #mSimien Mountains#m, the Simien Fox, which is also referred to as the Simien Jackal or Ethiopian wolf, is very rarely seen in Simien Mountains now. It is more common in #mBale Mountains National Park#m in the south of the country. Its high-pitched call may be heard at night, and its bright red coat is distinctive during the day. It feeds on the
many species of rodents found here.

See the #mpicture of the Simien Fox#m.

Click here also to hear the #msound of Simien Fox#m.

//Gelada Baboon

Gelada Baboon is an endemic animal which is found in #mSimien Mountains National Park#m. These baboons are grass eaters and will be seen in family units in many areas, one male guarding his harem of females and young ones. They are also known as the 'bleeding heart baboons' as there are red areas on the chest that show the sexual state of the animal.

See the #mpicture of the Gelada Baboon#m.

Click here also to hear the #msound of Gelada Baboon#m.

//Walia Ibex

Walia Ibex is an endemic animal where most visitors wish to see. This animal is found in the #mSimien Mountains National Park#m. The male of this member of the wild goat family has magnificent heavily ridged horns sweeping back over its shoulders. The Walia live on the crags of the steep escarpment, their hooves clinging to the smallest ledge.

See the #mpicture of the Walia Ibex#m.

Click here also to hear the #msound of Walia Ibex#m.

Declaration

This thesis is my original work and has not been submitted for a degree in any other university.

Melaku Kebede Eshetu

16 May, 1997

The thesis has been submitted for examination with my approval as university advisor.

G.G. Chowdhury

16 May, 1997