

# Digital Tourism Security System for Nepal

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## Abstract

Nepal is a sensitive and disaster-prone country where safety and security risk are of high concern for travelers. Digital technologies can play a vital role in addressing safety and security issues in the country. This research work proposes a Digital tourism security system design for addressing the safety and security issues in tourism industry of Nepal. The study uses Design science research methodology to identify artifacts, interactions, information flow and dependencies between them which are then mapped with existing prevalent technology to provide design solutions. Data is obtained from interview of tourist and experts as a primary source and technical documents/draft, software documentations, surveys as secondary source. Generalized information model, Use cases model, Network architecture model, Layered taxonomy model and Digital tourism technology reference model are the outcomes of the study. The work is very important as it talks specifically about implementation and integration of digital technologies in tourism security governance at federal, provincial, municipal and rural level. The research supplements as a knowledge document for design and implementation of digital tourism security system in practice. As there is very less work on digital systems in tourism security of Nepal, this work is a pioneer and first of its kind.

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**Keywords:** Nepal tourism, Risk management, Security systems, System design, Tourism governance.

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## 1. Introduction

**T**ourism security is a matter of great concern and it serves as an important parameter while tourist plan to select a destination for their visit. In general, tourist avoid travelling to places that are dangerous, risky or have some form of security concern attached with it. Safety and security are considered as one of major factor that is capable of causing change in the tourism industry in this new millennium [1]. Tourism industry is sensitive to crime, terrorism, food safety, health issues, natural disasters and any kind of social and political instability. These factors play a vital role for the rise or fall in the arrival of tourist in a particular destination [2]. Safety and security concerns are important for building up an image of a destination and a reason that keeps the visitors keep visiting the place. The guarantee of a safe travel increases the viability of business leading to sustainable tourism as well [3]. The governments around the world are concerned about the tourism business and they attach a lot of importance to tourist security. Many different countries have introduced Information and Communication Technology in their security system and formed strict laws and rules for providing a safe and open environment for the tourist destinations [4]. There are always special kind of police services, emergency services and rescue services that work very close during critical situations and mitigate any kind of risk that occurs in tourism sector [5]. The Travel & Tourism Competitiveness report has identified 4 major and 14 minor factors that guarantee the quality and sustainability of tourism destinations [6]. The enabling environment of tourism industry includes business environment, safety and security, health and hygiene, human resources, labor market and ICT readiness. Safety and security and health and hygiene are more closely related to personal and group safety which makes up as the primary component of tourism business. The ICT readiness is a very important tool that enables proper information collection, storage and distribution during risk and crisis management [6]. Hence, ICT has a great role to play in security, safety, development and management of tourism industry [6] [7].

Nepal is a popular tourism destination but has been a victim of unsecure destination image due to its geopolitical situations. The country faces serious challenges for providing safe and secure environment to the tourist visiting different destinations in the country [7] [8]. Nepal relies heavily on tourism industry as one of its vital fortune earners and job creators. The direct contribution of Travel & Tourism to GDP in 2018 is US\$0.8bn, representing 3.6 percent of GDP with 945,000 direct and indirect jobs in 2018, or roughly 6.4 percent of total employment [7]. Tourism is the second biggest industry of Nepal and is faced by many challenges in terms of poor infrastructure, difficult terrain, poor health and hygiene services, poor transportation and safety and security issues [7][8]. The issue is not only related to listed components but lack of ICT implementation and e-readiness of the country in tourism industry is also very poor [9]. The data from literature survey indicates that accidents in Nepal generally happen due to insufficient information, inappropriate equipment, inaccurate estimation, sudden weather changes and natural disasters, etc. [10]. The other reason that accounts for this is, poor communication channels, lack of synchronization among government, public, private and security agencies and there are no concrete execution mechanisms for risk monitoring, mitigation and management during crisis. The tourism governing bodies have policies and well documented action plans for emergency situations but the absence of a system to connect all the associated partners during such situations is missing at large [11]. Further, there are no pre-assessment systems working actively that can analyze data, information and events happening at regular intervals in tourism. The application of Information and Communication Technology has proven itself as a successful tool in working with security and disaster situations around the world. Nepal lacks the good implementation of an integrated information

system and good use of ICT system which can work with safety and security issues at all times. It argued that Information and Communication Technologies (ICT) systems are the immediate need of Nepalese tourism industry to improve the quality of tourism, work efficiency and management during disaster, crisis and security situations [12].

We argue that, as Tourism is the second most important industry of Nepal [6] that has huge role in the economic upliftment, job creation, sustainability and overall development of the country, the implementation of ICT technologies must be prioritized. A digital blue print for the tourism industry that works with different aspects of tourism like security and safety, sustainability, operations and management, promotion and advertising and institutionalization of policies and strategies must be implemented and integrated at all levels [6]. Further, information integration from different sources, collection at different levels, storage and management with proper mechanism for distribution also needs an introspection. In the light of above knowledge, it is inferred that digital tourism security system is very important component of tourism business and it must be implemented as a priority in Nepal.

## 2. Literature Review

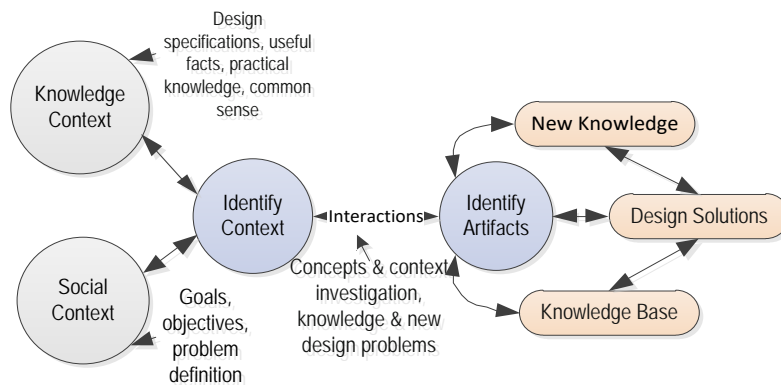
The World Trade and Tourism Organization has predicted that the average growth of tourism industry will be in the range of 3.4% by 2030 [6]. The statistical figures depict that global tourism industry has grown in the last decade and will continue to grow in future also [6]. Seeing the trend of global tourism industry, it is important to identify factors that are responsible for the growth and development of tourism industry, so that maximum benefit can be harnessed from this industry. Different authors have discussed different types of risk in tourism destinations and the role they play in selection of tourist destinations by the tourist [13]. Authors have argued that perceived risks and security issues is seen differently by different tourist individual and their decisions choices can also be relatively different [14]. Some tourist may drop a destination for a particular risk and security issue while the other may choose the same destination [14]. Authors include illness, crime, natural disasters, health problems, cultural risks, language barriers, uncertainty about specific laws and regulations, and transportation as important risk types [15] while some authors also suggests the risk of time waste, the risk of travel dissatisfaction, the risk of facing social problems, psychological risk, physical risk, operational risk, financial risk, the risk of political instability and the risk of health problems as the most important types of tourism risk [16]. With regard to the classifications mentioned in previous studies, given the fact that potential tourists have a limited knowledge about the characteristics of the tourism destination, the image of a destination which is formed in the mind of them is a key factor in selecting that destination [17]. Tourism destination inferred risk is one of the most important factors that can affect the mental image of tourists. Those who feel more risk in travelling to a specific destination, look for more information about that destination. Overall risk is an important attribute that serves as one of the major criteria for the selection of destinations by tourist around the world [18].

Tourism and technology has a great bond with each other since the development of internet applications [14]. Studies related to impact of technology on business, social context, development of tools, design of systems and solutions for tourism industry has always been a curious subject for researchers around the globe [16][17] [18]. Technology has found its heavy use in tourism industry including destination management, travel management, food and cuisine to personal recommendation and assistance. The use of technology during crisis, disaster management, risk and emergency situations has provided successful insights with accurate data and helped in making decisions at the right time [6] [9][12][13]. A number of

studies have been done on disaster and risk which include warning systems for highly aggregated crowd [20], IoT based warning systems for snow melting[21], IoT based earth quake warning systems [22], Big data and geo-spatial data study for smart environment [23], Social analytics for disaster management [24] etc. These technological systems have proved themselves as vital source of information and successful technological tools for risk and disaster mitigation, management and recovery.

Tourism studies have always attracted researchers from Nepal who have studied different aspects of tourism that include destination management, social impact, travel management, promotion and marketing, governance and operations but very less studies existed on risk and disaster [8]. Tourism risk in Nepal became important subject of study only after the earthquake in 2015 which led to huge loss in terms of human death and physical devastation. Authors have studied different aspects of tourism security related to natural disaster, human life, air crashes, health, hygiene, disaster and damage [25]but there are no evident studies in the field of digital system in safety and security management. There is an existence of few digital communication systems that work for disaster recovery and management but the availability of text or research in this area is limited. A report entitled National Position paper on Disaster Risk Management in Nepal is only the available document that talks about disaster and use of ICT system in emergency and disaster management. Besides this some other notable work includes the paper from Shrestha and Jeong, who have proposed an ICT framework for digital tourism model of Nepal [26], Devkota et. al. has worked with two very important research that include Utilizing User Generated Contents to describe Tourism Areas of Interest and Using Volunteered Geographic Information and Nighttime Light Remote Sensing Data [27] and Tan et. al. talked about challenges and barriers of ICT in tourism industry of Nepal [8].

### 3. Research Framework



**Fig. 1.** Research Framework based on Design Science Research

The research framework is based upon Design science research where the basic research is based on identifying the context, artifacts and interaction between the artifacts to understand problem domain. The context is dependent on two components that include the social context and the knowledge context which provides input to the problem scenario under consideration. The social context is defined by goals, objectives, problem definition while the knowledge context consists of inputs from problem scenario, extraction of useful facts, practical knowledge blocks, use of common sense and software engineering system standards that provides input for design solutions and knowledge building[28]. The output of this work is the

production of new problem-solving knowledge, design solutions and knowledge base of the system as shown in **Fig. 1**. The approach of this method is iterative and every iteration adds knowledge to the existing model to come up with enhanced and improved system model. The iteration is represented by the bidirectional arrows in the figure between different components of the proposed research methodology. This approach has application in different information system design application including digital ecosystems, computer based information systems, management information systems, etc.

#### 4. Tourism Security and Technology Facts and Figures

Nepal is considered as a risky country and stands at 84<sup>th</sup> rank out of 176 countries in the world security index with a score of 5.90/10 as per 2019 report as shown in **Fig. 3** [9] [10]. The country ranks 111<sup>th</sup> among 195 countries in the Global Health Security Index developed by The Economist Intelligence Unit of the Johns Hopkins Centre for Health Security [29]. The data of the health index portrays that besides natural disaster; the overall index value has decreased in the recent years since 2008. The year 2008 had the highest value of 8.5 due to flood in Koshi river, 2007 had an index value of 7.6 due to flood in the same river, 2015 had an index value of 7.2 due to earthquake and in 2019. Besides the disaster and natural hazard tourist encounter other kinds of safety risk shown in **Table 1** below. Altogether 22 risk are identified and categorized in three scales as, Most prominent, prominent and less prominent based on literature survey and data frequency obtained from the text [29] [30] [31].

**Table 1.** Categorization of tourism risk based on occurrence. Ref [29][30][31][32]

S.N	Type of Risk	Remarks
1	Natural disaster	Most prominent with earth quakes, landslides, snow storms, etc
2	Trekking risk in Nepal	Most prominent with difficult terrain and high altitude sickness
3	Travel and accidents	Most prominent many accidents and loss of life, bad roads
4	Disease	Prominent at villages, Dengu, Malaria, Diarrhoea
5	Poor infrastructure risk	Prominent, poor technology, roads, buildings, bridges, etc
6	Social rules & regulations	Prominent at religious, civil and cultural sites
7	Culture and religion	Prominent for hindus, buddhist and christian missionaries
8	Drugs and narcotics	Prominent and leads to legal sentences and fines
9	Immigration security	Prominent with over stay, visa issues and similar kinds
10	Sexual crimes and Assaults	Prominent as womens issues, assault, prostitution, child abuse
11	Political strikes and bands	Prominent with sudden strikes and political deadlocks
12	Health care and safety	Prominent with prostitution, AIDS, STDs, Gonorrhoea, etc.
13	Wild life issues	Prominent with illegal killing, smuggling protected animals
14	Air lines security	Prominent, many accidents at regular intervals, unsafe air travel
15	Cheating tourist	Prominent, cheating tourist at taxi, travel fares, shops, etc.
16	Pick-pockets/bag-snatching	Prominent around bus parks near borderlines of Nepal/India
17	Begging (panhandling)	Prominent at religious sites, some tourist centers
18	Digital scams	Less prominent as Nepal is still poor in digital implementations
19	Theft and robberies	Less prominent with few reported in hotels and tourist places
20	Terrorism	Less prominent with tourist, but exists at remote areas
21	Pollution and environments	Less prominent extreme in metros, less in hills and villages

Nepal is prone to accidents both from natural disasters like landslides, earthquake, snow storms and as well from manmade like fire, road drifts, land erosion etc. Similarly, aircraft

accidents are also common and data shows that they have occurred at regular intervals in the year 2008, 2010, 2011, 2014, 2016, 2018, 2019 with 18, 22, 19, 19, 18, 23, 49 and 3 casualties [23]. The reports submitted on these accidents depicted that most of these accidents accounted from poor weather conditions and lack of concrete information [30] [31]. Similarly, tourism report published by Nepal government showed that in the year 2018, 619 cases were specifically reported in tourism sector which included 450 lost or missing of valuable objects, 131 cases of theft and stealing, 18 frauds 7 harassment, 4 damage one or two related to pick pocketing, cheating, attack and misbehavior. An alarming data published in 2017 by leading news media The Himalayan Times reported that 62 tourists have gone missing in the last five years with unknown reasons and the high number raises concerns on tourism security [31]. The health and accident-related data and causes of death in 2017 in Nepal from tourism perspective includes, road accidents as 9.1%, HIV and AIDS accounting for 0.15% in adults, diarrhea 5.9%, lower respiratory infections 5.1% of total deaths [32]. This data is indicative of health and hygiene situation in Nepal and requires that information regarding such sensitive places and issues must be communicated properly to concerned tourist and stakeholders. It is further noted that it is not only the risk and disaster that has alarming concern but the state of rescue operation is also poor, which further worsens the conditions. The rescue operations are subject to poor communication, lack of strategic plans, resources, unskilled manpower and has no active preparedness for mitigation. The lack of integration of rescue divisions, public and private agencies and local bodies creates a vacuum in the risk mitigation and management.

The literature and textual evidences show that role of technology is indispensable for ensuring safety and security in tourism industry. Therefore, it creates a need for Nepalese tourism industry to trace its position in term of e-readiness and digital implementations in Nepal. The digital framework of Nepal and existing literature show that Nepal is considered as an evolving nation in technology breakthrough and implementation [6]. The E-Government development index rank for 2016 was 135 [7] and current department maturity is standing at 1.85 with process state as 'Managed' [7]. In mobile communications the rate has increased from 25% in 2013 to reach 65% in 2017 and it is forecasted to rise by 136% by end of 2022 [6][12]. Internet penetration rate has risen from 21% in 2012 to 57% in 2017. There are 250 new Internet users per hour where teenagers and youth are the focused group. In social networking area, as of January 2018, there are nearly 9.3 million Facebook users with 6.4 million registered users engaged in entertainment and video sharing on YouTube [6] [27][31]. The world bank data report of May, 2017 shows there are more than 56,286 registered websites in Nepal, including 40,000 commercial websites. The top three telecommunications operators in Nepal have launched 4G services in 2017 [6][7][31] with 2,144,887 subscribers. The ICT policy was framed on 2015 but implementation is at lower side and needs a unique administrative framework to enforce it [6] [12]. The data concludes that the opportunities for digital and communication technology look promising considering the growth in recent years.

## 5. The Tourism Security System Context

The above data and literature study depicts that tourism security is an essential part of tourism industry that must be addressed specifically for survival and success of tourism sector. The security scenario, technological scenario and the evidences from literature show that digital implementation is a critical need of Nepalese tourism industry that requires immediate initiation at all levels. Design Science research is one of the best methodology for the information technology systems as it captures human interactions and capabilities of organization by creating new and innovative artifacts that help in the design and development

of solutions to computer based systems [28]. Tourism security system is a social information system that has tourist as its target audience and tourism organizations as stakeholders in implementing security in tourism sector, which requires an introspection at human and machine side at varied levels. The following sections identifies the social context, knowledge context, related artifacts and interaction for design and development of security system model.

## 5.1 Social Context

**Table 2.** Representing major risk factor, problem description and respondent type

Major Risk Factors	Problem description	Ref.	Respondent Type
Infrastructure Issues	Congested tourist areas, poor management, regulations, laws	R1.1	GO, TO, TB
	Lack of last-mile connectivity in remote areas. Inaccessibility.	R1.2	GO, TO, TS
	Bad roads, Road safety issues, congestion, bad construction	R1.3	GO, TO, TB
Tourism Facilities	Lack of ATM, information centers, exchange counters	R2.1	GO, TO, TB
	Poor internet connectivity in treks, unable to track tourist	R2.3	GO, TB, TS
	Poor digital approach for hotels, vehicles and services.	R2.4	GO, TO
	Lack of standard prices, standard norms and standard policies	R2.5	TB, TO,
	Absence of digital systems during risk and emergency	R2.6	GO, TO, TS
ICT Infrastructure	Poor digital payment systems, International payment systems	R3.1	GO, TO, TP
	Tourism digital trekking cards don't work in remote locations	R3.2	GO, TO, TP
	Lack of integration between federal, provincial & local level	R3.3	GO, TO, TB
	Lack of system for data storage, processing, and distribution	R3.4	GO, TO, TB
Tourism Information Availability	Poor information: health and hygiene, disaster, biodiversity.	R4.1	GO, TO, TB
	Fragmented data and information clusters, incomplete data, poor integration, data quality, authenticity, inaccessibility	R4.2	GO, TO, TB, TP, TS
	Information authenticity, validity, variety, uniformity, access	R4.3	GO, TO
	Lack of post and pre risk analysis, prediction & management	R4.4	GO, TO, TS
	Less data on digital platforms, books, brochures, sources	R4.5	GO, TO, TP
Marketing & Promotional Strategies	Poor promotional activities of tourism products & services.	R5.1	GO, TO, TB
	Poor approach in capitalizing mountaineering, pilgrimage, medical tourism and ecotourism features.	R5.2	GO, TB
	Inability to diversify tourism products and services	R5.3	GO, TB, TP
	Poor grievance handling for tourists channels: email, media	R5.4	GO, TB, TP
	Tourists' negative perceptions about safety and security risks due to past instances, terrorism and natural disasters	R5.5	GO, TO, TB
Work Force and Manpower	Brain drain, Skilled labor migration, International investors	R6.1	GO, TB,
	Hiring unskilled men from rural areas due lack of manpower	R6.2	GO, TB, TP
	Lack of experience in tourism, Guides lack proper training	R6.3	GO, TB
	Gender, social and cultural issues. less women in tourism	R6.4	GO, TO
Policy and Governance	Imbalanced tourism policy: International and domestic tourist	R7.1	GO, TO,
	No active risk mitigation and rescue plans at local level	R7.3	GO, TO, TS
	Improper management of tourism infrastructure, services during crisis, Poor driving regulations, poor law management	R7.4	GO, TO, TS
Geography and Landmass	Difficult terrain, high altitudes, low lands, inaccessibility	R7.5	GO, TO, TB
	Unpredictable and extreme weather with no support systems	R7.6	GO, TO, TS
	Absence of support systems for extreme geographical places	R7.7	GO, TO, TB
Social & Business Issues	Women work force missing at large to address gender issues.	R8.1	GO, TO, TS
	Lack of community participation, local initiations, standards	R8.2	GO, TO, TP
	Silos in governance model: poor administration, governance	R8.3	GO, TP
Abbreviations used	Nepal Government Officials: GO Technology Professionals: TP	Tourist: TO	Tourism Business Personnel's: TB Tourism Security Personnel's: TS

Social context is a very important component for understanding the requirement of a system. It is the representation of people, organizations, business processes, services methods, techniques, conceptual structures, computer systems and interaction between them [28]. The proposed digital tourism security system is a social system working for the safety and security of a tourist visiting a particular destination in Nepal. To understand the system requirements, all the relevant actors related directly or indirectly with tourism security system and environment are considered. Social context is identified by interviewing people which include tourist, experts and personnel's having knowledge of safety and security in tourism sector. The approach taken is to interview at least two to three personnel of every class who has sound knowledge in technical, social and legal aspect of tourism security system and environment. From the perspective of Nepal, officials with good knowledge in digital and e-governance implementations are chosen. The list of respondents includes IT Directors from Ministry of Tourism and related departments, Nepal Information and Technology Center, Tourist Police, Computer Engineers and Entrepreneurs/Chairman of Travel and Tourism organizations. The tourists were randomly selected based on availability and their response when making contact provided by Nepal Tourism Board.

The interview data regarding social context identified 9 major categories that includes Infrastructure issues, Tourism facilities, Information and communication technology infrastructure, Tourism information availability, Poor marketing and promotion, Tourism manpower and Work force, Policy and governance, Geographical /Landmass and Social and business issues. The categories further had 37 problems identified from responses of 5 categories of tourism stake holders which included Nepal Government Officials: (GO), Technology Professionals (TP), Tourist (TO), Tourism Business Personnel's (TB), Tourism Security Personnel's (TS) as shown in **Table 2**. The further analysis on digital implementation situation and other tourism issues revealed that the problems rooted to perception of digital system in the mind of political leaders, government officials and general people. The top officials and strategic planners have limited knowledge on the role of ICT in security, governance and business which leads to poor budget allocation, poor project initiation and delay in project finalization. These issues further escalate the problem leading to poor planning, design and implementation hence losing further support and funds. The gap in lack educated and skilled manpower at different levels of tourism governance and management add up more critical issues due to their incapability of using digital systems. Economical resources, political instability, cultural rigidness and poor business models contribute further for the inability of Nepal to develop required system in different governing and business fields. All these social factors contribute to poor management of overall tourism industry of Nepal leading to safety concerns in the industry.

## 5.2 Knowledge Context

The knowledge context of a system development works by identifying current design specifications, useful facts and data related to product development, past experience, knowledge document and common sense to produce new design solutions and knowledge content [28]. The expert group served as important input in the analysis of knowledge context of digital tourism security system for Nepal. The interview data portray that problem in building of such systems is attributed to multi-dimensional scenarios. The issues that are responsible at the higher level include national issues, business issues and technological issues. The national issues are limited by infrastructural issues, geographical issues and social issues where as business issues relate to governance issues, tourism practices and customers'



requirements. The development of digital tourism security has challenges in terms of technological infrastructure, incompetent human resource, bureaucratic system, geographical scenario and adverse climatic conditions. The government of Nepal greatly relies on private sector for tourism development which leads to lack of standards and governing policies for security. The acute competition among tourism business organizations, lack of coordination among entities, poor approach for safety and security management and absence of proper documentation of incidents in the tourism limit the existence of a good system in place. The untrained and less competent manpower as tourist guides and business owners add more complications for a good tourism security in practice.

Tourist are the main stakeholders who consume the security related information in tourism destinations and an understanding of knowledge in term of these stakeholders is a very important aspect for this design. The tourist coming to Nepal belong to different countries and have different backgrounds with different expectations and needs binded to them. Safety and security at every step can be a priority for one section of tourist while other may want to enjoy the same environment as adventurous and challenging. The interviews data reveals that whatever section a tourist may belong to, he is conscious of basic safety needs and would generally opt for the safe travel. The massive use of technology in their home countries and developed tourism destinations of other countries, create the same expectations in Nepal. Most sought information in subjects around food, hygiene, sanitation, water, landmass, travel routes, cost, weather conditions and information on destinations. These type of system are either in a poor state or are missing at large in Nepal. Further, the success factors of technology depend on utilization of technology, user experience and their expectations with the technology. Therefore, a well-designed ICT system is the core need in the current time due to its capability of data collection, processing, analyzing and distribution in real-time. The higher level factors for a good Digital tourism security system are shown in Fig. 2.

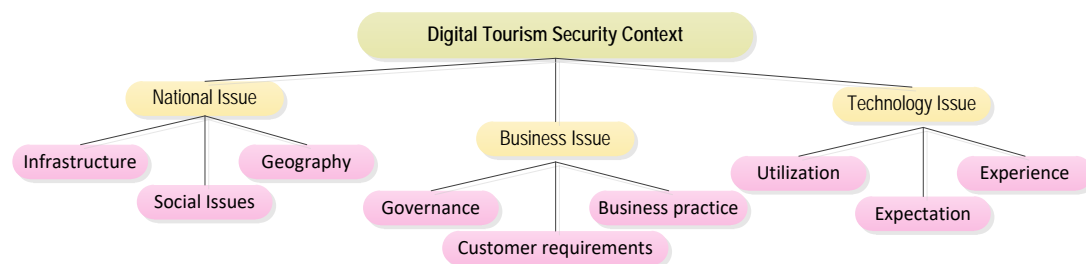
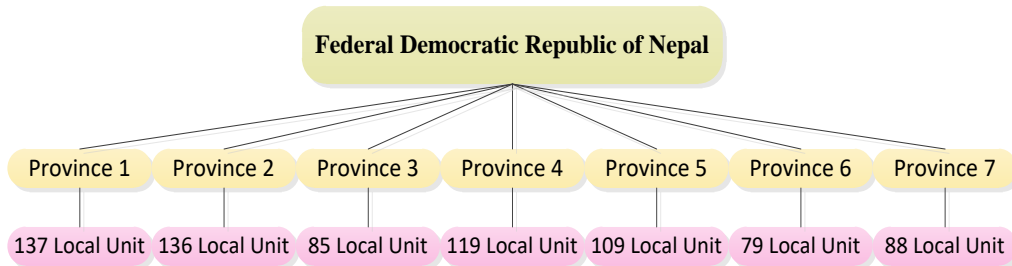


Fig. 2. Representing factors related to Digital Tourism Security System

### 5.3 Analyzing the Tourism Governance Artifacts

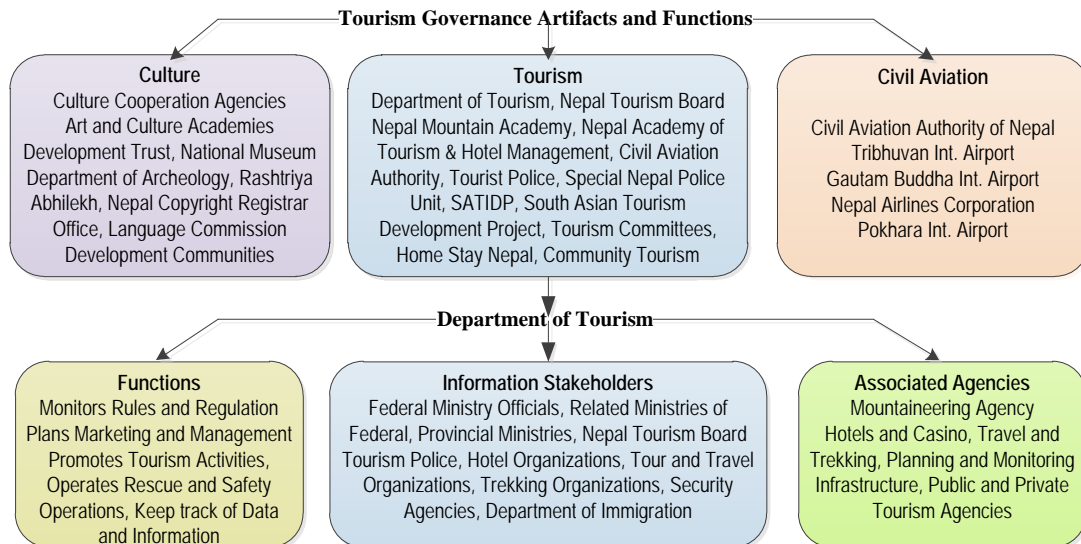
The tourism governance in Nepal is under The Ministry of Culture, Tourism and Civil Aviation which is responsible to frame rules, regulations and policies for tourism industry as well as implement safety and security protocols in the country. Nepal witnessed a change in the political system in September, 2015 with the introduction of new constitution which resulted in the replacement of the old constitution [6]. The new constitution restructured Nepal into Federal Republic with three tiers of government that includes Federal government, Provincial government and Local government. The new constitution provides autonomy to Provincial government to draft its own rules and regulations, plans and policies without being in conflict with the Federal government [6]. The new federal structure consists of 7 provinces, 77 districts and 753 local administrative units as shown in the Fig. 3. The change in governance

model of Nepal has led in the change of tourism governance which demands that any further planning and implementation in tourism must be in coherence with the new constitution.



**Fig. 3.** The Governance Model of Federal Democratic Republic of Nepal

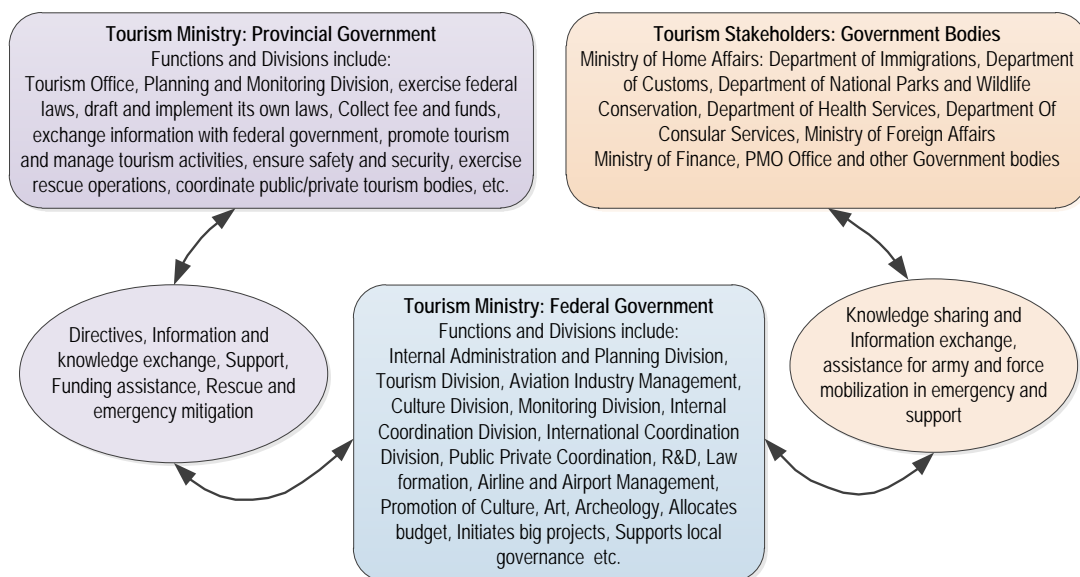
Federal government is the central body that is the first layer of the governance system, the provincial government forms the second layer and works with local governing bodies (third layer) to implement the rules, regulations and policies of Nepal government. The process of implementation of laws, action plans and strategies is through mixed approach, which is a combination of top-down and bottom-up mechanism. Though the model structure is a three layered model, every layer exercises independence, autonomy and control. The security and safety management in tourism is also managed in the same layered structure where drafting of a law and order, budget allocation and upper level governance is subject to the federal government, the lower level governments are free to modify and exercise federal rules and regulations according to their own needs. The only restriction to the amendment is to see that local governance rules, regulations strategies and policies do not get in conflict with the federal government.



**Fig. 4.** Nepal Tourism Governance Artifacts and Existing Functional Processes

The **Fig. 4** represents the Tourism Governance structure that consist of three major divisions at the first layer Culture, Tourism and Civil Aviation. Tourism is the major components of the ministry that is fully responsible for governing of tourism industry and

activities in Nepal. The ministry exercises its law, order and regulation through different divisions which include Department of Tourism, Nepal Tourism Board, Tourism Academies, Tourist Police, Tourism Committees, Home Stay, Tourism Associations and Project Development and Implementation Divisions. All the above divisions have their specific job in terms of regulating, promoting and managing tourism governance but Department of Tourism is the most important division that takes care of all other departments and extensions. Tourism is a multi-dimensional and information intensive sector which is associated with almost every other sector of governance. These departments share information, business processes, operational mechanism and governance mechanism to manage Nepalese Tourism Industry [31]. The onsite visit and interview of tourism officials stated that digitalization in the tourism governance is progressing at a slow speed and there are very few systems that are implemented in the tourism ministry that work with modern approach in tourism management. Some information systems under progress included, Assets Management System, Centralized E-tourism MIS, Digital Complaint Box, Office Automation and Tourism Management Information System. To provide security to tourist only two systems were in existence which included Trekkers' Information Management Systems (TIMS) and Digital Complaint Box.



**Fig. 5.** The Information Flow Model of Tourism Governance and Coordinating Entities

The analysis of the Tourism governance infers that there is no direct system that is deployed for the safety and security of the tourist and tourism destinations. Safety and security is taken as an associative component of tourism governance and the security agencies come into action only when an incident or disaster occurs. A traditional risk mitigation strategy is in practice that consist of regular patrols and routine checks at allocated places and time. The safety of tourist at first hand is directed as a duty of agency who has invited a tourist or person inviting them. In case of emergency also, it is the agency that first informs the Department of Tourism for help and rescue operations, which further informs its associated agencies to act and coordinate. The Department of Tourism is the main body that takes care of rescue operation and mobilizes the stakeholders consisting of Provincial Administration, Tourist Police, Civil Aviation, Public and Private Organizations, Armed Forces and sometimes Army

in consultation with the Ministry of Home Affairs when situations are of extreme nature. The Federal government has very clear directives for implementing safety and security related laws in tourism destinations all over Nepal. These directives are drafted with a great care so that it does not collide with tourism freedom and still act effective in providing a safe environment. Further, to strengthen the tourism security, Nepal government has also come up with a special unit named as tourist police that is specifically established to provide special attention to tourist safety and security.

Tourism safety is a highly information dependent service where timely and rich information is required between agencies to efficiently carry out rescue operations. A high cohesive information exchange and support between governing bodies and agencies at three levels of governance in Nepal is utmost requirement for tourism security implementations. **Fig. 5** depicts a working model of tourism governance that shows the individual scope of work, operational processes, functions and association among governing artifacts. It can be concluded that the working model lacks an integrated and real time approach mechanism in case of security concerns between security agencies. A vacuum and lack of digital integration is seen between the security governance entities which creates an operational deficiency during risk management and mitigation. Lack of data storage, processing analyzing, forecasting mechanism further weaken the tourism security scenario in Nepal.

## 6. Digital Tourism Security System: Concepts, Analysis and Design

This section propose Digital Tourism Security System Model at different levels of abstraction to address the needs of digital tourism security system in Nepal. The analysis from interview, survey and literature along with current technological development is considered as the base to propose models for different digital scenarios of tourism security. A Generalized model (Artifacts and Information flow), Use Cases Model, Network Architecture Model, Layered taxonomy model and Digital Tourism Technology Reference Model are analyzed, designed and proposed to come up with an effective integrated solution for digital tourism security in Nepal.

### 6.1 Security System Requirements and Technology Overview

Digital tourism security system is an information intensive, real-time based system that works with huge data sets and distributed sources. The development of such system must take care of tourism business requirements and the technological advancements before proposing or recommending any design solutions. The system must have a robust communication network that is able to work during emergency and post disaster situations, handle interoperability as data and information sources coming from different hardware and software platforms. Data standardization is the biggest challenge with data collection, cleansing and compiling from varied sources. This requires huge set of algorithm to address this issue and handle data integrity. The rise of social networks and internet based information systems have introduced crowdsourcing as a news source of data which works with geo tagged tweets, live data streams, text based data and other rich meta data. The digital tourism security system should be able to integrate all these technological developments to provide powerful, real time predictive systems. The advancement in technology has opened doors to different types of technological implementations with proven solutions. The **Table 3** represents some of the successful technological advancements and software solutions that have worked and have been tested in disaster and post disaster situations. These technological advancements can be used as current technological solutions and serve as a base for the recommendations of different

system models for digital tourism security of Nepal.

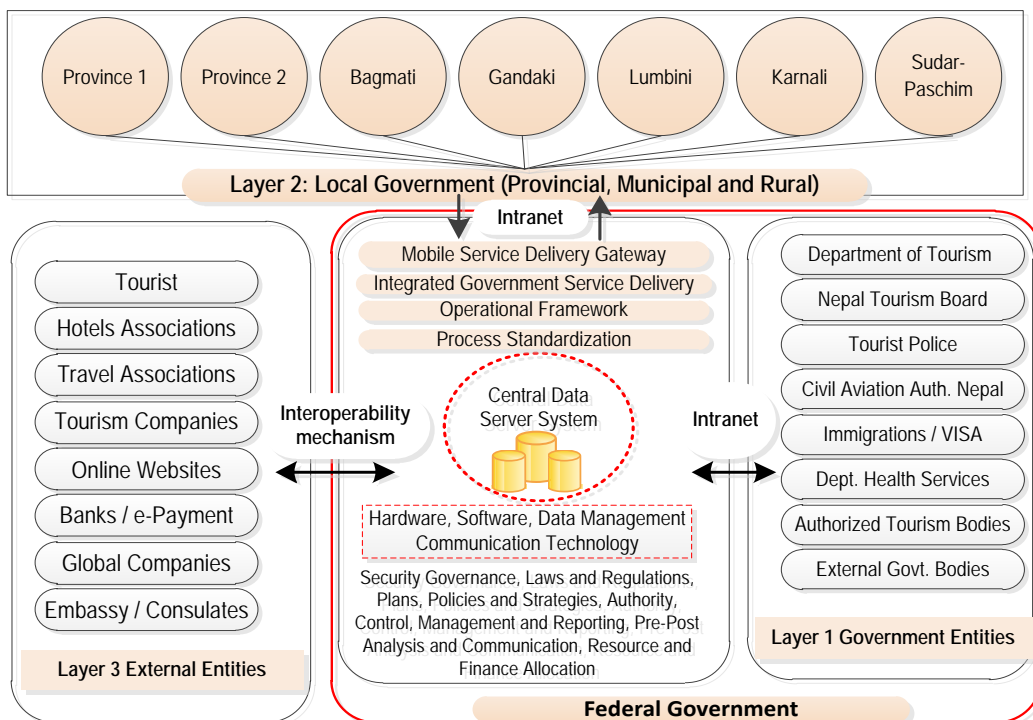
**Table 3.** Review of Technological advancements and solutions for Disaster and Security.

Publisher and Year	Research Area	Inference	Data Type	Ref
IEEE Access, 2019	Highly Aggregated Tourist Crowds Safety in China	HATCs System model prediction and warning	Geo tagged data, text data	[19]
Sustainability 2019	Geographic tweets, Nighttime Data for Tourism Area of Interest	Model and algorithm for Tourism Area of Interest	Geo tagged data, text data	[27]
Journal of Tourism, 2000	Safety and Security in Tourism	Conceptual framework	Survey, interview	[33]
IEEE Digital Explore, 2013	GSM/GPS based vehicle tracking	Real-time text alerts for vehicle	Geo tagged data, text data	[34]
ACM, Proceedings 2015	Social media sentiment in disaster	Visual analytics framework	Geo-data, text data	[35]
Springer 2016	Tourism risk perception	Security model	Survey data,	[36]
KSII -TIIS, 2016	Quality of service in Multi-tier Web	Resource usage and service quality	Survey based study	[37]
ACM, Proceedings 2017	Spatio-temporal data study for risk management	Spatio-temporal analytics system	Textual and spatial data	[38]
KSII -TIIS, 2018	Maturity models in critical infrastructure	Quantitative model for security	Survey and simulation	[39]
CISTI , 2018	Technology usage for safety and security	Model for technology and security	Survey and social data analysis	[40]
Inf. Syst. Frontiers, 2018	Big data crisis mapping system	Model for information on disaster	Social and spatial data	[41]
Sensors, 2018	Crowdsourced and sensor data in disaster	System for flood risk management	Social, geo-tagged, textual	[42]
Journal of Computer, 2014	Interoperability in Big, Open, and Linked Data	Interoperability framework	Meta data	[43]
IEEE Xplore, 2014	Interoperability of Systems	Ensured at technical, syntactic, semantic and pragmatic levels	Meta Data	[44]
Int. J. Disaster Risk Reduction 2016	Wireless sensor nodes for the disaster information management	Measured the output and improved the model	Meta data	[45]
ACM Proceedings 2014	Big Data Analytics	Cleansing model and the accuracy improvement	Big Data	[46]

## 6.2 Digital Tourism Security System: Generalized System Model

Digital tourism security system needs to be implemented at different levels, the federal, the provincial, the rural governance, external entities and global stakeholders. The designed system should be able to integrates all the sectors, keeping the data, functional and operational integrity among them. The generalized model of digital tourism security system shown in Fig. 6 represents three core layers Federal (L1), Provincial and Local (L2) and External entities (L3), connected to each other. The layer L1 and L2 are connected to each other through intranet and layer L3 is connected through internet with interoperability mechanism that supports open data exchange for different types of data formats from different sources. Layer (L1) is the core layer that includes hardware, software, data management and communication technology as the technical artifacts and mobile service delivery gateway, integrated government service delivery, operational framework and process standardization as the services artifacts. All the

system layers are controlled by security, governance, laws, policies, strategies, reporting, authority control and execution mechanisms between one another. The provincial and local governance further have their own local server and exchanges data and information through controlled mechanism with the central server. The third layer L3 comprises of artifacts that are external to the core system and serve as an important part of the system. These artifacts are the most important stakeholders who provider information, consume information and use the digital tourism security system. The layer 3 artifacts are business entities that are either the direct consumers or are in direct contact with the consumers of tourism products and services. The relationship between artifacts is bidirectional depending on the information type and requirement during risk mitigation and management situations.



**Fig. 6.** Digital Tourism Security System: Generalized System Model (Artifacts and Interaction)

### 6.3 The Use Case Model

Use cases are excellent way of capturing system processes from narrative description of domain processes. They provide partial understanding of the system and are used in analysis and design phase of a system modelling. It helps to capture the requirements in an excellent way describing the sequence of events of an actor with the system [47]. To further investigate and understand the requirements of the digital tourism security system, high level use cases of the system are identified. The digital tourism security system needs to address a number of pre-risk and post-risk situations. In pre-risk situations it needs to sense, monitor, process data, perform analysis, forecast risk, make prediction and issue warnings while in post risk situations it needs to invoke security mechanism, provide information, coordinate security agencies, allocate resources and manage reporting. Data processing, storage and update status in the concerned systems is a continuous function that system must perform at all times. The use case model shown in Table 4, represents primary use cases, actors and their description in the system context. Altogether 11 high level primary use cases are identified for the first level

of abstraction that cover all the major processes required in the design and development of Digital Tourism Security System. The use cases are built based problem identification in **Table 2** with problem reference number R1.3, R2.6, R3.2, R3.3, R3.4, R4.1, R4.2, R4.3, R4.3, R4.4, R4.5, R5.4, R5.5, R7.4, R7.5, R7.6 and R8.3 respectively [48]. The problems were extracted and formulated into a design solution in the form of processes of the system and depicted as Use cases as shown in **Table 4**.

**Table 4.** Primary high level use cases for Digital Tourism Security System

Use Case	Actor	Type	Description
Sense and Monitor	Department of Tourism, Provincial Tourism Office, Security Agencies	Primary	The system keeps tracking data received from various sources and in case of abnormal data instigate actors
Prediction & Forecasting	Department of Tourism, Provincial Tourism Office, Security Agencies	Primary	Continuous sensed data is analyzed, emergency situations are identified, risk prediction & forecasting processed
Issue Warning	Department of Tourism, Provincial Tourism Office, Security Agencies	Primary	When the data looks definite and risk probability becomes high, then this use case sends warning messages to actor
Provide Information	Department of Tourism, Provincial Tourism Office, Security Agencies, CAAN	Primary	Send information regarding place, time, priority, management of risk through data and information exchange. Gives information to the requesting source depending on the privileges
Coordinate Agencies	Department of Management Provincial Tourism Office	Primary	Initiated by DoT, it works in active information exchange helping security agencies to coordinate with other actors
Allocate Resources	Department of Management Security Agencies	Primary	Works during rescue operations by estimating and allocating resources man power and machineries.
Perform Analysis	Department of Tourism	Primary	Helps with data from pre and post rescue situations to draw meaningful information to be used in future
Manage Reporting	DoT, Provincial Tourism Office, Security Agencies, Tourism Stakeholders	Primary	Provides information in different forms and patterns for understanding about safety and security issues
Process Data Storage	DoT, Provincial Tourism Security Agencies.	Primary	Receive data from devices, sources and applications, filter, extract and store data.
Update Status	DoT, Provincial Tourism Office, Security Agencies, Tourism Stakeholders	Primary	Back up information and data after processing in the system for use by the actors associated
Invoke Security Mechanism	Security, Devices, Communication Systems	Primary	Gets initiated with emergency and critical data by setting up an environment for rescue and disaster.

#### 6.4 Digital Tourism Security System: Network Architecture

Network and communication architecture is a primary system of digital implementations in the current governance scenario. The design of network architecture is controlled by many factors that include the governing structure, data exchange mechanism, security concerns, data sources, available technology, performance and user requirements. The proposed network architecture comprises of four layers that include Access layer, Building distribution layer,

Tourism core layer and Server farm module. Access layer provides important services, such as broadcast suppression, protocol filtering, network access, IP multicast, and QoS. The Building distribution layer provides aggregation of the access layer networks using multilayer switching and performs routing, QoS, and access control. Requests for data flow into the multilayer switches and onward into the Tourism Core layer. The Tourism core is the layer of the tourism infrastructure module which is high-performance, switched backbone that connects the tourism governing bodies (federal, provincial and local) and buildings of the tourism ministry. Specifically, this layer interconnects the Building distribution layer with the Server Farm layer and the other enterprise modules. Server farm layer provides internal users with application, e-mail, and DNS services as shown in Fig. 7.

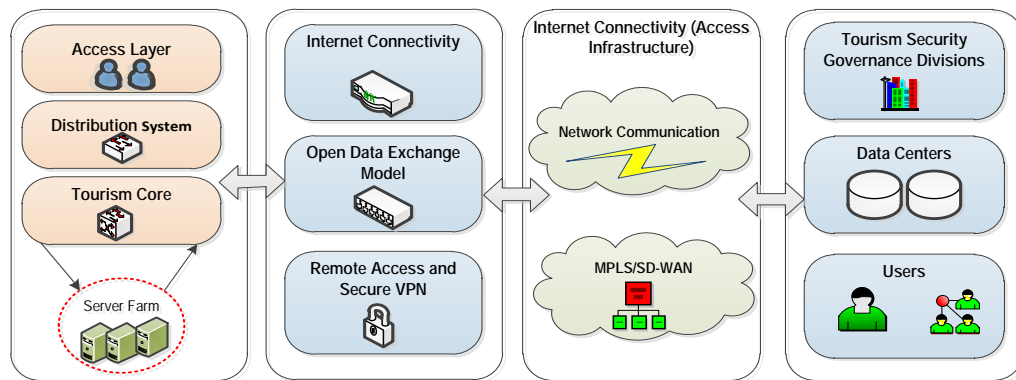


Fig. 7. The Digital Tourism Security System: Network Architecture

Table 5 represents the network architecture attributes in terms of latest technology, scalability, high availability, performance and cost per port for the Network infrastructure components, Access layer, Building distribution, Tourism core, Server farm layer and Edge distribution. The system needs a robust internet connection, open data exchange protocol and remote access and secure VPN as service components. The users are identified as all the external entities that exchange digital tourism security data through different devices and applications.

Table 5. Network architecture layers and attribute representation

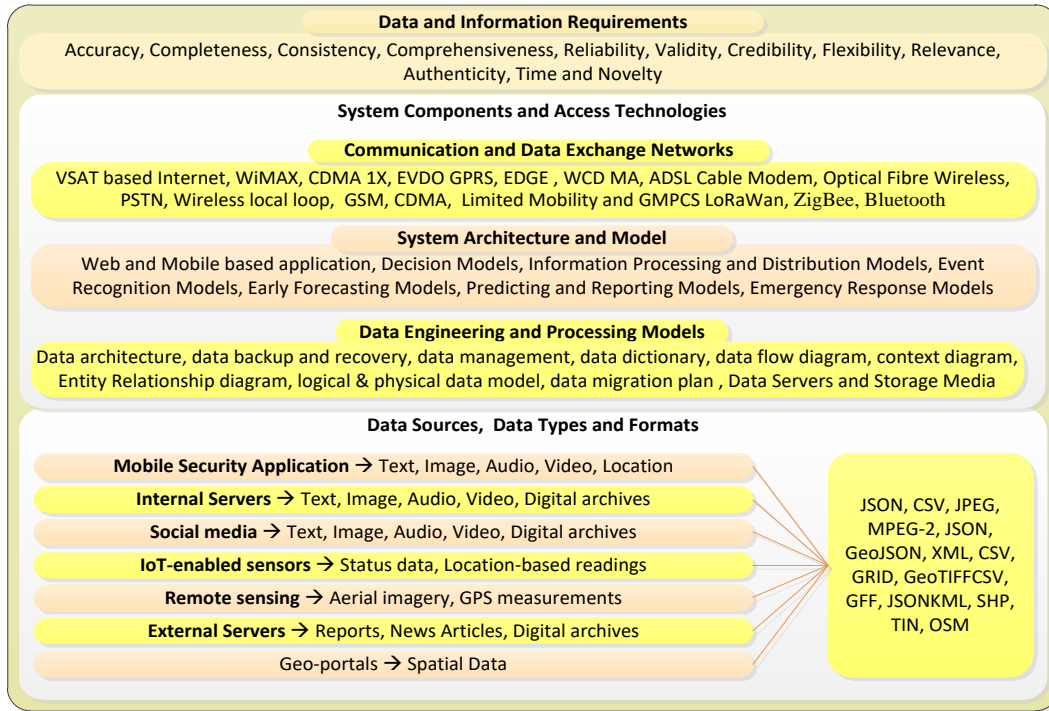
Requirement	Access Layer	Building Distribution	Tourism core	Server Farm Layer	Edge Distribution
Technology	Data Link Layer	Multi-layer switched	Multi-layer switched	Multi-layer switched	Multi-layer switched
Scalability	High	Medium	Low	Medium	Low
Availability	Medium	Medium	High	High	Medium
Performance	Medium	Medium	High	High	Medium
Cost per port	Low	Medium	High	High	Medium

## 6.5 Layered Taxonomy Model for Digital Tourism Security System

A system consisting of objects that are a part of system domain and their formal structure representation is known as taxonomy [49]. This work follows Nickerson et al. methodology for the construction of a Taxonomy model for this work [49]. The process involves an iterative approach and refinement is performed at different levels to design the structure. Literature



survey of existing technological developments, communication systems, network architecture, data models and quality parameters are considered as a knowledge base to design the Layered taxonomy model.



**Fig. 8.** A Layered Taxonomy Model for Digital Tourism Security System for Nepal

The layered taxonomy model identifies digital tourism security system components at different levels of abstraction by identifying specific attributes, categorization and correlation mechanisms. The first layer of data sources, data types and format includes Mobile security application which provide data in the form of text, image, audio, video and location. The second component of this layer are the internal servers which provide data as text, image, audio, video, and digital archives. Social media use has grown in the recent years and the data provided by social media is rich in information that includes text, image, audio, video, date and time. The IoT-enabled sensors provide continuous data in the form of status data, location-based readings whereas Remote sensing devices provide aerial imagery and GPS measurements. External servers which form an important component of this layer include media servers, news servers and external data servers which are rich in reports, news articles and digital archives whereas Geo-portals provide data as spatial data. The data obtained from these sources have formats like JSON, CSV, JPEG, MPEG-2, JSON, GeoJSON, XML, CSV, GRID, GeoTIFF, GFF, JSONKML, SHP, TIN, OSM as shown in the [Fig. 8](#). The second layer, security system components and access technologies consists of data engineering and processing models, system architecture model and communication and data exchange network model. The data engineering and processing models include data architecture, data backup and recovery, data management, data dictionary, data flow diagram, context diagram, entity relationship diagram, logical & physical data model, data migration plan, data servers and storage media as specific components of this layer. The system architecture and model consist of web and mobile based application, decision models, information processing and distribution

models, event recognition models, early forecasting models, predicting and reporting models and emergency response models as core components while communication and data exchange network model consist of technologies existing at present in Nepal which include VSAT based Internet, WiMAX, CDMA 1X, EVDO GPRS, EDGE , WCD MA, ADSL cable modem, optical fiber, wireless services, PSTN, wireless local loop, GSM, CDMA, limited mobility, Bluetooth [30] and other tested technologies like GMPCS, LoRaWan and ZigBee. Besides these taxonomy layers, a layer for data and information quality is also included which stresses that data and information requirements need to be accurate, complete, consistent, comprehensive, reliable, valid, credible, relevant, authentic and in near real time. The layered taxonomy helps in understanding the design parameters in an extensive detail which needs to be considered while designing the system at implementation level.

### 6.6 The Digital Tourism Security Reference System Model

The digital tourism security system reference model is a comprehensive model that represents artifacts, entities, technological recommendations, system cycle, governing laws, policies and information flow mechanism. The source layer recommends different data sources that are important in the current scenario and have proven their technological relevance in the security and disaster management (refer Table 3).

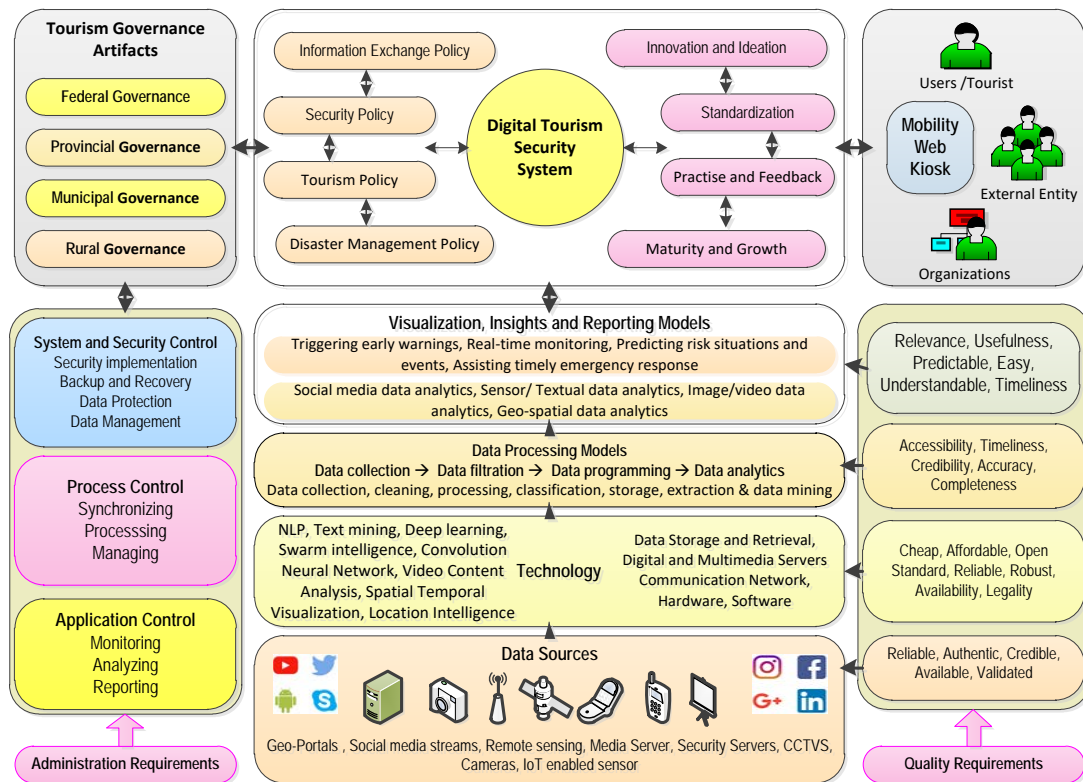


Fig. 9. The Digital Tourism Security Reference Model: Technology Architecture

These include geo-portals, social media streams, remote sensing devices, media servers, security servers, CCTVS, mobile devices, cameras and IoT enabled sensor. Any system needs a robust technology infrastructure for system to work properly. The technological components

proposed in this layer are the data storage devices, servers, communication network, hardware and software. Besides this the rising technologies like NLP, text mining, deep learning, swarm intelligence, convolution neural network, video content analysis, spatial temporal visualization, location intelligence are the core technologies required to make the system adaptive, intelligent and work in real time. Data model is a big challenge for the proposed system which requires a careful investigation in the design and development of database schema. A data collection, cleaning, filtration, normalization and storage is the core requirement of the data model. The database should allow programming, perform analytics, and extract patterns and information for tourism security purpose. Users need to use data and information which requires visualization, insights and reporting mechanism. The system proposes early warnings triggers, real-time monitoring, risk prediction and emergency response models. These models can be constructed using social media data analytics, sensor/ textual data analytics, image/video data analytics and geo-spatial data analytics.

The digital tourism security system for Nepal is a tourism governance model and needs to follow administrative protocols that can be implemented through application control, process control, system and security control procedures. The associated component of administrative requirements is shown in the [Fig. 9](#). System development is proposed as an iterative process which includes innovation, ideation, standardization, practice, feedback, maturity and growth with the passing time. The quality requirements are reliability, authenticity, credibility, availability, validated, affordability, legality, accessibility, relevance and must follow open standard. The related artifacts federal, provincial, local external stakeholders are dictated by information exchange policy, security policy, tourism policy and disaster management policy. The technology reference model shown in [Fig. 9](#), is one of the most comprehensive model that promises to be one of the vital knowledge base for digital security implementations at micro level.

## 7. Analysis and Discussions

The design of digital tourism security system is a comprehensive study that is built on the interviews, survey data, documents, literature, onsite visit and technological reports published by government authorities, researchers and academicians. The work analyzes current state of Nepalese tourism industry and builds knowledge around security and safety concerns. The opening section of the research highlights the introduction with immense arguments, data and proofs from literature validating the reason to undertake the study. The initial study and literature survey contributed in the development of tourism risk category table based on probability of occurrence. The table depicts types of tourism risk encountered by tourist and reported to security agencies. Study of existing tourism security management regulations, risk mitigation procedures, current working models and organizational structure charts helped in building a model of Nepal tourism governance artifacts and functional processes. A further analysis of the data helped in identifying factors that serve as a hindrance in the development of digital tourism security system for Nepal. The onsite visit and interview gave an extensive understanding of the information flow mechanisms and processes of the tourism governance and coordinating entities, which helped to design information flow model of tourism governance. The overall research is carried out using Design science research methodology which is considered as one of the best paradigms for design and development of information and computer based systems.

The analysis of the social context and knowledge context helped in understanding the social artifacts, social interactions as well as social needs of the system. This resulted in the identification of major factors and sub major factors of risk in tourism sector of Nepal. The further analysis of the scenario portrayed that security concerns are high in tourism industry of Nepal and there is a lack of proper implementation of digital technologies and systems at different governing levels. A vacuum is seen between federal, provincial, local government and external stakeholders in terms of integration, information exchange, data storage, process synchronization and proper working mechanism during risk and safety situations. Moreover, the current system follows a traditional and long procedural approach for disaster recovery, management and mitigation which attributed towards delay in rescue operations, loss of life and property, adding a bad reputation as a tourism destination. The issue of information scarcity, authenticity, credibility and lack of proper standards in tourism and hospitality industry have further added challenges to the security system design.

The system design and development process is carried out with careful and insightful investigation of tourism governance models and components by building the models based on data and input from interview and survey of tourism stakeholders. This knowledge base is combined with literature survey of tested and proven global technological developments in disaster and security management to recommend root technologies and algorithms in the design of digital tourism security system model for Nepal. Generalized information model, Use cases model, Network architecture model, Layered taxonomy model and Digital tourism technology reference model are produced as a result of the study. The Use case model describes system processes that can be further detailed to produce system sequence models, conceptual class diagrams and collaborative diagrams. The information flow model helps in capturing the information exchange requirement and data processing mechanism of the system while the network model can be used as a guideline during design of Network architecture at micro level. The technology reference model provides best suggestions and insights of the current available technology and help in design of more realistic application with less complexity. The proposed design models are high level design models that provide comprehensive suggestions and insights for the digital tourism security scenario of Nepal and lacks the details of real world implementation at micro level.

## 8. Limitation of the Study

This study is taken as a comprehensive study for the design and development of digital tourism security system for Nepal at high level and it does not include study at application level, code level, base structure and actual deployment process level. The study is built on interview of officials of government of Nepal, documents/response provided by them are considered valid and final. The study produces different models using technological literature of proven and tested methods and systems, best practices in software engineering and design science research methodology. The real world implementations may vary from the proposed design solutions and a lot of care should be taken while designing and implementing system at micro level. The real implementations may vary at large but the same design guidelines will not alter much from the proposed design. Finally, as this design and development of system models are the representations of high level system design they are not capable of providing performance, optimization and output guarantee.

## 9. Conclusion

The Digital tourism security system for Nepal is undertaken to design and develop digital solutions and models that serve as the knowledge systems for the digital implementations in tourism industry of Nepal. The basic objective is to analyze the current existing system through interviews, data collection, literature review and study them to draw basic knowledge for digitalization process. The data sources comprised of officials working in the tourism sector of Nepal, entrepreneurs, security personnel's and technological experts. Tourist were also interviewed as the one of the key stakeholders and security issues, problems and digital system expectations were identified. Technological recommendations were build based on literature survey of proven technological research paper and designs in risk and disaster management area. The study has successfully identified the problems related to digital implementations in tourism industry of Nepal, especially in the area of tourism security. Digital design solutions combined with rich technological recommendations are used to propose Generalized information model, Use cases model, Network architecture model, Layered taxonomy model and Digital tourism technology reference model that represent important aspects of digital tourism security systems in Nepal. The study is able to bring out the best solution at the current time due to use of knowledge based on current technological developments and interview data. The data of technological development in Nepal also shows the promising state of digital implementations as many of the discussed system and technologies have either come up as introductory technology or have the potentials to support it in future. The challenges of land, infrastructure, roads, literacy and skilled human resource are prominent and it is forecasted that due to active role of government and tourism industry professionals, this will get minimized in days to come. Overall the study is a complete representation of digital implementations in tourism security of Nepal and can be used for all different further developments which may include design micro at micro level, policy implementation, strategic build and knowledge base for any other project related to e-governance and digital implementation in Nepal.

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