TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
CENTRAL CAMPUS PULCHOWK

“CRIME CONTROL SYSTEM (VISUALIZATION AND ANDROID APP)”

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A PROJECT SUBMITTED TO THE DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING IN PARTIAL FULLFILLMENT OF THE REQUIREMENT FOR THE BACHELOR’S DEGREE IN COMPUTER ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING
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LETTER OF APPROVAL

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ACKNOWLEDGEMENT

This is our final year project which is entitled as "Crime Control System (Visualization and Android App)". Only with the single effort of team members definitely can't achieve the goal that we have dreamt of. There are friends and teachers who are willing to support in this project. As they have good response towards the project we have thought of, they share and advise us for the improvement of our project. Some of my friends shared the features that can be added in this project. We would like to thank Manoj Ghimire sir for his advice on data mining concept. His willingness of supporting inspired us to devote in this project. We would also like to thank our respectable sir and supervisor Dr. Dibakar Raj Pant for providing us the concept and idea about system's design.

We would like to thank our friends and teacher for their positive response towards our project.
ABSTRACT

Crime existed in the past, in present and, will be in future too. There is no place in earth where there is no crime. Crime rates and crime types are different in developed and undeveloped countries. Advancements in technology allows people from developed countries to use the law, computer and internet to commit crimes in majority where as in the developing countries we can witness the direct crimes such as murder, kidnapping, raping, girl trafficking etc. And such criminal activities should be controlled.

The main goal of this system is to provide the information related to crime to the government officials, and the local people. We have built the web applications which visualize all the data related to crime to generate the useful information like number of crime occurring repeatedly in a certain area, types of crime with their number in an area in a particular year, the crime with their cause in a region or in valley through pie chart and bar graph. This application also has the service of the data-entry and data-edit platform related to crime, criminals and victim, etc. We used Haversine formula in order to calculate the distance between two respective latitude and longitude on the earth. Data scrapping was done to get the data in the required format. The android application of this system has also been built which analyze the risk of a particular place where the user has installed the application. This system shows the visual information through the web and also analyzes the risk of a place through the app by showing different information related to crime. This system helps in patrolling the police team in right place at the right time, to measure the security level of a particular place, data entry software, extracting many more visualization by playing with the data in the system.

Keywords: Haversine Algorithm, Data entry, Data Scrapping, Mapping, GPS, Crime, Relational Database, Pie-chart, Bar-graph.
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1. INTRODUCTION

1.1. Background

As the population of the country is growing day-by-day. Huge resource is required for the growing population in the country. This led to the deficiency of the resource and the people starts for fighting and competing each other. This led to the increase of crime in each and every part of the country. This increase of crime and criminals should be controlled. As we have noticed that the trend of crime are increasing in great amount. Police Department are not being able to control the crime in well planed manner. This is all due to the unplanned management of the system in the Police department. Each and every officer should be accountable for their daily activities. Though we can’t make an organization without any flaw, but crime can be controlled to some extent. By making the proper analysis of the crime nature and their places of occurrences, time of occurrences, this can controlled to some extent. For that a system that keeps the record of the crime is required and not only keeping the records, but also visualization system is needed to analyze the place risk by finding the number of crimes and type of crime that took place in a particular location and particular time. Different types of crime such as social crimes, economic crimes, etc takes place in the city. If we can mine the data related to the crime such as time, place, etc, the crime can be minimized using the patrolling of police at that place at that time.

In the context of our country Nepal, maximum number of crime occurs in the central region according to the research we made. There is a software system to enter the data related to crime in the police department but not the visualization is done through system. According to the data that are entered in to the CRS, different visualization can be done to improve the system which helps in analyzing the current sceneries of the crime. This helps in controlling crime through different ways.
1.2. Overview

Our project “Crime Control System” is the system which is going to be used for the crime data visualization and risk analysis. Mostly the visualization about the location, type, time of the crime and analysis of the crime risk is going to be used by the government authority like Police Station, Police Headquarter, CIB, etc. This may be a new path to the development of the country by controlling the number of crimes in the country. This provides our system, a new data for data mining process which can be used for the visualization of the crime. Our system also contains an android application that analyzes the risk of a place by showing the visual information of the types of crime that took place in that location. Tremendous amount of crime that is taking place in our country may be controlled to a certain extent. Our system is going to be used by the Police Headquarter, Police Control, and CIB for their investigation that may lead to the decrease of the time that is invested in search of such location, etc.

1.3. Motivation

Crime can be regarded as one of the main factor for degrading the development of the country. As I live, in Raniban, Kathmandu, there different type crime occurs frequently. Similar crime also occurs in places like Boudha, Chabahil, etc. This crime can be controlled easily making the expert system that can analyze risk of place, data entry web platform to collect the data required by the system to find out the summarized output from the system. Analysis of data related to crime helps the different government organization to plan their control related to crime in the city, regionally. Hence, we thought to make the crime control system and make our research upon this topic in this final year.
1.4. Objectives

- To provide the visual information with about the crime data to concerned authority and local people to aware them about the recent crime.
- To improve/design the security level.
- To help the officers to take necessary action on the basis of those visual information and crime risk analysis.
- To help the local people to analyze the risk of his current location through android app.
- To deliver the system with proper managed and standard data entry platform for the 27 points related to crime.

1.5. Scope of Project

Our project has scope within the two targeted group. One is the Web application for the Police Department and the other one is Android app for the Local people. Web application can be used for the entry of data related to crime in the database from every part of the country. This web application provides the visual information related to crime. Different type of query can be made by the user to analyze the condition of the crime in the country. Those data which are collected in the database can be used for the visual information and also developing a complete expert system for prediction the crime in the future.

Android app can be used to analyze the risk of the current location of the android user. And the user can browse the location to find out risk of place easily which gives the visual information related to crime.
2. RESEARCH RELATED TO SYSTEM

2.1. Crime Prevention in Nepal

Crime has an age as old as civilization itself. In this world, it is difficult to find a place where there is no crime. The only difference is the type and the method of crime. Several crime issues such as kidnapping, raping, murdering, drug trafficking, hijacking are rampant everywhere in the world. Crime rates and crime types are different in developed and undeveloped countries. Advancements in knowledge and technology allows people from developed countries to use the law, computer and internet to commit crimes in majority whereas in the developing countries we can witness the direct crimes such as murder, kidnapping, raping, girl trafficking etc.

There are several reasons why the crime rate is increasing worldwide. Lack of education, greed, laziness, and poverty are the common reasons for the soaring crime rate. Still there are several other socio-economic issues needs to be dealt in the developing nations. Human rights have been a slogan for the developed countries only. Still there are people in this 21st century where they have no food to eat, clothes to wear and house to live. Education, equality in gender, and safety is way too far in these communities. Crimes are associated with several socio-economic issues such as poverty, illiteracy, unemployment, natural disasters, family and societal influence. A society is only safe, crime free and worth living when people have education, and can differentiate between good and bad. Utilitarian approaches, universalism approaches then slowly would develop as they become mature.

2.2. Existing System outside Nepal

Before actually starting the project, we went through the Internet to find out whether the crime alert security system has been really implemented in the International scenario. We
found that those systems have been successfully implemented in various European and American Nations. They have both crime control system for the police department as well as crime alert system for the public citizens. The following part which we find while doing the case studies in the internet in Boston, USA is also mentioned in this research part. Boston is launching the Crime alert system.

BOSTON --Phil Carver may never see the white Maxima stolen near his neighborhood, but the Description e-mailed to him by the Boston Police Department will be in the back of his head when he goes for a walk with his kids. "This is stuff I can tell my neighbors," Carver said. "At the very least it keeps people on their toes and aware of what's going on. The more people are aware and involved, the less crime you'll have."

Boston has become the latest -- and largest -- U.S. city to launch a crime alert system designed to get the word out about murders, bank robberies and other crimes to residents and businesses via e-mail, text messaging and fax. Carver, who lives in Boston's Dorchester neighborhood, is among an estimated 1,000 people who have registered since early June shortly after the program was launched in Boston, which has seen a spike in crime over the past 18 months. Alerts are sent not only about various violent crimes that have occurred but also about trends, such as car break-ins. Specific types of businesses, such as pizza shops, can be warned of Robberies.

The program is designed to both disseminate and solicit information, at a time when prosecutors Complain that witnesses too often remain quiet. The program allows anonymous tips. "The idea of this is to close cases," said Joseph Porcelli, civilian community service officer with the Boston Police Department. "What gets sent out is information that the community needs to know, or can take action on." The department's first alert was about a May 30 bank robbery in South Boston. A young white woman wearing dark sunglasses and a Gap sweat shirt made off with an undetermined amount of cash.
An alert was sent after two men were fatally shot outside a Dorchester store on Wednesday afternoon. None of the cases has been solved, but officials say the success stories in other cities using the technology are many. Cincinnati, and Fort Worth, Texas, are among the nearly 300 communities and law enforcement agencies that use the system. The service is provided by Citizen Observer, a company based in St. Paul, Minn. "A phone tree can take hours and days. This, you can get in a matter of seconds," said Sgt. Eric E. Franz, who runs the program for the Cincinnati Police Department and estimates he sends about three alerts per week. An alert was sent shortly after a downtown Cincinnati bank was robbed in March. A clothing store owner received the alert on his cell phone, and called moments later.

"A guy had just left his business. He bought new clothing and paid with cash," Franz said of the bank robber, who was later arrested on a city bus. That's the exception, not the norm, however. Franz estimates about a dozen crimes have been solved as a result of the 300 alerts they've issued in the past two years. Each alert generated about 100 calls from the public, he said. Alerts also can be sent about fugitives, missing persons and unsolved cases. Citizen Observer was created by Scott Roberts, who launched an Internet crusade in Minnesota six years ago leading to the arrest of a man who shot his mother. To receive alerts, users register for free at Citizen Observer's Web site. The Boston program is being piloted in three neighborhoods: South Boston, Dorchester, and Roxbury. Mayor Thomas Menino said he wants to expand it to the whole city. Peter Golemme, president of a South Boston neighborhood group, plans to register.

"I'm glad to see the police department trying to make something of the new technology," he said. "I'm fairly optimistic. You have to be careful not to overdo it. People get immune to it and tune it out." So far, Carver has received only two alerts. But Carver says the more chances he has to stay on top of crime, the better. "As a father of three living in the city, any tool we can use to stay aware and spread information. About crime is a good thing," said Carver, president of Pope's Hill Neighborhood Association.
Boston is launching a crime alert system that will send text messages, e-mails, and faxes to residents when crimes occur in their neighborhoods, police and city officials said yesterday. The system, run by the Boston police and the Internet company CitizenObserver.com, is meant to disseminate crucial information about crimes -- including times, locations, descriptions of suspects, and photographs -- into the hands of those most affected and those in the best position to help police find suspects.

 Officials said they hope to engage residents, especially community and crime watch groups, as police fight a major upsurge in crime in some Boston neighborhoods. By providing sometimes instantaneous information and ways for residents to message tips back to investigators, police hope to gain a powerful tool in identifying and catching criminals. The electronic tips that residents can send back to police would be anonymous, potentially freeing some from fears of retribution for helping authorities. "We want to send out information if there is enough to have the public help solve the crime," said Boston Police Captain Paul J. Russell.

The program, which is also being used in Cincinnati and in several other cities across the country, allows police to take the information they have gleaned from a break-in or bank robbery and post it on a website, where it is then automatically transmitted to anyone who signed up to receive the messages. The alerts are also available online. Police yesterday, in their first posting, sent out information on a Sovereign Bank robbery at 474 West Broadway. The posting included a photograph of the suspect and a description of the crime and evidence, including a vehicle that had been recovered with residue of an exploded dye pack inside. The suspect remains at large. "Good communication is an element to keep our city safe," said Boston Police Superintendent Robert Dunford. The program is initially being tested in three police districts in Dorchester, South Boston, and Roxbury, and could expand to cover the rest of the city later this year, officials said. The initial cost is about $1,475, police officials said. Target Corp., which donated gift cards for a city gun buyback program earlier this week, is paying much of the start-up cost, officials said.
The three police districts were selected because their residents overwhelmingly use the South Bay Shopping Center, where a Target store is located, said Dunford, who plans to work out the "kinks" in the program and assess its user friendliness before rolling it out to the entire city. Police are urging crime watch and community groups to sign up to receive the alerts, and officials are hoping young people in the test neighborhoods will elect to have them sent to their cellphones.

Electronic crime alerts will be sent out only when police decide members of the public may be able to aid an investigation or when the information can help communities cope with crimes, the officials said. Crimes will not be posted if public knowledge of the incidents could jeopardize investigations, officials said "We will share information that we need people to take action on," said Joseph Porcelli, a community service officer with the Boston Police Department. "There won't be alerts every five minutes." In time, officials said, they hope the system can be connected to the mayor's emergency hotline and distribute other important city information, such as notifications about snow emergencies and school closures. Officials yesterday said crime alert systems are being employed around the country, and distributed a letter from a Cincinnati police sergeant who wrote that the program had "become an integral part of communicating with the citizens" of the city and credited it for several solved crimes.

The program is also being introduced in Fresno, Calif., and Fort Worth, where it has been used for six months. "The old way just wasn't timely enough," said Lieutenant Dean Sullivan, a Fort Worth Police Department spokesman. Some in Boston yesterday welcomed the system. "I celebrate the police doing this," said Dorchester resident Bill Walczak, a member of the Columbia/Savin Hill Civic Association.
2.3. Existing System In Nepal

Then we started our research in our own context of Nepal. We made recommendation letter from the Department of Electronics and communication and went to police office at Hanumandhoka, Kathmandu to find out what sort of security system the Nepal police has been implementing for the crime control. According to them, there is only a crime records entry system that had just been digitized couple of years back. Then we became more curious and asked whether we can get those digitized data so that we can develop some sort of crime visualization and control system that will be helpful for police department itself. Then they implied that they do not have those data and referred to the police headquarter for the data as well as further detailed information. Then we went to the police headquarter at Naxal, Kathmandu for the data collection and further inquiry.

There at Naxal, they have digitized crime records and according to them, each crime record has 27 dimensions like crime location, time of crime committed, victim, criminal and so on. According to the police headquarter at Naxal, Kathmandu they have the following hierarchy of crime recording system in Nepal.
The crime is reported at the lowest level i.e. at the wards and forwarded to the tier above it and so on. Every tier does not have the digital recording system, so the crime data is entered and digitized at the layer where the computerized data entry system is available.

The whole crime record is eventually digitized when it comes to the topmost level and is stored in the central server at Naxal, Kathmandu. There at Naxal, Kathmandu, the police IT department has recorded and stored the crime data in the following 9 ways:

- District wise Crime Record
- Month wise crime Record
- All district total cases
- Police station by cases
- All district time wise
- Police Station yearly crime record
- Police station monthly crime record
- Age wise Crime record
- Case wise Crime record

The combination of these 9 different types of recordings taking 5 at a time gives as many as
\[ nCr = 9C5 = \frac{9!}{5!*(9-5)!} = 126 \] visualizations.

The Headquarter has used these recordings simply to run few database queries and has not
given much more attention to the visualization part.

2.4. Data Collection:

From our research at the police headquarter; we became highly inspired and motivated with
the feeling that we computer engineering students should contribute something to the
welfare of the nation and its people. And we decided to develop a crime visualization web
application which will be helpful for the police department for controlling the crimes in the
country. From there at headquarters; we collected the crime data of last 5 years. The data
contained the year wise, development region wise crime and sub-crime type’s records and
their total. The data was in word document format.

2.5. Moving on to android app:

After we decided to develop a web app for crime visualization and control system for the
police department, we again discussed among our project members and pitched an idea that
"what if we develop an android app that will alert the public about the crime statistic at a
particular location" so that the public will be alert every now and then whenever he goes to
that new location. We asked to our friends and seniors and they responded saying "What a
great idea?" We conducted a verbal survey on the public about the feasibility and usefulness
of the android app. They gave positive feedback saying that the android app will help them to alert and make them much safer whenever they go to any location. Then we decided to develop an android app as well to alert the public which will also help to control the crime happenings to great extent.
3. PROBLEM STATEMENT:

When we made a research in the police department of Nepal, we came to find out that there is no proper crime data entry system through computer to digitize those data. Similarly, no attention has been given to visualize those crime data. In fact, through visualization a number of inference can be made for crime control. Also, there has not yet been developed a system that gives a clear statistics of crime happened on a particular location so that the system will alert the public. So, we made a web application to make an efficient crime data entry plus visualization of those records on various dimensions so that the system will be helpful for the police department to take necessary action to control the crime in the country. In addition to that we made an android app as an alert system for public so that the public can analyze how risky the particular place is where he is currently located or where he is planning to go in the near future and adopt the necessary precautions.
4. DESCRIPTION OF DATA

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**Figure 1: Raw Data of Crime**

From the above data we came to know that all the data is in Nepali language which is very hard work to insert in to the database to use in our system. The crime data is divided in to the sub-crimes. So for the convenience, we converted the data into English language manually and then the data is transformed to the required form for the system.
4.1. Data Extraction and storage

The data we get from the Police Department at Hanuman Dhoka was in .docx format. Those data were converted into the HTML format by using converter as shown in the diagram. Then, these data were again parsed by using JSOUP parser and then a Java library was used to insert the data into the database for the storage of data. In this way data was extracted and stored into the database for further processing of the system.

Fig : Data extraction and storage
5. CURRENT SCENARIO OF CRIME IN NEPAL

Criminal activity remains high. Overall reported crime has decreased over the past year, although cases of reported burglaries in the Kathmandu Valley have increased. Minor street crime, such as pick-pocketing and bag snatching, occasionally occur in popular tourist and in trekking, areas such as Chitwan, Pokhara, the Annapurna region, and the Thamel area of Kathmandu. Small groups of young men have robbed trekkers, even on popular trails. Harassment against female travelers occasionally occurs. In several reported incidents, tourists have had their belongings stolen from their rooms while they slept. There has been an increase in the number of fraudulent schemes perpetrated against tourists. These schemes involve requesting the traveler's assistance in establishing shipping routes or business contacts with the U.S. or other countries, involving jewelry, antiquities, or carpets, and promise huge returns. Expatriates are potential targets due to their perceived wealth. Armed criminal groups are reported to engage in murder, kidnapping, extortion, abuse, and threats of violence, although reports of such activity decreased during 2012. The majority of these organizations operate in rural areas, particularly in the Terai border region with India. Though on the surface they may proclaim a political cause, these groups are mainly opportunistic criminal elements. Competing factions in the Terai have clashed with the Maoists, hill-origin Nepalese, police, and each other. These clashes instigated numerous strikes, demonstrations, and Indo-Nepal border road closures. While these groups have attempted to extort locally-employed staff, no Americans or U.S. Embassy.

5.1. Overall Road Safety Situation

Driving Nepal’s roads remains one of the greatest risks to the safety of Americans. Many roads outside Kathmandu are narrow, unpaved mountain lanes. These roads are often congested with heavy truck and bus traffic. Serious accidents happen frequently on rural roads primarily due to hazardous conditions, poor mechanical conditions of vehicles, and drivers’ total lack of adherence to traffic rules. When accidents happen, they are often
catastrophic due to overcrowded buses and the high roadways. In 2013, there were several major bus accidents; killing over 100 people, with scores of injured passengers. Driving in Kathmandu is equally dangerous. Motor vehicles, bicycles, pedestrians, and animals, all traveling at different speeds, congest narrow roads. Traffic is poorly regulated, and the volume of vehicles on the roads has increased significantly in recent years. Traffic lights and signs are sometimes ignored even in the most congested sections of downtown Kathmandu. Many drivers are neither properly licensed nor trained. Many vehicles are poorly maintained, and public vehicles are often over-loaded. Sidewalks and pedestrian crossings are nonexistent in most areas, and drivers do not yield the right-of-way to pedestrians. Compounding this problem is a roadway expansion project underway throughout Kathmandu Valley. Demolished walls and building facades litter many roadways, forcing pedestrians into the street and into the flow of traffic. Sidewalks are rare and commonly uneven with large cracks or holes. Pedestrians account for over 40 percent of all traffic fatalities.

5.2. Political, Economic, Religious, and Ethnic Violence

On November 19, 2013, Nepal held elections to replace the Constituent Assembly (CA), which was suspended in May 2012 after it was unable to draft a constitution by a deadline established by the Supreme Court. Despite sporadic violence and an effort by fringe parties to disrupt polling, the elections saw record turnout (more than 74 percent); domestic and international observers praised the elections as well-run and credible. The CA held its first meeting on January 22, 2014, and talks are underway among Nepal’s political parties to form a new government. Nepal continues to be governed by an interim election government.
5.3. Local, Regional, and International Terrorism Threats/Concerns

On September 6, 2012, the Department of State lifted its designation of the Maoist party as a terrorist organization, after determining that the party is no longer engaged in terrorist activity that threatened the security of U.S. nationals or U.S. foreign policy and had demonstrated a credible commitment to pursuing the peace and reconciliation process. The decision applies both to the Unified Communist Party of Nepal (Maoist) (UCPN(M)).

Indigenous groups have been responsible for a number of terrorist acts, most of which have been minor in scale. One individual was killed and several injured in sporadic violence in the run-up to the November 19, 2013, Constitutional Assembly elections. During this period, police and army bomb squads discovered more than 100 improvised explosive devices (IEDs), of which about 1/3 were in the Kathmandu Valley. While the vast majority was hoaxes, at least five exploded. There were no fatalities from the relatively unsophisticated IEDs.

On Election Day, however, a child was seriously injured when he handled an IED. Also on Election Day, an IED injured three people when it exploded near a polling station in Kathmandu. In addition, there were at least six petrol bomb attacks on long-distance buses and vans. A bus driver was killed in one of the attacks, and several individuals were injured. On March 13, 2013, a group of attackers ambushed a motorcade including Unified Communist Party of Nepal (Maoist) (UCPN(M)) Chairman Pushpa Kamal Dahal “Prachanda” en route to a campaign event in Kanchanpur. Media reports stated that a landmine exploded near the lead car, but nobody was injured. The police arrested more than 200 individuals for involvement in election-related attacks, including dozens of members of the Communist Party of Nepal–Maoist (CPN-M). At a December press conference, the chairman of the CPN-M stated that some party members, allegedly frustrated that demands to call off the elections were ignored, may have been involved in the petrol bomb attack. In 2012, an IED detonated in Kathmandu that killed three people and injured seven. Less than three months later, five people were killed and 30 injured.
In 2011, there were reports of small IED detonations carried out by various groups. The majority of these incidents occurred in the Terai Region. These IEDs were rudimentary, low-grade devices but could be fatal to people in close proximity at detonation.

5.4. Civil, Unrest

Protests, demonstrations, and disruptions continue to occur, often without advance notice. Demonstrations often block major roads or intersections, and demonstrators at these events, which occur throughout Nepal (including the Kathmandu Valley), have been known. Various political groups may also call bandhs (general strikes) that force the closure of all businesses and disrupt vehicular traffic. Some groups enforce observance of bandhs through violence and intimidation. The last significant, multi-day nationwide bandh occurred in the run-up to the November 2013 elections, organized by a coalition of small parties headed by a splinter Maoist party. The week-long bandh – billed as a “transportation strike” – saw some initial success in disrupting schools, businesses, and traffic but lost momentum after a few days. Unlike many previous bandhs that had been happening frequently, the government took vigorous action in November 2013 to arrest individuals responsible for bandh-related violence.

5.5. Religious

In 2009, the Nepal Defense Army (NDA), a pro-Hindu group, detonated an IED inside a Kathmandu Catholic church, killing three people and injuring 14 others. The NDA also claimed responsibility for the murder of a Catholic priest and bombing of a mosque, both in 2008. In the fall of 2009, the NDA’s top leaders were either arrested or fled to India, greatly diminishing the group’s ability to carry out attacks of this magnitude.
5.6. Young People Use Tech to End Violence against Women in Nepal

We and 80 other young techies and civil society representatives came together for the first time to create mobile applications to end gender-based violence as part of a hackathon sponsored by the World Bank. In that hackathon, different app was built to control the violence but no any app was found to work upon the Crime Control System of Nepal.
6. RELATED THEORY

6.1) Haversine formula:-

Our system includes android application that provides the visual information about the crime that took place in a particular place within past 2 years. When the user installs the Crime System app, our app first finds the GPS location of the android device. In accordance to that GPS location, our app finds the nearest Police bit using HaverSine formula.

In MySql database, there is table that stores the GPS location of Police bits and their corresponding GPS data. This android app calculates the distance between android device and police bits. When the nearest police bit is detected, its corresponding crime information is received and MySqIite database is formed in andoid mobile.

As we know, the distance between two points (x,y) and (x2,y2) can be calculated using Euler's formula. We tried to approach same procedure to calculate distance between two locations having two different GPS data. But it found that it is not the real solution to calculate distance. After research, it is found out that distance between two points on a sphere can be calculated using Haversine formula from their longitudes and latitudes. Haversine is a special case of a more general formula in spherical trigonometry, the law of haversines, relating the sides and angles of spherical triangles.

For any two points on a sphere, the haversine of the central angle between them is given by

\[
\text{haversine}\left(\frac{d}{r}\right) = \text{haversin}(\phi_2 - \phi_1) + \cos(\phi_1) \cos(\phi_2) \text{haversin}(\lambda_2 - \lambda_1)
\]
where

- *haversin* is the haversine function:
  \[
  \text{haversin}(\theta) = \sin^2\left(\frac{\theta}{2}\right) = \frac{1 - \cos(\theta)}{2}
  \]

- *d* is the distance between the two points (along a great circle of the sphere; see spherical distance),
- *r* is the radius of the sphere,
- \(\phi_1, \phi_2\): latitude of point 1 and latitude of point 2
- \(\lambda_1, \lambda_2\): longitude of point 1 and longitude of point 2

On the left side of the equals sign \(d/r\) is the central angle, assuming angles are measured in radians (note that \(\phi\) and \(\lambda\) can be converted from degrees to radians by multiplying by \(\pi/180\) as usual).

Solve for *d* by applying the inverse haversine (if available) or by using the arcsine (inverse sine) function:

\[
d = r \ \text{haversin}^{-1}(h) = 2r \ \text{arcsin} \left(\sqrt{h}\right)
\]

where *h* is haversin(*d/r*), or more explicitly:

\[
d = 2r \ \text{arcsin} \left(\sqrt{\text{haversin}(\phi_2 - \phi_1) + \cos(\phi_1) \cos(\phi_2) \haversin(\lambda_2 - \lambda_1)}\right)
\]

\[
d = 2r \ \text{arcsin} \left(\sqrt{\sin^2\left(\frac{\phi_2 - \phi_1}{2}\right) + \cos(\phi_1) \cos(\phi_2) \sin^2\left(\frac{\lambda_2 - \lambda_1}{2}\right)}\right)
\]

When using these formulae, ensure that *h* does not exceed 1 due to a floating point error (*d* is only real for *h* from 0 to 1). *h* only approaches 1 for antipodal points (on opposite sides
of the sphere) — in this region, relatively large numerical errors tend to arise in the formula when finite precision is used. Because $d$ is then large (approaching $\pi R$, half the circumference) a small error is often not a major concern in this unusual case (although there are other great-circle distance formulas that avoid this problem). (The formula above is sometimes written in terms of the arctangent function, but this suffers from similar numerical problems near $h = 1$.)

As described below, a similar formula can be written using cosines (sometimes called the spherical law of cosines, not to be confused with the law of cosines for plane geometry) instead of haversines, but if the two points are close together (e.g. a kilometer apart, on the Earth) you might end up with $\cos (d/R) = 0.99999999$, leading to an inaccurate answer. Since the haversine formula uses sines it avoids that problem.

Either formula is only an approximation when applied to the Earth, which is not a perfect sphere: the "Earth radius" $R$ varies from 6356.752 km at the poles to 6378.137 km at the equator. More importantly, the radius of curvature of a north-south line on the earth's surface is 1% greater at the poles ($\approx 6399.594$ km) than at the equator ($\approx 6335.439$ km)— so the haversine formula and law of cosines can't be guaranteed correct to better than 0.5%. More accurate methods that consider the Earth's ellipticity are given by Vincenty's formulae and the other formulas in the geographical distance article.

6.2) DBSCAN algorithm

DBSCAN algorithm can be used in the project. So far we have not implemented this algorithm but this algorithm can be used in order to find out that which region or part of the nation is more vulnerable to crime. The output of DBSCAN will be somewhat like HeatMap. The input for DBSCAN algorithm will be sets of longitude and latitudes of crime where the crime has taken place.
DBSCAN requires two parameters: \( \varepsilon \) (\( \text{eps} \)) and the minimum number of points required to form a dense region \( \text{tail} \) (\( \text{minPts} \)). It starts with an arbitrary starting point that has not been visited. This point's \( \varepsilon \)-neighborhood is retrieved, and if it contains sufficiently many points, a cluster is started. Otherwise, the point is labeled as noise. Note that this point might later be found in a sufficiently sized \( \varepsilon \)-environment of a different point and hence be made part of a cluster.

If a point is found to be a dense part of a cluster, its \( \varepsilon \)-neighborhood is also part of that cluster. Hence, all points that are found within the \( \varepsilon \)-neighborhood are added, as is their own \( \varepsilon \)-neighborhood when they are also dense. This process continues until the density-connected cluster is completely found. Then, a new unvisited point is retrieved and processed, leading to the discovery of a further cluster or noise.

In pseudocode, the algorithm can be expressed as follows:

```plaintext
DBSCAN(D, eps, MinPts)
    C = 0
    for each unvisited point P in dataset D
        mark P as visited
        NeighborPts = regionQuery(P, eps)
        if sizeof(NeighborPts) < MinPts
            mark P as NOISE
        else
            C = next cluster
            expandCluster(P, NeighborPts, C, eps, MinPts)

expandCluster(P, NeighborPts, C, eps, MinPts)
    add P to cluster C
    for each point P' in NeighborPts
        if P' is not visited
            mark P' as visited
            NeighborPts' = regionQuery(P', eps)
```

| 24 | 4  |
if sizeof(NeighborPts') >= MinPts
    NeighborPts = NeighborPts joined with NeighborPts'
    if P' is not yet member of any cluster
        add P' to cluster C

regionQuery(P, eps)
    return all points within P's eps-neighborhood (including P)

Figure 2: DBSCAN

Points at A are core points. Points B and C are \textit{density-reaching} from A and thus \textit{density-connected} and belong to the same cluster. Point N is a noise point that is neither a core point nor density-reachable. (MinPts=3 or MinPts=4)
7. SYSTEM DESCRIPTION

7.1. System Features:

- The system keeps the crime records.
- It provides the visual information regarding crime.
- Local people can view previous crime activities committed at particular place using smart phones.
- Police Control Stations can Analysis the current Scenario of the Crime in the city and can perform the patrolling as well on the basis of the output.

7.2. System Block Diagram

The proposed system is the application that keeps the crime record in efficient way so that the task of visualization can be done. This system keeps record like time, location, type of crime occurred at the particular area. The proposed system is applicable for police department .Records can be kept. On the basis of crime data, informative visualization can be achieved .Pie charts, bar graph ,a kind of heat map would provide visual information.
A particular officer will be assigned to keep the crime record in digital form rather than keeping the record in paper format. It requires to be logged in by a particular officer before entering into the system for keeping the records. After successful login, he/she will provide the detail information regarding crime like time and location of crime occurrence etc. Those recorded data will be useful for informative and clear visualization of the crime occurrence in the future.
The tremendous amount of data which is stored in the database can be utilized by the system for visualization, analysis and risk analysis of a particular place. Type of crimes occurred at particular month at particular place can be shown in pie chart and bar graph. On basis of that visual information, the concerned authority can take the necessary action. In order to view the visual data, the user has to do successful login. After the login, user (Police Officer) can perform the query like what type of crime has occurred in past year, yearly, location wise, time wise. And what type of age group of the people are engaged in which type of crime. Age factor and Gender factor can be used to analyze their engagement in the crime.

Data Mining is the emerging knowledge in computer world. By using the concept of data mining, different types of interesting result can be found out. Distance algorithm is used in the system to calculate the distance of the nearest police bit from the current location. The result of the system has resulted in visual information. The overall general block diagram is given below.
7.3. Explanation of the Block Diagram

Existing Data of the Criminal Record System and also the new recent data can be processed and stored in the Database for further processing. Those data can be utilized by our system for giving formatted output and result of the Query by the user. In the above block diagram, after processing the data, it can be used for visualization and Android App for the Risk Analysis.
7.3.1. Visualization In Web Application

In the web application, we have mined the data to get the output of the system in required form. We have made Data entry platform which is used enter the crime details (location, time, etc), criminal, victim information, etc. And then the data are processed through different method. Then the data are visualized in different manner in pie-chart and bar-graph. The visualization can be done to see the output of the crime yearly, time-band wise (early morning, morning, day, evening, night, etc). We can also visualize the type of crime occurrence with their cause. Those analysis can be used by the Police Control Station and headquarter for proper functioning. They can be used by them for data entry, patrolling by seeing the risk of a place. They can also conclude the cause of the crime, age-group of the criminals, gender wise criminals and victims. Those Police Officer who are appointed by the criminal record system (CRS) to enter the data into the system can update the system as per their need. Police officer can update the database weekly or monthly update the database so that the android output can be seen changing weekly and monthly.

7.3.2. Risk Analysis through Android App

Android app is built to analyze the risk of a particular place or the current location of the user of the Android app. In android app, user can browse the data related to crime of the current place of the smart phones and the place where he want to visit next. The visual information is provided in the app of the crime that took place in that particular place. Android user can analyze that which time band is more risky at his current location by seeing the data of the last one year. This data of the android database is updated by the Police officer of Control Room. The user can also check the risky and crime type details of the places he like to visit in future easily through the app. And When the User changes his location the user is asked to update the app for that particular location automatically which is controlled by the GPS of the device. The android app contains the data of the place where the application is installed and the place of the data where he browses. It doesn’t contain the data of the location at a time. This prevents the app from the problem of overloading of
database and the slow running of app. It also prevent from using excessive amount of memory of the smart phones.

7.3.3. Maintenance of Log File

We have also maintained the log file. Log file keeps the record of event that has occurred. The events that has to be logged in the system are like when the officer is signed in or out of the system, the event of editing, recording the data into the system, etc. These events are seemed to be logged as these events are related with the important and the sensitive data. The events performed by the particular officer can be known by the police head. Only the Police head can view the result of log file. S/he can have the information like who have entered or edited the data recently. The main objective of maintaining the log file is to view the recent activities performed by officers.
8. METHODOLOGY:

8.1. Case Studies and Project Proposal

From the past few decades the rate of criminal activities are increasingly rapidly degrading the pride of nation along with the trust of local people towards the nation's security service. People feel unsafe when they go out at the evening. Criminal activities like rape, murders, gang fights, pick pocketing, robbery etc have headache the government and local people at some parts of nation. As our concern there is no such system used by concerned security for visualization of criminal data and analysis of crime. Police Department keeps details information in the paper which is not very much reliable. It is obvious that one day this recording process will be digitized.

8.2. Detailed Planning

We already had visited the Police station and Crime Branch to know about their interest in our project. We already had got good response from them. So we also asked the people and the related organization about using our user interface for the visualization. The steps that should be taken for completion have been figured out. Division of work, selection of technologies and proper timing has been planned.

The time allocation and task division of the project was done properly. This was advised by our mentor at Verisk Information Technologies. Since we are three member in this project group for doing all the task related to crime, We first of all designed and pointed out the features, story and tasks related to the system i.e web application and android app. For each task of a story, time was allocated by the discussion and the work was started. We discussed and decided to use agile development technology to develop our system. This system is well suitable to use the agile development methodology. Agile development methodology is just
like waterfall model; the only different thing is that testing is done at each phase of the Agile Development Lifecycle.

8.3. Domain Analysis

In the development phase, we already had visited the Police station and Crime Branch to know about their interest in our project. We already had got good response from them. So we also asked the people and the related organization about using our user interface for Crime reporting and the visualization. Many people are interested in using our application. It sounds good when we heard of many more people and related organization using our system in their daily life. Our system named “Crime Control” is going to play a vital role in the development of our nation by controlling the Crime that can occur frequently.

8.4. Economic Analysis

As this is the major academic project, it had been completed by working within college hours. There’s no any expenditure on manpower, as it has to be completed by the major team members. On the period of launching this application finally in the market may need some economics support.

8.5. Technical Feasibility

As this project is going to be built by using machine learning and data mining concept, it will be easy to build as this subject have been included in our finals year curriculums. It will be built with the simple user interface design so that the authorized person can easily keep records about the crimes that take place in their surroundings. We implemented simple user interface design to support the users with excellent features. Smart phone has become the inseparable part of human. We can barely find the people that do not use the smart phones.
Therefore, we have decided to make an Android app that would provide visual information to local persons in their smartphones.

### 8.6. Implementation

As we all know that the development of any country really depends upon the number and the type of Crime that took place in the country. Our system is going to present the visualized data, predict the crime data that took place recently in the surroundings. And the local people can also report about the crime that they have been watching in their surroundings. So this system can be implemented in the police headquarter, CIB, Police station and also as a web protocol by the general people for reporting the recent crime.

### 8.7. Project Time Allocation and Task Division

The project time allocation for every task and feature is given below with the task division to the team members.
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<tr>
<td>16</td>
<td>Query for log maintinance</td>
<td>Yes</td>
<td>Yes</td>
<td>Pending</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>17</td>
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<td>10 days</td>
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<td>18</td>
<td>Create Display Display Formats and Design Layout</td>
<td>Yes</td>
<td>5</td>
<td>Estimated 6 days Taken 7 days Pending</td>
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<td>19</td>
<td>Query for CrimeType</td>
<td>Yes</td>
<td>Yes</td>
<td>Bihash and Saujan</td>
<td>Done</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>20</td>
<td>Query for Subcrime,location and time</td>
<td>Yes</td>
<td>Yes</td>
<td>Bihash and Saujan</td>
<td>Done</td>
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<td>Yes</td>
<td>Pending</td>
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<td>Bihash</td>
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<td>Yes</td>
<td>3 Overlapped with web application</td>
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<td></td>
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<td>29</td>
<td>Query for SubCrime</td>
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<td>Yes</td>
<td>4 Overlapped with web application</td>
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<td></td>
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<td></td>
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<td>30</td>
<td>Query for no. of Crime happened</td>
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<td>Yes</td>
<td>2 Overlapped with web application</td>
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<td></td>
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<td></td>
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Figure 6: Time Allocation and Work Division
8.8. Project Workflow:

We first of all designed the workflow of our CCS system. The project workflow means the work to be done for the completion of our project. In our system, we divided the work in our team members and then the project time allocation was designed by us to complete the project on time. The design of work flow is given below:

![CSS Work Flow Block Diagram](image)

Figure 7: CSS Work Flow Block Diagram
8.9. Agile Development:

We follow the agile development technology (SCRUM) for our product development as mentored by the Verisk Information Technologies. Agile development promotes adaptive planning, evolutionary development, early delivery, continuous improvement and encourages rapid and flexible response to change. It is a conceptual framework that focuses in delivering working software with the minimum amount of work. It can be best summarized in the following diagram.

![Figure 8: Lifecycle of Agile Development](image)
Approximately all the steps of Agile Development had been used in our system. They are highlighted below with all the necessary description.

8.9.1. Brainstorming (Requirement Analysis)

The entire functional and non-functional requirements are analyzed by making research, survey and other techniques. The non functional requirements are the reliability, scalability, efficiency, accuracy, flexibility, platform independent, portability, security, etc. These all the non functional requirements are covered up to some extent. Here, the functional requirements of our system are listed below:

- **Mining relationship**
  The system shall provide the all the necessary relationship between different crime factors. Crime associated with a single cause may lead to the cause of another crime. This type of crime mining can be done.

- **Clustering**
  Clustering is required for the mining of data related to crime for getting the resulted output in required manner. The visualization part output is mined output of the system.

- **Visualization**
  The entire crime query done by the Police Officer should result an output. The output should be like number of crime in a year, cause of a particular crime, region wise crime, types of crime that generally takes place in the valley, which Age-group committing what types of crime, etc.

- **Data Entry**
Data entry platform is required for the system to enter the data related to crime. The crime details, criminal details, victim details, time, place of the crime, etc should be entered into the system. In reality, 27 points are needed for entry for a crime according to CRS of the Police Headquarter, Naxal, Nepal.

- **Android app**
  Android application which can analyze the risk of a place easily is required by the System. It shows the number of crimes that took place in a particular place or the current position of the android mobile user.

- **Tools and Technology**
  All the tools and technology which are used to develop the CCS system are listed out. These tools are one of the major requirements of the system.

**8.9.2. Design, Document and prototype**

The document was designed first for the project defense in the department and the prototype was made to show in the Crime Record System (POLICE HEADQUARTER) and The Verisk Information Technology and also in the electronics and Computer department. Proposal was made and submitted to the different organization.
8.9.2.1. Design Of The WEB CCS System

8.9.2.1.1. Use case Diagram

Above use case diagram clearly shows what would be the mechanism of the Crime Control System. We are going to develop the system that will be used by the Police Officer and the local people. Obviously Police officer and people will be the actors of the system. The functions and their access to the system of these actors can be clearly known. General officer can keep crime record, get visual information, and also can edit the crime record. What next thing that system does is it maintains the log information of each and every activities performed by the officer. Police Head of the Department is the responsible people
for maintain the log of the system. He can create the user and delete the user as per the need of the system. The CRS of Police Department can be well managed by this system.

8.9.2.1.1. ER diagram of the System Database
The above diagram is the ER diagram of the CCS system. This diagram illustrates the design of the database of the system. There table named register which contains all the details of the user of the system. Similarly all the attributes with their respective table are shown clearly.
in the diagram. The three tables below named YearLocationTotal, YearTotal_XY_Crime, and LocationCrimeTypeTotal were designed to query the result of the system. The table named CrimeVictim and CrimeCriminal was designed to reduce the redundancy in the database. And the table named android user table is used to handle the query of the android user.

Relational Database Was to Designed according to the ER diagram of the system. A relational database is a database that stores information about both the data and how it is related. "In relational structuring, all data and relationships are represented in flat, two-dimensional table called a relation. For example, organizations often want to store and retrieve information about people, where they are located and how to contact them. Often many people live or work at a variety of addresses. So, recording and retrieving them becomes important—relational databases are good for supporting these kinds of applications.

In our Database, relation between the different table and attribute is maintained clearly as shown in the ER diagram. Normalization of the table was done to reduce the redundancy in the database. Database normalization is the process of organizing the fields and tables of a relational database to minimize redundancy. Normalization usually involves dividing large tables into smaller (and less redundant) tables and defining relationships between them. The objective is to isolate data so that additions, deletions, and modifications of a field can be made in just one table and then propagated through the rest of the database using the defined relationships. CrimeCriminal, CrimeVictim and AndroidUser table was designed to redundancy in our relational database design. It helps the database in fast processing the query and to increase the efficiency for the query that is made to database. Cascading relationship was also used in the database such as delete cascade, update cascade so that the changes made in a table or field also changes in their parent table or master table as per the need of the system.
8.9.2.1.3. Data Scraping

Since our project is related to crime, it was necessary to get real data of crime in order to know real crime situation in different parts of Nepal. We visited the police headquarter of Nepal which is located at Nauxal. Crime data was stored in docx file. In order to use that data in project, it was essential to convert it into suitable file format. Therefore, docx file was converted into HTML file using File Converter.

Inserter Java Application was used to get the data in the required format. Here Inserter Java Application is an application that scrapes the required data from the HTML file. It uses the JSOUP java class library which parses the HTML file. It collects the data from parsed file and pushes it into MySql database in proper manner so that it can be used for visualization.

Figure 11: Flow Chart of Data Scraping
Sequence Diagram of Data Scraping Mechanism is given below.

![Sequence Diagram]

Fig: Sequence Diagram of Data Scraping
8.9.2.1.4. Data Entry Mechanism

Our project is mainly focused on making the system that will keep the crime data in digital way. Keeping the records in paper format is old fashioned which is not relevant and reliable in present context. Computerized way is far better than using paper. In present context some of the police stations are still compelled to keep records in paper format.

So our Crime Control System can be the solution to eliminate the tedious way of keeping records in paper. This tedious activity can be minimized by our system. The data stored in the digital form can be used by the different system for data mining. The data mining of these data can help in picking out the different output to make the crime control system more efficient. As we have mentioned in the research part the approximate 126 visualization can be done easily through the data that is kept in the CRS of the system. Activity diagram of data entry action is shown below.
Figure 13: Activity Diagram of the Data Entry Mechanism
8.9.2.1.5. Visualization Mechanism

It is said that visual information is captured more quickly than the text information. Visual information is processed faster than the text information. We designed the activity diagram of the visualization part of the CCS system. It helps in analyzing the crime condition in Nepal more clearly.

![Activity Diagram of Visualize Form](image)

Figure 14: Activity Diagram of Visualize Form
8.9.2.1.6. Edit Mechanism

It is not guaranteed that the data entered by the officer is always correct. Officer may unknowingly enter false information. So there should be edit mechanism to overcome such mistakes. Besides that, officer can add additional information regarding through this edit mechanism.

For example:- Officer are involving in one crime investigation process that took place in Kupondole. Let’s say so far, they found out the victim details and time at which crime happened. But they still can’t find out who the criminal is/are. They have kept the crime information about victim details and time at which crime occurred in Crime Control System excluding victim details. Now let’s say, that crime case was solved. They found out the criminals. In that case, in order to add additional information regarding that case, edit mechanism is used.

The activity diagram of the Edit Mechanism of the CCS system is shown in the next page.
The main challenging task in edit mechanism is to build the query on basis of edit form filled. There are 11 empty boxes. When the officer fills all 11 empty text box, the query string for that case is different from the string query when 1 empty text box is filled. Our system handles about 11! Queries.
8.9.2.1.7. Class Diagram of the Web Application

Figure 16: Class Diagram of the Web application
In the above class diagram, there are different functions that work different activities. Popup class is used to auto-generate the fields. ProcessQuery is used to Query the different query in the system. This class helps in reducing the redundancy. Dataentry and databases class are used to enter the data into the database. Similarly all the classes shown in the class diagram have their particular functionality. One of the main classes is Update class which updates the database of the system easily weekly and the monthly. It updates the database whenever needed by the user.

8.9.2.2. Design Of Android App

Android app was developed by using the following development life cycle.

Figure 17: Android Methodology of System

Different steps we used for the android development is shown in the above diagram and the explained below.
8.9.2.2.1. Scope and Plan

The android app is used to analyze the risk of a place. Android app finds out risk percentage and number of the crime. We had planned to build this android app within a single month to find out the risk factor the people living at a place. It usually outputs the number of crime occurred in a particular place and shows the visual information in a bar-graph.

8.9.2.2.1. Design Of System

Then the Design of the system was made to accomplish the task. Database required for the android app was designed easily. Both the android app and web application uses the same database for giving the output of the Query made by the user. A table named android user was created to handle the android user query easily by reducing the redundancy of the database.
Class diagram of Android App

Figure 18: Class Diagram of Android App
In above class diagram, all the functions and the class of the android application is mentioned clearly. Different types of fragment are used to give a god look to GUI design. Createdatabase is the class which is used to create the database of the current location of the android user. It protects the app from overloading and making the app more tedious. In this tremendous amount of data was handled easily using data base normalization technique. GetLocation class was used to retrieve the current location of the smart phones, by using GPS in the system. The GPS present in the android device was used to calculate the current latitude and longitude of the device. Then this latitude and longitude were mapped to find out in which Police Bit, the device lies. And at last the crime details related to that place was extracted from the database by using different technology, methods and algorithm. Similarly, the class named visualize is used to obtain the data of that place in the visual form. We have used the bar-graph technique show the visual information which is shown in the screen shot below in the Results (Output Screen) part.

The Sequence diagram of Android application is shown below.
8.9.2.2.3. Verification and testing

Certain level of verification of the android app was done. The CCS app is easily installed in any android device generally built for higher version like JellyBean. The app was tested in the emulator and the different android device.

8.9.2.2.4. Implementation of the system

We are looking for the implementation of the system after completing some of the incomplete task. We are also talking with some of the government organization and taking the recommendation of the different Police Organization to make the system as per their need.
Class Diagram of the WEB-ANDROID connections

In the above class diagram, the android user doPost class to post the latitude and longitude to the web server i.e. servlet of the Java, which helps in retrieving the required information. Update class was used to update the database of the android sqLite database for change in the location or change in time like hourly, weekly and monthly or yearly.
8.9.3. Development phase of the system

Since we follow Agile Development Methodology for the development of the system, we developed the system to the extent we proposed to develop to our department. In the development phase, we used different algorithms and technology to develop the system. The code was programmed in such way that it can be understood easily. MVC framework was used for the development of the system. All the design was implemented into the code for the realization of the system. Class diagram, ER diagram of the system designed before were utilized for the development phase of the system.

Tools and Technology used to develop the system:

- Java Programming language
- JSP
- Android in java
- JavaScript
- JSON, CSS, BOOTSTRAP(Responsive Web Design)
- MySql programming
- XAMPP, GlassFish server
- Different Libraries and API, etc.
- NetBeans IDE, Eclipse for android, Sublime Text(Editor)

8.9.4. Quality Assurance

Identification of defects of the system was done in this phase. Different defects were realized in this phase. And that bugs were checked out to reduce it. Some of the bugs still lie in the system. Still this system has many bugs unresolved. We didn’t develop any testing tools for this system to test the system completely. Simple testing and verification was done for the system before deployment.
8.9.5. Deployment

Before deployment of the system, we need to verify and test the system for the successful deployment. Since, any software cannot be successfully developed; this system has also some bugs that is still unresolved. For deployment of this system we have been consulting to different Police organizations. Police Headquarter, Naxal of Kathmandu has also asked for the complete demonstration of the system. We are in phase to visit the Headquarter for the implementation talks.
9. PROBLEM FACED:

Generally the problem faced in the project can be categorized into two types:-

9.1. Non-Technical Obstacles in Crime Control:

9.1.1. The laws:

The laws itself is not strong enough in Nepal to control the crime. There are several faults in the law and people are taking advantage of that.

9.1.2. Impunity:

Crime rate would be controlled to some content it there was provision against impunity. Even the government officials are responsible for crime and get easily out of that. Due to impunity, people are encouraged to commit even more crime than before because they feel there is always someone to protect them.

9.1.3. Inefficiency of Police:

Police in Nepal is way too ineffective. It may be because of the absence of the proper training and modern techniques for the crime detection. One simple case takes years to resolve and people don't even have confidence of police officers. When people even don't believe the police where should they go for justice.

9.1.4. Forensic techniques:

Lack of advancement in forensic methods has certainly clouded the cause of crime and is unable to give the proper justification of the crime method.
9.1.5. Slow Court Procedure:

The inefficiency of court is another reason for increasing crime rate. One case takes years to settle down.

9.1.5. Lack of education:

Lack of education in people is certainly a huge factor to consider because in this condition people cannot decide what is good and what is bad. A good speaker with evil intentions can easily drive these ignorant people by his impressive words and easily encourages them to commit a crime. The interesting thing here is the people who are doing this don't realize that they are committing a crime.

9.2. Technical Obstacles in system design

9.2.1. Data Collection

Since our project was related to crime control through data visualization, the very first we need before we actually start the project was the crime data. For that we made a recommendation letter from the department and went to Hanumandhoka, Basantapur for the data. We didn't get the digitized data there at Hanumandhoka and they recommended us to visit police Headquarter there at Naxal, Kathmandu. Then we went to Naxal and went to IT department of police office at Naxal. We made a humble request there and finally we got the digitized crime data. We roamed for about 1-2 weeks for the very data.

9.2.2. Handling Queries
In our system multiple users can make different queries simultaneously and increased the query load. Query optimization and handling a number of queries at the same time was really challenging.

9.2.3. Address mapping

In the android app, the mapping of latitude and longitude of the current GPS location of the user with that of the nearest police bit was challenging and time consuming. At first we planned to use Euler's distance algorithm for the address mapping. We were delayed by around 2 weeks to come up with the real solution and finally decided to use haversine distance algorithm at last.

9.2.4. GUI design

In the android app development, at first we designed backend and then designed the GUI part. It seemed that the GUI design was not quite interactive. Then we changed the GUI design and implemented swapping to make the android app more user interactive. This compelled to disassemble the backend code and then again reassemble. We were panic by ourselves due to lack of proper planning beforehand we started the android app development part.
10. RESULT AND DISCUSSION:

10.1. Output of Data Entry Form

The layout of data entry form is given below.

(The above shown layout is not complete). Whenever crime happens, officer are more concerned about the location, time, criminal information and victim information. So the data entry form includes the input text boxes for entering the information regarding the victim, criminal information and time and location where the crime happened.

Some of the features of entry form are as follows:
• Since there are numerous empty text boxes, it might be tedious and boring to enter the crime data all in all. So 'Auto Popup ' of police bit name, police area name, district, location can be done by clicking 'AutoGenerate' button if officer knows the locality name where the crime has happened.

• Multiple criminals or multiple victims might be there. So, in this form, officer can enter multiple criminal information and victim information by clicking 'Add' button. Officer can edit the information of criminal or victims if any wrong information is entered.

• When officer submits the information, whole page does not reload. Ajax posting is used.

10.2. Visual Output

Our project focuses on visual output. Visual information is more informative than text information. On the basis of visual information, officer can take decision and make flexibility in the security level. By using our system, officer can know which region is more affected by 'Economic' or other crime. On the basis of that output, they can increase the security level of that area. By using available crime data, we manage to do three different visualizations. They are mentioned/explained below through the example of 'Murder' crime.

10.2.1. First type of Visualization

For this visualization, user has to fill two empty text boxes and select the radio button of Regions. After clicking the 'Visualize' button, user can have visual information like in which development region 'murder' or other crime has happened the most in the particular year.
In above bar graph, x-axis represents the development regions and y-axis represents the number. From the bar graph it can be concluded that murder case is more in central, eastern and valley area. Same thing is shown in pie chart. In pie chart different sectors represent different development regions. Bigger the sector area, bigger is the crime case in that development region.

**10.2.2. Second type Visualization**

User selects crime, year and Causes. After clicking the 'visualize' button, it gives visual information that by how many ways murder or other particular crime is committed in particular year. The output is displayed in pie-chart and bar-graph.
In above shown bar graph, x-axis represents ways of committing murder and y-axis represents the number of crime. From the above diagram, it can be understood that Murder due to poisoning is less while murder due to 'Vabitavya' is high.

In the pie-chart diagram, it is obvious that 'Vabitavya' sector is large. So, it can be concluded that most of the murder cases are due to 'Vabitavya'.

10.2.3. Third type of Visualization

This visualization shows the type of crime in a year with their causes and their number in different regions and valley.
In above shown bar graph, x-axis shows regions and valley while y-axis shows count of respective crime. In case of above diagram, number of robbery crime due to Dacaits in different regions in year 065/066 is shown. From that visual information, It is clearly known that 'robbery' crime due to 'Dacoits' in year 065/066 is the highest in the Central Development Region.

10.3. Android App output

Android application is developed for public people. People are more concerned about the security level of place where they are living or place where they are going to visit. Our app can be useful for such user as this app provides the visual information regarding the crime that occurred within past two years.
The output of android app is given below:

Figure 25: A screen shot of Android app output
Above figure is the output of android application. It shows the visual crime information of langankhel locality. Crimes that occurred over there are listed as shown above. The number of 'Social Crimes' crime occurred in that locality within 2 years is 3. By clicking 'Details' button, android user can get detail information about 'Social Crimes' or other crimes through bar graph.

X-axis represents the time-band (night, mid-night, morning, etc.) and y-axis represents the count of crime. Total number of crime related to 'social crimes' is 3. Among 3 crimes, 2 crimes were happened at mid-morning time band and rest crimes happened at Early-morning. Similarly, in case of 'Murder' crime, it can be found out that in which time band 'Murder' is more likely to happen. Let’s say if evening time band has more counts then, android user will be cautious and alert in such time band. In this way, this android app can alert the user and prevent them from being victim.
11. DISCUSSION

With the help of the web applications designed, we can easily take different output and analysis. We can mobilize more armed force at the place where crime like murder, shooting takes place in more amounts. Similarly, more police man should be mobilized in the area where more crime like robbery, pocket picking is done and civil police force should be mobilized at the place where gambling is done. For example, places like Birganj, where many Business men are shot out, should be mobilized by the armed force rather than baton policemen. With the help of our android app, user can know how risky is a particular place for particular type of crime at what time band. Hence, s/he will me more alert at that time whenever he is at particular location. Hence, the app user will know whether he is at risk or not and feel more secured. Also, if a particular crime is more common at a particular place at fix time band, then the police officer can increase the mobilization of patrol man there. Hence, using our app the police officer can make necessary arrangement of police force mobilization accordingly.
12. LIMITATIONS OF THE CCS SYSTEM:-

- Crime Control system uses the crime data and gives the visual information to user or officer but it does not recommend the officer what measureable step to take after showing visual information.
- Instant crime information can't be sent to police department using our system. Public can't send the instant notification to police department about the crime that occurred recently.
- There is no online reporting service.
13. CONCLUSION

In this project we have worked in two major parts; one is the web application and the other is the android app. In our web application part, we have developed a robust system for crime data entry and visualization that can be used by the police officer. We have used bar graph and pie-chart for visualizing the crime data. On the basis of the crime record visualization, the police department of Nepal Government can take necessary steps to maintain and optimize the security level of our country to their fullest. The data entry and storage has been automated for the purpose of further use. In the android application part, we have visualized the crime data of a particular place of user choice in a bar graph. The visualization shows the number of crime against the time band of a place where the user has installed our app. Using our android app, the public can analyze how risky a particular place is where he is currently located. The android application can make the public more alert. The android app on its trial phase has earned positive feedbacks from the user. Once, this android app paves its way towards the app store, we are sure that its user will grow day by day due to its applicability from the user prospective. Hence, we have developed our system as per the project proposal and tried to meet the objectives of the project.
14. FUTURE ENHANCEMENT

14.1. Log maintenance

Since the crime data is very important data. It is necessary to keep the record of events that took place during use of the System. The events can be like entering data, editing crime data, visualizing. The log file will be used by higher officer in order to study the behavior of junior officers. Higher officer will know by whom data was entered or edited. By studying log file, fraud officer can be detected.

14.2. Search features in android app

Some of the features are still remaining to be added in android application. Currently, it provides the visual information about the location where the Android App is installed. In the future, search feature will be added. After adding that feature, user will be able to view the crime information of desired place. User can understand through bar graph about the security level of desired place by staying at home.

14.3. Edit Part

Officer can knowingly or unknowingly enter the false crime information. So, edit mechanism is the most in our system. Officer can search the crime information that he wanted to edit. Officer can view the result after clicking the 'Search' button. But the task of editing the listed the output is remaining.
14.4. DBSCAN algorithm implementation

DBSCAN is data mining algorithm. After implementing that algorithm, it can be detected which region is more affected by crimes. The data input for that implementation are longitudes and latitudes of crime.

14.5. User interactive design

The current GUI of system is not our final GUI. The GUI of system will be improved and made more functional so that user can feel easier to use it.
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