River Pollution Detection Using Google Maps

Anurag Mishra
CSE Department
IMS Engineering College
Ghaziabad, India
+91-9582224203
anuragmishra21@gmail.com

Piyush Aggarwal
CSE Department
IMS Engineering College
Ghaziabad,
India
piyush2official@gmail.com

Rohit Chaudhary
CSE Department
IMS Engineering College
Ghaziabad,
India
rohitchaudhary29@gmail.com

ABSTRACT
River pollution is a major problem in India in the present time. Google Maps provide us satellite view and terrain view of earth in India for most of the places. But we can't get exact insights of pollution affected areas.

The paper is about how we can distinguish and highlight the pollution affected areas on the banks of rivers, what remedies can be taken to check the pollution on that spot, and to help people to know better about the severe river pollution. Google Maps has a lot of information and one can crawl the Google Maps to have very useful results. Our basic idea is to make a tool which may be helpful in identifying the causes and more polluted areas of the river and to give the correct remedies and suggestions to control the river-pollution of corresponding areas. The paper focuses on the problems that we face and can face in the near future like dangerous diseases, etc. This paper presents a detailed methodology of identifying the cities on the river banks along with their status of pollution as severe or moderate.

CCS Concepts
• Applied computing~E-government

Keywords
CPCB; Pollution index; Latitude-Longitude; API's; Markers

1. INTRODUCTION
Pollution refers to the chemicals or other substances in water or air in greater concentrations than would occur under the natural conditions [1]. Water is the most basic factor for life. But now almost every day a story about pollution is ready whatever may be the kind of pollution. It can be in the food that we eat, in the water that we drink, and in the surrounding air.

The major problem created by water pollution is that it harms and kills the life of those which depend on various water bodies. Crabs, dead fishes, dolphins, birds and sea gulls and many other animals living in water often wind up on the beaches, as the pollutants in their habitat kill them.

The major reason of water being polluted is the waste from the nearby Industries example car-wash, car-repair, laundry, gas Industries. Industry is a huge source of water pollution, it produces pollutants that are extremely harmful to people and the environment. Many industrial facilities use freshwater to carry away waste from the plant and into rivers, lakes and oceans.

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Many small-scale industries and factories that don't have enough capital and rely on government grants to run their day-to-day businesses often escape environment regulations and release large amount of toxic chemicals in water.

Today there is great need to identify the areas and causes which are resulting in river pollution. There are lot of surveys happening in India in which people go to field and analyse the water quality of the river from sensors. From time to time methods of detection the river pollution has changed. Government is focusing on different methodologies to identify the areas resulting in more river pollution. Government is focusing on real time (automatic) monitoring stations at 113 locations, quality assurance service for the real time water quality monitoring system etc. Geographic Information Systems (GIS) is technology that can be integrated into various system frameworks. GIS enables capturing, storing, analyzing, and displaying geographically referenced information. It allows us to view, understand, question, interpret, and visualize data in a way that is quickly understood and easily shared. GIS technology can be used for scientific investigations, resource management, and development planning.

Information and data plays a very important role in detection of river pollution. Google maps already provides a lot of information which can be crawled to generate very useful results, these results can help government analyze the areas and causes resulting in river pollution. The current software and tool are well efficient but lack in having useful inputs which tells the status of river pollution.

As we know that bulk of the water i.e. approximately 97% of the water on the Earth is saline. The remaining 3% of water is mostly frozen in the polar ice-caps.

The distribution of fresh water is such that the rivers, underground stores and lakes have less than 1% of the fresh water. The fresh water is precious and increasing level of pollution of rivers and other water resources indicates an alarm of danger [2]. Such a small amount of water is the only source of fresh water which is needed for the life on the earth.

The level of pollution may also depend on the population of the country [3]. Say it coincidence or not, China is the world's most populated country.

2. LITERATURE SURVEY
The water quality is very significant for health worldwide, whether it's for drinking, irrigation or for daily routine purposes. The quality of water can also have large effect on health through waterborne diseases which are due to pathogenic microorganism that are transmitted in the contaminated water [4]. For the effective analysis of water quality and for meeting the objectives of project, it is

required to obtain a well understanding of the infrastructure, studies carried out previously, and the various ways by which people interact and behave with the rivers.

The Ganga river in India acts as a lifeline for approximately 400 million people living in its delta and alluvial plains, being one of the highly agricultural and most densely populated regions of the world. Due to the toxicity and accumulation of heavy metals and sediments in microorganisms, animals, plants and humans, the river Ganga may have an adverse effect on the environment of delta regions and alluvial plain [5]. Generally, the networks of water quality monitoring are for multiple purposes, and hence the generated data is expected to provide the information on a set of objectives [6]. The two important questions fundamental to these objectives can be- first, detection of long term trends and second, differences between various locations.

Geographic Information Systems (GIS) is a technology that can be used and integrated into various system frameworks. GIS technology helps in capturing, storing, displaying and analysing geographically referenced information. It enables us to view, understand, interpret, question and visualize the data in the way that can be quickly understood and also easily shared. We can use GIS tool for scientific investigations, development planning and resource management [7]. That is why we are using GIS to display the final results.

In the less developed nations, releases of human sewage, especially near the rural groundwater wells and in the burgeoning urban areas is the cause of a serious damage to the people, having about one billion people those are suffering from a waterborne disease at any time [8]. In North America and Europe, contaminated sediments, leaking hazardous waste sites and the atmospheric deposition of toxic and acidifying substances put a complex challenge. Cultural and institutional barriers to the pollution abatement can be overcome by people and government by including interventions as an integral part of sustainable economic development initiatives.

There is an important concept in the allocation of resources for improving drinking-water safety. The concept says the incremental improvements towards some long-term targets. The long-term targets of further water quality improvements can be achieved by setting the priorities to remedy the most urgent problems (example- the improvement in the acceptability of drinking-water) [9]. The requirements which are essential for ensuring the safety of drinking-water are a framework for safe drinking-water, having health-based targets established by a competent health authority, adequate and properly managed systems having adequate infrastructure, effective planning and management and proper monitoring.

The pollution level of agriculture land due to herbicides was assessed in the Guarena and Almar river basins, Spain [10]. Fifteen herbicides were selected as pollution parameters due to their frequency and amounts used their toxicity and persistence in the environment. Surface and ground water was taken from various locations in the basin, then these were analysed for a period of 6-month. The six out of the fifteen herbicides were detected in several samples which show that the herbicides are also a major factor for the pollution.

Central Pollution Control Board (CPCB) is an organisation for controlling and monitoring the pollution in India. The monitoring of water quality is carried out by CPCB specifically w.r.t. the indicator of Pathogenic Bacteria (total coliform and faecal coliform) and w.r.t. indicator of oxygen consuming substances (BOD, Biochemical Oxygen Demand) [11]. And the results show that there is a gradual degradation in the quality of water (CPCB 2009).

Problem of river pollution is very serious in India. The Ganga is the largest river in India. It has a great religious importance for the Hindus. Some of the world's oldest cities like Kanpur, Patna and Varanasi are situated on its banks. The Ganga is source of water to about 40% population of India covering 11 states and it serves an estimated population of about 500 million people or even more than it that is larger than all other rivers in whole world [12] [13]. In the figure, we can see the relative comparison of India's total riverine length and polluted riverine length. But today, the Ganga is polluted at the extent such that it has fifth position in the global list of most polluted rivers. Though government and people took some initiatives for cleaning the river, but those initiatives were not able to deliver some remarkable results.

Human beings capture and use a lot of water for agriculture purpose, industrial and municipal use during the natural cycle of water coming from the mountain tops and going down into the oceans. When water comes to humans, it is in different form and when the water is used, it is returned back to the nature in a totally different condition, most of the times as dirty water; we can call it wastewater. Where the dirty water is thrown, it depends on where you live. It can be thrown away on the land, into the gutters, down into the kitchen drains, on grasses and flowers or in the bathroom drains. Ultimately, it is never returned in the same form in which it was withdrawn from nature.

The people depend on the fresh water for a wide range of causes, but it seems that need for fresh water will not be met in the future unless the way we deal with dirty water is revolutionized. The factors of producing too much dirty water are: first and foremost, population growth, then industrialization and then urbanization and food production.

The global population is expected to reach nine billion by 2050. The population in urban areas is expected to rise almost twice as fast, and is estimated to reach 6.4 billion by 2050 which will be nearly double of present (3.4 billion), while the people living in slum areas rising faster (from 1 to 1.4 billion in a decade).

This clearly shows that there is much pressure on the natural water resources. The quantity of wastewater produced is directly proportional to the quantity of fresh water withdrawn. More quantity of water we withdraw; more wastewater will be produced. In the developing countries, low quantity of water is withdrawn and low quantity of wastewater is produced in comparison to developed countries, but most of the developing countries have very little infrastructure for the treatment of the wastewater.

Pollution of river water is of particular concern in India. The State is dependent on river rater and the Indian Department of Environmental Management assessed over 99% of Indian's rivers and streams for their ability to support fish, shellfish, and other aquatic life, and it was found that only 64% of those waterways were able to completely support all aquatic life [14]. This discharge of the wastewater into the nature is a serious factor of river pollution and other water body pollution.

Digital processing of images and observed signals is closely related to the environmental sensing [15]. This can be achieved by taking the digital images and doing their processing which includes image segmentation, classification, feature extraction and detection of the important factors and sources of pollution.

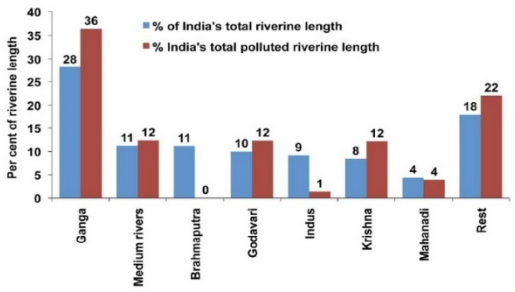

Figure 1: India's total riverine length VS polluted riverine length

3. PROBLEM FORMULATION

We want to live in a pollution free country as we know that air and water are the essentials of life and if these are polluted, there are produced a series of diseases.

There is need to control the river pollution and find out correct remedies to control the river pollution. GIS tools and sensors cannot alone help in detecting river pollution. These tools are efficient but they require more useful inputs to work more efficiently. The agencies working on river pollution detection are lacking in the information and useful data.

The problem of pollution is not small. It is not limited to just a particular area. If it has to be taken seriously, then a large system is needed which should be spread in whole country for monitoring the level of pollution. The system has to monitor the pollution level at different positions in order to take corrective measures. But the system is not there.

The project is to help the government at some extent. Google Map and its API are available, using which we can first identify the types and distance of industries of corresponding areas. Processing the above results helps in giving causes and remedies. Government officials can see easily the affected areas and can take appropriate actions according to the remedies. This will reduce human effort and will result in a quick response. Our methodology for detecting river pollution helps in identifying the pollution affected areas, locating those areas on the map for easy view and taking corrective actions as soon as possible. This will help in proper planning of choosing the correct place for them to live and to control large number of small scale industries which releases toxic gases in river. The results received from our methodology can help in contributing government to check lack of policies to control water pollution. This will help the people in to check whether an industry can be started on a particular place or not. Report can be generated for the river that includes source of pollution and remedy to control the pollution. The overall goal of the project is to help the Government of India in a giant problem of pollution.

4. NOVELTY

The tool that is being created may be at some extent useful for Government of India and other NGO's to detect the major source of river pollution and the remedy to control that pollution. According to information, there is no such tool present in the market that gives such report of the river including all the cities that have major contribution to the river pollution.

At present time, we can get some real time river pollution data only for few rivers and few cities on the banks of those rivers [16], but we can't get the detailed information about any particular river. We are trying to create that tool which may be useful to highlight the selected river on the map and deciding the status of pollution in different cities.

Our project will help in making Google Maps more informative as we are using the place search API's of Google as the baseline of the project and it will help in overall human welfare as it will locate pollution affected areas.

5. METHODOLOGY

In detection of river pollution using Google Maps, we are more interested in crawling the data which we are getting from Google Maps. When we crawl the Google Maps there is a lot of information available by Google Maps. The KeyHole Markup Language file of rivers gives the latitude and longitude of the all the points where the river flows. When the user selects the river, the river gets highlighted on the map with major cities using markers.

INPUT:

The Latitude and Longitude we got from the KML file of the river needs to be crawled. We have to specify the Latitude and Longitude and the Type of the Industries we are looking for the corresponding Latitude and Longitude.

Next input is how much Radius we are considering from a Particular Points.

Request = {

location: Latitude and Longitude,

radius:'500',

types: ['type of industry']

};

PROCESSING:

The Latitude and Longitude we get will be giving input to Google Maps Javascripts v3 places Api. Now our task is to collect all the major data points related to the particular Latitude and Longitude.

For the corresponding Latitude and Longitude, we got the various important Datasets. The important Datasets we got from it are the nearby industries and shops which may be responsible for river pollution. For example:

Car_wash, Car_repair, Laundary, Gas Industries etc.

After the crawling of corresponding Latitude and Longitude, we have the list of all the industries nearby to a river Latlong which may be result of the river pollution.

Now our task is to know the population and schools, university, park etc. near the corresponding latitude and longitude. This information will help us to determine the correct threshold for the particular place. Now we have maximum information which we can get from crawling Google Maps.

Now our task is group all the factors under one table and study the overall impact of these factors on the river area.

We can have both the results at one time. Means we can know:

1. The factors due to which river is being more polluted.
2. The impact of these industries on the nearby area.

Now the formula which is used is:

$Industries = \sum All\ the\ Industries\ resulting\ in\ pollution.$

Public Places = ∑ All the places which are publicly open.

Like this we will have different industries grouped into one category industries.

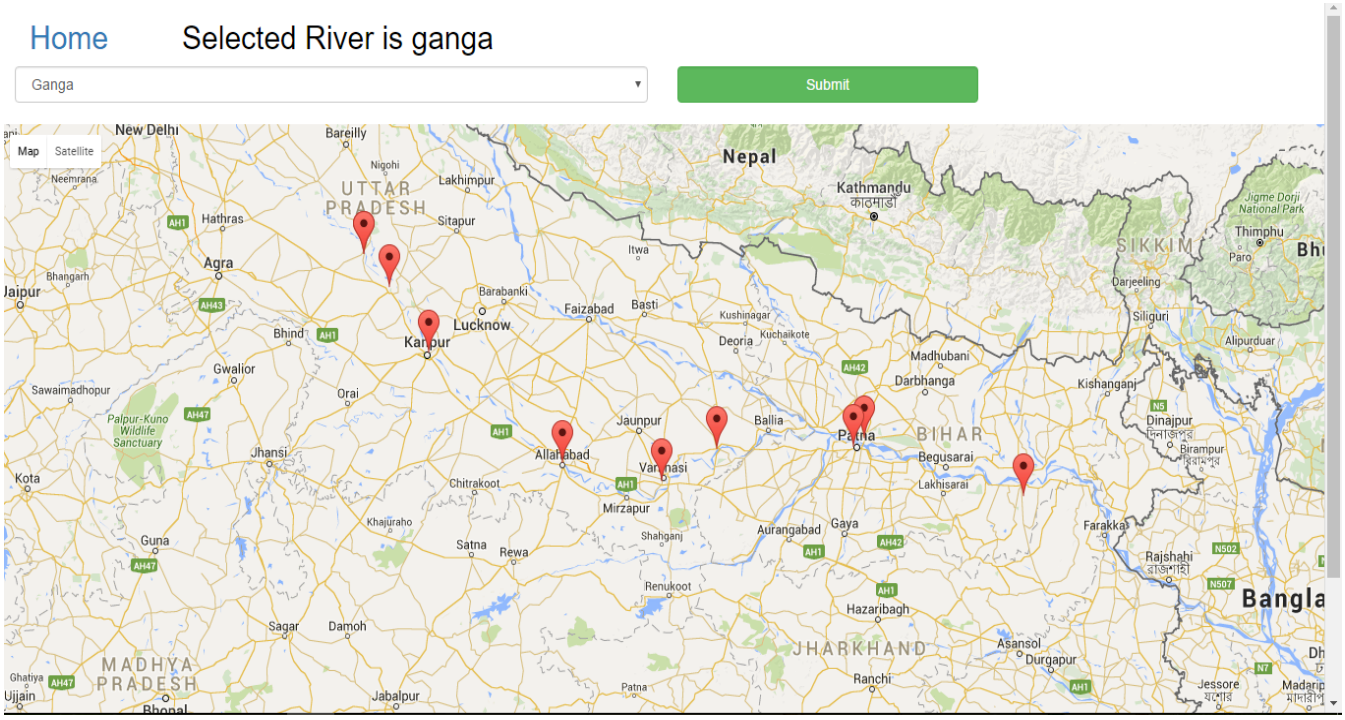

Figure 2: Selecting the river and displaying it on Google Maps using markers

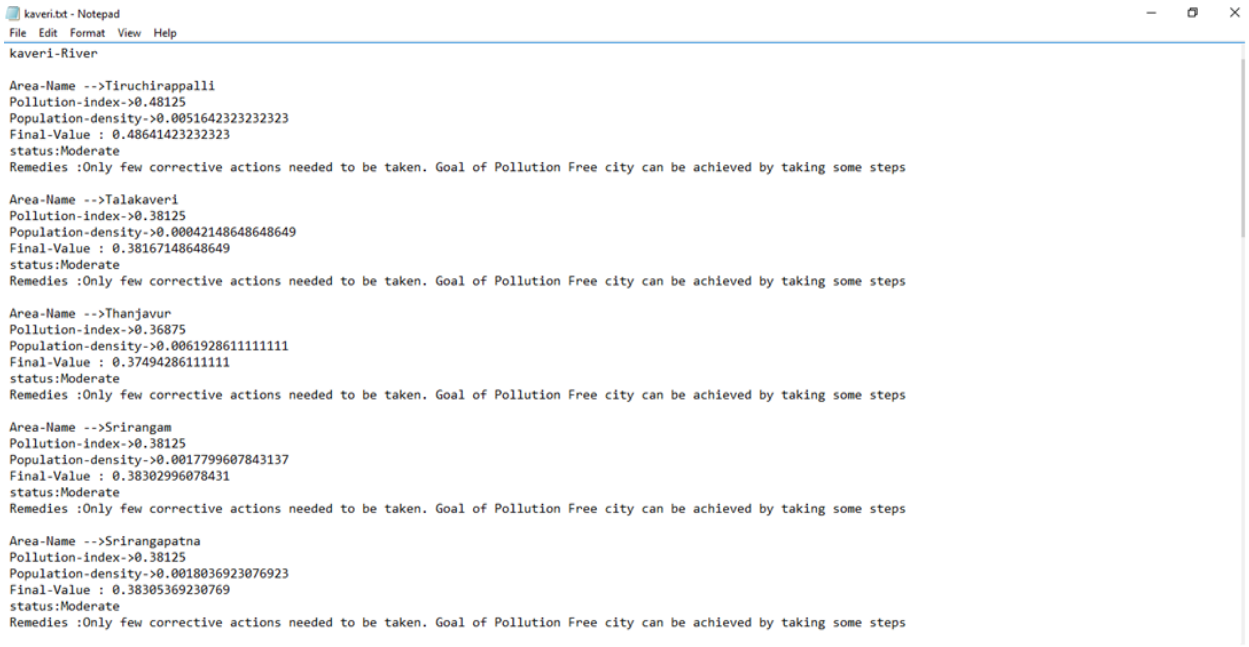

Figure 3: Generated notepad file to list the area wise status, R value and remedies

Industries = car_industry+ car_wash + gas plant + laundry + Rubber industries etc.

Public places = hospitals + schools + parks etc.

Now we can use:

R- value = ∑Industries / (Population).

R+ values = ∑Public places / (Population).

R value = (R- / R+)

We will have the R values for every corresponding Latitude Longitude of the river. Every river will be parsed and crawled like this. We have set a threshold to this R value. Case 1:

R value > Threshold value

Situation: Severe.

Listing factors due to which condition is severe.

Case 2:

R value < Threshold value

Situation: Good.

Listing what can be the future factors due to which R value may increase. Case 3:

R value = Threshold value

Situation: Moderate

End:

Similarly, we can study the impact of these industries on the people living nearby. Now our next task is to generate a GIS interface so that the output we received can be represented more clearly. With the help of GIS, we will show the River visualization on open Street Maps and showing the corresponding severe Latitude and Longitude.

From our MySQL Database, we will export it to CSV. This CSV consists of the corresponding LatLong and all the information related to that LatLong. Now we will generate shape file of the corresponding river. Similarly shape file will be generated for the corresponding industries. These shape files will be added as the vector layer on the Open Street Maps. These shape files can be used for other consideration. All the Information is also stored in corresponding notepad with the name of the rivername.txt. Now we have accomplished our task of crawling the river Lats and Longs and generating the useful results from it. These results are shown on GIS tool and a notepad file.

The results obtained from the report are given input into the QGIS tool and different layers are shown in QGIS. With the Help of QGIS the river layer is separated with the industries layer. The different layers are superimposed on each other to have better visualization of the report. This visualization helps in better classifying the industries which are responsible for the pollution of rivers.

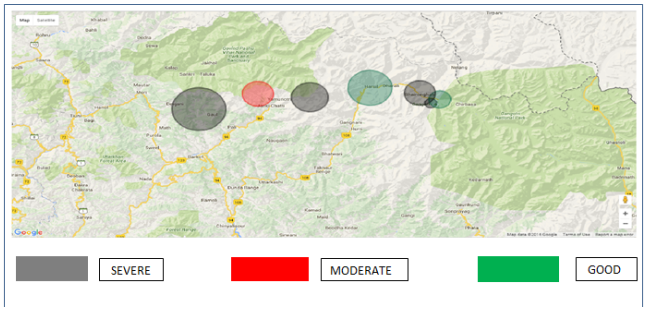

Figure 4: Showing the area condition of the river for corresponding latitude and longitude and the area affected around that latitude and longitude

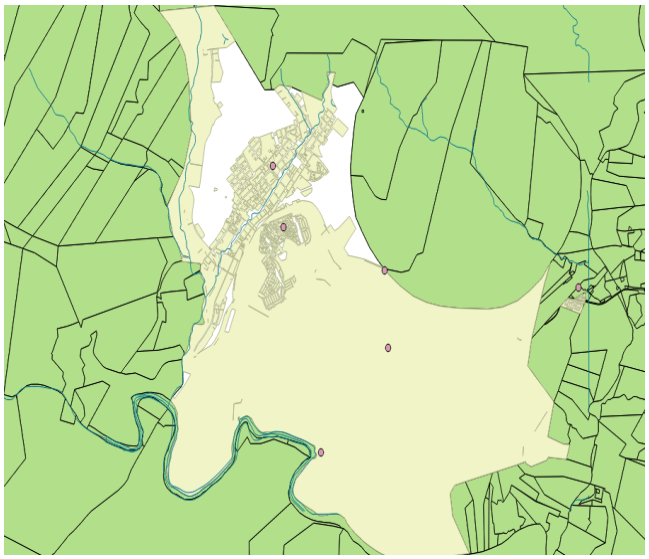

Figure 5: Showing the results on GIS tool for better visualization and further processing to see the results separately for urban and rural area

6. RESULTS

A report is generated with all the cities contributing to the pollution of the selected river which also includes a remedy to control or check on the pollution. The notepad and CSV's are generated which contains the R value of the corresponding areas. The corresponding areas are highlighted with 3 different colours according to the R value obtained

Black - Severe

Red - Moderate

Green – Good

For better visualization the above results are given input to QGIS tool.

7. CONCLUSION

The project is new in its kind as it works like a tool to get the insights of the level of pollution of the river. It will identify the cities which are on the banks of the river. The city which is more prone to pollution will be identified as severe factor of pollution. Government can also take help from our project, as it does not require to do survey for getting pollution information. Hence the necessary actions can be taken soon. In the near future, the problem of water pollution can be more critical. Hence, prevention is better than cure. The city which seems to be dangerous in terms of pollution should be considered for cleaning.

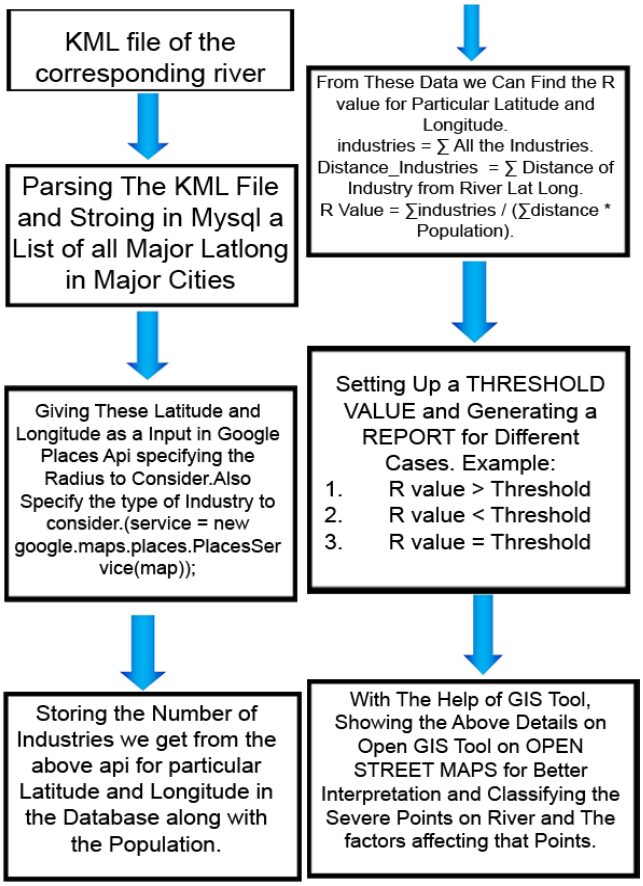

Figure 6: Step by step working of the project

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