HS-202: HUMAN GEOGRAPHY AND SOCIETAL NEEDS
2021-2022
PROJECT REPORT

VEHICLE MONITORING SYSTEM AT ROAD TURNS

Under the supervision of

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Certificate

This is to certify that the B.Tech project titled "Vehicle Monitoring System at Road Turns" prepared by Niraj Kumar, Milind Rathore, Sahil, and Vinay Jain is approved for submission for the course on Human Geography and Societal Needs in the Department of Humanities and Social Sciences, Indian Institute of Technology, Ropar.

Signature of Examiner

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Declaration

We, the members of project group-48 of the HS-202 course of the session 2021-W, the undersigned, hereby declare that the report entitled "Vehicle Monitoring System at Road Turns" is based on our work carried out during the course HS-202 Human Geography and Societal Needs under the supervision of Dr. Kamal Kumar Choudhary along with the other course instructors. We further declare that this report is based on our work where ideas of other persons have also been included. We have cited and referenced the sources whenever we have used them. We affirm that we have adhered to academic honesty and integrity principles.

Date: 20-04-2022
Place: IIT Ropar, Rupnagar, Punjab, India

Signatures of the group members:

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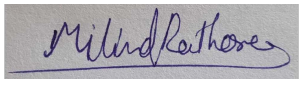
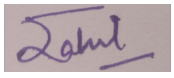
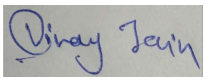
Milind Rathore (2020mcb1241) 

Sahil (2020mcb1248) 

Vinay Jain (2020ceb1034) 

Acknowledgment

We, the members of project group-48 would like to express our gratitude to the course instructor Dr. Kamal Kumar Choudhary and other faculty members who taught the course HS-202. This project could not have been completed without the guidance and support of the Instructors and the Teaching Assistant (TA) allotted to our group, Ankita Mishra. The role of the mentioned people was crucial in this research as the different aspects of the role of engineering in society like understanding and analyzing problems or gaps were explained by them in a very nice and informative manner. We would also like to thank all the people who took part in our survey. Finally, we would like to thank the Department of Humanities and Social Sciences, IIT Ropar for giving us the opportunity to study the HS-202 Human Geography and Societal Needs course.

CONTENTS

1. Title: Vehicle Monitoring System at road turns

2. Abstract

Road transportation is a major route of distribution of economic products in our country.
Currently, around 8 lakh accidents occur per year in our country and since the transport sector is going to grow in the future, we must come up with methods to prevent road accidents. Various factors are responsible for road accidents. According to Road Accident Sampling System - India (RASSI) data, nearly seven and a half lakhs of vehicles met accidents in the year 2019 which corresponds to a $0.57 to $1.81 billion economic loss.

We have focussed on curved roads and their role in accidents and other economic losses. After gathering opinions of people on road turns, we have tried to come up with a solution that reduces the chances of accidents near curved roads and also saves time by efficiently monitoring traffic near turns. In this research paper, the vehicle monitoring system we have presented is capable of detecting the speed and location of all vehicles in the vicinity of the road turning. Then, it analyses the data and shares the necessary information with the vehicles for safe passage on the turnings.

Figure 1 (source: Shutterstock)

3. Definition of the problem

3.1 Problem Statement

The turns on the roads are of critical importance due to their effect on driving. More than 25 percent of fatal crashes happen at turning points on roads (link). As per the survey we conducted, given in the next section, the vehicles are slowed down at turns to ensure safe passage without collision. Also, most people believe that turning points on roads have a high chance of accidents. We intend to make a monitoring system for vehicles at turning points on roads to ensure that accidents do not happen and also to save time in case when no vehicles are ahead, by giving information to a vehicle that there are no vehicles ahead and speed need not be reduced.

3.2 Identification of the problem

For identifying the problem, we have used the various methods which were discussed by the Course Instructors and the Teaching Assistant (TA).

3.2.1 Research Design

A. **Type of Design**: We, from our personal experience, felt that the road turns are vulnerable to accidents and also, they are responsible for wasting time as people have to slow down their vehicles to ensure safety. Also, some research papers (link) indicate the same that road accidents at curves are more dangerous compared to other cases. Then, we carried out a survey about the same and found that most people indeed think that road turns are causing harm in the form of accidents and also in the form of economic losses due to time wastage as vehicles are slowed down at turns. This particular aspect of road safety (road turns) has not been investigated in-depth as of now. Hence, our research may be considered exploratory research.

B. **Mode of Inquiry:** We have asked people about their opinion on the impact of the road turns on driving, by doing a survey. Since we asked respondents to answer questions yes or no, our method may be categorized as qualitative at the individual level. But after getting all responses, we have analyzed the overall data of responses quantitatively.

C. **Application of Research**: Our research is based on solving real-life problems which can significantly reduce the chance of accidents at turnings and also save time by efficiently monitoring the vehicles at road turnings. Our research can be categorized as applied research as it solves real-life practical problems.

3.2.2 Selection of Surveyee

For carrying out our research, we requested many people to take part in our survey. But the choice of taking part or not is completely dependent on them. And also, it is not possible to send our survey participation request to all different types of the population living in our country. Hence our survey sampling can be categorized as Convenience sampling which is a type of Non-Probability Sampling Method.

3.2.3 Method of Data Collection

We have used Google Form for carrying out the survey. And we have taken some other data like the economic losses due to road accidents and the number of accidents in the year 2019, using the Ministry of Road Transport and Highways website (link). Note that we have chosen data on the number of accidents and economic loss in the year 2019 because, after the beginning of 2020, the number of vehicles running on the road decreased due to the spread of the Covid-19 virus. Hence the data for 2019 is more reliable compared to recent year's data.

3.2.4 Analysis of Survey Data

In our survey, we asked two questions which are given below.
Q1) Do you think that vehicles need to be slowed down on road turns to reduce the possibility of the collision?
Q2) Do you think that turning points on roads are vulnerable to accidents?
In both the questions two options were given: Yes or No, out of which one needed to be chosen.
For Q1, 82.4% of respondents chose Yes and 17.6% of them chose No. And for Q2, 76.5% respondents chose Yes and 23.5% of them chose No.
Form details are given below.

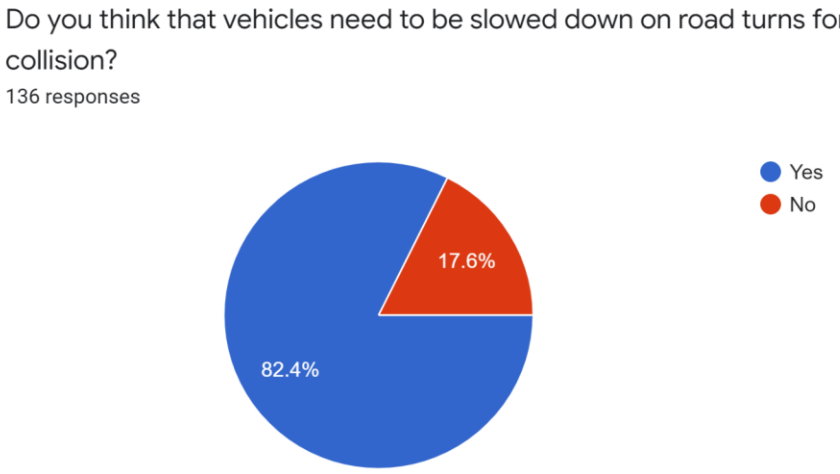


Figure 2 (Pie Chart of responses to Q1)

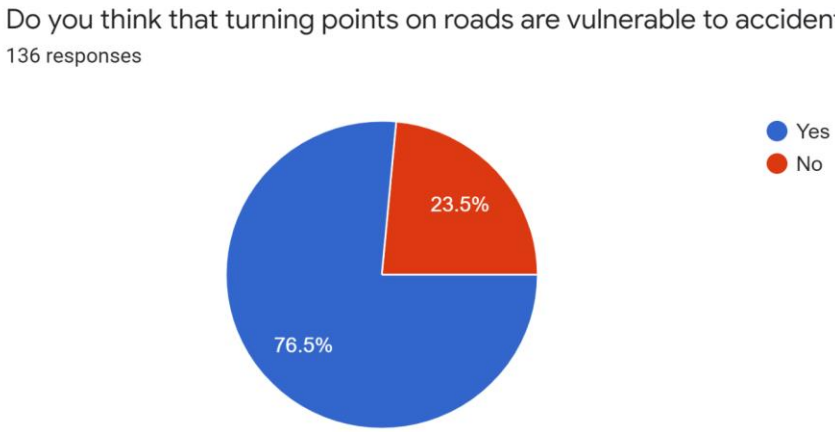


Figure 3 (Pie Chart of responses to Q2)

From the response of surveyees, it is clear that vehicles are slowed down near turns and also, they feel that road turns are vulnerable to accidents.

3.3 Detailed description of the identified problem

As per our own experience, research paper (link), and survey also, it is found that, at turning points on roads, there are more chances of accidents. Additionally, in the survey, we also found that people slow down their vehicles to reduce the risk of collision. The main reason behind slowing down is that, at turns, the vehicles which are coming toward us are not visible to us. To ensure that collision does not happen, we slow down at turns. The main concern here is that, even if no vehicles are coming toward us, we break our speed because we do not know if there are any obstacles ahead or not. This is unnecessary if no vehicles are coming toward us. Many times, we are in an emergency and we have to slow down at each road turn to ensure safety. So, we are designing a vehicle monitoring system which will give information about the other vehicles which are coming towards us at road turns. By having this system at turns, we will have information about other vehicles coming toward us and then, we can drive accordingly. If there are no vehicles at turns coming toward us, we can drive fast without breaking the speed. This will save time and also ensure safety.

3.4 Current developments in the Domain

Currently, there are systems (link) for avoiding collisions between vehicles that are in front by using sensors in vehicles to monitor the velocity of other vehicles which are in front. But at road turns, this system is not effective at turns because vehicles are not straight in front at turns, they come from different directions. As of now, we do not have any system for monitoring the vehicles at the turns. We have a traffic light system, but that is entirely different from the system we have proposed in this paper. Our vehicle monitoring system is for monitoring vehicles in the vicinity of road turning points.

3.5 Need and significance of resolving the problem

The proposed system will reduce the chance of accidents at the road turns and also it will save time. It is important to solve the problem of slowing down at road turns. And also, it is important to reduce the chance of collision at turns. The solution to this problem is crucial because due to it, we are facing heavy losses. Like, an ambulance needs to be slow at the turns even if no vehicles are coming towards it. After the implementation of our proposed system, a vehicle will be able to maintain its speed at turns if no other vehicles are coming toward it. This will save time and energy as breaking dissipates energy and also breaking, again and again, is harmful to vehicles.

4. Aim and Objectives

The aim of our project is to efficiently monitor the vehicle's movement near road turns to prevent accidents and also to save time if no vehicles are coming towards us, by getting information about the same.
The following are objectives that will help us achieve our aim:

1. To design a Vehicle Detecting Unit capable of locating vehicles in the vicinity of the road turns along with their velocities.
2. To design a Central Unit which uses the location and velocity information given by the Vehicle Detecting Unit along with the map of the road near the turn, to create different sets of information to be given to the vehicles near turns.
3. To design a Signal Processing Unit that uses the information given by the Central Unit to generate encrypted signals corresponding to each direction and send them to the vehicles.
4. To design a Signal Receiver Unit that receives relevant signals sent by the Signal Processing Unit. It has to be installed in vehicles.

5. Tools and techniques perceived to be effective for resolving the issue

Details of techniques involved in different units of our system are as follows:

1. **Vehicle Detecting Unit:** It uses a camera to record vehicle movement at different locations of road turnings. It uses artificial intelligence mathematical modeling to associate every vehicle to a 3D model and track their location and precise velocity.
2. **Central Unit:** It receives the velocity and location information of all the vehicles in the vicinity of the road turns, by the Vehicle Detecting Unit. It locates all the vehicles on the map of the road turn and also stores their velocity information.
3. **Signal Processing Unit:** It uses a radio wave signal generator for generating signals corresponding to data shared by the Central Unit. It generates encrypted signals.
4. **Signal Receiver Unit:** It detects the encrypted radio wave signals sent by the Signal Processing Unit. It then sends its location and velocity information to the Signal Processing Unit, and by using this information the Signal Processing Unit sends decrypting code for suitable radio wave signals having information relevant to the current vehicle. Further, by using the decrypting information, the Signal Receiver Unit gets the information about the velocity and location of other vehicles coming toward it.

6. Detailed Work Plan/Technological Interventions

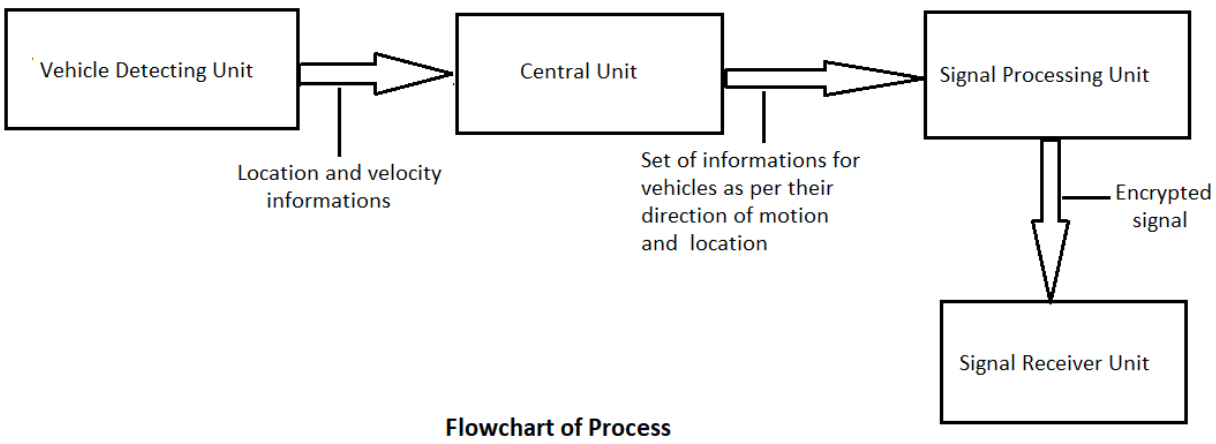


Figure 4 (Original, made by Niraj Kumar)

Vehicle Detecting and Signal Processing units are placed on a pole at a height of around 10 feet so that they can detect and send signals respectively. The Central Unit is at the bottom of the same pole in a box. Signal Receiver Units are to be there inside every vehicle. And a pole integrated with Vehicle Detecting and Signal Processing units is placed on every turn on the road.

The Vehicle Detecting Unit has a camera integrated with Artificial Intelligence which is capable of locating vehicles along with measuring their velocity precisely. The Central Unit which is at the bottom of the pole receives data from the Vehicle Detecting Unit and it analyzes the map of the road turns and creates a set of information to be shared with vehicles depending on their location and direction of movement. For example, assume that a person XYZ is driving a car and there the road is turning left with respect to him/her, then the central unit will prepare information like velocity and location about other vehicles which are coming towards (from the front) XYZ's car. In the same way, the central unit creates a set of information to be given to vehicles depending on their direction of movement and location. Now, this information is sent to the Signal Processing Unit which is at the top of the pole. The Signal processing Unit generates radio waves corresponding to each element of the set of information created by the Central Unit. It also carries out the encryption of the signals generated by itself so that information is not accessed by any device other than the Signal Receiver Unit installed in the vehicles. Now, the Signal Receiver Unit which is present inside the vehicle sends the vehicle's location information to the Signal Processing Unit and then the Signal Processing Unit sends corresponding decrypting information to the Signal Receiver Unit. By using the decrypting information, the Signal Receiver Unit is able to decrypt the information which is supposed to be shown to the vehicle in which it is installed. Now the relevant information about other vehicles coming towards the vehicle in consideration is shown on the screen attached to the Signal Receiver Unit present in the car. And using this information, the driver can decide whether to slow down or keep driving at a fast speed.

7. Novelty of the proposed interventions

As far as road safety is concerned, we have traffic rules. But traffic rules are for road intersections. There is a thesis (link) proposing accident prevention using sensors monitoring the speed of vehicles. But the drawback of this thesis is that the anti-collision system proposed here is not capable of detecting vehicles coming toward us at the road turns as near turns other vehicles are not in front of us.
Our vehicle monitoring system is for road turning portions. We have tried to solve the problem of vehicle monitoring at road turns. Methods that use sensors in vehicles to monitor other vehicles do not succeed at road turns because the direction of other vehicles relative to the vehicle in consideration is not straight. Our monitoring system overcomes this drawback by using a detection system installed at a pole near road turns and then sends relevant data to vehicles. This idea is new as every other detection system has sensors installed in the vehicle itself, which does not work at turning points on roads.

8. Approaches that could be taken to implement intervention plans

To implement the vehicle monitoring system proposed in this paper, we need to do the following:

1. Integrate the Vehicle Sensing Unit with the Signal Processing Unit and place them on a pole of the height of nearly 10 meters at the road turns.
2. Place the Central Unit at the bottom of the pole in a box, also connect it to the Vehicle Sensing Unit and the Signal Processing Unit via wire.
3. Integrate Signal Receiver Unit with a simple display to show information received. And place this integrated system of Signal Receiver Unit and display in the vehicles.

9. Possible constraints and barriers to implementation, design issues

Some of the constraints that we may face in implementing this vehicle monitoring system are as follows:

1. Design issue is to make the various units using materials that can withstand the different weather conditions. Otherwise, the maintenance cost may become very high.
2. Implementation challenge is to install Signal Receiver Unit integrated with a display to vehicles as we need to install it in all the vehicles.

10. Expertise available to each student to contribute to the development of the intervention

With respect to this project, all of us have almost similar levels of knowledge. Below given is the expertise as per interests.
Milind Rathore: In the integration of the vehicle Detecting Unit and the Central Unit.
Niraj Kumar: In the Signal Processing Unit.
Sahil: In the Signal Receiver unit.
Vinay Jain: In the material for making the overall system.

11. Expected Outcomes

The major component of our problem statement (given in the corresponding section) is that road turns are more vulnerable to accidents and also every time the vehicles are slowed down at turns to ensure that collision does not happen, but this sometimes leads to unnecessary wastage of time. If our vehicle monitoring system at road turns is implemented, then it will show the velocity and location of other vehicles coming towards (from the front) us, by using this information we can drive accordingly, for example, if there are no other vehicles then we can maintain our speed, otherwise we will slow down. It will reduce the chance of collision to great extent and also it will save time.

12. Suggested plan of action for utilization of outcome expected from the work

In order to achieve our aim of reducing accidents and also saving time at road turns, we need to install the vehicle monitoring system presented in this report, at the road turns and in the vehicles. To make installation possible, we need to make the process economical. Different units namely, the Vehicle Detecting Unit, the Central Unit, the Signal Processing Unit, and the Signal Receiver Unit can be manufactured separately. Then, their integration can be done. The Signal Receiver Unit is to be installed in all the vehicles. The Ministry of Road Transport and Highways can carry out the installation of poles having the integrated form of the Vehicle Detecting Unit, the Central Unit, and the Signal Processing Unit at the road turns. And also, they can make the Signal Receiver Unit compulsory. Also, the monitoring system we have proposed is not expected to be much costly because we have used simple electronic components for constructing the system. But the role of the government particularly, the Ministry of Road Transport and Highways, is very crucial for the successful implementation of the system presented in this paper.

13. Conclusion

Accidents have been a major concern in road transportation. Over the years, many reasons behind it are being solved. For example, the traffic light system was introduced to prevent accidents at road intersections. Nowadays, vehicles are being equipped with different safety features. But at the same time, road turns are of major concern because of their high vulnerability to collision (head-on) which leads to fatal accidents. In this project we have focussed on solving the problem of accidents at the road turns by designing a monitoring system at the road turns. This system will not only prevent accidents but also save time if there are no other vehicles near the turn by giving the same information to the vehicle.

14. Contribution of each student of the group to complete the assignment

1. **Milind Rathore:** Detailed Work Plan/ technological interventions, Novelty/Innovation of the proposed interventions.

2. **Niraj Kumar:** Abstract, Definition of the Problem, Aims and Objectives, Conclusion.

3. **Sahil:** Tools and techniques perceived to be effective for resolving the issue, Expected Outcomes, suggested plan of action for utilization of outcome expected from the work.

4. **Vinay Jain:** Approaches that could be taken to implement intervention plans, Possible constraints and barriers to implementation, and design issues.

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