

Navigation Application With Safety Features

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Abstract

In 2017, the number of car accidents that occurred were astonishingly high, even though, infrastructural road systems are being continuously built and renewed to make it more efficient. But a significant problem still remains that a staggering number of accidents is exactly what we want to avoid. So, what we are trying to achieve and discuss in this paper is how to develop several safety features in hopes of providing a safer route option for the public. We plan on using several techniques including clustering safe places, detecting, and warning our users about common accident places including junctions, the curvature of the roadway, and high traffic flow.

1 Introduction

1.1 Background

we want our users to be able to move about and proceed with their daily navigational tasks safely. Not to mention that, Current navigation applications do not consider road safety as a factor but rather, they simply give the driver the shortest path there is. That is why we retrieved some of the factors that result in an increased probability of accidents in order to attempt and make the user's path a little safer. we decided to tackle some of the main causes that lead to high accident rates like junctions, Traffic light detection and, with that, surveillance camera detection, well-lit roads detection, curvature of the roadway, and high traffic flow.

1.2 Motivation

This project takes into consideration how disastrous accidents may occur resulting in several fatalities. Therefore, it should always be of primary concern to provide the user with the safest route option available in an attempt to reduce the number of accidents and fatalities. A research was published in 2017, the number of car accidents that occurred recorded 11,098 [12] with 3,747 deaths, 13,998 injuries, and 17,201 damaged vehicles. And even though we always strive to make our roads safer, accident rates are still astonishingly high.

1.3 Problem Definitions

Navigation systems always focus on giving the user the shortest path, while completely neglecting the element of safety. In our project, we know that safety matters and that it varies from one person to another. So, The main problem is the suggestion of the best routes that takes into consideration the safety of the users.

2 Project Description

our system is a user-friendly navigation system, that implements safety features allowing the user to take the safest route that has fewer risk factors that could lead to accidents. furthermore, it will detect the junctions, traffic lights and, with that, surveillance cameras , well-lit roads, curvature of the roadway, and high traffic flow throughout the route which will make it a safer ride for the user.

2.1 Objective

our objective is to create a user-friendly application that focuses on the safety of the user. This application provides the safest routing options. This application will focus on keeping the user updated with regards to anything from blocked or closed roads, bridges, or even accidents in these places. The application will gather this information through feedbacks collected from multiple users. The Safety parameter is going to be determined based on several aspects that will be analyzed by multiple algorithms in order to determine the safest route for the user. Then, we are going to use these safety factors to provide a safe road for all users alike.

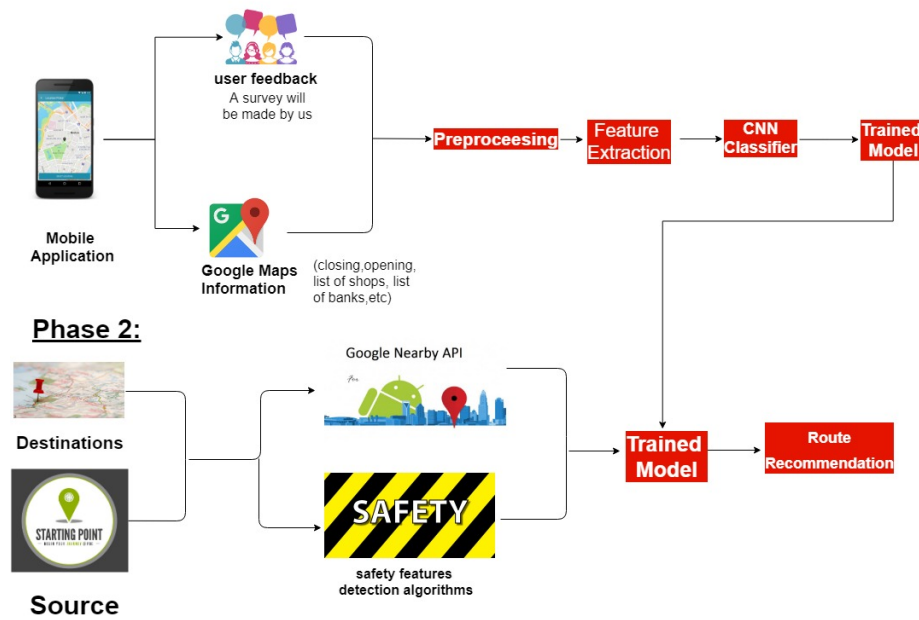
2.2 Scope

1. the application is android based
2. the application will take images from the user
3. the system will extract the Geo location of the features
4. the application process the image recieved
5. the system will detect the crowded area
6. the system will detect the well-lit roads
7. the system will detect the Traffic lights and surveillance cameras
8. the system will detect the
9. the system will detect the curved roads

10. the system will detect the risk areas
11. the system will extract the features through various algorithms
12. the system will save the data as JSON file

2.3 Project Overview

Phase 1:



3 Similar System Information

1. Road safety performance assessment a new road network Risk Index for info mobility
2. Vehicle to Vehicle communications applied to Road Intersection Safety, Field Results
3. Cloud Aided Safety-based Route Planning
4. An exploration of road safety parameters in Belarus and the European Union
5. Data Visualization Using Google Maps: the Hard Way and the Easy Way
6. Detecting road junctions by artificial neural networks

7. Using Analytics in the Implementation of Vertical and Horizontal Curvature in Route Calculation
8. Crossroad Detection Using Artificial Neural Networks
9. Identification of Curves and Straight Sections on Road Networks from Digital Vector Data
10. Traffic density determination and its applications using smart phone.
11. Road junction Detection from 3D point clouds

3.1 Similar System Description

3.1.1 Road safety performance assessment a new road network Risk Index for info mobility

This paper is talking about the road traffic safety and how improving it has become one of the most important targets of information technology for road users. And how detecting risk factors help in the prevention of accidents. The problem was that in the last few years traffic safety has become a big issue in road infrastructure management and many efforts were made to reduce the accidents risk. This paper proceeds to explain the 6 main factors that determine the probability of an accident. These factors are the number of previously occurred accidents, the density of intersections/lateral accesses on the road section, road surface anomalies and irregularities, problems related to horizontal road signs, problems related to vertical road signs, deficiency of the roadside and safety barriers. To conclude, this paper addresses the creation of a multi-platform mobile application that alerts drivers of the risk associated with specific traveled road segments, in relation with the driver current speed and the risk evaluation based on calculations composite indicator named risk index.

3.1.2 Vehicle to Vehicle communications applied to Road Intersection Safety, Field Results

This paper is talking about the intersecting roads and that a high percentage of accidents occur at these locations. The problem was that road junction accidents are becoming a social and economic problem for some countries because of the high number of deaths occurring in these areas. The paper proceeds to explain that the system relies on three fundamental technologies which are communication, location, and modeling of the surroundings between the vehicles sharing information about some areas and their conditions. The result after some Experiments showed that the limitation of the wireless network, the need for clock synchronization and time stamping and for means to compensate for communication delays or breaks.

3.1.3 Cloud Aided Safety-based Route Planning

This paper is talking about a safety-based routing planning and how improving it has become an important issue facing the worldwide and how road risk index considered as metrics. The problem was that according to a recent report from the National Highway Traffic Safety Administration many people lost their lives in road accidents due to the lack of safety features. The paper proceeds to explain how to generate optimal routes with safety-based metric through collecting data from over 30,682 road segments 144,821 crashes from the Highway Safety Information System. Then, this data is processed and used to develop a hybrid neural network model. This model is built by portioning the data into clusters algorithms, the aim is to find a route with the minimum travel time and risk weights. The result was the success in creating creation of novel safety-based route planning that optimizes over both travel time and accident risk metrics based on the available accident data, and Real-world case studies are considered that demonstrate changes in the route when safety is included in the optimization.

3.1.4 An exploration of road safety parameters in Belarus and the European Union

Road safety is an issue of general concern worldwide with major societal and economic impacts. Road accidents have become one of the leading causes of death in several countries and are deemed an issue that threatens public health. The problem presented in this paper is how to pinpoint the key parameters contributing to the road risks that caused 25,900 fatalities in 2013 in the European Union. After taking socioeconomic parameters into consideration, a plan called The Concept of Road Safety of the Republic of Belarus for the period 2006-2015 was devised with one of its primary goals being to reduce the number of fatalities in road accidents. This plan used a log normal regression model with 3 independent and one dependent variable. The results were that the plan was successful in reducing road accidents by 43 percent and has renewed its plan to reduce the road accidents by 50 percent more till the year 2020.

3.1.5 Data Visualization Using Google Maps: the Hard Way and the Easy Way

Commercial mapping tools and Geographic Information Systems are often costly and out of reach for many Organizations which operate on a low budget. The emergence of freely available spatial tools and web mapping applications such as Google Maps API has revolutionized online mapping service to display and integration of spatial data in a lot of different ways. The problem that this paper discusses is how to create a program that works primarily on spatial data that can be commercially used using Google maps API. The paper then continues to give step-by-step instructions and code snippets on how to create such a program with the help of PHP, Wamp and Google Fusion Table.

3.1.6 Detecting road junctions by artificial neural networks

In this paper, they are talking about using ANN to detect road junctions using raster and vector information. They use edge detection lanser algorithm because its rotation invariant, and they also use edge smoothing ramer algorithm. They used the Levenberg-Marquard algorithm to train their neural networks because this algorithm uses a learning rule of second order gradient descent with momentum; the momentum helps to avoid the local minima on the error hypersurface. To conclude the experiments have proven the general applicability of the new road junction detector based on integrating raster and vector information in an artificial neural network.

3.1.7 Using Analytics in the Implementation of Vertical and Horizontal Curvature in Route Calculation

This paper is talking about the best route for logging trucks. The main problem is that there are many road features to be considered. So there are methodologies to determine a good weight setting for these features they use lidar, aerial photos, and GIS databases but the horizontal and vertical curves and not collected in databases so they must be analyzed and estimated using geographical information. To conclude they have proposed a methodology to incorporate the contribution of vertical and horizontal curvature as features in the CRF.

3.1.8 Crossroad Detection Using Articial Neural Networks

This paper is talking about the obstacles an autonomous vehicle has to overcome, such as environment perception, obstacle detection, and safe navigation. So the main focus here is the detection of crossroads they use LIDAR (Light Detection And Ranging) sensor data. One of the advantages of using neural network is its capability to deal with noisy data their approach takes advantage of a road detector system that produces curb data and road surface data. They use Velodyne HDL-32E 3D LIDAR sensor with curb detection-based and road surface detection-based the neural network that classies urban road data into crossing or non-crossing. The AUC results were respectively 0.940589 and 0.981209 for curb and road surface data.

3.1.9 Identification of Curves and Straight Sections on Road Networks from Digital Vector Data

According to the research Identification of Curves and Straight Sections on Road Networks from Digital Vector Data, they tend to identify the curves and straight sections in roads in order to prevent traffic collisions. According to the World Road Association curve accidents happens 1.5 to 4 times than straight roads, so in order to avoid these accidents. first, the authors collect the maps on which the curves exist and add a Geometric line generalization which reduces and simplify the data without losing important information. Then use the Douglas-Peucker algorithm connects the start point and end point of the curve

and finds a simplified curve with fewer points, and then pass the result to an osculating circle calculation that detects the curves by drawing a circle on each point (curve) and run the equation using the radius of that circle. Using the osculating circle, the authors had a positive predictive value of 95.9 percent that allows them to identify the curves correctly.

3.1.10 Traffic density determination and its applications using smart phone

In the paper, the authors goal is to calculate the density of the traffic using smartphones in order to help the drivers to measure the quality of traffic flow. An experiment was conducted by two cars equipped with smartphones. The smartphones are equipped with an application called My Track which records the data of the drivers and synchronizes it to Google Maps, and the cars were headed from Al Azhar to Al Abasia antonyms. After collecting the data, the authors added a spatial road segment length to calculate the length of the trips. Then measured macroscopic traffic density and the speed and the flow of the traffic using their mathematical equations respectively. The authors had achieved an average accuracy of 92 percent using the proposed system.

3.1.11 Road junction Detection from 3D point clouds

In this paper, the authors discuss that safety doesnt only rely on obstacle detection but also on the road junctions because they can determine the safest speed and trajectory, and used for the global trajectory and planning. Road junctions can be detected using a detailed metric map and the Global Positioning System, but the GPS is not always precise which can lead to some miscalculations. In order to solve this problem the authors propose to use a method for road junction detection based on a 3D point cloud from a rangefinder. The authors take the data from the rangefinder and extract the features using Loop closure detection algorithm [1]. Then take the data and classify those using artificial neural networks, adaptive boosting algorithm, and Support vector machines. And finally take the result from the classification and insert it to Hidden Markov Models and Conditional Random Fields to detect the junctions for each frame. Using the SC2 dataset, the algorithm using the HMM and CRF separately produced an accuracy of 91% each, and using the K2 dataset the HMM produced 84% and the CRF produced 89%.

4 Project Management and Deliverables

4.1 Tasks and Time Plan

working with a mix between waterfall and agile techniques

- submitting proposal (2-10-2018)
- submitting survey paper (20-10-2018)

- submitting SRS (3 days after mid terms)
- submitting SDD (16-2-2019)
- almost finishing implementation (after spring break)
- submitting 8 pages (3 days after spring break)
- almost finishing technically (first week may)
- final thesis(25-6-2019)

4.2 Budget and Resource Costs

from 200 to 500 LE

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