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Voice Alert System for Traffic Sign Recognition and Nearby Places Finder

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ABSTRACT- This project seeks to develop a web application that combines traffic sign recognition capability with user's navigation needs. Users will have the ability to upload traffic sign images, capture the live feed from the camera for traffic sign recognition, and an automated system utilizing CNN will be deployed to recognize and encode the sign's meaning with a speech synthesis. The system is enhanced by the addition of a location service where users can look up the hospitals, restaurants, and gas stations available within a certain distance range from their locations. All the findings are presented to the user as clickable points on a map that shows the best route from the user's current location to the target place.
This project makes use of the Google Maps API to look for locations and draw routes on the map, while Flask captures input data for processing on the server side. This system is implemented in HTML and CSS and JavaScript with the client side being responsive. By integrating location-based technologies using machine learning, the traffic sign detection and real time navigation is fully automated, and it is very useful for various drivers and tourists.

KEYWORDS- Traffic Sign Images, Speech Synthesis, Machine Learning Models, CNN.

I. INTRODUCTION

The rise in the number of vehicles on the road combined with the changing traffic patterns has brought about the issue of road safety as a critical one in the modern world. One of the important aspects of safety is the correct recognition of traffic signs, which include vital information such as restrictions, warnings, and even speed limits to the motorists. However, new factors such as poor visibility or drivers being distracted, or even using an unfamiliar route makes the responsibility harder to accomplish. These challenges have led to the development of sophisticated and effective technologies such as automated traffic sign detection systems that aid in driving and promoting safety during travel.
The name of this project is Voice Alert System for Traffic Sign Recognition and Nearby Places Finder Using Google Places API. The goal of the project is to implement an integrated solution that merges traffic sign recognition and geo-information services. The system is capable of recognizing traffic signs and also offers essential services such as delivering real-time information to drivers about hospitals, restaurants, and gas stations that are in their vicinity. With the help of a TTS module, the system provides alerts in voice form so that drivers do not have to take their eyes off the road.
The core functionality of the system revolves around two main components.

A. Traffic Sign Recognition

Traffic Sign Recognition: The system implements a CNN to recognize and classify traffic signs within images accurately. It also gives real-time voice warnings to the drivers for improved safety and awareness on the road.

B. Nearby Places Finder

Using the Google Maps API, the system locates essential services like hospitals, restaurants, and gas stations within a custom radius given by the user.
Highway security and comfort measures seem convenient with the practical use of the system. The Voice alert system is exceptionally beneficial for the driver when he is occupied. While heavy traffic is there, or the drive is planned for night hours Voice alert system can assist in overcoming blunders. With the use of CNN's and Google maps API, the system is accurate and adaptive scaling.
To summarize, the report achieves the goal by creating and presenting a slogan that integrates traffic sign recognition technology with location-based services to greatly enhance road safety and assist drivers. By incorporating speech synthesis in the system, the unit becomes easier to operate for a broader audience. Utilizing speech synthesis in combination with convolutional neural networks makes it possible to instantly recognize pictures and combine them with super accurate positions provided by Google Maps API. These structures help to actively enhance global road security, which is still a sensitive topic around the world through helping prevent collisions and improving driver's experience.

II. LITERATURE SURVEY

Authors D. Divya Priya et al. [1] This document deals with traffic sign recognition using CNNs and its voice alert

system for drivers. It makes use of IoT devices to capture images of traffic signs while they are being driven through, thus making use of high-speed sophisticated machine learning models to ensure high levels of accuracy. The inclusion of a speech-based alert system improves usability by providing actionable information to the drivers when visibility is poor.

Authors P. S. Ganesh Kumar et al. [2] This study applies YOLOv5 and CNNs to traffic sign detection and classification in one pass. Focus is on extraction and inference speed performance with the text to speech system (PyTTSX3) voice alerting active. The system has been trained on a specific dataset containing most environmental factors that require adaptation like weather changes and motion blur.

Authors Geerthana Vimalambikaipakan et al [3]. This particular research study is based on a mural designed in a deep learning traffic sign detection system customized for Sri Lankan drivers and constructed using YOLOv5. The system is capable of detecting and recognizing 15 distinctive classes of traffic signs within diverse environmental conditions, and it captures and verbalizes these notifications to the drivers using the PyDub library. The combination of dataset Roboflow preprocessing together with the YOLOv5 training achieves the best combination between detection speed and recall mAP score accuracy. All of this results in enhancing road safety because of increased driver awareness [4].

Authors Himangshu Sarma et al. [5] This work brings out the design of a traffic sign recognition system based on deep neural networks (DNN) for enhancing driver assistance. The designed system recognizes traffic signs and gives voice instructions to the driver which helps in improving the reaction time and safety of the driver. The research also studies a number of novel object recognition methods and includes results of the detection of signs and classification performance of Faster R-CNN, and SSD and other related methods.

Authors Pawan Subhash Gade et al. [6] The research attempts to implement the R-CNN approach which allows for the recognition and classification of traffic signs in difficult weather conditions. It also looked at older methods, such as multi-stage systems, where detection is divided into simpler stages but are tedious, and colour-based recognition of standard traffic signs which cannot be used when the visibility is not clear.

In paper [7], the authors Samundiswary S et al, research analyses the real time recognition application of LeNet because it is efficient on systems with low processing capacity. It analyses colour segmentation with SVM, which works on normal conditions but does not work when there is varying light, and hierarchically fused CNNs for classifying traffic signs, which has high computational requirements. GTSRB as a benchmark during the training and evaluation phases is a good choice [8][9].

Authors Sakthimohan. M et al. [10] In this paper, the authors present a CNN system for recognizing speed limit sign boards, classifying them and then announcing the limit through a mobile phone application. The speed limit sign classification and detection model were trained using the Kaggle German Traffic Sign dataset. The system can perform sign recognition with high accuracy, even under adverse conditions due to preprocessing techniques of color enhancement and feature extraction through CNN [11].

Ms. S. JENCY et al. [12], this paper addresses the harnessing of the image data with the convolutional neural networks (CNNs) techniques to spot and identify traffic symbols using the LISA data base. The contouring and ROI image extraction highlight pre-processing techniques that are intended to improve accuracy. Unfortunately, the dependence on the LISA dataset restricts the system's ability to adapt to the region's traffic sign. The suggested techniques are cumbersome due to elevated system requirements which make them impractical for real-time low resource devices. Besides, the paper does not cover a lot of real-life experiments under conditions of low illumination, occlusions, and motion blur. It is noted that the performance is evaluated with PASCAL measure, but a wider scope of the performance measures will provide better understanding [13].

Authors Lai Jia Shyan et al. [14] This research proposes a real time Traffic Sign Detection and Recognition (TSDR) system based on CNN architecture which runs on a GPU such as the NVIDIA Jetson TX2 microcontroller. The system is customized for individual countries' traffic signs and works at real-time speeds ranging from 70 to 92 FPS. However, the model is only adaptable to the specific country's dataset, which means it needs to be retrained for other regions. The study also suffers from overfitting because it utilizes small datasets (90 to 100 images per class). The model has not been evaluated in the absence of controlled conditions, such as different levels of weather and lighting, which greatly decreases its scalability and robustness.

Krish Sukhani et al. [15] This research analyses several different solutions that are available for vehicle traffic sign detection and classification. Support Vector Machine (SVM) is able to perform color segmentation and shape recognition but requires manual feature extraction which is both tedious and complicated. The Raspberry Pi version is less complicated but offsets this benefit with increased costs in hardware [16][17][18]. Image preprocessing and template matching concentrate on shape-based classification and suffer from occlusion and variation in lighting conditions. CNN variants such as AlexNet, GoogleNet and VGG and their ability to assist in augmented accuracy while inhibiting the model with problems like overfitting or too much computation were other methods that were analysed in depth.

III. PROPOSED SYSTEM

The flowchart in Figure 1 presents the systematic process for the implementation of a CNN model into the development of the image recognition system that monitors traffic sign recognition and related notifications. The first phase involves acquiring the relevant images and conducting some minor preprocessing to be performed before training and testing the model against the traffic sign dataset. If the model detects a traffic sign, it generates text translated into audio to command a voice alert. From the time a voice alert is generated, the act of recognizing the traffic sign is completed.

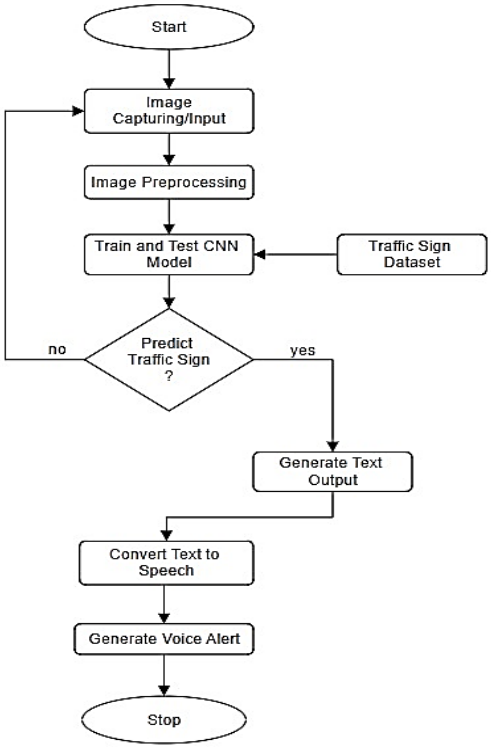

Figure 1: Flowchart for Traffic Sign Detection System

The flowchart in Figure 2 illustrates a method on how to search for and display important services in a particular area like hospitals, restaurants, and gas stations based on their geographic coordinates. The process starts with the entry of latitude and longitude along with a radius which is then followed by a query to Google Places API. The Haversine formula is used to compute distances for the best available route. The services are then displayed on the map to assist in quick finding and navigation against the services that are nearby.

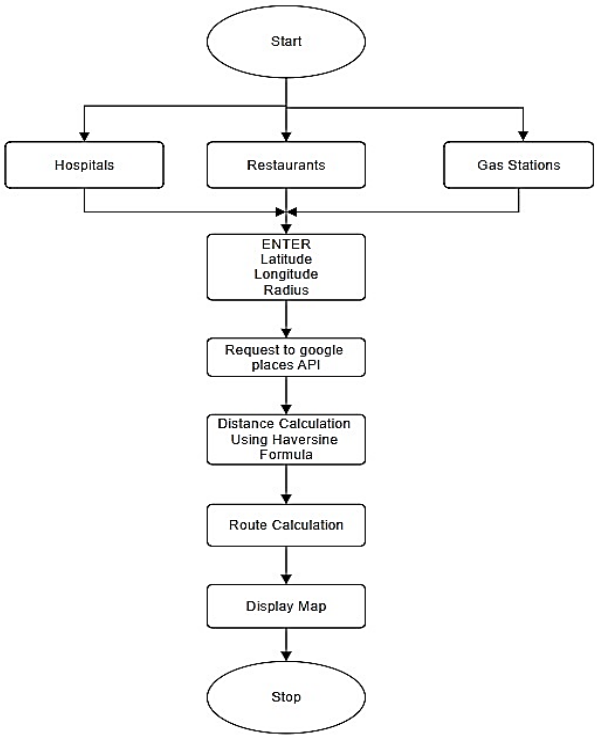

Figure 2: Flowchart for Places Finder

The Voice Alert System for Traffic Sign Recognition Using Convolutional Neural Network and Nearby Places Finder Using Google Maps API is developed to improve the driver's awareness and safety while driving. The system incorporates an innovative traffic sign recognition scheme along with a service discovery feature which enables vocal alerts to drivers. This method allows the signification of the information to be relevant and timely while dealing with emphasis on the protection of the driver's attention.

First, the system's camera takes an image of the traffic sign that is located on the driver's road. These images are processed with a Convolutional Neural Network (CNN) which has been trained on specific data related to traffic signs detection and classification. The speed limit, stop and warning signs are detected and recognized by the CNN model even when there is poor visibility or unusual weather conditions. After the recognition of a traffic sign, the system activates a Speech Synthesis Markup Language (SSML) which enables Text to Speech (TTS) engine equipped with Gide protocol 3 which verbally express the information to the driver without any delay.

At the same time, the system fetches from Google Maps API for critical places around the driver such as hospitals, temples, and restaurants that are within certain radius from the current location of the driver. Using the GPS coordinates, the system makes calls to the API, and retrieves place details including names, distances, and categories. These results are also generated as voice output so that the drivers can receive the information while focused on driving.

The system is geared to work in real-time, which makes it ideal for navigation and safety. The system combines traffic sign recognition and the discovery of nearby places. This functionality solves the most important problems that drivers face, enabling them to make better decisions on the road. The benefits of CNN and Google Maps API is the accuracy, scale, and flexibility that this system utilizes for multiple driving conditions.

IV. EXPERIMENTAL RESULTS

The proposed system describes that one can use this platform for either recognizing and predicting the traffic sign or find nearby places such as Hospitals, Restaurants and Gas Stations. Figure 3 shows the home page where the user gets to access all these services mentioned.

Figure 3: Home page

In Figure 3 we can see that one can assess the services that are required. Now let us see in detail the page navigations and working of traffic sign detection service.

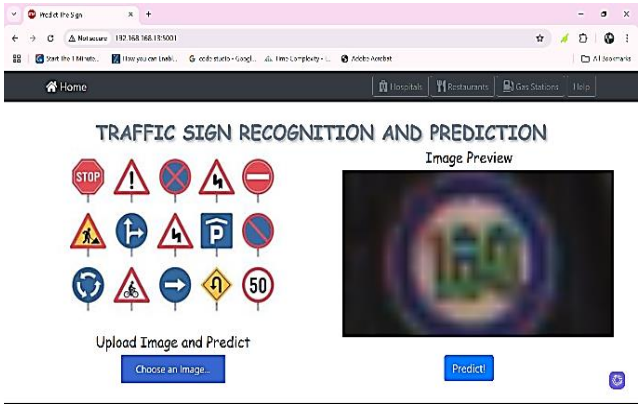

Figure 4: Uploading image

As we can see in Figure 4, we have uploaded a traffic sign. Now if we click on predictions, we can get the result. Let's see how that works.

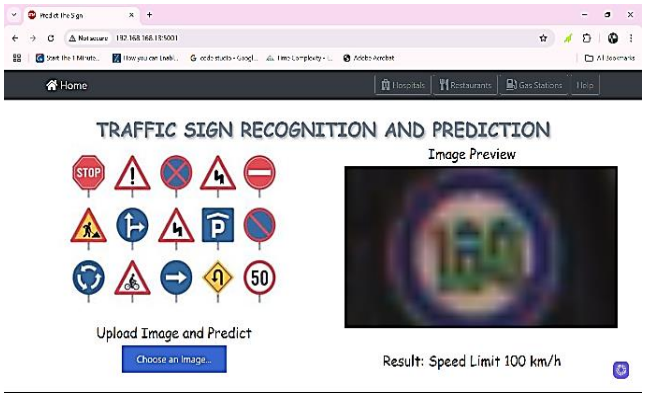

Figure 5: The Result

As we can see in Figure 5, the result "Speed Limit 100 km/h" is being displayed and also a voice over is also given when we click the Predict button. Now let us see at another feature which captures the live feed, converts them to frames and predicts based on the image shown to the camera.

Figure 6: Webcam feed

As shown in Figure 6, we have shown a traffic sign to the webcam and it says out the name of the sign. As this is a live feed, as we change the sign, the output also changes accordingly. This is all about traffic sign recognition and prediction next let us see about the nearby places' finder. In order to do that, let us first navigate to the main page by clicking the Home button.

Now let's click on "Hospitals" on the top navigation bar to get into the Hospitals interface where the system asks the user to enter latitude, longitude and radius.

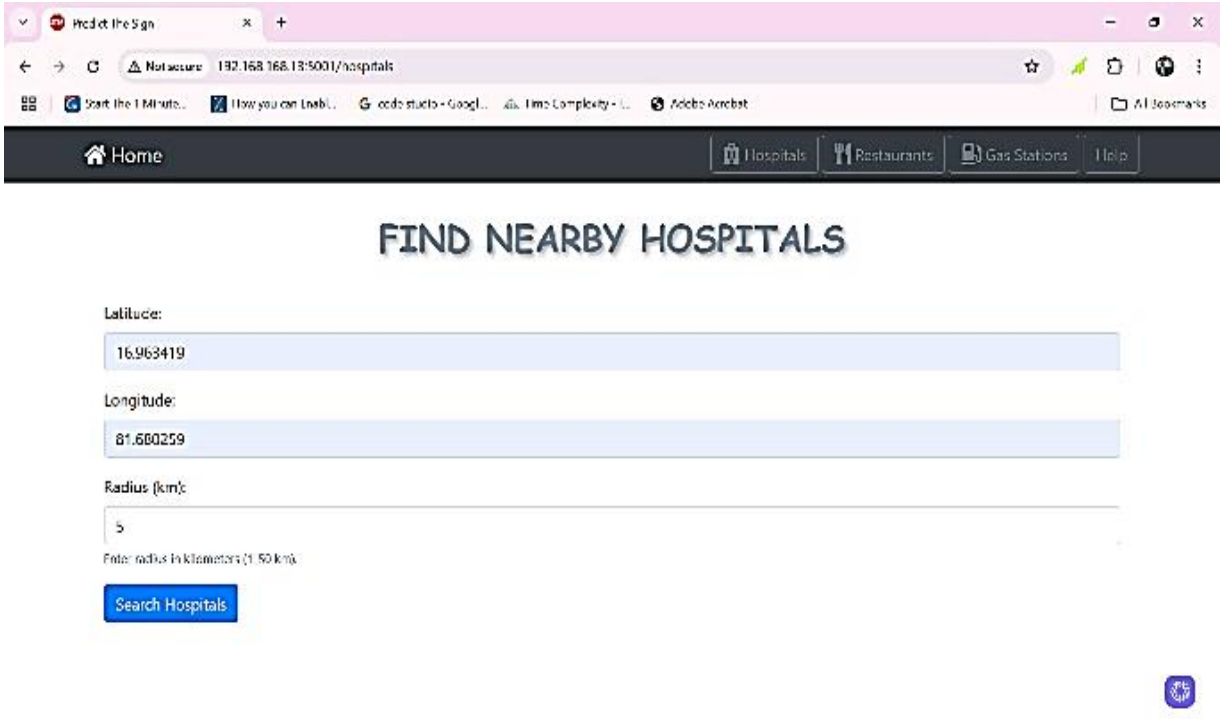

Figure 7: Hospitals page interface

As we can see in Figure 7, we have entered the location coordinates and the radius. Now let us click on "Search Hospitals".

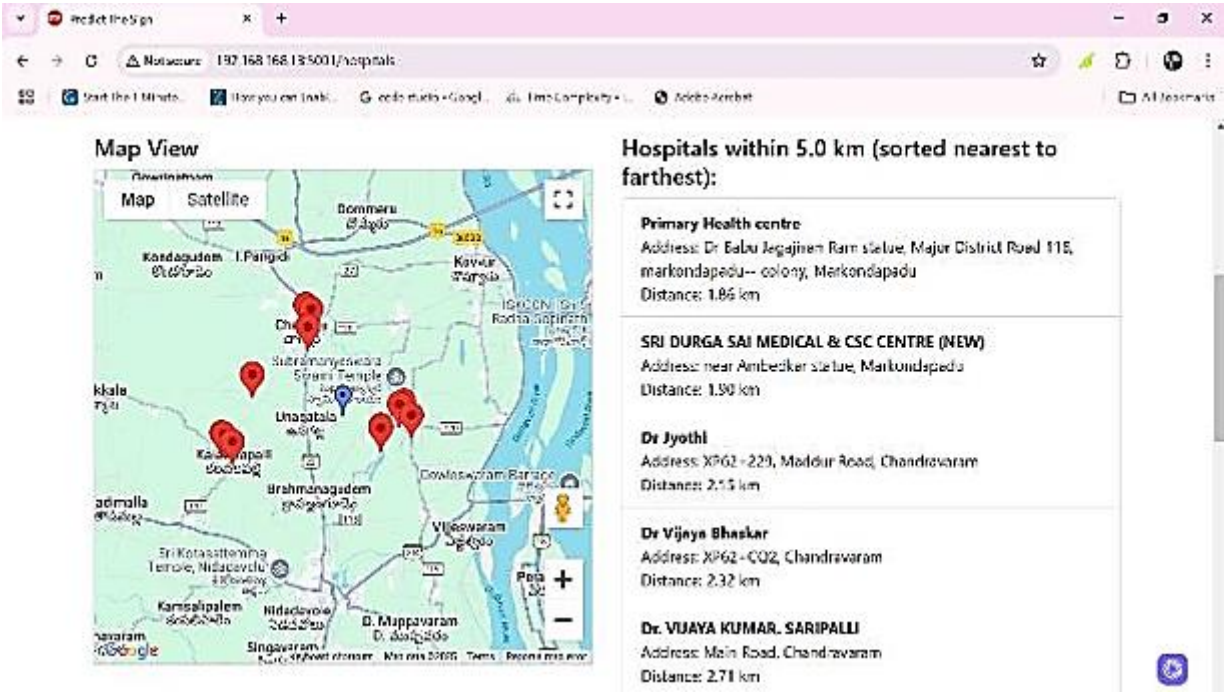

Figure 8: Result

As we can see in Figure 8, a map is displayed marking all the hospitals within the given radius range and on the right side, we can see a list of hospitals, sorted from nearest to the farthest from the current location. Now let us click on any one of the hospitals in the list and see what happens.

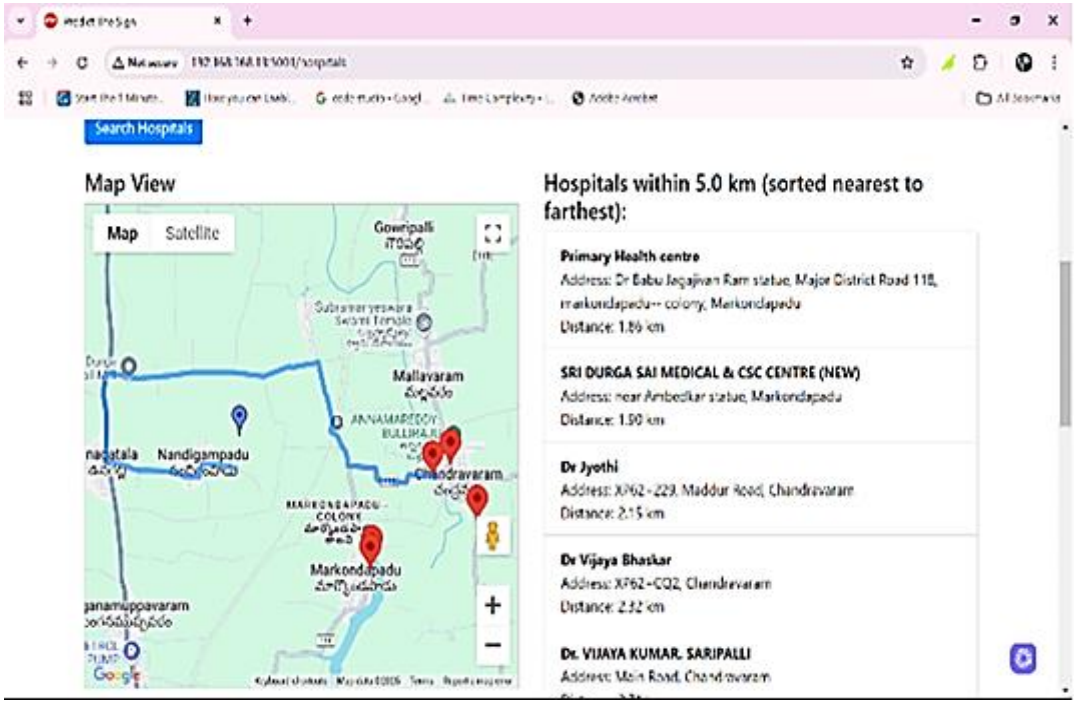

Figure 9: Route Map

As we can see in Figure 9, as we click on the hospital, a route map appears from the current location to the destined hospital.

So, this is how the hospitals feature works now let us see for Restaurants and Gas Stations also.

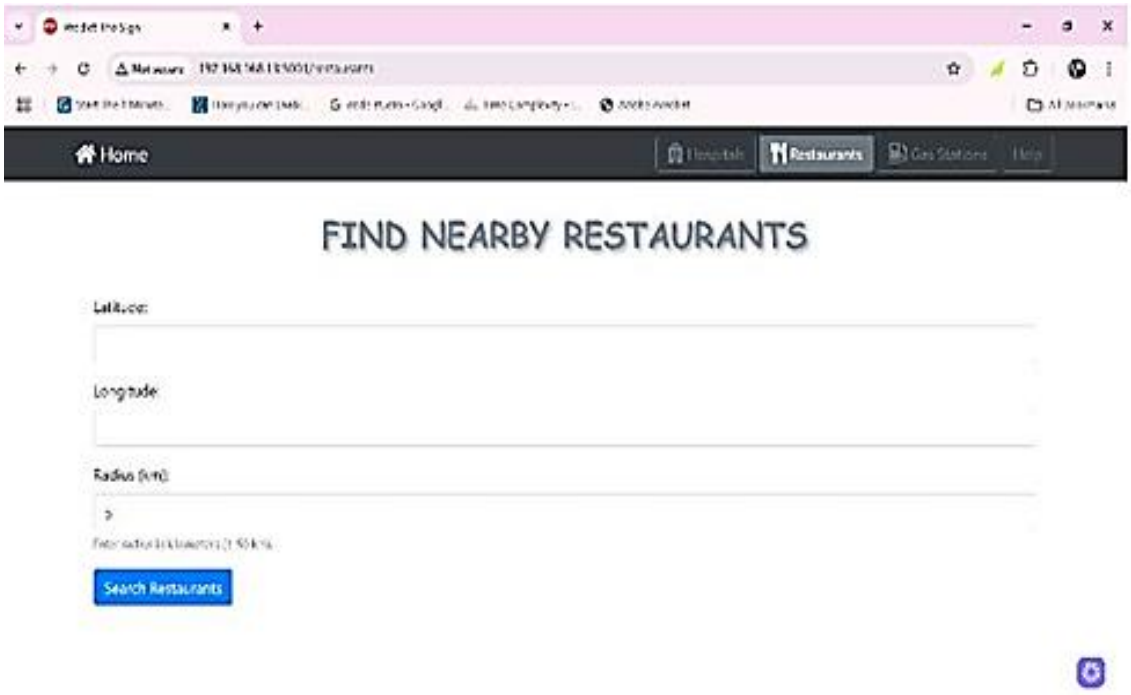

Figure 10: Restaurants page interface

As we have seen in the previous case, similarly here on the Figure 10 we have to enter the latitude, longitude and a certain radius to show all the restaurants in that particular area.

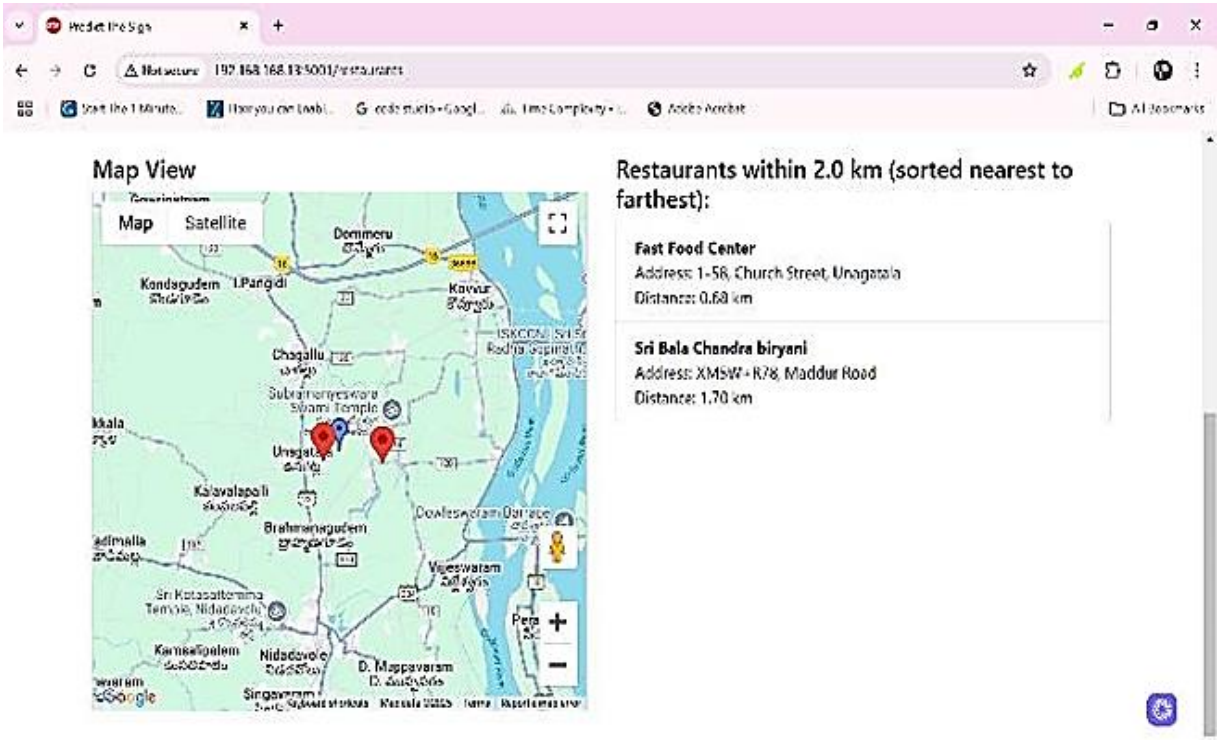

Figure 11: Result

As we can see from Figure 11, a map and a list of restaurants in that area are being displayed.

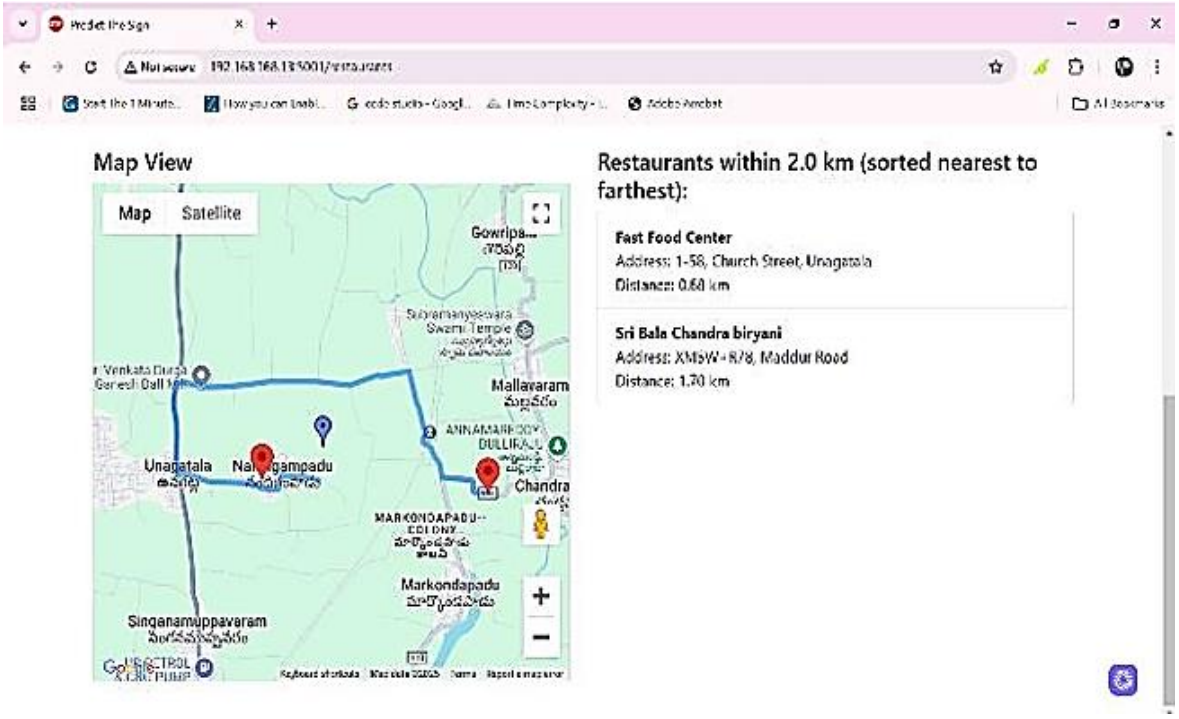

Figure 12: Route Map

In Figure 12, As we click on any one of the restaurants' names, it'll show the route map from the current location to the destined restaurant. In the similar manner as Hospitals and Restaurants, Gas Stations also follow this process. Now let's see about that service.

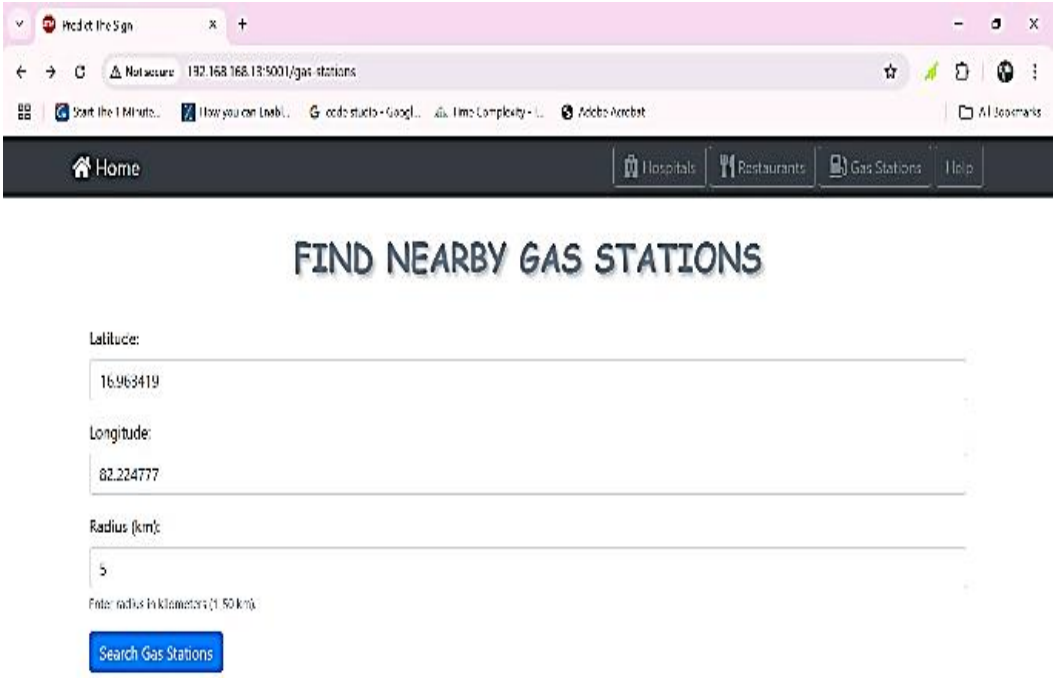

Figure 13: Gas Stations page interface

Now we have entered latitude, longitude and given the radius as shown on Figure 13. Now let us click on Search to get the results.

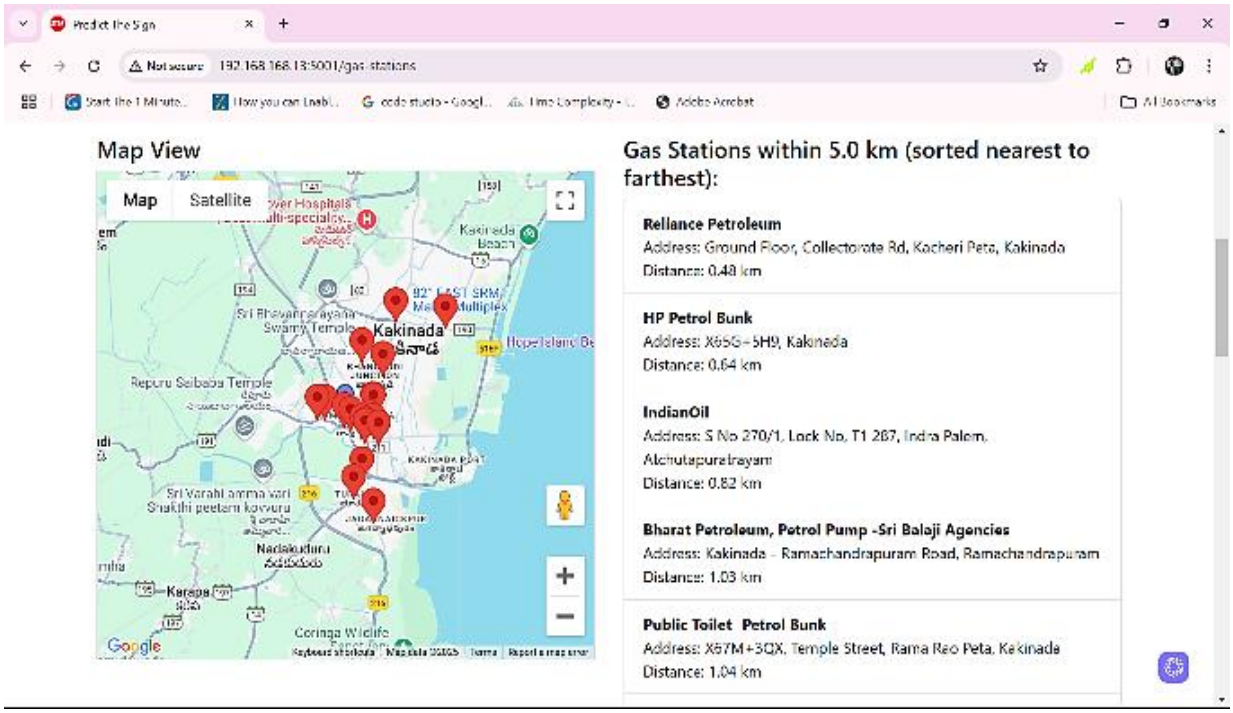

Figure 14: Result

As we can see on Figure 14, there is a map plotted with all the gas stations and a list of gas stations in that area.

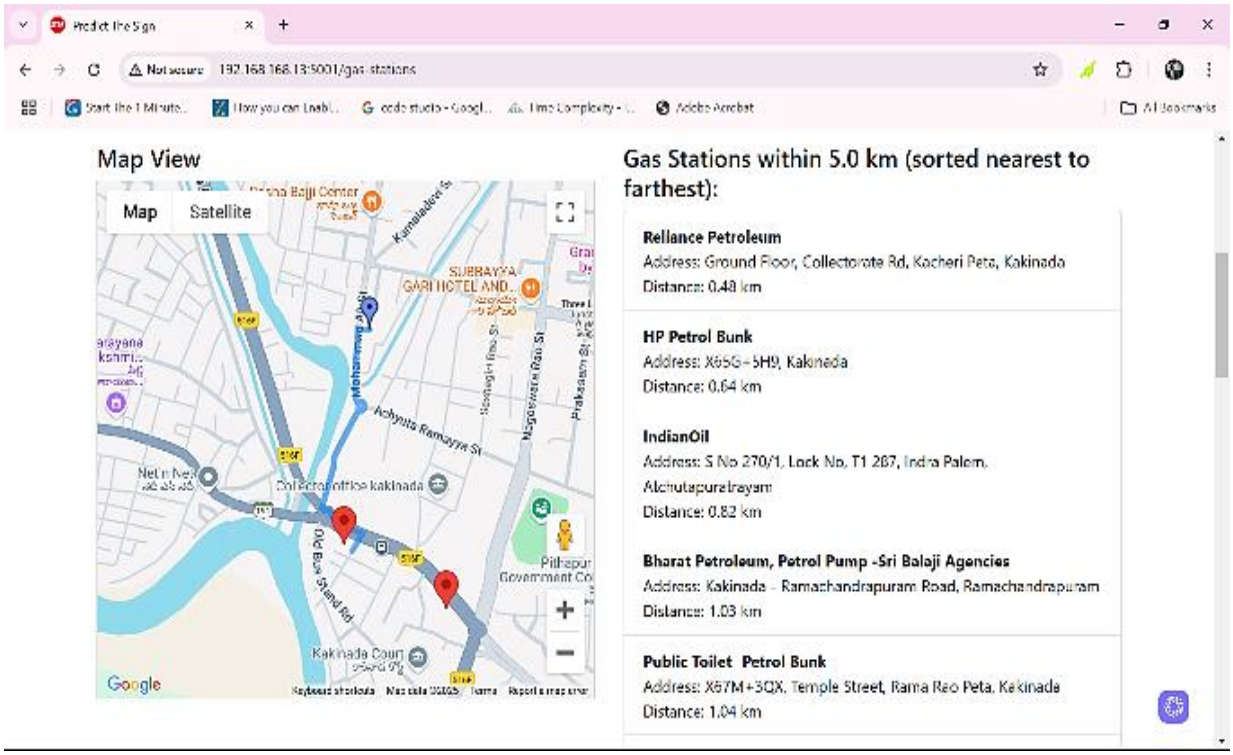

Figure 15: Route Map

By clicking on any one of the gas stations on the list, we'll get a route map to that particular gas station as illustrated in the Figure 15.

V. CONCLUSION

The project entitled Voice Alert System for Traffic Sign Recognition Using CNN and Nearby Places Finder Using Google Maps API attempts to overcome two important challenges of driving, which are safety and convenience. The system integrates Convolutional Neural Networks (CNNs) that enables speedy and accurate traffic sign detection and utilizes the Google Maps API for location-specific services. This greatly enhances most system users' and drivers' experience because the TTS (Text to Speech) module of the system can provide timely and effective

voice alerts to drivers while minimizing distractions and enhancing concentration on the driving tasks.

The traffic sign recognition component of the system is a perfect example of solving a complex problem associated with machine learning that involves detecting and recognizing traffic sign symbols within a frame picture and classifying them with a high level of accuracy in real time and in difficult environments. The nearby places finder gives voice instructions to users to find essential amenities and services, like a hospital, restaurant, or gas station, that are available within a distance the user can specify. These greatly improve the system's ability to ensure the safety of drivers and other road users, reduce road accidents, and increase the benefits of driving.

The combination of CNN, Google Maps API, and TTS highlights further innovations AI can achieve with geolocation services of these sorts along with driver assistance systems. As one of the major problems worldwide, road safety can be aided by systems like these. This project develops the base that can lead to further innovations with driver assistance systems. It also highlights the real-world applications of AI and geolocation services. Like other designs of driver assistance systems, the automatic recognition of road signs directly contributes to reducing road accidents. With this system, all drivers can have safer and more informed journeys regardless of what part of the world they find themselves in.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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