SMARTLMD: A Smart Technique for Lane Markers Detection In Urban Area Roads using IoT

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Abstract

Detecting the lane is a complex problem due to the changing conditions of road that are encountered at the time of driving. These complexities come from shadows, blockage by other vehicles, road surface changes, and lane marking types. A vision-based system for assisting the driver demands extraction of lane marking features under various environmental conditions such as daylight, sunset, night and shadows. The proposed smart system deals with these requirements and reduces the threats of road accidents as well as enhances the vehicle and human safety. Also, it improves the conditions of traffic. For this, we present here an algorithm that detects lane marks of road and the boundary of road for smartly navigating the intelligent vehicles. The proposed smart system implements an algorithm for recognition of the road lanes at real-time by a moving vehicle on the road.

Keywords — *IoT, Lane marking, Arduino.*

I. INTRODUCTION

Many road accidents occur every year because of inattention of drivers. Lane detection systems are useful in avoiding these accidents as safety is the main purpose of these systems. These systems can detect marks of the lanes for warning the driver in the case where the vehicle is tending to depart from the actual lane. Intelligent lane detection is very much crucial for any smart transport system. But having known this thing, there are many challenges in the way of lane detection task. These challenges make the task of marking the lane difficult and also impose complexities on driving task. One of these main challenges is that the drivers can come across varying conditions of road. With the rapid urbanization, the traffic safety is becoming more and more important. About 30% of all road accidents have the cause of leaving the lane on the highway. Most of these road accidents get resulted due to distraction of the driver. So, there is huge need of a system that can give a warning to drivers in dangerous situations like departure of vehicle out of lane. These kinds of systems can save the lives of people. In recent years, many approaches for lane detection have been proposed by various researchers.

Lane detection is nothing but the process of locating lane markers present on the road and presenting the markers to a smart system. In intelligent transportation systems, intelligent vehicles cooperate with smart infrastructure for achieving a safer environment as well as better traffic conditions.

Problem Statement

Detection of lane markers from given video clip of road and signaling the warning using arduino device.

Scope

The project aims to build a monocular vision autonomous car prototype. This automated system will help to avoid accidents and reduce congestion. The limitations faced here are:

• In absence of both lane markings the vehicle may go into false assumptions and may take inappropriate decisions.

• The vehicle is able to sense the obstacle but lacks the ability to distinguish its type.

• Due to the lack of hardware availability, the system is not sturdy and thus needs to be handled with care.

Problem definition

The problem for the smart system for lane marker detection is to take capture video that can be processed frame by frame, and the camera (the one mounted on vehicle) passes video frame to the computer system. The system shall provide following functionality to each frame:

- The computer system processes the given video and runs the set of lane detection algorithm on them thus extracting required information from the images.

- The output provided by the computer system sends a signal to Arduino board which in turn helps the vehicle to locomote appropriately.

LITERATURE SURVEY

Gurveen Kaur and Dinesh Kumar in [1] proposed a method for automatically determining the vehicle's lateral offset related to the center of the lane. They used linear-parabolic model for detection of the boundaries of lane. Linear part of this model was used for estimating lateral offset, without the knowing any intrinsic or extrinsic parameter of camera. Finally, lane departure was measured, to detect lane crossings in advance.

A. Borkar, M. Hayes, M. T. Smith and S. Pankanti [2] designed an approach for addressing the real-world problems that an lane detection system could encounter. They first extracted from the image the region of interest and an enhancement procedure was used for manipulating the lane marker's shape. Then the extracted region was converted into binary with the help of adaptive threshold. Final lane position was then estimated by iterated matched filtering scheme. Their system showed better performance on real-world data containing fluctuating illumination.

Sirmacek, Beril & Unsalan, Cem. [3] proposed a novel approach for automatically detecting road segments from color aerial and satellite images having very high resolution. It was dependent on manually choosing a training set from the input image. Color chroma values of pixels were used as the discriminative features. They labeled road segments and fitted a road network shape on the segment that was detected.

F. Mariut, C. Fosalau and D. Petrisor [4] proposed an algorithm that emphasized the lane marks automatically and recognized them from the given input digital images.For this task they have used the technique of Hough transform.They claimed to have achieved the goal of designing an intelligent system that improved the road safety.

M. Aly [5] presented an approach that was said to be robust and real time for lane marker detection in urban roads. This approach used a top view of the road. Also, techniques of filtering (selective oriented Gaussian filters) and fiiting (RANSAC line fitting) were used. This algorithm detected lanes in still images of the streets and achieved comparable results to previous methods.

S. Srivastava, R. Singal and M. Lumb [6] presented an approach to improve the performance of lane detection algorithms by making use of filtering techniques. Image Noise reduction using different filtering techniques was used. They also shown the performance improvement by experimenting on some selected road images.

It is observed that the initial work focused on boundaries detection of roads. But the accuracy shown was not up to the expectation. Also the environmental factors and road curvature and other road characteristics have influenced the performance of the lane markers detection techniques. So, there is enough chance of improvement in this area and the proposed system can deal with the discussed issues and difficulties in lane markers detection.

II. PROPOSED SYSTEM

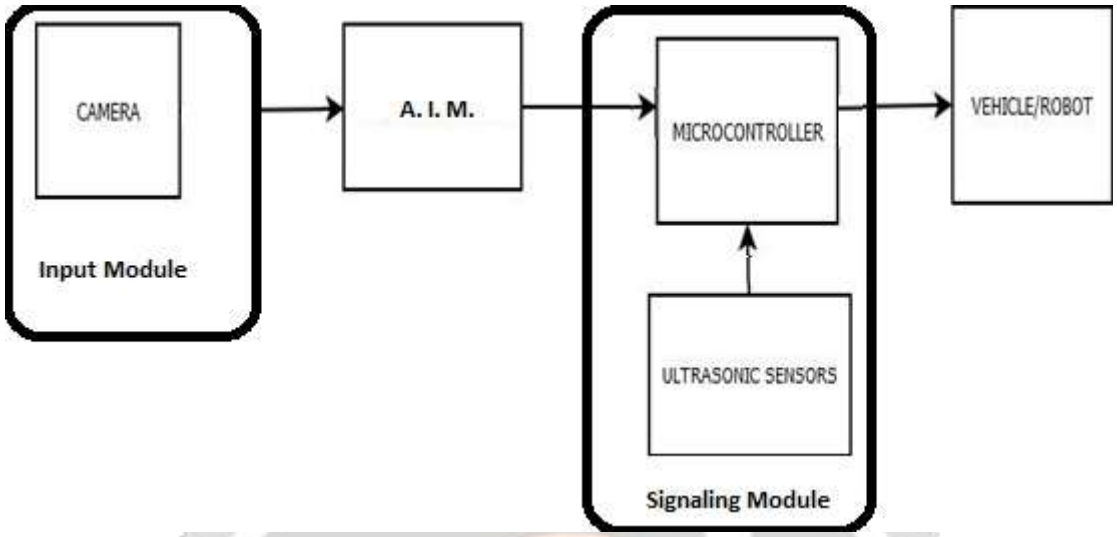

Figure 1. System Architecture

System Architecture

Figure 1 shows the architecture of the proposed System for lane markers detection in urban area roads, which consists of three major modules Input module, Algorithm implementation module (AIM) and Signaling module. Survey of existing techniques has motivated for discovering the use of IoT for detection and signaling of lane markers. This can be very useful for the discovery of departure of vehicle from out of the normal way. Input

III. METHODOLOGY

1. The Input module:

This is the first module that takes as input in the form of real-time video that is captured by the camera and forwards this to the AIM module. The frames in video are preprocessed to bring it into the form that is needed for further processing.

2. Algorithm implementation module (AIM)

AIM is the second module of the proposed system that uses the SMARTLMD algorithm for marking the lane on the input that is coming from the input module. Figure 2 shows the steps included in the SMARTLMD algorithm.

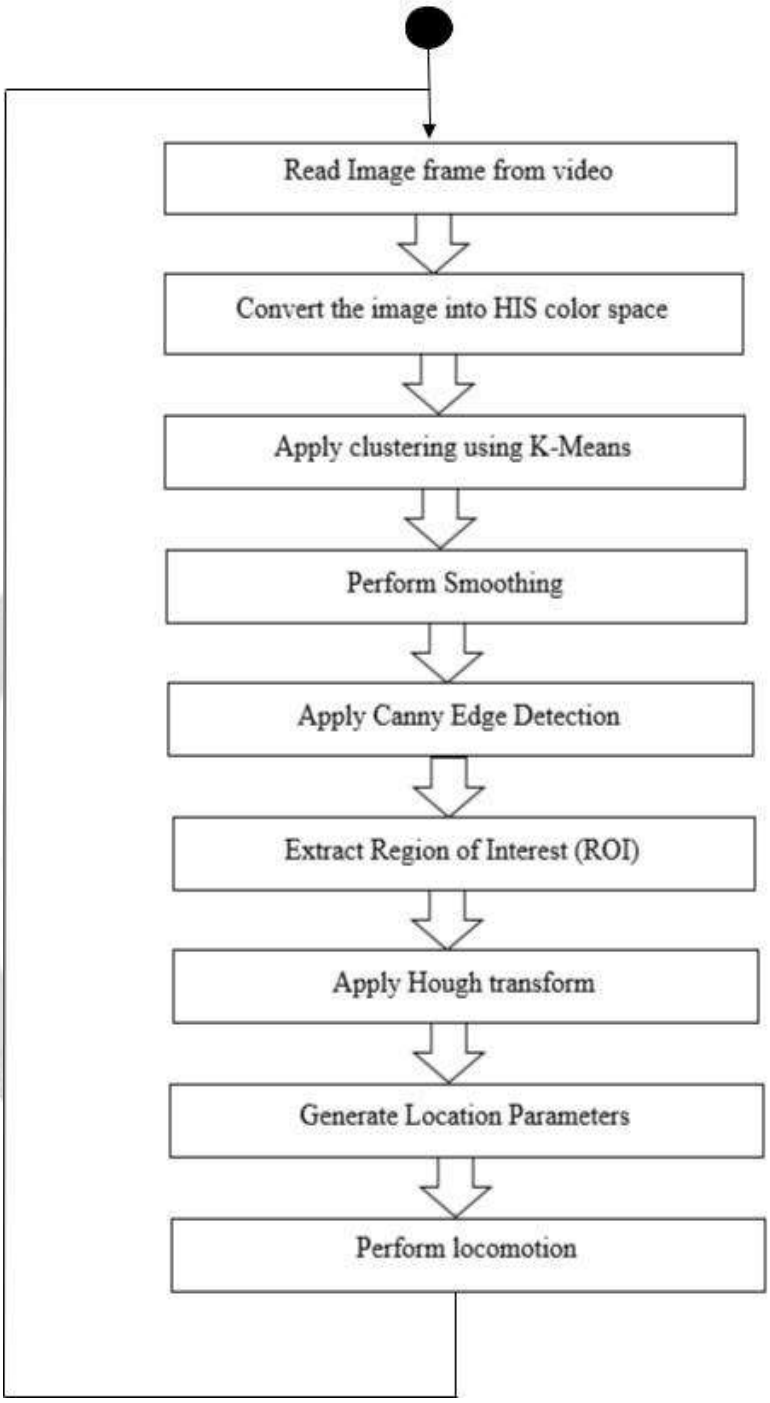

Figure 2. SMARTLMD Algorithm .

3. Signaling module

This is the third module as shown in the Figure 1. It uses the components such as microcontrollers and ultrasonic sensors that help in the task of giving the signals to the vehicle after detecting the lane markers.

Arduino:

• Setup board:

Before making use of the Arduino board, it is initialized to certain default parameters like initializing serial

communication, baud rate, pin configuration, and pin mode(which specifies weather a certain pin is for input or output).

• Loop:

Once the board is powered on after initialization it has to run certain instruction continuously. Here the board continuously senses the incoming signal from the laptop and based on specific value the board sends signal to motor driver IC to run the motors.

Arduino pseudo code:

```
While (true)
    if (ObstacleDistance > 20)
        if (data available on arduino port)
            if (data == 'f')       #f: forward Signal
                Move forward
            if (data == 'l')       #l: left signal
                Move left
            if (data == 'r')       #r: right signal
                Move right
            if (data == 's')       #s: stop signal
                Stop
        end if

        else (data not available on serial port)
            Continue with previous instruction

        Calculate distance using ultrasonic sensor
    end if

    else
        Stop
    Calculate distance using ultrasonic sensor
end while
```

IV. EXPERIMENTAL RESULTS

Main motive behind the lane detection algorithm is that it only detects the lane which is present in the region of interest of the frame to find the direction for locomotion. The algorithm discards the remaining pixels thus improving the performance.

Performance analysis of this project is done based on:

1) The quality of the image.

2) The angle of view (AOV) of the camera.

3) The processing time of the system to execute the algorithm.

Based on the above parameters the algorithm has shown distinguishing performance for the task of lane maker detection and proved very effective as compared to the previous techniques discussed in the literature review.

V. CONCLUSION

The proposed smart system deals with the difficulties of lane marker detection and reduces the threats of road accidents as well as enhances the vehicle and human safety. Also, it improves the conditions of traffic. The proposed algorithm detects lane marks of road and the boundary of road for smartly navigating the intelligent vehicles. In future, the algorithm can be parallelized for improving the performance.

VI. REFERENCES

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