(12)Indian Patent Application

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(21) Application Number: 201941009524

(22) Filing Date: 12/03/2019 (43) Publication Date: 18/09/2020

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(51) International Classifications: G06K 9/32 G08G 1/017 B60R 13/10 G06K 9/00 G06K 9/54

(54) Title: A METHOD AND SYSTEM FOR RECOGNIZING CHARACTERS ON A LICENSE PLATE

(57) Abstract: This disclosure relates to a method 100 and system 200 for recognizing characters on a license plate, in an embodiment, a method may include capturing an image of the license plate. The license plate may,be localized in the captured image. The method of localising may include semantically segmenting the captured image, assigning a unique colour to the license plate and analyzing the unique colour in the image. After localizing the license plate,-,the method may pre-process the image of the license plate. Once pre-processing is performed1, the characters may be recognized from the pre-processed image. The method of recognizing may include semantically segmenting the pre-processed image, assigning a unique colour to each character in the image and mapping the unique colour with a predefined colour information. On recognizing the characters, the method may post-process the image to convert the recognized characters into a text form.

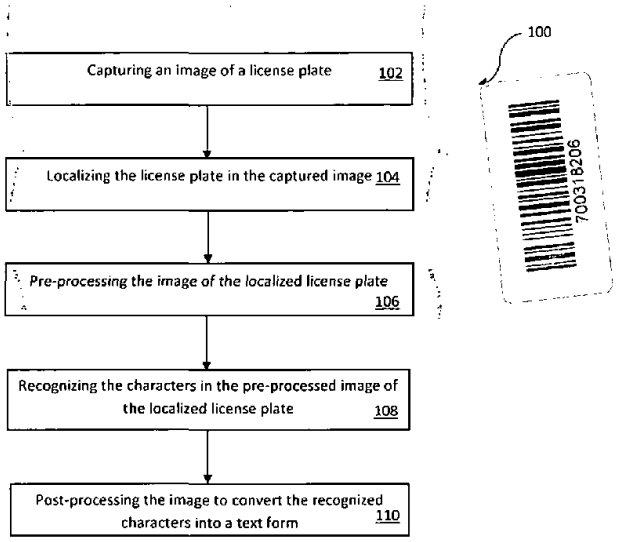


Figure 1

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## ABSTRACT

A Method and System for Recognizing Characters on a License Plate

This disclosure relates to a method 100 and system 200 for recognizing characters on a license plate. In an embodiment, a method may include capturing an image of the license plate. The license plate may be localized in the captured image. The method of localizing may include semantically segmenting the captured image, assigning a unique colour to the license plate and analyzing the unique colour in the image. After localizing the license plate, the method may pre-process the image of the license plate. Once pre-processing is performed, the characters may be recognized from the pre-processed image. The method of recognizing may include semantically segmenting the pre-processed image, assigning a unique colour to each character in the image and mapping the unique colour with a predefined colour information. On recognizing the characters, the method may post-process the image to convert the recognized characters into a text form.

We claim:

1. A method 100 of recognizing characters on a license plate, the method comprising:

capturing an image of the license plate;

localizing the license plate in the captured image, wherein the localizing method comprising:

semantically segmenting the captured image and assigning a unique colour to the license plate in the captured image; and

localizing the license plate by analyzing the unique colour in the captured image assigned by sematic segmentation;

pre-processing the image of the localized license plate; and

recognizing the characters in the pre-processed image, wherein the recognizing method comprising:

semantically segmenting the pre-processed image of the license plate and assigning a unique colour to each character in the image of the license plate; and

recognizing the characters by mapping the unique colour assigned to each character in the image of the license plate with a predefined colour information; and

post-processing the image of the license plate to convert the recognized characters into a text form.

2. The method 100 of recognizing the characters on the license plate as claimed in claim 1, wherein the image capturing device is supported on a stationary post.

3. The method 100 of recognizing the characters on the license plate as claimed in claim 1, wherein the image capturing device is supported on a moving device.

4. The method 100 of recognizing the characters on the license plate as claimed in claim 1, wherein the method of pre-processing the image of the localized license plate comprising:

eliminating noise in the image of the localized license plate; and

converting the image of the localized license plate into a binary image.

5. The method 100 of recognizing the characters on the license plate as claimed in claim 1, wherein the method is automatic.

6. A system 200 for recognizing characters on a license plate 202, the system 200 comprising:

an image capturing device 204; and

a processor 210 communicatively coupled to the image capturing device 204, wherein the processor 210 comprising:

a localization module 212, the localization module 212 being configured to:

semantically segment a captured image and assign a unique colour to the license plate 202 in the captured image; and

localize the license plate 202 by analyzing the unique colour in the captured image assigned by semantic segmentation;

an image pre-processing module 214 configured to pre-process the image of the localized license plate 202 for character recognition;

a character recognition module 216, the character recognition module 216 being configured to:

semantically segment the pre-processed image of the license plate 202 and assign a unique colour to each character in the image of the license plate 202; and

recognize the characters by mapping the unique colour assigned to each character in the image of the license plate 202 with a predefined colour information; and

an image post-processing module 218 configured to post-process the image of the license plate 202 to convert the recognized characters into a text form.

7. The system 200 for recognizing characters on the license plate 202 as claimed in claim 6, wherein the localization module 212 comprising:

a deep learning based semantically segmenting module for the captured image;

a database having predefined information related to unique colour assigned to the license plate 202 by the deep learning based semantically segmenting module; and

a deep learning based image analyzer to analyse the unique colour assigned in the semantically segmented image and localize the license plate 202 in the image.

8. The system 200 for recognizing characters on the license plate 202 as claimed in claim 6, wherein the character recognition module 216 comprising:

a deep learning based semantically segmenting module for the pre-processed image;

a database having predefined information related to unique colour assigned to each character by the deep learning based semantically segmenting module; and

a deep learning based image analyzer to map the colours assigned to each character in the semantically segmented image with the predefined colour information and recognize the characters on the license plate 202.

Dated this 12th day of March 2019

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## FIELD OF INVENTION

The invention generally relates to a field of character recognition, and more particularly to a method and system for character recognition on a license plate.

## BACKGROUND

Automatic License Plate Recognition (ALPR) is a technology used to identify the registration number of vehicles. ALPR performs certain image processing techniques on an image of the vehicle's license plate and recognizes the characters on the license plate. ALPR is primarily used in law enforcement scenarios such as, for traffic monitoring, for identifying over speeding vehicles, for toll collection etc. ALPR is also used in identifying a stolen vehicle by comparing the license plate of a vehicle against a database of stolen vehicle license plates to determine any potential matches. The ALPR system uses a camera to capture an image of the vehicle's license plate and performs image processing techniques on the image to recognize the registration number.

The conventional ALPR systems require large amount of calculations to localise the license plate from the image. Furthermore, the conventional ALPR systems provide wrong prediction of numbers due to the presence of screws on the license plate. These challenges affect the accuracy and speed of determining characters on the license plate.

Hence there is a need for an improved method and system for license plate character recognition.

## SUMMARY OF THE INVENTION

According to an embodiment of the invention, a method of recognizing characters on a license plate is disclosed. The method may include capturing an image of the license plate. The license plate is then localized in the captured image. The method of localizing the license plate may include semantically segmenting the captured image and assigning a unique colour to the license plate in the image. The method of localizing may further include analyzing the unique colour in the captured image. On localizing the license plate, the method may pre-process the image of the localized license plate. Once pre-processing is performed, the characters may be recognized from the pre-processed image. The method of recognizing the characters from the pre-processed image may include semantically segmenting the pre-processed image and assigning a unique colour to each character in the image of the license plate. The method of recognizing the characters may further include mapping the unique colours assigned to each character in the image of the license plate with a predefined colour information. On recognizing the characters, the method may post-process the image of the license plate to convert the recognized characters into a text form.

*According to another embodiment of the invention, a system for recognizing characters on a* license plate is disclosed. The system may include an image capturing device. The system may further include a processor that is communicatively coupled to the image capturing device. The processor may include a localization module, configured to semantically segment a captured image and assign a unique colour to the license plate in the captured image. The localization module may further analyze the unique colour in the captured image to localize the license plate in the image. The processor may further include an image pre-processing module to pre-

process the image of the localized license plate for character recognition. The processor may include a character recognition module for recognizing the characters from the pre-processed image. The character recognition module may be configured to semantically segment the pre-processed image of the localized license plate and assign a unique colour to each character on the license plate. The character recognition module may further map the unique colour assigned to each character with a predefined colour information and recognize the characters. A post-processing module in the processor may post-process the image of the license plate to convert the recognized characters into a text form.

## BRIEF DESCRIPTION OF DRAWINGS

Other objects, features, and advantages of the invention will be apparent from the following description when read with reference to the accompanying drawings. In the drawings wherein, like reference numerals denote corresponding parts throughout the several views.

Figure 1 illustrates a flowchart of a method of recognizing characters on a license plate according to an exemplary embodiment of the invention.

Figure 2 illustrates a block diagram of a system for recognizing characters on a license plate according to another exemplary embodiment of the invention.

Figure 3 illustrates a schematic view of an image capturing device capturing an image of a license plate according to another exemplary embodiment of the invention.

## DETAILED DESCRIPTION OF DRAWINGS

The following description with reference to the accompanying drawings is provided to assist in a comprehensive understanding of exemplary embodiments. It includes various specific details to assist in that understanding but these are to be regarded as merely exemplary. Accordingly, those of ordinary skilled in the art will recognize that various changes and modifications of the embodiments described herein can be made without departing from the scope and spirit of the invention. In addition, descriptions of well-known functions and constructions are omitted for clarity and conciseness.

Figure 1 illustrates a flowchart of a method 100 of recognizing characters on a license plate, according to an exemplary embodiment of the invention. The method 100 of recognizing the characters may be employed for reading the registration number of a vehicle. The method 100 may be used to recognize vehicles in scenarios such as, but not limited to, monitoring traffic conditions, identifying stolen vehicles, monitoring parking lots, monitoring toll booths etc. The method 100 of recognizing the characters on a license plate may be a completely automatically method and may not need any manual intervention. It will be apparent to a person skilled in the art that the method 100 may enable recognition of characters from various plates such as, a sign board, a poster, a notice board etc and may not be restricted to recognize characters only on the license plates of the vehicle. The method 100 may be further capable of recognizing characters from various colours of license plates such as, a white, yellow, or red coloured license plate.

At step 102, the method includes capturing an image of the license plate of the vehicle by an image capturing device (shown in figure 2). According to an embodiment, the image capturing device may be a camera. According to another embodiment, the image capturing device may be a video recorder. It will be apparent to a person skilled in the art that the camera may include all types of cameras such as a surveillance camera, traffic camera, digital camera and any other cameras known in the art. According to an embodiment, the image capturing device may be mounted on a stationary post. According to another embodiment, the image capturing device may be mounted on a moving device. By way of an example, the image capturing device may be mounted on a signal post to monitor the traffic and recognize the license plate characters of any vehicle breaking the law. By way of another example, the image capturing device may be mounted on a police vehicle to identify the license plate characters of a vehicle during a chase. *It should be noted that the image capturing device may capture either the front license plate or* the rear license plate depending on the position of the image capturing device with respect to the vehicle. It should be noted that, in step 102, when the image capturing device captures an image of the license plate, the image capturing device may also capture the environment surrounding the license plate. The surrounding environment may be elements such as the vehicle body, sky, road, pedestrians, other vehicles etc. In some cases, the image capturing device may also capture a license plate of another vehicle in the same image. Such elements are undesirable in the character recognition process and hence the required license plate may be localized in the captured image.

At step 104, the method 100 localizes the license plate in the captured image. The method of localization may enable identification of the required license plate among the undesirable elements. The localization of the license plate may be achieved by performing a deep learning colour based sematic segmentation on the captured image. On performing the semantic

segmentation on the captured image, the license plate in the image may be assigned a unique colour and the undesirable components may be assigned a black colour. By way of an example, in an image having a license plate, a vehicle rear portion, sky, road and pedestrians, the deep learning colour based semantic segmentation may assign white colour to the license plate, and black colour to the vehicle rear potion, the sky, the road and the pedestrians. In some cases, if the captured image includes an additional license plate of another vehicle, the deep learning colour based semantic segmentation may assign the unique colour to the additional number plate also. It should be noted that the information regarding assignment of colours to the number plate may be predefined in a database. The localization method may further analyse the assigned unique colours and localize the license plate in the captured image. For an image having an additional license plate, the analysis method may compare the area of colour occupied by each license plate and localize the required license plate. For the purpose of illustration, the output of the localization method may be such that the required license plate will be white and the undesirable components may be in the background in black.

At step 106, the method 100 includes pre-processing the image of the localized license plate. The image of the localized plate may be pre-processed to remove distortions in the localized image and enhance the characters in the image. In other words, the image pre-processing method improves the process of recognizing the license plate characters. The pre-processing method may eliminate noise from the localized image and may convert the image of the license plate into a binary image.

At step 108, the method 100 includes recognizing the characters from the pre-processed image. The method of recognizing the characters from the pre-processed image may be achieved by performing a deep learning colour based sematic segmentation of the pre-processed image. The

pre-processed image of the license plate may be semantically segmented and each of the character may be assigned a unique colour. By way of an example, for a license plate having registration number DL 01 AR 1234, the semantic segmentation may assign a unique colour to each of the characters 'D', 'L', '0', '1', 'A', 'R', '1', '2','3' and '4'. It should be noted that the information regarding assignment of unique colours to each of the characters may be predefined in a database. The database may be predefined with a unique colour for each of the 26 alphabets from A-Z and for each of the number from 0-9. Once the unique colours are assigned to the characters of the number plates, the character recognition method may map the unique colour assigned to each character in the image of the license plate with the predefined colour information to recognize the characters of the license plate.

At step 110, the method 100 includes post-processing the image of the license plate. In the post-processing method, the characters recognized from the pre-processed image are converted into a text form.

Figure 2 illustrates a block diagram of a system 200 for recognizing characters on a license plate 202 (shown in Figure 3) according to another exemplary embodiment of the invention. The system 200 for recognizing the characters may include an image capturing device 204. Referring now to figure 3, the image capturing device 204 may capture an image of the license plate 202 of a vehicle 206. According to an embodiment, the image capturing device 204 may be a camera. According to another embodiment, the image capturing device 204 may be a video recorder. The image capturing device 204 may include all types of cameras such as a digital camera, a surveillance camera, mirrorless camera, traffic camera and other cameras known in the art. According to an embodiment, the image capturing device 204 may be mounted on a stationary post. According to another embodiment, the image capturing device 204 may be

mounted on a moving device. By way of an example, the image capturing device 204 may be mounted on a signal post to monitor the traffic and identify any vehicle breaking the law. By way of another example, the image capturing device 204 may be mounted on a police vehicle to identify a vehicle 206 during a chase. It should be noted that the image capturing device 204 may capture either the front license plate 202 or the rear license plate 202 depending on the position of the image capturing device 204 with respect to the vehicle 206. It should be noted that when the image capturing device 204 captures an image of the license plate 202, the image capturing device 204 may also capture the environment surrounding the license plate 202. The surrounding environment may be elements such as the vehicle body, sky, road, pedestrians, other vehicles etc. In some cases, the image capturing device 204 may also capture a license plate of another vehicle in the same image. Such elements are undesirable in the character recognition process and hence the required license plate 202 may be localized in the captured image.

The system 200 for recognizing the characters on the license plate 202 may further include a processor 210. The processor 210 may perform multiple image processing techniques on the captured image to recognize the characters on the license plate 202.

The processor 210 may include a localization module 212. The localization module 212 may localize the license plate 202 in the captured image. The localization module 212 may further include a deep learning colour based semantically segmenting module. The semantically segmenting module may segment the captured image based on colours. The semantically segmenting module may assign a unique colour to the license plate 202 in the image. The localization module 212 may further include a database. The database may be predefined with information related to unique colour assigned to the license plate 202 by the deep learning

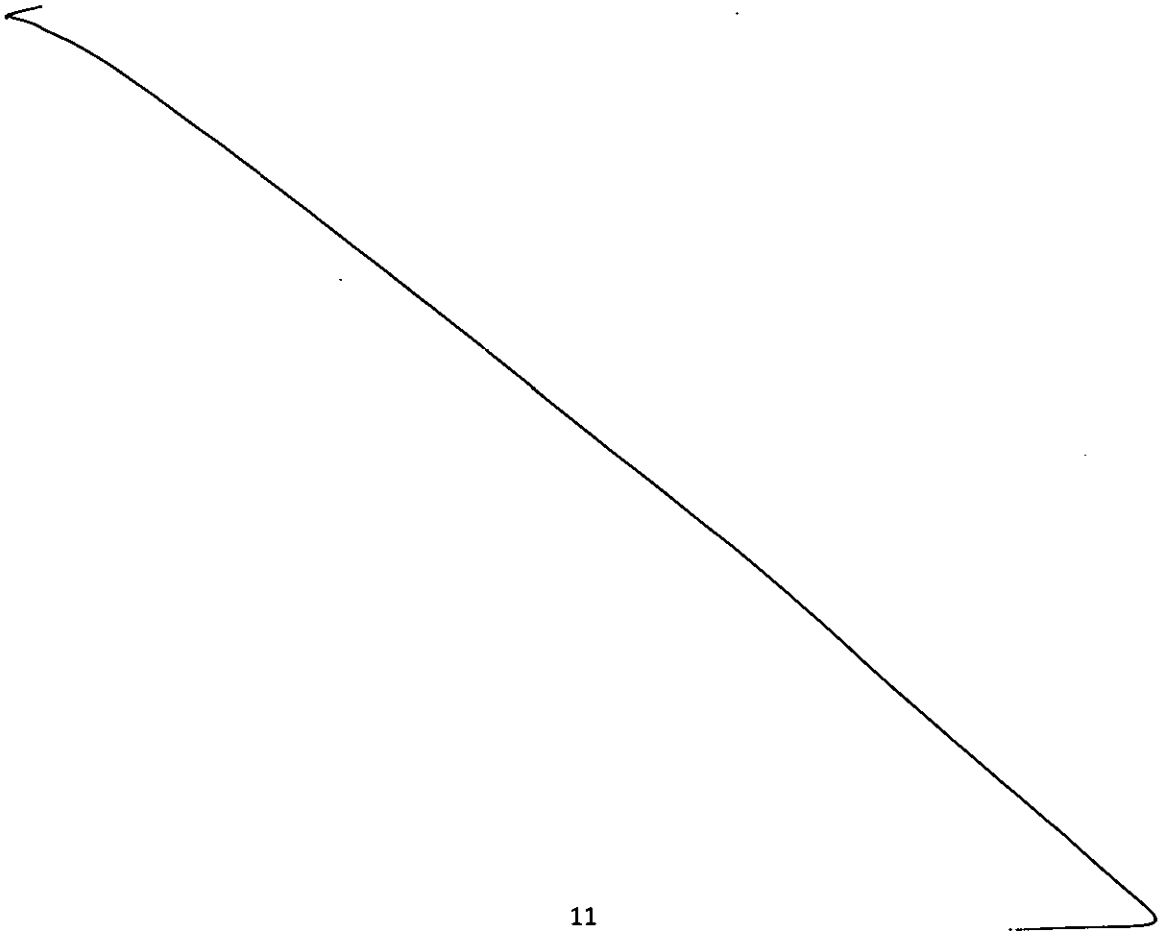
colour based semantically segmenting module. It will be apparent to a person skilled in the art that the information in the database can be fed or modified as required by a user. The localization module 212 may further include a deep learning based image analyzer. The deep learning based image analyzer may analyze the unique colour assigned to the license plate 202 in the semantically segmented image. After analysing the unique colours in the image, the localization module 212 may localize the license plate 202 in the image.

The processor 210 in the system 200 for recognizing the characters on the license plate 202 may further include an image pre-processing module 214. The image pre-processing module 214 may perform further operations on the localized image. The localized image may be pre-processed to remove distortions in the image and enhance the characters in the image. The pre-processing module 214 may eliminate noise from the localized image to enhance clarity of the image. The image pre-processing module 214 may further convert the image into a binary image.

The processor 210 may further include a character recognition module 216. The character recognition module 216 may include a deep learning colour based semantically segmenting module. The deep learning colour based semantically segmenting module may segment the pre-processed image based on colours. The character recognition module 216 may further include a database. The database may be predefined with information regarding unique colour assigned to each character by the deep learning based semantically segmenting module. The character recognition module may further include a deep learning based image analyzer. The deep learning based image analyzer may map the colours assigned to each character in the semantically segmented image with the predefined colour information and recognize the characters on the license plate 202.

The processor 210 may further include an image post-processing module 218. The image post processing module may post-process the image to convert the recognized characters into a text form.

It is understood that the above description is intended to be illustrative, and not restrictive. It is intended to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as defined in the appended claims. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. In the appended claims, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein," respectively.



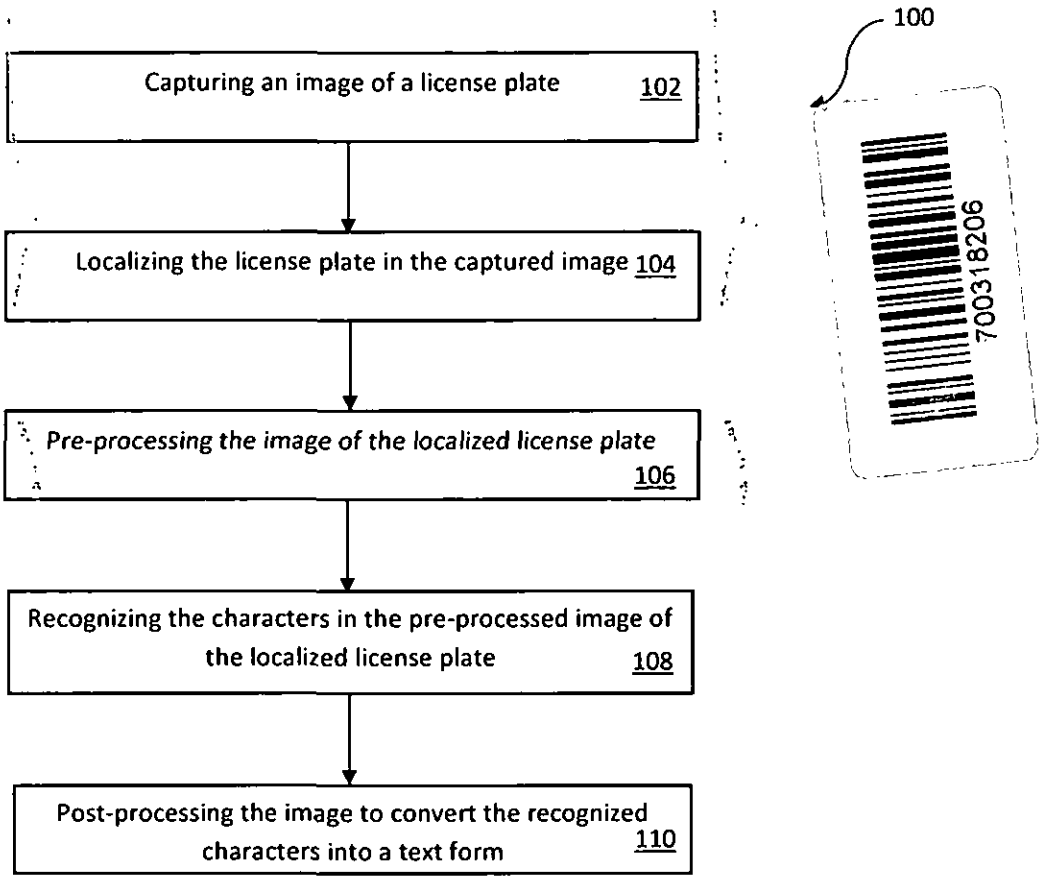



Figure 1

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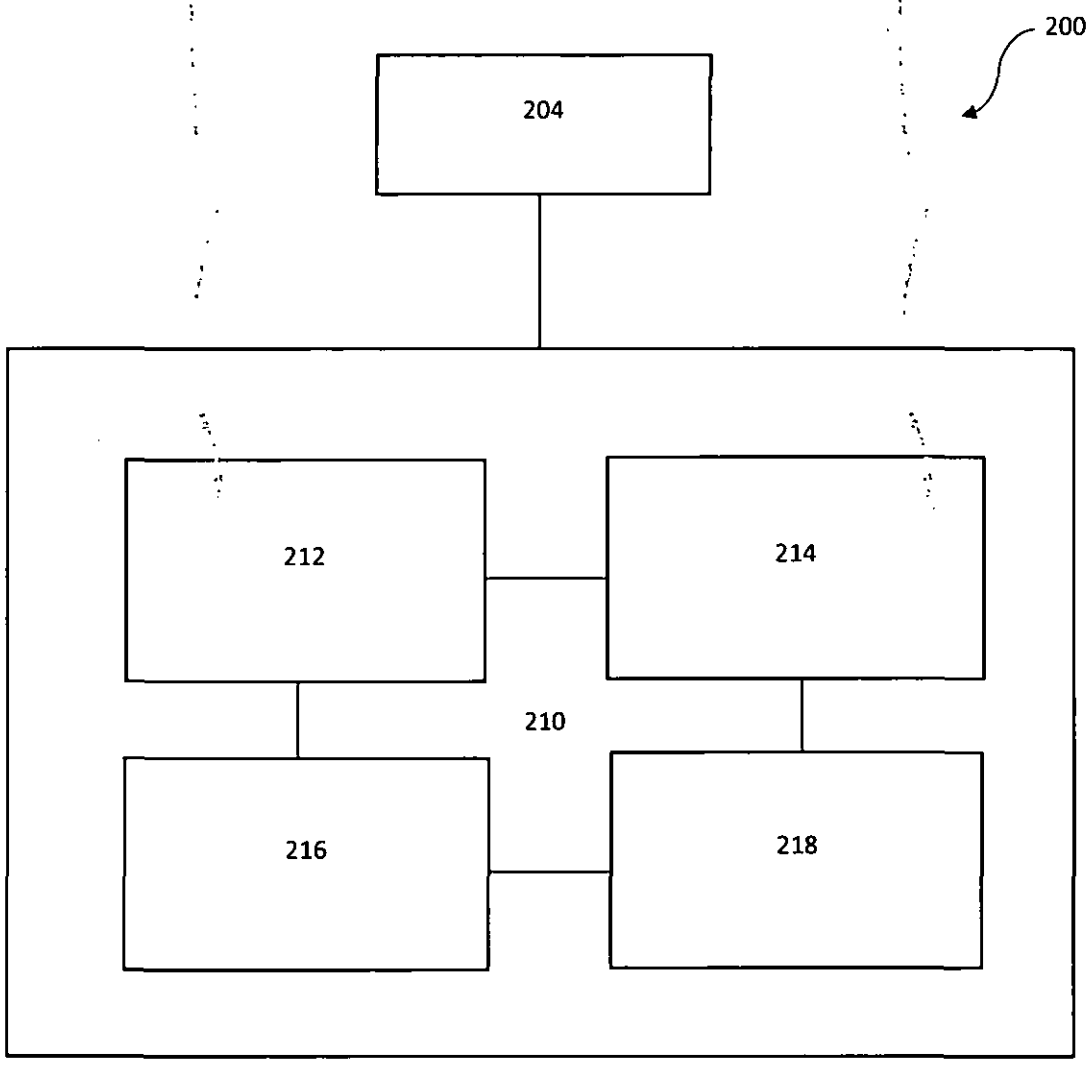


Figure 2

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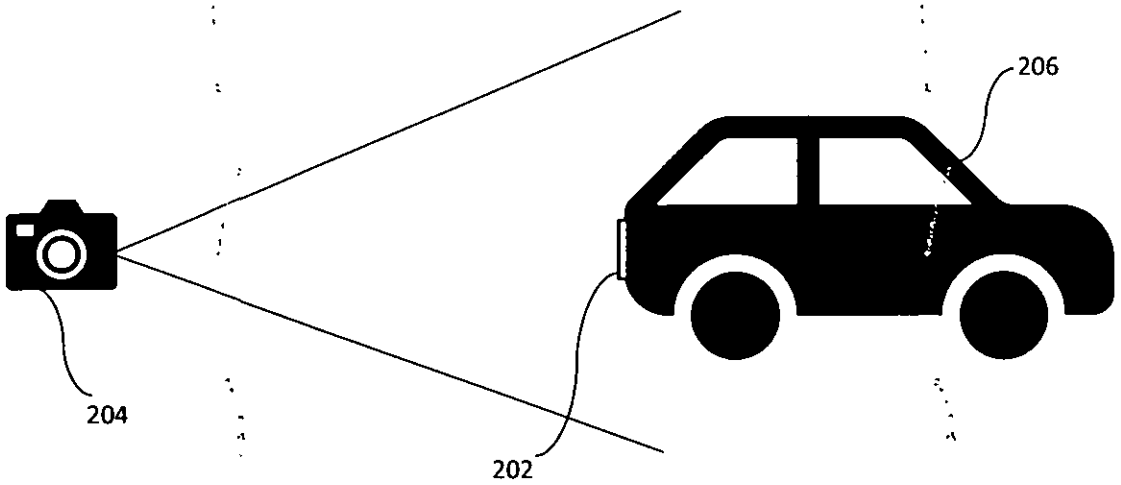


Figure 3

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