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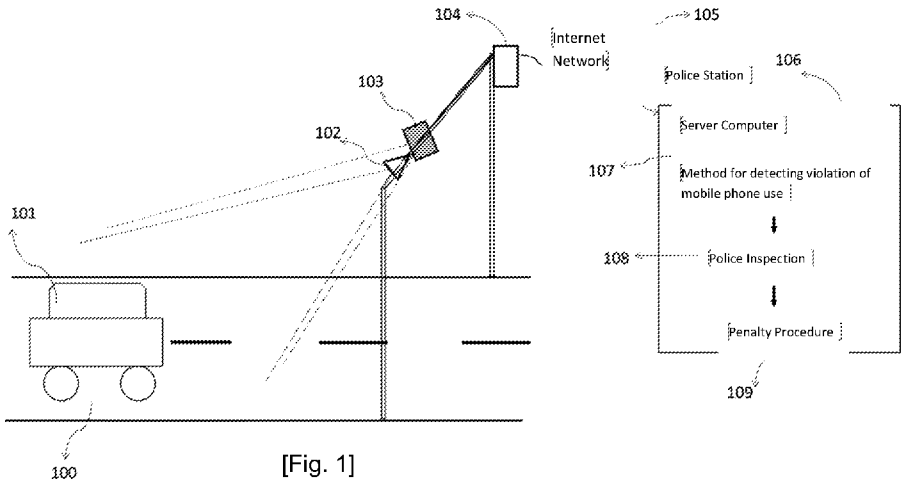
(54) Title: A METHOD FOR DETECTING THE VIOLATION OF MOBILE PHONE USE BY DRIVER THROUGH USING CAMERA IMAGES OF THE LICENSE PLATE RECOGNITION SYSTEM




[Fig. 1]

(57) Abstract: The inventive product is a method developed to scan the violation detections of mobile phone use in the images by processing image data collected from images of near infrared or visible camera positioned at the fixed platforms on roads. Accordingly, a model for various stages is formed by processing the images with the deep learning model-based algorithms and the detection process is carried out by means of running images on said models.

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# Title of Invention: A METHOD FOR DETECTING THE VIOLATION OF MOBILE PHONE USE BY DRIVER THROUGH USING CAMERA IMAGES OF THE LICENSE PLATE RECOGNITION SYSTEM

[1]

## Technical Field

[2] The inventive product relates to a method for monitoring mobile phone use of drivers and detecting thereof in case of violation through monitoring driver's area of vehicles traveling on roads by means of near infrared or visible cameras positioned at the fixed points. Inquiry for a license plate recognition is performed additionally for vehicles with the violation of mobile phone use, thereby ensuring that the information required to start a penalty process is provided in the system.

## Background Art

[3]

## Summary of Invention

[4] The inventive product is a method developed to scan the violation detections of mobile phone use in the images by processing image data collected from images of near infrared or visible camera positioned at the fixed platforms on roads. Accordingly, a model for various stages is formed by processing the images with the deep learning model-based algorithms and the detection process is carried out by means of running images on said models.

## Technical Problem

[5] Some of the documents in the state of art are given below:

[6] In the US patent application numbered US8384555, it is disclosed a method employing facial recognition algorithms to detect mobile phone use. Accordingly, an apparatus light the road and monitors the area that it lights. Meanwhile, it processes the obtained images on a facial recognition algorithm and after detecting the facial area, it searches for any image that may provide a mobile phone image in proximity. Since the recommended method offers generally a method trying to solve all problems at once, its hit rate remains low. Furthermore,

performing a direct facial recognition at a single stage requires a great deal of processor power and also causes some legal problems related to collecting personal data. Consequently, a system constituting an addition to any of facial recognition algorithms without using deep learning techniques and without performing a modeling process.

[7] In the US patent application numbered US9721173, it is disclosed a method for detecting a mobile phone use by driver by means of a machine learning. This method substantially depends on extracting features on the image through machine learning and checking whether the mobile phone feature is available by finding driver after positioning and comparing relatively the extracted features. However, this method constitutes a number of application problems. These are substantially to extract all features on each image. Since it is not possible to determine features corresponding to driver and mobile phone without extracting all features on the image, all features on the image must be extracted and compared with the driver feature that is learned by the machine previously. This process both has a low hit rate and requires a higher server.

[8] The inventive product is provided so as to overcome shortcomings.

## Solution to Problem

[9] The inventive product is a method designed on a server, on which the images received from license plate recognition cameras located on a platform are saved. The technical problem, for which the inventive product provides a solution, is the problem with detecting high-accurately mobile phone uses without an operator by using a deep learning model by means of processing camera images and transferring the detections to individuals at the penalty process implementing point together with additional required information. Accordingly, the image received from a visible (RGB) camera with a resolution of at least 2 mega pixels located on a stable platform and/or images from near infrared camera with a resolution of at least 2 mega pixels are considered as a basis for the processes to be performed. Images received said cameras are kept conjugately to each other in this two-camera system. Accordingly, camera images are firstly separated into training images (201) and test images (301). Herein, it is substantial that an image taken in a group is not subjected to the process sequence, to which any of images in the other group is subjected. Training

images (201) are used for training the system based on deep learning and test images (301) are used for running the models and yielding results.

[10] Deep learning, which is mentioned throughout the description, learns to represent the object to be detected in the multi-layer convolutional neural networks layers in a visual (appearance features) and structural (geometrical features) manner. In the state of the art, it is used commonly in field such as object detection, object tracking and image classification. Technical advantage provided in terms of the inventive product is that; it is not obligatory that the camera (102) is positioned such that it views vehicles (101) at a certain angle from a certain distance. The inventive method may operate on every image group, in which violation of mobile phone use is detected on the image. Another technical advantage is that cameras (102) is not necessarily to be standard. Every camera (102) with other conditions mentioned throughout the description may take images that will be a basis for the inventive method and the method is able to operate properly at the end of the process.

[11] After images are separated into two groups, the process for creating a windshield area detection model on the server is triggered. Accordingly, training images (201) are marked by user in deep learning modules preferably in a rectangular manner and the marked portion is cut and kept on the server (107). When every training image (201) is marked on the deep learning algorithm, the algorithm updates the model. Thus, every training image (201) is marked by user on the deep learning algorithm, thereby contributing to updating the model and increasing its precision.

[12] It is ensured that the windshield area detection model (202) is created by means of said regular updates.

[13] The windshield area detection model (202) is kept on the server (107) for processing test images (301). After this process step, the windshield area detection (203) is triggered by using the windshield detection model. Accordingly, after the windshield area is detected on the images received from NIR and/or RGB camera by using the windshield area detection model, this area is removed from the image. Afterwards, the process for creating (204) a driver detection model by means of utilizing windshield area images is triggered. Accordingly, the

marking performed by user is employed within the scope of creating a model independently from the previous one. Accordingly, the driver detection model is created by updating said algorithm with the marking performed on the deep learning algorithm. An example of this selection process is given on Drawing 2. Afterwards, the driver's area detection (205) process is triggered on the windshield area. Thus, the driver's areas detected are separated and saved.

[14] Since it cannot be detected whether images received from cameras (102) exhibit a mobile phone use or not, it is selected by user one by one at this stage and required to select (206) the images with mobile phone use. It is preferred to use SSD (Single Shot Detector) technique so as to solve this problem. Thus, images are divided into three groups, namely images without mobile phone use (negative), images with mobile phone use (positive) and images with a difficulty to decide (uncertain). Training processes are performed by employing every three group images. It is ensured through the detection performed with the trained model that it is decided whether driver uses mobile phone or not and the process for creating model is completed.

[15] After all of those model creation processes, the inventive method is ready to run on the test images (301). Accordingly, the process for test images (301) is performed by using the model from the image resulting from the automatic windshield detection (302) process and the windshield detection model creation (202) process. Accordingly, the windshield area portion is removed from the image by running the image on the model and saved to be used in the processes continuing. The process to be proceeded varies depending on whether there is a detection or not; there is no process for images without windshield detection, the instruction "proceed to the next image (303) is given. The windshield area driver detection (304) process is performed on images by using the model created in the driver detection model creation (204) process by means of the windshield area images for images with the detection of the automatic windshield area detection (302) only from the image. Accordingly, the driver's area detection is performed on images by employing the related model created by way of using training images (201).

[16] While the instruction to "proceed to the next image (305) is given for images without driver's area detection, the next step is proceeded only with images with

driver's area detection. After this elimination, the process for removing (306) the driver's area from image is triggered for the images being processed. Accordingly, the driver's area is removed from the rest of the image and the next steps are carried out with this portion. Afterwards, the mobile phone detection (307) step is run on images eliminated and cut by using the model created and saved in the mobile phone violation detection model creation (207) step at the driver's area. If there is no detection at this step, the process is directly ended and the instruction "proceed to the next image (308)" is given. However, it is proceeded to the next step only with images with the detection. At this step, the driver mobile phone detection result (309) data is created and transferred to predetermined points for police inspection (301). Thus, it is ensured through a three-stage process sequence that it is detected whether an individual driving a vehicle on the road constitutes a violation of a mobile phone use.

## Advantageous Effects of Invention

[17] Thus, cameras positioned at various angles, comprising various features and taking images in different light wave lengths, particularly for those used for license plate recognition apparatuses may be used just by performing a setup on a deep learning algorithm. Images are processed without requiring any calibration and similar processes and it is ensured that the violation detection is performed high-accurately. Furthermore, a number of gripping positions that drivers prefer so as to avoid the mobile phone violation detections are detected easily by the inventive product.

## Brief Description of Drawings

[18] Disclosure of drawings annexed in the description is as below;

## Fig.1

[19] illustrates an exemplary drawing of a hardware on which the inventive method operates and an environment wherein the hardware is available. Accordingly, for a vehicle (101) traveling on a road (100), a camera (102) viewing a certain area of said road and a PTS light source (103) isotropic with the camera are positioned on a camera carrying platform (104). Herein, images received are transferred to police station (106) by means of internet network (105) and the server detects mobile phone use violations by operating the inventive method on

a computer (107) and results are presented to police inspection (108) for implementing a penalty. Thus, it is ensured through this apparatus to collect and process data for forming seatbelt violation results in a high accurate manner without any operator interference.

## Fig.2

[20] illustrates a flow chart representing the operation principle of the inventive product. The inventive method is run on the server computer (107) and said server computer (107) is in a server form, of which features are to known clearly by those skilled in the art; comprised of a data bus and at least one processor operating on this data bus, at least one random access memory (RAM) connected to this processor, at least one permanent memory disk, an image processing element, an image transferring output connected therewith; an internet connection port connected with the data bus and additional elements connected to them. The term "processing" means that the process is performed by the processor, the term "saving" means saving on the memory element, the term "transferring" means transferring on the internet port as long as otherwise is not specified. The image group transferred on the server computer (107) firstly is divided randomly into two parts. The first part is named as training images (201) and is used for training activities of user on the deep learning algorithm. Firstly, by means of employing training images (201), training and model creation processes are performed on the deep learning algorithm by detecting the windshield area by user through the process step of the windshield area detection model creation (202) on the deep learning algorithm. Herein, by means of using the model, the automatic windshield area detection (302) process is triggered through the image on the test images and saved by removing the windshield area. After creating the windshield area detection model (202), the windshield area detection (203) process is triggered by using the windshield area detection model. The windshield area is removed by using the model created in this process step and the driver detection model creation (204) processes is triggered by using the windshield area images on the removed windshield area. In the course of this process, the driver detection (304) process is performed on the windshield area by carrying out on images marked, such that the detection is available, from outputs of the automatic windshield area detection (302) process

from the model image created after a model creation process on the deep learning algorithm by marking the driver's area by user. Detection is performed by using the model created in the process step of driver detection model creation (204) by employing the driver's area windshield area images in case the windshield area is available on the windshield area image removed from the image during the windshield area detection (302) in the driver detection (304) process on the windshield area. Herein, in case there is a driver in the image, the driver's area is removed and saved to be used in the next step. Driver's detection (205) process is triggered on the windshield area after the driver detection model creation (204) process by using the windshield area images and the driver's area is detected by user on the windshield area. Afterwards, it is proceeded to the process of the selection (206) of images with mobile phone use. This is necessary to create a model properly at the next stage. Driver mobile phone result (309) data is generated in case of detecting by running on the driver images detected and removed in the process step of the driver detection (304) on the windshield area with the model created through selections performed on the deep learning algorithm by user with the process step of the mobile phone violation detection model creation (207) on the driver's area on the selected images by user and the yielded result is transferred to the related user together with the conjugate image in the test images (301) for the police inspection (310).

## Fig.3

[21] illustrates an example representing the process, in which the inventive product performs test images (301), on an exemplary image. Exemplary representation of the output obtained from the image performed in the first place after the automatic windshield area detection (302) process is given on an exemplary image selected from the image group (200) into the test images (301). Afterwards, the driver's area removed through the windshield area driver detection (304) from the exemplary image is shown for example. An important problem that the inventive product solves is the re-programming problem at every camera montage according to vehicle type, average driver phenotype, camera height, light intensity and similar elements. Since the inventive product process, the markings carried out by user on the deep learning algorithm and creates various model and performs detections, it is able to create a new model in case of new

markings at every montage place and may draw differently the image limits according to these markings. Hence, images shown in the drawing is an example for providing a better understanding of the invention. After said process, the mobile phone detection (307) process is run on the removed image. Herein, if the driver mobile phone detection result (309) is positive, the test image (301) used in the first place is transferred for the police inspections (310) such that it is marked.

## Description of Embodiments

[22]

## Examples

[23]

## Industrial Applicability

[24] The inventive method is a system designed to operate on computer, wherein it can be operated on various types of computers. The server computer (107) is used to refers generally to machines with the data processing capacity, not just to the servers.

### Reference Signs List

[25]

## Reference to Deposited Biological Material

[26]

## Sequence Listing Free Text

[27]

## Citation List

[28]

## Patent Literature

[29] PTL1:

## Non-Patent Literature

[30] NPL1:

# Claims

[Claim 1] Process sequence run on a server on which images are saved through camera or cameras positioned on a stable platform to detect whether driver of a vehicle traveling on a road constitute a violation of a mobile phone use by means of camera images of a license plate recognition system, characterized in that it comprises the process steps of;

a. dividing images received from camera or cameras into two groups, such that an image will be in only one group; naming the first group as training images, naming the test images as the second group;

b. triggering the windshield area detection model creation process on the training images in the deep learning algorithm; marking the windshield area by user to an image received from the training group on the deep learning algorithm in the windshield area detection model creation process;

c. repeating this marking process for every image in the training group and separating the marked portion from the image and saving on the server additionally;

d. creating thus the windshield area detection model and saving the created windshield area detection model on the server;

e. extracting the driver's area from the image by way of processing images in the test group through the windshield detection model saved on the server and repeating this process for every image introduced into the test group;

f. triggering the driver detection model creation process by remarking the extracted image from the image on the deep learning algorithm after the marking process;

g. repeating this marking process for the image extracted from every image in the training group and separating the marked portion from the image and saving on the server additionally;

h. creating thus the driver's area detection model and saving the created driver's area detection model on the server;

i. extracting the driver's area from the image by way of processing image in the test group through the driver's area detection model saved on the server and repeating this process for every image introduced into the test group;

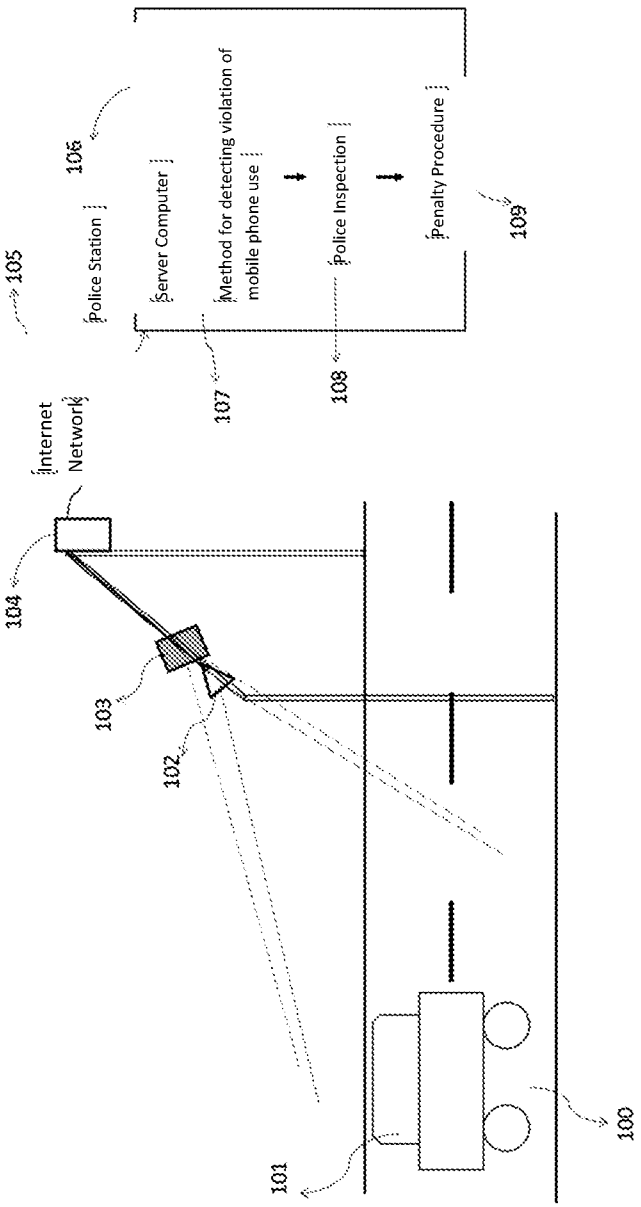
j. separating images with and without mobile phone use by user on the deep learning algorithm and creating the mobile phone violation detection model by way of repeating this process for the image part received from every image in the training group and saving the created mobile phone violation detection model on the server;

k. detecting the mobile phone violations by way of executing three models respectively for each test image and images to be added to test images.

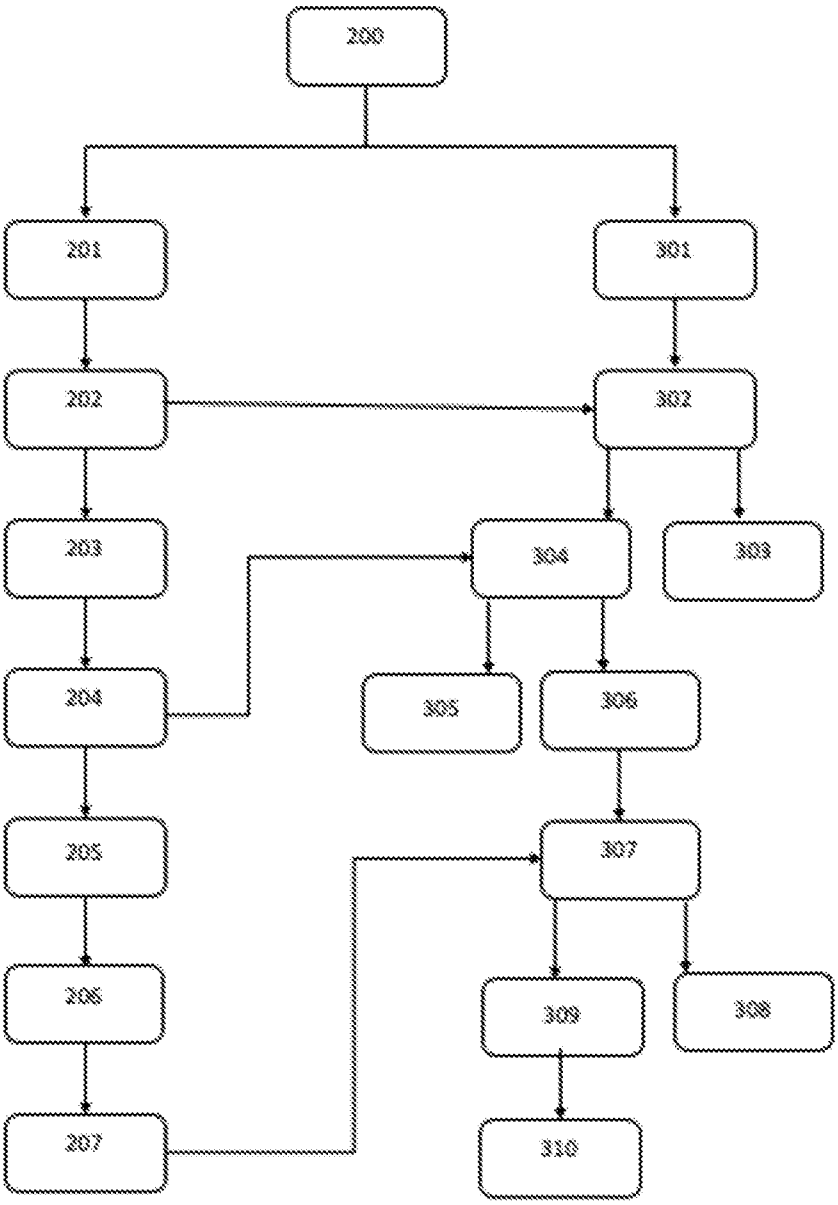
[Claim 2] Method according to Claim 1, characterized in that it is operated on images received from camera or cameras taking images in infrared or visible area to be at least two mega pixels.

[Claim 3] Method according Claim 2, characterized in that images are processed conjugately to each other in case images are received from multiple cameras.

[Fig. 1]

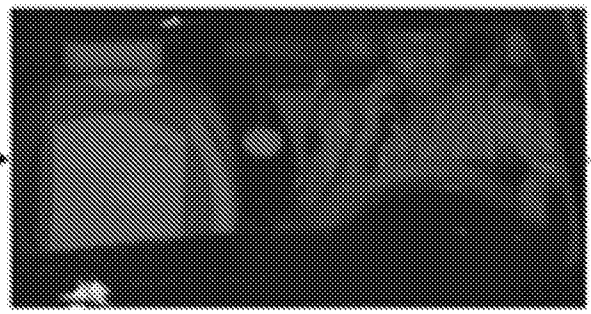

106
Police Station
Server Computer
Method for detecting violation of mobile phone use
Police Inspection
Penalty Procedure
109
105
107
108
Internet Network
104
103
102
101
100

[Fig. 2]


200
201
301
202
302
203
304
303
204
305
306
205
307
206
309
308
207
310

[Fig. 3]

Day/Night Camera Image (2)



Windshield Area Detection (3) from Image

Indicating (6) the area with the detection of violation of mobile phone use on the unprocessed image