

Using Computer Vision and Machine Learning Algorithm to Prevent and Detect Vehicular Stalking

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Available online at: www.ijcseonline.org

Abstract—Vehicular stalking is a can be termed when a motorist is deliberately following another motorist for various reasons such as investigative, spying or stalking. Stalking has been proved to be expensive as it breaches the privacy of the victim and can be used for other illicit activities. The victim is mostly unaware that they are being stalked and it becomes difficult to report stalking to law-enforcement authorities as victims do not have strong evidence to prove. The vehicle stalking is generally in close proximity or is in the length of sight to the victim being stalked. This paper introduces an idea which can help the victim know if they are being stalked by using Computer vision and Machine learning algorithm to extract information like number plate details, vehicle type, time, colour, brand and model from the vehicles on the road during travelling to predict the stalker's vehicle based on the occurrence and alert the victim with a report.

Keywords—Computer Vision, Machine Learning, Humanitarian Technology, Stalking

I. INTRODUCTION

Stalking is an unwanted or repeated surveillance towards another person by an individual or group. Stalking behavior may be related to harassment and intimidation and may include in person following or monitoring the victim. The term stalking is used with several different definitions in psychiatry and psychology as well as in some legal jurisdictions as criminal term [1].

A 2002 report by the US National Centre for Victims of Crime, virtually any unwanted contact between two people that directly or indirectly communicates a threat or places the victim in fear can be considered stalking [1].

In United States of America 3.3 million people are stalked in one year alone [2].

This paper will explain how Computer Vision and Machine learning algorithm can be used to prevent and detect vehicular stalking. The paper explains a method which can be practically implemented.

This Technology uses Machine learning and Automatic Number Plate Recognition System to extract identifiable information and number plate information of the vehicles on the road during at any instance of time and stores the registration number on a database and determines the stalker based on frequency of appearances.

The paper is organized as follows, Section II Explains the Related Work in Automated Number plate Readers and the

reason for choosing this problem and how Computer vision and Machine Learning can be used as a solution.

Section III explains the problem and reason for choosing this problem and the viability of Machine Learning and Computer Vision as a solution to the problem statement.

Section IV describes the Development process including the appropriate software and hardware used in the process of development which also includes the working algorithm which detects the stalker.

Section V ends with an example and then followed by the closure with sections explaining the Conclusion, Future Work and References.

II. RELATED WORK

There are different ways for extracting vehicle information Chirag Patel et al. [3] used ANPR algorithms which is mainly divided in four steps:

- 1) Image acquisition.
- 2) Number plate detection.
- 3) Character segmentation.
- 4) Character recognition.

In this method Image acquisition refers to the image captured by the camera then the number plate detection is executed by using image segmentation followed by character segmentation which extracts the characters from the number plate and then Artificial Neural Network is used to recognise the character or convert it to text.

M. M. Shidore et al.[4] proposed how ANPR systems can be used to recognise Indian Number plates .In this work the image of the vehicle is first converted to grayscale then applying Sobel edge detection to extract candidate number plate area from the image which is followed by true number plate extraction then Vertical projection analysis is used to isolate each character followed by Character recognition using Support vector Machine.

S. Kousalya et al. [5] explained how colour can be extracted from an image using Classification Techniques. This paper describes how colour similarity mining for extracting colour from specific images and retrieving the similar pixels using Euclidean distance measure and how pixels can be grouped based on nearest neighbour algorithm to reduce complexity.

III. PROBLEM AND SOLUTION

A. Motivation

According to reports, a statistical survey conducted by the US Department of Justice reports that an estimated 3,3 million people aged 18 or older were deliberately followed or stalked during a 12-month period [2].

According to the study, more females experienced stalking than males. During the study period, at least 2.2% of females experienced one stalking incident compared to 0.8% of males. Men and women were equally likely to be harassed [2].

As per the study Stalkers mostly target victims based on Age, Race, Marital status, Profession, Income and Relationships [2]. Besides the above mentioned cases people who are famous or are being sued in court are also stalked on daily basis.

Most of the time the victim is not aware about the fact that people are stalking them and even if they know that their being stalked little can be done to press charges against the culprit as law enforcement officers need evidence in-order to press charges.

B. Problem Statement

The solution is therefore to create a device that will -

- Extract Vehicle information
- Detect Vehicular stalking
- Alert Victim
- Generate Report

C. Computer Vision and Machine Learning as a solution

Computer vision is a field of computer science that works to allow computers to view, identify and process images in the same way as human vision, and then produce the appropriate output.

Machine learning is an artificial intelligence application that enables systems to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on developing computer programs that can access and use data to train themselves.

Computer Vision with Machine Learning will be used to detect the vehicles on the road and relay information to the device such as colour, vehicle type, model and store the number-plate data as text using OCR.

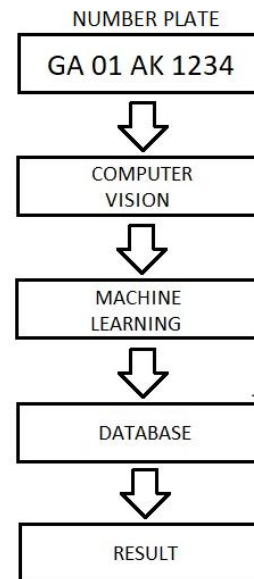


Figure. 1. Working block diagram

IV. DEVICE DEVELOPMENT

It The device is still under development stage the details mentioned below will be reflected on the final finished device.

A. Technologies used

The following tools and technologies will be used in the development of the Device.

- Raspberry pi 3 as single-board computer.
- MySQL for database management.
- Open-CV for Computer vision.
- Tensor flow for machine learning.

B. Hardware Development Process

The Hardware of the device will mainly consist of a Single-board computer something similar to the Raspberry pi-3. A Single-board computer will be required as it will have greater processing capabilities compared to a micro-controller.

The CPU will consist of a minimum of 4 processing cores in order to efficiently distribute the work of capturing real-time images from the on-board cameras C1 and C2 (Fig.2) to detecting the stalker and generating a report.

The device will consist of GPS module in-order to put a location stamp on images as it will help in determining if the victim is being followed and give a route of the stalker.

A 3-axis accelerometer will be used in-order to measure the acceleration of the vehicle and counter the disturbance which might cause to the image due to the vibrations caused by the uneven roads and to regulate the shutter speed during the capture of the image.

The device will consist of an internal flash memory which will house the local database which will be used by the machine learning algorithm to store, retrieve and process data and an LCD screen will be used to display information.

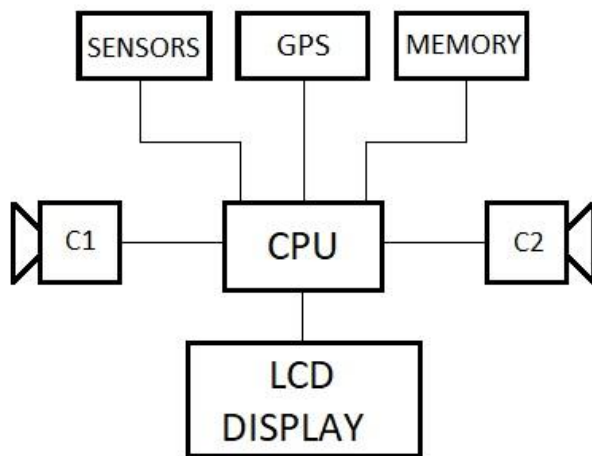


Figure. 2. Hardware Block Diagram

C. Software Development Process

The Software is written in Python of its ease-of-use and support for implementing Machine learning and Computer Vision. The implementation of the software is further divided into 4 major parts.

1) Real time image capture

The software is designed in such a way that it continuously monitors the traffic on the road in order to accomplish this real time video feed is used from both the front and rear of the vehicle. The frame rate is 60fps at 1080p resolution.

2) Extracting Information

The main component is vehicles, so the first step is to detect if a vehicle is present then the type of vehicle followed by the number plate details and additional information such as brand and Vehicle model proceeded by minute details such as Vehicle colour and time of appearance.

3) Database implementation

A local database is maintained in order to keep track of the information extracted from the Machine vision system. Data from the GPS module and internal timing will be logged depending on the appearances of the vehicle. A UID key will be generated for each vehicle detected in order for easy manipulation of data (e.g. Table 1).

- UID: Unique Identification (Primary Key)
- V_N: Number of appearances.
- V_I: Vehicle Information (Type, Brand, Model)
- V_R: Vehicle Registration number.
- V_TD: Vehicle appearance time/date.
- V_G: Vehicle GPS Location.

Table 1. Database Implementation

UID	V_N	V_I	V_R	V_TD	V_G
143	1	Car Suzuki Sx4	GA01A1234	10:00AM 01/05/2018	15.4013071 74.0074897
241	3	Car Honda Amaze	GA01A4567	5:00PM 08/10/2018	15.4013073 74.0074899

4) Computing data and generating report

A stack is created which stores and sorts the UID of the vehicles depending upon the frequency of the appearances of the stalker's vehicle. The report can be generated on the victim's direction or if the frequency of appearances of the stalker's vehicle exceeds a certain threshold.

Algorithm:

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STEP 1: Start
STEP 2: Detect Vehicle.
STEP 3: Determine and Extract Vehicle Information.
STEP 4: Determine GPS location and Time.
STEP 5: Store information on database
STEP 6: Check Frequency of vehicle
STEP 7: Arrange and Store on stack depending on frequency
Repeat STEP 2
  
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V. USECASE SCENARIO

The device will be able to capture and monitor vehicles on the road and extract information of the vehicle. The information of each vehicle which comes in front of the camera will be stored on the database with additional

information such as time, location, speed, colour, registration number and the frequency of appearances.

The machine learning algorithm will detect the vehicle which is deliberately following the victim based on a set of rules which will differentiate from vehicle's which may occur frequently but with no intention of following.

This device is made for users in-order to protect their privacy and safety and alert them when they might be a victim of stalking or if their being followed and prevent any mishaps which might occur and provide evidence in form of a report which can be forwarded to law enforcement agency (e.g. Table 2).

The user will just have to mount both the front and rear camera on their vehicle and they will be notified via the LCD display.

Table 2. Report Implementation

REPORT	
UID	241
FREQUENCY	3
VEHICLE DETAILS	Car, Honda, Amaze
NUMBER PLATE	GA01A4567
TIME/DATE	5:00PM - 08/10/2018
GPS LOCATION	15.4013073 74.0074899

VI. CONCLUSION AND FUTURE WORK

This paper proposes a method which can be used to detect vehicular stalking in real life scenario. Vehicular details such as Number plate, type make, model, time and GPS location were extracted using software and hardware and a report is generated which can be used as evidence of stalking.

In the future the plan is to add more features such as cloud-computing, android application and a server back-end.

A server backed will be used in-order to upload data from all devices and use the data collected to improve the machine learning algorithm, cloud-computing will be used to reduce the processing load on the on-board CPU and also compare data collected to the database of law enforcement agency.

An android application will be developed to give the user insights and to mark vehicle's as known or unknown thus reducing the complexity in determining the stalker.

ACKNOWLEDGMENT

I would like to acknowledge the help and support provided by my Principal Mr V.N Shet and Head of Department Dr. J.A Laxminarayana and. I would also like to acknowledge the guidance provided by Associate Professor Mrs. Maruska Mascarenhas

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Authors Profile

Mr. Shonal Fernandes pursued Diploma in Electronics Engineering from Agnel Polytechnic Verna, Goa, in 2016 and He is currently pursuing Bachelor Degree in Computer Engineering at Goa College of Engineering. He is a member of Computer society of India since 2017. He is a Technology enthusiast and has worked on Hardware and Software projects. His interest includes 3D printing, PCB fabrication and Internet of Things. His main interest is Image processing and Machine learning.

