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Traffic control using computer vision

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ABSTRACT

Nowadays traffic density on the streets increasing around the world tremendously. It causes several problems on the day to day life of people. As we know that it is the era of speed so that nobody wants to wait for a long time at any cost. Everybody prefers to low traffic density streets. This proposed system introduced a vehicle density-based traffic control system to avoid the above issues. This problem can be resolved by controlling the traffic density on the roads. This system introduces a new method to control vehicle density by controlling the traffic lights using Image processing. Vehicle density is measured using predefined classifiers available in image processing. If the measured density is above the normal density (threshold value) it passes an indication to the microcontroller which controls the projector and thereby we can give appropriate traffic signal to display.

Keywords— *Computer vision, Traffic density, Arduino Uno, Open CV*

1. INTRODUCTION

One important application of computer vision is traffic monitoring and control. Here we are presenting a system for detection of moving vehicles approaching an intersection or in a highway by the camera in the context of traffic light control systems. As the system is dedicated to outdoor applications, efficient and robust vehicle detection under various weather and illumination conditions is examined. To deal with these ever-changing conditions, vehicle detection relies on motion segmentation and colour mapping to achieve feature space segmentation. Experimental results using real outdoor sequences of images demonstrate the system's robustness under various environmental conditions. It detects the number of vehicles on each road and depending on the vehicles load on each road, this system assigns the optimized amount of waiting time (red signal light) and running time (green signal light). This system is a fully automated system that can replace the conventional pre-determined fixed-time based traffic system with a dynamically managed traffic system. It can also detect vehicle condition on road and auto-adjust the system according to the changing road conditions which make the system intelligent. The designed system can help to solve traffic problems in busy cities to a great extent by saving a significant amount of man-hours that get lost waiting on jammed roads. This research focuses on factors, low-cost image processing and traffic load balancing. Moreover, we are also replacing the conventional traffic light system with a more efficient system using an LCD projector. This computer vision technology can be used to reduce traffic congestion and also helps to detect people who are not wearing helmets to an extent.

2. LITERATURE SURVEY

The first system represents a traffic control system using ZigBee module. ZigBee module is wireless communication. It is connected to 3 parts: vehicles, traffic signals and control unit. ZigBee follows IEEE 802.15.4 physical radio specifications. The main idea of this project is to provide better navigation to emergency vehicles. This system will also help in identifying any stolen vehicles when crosses the different traffic light signals. This project is divided into two: Description of ZigBee transmitter that is placed in the ambulance and details about ZigBee receiver implemented at the traffic pole. Here the ZigBee transmitter is switched on only by the driver, in case of emergency situation. There are situations where the ambulance is not carrying patients. As soon as the driver on the ZigBee module transmitter part will start communication with a nearby traffic signal, then: Greenlight is made on to reduce congestion. Here an RFID reader is connected to traffic pole. Due to RFID, we can find stolen vehicles.

The next conventional system we present is an efficient traffic control system based on density. The project is designed to develop a density-based dynamic traffic signal system. Here vehicle moving method is based on the density. Initially, the road image is captured while there is no traffic on the road. This null image is saved as a reference image in a specific position. The primary process is to obtain the input image using the camera. Noise occurs when camera capturing due to climate conditions. Noise removal is done by a median filter. If an accident occurs then the message will be displayed. Priority is determined based on the following: If two or more roads of an equally high priority than any one of the road is opened and if all road are having no traffic, a yellow signal appears.

Next is about intelligent traffic control system for an ambulance using perfidy and cloud Ambulance service is one of the major services which gets affected by traffic jams. This paper helps to smoothen the ambulance movements. This system creates an android app that connects both the ambulance and the traffic signal station using a cloud network. Here we use RFID technology. The basic idea behind the proposed system is: If the ambulance halts on the way due to traffic signals, then RFID installed at the traffic signal tracks the RFID tagged ambulance. It sends the data to the cloud after the acknowledgement for the user through the mobile app. The particular signal is made green for some times. After the ambulance passes by, it regains its original flow of a sequence of signalling. This scheme is fully automated, it finds the ambulance spot, control traffic lights. The microcontroller based RFID system is used to alter the traffic lights. This system controls the traffic light and saves time in emergency periods. Thus it acts as a lifesaver project.

Next one is a smart traffic control system using image processing. This project is implemented using mat lab software. The image processing technique is used here. First, the image is captured by using a camera. The web camera is placed in a traffic lane. Images are processed to know the traffic density. According to the data, the controller will be sent the command to the traffic LED s to show a particular time on the signal. If the number of cars exceeds a specific threshold, warning of heavy traffic will be shown automatically. Here we use a microcontroller, traffic signal, buzzer, IR sensor, camera and ICD display. The advantage of image processors over sensors are low cost, easy setup and relatively good accuracy and speed. Production cost is low than other techniques.

Another system represents the modern traffic control system. This system proposes the concept of intelligent management of traffic control. In this paper, we introduce fuzzy logic in the solution of traffic control. With the help of fuzzy logic, we are going to set some rules which depend on two factors: Number of vehicles and the rate of vehicles approaching towards traffic signal poles. According to the rules, the timer is set. Simulation is done in the Mamdani fuzzy interference system. CCTV cameras are used to give a clear vision of the road. Neural network and fuzzy system are dynamic parallel processing systems that estimate input-output functions. They estimate a function without any mathematical model and learn from the experience. This technique is implemented by using two sensors to give input to the fuzzy interference system. Sensors used are an acoustic detector and Doppler radar microwave sensors. The acoustic detector detects the vehicles on the basis of sound generated by the vehicles as it passes the sensor. The sensor is mounted on the poles which are pointing down towards the traffic. It can collect one or more lanes. Doppler padar microwave sensors are used for detecting distant objects and speed and their position. Both are installed on the pole 150 meters away from the traffic signal. Vehicles are counted on basis of sound generated from the vehicles. This serves as an input for a fuzzy interface system. According to the set rule in the fuzzy system, the timer is set. For set timer the car allowed to move from side 1 and 3 that is, north and south at that time sensor count the vehicles on side 2 and 4. This help to solve traffic congestion in many cities. Most of the traffic control system is based on fixed time. The fuzzy logic toolbox has a GUI.

3. PROPOSED SYSTEM

The system that we are proposing involves the counting of cars entering and leaving a specific lane. This involves the placement of two individual computer vision systems, as mentioned in the previous chapter. They will be responsible for counting the cars entering a specified region and this will be calibrated manually since all lanes are not of the same dimensions. This data will be used to measure the number of cars present in a lane at any given time. Number of cars in lane = Cars Entering the lane – Cars Leaving the lane.

The Software requirements, in this case, may vary. The library used here is OpenCV. The IDE is Qt and the language used here is C++ and python. The Operating System for this purpose is Windows XP/7/8/10. Hardware Requirements are as follows. The microcontroller used here is Arduino Uno. The compiler is Turbo C. RAM is of 512 MB. Hard Disk size is 40 GB. The camera is 2 Megapixel. Also, we are including Bluetooth and an LCD Projector

3.1 Helmet detection

(a)Training:

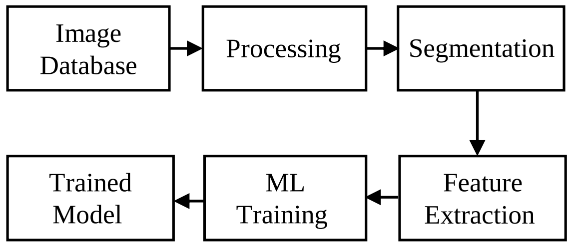

Fig. 1: Training process

From the above block diagram segmentation, feature extraction, machine learning training are based on cascade classifier which contains two methods, which are viola Jhones-Haar features and Adaboost learning method.

Cascading is a particular case of ensemble learning based on the concatenation of several classifiers, using all information collected from the output from a given classifier as additional information for the next classifier in the cascade. Unlike voting or stacking ensembles, which are multi-expert systems, cascading is a multistage one. After the classifier is trained it can be applied to a region of an image and detect the object in question. To search for the object in the entire frame, the search window can be moved across the image and check every location for the classifier. This process is most commonly used in image processing for object detection and tracking, primarily facial detection and recognition.

(b) Validation:

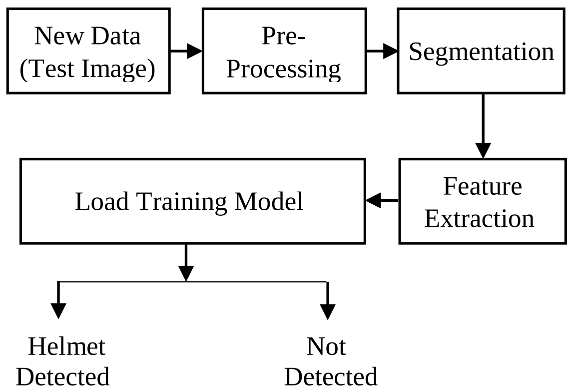

Fig. 2: Validation process

(c) Vehicle Detection

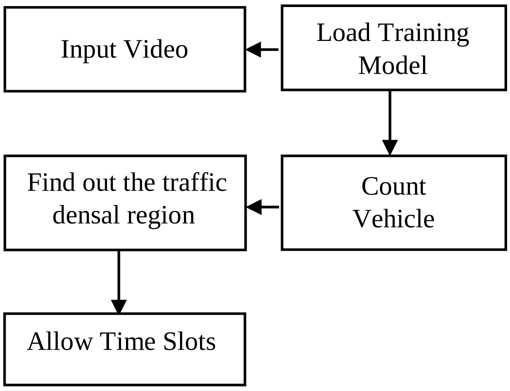

Fig. 3: Vehicle detection process

3.1 Components required

3.1.1 Library-OpenCV: OpenCV is written in C++ and its primary interface is in C++, but it still retains a less comprehensive though extensive older C interface. There are bindings in Python, Java and MATLAB/OCTAVE. The API for these interfaces can be found in the online documentation. Wrappers in other languages such as C#, Perl, Ch, Haskell and Ruby have been developed to encourage adoption by a wider audience. All of the new developments and algorithms in OpenCV are now developed in the C++ interface. If the library finds Intel's Integrated Performance Primitives on the system, it will use these proprietary optimized routines to accelerate itself. A CUDA-based GPU interface has been in progress since September 2010. An OpenCL-based GPU interface has been in progress since October 2012, documentation for version 2.4.13.3 can be found at docs.opencv.org.

3.1.2 IDE- Qt: The Metaobject compiler, termed moc, is a tool that is run on the sources of a Qt program. It interprets certain macros from the C++ code as annotations and uses them to generate added C++ code with Meta information about the classes used in the program. This Meta information is used by Qt to provide programming features not available natively in C++: signals and slots, introspection and asynchronous function call.

3.1.3 Arduino Uno: The Arduino Uno is an open_source microcontroller broad based on the microchip ATmega328P microcontroller and developed by Arduino.c.c. The board is equipped with sets of digital and analogue input /output pins that may be interfaced to various expansion board (shields) and other circuits. The board has 14 digital pins, 6 analogue pins, and programmable with the Arduino IDE (integrated development environment) via a type B USB cable .it can be powered by a USB cable or by an external 9-volt battery, though it accepts voltages between 7 to 20 volts. It is also similar to the Arduino Nano and Leonardo.

3.1.4 Bluetooth: It is a wireless technology standard for exchanging data over short distances using short-wavelength UHF radio waves in the ISM band from 2.400 to 2.485 GHz from fixed and mobile devices, and building personal area networks (PANs). It was originally conceived as a wireless alternative to RS-232 data cables.

Bluetooth is managed by the Bluetooth Special Interest Group (SIG), which has more than 30,000 member companies in the areas of telecommunication, computing, networking, and consumer electronics. The IEEE standardized Bluetooth as IEEE 802.15.1, but no longer maintains the standard. The Bluetooth SIG oversees development of the specification, manages the qualification program, and protects the trademarks. A manufacturer must meet Bluetooth SIG standards to market it as a Bluetooth device. A network of patents applies to the technology, which is licensed to individual qualifying devices.

3.1.5 LCD projector: It is a type of video projector for displaying video, images or computer data on a screen or other flat surface. It is a modern equivalent of the slide projector or overhead projector. To display images, LCD (liquid crystal display) projectors typically send light from a metal-halide lamp through a prism or series of dichroic filters that separate light to three polysilicon panels – one each for the red, green and blue components of the video signal. As polarized light passes through the panels (combination of the polarizer, LCD panel and analyzer), individual pixels can be opened to allow light to pass or closed to block the light. The combination of open and closed pixels can produce a wide range of colours and shades in the projected image.

4. CONCLUSION

We divided our thesis work into two parts. At first, we have successfully detected moving vehicles from video input. We discussed our work step by step in this paper. We briefly described the functions which are necessary for real-time computer vision. However, due to inadequate datasets of the variant vehicles in Bangladesh, we could not approach the SVM method which could yield a more accurate result. We managed to collect a dataset of other countries which didn't work on the video sample we used, due to a different model of cars. The next part was about dynamic traffic control. Number of cars in a specific region will be calculated by the difference between entering and leaving vehicles. Then we calculate the density at any intersection point by dividing the number of cars in that lane by the length and width of the lane. We set logic for controlling the traffic signals by setting some rules. While working in the detection part, we noticed detecting vehicles at night was not very accurate. Our system can detect an object when there is a sufficient amount of light. We are looking forward to fixing the problem in future. Priority was given to emergency vehicles. We plan to provide separate priority for emergency vehicles in future. In order to get a better result, our future work includes, collecting datasets and models of all type of vehicles. Once they are collected we can train the model to give better detection capability.

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