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Automatic Detection and Counting of Vehicles Based on Image Processing

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Abstract: ***When a driver enters a certain parking area, the driver takes a long time to find an available parking space. Design and implementation of a system for image based automatic detection and counting of vehicles has been developed to solve the problem that the drivers faced with low cost. This system uses image processing techniques. First, the type of vehicle that enters the lot is detected and it is directed to their corresponding location. Also this system uses the image of parking lot to count the number of vehicles that are present in the parking area and displays it at the entrance. This system is implemented using MATlab simulation with Artificial Neural Network (ANN) and it will give information about the location of available parking space and the number of available parking space. This information will be very beneficial to all the drivers when entering a parking lot.***

Keywords: Image processing, ANN, MATlab,Gaussian mixture model

1. Introduction

In metropolitan areas, the occurrence of traffic jam is very high. People are facing many problems to find an available parking space due to the tremendous increase of occupancy of cars. The analogy is when a driver enters a certain parking area, the first thing that the driver do is looking forward of some sign to telling that the parking lot is fully occupied, partly occupied or vacant. The driver also do not know how many are there and where to find a parking division for his/her car. Some of the parking divisions may remain unoccupied even the total occupancy is high. This will cause ineffective use of parking divisions as well as traffic jams around the entrance of parking lot. Therefore, offering drivers with relevant information on the parking lot while entering a parking lot becomes an important issue.

The proposed system is known as "Design and implementation of a system for image based automatic detection and counting of vehicles". This system uses Image processing techniques. This system proposes a method for detecting the type of vehicle at the parking entrance and directs it. Also, based on the image captured from the parking area, the system processes it and counts the number of vehicles and displays the information at the parking entrance.

2. Literature Review

In Thomas Moranduzzo*et al* [1] this paper presents among fast growing remote sensing technologies, one can find Unmanned Aerial Vehicles (UAVs) for research and investigation activities revolving around object detection problems. UAVs have been initially developed for military purposes, but thanks to their great potential they have started to be used also for civilian applications. UAVs are small aerial platforms equipped with automatic positioning and stabilization systems.

These vehicles present several interesting characteristics, i.e., they are electric, ecologic, silent, safe, flexible, and customizable. Thanks to UAVs, observing and monitoring the Earth has become easier and faster because they can reach an area of interest in very short time. An UAV can be equipped with different imaging sensors depending on the desired application. Nowadays, the main areas, in which UAVs are exploited, range from environmental monitoring to land surveillance. Despite their great potential, these vehicles present some problems especially related to the control procedures and to the information acquisition. In, an object-oriented image analysis method to detect and classify road vehicles from airborne color digital ortho imagery at a ground pixel resolution of 20 cm is adopted. In, the problem of vehicle detection with UAV images is faced by combining a fast detection process with a classification stage. In this paper, we propose an alternative method to detect cars for very high resolution images (2 cm) acquired by means of an UAV sensor. It begins with a screening step of asphalted zones in order to restrict the areas where detecting cars and thus to reduce the probability of false alarms. Then, we perform a feature extraction process based on scalar invariant feature transform (SIFT) thanks to which a set of consistent key points is identified. The algorithm then aims at the classification of these key points, namely at discriminating between the points which belong to cars and all the others, by means of a support vector machine (SVM) classifier. The last step of our procedure is focused on the grouping of the key points belonging to the same car in order to get a "one key point–one car" relationship. At the end of the procedure, the number of cars present inside the scene is given by the number of final key points identified.

The main differences between our method and those available in the literature are as follows:

1) the car detection and description mechanisms;
2) our method is invariant to the car orientations;
3) it associates several pointers with the same car making the detection process more robust but requires a merging operation;

4) it allows handling occlusion problems due to shadows or trees for instance;
5) it combines the detection process with a screening operation of the asphalted areas;

In FaridMelgani, *et al* [2] proposed a system The last decade has been characterized by attempts to create urban environments that are more and more eco- logically sustainable. One of the points on which a great number of local municipalities have directed their attention concerns the problem of transportation systems. Being able to constantly monitor the concentration of vehicles inside urban environments allows preventing problems tied to traffic jams and congestions and consequently allows limiting the problem of air pollution. Moreover, problems connected to surveillance could be faced by estimating the number of cars inside parking lots or along specific roads. The advent of unmanned aerial vehicles (UAVs) has permitted to combine the necessity to continuously monitor precise urban areas with the possibility to do it in a completely ecological manner.

Initially developed only for military purposes, these acquisition systems in the recent years have started to become established also for civilian aims. UAVs are small, ecologic, and silent aerial platforms which allow collecting images from a very low altitude and only when it is necessary. Acquired images from a low altitude describe the objects present in the analyzed areas with an extremely high level of detail. In this way, all the objects which belong to the same class (e.g., vehicles) appear to be very different, and consequently, the detection of entire classes becomes particularly challenging. In the current literature, one has the possibility to find several car detection techniques which mainly exploit low resolution images, and many of them are based on satellite imagery. Satellites allow observing very wide areas, but they lack spatial resolution with respect to airborne or UAV platforms. In, the authors propose an approach to detect cars from optical satellite images. By using Haar-like features, they aim at detecting single vehicles and queue of vehicles from which single cars are identified by means of line extraction technique.

In Katy Blumer*et al* [3] this paper focus onIn crowded cities, the problem of finding an empty parking space can be so dominant that it often enters everyday conversations of citizens. A driver often has to search for several minutes in order to find an empty parking spot close to his intended destination and sometimes after spending enormous amount of time searching in parkinglot, the driver realizes that there is actually no space available. In many cases, the projected future does not seem to be more attractive: with rapid increase in populationsize in many cities, parking spaces are getting filled up fast so that the above situationcan only deteriorate further, if no ingenious solutions are found and applied. Furthermoreit is estimated that the part of city traffic generated by the vehicles looking for a space could represent from 5 to 10% of global traffic – translating to huge losses.

Thus, suppression of searching time is an important goal to be pursued. Even more so, this is an important goal, in light of the fact that the current unfortunate state of affairs, Has multiple side effects: First of all, driving in circles around the parking lot to find any empty space is time consuming with – and millions of man hours are spent globally. Second, gasoline and diesel fuel is consumed from the act of examining all the spaces in a parking lot; it is a waste of natural resources and also adds to air pollution and other forms of environmental degradation. And third, this situation causes traffic accidents and frustration for the driver. As a further consequence of these problems, during peak hours, A driver might become tempted to park in authorized areas – which in turn can intensify Traffic problems even further. On the positive side, there do exist many ways this problem can start to be tackled: for example, assigning fixed parking numbers, toll parking, valet parking etc. However, in practice, and even more so when routes are not Highly regular, such methods are very inflexible and can be highly inefficient.

3. Proposed System

3.1. Image Processing

Image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Image processing usually refers to digital image processing, but optical and analog image processing also are possible. This article is about general techniques that apply to all of them. The acquisition of images (producing the input image in the first place) is referred to as imaging. Image defects which could be caused by the digitization process or by faults in the imaging set-up (for example, bad lighting) can be corrected using Image Enhancement techniques. Once the image is in good condition, the Measurement Extraction operations can be used to obtain useful information from the image.

Each pixel in the image is stored as a number from 0 to 255, where 0 represents a black pixel, 255 represents a white pixel and values in-between represent shades of grey. In a (8-bit) greyscale image each picture element has an assigned intensity that ranges from 0 to 255. A grey scale image is what people normally call a black and white image, but the name emphasizes that such an image will also include many shades of grey.

4. Block Diagram

This is the block diagram of the designed system. There are two processes that are carried out in this system. First, the input image of car/bus is pre-processed and the vehicle is identified and directed to their location. Then the image of the parking lot is processed and the counting of vehicles is performed.

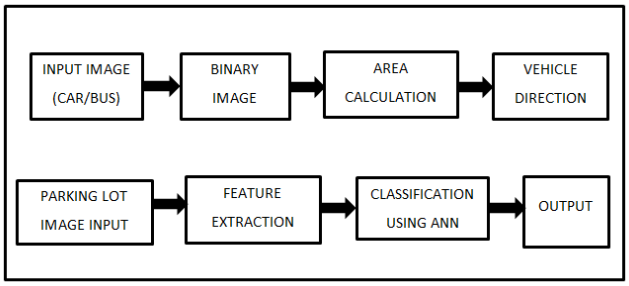

Figure 4.1: Block Diagram OfObject Detection System

In this system, the input image used is the image of the different types of vehicles used in the parking setup. Here, the vehicles that have been used are the Cars and Bus. Hence the input image involves the images of Cars and Bus. First, the input image is fed as an input to the system. Then by using Image processing techniques, the colored input image is converted into black and white image and then processed.

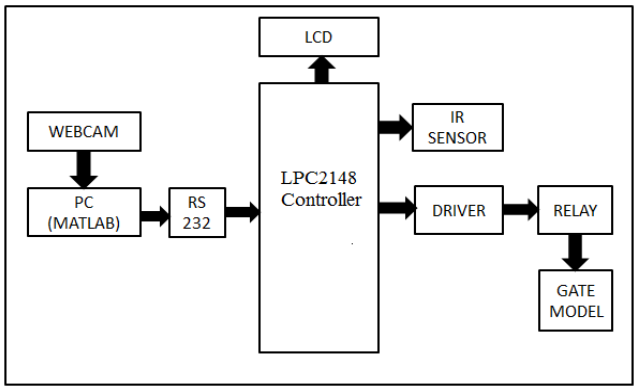

Figure 4.2: Block Diagram of Hardware System

4.1Power Supply Unit

A power supply is an electronic device that supplies electric energy to an electrical load. The primary function of a power supply is to convert one form of electrical energy to another and, as a result, power supplies are sometimes referred to as electric power converters. Some power supplies are discrete, stand-alone devices, whereas others are built into larger devices along with their loads. Examples of the latter include power supplies in desktop computers and consumer electronics devices. Every power supply must obtain the energy it supplies to its load, as well as any energy it consumes while performing that task, from an energy source.

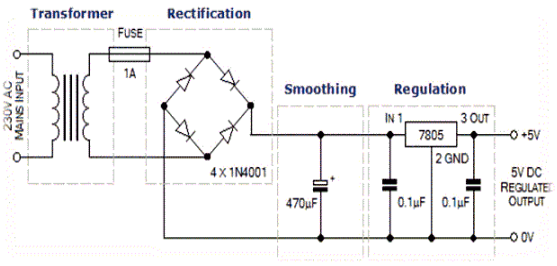

Figure 4.3: Power Supply Unit

4.2 LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; Easily programmable; have no limitation of displaying special and even (unlike in seven segments), animations and so on.A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc.

Figure 4.4: 16x2 LCD Display

The LCD display units data pins D4 to D7 are interface to the port are p0.16 to p0.19 of the controller for data receiving and controlling process. The interfacing ports are getting the data and display to the LCD display. RS-Reset pin interface to the port of p1.16 and EN-Enable pin interface to the port of p1.17.the read and write pin are connecting to the ground. Using the reset enable pin is used to display the receiving data.

4.3 LPC2148 Controller

LPC 2148 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine the microcontroller with embedded high-speed flash memory ranging from 32 kb to 512 kb. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 percentageswith minimal performance penalty.In-System Programming/In-Application Programming via on-chip boot Loader software. Single flash sector or full chip erase in 400 ms and programming of 256 B in 1 ms.Embedded Trace interfaces offer real-time debugging with the on-chip Real Monitor software and high-speed tracing of instruction execution.USB 2.0 Full-speed compliant device controller with 2 kb of endpoint RAM.

In addition, the LPC2148 provides 8 kb of on-chip Random Access Memory accessible to USB by Direct Memory Access.One or two 10-bit ADCs provide a total of 6/14Analog inputs, with conversion times as low as 2.44 ms per channel. Single 10-bit DAC provides variable analog output.Two 32-bit timers/external event counters (with four capture and four compareChannels each), Pulse Width

Modulation unit (six outputs) and watchdog.Low power Real-Time Clock with theIndependent power and 32 kHz clock input.The LPC 2148 incorporate a 32 kb, 64 kb, 128 kb, 256 kb and 512 kb flash memory system respectively. This memory may be used for both code and data storage. Programming of the flash memory may be accomplished in several ways. It may be programmed In System via the serial port. The application program mayalso erase and/or program the flash while the application is running, allowing a great degree of flexibility for data storage field firmware upgrades, etc. Due to the architectural solution chosen for an on-chip boot loader, flash memory available for user's code on LPC 2148 is 32 kb, 64 kb, 128 kb, 256 kb and 500 kb respectively.

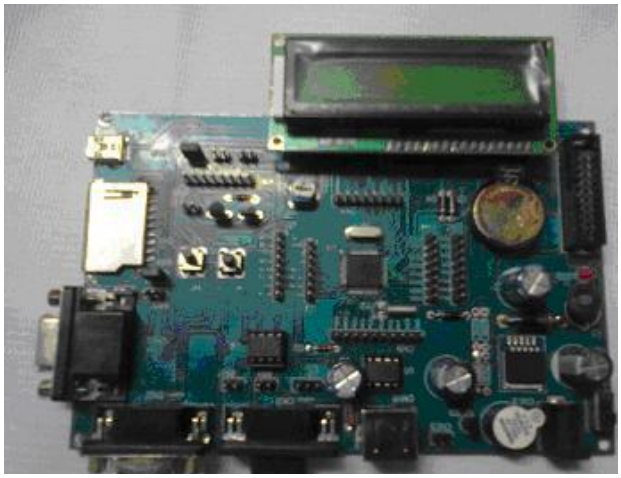

Figure 4.5: LPC2148 Controller

reality. In a practical device, the contacts are never perfectly aligned, so each switches at a different moment.

5. Working Model

The working model of the system is presented In this project I demonstrate the automatic vechicle detecting and counting system. In this project I used LPC 2148 ARM based microcontroller programmed in keil uvision4 compiler. The analogy is when a driver enters a certain parking area, the first thing that the driver do is looking forward of some sign to telling that the parking lot is fully occupied, partly occupied or vacant. The driver also do not know how many are there and where to find a parking division for his/her car. Some of the parking divisions may remain unoccupied even the total occupancy is high. This will cause ineffective use of parking divisions as well as traffic jams around the entrance of parking lot. Therefore, offering drivers with relevant information on the parking lot while entering a parking lot becomes an important issue.

6. Implementation Environment

MATLAB (matrix laboratory) is a multi-paradigm numerical computing environment and fourth-generation programming language. Developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of use interfaces, and interfacing with programs written in other languages, including C, C++, Java , Fortran and Python.Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing capabilities. An additional package, Simulink, adds graphical multi-domain simulation and Model-Based Design for dynamic and embedded systems.MATLAB users come from various backgrounds of engineering, science, and economics. MATLAB is widely used in academic and research institutions as well as industrial enterprises. MATLAB supports developing applications with graphical user interface features. MATLAB includes GUIDE (GUI development environment) for graphically designing GUIs. It also has tightly integrated graph-plotting features. MATLAB's support for object-oriented programming includes classes, inheritance, virtual dispatch, packages, pass-by-value semantics, and pass-by-reference semantics.The MATLAB application is built around the MATLAB language, and most use of MATLAB involves typing MATLAB code into the Command Window or executing text files containing MATLAB code, including scripts and/or functions.

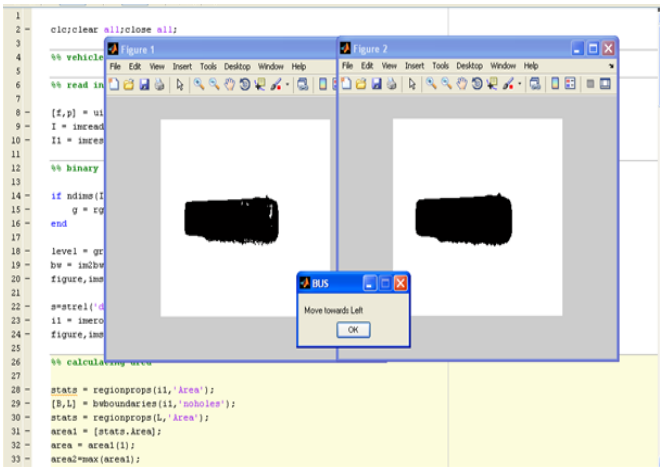

Figure 6.1: Simulated output to direct bus

When a bus approaches the parking area, its image is processed and it is converted into a grey scale image. The white area is calculated and based on the obtained area, the system identifies it as a bus and directs it towards the left.

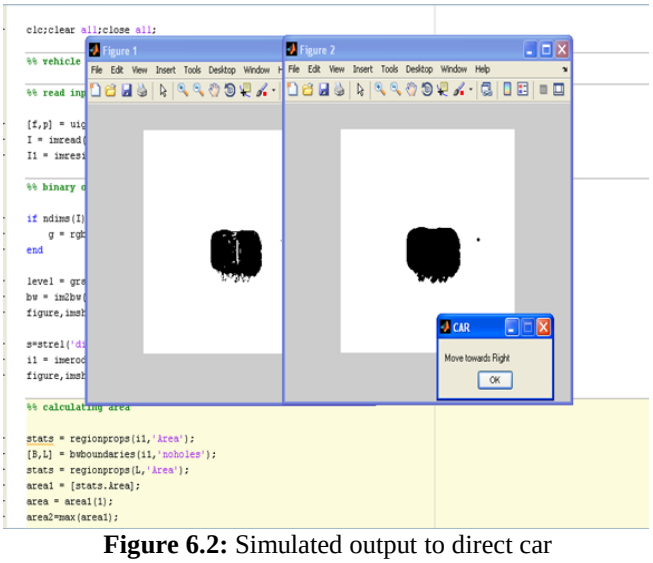

Figure 6.2: Simulated output to direct car

When a car approaches the parking area, its image is processed and it is converted into a grey scale image. The white area is calculated and based on the obtained area, the system identifies it as a car and directs it towards the right.

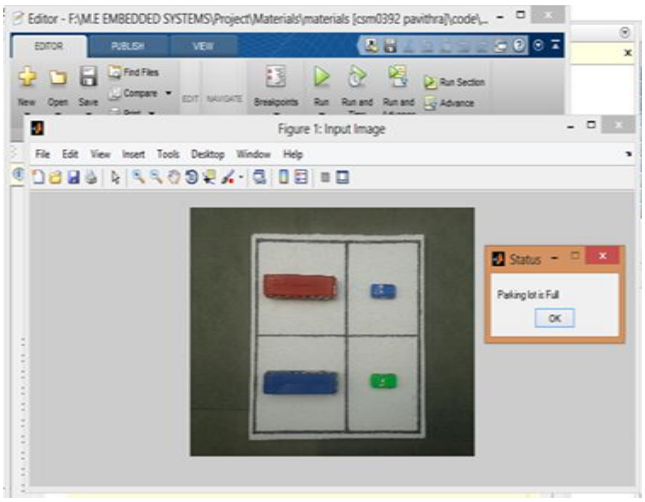

Figure 6.3: Simulated output when parking area is full

When the image of the parking area that is fully occupied is given as an input to the system, the system processes the image in Matlab and displays that the parking area is full.

7. Conclusion

A system has been designed for automatically detecting and counting the vehicles at the parking area. The working of this system proves efficient for the developed prototype model of the parking system involving the parking lots for four vehicles, two for parking cars and the remaining two for parking buses. This system will be beneficial for the usage in the institutes which involves the parking of cars and buses.

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