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Research on Smart Car Auto-Imagine Processing System Meeting Traffic Light Based on IN-RE

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ABSTRACT*: This article tackles the problem of the autonomousimagine processing and coordination of multiple driver-less vehicles for the transport of persons or goods in outdoor environments. The system composed of fully automated road vehicles, capable of providing an effective transportation service, was recently tested at the city of wen-hui road in shanghai..This same system was further improved, and automatic braking technology is based on multi-sensor data fusion, in order to demonstrate the validity of the concepts for a coordinated navigation in the presence of ambiguous and conflictual situations in a mixed environment, which perceived traffic light distribution, distance and other information mainly through the plurality of sensors mounted intheir ownbody, then carry out the corresponding braking behavior. The originality of the approach relies on the use of new cooperative concepts and their combination with advanced perception tasks operating simultaneously on IN-RE robots, but there are no reports of a system which would model the suitable strategy for the purpose of autonomously driving a car. The paper describes a automaticbraking system about traffic light cancorrectly completetheobstaclebraking behavior, meetthe requirements of the smart car automatic braking solved someproblemsincurrent problem of running a red light, in order to achieved the desired target in the traffic.*

Keywords*: intelligent interaction,traffic light,image identification,control* algorithm

I. INTRODUCTION

The main objective of the project was to design and develop new advanced concepts for efficient to intelligent vehicle.Automatic avoidance system take advantage of the surrounding environmental information by sensoracquisition, to perceive the function of surrounding operating environment, and have some adaptive capability, according to the given mean that completing the correspondingly the operation of complex.Automatic obstacle technology is a prerequisite for smart car movement carried research can imagine system is to achieve smart car automatically avoid running a red light. In recent years, increasingly imagine algorithm, obstacle avoidance's strategies all to improve the accuracy of the intelligent car can real-time to control thetraditionalcarcan force direction usually forward intelligent, automated, functional diversification, strong environmental adaptation. The car information collection system using a single ultrasonicPlus steering gear rotatably sensor front of the front gathering information, without considering the information on both sides of the body, and the rotation of the steering gear required to time, so this design presence information collection is not comprehensive, low efficiency, it can not collect real-time information and other defects[1].Automatic collision avoidance system to achieve movement and many other tasks to complete the foundation, but the automatic obstacle avoidance is a measure of the level of their intelligence level of a indispensable key performance indicators. Avoidance technology can improveIntelligent vehicle movement stability and flexibility[3], and superior performance of automatic obstacle avoidance technologies make the car can not adapt with engineering background and more areas.

Estimated distance is alsoused to enhance detection results, excluding a large number offalse detections in tracking stage. The system achieves positiveresults at different vehicle urban speeds, using a pick-up head on the IN-RE.Through ground truth provided by an integrated laser scanner inour test platform, our method has been able to detect suspendedtraffic lights from 50 to 5 m. The detection results are validatedusing more than one hour of videoand the distanceresults are validated with 2700 correct detections[2]. A digital mapof the studied area on the MATLAB could help to reduce some false positives andto save processing time: a first test using a map has been alreadycarried out. Computational times have been reduced by paralleliz-ing the method functions to achieve the real time processing.

The paper is structured as follows: A summary of the closestrelated works is given in Section 2. Section 3 describes the imagine used MATLAB in our experiments, present the methodology usedfor traffic light detection and distance approximation. Section 4 shows the results obtained .

II. IN-REWheeled mobile robot

IN-RE is Shanghai's future partner robots limited development of wheeled mobile robot for teaching and research.In this study, the wheeled mobile robot platform for experiments, the use ofC++ languages under the dynamic work environment no one drove.Drive automatic obstacle-avoidance program guide a wheeled robot to the target point, complete theIN-RERobot DynamicsUnder automatic obstacle-avoidance experiment.

2.1.The construction of IN-REWheeled mobile robot

IN-REWheeled mobile robotCOM component technology, able to use the software development kit (SDK）Supported interfaces to complete preparation of simulation studies of a single program.IN-REBasic functional modules, including image acquisition modeBlock, a sonar ranging module, network, system, data acquisition, image processing, motion control module module voice acquisition andrecognition modules[5], and so on.Figure -2

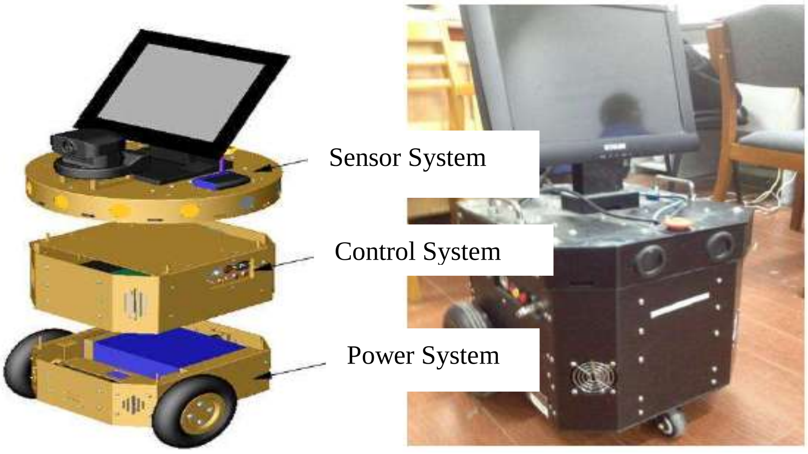

Fig -2IN-RE unmanned vehicle graphic and entity diagram

2.2 Basic parameters of IN-RE mobile robot

IN-RE unmanned vehicles three dimensional diagram and entity diagramFig-1 IN-RE unmanned vehicle graphic and entity diagram in Figure-1, The left is the use of three-dimension modeling software of the wheeled mobile robot, is divided into three systems, Sensing systems, control systems and power systems, is a robotic entity graph on the right.IN-RE Intelligent mobile machines People are driven by a motor, two relatively larger wheels are driving wheels, front steering wheels, used in this experiment IN-RE Intelligent mobile robot on behalf of driver-less cars, table-1 ,is IN-RE the basic parameters of mobile robots.

Title	Trait	Parameter
	Length	455 mm
	Wide	470 mm
Body	High	380 mm
	Weight	36 kg
	Load	30 kg
	Material	4 mm ardal
Power	Battery	24 V lead-acid cell
	Power Supply	27 V
	Run Time	2 h

Table -1 Basic parameters of IN-RE mobile robot

Ⅲ. IMAGINE PROCESSING AND RECONGI

Detection and identification of the traffic lights are the core of any signal recognition system, are no substitute for two modules[6]. Detector input images collected by the cameras, the output image may contain lights regions, completed a segment from the whole image containing the capabilities of the target area. As described in chapter II, the detectors are used by the system of classification based on color, but in order to improve the real-time, using the sampling method low resolution. Traffic light recognition is the essence of classification of binary pattern, shape into circles, arrows or other non-light patterns in different directions[4]. Through the various pattern recognition algorithms can include attributes. This classification is used by the system design based on Computational geometry. Below detection and recognition algorithms used in this system.

3.1 detection algorithm based on color classification

The signal recognition system using the camera's resolution is 6 million (2736x2192). Due to the installation of lights is located at location high above the horizon, and the camera horizontally, so in practical use, the image of the region of interest for the upper part of the image, about 3 million pixels (2736x1096). If you are using a colour classifier classifies each of 3 million pixels directly, and will take a lot of computing resources, algorithms in real time will be greatly affected. In the test, this topic uses the images down-sampling algorithm, first reduce the image resolution. Then use color categories to classify pixels in an image, which can be divided into four red, yellow, green, and other colors. The color classification used in this topic is based on HSV color space, In this way, the classifier is a linear classifier.

3.2 Imaging Processing

In order to improve the algorithm in real time, reduce the processing burden of the subsequent color classifier. Firstly, the image down sampling, reducing the resolution. Similarly, real-time considerations[5], here is the most simple sampling algorithm, that is, equal interval sampling method. The original image is $I(u,v)$, where $0 \leq u < W$, $0 \leq= v < H$, two directions of sampling intervals were $STEP_u$ and $STEP_v$ and under sampling in the image I_{ds} can be expressed as:

$$I_{ds}(i,j) = I(i * STEP_{u,}, j * STEP_v)$$

Which,respectively meet $0 \leq i \leq [W / STEP_u]$ isless than or equal to $W / STEP_u$ and $0 \leq= v \leq [H / STEP_v]$ is less than or equal to $H / STEP_v$. So can the resolution $W * H$ of original image narrowed to $STEP_u * STEP_v$. In unmanned vehicle platforms in the actual operation of the algorithm, the sampling interval is selected for the four pixels[8]. The full resolution image of a region equal interval sampling position. By such sampling can be about three million pixel image reduced to the original one sixteenth of the obtained new image resolution of about 370000 684x548. the original first after take part as region of interest, the resolution is reduced to half of the original. After sampling, with a resolution down to 1 / 32 of the original.

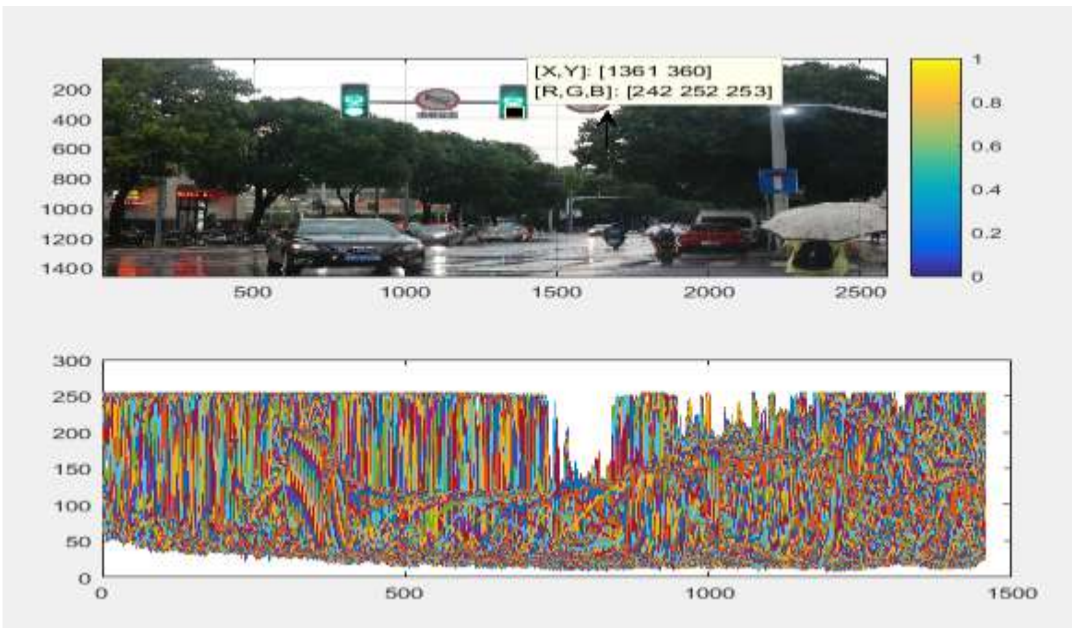

Fig -2image of a region

Original image captured by the camera is in the RGB color space, the RGB color space can correspond to the principle of human vision imaging, accurate representation of visual perception of color. But a certain color need RGB three quantities can be determined for R, correlation exists between the G and B three quantities. Relative, HSI color space is the color space according to hue (corresponding to h, hue), saturation (corresponding to the s, saturation) and bright (correspondingto I, Identify decomposition). The so-called hue to determine the kinds of colour, answer is what color. The so-called saturation to determine the purity of color. So-called brightness to determine the color brightness. Hue value is 0 degree to 360 degree of cyclical, saturation and brightness range is 0 to 1.And under the requirements of the national standard, in each lane are suitable intensity of traffic signal lamp is within sight of the right angle. In such a situation, the camera will often be able to collect full color, bright brightness signal lamp image.Due to the self luminous objects, such as the introduction of analysis[8], lamp panel chromaticity and brightness GB do clear requirements for traffic signal lamp panel. And under the requirements of the national standard, in each lane are suitable intensity of traffic signal lamp is within sight of the right angle.

Image from the capture to transmission and transformation process, resulting in reduced quality of phenomena in order to improve image quality, enhanced visual effects and image enhancement in early, there are spatial enhancement and enhancement in frequency domain methods, spatial enhancement methods including: gray-level transformation, histogram equalization, etc. Frequency enhancement methods including frequency domain low-pass and high-throughput image processing in frequency domain gray in gray-scale transformation by changing the image's dynamic range, enhancing image details, achieve the purpose of enhancing image[7]. Histogram balanced of is in gray transform Hou for of gray approximate uniform processing, main used cumulative distribution function do transform function. image color of recognition is existing image recognition system in the most basic of method, color of said by color space of select decided, common color model is RGB three color model, collection to image Hou first on image for classification, ring and track information through color for recognition, not for follow-up of operation, Chess images and other images directly from gray-scale transformation of robot images for later identification, you can speed up the process. MATLAB's function rgb2gray () can be collected directly convert RGB color images to grayscale images, parameters for the color image you want to convert, rgb2gray () conversion formula is RGB=0.2989*R+%0.5870*G+0.1140*B, gray, then use imhist () function will gray image histogram display[9].

Fig -3 Imagine Enhancement Processing diagram

3.3 Basis theory of compressive image

Compressed image theory pioneered by people such as the year it was based on a new architecture, in which framework the sampling rate of the signal below the Nyquist sampling and reconstruction of sparse signals with high probability. This compression and sampling way of combining together brings a new benchmark for signal processing. Compressed sensing over the past few years a great deal of attention, not just in the field of information theory, in mathematics, computer science, electrical engineering and communication have greatly developed in many fields. A compressed image system consists of two parts: the measurement of compression and reconstruction. Product can measure is the original linear projection to a set of unrelated high-dimensional signal based on vector, get a set of low-dimensional measuring signal and complete compression and sampling process. The reconstruction process is the receive signal from the signal after compression measurement process. Sparse signal reconstruction algorithm for solving non-linear equation of a process. This equation is usually a difficult issue. Only measurement matrices and sparsity of the original signal to meet certain conditions, measurement signal can be accurately reconstructed. This section will be sparse signal, compression measurement processes, conditions of reconstruction and the reconstruction process is introduced. Finally, the theory of compressive sensing compared with the traditional process of this product [7].

For band-limited signals the Nyquist sampling rate determines the bandwidth. When the signal does not use its bandwidth when deciding on all degrees of freedom, reduce the sampling rate will become feasible. Sparse signal for such a signal, it uses the content and structure of the signal, which can be expressed in the appropriate base through a few meaningful expressed as a coefficient[6]. If a signal can be non-zero coefficient k says the signal is said k sparse. If signal $x \in C^N$ have K non-zero value, the sparse signal can be represented as $P = K / N$. Usually when $K << N$ or $p << 1$, the signals are called sparse. For a finite discrete signal itself does not have a sparse attribute $a[n]$, when it has sparse under certain radical transformation when it becomes thin. This process of transformation to a sparse matrix is often called transform coding, has a wide range of applications in coding. Orthogonal basis assuming a under the sparsity $\{\Psi_1, \Psi_2, \Psi_3 \ldots\ldots\ldots\}$, you have transformed the establishment.

$$a = \sum_{i=1}^{N} x_i \Psi_i \tag{1}$$

In the last $x = \{x_i\}_{i=1}^{N}$ is a sparse signal. When using matrices said when the transformation matrix $\{\Psi_1, \Psi_{2,} \ldots\ldots\ldots\ldots \Psi_N\}$, you have set up.

$$a = \Psi x \tag{2}$$

Sparsity is usually determined by the norm l_0 , Norm is defined as the vector the number of nonzero coefficients: $\sup p(x) = \{i \mid x_i \neq 0\}$.

$$K = \| x \|_0 = | \sup p(x) | \tag{3}$$

Norm l_0 can be defined by the Fukushima Daiichi unit norm l_p , and norm l_p by type definition, which $p \in [1, +\infty)$.

$$\lim_{p \to 0} (\| x \|_p)^p = \| x \|_0 \tag{4}$$

$$\| x \|_p = (\sum_{n=1}^{N} | x_n |^p)^{1/P} \tag{5}$$

Natural signals are usually not sparse, even under the unrelated radical is not a perfectly sparse but sparse. These signal sparse matrix representation, their amplitude descending often decay quickly, such a signal is called compressible signals. This means that these natural signals can use a few sparse representations of signals and the other approximately close to zero value[6]. Produced by these non-zero values close to zero errors can usually be ignored.

IV. CONCLUSION

Paper proposed has a traffic lights recognition system of schema, this schema will lights detection device get of candidate regional as a is on lights of observation. specific algorithm by MATLAB programming achieved, algorithm thought clear, and operation simple, and reliability strong, and transplant sex strong, but also exists insufficient, like, dang analysis large data Shi, need through modified poly class times to reached classification effect, then minimum distance guidelines algorithm has cannot precise of for analysis, here still needed improve improved. In order to predict increase in vehicles near the lights, the task ahead is to design lights location algorithm for real-time operation, to support the model.

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