Pedestrian Detection Method Based on Neural Network and Data Fusion

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Abstract: Pedestrian detection is a research topic that has attracted much attention in computer vision, and it has a wide range of applications in many occasions such as public safety, scene monitoring, and traffic operations. The purpose of this article is to use neural network and data fusion technology to detect pedestrians and improve traffic safety. This article first analyzes the pedestrian detection technology based on neural network and data fusion, and summarizes the basic knowledge of convolutional network applications from four aspects: network structure design, loss function design, regularization method and optimization strategy; Take handwritten digit recognition as an example. It focuses on comparing the differences between different variants of gradient descent optimization algorithms. It uses many of the most popular algorithms, applies graph theory and ID3 algorithms, and uses post-pruning techniques to implement classification decision trees. The classification rules are generated, and the application scenarios under the fusion of neural networks and data are completed. The classification decision tree model is constructed. Secondly, based on the leading methods in the target detection field, based on the summarized design criteria and the scale characteristics of pedestrians, adjusted The anchor window setting of the network and the area generation network method have added the environment area pooling layer. Then based on the open source deep learning framework, the network is implemented on the pedestrian data set. The experimental results show that this method can achieve efficient pedestrian detection. According to the statistical results, the detection efficiency has reached 90%.

1. Introduction

In recent years, with the rapid development of science and technology, computers have played an increasingly important role in people's lives. How to make computers smarter and better serve people is a hot issue in the scientific community today [1]. People hope that computers can not only complete some mathematical calculations, but also perform intelligent functions such as monitoring road conditions, manipulating machinery, statistics, and analyzing data. To do this, the computer must be able to observe and analyze the external environment like a human, detect and identify objects, and perform statistics and analysis on them [2]. The realization of these functions is inseparable from various technologies in the field of computer vision.

In the field of computer vision, researchers at home and abroad are committed to enabling computers to understand specific objects from the received image signals, and then feed back the processed images to people for subsequent research and application [3]. Foreign scholar Jeffrey T believes that pedestrian detection technology is considered a very basic and very important technology in this field. The goal of pedestrian detection is to hope that the computer can accurately find the location of the pedestrian from the image signal [4]. Domestic scholar Liang G also expressed support and pointed out that its difficulty lies in the complexity of the real scene. Factors such as illumination changes, camera lens movement, pedestrians being blocked, different pedestrian dresses, body postures and other factors have brought extremely high challenges to pedestrian detection [5]. Whether the pedestrian detection technology can eliminate various interferences and accurately find the location of the pedestrian directly determines the pros and cons of the subsequent algorithms such as motion detection, pedestrian tracking, and pedestrian

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recognition [6-7]. Two important indicators to measure pedestrian detection technology are accuracy and algorithm speed [8]. Accurate and real-time pedestrian detection can be really used in real life and production, allowing computers to share the work for people [9]. Therefore, an excellent pedestrian detection method has very important practical significance and application potential [10].

This article hopes that target tracking can also feed back pedestrian detection to improve its accuracy and speed. The non-directional movement of pedestrians, changes in the appearance of pedestrians and scenes, non-rigid pedestrian structures, occlusions between pedestrians and between pedestrians and scenes, and camera movement are difficult points in pedestrian detection. Target tracking can be based on pedestrians' current The location predicts the area where pedestrians may appear next, reducing the scope of pedestrian detection. Therefore, in many existing algorithms, pedestrian detection and target tracking are two complementary parts. Their realization can reduce the occurrence of most traffic accidents.

2. Technical Research on Pedestrian Detection Method Based on Neural Network and Data Fusion

2.1 Use of Data Fusion

Using neural network and data fusion technology to present the identification of pedestrians to the computer, using algorithmic analysis in digital form, using different algorithms to simulate the scene and details, using simulated reality technology and finally presenting it in the computer algorithm.

(1) Logical reasoning and theorem proof

Logical reasoning is one of the most enduring sub-fields in artificial intelligence research. Among them, it is particularly important to find some ways to focus only on the relevant facts in a large database, pay attention to credible proofs, and revise these proofs when new information appears. It is indeed an intelligent task to find a proof or counter-evidence for the theorems speculated in mathematics. This requires not only the ability to deduce based on assumptions, but also some intuitive skills.

(2) Scene Simulation Search Algorithm

In an AND or tree, the "and" or "or" mark added to a node depends on the relationship between the node and its parent node. The tasks of the production system can be Think of it as looking for a solution graph from the start node to the end node. Roughly speaking, a solution graph from a node of an AND-OR graph to a set of nodes is similar to a path in an ordinary graph.

The recursive definition of solution graphs is defined as a solution graph from node n to a set of node N in some and or graph G. It of G. If n is an element of N, it is$\{ n_1, n_2, \ldots\ldots, \mathrm{n}_k, \}$ composed of a single node n; if there is an outward connector K pointing to node, there is a solution graph from each to K, where i= 1,2 ,……,, are composed of node n, connector K, node$\{ n_1, n_2, \ldots\ldots, \mathrm{n}_k, \}$ and the solution graph from each node in$\{ n_1, n_2, \ldots\ldots, \mathrm{n}_k, \}$ to N, otherwise There is no solution graph from n to N.

2.2 Detail Calculation Algorithm

Describe the search process of an evaluation function with heuristic components, which can be designed for AND-OR graphs. h(n) is an estimate of h*(n), and h*(n) is the cost of an optimal solution graph from node n to a set of end nodes. Just like search in the figure, if h satisfies a certain limit, Then the search process sentence may be simplified to impose a monotonic restriction on h, that is$n_1, n_2, \ldots\ldots, \mathrm{n}_k$, to impose restrictions on each connector in the implicit graph from node n to its successor. Assumptions

$$\mathrm{h(n)} < \mathrm{c} + h(n_1) + ...,+ h(n_k) \quad (1)$$

Where c is the cost of the connector. This restriction is similar to the monotonic restriction on

heuristic functions in ordinary graphs. For the case where n is in the set of terminal nodes, if h(n)=0, then the monotonic restriction means that h is a lower bound of h*, that is, for all nodes n, h(n)<h*(n)

2.3 Virtual Scene Realization Algorithm

The core of ID3 algorithm is to determine an optimal splitting attribute. The information gain metric is usually used to select attributes. Select the attribute with the highest information gain as the test attribute of the current node. Before giving the specific calculation formula of information, it is necessary to clarify the two basic conditions that the formula should meet:

(1) If there is no instance of a certain class, information=0;

(2) If the number of instances in each class is equal, information=1.

Let T be a set of t samples, and the target attribute has m values, namely $\{C_{1,}C_{2,}C_3....,C_m\}$. Let Si be the number of samples of class Ci. Then the information entropy required when classifying a given sample is:

$$\inf o(T) = -\sum_{i=1}^{m} p_i \log_2(p_i) \qquad (2)$$

Where p_i is the probability that any sample belongs to c_i, that is, s_i / t estimation. Under normal circumstances, the logarithmic function takes 2 as the base, and the entropy uses bits as the unit.

Let attribute X have n different values $\{C_{1,}C_{2,}C_3....,C_m\}$. Then the information entropy divided into subsets by X is: $\inf o_X(T) = \sum_{i=1}^{n} \frac{|T_i|}{|T|} \inf o(T_i)$ (3)

$\frac{|T_i|}{|T|}$ serves as the weight of the subset. The smaller the entropy, the higher the purity of the subset. Among them, the information entropy of subset T_i:

3. Experimental Research on Pedestrian Detection Method Based on Neural Network and Data Fusion

3.1 System Simulation Experiment Data Collection.

The system reference input is a square wave signal. The sensor node is time-driven, sampling the stepper motor regularly, the sampling period is 10ms, and the sampling signal is transmitted to the controller node through the network node. The controller node adopts an event-driven method. After receiving the information from the sensor node, it calculates the control value and transmits the result to the actuator node through the network.

3.2 Generalized Predictive Control Based on Error Correction

The dynamic BP network is used to predict the prediction error of generalized predictive control. The weight of the dynamic BP network can be adjusted online, which changes the situation that the traditional BP network performs error correction once the network weight is fixed after training.

3.3 Fuzzy PID Controller

Adaptive fuzzy PID control uses the basic theories and methods of fuzzy mathematics to express the conditions and operations of the rules in fuzzy sets, and express these fuzzy rules and related information in the knowledge base, and then apply fuzzy inference according to the response of the system, online Tuning the parameters of PID.

4. Experimental Analysis of Pedestrian Detection Method Based on Neural Network and Data Fusion

4.1 Simulation Analysis of Smith Predictive Controller System Experiment

In this paper, the Smith predictive controller and the fuzzy PID controller are combined, and the fuzzy PID controller is used to replace the conventional PID controller in Smith predictive, so that the system has better performance. In the MATLAB environment, the Smith predictive fuzzy PID controller is designed and the system is simulated. The experimental results are shown in Table 1.

Table 1. Experimental Simulation Analysis of Smith Predictive Controller System

Time(s)	Smith predictive control step response	Smith predicts fuzzy PID controller when graphics are accurate	Smith predictive fuzzy PID controller described in this article
1	0	0	0
3	0.42	0.56	0.35
5	0.73	0.98	0.61
7	0.84	1.35	0.71
9	0.91	0.89	0.93
11	0.99	0.97	0.98

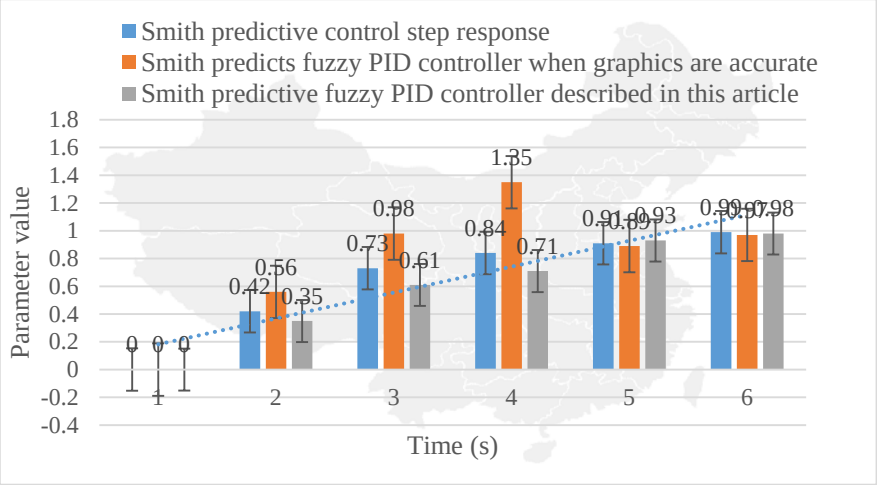

Figure 1. Experimental Simulation Analysis of Smith Predictive Controller System

As shown in Figure 1, the experiment shows that this method can accelerate the system response when the system model is accurate, and the steady-state performance is better. Since the time delay of the network automation control system is random, the Smith prediction model is difficult to be accurate. At this time, the use of Smith prediction fuzzy PID control can improve the dynamic performance of the system and has strong robustness.

4.2 Simulation Experiment Analysis of Neural Network and Data Fusion

In the simulation system, the second-order object transfer function model is selected, the controller side adopts a generalized predictive control algorithm based on the error correction of the pedestrian detection method based on neural network and data fusion, the sensor side adopts a time-driven method, and the controller side and the actuator side are both Using event-driven approach, the experimental results are shown in Table 2.

Table 2. Traditional Identify and Dynamic BP Error Correction Identify Experimental Analysis

Time (s)	Traditional GPC	Modified GPC
0	0	0
5	0.46	0.36
10	0.83	0.72
15	1.24	1.21
20	0.91	0.95
25	0.97	1.01

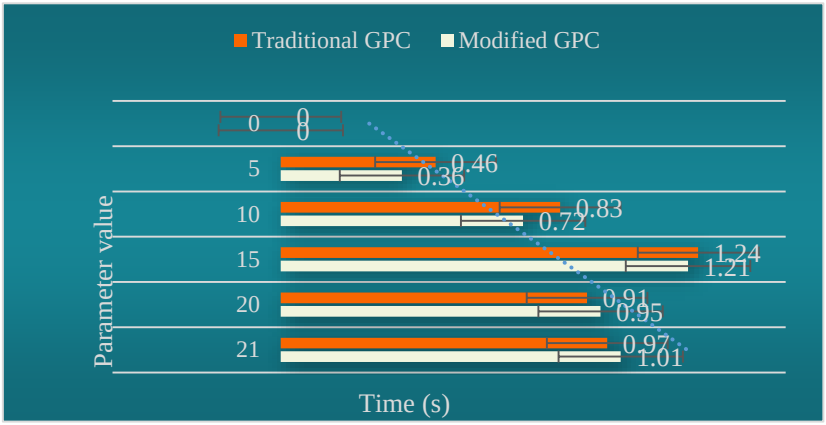

Figure 2. Traditional Identify and Dynamic BP Error Correction Identify Experimental Analysis

When the system has a large recognition error, the response of the traditional recognition algorithm and the recognition algorithm based on dynamic BP network error correction is shown in Figure 2. The data shows that the control system designed using the recognition algorithm with dynamic BP network error correction has faster response time and smaller overshoot, and the control effect is better than the traditional recognition algorithm by about 95%.

5. Conclusions

In this paper, in the context of the application of pedestrian detection methods and technologies, the combination of neural network and data fusion technology can quickly identify pedestrians through algorithms. Propose a continuous neural network that can learn temporal and spatial correlations from continuous frames. Aiming at the shortcomings of traditional neural networks that can only handle a single image, this paper combines consecutive frames into a multi-channel image, and trains the network to learn the temporal correlation between consecutive frames. Through comparative experiments, this paper verifies that the neural network can learn time features and can detect pedestrians that are largely blocked, which helps improve the accuracy of pedestrian detection. In addition, this paper found that the use of continuous frame images with a larger time range can better improve the accuracy of pedestrian detection. In order to further improve the accuracy, this paper introduces the target tracking method. Then the prediction result calculated by the target tracking method is confirmed with the detection result of the pedestrian detection method based on neural network and data fusion.

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