# Development and Application of Tld Technology in Urban Intelligent Rail Transit System

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**Abstract:** With the continuous development of science and technology in China, visual tracking technology has been widely used in the intelligent video monitoring of urban rail transit in China. However, due to the complex application environment, the traditional visual tracking technology in China fails to overcome some difficulties. Since TLD technology was put forward, it has effectively solved the problems existing in the application. The so-called TLD technology is a tracking technology integrating detection, tracking and learning, which can learn online and update the target in real time. Even if the shape of targets changes, they will be tracked comprehensively. TLD technology is of many advantages, including adaptability, precise positioning and anti-occlusion. Through its application, various problems in urban intelligent rail transit in China are effectively settled.

## 1. Introduction

For the urban intelligent rail transit in China, its monitoring environment has certain complexity, such as more platforms, more entrances and exits, large flow of people and a wide range of areas. In the face of this complex environment, there will be a lot of problems in the process of video monitoring of urban intelligent rail transit. First of all, the occlusion. Since moving objects are often sheltered partially or even completely, part of information data of the affected objects is missing and the accuracy and stability of video tracking are greatly reduced. Secondly, due to the change of illumination, the background also changes, which is quite easy to cause the problem of error tracking and detection. Moreover, there is a time-varying problem in video tracking. In order to ensure the effectiveness of tracking, it is of great necessity to obtain and apply the latest target information. Finally, the robustness and real-time problem. For both of them, to guarantee the real-time performance, it is essential to reduce the calculation amount of algorithm, and to ensure the robustness, it is necessary to improve the adaptability of algorithm to the complex environment. As a result, there is a certain contradiction between the robustness and real-time performance. However, through the reasonable application of TLD technology, these problems have been effectively solved. This technology tests and tracks synchronously, and also learns online. In this way, the learning results are applied in the process of tracking and detection. The final positioning of the target is achieved through the cooperation of the two. For TLD technology, it not only contains real-time performance, but also accuracy. It is an effective and scientific method to settle tracking problems of urban rail transit in China.

## 2. Tld Technology Overview

With the continuous development of the times, people are also constantly studying the visual tracking technology. In the field of video intelligent monitoring, visual tracking technology plays a vital role. Generally, motion detection is the premise of target tracking, which not only provides the trajectory of the target, but also provides effective data reference for scene analysis and other work. Nowadays, with the continuous development of science and technology, various target tracking algorithms appear, including TLD technology. As a positioning system with high accuracy, TLD technology is developed by a British college student. This system tracks all objects in the lens. In addition, it also has the characteristics of ceaseless learning of the target, so that the latest features

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of the target can be obtained and tracking records can be improved. This also means that the target's movement will be continuously detected even if it was initially still. Moreover, the target's changes in some aspects will be obtained and identified. After a period of learning, the target is easy to be found.

## 3. Analysis of Tld Technology

TLD technology includes the tracker, learning process and detector. It is a kind of tracking technology which combines detection and tracking organically, with strong reliability and adaptability. In this technology, the detector and tracker run synchronously, and the results formed will also be integrated into the learning process. The model achieved after learning is also applied to the detector and tracker. Through real-time update, it can continue to track the target under the premise of appearance change. As shown in the figure below, it is the working framework of TLD.

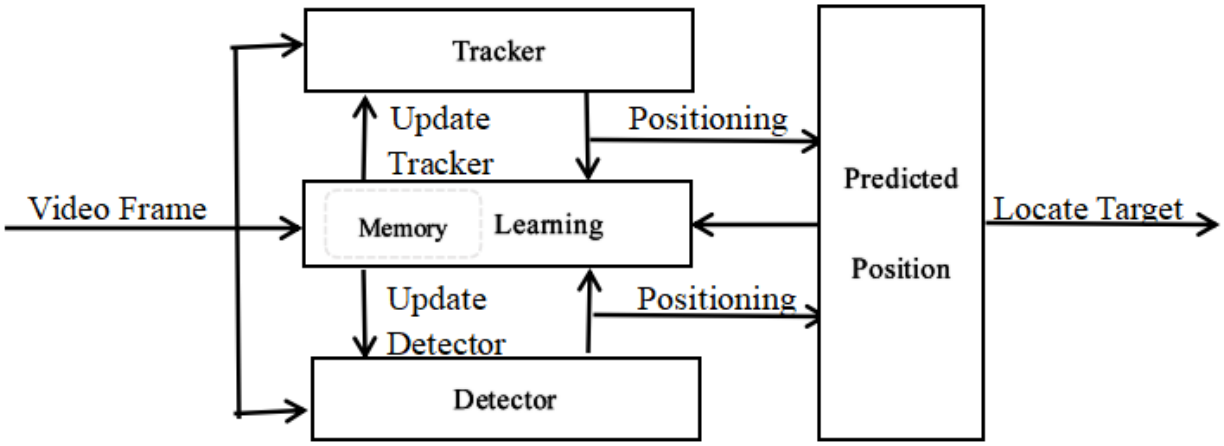


Fig.1 Schematic Diagram of Tld Working Frame

### 3.1 Tracker Analysis

In TLD tracker, overlapping block tracking mode is applied. Lucas-Kanade optical flow method is used for single block tracking. Before carrying out tracking, TLD needs to determine the target to be tracked, and then mark it with a rectangular box. As for the final movement of the target, the median value of movement of all local blocks is taken. This tracking method can also effectively solve the existing occlusion problem in urban rail transit.

### 3.2 Learning Process Analysis

The learning process of TLD is realized with the help of online model. Generally, the online model is composed of 15 × 15 image blocks, which are the results achieved by the tracker and detector. For the original online model, it is the target image initially tracked and determined. The model is dynamic, increasing or decreasing with the change of video. The development of the model is affected by the growth and pruning events. In real life, the target is affected by the environment and produces appearance change, which also lead to many other factors in the target image generated by the tracker. If all the target images are regarded as a space, then with the change of video sequence, the space formed by the tracker will gradually become larger, which represents the growth event. Secondly, in order to avoid the impact of growth events on tracking, a balance will be achieved by pruning events. Pruning event is to remove the non target image generated by the growth event. Under the influence of growth and pruning events, the online model keeps the same as the current target tracked.

In addition, the space increase caused by the growth event is generated by the tracker. That is to say, it is the selection of samples from the target image of tracking trajectory, and it is also the update of the model based on the samples. In this process, image blocks similar to the original target are added to the model. When the next frame is similar to the previous frame, the image of

the current tracking results will be integrated into the current model. Moreover, through the selection of growth events, the online model is always in the latest state of target, so as to avoid the problem of tracking loss due to the failure of real-time update of the model. Moreover, with the characteristics of adaptive tracking, in the case of tracking drift, the tracker will automatically adapt to the background, so that the target can also be tracked all the time without being affected. Pruning event is to delete automatically the rest of the detected images after the detector and the tracker determine the target position together. By extracting materials in the learning process of TLD technology, the online model gets samples. When TLD forms classifier, P and N are used to achieve constraint. The image block which is relatively close to the target image is a positive sample, which is also a P constraint, and the far image block is a negative sample, which is also a N constraint. With P, N constraints, the error rate of the classifier will be greatly reduced [1].

### 3.3 Detector Analysis

If the result of the tracker fails, it needs to be corrected with the aid of the detector. The tracker also needs to be initialized. During the synchronous operation of the two, the tracker will predict a location information while the detector detects a lot of image information. In the process of the final determination of the target position, the predicted result of the tracker should be considered first. If the similarity value between the image tracked by the tracker and the original image exceeds a certain threshold, then this result will be used. Otherwise, the image among those detected by the detector most similar to the original target image will be selected as the tracking result. The detector is a kind of classifier generated by the training and learning of online model samples. The features selected by the classifier are called 2bitbp, which is anti-light. After quantization, there may be four kinds of coding. The specified area has only one encoding. As shown in the figure below, it is the feature acquisition diagram.

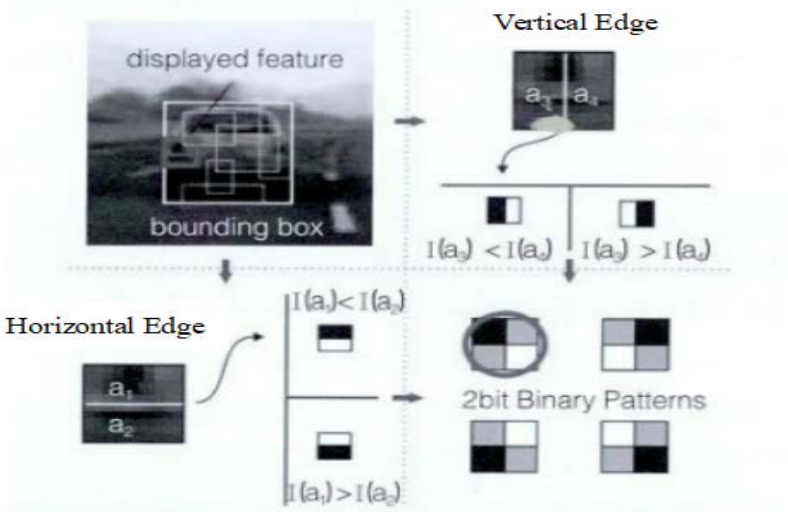


Fig.2 Schematic Diagram of Tld Feature Acquisition

The graphics block are represented by 2bitbp features which are further grouped with different size. These different groups refer to various image block appearances. When the classifier carries out detection, it needs to take the form of random forest in which trees are composed of feature groups, and the features of trees are the nodes of decision-making. In addition, the random forest is updated online with the help of growth and pruning events. Initially, the target module features constitute trees and each tree has “branches”. It does not add new “branches” during the positive sample selection of growth events. The pruning event is the opposite of the growth event, which is to remove unnecessary “branches” from the forest. This kind of detector works in the form of window scanning, while TLD technology tracks the target in real time by combining detector, tracker and learning process [2].

## 4. Performance Introduction of Tld

TLD technology is of good performance. The designer of TLD technology has tested its performance by using multiple videos. The video sequence also includes various scenes, such as outdoor, indoor, etc. Besides people, vehicles and animals are also the objects to be tracked. In the process of testing, the plush toys in human hands are set as objects. There are lots of difficult factors in this video sequence, for instance, the change of object shape, the change of light and so on. In face tracking, there are a lot of indoor scenes in which people move alternately in the video sequence and the face tracked is always partially blocked. In the tracking of pedestrians in the shopping mall, some people's walking is completely blocked. In the process of tracking the cars on the highway, the video sequence shows the whole driving process on the highway, including the fast movement and occlusion of objects.

In the above tests, TLD technology has achieved the accurate tracking of the target, which is well adapted to the occlusion of the target, the change of the light and the movement. Thus, TLD technology is with a strong effectiveness and real-time performance [3].

## 5. Development Prospect of Tld Technology in Urban Intelligent Rail Transit in China

TLD technology owns great advantages and can solve the problems in rail transit effectively. At present, there are numerous scenarios in rail transit that need to be monitored.

### 5.1 Perimeter Monitoring

By monitoring the perimeter, it is possible to observe whether there is an object nearby. If there is an object moving within a certain range, the alarm will be triggered. Not only that, rail transit has a large hub platform, so TLD system is required to combine the actual situation to divide the boundary into several small areas, and reasonably refine the control management, so the accuracy of the alarm will be greatly improved.

### 5.2 Facility Monitoring

Urban rail transit has a lot of supporting facilities, including fences, screen doors, automatic ticket vending machines, etc. Only by ensuring the safety of facilities, can rail transit operate safely. For the monitoring of facilities, it is necessary to prohibit people or unknown objects from approaching when the locomotive is idle. Only in this way can the safety of the locomotive be guaranteed. Secondly, all kinds of auxiliary equipment should also be monitored to prevent others from stealing or even damaging. Moreover, TLD technology is constantly improved, and it will be more widely used and developed in the field of urban intelligent rail transit in China [4].

## 6. Conclusion

All in all, with the continuous development of China's economy, urban rail transit has become an extremely important transportation hub in China. If the relevant departments want to better protect it, they must strictly require intelligent video monitoring technology. Not only that, China also needs to improve and innovate the video intelligent monitoring technology. In the field of intelligent analysis, tracking technology produces a vital impact, whose advantages and disadvantages have a great correlation with the performance of monitoring system. Since the development of TLD technology, it not only solves the problems of rail transit in China, but also shows excellent performance. Its application will also promote the overall development of intelligent video analysis technology.

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