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Эмоциялық классификация мәселелерін терең оқыту арқылы шешу

Аңдатпа. Сөйлеу эмоциясын жіктеу – қазіргі әлемдегі ең қызықты және күрделі мәселелердің бірі. Бұл тапсырманың басты кедергілерінің бірі – эмоциялар субъективті және оларды тану қиын. Осы жұмыста біз аудио негізінде эмоцияны жіктеу мәселелерін шешетін терең оқыту әдістерін ұсындық. Ал енді жұмыста үш әдіс қарастырылады және салыстырылады. Бірінші әдіс шеңберінде көп қабатты Перцептрон моделі құрылды. Екінші әдіс ұзақ мерзімді жад модельдерінің дәлдігі төмендеуін көрсетеді. Сонымен басқалардың арасында ең жақсы дәлдікке жеткен үшінші әдіс – бұл жүйкелік жүйенің конволюциялық модельдері. Ағылшын тіліндегі әрекет етуші және спонтанды эмоциялар үлгілерінен тұратын сөйлеу корпусы егжей-тегжейлі сипатталған. Аталған деректер базасы осы ұсынылған әдістердің көмегімен тексеріліп, оқытылды. Біздің эмоцияны жіктеу мәселесі үшін CNN моделі 70% дәлдікке қол жеткізді.

Түйінді сөздер: сөйлеу эмоциясын тану, конволюциялық жүйке жүйесі, терең жүйке жүйесі, ұзақ мерзімді есте сақтау, көп қабатты перцептрон

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OBJECT TRACKING

Abstract. *Moving object tracking is very useful in many computer vision applications. The most famous examples are surveillance systems in crowded public places, traffic control systems, motion capture systems for electronic games, applications for human-computer interaction, and many others. Recently, a large number of approaches have been proposed for tracking objects. However, no algorithm has yet been developed that would cope with all the existing problems of object tracking. This article aims to analyze the existing problems, as well as consider ways to solve them.*

Key words*: object detection, object tracking, background subtraction, image subtraction, optical flow, speeded-up robust features.*

Introduction

Object tracking is one of the most researchable topics in computer vision today, with interest increasing dramatically over the last few decades. This demand has been due to the rapid development of information technologies, the availability of high-quality, low-cost cameras, and the increased need for tracking applications in various fields such as traffic monitoring, human- computer interaction, surveillance and medical imaging. Reliable detection and tracking of an object in a video remains an open research problem even after several years of study in this field. In spite of significant progress made in recent years, it still remains a very challenging problem. The problems with existing tracking algorithms are due to a number of factors such as illumination changes, background noise and occlusion. There is no single tracking algorithm that can cope with all the challenges. Therefore, this research field, particularly designing a robust tracking approach, is becoming a very attractive research area.

In general, object tracking is very closely related to object detection in computer vision. In order to track an object, first the object should be accurately detected in a single image that represents a snapshot of the scene. Continually detecting objects in different frames of a video taken over time allows us to track an object in consecutive frames, a set of which is known as a video.

A number of tracking approaches and methodologies have been proposed over the last few decades. Well-known examples are background subtraction, image subtraction (also known as temporal differencing), optical flow and some statistical approaches. They all have shortcomings depending on the complexity of images, which do not allow them to be a reliable method of object detection. For example, a background subtraction method is inefficient for dynamic (changing) backgrounds and temporal differencing fails to detect stopped objects.

Object Detection and Tracking

Accurate detection of regions that correspond to moving objects in a video scene is one of the key tasks in many computer vision applications today. The difficulty of this task is mainly due to continuous changes in natural video scenes such as occlusion, cluttering, illumination changes and others presented in the last section.

The term object detection means the verification of the presence of an object in image sequences extracted from a video. Object detection is the first basic step for most computer vision applications, providing important information, specifically where an object is located in the image, which can be used to make further analysis easier.

Continuously detecting objects in a sequence of frames allows us to track their motion in a scene. Tracking an object over time is one of the essential challenges in video processing. Morris [7] defines object tracking as “following the object’s position as it moves in front of us”. It means that the idea of object tracking is to analyse video frames and find the location of moving objects in every single video frame.

However, Bansal and Mullur [1] argue that the object tracking problem is not merely following the object position but also estimating other relevant information like trajectory, shape, size and number of moving objects in an image sequence. In general, definitions may differ based on the application context.

The tracking task, in general, can be performed by processing video frames either separately or jointly. In the case of independent processing, an object tracking process usually consists of two main stages. It starts with detecting objects in a single video frame and then moves to the next stage where the moving object region is labelled in an image. This two-stage process is repeated recursively in a loop as demonstrated in Figure 1.

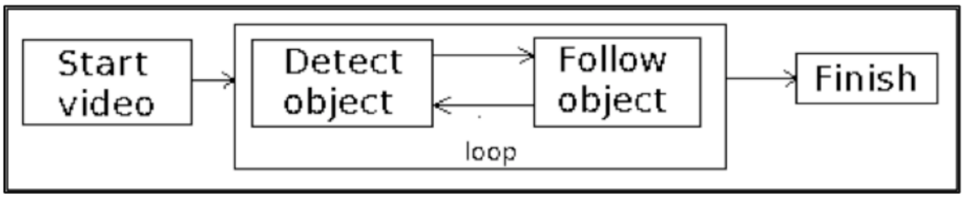

Figure 1 - Object tracking algorithm general framework

However, this approach does not include temporal information of the object’s previous positions since each frame is processed independently. Consequently, the approach cannot be used in applications such as behaviour detection, motion recovery or position estimation. For these kinds of system, there is a joint processing approach.

In the case of joint processing, object motion is estimated by continually updating the object position and using location information from previous frames. In order to make a tracking algorithm more robust and accurate, it is desirable to keep the object's position over time, for example as shown in Table 1.

Table 1 - Object position over time

Time	1	2	3	4	5	6	7	8	9	...
x	1	2	4	4	6	7	9	10	12	...
y	1	3	4	6	7	7	4	2	5	...

To simplify the visual perception of object movement, the coordinate numbers in Table 1 can be illustrated in a two-dimensional coordinate system by a curve connecting the object's position in a scene over time (Figure 2).

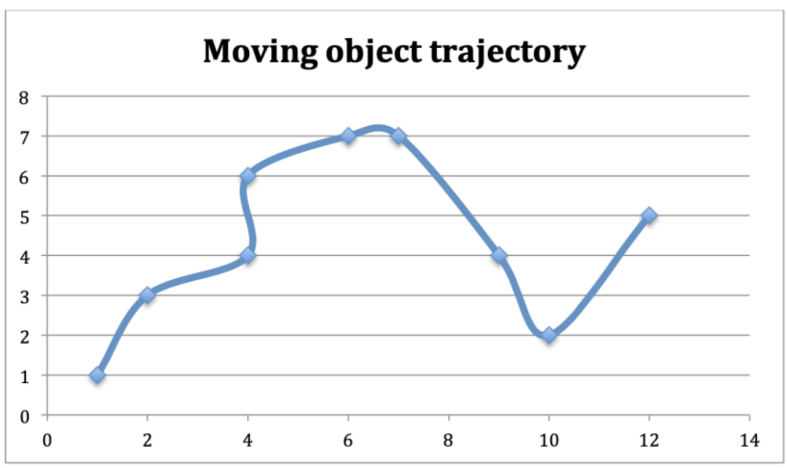

Figure 2 - Moving object trajectory visualisation

The stored information is used to estimate the object's next position and then compared with the actually detected one. A very interesting example has been found in the work of Ho & Lou [4]. According to them, after accurately recording a moving person's motion, we can modify the motion record to get different motions using a rendering process. For instance, this feature can be useful in the cinematography industry to produce motion sequences that an actor does not wish to do.

However, object tracking has many other applications used in various fields. The next section discusses the most useful and important ones.

Applications of Moving Object Detection and Tracking

Notable examples of object tracking are the following:

- Security and surveillance systems. These applications are used for tracking suspicious objects, as well as monitoring security sensitive areas such as cash offices, public areas, supermarkets and national borders.
- Robot control systems. The main goal of such systems is to create more human-like "brains" in robots, forcing them to act like a human by real-time processing of captured images from a robot's camera.

● Applications used in sports are valuable, for example, in understanding the manner of an athlete's motion and further improving his or her performance.

● Traffic management systems. The key element of any traffic management system is the actual information obtained from the monitoring cameras on highways. The system processes that information and provides accurate measurements for intersection and speed control, traffic light control, vehicle counting etc.

Moving Object Detection Approaches

This section discusses the results of a study of three well-known and widely used approaches: background subtraction, image subtraction and optical flow. The penultimate section describes the SURF algorithm.

Background Subtraction

Background subtraction is a well-known approach for detecting moving objects in static scene videos. The basic idea of background subtraction is to detect moving object regions by subtracting the current frame from a reference frame, also called a "background model" or "background image", and thresholding the resulting image to obtain the moving objects' regions. In this case, thresholding means checking the results of pixel-by-pixel subtraction against some threshold value: if it is above this value, the pixel is classified as foreground. The overall process is illustrated in Figure 3.

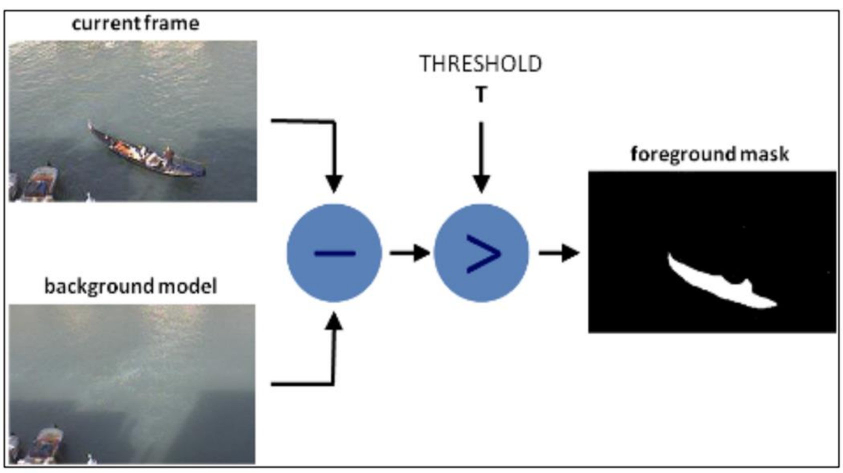

Figure 3 - Background subtraction scheme

Background subtraction techniques perform quite well on most video scenes, even with stopped objects. However, they are usually sensitive to a dynamic background or sudden illumination changes.

Image Subtraction

Image subtraction, often called "temporal differencing", is a simple and effective way of detecting changes in a pair of images. The method has been proposed to solve the problem of dynamic background. As stated in the previous section, if we apply a background subtraction method in situations with an unstable background, the method will fail to detect the correct moving object regions. Image subtraction solves the problem.

The concept of the image subtraction technique is to detect moving object regions by taking pixel-by-pixel differences of two (or more) consecutive frames. Image subtraction operates exactly as background subtraction, except for the fact that one or more previous frames are used as a background model.

However, detecting moving objects using an image subtraction approach has two significant problems. The first issue is the inability to detect objects that are not moving. Let us assume that a moving object stops its motion; subsequently, the current image and previous image(s) would be identical after a short amount of time so no change would be detected after performing image subtraction. Eventually, the method would fail to detect the existing object in a scene. On the other hand, the background subtraction approach does not face such a problem as it is indifferent to whether an object is moving or not because the background model is always the same for a given scene.

The second problem of image subtraction is that of producing incorrect results if an object is moving very fast in a scene. In such cases, the result is two separate object regions (Figure 4), one of which is a so-called “ghost object”. It comes from the previous frame(s) showing the object’s last position.

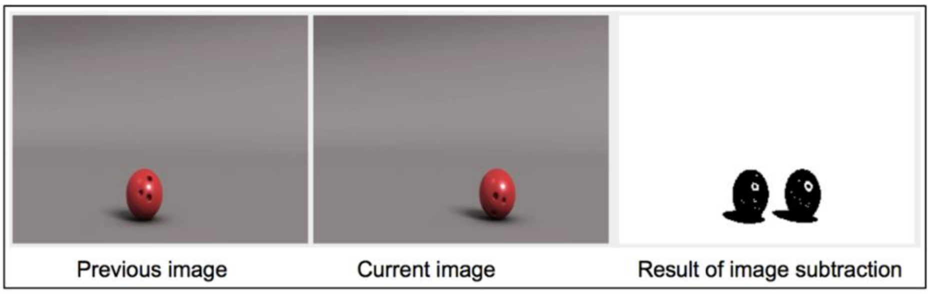

Figure 4 - "Ghost object" example

Optical Flow

In computer vision, optical flow is a widely researched topic. The basic optical flow technique was first described in a paper by Horn & Schunck [5]. It is one of the most influential works on this topic since the paper describes a baseline for almost every dense flow computation algorithm.

The optical flow method can be used to detect moving objects even with a moving camera and a dynamic background. The generic process of object detection starts from computing the motion estimation for each pixel in an image. It then identifies the moving object by the flow in the direction of an image gradient. Some examples of moving object detection using optical flow are demonstrated in Figure 5.

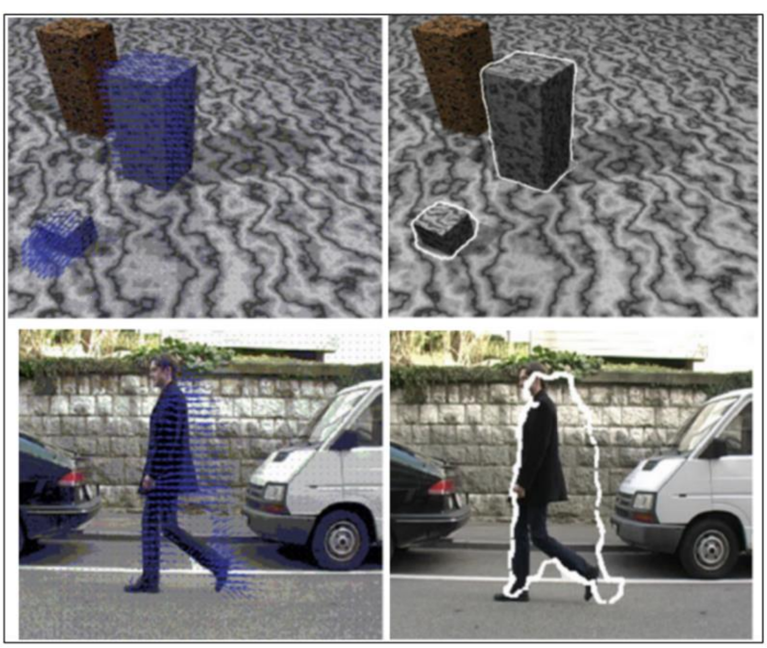

Figure 5 - Examples of moving object detection using optical flow. Upper row: slow-extent motion; Lower row: large-extent motion

Above all, it can be concluded that optical flow is an effective approach, but, as Shaikh et al [8]. reported, computationally complex. Therefore, this method cannot be used in real-time applications without having powerful software.

Speeded-Up Robust Features (SURF)

SURF is a quite new scale- and rotation-invariant interest point detector and descriptor algorithm. It approximates or even outperforms previously proposed interest point detector and descriptor algorithms in terms of repeatability, distinctiveness and robustness. In computer vision, repeatability is usually considered as when the same keypoints are found in each frame of a video with changing scenes. The next property is distinctiveness, when keypoints are detected at distinctive locations, such as edges, corners and blob lines. The strength of these two properties defines the robustness of the SURF algorithm as a whole.

In general, SURF follows the same ideas as the scale-invariant feature transform (SIFT) algorithm by Lowe [6]. The basic idea in developing SURF was to design a high-speed interesting point detector and descriptor algorithm, without losing the performance of state-of-the-art algorithms. In order to achieve this aim, Bay, Tuytelaars & Van Gool [3] decided “to reduce the descriptor’s dimension and complexity, while keeping it sufficiently distinctive”.

Object Tracking Challenges

In general, object tracking is a challenging task. Even after several years of research in this area, it remains an open research problem. There have not been investigated an all in one, robust, time-efficient and accurate algorithm. Object detection and tracking is so challenging because the real world is made up of a variety of objects, which all occlude one another and appear in different poses. Usually, difficulties in tracking objects arise due to numerous factors which can be summarised in the following list:

- Dynamic background. The scene may contain moving objects that should be classified as background. Obvious examples include the movement of clouds, flowing rivers, the sway of tree leaves and so on. It is quite a hard problem to distinguish such kinds of environment change from real object movement.
- Occlusion. During tracking of objects, there may occur object-to-object or object-to-scene occlusions. In such cases, tracked objects need to be re-identified with the visible part.
- The presence of shadows. Shadows may cause another problem for moving object region detection since shadows move along with the moving object and might be determined as part of it.
- The speed of moving objects. It plays an important role in object tracking. Many proposed approaches are dependent on the speed of moving objects. For example, as mentioned earlier, the image subtraction method fails in detecting stopped or very fast moving objects, resulting in an appearance of ghost objects.
- Illumination changes. These changes undoubtedly cause problems for accurate object detection, especially when the change occurs suddenly, e.g. when switching on or off an artificial light in a room.
- Video noise. Video signals can have different kinds of background noise, such as noises caused by a camera sensor or lens, or a non-static illumination. It may result in erroneous labelling of a moving object region.
- Camera jitter. Video captured by a vibrating camera is another object tracking challenge. In such cases, the vibration magnitude should be taken into account when processing the video frame.
- The computational expense of a tracking algorithm. If an algorithm for object detection and tracking is used in real-time applications, it needs to be fast enough to process video frames online, thus, computationally inexpensive.

● Camouflage. Some objects can have almost the same appearance characteristics as the background, e.g. objects that have identical colours to the background, which makes their detection difficult.

Conclusion

This article provided background knowledge on the object tracking topic and discussed brief information on basic state-of-the-art object tracking techniques. The described techniques are background subtraction, image subtraction and optical flow. The penultimate section gave a description of the SURF algorithm. At the last section, the challenges of object tracking processes were listed, based on the research of existing tracking methods.

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Нысанды бақылау

Аңдатпа. Нысанды бақылауды жылжыту көптеген компьютерлік көру қосымшаларында өте пайдалы. Мұндай қосымшалардың белгілі мысалдары көпшілік жиналатын жерлерде бақылау жүйелерін, электронды ойындарға арналған қозғалысты түсіру жүйелерін, трафикті басқару жүйелерін, адам мен компьютердің өзара әрекеттесу қосымшаларын және басқаларын қамтиды. Соңғы жылдары объектілерді қадағалау тәсілдерінің көп саны енгізілді. Алайда объектіні қадағалаудың барлық қиындықтарын жеңе алатын алгоритм әлі жоқтың қасы. Бұл мақала объектілерді қадағалаудың сол қиындықтарын талдауға, сондай-ақ оларды шешу жолдарын ұсынуға бағытталған.

Түйінді сөздер: объектіні анықтау, объектіні қадағалау, фондық алып тастау, кескінді алып тастау, оптикалық ағын, жеделдетілген сенімді мүмкіндіктер

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Отслеживание объектов

Аннотация. Отслеживание движущихся объектов очень полезно во многих приложениях компьютерного зрения. Хорошо известные примеры таких приложений включают системы наблюдения в многолюдных общественных местах, системы захвата движения для электронных игр, системы управления дорожным движением, приложения для взаимодействия человека с компьютером и многие другие. В последние годы было внедрено большое количество подходов к отслеживанию объектов. Однако пока не разработан алгоритм, кото-

рый справился бы со всеми существующими проблемами отслеживания объектов. Эта статья призвана проанализировать существующие проблемы слежения за объектами, а также предложить способы их решения.

Ключевые слова: обнаружение объекта, отслеживание объекта, вычитание фона, вычитание изображения, оптический поток, ускоренные надежные функции

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ПРОЕКТИРОВАНИЕ СХЕМЫ БАЗЫ ДАННЫХ ДЛЯ ИНФОРМАЦИОННОЙ СИСТЕМЫ ПО СБОРУ ДАННЫХ

Аннотация. *В статье приведен процесс разработки схемы БД для системы по работе с динамическими данными, а также основная концепция создания структуры таблиц для интернет магазина.*

Ключевые слова: *разработка, схема базы данных, форматирование данных, тестирование системы, база данных*

Введение

Схема базы данных - это ее структура, описанная на формальном языке, поддерживаемом системой управления базами данных (СУБД). Термин «схема» относится к организации данных, как к схеме построения базы данных (разделенной на таблицы базы данных в случае реляционных баз данных). Формальное определение схемы базы данных - это набор формул, называемых ограничениями целостности, наложенными на базу данных. Эти ограничения целостности обеспечивают совместимость между частями схемы. Все ограничения выражаются на одном языке. База данных может рассматриваться как структура в реализации языка баз данных [1]. Состояния созданной концептуальной схемы преобразуются в явное