

A Study for Object Recognition and Tracking Service using IR camera

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Abstract

Stamp tour operators for the most part seem rely merely on a demonstration offer. While diving deeper into how to design such tours more interestingly, object recognition and tracking technology using IR (infrared) cameras as an input tool is thought to open an opportunity to entire more visitors.

Batches of raw data fed from an IR camera are analyzed for object characteristics and added to a specific machine learning model to classify them into unique categories. These datasets are then further analyzed and compared to identify different objects. A variety of machine learning algorithms can be combined with feature extraction methods to build a high-accuracy object recognition model based on which analyzed data are utilizable to provide more meaningful stamp tours. IR cameras installed for such purposes may, when not in use, serve as CCTV cameras to help prevent potential accidents.

An IR camera is a device that detects infrared energy in a tracked form and converts it into an electrical signal, which is then processed to produce a thermal image or video and output it on a monitor. As we can obtain temperature related information, heat sensed by an IR camera can be very precisely measured, allowing us to not only monitor thermal performance, but also evaluate the relative severity of thermal energy-related issues. Image processing is technology that intelligently analyzes images collected by image sensors, which includes CMS (content management software) and VMS (video management software) that collect, monitor and manage video, as well as all intelligent components built in image sensors themselves. IR cameras where necessary make the most of infrared image pretreatment method including background modeling or image compensation, detection and classification method for detecting and classifying objects of interest, tracking method for continuously tracking detected objects, and method for security of infrared image data. Just stepping by famous tourist attractions meaninglessly is not pleasurable. Stamp trail tours designed to add an element of fun would be more utilizable if visitors are given chances to not only collect stamps on designated sites, but also solve random quizzes on places they visit by scanning QR code with their smartphones to connect the internet.

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The study hereof caters to user demands and social trends since object recognition and tracking services using IR cameras surely push motivations for travel and enhance the quality of tourism.

Keywords: IR camera, deep learning, machine learning, video processing, stamp tour

1. Introduction

Historical trip services exist not infrequently allowing tourists abroad and at home to enrich the motivation of travelling by way of puzzle stamp tours which aim to introduce popular tourist attractions, to help tourists find routes to destinations and to add an element of fun by encouraging them to collect a unique stamp at each location. However, most of such tourism services are designed often simply and offered without making participation enticing. Therefore, it is important to improve quality in tourism and help tourists find their sense of purpose by providing some extra motivation to travel goals. It would be a good example if a stamp tour is more developed and utilized in many quarters than it is now, getting away from a one-off event that fails to receive attention from most students or people.

The important part of an IR camera in the context of stamp tours relates to how to process input signals. The objective of this proposition is to make the most of thermography based on the concept of tracking service using the IR camera. Such a camera is capable of measuring thermal

energy emitted from an object as infrared radiation has a longer wavelength than visible light and, with thermal imaging, the portion of the spectrum we perceive is dramatically expanded[1]. In the infrared world, everything with a temperature above zero emits heat and its value can be measured using thermal energy data, which is accordingly usable as input signal for an infrared thermography camera. Even very cold objects, like ice cubes, also emit infrared energy, so the IR camera can provide precise temperature measurement capabilities even in highly lit and totally dark environments.

2. Necessity of the proposition

You may handily encounter stamp tour programs in famous tourist spots. The author of this paper thought that it would be an interesting topic of thesis if it is feasibly possible to portray objects in video, extract their characteristics and apply them to the domain of stamp tours. The conception is such that video stream is compressed in a form as intended using thermographic images of an object and the compressed data is used for analyses [Figure 1].

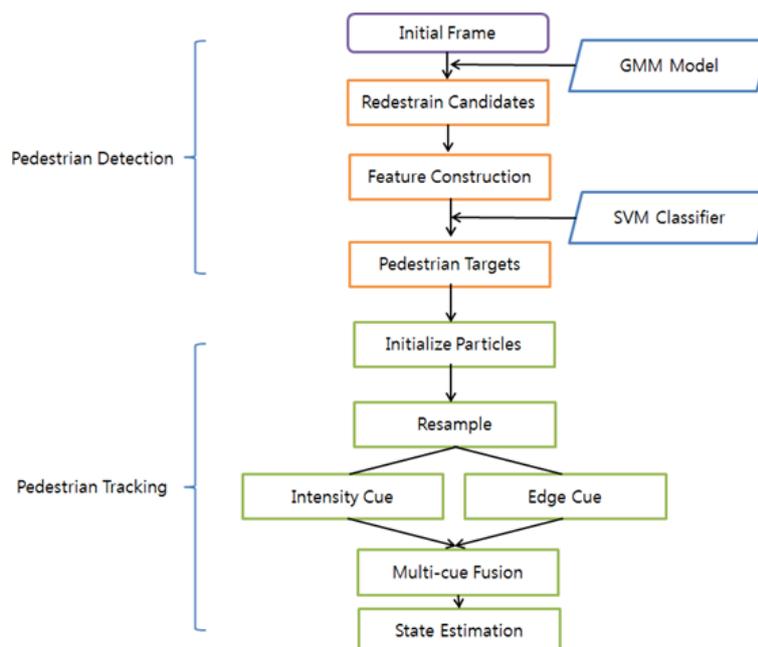


Figure 1. Flow chart of the proposed infrared pedestrian detection and tracking algorithm.

The primary purpose of IR cameras in their early days was to simply capture and store images. But today, with one step further, they are able to extract data you want, analyze patterns by generalizing the retrieved data, and track objects to predict future positions. The use of such prediction imposes the requirement of security. Although admitting that the proposition hereof may be developed without paying attention to the security issue, stamp tours paired with infrared technology eventually require a keyword named 'security'[2,3].

Cameras as a segment of the hardware market have gradually been advanced from low to high definition and from simple to smarter type. The intelligence at the edge is backed up by digital technology that makes it possible to recognize objects while shooting and separate tracked objects from the background in image. While evolving from analog- to digital-based image processing, network-based video camera technology sees breakthrough in terms of definition, image compression codec, storage device and image analysis, thereby incorporating such features as thermal imaging, 4K UHD(ultra-high definition), etc. Other examples that showcase the technological development include H.265(also called HEVC (high efficiency video codec)), an advanced video compression standard, which can encode video data, as well as NVR(network video recorder) storage unit and

intelligent imaging analysis depending on situational awareness[4,5].

Various techniques are made available to recognize and analyze objects by using e.g. machine learning and deep learning. Besides, objects can be detected depending on similarity of patterns. Visual search engine, when used to take a photo of a physical object, shows the result by searching and retrieving information about the image. Here, the term 'object recognition' refers to a computer vision technology for identifying objects in images or videos. Object recognition is a key output of deep learning and machine learning algorithms. When humans look at a photo or watch a video, we can readily spot people, objects, scenes and visual details. But it is quite natural that object recognition via a tool like camera is not made understandable. Since the same object appears differently based on level of illumination, occlusion, etc., the vision system must be at the very least capable of doing what comes naturally to humans. If so, it is useful in a variety of applications such as disease identification in bioimaging, industrial inspection and robotic vision[6]. In particular, object recognition enables driverless cars to reduce speeds by recognizing lanes and objects, or detecting distance-to-object. It can also recognize a stop sign or to distinguish a pedestrian from a lamppost [Figure 2].

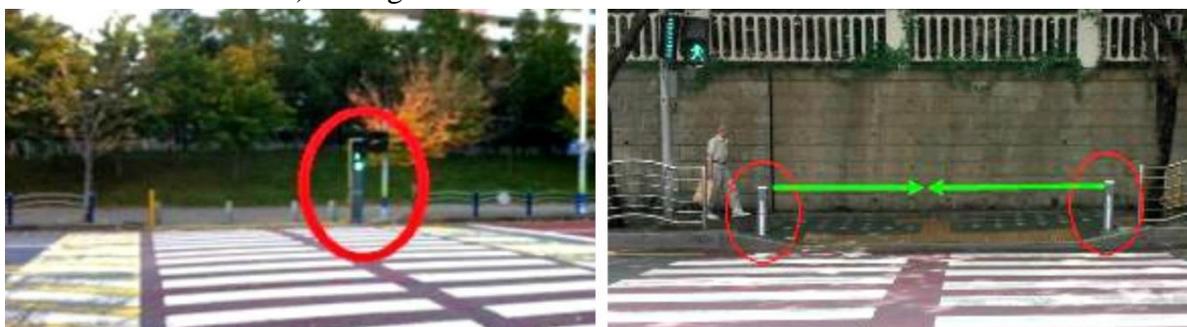


Figure 2. Method of identifying pedestrian and lamppost using an IR camera.

Technological progress for traffic safety systems is relatively slow compared to other fields. Traffic

safety relies on traffic signs or road safety instructors, but they are often deployed to oversee

children going to or from school, where their absence during after-school hours (from 2 to 8 p.m.) makes children vulnerable to traffic accidents. Auxiliary systems for pedestrian crossing safety by utilizing ICT are installed in some districts, which is however problematic due to lack of the night visibility and capacity to

respond to pedestrian safety. Despite efforts for road safety campaign and relevant technology development, traffic accident and fatality rates are still high. This paper analyzes current traffic situations using cameras clung beside roads to monitor traffic lights and colors [Figure 3].

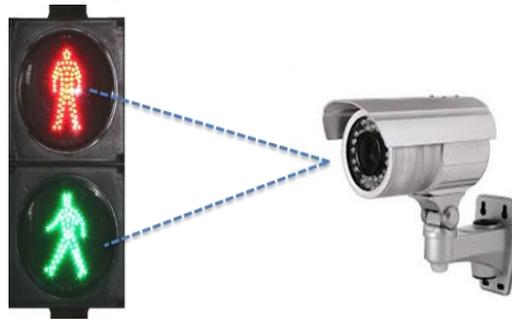


Figure 3. Traffic situation analysis system using IR cameras.

Typical machine learning models encompass HOG(histogram of oriented gradients) feature extraction using SVM(support vector machine), BoW(bag-of-words) model that is a way of extracting features such as SURF and MSER. In addition, the Viola-Jones algorithm is the first object detection framework to provide competitive object detection rates in real time so as to recognize a variety of objects including face and upper body. To perform object recognition using a standard machine learning approach, you start with a collection of images or video, and select the relevant features in each image[7]. For example, a feature extraction algorithm might extract edge or corner features that can be used to differentiate between classes in your data. The intelligent image analysis system working on a computer equipped with a GPU(graphics processing unit), which is currently available to send images from the hardware camera module, can be remodeled capable of detecting and tracking objects or perceiving the situation via a mounted camera, and sending events of interest to a separate server.

3. Results and Discussion

The service devised hereby suggests a method for tourists to move to destinations for a stamp tour by getting bus routes via GPS or API. The tour finishes when they arrive each place and complete all arranged missions.

The objective of the service hereof is not just to allow elementary, middle and high school students and university students to explore historic sites, but to give them opportunities to learn more about places they visit via quiz-solving and machine-readable QR code that contains information that should be known. Travelling together with family or friends based on the information and knowledge gained as such would contribute to establishing a good rapport. This paper proposes an IR camera-based object recognition/tracking scheme to allow tourists to enjoy historic heritage stamp tours more interestingly by providing them with two things-to-do, i.e. quiz solving and knowledge travelling, which enhances the experiential value [8].

IR cameras, like CCTV cameras, are able to shoot continuously, but none of them cannot store images and generate reports. However, our scheme enables an IR camera to be turned on

and enter into the quiz-solving mode when a tourist conducts specified motions in front of the camera to get a stamp on the destination. If he or she in such OX quiz challenge gets the correct answer by taking body motions to the left and right, the stamp is sent to the corresponding smartphone; if answered incorrectly, another quiz is created for additional attempt. This scheme provides the effect of ‘killing two birds with one stone’ as visitors are chanced to get stamps using IR cameras and study history while solving a quiz for amusement.

If an IR camera is unable to store images, it cannot play a role of the true sense of camera. But the scheme hereof ensures effective

shooting since the IR camera remains turned on and stores captured images for a specific period of time in the event of danger if occurred while a visitor is taking motion routines, which means the shooting is not made for unspecified individuals but triggered only when an incident with a hazard occurs. Furthermore, retrieving stored images is prohibited except when attended by the corresponding individual and the administrator, thereby causing no problem associated with security[9,10].

For a historic site exploration tour, the mission at a specific destination is cleared when a visitor gathers all stamps as required, the procedure of which is repeated in other places to complete several missions [Table 1].

Table 1: Historic Stamp Tour Process

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| <ol style="list-style-type: none"> 1. Continuous shooting using IR cameras in a historic site(images are stored and retrievable when manipulated as specified) 2. Arrival of a visitor participating in a historic heritage stamp tour 3. Quiz solving by scanning the QR code(quizzes differ with places and are given randomly) 4. At the moment when the QR code is scanned by the visitor, the IR camera is turned on to be ready for quiz solving. 5. When answered correctly, a stamp is sent to the corresponding app; if not, there appears a message of whether to solve another quiz. 6. When the mission is complete, a proof shot is taken as an evidence of procedural termination. |
|--|

Stamp related services in tourist destinations are on the rise, but they lack of the utilization and proceed in a form of one-off event for a specific period of time without rewarding for successful stamp collectors. To the contrary, the scheme hereof affords advantages by allowing tour operators to provide discount benefits and gift coupons depending on how many stamps are collected, in addition to reduction of physical papers otherwise unnecessarily used via a mobile app, as well as the sense of accomplishment and tourism promotion via content sharing on social media platforms. The kill-two-birds-with-one-stone effects surely maximize the fun factor for tourists.

The scheme hereof would be good PR if adopted by governmental agencies as a means for posting video clips on social media platforms or linking to

travel-related cafes or clubs, or in offline cases incorporating a course of e.g. visiting city halls within the tour program. Moreover, it is also a good idea that, as a marketing strategy relating to historic site exploration tour services, addition of a new destination in a themed course is eligible for special benefits during a predetermined period. Object recognition services using IR cameras as a means of attracting tourists and accordingly promoting tourism will be applied more diversely if combined with benefit packages offered in collaboration with the franchisee, gratuities in random drawings for those who collect all stamps, etc [Figure 4].



Figure 4. L Schematic of a stamp tour for visiting historic places.

3.1 Stamp system

Bingo game creates additional excitement, apart from simple touring, for participants in a historic heritage exploration tour who complete the mission by successfully collecting all stamps. In this regard, the size of bingo board may be diversified such as 1x2~4x4 depending on schedule or type of stamp tours, or themes of tourist attractions.

Each participant should solve questions on the game of Bingo and retry if answered incorrectly upon arrival at each destination to get stamps, which is facilitated to add a fun thing-to-do to improve the tour objective. Bingo winners are rewarded by perks such as discount coupons for use of facilities around tourist attractions, giveaways offered by lot, and jackpot numbers announced via social media to let them feel a sense of accomplishment [Figure 5].



Figure 5. Modified form of stamp tour service.

3.2 Stamp tour service system by theme

Each user is allowed to choose, or be recommended, travel themes he or she wishes. The scheme hereof sorts out and introduces

themes by region during the project period, where stamps differ with individual themes and locations of their values are randomly processed to provide various services [Figure 6].



Figure 6. Different types of stamp services by theme.

3.3 Object recognition and tracking

The find-route service using GPS tracks waypoints and shows routes up to the destination in which the IR camera is installed for users intending to solve quizzes. The finder is also capable of providing public transport information and maps via API, or managing tourist attractions by utilizing IR cameras. IR cameras can serve as CCTV at other times to deter crimes through continuous shooting, whereas they when on the

assignment enable tourists to perform QR code based quiz solving. More specifically, the camera is switched to the readiness mode when the tourist correctly takes specified motions in front of it, sends stamps to the corresponding smartphones or captures commemorative photos if correctly answered to quizzes. At the point the security concern is eliminated by enforcing attendance of the corresponding individual, administrator or equivalent when retrieving captured video [Figure 7].

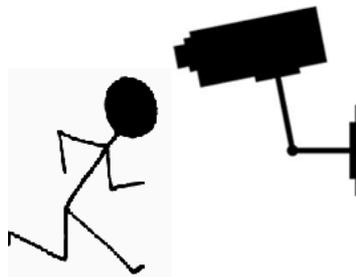


Figure 7. Object recognition using IR cameras.

4. Conclusion

The current scheme that is, stamp tour services using IR cameras is expected, when commercialized, to receive more refined solutions or propositions from practitioners. In addition to technical elements proposed herein, the scheme

can evolve by further incorporating a solution that provides actions to take against dangerous situations during touring. It could also lead to the creation of a new market in demand of cameras using object recognition technology and achieve the desired effect of putting object tracking

technology into practice. The direction for future research is to develop manuals, with focus on security issues, allowing in-field personnel to deal with image retrieving with more ease and less discomfort, or network-based solutions staying away from localized historic heritage exploration tours.

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