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An Intelligent Gradient Detector with Minimization of Visual Landmarks Distortion for Monitoring of Passenger Flows

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Abstract

In this paper, we study the problem of monitoring of passenger flows. We consider an intelligent gradient algorithm to solve the problem. We use a method of minimization of visual landmarks distortion to improve the quality of recognition.

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The problem of monitoring of passenger flows extensively studied recently (see e.g. [1] – [3]). In particular, an intelligent gradient algorithm to solve

the problem was proposed in [3]. This algorithm uses the intelligent visual landmarks model from [1]. This model allow the algorithm re-adjust reference images. In this paper, we consider a method of minimization of visual landmarks distortion to improve the quality of recognition.

Let $V(\mathrm{Im})$ be the set of detected visual landmarks of the image Im. We can consider two consecutive images Im[1] and Im[2].

We can define each mapping from $V(\mathrm{Im}[1])$ to $V(\mathrm{Im}[2])$ as a function F. We can assume that

$$F(x) \in V(\mathrm{Im}[2]) \cup \{\infty\},$$

for any $x \in V(\mathrm{Im}[1])$. Also, we assume that if

$$x[1] \neq x[2],$$

then

$$F(x[1]) \neq F(x[2]).$$

Let

$$W(\mathrm{Im}[1]) \subseteq V(\mathrm{Im}[1])$$

such that $x \in W(\mathrm{Im}[1])$ if and only if $F(x) \neq \infty$.

Let $K = |W(\mathrm{Im}[1])|$. We assume that

$$W(\mathrm{Im}[1]) = \{x[1], x[2], \ldots, x[K]\}.$$

To minimize the distortion of visual landmarks in space of the image, we can minimize the following energy function [4]:

$$E = \sum_{i=1}^{K} \parallel F(x[i]) - x[i] \parallel + \lambda E_F$$

where

$$E_F = \int\int_{\mathrm{Im}} (F''_{xx} + 2F''_{xy} + F''_{yy}) dxdy,$$

λ is the regularization parameter.

Usage of minimization of visual landmarks distortion allows us to use more similar landmarks in different positions. Let $N(m)$ be the number of visual landmarks that can be used without visual landmarks distortion for m consecutive images. Let $N_d(m)$ be the number of visual landmarks that can be used with visual landmarks distortion for m consecutive images. Selected experimental results are given in Tab. 1.

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m	2	10	10^2	10^3	10^4	10^5	10^6
$\frac{N(m)}{N_d(m)}$	84 %	82 %	76 %	71 %	42 %	12 %	0.3 %

Table 1: The number of visual landmarks for m consecutive images.

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