人脸检测技术在 ATM 自动识别功能拓展系统中应用

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摘　要：针对ATM机存在的不安全因素，开发研制了ATM自动识别功能拓展系统。鉴于人脸特征的独一无二性，在现有的ATM机上增加人脸识别作为一种身份验证手段。而人脸检测是人脸识别的首要环节，采用了基于AdaBoost算法，构造了人脸检测系统。实验结果表明，该算法实现人脸检测时间在70ms左右，在环境较好的情况下，可有效检测单个人脸和多个人脸，满足了该系统的要求。

关键词：人脸检测；ATM；自动识别；AdaBoost 算法

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0　引言

针对目前银行系统中ATM(Automatic Teller Machine)自动柜员机存在的不安全因素，开发研制了ATM自动识别功能拓展系统，该系统将生物识别技术与ATM系统结合，在现有的ATM机上，增加人脸识别等识别功能，有效保护银行声誉和持卡人合法利益的设计。

人脸特征是人体独一无二的"身份证"，是与人不可分割的，具有获取直接、友好、鉴别简便、安全性高、随身携带等特点，因此人脸识别适合作为ATM系统的一种身份验证手段。而人脸检测是人脸识别首要环节，其处理的问题是确认输入图像中是否存在人脸，如果存在，则确定所有存在人脸的位置、大小、姿势。人脸检测是ATM自动识别功能拓展系统中的一项关键技术。

1　ATM 自动识别功能的拓展系统

目前市场上使用的 ATM 柜员机，仅具备一些必备的功能，存在许多不安全因素，如 ATM 被恶意破坏、出钞口被蓄意改造、出钞口吐钞与否、持卡人有无取钞、无法确定取款人、使用假卡、盗用卡等。

针对目前 ATM 自动柜员机使用过程中存在的不安全因素，运用生物识别技术，在现有的 ATM 自动柜员机上拓展人脸识别等识别方式，以增强 ATM 自动柜员机的自动识别及安全监控能力。

1.1　ATM 自动识别功能拓展系统的组成

ATM 自动识别功能拓展系统，由 ATM 机、自动识别功能软件组成。人脸识别模块是自动识别功能的一部分，是利用取款人的人脸图像的自动识别进行身份鉴别，防范恶意持卡人的诈骗行为。

系统硬件由ATM自动柜员机、两个摄像头、人体接近传感器、出钞口传感器、振动传感器、DSP处理器、计算机及接口电路等设备组成。摄像头均采用针孔式，用来采集取款人的人脸图像和信息，DSP和计算机用于图像处理和信息比对。

1.2　ATM 自动识别功能拓展系统的功能结构

在整个系统中，图像采集装置用于采集取款人的图像信息并将其传输给 DSP 处理器，由 DSP 处理器提取图像特征信息，将其转化为数字编码，并对该数字编码进行实时计算和处理；同时将处理结果传递给终端计算机，由终端计算机将计算和处理的结果与其数据库中存储的持卡人图像数据进行信息比对，确定其相似度；如果相似度大于规定的阈值，则说明取款人的信息与数据库中持卡人的图像数据信息匹配，此时终端计算机发出吐钞指令，ATM 自动柜员机吐钞，完成取款过程；若取款人的信息与数据库中持卡人的信息不匹配，则终端计算机报警。通过取款人与持卡人的信息比对，可以确定取款人身份的真伪，避免了取款人使用假卡、盗用卡盗取持卡人的钱款；并且可以实时记录和显示取款人图像信息，将其与终端计算机数据库中犯罪分子图像作比对，以便及时报告警方。

2　人脸的检测技术

人脸检测问题一直备受关注，在很大程度上源于其自身的难度，主要包括：脸型、肤色、表情、姿态的多样性、人脸局部遮挡、光照影响、人脸图像的成像质量[1]等。人脸检测的现有方法很多，主要有：基于特征的算法、基于人脸肤色的算法和基于统计模型的算法。其中基于统计模型的算法，是目前解决复杂背景图像中人脸检测问题的有效途径。1995年，Freund 和Schapire [2][3]提出了AdaBoost（Adaptive Boosting）算法，最近,Viola 等人[4]提出了一种基于Haar 型特征的Adaboost 算法，是目前正确率最高的算法之一，而在速度上要远远快于几乎所有其他算法,达到实时效果。

2.1　AdaBoost 算法的描述

AdaBoost算法的基本思想是它将单个目标特征作为弱学习算法，给定一个训练集 $(x_i, y_i), \cdots, (x_L, y_L)$，其中，$x_i$是输入的训练样本，$y_i$是分类的类别标志。由于人脸检测的任务是判断某幅图像是否是人脸图像，因而可以视为两类

区分问题，故可以取$y_i \in (1,0)$分别表示真假样本。在初始化时，对所有训练样本均赋以一个相同的权重，然后用该弱学习算法对训练样本集进行T轮训练。在每一轮训练结束后，从若干个简单分类器中选择最小误差的那个，作为一个弱分类器h_i，并对训练失败的样本赋以较大的权重，以便让学习算法在后来的学习中，主要对比较难的训练样本进行学习。这样，就可以得到一个弱分类器序列($h_1, h_2, \cdots, h_t$)，其中，分类效果比较好的权重较大。最终的分类函数$f(x)$采用一种有权重的投票方式产生，即将多个弱分类器通过一定的方法叠加(boost)起来组合成一个强分类器，即

$$f(x) = \sum_{t=1}^{T} \alpha_t h_t(x) \tag{1}$$

该算法通过结合多个特征构造的强分类器，共同完成目标的检测任务，大大提高了检测的稳定性和精度。具体算法如下：

(1) 对于训练集合(x_1，y_2)，$\cdots$，(x_L，y_L)，(g_j，y_L) $g_j(x_i)$代表第i个训练图像的第j个Haar-Like特征，$y_i \in (1,0)$分别表示真假样本。

(2) 初始化权重w_1，$i=1/2m$，$1/2n$，其中m，n分别是真样本、假样本的数目，总样本数$L=m+n$。

(3) 寻找T个弱分类器$h_t(t=1,2,\cdots,T)$。

1）对所有样本的权重进行归一化

$$w_{t,i} = w_{t,i} / \sum_{i=1}^{L} w_{t,j} \tag{2}$$

2）对于每个样本中第j个 Haar-Like 特征，可以得到一个简单分类器h_j，也就是确定阈值θ_j和偏置p_j，使得误差$\varepsilon_j = \sum_{i=1}^{L} w_{t,j} | h_j(x_j) - y_i |$达到最小，而

$$h_j(x) = \begin{cases} 1 & p_j g_j(x) < p_j \theta_j \\ 2 & \text{其他} \end{cases} \tag{3}$$

偏置p_j决定不等式方向，只有± 1两种情况。

3) 在确定的简单分类器中，找出一个具有最小误差ε_t的弱分类器h_t。

4) 对所有样本的权重进行更新：

$w_{t+1,i} = w_{t,i}\beta_t^{1-e_i}$，其中$\beta_t = \varepsilon_t/(1-\varepsilon_t)$，如果$x_i$被$h_t$正确分类，则$e_i = 0$，反之$e_i = 1$。

(4)最后得到的强分类器为

$$H(x) = \begin{cases} 1 & \sum_{t=1}^{T} \alpha_t h_t(x) \geq 0.5 \sum_{t=1}^{T} \alpha_t \\ 2 & \text{其他} \end{cases} \tag{4}$$

其中$\alpha_t = \ln(1/\beta_t)$，是根据$h_t$的预测错误衡量的，也就是对第$t$轮产生的分类规则$h_t$的评价，$a_t$越大，$h_t$的重要性越大。

2.2　实验结果

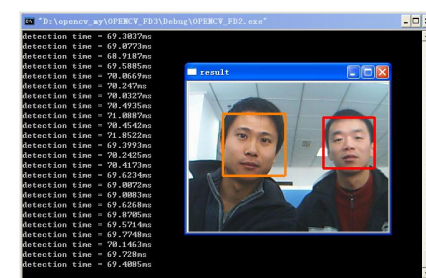在 ATM 自动识别功能拓展系统中，我们基于 AdaBoost 算法构造了人脸检测系统，实验结果如图 1 所示。目前在 ATM 自动识别功能拓展系统中，使用该算法实现人脸的检测时间在 70ms 左右，在环境较好的情况下，可有效地检测单个人脸和多个人脸。

3　结论

针对ATM机存在的不安全因素，开发研制了ATM自动识别功能拓展系统，在现有的ATM机上增加人脸识别功能，而人脸检测是人脸识别首要环节，是该系统中的一项关键技术。采用了基于AdaBoost算法，构造了人脸检测系统，实验结果表明，该算法实现人脸检测时间在70ms左右，在环境较好的情况下，可有效检测单个人脸和多个人脸，满足了ATM自动识别功能拓展系统的要求。
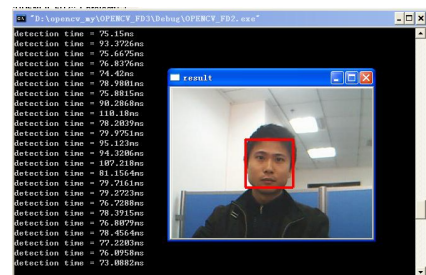
（a）单人

（b）多人

图2　人脸检测图片

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The Key Elements of Successful Application of Electronic Medical Records··（21）

Wang Yi, Xia Chuanjiang (Information Center of Fudan University, Shanghai Cancer Center, Shanghai 200032, China)

Abstract: Fudan University Shanghai Cancer Center has been established EMR (Electronic Medical Records) system since 2005, and integrated with HIS, LIS, RIS, PACS systems. During the implementation of EMR, our hospital has been greatly improved in medical process optimization, quality of healthcare, efficiency and medical research. Based on the successful experience of Fudan University Shanghai Cancer Center, several key elements are summarized including the top-down management and goal-oriented management in the management aspects and including integration, comprehensive and values on the technical side.
Key words: EMR; Key Elements of Management; Key Elements of Technical; Fellow-up

The Application of Face Detection Techniques in ATM Automatic Identification Function Expands System ·····················（24）

ZHANG Minghui[1,2],ZHANG YaoYu [2](1.Changchun Aviation Institute of Chinese Air Force, Changchun 130022, China 2. Changchun Institute of Optics, Fine Mechanics and Physics, Changchun 130033, China)

Abstract: The ATM automatic identification function expanding system is developed in the light of ATM machine safety factor.Seeing that people's face characteristic is unique,it increases the face recognition means on existing ATM as a kind of identity in order.And face detection is primary links of face recognition,the system adopts AdaBoost algorithm conforming face detection.Experiment results demonstrate that people's face detection time is about 70ms using this algorithm,and can effectively measure the single and many personal faces under better environment,meeting the demand of the system.
Key words: Face Detection; ATM Auto Recognition; AdaBoost Algorithm

Automatic Monitoring and Alarm System for High-school Network··（26）

DING Qing,FAN Qingya ,YU Haiping,ZHANG Yidong,JI Xiang(Net Center,College of Engineering,Nanjing Agricultural University，Nanjing 210031,China)

Abstract: Increasingly complicated high-school network brings high frequency of network faults and improve management efficiency.Faced with automatic changing network, the management more and more focus on the automatic monitoring system.As the rapid development of the mobile communication technology, short message service (sms) gets rapid development. The Automatic Monitoring and Alarm System for High-school Network is proposed and developed independently in this paper.The system is implemented using the advanced NET technology,in which core devices and servers of high-school network will be checked every several minutes and short message alarm will be sent to network administrators if there is something wrong in order to save manpower and resource.What's more, specific alarm strategy is adopted to control the system cost, which enhances the usability in practice.
Key words: High-school Network; Monitor; Alarm; Short Message; NET

Design and Development on CD-ROM/DVD Motor Drive Circuit··（29）

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Abstract: This article introduces the design of a CD-ROM/DVD motor driver IC and describes its functions concisely.Taking AM5954 as an example, this paper gives the operating principle of the voltage reference in key functional modules, the thermal protection circuit, the current transfer circuit and the Cascode operational amplifier with mathematical derivation.Finally,the design of layout is discussed,especially the difficulty and key point in the layout design of a motor driver IC, and corresponding solutions are provided.
Key words: Band-gap Reference; Temperature Hysteresis Protection; Current Transmit; Cascode Operation Amplifier

The Design and Implementation on Electronic Balance Testing Platform··（33）

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Abstract: This paper discusses the function design of electronic balance testing platform and its implementation. This testing platform uses Visual Basic as programming tool and database as the test data storage system. With the friendly interactive interface,the platform realizes data acquisition,data storage, data analysis,real-time curve display,and mathematics modeling. This platform can be used as the base for improvement and development of new high precision electronic balance.
Key words: Electronic Balance; Test System; Visual Basic; Digital Filtering; Mathematical Model

Research and Realization on Interface between Softwares··（36）

XIAO Ruohui (Wenzhou Vocation College of Science and Technology, WenZhou 325006, China)

Abstract: Interconnection of software,which limited network bandwidth, data capacity,and data complicated to operate,the design idea of "middleware" has been used.Then "Interface middleware " concept and design of the interface middleware protocol are proposed.A cross - Platform interface design which meet the requirement of large-scale data communicating after practice is explored in this paper.
Key words: Middleware; Cross-platform; Communication Protocol

Implementation of Plate Information Management System Based on PDA and Web Service··（38）

WANG Deguang (Software Technology Institute, Dalian Jiaotong University, Dalian 116052, China)

Abstract: To address the Dalian Shipbuilding Industry Co., Ltd.A factory of steel plate library of information collection and efficient processing,a plate information manageable system which bases on PDA and Web Service is presented. Users scan Barcode from the steel plate by PDA which transmits data to the Web Service client via wireless AP after the data processed,and interacts with the database and feedbacks results to the user.Finally, the results show that the system ends users manually record the history of plate information,improves work efficiency,and manages plates on real-time,information and visual.
Key words: PDA; Web Service; WLAN; Barcode; Windows Mobile

TECHNICAL COMMUNICATION

Analysis and Capture of the Definition of the Face in the Motion ImagesT··（40）

Li Ke, Liu Yuncai (Institute of Image Processing and Pattern Recognition, Shanghai Jiaotong University, Shanghai 200240, China)

Abstract: The definition of the image mostly depends on the energy of the high frequency.FFT and wavelet transform are two excellent transform tools. This paper proposes a method using FFT and wavelet transform to analyze the face definition in the motion images, which consists of three steps: Firstly, the image by Histogram equalization and morphology are processed.Secondly, face detection and tracking are processed. Finally, the clearest face are captured.Through comparing the FFT with wavelet transform, the experimental results show that the bior wavelet is the most efficient.
Key words: Face Detection; Face Tracking; FFT; Bior Wavelet; Haar Wavelet

A New Fast License Plate Location Algorithm··（42）

Pu Dongbing, Zhao Dawei, Zhao Donglai, Ma Zhiqiang (School of Computer, Northeast Normal University, ChangChun 130024, China)

Abstract: This paper presents a fast algorithm for license plate location.Firstly, the new algorithm analyses the obtained vehicle's license regional characters distributions and changes according to the characteristics of image texture which is pretreated.Secondly,the advantage of pixel's change frequency to point the horizontal and vertical positions of the vehicle plate under a given scope are taken.Finally,experimental results show that the algorithm proposed in this paper can be used to quickly position the region of the license plate.
Key words: Intelligent Transportation; Image Processing; License Plate Recognition; License Plate Location