

Design of Intelligent Mobile Human Recognition and Location Identification System Based On Arm7 and OpenCV



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Abstract : This paper presents the development of an intelligent portable human recognition and location identification system using ARM7 based microcontroller, OpenCV based machine and advanced communication technologies like GPS and GSM. With the development of video surveillance gradually from the traditional security surveillance to intelligent surveillance, we present a method, to process the image and matching the detected image or face to one of many the faces known to the file system, now this system generates a command to perform location identification using GPS and forward the necessary information about the identified person using GSM. The hardware system is developed and tested successfully.

Key Words : Human Recognition, ARM7, OpenCV, GSM, GPS.

INTRODUCTION

With the rapid development of internet and multimedia technology, image processing-based intelligent surveillance system is widely used in various monitoring sites. Face based applications such as lip detection, face recognition and video surveillance systems have been more popular in computer vision topic during past several years. Such systems perform image processing on the human face and produce throughputs according to their purpose. It can be seen easily that the main step of those applications is detecting the human face in the given video frame or image; hence face detection is very important for such applications [1].

There are many results reported by researchers for face detection in the past decades especially for frontal images [2]-[8]. However, some problems in face detection are not fully solved yet because of face is non rigid object. Besides, its appearance is varied depending on face position, illumination, face scale, facial expression, skin color, etc.

The objective of this study is to develop human detection and location identification system using ARM7 and OpenCV library with capability to capture the object that appears in front of camera in a short time. However, due to the most algorithms complexity and poor real time function, it is difficult to make reality with engineering. Therefore, this paper presents digital

image processing in a powerful combination of OpenCV and ARM7 to build a new intelligent system.

FACE DETECTION IN OPENCV LIBRARY

OpenCV(Open source computer vision) is a library of digital image processing and computer vision, by the Intel Microprocessor Research Lab of the visual interaction group development [9]. OpenCV is written in C and C++can be used under the windows system and Linux system, the library is open source. There is active development on interfaces for Python, Ruby, Matlab and other languages. OpenCV was designed for computational efficiency and with a strong focus on real time applications. OpenCV automatically uses the appropriate integrated performance primitives (IPP) library at runtime if that library is installed.

The OpenCV library contains over 500 functions that span many areas in vision, including factory product inspection, medical imaging, security, user interface, camera calibration, stereo vision, and robotics. OpenCV provides many standard image processing algorithms, these functions can be directly used in specific video development projects, the scientific research and developers could complete the development of large complex tasks by just adding their own written procedures, it is so-called "get twice the result with half the effort".

SYSTEM FUNCTION AND COMPOSITION

As shown in the fig 1,this system builds a new intelligent human recognition system based on ARM7 embedded processing technology, processing technology of digital videos, image identification technology, GSM wireless mobile telecommunication technology, GPS positioning technique, implements the checking to images continuously taken by a camera. This system has the following features:

- 1) *Image capture:* When the system works, the camera collects the data automatically and saves it in the video buffer;
- 2) *Human recognition:* The system recognizes human face

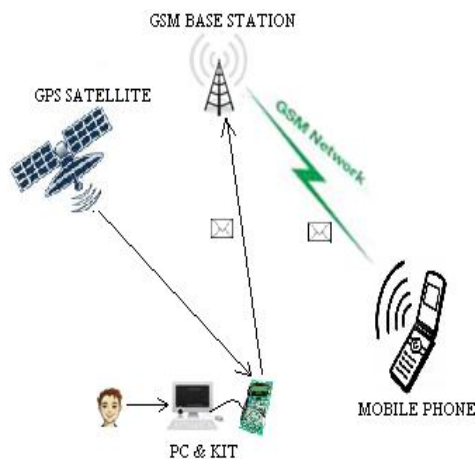


Fig 1: System Composition

- by digital video data;
- 3) *Communication function:* The human recognition terminal communicates with the mobile phone by the SMS message on the GSM network;
 - 4) *GPS positioning:* The system can correctly send the location coordinates to the hardware module or kit when a person is detected, therefore, the terminals can be coordinated properly.
 - 5) *GSM network:* The system sends the message to mobile phone via the GSM network wherever the human face is recognized.

Intelligent human recognition system is composed of ARM7 microprocessor, peripheral equipment, and video capture device, GPS positioning module, wireless telecommunication module. The detailed hardware composition is shown in fig 2.

HARDWARE DESIGN

A. ARM7 microprocessor and peripheral equipment:

The circuit of ARM7 microprocessor and peripheral equipment includes an ARM7 chip, a clock circuit, a reset 115 circuit, a 32MB flash memory, a LCD. All of these make up the control and process core of the system.

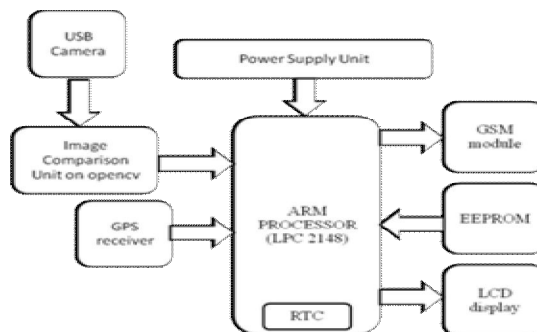


Fig 2: Hardware Composition

B. Video capture:

The video capture module includes: video decoder and output, data buffering and data transmission. The implementation-principle of video capture is shown in fig 3. The analog video signal captured from the camera is changed to digital signal by SAAA7111A signal-chip video decoder. The SAAA7111A signal chip is initialized and controlled by ARM7. The SAAA7111A output data is written into FIFO buffer. The ARM7 generates interrupt when the data reaches a certain amount. The DMA is started after ARM7 interrupt and sends the video data into buffer.

C. Equation output and input of GPS data:

The GPS module can receive the data when connected to ARM7 development-board URAT0 through RS232 port. When the ARM7 chip sends the instruction AT to GPS module, the GPS module starts receiving the data and saves it into memory. This instruction sends the region information with the detected person information to the predefined mobile number.

D. GSM Wireless Communication:

The GSM module is installed on the development-board, the RS232 port on the development-board is connected to URAT1 on the ARM7 experiment & development board in order to implement that the ARM7 chip has control over the GSM communication device. The GSM device is controlled by the ARM7 through AT instructions. The GSM device has message operation instructions and TCP/IP operation instructions. Some simple operations, such as signal strength checking, module vision checking, serial port baud rate checking, SIM card state reading, should be done when the GSM device connects to the support-server center. After making sure that the state which the ARM7experiment-development board connects to the server center by the GSM device is normal, the ARM7 chip outputs the AT instructions in order to send the recognized face information which is acquired by image capture module and image information

which is acquired by image reading and distinguishing device to the mobile phone through GSM network.

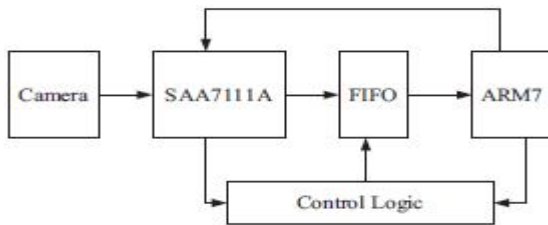


Fig 3: Principle of Video Capture

The LCD screen on the board shows the longitudinal and latitudinal coordinates.

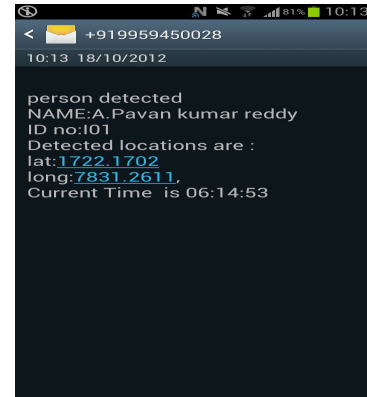


Fig 4: Received Message

SOFTWARE DESIGN

The software of the new intelligent human recognition system includes two parts, the OpenCV software and embedded terminal software. The development of the software is based on ADS integrated development environment.

A. Introduction of ADS integrated development environment:

The ADS integrated development environment is a microcontroller for ARM which is developed by the ARM Company, its full name is ARM Developer Suit and the mature vision is ADS1.2. ADS1.2 supports the entire ARM microcontroller before ARM10, supports the software debug and JTAG simulate, supports the assembly language, C and C++ language. It has the merits of high compile efficiency and rich system libraries. The environment can run on Windows98 Windows XP Windows 2000 and Red Hat Linux.

B. OpenCV:

OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real time computer vision. It is free for use under the open source BSD license. The library is cross-platform. It focuses mainly on real-time image processing.

Face detection is a computer technology that determines the locations and sizes of human faces in arbitrary (digital) images. It detects facial features and ignores anything else, such as buildings, trees and bodies.

RESULT

The figure below shows the message sent to a predefined mobile number with the information like person name, ID no., detected locations and time of detection.

The fig 5 below shows complete hardware module, consisting of LPC2148 board, GSM module and GPS module.

OpenCV installed in pc is not shown in the hardware module.

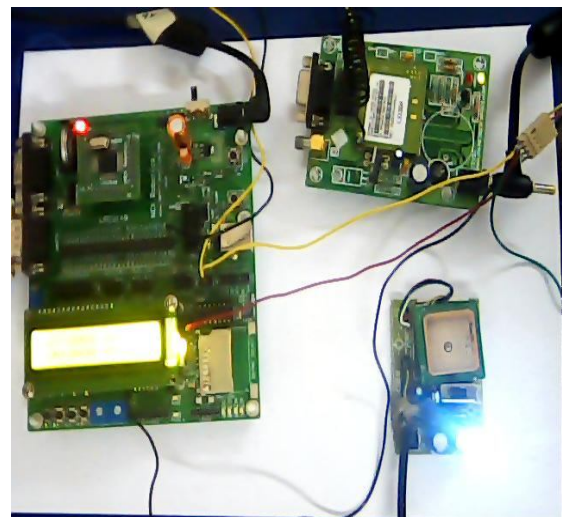


Fig 5: Hardware Kit

CONCLUSION

This paper has studied the methods of human recognition and location identification by flexible use of OpenCV, the wireless communication technology to form a complete intelligent surveillance system. The system has the advantages of small size, low costs full featured and powerful expansibility. We deeply believe that the design model of this intelligent surveillance system has considerable practicality and significance of promotion.

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