Implementation of an Embedded System for Image Tracking Using Web Camera (ICCAS 2005)

Chul Nam*, Kwan- ong Ha*, odgelral*, Hie-Sik Kim*
* Department of Electrical Engineering, University of Seoul, Korea
(Tel : +82-2-2210-2210; E-mail: namchul@uos.ac.kr)

Abstract: An embedded system has been applied to many fields including households and industrial sites. In the past, user interface products with simple functions were commercialized .but now user demands are increasing and the system has more various applicable fields due to a high penetration rate of the Internet. Therefore, the demand for embedded system is tend to rise In this paper, we Implementation of an embedded system for image tracking. This system is used a fixed IP for the reliable server operation on TCP/IP networks. A real time broadcasting of video image on the internet was developed by using an USB camera on the embedded Linux system. The digital camera is connected at the USB host port of the embedded board. all input images from the video camera is continuously stored as a compressed JPEG file in a directory at the Linux web-server. And each frame image data from web camera is compared for measurement of displacement Vector. That used Block matching algorithm and edge detection algorithm for past speed. And the displacement vector is used at pan/tilt motor control through RS232 serial cable. The embedded board utilized the S3C2410 MPU Which used the ARM 920T core form Samsung. The operating system was ported to embedded Linux kernel and mounted of root file system. And the stored images are sent to the client PC through the web browser. It used the network function of Linux and it developed a program with protocol of the TCP/IP.

Keywords: Embedded System , CGI, Image Tracking, BMA

1. INTRODUCTION

In the Information and communication field of 21 centuries many products have been applied by embedded system and embedded equipment is connected with wire-less or wire net-work system.

In this study, we constructed embedded system with embedded Linux and looking at the object that is moving continuously by using Web Camera. Embedded board works with fixed IP and network environment. The image is compared with BMA (Block Matching algorithm)[1][3] 8*8 block. We continuously observe the moving object through the pan/tilt motor control on the web camera. The input images are real-time broadcasting with CGI (Common Gateway Interface) program on the network[7]. this real-time image broadcasting system will be using on the many industry field or at home for visual monitoring.

2. System Design and Architecture

2.1 System Development Environment

Fig1 is Development Environment on the embedded system for real-time image broadcasting with USB camera.

It is composed whit Host PC (Linux server) and SoB(System on Board), HUB(Ethernet LAN), JTAG Dongle, RS232 Serial Cable. Host PC is using Red Hat Linux 7.1 to operating system.

The kernel is using linux2.4.18 that is same at the SoB using. it was kernel compile for adjustment hard ware environment.

The host pc is using for Flash Memory Setting and Kernel compile and that is using for cross compile Root file system and user file system

The embedded board utilized the S3C2410 MPU. that used the ARM 920T core form Samsung. And this board have UART, USB, Memory Controller and 64M Flash memory and 64M SDRAM .

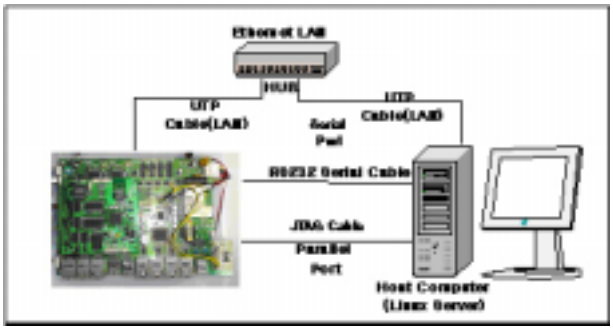

Fig 1 Development Environment

2.2 The Communication Environment between ost PC and Target oard

It is very important that make the net-work environment on the embedded system

Network environment is to be best efficiency Target board Of poor work environment in Host PC But physical connection between Host PC and Target have to be considered to construct network environment.

In this system, we used Parallel telecommunication that uses

JTAG Dongle and serial telecommunication that uses RS232 At the same time and used Minicom with emulator. Basically HOST PC was constructed to act with NFS SERVER, FTP SERVER. Through this network environment, we could work with HOST PC that has better development environment than embedded system. Also we could experiment with this way that colonize execution file to embedded board that was made from Cross Compiler.

2.3 Image tracking algorithm

To chase real time moving object, ED (Edge Detection) and BMA (Block Matching Algorithm)[4] is used frequently
ED way needs a lot of time. Because that has to work complicate calculation about every pixel.
So, that way is not profitable for image processing for moving object. BMA is much faster than ED. But BMA has a possibility that Can error by accident. Also it is fixed Block size for convenience of operation. In this paper we used ED and BMA those have advantages so we obtain more fast speed at Image tracking.
in BMA is block by block matching algorithm that used for image processing.
That is using with the Maximum correlation for analyzing Previous (n) frame and Current (n-1) frame block data.
MAD(Mean Absolute Difference 와 MSB(Mean Squared Difference) is using for BMA. The Following equations define the MAD and MSD mathematical. [6]

$$MSD(u,v)=\frac{1}{N_1N_2}\sum_{i=0}^{N_1-1}\sum_{J=0}^{N_2-1}[L^{N+1}(i+u,j+v-L^n(i,j)]^2 \quad (1)$$

$$MAD(u,v)=\frac{1}{N_1N_2}\sum_{i=0}^{N_1-1}\sum_{J=0}^{N_2-1}[L^{N+1}(i+u,j+v-L^n(i,j)] \quad (2)$$

where Land L represent values of pixel in (n)th and (n+1)th frame respectively and (u, v) is a search point in the search area, N*N represent values of block size, MAD has been used more widely then MSD because MAD requires less computations and also is easier to implement the hardware then MSD. If the over crossed block have similar brightness the value of MSD and MAD is convergence to 0
If frame sizes (R*C) and block sizes (M*N) that are compared with block by block (R-M)*(C-N).
the frame sizes 320*240pixel and divided 8*8 block that is block size 40*30 pixel so that have a chance at 280*210 times over cross. So it occur time complexity problem.
In case MAD have to subtract calculation each over crossed status so total number of calculations are (R*M) * (C-N) * (M*N)
T(total) = (R*M)*(C-N)*(M*N)
So these algorithms are not suitable for past image processing on the embedded system.
we used RB(Representative Block) [6] for measurement Moving Object s displacement Vector. In this method is using that the representative block value.

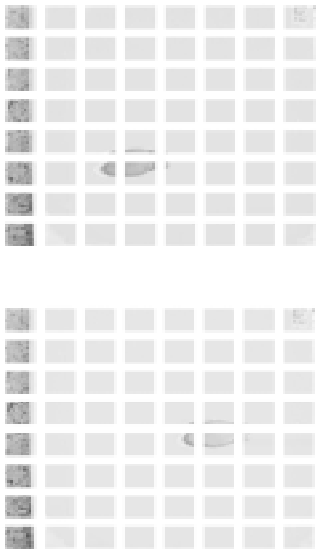

Fig 2 lock Matching Motion Estimation

as shown Fig.2, in the (n) frame and (n+1) frame moving objects have different RB value. Because they have same backgrounds so we detect the motion vector by compared block s represent value .

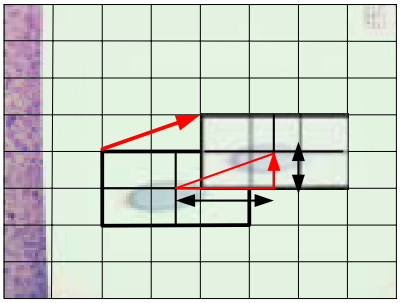

Fig 3 Motion Vector

2.4 pan tilt motor control

The displacement Vector value is used at the pan/tilt motor control by RS232 serial cable Table1 shows telecommunication information

Table 1 Set the Serial Environment

Baud Rate	19200bps	Parity bit	None
Data bit	8bits	Stop bit	1bit
Tilt Offset	0~60	Pan Offset	0~180

Pan/tilt moving values are using 2Byte
Pan Moving: (360/412.3) degree per offset value

Tilt Moving : (360/362.15)degree per offset value

3. Implementation of the Image Tracking system

3.1 The System

In order to measure a gap of moving substance, it is needed to compare of screen data from web camera.

Fig4 is system flowchart for image tracking

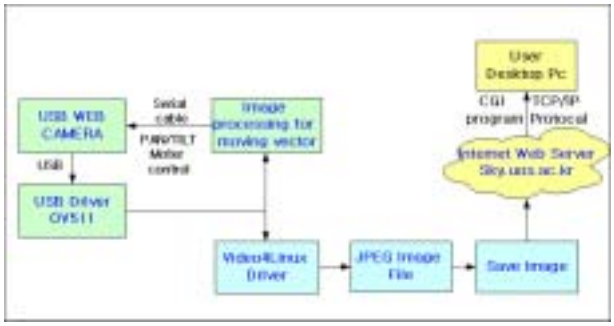

Fig 4 System Flow Chart

An embedded board is connected with USB and Serial port. USB is a terminal of image frame via vision sensor, and RS232 Serial cable is using for controlling of pan/tilt motor.

The methods of installation for embedded system are using web camera, one the device driver including into the Linux kernel another insert the module in Kernel. This examination is used device driver module in kernel. To install USB camera is needed to appropriate circumstance. Embedded board works with fixed IP, can get over sharing memory via NFS server with HOST PC.

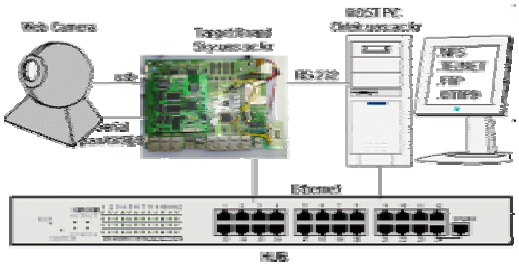

Fig 5 Image Tracking System

3.2 Implementation Web Server on the Embedded System

This embedded System is used to Boa web sever utility because this embedded system have small memory ability. Images are transport by CGI (Common Gateway Interface) program[5]. Web server was designed of HTML. And These data from USB Digital, stored to JPEG file system caused to Web camera program embedded Linux [2]

The data of JPEG is stored to unique directory and Client PC updates to web and will be matched changeable time in TCP/IP

There is a html coding.

META HTTP-EQUIV="pragma" CONTENT="no-cache"

META HTTP-EQUIV="refresh" CONTENT="1"

Table 2 shows how to install and stop exactly

Table 2 Shell program for install web camera

```
WEBCAM DIR=/usr/local/webcam
webcamd= WEBCAM DIR/webcam
prog=webcam
RETVAL=0
CONFIG FILE= WEBCAM DIR/webcamrc
CAMIMGES DIR=/var/camimages
MODULES FILE=/usr/lib/modules/spca50x.o
CAM MODULE=spca50x
start() {echo -n "Starting webcamd: "
        insmod MODULES FILE
          webcamd CONFIG FILE &
        echo
}
stop() { echo -n "Stopping prog: "
        killproc webcamd
        echo
        rmmod CAM MODULE
        echo
}
```

Fig 6 shows embedded system contacted client PC storing file of USB camera. We can monitor embedded system using digital camera into moving object by real time.

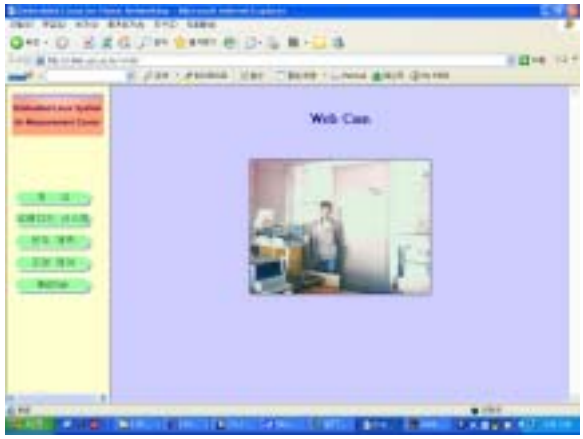

Fig The image of web site

http: sky.uos.ac.kr

4. CONCLUSIONS

In this paper We measure displacement Vector of moving object through the Black Matching Algorithm and Represent block algorithm. [6]

this system we fixed image at 320*240 pixel format we obtain about 5frame/sec data and it possible to image broadcasting by network. Those real-time image broadcasting system will be using on the many industry field

or home-network for monitoring. Just a few costs

5. REFERENCES

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