REAL TIME TRAFFIC MONITORING SYSTEM BASED ON ARM

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Abstract— Different monitoring systems are used for video surveillance, such as analog based monitoring system, PC based monitoring system etc. These monitoring systems have different disadvantages such as they are only suitable for small scale monitoring, size is large, and system installation cost is high. The main focus of ARM based digital video monitoring system is to provide efficient and high quality video surveillance which is cost effective. ARM based digital video monitoring system consist Hardware platform that uses Samsung S32440 processor in which ARM is act as control panel. ARM has strong control transmission capacity and good video processing capability. Samsung S3C2440 uses H.264 video coding technique which is use for video encoding and decoding. S3C2440 consist of RTP (real time transport protocol) which completes video capture, encoding and transmission process. Samsung S3C2440 processor has small size and rich interface. Its frequency is up-to 433MHz. Software includes boot loader, Linux kernel. NAND flash driver & Network card driver are compiled directly into kernel. Video monitoring has been applied to variety of fields for example family security, traffic monitoring and telecom education. The system is cost effective and provides better video quality compare to other video compression techniques in terms of efficiency, reference frames, resolution.

Keywords- ARM9-S3C2440, real time traffic monitoring, H.264, video encoding& decoding.

I. INTRODUCTION

Real time video transmission is widely used in the fields for example, family security, traffic monitoring, tele-education, forest fire prevention and remote medical. In recent years there has been increase in video surveillance system in public & private environment due to high sense of security [2]. There are two main existing video monitoring systems. One is the traditional analog video monitoring system. It is only suitable for small-scale video monitoring and its extensibility is poor. Moreover, the disassembly process is very cumbersome. The other is a PC-based monitoring system. There are several problems in such system. Its size is large, installation process is very troublesome, development costs are relatively high and wiring is inconvenient. For this we are going to design ARM-based remote digital video monitoring systems. It uses ARM with H.264 codec, transmission and real-time display [1]. Previously CCTV'S are use for video surveillance, but there are some disadvantage of CCTV'S. CCTV'S are fail to achieve all the activities because of its position. CCTV'S are very expensive to install, this system is incompatible[14]. In the proposed system S3C2440 Samsung processor is used which has very high speed, high efficiency, low frame loss rate. It is convenient to install & also it is cost effective method. MATLAB based system can be used for video monitoring, but MATLAB is basically use for research & analysis purpose. If we think for such system their cost is very high. When we are going to product level we want an embedded system which is compact, highly reliable & efficient. Here Samsung S3C2440 Samsung processor with ARM architecture is use [4]. This makes the system compatible. In propose system H.264 coding technique is use for video coding & decoding, it is advance video coding technique as it is written in "EMBEDDED C" it is going to easily interface with ARM. Digital video is present in many applications, including video conferencing, video entertainment, DVDs, and broadcast television [9]. Since digital video requires a prohibitive amount of storage in uncompressed form, lossy digital video compression is commonly employed as a compromise between data rate and quality [6]. One of the most prevalent video compression standards is MPEG-2, found in DVD video. Recent advances in digital video coding tools have led to the introduction of the recent H.264 video coding standard, which promises increased visual quality and reduced bandwidth [1]. Although H.264 is similar to MPEG-2 in that both are hybrid coders that use motion compensation, H.264 also includes advanced features such as improved entropy encoding, in-loop filtering of reference frames, flexible macro block sizing, and multiple reference frame capability.

II. SOFTWRE DESIGN

The proposed system is defined under following stages.

1. Creating software environment

Software system uses boot-loader; which is piece of code that runs before operating system functions. LINUX 3.0.1 is used as an operating system.

2. Video capture

In this system video is capture using VGA camera. Camera driver is compiled directly into Linux kernel. The camera supports different data formats such as R.G.B, YUV, YCrVb.

3. Video encoding & decoding

H.264 video encoding & decoding algorithm is use which achieves 50% improvement in bit rate efficiency. H.264 is performing by MFC (Multi Format Codec) which is integrated in Samsung S3C2440 processor.

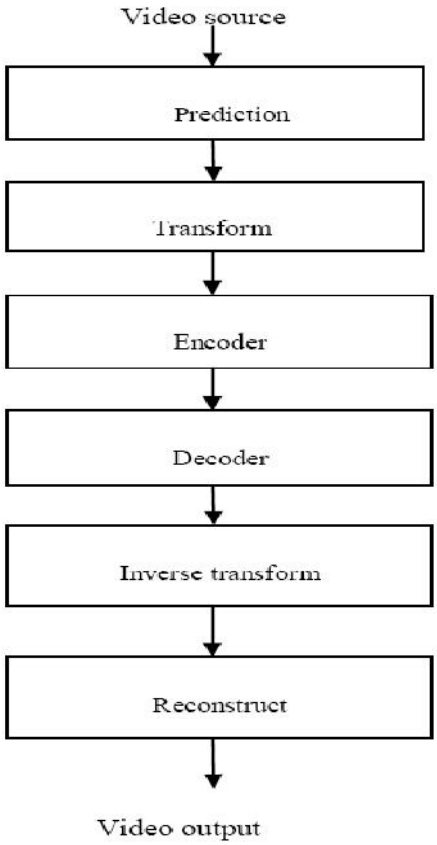

Fig1. H.264 video encoding & decoding.

A) Encoding Process

Encoder processes a video in terms of macroblock (16*16 displayed pixels). The Digitized video signal consist of sequence of images called frame. Each frame consist of two dimensional array of pixel, pixel data is converted from RGB to YUV, to compress macro block prediction, transformation, quantization & entropy coding is use.

1. Prediction

It forms a prediction of macroblock based on previously coded data either from current frame or from other frame. That other frame has been already coded & transmitted. Encoder subtracts prediction from current macroblock to form residual.

2. Transform

The difference between current macroblock & its prediction called residual is transformed from spatial domain to frequency domain. D.C.T transform is use because it has strong energy compaction & speed of operation is fast. The output of transform coefficients is quantized; each coefficient is divided by an integer value as shown in Figure 2.

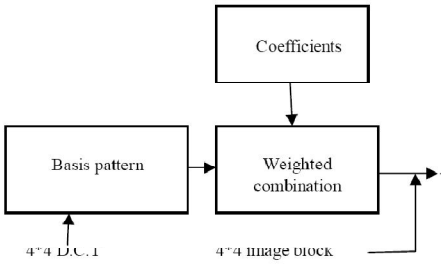

Figure 2. Transform procedure

3. Encoder

The video coding process produces a number of values that must be encoded to form compress bit stream. The values include quantized transform coefficients, information about the complete video sequence, and information about the structure of compress data. These values are converted into binary codes using variable length coding or arithmetic coding. Arithmetic coding achieves up-to 7% bit rate saving compare to variable length coding. Arithmetic coding encodes a symbol by its appearance probability. So it can represent symbol by its probability. After arithmetic coding, syntax element are decoded to get real syntax element value.

A) Decoding Process

1. Decoder

Video decoder receives the compressed H.264 bit stream, decode each of the syntax elements& extract the information such as quantized transform coefficients, prediction information. This information is then use to reverse coding process & recreate sequence of video images.

2. Rescaling & Inverse Transform

The quantized transform coefficients are rescaled. Each coefficient is multiplied by an integer value to restore its original scale an inverse transform combines basis pattern, weighted by the rescale coefficients to create each block of residual data.

3. Reconstruction

A reconstruction filter can be applied to decoded macroblock in order to reduce blocking distortion. For each macroblock, the decoder forms an identical prediction to the one created by the encoder. The decoder adds the prediction to the decoded residual to reconstruct a decoded macroblock which can be display as part of video frame. The filter has two advantages that block edges are smoothed, improving the appearance of image. Second advantage is filter macroblock is used motion compensated prediction of further frames in the encoder, resulting in smaller residual after prediction.

The biggest advantage of H.264 video encoding & decoding is its compression performance. It gives better image quality at lowest bit rate .H.264 video coding technique is now widely use in high definition internet video, video conferencing, mobile T.V broadcasting [6] .

III. HARDWARE DESIGN

The hardware approach uses ARM 9 architecture. Samsung S3C2440 processor is used whose frequency is upto 433 MHz. The board has inbuilt CMOS camera interface it can accessed via CON20. The board has got 41 pin display connector.

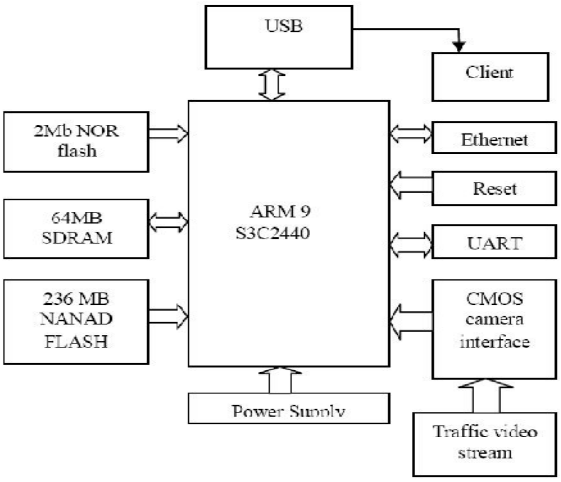

Fig 3. Overall System Structure

S3C2440 integrates multimedia encoding & decoding. Its size is small having greater interface capability. Samsung S3C2440 is cost effective, having low power consumption [8]. ARM platforms are easily available in market it has high speed & good video processing capability [10]. For supporting boot loader in the NAND flash is load to SDRAM & it is executed. The content of NAND flash is copied into SDRAM. S3C2440 UART provides 3 serial input & output port having baud rate of 1152 kbps. Camera continuously captures video of fabric production plant .video will be transferred to S3C2440 processor for video coding & decoding .The main goal of the system is to provide efficient & good quality video.

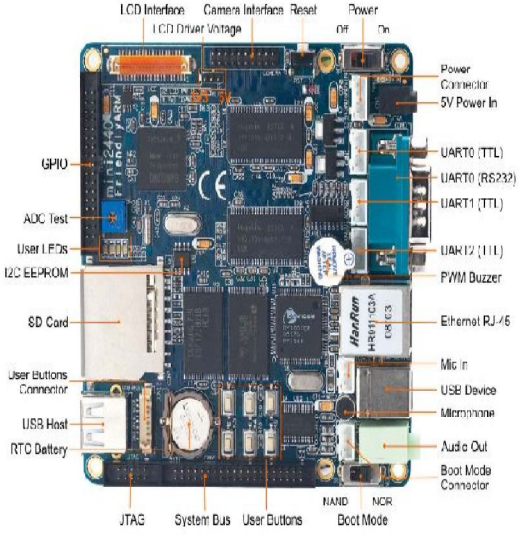

Fig4. Detail ARM board description

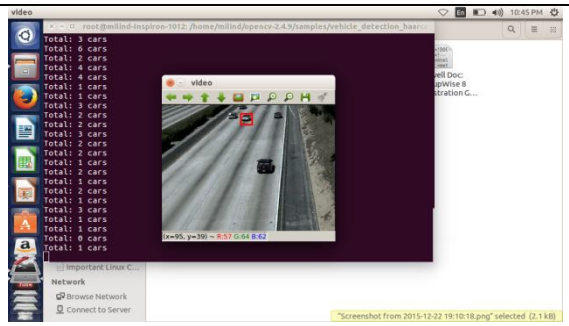

Fig5: Result Screen 1

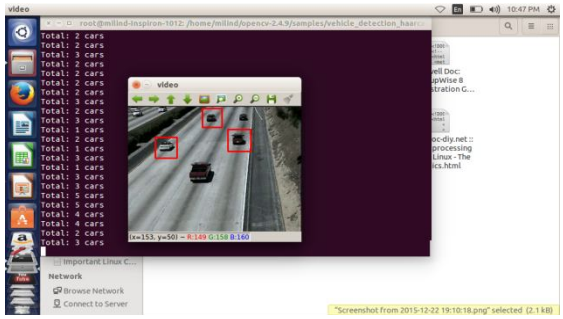

Fig6: Result Screen 2

Table1: Accuracy of system [6]

No of video	Detected vehicles	Actual vehicles	Probability of Detection
1	138	145	95.17
2	127	135	94.04

Table2: Comparison between H.264 & MPEG-4[7]

Parameter	H.264	MPEG-4
Block size	16*16 to 4*4	16*16 or 8*8
Transform	4*4 DCT	8*8 DCT
Entropy coding	CAVLC,CABAC	VLC
Ref frame	Multiple frames(5)	1 frame
Frame resolution	Very high	High
Coding efficiency	2	1

This real time system proves beneficial comparison to MPEG-2, MPEG-4. It has total five reference frames. Coding efficiency is doubled. It supports various entropy coding techniques such as VLC, CAVLC, CABAC. One of the major fields of traffic monitoring is to study traffic flow, traffic speed, traffic delays, traffic volume, through which short & long term planning can be done. Our system proves a new plan for real time traffic monitoring. This shows that H.264 is best technique compare to other video coding technique.

V. FUTURE DEVELOPMENT

The proposed system that provides efficient traffic video monitoring using H.264, i.e. object detection background subtraction method. However other parameters such as speed, type etc can be monitored further with some modification in the system. The main challenge for future research is to ensure the security of smart objects in the traffic monitoring management system. Further processing and analytics

of large volume of disparate data from traffic system can be defined to create applications that help to manage the traffic flow throughout the city.

CONCLUSION

ARM core unit is designed for real time traffic monitoring. H.264 video coding & decoding offers greater flexibility in terms of compression. The system have stable performance with low poor consumption. The video quality is best compare to MPEG-2, MPEG-4. This proves a small plug & play system that we can connect to LAN & WAN. The systems web server can directly connected to the network without cable length & signal attenuation. This system has a definite application in different real time video monitoring systems such as family security, video conferencing.

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