천이 시간 개선과 색검출 안정화 기반의 색 향상 시스템

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요 약

본 논문에서는 TV에 있어서 위상 정보를 이용하여 특정색을 조정할 경우 색신호의 천이 시간에서 발생하는 검출 오류들과 색신호의 안정화를 위한 색향상 시스템을 제안하였다. 제안한 색향상 시스템은 시간차 보정 방법을 적용하여 색신호와 색부 반송 신호의 전송 과정에서 발생하는 시간차를 보정하여 색신호 검출 오류를 줄였다. 또한 변화하는 색신호의 위상을 검출함에 있어서 실제적으로 존재하는 천이 시간에 따른 검출 오류를 개선하고자 수평 동기 시간내에서 검출 전압값의 평균 차성분을 구하여 이웃한 색신호의 최소 구별 전압값보다 큰값을 가질때 설정 기준색을 조정하도록 하는 안정화 방법을 제안하였다. 제안한 개선된 색향상 시스템은 기타의 색신호로 부터 보정 범위가 중복되지 않고 특정색의 검출 및 조정이 개선되었다.

Color Enhancement System Based on the Improvement of Transition Time and Color Detection Stability

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ABSTRACT

In this paper, we propose a color enhancement system which is based on the improvement of transition time problem and specific color detection stability. The proposed system apply the time difference correction step to corrects time difference which is taken place at the transimission process between color signal and color subcarrier signal and to reduce detection errors. And also, we proposed stability method to improve transition time problem and detection efficiency as the control of reference color. The proposed system controls specific color when the mean difference value of detected voltages greater than the value of minimum discriminate voltages of two adjacent color signals. Thus, the color enhancement system improves detection efficiency and controls specific color from the color signal without overlapping of correction range.

1. Introduction

Readjustment of incorrect color in the CPT has been a important problem at the view point of color reproduction[1]. The viewer can adjust the color control at the receiver for optimum color reproduction, but changes in color on a given picture as well as from the unreasonable adjustment. Thus, some form of automatic color control is desirable. However, the viewer does not have a reference color to correct the reproduced colors.

Since the reference color is ambiguous and influenced by many factors, it is not easy to determine and define it precisely. But, it is important remember that

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some colors are more important than others[2]. One of the subtle problems in reference color control is the difficulty of defining objective reference color, detecting specific reference colors at real time and reducing color distortion of detecting colors[2].

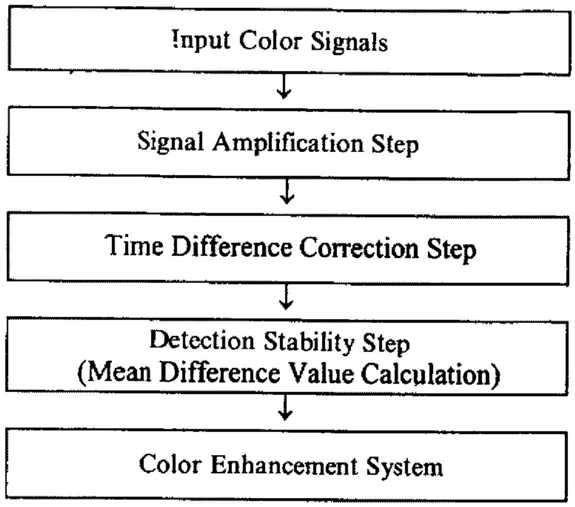
In TV system, many colors can be defined as a specific color, but we used three specific colors such as flesh tone, green, and blue. Flesh is the most critical and common color reference in color display system that the viewer can rely on[3-4]. Blue is directly relate to tri-stimulus value in human visual sensitivity. And also, green has higher visual sensitivity than other colors. The standard phase of flesh tone, green, and blue are 123°, 241°, and 347°, respectively.

In this paper, we propose color enhancement system to provide a specific color in TV system which is used to the standard color. And also, we focus on the stability of distorted colors due to the overlapped range of three specific colors as well as the time difference correction to improve detection efficiency.

2. Color enhancement system based on the improvement of transition time and detection stability

In the proposed color enhancement system, we first process a time difference correction step to improve the detection efficiency of three reference colors, and also process a stability step to improve the additional transition time problem due to the retrace of color signal. To solve the second step, we find the mean difference value of detected voltage and the value of minimum discrimination voltage of two neighbor colors. Thus, the proposed system represent reference value to CPT when mean difference value of detected voltage greater than the value of minimum discrimination voltage of two neighbor colors. (Fig. 1) shows the block diagram of proposed color enhancement system.

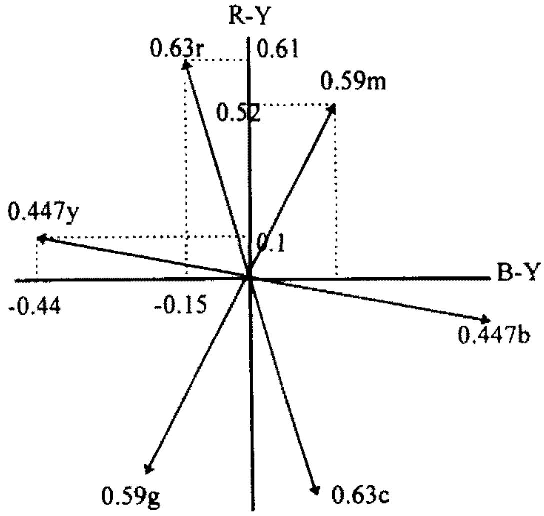
In the time difference correction step, to detect three reference colors exactly using phase detector, we should readjust the phase of color signals. we readjust the phase of reference color signals which is included in the region of linear range from 0 to saturation voltages.



(Fig. 1) Block diagram of improved reference color control system.

To facilitate signal processing of phase detector, we should readjust color burst signal amplitude to 1.5V_{P-P}, color signal amplitude to 1.0V_{P-P}. From the readjustment of time delay and magnitude factors, the signal range of color burst signal becomes 140nsec. As shown in (Fig. 2), flesh tone signal lag color burst signal by 57°, green signal and blue signal lead color burst signal by 61°, 167°, respectively. As the one cycle color signal delay time is required for 280nsec, flesh signal lagged by 44.3nsec, green signal leaded by 47.3nsec, and blue signal leaded by 129.6nsec from the color burst signal.

In the time difference correction step, if the phase detector output voltages exist within the linear range, three reference colors are detected from the other color signals. However, in the nonlinear range, ambiguity of reference colors take place. The phase range of color demodulation axis corresponding to the nonlinear output voltage range of phase detector is 65° from 225° to 310°. For the correction of distortion range, we should readjust color signal phase about 150° from the color burst signal which is delayed about 117nsec.



(Fig. 2) Amplitude and phase of color signals in TV.

Meanwhile, as shown in (Fig. 3), when the phase correction step detects the phase of color signals, transition times are required in the range of color change. Thus, in the case of colorbar picture, 7μsec total transition time is delayed. If the detection of reference color is setted at this time, detection errors take place. And also, the detection voltage of achromatic colors such as white and black over saturation voltage, additional transition time due to the retrace of colors is take place.

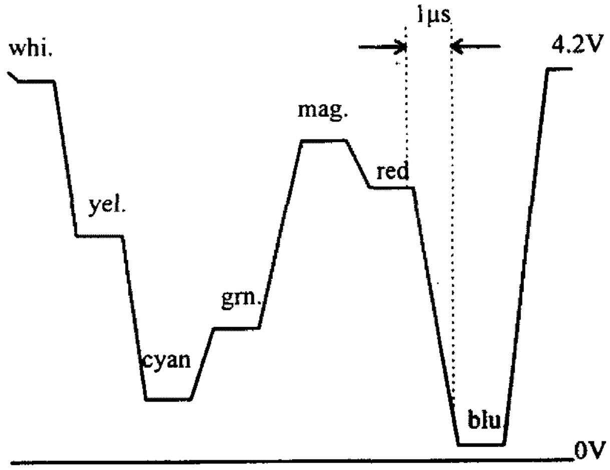
To overcome these problems, we proposed the additional stability step. In the stability step, we find the mean difference value of detected voltage E_{SYNC} and the value of minimum discriminate voltages of two neighbor colors DMIN as shown in equation (1)-(2). Thus, the proposed system represent reference value to CPT when mean difference value of detected voltages greater than the value of minimum discrimination voltages of two neighbor colors.

$$\sum(V_N - V_{N-1})/N = E_{SYNC} \quad (1)$$

N : number of detection per horizontal sync time

V_N : phase detector output voltage of color signal

$$D_{MIN} = V_N - V_{N-1} \quad (2)$$



(Fig. 3) Voltage characteristic of color signals in the correction process.

As the output voltage of reference colors reproduced on CPT a little vary with saturation value, it can be perceived other colors without considering of saturation value. Thus, in the proposed algorithm, we use phase range of the reference color is just slightly off the ±7 degrees from standard angle and also use saturation range to 25%~75%.

From the time difference correction and stability step, the three reference colors are easily detected from phase detector output voltages.

In the reference color control process, we use color control chip which correct each detected color to standard reference color and use sub-micom to reproduce controlled colors at real time.

3. Experimental results

In the experiment, we focus on the control of reference colors such as flesh tone, green, and blue. And also, standard reference xy color coordinates for flesh tone, green, and blue are (0.401, 0.368), (0.210, 0.

810), and (0.140, 0.180), respectively.

(Fig. 4) and (Fig. 5) show the photography of real images on CPT from without and with the proposed algorithm. (Fig. 4(a)) is the original beautiful girl image reproduced on CPT, (Fig. 4(b)) is the resulting image controlled on the reference flesh tone. (Fig. 5 (a)) is the original beautiful girl image which includes green and blue signal, (Fig. 5(b)) is the resulting image controlled on the reference green and blue colors. From the result, the improved reference color control system represent three reference colors more vivid than others.

(a)

(b)

(Fig. 4) Comparison of beautiful image reproduced on CPT : (a) original image : (b) resulting image.

(a)

(b)

(Fig. 5) Comparison of beautiful girl image with green and blue signal reproduced on CPT : (a) original image : (b) resulting image.

4. Conclusion

In this paper, we propose a color enhancement system which is based on the improvement of transition time and detection stability. For the enhancement of specific color control problems, we implemented specific color stability step as well as time difference correction step.

The proposed system use phase detector to detect the specific colors, and correct time difference from the color signal in order to improve detection efficiency of reference colors. After setting of specific color range, we also process specific color stability step to avoid the transition time problem which is considered at the detection of color signals.

The proposed system provide enhanced colors to viewer without distortion of controlled specific color and the need for frequently adjustment of the color control by the viewer were reduced.

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