A NEW TECHNIQUE FOR CONTRAST REVERSAL AND ITS APPLICATION FOR REPLICATION OF PHOTOGRAPHIC TRANSPARENCIES

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ABSTRACT

A new technique, based on the appropriate viewing of a photographic transparency in reflected light, for getting a Contrast Reversed Image (CRI) is described. It is demonstrated that this technique could be useful for obtaining replicas of transparencies in a single step.

WE report a new technique for obtaining Contrast Reversed Image (CRI) from the Original Image (OI) present on a photographic transparency. Also we demonstrate that this technique could be utilised for getting replicas of photographic transparencies in a single step.

Reversal of contrast in a photographic image is a very intriguing and important phenomenon and some of the well known pnotographic effects—such as Herschel, Clayden and Weigart effect—have bearing on the phenomenon of photographic reversal. Sheppard and Mees[2], the pioneers of photographic science, have attempted a classification, into five categories, of the various forms of reversal. The available techniques for obtaining reversal could conveniently be classified into two major categories : (i) techniques involving chemical processing[1-4] and (ii) techniques utilising the methodologies of digital and/or optical computing[5-7]. Under the first category, the use of some combinations of the following ingredients, *viz.*, special films, special illumination with appropriate radiation, special chemicals for development and ng, etc., is envisaged. Whereas the utilisation of niques known as spatial frequency modification filtering is involved under the second category. h categories of processing need elaborate equip-s and cumbersome procedures.

While carrying out experiments with coherent optical systems in the context of optical computing and holography, we have noticed the formation of CRIs when an object transparency is viewed in reflection mode. To the best of our knowledge nothing about this phenomenon has so far been reported in the literature. Naturally intrigued by this new phenomenon, we have carried out systematic investigations and we report our findings here.

Beam of proper diameter in order to completely bathe the object transparency is derived from a He–Ne laser using the standard technique and it is then used to illuminate the transparency on its emulsion side at normal incidence as shown in Fig. 1. The formation of CRIs is observed in the θ-space indicated in Fig. 1. For convenience of viewing and recording of the CRIs (as well as the OIs), a configuration where the illuminating light is allowed to fall on the transparency at an angle to the normal has been used. It should be emphasized that both types of illumination produced the same results.

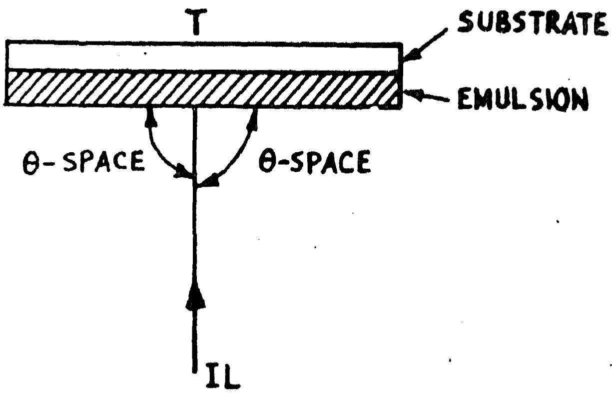

FIG. 1. Schematic for observing in reflection mode the CRIs and OIs from a photographic transparency. IL = Illuminating light; T = Transparency under study. The CRIs and the OIs available in the θ-space are recorded with a camera as explained in the text.

A wide variety of transparencies (*e.g.*, halftones, continuous tones etc., of different contrast) have been examined in reflection mode and the results about the image information available in the θ-space are found to conform to the following two categories : (*a*) CRIs are observed at some specific directions while the OIs are observed at other directions. (*b*) CRIs are observed throughout the θ-space. The former category of results are obtained with continuous tone transparencies whereas the second category of results are observed with halftone transparencies. The CRIs as well as the OIs available from a given transparency are recorded with a camera fitted with a closeup lens and using ordinary 35 mm negative film as the recording medium.

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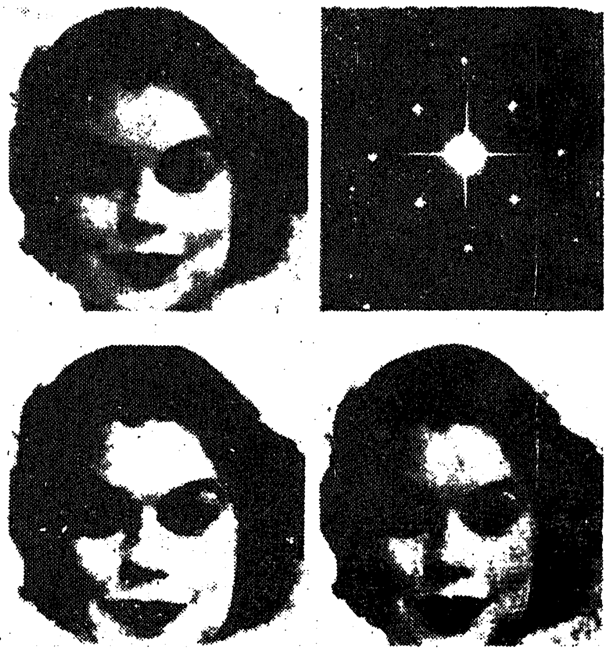
Typical results on CRIs and OIs obtained from a transparency are displayed in Fig. 2. In this example the object used is a negative. Fig. 2*a* is the print obtained from the original negative transparency. Fig. 2*b* is the print made from the negative film on which the CRI is recorded; naturally we expect it to be identical to the print shown in Fig. 2*a* and it is so. Fig. 2*c* is the print made from the negative film on which the OI is recorded and as expected it contains an image which is reversed in contrast compared to the image shown in Figs. 2*a* and 2*b*. Of course, it is clear that if prints of the as-viewed CRIs and OIs only are of interest, then they could have been faithfully recorded by putting a printing paper, instead of a negative film, in the θ-space along with an appropriate imaging system (*e.g.*, a simple spherical lens).

From the above results it is evident that by the simple operation of viewing a given transparency in reflection mode and then recording the CRIs available in the θ-space on an ordinary negative film, we could obain replicas of a given transparency in one step.

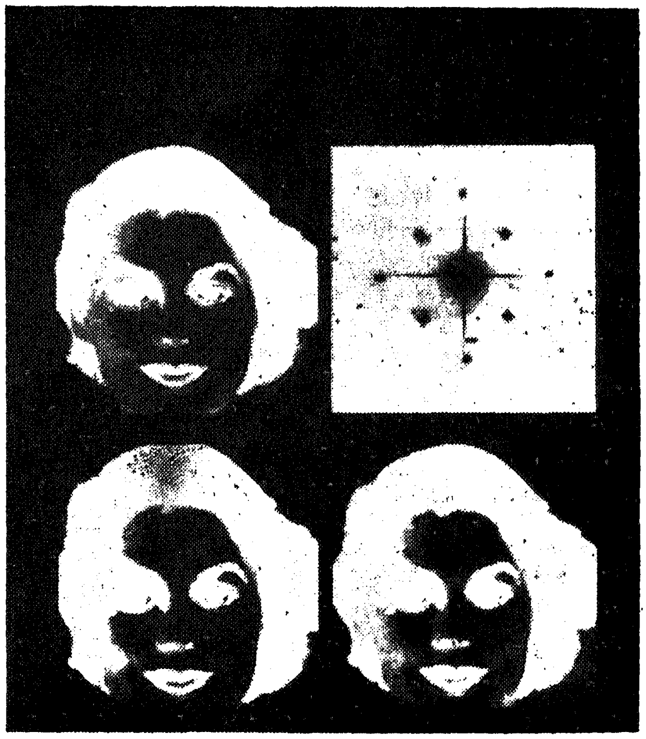
A very significant observation from our studies is that the CRIs could *only be observed* when the emulsion side of the transparency is illuminated. The emulsion is expected to exhibit a diffuser-type function upon illumination and hence we surmised that the formation of CRIs should be connected somehow to the diffuser-type function of the emulsion. We have carried out a simple experiment to obtain proof for this conjecture.

A glass plate having on one side a diffuser-type surface and on the other side a polished surface is taken and a sketch with India Ink is drawn on the diffuser-type surface. Then the glass plate is illuminated on its diffuser-type surface using the setup shown in Fig. 1 and the anticipated CRIs as well as the OIs of the object are observed in the θ-space. The results of this experiment are shown in Fig. 3 and they agree with the results shown in Fig. 2. When the polished



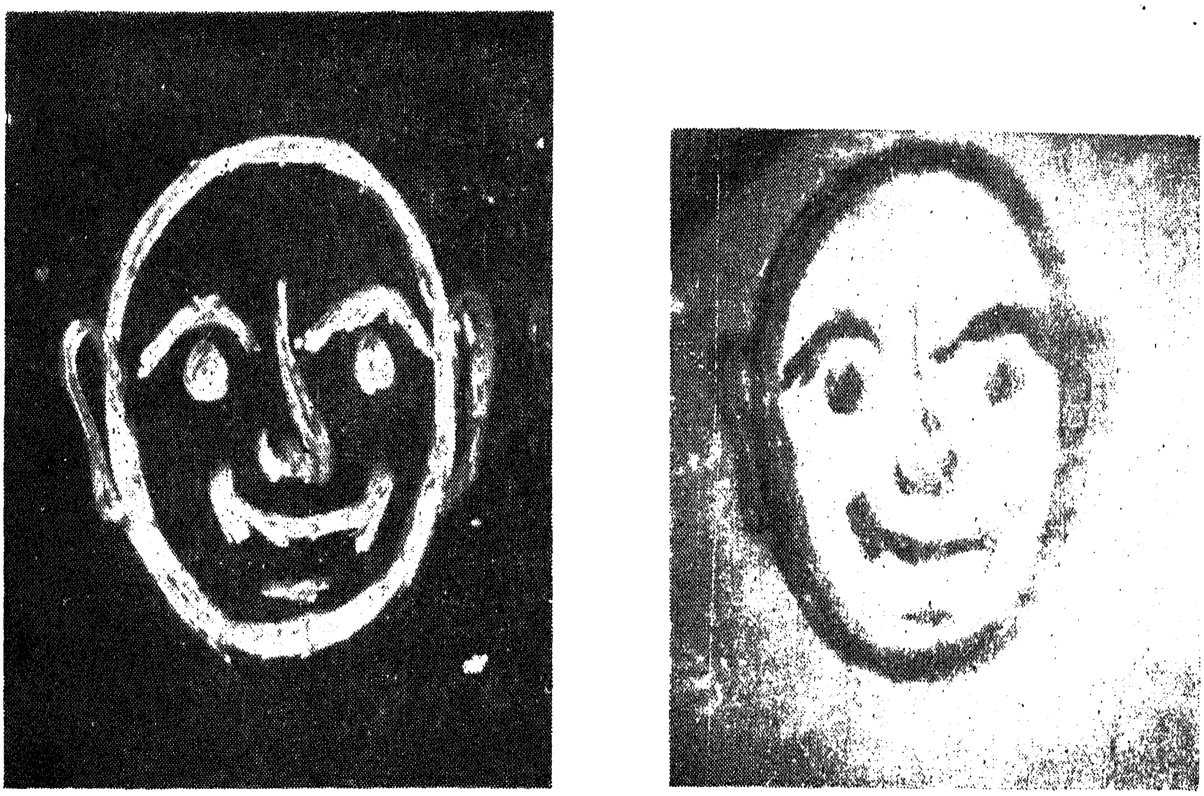
(*a*)

(*b*)



(*c*)

FIG. 2. Results on CRIs and OIs obtained from a negative object transparency. (*a*) Print made from the original negative transparency. (*b*) Print made from the negative film on which the CRI of the object transparency is recorded. (*c*) Print made from the negative film on which the OI of the object transparency is recorded.



(a) (b)

FIG. 3. Results on CRIs and OIs obtained from a sketch drawn with India Ink on a diffuser-type surface of a glass plate. This is equivalent to a positive transparency. (a) Print made from the negative film on which the CRI of the sketch is recorded. This image resembles in so far as contrast behaviour is concerned, as expected the print shown in Fig. 2c. (b) Print made from the negative film on which the OI of the object sketch is recorded. This resembles, as expected, the print shown in Fig. 2b.

surface of the glass plate is made to face the illumination, however, no CRIs could be observed; thus confirming our conjecture that the CRI formation is intimately connected to the diffuser-type function of the photographic emulsion.

At this juncture it should be mentioned that we have carried out all the above mentioned experiments, just out of curiosity, with white light from an ordinary source and found that the results remain the same. This fact demonstrates that neither the coherence properties nor the monochromaticity of laser light have any role to play. Intuitively it appears from our experimental findings that some sort of self-imaging phenomenon, occurring through the diffuser-type action of the photographic emulsion, is responsible for the formation of CRIs as well as OIs in reflection mode. But then, a quantitative understanding of the formation of CRIs and OIs under the schemes of illumination discussed here, however, should await a theoretical comprehension of the problem of image formation through diffuser-type action.

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