

**DEVICE FOR CONVERTING PICTURES OR IMAGES INTO
ELECTRONIC SIGNALS**

The invention relates to a device for
5 converting pictures or images into electronic signals
according to the precharacterizing clause of Claim 1.

The term "pictures or images" is to be
understood as meaning both pictures in the conventional
sense, such as photographs, slides, drawings, etc., as
10 well as other information records, such as text pages,
documents, etc., as well as objects of any kind,
including moving objects.

Such a device is described in EP-B1-362 737, in
which an optical projector in the interior of the
15 device projects a field of light of the same size as
the recording area of a video camera onto the working
surface via a mirror system. The picture is recorded
by the camera in the same way. The optical systems of
the optical projector and of the camera are
20 synchronized with the result that the size of the field
of light on the working surface changes on changing the
zoom range of the camera. The scanning and
illumination system ensures essentially shadow-free
illumination and an extremely large depth of field. In
25 addition, owing to the precise projection of the light
onto the image size on the working surface, there is no
troublesome scattered light, a not inconsiderable
convenience for reproduction using projectors.

By using zoom lenses having a plurality of lens
30 elements, a plurality of focal distances is permitted.
At relatively high zoom factors, however, the speed of
the lens and the precision of the image reproduction
are reduced owing to reduced resolution, greater

9904485-1

14 SEP 1999

distortion and possibly not completely correct colour reproduction.

If it were also possible to achieve the best picture quality with fixed lenses displaceably mounted on generally perpendicularly arranged axes, so-called repro systems, the illuminating means being adjusted parallel thereto and the scanning distance being adjusted, such an apparatus is in general too large and inconvenient for presentation technology, as well as for video conferences or use as a 3D scanner.

Owing to requirements relating to the transportability and means of handling of such presentation devices, it is necessary to limit the dimensions of the presentation devices, with the result that the lens size of the camera arranged in the device and hence its zoom range will also be limited. There are also commercial considerations which take into account the costs involved with the use of cameras having relatively large zoom ranges.

Accordingly, it is the object of the invention to provide a device of the above-mentioned type, having a zoom effect over and above the effect of the optical system, in combination with constant depth of field and resolution.

This is achieved by realizing the characterizing features of Claim 1. Advantageous or alternative embodiments are described by the features of the dependent Claims.

Because displaceability of the mirror along a support is also present in addition to the mobility or pivotability, known from the prior art, of the mirror serving as a scanning head about its axis, the beam path from the picture to the camera lens is lengthened

or shortened in each case by twice the displacement distance of the mirror. For the camera intended for recording, the lengthening or shortening of the beam path results in an increase or decrease in the size of the picture to be recorded. When a fixed lens is used, this results in a zoom lens effect; for zoom lenses, the zoom effect is increased without it being necessary to use further lenses which are detrimental to the picture quality.

10 The device can be operated very simply when, with the displacement of the mirror and its use as a "zoom", both the mirror is swivelled about its own axis, thus ensuring that the same point on the object to be recorded is always scanned, and the focus of the camera lens is readjusted according to the new scanning distance. These functions to be combined can be realized mechanically, electrically or electronically.

 The invention is described purely by way of example below with reference to the drawing.

20 Fig. 1 shows an oblique view of the device;
 Fig. 2 shows a side view of the device according to Fig. 1, for which
 Fig. 2a shows the beam path with adjusted second mirror;

25 Fig. 3 shows a block diagram illustrating the mode of operation of a zoom means according to the invention and
 Fig. 4 shows a flow diagram representing the software-controlled sequence.

30 Fig. 1 and 2 show a device for recording pictures from a projection area 10 comprising a light source 16 housed in a housing 12. The housing contains a camera 14 which records the pictures present or

represented on the projection area 10. However, pictures or objects present outside this projection area, for example in the room, can also be recorded by appropriate rotation of a support arm 24 connected to the housing 12.

Light emitted by the light source 16 - a projector with a lens - is directed via a first mirror 21 and a second mirror 22 onto the projection area 10. A picture present there or projected thereon and illuminated in this manner is in turn reflected by the two mirrors 22 and 21 into the lens of the camera 14. The second mirror 22 is pivotable on the support arm 24 about a ball joint, so that each region or desired part of the projection area 10 can be imaged. The camera 14 and the projector - the light source 16 - are arranged in the housing so that their optical axes 30 and 31 make an angle of a few degrees with one another. The camera 14 is connected by an electric cable 37 to one or more reproduction devices, such as, for example, a monitor 38.

The projection area is accordingly very generally any area onto which the light beams are projected, with or without their own image content; said area can be randomly chosen by swivelling the second mirror, and the picture or image is recorded by the camera from said area. It may be present on or next to the housing, for example on a table surface or wall surface or may be formed from the surface of any object.

Finding a specific region of a projection area with the camera takes place - as disclosed in EP-B1-0 362 737 - relatively automatically by swivelling the second mirror about a ball joint provided on the

support arm, the mirror simultaneously deflecting the light beam onto precisely this region and illuminating it so that it is clearly visible to an operator. The operator thus orients the recording location of the camera by orienting the light beam onto a specific point on the projection area. The mirror combination comprising first and second mirror simultaneously results in a lengthening of the light path from the picture to the lenses, with the result that a good depth of field can be achieved, which is otherwise possible only by means of excessively long lenses. From a light path of about 90 cm, the depth of field corresponds to the most frequent requirements.

In the same way, however, any region on the projection area can be scanned, found and swivelled away by swivelling the first mirror 21. The combination of the swivel movement of both mirrors is also possible.

The use of synchronized zoom lenses corresponding to EP-B1-0 362 737 ensures imaging congruence even in the case of various image cutouts and increases the user-friendliness of the device, in particular during remote control.

If the two lenses of camera and projector can be synchronized with one another, various additional effects are possible, such as, for example, the finding of any desired positions on a relatively large illuminated projection area, in which case the two zoom lenses should be capable of being operated separately from one another. In addition, the point of intersection of, or the angle between the two central beams of the two lenses can thus be adjusted also with any distances between the projection area and the

lenses, so that said point of intersection or angle is located in the plane of the projection area, which promotes the lateral imaging congruence.

An autofocusing means and/or an autoiris means
5 serve for user-friendly control of the camera for recording. A concomitant third beam path - corresponding to the disclosure of EP-B1-0 362 737 - can be provided for a very wide range of applications, for example in combination with a control unit for
10 measuring specific states in the region of the projection area and/or for controlling the lenses and/or the light source, such as focusing, distance measurement, bright/dark monitoring, etc.

The second mirror 22 on its support arm 24 now
15 not only can be swivelled around a ball joint 24a provided on this support arm 24, as already disclosed in EP-B1-0 362 737, but is adjustable in height on this support arm, as shown by way of example in Fig. 1 and 2. Fig. 2a shows the beam paths. In a first position
20 of the second mirror 22, denoted here by I, a first region b can be recorded by the camera 14 or illuminated by the projector 16. If the mirror 22 is moved along its support arm and - as shown here - the beam path is shortened, a smaller region can thus be
25 recorded or illuminated. In order that, in spite of the movement of the mirror, the alignment with the desired section a of the first region b exists, the mirror 22 must be swivelled about the joint 24a. The zoom factor produced entirely by the mirror movement is
30 thus given by the factor b/a . The focus at the camera lens must be adjusted according to the shortened beam path and hence shortened scanning distance. It will also be necessary to adjust the projector lens in

accordance with the preferred synchronized picture size and light size.

Thus, for example for a 20-170 mm lens and a $\frac{1}{2}$ " camera with a distance of 1.50 m, pictures of 49.23 mm to not more than 418.46 mm are achievable, corresponding to a zoom factor of 8.5. In the case of a folded beam path, the scanning distance is shortened by 40 cm - as shown in Fig. 2a - when the mirror is lowered by, for example, 20 cm, and continuous scanning of a picture from 36.10 mm to not more than 418.46 mm is possible. This means an increase in the zoom factor to 11.6 without restriction of resolution and trueness of colour and without distortion. Since recording elements such as CCDs with increasingly high resolution are constantly being developed, this "mirror zoom technology" has major advantages.

Of course, an identical effect can also be achieved by tilting the support arm 24, i.e. without moving the mirror 22, the desired alignment being obtained by swivelling of the mirror 22 or of the mirror 21 or combined swivelling of both mirrors. By tilting the support arm 24, it may be possible to avoid any reflections which occur.

Fig. 3 shows, on the basis of a block diagram, the possible catalogue for the organizational assembly of the individual functional units, which catalogue can be controlled by means of a control unit 30, for example a microcontroller. If a specific zoom factor is input and entered by means of the control unit 30, a motor 31 which effects the movement of the second mirror and/or a motor 31a which effects the movement of the support arm and/or a further motor 32 which effects the swivelling of the second mirror 22 about the ball

joint 24a and/or a motor 32a which effects the swivelling of the first mirror 21 and the focus motor 33 of the optical system 34 of the camera can be operated on the support arm 24, it being possible to provide position transmitters, such as shaft encoders 35, 35a for the swivelling of the mirrors 22, 21, an arm length position transmitter 36 for the displacement of the mirror or a support arm shaft encoder 36a for the tilting of the support arm 24 and a focus position transmitter 37 for focusing. These position transmitters may be potentiometers, incremental encoders or similar signal transmitters.

Furthermore, the zoom motor 38 of the optical system 34 of the camera can be controlled by means of the control unit, a zoom position transmitter 39 delivering corresponding signals to the control unit. As described above, mirror zoom - i.e. lengthening or shortening of the beam path for changing the scanning distance by adjusting the mirror - and camera zoom can be operated independently of one another or in combination, optionally synchronously with one another; it is thus possible to employ mirror zoom only after the camera zoom has been completely exhausted. The adjustment of the mirror rotation can, but need not, be carried out according to the desired application. As already mentioned above, the projector, too, will be controlled in a corresponding manner, and here too position transmitters are to be provided for lens adjustment.

The provision of transmitters for determining the various positions and angular positions makes it possible to obtain the required angular position, relative position or tilt position or swivel position

of the respective components, according to the desired picture cutout, from any position - whether reached mechanically by a manual procedure or calculated electronically and determined by means of the control unit.

Fig. 4 shows a simplified flow diagram with the sequence of required operations. On the basis of the desired zoom factor, the required, chosen beam path length is calculated in a first step 41, and the new support arm length or support arm angular position is calculated, in a second step 42, from this beam path length, the mirror distance (support arm length or support arm angular position) known through the corresponding transmitter and the angular position known through the corresponding transmitter. If (third step 43) the actual support arm length determined by means of the arm length position transmitter 36 should be smaller than the newly calculated, desired support arm length, the support arm is extended; otherwise the arm is retracted. The values available via shaft encoder 35, focus position transmitter 37 and current and old arm length permit the calculation of the new focus position (step 44), as well as the calculation of the necessary swivelling for mirrors 22 and/or 21 (step 45). On the basis of the values calculated in this manner, focus and mirror are newly positioned by operating the corresponding motors (step 46). At the branch 47, the process will be complete (step 48) where the new arm length was reached in accordance with the calculated arm length; in the negative case, the procedure returns to step 43 and the subsequent steps. This diagram is applicable in context to the projector.

Of course, this procedure can at least partly

be carried out purely mechanically by the operator, and a combination of manual mechanical operation with a sequence controlled purely by the control unit is also possible.



PATENT CLAIMS

1. Device for converting pictures or images into electronic signals, comprising a camera (14) having a first lens (1) for recording pictures or images present on a projection area (10), and comprising a light source (16) having a second lens (3) for focusing the light beams onto the projection area (10), optionally both lenses, preferably at least the first lens, being designed in particular as motor-adjustable zoom lenses, and at least one - second - mirror (22) mounted on a support arm (24) - optionally pivotable about a joint (24a), preferably two mirrors (21, 22), being provided for deflecting the two beam paths to be coordinated with the camera and light source, which mirror or mirrors is or are arranged between the projection area (10) and the two lenses (1, 3), characterized in that the relative position of the second mirror (22) on the support arm (24) is variable so as to shorten or lengthen the beam path lengths.

2. Device according to Claim 1, characterized in that the adjustment of the relative position and optionally also the swivelling of the second mirror (22) are effected by means of at least one motor (31, 31a) and optionally under remote control by a control unit (30) coordinated with the device, in particular at least one position transmitter (36, 36a) for registering the respective support arm length or the angular position of the support arm (24) and optionally a shaft encoder (35) for registering the respective angle of rotation being provided, which position transmitter (36) and, optionally, shaft encoder (35) deliver corresponding signals to the control unit (30).



3. Device according to Claim 2, characterized in that the first lens (1) designed as a zoom lens is motor-adjustable by means of the control unit (30), optionally as a function of or together with the adjustment of the relative position of the second mirror (22) and/or of the swivelling of the second mirror (22), optionally via a synchronization means together with the second, likewise motor-adjustable lens (3).
4. Device according to Claim 2 or 3, characterized in that a zoom position transmitter (39) by means of which corresponding signals are available to the control unit (30) is coordinated with the first lens (1) designed as a zoom lens.
5. Device according to any of Claims 2 to 4, characterized in that a focus position transmitter (37) whose signals are available to the control unit (30) is coordinated with the first lens (1) equipped with a motor-adjustable focus means.
6. Device according to any of Claims 2 to 5, characterized in that a zoom position transmitter and/or a focus position transmitter, via which transmitter or transmitters corresponding signals are available to the control unit (30), is or are coordinated with the second lens (3) designed as a zoom lens and having a motor-adjustable focus means.
7. Device according to any of the preceding Claims, characterized in that a motor (32a) which permits tilting of the mirror (21) is coordinated with the first mirror (21), a transmitter (35a), via which corresponding signals are available to the control unit (30), optionally being provided.