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APPARATUS NOTES

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The TRS-80 color computer as a 4-channel data logger

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I. INTRODUCTION

In the course of automating some data-acquisition procedures associated with research on radio-wave propagation, a rather inexpensive data-logging system was developed, making use of the popular and inexpensive TRS-80 color (sometimes called a CoCo) computer from Radio Shack. Equipped with a printer (such as the Radio Shack DMP-100) and a simple black/white TV set, the system constitutes a low-cost, 4-channel, multiplexed, 6-bit data-acquisition, processing and print-out facility for analog voltages between 0 and 5 V (positive only).

The significant feature of this particular system is the fact that the computer contains a 6-bit A/D converter and a 4-input analog multiplexer associated with the "joystick" ports, and is thus directly applicable to those situations where a resolution of 1 part in 64, or approximately 1.6% is adequate. No hardware modifications to the computer are required, and there is nothing to build; it is simply a matter of connecting (up to four) analog voltage signals to the appropriate pins on the joystick sockets and then running the desired program in BASIC. For the information of those contemplating the use of other computers equipped with joystick ports, it should be noted that most of these machines do not have an A/D converter associated with the joystick, but rather a simple on–off switch arrangement which is software controlled to produce the joystick effect. For such machines, an A/D converter (or equivalent) would need to be provided by the user. An example of such a system, using the Commodore VIC, appeared recently in these pages.[1]

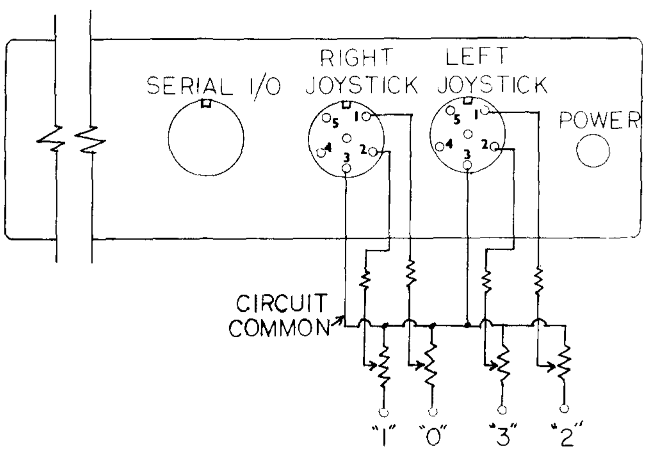

Fig. 1. Rear view (not to scale) of the TRS-80 color computer, showing the two joystick ports. Joystick inputs "0" and "1" are associated with pins 1 and 2 of the right port, and inputs "2" and "3" with the left. The series resistors discussed in the text are also shown, as are the optional potentiometers. These potentiometers could be 100 to 500 kΩ types.

II. DETAILED DESCRIPTION

First, it should be noted that the joystick inputs are designed to accept analog voltages between 0 and 5 V (negative voltages not allowed) and these voltages see a very high impedance looking into the joystick port. Inside the computer, there is a 0.02-μ F capacitor connected from each of the four joystick inputs to ground; hence, in some applications, the time constant associated with the joystick inputs may need to be modified.

Second, if the CoCo happens to be switched off while the analog voltages are still connected, the joystick inputs assume a very low resistance which could possibly lead to excessive currents. A remedy for this is a resistor of approximately 5 kΩ ($\frac{1}{4}$ W) in series with each joystick input.

Third, since the range of allowable input voltages is from 0 to 5 V (positive), it is probably convenient to provide each input with a potentiometer, as shown in Fig. 1. This allows convenient control of the analog input voltage.

Fourth, suitable cables connecting the analog voltage(s) to the CoCo may be fabricated quickly by simply removing the joystick potentiometer assembly from the joysticks as supplied by Radio Shack (part No. 26-3008).

Fifth, it is a peculiarity of the CoCo that joystick "0" must be read first; presumably, the CoCo's software initializes the internal circuitry when joystick "0" is read. Once this particular joystick input is read, then any (or all) of the remaining joystick inputs may be read, in any sequence. A rudimentary BASIC program for reading all four joystick inputs is shown in Table I.

Sixth, detailed information on the circuit in the CoCo is

Table I. Program in BASIC showing how to read all four analog voltage inputs and display their values (from 0 to 63 inclusive) on one line.

```
100 A = JOYSTK(0)
200 B = JOYSTK(1)
300 C = JOYSTK(2)
400 D = JOYSTK(3)
500 PRINT A;B;C;D
```

given in the *TRS-80 Colour Computer Technical Reference Manual* (Radio Shack No. 26-3193).

Finally, this paper only "scratches the surface" of the possibilities associated with the CoCo as a data logger.

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[1] F. J. Wunderlick and D. E. Shaw, Am. J. Phys. **51**, 797 (1983).

A useful setup for holographic construction

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I. INTRODUCTION

The classical experimental setups for holographic construction employ, as is known,[1,2] one or two objectives, a beam splitter, and one or two mirrors.

Many solutions have been proposed to make simplifications possible; some mainly aimed at making particular geometries or particular cases,[3–6] others aimed at eliminating the problems connected with the delicacy and cost of optical components, proposing alternative solutions for beam splitters, objectives, and mirrors.[7–12]

Concerning the purposes of this second class of papers, this work will describe certain advantages derived from an unusual use of a common plano-convex lens having short focal length.

II. EXPERIMENTAL SETUP

With reference to Figs. 1 and 2 which illustrate the experimental setup used, a plano-convex lens (focal length 3 cm) is inclined by an angle ϑ around a diameter orthogonal both to the laser beam incident on it, and to the plane of the optical bench. The laser beam incident on a portion of the convex surface of the lens, gives rise to three divergent beams: beam a very intense, illuminating the object; beam b reflected on the flat surface of the lens and thus less intense than beam a, and finally beam c reflected on the convex surface of the lens and even less intense than beam b. In the experimental setup employed, beam b with a front silvered mirror M_1 can also be used to illuminate some particular of object O, while beam c is used to send the reference wave on plate P.

If the laser beam is incident at the height of the horizontal diameter of the lens, the directions of beams a, b, and c

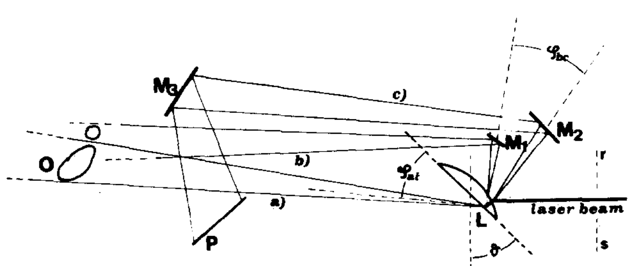

Fig. 1. Experimental setup. L: tilted lens; M_1, M_2, M_3: front silvered mirrors; O: object; P: photographic plate.

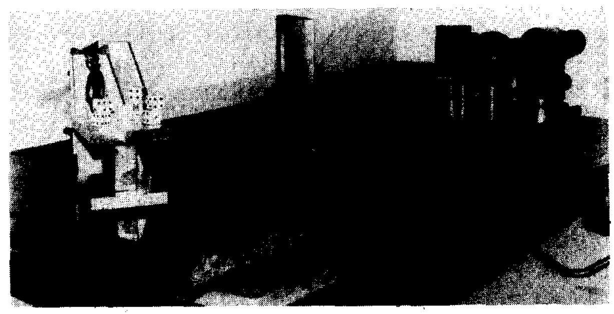

Fig. 2. View of the experimental setup. The optical table is a common workbench with a marble slab. The laser tube is an LHN 15P/02 Philips (1 mW).

Fig. 3. Virtual image from a hologram obtained with the experimental arrangement shown in Fig. 1. Note the elliptical section of beam a illuminating the clock on the left. Beam b supplies partial illumination on the dice to the right of the scene. Agfa Geyaert 10E75 35-mm holographic film.