

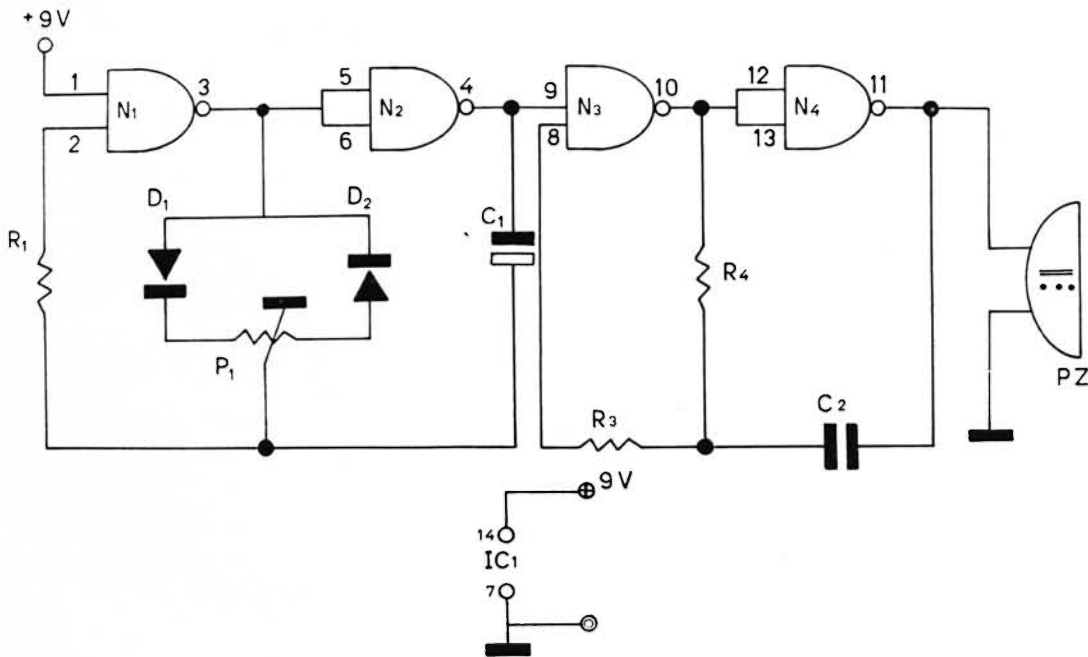
An Electronic Device for Repetitive Auditory Cues

TO THE EDITOR:

Lagophthalmos is one of the complications of Hansen's disease. Patients with early or partial lagophthalmos are prescribed muscle-strengthening exercises. The temporalis transfer operation of Gillies is the procedure of choice in the majority of cases (¹⁻³). Postoperatively, the patient is taught chewing exercises in order to activate the

upper and lower lids (⁴). Since this is a voluntary action, the patient often forgets to do so, and this subjects the cornea to the detrimental effects of exposure to air.

A simple portable device capable of delivering a low-volume audible warning at fixed predetermined intervals was designed and built by the author. This serves as a pacer during the muscle-strengthening ex-



THE FIGURE. Circuit diagram of the device.

IC₁ = CD 4011B

R₁ = 150K ohms

P₁ = 1M preset potentiometer

R₃ = 1M ohms

R₄ = 190K ohms

C₁ = 25 uF 16VW

C₂ = 1nF 12VW

D₁, D₂ = 1N 4148

PZ = piezo-ceramic buzzer

ercises for early lagophthalmos. It also finds application during the relearning period after the temporalis transfer operation. Both groups of patients need the constant supervision of a physiotherapist to accomplish the task of activating the eyelids at a specified rate. The device presented here is an unambiguous substitute for the pacing normally provided by a physiotherapist.

The device fulfills the following design criteria: It should a) be portable: It measures 5 cm × 5 cm × 3 cm and weighs 96 g with a 9-volt battery pack; b) consume minimal current to ensure economic operation: The circuit is based on CMOS NAND gates. The current consumption in the quiescent state is 7 μ a, and during the brief audible state, it is 500 μ a. The 9-volt battery should last for more than 1 year of continuous use; and c) be unobtrusive: An optional earphone socket may be included to cut off the piezo-ceramic buzzer and to deliver the sound through an earphone to the ear.

The circuit is based on a single Quad CMOS-dual input NAND gate integrated circuit of type number 4011B (The Figure). N_1 and N_2 form the delay circuit along with R_1 and C_1 . D_1, D_2 and the preset potentiometer P_1 determine the duration of the sound. N_3 and N_4 , with the associated components R_3, C_2 and R_4 , form a square wave audio oscillator, the output of which is delivered directly to a piezo-ceramic buzzer. A further gain stage must be added to this oscillator if an earphone is to be driven since the output impedance is 400 ohms. However, the addition of an earphone will place a greater current demand on the power source.

The cost of the device is approximately Rs.60/- (Indian rupees) and all components are readily available in the local electronics market. There may, of course, be possible variations in the performance of the device due to component variability and tolerance.

This device has had an initial period of testing with two patients, and the response of the participating physiotherapists and patients has been encouraging.

—J. Devasundaram, M.B.B.S.

Medical Officer
Branch of Laboratories
Schieffelin Leprosy Research &
Training Centre, Karigiri
N. Arcot District
Tamil Nadu 632106, India

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