Def Sci J, Vol 33, No 3, July 1983, pp 247-251

New Reaction Timer for Physiological and Psychological Studies

A. K. GUPTA
Dte of EDPS/DRDO Computer Centre, Metcalfe House, Delhi

A. K. BHATTACHARYA
Defence Institute of Physiology and Allied Sciences, Delhi Cantt

Received 4 February 1981; revised 28 January 1982

Abstract: In physiological and psychological measurements, the response to some form of external stimulus is required. The instrumentation used for the measurement of Reaction Time is vital part of the main instrument system. Instrument design reported here is suitable for the measurement of Reaction Time under environmental stress. The stimulus are visual (flash of light and auditory tone). This instrument is solidstate, portable and can be used with any electronic timer.

1. Introduction

Measurement of Reaction time is a vital parameter for the selection of a suitable person to work under environmental stress. The existing instruments are not efficient because of terminal and running errors. Terminal error is caused by the time lag in starting the recording instrument and overshoot caused by a faulty speed running mechanism. Designed instrument generates and presents the stimulus to the subject and recording instrument records the response. It is a modular design and building blocks can be assembled by any experimenter into specialised system.

The system reported, consists of three modules; Operator Console, Subject, Console and Recording Instrument. Circuit details of operator console and subjects console have been given. Operator's console generates visual and sound stimulus. It keeps the log of stimulus generated. Subject's console generates visual stimuli by flashing light and audio stimuli by producing tone. There are four types of visual stimuli and two types of audio stimuli. Key board is provided to the subject for responding to the stimulus. It deactivates the stimulus. Recording of the reaction

time is done on electronic counter/timer of ECIL India. However, any similar recording instrument can serve the purpose.

2. System Organisation

System's Organisation is shown in Fig. 1. Operator's console, subject's console and recording instrument are connected with each other by a 12 wire cable. Signals are

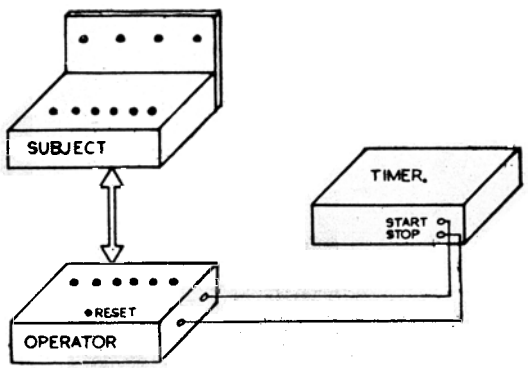

Figure 1. System organisation.

transmitted over these wire for generating stimulus, starting the timer and stopping the timer. Subject's console contains all the control circuitary for generating stimulus. There are four types of visual and two types of audio stimulus circuits contained in it. Key board on the pannel of circuit box is used by the subject for responding to a given stimulus. It results in putting off the stimulus and signal is sent to stop the timer. Operator's console contains the control circuitary for logging the events completed successfully. Key board is provided for resetting the whole activity and initiating any one of the stimuli. Stimulus signals are generated by pressing any one of the keys. It results in activating any one of the stimuli and simultaneously starts the recording instrument. As soon as the subject responds to a given stimuli and acts to press correct key on his panel, it deactivates the stimuli and stops the recording instrument.

3. Circuit Description

Circuit is designed using IC 5473. It is a dual Master-slave flip-flops. It has clear, J, K & clock inputs and Q and $\overline{Q}$ outputs. The block diagram of the IC and its

truth table has been shown in the Fig 2. Clear input of flip-flop is independent of clock pulse. Whenever J = high/low, K = high/low, $\overline{Cp}$ (clock) = high/low and Rd (Reset) = low, flip-flop is forced to reset i.e. whenever J = high, K = low, Rd = high, the next clock pulse sets flip-flop i.e. Q becomes high.

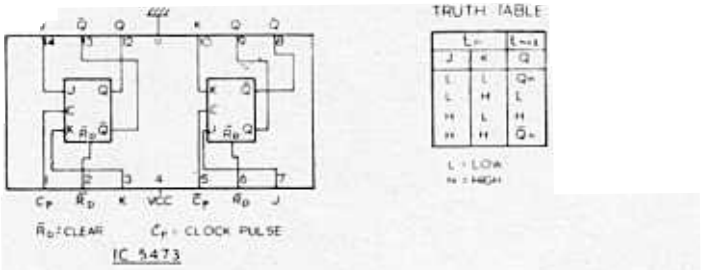

Figure 2. Dual JK master/slave flip-flop with separate clear & clock.

The control circuitary for generatings timulus designed is shown in Fig. 3 and it is contained in the subject's console. Transistor T_1 is used as an inverter and acts as an input to IC 5473 at the clock input. Key board key is made of microswitch. It is connected as input to the inverter. The input to the inverter is $a + 5$ volt step pulse. Inverter changes its state to the low level i.e. logical zero. The IC is having J = high, K = low, Rd = high condition and it sets the flip-flop output Q to high value. The Q output is connected to a LED (i.e., Light Emitting Diode), which is illuminated on receiving high input. Transistor $T2$ is also being used as an

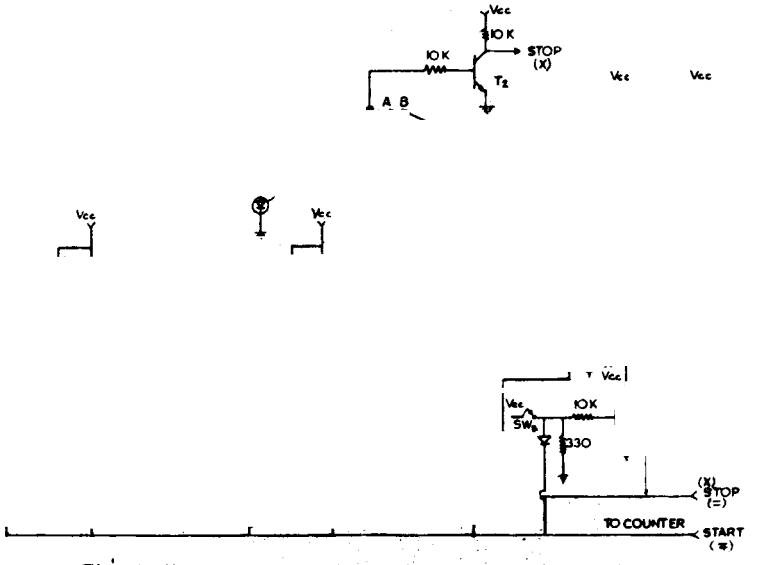

Figure 3. Circuit diagram.

inverter. It acts as an input to Reset (Rd) pin of IC 5473. The input to this inverter is available from Q (high) output of the IC. Whenever Reset (Rd) input becomes high, it forces flip-flop to reset i.e., Q output becomes low and LED is put-off. Inverter input is connected through six keys of microswitch from the Q outputs of all six flip-flops. The circuit contains four modules of visual stimuli generating modules, all of them are integrated in one visual system.

In the audio system stimulus signals are generated by inverter in the similar way as for visual stimulus. At the Q output of two ICs two relays are connected through power amplifiers. Power amplifier is designed using SL 100 transistor. Relay coil is connected in series with the collector of transistor to the + 5 volt supply. Whenever the Q output of the IC 5473 becomes high, it activates the relay and subsequently tone generating circuits shown in Fig. 4 becomes operational and sound stimuli is generated. The Q output of this IC is connected to the inverter $T2$ through a microswitch. This inverter is connected to Reset (Rd) input of IC. Whenever the switch is depressed, it deactivates the stimuli. The designed system contains two modules of audio stimulus. Each audio stimuli is having different tones.

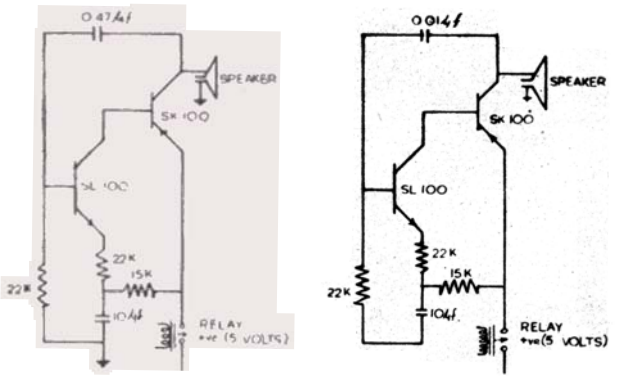

Figure 4. Event counter

Event counter is designed for counting the number of instruction executed by the subject successfully. It is contained in the operator's console. It is incremented, whenever a pulse appears, it signifies the correct depression of the switch by the subject. The circuit is shown in Fig. 5. It consists of IC 7490 (Decade Counter).

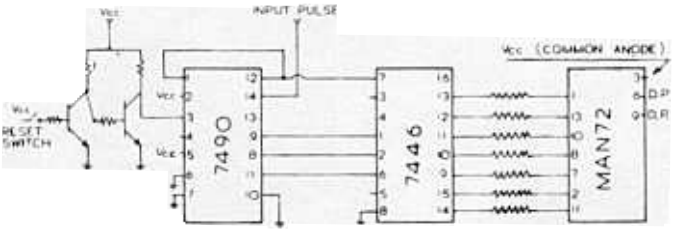

Figure 5. Tone generator.

Whenever a pulse appears in clock input of IC, it generates BCD (Binary Coded Decimal) output. The counter output is connected to the IC 7446 (Seven Segment Decoder), which is further connected to MAN 72 (Seven Segment Display). Successfully, completed events appears as decimal numbers on the display.

4. Conclusion

System is designed for carrying studies of 'Reaction Time' of human being in the environmental stress condition, like noise, hypoxia, high altitude, hot and cold climates, etc. Subject sits in perfect isolation in the environmental chamber. Experimenter presents stimulus to subject sitting in the test chamber. The stimulus may be visual or auditory and six choices are available to experimentor. Instrument is being tested successfully for the measurement of 'Reaction Time' of ten subjects in age group of 50-60 years in the Psychology Group of Defence Institute of Physiology & Allied Sciences. Further enhanced system can be developed for generating other sensory stimulus like Tactile (e.g., a blow to the Achilles tendon), or direct electrical stimulation of some part of the nervous system. It is also possible to design the system for measuring the response if more than one subject simultaneously.

References

1. Krishnaswamy, N. & Raju Vankats, R., *Electro Technology* **9** (1965), 135.
2. Woodworth & Schlosberg, Experimental Psychology, Second Edition, (1970).