A. Seitz

fido

Fido is a new electronic game in which an unfortunate dog is called by four masters at the same time. The command "Fido come" is given by means of a pushbutton. At each push on one of the four buttons controlled by each player Fido jumps in the required direction. However, the four masters and/or mistresses have one handicap: After one successful command to Fido, the would-be Fido owner who has given the order has nothing more to say for a certain time. Then the other players can go on with Fido. If one of the players succeeds in getting Fido into his kennel, the game is decided: Fido stays where he is.

Construction and operation

Since Fido is clever enough to let himself be represented by a small incandescent lamp, he is not going to suffer from an otherwise unavoidable nervous breakdown. The worst that can happen is that after a prolonged fight for mastery over Fido our doggy will suffer from a flat battery.

On the playing board nine lamps are arranged in a square (figure 1). On the extension of each side there is a lamp representing a kennel (so in total four). Furthermore, at each of the corners there are four push buttons with a pilot lamp to indicate when a player can join the game. The buttons make Fido jump in four directions (away, towards, left or right with respect to the particular player). The photograph also shows that the "gaming table" is provided with an on/off switch, an interval switch (coarse) and an interval control (fine) for setting the obligatory rest period for the players. These switches can be calibrated "bloodhound/whippet" and "dog-tired ... alert" respectively.

Furthermore there is a switch to disable the "rest" lamps and there is also a starting switch. By pushing this button, Fido takes up his position in the centre of the field; i.e. the middle lamp is alight. By pushing one of his buttons, each player can now try to direct Fido into his kennel. Once a player has pushed a button, he is obliged to take a breather before he can push a button again. The lamps fitted near the buttons indicate when the next command can be given. Each player can give only one command at a time. If an impatient player pushes his button too soon, the penalty is a new start of the waiting period. So Fido will not respond to a command that comes too early.

To make the game a bit more exciting, the pilot lamps can be switched off, so that each player must just guess when he may next give a command.

The block diagram

Fido's position in the field is indicated by nine lamps arranged in a square. These lamps are located at the intersections of 3 x 3 matrix rails. The signals for these rails are driven by two left/right shift registers. The clock pulses to the registers are produced by the players pushing one of the buttons. Since each player has four buttons at his disposal, Fido can be sent in all directions including the kennel of another player.

The directing signals for left, right, up and down are coupled into the registers via the multiplexer. Once in a corner, the dog can be made to jump into the kennel situated below the corners as seen from the player's position. The register input driving the "kennel" flipflop is so connected that the command for jumping is only followed if the other register, too, is in the proper position. The lamp field is blocked to prevent lamps from lighting up after a jump into the kennel. At the same time all register outputs are blocked so that no more "kennel" flipflops can be driven.

The game is started by pushing the starting button; then all the "kennel" flipflops are reset and the two shift registers take up a central position. In that case the middle lamp is alight.

The left/right shift register

Figure 3 shows how a flipflop can be turned into a "flipflopflap". The inputs of each nand are connected to the outputs of the other nands. Consequently, only one output at a time can be low ("0"). This "0"-signal produces a high output level ("1") at all the other nands; these high levels in turn cause the low output level on the first nand. A negative-going pulse on one of the coupling rails causes all nands connected to this rail to change to "1", whereas the nand whose output is connected to this rail ensures that this rail remains "0".

If gates with a so-called totem-pole output are used (7400, 7420 and 7430) the outputs must be separated by means of a diode as otherwise none of the

1

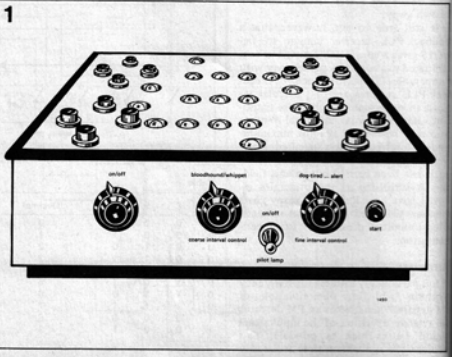
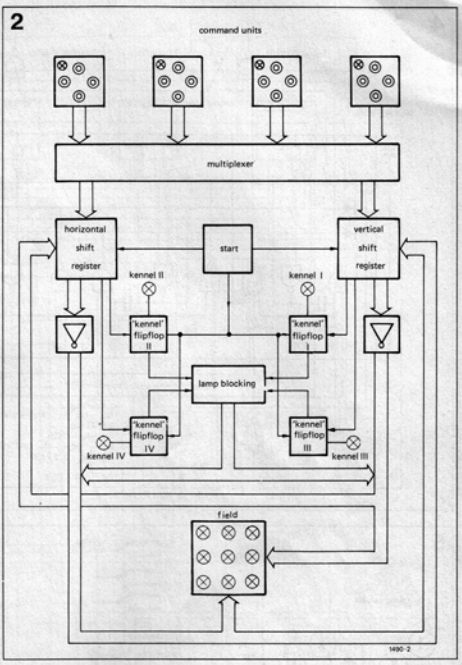


Figure 1. Artist's impression of Fido.

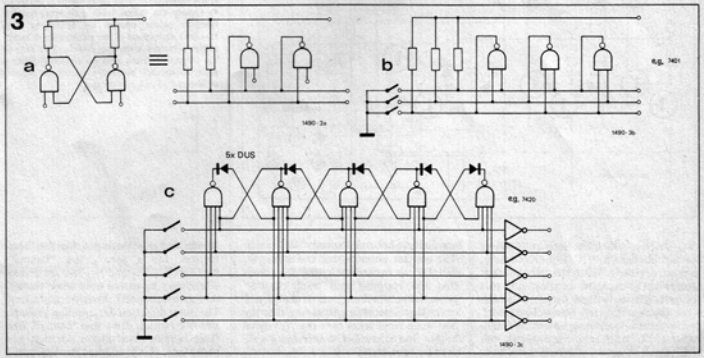
Figure 2. The block diagram. The command-units also comprise the waiting time indication. The push button "start" resets all "kennel" flipflops and sets the registers at the central positions, so that the lamp in the center of the field lights up. Multiple connections between the circuits are indicated by means of broad arrows.

Figure 3. The development of a multiple flipflop starting from the fundamental principle.
a. Two methods of drawing a simple flipflop
b. A 3-fold flipflop
c. A 5-fold flipflop.

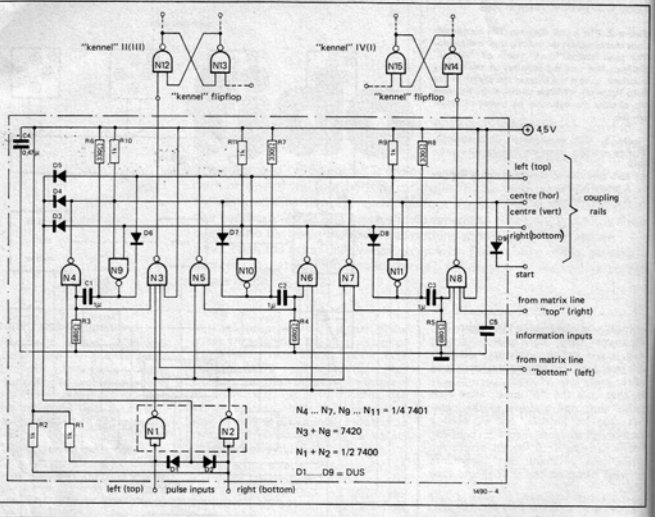


outputs would change to low (figure 3c). With types with an open collector output this is not strictly necessary, although it is recommended to keep the input load of the pulse low.
In that case the "0" must, after each pulse, shift one position to the right, left, top or bottom. So we need a memory which remembers what coupling rail is carrying a "0" signal before the pulse, and a circuit that determines in what direction the shift should take place.

The memory is formed by C_1, (C_2, C_3, figure 4); the direction of shift is determined by two nands (N_3 and N_4, N_5 and N_6, N_7 and N_8) which receive their signals via N_1 and N_2. When the button is pushed, say left, this is what happens: Via N_1, connected as an inverter, the "1" signal is fed to the nands N_3, N_5 and N_7 via the "left" conductor. At the same time all the connecting rails are brought to the "0" level via the diodes D_1, D_3, D_4 and D_5. As a result, the nand N_9,



4



5

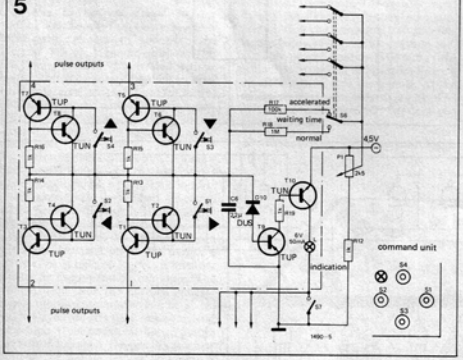


Figure 4. Complete "shift register for a zero", 3-fold, for the matrix line of the horizontal shift register. The vertical register is of the same construction (description between brackets).

Figure 5. Field with waiting time indication. Depending on the type of field used, the trigger unit is required several times. It serves to suppress contact bounce.

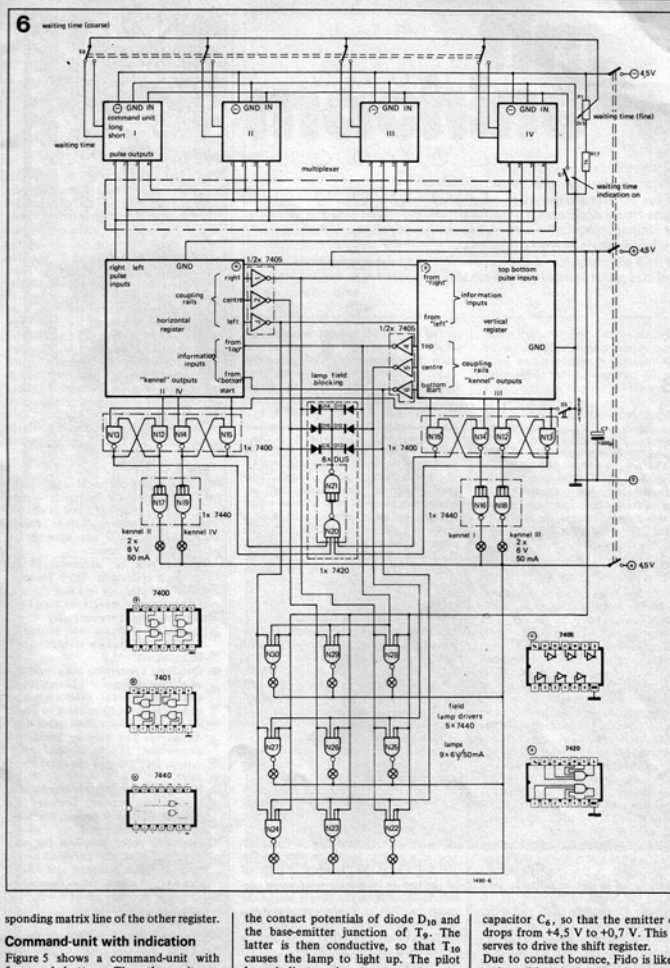
Figure 6. Diagram for Fido with nine lamps. If the whole is fed from batteries, it is advisable to supply the lamps from a separate battery because pulses caused by switching (low filament resistance of an extinguished lamp) might interfere with the circuit. The bias of C_6 (figure 5) must also be obtained from a separate battery because a maximum current of about 200 mA can occur.

N_{10} or N_{11}, which has been at "0" level so far, changes to "1". Simultaneously, a positive pulse is fed to the two adjacent nands via the capacitor connected to this output. The gate thus prepared by the "1" signal via the conductor "left" maintains the collecting line of its neighbour at "0" until again via diode D_1 the "0" signal disappears and the remaining conductors become logically "1".

The contact potentials of the diodes D_1 and D_3 up to and including D_5 ensure that the coupling rails reach the "1" potential before the inputs of the gates 1 or 2. This is necessary to ensure that the new main nand takes over the "0" signal before the direction determining gate changes back to "1".

In the extreme positions for the "shift register for a zero", the "kennel"-flipflops N_{12}-N_{13} and N_{14}-N_{15} are driven. These may be driven only when the second register reports the correct position. The outer direction determining gates N_3 and N_8, which drive the "kennel" flipflops require three inputs for that purpose; one being coupled to the corre-

6 waiting time (coarse)



sponding matrix line of the other register.

Command-unit with indication

Figure 5 shows a command-unit with four push buttons. The other units are similar.

Via P_1 and R_{17} or R_{18}, respectively, capacitor C_6 is negatively charged until the voltage across C_6 equals the sum of the contact potentials of diode D_{10} and the base-emitter junction of T_9. The latter is then conductive, so that T_{10} causes the lamp to light up. The pilot lamp indicates when a command can be given. The waiting time can be adjusted with P_1.

When pushing a button, say S_1, T_1 is turned on by the negatively charged capacitor C_6, so that the emitter of T_1 drops from +4,5 V to +0,7 V. This pulse serves to drive the shift register.

Due to contact bounce, Fido is likely to make wild and unpredictable jumps, or just stays where he is. To avoid such "disobedience", each push button must be connected to a trigger. Even the shortest pulse at the base of T_1 is suffi-

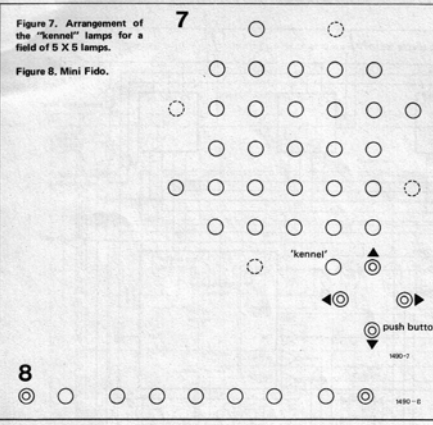


Figure 7. Arrangement of the "kennel" lamps for a field of 5 X 5 lamps.

Figure 8. Mini Fido.

cient to cause the two transistors (T_1 and T_2) to switch. As a result capacitor C_6 is connected to the control line until the voltage drop across R_{13} caused by the charge current is no longer high enough, and the trigger returns to its initial position. Then capacitor C_6 discharges across R_{17} (R_{18}) and P_1.

The complete diagram

Owing to the large extent of the circuit, some of the sections are represented as blocks in figure 6. The positions indicated by the coupling rails are represented by "0"-signals. For the remainder, only "1"-signals are used; hence the inverters 7405 for inverting the signals. These signals are fed to the lamp drivers 7440 which cause the lamps to light up when all inputs are "1".

Since only two of the four inputs of the lamp drivers are used, all the others can be connected to the positive of the supply, which, however, is not necessary. Once Fido has disappeared into a kennel, that is to say: when a "0" signal has reached the input of a goal flipflop, a "1" is produced at the driver of the goal lamp, and a "0" at the gate N_{20}, which via the inverter N_{21} and six diodes D_{11} up to and including D_{16} transfers this signal to the outputs of the inverters I_1 up to and including I_6. As a result all the lamps in the field are extinguished. Furthermore, all the outer direction-determining gates (figure 4) are blocked ("0"-signal at the inputs that are connected with the inverter outputs), so that no further goal can be scored by the now invisible Fido, if more buttons were pushed.

The start- or reset button returns the goal flipflops and the registers to their initial positions again. The middle coupling rails must be connected to the reset conductor via the diodes (D_9 in figure 4). The words "left", "right", "top", "bottom", "vertical" and "horizontal" are related to a group of push buttons which is fixed by an arbitrary position of a player and is called command-unit 1. The other command-units are numbered clock-wise. The arrows in figure 5 are related to the way in which Fido moves as regards the player concerned.

Variations

The game can easily be changed. A first possibility is to expand the field so that the game will last longer (figure 7, according to the principle in figure 3c). This will, of course, increase the cost of the unit by a considerable amount, especially if the 25 lamp version of figure 7 is used. Furthermore, it should be noted that the field is in fact only suitable for four or eight players, whereas the smaller field can also be used by two without Fido endlessly running up and down.

On the other hand, the field with 25 lamps can easily be connected to eight command-units, so that eight "dog lovers" can join the game.

A "mini Fido" is also a possibility if we restrict ourselves to one register (see figure 3c), and if the "kennels" are placed at the two ends of the row of lamps (figure 8). In spite of the simple set-up the game can still be fun; playing with the push buttons alone is most amusing. In addition this version offers the possibility of studying the register.

Of course, other possibilities can be worked out, but then again it is up to the reader to find an arrangement in accordance with his taste and, lets face it, budget.