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Use of a Calculator Chip for Realtime Data Processing

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There is no correlation between Sr-90 activity and TDS at the upriver stations (2 and 3), where there should be no appreciable amounts of Sr-90 adsorbed on the sediment. At Station 1, where the highest concentrations of adsorbed Sr-90 would be expected, the correlation is quite good. At Station 4, approximately two miles downriver from the reactor where there may be some deposition of suspended sediment, the correlation is modest.

Preliminary data gathered since August, 1979, indicates that the correlation coefficient of Sr-90 activity with total hardness (Ca^{2+} + Mg^{2+}) is >0.9 at Station 1.

Thus, it seems likely that the release of Sr-90 adsorbed on sediment is a significant source of that radionuclide in water downstream from the reactor.

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THE USE OF A CALCULATOR CHIP FOR REALTIME DATA PROCESSING

The problem of collecting data in a digital form ordinarily might be handled by dedicating a microprocessor system to the task of collecting the data from the sensor, processing that data and finally outputting the data in an intelligible form. However, the power of a microprocessor system may be a case of "overkill' if it is to be dedicated to one or more relatively slow speed tasks. In place of a microprocessor system, one may find that a low cost calculator chip such as found in readily available four function calculators can provide the computing power along with a degree of programability necessary to carry out the required tasks for a small processing system.

The problem of interest here is to design a digital system which measures rate of fluid flow, elapsed time and total travel distance. A calculator chip is used to process and display total volume, rate of flow, total distance and elapsed time. The data are displayed by (seven segment), L.E.D.'s. The particular data displayed are switch selected by the operator.

The circuit (Fig. 1) consists of five principle blocks, numbered 1 through 5 for discussion. The time base for the circuit, (block 1), a 555 timer wired as a bistable multivibrator, drives a series of J-K flip-flops and gates to produce a nonoverlapping two-phase clock output, (after Heathkit Digital Techniques, 1975, page 7-99). The phase one, (1), increments a counter which addresses the program stack while the second clock phase, (2), drives the multiplexer that carries out the instructions stored in the stack.

A 3-input nand gate stops the clocking of the J-K flip-flops when a stack instruction commands it. This feature is useful for extended periods of data collection.

The memory, (block 2), contains the program stack and is sequentially addressed by the 6-bit counter mentioned earlier. The program stack consists of 4-bit commands sent in parallel to two tri-state buffers, (blocks 3 and 4). The buffers direct the 4-bit control information to one of two multiplexers; these multiplexers carry out the instructions provided by the 4-bit control code by activating one of sixteen output lines of the multiplexers.

Switches, (block 2), are used to program the stack. Switches A through D provide the 4-bit code which is loaded by switch W. E. at a location provided by the stack pointer. The stack pointer is incremented by switch INC: switch RST is the resent switch which initializes the stack pointer, (address 000000).

The tri-state buffers, (blocks 3 and 4), are activated by the outputs Q; Q of a J-K flip-flop. This provides an alternate activation scheme for the buffers insuring only one is active at a given instant.

The 4-bit stack commands are normally channeled through the buffer of block 4 to the multiplexer contained therein. This addresses one of the 16 mutually exclusive lines of the multiplexer whenever the two clock pulse is low. The activated line performs the specific function wired to it, (e.g., register shift, data clear, latch enable, or multiply, etc.). The multiplexer interfaces to the calculator chip, (block 5), through PNP transistors acting as on-off switches.

The block 3 buffer is used for direct entry of program constants to the calculator chip. These constants are used in the data processing stage of the function. Data are entered by reversing the states of the two buffers. Once data are entered, the buffers are returned to their normal state.

With the buffers in their normal state, data are entered from the counters via a tri-state data selector. The selector enable and selection lines are both driven by the multiplexer of block 4. The counters are each 3-digit decade counters with an internal left circulating shift register, which determines which digit is displayed at the output line. The chips may be latched, reset and selected independently, so that data entry is not interrupted during chip selection.

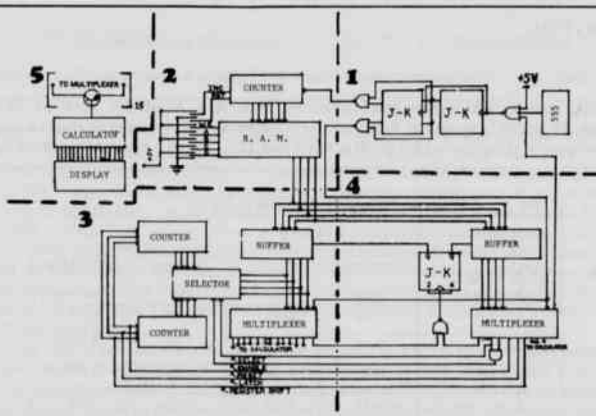

Figure 1. Schematic interface circuit. Lines Inc., RST, W.E. and A-D (block 2) are on-off switches.

In this particular application, the calculator chip along with its associated display circuitry was used to perform required mathematical manipulation and to drive the L.E.D. display.

The application discussed here is only one of the large variety of applications in which a limited computing and control capability is useful. One might consider the use of a calculator chip in place of a microprocessor whenever the application requires principally the calculating power of the chip rather than the control power inherent in a microprocessor system. As a bonus the display driving capabilities are available for outputting the processed information. The display output also may be used for control purposes if desired.

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REMNANT PRAIRIE IN FAULKNER COUNTY, ARKANSAS?

Before white man came to Arkansas, several areas of the state supported large tallgrass ecosystems. The largest of these was the Grand Prairie, located north of the lower half of the Arkansas River; in other parts of the state smaller prairies existed. The Grand Prairie is estimated to have covered one-half to three-quarters of a million acres well past 1900 (Arkansas Department of Planning, Arkansas Natural Area Plan, Little Rock, 247 pp., 1974; Irving and Brenholts, An Ecological Reconnaissance of the Roth and Konecny Prairies, Arkansas Natural Heritage Commission, 50 pp., 1977). Today, the tallgrass prairie remnants can be found in Arkansas counties designated in Figure 1. No prairie remnants have been documented in Faulkner County. This major, distinct ecosystem largely has disappeared from the landscape due to cultivation and other activities of man, so much so that it has become important to identify any remaining prairie of high quality for preservation.

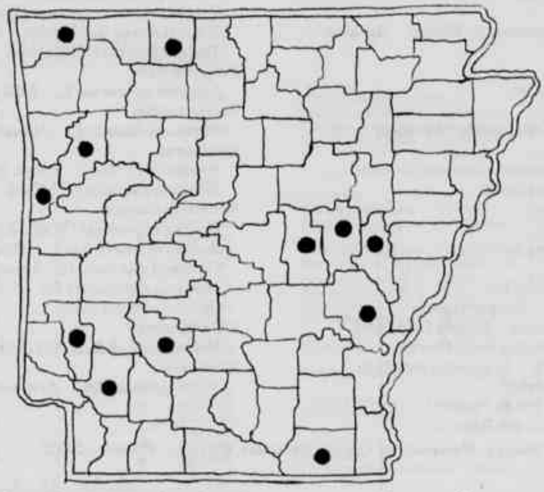

Figure 1. Arkansas counties where there are extant, tallgrass prairie remnants.

On the southern edge of Conway adjacent to industrial development lies an 18-20 acre open field owned by Frank Henze where a large population of *Castilleja coccinea* flowers each spring. *C. coccinea* is a species that typifies remnant areas of prairie in Arkansas (Ark. Dept. of Planning, 1974); this species should be considered rare and endangered in the state. According to the owner, several acres of the Henze property being studied have not been under cultivation for at least 40 years; the sole maintenance of this land has been an annual, fall mowing for hay. A number of collection trips were made to the Henze property between mid-April and early November, 1979. Plants were collected, processed and filed in the University of Central Arkansas Vascular Plant Herbarium. Since the central portion of this field has been cultivated, plants from the obviously disturbed areas were not collected.

Plants that are commonly found in and indicative of areas of remnant prairie (Ark. Dept. of Planning, 1974; Irving and Brenholts, 1977; Weaver, North American Prairie, 348 pp., 1954; Bill Shepard, *pers. comm.*) that were collected from the Henze prairie are: *Andropogon ternarius*, Split-Beard Bluestem; *Andropogon gerardi*, Big Bluestem; *Andropogon virginicus*, Broomsedge; *Sorghastrum avenaceum*, Indian Grass; *Liatris pycnostachya*, Blazing Star; *Eryngium yuccifolium*, Rattlesnake Master; *Buchnera americana*, Blue Hearts; and *Castilleja coccinea*, Indian Paintbrush (see List of Species Collected). Weaver (1954) indicates that the presence of Big Bluestem and Indian Grass (which are found on the Henze property) suggests that a piece of land is a remnant of the tallgrass prairie which grew in areas that were more moist. He further suggests that Little Bluestem *(Andropogon scoparius)* is usually found on better drained soils, which may help account for its absence on the Henze property. The annual fall mowing for hay may also retard or eliminate such expected species. A number of species were likely present but not collected due to staggered collecting trips. Should this field be remnant prairie, it does not appear to be in prime condition (Bill Shepard, *pers. comm.*).