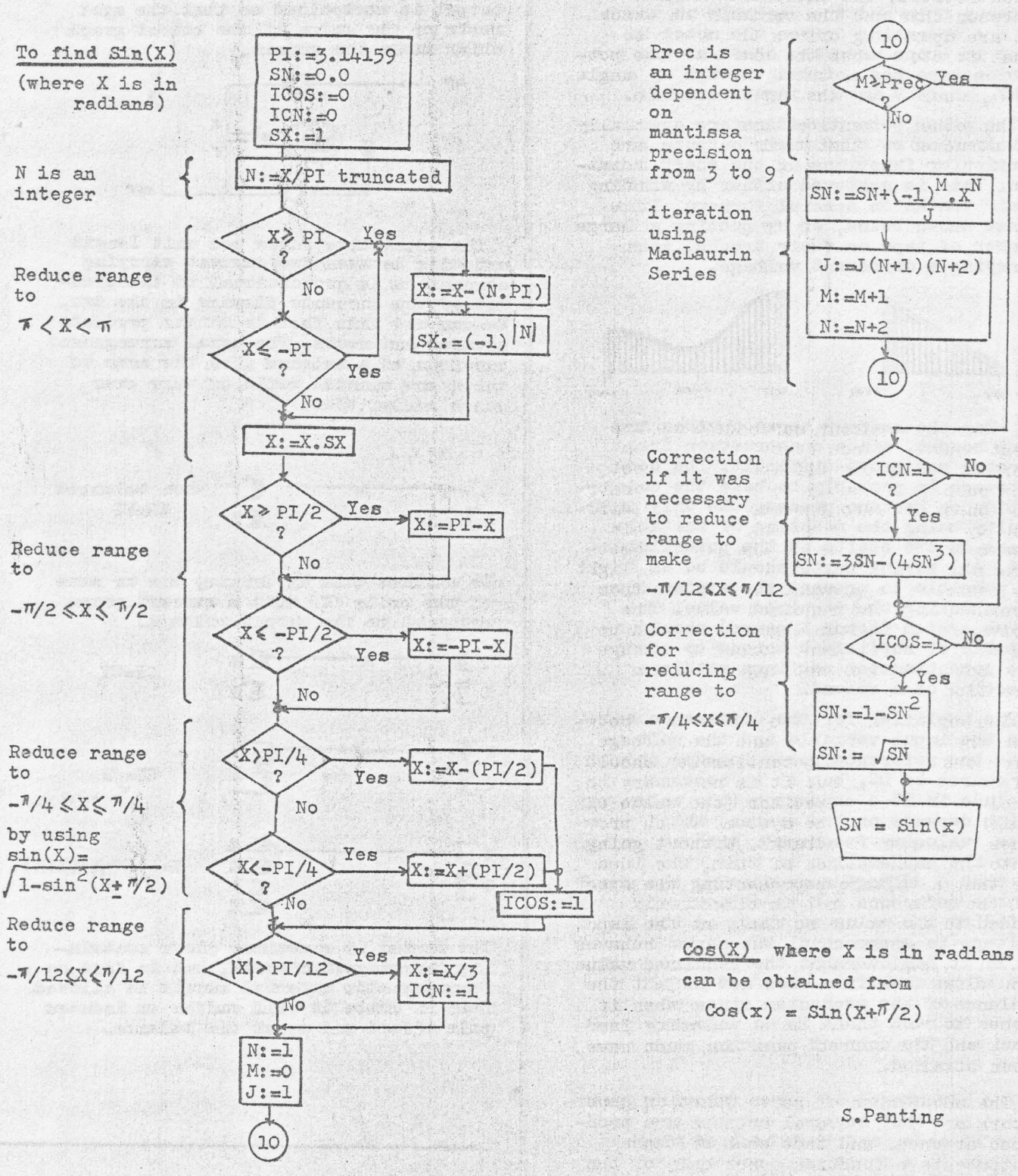
A.C.C NEWSLETTER VOL 2 ISS 2 JUNE 1974



Cos(X) where X is in radians can be obtained from

$\cos(x) = \sin(X+\pi/2)$

S.Panting

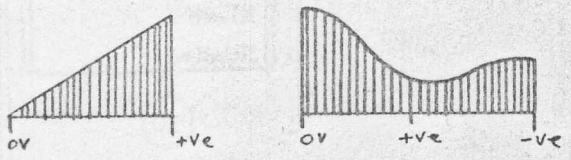
ANALOGUE COMPUTERS
for the Amateur Constructor

part 3 J.Allen

Servo Devices

These devices are based on potentiometers. A small electric motor drives a set of ganged potentiometers, one of which produces an output proportional to the angle through which its shaft has been rotated. The difference signal between this and the variable on which we are operating drives the motor so that it stops when the shaft of the potentiometers has rotated through an angle a=kV, where V is the input variable.

The other potentiometers are specially constructed so that their outputs are particular functions of the shaft rotation. This is achieved either by winding their tracks on special formers, like those shown below, or by putting a large number of taps on their tracks, each carrying a different voltage.



For the amateur servo devices are best bought, since construction from scratch may prove difficult. The best approach is probably to base the construction on Meccano pieces, the only difficulty being the mounting of suitable gears on the shafts ot the potentiometers. All moving parts should be as light as possible to prevent the system from overshooting the required value. The drive system (motor & gears) should be capable of sufficient torque to change the potentiometer settings within a fraction of a second.

The amplifier for the difference between the input variable and the voltage from the reference potentiometer should of course be DC, but it is necessary to include in it a capacitor (the value of which depends on the system) which provides 'velocity feedback'. Without going into the mathematics of this, the idea is that a voltage representing the speed of the reference pot is effectively added to its value so that, as the input voltage is approached, the servo behaves as if it has overshot the required value and slows down. This does not affect the balance of the mechanism since when it comes to rest there is no velocity feedback and the correct position must have been attained.

The advantages of servo function generators are that several outputs are produced at once, and that each of these outputs is a function , not only of the input variable matched by the reference pot, but also of the voltage supplied to the potentiometers themselves; it may be of the form

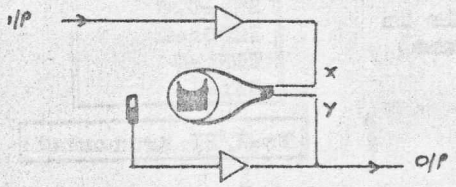
$$V_o = v_1 \, f\left(\frac{V_2}{V_3}\right)$$

Unfortunately their cost and frequency response leave much to be desired.

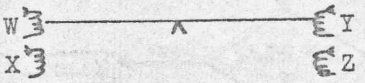
Exotica

The following devices are included more for interest and completeness than as constructional suggestions.

The arrangement of any single valued function can be read almost directly from its graph by means of the arrangement below. The deflection in the X direction of the spot on a CRT is proportional to the input variable, and the output is controlled so that the spot rests on the curve of the cutout graph which masks the screen.

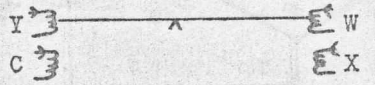


The attractive force per unit length existing between two current carrying conductors is proportional to the product of the currents flowing in the two. We can use this fact to obtain products squares and roots. The usual arrangement consists of a balance , on the arms of which are mounted coils of wire over other coils, thus;

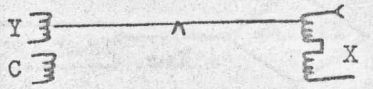


when balanced WX=YZ

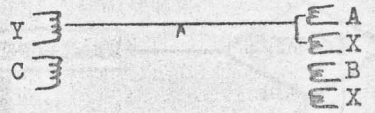
We utilise this by driving one or more of the coils (Y) with a current proportional to the output voltage.



CY=WX



$CY=\sqrt{X}$



$Y=\frac{1}{C}(X+A)(X+B)$

The device is sometimes shown containing ferromagnetic cores, but in fact no ferromagnetic material should be allowed near it since it will suffer an induced pole effect and upset the balance.

I would like to base a forthcoming issue of the ACCN on the INTEL 4 and 8 bit microprocessor I/C's and would therefore be grateful for contributions from anyone who has any knowledge of these wee beasties.

mike lord

SYSTEM 570

Some details of the computer I am currently building - System 570-

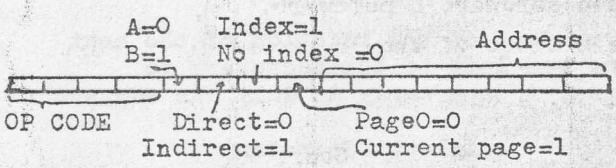
General

16 bit words. Basic memory capacity of 4K, expandable to a maximum of 64K divided into pages of 256 words. 2's complement arithmetic.

Registers

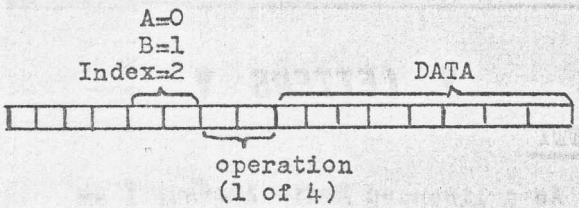
PCR Program Counter (16 bits)
IND Index Register (16 bits)
MAR Memory Address Register (16 bits)
MBR Memory Buffer Register (16 bits)
ISR Instruction Register (16 bits)
AReg Data registers of arithmetic unit,
BReg each register assosciated with it (16 + 1 bits)
SWR Console hand switch reg. (16 +1 bits)

Memory Reference Instructions
(OP CODE 1 - 10)



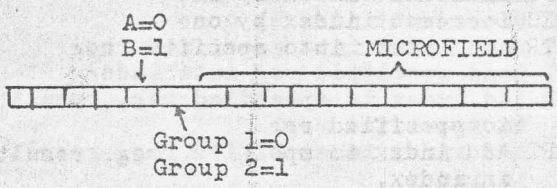
1 STR Store contents of specified reg in specified address.
2 LDR Load specified reg with contents of specified address.
3 ISZ Increment contents of specified address by one, skip next instruction if result is zero.
4 DSZ Decremtnt contents of specified address by one, skip next instruction if result is zero.
5 CSE Compare contents of specified reg and specified address, skip next instruction if equal.
6 CSU Compare contents of specified reg and specified address, skip next instruction if unequal.
7 JMP Unconditional jump to specified address.
8 JMS Jump to subroutine (stores return address)
9 AMR Add contents of specified address and specified reg, result to reg.
10 ARM Add contents of specified address and specified reg, result to addr.

Immediate Data Instructions
(OP CODE 11)



ADD Adds contents of immediate field to specified register
SUB Subtracts contents of immediate field from specified register.
AND Logical AND between immediate field and specified register.
CPY Copy immediate field into low order bits of specified register.

Single Register Instructions
(OP CODE 12)



Group 1

CLR Clear specified reg.
CLL Clear specified link.
CMR Complement specified register.
CML Complement specified link.
SRR Shift specified register and link one place right.
SRL Shift specified register and link one place left.
ART Arithmetic shift (if bit is unset by ART, shift is logical)
CVC Cyclic shift (if bit unset by CYC shift is linear)
INR Increment reg.
DER Decrement reg.

Group 2

SRP Skip next instruction if reg >0
SRM " " " " " <0
SRZ " " " " " =0
SRN " " " " " ≠0
SRE " " " " " even
SRO " " " " " odd
SLZ " " " " link =0
SLN " " " " " ≠0
SKP Unconditional skip
STP Stop

Certain instructions within a particular group may be combined to give another instruction. For example a combination of CMR and INR would yeild the 2's complement of the register contents.

Dual Register Instructions
(OP CODE 13)

Group 1

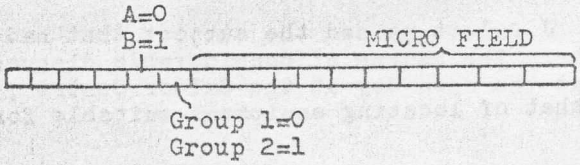
NND A.B Result to specified reg. } logical
IOR A+B
XOR A⊕B

APB A+B Result to specified reg } arith
AMB A-B
BMA B-A
TRN Copy contents of specified register into the other register.

Group 2

SAE Skip next instruction if A=B
SAU " " " " A≠B
SAG " " " " A>B
SAL " " " " A<B
SGE " " " " A≥B
SLE " " " " A≤B

Index Register Instructions
(OP CODE 14)



Group 1

CLI Clear index
CMI Complement index
INC Increment index by one
DEC Decrement index by one
ITR Load index into specified reg
RTI Load specified reg into index
AIR Add index to specified reg, result to specified reg.
ARI Add index to specified reg, result in index.
IMR Index minus specified register, result to index.
RMI Reg minus index, result to reg.

Group 2

SEI	Skip	next	instruction	if	index = reg
SUI	"	"	"	"	" ≠ reg
SGI	"	"	"	"	" < reg
SLI	"	"	"	"	" > reg
SIE	"	"	"	"	" even
SIO	"	"	"	"	" odd
SIZ	"	"	"	"	" =0
SIN	"	"	"	"	" ≠0
SIP	"	"	"	"	" >0
SIM	"	"	"	"	" <0

The extensive index register instructions provide what is virtually a third accumulator.

Input and Output Instructions
(OP CODE 15)

Programmed I/O passes through either of the main data registers, however a DMA (cycle stealing) facility has been provided to allow for expansion which envisages mag tape. The console hand switch register can also be loaded or stored under programmed I/O.

All I/O instructions are 'skip next instruction if successful', if unsucessful a light is illuminated on the console for a check on device malfunction.

Mick Reeve.

ACC COMMITTEE MEETING of 25 MAY 1974

Officers & Committee members present ; M.Creutzberg, M.Lord, J.Aslett & M.Reeve

Upon the request of M.Lord a resolution was carried such that a bank account in the name of the ACC could be opened at Lloyds Bank, Basildon, Essex. Lloyds had agreed to this subject to the resolution being passed.

The chairman raised the subject of local groups and after some discussion it was agreed that a list of names and addresses of those interested in forming local groups should be published in the newsletter so that interested persons could write in to the local group concerned.

J.Aslett raised the subject that had been the source of considerable discussion at the open day at the Galdor Centre ; that of locating equipment suitable for I/O devices for members building their own computers ie. Typewriters, paper tape readers/punches, drum, core and tape storage units etc.

After a lot of discussion it was decided to set up some form of information point in the club where details of computer systems and parts can be held so that a member requiring a unit can contact the information point and we hope be directed to a source that could supply his requirement cheaply.

M.Lord reported that the membership stood at 140 which now exceeds the calculated break even point for Vol 2 of the newsletter.

Discussion followed on how to open up the software side of the club.

Mr. Creutzberg agreed to start an article in the newsletter of simple yet interesting problems for computer solution to give those learning software some interesting examples to work out.

M.Lord agreed to attack the subject of Hardware vs Software which should be of interest to the club constructor & computer designer as to where to draw the line between hardware & software.

The subject of the location of the next meeting was left to the Secretary to organise. A date early in July was suggested.

J.Aslett Secretary

The July edition of Practical Electronics carries an article by R.Mount describing the construction of a special purpose digtal machine to play the game of NIM.

LETTERS

8 TTY

As a licenced Radio Amateur I am currently able to receive 50 baud RTTY on a Creed 54 teleprinter using 850 Hz audio shift and posess the software originally written by the previous owner to use the 5 unit machine as input/output device for a PDP8-S including Hexadecimal and bootstrap loaders (3x5 unit bytes per 12 bit word) and ASCII/RTTY - RTTY/ASCII conversion routines

written to occupy high speed reader and interrupt handler areas of the FOCAL (BASIC-like interpreter) program.

None of these are tried - since I never had a 20 mA -ve logic PDP-8 to try it on.

I hope soon to be able to transmit RTTY as well, but am keeping an eye open for a second-hand mini to use. I do have a slight chance of acquiring a 1Kx8bit MINIC but would prefer a PDP8 for obvious reasons.

If anyone would like to correspond with me about PDP8,11 or 12 and/or peripherals?

Soon I shall be send-receive on Radio Teletype and if anyone similarly equipped would like to contact me I should be able to discuss computers on the air, though I don't yet know the "official" view about swapping programs over the air. My callsign is G3NBW and I operate on 80,20 & 15 metres.

Peter J Bendall
16 Three Firs Way
Burghfield Common, Reading, Berks.

THE WINNERS !!

I am particularly interested in programming of computers but have had no training in their use. I am a chemistry teacher with very little maths., but am interested inproblem solving as well as possible uses in the teaching of chemistry.

Our school has just won a prize offered by Cybernet, a computer terminal and free use of it for a year (after 4.30 pm) It will not be available till July, but I would welcome any information at all on teaching by computer.

J.Jardine, 21 Fullarton Drive,
Troon, Ayrshire KA10 6LE

GAMES PLEASE

If anyone knows of games for two players which are logical in the way of playing and could be adapted for a solitaire game against a logic machine would they please write to me.

J.Whitfield, 94 Farnworth Rd.
Perketh, Warrington, WA5 2TS

BOOKS & BITS & ART

Interesting book out by Brice Ward (Fowlsham -TAB) called COMPUTER TECHNICIANS HANDBOOK £2.25 runs into 500 pages. Really intended for a computer service engineer but contains many circuits of small computer systems and lots of programming details.

Interesting bit in Electronics Today International Oct '73 about modified Garrard 401 turntable which is used to store (digitally) TV captions. Uses magnetic disc with LED photocell system with holes in turntable . Unfortunately only a brief description is given but even so it sounds quite interesting.

A very basic book for the beginner from Mullard Mini books called MAGNETIC CORE MEMORIES costs 25p + postage.

A more advanced booklet from Mullard Industrial Electronics Division, Torrington Place London WC1 called HOW TO USE DIGITAL MAGNETIC CORE MEMORIES their book cat No TP1193 runs to about 28 pages (A4) and free from technical Information Dept.

Have you heard about RTTY or Computer art ? - the idea being to build up a picture using letters of the alphabet with spaces to build up the light and shade when viewed from a distance.

J.J.Smith

SURVEY

How about some form of opinion survey related to the sort of articles members would like to see ? I'm sure I'm not the only programmer in our midst, but what do people want to hear about ? e.g. implementing recursive procedure calls, operating systems, syntax analysis, macro generators, examples of specific languages etc. etc ?

Can we encourage a discussion about the 4th generation, microprocessors, stack architecture etc. where I think the amateur can make a genuine contribution.

C.Lee

How about it then ? To start things off can anyone suggest a real application (apart from their use in compilers) for recursion ?

M.Lord

BOOKLIST

May I suggest the following titles;

MICROPROGRAMMING - PRINCIPLES AND PRACTICES
S.S.Husson 1970 Prentice Hall

DESIGNING WITH TTL
Morris & Miller Mc Graw Hill

HANDBOOK OF LOGIC CIRCUITS
J.D.Lenk Reston Publishing Cy.

LOGIC DESIGN WITH INTEGRATED CIRCUITS
W.E.Wickes John Wiley & Sons

DIGITAL DESIGN
R.K.Richards Wiley Interscience

M.Dreyfus

INTEGRATED CIRCUITS IN DIGITAL ELECTRONICS
by A.Barna & D.I.Porat
John Wiley & Sons Ltd. 484pp. £11.25

STRUCTURED PROGRAMMING
by Dahl, Dijkstra, Hoare
Academic Press, London & New York 1972

THE MAD MACHINE ?!

A PSYCHOSIS SIMULATOR

P.Lockerby

It is generally agreed that to build computers and robots that obey Isaac Asimov's famous "Three Laws of Robotics" is highly desirable. These laws are as follows;

First Law : A robot may not injure a human being or, through inaction, allow a human being to come to harm.

Second Law : A robot must obey the orders given it by human beings, except where such orders would conflict with the first law.

Third Law : A robot must protect its own existance, except where such protection would conflict with the first or second laws.

I will now attempt to show that if a robot is to be able to obey these laws, it must be able to hold beliefs.

Suppose a man tells a robot "I feel hot". If the man is healthy, the robot should act to reduce the room's temperature, but if the man feels hot because he is ill, the robot should summon a doctor.

In the first case, the robot will "know" that a certain range of temperatures is generally accepted as comfortable, but must believe anyone who says that a temperature within this range is uncomfortable. In the second case, the robot should be able to "believe", from appearances, that the man is ill, because it is undesirable that the robot should carry out a medical examination every time that it is given an order. (Similarly it must be able to "believe" in the sanity of a human before obeying commands).

A robot with the ability to hold beliefs would be capable of showing personality. It is possible that damage could cause the robot to assume a psychotic personality, and thus be a potential menace to humans. It is necessary that a robot should be able to tell belief from fact, and thought from reality, and that if a fault develops in the "reality detector", then the robot should automatically shut down.(To require it to "consciously" switch itself off would set up a conflict centred around the First & Third Laws and could add neurosis to psychosis).

Fig 1 shows one possible form of robotic "nervous system", in which "imagination" is effected by passing memory signals to the CPU by way of the input filter so that they appear as a response to an imaginary stimulus. The "reality detector" nerves tell the CPU that the appropriate sensory organ "muscles" are not in use, allowing the CPU to "know" that the input signal does not necessarily correspond to an external stimulus. (in this context "thought" or "signal" = an electrical or bio-electrical analogue of a stimulus ; "reality" = an external stimulus).

The CPU thus "knows" whether it is "thinking" or responding to reality.

If the "reality detector" nerves are cut, then the CPU may "think" that all inputs are imaginary. If these nerves are shorted, then the CPU may see all inputs as real. Either event corresponds to a psychotic state.

Fig 2 shows a simplified version of Fig 1, which can readily be modelled as hardware or as the program "Psychosis Simulator". I will give some details for those who wish to construct the latter, also a flowchart.

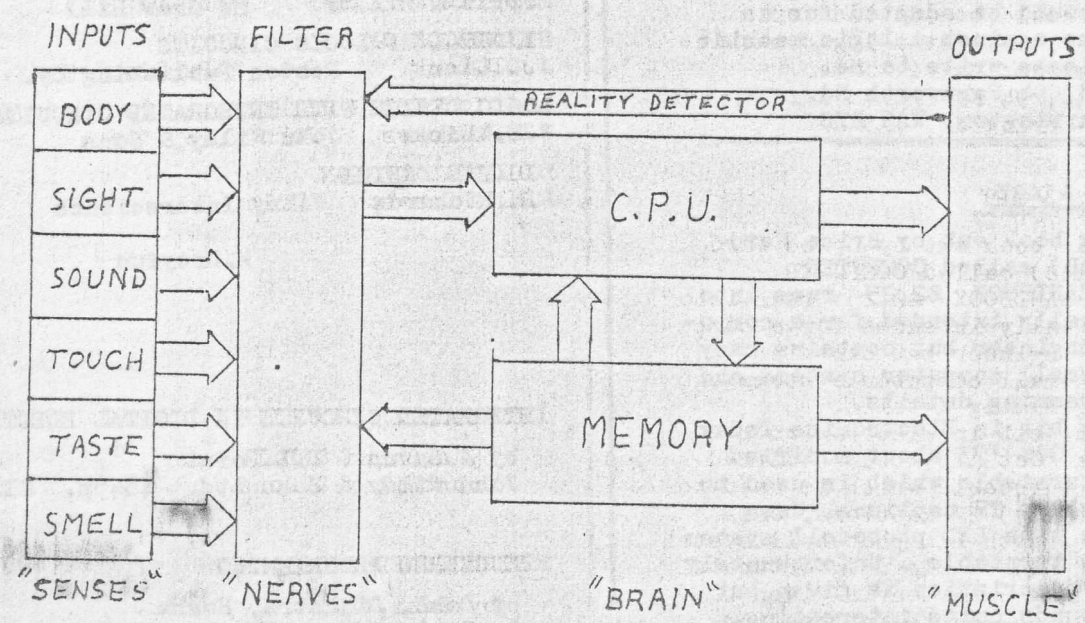
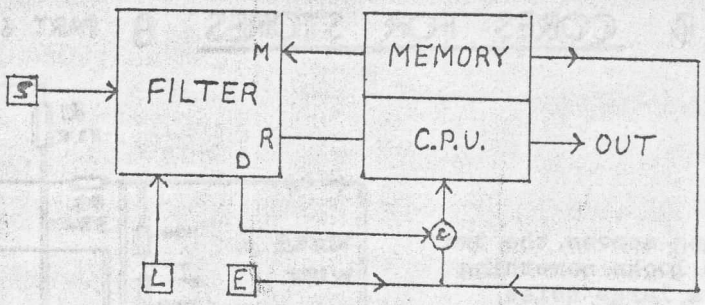


FIG. 1



E = "EYE" (DATA INPUT)

L = 1 = "EYELID OPEN"

M = 1 = "MEMORY" ACTIVE

S = 1 = "PSYCHOTIC"

D = 1 = ACCEPT DATA

R = 1 = "DATA IS REAL"

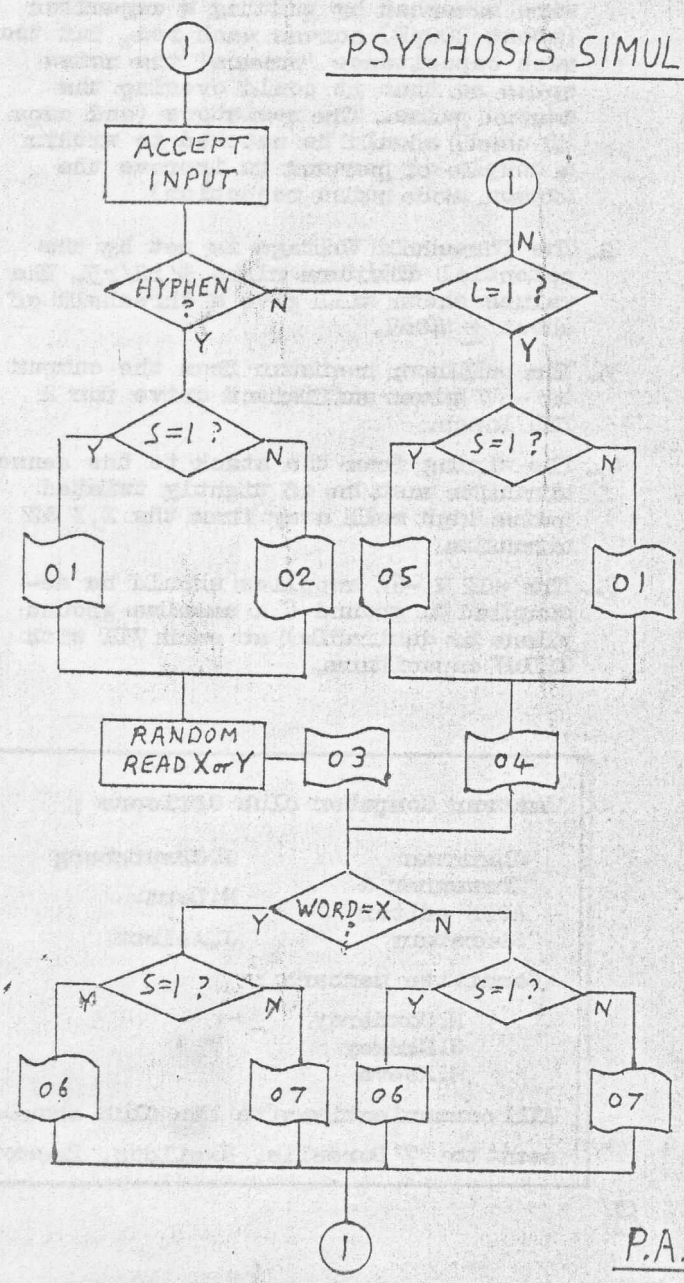
FIG. 2

FILTER TRUTH-TABLE

L	M	S	D	R
0	0	0	0	X
0	0	1	0	X
0	1	0	1	0
0	1	1	1	1
1	0	0	1	1
1	0	1	1	0
1	1	0	0	X
1	1	1	0	X

X = AMBIGUOUS

PSYCHOSIS SIMULATOR



The "eye" would be a typwriter input, and the "eyelid" and "illness input" would be console switches. Two storage locations are required, one "X" to contain the names of real things, the other "Y" to contain the names of mythical or imaginary things.

If a mane is typed, it is compared with memory and classified. Also "Sane P.S." states that it "sees" the input. "Psychotic P.S." states that it has "imagined" the input and classifies it wrongly. Depression of the hyphen key causes print-outs the reverse of the foregoing, since it triggers a random READ from memory. Referring to the typewriter keys, one might almost say that if P.S. is "sick", then "depression" will trigger a psychotic state !

Key to flow chart "Print Outs"

01 Print "I CAN SEE "---
02 Print "I AM THINKING OF" ---
03 Print randomly selected word
04 Print input word

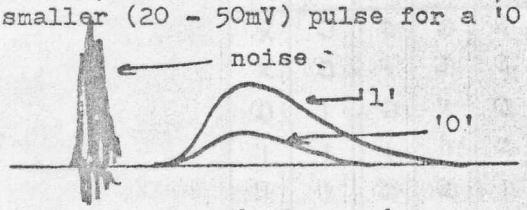
After 01 or 02, repeat on new line.

05 Print "I AM IMAGINING I CAN SEE"
06 Print "--- ARE NON EXISTANT"
07 Print "---REALLY EXIST"

CORES FOR STORES PART 6

MAKING SENSE OF IT ALL

The voltage appearing across the two ends of the sense wires looks something like that shown below; a large noise spike when the X & Y select currents are turned on, followed by a fairly small (50 - 200mV depending upon the type of cores used) if a '1' had been stored, or a smaller (20 - 50mV) pulse for a '0'



We therefore need, for each sense wire, a circuit that will;-

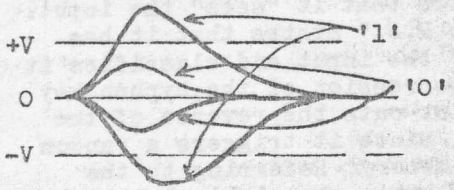
a) Discriminate between the medium sized '1' pulse and the smaller pulse resulting from a stored '0'.

b) Allow you to 'blank' the noise spike.

c) Give a logic level output.

d) Detect both positive and negative '1' pulses (the sense wire is always threaded through the cores in a pattern designed to minimise unwanted pickup. Unfortunately this has the effect of making the polarity of the sense signal vary according to the exact position in the pattern of the core that is being 'read'.)

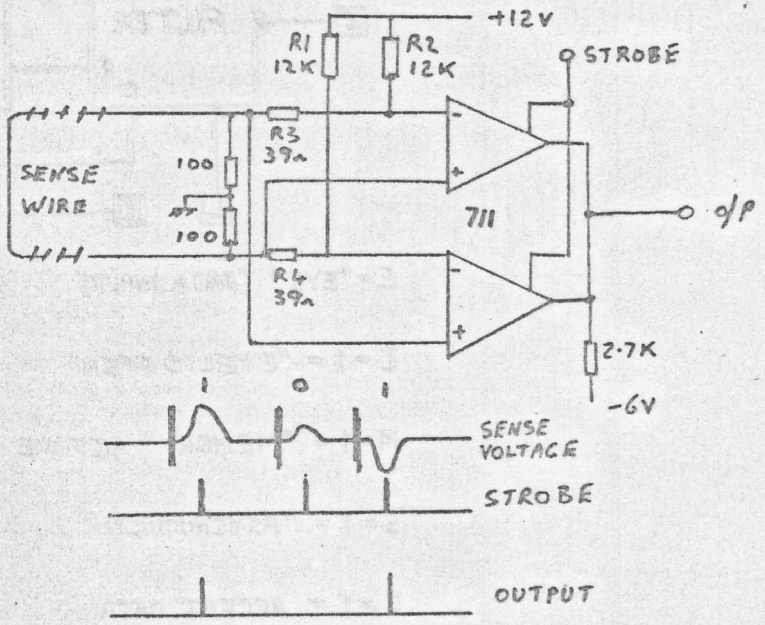
To discriminate between '1' and '0' we establish a threshold voltage V such that we hope the '0' pulses will always lie within ± V, and the '1' pulses will be outside ± this threshold:



Obviously an amplifier is needed to produce the logic level output. Great care must be taken to ensure that the amplifier is not 'blocked' by the large amplitude noise spike, and the easiest way of doing this is to use one of the integrated circuit amplifiers designed especially for this purpose.

The best (cheapest, easy to use) I/C for the amateur is the 711 - available from Fairchild & SGS as the μA711 and with similar codes from many other manufacturers.

This circuit comprises two fast voltage comparators with their outputs 'wired-or'ed' together so that either amplifier can make the output go 'high'. The application of a 'low' signal to a strobe input forces the output low. It is used in the following circuit;



Practicalities

1. The two 100 ohm resistors act as a termination for the sense wire. You can reduce the noise on the sense wire somewhat by putting a capacitor (about 200pF) across each res, but too much capacitance 'smears' the noise spike so that it could overlap the wanted pulse. The resistors (and caps if used) should be matched to within a couple of percent to improve the common mode noise rejection)

2. The Threshold Voltage is set by the potential dividers r1/r4 & r2/r3. The values shown will give a threshold of about ± 40mV.

3. The pulldown resistor from the output to -6V gives sufficient drive for 2 TTL loads.

4. The wiring from the stack to the sense circuits must be of tightly twisted pairs kept well away from the X,Y &Z circuits.

5. The +12 & -6V supplies should be decoupled to ground (a massive ground plane is desirable) at each 711 with 0.1uF capacitors.

Amateur Computer Club Officers ;

Chairman	J.Creutzberg
Treasurer & ACCN editor	M.Lord
Secretary	J.Aslett

Committee members ;

R.Cowderoy
G.Hankey
M.Reeve

All communications to the Club should be sent to 7 Dordells, Basildon, Essex