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80micro

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Great Barrier Reef

Micro-Melodies

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Armageddon

Rat Maze

And Much More!

C-Notes
80's Model 100 Section


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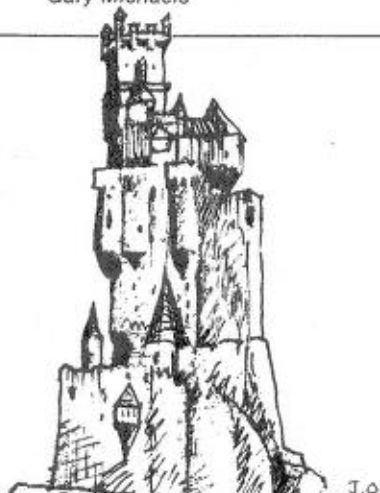
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Maxwell's Demon

by Lee Morgenstern

Learn something about Maxwell's Hypothesis while you try to keep the hot and cold molecules separated in this physics-based game.

The hottest debate in physics in 1871 centered around James Clerk Maxwell's theory of thermodynamics. Maxwell hypothesized that if you manipulate a valve between two containers filled with gas at identical temperatures so that fast-moving molecules accumulate in one container and slow-moving molecules in the other, the temperature difference created produces useful energy.

But Maxwell's theory seemed to violate the second law of thermodynamics,

which states that in a closed system, you can't create order from chaos. When Maxwell first described his hypothesis, it sparked a great deal of debate in the scientific community. However, the hardware necessary to test his hypothesis wasn't available, so the theory could be debated but never proved or disproved. As such, it was a thought experiment only.

Today, computers make thought experiments obsolete. With the help of

your Model I/III, you can demonstrate Maxwell's theory visually. It also makes an entertaining game.

The Game

Maxwell's Demon, as the game is called, is so named because the concept of a controllable valve, while central to Maxwell's idea, did not exist in his time. Instead, Maxwell proposed that a supernatural being—a demon—maintained the temperature difference between containers.

In this game, you are Maxwell's demon, the force that separates fast-moving molecules from slow-moving molecules. These hot and cold molecules are depicted on the screen as large H and C characters.

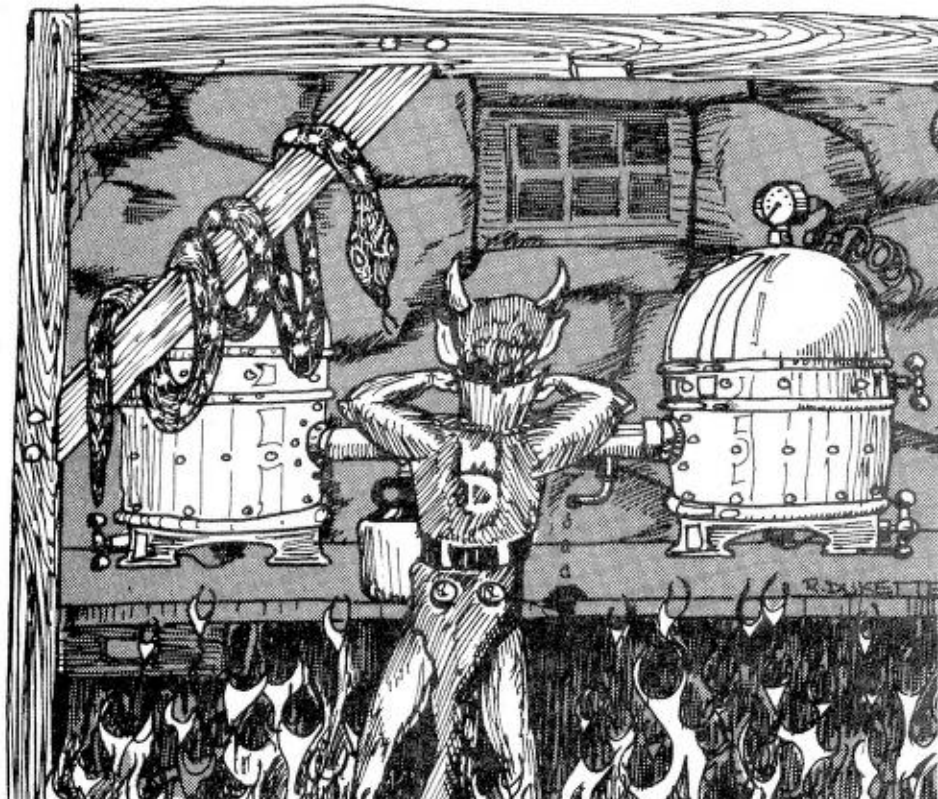
There are six levels of play. The lowest level has four slow-moving molecules, and the highest has 12 fast-moving molecules. The space bar opens and closes the valve separating the two compartments and the break key lets you exit from the game or select a new playing level.

Program Design

The program is written in Assembly language for fast animation. Data tables drive most of the logic for animating the molecules.

Data-driven logic makes the program simple to understand and makes program modification easier since it reduces processing time.

A data base containing all possible



The Key Box

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Assembly Language
Editor/Assembler

situations, such as the positions of an animated figure, increases processing speed and improves animation quality.

The idea of referring to a table of pre-calculated values is not new. Techniques to do so have existed for a long time, but were impractical due to the amount of memory required. Since memory is less expensive today, such techniques are now feasible. The following program provides an example of one of these techniques.

Data Structure

The tables in this program are two-dimensional arrays. The first dimension points to a list of starting addresses for lists in the second dimension. Each list in the second dimension contains the actual table entries.

The first table in the program listing, the move table, uses pixel position and move direction as the two indexes. MOVX, the first list, consists of the addresses MOV0 through MOV5, which correspond to the six pixel positions. MOV0 through MOV5 are the second dimension lists; they are indexed by move direction, and contain the final entries.

The program accesses an entry in the table by following these steps:

- (1) Load the DE registers with the first index.
- (2) Load the HL registers with the address of the first list.
- (3) Add DE to HL.
- (4) Reload DE with the 2 bytes addressed by HL. This is the starting address of the proper second list.
- (5) Load HL with the second index.
- (6) Add DE to HL.
- (7) Load the table entry bytes addressed by HL.

Data Tables

The move table, MOVX, determines how to move a molecule. It handles eight move directions including up left, up right, down left, and down right in each of two ways. The first way moves one pixel up or down and one pixel left or right. The other way moves one pixel up or down and two pixels left or right. The indexes of MOVX are pixel position (zero through five) and move direction (zero through seven). There are two values in each entry: the new pixel position and the video address offset.

The wall table, WALLX, determines how to bounce a molecule off a wall. The indexes of WALLX are move direction (zero through seven) and wall number (zero, 2, 4, 6). The entries in the table are new move directions.

The hot table, HOTX, and cold

Program Listing

```

00100 ;MAXWELL'S DEMON
00110 ; BY LEE MORGENSTERN, MAY, 1982
00120 ;
7000 00130 ; ORG 7000H
00140 ;
00150 ;MOVE TABLE - INDEXED BY PIXEL AND MOVE DIRECTION
00160 ; OUTPUTS NEW PIXEL AND VIDEO ADDRESS OFFSET
7000 0C70 00170 MOVX DEFB MOV0
7002 1C70 00171 DEFB MOV1
7004 2C70 00172 DEFB MOV2
7006 3C70 00173 DEFB MOV3
7008 4C70 00174 DEFB MOV4
700A 5C70 00175 DEFB MOV5
00180 ;
700C 05 00190 ; MOVE DEFB 5
700D 0F 00191 DEFB 191
700E 05 00192 DEFB 5
700F 0B 00193 DEFB 192
7010 04 00194 DEFB 4
7011 0F 00195 DEFB 255
7012 04 00196 DEFB 4
7013 00 00197 DEFB 0
7014 02 00198 DEFB 2
7015 0F 00199 DEFB 191
7016 02 00200 DEFB 2
7017 01 00201 DEFB 193
7018 01 00202 DEFB 1
7019 0F 00203 DEFB 255
701A 01 00204 DEFB 1
701B 01 00205 DEFB 1
701C 03 00206 MOV1 DEFB 3
701D 0F 00207 DEFB 255
701E 03 00208 DEFB 3
701F 00 00209 DEFB 0
7020 05 00210 DEFB 5
7021 0F 00211 DEFB 255
7022 05 00212 DEFB 5
7023 00 00213 DEFB 0
7024 00 00214 DEFB 0
7025 0F 00215 DEFB 255
7026 00 00216 DEFB 0
7027 01 00217 DEFB 1
7028 02 00218 DEFB 2
7029 0F 00219 DEFB 255
702A 02 00220 DEFB 2
702B 01 00221 DEFB 1
702C 04 00222 MOV2 DEFB 4
702D 0F 00223 DEFB 255
702E 04 00224 DEFB 4
702F 00 00225 DEFB 0
7030 03 00226 DEFB 3
7031 0F 00227 DEFB 63
7032 03 00228 DEFB 3
7033 00 00229 DEFB 64
7034 01 00230 DEFB 1
7035 0F 00231 DEFB 255
7036 01 00232 DEFB 1
7037 01 00233 DEFB 1
7038 00 00234 DEFB 0
7039 0F 00235 DEFB 63
703A 00 00236 DEFB 0
703B 01 00237 DEFB 65
703C 02 00238 MOV3 DEFB 2
703D 00 00239 DEFB 192
703E 02 00240 DEFB 2
703F 01 00241 DEFB 193
7040 01 00242 DEFB 1
7041 00 00243 DEFB 0
7042 01 00244 DEFB 1
7043 01 00245 DEFB 1
7044 05 00246 DEFB 5
7045 0F 00247 DEFB 191
7046 05 00248 DEFB 5
7047 01 00249 DEFB 193
7048 04 00250 DEFB 4
7049 0F 00251 DEFB 255
704A 04 00252 DEFB 4
704B 01 00253 DEFB 1
704C 00 00254 MOV4 DEFB 0
704D 00 00255 DEFB 0
704E 00 00256 DEFB 0
704F 01 00257 DEFB 1
7050 02 00258 DEFB 2
7051 00 00259 DEFB 0
7052 02 00260 DEFB 2
7053 01 00261 DEFB 1
7054 03 00262 DEFB 3
7055 0F 00263 DEFB 255
7056 03 00264 DEFB 3
7057 01 00265 DEFB 1
7058 05 00266 DEFB 5
7059 0F 00267 DEFB 255
705A 05 00268 DEFB 5
705B 01 00269 DEFB 1
705C 01 00270 MOV5 DEFB 1
705D 00 00271 DEFB 0
705E 01 00272 DEFB 1
705F 01 00273 DEFB 1
7060 00 00274 DEFB 0
7061 00 00275 DEFB 64
7062 00 00276 DEFB 0
7063 01 00277 DEFB 65

```

Listing continues

Listing continued

```

7064 04      00270      DEFB      4
7065 PF      00279      DEFB     255
7066 04      00280      DEFB      4
7067 01      00281      DEFB      1
7068 03      00282      DEFB      3
7069 3F      00283      DEFB     63
706A 03      00284      DEFB      3
706B 41      00285      DEFB     65
              00250 ;
              00260 ;WALL TABLE - INDEXED BY WALL(L,R,U,D) AND MOVE DIRECTION
              00270 ; OUTPUTS NEW MOVE DIRECTION
706C 7470    00289 WALLX      DEFW      WALLL
706E 7C70    00290      DEFW      WALLR
7070 8470    00291      DEFW      WALLU
7072 8C70    00292      DEFW      WALLD
              00290 ;
              00300 WALLL      DEFB      1
7074 01      00301 WALLL      DEFB      1
7075 01      00302 WALLL      DEFB      3
7076 03      00303 WALLL      DEFB      3
7077 03      00304 WALLL      DEFB      5
7078 05      00305 WALLL      DEFB      5
7079 05      00306 WALLL      DEFB      7
707A 07      00307 WALLL      DEFB      7
707B 07      00310 WALLR      DEFB      0
707D 00      00311 WALLR      DEFB      0
707E 02      00312 WALLR      DEFB      2
707F 02      00313 WALLR      DEFB      2
7080 04      00314 WALLR      DEFB      4
7081 04      00315 WALLR      DEFB      4
7082 06      00316 WALLR      DEFB      6
7083 06      00317 WALLR      DEFB      6
7084 02      00320 WALLU      DEFB      2
7085 03      00321 WALLU      DEFB      3
7086 02      00322 WALLU      DEFB      2
7087 03      00323 WALLU      DEFB      3
7088 06      00324 WALLU      DEFB      6
7089 07      00325 WALLU      DEFB      7
708A 06      00326 WALLU      DEFB      6
708B 07      00327 WALLU      DEFB      7
708C 00      00330 WALLD      DEFB      0
708D 01      00331 WALLD      DEFB      1
708E 00      00332 WALLD      DEFB      0
708F 01      00333 WALLD      DEFB      1
7090 04      00334 WALLD      DEFB      4
7091 05      00335 WALLD      DEFB      5
7092 04      00336 WALLD      DEFB      4
7093 05      00337 WALLD      DEFB      5
              00340 ;
              00350 ;HOT MOLECULE GRAPHICS - INDEXED BY PIXEL
7094 A070    00360 HOTX      DEFW      HOT0
7096 A070    00361 HOTX      DEFW      HOT1
7098 B070    00362 HOTX      DEFW      HOT2
709A B070    00363 HOTX      DEFW      HOT3
709C C070    00364 HOTX      DEFW      HOT4
709E C070    00365 HOTX      DEFW      HOT5
70A0 3F      00370 HOT0      DEFB     3FH
70A1 0C      00371 HOT0      DEFB     0CH
70A2 3F      00372 HOT0      DEFB     3FH
70A3 00      00373 HOT0      DEFB     00H
70A4 00      00374 HOT0      DEFB     00H
70A5 00      00375 HOT0      DEFB     00H
70A6 00      00376 HOT0      DEFB     00H
70A7 00      00377 HOT0      DEFB     00H
70A8 3C      00380 HOT1      DEFB     3CH
70A9 30      00381 HOT1      DEFB     30H
70AA 3C      00382 HOT1      DEFB     3CH
70AB 00      00383 HOT1      DEFB     00H
70AC 03      00384 HOT1      DEFB     03H
70AD 00      00385 HOT1      DEFB     00H
70AE 03      00386 HOT1      DEFB     03H
70AF 00      00387 HOT1      DEFB     00H
70B0 30      00390 HOT2      DEFB     30H
70B1 00      00391 HOT2      DEFB     00H
70B2 30      00392 HOT2      DEFB     30H
70B3 00      00393 HOT2      DEFB     00H
70B4 0F      00394 HOT2      DEFB     0FH
70B5 03      00395 HOT2      DEFB     03H
70B6 0F      00396 HOT2      DEFB     0FH
70B7 00      00397 HOT2      DEFB     00H
70B8 2A      00400 HOT3      DEFB     2AH
70B9 1D      00401 HOT3      DEFB     1DH
70BA 2E      00402 HOT3      DEFB     2EH
70BB 15      00403 HOT3      DEFB     15H
70BC 00      00404 HOT3      DEFB     00H
70BD 00      00405 HOT3      DEFB     00H
70BE 00      00406 HOT3      DEFB     00H
70BF 00      00407 HOT3      DEFB     00H
70C0 28      00410 HOT4      DEFB     28H
70C1 34      00411 HOT4      DEFB     34H
70C2 38      00412 HOT4      DEFB     38H
70C3 14      00413 HOT4      DEFB     14H
70C4 02      00414 HOT4      DEFB     02H
70C5 01      00415 HOT4      DEFB     01H
70C6 02      00416 HOT4      DEFB     02H
70C7 01      00417 HOT4      DEFB     01H
70C8 20      00420 HOT5      DEFB     20H
70C9 10      00421 HOT5      DEFB     10H
70CA 20      00422 HOT5      DEFB     20H
70CB 10      00423 HOT5      DEFB     10H
70CC 0A      00424 HOT5      DEFB     0AH
70CD 07      00425 HOT5      DEFB     07H
70CE 0B      00426 HOT5      DEFB     0BH
70CF 05      00427 HOT5      DEFB     05H
              00430 ;

```

Listing continues

table, COLDX, each contain the graphics bits for the molecules in each of the six pixel positions. Figure 1 shows the H graphics in each of the pixel positions.

The molecule control variables, H0 through H5 and C0 through C5, contain parameters that maintain the current status of the molecules. The data in the HC table initializes the values. Each list consists of the pixel position, video address, move direction, and molecule type.

There are three more tables that contain program control parameters. Each is indexed by the playing level. The molecule update table, LEVELX, con-

*“The program begins
by disabling interrupts
and setting the stack
pointer to the highest point
in a 16K memory.”*

tains pointers to active molecule update sequences. The molecule update count table, FIGCTX, contains the length of the molecule update list. The molecule timing table, TIMX, contains the time delays between molecule updates.

Program Control

The program begins by disabling interrupts and setting the stack pointer to the highest point in a 16K memory.

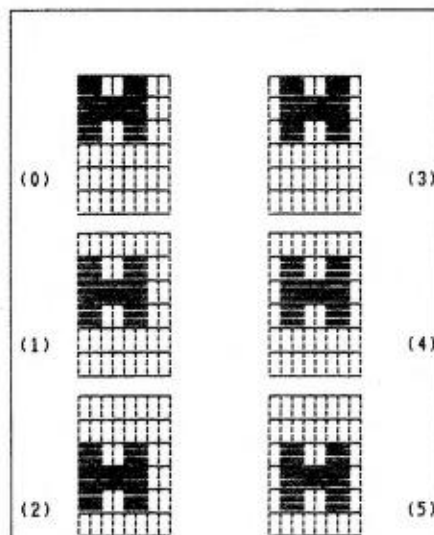


Fig. 1. Pixel Positions for Hot Molecule Graphic.

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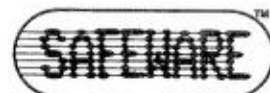
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Listing continued

		00440	;COLD MOLECULE GRAPHICS - INDEXED BY PIXEL	
70D0	DC70	00450	COLDX	DEFB
70D2	E470	00451		DEFB
70D4	EC70	00452		DEFB
70D6	F470	00453		DEFB
70D8	FC70	00454		DEFB
70DA	0471	00455		DEFB
70DC	3F	00460	COLD0	DEFB
70DD	33	00461		DEFB
70DE	33	00462		DEFB
70DF	00	00463		DEFB
70E0	00	00464		DEFB
70E1	00	00465		DEFB
70E2	00	00466		DEFB
70E3	00	00467		DEFB
70E4	3C	00470	COLD1	DEFB
70E5	0C	00471		DEFB
70E6	0C	00472		DEFB
70E7	00	00473		DEFB
70E8	03	00474		DEFB
70E9	03	00475		DEFB
70EA	03	00476		DEFB
70EB	00	00477		DEFB
70EC	30	00480	COLD2	DEFB
70ED	30	00481		DEFB
70EE	30	00482		DEFB
70EF	00	00483		DEFB
70F0	0F	00484		DEFB
70F1	0C	00485		DEFB
70F2	0C	00486		DEFB
70F3	00	00487		DEFB
70F4	2A	00490	COLD3	DEFB
70F5	37	00491		DEFB
70F6	33	00492		DEFB
70F7	11	00493		DEFB
70F8	00	00494		DEFB
70F9	00	00495		DEFB
70FA	00	00496		DEFB
70FB	00	00497		DEFB
70FC	20	00500	COLD4	DEFB
70FD	1C	00501		DEFB
70FE	0C	00502		DEFB
70FF	04	00503		DEFB
7100	02	00504		DEFB
7101	03	00505		DEFB
7102	03	00506		DEFB
7103	01	00507		DEFB

Listing continues

Before starting any animation, the program calls four routines to set the scene: DMSG displays the opening message containing the name of the program and a list of the playing levels, GETLV reads the keyboard and inputs a playing level from the operator, Setup sets up the playing level parameters and initializes the locations of the molecules, and BRD draws the playing area on the screen.

Demon then executes a loop that updates the location and movement of each active molecule. FIGCNT contains the number of passes to be made through this loop. FIGX points to a list containing the molecule control variable addresses in the sequence to be updated. Notice that each active hot molecule appears twice in the list and each active cold molecule appears once. This causes the hot molecules to be moved twice as fast as the cold ones.

For each pass through this loop, Demon updates a molecule by calling four routines. Each routine requires that the IX register contain the address of the molecule control variable list. Wall controls the animation of the wall bouncing—it checks for wall contact, and if any occurs, it changes the move



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direction in the control variable list for that molecule.

REM removes the molecule graphics from the screen. Move calculates the next screen location for the molecule, and Add redraws the molecule graphics at the new location.

When Demon finishes with the molecule update loop, it calls the Open routine to control the opening or closing of the partition. It then executes a time delay before restarting the loop. During this delay, any wall contact produces a beeping sound through the cassette port. When the time delay is finished, the loop is repeated unless the break key is pressed. The break key restarts the entire program, letting the operator select a new playing level.

At slow playing levels, Demon calls the Open routine in the middle of the molecule update loop. This provides better response time for the operator.

“During this delay, any wall contact produces a beeping through the cassette port.”

Routines

The MSG routine clears the screen and displays the opening message with the name of the program and a list of the playing levels. MSG scans the message text and transfers each character to the video memory. There are two control characters that MSG processes differently: The dollar sign indicates a carriage return and an asterisk signals the end of the message.

The GETLVL routine reads the memory-mapped keyboard byte for the number keys to determine the playing level selected. It loops until it detects a bit set, indicating a depressed key. It then shifts and counts the bits to find the key and the corresponding playing level.

The Setup routine establishes control parameters based on the selected playing level. The parameters consist of the number-of-molecules updates, FIGCNT; the time delay between updates, TIMING; and the molecule update list pointer, FIGX. Setup then performs a block move from HC to H0 to

Listing continued

```

7184 28      00510 COLD5  DEFB  28H
7185 30      00511      DEFB  30H
7186 38      00512      DEFB  30H
7187 18      00513      DEFB  18H
7188 0A      00514      DEFB  0AH
7189 0D      00515      DEFB  0DH
718A 0C      00516      DEFB  0CH
718B 04      00517      DEFB  04H
00520 ;
00530 ;MOLECULE UPDATE SEQUENCE - INDEXED BY PLAYING LEVEL
718C 1871    00540 LEVELX DEFW  L1
718E 2471    00541      DEFW  L2
7110 2471    00542      DEFW  L2
7112 3C71    00543      DEFW  L4
7114 3C71    00544      DEFW  L4
7116 3C71    00545      DEFW  L4
7118 A672    00550 L1     DEFW  H0
711A C472    00551      DEFW  H5
711C CA72    00552      DEFW  C0
711E A672    00553      DEFW  H0
7120 C472    00554      DEFW  H5
7122 E872    00555      DEFW  C5
7124 A672    00560 L2     DEFW  H0
7126 AC72    00561      DEFW  H1
7128 CA72    00562      DEFW  C0
712A BE72    00563      DEFW  H4
712C C472    00564      DEFW  H5
712E D072    00565      DEFW  C1
7130 A672    00566      DEFW  H0
7132 AC72    00567      DEFW  H1
7134 E272    00568      DEFW  C4
7136 BE72    00569      DEFW  H4
7138 C472    00570      DEFW  H5
713A E872    00571      DEFW  C5
713C A672    00572 L4     DEFW  H0
713E AC72    00573      DEFW  H1
7140 CA72    00574      DEFW  C0
7142 B272    00575      DEFW  H2
7144 B872    00576      DEFW  H3
7146 D872    00577      DEFW  C1
7148 BE72    00578      DEFW  H4
714A C472    00579      DEFW  H5
714C D672    00580      DEFW  C2
714E A672    00581      DEFW  H0
7150 AC72    00582      DEFW  H1
7152 DC72    00583      DEFW  C3
7154 B272    00584      DEFW  H2
7156 B872    00585      DEFW  H3
7158 E272    00586      DEFW  C4
715A BE72    00587      DEFW  H4
715C C472    00588      DEFW  H5
715E B872    00589      DEFW  C5
00590 ;
00600 ;MOLECULE UPDATE TIMING - INDEXED BY PLAYING LEVEL
7160 60      00610 TIMX  DEFB  96
7161 30      00611      DEFB  48
7162 0C      00612      DEFB  12
7163 08      00613      DEFB  8
7164 04      00614      DEFB  4
7165 01      00615      DEFB  1
00620 ;
00630 ;MOLECULE UPDATE COUNT - INDEXED BY PLAYING LEVEL
7166 06      00640 FIGCTX DEFB  6
7167 0C      00641      DEFB  12
7168 0C      00642      DEFB  12
7169 12      00643      DEFB  18
716A 12      00644      DEFB  18
716B 12      00645      DEFB  18
00650 ;
716C 4D      00660 MSG   DEFM  'MAXWELL'
41 5B 57 45 4C 4C
7173 27      00670      DEFB  27H
7174 53      00680      DEFM  'S DEMON$'
20 44 45 4D 4F 4E 24
717C 24      00690      DEFM  '$ENTER PLAYING LEVEL:$'
45 4E 54 45 52 20 50 4C
41 59 49 4E 47 20 4C 45
56 45 4C 3A 24
7192 24      00700      DEFM  '$1. 4 SLOW MOLECULES'
31 2E 20 20 34 20 53 4C
4F 57 20 4D 4F 4C 45 43
55 4C 45 53
71A7 24      00710      DEFM  '$2. 8 SLOW MOLECULES'
32 2E 20 20 38 20 53 4C
4F 57 20 4D 4F 4C 45 43
55 4C 45 53
71BC 24      00720      DEFM  '$3. 8 MEDIUM MOLECULES'
33 2E 20 20 38 20 4D 45
44 49 55 4D 20 4D 4F 4C
45 43 55 4C 45 53
71D3 24      00730      DEFM  '$4. 12 MEDIUM MOLECULES'
34 2E 20 31 32 20 4D 45
44 49 55 4D 20 4D 4F 4C
45 43 55 4C 45 53
71EA 24      00740      DEFM  '$5. 12 FAST MOLECULES'
35 2E 20 31 32 20 46 41
53 54 20 4D 4F 4C 45 43
55 4C 45 53
71FF 24      00750      DEFM  '$6. 12 SUPER FAST MOLECULES*'
36 2E 20 31 32 20 53 55
50 45 52 20 46 41 53 54
20 4D 4F 4C 45 43 55 4C
45 53 2A
00760 ;
721B 4C      00770 PROMPT DEFM  'LEVEL X - '
45 56 45 4C 20 58 20 2D

```

Listing continues


```

20
7225 50 00780 DEFM 'PRESS SPACE BAR TO OPEN DOOR - '
52 45 53 53 20 53 50 41
43 45 20 42 41 52 20 54
4F 20 4F 50 45 4E 20 44
4F 4F 52 20 2D 20
7244 50 00790 DEFM 'PRESS BREAK TO EXIT'
52 45 53 53 20 42 52 45
41 4B 20 54 4F 20 45 58
49 54

0001 00010 ;
0001 00010 DOOR DEFS 1 ;Z=DOOR OPEN, N2=DOOR CLOSED
0001 00020 LEVEL DEFS 1 ;PLAYING LEVEL (0-5)
0001 00030 TIMING DEFS 1 ;TIME DELAY INBETWEEN UPDATES
0001 00040 FIGCNT DEFS 1 ;MOLECULE UPDATE COUNT
0002 00050 FIGX DEFS 2 ;MOLECULE LIST POINTER
0001 00060 WALLF DEFS 1 ;N2=WALL CONTACT, 2=NO CONTACT
00070 ;

725E 00 00800 HC DEFB 0 ;H0 PIXEL
725F A73C 00800 DEFW 3CA7H ;VIDEO ADDRESS
7261 00 00900 DEFB 0 ;MOVE DIRECTION
7262 9470 00910 DEFW HOTX ;GRAPHICS POINTER
7264 00 00920 DEFB 0 ;H1
7265 033E 00930 DEFW 3E03H
7267 01 00940 DEFB 1
7268 9470 00950 DEFW HOTX
726A 00 00960 DEFB 0 ;H2
726B 333F 00970 DEFW 3F33H
726D 02 00980 DEFB 2
726E 9470 00990 DEFW HOTX
7270 00 01000 DEFB 0 ;H3
7271 0F3E 01010 DEFW 3E0FH
7273 07 01020 DEFB 7
7274 9470 01030 DEFW HOTX
7276 02 01040 DEFB 2 ;H4
7277 7B3D 01050 DEFW 3D7BH
7279 04 01060 DEFB 4
727A 9470 01070 DEFW HOTX
727C 02 01080 DEFB 2 ;H5
727D 5B3D 01090 DEFW 3D5BH
727F 06 01100 DEFB 6
7280 9470 01110 DEFW HOTX
7282 00 01120 DEFB 0 ;C0
7283 0F3D 01130 DEFW 3D0FH
7285 00 01140 DEFB 0
7286 D070 01150 DEFW COLDX
7288 00 01160 DEFB 0 ;C1
7289 333F 01170 DEFW 3F33H
728B 01 01180 DEFB 1
728C D070 01190 DEFW COLDX
728E 00 01200 DEFB 0 ;C2
728F 033E 01210 DEFW 3E03H
7291 02 01220 DEFB 2
7292 D070 01230 DEFW COLDX
7294 00 01240 DEFB 0 ;C3
7295 A73C 01250 DEFW 3CA7H
7297 04 01260 DEFB 4
7298 D070 01270 DEFW COLDX
729A 00 01280 DEFB 0 ;C4
729B 0F3E 01290 DEFW 3E0FH
729D 05 01300 DEFB 5
729E D070 01310 DEFW COLDX
72A0 00 01320 DEFB 0 ;C5
72A1 333F 01330 DEFW 3F33H
72A3 07 01340 DEFB 7
72A4 D070 01350 DEFW COLDX
01360 ;
01370 ;MOLECULE CONTROL VARIABLES
0006 01380 H0 DEFS 6
0006 01390 H1 DEFS 6
0006 01400 H2 DEFS 6
0006 01410 H3 DEFS 6
0006 01420 H4 DEFS 6
0006 01430 H5 DEFS 6
0006 01440 C0 DEFS 6
0006 01450 C1 DEFS 6
0006 01460 C2 DEFS 6
0006 01470 C3 DEFS 6
0006 01480 C4 DEFS 6
0006 01490 C5 DEFS 6
01500 ;
01510 ;START OF PROGRAM
72EE F3 01520 DEMON DI ;DISABLE INTERRUPTS
72EF 310000 01530 LD SP,8000H ;SET STACK POINTER
72F2 CD4B73 01540 CALL DMSG ;DISPLAY OPENING MESSAGE
72F5 CD7973 01550 CALL GETLV ;GET PLAYING LEVEL
72F8 CD8E73 01560 CALL SETUP ;SET UP INITIAL LOCATIONS
72FB CDBE73 01570 CALL BRD ;DISPLAY PLAYING BOARD
72FE 2A5B72 01580 DEMON1 LD HL,(FIGX) ;MOLECULE LIST POINTER
7301 3A5A72 01590 LD A,(FIGCNT) ;NO. OF MOLECULE UPDATES
7304 47 01600 LD B,A ;
7305 C5 01610 DEMON2 PUSH BC ;
7306 E5 01620 PUSH HL ;
7307 5E 01630 LD E,(HL) ;MOLECULE CONTROL LIST
7308 23 01640 INC HL ;
7309 56 01650 LD D,(HL) ;
730A DD210000 01660 LD IX,0 ;
730E DD19 01670 ADD IX,DE ;
7310 CD2174 01680 CALL WALL ;REFLECT FIGURE OFF WALL
7313 CDB274 01690 CALL REM ;REMOVE FIGURE
7316 CDE274 01700 CALL MOVE ;MOVE FIGURE
7319 CD1175 01710 CALL ADD ;ADD FIGURE
731C 3A5872 01720 LD A,(LEVEL) ;
731F FE02 01730 CP 2 ;
7321 DC3F75 01740 CALL C,OPEN ;OPEN/CLOSE DOOR

```

Listing continues

initialize the molecule locations and move directions.

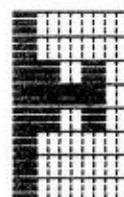
The BRD routine draws the playing area on the screen. It stores a one into the door status flag (DOOR) indicating a closed door. It displays the playing level and operating instructions on the last line of the screen.

The Wall routine deflects molecules after a wall contact by changing the move direction appropriately. It also takes into account a corner contact,

*“The Wall routine
deflects molecules after
a wall contact by changing
the move direction
appropriately.”*

where the molecule can touch two walls simultaneously.

The Wall routine checks for a wall contact by extracting the X and Y coordinates of the molecule location and then comparing these values to the known locations of the walls. Figure 2 shows the pixel positions where wall



Left Wall Contact
Pixel positions
0, 1, 2



Right Wall Contact
Pixel positions
0, 1, 2



Upper Wall Contact
Pixel positions
1, 4



Down Wall Contact
Pixel positions
2, 5

Fig. 2. Possible Pixel Positions for Wall Contacts.

MODEL IV DISK UPGRADE ONLY FROM MICRO MAINFRAME SHIPPING FROM STOCK

- Our **FDC-3B** Standard Grade controller is for single sided disk operation only and does not provide for 8" disk operation.
- Our **FDC-3C** Premium Grade controller is for double sided and/or 8" disk drives.

BOTH COMPLETE DISK UPGRADE KITS INCLUDE THE TEC 5" SINGLE SIDED, DOUBLE DENSITY TEC DISK DRIVE. Double sided drives will be available at extra cost. 8" drives are available from a number of vendors. Please order according to the stock numbers listed below:

DRIVE UPGRADE KIT INCLUDES CONTROLLER, SWITCHING POWER SUPPLY, INSTALLATION KIT, TEC DISK DRIVE AND COMPLETE INSTRUCTIONS.

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- **EVERY MICRO MAINFRAME CONTROLLER PRODUCED HAS INCLUDED GOLD PLATED CARD EDGE CONNECTORS FOR INCREASED RELIABILITY AT NO EXTRA COST.**
- **MICRO MAINFRAME IS FIRST TO USE THE STATE OF THE ART 9216 DATA SEPARATOR (FDC-3C ONLY).** We have proven this data separator for a full year and have used it beginning with the very first **FDC-3C** disk controller. Unlike other controllers, **NO ADJUSTMENTS ARE EVER REQUIRED TO OUR DATA SEPARATOR.**
- **MICRO MAINFRAME IS FIRST TO PROVIDE FOR 8" DISK OPERATION ON BOTH OUR FDC-3A and FDC-3C MODELS.**
- **MMF GIVES YOU A SYSTEM THAT CAN GROW WITH YOUR NEEDS,** from floppy disk systems to state of the art hard disk systems with full ECC and the industry's only SASI Multiplexer with our SASI-NET **.
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Listing continued

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7324 3A5972 01750 LD A,(TIMING) ;DELAY BETWEEN UPDATES
7327 47 01760 LD B,A ;
7328 3A5D72 01770 LD A,(WALLP) ;
732B C5 01780 DEMON3 PUSH BC ;
732C E803 01790 XOR 3 ;
732E D3FF 01800 OUT [255],A ;BEEP WHEN WALL CONTACT
7330 0640 01810 LD B,40H ;
7332 10PE 01820 DJNZ 5 ;
7334 C1 01830 POP BC ;
7335 10F4 01840 DJNZ DEMON3 ;CONTINUE DELAY LOOP
7337 E1 01850 POP HL ;
7338 C1 01860 POP BC ;
7339 23 01870 INC HL ;
733A 23 01880 INC HL ;
733B 10C8 01890 DJNZ DEMON2 ;CONTINUE UPDATE LOOP
733D CD3F75 01900 CALL OPEN ;OPEN/CLOSE DOOR
7340 3A4038 01910 LD A,(3840H) ;BREAK KEY?
7343 E604 01920 AND 4 ;
7345 CAF72 01930 JP Z,DEMON1 ;CONTINUE IF NOT BREAK
7346 C3EE72 01940 JP DEMON ; ELSE START PROGRAM OVER
01950 ;
01960 ;DISPLAY OPENING MESSAGE
734B 21003C 01970 DMSG LD HL,3C00H ;CLEAR SCREEN
734E 11013C 01980 LD DE,3C01H ;
7351 01FF03 01990 LD BC,1023 ;
7354 3620 02000 LD (HL),20H ;
7356 EDB0 02010 LDIR ;
7358 116C71 02020 LD DE,MSG ;MESSAGE ADDRESS
735B 21003C 02030 LD HL,3C00H ;VIDEO ADDRESS
735E 1A 02040 DMSG1 LD A,(DE) ;GET MESSAGE CHARACTER
735F FE2A 02050 CP '*' ;
7361 C8 02060 RET Z ;RETURN IF END OF MESSAGE
7362 FE24 02070 CP 'S' ;
7364 CA6D73 02080 JP Z,DMSG3 ;JUMP IF CARRIAGE RETURN
7367 77 02090 LD (HL),A ;STORE CHARACTER IN VIDEO
7368 13 02100 INC DE ;
7369 23 02110 INC HL ;
736A C35E73 02120 JP DMSG1 ;NEXT CHARACTER
736D 13 02130 DMSG3 INC DE ;
736E 7D 02140 LD A,L ;COMPUTE NEXT LINE ADDR
736F E6C0 02150 AND 0C0H ;
7371 6F 02160 LD L,A ;
7372 014000 02170 LD BC,64 ;
7375 09 02180 ADD HL,BC ;
7376 C35E73 02190 JP DMSG1 ;START NEXT LINE
02200 ;
02210 ;GET PLAYING LEVEL
7379 3A1038 02220 GETLV LD A,(3810H) ;KEYBOARD NUMERIC KEYS
737C E67E 02230 AND 7EH ;MASK FOR KEYS 1-6
737E CA7973 02240 JP Z,GETLV ;LOOP UNTIL 1-6 PRESSED
7381 0F 02250 RRCA ;
7382 0E00 02260 LD C,0 ;
7384 0C 02270 GETLV1 INC C ;
7385 0F 02280 RRCA ;
7386 30FC 02290 JR NC,GETLV1 ;LOOP UNTIL KEY FOUND
7388 0D 02300 DEC C ;
7389 79 02310 LD A,C ;
738A 325072 02320 LD (LEVEL),A ;SAVE PLAYING LEVEL
738D C9 02330 RET ;
02340 ;
02350 ;SET UP PLAYING LEVEL PARAMETERS
02360 ; AND INITIAL FIGURE LOCATIONS AND MOVE DIRECTIONS
738E 3A5072 02370 SETUP LD A,(LEVEL) ;
7391 4F 02380 LD C,A ;
7392 0600 02390 LD B,0 ;
7394 216671 02400 LD HL,FIGCTX ;
7397 09 02410 ADD HL,BC ;
7398 7E 02420 LD A,(HL) ;
7399 325A72 02430 LD (FIGCNT),A ;NO. OF MOLECULE UPDATES
739C 216071 02440 LD HL,TIMX ;
739F 09 02450 ADD HL,BC ;
73A0 7E 02460 LD A,(HL) ;
73A1 325972 02470 LD (TIMING),A ;DELAY BETWEEN UPDATES
73A4 79 02480 LD A,C ;
73A5 0F 02490 ADD A,A ;
73A6 4F 02500 LD C,A ;
73A7 210C71 02510 LD HL,LEVELX ;
73AA 09 02520 ADD HL,BC ;
73AB 5E 02530 LD E,(HL) ;
73AC 23 02540 INC HL ;
73AD 56 02550 LD D,(HL) ;
73AE ED535B72 02560 LD (FIGX),DE ;MOLECULE UPDATE LIST
73B2 014000 02570 LD BC,72 ;SET MOLECULE VARIABLES
73B5 215E72 02580 LD HL,HC ;
73B8 11A672 02590 LD DE,H0 ;
73BB EDB0 02600 LDIR ;
73BD C9 02610 RET ;
02620 ;
02630 ;DRAW BOARD
73BE 21003C 02640 BRD LD HL,3C00H ;CLEAR SCREEN W/GRAPHICS
73C1 11013C 02650 LD DE,3C01H ;
73C4 01FF03 02660 LD BC,1023 ;
73C7 3680 02670 LD (HL),00H ;
73C9 EDB0 02680 LDIR ;
73CB 21003C 02690 LD HL,3C00H ;DRAW TOP WALL
73CE 11013C 02700 LD DE,3C01H ;
73D1 013F00 02710 LD BC,63 ;
73D4 3683 02720 LD (HL),83H ;
73D6 EDB0 02730 LDIR ;
73D8 21003F 02740 LD HL,3F00H ;DRAW BOTTOM WALL
73DB 11013F 02750 LD DE,3F01H ;
73DE 013F00 02760 LD BC,63 ;
73E1 36B0 02770 LD (HL),000H ;
73E3 EDB0 02780 LDIR ;
73E5 21003C 02790 LD HL,3C00H ;DRAW LEFT WALL
73E8 3EBF 02800 LD A,0BFH ;

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Listing continues

contacts are possible. For the left and right walls, the molecule must be in pixel positions zero, 1, or 2. Only pixel positions 1 and 4 can contact the upper wall. For the down wall, only pixel positions 2 and 5 can make contact.

If Wall finds that a molecule is at a wall with the right pixel position, it calls CONTC to change the move direction unless the wall is the partition and the door is open. If the Y coordinate of the molecule is within range of the door, Wall makes no change to the move direction and lets the molecule continue through.

Wall handles a corner contact by first processing the left or right wall move change and then recalling CONTC for the upper or lower wall.

CONTC finds the new move direction for a molecule contacting a wall. It requires that the E register contain the wall number zero, 2, 4, or 6 (corresponding to left, right, up, or down). It uses this wall number, along with the move direction. CONTC stores the new move direction in the molecule control variable list by way of the IX register.

The REM routine removes the molecule graphics from the screen. It performs two loops, each processing four graphics characters. To avoid too much interference with an overlapping molecule, it masks out the graphics bits rather than storing blanks. REM uses the pixel position and the type of molecule to index into the proper table to find the graphics characters.

The Move routine calculates the next location and pixel position for a molecule. It indexes into the move table to find the next pixel position and video address offset. It then adds this offset to the current video address and stores it into the molecule control list.

The Add routine redraws a molecule on the screen. It performs a logical OR of the graphics bits with the video memory bits for each graphics character and prevents any blanking of an overlapping molecule or wall.

The Open routine opens or closes the door in response to the space bar. If the space bar is pressed and the door is closed, it blanks out the door on the screen. If the space bar is not pressed, it draws the door on the screen. It also redraws the partition each time in case it is overwritten by a passing molecule. ■

Contact Lee Morgenstern at 14358 Dyer St., Sylmar, CA 91324.

Listing continued

```

73EA 114000 02810 LD DE,64 ;
73ED 060F 02820 LD B,15 ;
73EF 77 02830 BRD1 LD (HL),A ;
73F0 19 02840 ADD HL,DE ;
73F1 10FC 02850 DJNZ BRD1 ;
73F3 213F3C 02860 LD HL,3C3FH ;DRAW RIGHT WALL
73F6 060F 02870 LD B,15 ;
73F8 77 02880 BRD2 LD (HL),A ;
73F9 19 02890 ADD HL,DE ;
73FA 10FC 02900 DJNZ BRD2 ;
73FC 211F3C 02910 LD HL,3C1FH ;DRAW MIDDLE PARTITION
73FF 1B 02920 DEC DE ;
7400 060F 02930 LD B,15 ;
7402 77 02940 BRD3 LD (HL),A ;
7403 23 02950 INC HL ;
7404 77 02960 LD (HL),A ;
7405 19 02970 ADD HL,DE ;
7406 10FA 02980 DJNZ BRD3 ;
7408 3E01 02990 LD A,1 ;INDICATE DOOR CLOSED
740A 325772 03000 LD (DOOR),A ;
740D 211B72 03010 HL,PROMPT ;DISPLAY PROMPT AT BOTTOM
7410 11C23F 03020 LD DE,3FC2H ;
7413 013C00 03030 LD BC,60 ;
7416 EDB0 03040 LDIR ;
7418 3A5872 03050 LD A,(LEVEL) ;DISPLAY PLAYING LEVEL
741B C631 03060 ADD A,31H ;
741D 32C83F 03070 LD (3PC8H),A ;
7420 C9 03080 RET ;
03090 ;
03100 ;REFLECT OFF WALL
03110 ; INPUT IX POINTING TO PIXEL,VIDEO ADDR,MOVE DIRECTION
03120 ; OUTPUT NEW MOVE DIRECTION IF WALL CONTACT
7421 AF 03130 WALL XOR A ;
7422 325D72 03140 LD (WALLF),A ;INDICATE NO WALL CONTACT
7425 DD6E01 03150 LD L,(IX+1) ;GET FIGURE VIDEO ADDRESS
7428 DD6602 03160 LD H,(IX+2) ;
742B 7D 03170 LD A,L ;EXTRACT COORDINATES
742C 1108C4 03180 LD DE,-3C00H ;
742F 19 03190 ADD HL,DE ;
7430 29 03200 ADD HL,HL ;
7431 29 03210 ADD HL,HL ;H = Y COORDINATE
7432 E63F 03220 AND 3FH ;
7434 6F 03230 LD L,A ;L = X COORDINATE
7435 DD7E00 03240 LD A,(IX) ;GET PIXEL POSITION
7438 FE03 03250 CP 3 ;
743A D26F74 03260 JP NC,WALL1 ;JUMP IF HALF POSITION
743D 7D 03270 LD A,L ;GET X COORDINATE
743E 1E00 03280 LD E,0 ;INDICATE LEFT WALL
7440 FE01 03290 CP 1 ;
7442 CA6C74 03300 JP Z,WALL2 ;JUMP IF WALL CONTACT
7445 FE21 03310 CP 33 ;
7447 CA5974 03320 JP Z,WALL3 ;JUMP IF PARTITION CONT
744A 1E02 03330 LD E,2 ;INDICATE RIGHT WALL
744C FE1C 03340 CP 28 ;
744E CA5974 03350 JP Z,WALL3 ;JUMP IF PARTITION CONT
7451 FE3C 03360 CP 60 ;
7453 CA6C74 03370 JP Z,WALL2 ;JUMP IF WALL CONTACT
7456 C36F74 03380 JP WALL1 ;CHECK UP, DOWN WALLS
7459 3A5772 03390 WALL3 LD A,(DOOR) ;GET DOOR STATUS
745C A7 03400 AND A ;
745D C26C74 03410 JP NZ,WALL2 ;JUMP IF CLOSED
7458 7C 03420 LD A,H ;GET Y COORDINATE
7461 FE06 03430 CP 6 ;
7463 DA6C74 03440 JP C,WALL2 ;JUMP IF TOO HIGH
7466 FE08 03450 CP 8 ;
7468 D26C74 03460 JP NC,WALL2 ;JUMP IF TOO LOW
746B C9 03470 RET ;ALLOW PASSAGE THRU DOOR
746C CD9774 03480 WALL2 CALL CONTC ;CHANGE MOVE DIRECTION
03490 ;CONTINUE IF CORNER
03500 ;GET PIXEL POSITION
746F DD7E00 03500 WALL1 LD A,(IX) ;
7472 FE01 03510 CP 1 ;
7474 CA7C74 03520 JP Z,WALL1A ;JUMP IF MIDDLE PIXEL
7477 FE04 03530 CP 4 ;
7479 C28574 03540 JP NZ,WALL1B ;JUMP IF NOT MIDDLE PIXEL
747C 7C 03550 WALL1A LD A,H ;GET Y COORDINATE
747D 1E04 03560 LD E,4 ;INDICATE UPPER WALL
747F FE08 03570 CP 8 ;
7481 CA9374 03580 JP Z,WALL4 ;JUMP IF WALL CONTACT
7484 C9 03590 RET ;
7485 FE02 03600 WALL1B CP 2 ;
7487 CABD74 03610 JP Z,WALL1C ;JUMP IF BOTTOM PIXEL
748A FE05 03620 CP 5 ;
748C C0 03630 RET NZ ;RET IF NOT BOTTOM PIXEL
748D 7C 03640 WALL1C LD A,H ;GET Y COORDINATE
748E 1E06 03650 LD E,6 ;INDICATE DOWN WALL
7490 FE0D 03660 CP 13 ;
7492 C0 03670 RET NZ ;RET IF NO WALL CONTACT
7493 CD9774 03680 WALL4 CALL CONTC ;GET NEW MOVE DIRECTION
7496 C9 03690 RET ;
03700 ;
03710 ;GET NEW WALL REFLECTION MOVE DIRECTION
03720 ; INPUT IX POINTING TO PIXEL,VIDEO ADDR,MOVE DIR
03730 ; INPUT E=WALL NUMBER (0,2,4,6) (L,R,U,D)
03740 ; OUTPUT NEW MOVE DIRECTION
7497 E5 03750 CONTC PUSH HL ;
7498 3E01 03760 LD A,1 ;
749A 325D72 03770 LD (WALLF),A ;INDICATE WALL CONTACT
749D 1E08 03780 LD D,0 ;
749F 216C70 03790 LD HL,WALLX ;GET WALL TABLE ADDRESS
74A2 19 03800 ADD HL,DE ;COMPUTE WALL LIST
74A3 4E 03810 LD C,(HL) ;GET MOVE DIR LIST ADDR
74A4 23 03820 INC HL ;
74A5 46 03830 LD B,(HL) ;
74A6 DD6E03 03840 LD L,(IX+3) ;GET MOVE DIRECTION
74A9 2E00 03850 LD H,0 ;

```

Listing continues



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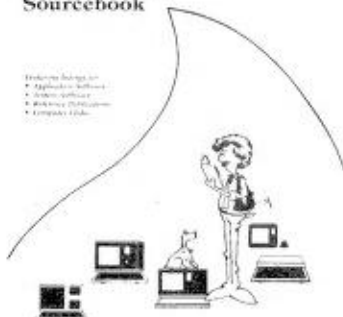
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Listing continued

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74AB 09      03868      ADD      HL,BC      ;
74AC 7E      03878      LD       A,(HL) ;GET NEW MOVE DIRECTION
74AD DD7703  03888      LD       (IX+3),A ;STORE
74B0 E1      03898      POP      HL      ;
74B1 C9      03908      RET       ;
              03918 ;
              03928 ;REMOVE FIGURE
              03938 ; INPUT IX POINTING TO PIXEL,VIDEO ADDR,MOVE DIR,FIGURE
74B2 DD7E00  03948      REM      LD       A,(IX) ;GET PIXEL
74B5 87      03958      ADD      A,A      ;
74B6 5F      03968      LD       D,A      ;
74B7 1600    03978      LD       D,0      ;
74B9 DD6E04  03988      LD       L,(IX+4) ;GET FIGURE POINTER
74BC DD6605  03998      LD       H,(IX+5) ;
74BF 19      04008      ADD      HL,DE    ;
74C0 5E      04018      LD       E,(HL)   ;GET GRAPHICS POINTER
74C1 23      04028      INC      HL      ;
74C2 56      04038      LD       D,(HL)   ;
74C3 DD6E01  04048      LD       L,(IX+1) ;GET VIDEO ADDRESS
74C6 DD6602  04058      LD       H,(IX+2) ;
74C9 0604    04068      LD       B,4      ;
74CB 1A      04078      REM1    LD       A,(DE)   ;GET VIDEO CHARACTER
74CC 2P      04088      CPL      ;
74CD A6      04098      AND      (HL)    ;MASK OUT FIGURE
74CE 77      04108      LD       (HL),A   ;STORE VIDEO
74CF 23      04118      INC      HL      ;
74D0 13      04128      INC      DE      ;
74D1 10F8    04138      DJNZ    REM1     ;CONTINUE FIRST LINE LOOP
74D3 013C00  04148      LD       BC,60    ;
74D6 09      04158      ADD      HL,BC    ;COMPUTE NEXT LINE ADDR
74D7 0604    04168      LD       B,4      ;
74D9 1A      04178      REM2    LD       A,(DE)   ;GET VIDEO CHARACTER
74DA 2P      04188      CPL      ;
74DB A6      04198      AND      (HL)    ;MASK OUT FIGURE
74DC 77      04208      LD       (HL),A   ;
74DD 23      04218      INC      HL      ;
74DE 13      04228      INC      DE      ;
74DF 10F8    04238      DJNZ    REM2     ;CONTINUE SECOND LINE
74E1 C9      04248      RET       ;
              04258 ;
              04268 ;MOVE FIGURE
              04278 ; INPUT IX POINTING TO PIXEL,VIDEO ADDR,MOVE DIR
              04288 ; OUTPUT NEW PIXEL,NEW VIDEO ADDR
74E2 2670    04298      MOVE    LD       H,MOVX<-8 ;MOVE TABLE
74E4 DD7E00  04308      LD       A,(IX)   ;GET PIXEL
74E7 87      04318      ADD      A,A      ;
74E8 6F      04328      LD       L,A      ;
74E9 5E      04338      LD       E,(HL)   ;GET MOVE POINTER
74EA 23      04348      INC      HL      ;
74EB 56      04358      LD       D,(HL)   ;
74EC EB      04368      EX       DE,HL    ;
74ED DD7E03  04378      LD       A,(IX+3) ;GET MOVE DIRECTION
74F0 87      04388      ADD      A,A      ;
74F1 5F      04398      LD       E,A      ;
74F2 1600    04408      LD       D,0      ;
74F4 19      04418      ADD      HL,DE    ;
74F5 7E      04428      LD       A,(HL)   ;GET NEW PIXEL
74F6 DD7700  04438      LD       (IX),A   ;SAVE IN VARIABLE LIST
74F9 23      04448      INC      HL      ;
74FA 6E      04458      LD       L,(HL)   ;GET VIDEO ADDR OFFSET
74FB 2600    04468      LD       H,0      ;
74FD CB7D    04478      BIT     7,L      ;
74FF 2002    04488      JR      2,MOVE1   ;
7501 26FF    04498      LD       H,0FFH   ;
7503 DD5E01  04508      MOVE1  LD       E,(IX+1) ;GET CURRENT VIDEO ADDR
7506 DD5602  04518      LD       D,(IX+2) ;
7509 19      04528      ADD      HL,DE    ;COMPUTE NEW VIDEO ADDR
750A DD7501  04538      LD       (IX+1),L ;SAVE IN VARIABLE LIST
750D DD7402  04548      LD       (IX+2),H ;
7510 C9      04558      RET       ;
              04568 ;
              04578 ;ADD FIGURE
              04588 ; INPUT IX POINTING TO PIXEL,VIDEO ADDR,MOVE DIR,FIGURE
7511 DD7E00  04598      ADD      LD       A,(IX) ;GET PIXEL
7514 87      04608      ADD      A,A      ;
7515 5F      04618      LD       E,A      ;
7516 1600    04628      LD       D,0      ;
7518 DD6E04  04638      LD       L,(IX+4) ;GET FIGURE POINTER
751B DD6605  04648      LD       H,(IX+5) ;
751E 19      04658      ADD      HL,DE    ;
751F 5E      04668      LD       E,(HL)   ;GET GRAPHICS POINTER
7520 23      04678      INC      HL      ;
7521 56      04688      LD       D,(HL)   ;
7522 DD6E01  04698      LD       L,(IX+1) ;GET VIDEO ADDRESS
7525 DD6602  04708      LD       H,(IX+2) ;
7528 0604    04718      LD       B,4      ;
752A 1A      04728      ADD1   LD       A,(DE)   ;GET VIDEO CHARACTER
752B 86      04738      OR      (HL)     ;ADD FIGURE
752C 77      04748      LD       (HL),A   ;STORE VIDEO
752D 23      04758      INC      HL      ;
752E 13      04768      INC      DE      ;
752F 10F9    04778      DJNZ    ADD1     ;CONTINUE FIRST LINE LOOP
7531 013C00  04788      LD       BC,60    ;
7534 09      04798      ADD      HL,BC    ;COMPUTE NEXT LINE ADDR
7535 0604    04808      LD       B,4      ;
7537 1A      04818      ADD2   LD       A,(DE)   ;GET VIDEO CHARACTER
7538 86      04828      OR      (HL)     ;ADD FIGURE
7539 77      04838      LD       (HL),A   ;STORE VIDEO
753A 23      04848      INC      HL      ;
753B 13      04858      INC      DE      ;
753C 10F9    04868      DJNZ    ADD2     ;CONTINUE SECOND LINE
753E C9      04878      RET       ;
              04888 ;
              04898 ;OPEN/CLOSE DOOR
753F 3EBF    04908      OPEN   LD       A,0BFH ;RESTORE PARTITION
    
```

Listing continues

Listing continued

```

7541 32DF3C 04910 LD (3CDFH),A ;
7544 32E03C 04920 LD (3CE0H),A ;
7547 321F3D 04930 LD (3D1FH),A ;
754A 32203D 04940 LD (3D20H),A ;
754D 325F3D 04950 LD (3D5FH),A ;
7550 32603D 04960 LD (3D60H),A ;
7553 325F3E 04970 LD (3E5FH),A ;
7556 32603E 04980 LD (3E60H),A ;
7559 329F3E 04990 LD (3E9FH),A ;
755C 32A03E 05000 LD (3EA0H),A ;
755F 32DF3E 05010 LD (3EDFH),A ;
7562 32E03E 05020 LD (3EE0H),A ;
7565 3A5772 05030 LD A,(DOOR) ;GET DOOR STATUS
7568 A7 05040 AND A ;
7569 CA7775 05050 JP Z,OPEN3 ;JUMP IF DOOR OPEN
756C 3A4038 05060 LD A,(3840H) ;GET SPACE BAR STATUS
756F E680 05070 AND 80H ;
7571 CA7D75 05080 JP Z,OPEN2 ;JUMP IF NOT PRESSED
7574 C39775 05090 JP OPEN1 ;JUMP IF PRESSED
7577 3A4038 05100 LD A,(3840H) ;GET SPACE BAR STATUS
757A E680 05110 AND 80H ;
757C C0 05120 RET NZ ;RET IF SPACE BAR PRESSED
757D BE95 05130 LD A,095H ;CLOSE DOOR
757E 325772 05140 LD (DOOR),A ;
7580 329F3D 05150 LD (3D9FH),A ;
7583 32DF3D 05160 LD (3DDFH),A ;
7586 321F3E 05170 LD (3E1FH),A ;
758B EA 05180 LD A,8AAH ;
758D 32A03D 05190 LD (3DA0H),A ;
7590 32E03D 05200 LD (3DE0H),A ;
7593 32203E 05210 LD (3E20H),A ;
7596 C9 05220 RET ;
7597 3E80 05230 LD A,080H ;OPEN DOOR
7599 329F3D 05240 LD (3D9FH),A ;
759C 32A03D 05250 LD (3DA0H),A ;
759F 32DF3D 05260 LD (3DDFH),A ;
75A2 32E03D 05270 LD (3DE0H),A ;
75A5 321F3E 05280 LD (3E1FH),A ;
75A8 32203E 05290 LD (3E20H),A ;
75AB AF 05300 XOR A ;
75AC 325772 05310 LD (DOOR),A ;
75AF C9 05320 RET ;
75B0 05330 ;
72EE 05340 END DEMON
00000 TOTAL ERRORS
    
```

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4	E	44 Append	
5	F	55 Memory Dump	
6 Graphics Synthesis		66 Map	
7 Special characters 0-31		77 Size	
8		88 New Data Entry	
9		99 Device I/O	

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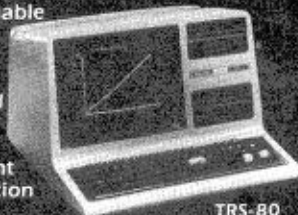
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