The APM Mouse Interface

The Souris Mouse is a graphics pointing device consisting of a hemi-spherical plastic box which is grasped by the hand lying on the domed top with the thumb and small finger gripping the flattened sides. Three switches are mounted on the front edge, corresponding to the middle three fingers.

A steel ball is held, free to rotate, in a chamber above the base of the mouse with a hole in the base so that the ball can run on any reasonably flat and horizontal surface. Spring loaded rollers press the ball against two steel shafts whose axes lie at right angles to each other in the horizontal plane. These shafts carry encoders which send signals to the interface to control x and y counters. The states of the switches are also transmitted to the interface so that they can be used as command inputs.

Although the mechanism is accurately made it is not suitable for use as a digitiser. It should be used only as an interactive device where the position of some object, eg a cursor on a screen, is related to the position of the mouse on whatever surface it is running on. The advantages of the mouse are that it does not require any special surface to run on and it is less expensive than a digitiser.

Low level Software Interface

The state of the mouse is held in three 16 bit registers: the x axis counter, the y axis counter and the buttons register. These are available at addresses 16_7FFF0, 16_7FFF2 and 16_7FFF6 respectively.

The buttons register is read only. The left button corresponds to bit 8, the middle button corresponds to bit 9 and the right button corresponds to bit 10, where bit 0 is the LSB of the 16 bit register.

The x and y axis counters are read/clear only. Their resolution is 15 counts per mm. Clearing is accomplished by writing 0 to them. Writing any other value has the same effect.

No interupt mechanism is provided by this interface since it is assumed that a system timer will be available to provide a general timed interupt mechanism which was thought to be the most appropriate way to handle this device. Since the device keeps track of the X and Y positions it is not time critical below human reaction times.

Hardware Interface

The Souris Mouse is interfaced to the APM Control Processor Local bus but aquires its Power and Ground from the EUCSD Bus Connector. The interface occupies part of the bottom half of a double height extended length Eurocard. The first batch are built using the department's Zap technique since it was thought possible to incorporate a keyboard

interface on the same board at a later date.

The Souris Mouse provides quadrature signals for each of the X and Y axes of movement and three signals indicating the state of the three buttons. These signals along with power and ground are carried through a 9-way cable to a 9-way D-type plug which mates with a 9-way IDC ribbon cable socket. The ribbon cable terminates in a 10-way IDC socket which mates with the on board 10-way 3M type dual in line IDC plug.

The X and Y axis quadrature pairs are taken to a 74LS374 latch (N50). The corresponding outputs are fed back to the remaining 4 inputs so that following each clock edge the latch outputs give the current and previous states of the quadrature pairs. These signals are fed into the least significant 8 address lines of a 2716 Eprom (M50). The least significant 4 data outputs of the Eprom provide count enable and Up/Down signals to each of the X and Y counters (A,B,C,D50 and A,B,C,D62).

The X and Y counters are 16 bit synchronous counters with asynchronous clear and tri-state outputs. Each change of state of the X or Y quadrature signals results in an up or down count of the X or Y counters so that the resolution of the counters is one 15th. of a mm.

Use is made of the 800KHz E clock of the Control Processor Local Bus. This is devided by 2 using a 74LS74 (E74) to give CLOCK which is used to clock the X and Y counters and the Latch/Eprom state machine mentioned above.

The interface to the Control Processor Local Bus provides read access to the X axis counter, the Y axis counter and a Buttons register (E62). The counters can be cleared by writing to them but the write data is ignored. The register

addresses are as follows:-

X axis Counter	16_7FFF0
Y axis Counter	16_7FFF2
Buttons Register	16_7FFF6

Address 16_7FFF4 is taken but not used. Otherwise, the addresses are fully decoded.

The bus signals UDS' and LDS' are ORed together by a 74LS08 (D74) and inverted by the permanently enabled half of a 74LS240 inverting bus buffer (E62) to give the signal UDS. The signals R/W', A3 and AS' are similarly inverted to give the signals R'/W, A3' and AS.

A3' and A(4:18) are taken through two 74LS30 nand gates (A74 and B74) to give signals EN1' and EN2' which, together with AS and UDS, enable the 25LS2548 address decoder (C74). A1,A2 and R'/W provide the address inputs to the decoder which produces the valid signals RD0',RD2',RD4',WD0' and WD2'. In addition the Bus signal DTACK' is produced by the 25LS2548 when it is enabled and LUDS' is active.

LUDS' is produced by latching UDS with the system clock CLK and is simply a delayed and inverted UDS. It is almost certainly redundant and was incorporated only because it cost nothing and was "purer".

RD0' enables the x counter outputs to the bus. RD2' enables the y counter outputs and RD4' enables the buttons register (half of E62). RD0' and RD2' are ORed by the 74LS08 (D74) to give HCLK' which holds the signal CLOCK during read access to the counters.

The bus signal RST' is similarly ORed with WD0' to give CLRX' which clears the x counter and with WD2' to give CLRY' which clears the y counter. In addition it initialises LUDS' to be inactive.

It was found that the mouse interfaces were failing intermittently and not so intermittently depending on the particular board and which APM they were plugged into. This was traced to noise on the RST' signal and as a result a small AC filter in the form of a 100 ohm resistor in series with a 100 pF capacitor was connected between RST' and GND to remove this problem. This fix was found to be of more general benefit to the APM system and it is recommended that the APMs have such filters fitted to all bus control lines.