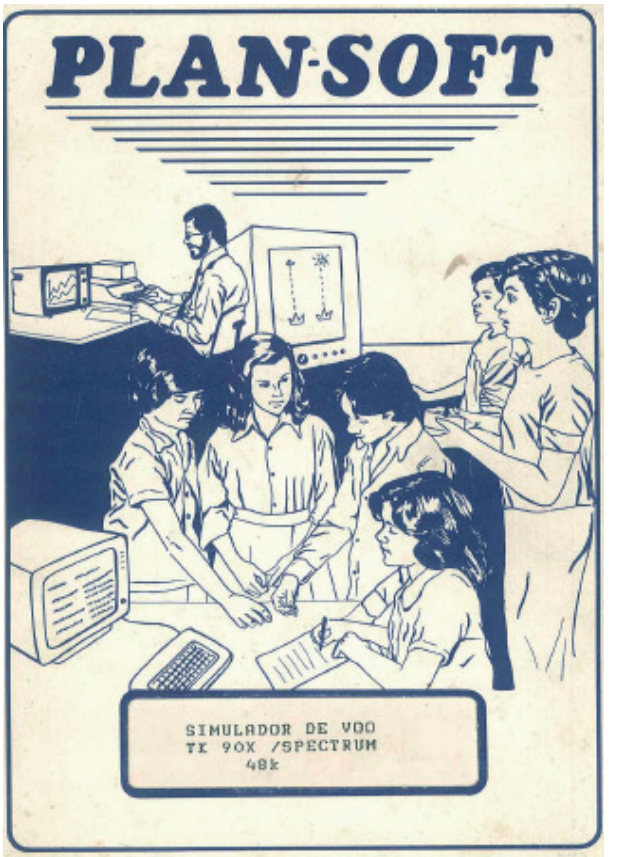

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FLIGHT SIMULATOR

OPERATING INSTRUCTIONS:

This Program Produces a simulation with the real characteristics of flight in a jumbo jet, providing both a "pilots eye view" accurately showing the runway along with a realistic portrayal of the flight deck instruments. All essential flight instruments are represented on the screen and these, along with a number of other indicators, keep you abreast of the aircraft's situation.

To load type "LOAD"

The flight simulator allows you to do the following:
- Take Off
- Fly the route between airports
- Landing in any one of seven airports (London-Heathrow, London-Gatwick, Manchester, Birmingham, Newcastle, Edinburgh & Prestwick)
- Taxiways and runways scroll (up to 40 knots)
- Option for a direct approach for landing (Heathrow) aligned with the runway.

You have control over some devices, and aircraft systems. These are:
- Engines on/off
- Engine power (Throttle Setting)
- Engine forward/reverse thrust
- Fuel (Supply/Dump)
- Elevators (keyboard or joystick)
- Ailerons (keyboard or joystick)
- Flaps
- Spoilers (air brakes)
- Landing gear (up/down)
- Landing gear controls
- Wheel brakes
- Instrument Landing System
- Warning alerts

- Choose your airport of destination
- Stop/Restart Simulation

THE INFORMATION PROVIDED FOR YOU INCLUDES:
- Airspeed (true airspeed)
- Altitude (dial and digital, in feet)
- Direction (in compass degrees)
- Altitude of aircraft (Artificial Horizon)
- Vertical speed (rate of rise and fall)
- Positions of the control surfaces (ailerons and elevators)
- Position of the aircraft

- Instrument Landing System - distance to the runway

- Position/Status of landing gear
- Position of the thrust reverser
- Position of flaps
- Position of air brakes
- Fuel flow rate
- Engine Coil Speed
- Engine pressure
- Temperature of engine exhaust gases
- Fuel Weight (in tons)
- Notice board (various alarms and warnings)
- Audible alarms
- 3D view of the chosen runway in perspective

READING THE INSTRUMENTS

This section describes the purpose and function of each instrument or indicator and shows how to interpret the readings. Note also the diagram "Description of the display components". The key symbols used in the diagram notations are identical to the paragraphs below.

a) Airspeed indicator

The airspeed is given in both analogue(dial) and digital, within that instrument. The units are in nautical miles per hour. Each number on the dial represents 100 Knots. So if the needle is pointing to "2", this means your airspeed is 200 knots. For comparison 200 knots is approximately 230 miles per hour. The digital readout is below the centre of the dial, in the form of a rotating drum of three digits.

b) Control surface position indicator

The control surfaces are the moving parts of the wings, over which the pilot has control to manoeuvre the aircraft in flight. The most significant are the elevators and ailerons. The elevators control the angle of the aircraft, which in combination with the speed, controls the elevation and descent of the plane. When the flaps are lifted, the nose rises, typically producing a higher rate of elevation and is shown by the control surface position in the top horizontal line

Elevating the flaps moves the two outer portions of the line up, and lowering the flaps moves the lines down. The ailerons on the edge of each wing move up and down causing the inclination or roll of the aircraft. To achieve this they must move in opposite directions on each wing. These movements are indicated by similar movements of the bottom horizontal line. The best way to look at this instrument is to imagine it as a representation of the aircraft from behind and underneath. The wing aileron which is seen rising will be the direction in which the aircraft is inclined and thus turned.

c) Compass

Te compass, identified by the symbol in the centre of the display, provides a digital readout of the "alignment" or direction of travel of the aircraft. The reading is from 0 (zero) to 360 degrees. These readings form a complete circle with 0 and 360 coinciding, both representing North.. If you take off at an alignment of 0 degrees and then begin to turn to the right, the reading shows 1,2,3, etc. when it reaches 90 degrees your alignment will be East. If you start at 0 degrees and turn left, the reading is 360, falling to 359,358,357 etc. Until it reaches 270 degrees which is West. Continue to turn the aircraft, eventually reaching 180 degrees, which is exactly South.

Also represented in the four compass lights, symmetrically placed around the symbol of the aircraft. They are "non-standard" and were added to aid you in navigation. One of the four indicators is always lit, and shows the position of your aircraft relative to the airport you have chosen (or the one you have just left, if your destination has not yet been chosen). To read these indicators, imagine the symbols representing the aircraft and airports on a map with North at the top. Thus, the indicator shows in which quadrant of the map you are in relation to the airport (I.e. if the South light is on, that means your chosen airport is North of your position).

d) Altimeter

As the airspeed indicator, this instrument provides both analogue and digital readings. The analogue dial has two needles. The longer of the two rotates once for every thousand feet of altitude, the shorter needle rotates once for every ten thousand feet. The digital display type "rotating drum" has three digits representing the number of "hundreds" of feet of altitude.

A reading of "123" therefore represents an altitude of 12,300 feet

e) Vertical Speed Indicator

The vertical velocity, also known as the "rate of rise and fall" and shows in feet per minute the rate your aircraft is gaining or losing altitude, this has nothing to do with forward speed, which is shown separately by the airspeed indicator (a). The indicator with the digits 0,2,4, and 6 representing "thousands of feet per minute". The top half of the instrument shows rate of increase in height , and the bottom half shows the rate of decrease in height. This instrument is limited (even in prototype) and should not be relied upon for an accurate reading. Correct flight procedure, if followed, should maintain vertical velocity within the limits of the 6000 feet per minute indicator.

f) Warning Panel

This is a set of warning lights, related to various systems or in flight situations. Some alarms are accompanied by warning sounds. Each indicator can be identified by a two letter code, this becomes easier to read with the illumination of the indicator. The codes and their meanings are :

BR	Brakes On
OH	Overheated Brakes
IS	Left Wing Stalled
RS	Right Wing Stalled
FR	Load Relief Flap System
XS	Excessive Speed
AL	Altitude Alarm
ST	Stall Alarm

Most of the above codes are self evident. Overheating of the brakes is caused by over application of the brakes at high speed. Apply the brakes lightly at high speeds,

gradually increasing the force of braking (if necessary) as the speed decreases. Airlines recommend avoiding the use of brakes, wherever possible, as tyre life is considerably reduced by heavy braking. Much of the deceleration during aborted take off, or upon landing is provided by the reverse thrusters.

The aircraft may stall if the airspeed is too low and/or the nose is too high. If this happens, recovery is then achieved by applying full throttle and lowering the nose.

During this process, the jumbo will stay level, although the controls may be affected to some extent, and altitude will be lost. These are the consequences of a stall (and recovery).

The system of Load Relief Flaps operates automatically at speeds above 176 knots in the event that the flaps are fully extended. The system changes the position of the flaps 30 degrees to the position of 25 degrees to avoid an excessive structural stress. The indicator is illuminated whenever the system is activated

The overspeed alarm, along with an audible alarm, are produced at speeds of 390 knots and above.

The altitude alarm, accompanied by an audible alarm is automatically produced during a descent to about 2000 feet and again at 1000 feet. It will also happen below 2000 feet when moving to a lower elevation. The alarm can be acknowledged and cleared.

The stall horn is provided, along with an audible alarm, This sounds about 10 knots before “stall speed” is reached. The stall speed varies considerably, according to the configuration of aircraft, the use of flaps reduces the stall speed, as does the use of the Spoilers. The gross weight of the aircraft also has a considerable effect on stall speed.

g) Weight of Fuel

This digital meter type "rotating drum" shows the number of tons of fuel on board. The fuel can be supplied as required in the land or air. As the fuel is consumed, the weight of the aircraft will gradually drop. Unless offset by a reduction in acceleration adjustment from time to time, the aircraft will slowly climb in level flight as the weight is reduced.

h) Crank (and Lever) of the spoiler (speed brake)

When operating the Spoilers, the Spoiler lever moves on its track to show the degree of extension. Also called speed brakes, spoilers are the panels on the upper surface of the main wing, which extend up into the airflow, causing drag (the braking effect) and "undoing" the airflows that create lift , thus causing the aircraft to lose altitude. They are always at maximum extension. Just after landing, the spoilers can be tilted, to assist in deceleration.

i) Flaps lever

Functioning the same way as the spoiler lever, this indicates the degree of extension of the flaps. Flaps are large movable sections of main wing, located along the leading edges of each wing . These can be extended on the outward or inward wing. Flaps change the shape of the airfoil of the wing, greatly increasing its lift capacity, mainly used during takeoff and landing, flaps allow the pilot to fly at low speeds that would be impossible without them, thus reducing the required length of the runway.

The flaps can be extended in six positions, to calculate the degree of flap used at what speed should take into account several factors, such as the overall weight. for simplicity, the following specifications can be used:

1	degree	of	flap	- 270	mph and below
5	“	“		- 250	“ “
10	“	“		- 230	“ “
20	“	“		-210	“ “
25	“	“		-190	“ “
30	“	“		-170	“ “

These adjustments are reduced when taking off with lighter loads.

j) Fuel Flow Indicators

These indicators, together with those described in (k), (l) and (m) below, are shown in sets of four, one for each of the Jumbo's four-engine. For each engine running the fuel flow indicator shows the volume of fuel being consumed

k) Exhaust Gas Temperature Indicator

One for each engine. The engine must not be driven at high temperatures for long periods.

l) Engine Coil Speed

Jet engines suitable for the Jumbo, such as JT9D, have three sets of rotating blades (or coils.) The readings provided by these indicators can be considered equivalent to engine revolutions, and are used for monitoring the performance of the engine.

m) Engines Pressure Differentials

The readings given here are the main indicators for extra performance of each engine. Produced by monitoring and comparing the gas pressures at each end (intake and exhaust). Engine EPDs will vary with both the engine speed, and with air speed. The later because of the "ram effect ", This is when the front of the engine is being forced through the air, at higher speeds. This reduces the differential between the two measured pressures, thus presenting a drop in engine performance at high speeds. This can be seen when an engine is stopped or held in low revolution; reaching a higher air speed will give a negative EPD reading. This is because the motor is showing more resistance to forward movement than is being delivered by the thrust.

n) Thrust reversal rate.

When you move the reverse thrust mechanisms into position, the "reverse thrust" indicators will light. The reversal of engine thrust is not caused by changing the rotational direction of the engine blades. It and performed by a mechanism that intercepts the flow of gas and or high velocity air produced the engine and deflects it forward. Only about 50% of the thrust can be effectively applied in this way, but it is still a very significant contribution to the deceleration needed to slow the aircraft.

o) Landing Gear Status Indicators

When these indicators are lit, then the five sets of landing gear are down and locked into position for landing. During the time in which the landing gear is moving up or down, the indicators will twinkle . When the lights are off, the landing gear is locked home inside the aircraft and the covering flaps are closed.

p) Instrument Landing System Indicator

Follow the ILS diagrams the accompany this text. On the approach to landing, and when the indicator reading your destination is 50 miles or less, the ILS can be activated. The system is designed to show th pilot if his aircraft is approximately (or not) on the right approach path, both in terms of altitude and direction. The system uses directional radio waves.

jFor each approach there are two transmitters. One is called the locator, and the other is the Vertical Guidance (the glide slope or glide path). The Locator signal transmits along the correct approach bearing to the runway, and the V.G. transmits along the correct descent path down to the runway.

The receiving equipment of an aircraft with ILS can determine if the aircraft is closer to one wave than the other, this “reference point” will show if the aircraft is off course, or too high or too low. The ILS panel will initially indicate that one or both waves have been "captured" it will then show, by the use of illuminated arrows, the direction in which to be aircraft must be moved in order to be on approximately the correct approach path.

q) Distance to the Runway

Many aircraft have onboard radio and computational navigational equipment to assist flight crews in determining their position and distance from their destination, etc.. In this simulation, more as a support to establish the correct attitude of approach, it employs a reading of "alignment" which certifies the number of miles (approximate the nearest ten miles) a point in the exact centre of the runway. When properly aligned for landing, and the computer reading indicates that it is one mile away from the “entrance” to the runway, this is the actual start of the runway.

r), s) and t) the pilot's view

This part of the display adds the final touch of realism to the simulation, providing a real perspective of the runway. Inside the lane markings is the only place where the simulator allows high-speed movement on the ground. The area surrounding the runway in each airport could be used to taxi, but Never Exceed 40mph, or you will "crash" this is also the case when any contact with the ground happens, without the landing gear locked into the lowered position. The safe area for taxing extends for about 8000 feet in all directions from the midpoint of the runway.

The simulator, from the initial load or after a reset, will always start the aircraft at Heathrow Airport in London at the end of the runway. After takeoff, any of seven other airports available may be selected as the destination. After which, this is the only airport within sight of the pilot. The option can be changed

any number of times, once the aircraft is in the air.

The simulator was designed so that there is no limitation to visibility, unlike those experienced under real atmospheric conditions. This allows the target airport to be viewed from any distance, without navigational aids. If you do not want this effect, delay choosing the target airport after you depart, until you estimate your position to be within the line of sight of your chosen airport.

u) Artificial Horizon

This instrument tells the pilot the position of the aircraft, relative to ground level using a horizontal plane along two axes. A tilt or roll of the aircraft is shown by the horizon of the instrument “sloping”. The tilt angle is equal to the angle of the aircraft relative to the horizon, this is limited to 90 degrees for both sides. The gradation lines across the face of the horizon indicate the what extent the nose is pointing up or down, with each line representing a slope angle of two degrees.

The Controls

The simulator can be fully controlled by keyboard, or alternatively, a joystick can be used to emulate the keys, and simulate the control column of the aircraft.

Moving the joystick left or right when the aircraft is travelling at a speed faster than stalling (airborne or not) will make the aircraft turn in the respective direction. When airborne, this produces a curve in the flight path. This is because the movement to the left / right joystick controls the ailerons. Once the ailerons have been deflected from level, they will remain there until the joystick moves in the opposite direction or the fire button is pressed In the latter case, the ailerons return to a level position, but this alone will not cause the aircraft to fly straight , as may be anticipated. Once tilted, the aircraft will remain so until you apply the opposite aileron, Therefore the simple levelling of the aileron only freezes the rate of curvature, it does not negate the curving effect. During the period in which the ailerons are deflected, the slope and curvature rate grow gradually. It follows then that, to obtain smooth curves, controlled, small movements are required, as when practicing alignment with the runway, simply tap the joystick to the side, then press the fire button. The aircrafts path will then be only slightly curved. So to achieve the desired alignment, repeat the process with the opposite movement until the aircrafts straight and level flight is resumed.

Move the joystick forward or back to operate the elevators, located on the trailing edge of the horizontal stabilizer. A tap on the joystick raises the elevators, which makes the nose of aircraft rise. This also causes the main wing’s angle of attack to increase, thus making the aircraft climb (or reduce the rate of descent). This increase in drag will also slow the aircraft, unless the power is increased to compensate for the extra drag. If airspeed is lost, the rate of climb will also disappear as a result. The control of the aircraft's vertical speed (rise and fall) and almost always achieved through the combined use of elevators and the engine power. In fact, small changes in the rate of descent on approach for landing is best performed by adjusting the level of acceleration alone.

Keyboard Controls

Many of the keyboard keys are used to control many parts of the aircraft simulator. The keys can briefly pressed, or can be kept pressed, in which case the chosen action will "repeat" at varying speeds, depending on the function.

Control column

The keys that can be used in place of (or alongside) a joystick, and produce the same effects described above are, 5 and 8, used for left and right (the left and right arrows), and 6 and 7, (up and down arrows) to move up and down. The 9 key has the same effect as the fire button (acting on both the ailerons and elevators).

Engine Start-up/Shutdown

The four engines are stopped or started by keys 1-4 respectively. when an engine key is pressed, the appropriate engine will, shutdown if it was running, or start if it had previously been shutdown . Each engine separately contributes to the production of the thrust of the aircraft. If you are not sure which engines are delivering active thrust to the aircraft. You can find out which motors are active by referring to the fuel flow indicators, which read the minimum only when an engine is completely stopped, also the small green light that refers to each engine is only lit when that engine is running.

The A key increases the acceleration, and the Z key decreases acceleration.

To Extend / Retract Spoilers (air brakes). The S key extends the spoilers, the X key retracts them.

Landing Gear: Use the B key to lower the landing gear, and the G key to lift them.

Wheel Brakes : The D key applies the wheel brakes, the C key releases them (0s brakes are variables).

Thrust Reversal : The H key activates the thrust reversers, the N key deactivates them

Fuel Fill / Discharge : Use the M key to fill with fuel(only works on the ground), and the J key to dump fuel(only works in the air). Both operations will adjust the fuel level by 10 tons per key press, up to the maximum load of 150 tons, or until the tanks read or zero.

Taxiing Left / Right : Use the O key to taxi to the left and key P to taxi right. The press of the 9 key or fire will make the aircraft return to a straight course.

Enable Instrument Landing System (ILS) : If the aircraft is within range of the airport transmitters (about 50 miles), press K to activate the ILS. The Symbol Shift key deactivates the ILS

Abort / Restart : at any time the simulation can be aborted (Press CAPS SHIFT with SPACE) this will return you back at Heathrow, on the ground at the end of the runway. Pressing ENTER with CAPS SHIFT will approximate an airborne re- start, the aircraft on an approach path to Heathrow runway

Pause : the simulation may be frozen at any time, by pressing the zero key. To resume, press any key.

The Altitude Alarm : this produces an audible alarm in addition to the warning indicator. Both can be cancelled by pressing the L key

Choice of Airport Destinations :

There are seven airports you can choose as a destination. Check the map below.

Conditions of Flight (Day / Night) :

The I key alternates between the flight conditions of day and night.

FLIGHT PROCEDURES

Take Off

This is easier than the landing, but it should still be carried out using the correct procedures. Assuming all the systems and instruments have been checked and all is ready then, get ready for takeoff :

1) Start all engines (keys 1 to 4)

2) Adjust the flaps at 10 degrees (weak effect) or 20 degrees (strong effect)

3) Apply the brakes. Optional, but this avoids the possibility of the aircraft rolling off the runway, before the engines reach the power levels required for take off.

4) Increase the acceleration to until the aircraft begins to move.

6) Increase to maximum power to accelerate;

7) Observe the airspeed indicator

8) Keep the aircraft in the centre of the runway, using the tail rudder (see the keys for taxiing).

9) When the airspeed reaches 170 knots, pull back on the joystick (or press the 6 key), to raise the elevators, until the indicators rise. Note the rate of elevation (vertical speed). If it remains at zero, apply more angle to the elevators until take off is achieved;

10) Once airborne, raise the landing gear.

11) Ensure that the rate of elevation(climb) is no more than 4000 feet per minute. In this case reduce the amount of lift, by reducing the angle of the elevators until the rate of climb is reduced to 2000 - 4000 feet per minute.

12) Observe the increase in airspeed. When a speed of 230 knots is achieved, retract the flaps slightly. When 270 knots is reached, retract the flaps fully.

13) Reduce power to avoid overheating the engines.

14) As the airspeed increases, reduce the amount of lift applied, to maintain a constant rate of climb.

15) Arriving at the desired altitude, reduce power until the rate of climb reaches zero.

Course alteration or selection of the destination airport may take place during the above procedure, once the aircraft is at least 500 feet clear of the runway.

Landing :

This task is a little more complex than the takeoff, but it can be mastered by following these safety recommendations. You will need lots of practice, with the emphasis on delicacy. The easiest way to lose sight of the runway is by steering too heavily trying to correct for a slight error in alignment., this is usually because the result of a curve happens slowly, but the recovery from such an inclination will need to be longer and steeper. The best way to get enough practice landing and taking off is to take off from Heathrow and then go into a wide curve of 180 degrees (toward south) straight to Gatwick. Do not ascend above 3000 to 4000 feet or allow the airspeed to exceed about 230 knots. The airports all have their runway alignment north / south (unlike the actual installations) and can be addressed in both directions. This means they have the number 18 (flying South-180 degrees) and 36 (flying North -360 or 0 degrees).

1) Align your level of flight as much as possible before you approach the runway (around 20 miles is a reasonable distance). To help in this task, the four compass indicators are quite useful. they can aid you, even if you are too far away to make out any details of the runway. Within a range 50 miles, turn on the ILS for further alignment assistance.

2) Reduce your approach speed quickly. That's more time to think and react during the final approach. Reduce the acceleration, with a series of bursts. Between each “burst”, note the rate of descent, and as the aircraft falls, increase the angle of the elevators to compensate. This creates drag and decelerates the aircraft further. Upon reaching 160 to 170 knots, adjust the acceleration to maintain a steady airspeed. The rate of descent should be between 600 to 800 feet per minute.

3) Watch your angle of descent. This should form an angle with the ground about 3 degrees, which means that at all times your altitude should be one twentieth of the distance remaining, with relation to the desired area of touchdown. Thus at 20 miles, your height should be 5000 to 6000 feet, at 5 miles, 1200 to 1500 feet and at 1 mile, 250 to 300 feet. Remember that the reading shown points to the midpoint on the runway, thereby reducing by one mile the distance to the actual start of the runway.

4) Lower the landing gear 5 or 10 miles beforehand, to avoid last minute acceleration changes to compensate for the additional drag.

5) The flaps must be extended too as the airspeed drops. Remember that even though they give additional elevation, they also increase drag considerably. You should increase the power to overcome this. When the aircraft is descending, it is quite possible that the engines will be running at up to 50% power.

6) The hardest part will be landing in alignment with the centre of the runway. When the runway is clear enough to see and you find you are offset to one side, correct immediately but gently. Enter a curve and then level the ailerons quickly, so that the inclination is never steep, then perform a similar curve in the opposite direction to realign

7) During the last mile, lower your altitude of 250 feet to 50 feet at the threshold of the runway(when the alignment reads 1 mile). If you are falling faster than this, increase the acceleration to recover some altitude. Do not raise the elevators. If you do, you are likely to rise rapidly, losing the opportunity of a smooth safe landing. Once the threshold has passed, allow the aircraft to continue to fall on the runway. If you're too high or if the rate of descent is too slow, decelerate

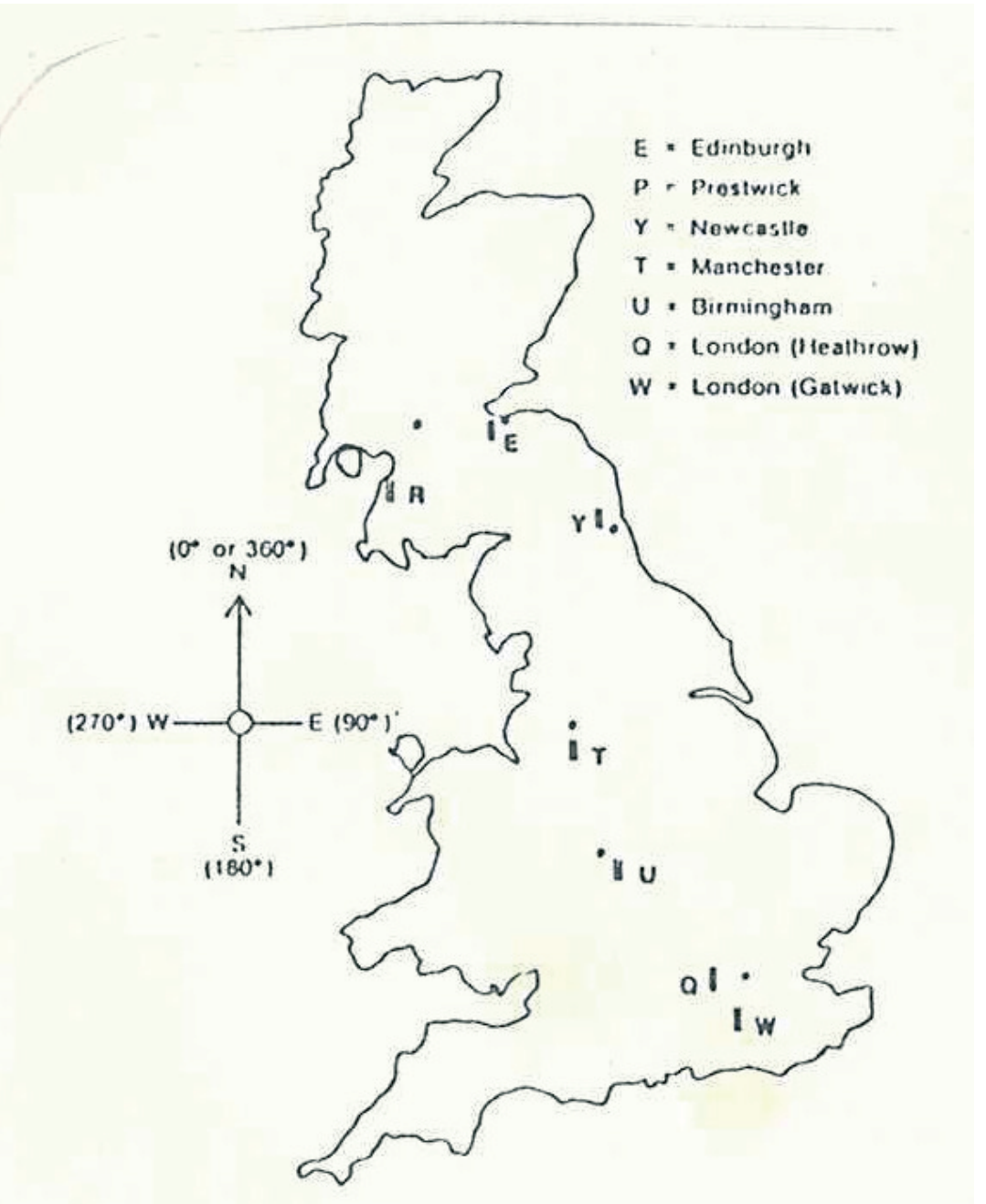
9) Touchdown!. Now, there are several things to do, as quickly as possible. Verify that both the altitude and vertical speed are zero, but that is only rear suspension contact. You do not have control of the aircraft's direction until the nose wheel touches the ground, and you will have to make this happen.
- Drop the elevators
- Turn on the reverse thrust
- Extend the spoilers fully
- Raise the acceleration to full power.
- Steer into the centre of the lane

When the speed has fallen to about 50-60 knots, reduce the acceleration and turn on the reverse thrust. This is done to avoid ingestion of particles of debris on the runway. Use the brakes to slow to 10-15 knots, gently but firmly. After a successful landing, you can taxi off of the runway, or taxi to the end, turn around and start again.

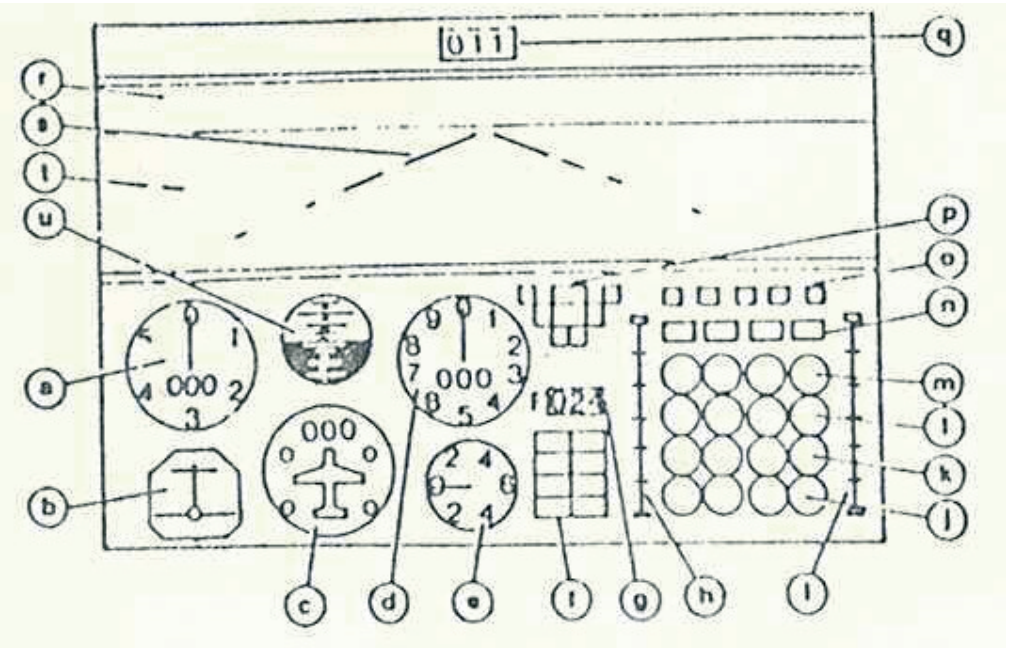
On landing, the aircraft your weight is limited, because to stop a large heavy aircraft may not be possible. If you land with over 60-70 tons of fuel on board, the aircraft's speed must be higher, and so stopping safely becomes more difficult. The fuel can be dumped before landing to reduce weight, thus avoiding the problem.

Of great importance to the flying of any aircraft is that the pilot can look out the cockpit window, ignoring the instruments. So learn to scrutinize all the instruments quickly and frequently. This flight simulator was designed to be good fun, but during the process you may develop some of the techniques of a pilot, and enjoy the feeling of excitement and satisfaction of flying!

CHOICE OF AIRPORTS AND THEIR CODES



DESCRIPTION OF DISPLAY COMPONENTS



a) airspeed indicator
b) Control Surface position indicator
c) Compass
d) Altimeter
e) Vertical Speed Indicator
f) Notice Board
g) Fuel Weight
h) Spoiler lever(speed brake)
I) Flaps lever
j) Fuel Flow Indicators
k) Exhaust gas temperature indicator
l) Engine coil Speed
m) Engine Pressure
n) Thrust reversal rate Indicators
o) Status of the landing gear
p) Instrument Landing System(ILS) indicator
q) Distance to runway
r) Pilot's view - Sky
s) Pilot's View - rolling runway
t) Pilot's view - solo
u) Artificial Horizon

Summary of simulator commands for ZX Spectrum

0 : pause

5 & 6 : ailerons left and right

6 & 7 : elevators up and down

9 : levels ailerons and elevators

1,2,3 & 4 : start/stop engines

A & Z : increase / decrease speed

F & V : extend / retract flaps

S & X : open and close spoilers

B & G : raise and lower the landing gear

D & C : apply and release the brakes

H & W : reverse and normalize the turbines

M : supply with fuel (on land)

J : jettison fuel (in flight)

O & P : left / right (for taxiing)

Caps Shift + Space : to abort

Translated from Portuguese with (more than a little) help from “Google Translate“.