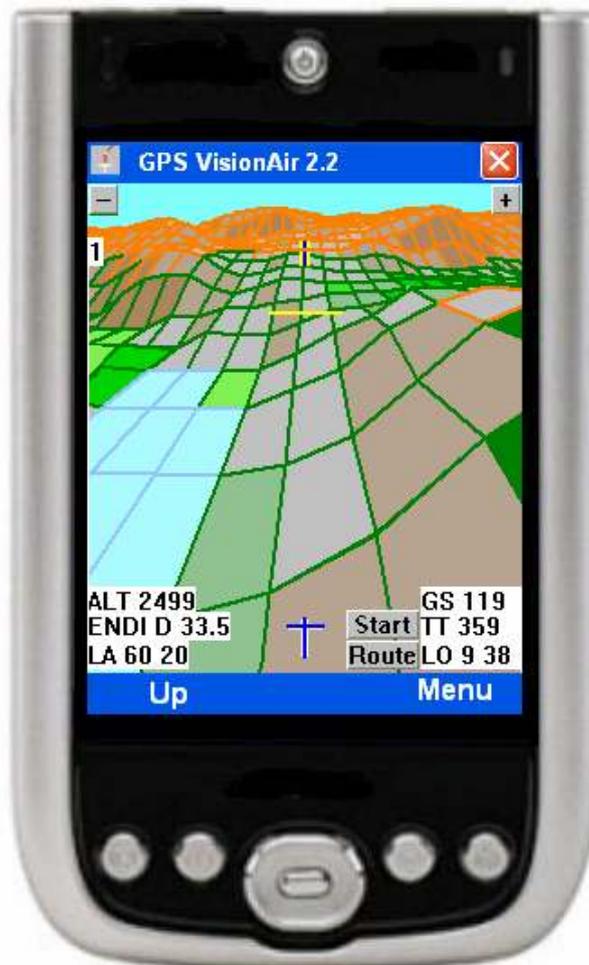


NUCHEM RESEARCH AB

presents

GPS-Vision-Air for Pocket PC

Version 2.2



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Cover picture: Display view during a flight among the Norwegian mountains close to Geilo.

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DISCLAIMER

Although this software has been used in my aircraft, and has been tested in several ways, no warranty, expressed or implied, is made by the author (Allan Emrén) as to the accuracy or functioning of the software and related software materials nor shall the fact of distribution constitute any such warranty, and no responsibility is assumed by the author in connection therewith.

The data bases are of **experimental nature**, and not complete. No warranty on correctness is given. Also, it is the responsibility of the user to make sure that correct data are used in real flights. Also, changes needed for customization purposes are made at the users responsibility.

Licence conditions

This software may be downloaded and used by anyone without any charge. A donation for covering of development costs is appreciated, but you do not have to give any. See website for details.

Anyone may distribute the software under the following conditions:

- * No charge of any kind is allowed, not even for distribution media (diskettes, CD-ROM etc)
- * The software, the Readme file, and the present user instruction file both have to be included.

User instructions

Installation of the program

Unzip the file, and copy the entire directories to your Pocket PC.

If you have a memory expansion card, place the program there.

Make sure that the following files are included:

Readme.txt

GPS-Vison-Air.exe

ESGO-ESSE.txt

port.txt

waypoints.txt

zones.txt

Also the directory named Maps, with contents, should be placed in the same directory as the program.

Possibly, the file port.txt has to be modified. You have to know which port, baud rate, and other settings are used for communication with your GPS-unit. Normally, this information can be found in the GPS instruction book. Find the appropriate settings and enter correct data into the port.txt file.

Start of the program

In the File Explorer at the PDA

Click the file GPSVisionAir2-2.exe.

The program starts, and you will see a white screen with a few buttons.

Make sure that your GPS unit is working and connected to the PDA. If you are using Bluetooth, you should have Bluetooth indication at booth units.

Click the button labelled 'Start'.

Within a few seconds, an essentially white screen should appear and texts will tell which databases are loaded. When a FIX is established, the unit will load terrain data for the area. If no data base is found for this area, a message is shown, and the program will continue as version 1.2

If nothing happens, connection to the GPS has failed. Common reasons are that another program is using the GPS-unit or that you are out of range for the Bluetooth transmitter. Go to the section 'Trouble shooting' for more information.

While you are on ground, the landscape is drawn as flat. This state remains until you have reached an altitude of 100 feet. Then, it switches to a 3D view.

Information displayed

To the right, an example is given, showing what the screen may look like. In the foreground, you see the hill Kinnekulle, about 900 feet high. To the right of it is a part of the lake Vänern, and at its far end, the airport of Lidköping (ESGL).

The text at the top of the screen, '091334', tells current time as hhmmss.

The route is shown as two black lines (highway in the air). The width is 0.5 nm (about one km). At its waypoints, ETA (estimated time of arrival) is shown. The distance to next waypoint is shown in the lower left corner to be 13.4 nm. At the top of the display, current time is shown.

The blue lines are borders for Sätenäs TMA and Göteborg TMA. Far up to the left, Halmstad TMA is seen. Blue color means that you are flying below the TMA. The control zone of Sätenäs (ESIB) is shown with red lines, meaning that you need clearance to enter.



Additional airports displayed are Borås (ESGE), Trollhättan (ESGT), and the destination Vårgårda (ESGO). It is estimated that you will be there in about 20 minutes.

The character '4' in the upper left corner means that the screen width is 4 nm at the bottom. The two buttons are used to zoom out [-] and zoom in [+].

The horizontal yellow line above "Kinnekulle" gives estimated glide range at the current terrain profile. To the left of "ESGL", three short vertical blue and yellow lines are shown. Their ends indicate estimated positions in 5, 10, 15, 20, 25, and 30 minutes respectively.

The terrain grid has squares that are 0.5 by 0.5 minutes longitude and latitude respectively.

During the flight illustrated above, you will reach your destination in about 20 minutes. When closer than 5 nm, the runway is drawn rather than a waypoint symbol. Also, you might want to increase the resolution when you approach the destination. With the highest resolution possible, it may look like in the picture right. Here, the screen width is merely 0.5 nm.

Airspace is shown if it is closer than about 60 - 120 nm. Borders are coloured blue (like sky) if you are below. They are red if you could enter at present altitude (you will need a clearance), and if you are higher than the airspace in question, it is drawn black (like soil).

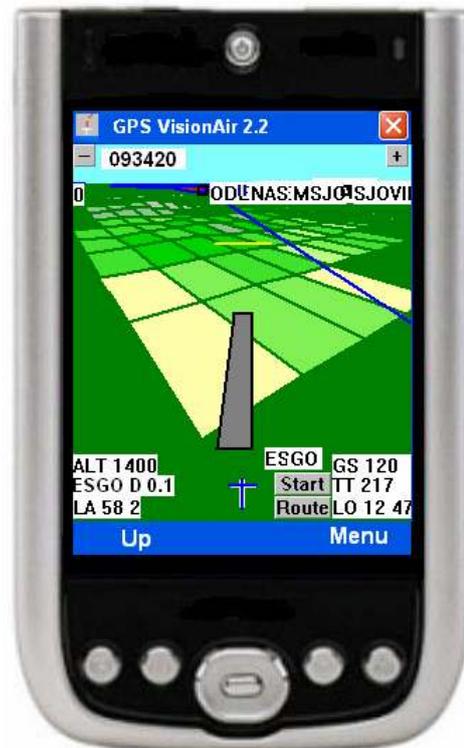
If you are flying in a zone, and the boarder changes color from blue or black to red, you might have entered the region from above ore below. But before doing anything else, check the GPS-altitude vs you altimeter. I could be a result if inaccuracy from the GPS.

Waypoints are drawn as squares in the current program version. To the right of the waypoint, there is a label with its name.

Modes of operation

The program has two modes of operation, 'On ground' and 'Airborne'. If you are moving slowly, the program assumes that you are on ground. Then, limited information only is displayed, and the terrain is drawn as flat until your altitude becomes more than 100 feet.

When the speed exceeds 30 knots during 20 seconds, the airborne mode is entered. If 'Airborne', the mode 'On Ground' is entered if the speed becomes less than 20 knots during more than 20 seconds. Even in a stall situation, this is rarely possible during that many seconds.



Loading a route

Below the Start button, there is a button labelled Route. Pressing that, takes you to the file viewer. There, you may choose a route file. It will be checked for valid waypoints, and then displayed on screen. See Appendix for information on how to create a route.

De-cluttering

To avoid cluttering of the screen, objects are shown only when needed. Thus, airspace is shown only when closer than 60 - 120 nm, obstacles and entry points have to be closer than 15 nm (5-10 minutes) to be displayed, airports are displayed up to a distance of 120 nm, and all other waypoints have to be closer than about 40 nm to be displayed. Exceptions are waypoints used in the current route. They are displayed irrespective of distance. So you will have an overview of your entire route.

Dead reckoning

If no position update is received from the GPS unit, or if the information is unreliable, the program should switch to dead reckoning. In the present version, this does not generally happen. Rather, the position often will not be updated until a good FIX has been received.

When the program actually switches to dead reckoning, this is indicated by red color in the aircraft symbol. Satellite drop outs have a tendency to happen at inconvenient moments. For myself, it happened once just after ATC had told me to "Report when leaving control zone". With dead reckoning, you will have a fairly accurate display of your position if you do not turn. So if you would see the aircraft symbol turn red, check your heading, and then keep that heading, if possible.

Normally, poor satellite positions do not last very long. So you could expect to get the signal back in some five or ten minutes. After ten minutes, your displayed (dead reckoning) position will typically be less 0.5 nm from the real one.

Log book and flight log

When the speed exceeds 30 knots during more than twenty seconds, the flight is considered to be airborne and the time is noted into the log book file (logbook.txt). Similarly landing is assumed to have happened when the speed is less than 20 knots during twenty seconds.

Each time a shut down happens, the program will generate a new start time when it finds itself to be in Airborne mode. So in the logbook file, you should ignore all start times except the first one. The program does not give any information about date, so I suggest that you write current date into the logbook file manually before take off. (Or some other way to know which day the flight took place.)

Every ten seconds, the program writes flight data into a file (raw data from the GPS unit). This can serve as a silent witness in case of an incident or if you are accused for airspace intrusion. The file is easily imported to a spreadsheet program, and then a lot of data can be extracted. An example from real life could be viewed at the following site:

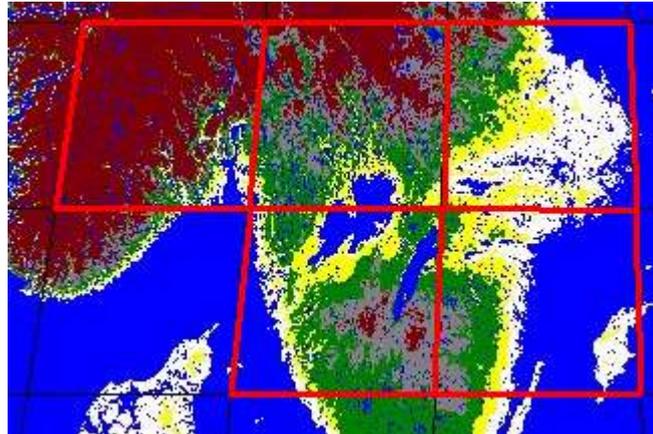
<http://www.nuchem.se/allan/EHWO-08.htm>

Track

Every ten seconds, the program makes a note of the present position in its memory. The remembered positions are displayed as a red track behind the aircraft symbol. Normally, you cannot see much of that track. If you turn, you will be able to see a larger part of the track. This may be useful if you meet bad weather and want to return to a place where you recently had better conditions. Just turn 180 degrees, and then follow the red track backwards.

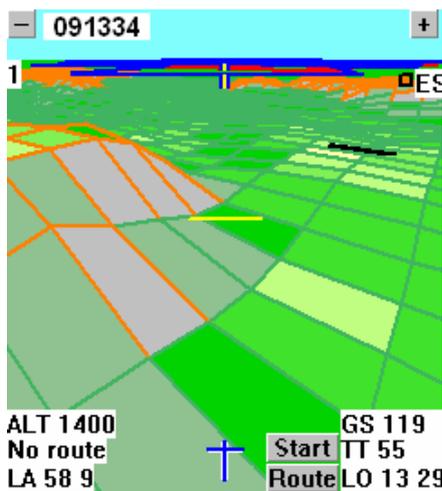
Terrain data

Each data base covers 2x4 degrees. This corresponds to about one hour of flight time in most light aircrafts. When this is written, the data bases available are shown in the picture to the right. Each square surrounded by red lines is an available data base. This is no serious restriction. At request, a any data base within Sweden, Denmark, Norway, Finland, and some parts of Estonia, Lithuania, Latvia, and Poland will be prepared for free.



For areas outside Scandinavia, data bases will also be produced for free, but this might require more than a couple of days.

If the flight proceeds outside the area covered by the data base loaded, the program will continue like version 1.2 (see below). Thus, aeronautical data will be displayed, in unchanged ways, but no new data base will be loaded automatically by the present program version. So if you still want terrain data to be displayed, you will have to stop the program and restart it. This can be done at any time, so you could wait until you have a low workload before this is performed.



In maps, one often make use of colours to tell the elevation. In this program, the colours are rather used to tell the steepness of the terrain. If all four corners of a square are at the same level, the program assumes that there is a lake. The steepness is indicated by yellow and a darkening scale of green assumed to look like grass-bushes-forest. Even steeper terrain is drawn in grey colours.

If the terrain high enough to be less than 500 feet below your current altitude, the grid lines are drawn in orange like in the picture to the left. This shows approach to Falköping airport (ESGK). This airport is situated in a valley between several hills. As no hill extends above the horizon, there is no immediate danger of collision at the present altitude.

WARNING!! Due to round off errors, your displayed position could be wrong by one grid point in either direction. Thus, keep more than one rectangle between yourself and a hillside when the visibility is poor.

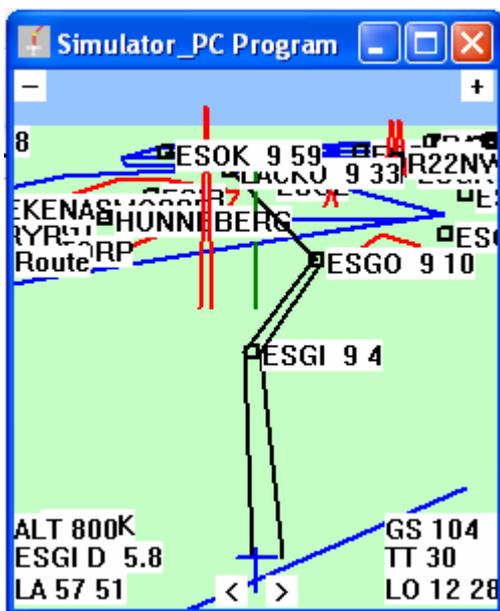
Leaving the area covered by terrain data

Each square of terrain data covers two degrees latitude and four degrees longitude. This corresponds to about one hour flight time with most GA aircraft. When a flight proceeds outside such a square, the message "Outside terrain data area" will be displayed. To load new terrain data, stop the program, and restart it. If a terrain data base for the area entered is available, it will be loaded automatically. Otherwise, a message will be shown telling that no data are available.

Operation outside valid terrain data

If you are outside the area for valid terrain data, the navigation may proceed without any trouble. The program automatically switches to No Terrain Data mode. You still have the perspective display, and if you have loaded a flight plan, you still have your highway.

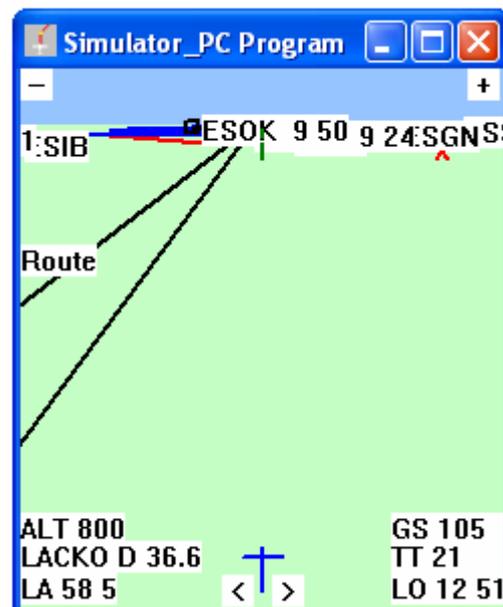
The two closest legs are drawn like a road. The width is 0.5 nm. Thus, you get an idea of scale at different parts of the picture. If you keep to right, particularly close to reporting points, the collision probability is decreased considerably.



At the bottom left, the distance to next waypoint is given. May be of use for communication with ATC. If you are airborne, ETA:s for all waypoints along the route are displayed. The drawing order is arranged so that you always will be able to see ETA for your destination, even if there is a clutter when the remaining part of the route is long.

Sometimes, one might need a better overview, which may be accomplished by zoom out, as seen below. Although the screen width is merely one nm, You are able to see 10 minutes forward, and even the destination, 45 minutes away is clearly visible.

The screen is updated



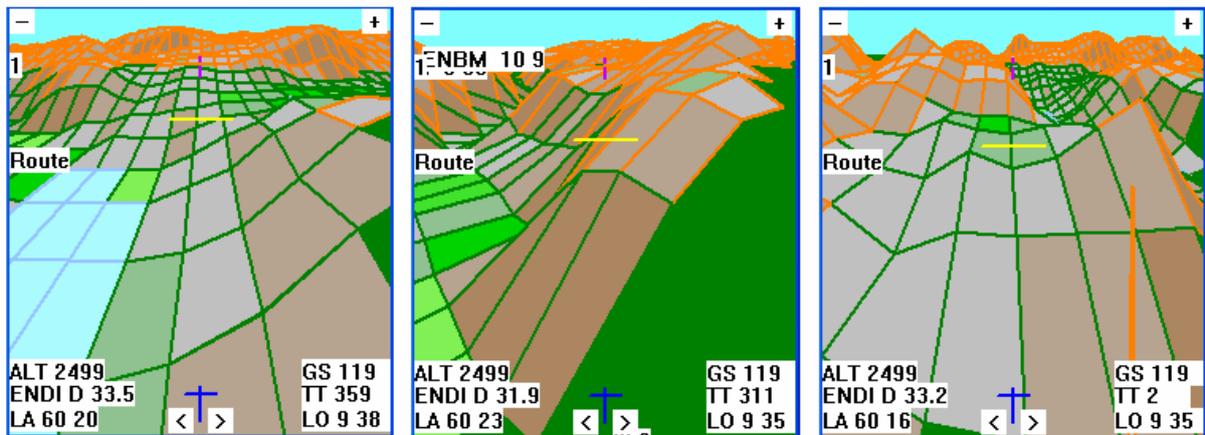
every four seconds. This is more seldom than common in GPS programs. I have tested this in flight competitions (e.g. The International Malta Air Rally), and in training for such, finding that the better accuracy given by a larger interval is beneficial. 4- 5 seconds appear to be optimal.

Similarly, one sometimes needs high lateral resolution. Then, zooming in gives the desired property. In common GPS programs, it may be difficult to follow the track at high resolution. It simply goes away from the screen. This is no problem with the GPS-Vision-Air program. In the right hand picture, the screen width means 1.0 nm.

Flying in mountainous terrain

When you are flying among mountains, perhaps in darkness or on top of a solid cloud layer, your situation will be really bad if you get an engine failure, or are forced down for other reasons, e.g. icing. With the synthetic vision, your probability for survival will improve considerably. You will be able to find terrain that is as low and flat as possible.

Similarly, if you are climbing towards a mountain, you might not be able to see that you are going to collide with it, as the mountain may be hidden below your nose. The picture below shows three screen captures from the Norwegian mountains. As you can see, valleys are easily found. As the mountains rise above the horizon, there is a collision hazard at the present altitude.



IMPORTANT!

NEVER try to use this program as a substitute for IFR procedures. What I describe here is merely meant to give hints on how to slightly improve an extremely dangerous situation.

Limitations and known bugs

1. Sometimes the program accidentally flushes the serial port's buffer while the GPS unit is transmitting. If this happens, the received record is faulty, and no meaningful data can be extracted. So the program has to switch to dead reckoning. The text 'No GGA' is shown at the middle of the screen. The program normally recovers within a few seconds.
2. The altitude above ground could be wrong above terrain with steep slopes. The reason is that the program randomly makes a choice of one corner to decide the ground elevation at present location.
3. Similarly, waypoints may be misplaced with respect to the landscape. The error decreases as you approach the waypoint. The distance displayed is correct, and when the program indicates that you have reached a waypoint, this is correct in reality too.
4. The screen is updated about every fifteen seconds, so you may view information that is between ten and fifteen seconds old.
5. Often, an incomplete terrain picture is drawn. Particularly this is the case for areas close to your position.
6. The terrain is drawn up to a distance of 12 nm. Beyond that, the ground is drawn as with solid green colour.
7. There is no double buffering in the graphics, so the terrain picture is drawn in full view. This requires a few seconds, and during that time, no meaningful information is displayed.
8. The dead reckoning facility does not work properly in the present program version.
9. If the connection between PDA and GPS unit is lost, the program will stick, and will have to be halted and restarted when connection is re-established. Sometimes, the PDA has to be reset in such cases.

Trouble shooting

A. Program fails to start

Within ten seconds after you press the 'Start' button at the screen, you should see messages on progress of the data base loading. If this does not happen, the most common reason is that the program is unable to connect to the GPS unit. There may be other causes, however. One is the operative system does not really start the program properly. Here follows a suggestion of how to proceed.

1. Close the program and restart it.
2. If this does not solve the problem, reset the PDA and try again.
3. Make sure that the GPS unit indicates that it is started, and that it sends information.
4. Check that Bluetooth is on both in PDA and GPS. This should be indicated by a blinking blue LED.
5. Check that no other program uses the GPS unit. This could be checked in Settings/System/Memory/Running Programs at the PDA. If any program using the GPS is displayed there, stop it.
6. In Settings/System, there is a program named External GPS. Set the correct port there.
7. If you are not sure about which port and settings to use, you could usually find information in the GPS manual. Often, there is also a program supplied with the GPS unit, that will help you connect to the GPS. Check out the settings it tells you, and copy them into the file port.txt. After that, make sure that the program mentioned is closed.

NOTE, closing it with the X at the top right of the screen, is not enough. You have to use the procedure described under item 5.

B. No screen updates

Every ten or fifteen seconds, you should notice a screen update. Should the screen stop being updated, something has happened with the display system. Note that longitude and latitude may be updated even if the screen update stops.

First check the aircraft symbol is blue. If it is red, dead reckoning is used, and there is no change in displayed direction if you are turning.

If you suspect that the update is out of service (green aircraft symbol), make a little turn. If that does not become visible at the screen within fifteen seconds, there is an update error. You then have to restart the program, or if it cannot be closed by clicking the X in upper right corner, you have to reset the PDA and then restart the program.

C. Next waypoint is not updated properly

This could happen if the angle between two legs is less than 90 degrees. If the program does not detect that you have passed a waypoint, you are able to cure that by closing the program and open the route file. Delete the previous legs and save it under a new name. Then restart the program and load the new route file.

D. No GGA

This could be caused by a poor satellite signal. The program should switch to dead reckoning. If that does not happen, and the message does not disappear within five minutes (very seldom), you should stop and restart the program.

E. Memory full

The raw satellite data are stored every ten seconds in the file raw-data.txt. This file is growing all the time, so eventually, it may fill the memory. So when it grows too large, it should be deleted.

Feedback

As you might understand, the GPS-Vision-Air program is still under development. (All programs are, more or less.) So if you find bugs, that are not mentioned here, or if you have suggestions on how to improve the program or its handling, please tell me. If I like the ideas, I will incorporate them in later versions.

Similarly, all aeronautical data bases are experimental, and cover parts of Sweden only. If you prepare additional data, please make it possible for other users to take advantage thereof. With your permission, I will upload you data to the web site, to be downloaded by others free of charge.

Registration.

The program is under development. So I recommend you to send a mail to me if you download the program. Then, you will be able to get a notification when a new version is available.

My purpose with uploading the program and my own data is to prevent the usage of good navigation tools from being a question of the size of your wallet.

Good luck and wishing many nice flights

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APPENDIX

Data files

All data files are written as plain text, so the user is able to read and edit according to needs. Each object (waypoint, airspace sector etc) is written as a single line. Items are separated (blank space and TAB are recognized). Coordinates are given as degrees.decimals. Negative values mean south and west respectively. The program is case sensitive, so I recommend upper case for names. Examples and explanations are given below.

All fields are required, except when stated to be optional.

Waypoints

The current version of the program can handle 1000 waypoints. This number will have to be increased in later versions. The waypoints may be given in any order irrespective of type. Several waypoints may share the same name. If, however, a waypoint is used in a route, the name has to be unique. Otherwise, the program will choose the first entry in the list, that matches the name, and that could cause severe navigational errors.

Example

TOBO	59.3247	16.8639	E	ESSU
Name	Latitude	Longitude	Type	Info

In the example above, the type is airport, and the optional info is frequency. The following types are recognized by the GPS-Vision-Air program:

A	Airport	Info is optional frequency Runway coordinates are optional
E	Entry point	Info is optional, could be airport
N	NDB	Info is optional frequency
O	Obstacle	Info is compulsory height (MSL)
R	Reporting point	Info is optional frequency
U	User point	Info is optional
V	VOR	Info is optional frequency

A name may contain up to 19 characters.

A line may contain 399 characters or less

Lines starting with the # character are ignored (comment lines)

Coordinates are given as degrees.decimals

File name: waypoints.txt

Airports

For name, it is recommended that the ICAO code is used. This makes the name require a limited space when displayed. As optional info, the frequency is suitable.

You may enter runway data, giving lat long lat long of its ends.

The present program version ignores runways given, except the first one.

Example

ESGO 58.0422 12.7900 A 123.65 58.04245 12.79048 58.0362 12.78117

If runway data are given, the program draws the runway if the distance is less than 5 nm. The runway is drawn as a grey rectangle surrounded by black lines. The width of the runway is always a bit overestimated. To make it clearly visible, the runway is always drawn as 100 meters wide.

Airspace

The current version of the program can handle up to 200 sectors of airspace. This number will have to be increased in later program versions. Each sector may have up to 25 corners. Circular sectors have to be approximated as polygons.

Example

	Info	Lower limit								
Oskarshamn	TIZ *	122.15	G 0	1000	57.4233	16.4644	57.4169	16.5633	57.2822	16.5339
Name	Type	Freq	Class	Upper limit	Coordinates of corners					

The star is used to give nonsense information into a compulsory field, meant for call sign etc.

Lines starting with the # character are ignored (comment lines)

Limitations: The fields for name and info may consist of up to 19 characters

File name: zones.txt

Communication port

The program is connected to the GPS unit via a serial port (typically Blue Tooth). The port settings are given in this file. Available options are described in separate lines followed by the actual value. All lines have to be present and order must not be changed.

Example

Comm Port 0 1 2 3 4 5 6 7 8
6
Speed 1200 2400 4800 9600 19200 38400 57600 115200
38400
Parity 0-4 = no, odd, even, mark, space
0
Data bits 4-8
8
#Stop Bits 0=1 1=1.5 2=2
0

File name: port.txt

Logbook

Start and landing times are noted in this file. A flight may be recorded in the following way:

.....
Start 12.2
Landing 13.14

This means that the start time was 12.02 and the real landing time 13.14.
The log book file is never automatically erased, so when it becomes too large, you will have to erase it manually.

File name: logbook.txt

Flight log

Data on the flight are written every ten seconds. As mentioned above, it may be a rather big file, that can be useful for handling incidents, like accused airspace intrusion. An example of the usefulness is given here: <http://www.nuchem.se/allan/EHWO-08.htm>

The file grows rapidly, so you should delete it regularly. Make sure, however, not to delete it until you know the information is not needed any more.
One way is to back up the file in a PC before deleting it.

A record might look like the following:

```
$GPGGA,155635.000,5743.2653,N,01258.3882,E,1,08,1.0,169.4,M,38.1,M,,0000*5C
```

There are several fields separated by comma signs. The meaning of the fields are:

\$GPGGA Type of record. This kind gives time, position and some additional info.

155635.000 UTC time. The value is hhmmss.decimals. Most GPS units do not transmit fractions of seconds

5743.2653,N Latitude. Degrees minutes.decimals

01258.3882,E Longitude. Degrees minutes.decimals

1 Fix quality. 0=invalid, 1=GPSfix, 2=DGPSfix

08 Number of satellites

1.0 HDOP. Relative horizontal accuracy.

169.4,M Altitude (m)

38.1,M Height of geoid above WGS84 ellipsoid

„0000 Fields not used here

*5C Checksum to verify correctness of data transfer

File name: raw-data.txt

Routes

The content of a route file is simply a list of waypoint names. All names have to be found in the waypoint list. The names are case sensitive. A route may contain up to 100 waypoints. The file should be a .txt file, and a descriptive file name is recommended.

An example is shown below

ESGO
LJUNGA
LANDSJOE
VIBAR
ESMZ

A suitable file name for this route would be ESGO-ESMZ.txt

The synthetic vision makes it possible to navigate even comparatively long trips without having a route calculated. If only, one knows that there will be fuel in large excess of what is needed, one may travel without loading a route.