Spyglass

Spyglass is a sophisticated multifunctional navigation utility, a viewfinder and a compass with augmented reality features – it simultaneously displays live, detailed information related to the current location and multiple objects of interest right over the live feed from the built-in camera or a map.

Spyglass serves as a useful tool to solve a range of tasks arising during all types of outdoor activities from marking visited places like a car, camp or hotel to easily find them later as well as during hunting, fishing, hiking, scouting, seafaring, sports and touring.

Spyglass includes a milspec compass, GPS locations and constant bearings tracker and finder, Sun, Moon and stars tracker, inclinometer, sextant (stadimeter), rangefinder, angular calculator, camera (with 5x zoom), maps and lots of other useful features.

Spyglass is designed with passion to real milspec devices and is based on an idea to create a tool similar to binoculars that are commonly used in sci-fi, military and action movies.

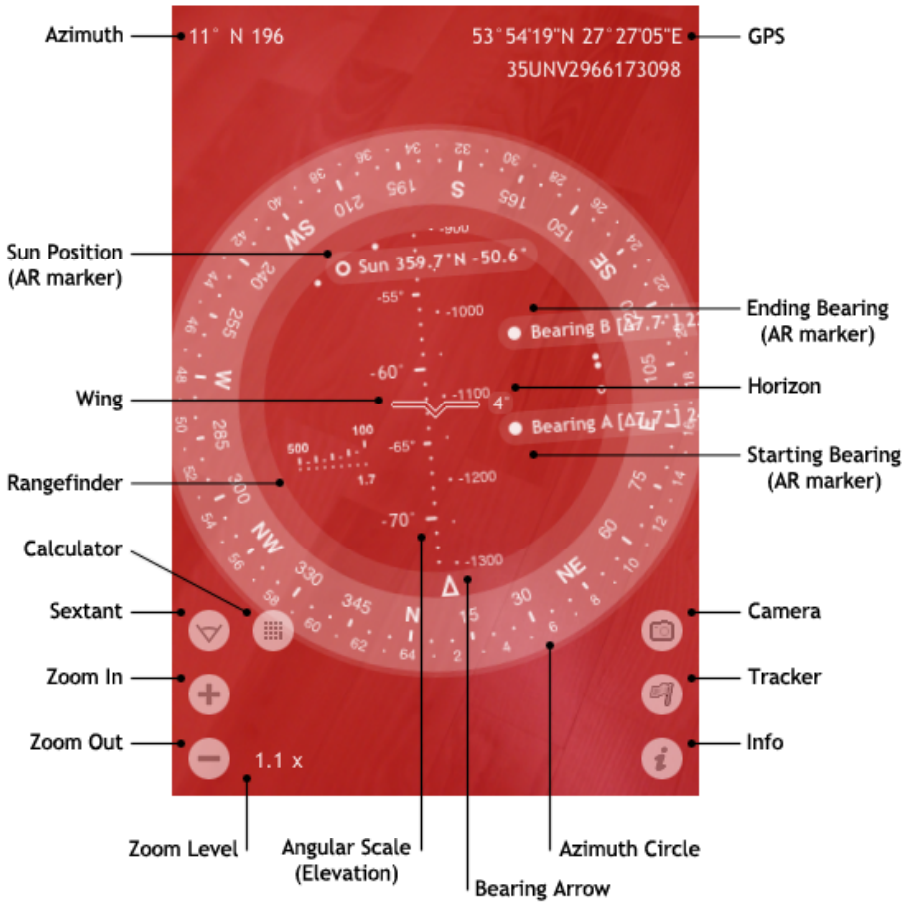
Heads-up display and user interface

Spyglass displays information using style of heads-up display (HUD) or on-screen display (OSD) that is commonly used in airplanes, computer games or hi-tech devices from sci-fi movies.

Heads-up display overlays the live feed from the build-in camera or a map. Map when enabled automatically appears when the device is face up and parallel to the ground and disappears otherwise.

Heads-up display presents the current time, GPS, compass, inclination, zoom and tracking information along with the crosshair and a rangefinder. The information (latitude, longitude and MGRS coordinates along with an altitude, speed, course, azimuth, elevation and horizon) is only displayed when available.

Spyglass is controlled with touch gestures and buttons. Buttons automatically disappear after five seconds since the last touch and appear immediately after the next touch.



Heads-up display colors and filters

Heads-up display overlays a constantly changing picture and that is quite hard to foresee which color combination fits best to archive finest contrast to distinguish between the HUD and the picture.

Spyglass provides the fast and easy way to switch current colors for HUD, its transparent background and picture filter thus allowing setting the color combination that fits current needs.

Slide horizontally with one finger to change the current color of HUD elements, slide diagonally to change the HUD transparent background or slide vertically to change the screen filter. Sliding back and forth selects either previous or next color in a cyclic row. Color settings are persistent and recalled upon next launches.

Scales and zoom

Zoom, the primary feature of many optical instruments is tightly integrated with Spyglass augmented reality features. Spherical coordinate mapping and all scales are close to real camera field of view and dependant on current zoom that makes positioning of augmented reality markers and scale marks more precise.

Pinch with two fingers or use plus and minus buttons to zoom in or out. Current zoom level is only valid for the current run and is not persisted within restarts.

Zoom affects either the live picture from the built-in camera or a map depending on which of them is active in the moment as well as spherical coordinate system, all scales, augmented reality markers positioning and rangefinder.

Precision and accuracy

Spyglass precision that as well as zoom affects all of its augmented reality features is directly dependant on the precision of the built-in hardware sensors – GPS receiver, accelerometer and magnetometer. The maximum precision is only available outdoors – while indoors despite GPS information is also available the accuracy is quite low. To achieve a better precision Spyglass averages the input from all sensors over time and uses basic motion dampening.

The precision of the accelerometer is the best thus the vertical (elevation) accuracy of the Spyglass is good almost at any time and at any place – both indoors and outdoors.

The magnetometer is slightly less precise however its relation to the true north is much dependant on the GPS receiver that in its turn is even less precise and has quite low accuracy while indoors thus the horizontal (azimuth) precision of the Spyglass is very dependant on the location, GPS signal and disturbances in surrounding magnetic fields.

Upon detection of significant disturbances in surrounding magnetic fields a message reporting magnetic interference pops up with calibration instructions displayed.

Following instructions and moving the device in a figure 8 motion recalibrates the compass and also helps to improve the accuracy even in case no any interference being reported.

Compass and maps

Compass in Spyglass unlike others works in any orientation and is displayed over the live feed from the build in camera or a map. Map is automatically rotated accordingly to the current azimuth.

Compass behaves as a classic compass or as a backwards compass.

Classic, common compass is designed in a way to be looked at it from the top (as it would be on a floor) – the arrow showing current bearing is directed from the observer and placed to the opposite part of the azimuth circle symbolizing moving forth. Classic compass perfectly fits to be used with maps.

Backwards compass is intended for looking at it from aside (as it would be on a wall) – North and South are inverted thus the arrow showing current bearing despite being also directed from the observer is placed at the bottom part of the azimuth circle symbolizing the direction of the observers gaze. Backwards compass is perfect to be used in viewfinders.

Compass can use either true of magnetic north. Magnetic north and magnetic declination are mostly used in conjunction with specific tasks of aeronautical and nautical navigation. Common tasks like in Spyglass should normally use true north.

Precise mode triples the amount of marks on the azimuth circle – marks are placed on it at each 5 degrees. Usual placement is one mark at each 15 degrees. Precise mode only affects degrees scale.

Milspec mode adds angular mils scale to azimuth circle with marks placed at each 100 mils. Zeroes on scale are omitted to save space. The angular mil is 1/6400 of a circle and is commonly used by military organizations in artillery, ballistics and similar tasks. 1 mil at 1 kilometer is 1 meter – an easy to remember.

Spyglass averages the azimuth over time to get better azimuth precision that is affected by disturbances in local magnetic fields. In case the disturbance is significant an infinity sign starts flashing at the top left corner of the screen and a message pops up – follow the instructions in the message to recalibrate the compass.

True or magnetic

Using magnetic north only affects the compass and the azimuth information displayed at HUD – all other features rely on, use and show true north. Azimuth for tracked objects is always displayed using true north.

GPS locations and bearings tracker

Spyglass allows simultaneous tracking of multiple targets or points of interest.

For each target being tracked when it is in sight an augmented reality marker is displayed at the place that matches the real object location. For GPS targets distance and azimuth are shown. For bearing targets azimuth and elevation are shown.

For targets that are not currently in sight bearing hint marks are shown at the inner edge of the compass azimuth circle. Tracker in Spyglass unlike others operates in three-dimensional space thus hint marks suggest the shortest rotation direction to get the object of interest in sight. True azimuth to targets is only shown by hint marks when the device is parallel to the ground.

Spyglass allows navigation along rhumb lines. Following a shortest path to the target means that the azimuth to the target will be constantly changing while course will remain same. Following a rhumb line requires continual changes in the track of the vehicle to maintain a constant course.

Use tracker button to add or edit targets.

Targets can be manually or automatically defined as GPS locations by either latitude and longitude or MGRS (Military Grid Reference System) coordinate or as constant bearings by azimuth and elevation.

The latitude and longitude can be entered as decimal degrees as well as degrees, minutes and seconds while separating characters are ignored like “4.283891”, “4 17 02 N” or “4°17'02"N” for latitude and “73.553333”, “73 33 12 E” or “73°33'12"E” for longitude. Locations can also be entered as MGRS WGS84 coordinates like “43NCE3945273659” or “43 NCE 39452 73659” – separating characters are also ignored.

By using current location or bearing as well as by selecting a point on a map for tracking – the target point of interest will be automatically created with tracking enabled.

Thus Spyglass allows to either select geographic locations on a map or enter them manually as well as to mark visited places to find them later. Also Spyglass allows tracking of any constant bearing in a three-dimensional space.

Tracking primary target

Spyglass allows simultaneous tracking of multiple targets thus it is very useful to assign particular bearings, locations or stars as primary targets. However only one primary target can be configures in the same time.

Primary target uses a different hint mark – a triangle arrow that is displayed at the corresponding place of the inner edge of the compass azimuth circle thus making it easier to distinguish it from others.

Observing locations on a map

Along with automatically rotating map Spyglass allows to observe locations on a map in different modes – it can show a single location, all or tracked locations or all and tracked locations that are in range.

Locations on a map are represented with custom pins. The current location uses green color. Primary target uses red color. All other locations use purple colors. Map automatically zooms to fit the locations into the screen.

Observing locations on a map is available through the compass button that is located and the bottom of the list of all locations or at the bottom of the particular location details.

Tapping compass button pops out the menu with a multiple choices. Choices to show locations that are in range are only available when the current location information is available and the maximum tracking limit is set.

The compass button at the bottom of the location details also offers to launch the "Maps" application to get directions from the current location to the designated one.

Sun, Moon and stars tracker

Sun and Moon positions along with positions of other celestial bodies are calculated with the arc second precision taking into account the Terrestrial Dynamical Time (TDT), precession, nutation, aberration, air mass and refraction along with major perturbation terms and gravitational deflection of light corrections.

However positional astronomical formulae uses average air humidity, temperature, pressure and altitude. Moreover the light from distant stars with different wavelengths is refracting differently while refraction formulae is averaged for yellow light of Sun. Thus precision of celestial bodies is slightly lowered although in common civilian terms it is quite high.

Stars can be either manually defined by entering star coordinates (right ascension, declination and proper motions corresponding to the standard equinox of J2000 epoch) or taken from the internal catalogue consisting of the brightest stars known.

Stars are shown as either common augmented reality markers or as graphical markers that correspond to the star spectral classes. The representation of stars controlled by settings and the graphical is default.

Star positions can be used to refine the magnetic declination information by visually measuring the angles between the real celestial bodies positions and their augmented reality markers.

Sextant and inclinometer

Inclinometer in Spyglass displays two angles – horizon and elevation. Horizon unlike roll is relative to the current orientation of the device. Elevation unlike pitch is relative to the current roll, pitch and gravitation vector – it is the angle between the direction of sight and the imaginary line towards horizon.

Sextant allows measuring relative azimuth, elevation and spherical angles. Spherical angle is the smaller angle between two vectors defined by both azimuth and elevation as spherical coordinates – it is the angle that matches the physical angle defined by the shortest line between two measuring points while azimuth angle delta can be relatively big especially for big elevation angles.

Sextant in Spyglass is a visual tool that uses augmented reality – it uses special markers to aid measurement in a way to overcome device accuracy limits to reach better precision.

Tap on sextant button sets starting bearing and displays its marker. Tapping it again sets ending bearing and displays the calculator button and the second marker. Both markers are updated to display the spherical angle delta for a quick reference. Next tap on sextant button clears both bearings and hides the calculator button.

Angles between any bearings, locations and stars can be measured by using their corresponding augmented reality markers as targets for the sextant.

Best is to measure in portrait orientation or rotate 90° CCW. Rotate the device using camera pivot when measuring for maximum precision. Ensure starting bearing marker points to its target before selecting ending bearing. Zoom aids reaching a better precision for smaller angles.

Use calculator button to start the angular calculator with one of the measured deltas for azimuth, elevation or spherical angles. Angular calculator allows calculating the distance to a remote object when its size is known or vice versa taking one of the measured angle deltas or manually entered angle in either degrees or angular mils.

Stadiametric optical rangefinder

Stadiametric optical rangefinder in Spyglass is derived from ones commonly used in sniper scopes – it allows to quickly measure the distance to humans or other objects relative in height without additional calculations.

Rangefinder scale is adjusted for an average human height – 5.6ft or 1.7m. It allows measuring objects at distances from 300ft or 100m up to 1500ft or 500m with interval of 150ft or 50m.

Arrange the device in way the object in the viewfinder perfectly fits between lower and upper marks of the rangefinder scale – that shows the approximate distance. Zoom aids reaching a better precision for lager distances.

Measuring approximate distances to objects relative in size is possible by positioning them accordingly between rangefinder marks – a half size objects should be positioned to fit the half of the height between the corresponding scale marks.

Wing and crosshair

Wing and crosshair helping in aiming also help in stadia readings. Wing and crosshair sizes are adjusted in a way to correspond to approximately 100 angular mils at 1x zoom, 50 mils at 2x zoom, 25 mils at 4x zoom and etc.

Camera and screenshots

Use camera button to take a picture from the built-in camera or make a screenshot. Pressing power and home buttons simultaneously makes sharper screenshots.

Taken pictures or screenshots are saved into the camera roll from which it can be later copied or sent out via e-mail. The image preview seems blurred in the camera roll until next sync with the iTunes.

Compass mode and battery life

Spyglass running in viewfinder mode (camera is on) consumes more power because processing the live video from the built-in camera requires more computing power.

Compass mode (camera is off) consumes less power and can be switched on or off by double tapping at any place of the screen or in settings.

Reducing the number of targets that are being simultaneously tracked also preserves battery power allowing longer runtime.

Settings

Use info button to access settings controlling Spyglass behavior and features.

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