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1. Introduction

- G-Compass ™ uses augmented reality to allow visualization of a ground mounted solar array in a desired location.
- G-Compass ™ is primarily intended for sales, marketing, design, and installation of ground mounted solar arrays.
- System requirements: Designed for iPhone and iPad
    - iOS 17.6
    - For best results, iPhone Pro or iPad Pro, which have LiDAR (Light Detection and Ranging) capability.
- Glossary:
    - **Augmented Reality (AR)** is a technology that overlays digital content—such as images, 3D models, or information—onto the real world in real-time, enhancing the user's perception of their environment through devices like smartphones, tablets, or AR glasses.
    - **Global Navigation Satellite System (GNSS)** is a system of satellite constellations used for positioning and navigation. There are constellations supported by several nations, including the United States, the European Union, Russia, China, and regionally, by India and Japan. **Global Positioning System**

(GPS) refers to the constellation of satellites maintained by the United States of America.

2. Installation & Setup

- G-Compass ™ is available on the Apple App Store.
- Required Permissions
    - **Camera:** Camera permissions must be enabled to support the use of augmented reality (AR) within the app.
    - **Location Services:** Location services must be enabled because Global Navigation Satellite System (GNSS) data is used for determining orientations.

3. Core Features & Functionality (see Appendix I for detailed steps)

G-Compass ™ uses Augmented Reality (AR) to place virtual objects in a visual scene and Global Positioning System (GPS) to establish or measure the orientation of those objects. Here are the major features and the high-level steps for each:

Measure Two Points: Measure the compass direction between two points using GPS.

1. Calibrate AR to GPS (See **Tips & Best Practices** for more information)
2. Select Points

Two Point Layout: Lay out two points using GPS.

1. Calibrate AR to GPS (See **Tips & Best Practices** for more information)
2. Enter the direction and distance from the reference point to the second point.
3. Set a reference point.

Rectangle Layout: Lay out a properly oriented rectangle using GPS.

1. Calibrate AR to GPS (See **Tips & Best Practices** for more information)
2. Enter the rectangle dimensions and orientation.
3. Set one corner.

Indoor Training Mode: Learn the app functions indoors, simulating GPS.

1. Tap the satellite icon in the bottom of the screen. It will change to an icon reading "INDOOR".
2. Conduct your calibration just like you would with GPS.
3. For the training mode, the second calibration point is always due south (180°) of the first calibration point. The remaining functions are unchanged.
4. Tap the INDOOR icon to return to GPS mode, if desired.

4. G-Compass ™ Use Cases

Purposes:

1.1. Determine the compass direction between two points using AR/GPS calibration.

1.2. Lay out two points in a specified orientation.

1.3. Lay out a rectangle in a specified orientation.

When to Use: Site analysis for assessing orientation of existing structures, proposed arrays, or existing stakes.

5. Troubleshooting & FAQs

- Common issues and solutions:
    - Augmented Reality:
        - What can cause AR to be inaccurate?
            - Poor Lighting Conditions – Too dark or too bright environments can affect camera tracking and depth sensing.
            - Reflective or Transparent Surfaces – Glass, mirrors, or shiny floors can cause tracking errors due to poor depth perception.
            - Low-Texture Environments – AR relies on feature points in the environment; uniform surfaces reduce accuracy.
            - Fast or Erratic Camera Movements – Quick motions can cause motion blur, affecting tracking stability.
            - Camera Quality and Dirty Lenses – Smudges or scratches on the lens can reduce AR tracking precision.
            - Low Battery Mode – Reduces processing power, affecting AR performance.
        - What should I do if I see a virtual object moving on the screen?
            - Most likely, the AR has not fully initialized.
            - You should back up one step in the app process or start over, allowing time for the camera and AR to stabilize.
    - GPS:
        - How long does it take to acquire satellites? When outdoors, an iPhone needs approximately 45 seconds to get a good fix on position. An iPad with GPS capabilities needs about 60 seconds.
        - What are the optimal conditions for GPS usage?
            - You should have a good view of the sky.
            - There can be issues with reflections such as from a metal building. Our data indicates that this becomes particularly significant within about 20 feet of a building.
        - What can cause errors in GPS positioning?
            - Obstructions – Buildings, trees, tunnels, and mountains can block satellite signals (urban canyon effect).
            - Multipath Interference – Signals bounce off surfaces like buildings or water, causing delayed reception.

        - Weather Conditions – Heavy rain, snow, or ionospheric disturbances can weaken GPS signals.
        - Poor Initialization – Allowing insufficient time for initialization may result in lower accuracy at startup. The app should run for two minutes outdoors prior to use.
- What is the azimuth (directional) accuracy of the GPS? In open sky conditions with a proper satellite initialization (approximately 2 minutes), it depends on the separation between the two reference points:

Confidence	100'	150'	200'
90%	**3.4°**	**2.4°**	**1.8°**
95%	**4.0°**	**2.8°**	**2.1°**
97%	**4.4°**	**3.1°**	**2.4°**
99%	**5.2°**	**3.7°**	**2.8°**

6. Tips & Best Practices

- General Instructions for Manipulating Points:
    - **Place a point:** Line up the point in the target and tap the appropriate button.
    - **Drag a point:** Swipe the object.
    - **Delete a point:** Tap the object.
    - Indications will appear on the screen when tap and drag actions are active.
- Calibration of Augmented Reality to GPS
    - Select two points with a clear view of the sky. The points do not have to be next to the array, but the camera session must be maintained in progress when moving from the calibration points to making measurements or displaying the array. In open sky conditions with a proper satellite initialization (approximately one minute), the accuracy of the calibration depends on the separation between the two reference points:

Confidence	100'	150'	200'
90%	**3.4°**	**2.4°**	**1.8°**
95%	**4.0°**	**2.8°**	**2.1°**
97%	**4.4°**	**3.1°**	**2.4°**
99%	**5.2°**	**3.7°**	**2.8°**

- Global Positioning System (GPS)
    - GPS is used wherever orientation relative to the compass points is required.
        - Array Layout
        - Azimuth Measurement
    - How to maximize precision
        - Allow time for initialization.
        - Use GPS features in an open area without obstructions.
        - Don’t establish reference points by walking toward or away from a reflective building (metal siding, for example).

- Augmented Reality (AR)
    - AR is used whenever you see a camera view. It is used for precise calculations of distance and elevation.
    - Obtaining the best AR results
        - Augmented Reality can measure and lay out features in space quite accurately when used properly.
        - Erratic motion of the camera can cause tracking errors. It's best to hold the device in a nearly fixed orientation where it has a view of the ground while walking from one point to the next.
        - When marking a point, follow the on-screen prompts with respect to phone angle to get the most precise results.

7. Contact & Support

- Report bugs or request features: apple@solarfoundationsusa.com
- Terms of Use: https://www.arrayvue.com/terms-of-service.php
- Privacy Policy: https://www.arrayvue.com/g-compass-privacy-policy.php
- Patent Pending

Appendix I: Detailed Instructions for Major G-Compass ™ Functions:

Measure Two Points

- If calibration has not been completed within the AR session:
    - Choose the first point and tap **Select 1st Cal Point**.
    - Move on to the second point. Note that the distance updates as you move.
    - Tap **Select 2nd Cal Point** to select the second point.
    - Tap **Continue**.
- Go to the first point and tap **Set First Point**. You can drag the marker to the correct point.
- Go to the second point and tap **Set Second Point**. You can also drag either marker and see a continuous update of azimuth and distance between the points. You can tap on a marker to delete it.

Two Point Layout

- If calibration has not been completed within the AR session:
    - Choose the first point and tap **Select 1st Cal Point**.
    - Move on to the second point. Note that the distance updates as you move.
    - Tap **Select 2nd Cal Point** to select the second point.
    - Tap **Continue**.
- Enter the desired azimuth (in compass degrees) and distance (in feet) that you want to place a marker relative to a reference point.
- Tap **Continue.**
- Go to the first point and tap **Set Reference**. The reference point and your second point will be displayed. You can drag the markers to new locations while maintaining orientation and separation. You can tap on either marker to delete them.
- Tap **Reset** to start over or **Main Menu** to go back to another function.

Rectangle Layout

- If calibration has not been completed within the AR session:
    - Choose the first point and tap **Select 1st Cal Point**.
    - Move on to the second point. Note that the distance updates as you move.
    - Tap **Select 2nd Cal Point** to select the second point.
    - Tap **Continue**.
- Enter the desired azimuth (in compass degrees) and dimensions (in feet) for the rectangle. The azimuth is the direction perpendicular to the south edge of the rectangle.
- Choose a corner to start with.
- Tap **Continue.**
- Go to the selected corner and tap **Set SW Corner** (or SE, NE, or NW Corner). The four corners of the rectangle will be displayed. You can drag the markers to new locations while maintaining orientation and separation. You can tap on any of the markers to delete them.
- Tap **Reset** to start over or **Main Menu** to go back to another function.