IndoTraq™ Development Kit 1: Getting Started Guide

April 2016

Contents

This development kit is designed to demonstrate high speed precision wireless tracking. The system consists of anchors that are placed around the perimeter of the tracking space and tags, which are designed to be tracked within the space.

1 Introduction

1.1 Minimum Requirements

- Computer with a minimum of 1 USB port
- Windows 7 (Windows XP will also work, but may be limited in some areas).
- For virtual reality, a HMD (head mounted display) is required. It can get position updates from:
  - USB from the Tag
  - Bluetooth from the Anchor 1
  - WiFi from Anchor 1.
- IndoTraq's example VR code is designed to be run using both GearVR S6 Innovator Edition and S6 mobile phone. However, the example code can be modified to work with other HMDs.
  - Note: For data transport, a USB data port, Bluetooth or WiFI is required. USB data port is recommended for low latency data transport. The GearVR S6 Innovator Edition has an external USB data port, whereas in the current GearVR consumer version the USB data port has been disabled.

1.2 Optional Requirements

- For mobility and demonstration, four Neewer light stands or equivalent are recommended to mount the anchors.
- For flexibility in mounting anchors at specific angles, a Neomark Tripod Mini Ball Head can be used.

1.3 External resources

- Available for download at IndoTraq.com/support :
  - VR demonstration game with source code.
  - Android data gathering and logging app with source code.
  - PC application (python) for graphically displaying anchors and tags being tracked with source code.
  - PC application (32 bit or 64 bit) for communicating with the anchors and tags in order to configure them for your application.
- Available for download on external websites:
  - Termite Serial Communication Tool (freeware). This can be used to view all the data being transmitted from Anchor 1 (Master) or from any of the tags. It can also be used to change the configuration of any of the devices. http://www.compuphase.com/software_termite.htm

1.4 Writing Conventions

This User Guide follows a set of typographic rules that makes the document consistent and easy to read.   The following writing conventions are used:

- Commands are written in *Lucida Console*.

1.5 Development Kit Release Notes

Date	Kit Version	Description
March 31, 2016	1.0	• The kit can demonstrate tracking of 1 to 4 tags. • The update rate is dependent on the number of tags tracked. Up to 250 Hz for 1 tag, 100Hz for 4 tags. Each additional tag adds 2ms latency to all tag updates. • Up to ten tags can be tracked with the current firmware. • Up to six anchors can be used for better precision. • Future firmware will allow virtually unlimited number of tags to be tracked and virtually unlimited number of anchors to be used in a mesh type network.

                                       DK1 Getting Started Guide v1.2

2 Development Kit Contents

The Development Kit 1 consists of hardware and access to software components and documentation at IndoTraq.com/support.

2.1 Development Kit Hardware Content

Kit Item	Quantity	Description
Anchor	4	• Wireless transceiver that sends and receives measurement distances to other items, such as anchors and tags • Anchor #1 is the master which also has the ability to transmit position data with Bluetooth or WiFi. • 2D requires (3) anchors • 3D requires (4) anchors with Anchor #4 being at a different height than the Anchors #1 - #3
Small Antenna	4	Omni-Directional Multi-Purpose (for most applications).
Large Antenna	4	Directional (for specialized applications). This User Guide does not cover using large antennas. For more details, please go to IndoTraq.com/support
Tag	4	Wireless transceiver that sends and receives measurement distances to the Anchors. The tag is used to track the precise position and rotation of the object being tracked.

Tag Battery	4	• 150mAh capacity
		• Rechargeable
		• Battery Life:
		  ▪ 1 Hour at High-Speed Tracking
		  ▪ Up to 150 Hours at Lowest-Speed Tracking

Shark Fin	1	• For Virtual Reality (VR) applications only • Optional use as an enclosure for the tag.
Micro-USB Cable – General Use	4	Attach to anchor and/or tag to charge battery and/or output data
Micro-USB Cable – OTG (On-The-Go) Cable (not in pictured)	1	Specialty cable **required** to attach tag to Android phone

3 System Overview

Please refer to IndoTraq's website for Frequently Asked Questions: FAQs
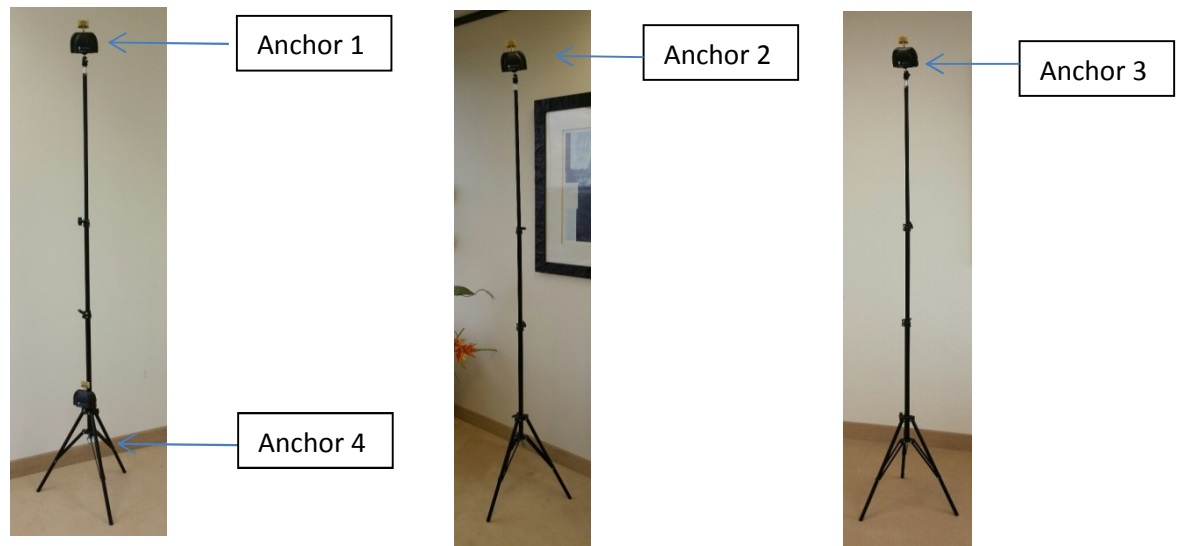
3.1 Development Kit Set-Up

3.1.1 Anchor and Antenna
Attach the small antenna to each anchor. The small antenna is to be used for most applications.   For details on using other antenna types, refer to User Manual at IndoTraq.com/support . Do **not** mix the antenna types within the application – use all small antennas or all large antennas together only.

- For 2D applications, (3) anchors and (3) antennas are required.
- For 3D applications, (4) anchors and (4) antennas are required.

3.1.2 Anchors and Tags
For mobility and easy demonstration, attach the anchors to light stands (see Section 1.2).

Anchor 1

Anchor 2

Anchor 3

Anchor 4

A. Multiple automatic anchor location algorithms are available. The development kits are shipped in *Automatic Mode 1 and 3D tracking of 1-4 tags*. This requires Anchors 1-3 to be at the same height and the Anchor 4 to be at a *lower* height, but at the same X and Y location as Anchor 1. The larger the separation between Anchors 1-3 and Anchor 4, the better the Z axis (up and down) precision.

B. Anchors must be positioned in a counter clockwise triangulation such as:

2 ⟵———— 1&4

3
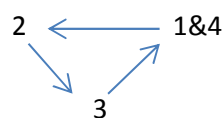
C. Once anchors are positioned, turn them on.   Anchors will auto-calibrate and determine their positions.

D. Turn ON the tag(s) to start the tracking.

    a. By default, Anchor 1 is configured to track (4) tags.

    b. To get the highest update frequency, set Anchor 1 to track just 1 tag. With only 1 tag the update rate is up to 250Hz. Each additional tag after 4 tags will increase the latency by 2ms for all tags being tracked. For example, the 5th tag will lower the update rate to 83Hz (1 / (10ms + 2ms)) for all 5 tags.

    c. *Note: The last numbered tag must be ON in order to get the 100Hz update rate for all the tags, otherwise each tag will update at only 30Hz.*

3.1.3 Anchor 1 Data Output

A. Connect Anchor 1 to a PC using the general purpose Micro-USB cable.

    a. NOTE: The first time the anchor or tag is connected to the PC, allow Windows to automatically install the driver.

B. Start Termite (see Section 1.3). Anchor 1 data will begin to stream. Provided that Anchor 2,3 and 4 are turned on and in range. The format of the data is
`$,10001,TagID,X,Y,Z,RW,RX,RY,RZ,*`

    a. The number `10001` is the command to send tag tracking data, which consists of the coordinates (units: mm) and rotation quaternion (unitless). To get the real value of the quaternion you must divide by 1000. The quaternion has a range of -0.9999 to 0.9999.

    b. NOTE: At high update rates, the amount of serial data being transmitted will be hard see and may overload your computer's serial buffer depending on your computer's speed. At the bottom of the Termite, there is a window to enter commands. Type `$,20032,100,*` and click the Enter Button on the right. *NOTE: this does not change the tag update rate, just the rate at which the data is output.* The number `20032` is the command to set the output transmission delay. The `100` is the delay in ms.

C. After the tracking data is sent for all the tags being tracked, the following is displayed:
`$,10006,DevID,A1X,A1Y,A1Z,A2X,A2Y,A2Z,A3X,A3Y,A3Z,A4X, A4Y,A4Z,A5X,A5Y,A5Z,A6X,A6Y,A6Z,*`

    a. The number `10006` is the command to display all the anchor positions. The format of this command is
`$,10006,DevID,Anchor#X,Anchor#Y,Anchor#Z`

    b. Up to 6 anchors can be used with the current firmware.

D. *NOTE: TagID and DevID fields are zero referenced. In other words, Tag 1 is represented by a 0. Tag 2 is represented by a 1.*

E. For list of all the commands available, refer to User Manual at
IndoTraq.com/support .

3.1.4 Tag Data Output

A. Connect a Tag to a PC using the general purpose serial cable. Start Termite (see
above). The data will begin to stream out of the Tag and will be similar to the
anchor data above. See Command Reference for details on other commands
available.
a. NOTE: The first time the anchor or tag is connected to the PC, allow
Windows to automatically install the driver.

3.2 How system works

The system is based on wireless radio frequency (RF) signals. Stationary anchors (three
for 2D positioning, four for 3D positioning) are placed around the perimeter of a space. Each tag
within the space actively communicates with the anchors to determine its own location. Each
tag also incorporates technology to determine its 3D rotation in space, in the form of a
quaternion.

4 PC Tracking Application (Python) Overview

4.1 What does it do?

It is designed to display graphical indication of the anchors and tags being tracked.

4.2 Setup

A.   Insert USB cable (General purpose) into Anchor 1 and other end of cable to a computer/laptop.

B.   Run Python tracking program provided.

C.   Turn on Anchors.

D.   Turn on Tag(s) that are being tracked.

E.   Click on Connect.

F.   Anchors will be displayed according to how you have them physically laid out in 2D. The Z axis information is displayed in the bottom tray.

G.   Tag(s) will appear in their respective location.

H.   For more details please refer to IndoTraq.com/support .

5 VR Demo Overview

5.1 Setup

A. Untighten (4) screws at bottom of Shark Fin to remove the tag holder.
B. Take Tag and fasten into the tag holder.
C. Input straight end of the OTG USB cable into the side of the Tag and run the remainder of the cable along the front strap of the Shark Fin.
D. Re-assemble tag holder to Shark Fin.
E. Place screw into the hole and tighten.   Repeat until all (4) screws are in place.
F. Mount Shark Fin to the GearVR S6 Innovator Edition or other HMD using the provided Velcro straps.

5.2 Startup

A. Download Virtual Reality Demo App from IndoTraq support website.
B. Load app on your S6 mobile phone.
C. Connect the right angled OTG USB cable directly into your S6 phone.
D. A display will pop up requesting USB permission.

*****Please select to always give this app permission to use USB otherwise no data will be transmitted through the mask to the phone. This only has to be done once unless the app is reinstalled.*****

E. Disconnect the right angled Micro-USB Cable – OTG from the S6 phone and connect into the external USB port located on the bottom of the mask.
    Normally the Micro-USB Cable – OTG is left connected to the mask and only has to be directly connected to the phone one time.
F. Turn Tag power switch ON.
G. Insert S6 mobile phone into mask without blocking the proximity sensor in the mask. A "ding" will be heard to acknowledge the phone was inserted.
H. Wait until the game music starts then quickly place on your head. Otherwise the game goes back to sleep, which then requires time for the game to restart.
I. Begin to walk around freely in VR and use the button on the right of the mask to shoot.

6 Troubleshooting

Please refer to IndoTraq's website for Frequently Asked Questions (FAQs):
http://indotraq.com/?page_id=555

Additionally, forum is located here:

http://indotraq.com/forum

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