Sixdof Space
ULTRA FAST OPTICAL TRACKING

Welcome to...

Sixdof Space
ULTRA FAST OPTICAL TRACKING

Offering the low-latency, no-camera tracking technology of the future.

the
FUTURE of TECH
without accurate
TRACKING

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Our Technology

- Reports object or user position/orientation at **blazingly high speed**
- Uses infrared lights as beacons, **does not use cameras**
- Optical **sensors** and **algorithm code integrated** into OEM hardware

This approach offers the unique and sought-after combination of:

HIGH-SPEED **PRIVACY** **ACCURACY**

LOW LATENCY **LOW POWER** **LOW BANDWIDTH**

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The SIXDOF Advantage

A device using Sixdof tracking can transmit lightweight coordinates instead of data-intense photographic imagery. This impacts speed, bandwidth and latency, and is a **performance game-changer**.

Another key benefit: In our **privacy-obsessed** society, collecting footage with cameras is often unacceptable, with hacking an ongoing risk.

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Drone Target Landings

Guiding that drone down for the last 20-40m is no simple feat, especially in sunlit outdoor environments. The Sixdof technology is the answer for package delivery or maintenance scenarios where you need to land a drone on a stationary platform or moving deck.

The Sixdof sensor unit is installed on the drone, aiming down. When the drone locks into the coded beacon that is installed on the landing platform, the drone receives directions from the sensor to guide it into a targeted landing.

In areas with multiple landing options, each beacon flashes a unique code for the sensor to see and to know which to target.

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Robotic Movement Tracking

It could be a robotic arm of a medical device, or a lift in an industrial machine. Tracking the movement is critical to the application.

The Sixdof technology does not rely on any wireless or radio communications. The technology requires only line of sight between the sensor unit and the IR beacons to report accurate, rapid tracking information.

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Factory & Warehouse Logistics

Patented Sixdof technology tracks all moving vehicles in a factory or warehouse open space. This includes, but is not limited to, robots, forklifts, and trains.

In a typical setup, each moving vehicle carries a Sixdof sensor facing upward. The ceiling of the space is outfitted with our IR light sources (beacons). Each sensor independently calculates and sends the host server the positional data of its vehicle. Our simple API allows you to interface the data into your existing software.

Data transfer between sensors and the host can be achieved over your existing communications interface. The technology has been tested over WiFi networks, cable networks, and indoor 5G networks.

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The Metaverse

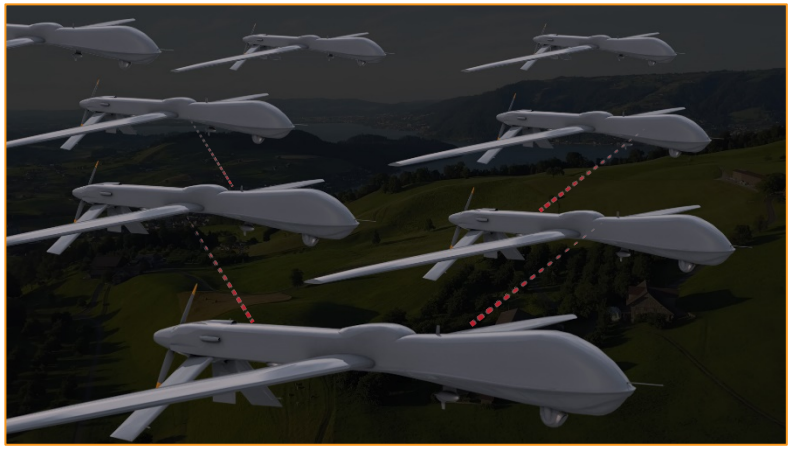
The challenge: Bringing a high-level augmented reality experience into a large open indoor space, without the various interference factors that other technologies include.

Integrating the Sixdof technology into standard and custom AR headsets enabled smoother and faster head tracking. A device using Sixdof tracking can transmit lightweight coordinates instead of data-intense photographic imagery. This impacts speed, bandwidth, and latency, and is a performance game-changer.

Another key benefit: In our privacy-obsessed society, collecting footage with cameras is often unacceptable, with hacking an ongoing risk.

Sixdof technology uses no camera.

Defense and Space Applications



Drones: Navigation and position when flying in swarms

AR: Tanks, Simulators, Maintenance
(at a fraction of the cost of existing military grade helmet tracking systems)

Autonomous navigation:
In large indoor facilities and tunnels using installed light sources

Follow-me technology:
Using head/tail or other lights to help vehicles follow each other

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Positioning, Tracking and Navigation

Absolute Localization with Coded Beacons

- Individually coded infrared light beacons
- cm-level positional accuracy
- Ability to re-localize if/when tracking is lost due to a momentary obstruction of line-of-sight
- Pre-defined light map
- Support supplemental data transmission over IR channel

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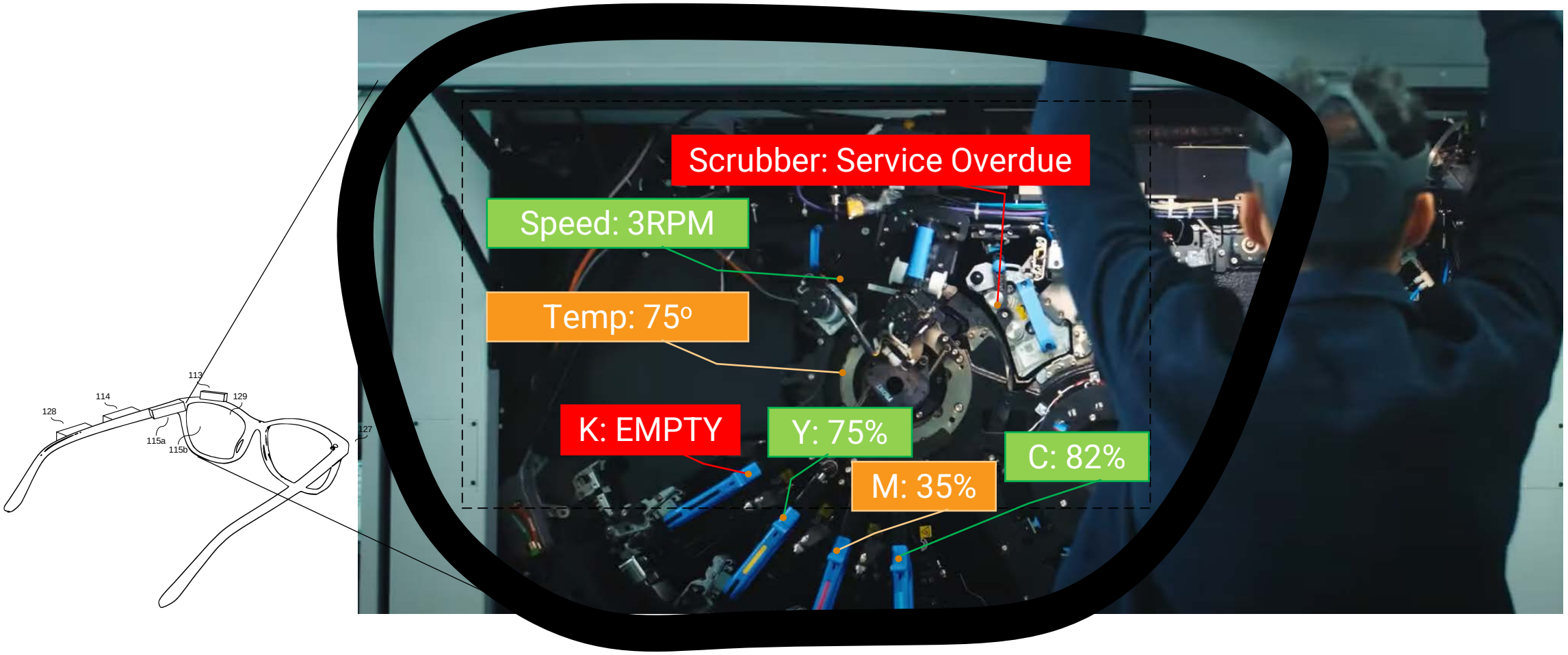
Dynamic Status Augmented Reality (DSAR)



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THE SOLUTION:
How we do it

- Custom **compression optics** and **linear sensor modules**
- Reliably analyzes and tracks the optical signatures of multiple light sources simultaneously
- Minimal computational overhead
- Lightweight Optical Compression visual SLAM capable of mapping and tracking 6DOF position based *solely* on viewing existing lighting fixtures* or coded infra-red LEDs to serve as location beacons.

* Use of existing light fixtures has been technologically proven. A coded beacons approach, however, offers multiple advantages and is currently the design focus.

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TECHNOLOGY
Principles

1. Performs **image compression** in the optical domain
2. Maintains **high horizontal visual entropy** during compression
3. Uses specialized optical sensor to **move data** to electrical domain
4. Result is complete tracking along a **single axis**

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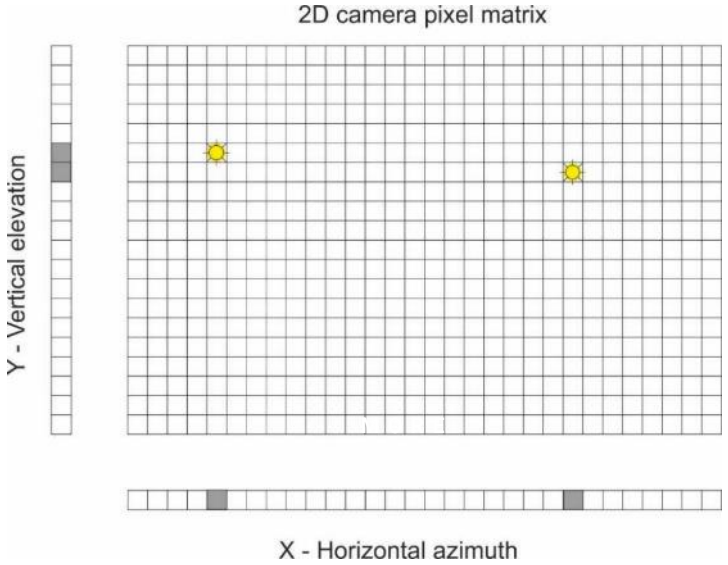
TECHNOLOGY
Principles

Given a 2D sparse image matrix:

- Sum rows to get a 1D vertical elevation representation
- Sum columns to get a 1D horizontal azimuth representation



Pixel count scales linearly with resolution

Capture resolution	2D total pixels	2 x 1D total pixels	Data reduction
30 x 15	450	45	**10 x**
640 x 480	307,200	1,120	**274 x**
1024 x 512	524,288	1,536	**341 x**
2048 x 1024	2,097,152	3,072	**682 x**
4096 x 2048	8,388,608	6,144	**1,365 x**

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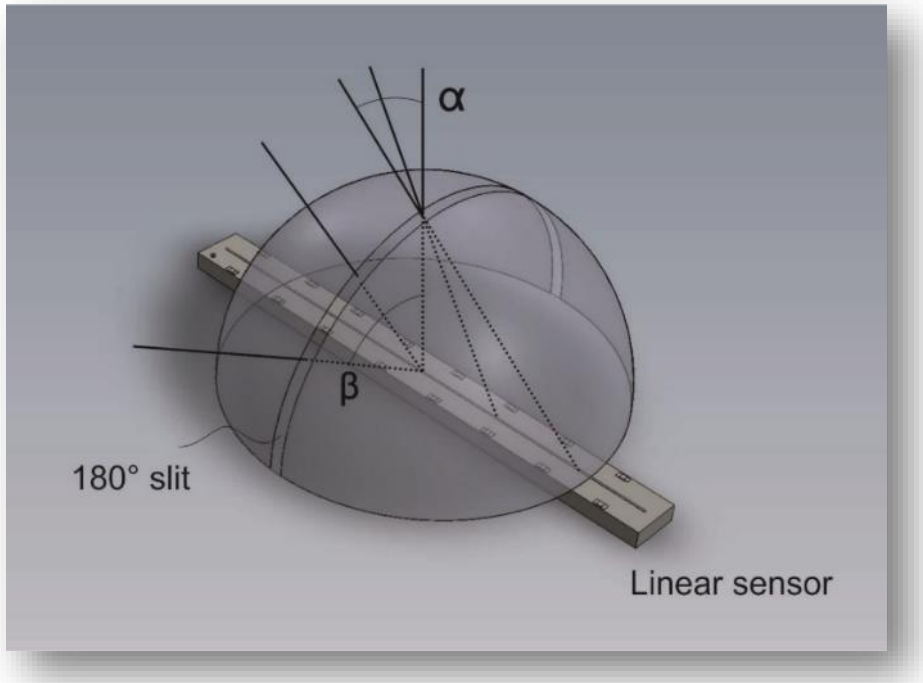
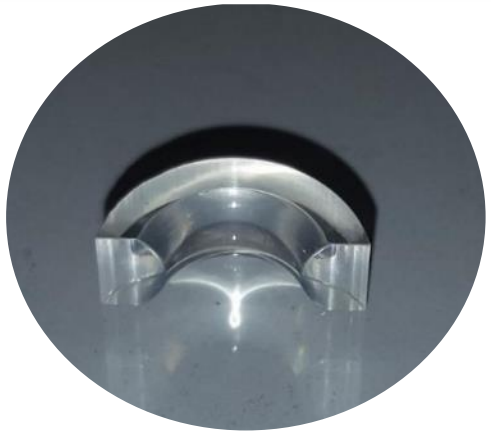


TECHNOLOGY

Optics

- Light from any elevation angle β arriving at a given azimuth angle α will be integrated at the same pixel
- Light from different azimuth angles α will be mapped to a unique pixel on the sensor
- The result is an instantaneous 1-dimensional representation of the 2-dimensional image scene



Aspheric Toroid Compression Lens

- Large field of view (>120 degrees in both axes)
- High optical efficiency – large NA
- Very high image resolution
- Single element optic design

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System Architecture

Designed for Low Processing Requirements

- **Front end** - Feature extraction
- **Back end** – Localization and tracking
- Both processes require a **low memory footprint** (<<1MB)
  - No DSP
  - No GPU
  - Can be implemented using fixed-point arithmetic (no FPU)
- Currently running at over **240 frames/second** on a single 32-bit processor core clocked at 1.5GHz

Designed to run on a single core of a low-cost CPU. Demonstrated on a Raspberry Pi 3B.

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Summary

- Uses IR LEDs as reference beacons
- Low-cost, low-power and installation-free
- Large field of view with very low data bandwidth
- Tracking rates up to 1KHz
- End-to-end latency (motion to absolute pose data) as low as 2ms
- Minimal disruption to work site
- Avoid Security and privacy issues of cameras
- Flexible integration

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COMPETITION ADVANTAGES

Qualcomm snapdragon

Camera-based solutions

Less accurate and stable

Slower

Require more bandwidth - photographic data

OptiTrack

Higher cost

VIVE STEAMWORKS

Slower, smaller operating area

POLHEMUS

Magnetic tracking solutions

EMF Interference

Thank You

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