VISUAL CORTEX INSTRUMENTS

Lab 2: Visual Odometry

The Project: Visual Odometry

Company X, our local version of NASA, is developing an instrument to measure the position, velocity, and acceleration of objects from live video footage for its upcoming unmanned DRIFTER missions to several celestial bodies, such as asteroids and planets. Since launching probes into space is extremely expensive, the instrument must provide accurate and reliable measurements. The user must be able to communicate and control the instrument remotely.

A previous team of scientists and engineers have already implemented Phase 0 of the design. The implemented camera detects the position in pixel units in the reference frame of the live video.

Your team has been hired for Phase 1 of the design and implementation of this instrument to measure the velocity and acceleration of live video footage and characterize its precision (using SI units).

Equipment:

- Camera
- CNC
- Meter stick
- Air Hockey Pucks
- Tracking stickers
- Frictionless air hockey table

The Requirements:

Use the existing system to track the time-dependent position of selected objects and to complete the following tasks:

1. Calibrate the camera to report positions of objects in S.I. units for different viewing depths.
2. Compute velocity and acceleration vectors of tracked objects. The software should either provide options to overlay velocity and acceleration vectors or to log them to a file as needed.
3. Save example videos of tracked objects and save data as needed for further analysis.
4. Use your system to find a numerical value for **g** along with the measured error.

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Presentation of the solution:

Your team must prepare 2-3 page written report (including figures) summarizing the results of the project. The report must include the following:

- A description of the basic physics principles used in the project, including equations used to convert the measured position data (in pixels) into the position, velocity, and acceleration of an object (in SI units).
- A plot of the x and y components of ***r***(*t*), ***v***(*t*), and ***a***(*t*) for a tracked object in simple 2D motion. Acceptable examples include (but are not limited to) projectile motion, motion on an inclined plane, and circular motion (around an axis external to the object itself).
- A description of standard operating practices of your instrument.
- The technical specifications of your instrument, such as the precision.
- A summary of the experiments performed to calculate the value of ***g***, including the final result obtained by your group (with uncertainty).