

## **Future Works**

Although the current flat-sensor grid successfully provided accurate directional feedback for solar alignment, it required frequent re-orientation as illumination angles changed throughout operation. Future work should therefore investigate a curved or hemispherical sensor surface to achieve more uniform light distribution across the sensing array. A curved geometry would enable a semi-passive tracking approach, allowing the system to maintain alignment for longer periods without continuous motor actuation. This modification has the potential to reduce overall energy consumption and mechanical wear while improving the responsiveness of the tracking mechanism under varying illumination conditions.

Furthermore, optimisation of the motor control subsystem is recommended to address the relatively high power draw observed during testing. The NEMA 17 stepper motor provided reliable precision but introduced significant current and voltage fluctuations, increasing the system's energy profile. Replacing this actuator with smaller, low-torque motors or hybrid stepper-servo mechanisms could offer comparable positional accuracy at lower electrical cost. Incorporating advanced control techniques such as duty-cycled or event-driven operation would further minimise unnecessary power usage and align the subsystem with the project's low-power design objectives.

For the communication subsystem, several key enhancements could substantially improve performance. Implementing continuous FSK modulation would eliminate flickering and produce a more stable transmission. Integrating FFT-based message decoding would likely extend the operational range beyond the 1.5 m achieved in this work by enabling more robust signal recovery in noisy conditions. Finally, future experiments should utilise a stronger light source such as direct sunlight, to better reflect real-world operating environments and improve the overall signal strength and reliability of the system.

The project was initially intended to be fully integrated, combining both subsystems; however, due to the unfeasibility of the motor control system, full integration was not achieved. With further research into the motor control subsystem, complete integration would be desirable to enable a comprehensive system evaluation and assess overall feasibility.