Ultra-low-light camera project marks 'major step forward' in Earth observation missions

A new highly sensitive camera system the size of a beer mat is set to overcome some of the most significant challenges faced by Earth observation missions – night-time conditions and low light.

The ultra-low-light camera, developed by XCAM with support from Fairchild Imaging, represents a major step forward in space imaging capabilities, with the new system promising to enhance Earth observation missions.

Through its ability to operate in low-light conditions, the camera will deliver better environmental monitoring, including tracking biodiversity, pollution and changes to the atmosphere. In addition, the system's improved imaging capabilities enables more insightful and effective tracking of natural disasters.

The emergence of the ultra-low-light camera

Rather than starting from scratch with a completely new concept for an ultra-low-light camera, the XCAM team drew on its expert knowledge and experience to adapt existing high performance, advanced sensor technology traditionally used for microscope or ground-based imaging.

The team set about adapting the existing technology for use in space, developing a platform called NuScis, a range of compact SmallSat and CubeSat compatible space imager products.

One part of the project was looking at a low light level sensor and a grant from the Centre of Earth Observation Instrumentation (CEOI) allowed the team to design and build an engineering model and test it.

Then came the next stage – upscreening qualification, a process of testing to verify the rigorous standards for use in space are met and ensure the system can survive in the space environment.

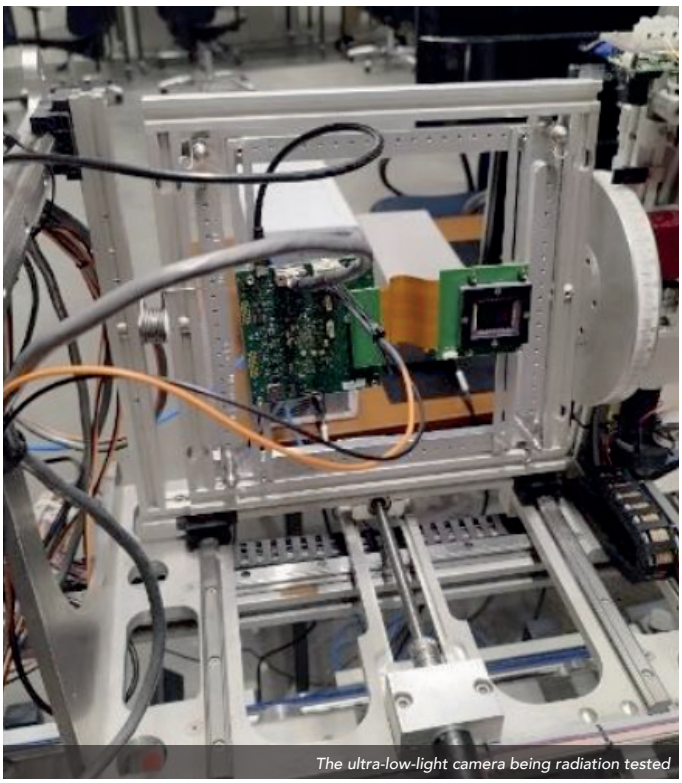
The protons, electrons, heavy irons and neutrons found in space can cause complex electronics, such as microchips, to shift out of their optimum position and stop working. Similarly, radiation can corrupt the data produced or burn systems out completely – so it was vital the camera system was tested under space conditions.

The result was a modular, space qualified camera system that can be used in scientific and commercial applications. It can be adapted for a myriad of applications by adding different optics – a lens, mirror or telescope – according to the required use. This could include the wide fields of view required for detecting oceans or shipping, to the smaller resolutions needed for examining vegetation or agriculture in detail.

It is one of the first of its kind to work both during the day and at night, using moonlight or starlight for illumination. This could allow, for example, the north and south poles to be monitored during the winter.

The system's capabilities also include looking horizontally or upwardly, meaning it could be utilised for astronomy and space situational awareness (SSA), the tracking of man-made objects and monitoring natural hazards.

The engineering model has already attracted interest and buyers, with XCAM expecting a return on investment of 10 to one or more in the next five years.

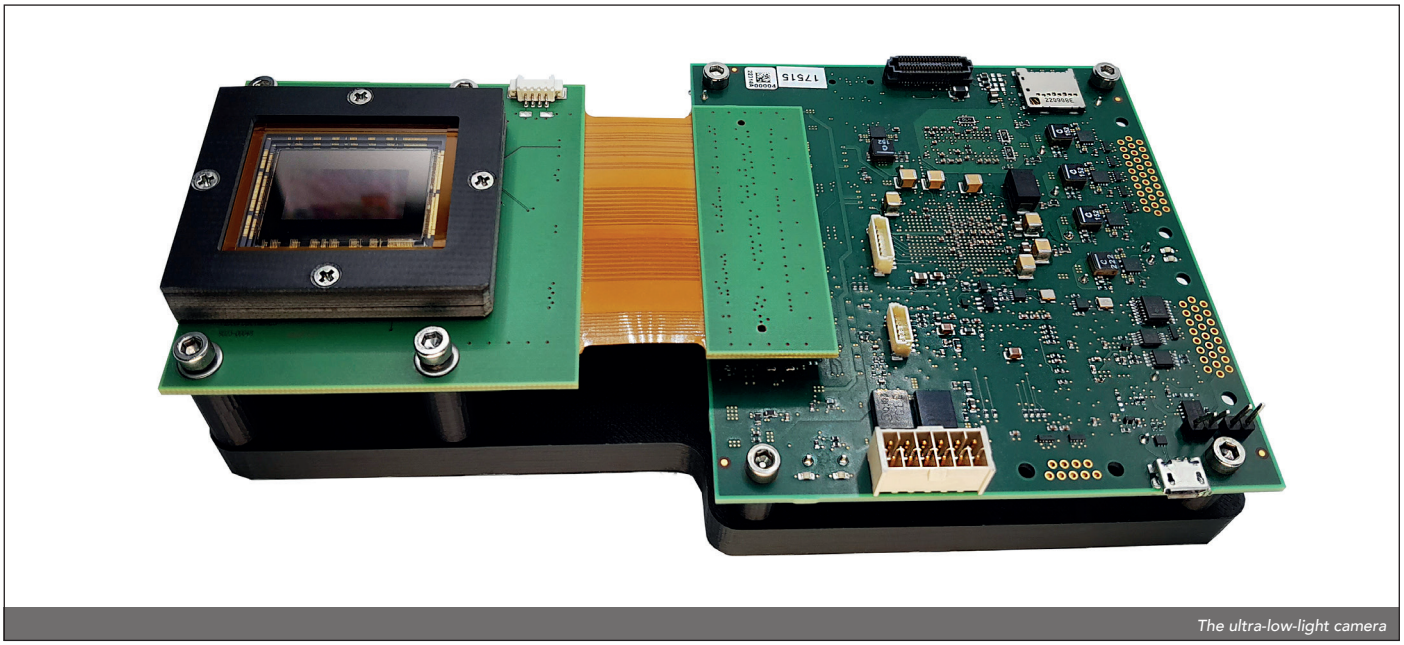


The ultra-low-light camera being radiation tested

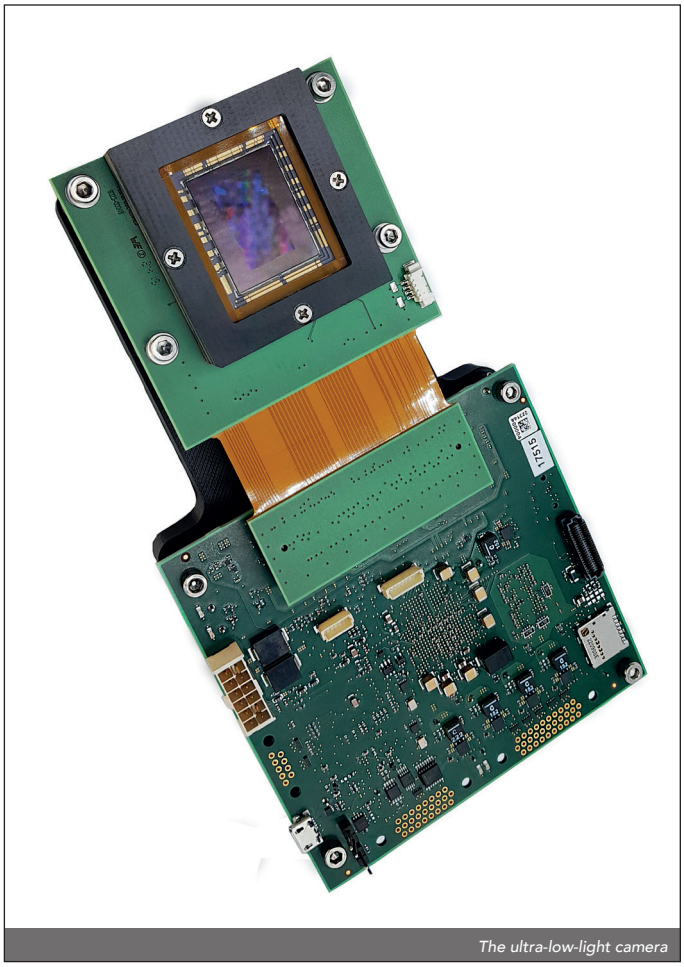
Next steps

With the engineering model completed, the XCAM team is aiming to produce a flight model next year, advancing the technology for full-scale deployment in upcoming space missions.

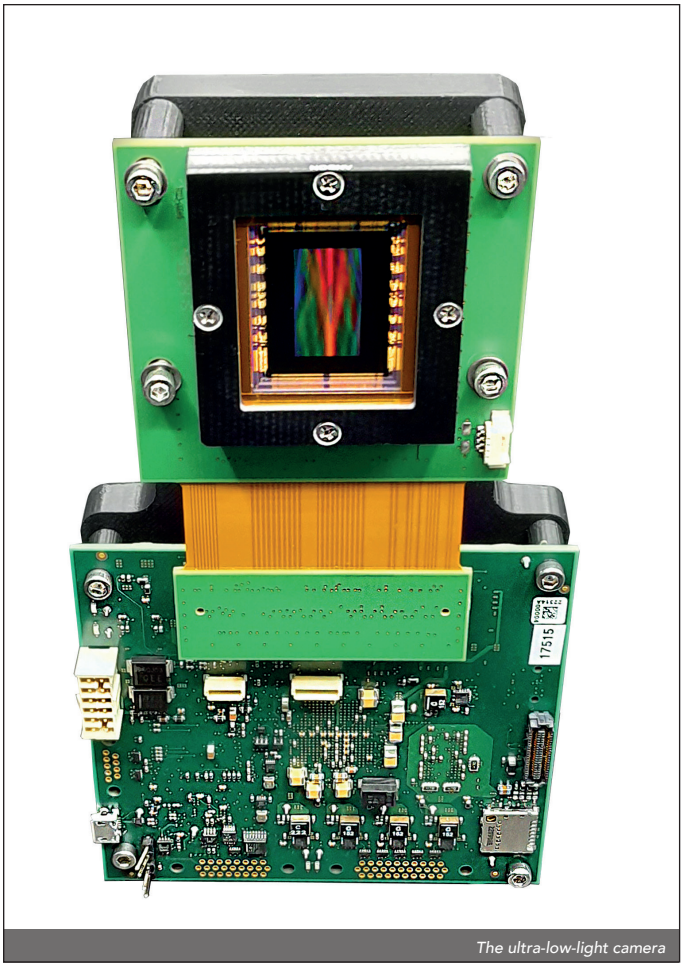
There are also opportunities for the camera system to be utilised beyond its initial scope and outside of Earth observation, including in security and medical imaging.



The ultra-low-light camera



The ultra-low-light camera



The ultra-low-light camera

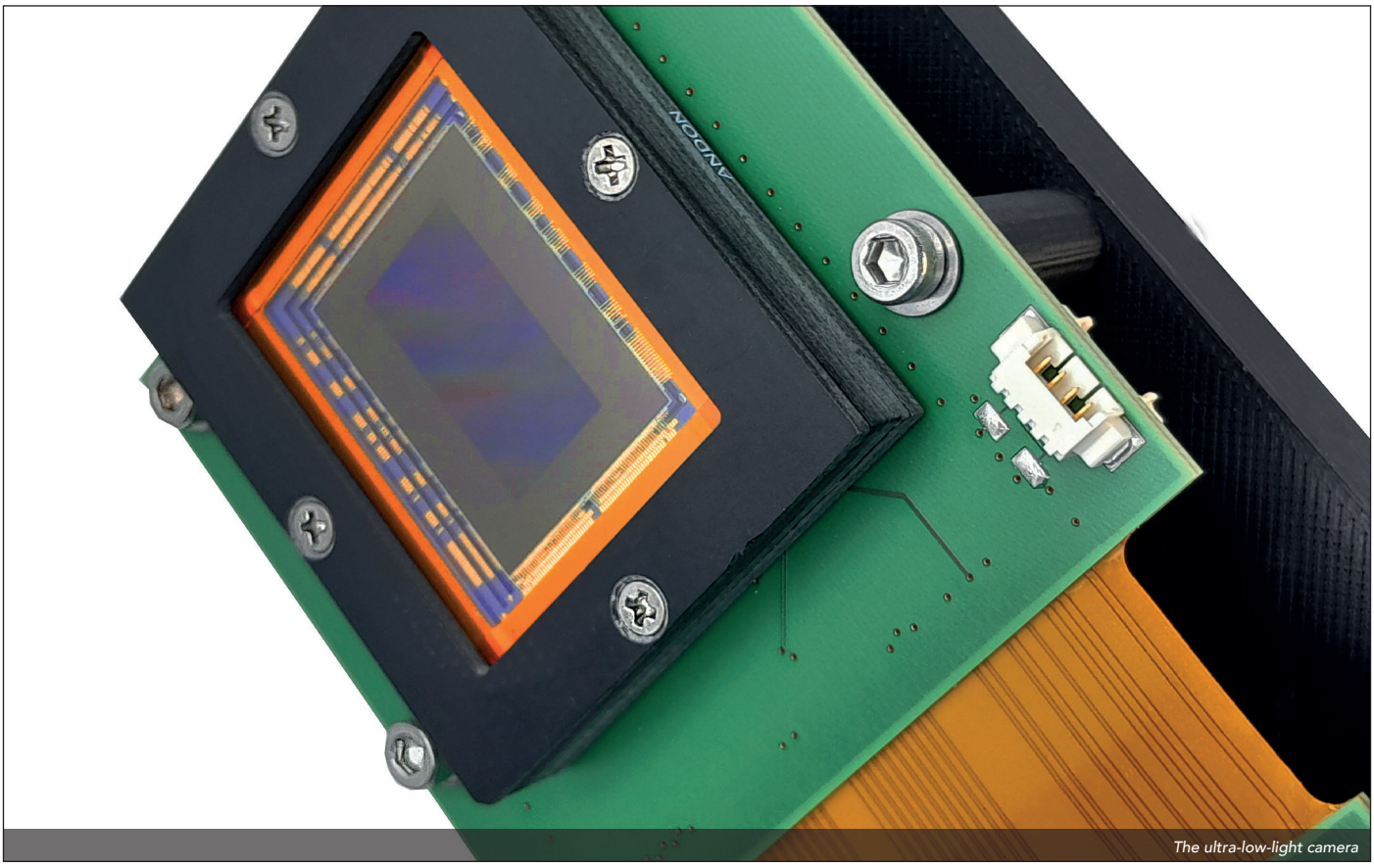
In the words of Andrew Holland

Technical Director, XCAM Scientific Ltd

> "This is an off the shelf product that is ready to go and can be adapted according to specifications. It has scope for lots of different uses – we're agnostic as to the application.
> For system integrators or those building instruments or spacecraft, it removes the risk, and it saves them starting from scratch. It means the whole build cycle reduces from years to months and in that sense, it is cheaper, faster and potentially more capable.
> Developing this system has raised and improved our technical capability and offering. This project has also been the catalyst to developing excellent working relationships with partner organisations, such as Fairchild Imaging.
> Our traditional markets are terrestrial; in the last five years we've been growing into the space market and it's our fastest growing and biggest market opportunity. This is a key product development which helps to position us in the supply chain."

The impact of CEOI funding

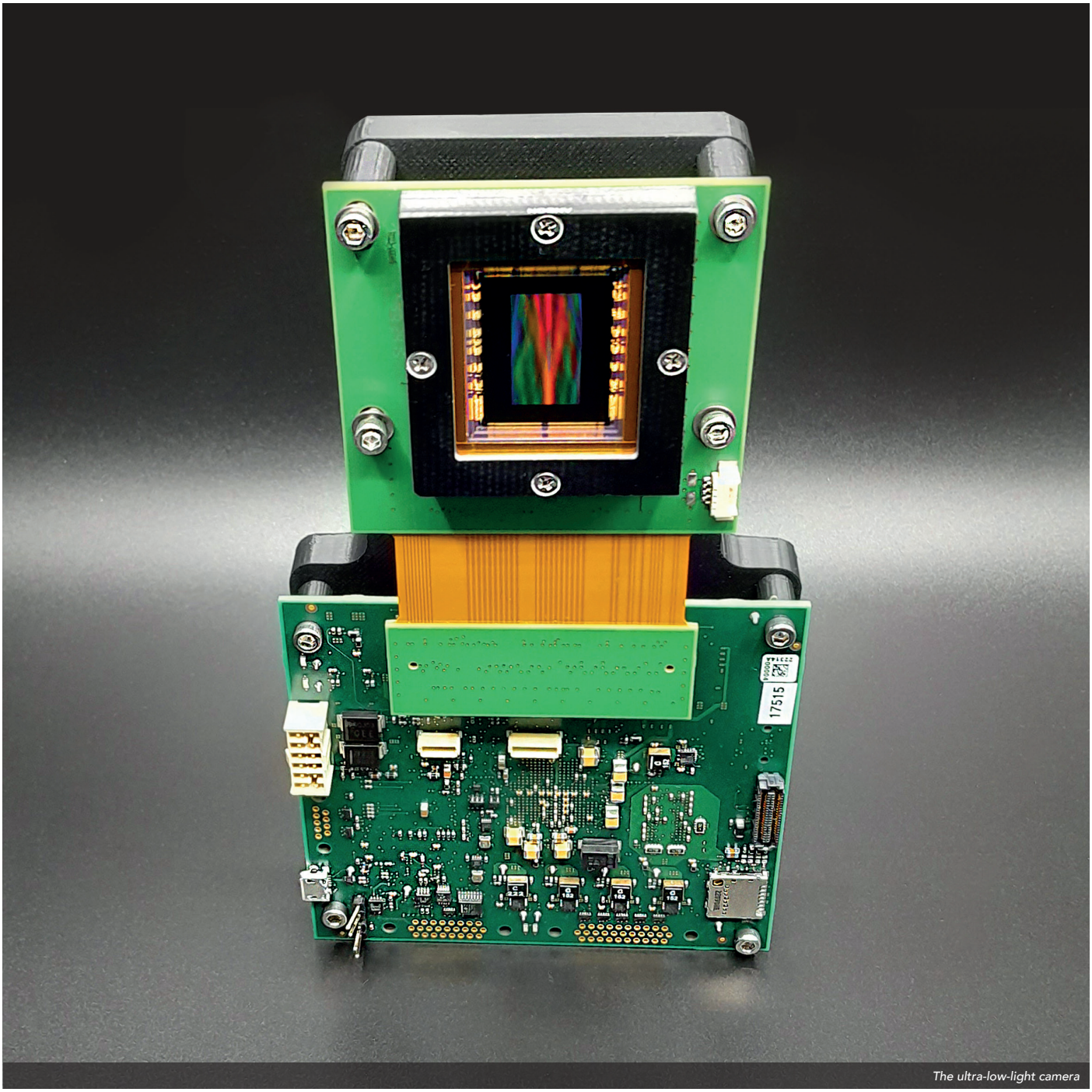
The funding enabled rigorous testing of the camera system, ensuring its readiness for future space missions. By progressing from an initial concept to a near-deployable system, the project has de-risked future investments, making it more attractive for commercial and governmental partners.
In addition, the collaboration between UK industry and global technology leaders has positioned the UK at the forefront of cutting-edge space imaging development.



The ultra-low-light camera

At a glance

- Key facts: The camera can detect much lower levels of light compared to normal imagers due to its sub- electron noise levels; it can also run at high frame rates
- Funding from CEOI: **£207,000** (phase 1), **£109,000** (phase 2)
- Number of people involved in the project: **9**
- Contribution to turnover: Total sales in year one post grant could be **more than £250,000**
- Number of years from design to first sale: **2**



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