Compact High pErformance QUantum cascadE laseR Sensors

Sprawozdania

Informacje na temat projektu

CHEQUERS

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Strona internetowa projektu

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Podsumowanie kontekstu i ogólnych celów projektu

In a world where explosive, toxic or otherwise lethal substances are, sadly, are becoming increasingly common in civilian areas, the ability to detect and identify hazardous chemicals and compounds quickly, easily and at significant range is highly attractive. Even after an attack has occurred,

significant danger still exists from the threat of further concealed devices, thus significantly impeding the rendering of aid until the scene is declared safe. While there has been significant investment in sensor technology to address this need, no single solution has yet been demonstrated which can fulfil the often-conflicting needs of high sensitivity, speed, low cost, ease of use, portability and the ability to detect and identify multiple target molecular compounds against confused and unforgiving scenes. CHEQUERS developed a device which addresses the urgent requirement for highly portable, low-cost detection hardware. We optimised the usability and value of the instrument by sacrificing unnecessary (i.e. long-range) performance. Therefore, for use in confined areas, or scenes where the presence of dangerous substances is suspected, we developed a very low-cost, highly-compact, handheld device, which, will be highly pervasive due to its lower cost, extreme portability and ease of use.
By working with potential end users of the devices and taking on-board their feedback at relevant stages throughout the duration of the project, the ultimate goal of the CHEQUERS project, to develop a highly impactful technology, which will deliver safety, security and economic benefit to society, has been achieved.

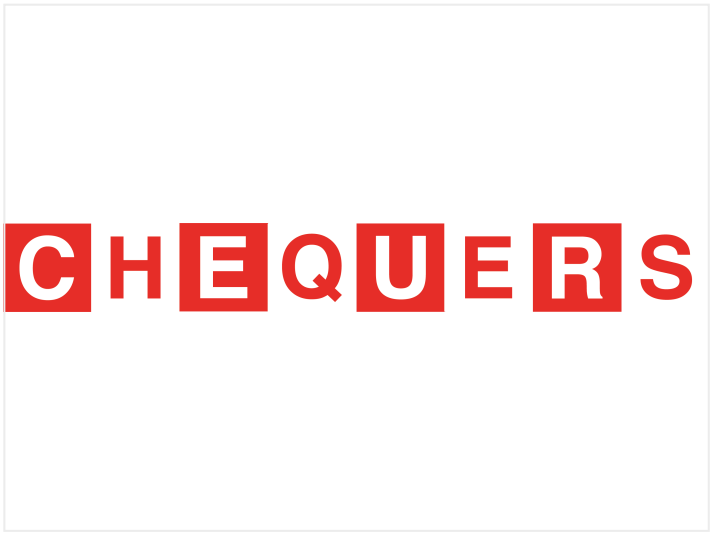
Prace wykonane od początku projektu do końca okresu sprawozdawczego oraz najważniejsze dotychczasowe rezultaty

Within the project good collaboration and communication was established as a solid and essential basis of the project work. This has enabled the project to realise a number of potential exploitable outcomes within the lifetime of the project.
A high-level hand-held demonstrator device capable of stand-off detection of explosives and other substances has been developed and tested. The unit was demonstrated to a panel of end-users and a very positive response was received from all involved. A spectral database containing 21 substances has been established and the spectra covering the relevant range between 7.5 µm and 10 µm were recorded using well established spectroscopy methods. This database can easily be expanded as required and new spectra added. Real time operation of the data analysis algorithms developed within the project have been demonstrated.
Enhanced detector technology including linear array and immersion lens detectors have been developed and are already available to purchase. DAQU unit for converting signals from a detection module to the digital domain have also been realised within the project. These will have applications in many areas.
Units have been developed for ERC-QCL and integrated µEC-QCL sources, which are critical to the realisation of both hand-held and tripod devices. These sources are remarkable in their performance with operation in the challenging wavelength regime of 8.7 µm and will find application not only in the stand-off detector technologies of CHEQUERS but also more widely in mid-IR spectroscopy applications.
MOEMS units were also manufactured and tested during the project which will see deployment in future H2020 projects and photonics applications other than those in the CHEQUERS project.
The project was disseminated widely as various national and international conferences and trade fairs

throughout its duration, and also published 2 papers in peer reviewed journals, with at least 1 more being planned for the near future.

Innowacyjność oraz oczekiwany potencjalny wpływ (w tym dotychczasowe znaczenie społeczno-gospodarcze i szersze implikacje społeczne projektu)

CHEQUERS is an innovative and timely advance in optically-based sensing solutions for the detection of threats and hazards in civil safety and security applications. For the first time, novel lasers, state-of-the-art low-cost infrared detectors and advanced optical Micro-Electro-Mechanical Systems have been combined to form a disruptive synergy that will release the potential of high-resolution detection in the crucial molecular fingerprint region, at safe standoff distances and with real-time imaging capabilities. To date, no sensing systems have been able to meet the form factor and performance criteria necessary to attempt to address the technical challenge being addressed by CHEQUERS. The wavelength agility and compact form factor of the quantum cascade-based laser source combined with the MEMS-based imaging module has not only provided a compelling solution to this challenge but meets an unprecedented cost point that no competing technology is currently close to matching.
The technology development within CHEQUERS has been driven by application and end-user requirements, obtained through a strong supply chain feedback process. For this reason, the consortium established an end user network of civil security agencies that has shaped the technological capability and ultimately provide access and engagement in target markets across a number of national security organisations, initially in Europe but eventually worldwide. It is difficult to identify the precise addressable market for the technology developed within CHEQUERS, however, its scale can be estimated by looking at it bottom up as well as top down. Taking into account all the potential exploitable outcomes from the project an estimate of €40.83M could be generated from revenue streams by the partners within 5 years from the end of the project.
The impact of CHEQUERS will be consistent with the Europe 2020 targets on employment and R&D investment. The results will increase employment levels in the industrial partners and down through their supply chains, estimated in the region of 22 positions in the 5 years after the end of the project. The necessary and substantial R&D investment beyond the project to fully realise the product in mass markets will be undertaken. The complex and interdependent technologies envisaged in this project require a high level of complementarity of key players in this area: material growers, laser system designers, MEMS specialists, system integrators and end-users. The collaborative work that will be carried out has all the ingredients to be extremely successful. The consortium participants all have international reputations in the development of semiconductor materials/structures as well as their use in efficient mid-wavelength infra-red lasers and related applications. The research and development in the area of compact active hyperspectral imaging systems has emerged as a success story in the European photonics industry however there is significant competition in the source and application areas targeted in this project from researchers and companies in the Far East and US. The research carried out in CHEQUERS is therefore essential to guarantee that Europe remains a worldwide leader in the area of compact hyperspectral imaging systems.



CHEQUERS Project Logo

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