Microsoft

Industry course projects programme

Altitude Angel and Imperial College team with up with Microsoft to optimise safe air travel by drones

Microsoft Imagine

ALTITUDE ANGEL

Imperial College London

Executive summary

Civilian drone technology has massive potential – with a wide range of applications ranging from civil engineering, agriculture, e-commerce, security, insurance and many other markets. However, for this sector to flourish, it is essential to create a safe airspace for both drones and manned aircraft.

Backed by Microsoft, this project combined the industry expertise of Altitude Angel with the research capability of software engineering students at Imperial College London. The result demonstrates how an autonomous air traffic control system can be developed for drones that safeguards both manned and unmanned aircraft while optimising journey times between locations.

The Microsoft University Industry Course Projects programme is designed to help established industry customers and partners work with computing technology students, and solve practical problems with real world applications.

The challenge

Civilian drone technology has the potential to revolutionise a wide range of applications. Several businesses are experimenting with drone product delivery services, and there is massive scope for security supervision, traffic monitoring, geological and archaeological analysis, plus photography and leisure using drones. But this potential can only be achieved if the industry can show that it complies with rigorous aviation safety standards. Current air traffic control systems do not scale well to this new world of unmanned drones.

"The students came up with some really innovative designs which complement our existing solution. The proof of concept research undertaken is truly ground-breaking. We are already investigating options for further development of these options and their use with our GuardianUTM service."

Lawrence Gripper
Head of Product, Altitude Angel

"Altitude Angel partnered with Microsoft and Imperial College London to further leverage the technology and academic expertise that advances the future of safe and efficient UAV (drone) operations. The project work contributes to Altitude Angel being able to explain and demonstrate to stakeholders that the technology for autonomous drone flights is closer than currently believed. It also unveiled potential algorithms that may be adopted during the next development phase of the Altitude Angel platform, accelerating the time to production."

Chris Forster
Chief Operating Officer, Altitude Angel

"Autonomous air traffic control was an amazing opportunity to learn new programming languages such as C#, improve those we already had been familiar with e.g. JavaScript or Python and use tools we haven't used before like Rider and Azure."

Year 3 Computer Science student team
Imperial College London

The solution

Altitude Angel is building the Internet of Flying Things™ – an open, global platform that connects drone users, manufacturers, authorities, software developers and other aviation stakeholders with a rich source of airspace and regulatory data, plus advanced back-end services including flight automation and collision avoidance.

The Altitude Angel team were the perfect partners for this project, which gave two teams of computing students at Imperial College London the challenge of developing a new kind of autonomous air traffic control system for drones. The resulting system would need to enable drones to travel safely while avoiding each other, other air traffic and hazards. The students had to verify their proof of concept algorithms against a simulation powered by Altitude Angel's drone cloud platform.

Current situation

Drones do not currently hold information about obstacles they need to avoid:

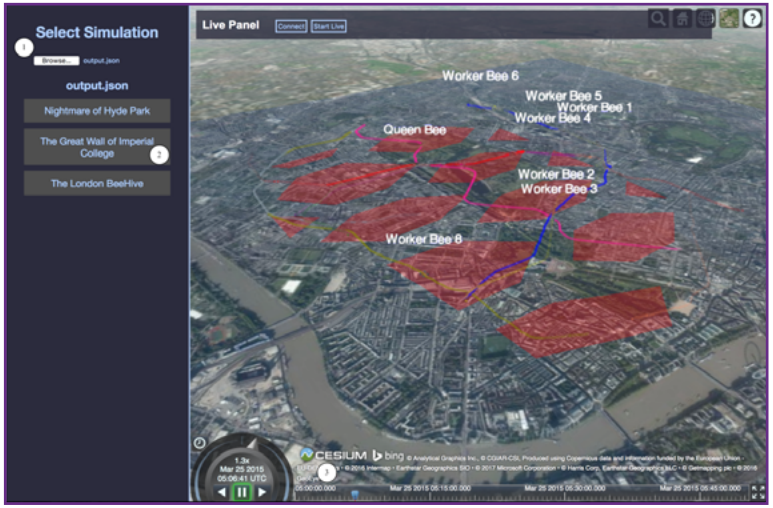
- No Fly Zones – static obstacles or areas like buildings, airports and military facilities
- Manned aviation – any airborne vehicle with humans on board
- Other drones

Important criteria

The students focused on designing an efficient, fair and robust approach to navigating all drones from their starting point to their destination. They predefined No Fly Zones as areas that drones must not cross at any altitude, and covered manned aviation through information on start and end points of plane flights. The automated air traffic control system would need to be able to send signals to all drones for path correction measures to avoid the risk of collision with manned aircraft and other drones. This is particularly important for drones that had stopped sending their telemetry data for a short time, or rogue drones that did not follow the paths the system suggested.

Teamwork

Each member of the student team was given a specific responsibility, from research and development to visualisation. They worked in 1-2 week cycles with regular meetings to discuss progress. They communicated bi-weekly with Altitude Angel via Skype and a Slack channel at each stage, to ensure that the project's potential closely matched their requirements.



The result

Using a modest amount of compute power provided by the Microsoft Azure Cloud, the students designed and tested a number of algorithms in a simulated environment. The most successful approach treated the drones like magnetic or charged particles, so that if two or more drones were due to share the same airspace at the same time, conceptual "repulsion" would prevent this occurring. The system development proved that over 1,000 drones could successfully co-exist with both manned and unmanned aviation in a 1 km^2 area, crossing paths at a safe distance without human intervention. The researchers believe that this initiative can be scaled up to much larger geographical areas in the future. Altitude Angel will be able to use this valuable research as proof of concept for regulators and stakeholders, as well as gaining valuable insights into possible future developments of its platform.

"This project demonstrates why it is so mutually beneficial for computer science researchers to interact with industry. In this instance, our students were empowered to achieve to the best of their potential by Altitude Angel, who provided valuable domain expertise, test infrastructure and regular feedback, and Microsoft, who provided cloud-based compute resources. It also shows the importance of being open to ideas from other disciplines: in this case the physics-based notion of treating the drones as charged particles which naturally repel one another turned out to be a critical element of the solution."

Professor William J Knottenbelt
Department of Computing, Imperial College London

"The use of Microsoft's Azure Cloud platform by Imperial's students enabled them to bring the worlds of data science and data visualisation together to demonstrate how a concept would work in a real world environment. This is a perfect example of how the cloud can bring learning to life and help solve some of the key challenges ahead as drone technology becomes more pervasive."

Emily Byle
University Engagement Team, Microsoft UK

Microsoft Industry Course Projects – learning by doing rather than learning by lecture

Universities increasingly see a role for shared group learning experiences, to better prepare their students for the world of work. Microsoft facilitates a number of projects, typically running over 3-4 months, where students work on a "real world project" defined by a Microsoft customer or partner to solve a technical problem or act as a proof of concept to showcase the "art of the possible" enabled by Microsoft's open Azure platform and other technologies. At the end of the project the students are assessed on how well they have met the project requirements by their professors, with feedback provided by the customer or partner.

Microsoft's partner for this project was Altitude Angel, a startup company based in Reading and alumni of the Microsoft Accelerator Programme in London. They are focused on providing data and services to enable drones to be 'connected' to their environment, removing the need for human control/intervention.

Imperial College London is a science-based university with an international reputation for excellence in teaching and research. Consistently rated amongst the world's best universities, Imperial is committed to developing the next generation of researchers, scientists and academics through collaboration across disciplines. Located in the heart of London, Imperial is a multidisciplinary space for education, research, translation and commercialisation, harnessing science and innovation to tackle global challenges.

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