Project Robots Everywhere

Group 4

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Introduction

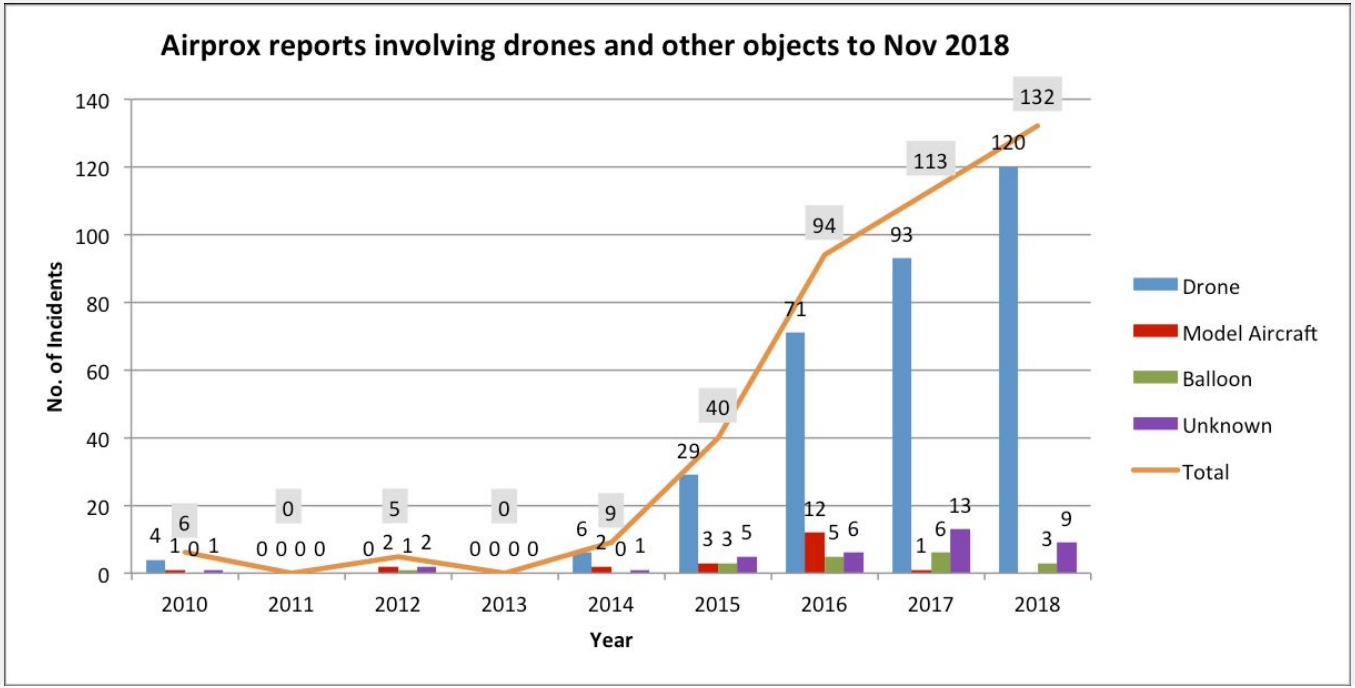
- 19 – 21 December 2018
- Gatwick Airport, England
- Reports of drone activity within 1 km of the airport boundary

- ~140,000 passengers affected
- ~1,000 flights diverted/cancelled

- More than £50m (extrapolated by The Independent from EasyJet's announcement) [1]
  - EasyJet's announcement (£15m)
  - Other carriers (£35m - £40m)
  - Gatwick revenue (at least £15m)

Introduction

- U.K. Airprox Board



[2]

Problem

- Illegal UAV activity around airports
- Airports → any type of airport
  - Commercial airport
  - Military airbase
  - Recreational airfield
- Why is it a problem?
  - Damage to humans and aeroplanes
  - Financial (delay compensation, repairs)
  - Reputation
- Users are central in our problem (direct/indirect users)

Objectives

Goals

- Not the typical design
- Go out of our comfort zone
- Tackle an ongoing issue that has not as much coverage yet

Deliverables

- Literature Research (Wiki)
- Decision Model

Approach

Literature Research

- Propose a problem description (already done)
- Identify and specify USE stakeholders
- Extensive study on the current State of the Art
  - Gain insight into accidents and incidents
  - Identify and specify existing solutions
  - Research the advantages and disadvantages of the solutions

Decision Model

- Research on decision models
- Propose a collection of attributes based on the USE stakeholders
- Score the solutions based on these attributes
- Design propositions based on the differences
- Create a Web App

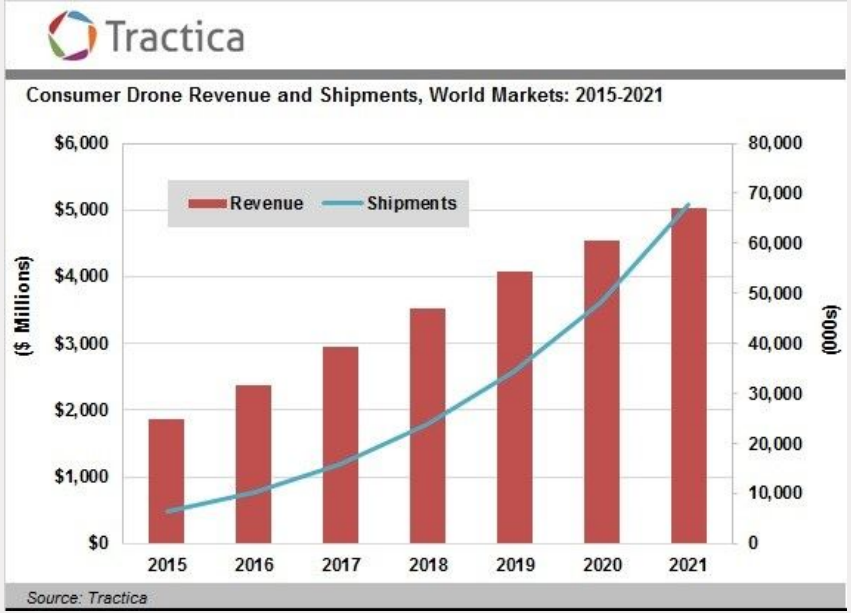
Literature Research

Stakeholders

- Users
  - Airports
  - Airlines
  - Military airbases
- Society
  - Flight passengers/employees
  - Government
- Enterprise
  - Companies that provide solutions
  - Companies that produce drones (geofencing)

Drones

- Technological advancements
  - Before → a fun small toy
  - Future → weaponised UAV
- Number of drone enthusiasts growing
- Recipe for disaster without strict legislation



[3]

Rules and regulations

- Not interesting to consider all rules and regulations here
  - See `Present situation' section on the Wiki
- Current rules and regulations
  - Mainly on a national level
- Future rules and regulations
  - International level (EU)
  - European Aviation Safety Agency (EASA)

Rules and regulations (The Netherlands)

- Drs. C. van Nieuwenhuizen Wijbenga (Minister van Infrastructuur en Waterstaat) is currently making a plan for the national implementation of the European drones rules [6]

- EASA rules (estimated first quarter 2019) [7]
- Active roughly a year after publishment [7]

- Rather tough for a general customer to find a concise overview of information from **official** sources

Types of airports

- Three main categories based on analysis
  - Commercial airports
  - Military airbases
  - Recreational airfields
- For each type, see image
- Too much to cover → can be found on the `Airports analysis' page on the Wiki

Solutions

- What are solutions?
- Purposes
  - Detection (and Identification)
  - Neutralisation
- Categories
  - Preventative
  - Corrective
  - Destructive
- Interview with Airport representative
- Lacking to no countermeasures

Solutions

- Limitations of current solutions
  - Eagle experiments (ethical, reliability)
  - Geofencing (easy to bypass)
- Strict requirements on safety and reliability
- 15 specific solutions for detection (and identification)
  - Radars, bystanders, eagles, geofencing, coded signals, et cetera
- 31 specific solutions for neutralisation
  - Missiles, drones, nets, hacking, radio jammers, eagles, et cetera

Decision Model

Decision Model

- The goal of the decision model is to
  - Spark a debate regarding solutions
  - Raise awareness for the issue
  - Suggest a solution based on needs, beliefs, and wants for any type of airport
- Exhaustive research on different types of models
- Brainstorm session, what can we use?
- Multiple iterations of models
- Voting Advice Application (VAA)
  - Stemwijzer

Working of the model

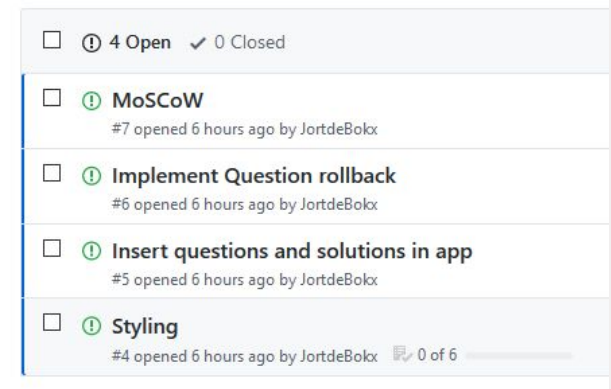
- Transition from VAA to our model
  - Parties → solutions
  - Statements based on issues → propositions based on attributes
- Propositions (agree, disagree, or neutral)
- Scoring
  - Default weights (x1)
  - Solutions in a subcategory (agree or disagree) get a point when . .
  - MoSCoW implementation
  - Extra importance at the end (multiplier)
- Result
  - Ranking of top x solutions in percentages
  - Detailed description of those solutions

Propositions

- Based on the differences of attributes for all solutions
- Attributes are based on the USE stakeholders in the airport analysis
- Examples: scalability, portability, weather, disturbance to the environment, speed of operation, level of autonomy, range, and power outage
- Enormous table of solutions against attributes (See Wiki)
- Form propositions based on the differences
- Providing context and motivation for each proposition

Demo

- Hosted on GitHub pages
- Streamlined workflow (issues, branches)
- https://drones.jortdebokx.nl/



Model validation

- Tough for validation and verification due to subjective nature
- Hard to validate correctness → measure credibility
- Best option → talk to airport representative directly
- Questionnaire to first commander air traffic control at Eindhoven Airbase
- Use feedback to improve model

Future

- Technology advancing (autonomous weaponised UAVs, terrorism, et cetera)
- Number of drone customers growing (need strict regulation)
  - EASA new rules and regulations soon
- VAAs are still rather new
  - `Wrong solution?'
- Proposed model is easy to extend with additional solutions and propositions
  - Other groups taking the course can easily continue to build on the project

Conclusion

- Unwanted UAV presence at airports → growing problem
  - Many airports have no solution for this problem (yet)
  - Many airports are in search for a solution

- This is where we come → the decision model
  - Exhaustive research on state of art, solutions, stakeholders, airports
  - Created a decision model for airports based on research
  - Hosted decision model on web page for the users

Discussion

- Issues deciding on
  - a topic
  - detailed deliverables
- Quite some difficulties within the project, mainly with the decision model
  - More complex than we expected
  - Think, discuss, decide
- Met all defined objectives and finished all proposed deliverables
- The main takeaways are
  - Detailed planning with clearly described deliverables for each week
  - Verification of the quality of each other's work
  - Meetings can be useful, but can easily turn into a waste of time
  - Verify if ideas are feasible

References

[1] Calder, Simon. “Gatwick Drone Disruption over Christmas Cost £50m.” The Independent, Independent Digital News and Media, 22 Jan. 2019, www.independent.co.uk/travel/news-and-advice/gatwick-drone-airport-cost-easyjet-runway-security-passenger-cancellation-a8739841.html.

[2] Editor, The. “UK Airprox Board Reports 30% Rise in Drone Incidents.” UAS VISION, 2019, www.uasvision.com/2019/01/25/uk-airprox-board-reports-30-rise-in-drone-incidents/.

[3] Tractica. Tractica, 2016, www.tractica.com/newsroom/press-releases/consumer-drone-sales-to-increase-tenfold-to-67-7-million-units-annually-by-2021/.

[4] European Aviation Safety Agency, Opinion No 01/2018, “Introduction of a regulatory framework for the operation of unmanned aircraft systems in the ‘open’ and ‘specific’ categories.”, 2019, https://www.easa.europa.eu/sites/default/files/dfu/Opinion%20No%2001-2018.pdf.

[5] “EU Drone Rules.”, 2019, https://drohnen-einsteiger.de/2019/02/eu-drohnen-regeln/.

[6] Rijksoverheid, “Beantwoording Kamervragen over drones bij Londen-Gatwick.”, 2019, https://www.rijksoverheid.nl/onderwerpen/drone/documenten/kamerstukken/2019/01/15/beantwoording-vragen-van-het-lid-remco-dijkstra-vvd-over-drones-bij-londen-gatwick.

[7] Inspectie Leefomgeving en Transport, “Nieuwe Europese regels.”, 2019, https://www.ilent.nl/onderwerpen/drones/nieuwe-europese-regels.