

Abstract

A framework is developed for the implementation of an autonomous drone-based delivery system. The concept stems from the need for more efficient methods of clinical transport in underdeveloped regions.

A case study of a region in Mpumalanga investigates the requirements of the delivery system and scale of the intended solution. The travelling salesman problem (TSP) is used to determine that a region with 19 request points can be serviced by a single drone with a 30 minute flight range and 2 - 4 kg payload capacity.

A notional region containing 20 clinics and one laboratory is used to simulate scenarios with dynamic request points using a reward-based inspection algorithm. Delivery routes are optimised based on global conditions.

An evaluation of the inspection algorithm resulted in the drones averaging 103.53 km in 139.21 minutes. A framework is thus developed which allows for a theoretical scenario analysis for future implementations.

The specimen turnaround time from clinic to laboratory is assessed using 120 scenarios of varying wind speed and request generation rates. In wind conditions similar to that observed in Mpumalanga (5 - 25 km/h), the drone averaged 93.94 minutes per request. At a request rate of two requests per hour the drone delivered an average of 180 samples generated in the first nine hours of simulation. At a request rate of one request every 6 hours the drone averaged 29 samples. The results indicate that as less requests are generated, reduced turnaround times are presented.

Future work may include an in depth study of seasonal request rates and weather pattern data in order to influence the path of the drone for a further optimised approach.

The simulated system proves feasible with regard to external effects such as wind and request point generation. The simulation enables the system to find the most efficient route for a given area in real time and presents a clear indication of turnaround times.