

# Invasive Spear Thistle Weed Detection and Zoysia grass Mapping Using UAV Aerial Imagery

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## **Abstract:**

Manned aircraft and satellite remote sensing are very useful for weed detection at late growing 16 stages (e.g. flowering or senescence) (Pérez-Ortiz et al., 2016, Kelly, 2013). UAV imagery on the other hand can be very useful for early weed detection (e.g. seedling) (Peña et al., 2013, Torres-Sánchez et al., 2015). Each platform has its utility according to the problem. In general, UAVs can provide higher spatial resolution at lower operational costs. This paper describes a UAV platform, sensor payload and post-processing pipeline customized to detect Spear Thistle, Black Thistle (*Cirsium vulgare*) invasive weed found in crops and unmanaged farmland. A computer vision algorithm was developed to differentiate Spear Thistle weed and Zoysia grass. The system creates GPS tabulated locations for detection weed. The results are measured based on the sensitivity and the selectivity of the algorithm. The sensitivity is the ability of the algorithm to identify and detect the true positive target while the selectivity is the capability of the algorithm to filter out the false negatives for detection targets. Results have shown a 95% sensitivity and 98% selectivity when the height above ground is 5 m, 90% sensitivity and 94.5% selectivity when the height above ground is 7 m and 80% sensitivity and 85% selectivity when the height above ground is 15 m. The detection map provides useful information as a cost-effective decision-making tool to estimate herbicide requirements and overall costs of weed management. The Methodology presented in this paper has potential benefits in the fields of precision agriculture, geospatial referencing and weed detection which could benefit from early detection.

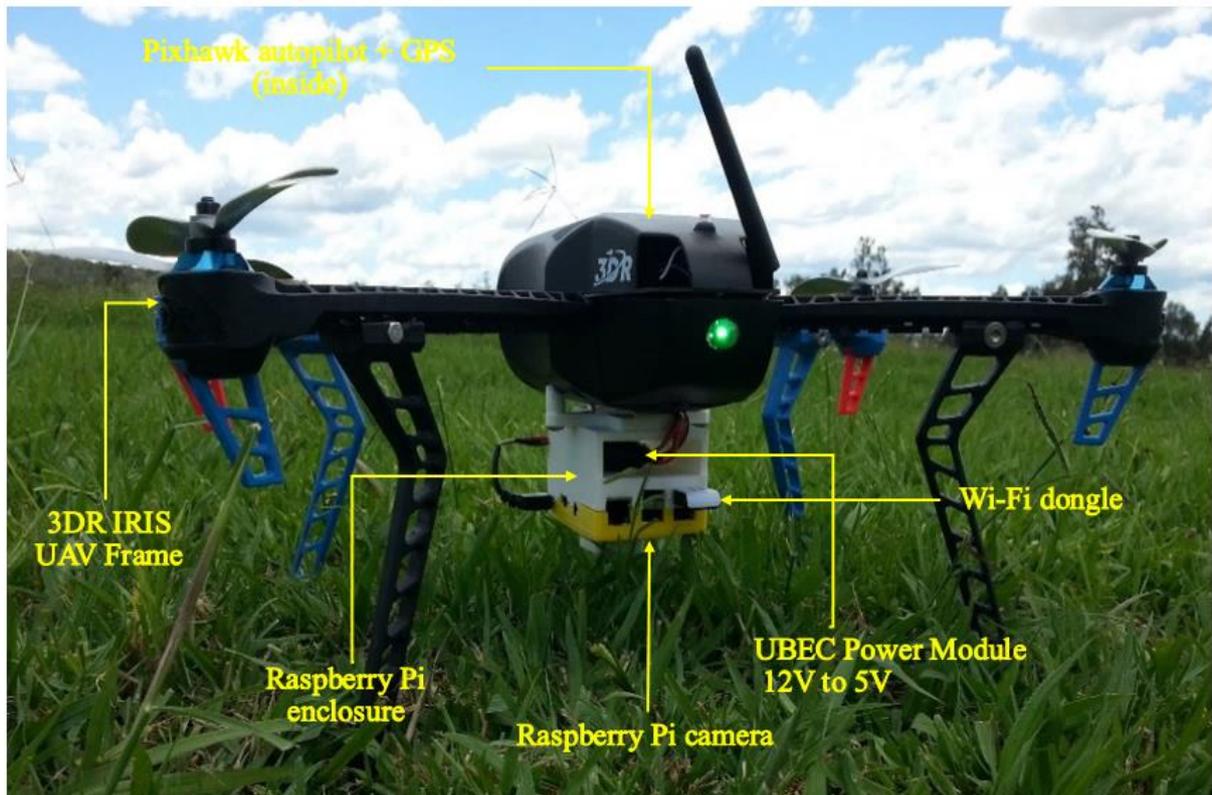


Figure 1. On-board system Hardware architecture.

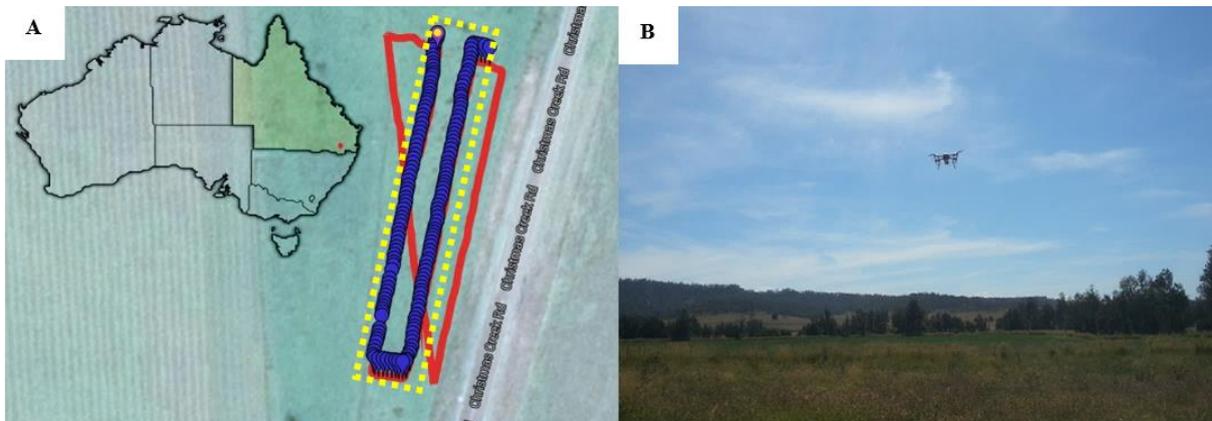


Figure 2. Experimental site and area. A: where UAV aerial images were taken, image locations in blue and the UAV flight path in red area covered by image in yellow; B: Unmanned quadrotor-type aerial vehicle flying above experimental field..

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