



## MECHANICAL ENGINEERING DESIGN PROJECTS

### FINAL REPORT

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## PROJECT OVERVIEW

This project will address the need for a low cost UAV that can be easily deployed by military personnel for near-field surveillance purposes. The low cost feature of this system will allow the rocket-launched glider to be considered disposable. Furthermore, the system must be fast and easy to deploy, allowing field units to remain agile and gather the needed information quickly. The camera that will be on board the glider will transmit back to the unit, giving the troops a real time video of the area being surveyed and rendering the retrieval of the plane unnecessary. Lastly, the system must be able to cover a large range so that the use of the surveillance equipment will provide the troops with information they would not be able to easily attain using other means.

The UAV will undergo two distinct phases during its flight: launch phase and flight phase. The launch phase will use rocket engine propulsion to elevate the system to a height that will allow the glider to reach a desirable range. The flight phase will occur after the propulsion is concluded and will carry the surveillance equipment to the sites which must be surveyed. The glider must be able to carry a payload of the battery, camera, transmitter, necessary electronics, and control system (needed for autonomous flight and stabilization).

The challenge in constructing a UAV that can execute both a rocket launch and autonomous flight phase is that these two modes have very different demands on the vehicle. For rocket launch, high forces are present due to the thrust from the engine and the lift and drag forces on the wings. Due to these forces, the glider must have enough structural strength to ensure that the wings and tail survive the launch. These components must also be able to survive the heat generated from the rocket engine. Additionally, the forces acting on the glider must be located properly to ensure stability throughout the launch. For the flight phase, the glider must have the appropriate control surfaces to allow for continuous control from the flight program. These control surfaces will have to be used to ensure that the glider reaches its designated waypoint.

The current state of the art in this field is quite limited. Although the U.S. military currently uses countless drones in the field such as the Predator and Reaper UAVs, these are relatively expensive, slow to deploy vehicles that may not be available to a team in the field. There are many systems that can be easily hand-launched by a small team, though the advantage of a rocket would be the speed of deployment and extended range of the UAV. A senior design team from Vanderbilt University appears to have already successfully implemented a rocket-launched UAV, but they used a very large rocket that would not be suitable for use by a small remote team. A few other teams have developed smaller rocket-launched UAVs, including a project called "Guardian 2.0" and a UAV developed at the University of

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