An Adaptive Training Prototype for Small Unmanned Aerial System Employment

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Abstract

An adaptive computer based training prototype to teach Soldiers how to use small unmanned aerial systems (SUASs) will be described. This system provides a mix of instruction and knowledge application scenarios to provide "intstructorless" training. After an initial assessment of student knowledge, each student is presented with customized multimedia instruction. This is followed by scenario based knowledge application. During scenarios students are required to make decisions about SUAS employment in the context of either offensive or defensive operations. Each operation is divided into a planning, preparation, and execution phase. Each decision is linked to one of nine terminal learning objectives and contributes to the student model. Should evidence accumulate that the student requires remediation (because of poor decision making), instructional remediation is provided on the deficient knowledge. The student then restarts the particular phase of the scenario they were completing before. A unique aspect of this training is that it is designed to provide training across echelons of leaders involved in SUAS employment (company and below).

Introduction

Unmanned aerial systems are considered small if they are man-portable and their employment does not require an established infrastructure (such as a runway or airport). Several types of SUASs are already in use by the military, and fielding is expected to increase. The Army vision for SUAS is that they would be fielded at the lowest echelons to infantry platoons and squads in order to enhance their situation awareness by providing information about what was over the next hill or around the next corner. However, there are several barriers to the use of SUAS in this fashion, and many of these revolve around providing adequate training. In particular, Army training development concerning SUAS has, to date, focused almost entirely on training the operator how to fly the vehicle. The job of operator, however, is not designated as an occupational specialty, and trainees (corporals and privates) do not receive supplemental training in valuable enabling skills such as tactics, terrain analysis, imagery interpretation, or communication. More senior members of the operator's unit are therefore required to contribute expertise in these areas; however, these leaders receive little to no training on system capabilities and operator requirements, air space coordination, or tactics, techniques, and procedures related to the system. Unless company commanders, platoon leaders and sergeants are educated about the factors they ought to consider in the use of an SUAS, including weighing potential drawbacks and benefits, these systems will likely be under-utilized, or utilized inappropriately. Today's leaders, companies, and platoons preparing for deployment may not have had any training concerning their SUASs prior to their final pre-deployment live training exercise at the National Training Center or the Joint Readiness Training Center. Training with a system like the prototype described here could better prepare these leaders to reap the most out of these resource-intensive live training opportunities.

Our prototype aims to meet the Army's goals that training be efficient, effective, and available. Traditional intelligent tutoring systems (ITS) provide problem solving practice (e.g., Aleven & Koedinger, 2002; Graesser, et al., 2005; VanLehn, et al., 2005) to supplement classroom instruction. Multi-player simulations also provide opportunities to put knowledge into practice; but like ITS, assume players already have pre-requisite knowledge obtained elsewhere, and also rely on human facilitators to provide feedback. The intention behind our prototype was to provide both instruction and practice opportunities, enabling the student to learn about SUAS employment without the need for an instructor or the assembly of a whole team of players.

The training is adaptive in two main ways. First, a pretest determines which learning objectives (if any) require instruction for each individual, prior to their entering the scenario context. This adaptation is intended to deal with the varied prior experience of the potential training audience (e.g., previous deployment history or not). Second, performance during each scenario is used to determine what (if any) remediating instruction the learner requires. Mastery is required as demonstrated in scenario completion; and, instructional time is tailored to achieve this.

Learning Objectives

Nine terminal learning objectives were selected based on the scope of our project and analysis of the knowledge leaders need to bring to bear on SUASs operations. Each terminal learning objective had three to 10 associated enabling learning objectives, for a total of 48 enabling objectives. For example for Airspace mission requests, there were three types of requests to be covered: planned, immediate, and dynamic. Didactic materials to teach knowledge of the enabling objectives were constructed by selecting information from relevant doctrine and other Army publications. Subject matter experts then constructed scenarios which would allow students to demonstrate knowledge of the learning objectives in the context of tactical missions.

Scenario Structure

Each scenario consists of three phases: planning, preparation, and execution. Each phase consists of three to four decisions points, and each decision point is linked to one or more learning objectives. At each decision point, the student is offered an update of the situation and must decide among one of four possible choices. A challenge of this domain is that the correctness of decisions may be debated. "Doctrine," as written in a field manual, is not necessarily the best practice compared to that which has evolved as a result of real-world experience. We therefore decided to include at each choice point: the doctrinal solution, two non-doctrinal, but viable solutions, and one very poor (unacceptable) solution. Each decision is followed by feedback, and then, depending on which decision was selected, the scenario branches to one of three alternate updated situations. In the case of an unacceptable choice, the student is directed to choose again.

A novel aspect of these scenarios is that the student's role may change in the scenario from one decision point to another. For example, at one point in the mission the student may be a company commander, whereas in another, they may be a squad leader. This provides the student with an overall picture of the decisions that must be made to employ the SUAS, regardless of their specific position. It also copes with the fact that there is no standardized cross-unit assignment of who makes what decisions regarding SUAS employment. This is up to the discretion of the leader to whom the SUAS is assigned. He may decide to be involved in the employment of the SUAS himself, or completely delegate its employment to a lower echelon.

The Student Experience

At the beginning of training, the student will take a brief pre-test, sampling knowledge of the learning objectives. On the basis of the test results, relevant instructional materials will be selected by the system for the student to review. A student showing proficiency can be routed directly to a scenario. A student requiring instruction on a limited set of learning objectives will receive that instruction and then go on to the scenario. A student showing little to no proficiency will received instruction and scenarios by phase (e.g., the planning phase instruction and then planning phase scenario). The intention here is to avoid a lengthy period of instruction without opportunity to apply the knowledge.

Once the student begins a scenario, the following rules apply. As mentioned before, each decision point consists of situational background followed by a decision, with four possible choices. A hint button is available, and hints are provided at three levels of specificity. The first level is fairly general. Asking for the first hint does not affect the student model. Asking for the second level hint degrades the learning objective score by half a point, and asking for the third level hint degrades the learning objective score by a full point. Acceptable decisions lead the student to the next node in the decision tree. Unacceptable decisions affect the student model on a terminal learning objective basis. If the total "strikes" for a terminal learning objective reaches three, the scenario is aborted and the student is given relevant remedial instruction. Following remediation, the student restarts the scenario phase they were in before (planning, preparation, or execution).These parameters for transitioning from scenario to remediation were based on intuition. They can be altered based on student testing or absolute standards required by the work place, in this case, the Army. Scenarios end with a review of performance.

References

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