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Usability Evaluation of Desert Locust Military Goggle System with Recon MOD Live Heads-up Display

Preliminary Heuristic Analysis Results

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IMPORTANT INFORMATIVE STATEMENTS

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Abstract

The Toronto Research Centre of Defence Research and Development Canada (DRDC) had a Defence Industrial Research Program (DIRP) project (2010–2013) with Revision Military Incorporated for a see-through eyeglass wearable display. Revision provided DRDC with two prototype Desert Locust Military Goggle Systems fitted with Recon MOD Live Heads-up Displays (HUD), so that DRDC could investigate display requirements for a dismounted infantry soldier see-through HUD.

This report presents preliminary heuristic analysis results of a usability evaluation of the prototype HUD. Both the software and hardware of the prototype HUD were evaluated based on multiple workbench testing sessions and three days of field trials. The prototype HUD was assessed against a set of usability heuristics, and the HUD recommendations of the Soldier Information Requirements (SIREQ) Technology Demonstration Program (TDP).

This report provides 23 recommendations for improving the usability of the prototype HUD and six recommendations for future HUD human factors evaluations. The recommendations are relevant to Revision's design integrating a see-through display into the Sawfly spectacle (the standard issue ballistic eyewear of the Canadian Army), and may be generally relevant to the design of HUDs for dismounted soldiers.

Significance to Defence and Security

The SIREQ TDP demonstrated that heads-up displays can improve dismounted solider performance [1]. This report provides preliminary guidance for improving HUD design for dismounted soldiers. The Canadian Army is considering procuring HUDs through the Integrated Soldier System Project to improve situational awareness of dismounted soldiers. This report documents preliminary usability recommendations for improving the Revision Desert Locust Military Goggle System with Recon MOD Live HUD. Many of the recommendations for usability improvements should also be considered for dismounted soldier HUDs in general.

Résumé

Le Centre de recherches de Toronto de Recherche et développement pour la défense Canada (RDDC) a mené un projet dans le cadre du programme de recherche industrielle pour la Défense (PRID) (2010-2013) en collaboration avec Revision Military Incorporated pour concevoir un dispositif de visualisation tête haute intégré à des lunettes. Dans le cadre du projet, Revision a fourni à RDDC deux prototypes de lunettes militaires Desert Locust comportant un dispositif de visualisation tête haute Recon MOD Live afin qu'elle évalue les besoins des soldats d'infanterie débarqués à l'égard de ce type de dispositif.

Le présent rapport contient les résultats de l'analyse heuristique préliminaire de l'évaluation de la facilité d'emploi du dispositif de visualisation tête haute intégré aux prototypes de lunettes fournis par Revision. Le Centre de recherches a évalué le matériel et le logiciel du dispositif en procédant à de nombreuses séances d'examen en atelier et trois jours d'essais sur le terrain. L'évaluation des prototypes a été effectuée en fonction d'un ensemble d'éléments heuristiques de convivialité, ainsi que des recommandations à cet égard du Programme de démonstration technologique des besoins des soldats en matière d'information (SIREQ TDP).

Le rapport présente également 23 recommandations pour améliorer la facilité d'emploi du dispositif de visualisation tête haute et six recommandations pour les prochaines évaluations ergonomiques. Ces recommandations sont pertinentes pour la conception, par Revision, d'un dispositif du même type pour les lunettes Sawfly (les lunettes de protection balistique standard de l'Armée canadienne) et, dans une perspective plus générale, pour la conception des dispositifs de visualisation tête haute destinés aux soldats débarqués.

Importance pour la défense et la sécurité

Le Programme de démonstration technologique des besoins des soldats en matière d'information (SIREQ TDP) a permis de démontrer que les dispositifs de visualisation tête haute pouvaient accroître le rendement des soldats débarqués [1]. Le présent rapport fournit une préorientation pour améliorer la conception des dispositifs destinés aux soldats débarqués. L'Armée canadienne envisage d'acheter ces dispositifs dans le cadre du Projet d'équipement intégré du soldat afin de permettre aux soldats débarqués d'améliorer leur connaissance de la situation. Le rapport présente aussi des recommandations préliminaires pour améliorer la facilité d'emploi du dispositif de visualisation tête haute Recon MOD Live intégré aux lunettes militaires Desert Locust de Revision Military Incorporated. Bon nombre de ces recommandations devraient également servir, de façon générale, à améliorer la convivialité des dispositifs de visualisation tête haute destinés aux soldats débarqués.

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1 Background

The Canadian Army is seeking to improve human performance through new technologies to extend soldier capability and survivability on operations. Defence Research and Development Canada (DRDC) conducted a Soldier Information Requirements (SIREQ) Technology Demonstration Program (TDP) (1999–2005) to look at what information soldiers need and how best to provide that information. SIREQ found that Heads-up Displays (HUDs) were a promising technology for improving soldier's situational awareness [1].

Following SIREQ, DRDC initiated a Defence Industrial Research Project (2010–2013) with Revision Military Incorporated to develop see-through eyeglass wearable displays. The objective of the project was to augment ballistic protective eyewear—the in-service SAWFLY spectacle—with a see-through HUD.

To begin human factors evaluations of eyewear-integrated displays Revision procured ten Recon MOD Live HUDs and installed them into ten Revision Desert Locust Military Goggle Systems (Figure 1). These relatively quick-to-procure and quick-to-assemble occluded displays were used to begin investigating see-through HUD requirements to inform the design of the final see-through protective eyewear. DRDC received two HUDs from Revision to evaluate the human-machine interface. This document presents results from a preliminary usability heuristic analysis.

The Recon MOD Live HUD is a commercial off-the-shelf (COTS) HUD with an Android 2.3.4 operating system. It is designed for alpine sports and is typically integrated into compatible goggles. The information displayed by the Recon MOD Live HUD is thus tailored to the needs of skiers and snowboarders. Despite being designed for alpine sports, the Recon MOD Live HUD provides hardware and software potentially useful for enhancing the situational awareness of dismounted infantry soldiers. This includes a: liquid crystal micro-display, compass, Global Positioning System (GPS), geospatial information display (e.g., map with landmarks and other users), Bluetooth interface to other devices (e.g., video camera, heart rate monitor, smartphone) and software development kit (SDK) that allows customization.

Evaluating the usability of the Recon MOD Live HUD should help elicit display requirements for a dismounted infantry soldier see-through HUD, and HUD requirements more generally. The analysis in this report is based on multiple workbench testing sessions and three days of field testing. We anticipate that the analysis and recommendations of this report will help to define design requirements for the integration of a see-through display into the SAWFLY spectacle.

Section 2 of this document contains an overview of the prototype HUD. Hardware and software components are described. The descriptions focus on components most relevant to dismounted infantry soldiers. Recon continuously upgraded the HUD's firmware during the execution of this evaluation. As there were major changes to the user interface two versions of the firmware were presented and evaluated.

Section 3 contains an assessment of the prototype HUD considered against Nielsen's ten usability heuristics [2]. For each heuristic, relevant system components are identified and recommendations for improvement are provided when warranted.

The SIREQ TDP developed HUD recommendations for future dismounted soldier systems [1, 3]. These recommendations are presented in Section 4. Conformity of the prototype HUD to the SIREQ HUD recommendations are discussed and courses of action suggested to improve the prototype HUD.

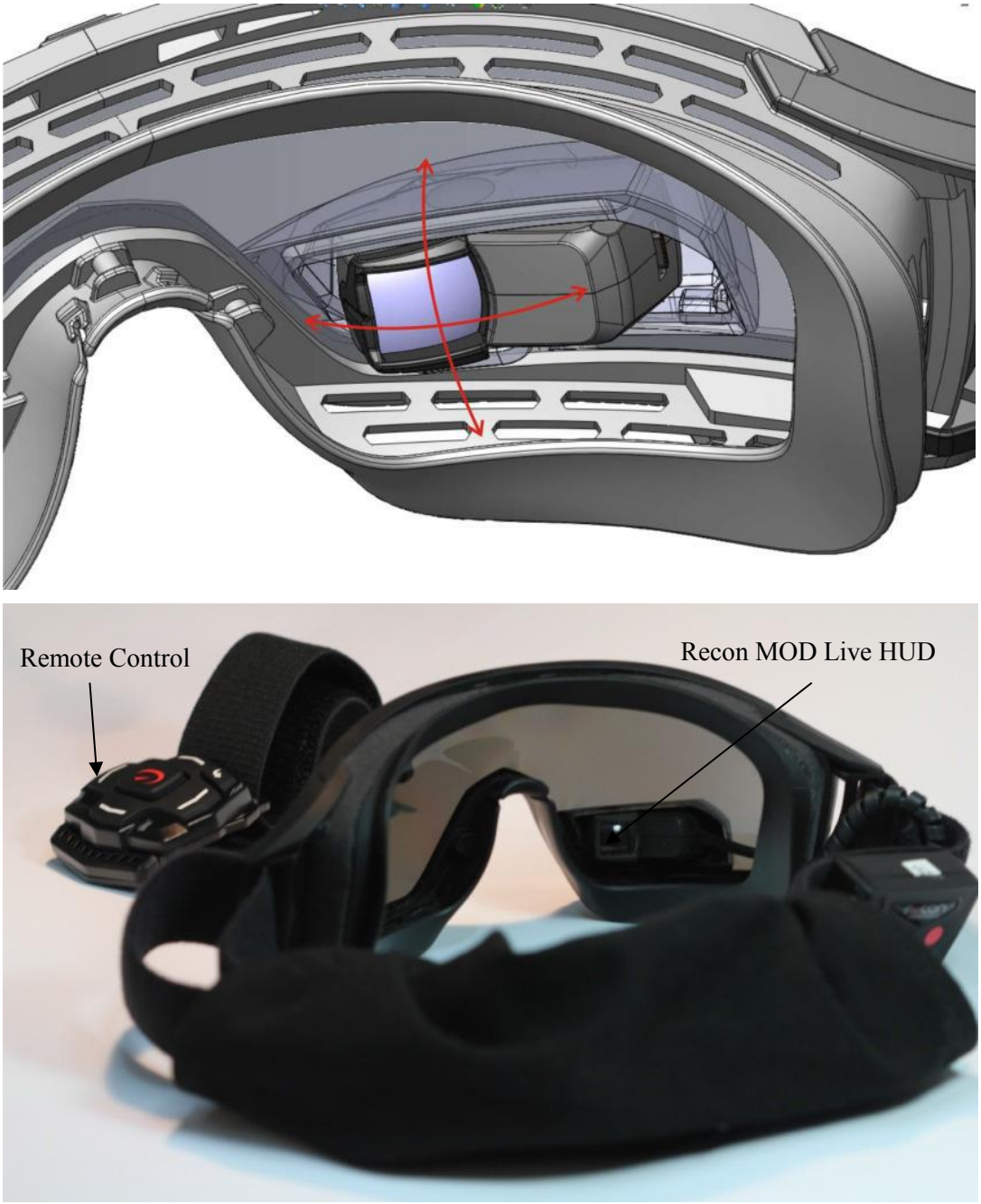

Figure 1: *Prototype Revision Desert Locust Military Goggle System with a Recon MOD Live HUD [4].*

Section 5 encompasses additional observations. Section 6 contains design recommendations and recommendations for future HUD interface evaluations. These are based on the heuristic evaluation, the SIREQ recommendations, and the additional observations.

2 Prototype Overview

The prototype Revision Desert Locust Military Goggle System fitted with a Recon MOD Live HUD was part of a system of hardware and software components:

Hardware:

- Revision Desert Locust Military Goggle System with Recon MOD Live HUD
- Recon Bluetooth six-button, wrist-mounted remote control
- Contour+ Bluetooth Video Camera
- Sony Ericsson Xperia Arc (LT15a) phone with Android 4.0.4

Software:

- MOD Live firmware versions 1.4 and 2.1.3 (both versions were evaluated)
- Contour Connect 2.0.1 Android Application
- ReconHQ 2.4.1
- Engage website
- Engage 1.1 Android Application

Specific hardware and software components will be described in the following sections.

2.1 Hardware

2.1.1 Revision Desert Locust Military Goggle System with Recon MOD Live HUD

Revision modified their Desert Locust Military Goggle System to embed a Recon MOD Live HUD in the bottom of the lens (Figure 1). The MOD Live processor was attached to a headband. A flexible cable connected the HUD monitor to the processor.

The Recon MOD Live ran on Android 2.3.4 (Gingerbread). It had a built-in GPS receiver, accelerometer, gyroscope, magnetometer, temperature sensor, and barometer. For data connectivity the Recon MOD Live had Bluetooth 2.0 and a micro-universal serial bus (USB) 2.0 connection.

The Recon MOD Live HUD monitor had the following specifications [5]:

- Display resolution: 428x240 (wide quarter video graphics array)
- Display Type: liquid crystal micro-display
- Maximum vertical field of view (FOV): 8°
- Maximum horizontal FOV: 6°
- Maximum diagonal FOV: 10°

- Color depth: High Color 16-bit (5:6:5)
- Brightness & contrast control: Adjustable

2.1.2 Recon Bluetooth Six-Button, Wrist-Mounted Remote Control

Users interacted with content shown on the MOD Live HUD using a six-button, wrist-mounted Bluetooth remote control (Figure 1). The remote control had four directional buttons: left, right, up and down. The centre button with the Recon logo served as an "Enter" button. A sixth button on the bottom left served as a "Back" button.

2.1.3 Contour+ Bluetooth Video Camera

A Contour+ video camera (Figure 2) was used to evaluate how the HUD could be used to view live video. The Contour+ camera had a 170° FOV, high-definition (HD) adjustable resolution (1080p/960p/720p), GPS receiver, and Bluetooth connectivity. The Contour+ camera used had firmware version 1.36.15.

Figure 2: *Contour+ HD, GPS, Bluetooth video camera.*

2.1.4 Sony Ericsson Xperia Arc (LT15a) Phone with Android 4.0.4

A Sony Ericsson Xperia Arc (LT15a) smart phone running Android 4.0.4 was used to evaluate the Engage 1.1 Android application.

2.2 Software

2.2.1 MOD Live Firmware Version 1.4

The HUD used MOD Live HUD firmware (v. 1.4). An example of the menu screen is presented in Figure 3.

Figure 3: *MOD Live HUD 1.4 menu with Navigation icon centred.*

The centre of the menu screen showed an icon for each menu item. There were nine menu items: Chrono (stopwatch), Contour Connect (video camera), Dashboard, Jump, Music, Navigation, Phone, Settings and Stats (performance data). Menu items were displayed in alphabetical order. Users navigated between the menu items using the left and right buttons on the Bluetooth remote. The following sections describe the Dashboard and Navigation menu items.

2.2.1.1 Dashboard

The Dashboard feature presented real-time user performance and environmental data. Users could configure up to five Dashboards and switch between them. Each Dashboard could be configured using ReconHQ. Users could select one of four layouts for each Dashboard (Figure 4). Within each layout there were placeholders for Dashboard data "widgets." There were nine Dashboard data widgets: Air Time, Altitude, Chrono, Distance, Maximum speed, Music, Temperature, Vertical, and Polar HR. The most information-rich Dashboard layouts contained placeholders for four data widgets. Not all data widgets could be presented on a single Dashboard (presumably to reduce clutter). Multiple Dashboards allowed users to optimize data presented with the nature of the task. For example, in the case of a dismounted infantry soldier, one could consider unique Dashboards configured for patrol, attack, defence, etc.

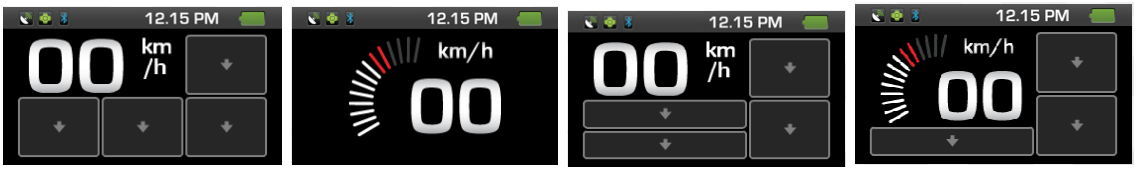

Figure 4: *Four Dashboard layouts available with MOD Live HUD 1.4.*

Figure 5 provides an example of a configured Dashboard (one of the Dashboards evaluated). The current speed was shown in the centre of the display (present on all Dashboard layouts), the vertical distance travelled was shown on the bottom-left, the total distance travelled was shown on the centre-bottom, the current temperature on the bottom-right and the height above sea level was shown on the centre-right. Users could display data in either imperial or metric units.

Figure 5: *Example MOD Live HUD 1.4 Dashboard.*

2.2.1.2 Navigation

The Navigation feature had a database of resort maps with ski runs, roads, parking lots, restaurants, and chair lift routes. The software automatically loaded the correct resort map when users visited a resort (given a GPS connection). Users could also browse other resort maps.

When users entered the Navigation feature at a resort with GPS connection it began in an automatic control mode. In this mode the map was centered on the user's position and rotated based on the user's orientation. The user's position was shown with a red circular Recon logo icon, surrounded by a larger red circle (Figure 6).

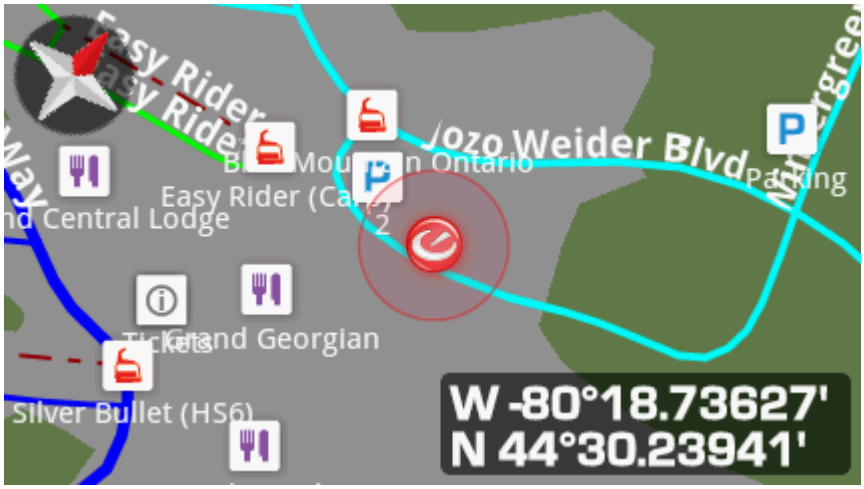

Figure 6: *MOD Live HUD 1.4 map. The user's location is indicated by a red circular Recon logo symbol.*

Pressing the centre button on the remote control brought the Navigation feature into a manual pan mode with four arrows appearing on the screen (Figure 7). In this mode users could pan over the map using the up, down, left, and right buttons on the remote control. When users panned such that their location was no

longer within the screen bounds, the red Recon logo was shown on the top, bottom, right, or left border of the screen with a cyan arrow pointing to the user's location. There was white text on a cyan background with the label "Owner" and the distance from the centre of the screen to the user's location.

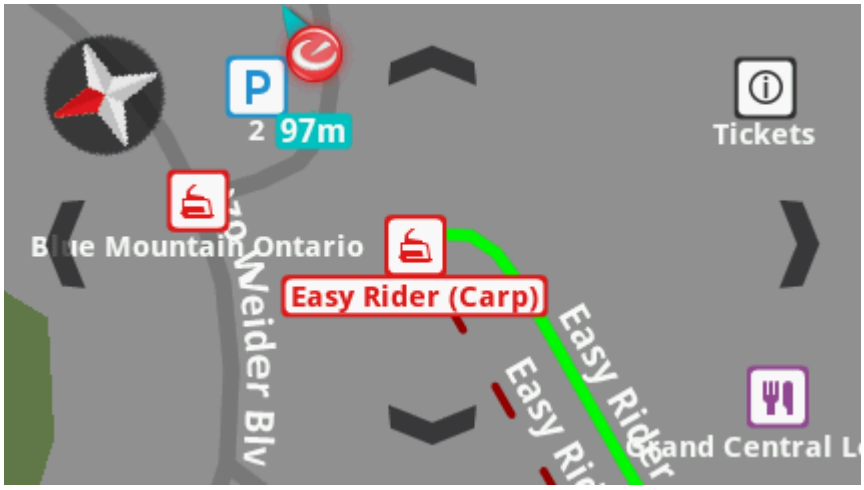

Figure 7: *MOD Live HUD 1.4 map with user's location shown near the top of the screen.*

A second press to the centre button on the remote control put the user into manual zoom mode. This mode allowed users to zoom (up and down buttons) and rotate (left and right buttons) the map (Figure 8). There were 22 zoom levels. Each button press zoomed in (or out) one level. There was an approximately 1.2 times magnification difference between each zoom level. When zoomed in, parking lots, restaurants, and chair lift routes were indicated by symbols with text descriptions. The map appeared cluttered with overlapping symbols. As users zoomed out, the text descriptions for symbols and text labels for ski runs and road names disappeared (between zoom level eight and nine). As users zoomed out further the parking lot, restaurant, and chair lift route symbols were replaced by small coloured dots (halfway through the zoom levels). Only the symbol closest to the centre of the screen remained with a text description (e.g., a fork and knife symbol with the text: "Grand Central Lodge"). When zoomed out fully users were shown the entire map, beyond which there were no data.

Users entered the Navigation menu by pressing the up or down button on the remote control when in the automatic control mode. From the Navigation menu users could scroll through lists of pre-saved points of interest: chair lift entrances, information centers, parking lots, and restaurants. Users could also add their own points of interest (pins) on the map. Pins could be used to remind users of important locations. Since there was no keyboard pin names could not be changed to identify points of interest. Users were required to remember the significance of each pin.

On the Locations tab of the Navigation menu there was an item called "My Location" that switched to the map view and centred the map on the user's location at a medium zoom.

Figure 8: *MOD Live HUD 1.4 map with zoom and rotate options available. This was the default zoom for the map. Note how cluttered the map is.*

2.2.2 MOD Live Firmware Version 2.1.3

MOD Live HUD 2.1.3 had five main screens: Music, Radar, Dashboard, Live Feed and Apps/Settings (Figure 9). Each screen is described in more detail, from left to right, in the following sections.

Figure 9: *MOD Live firmware version 2.1.3 main screens.*

2.2.2.1 Music

The Music feature allowed playback of audio stored on a Bluetooth connected mobile phone.

2.2.2.2 Radar

The Radar feature had three main displays (compass, radar map, and resort map). The MOD Live firmware version 2.1.3 used the same resort map database of ski runs, roads, parking lots, restaurants, and chair lift routes as version 1.4. Like version 1.4 the resort map loaded when users visited a resort with map data (given a GPS connection). Users could not browse maps for other resorts.

The default view showed a rotating compass (Figure 10). The compass rotated as the user's head rotated in the azimuth.

Figure 10: *MOD Live firmware version 2.1.3 compass.*

Users switched to the radar map by pressing the down button on the remote control. The radar map (Figure 11) displayed the user's position in the centre of an oval map containing an overlay of chair lift routes. The user's position was represented by a white arrow in a blue oval. The map rotated based on the user's azimuth orientation. There were grey bars drawn from the blue oval that were between 45 and 90 degrees apart. The area between the grey bars was shaded blue close to user icon and faded away along the length of the grey bars. The angle between the grey bars appeared to represent the user's forward FOV, but this was not tested. To see a different area of the map required head rotation.

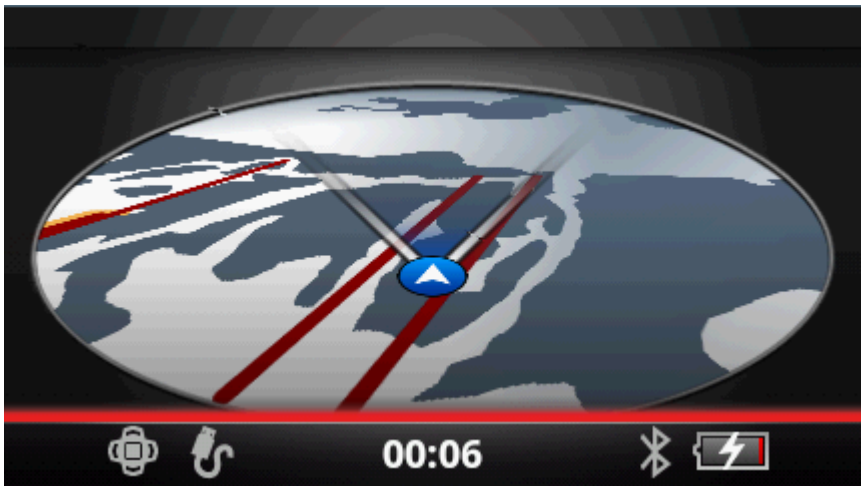

Figure 11: *MOD Live firmware version 2.1.3 radar map.*

Pressing the centre button on the remote control switched from the radar map to the resort map (Figure 12). The radar map transitioned to the resort map with the radar map fading-out and the resort map fading-in. The viewpoint (virtual camera) also zoomed into the blue oval and the map rotated downward into a more immersed perspective. The resort map also rotated based on the user's azimuth orientation. These dynamic transitions from one viewpoint to another provide visual momentum [6] and have been shown to improve human judgement of relative heights and intervisibility [7].

The resort map showed ski runs, roads, and chair lift routes overlaid onto the map. Blue restaurant and red chair lift symbols were presented perpendicular to the terrain.

There was a set of grey parentheses in the centre of the display (see Figure 12). When the user rotated their head such that one of the restaurant or chair lift symbols enters the parentheses the symbol disappeared and a callout appeared with a text description and a distance to the location e.g., "Southern Comfort (HS6) 318m." If the name was too large to fit all at once in the callout, the text scrolled.

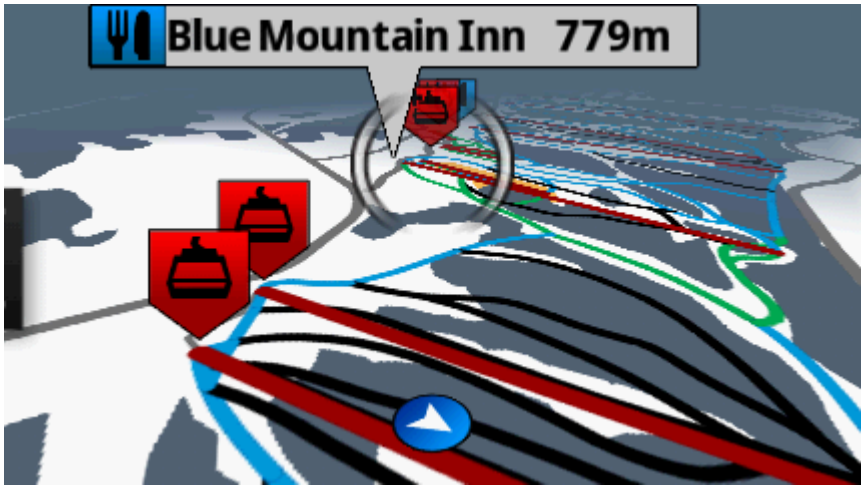

Figure 12: *MOD Live firmware version 2.1.3 resort map. Note the grey parentheses just above screen centre.*

Pressing the up and down arrows on the remote control zoomed the map in and out. When zooming, a magnifying glass appeared on the left of the screen with the zoom level. There were four levels of zoom.

The left and right arrows were used to rotate the map in a direction independent of the head. The white arrow within the blue dot continued to show the user's heading. When the centre button on the remote control was pressed the map rotated with changes in the user's azimuth. The map smoothly rotated from the current orientation to the direction the user faced.

Pressing the back button returned users to the radar map.

2.2.2.3 Dashboard

The dashboard was the first screen presented to the user when starting the MOD Live HUD. The default screen is shown in the centre of Figure 9. The current speed of the user was shown numerically in the centre of the screen. On either side of the numeric current speed were green curves representing the user's daily maximum speed. The grey curves represented the user's current speed relative to the daily maximum.

The dashboard had various screens with real time data similar to firmware version 1.4. The default screens were:

1. Current speed and maximum speed;

2. Current speed, maximum speed, and current altitude; and

3. Current speed, maximum speed, air time, and vertical (Figure 13).

ReconHQ 2.4.1 could be used to configure the dashboard display to have the same layouts as the 1.4 firmware, although the data were displayed with the 2.1.3 interface aesthetic shown in Figure 13.

Figure 13: *MOD Live firmware version 2.1.3 dashboard.*

2.2.2.4 Live Feed

The Live Feed display listed speed, vertical drop, distance, altitude, and best jump data for the last run, day, and device ("all-time") (Figure 14). Pressing the centre button on the remote control with an item selected showed the last run, day, and all-time data for that item (Figure 15).

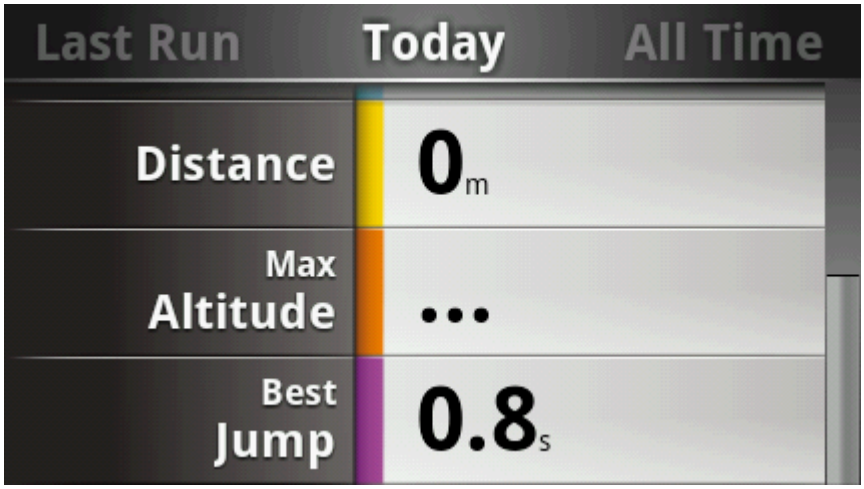

Figure 14: *Live Feed display.*

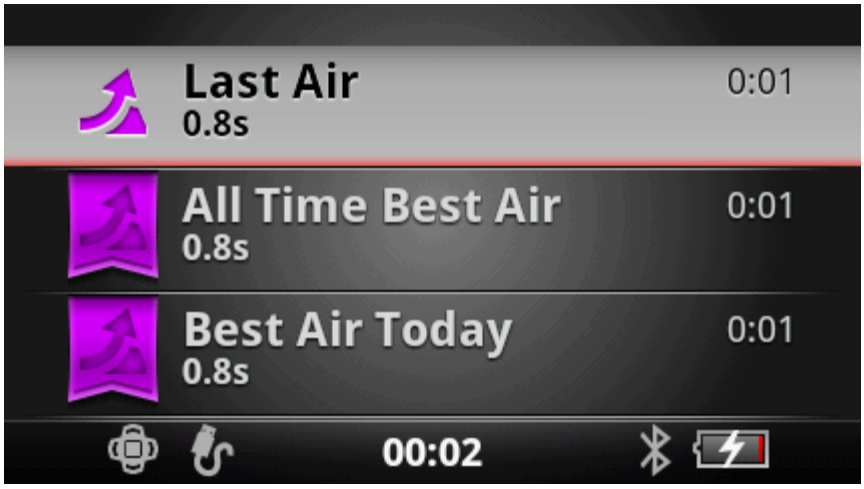

Figure 15: *Data for last jump, best jump of the day and all-time best jump.*

2.2.2.5 Apps/Settings

The Apps screen allowed users to access the HUD settings and other applications. The settings feature provided users with the following options: brightness, smartphone connection, Bluetooth, set time, reset stats, set units, software update, compass calibration, about, help, and advanced.

By default there were five applications preinstalled: Alarm Clock, Contour Connect, Polar, Stop Watch, and Tracker. Polar was a heart rate monitoring application (not tested). Users could view performance data with the Tracker application. The Tracker application displayed the following data: number of runs, maximum speed, vertical drop, distance, maximum altitude, best jump for the user's last run, day so far, and all time totals.

2.2.3 Contour Connect 2.0.1

Contour Connect was an Android application (an iOS version was also available) to connect Contour helmet cameras with mobile phones. Contour Connect allowed users to use their mobile phone or MOD Live to:

1. View live camera video with start and stop functionality.

2. Configure Contour Camera recording settings.

Figure 16 shows the Contour Connect interface. The Contour+ camera did not support viewing video while recording. The Contour+2 camera supported simultaneous recording and viewing, but a delay in the viewing image may be noticeable [8].

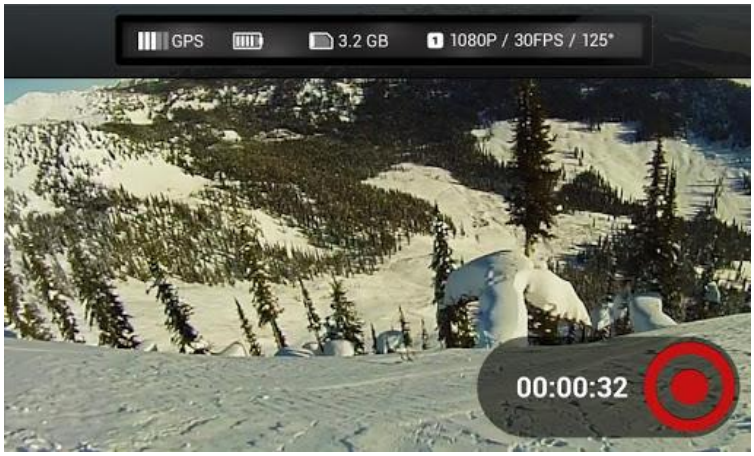

Figure 16: *Contour Connect interface.*

2.2.4 ReconHQ 2.4.1

In late 2012 ReconHQ was in the process of being replaced by the Engage website [9]. ReconHQ had features that were not yet available on the Engage website. ReconHQ allowed users to:

1. Review past MOD Live trips. Users could view recorded runs on a map and view speed, vertical, distance, altitude, and jump data.
2. Configure the MOD Live Dashboards to display the user's preferred data.
3. Upgrade MOD Live devices to the latest firmware. MOD Live devices could no longer be updated with the latest firmware versions using ReconHQ.

2.2.5 Engage Website

The Engage website [9] allowed users to:

1. Review past MOD Live trips. Users could view recorded runs on a map and view speed, vertical, distance, altitude, and jump data.
2. Upgrade MOD Live devices to the latest firmware. This feature did not work. A zip file was obtained from Recon Support to manually upgrade the firmware.

2.2.6 Engage 1.1 Android Application

The Engage 1.1 Android application allowed users to:

1. Review past MOD Live trips. Users could view recorded runs on a map and view speed, vertical, distance, altitude, and jump data.
2. View the location of other MOD Live users on a map—"Buddy Tracking."
3. Play audio stored on phone.
4. Pair the phone with a MOD Live device using Bluetooth.

3 Application of Nielsen's Usability Heuristics to the Recon MOD Live HUD

Prototype Revision Desert Locust Military Goggle Systems fitted with a Recon MOD Live HUD (firmware v. 1.4) were used on a two day ski trip to Mont Tremblant Ski Resort in March 2013. The goggles were used to view performance data going down ski runs and up chair lifts. Prototypes with firmware versions 1.4 and 2.1.3 were used on a day trip to Blue Mountain Resort in October 2013. Testing during this trip focused on the mapping features (Navigation, Radar and Buddy Tracking). These and other hardware and software components described in Section 2 were tested through multiple workbench sessions with an application to simulate being at a resort.

This section provides an assessment of Recon MOD Live HUD against Nielsen's ten usability heuristics [2]. The Nielsen heuristics are general "rules of thumb" designers can use when designing digital systems for people's use. For each of Nielsen's heuristics relevant system components are identified and recommendations for improvement are provided when warranted.

3.1 Visibility of System Status

"The system should always keep users informed about what is going on, through appropriate feedback within reasonable time" [2:30].

Observations:

1. It was difficult to tell if the MOD Live battery was charging or not. Sometimes when plugging the HUD into a power source the red charging light did not turn on right away. The red light turned off when the device was fully charged so at a glance it was impossible to tell if the device was charged.

2. Sometimes after charging for a while the device would not turn on. No feedback was provided to indicate why.

3. The Live Feed display with firmware version 2.1.3 was not accessible until the user had an "event" such as the best airtime of the day. The HUD was thrown into the air to obtain airtime so that other data could be reviewed.

Recommendations:

1. The charging light should always turn on when connected to a power source. Ideally the red light should be replaced with a light emitting diode (LED) that changes from red to green to indicate the percentage of battery charge. For instance, the Sony Ericsson Xperia Arc phone had an LED beside the USB connection that shows the level of charge.

2. The MOD Live HUD should turn on when the power button is pressed. If the device cannot be turned on the reason should be communicated to the user.

3. There is no reason why the Live Feed display needs to have an "event" before other data are accessible (i.e., max speed, max distance). Available data should be accessible.

3.2 Match between System and the Real World

"The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order" [2:30].

Observations:

1. The terminology used in the Recon MOD Live software was designed for alpine sports. Terminology and measures would need to be adjusted for a dismounted soldier. Occasionally the terminology was not clear. For example in version 1.4 the stopwatch was called "Chrono." It was appropriately named "Stopwatch" in version 2.1.3. The meaning of "Polar," "Contour Connect," and "Tracker" (applications in version 2.1.3) were not immediately clear.

2. Applications in MOD Live version 1.4 were ordered alphabetically in a continuous loop. In version 2.1.3 the main screens (Music, Radar, Dashboard, Live Feed and Apps/Settings) were ordered with the most used display in the centre and the less used displays accessible to either side. The applications within the Apps/Settings screen were ordered alphabetically.

Recommendations:

1. For the system to be used by dismounted soldiers the terminology must be revised. Menu items do not have to be labeled with the application name e.g., "Polar." the brand, could be replaced with "Heart Rate" and "Contour Connect" with "Video."

2. Continue to organize information in a logical order.

3.3 User Control and Freedom

"Users often choose system functions by mistake and will need a clearly marked 'emergency exit' to leave the unwanted state without having to go through an extended dialogue. Support undo and redo" [2:30].

Observation:

1. The Recon Bluetooth six-button, wrist-mounted remote control had an integrated "Back" button that was consistently programmed within the Recon MOD Live software as a way to return to a previous screen.

Recommendation:

1. Continue to program "Back" functionality using a consistent user action.

3.4 Consistency and Standards

"Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions" [2:30].

Observations:

1. The meaning of the shaded red circle surrounding the Recon logo icon (Figure 6) with version 1.4 of the MOD Live software was unknown. The shaded circle looked similar to representations of spatial error on other devices, but the circle did not get larger when zooming in on the map.

2. In version 1.4 of the MOD Live software there were two different, but confusable versions of the Navigation menu. The first version was accessed from the main menu. The first version had Locations and Find Resorts tree options. Pressing the back button returned to the main menu. The second version of the Navigation menu was accessed by pressing the up or down buttons on the wrist remote control when viewing a map. The second version had Locations, Find Resorts, Points of Interest, and Pin Location tree options. Pressing the back button in the second version of the Navigation menu returned to the map view. Sometimes pressing the back button in first version of the Navigation menu displayed a screen saying "No Map Loaded." The inconsistency was confusing.

Recommendations:

1. Do not use symbols that have a standard meaning in an incongruous manner. The North Atlantic Treaty Organization has an extensive standard for military symbology (Allied Procedural Publication 6C) [10]. DRDC has also begun the work of defining a symbology standard for individual dismounted soldiers [11].

2. There should be one menu for selecting maps and another for selecting layers to show on the current map. On the layer selection menu there should be labels reminding the user which map the layers apply to. The back button should always take the user back to the screen they were previously viewing.

3.5 Error Prevention

"Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action" [2:30].

Observations:

1. See Section 3.9.

2. On the second day of field testing at Mont Tremblant the Recon Bluetooth six-button, wrist-mounted remote control was forgotten in a car.

Recommendation:

1. Integrate the six-button remote control into existing equipment. For the dismounted soldier it could be integrated into gloves or the soldier's uniform. Voice or gesture interfaces should also be considered.

3.6 Recognition rather than Recall

"Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate" [2:30].

Observations:

1. There were three remote control modes available when viewing maps in version 1.4 of the MOD Live software:

   a. Standard mode (centred on own location)—Remote control up and down buttons returned the user to the Navigation menu.

   b. Pan mode—Remote control up, down, left and right buttons panned the map, up, down, left and right.

   c. Zoom and rotate mode—Remote control up and down buttons zoomed and the left and right buttons rotated the map.

   The three modes were not intuitive. Users switched between modes by pressing the select button on the remote. The default mode was the standard mode. It was expected that panning would be possible using the remote control arrows in the standard mode, but this was not possible. The standard mode had no overlaid arrows, but the other modes had helpful arrows overlaid onto the map to show the ways you could interact with it.

2. When viewing a series of Points of Interest such as a list of chair lifts, the map discretely shifted from one chair lift location to another.

Recommendations:

1. There should only be one remote control mode when interacting with maps. Adding two scroll wheels to the remote control would provide the degrees of freedom required for a single mode to pan, zoom and rotate the map. The up, down, left and right remote control buttons should always be available for panning. Ideally the system would know which direction the user is facing and the map would be automatically rotated forward-up.

2. When viewing a series of Points of Interest (e.g., a list of chair lifts) the map could continuously transition from one location to another offering better visual momentum [7]. Visual momentum was used in MOD Live version 2.1.3 when transitioning from one main screen to another; when users navigated to a menu item on the right the icon for the previous menu item slid to the left.

3.7 Flexibility and Efficiency of Use

"Accelerators – unseen by the novice user – may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions" [2:30].

Observation:

1. ReconHQ allowed advanced users to configure Dashboards for both 1.x and 2.x versions of the MOD Live software.

Recommendation:

1. In late 2012 ReconHQ was in the process of being replaced by the Engage website. Users should be able to configure Dashboards on the Engage Website.

3.8 Aesthetic and Minimalist Design

"Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility" [2:30].

Observations:

1. Performance data in the Dashboard displays with version 1.4 of the MOD Live software used a quadruple redundant code: location on display, colour, symbol, and text label.

2. The text label was as large as the performance data text. The symbol also took up a significant amount of display real estate.

3. Only speed data was large enough to read when moving (Figure 5).

4. Vertical information was assigned blue and distance was assigned purple (See Figures 5 and 13). Blue and purple text was nearly impossible to see in outdoor natural light. Version 2.1.3 mainly used white text on a black background.

Recommendations:

1. Continue to redundantly code performance data, but both a symbol and text label are unnecessary. Improve symbols so that a text label is not required or use only a text label.

2. Make performance data the largest and most salient part of the display.

3. Use white text on a black background or black text on a white background.

3.9 Help Users Recognize, Diagnose, and Recover from Errors

"Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution" [2:30].

Observations:

1. Only one of the MOD Live HUDs could be paired (via Bluetooth) with the Contour Camera and Android phone. There were no error messages or other feedback. With the HUD that did not pair,

MOD Live recognised the Contour Camera and phones and there were prompts on the phone/HUD, but selecting yes to pair did not connect the devices. Recon Support recommended that a factory reset be performed and that the firmware on the MOD Live be updated. A factory reset did not help. It is not known why it worked with one HUD and not the other with the same firmware.

2. The MOD Live firmware could not be updated using the Engage website. Different browsers were tried (Internet Explorer, Firefox and Google Chrome) on multiple Windows machines. There was a "Recon Uplink plugin" required to perform updates with Engage. The plugin did not work with Internet Explorer and there was no feedback as to why it did not work. When using Google Chrome there was the following error: "Software Update Failed: There was an error while updating your firmware. Please Try Again." Trying again did not help. Recon Support provided files and instructions to manually update the firmware. On one occasion a manual update worked on one HUD, but not the other.

Recommendations:

1. Interfacing the MOD Live HUD with other devices via Bluetooth or USB to desktop software should require less user intervention and be less error prone. MOD Live easily connects to GPS satellites. From the user's perspective. Bluetooth connectivity should be just as easy.

2. Overall the system needs to be made much more reliable. If an error does occur, users need to be informed as to what can be done to prevent the error.

3.10 Help and Documentation

"Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large" [2:30].

Observations:

1. Recon had a useful and extensive MOD Live User Manual for 1.x versions of the HUD software [12].

2. There was no User Manual for 2.x versions, but there was a helpful introductory video that plays the first time the software is used. The video could be replayed from the Help option of the Settings menu.

Recommendation:

1. Design HUD such that it can be used without documentation. If documentation is required ensure it is kept current.

4 SIREQ Recommendations for HUDs

The Soldier Information Requirements Technology Demonstration Program (SIREQ TDP) led by DRDC Toronto conducted a series of experiments between 2000 and 2005 with HUDs (among other technologies) helping to define requirements for future dismounted soldier systems. The SIREQ TDP presented recommendations for HUDs in Annex D to SIREQ TD Technical Capstone Report [3] and SIREQ TD: Major Lessons Learned [1]. Table 2 contains a collation of the SIREQ HUD recommendations and a discussion of how well the prototype Revision Desert Locust Military Goggle System fitted with a Recon MOD Live HUD conforms to them. Table 2 also contains suggestions to improve future HUD prototypes to conform to the SIREQ recommendations.

Table 1: *SIREQ HUD recommendations.*

SIREQ Recommendation	**Prototype Revision Desert Locust Military Goggle System fitted with a Recon MOD Live HUD**	**Suggested Course of Action**
"A monocular display shall be provided for any head-mounted configuration" [3:5].	The prototype HUD provided a monocular display.	None.
"Head-mounted displays shall be provided for heads-up tasks requiring tactical cues, wayfinding cues, off-bore weapon video, etc." [3:5].	Information available in the prototype HUD was tailored for alpine sports. New applications are required for presenting tactical cues and wayfinding information. The HUD did not support loading additional maps that could show tactical and wayfinding cues. Mountain Dynamics Inc. made the maps for Recon. The Contour+ camera could be used as off-bore weapon video source and viewed within the prototype HUD. The Contour+ image quality was good, but a very low frame rate would limit its usefulness if there was a requirement to view the video while the weapon was in motion.	Investigate the possibility of running COTS Android applications relevant to dismounted soldiers (e.g., BattleTac) on the HUD. There needs to be a method to load/view custom spatial info (tactical and wayfinding cues) that is not necessarily map based. Live video presented in the HUD needs to have a higher frame rate than the current prototype. The ideal frame rate will depend on the use of motion blur, the rate of camera movement and the consistency of the frame rate.

SIREQ Recommendation	Prototype Revision Desert Locust Military Goggle System fitted with a Recon MOD Live HUD	Suggested Course of Action
Tasks requiring map use and messaging should be conducted with a tablet display [3].	The prototype HUD provided features for viewing maps and sending "canned" text messages. The Engage 1.1 Android application also had a mapping feature for "buddy tracking." The 1.4 Navigation feature was not useful during field testing. Its use was limited by confusing indications of heading and challenges panning and zooming.	Soldiers should view maps and send text messages from handheld display surfaces (e.g., tablets and smartphones) with sufficient resolution.
"Any head-mounted display shall not occlude the soldier's natural field of view, to the extent that it affects their local situation awareness" [3:5].	When users looked down the prototype HUD occluded their FOV.	Revision is working to integrate a see-through display in the SAWFLY spectacle. This development should continue.
"Any head-mounted display shall be able to be removed from the soldier's field of view quickly with one hand" [3:5].	As the prototype HUD display was integrated into the Desert Locust ballistic goggles the HUD cannot be removed from the soldier's FOV without removing the goggles. The goggles were fastened to the user's head with an elastic strap. The HUD could be shut down in less than ten seconds.	Add a quick release button or buckle to the head strap.
"Any head-mounted display shall be able to be mounted over the left or right eye" [3:5].	The prototype HUD was only available in a right-eye version.	Develop HUD prototypes for the left eye.
"Any head-mounted display shall include a full or partial look-through capability" [3:5].	It was not possible to look through the current HUD.	Continue development of see-through display for the SAWFLY spectacle.

SIREQ Recommendation	Prototype Revision Desert Locust Military Goggle System fitted with a Recon MOD Live HUD	Suggested Course of Action
"Any visual display must include a nighttime configuration that prevents light emissions that could be detected by an enemy wearing night vision equipment" [3:6].	The light emissions of the prototype were not evaluated.	N/A
"The SOLDIER SYSTEM shall be capable of displaying real-time, augmented reality information about entity location and characteristics, in relation to the facing direction (heading) of the soldier" [3:6].	The prototype HUD with MOD Live firmware versions 1.4 and 2.1.3 had a map mode where the map rotated based on the user's azimuth orientation (see Figure 11 for v. 2.1.3). The Mod Live HUD also had a "Buddy Tracking" feature. When users connected the HUD via Bluetooth to the Engage Smartphone application they could see the location of other HUD users. Only name and distance characteristics of the other users were available. See Section 5 for more detail.	Future versions of the HUD should have a Blue Force Tracking capability integrated into the HUD without having to connect to a Smartphone.
"The SOLDIER SYSTEM shall provide a voice input capability for discrete tabbing between menu items and select control interfaces [3:9].	The prototype HUD did not provide a voice input capability.	Future versions of the HUD should include a voice input capability.
"The SOLDIER SYSTEM shall include a means of determining the facing direction (heading) of the soldier" [3:10].	The prototype HUD had this capability although it did not work well with MOD Live firmware version 1.4. There was considerable lag with 1.4 and it did not always update accurately. The heading indication worked better with firmware version 2.1.3 (see Figure 11).	Continue to reduce lag and improve the accuracy of heading indicator.

SIREQ Recommendation	Prototype Revision Desert Locust Military Goggle System fitted with a Recon MOD Live HUD	Suggested Course of Action
"Visual display to include an egocentric display indicating the extent and direction of offset from the facing direction (heading) to the intended waypoint [3:10].	The prototype HUD with MOD Live firmware version 1.4 did not offer an egocentric perspective (the available 2D map only rotated with head azimuth). Firmware version 2.1.3 provided an egocentric perspective and showed the distance to restaurants and chair lifts. The egocentric perspective in version 2.1.3 came at the expense of the top-down 2D map.	2D perspectives are better than 3D perspectives for tasks requiring the judgement of relative positions [7][13] thus users would be less accurate judging the distance between two chair lifts (soldiers or waypoints) with a 3D egocentric perspective than with a 2D top-down view. As there are advantages for both 2D and 3D perspectives, future HUD prototypes should have both 3D egocentric and navigable 2D perspectives.
"The SOLDIER SYSTEM digital map shall be capable of rotating in the visual display such that the map information remains oriented to the facing direction (heading) of the soldier" [3:10].	The prototype HUD had this feature with both firmware versions.	Continue to rotate map data based on the user's heading.
"The network status of all tracked entities shall be displayed in such a way as to indicate the time the entity last updated on the network" [3:13].	The Buddy Tracking feature with the Engage Smartphone application showed the time entity locations were last updated.	Display the time entities were last updated within the HUD.
"Visual display resolution must be a minimum of 640x480 pixels. SIREQ studies have shown that response time to target detection and accuracy of detecting true targets improves up to a resolution of 640x480" [1:13].	The prototype HUD did not meet this minimum resolution. The HUD resolution has 1/3 of the recommended pixels: 428x240.	If the HUD will be used to detect targets the HUD should have a minimum of 640x480 pixels.

SIREQ Recommendation	Prototype Revision Desert Locust Military Goggle System fitted with a Recon MOD Live HUD	Suggested Course of Action
"Augmented reality cues, visually overlaid in the soldier's field of view, improve locational and situational awareness of the battlefield tactical picture" [1:13].	As the prototype HUD was opaque it does not afford augmented reality cues.	Augmented reality cues could be overlaid onto the Contour video with the current prototype HUD. Continue development of see-through display for the SAWFLY spectacle that could be used for augmented reality.
"Use of 3D terrain maps, while navigating open and wooded terrain, is desirable for terrain visualization but 3D maps only augment, not replace, 2D map information; both configurations are desirable to support different navigational functions" [1:15].	The prototype HUD did not support 3D terrain maps.	Add elevation data to egocentric perspective, but also provide a navigable 2D perspective.
"GPS systems are unsuitable for tracking dismounted tactical movement in city streets, due to the buildings obstructing satellite signals" [1:16].	The prototype HUD used only GPS for tracking.	Urban tracking would improve through assisted GPS if the HUD was on a network.
"While digital maps are very useful for enhancing situational awareness, route guidance systems (e.g., FIND) are more effective for wayfinding" [1:16].	The prototype HUD did not offer route guidance.	Future versions of the HUD should include a route guidance capability.

5 Additional Observations

The following observations from use of the prototype Revision Desert Locust Military Goggle System with a Recon MOD Live HUD were not captured in the heuristic evaluation or discussion of the SIREQ requirements:

1. The legibility of the HUD was very sensitive to its position on the head. If positioned for optimal legibility at display centre then the periphery was blurry.

   The optics of the display must be resilient to changes in the position of the display relative to the eye(s) of the user such that the display is always readable. Dismounted soldiers are continually moving about and the display will move on their heads.

2. When moving it was difficult to look at the HUD. It was only comfortable looking at the display for a couple of seconds. The HUD was easier to use when stationary.

   A HUD will be most useful to soldiers when they can view it with their full attention. It is unreasonable to expect soldiers will be using the HUD while conducting visually demanding tasks such as engaging in a firefight. Soldier's tasks must be considered when deciding what, when and how to display information in the HUD.

3. A fully-charged battery lasted three to four hours during field testing without using Bluetooth features. This is much less than the expected six to eight hours at -10°C claimed in the User's Manual [12]. Using Bluetooth reduces the battery life further [12]. One HUD was returned to Revision because it stopped holding a charge.

   Soldiers will require much longer battery life in both hot and cold environments. Carrying replaceable batteries is not a practical option as soldiers are already heavily burdened.

4. It was challenging to center map symbols within the parentheses to obtain text descriptions (Figure 12) (firmware v. 2.1.3). Changing the zoom level helped. Sometimes symbols were too far away (greater than approximately 900 m) or they overlapped. No combination of zoom and head position would position the symbol within the parentheses.

   It was frustrating and fatiguing to control the cursor (the parentheses) with the user's head movement. The effort to make the control of the display less dependent on the remote control, making the system in some sense aware of what the user is looking at, was appreciated, but the current method did not work. Gaze interaction interfaces could also be explored, but will likely have higher error rates and task completion times than with the remote control [14].

5. Near the end of this evaluation Recon released firmware version 3.1.1 for the Mod Live HUD. Firmware version 3.1.1 significantly changed the compass and map interfaces. The compass (Figure 17) changed to a rolling compass like the one examined in [15]. The map returned to a single 2D map with two modes. In the first mode the map rotated based on the orientation of the user's head. In the second mode users could pan and zoom on the map. Panning was accomplished using the arrow keys on the remote control. Users could zoom by pressing the remote control's centre button. There were

four zoom levels. Each press of the center button zoomed in one level. When the maximum zoom was reached and the centre button was pressed again, the map showed the maximum extent and the zoom cycle repeated. The user's position was shown with an orange arrow (Figure 18). When the user's location was not visible on the screen an orange dot was displayed on the white circle surrounding the cursor in the direction of the user's position (Figure 19). Moving the centred white cursor with a ring around it over symbols showed a text description of the item.

Figures 17 through 19 also show how Buddy Tracking was implemented in Firmware version 3.1.1. The compass notified users of the number of buddies in the area. When other users were within the user's forward FOV a blue dot appeared on the compass. When the blue dot approached the user's location the blue dot turned into a pin shape, the user's name appeared and the distance to that user was shown (Figure 17). On the map other users were shown with a blue dot. Moving the centred white cursor over the buddy symbol turned the symbol into a pin and showed the name of the other user (Figure 18). Buddies that were off the viewable extent of the map were indicated by a blue dot on the white circle surrounding the cursor (Figure 19).

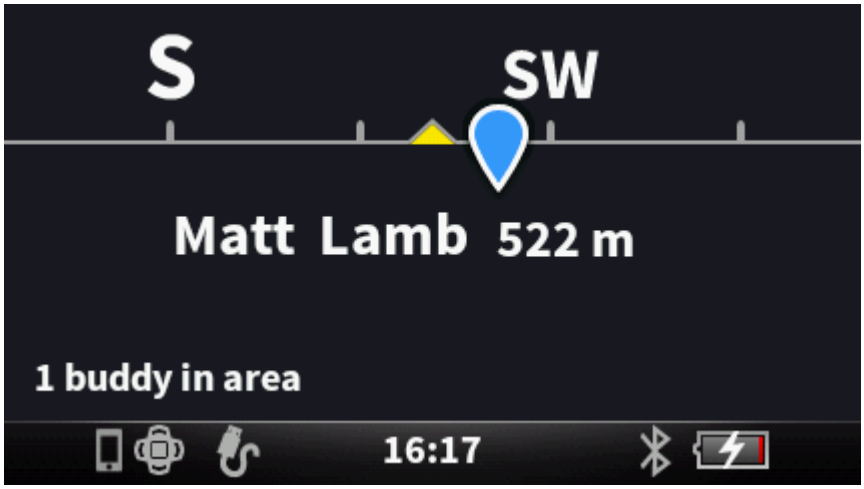

Figure 17: *Mod Live HUD firmware 3.1.1 Compass with blue buddy location.*

Figure 18: *Mod Live HUD firmware 3.1.1 Map.*

Figure 19: *Mod Live HUD firmware 3.1.1 Map with user and buddy location off the screen.*

By returning to a 2D map Recon addressed the firmware version 2.1.3 observation that it was challenging centering a chairlift or restaurant symbol into the parentheses with the egocentric resort map view (Additional Observation 4) and that a 2D map provided the best perspective for tasks requiring the judgement of relative positions. There remains a requirement for a 3D perspective for tasks requiring shape understanding. This is particularly important with the absence of contour lines on the 2D map. The new rolling compass provides an unimplemented opportunity to show the bearing of points of interest in addition to buddy locations. It would be useful to have a blue arrow pointing to the left or right of the screen (whichever is closest) when other users are not visible within the user's forward FOV.

6 Recommendations

6.1 HUD Design

This report presented a preliminary usability evaluation of the Revision prototype HUD based on Nielsen's heuristics, HUD recommendations from the SIREQ TDP, and field testing. The following recommendations are summarized from the previous sections, and should be considered to improve the usability of the prototype. Recommendations arising from Nielsen's heuristics are indicated with "[N]," SIREQ with "[S]" and other observations from field testing [F].

6.1.1 Display

1. Make performance data the largest and most salient part of the display. [N]

2. Place display information in a logical order. [N]

3. Minimize jargon. [N]

4. Use visual momentum techniques [6] where applicable. [N]

5. Let users configure dashboard information screens. [N]

6. Use white text on a black background or black text on a white background. [N]

7. Provide at least 640x480 pixel resolution. [S]

8. Make legibility independent of the position of the HUD on the user's head or the point of fixation on the HUD. [F]

6.1.2 Input Interface

1. Consider the addition of a scroll wheel to the HUD remote control, the integration of the remote into existing dismounted soldier kit, and voice and gesture interfaces. [N]

2. Use consistent "Back" menu navigation functionality. [N]

3. Improve the interface between head movement and display control. [F]

6.1.3 Functionality

1. Integrate a Blue Force Tracking capability that shows when entity information was last updated. [S]

2. Support both 3D egocentric and navigable 2D maps. [S]

3. Provide a route guidance application. [S]

4. Use assisted GPS for urban tracking. [S]

6.1.4 Hardware

1. Simplify the connection of peripheral devices. [N]

2. Keep users informed about the battery charging status of the HUD. [N]

3. Optimize the HUD position for the tasks of a dismounted soldier. The display may need to be in different locations for different tasks. [S]

4. Make a left-eye HUD available. [S]

5. Improve battery life beyond four hours and/or there needs to be an easy way to switch batteries. [F]

6.1.5 Other

1. Inform users about what causes errors and what can be done to prevent them. [N]

2. Design HUD such that it can be used without documentation. [N]

3. Improve the reliability of the system. [F]

6.2 Future HUD Evaluations

The user interface evaluation in this report is a preliminary effort. Further work is required to define requirements for a wearable see-through display for dismounted soldiers:

1. The design of the HUD user interface could further benefit from multiple independent heuristic evaluations. The current evaluation is limited by having only one evaluator.

2. Further effort should be spent determining what information should be displayed to dismounted soldiers via HUDs and how the information should be displayed. The SIREQ TDP provided general categories of information (i.e., tactical cues, wayfinding cues) but more specification is required as to what these cues are, who needs them, how they should be displayed, when they should be presented, and which are of greater priority. An initial attempt was made in [16] to answer some of these questions for mobile geographic information systems. These were mainly handheld and map-based. A more detailed investigation for HUDs should be conducted. Possible information types to be investigated include: effective weapon ranges, dead ground, optimum observation points, locations of previous enemy engagements, ammunition count, and lines of sight. Cognitive task analyses developed for SIREQ, the Integrated Soldier System Project and the Future Small Arms Research program would be helpful resources.

3. Once HUD information requirements are defined COTS (Mod Live compatible) Android applications should be evaluated for their usefulness. A company called Overmatch provides situation awareness software. A few Android applications to try are: BattleTac airsoft, Personal Eye System, and Range Card.

4. If existing COTS software does not meet the HUD information requirements custom Android applications should be developed using the Mod Live SDK.

5. Once software is available that meets the HUD information requirements of dismounted soldiers a usability evaluation should be conducted with subject matter experts (SMEs) using prototype HUDs with realistic tasks in realistic scenarios.

6. Alternatively, once the HUD information requirements have been defined, displays could be mocked up in a first-person-shooter simulation such as Virtual Battlespace 2 and evaluated by SMEs doing realistic tasks in realistic scenarios.

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List of Symbols/Abbreviations/Acronyms/Initialisms

COTS	Commercial off-the-shelf
DRDC	Defence Research and Development Canada
FOV	Field of View
GPS	Global Positioning System
HD	High Definition
HUD	Heads-up Display
LED	Light Emitting Diode
SDK	Software Development Kit
SIREQ	Soldier Information Requirements
SME	Subject Matter Expert
TDP	Technology Demonstration Program
USB	Universal Serial Bus

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12. KEYWORDS, DESCRIPTORS or IDENTIFIERS (Use semi-colon as a delimiter.)

Heads-up Displays; Situational Awareness; Usability; Defence Industrial Research Project; Revision Military Incorporated; Integrated Soldier System Project; Soldier Information Requirements Technology Demonstration Program

13. ABSTRACT (When available in the document, the French version of the abstract must be included here.)

The Toronto Research Centre of Defence Research and Development Canada (DRDC) had a Defence Industrial Research Program (DIRP) project (2010–2013) with Revision Military Incorporated for a see-through eyeglass wearable display. Revision provided DRDC with two prototype Desert Locust Military Goggle Systems fitted with Recon MOD Live Heads-up Displays (HUD), so that DRDC could investigate display requirements for a dismounted infantry soldier see-through HUD.

This report presents preliminary heuristic analysis results of a usability evaluation of the prototype HUD. Both the software and hardware of the prototype HUD were evaluated based on multiple workbench testing sessions and three days of field trials. The prototype HUD was assessed against a set of usability heuristics, and the HUD recommendations of the Soldier Information Requirements (SIREQ) Technology Demonstration Program (TDP).

This report provides 23 recommendations for improving the usability of the prototype HUD and six recommendations for future HUD human factors evaluations. The recommendations are relevant to Revision's design integrating a see-through display into the Sawfly spectacle (the standard issue ballistic eyewear of the Canadian Army), and may be generally relevant to the design of HUDs for dismounted soldiers.

Le Centre de recherches de Toronto de Recherche et développement pour la défense Canada (RDDC) a mené un projet dans le cadre du programme de recherche industrielle pour la Défense (PRID) (2010-2013) en collaboration avec Revision Military Incorporated pour concevoir un dispositif de visualisation tête haute intégré à des lunettes. Dans le cadre du projet, Revision a fourni à RDDC deux prototypes de lunettes militaires Desert Locust comportant un dispositif de visualisation tête haute Recon MOD Live afin qu'elle évalue les besoins des soldats d'infanterie débarqués à l'égard de ce type de dispositif.

Le présent rapport contient les résultats de l'analyse heuristique préliminaire de l'évaluation de la facilité d'emploi du dispositif de visualisation tête haute intégré aux prototypes de lunettes fournis par Revision. Le Centre de recherches a évalué le matériel et le logiciel du dispositif en procédant à de nombreuses séances d'examen en atelier et trois jours d'essais sur le terrain. L'évaluation des prototypes a été effectuée en fonction d'un ensemble d'éléments heuristiques de convivialité, ainsi que des recommandations à cet égard du Programme de démonstration technologique des besoins des soldats en matière d'information (SIREQ TDP).

Le rapport présente également 23 recommandations pour améliorer la facilité d'emploi du dispositif de visualisation tête haute et six recommandations pour les prochaines évaluations ergonomiques. Ces recommandations sont pertinentes pour la conception, par Revision, d'un dispositif du même type pour les lunettes Sawfly (les lunettes de protection balistique standard de l'Armée canadienne) et, dans une perspective plus générale, pour la conception des dispositifs de visualisation tête haute destinés aux soldats débarqués.