HARVESTING TECHNICAL NOTE

HTN13-03
2021

Augmented Reality In-field Servicing Tool

Summary

Mechanised harvesting heads are sophisticated pieces of equipment and must be maintained to very exacting specifications. Failure to do this can result in damage to the head, downtime, and lost productivity. With guidance from Waratah NZ Ltd, manufacturers of Waratah processor and harvester heads, an in-field servicing tool using augmented reality (AR) was developed which provides a detailed "walk around" view of the head. The user is guided through safety information, fault reporting, training, maintenance, and service tasks. Ongoing user experience of the tool will inform further improvements so that it will become an essential and practical tool for harvester head service and maintenance.

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Introduction

In a report summarising injury reports supplied to the New Zealand forest industry Incident Recording Information System (IRIS) database related to harvesting machine maintenance from January 2015 to December 2019, a total of 482 harvesting maintenance work-related incidents were recorded. As the New Zealand forest industry increases the level of mechanisation, machinery maintenance incidents will continue to be a focus area for improvement.

Forest Growers Research in association with Scion and StaplesVR set out to develop a practical solution to minimise downtime and the potential for, and consequences of, accidents during maintenance by harvesting crews.

Augmented Reality

With marked improvements in cost, application and content quality, Augmented Reality (AR) is set be a powerful tool in machine maintenance, service, and support (Thompson *et al.* 2020). AR enables information to be superimposed on a real-life view of the world, with step-by-step instructions to guide maintenance processes onsite.

AR overlays real world information in real time using a tablet, phone or head mounted display. Being able to overlay information onto spaces and equipment can be a valuable resource in improving work safety, productivity and reducing the time needed to maintain expensive equipment.

Within forestry maintenance, the AR overlay provides the opportunity to feed guidance and information to individuals conducting repairs onsite, as well as returning live data streams to a central maintenance management centre.

Scion partnered with technology and industry leaders StaplesVR and Waratah NZ Ltd, to explore AR applications building on from an initial AR demonstration application for a harvester head (Figure 1).

Figure 1. AR demo application

Waratah has served the global forestry industry for over 40 years, pioneering mechanised harvesting with quality products, such as feller bunchers, processors and harvesters. StaplesVR is a creative technology company comprising leading experts in developing custom-designed creative technologies.

Scope

Pre-production discussions identified the primary potential of an AR application is to reduce time for maintenance and service tasks. The developers saw an opportunity to incorporate safety precautions, and

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to utilise gamification for better retention of key safety information.

Assisted fault reporting and assisted installation / repairs were also suggested as potential functions. Both offer capacity to build machine understanding and expand practical training resources.

The scope for the current design was agreed as follows:

i. One harvester head model
ii. One task with subsystem highlighting
iii. Multiple maintenance tasks (number depending on timeframe and difficulty, built with scalability)
iv. New features referenced below to be added to the application functionality.

The definition of maintenance and service tasks is a step-by-step guide on how to perform routine, daily tasks on the harvester head. This includes machine checks and diagnostics, and manageable installation and repair work.

Some limitations were considered. Due to the shortcomings of current mobile devices, simultaneous presentation of all the parts of the harvester head model is unattainable (given the visual detail of the proposed additions). However, it was decided that the parts of the harvester head model peripheral to the present task can be less detailed for the duration of the task. The demo application was designed for high-end iPad devices as is this current output. If older or less powerful devices are utilised, further limitations, such as switching unused parts of the model off completely, may be required.

Key New Features

Based on feedback from demonstration of the prototype, and further discussions on the topic, the following features were integrated:

New Safety Module

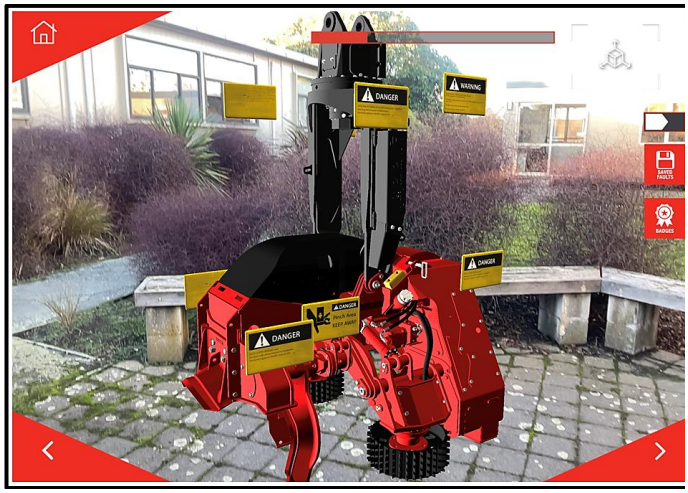

Figure 2. Safety module

A general safety module (Figure 2) was added to the beginning of any selected task without the ability to skip. References to this module exist throughout the rest of the tasks, displayed as selectable warning messages, colour outlines, arrows and sounds accompanied by pop-up messages (Figure 3). Safety terminology was directly referenced and copied from the manuals and documentation provided by Waratah NZ Ltd.

Figure 3. Safety information example

New Fault Reporting Module

When completing a task, at any time the user can choose to 'save fault report information.' The user is then prompted to select one or more parts of the harvester head. That information is then saved to the new fault report tab, allowing the user to access key information for later review.

New Training Tab and Badges

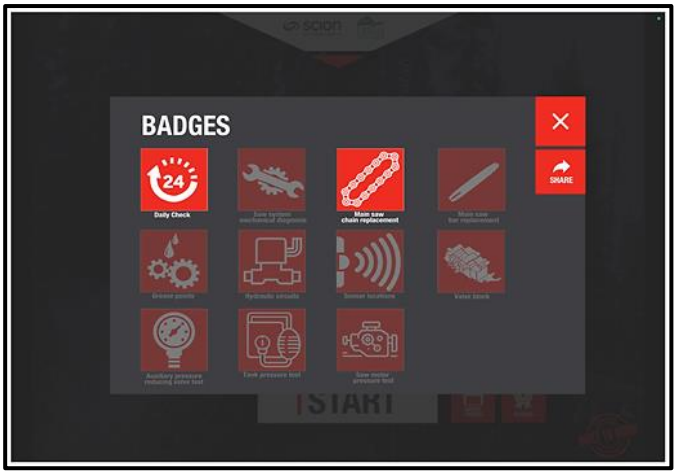

Figure 4a. UX training tab and badges
****For detailed view, please see Appendix***

Figure 4a. shows the UX training badges. For a detailed view of the procedure for operating the UX training tab, see Figure 4b in the Appendix. Once a safety module, maintenance task or service task has been completed end-to-end, the user will be able to see a list of badges representing the content completed. The user can then select to share this

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information via email or other platforms, to allow others to know this has been completed.

Maintenance and Service Tasks Update

Figure 5. Application screen view

Tasks show more detailed representations of the current state of the harvester head and its moving Components (Figure 5). This means that more parts will be shown moving, and representations of certain conditions such as damage or debris will be seen by the user.

Highlighting Machine Subsystems

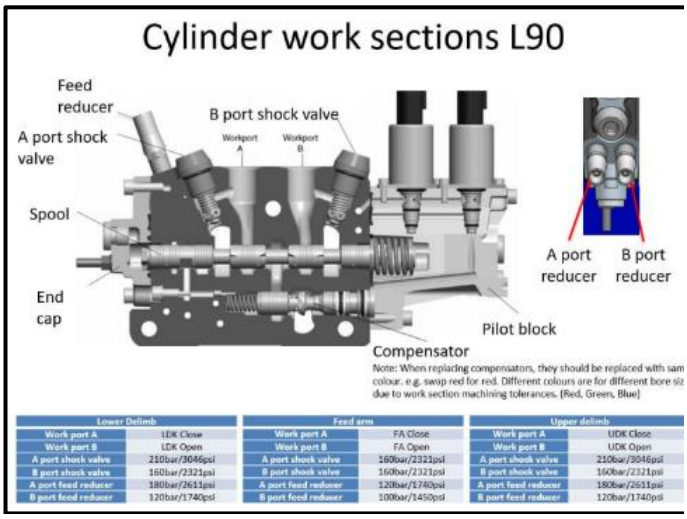

Figure 6. Machine subsystems example

To assist with tasks for appropriate equipment, machine subsystems were highlighted and annotated on for better in-depth understanding of the equipment. As an example, information on hydraulic subsystems was provided which was represented in augmented reality and annotated (Figure 6).

User Interface Design Updates

The StaplesVR designer created a new User Interface content for the new broadened content. Keeping to the original designs, a representation of where the new features were added is shown in Figure 7.

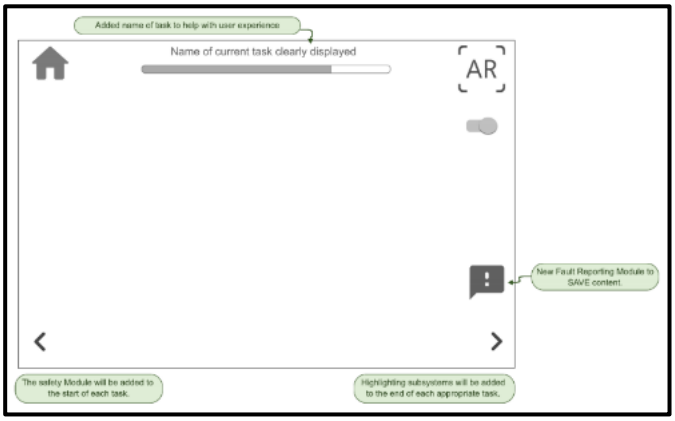

Figure 7. User interaction design

Production

Additional 3D Modelling to Waratah Head

Waratah supplied StaplesVR with detailed 3D models of the HTH 622B harvester head, with all parts included. Access was granted to the Waratah online Parts Catalogue to ensure detail at all levels was captured (Figures 8 and 9).

Figure 8. Application task view

Figure 9. Application task view - detail

Programming Highlights and Annotations

Waratah engineers and mechanics met with StaplesVR to provide expert guidance on

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maintenance and service tasks that were included in the application. Safety information and redundancies were incorporated throughout each task. Furthermore, all training, safety and service documentation on the selected harvester head maintenance and service tasks was collected, referenced, and annotated throughout the application.

Seven tasks were selected to be included in the application:

1. Saw System Mechanical Diagnosis
2. Daily Check
3. Main Saw Bar Replacement
4. Main Saw Chain Replacement
5. Grease Points
6. Functions (Hydraulic Circuits; Sensor Locations; Valve Block)
7. Adjust Function Pressure (Auxiliary Pressure Reducing Valve Test; Tank Pressure Test; Saw Motor Pressure Test)

Fault Reporting Module

Figure 10. UX fault reporting
****For detailed view, see Appendix***

Figure 10 shows the UX Fault Report page. A detailed procedure representing the user experience for the Fault Reporting Module is shown in Figure 10b in the Appendix. This information includes:

- A direct link to the parts catalogue for the selected pieces of equipment (requires internet connection).
- The name of the part or parts.
- The name of the task that was being completed.
- The date and time.
- A screenshot of what the device camera sees when captured.

Due to device limitations, infinite amounts of data were not able to be held. Instead, the developers designed a process to ensure that the user can easily add and remove content. An initial estimate would be roughly three to five data sets. To clarify, this is for use of identifying faults with real world equipment, and not content within the app.

Testing and De-bugging

Progress of the application development was shared in the form of documentation and videos. Waratah provided regular feedback on authenticity throughout development. User Experience (UX) and Field Testing was also undertaken by Waratah to refine the application.

Deployment

The Waratah AR application has been downloaded onto select iPads. Comparative analyses will be undertaken to benchmark performance gains and knowledge transfer.

Conclusions

It is expected that this application, once fully deployed, will markedly improve the productivity and safety of onsite maintenance. The current status of maintenance leaves forestry crews with limited onsite support/knowledge (beyond the initial delivery of equipment onsite) and expensive service requirements, if routine maintenance and daily checks are not performed adequately. This solution offers opportunities to bridge those knowledge gaps in a reasonable and realistic timeframe. Information, such as critical safety information, can be overlaid implicitly teaching operators to take care of themselves and reducing the risk of maintenance injuries arising from limited understanding of the machinery. Furthermore, unnecessary service expenditure and product malfunction can be eliminated, saving all industry stakeholders money and time.

Using a ‘fail-fast’ approach to explore the potential of this technology in the New Zealand forest industry with Waratah NZ machinery and StaplesVR has resulted in a successful AR application, ready for trialling and scaling.

Beyond that, AR provides the opportunity to feed guidance and information in real time to individuals onsite conducting repairs on any machine type, as well as returning live data streams to a central maintenance management centre. Applications for AR beyond service and support include manufacturing and marketing/education tools.

References

Thompson, K., Hooper, B., Staples, A. and Parker, R. 2020. Applications of Augmented Reality and Virtual Reality. Harvesting Technical Note HTN12-10, Forest Growers Research Ltd, Rotorua, New Zealand. 2020.

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APPENDIX

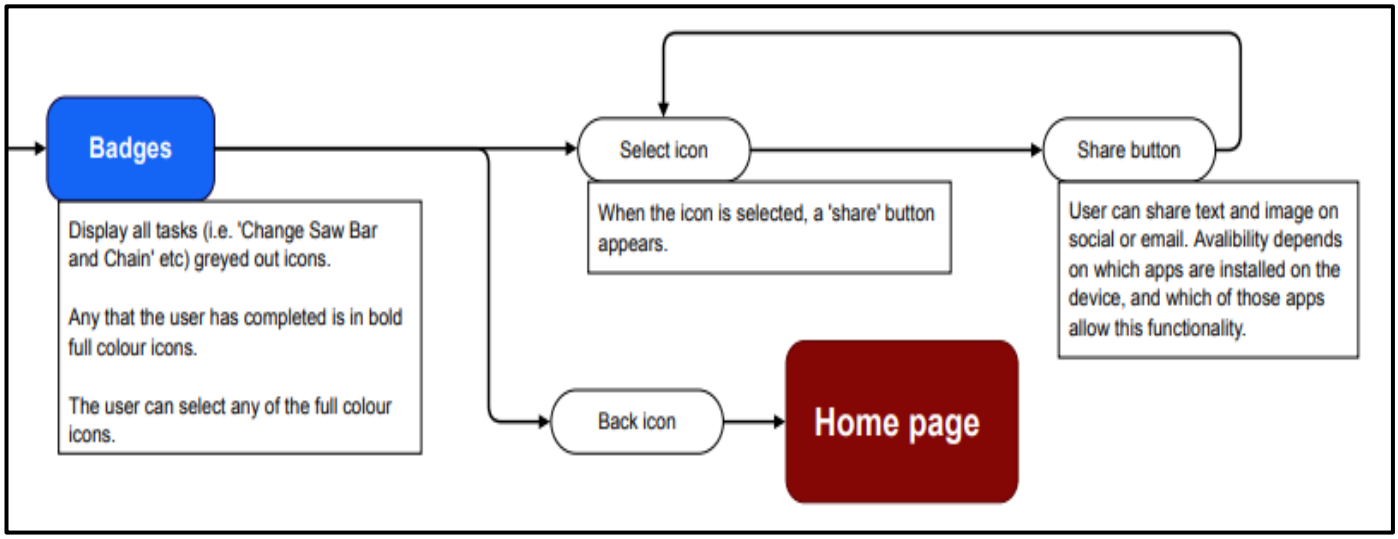

Figure 4b. UX training tab operating procedure

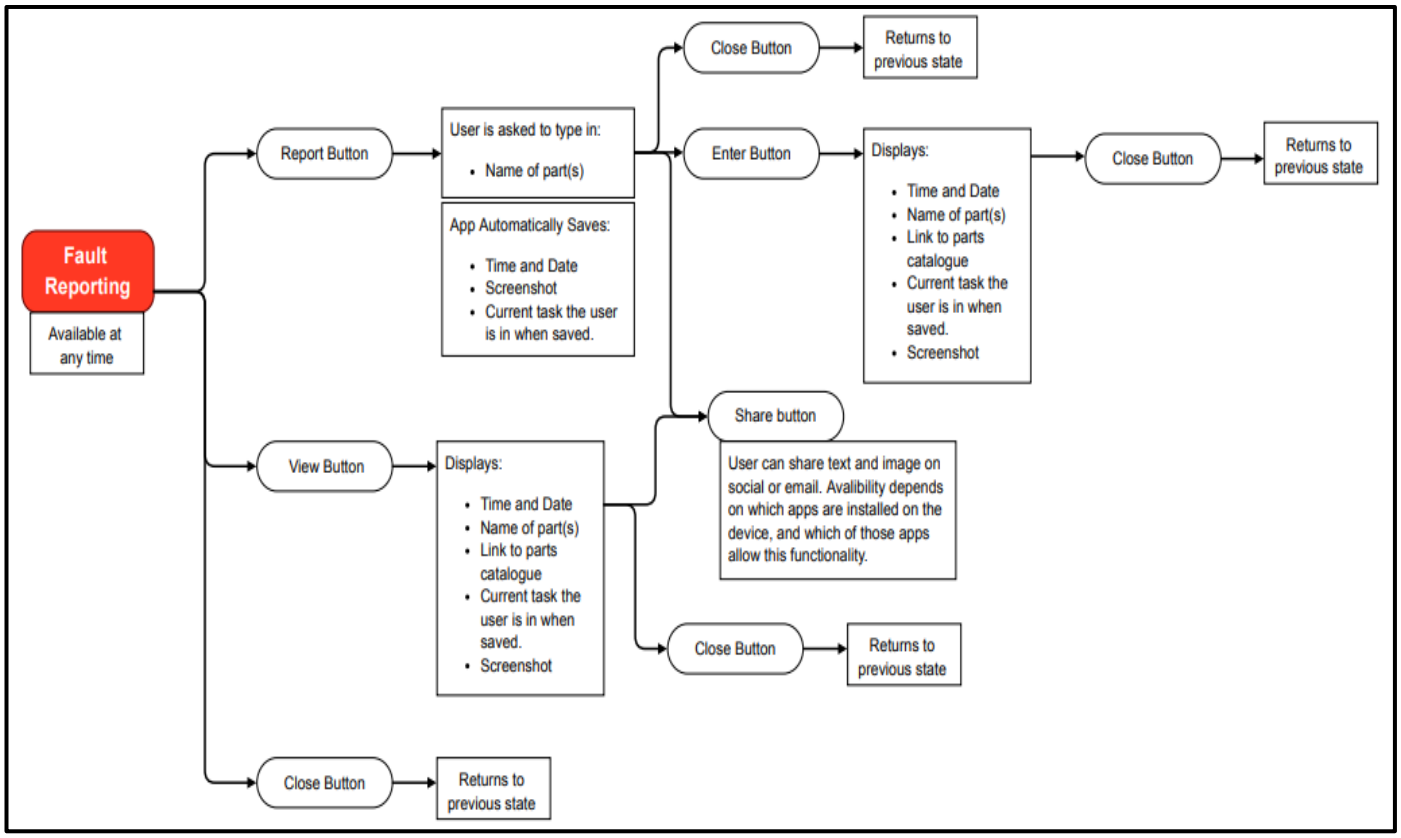

Figure 10b. UX fault reporting procedure

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Scion Augmented Reality Demo

Follow the instructions below on your phone to try a demo Scion Augmented Reality experience.

1 SCAN THE QR CODE

Use your device's camera to scan the QR code below. You will be sent to the app store to download the Scion AR app.

2 INSTALL THE APP

Install the free Scion AR app onto your device to use and experience the augmented reality features of this page.

INSTALL

3 SCAN THE IMAGE

Open the app and use your device's camera to scan the image below to view the latest technology developed to maximise safety and efficiency in the woods.

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