AMPC
AUSTRALIAN MEAT PROCESSOR CORPORATION

Whizard Trimmer Immersive Training

Immersive Reality - Equipment Training - Whizard Trimmer

Contents

1.0 Executive Summary

The ongoing training of staff is time consuming and presents a particular challenge to the meat processing industry due to the high staff turnover. This project tries to address this by creating an immersive training tool which a trainer could use to support trainees remotely.

The project included tackling some large technical and developmental challenges to reach the goal of creating a virtual experience that would allow users to remove fat from a carcase with a Whizard Trimmer handset in a collaborative environment. To achieve success the team had to answer questions such as:

◆ How do we simulate the look, feel and sound of a Whizard Trimmer?
◆ How do we simulate the fat on a 3D model carcase in such a way that it can be removed?
◆ How do we recreate the interaction of the Whizard Trimmer with the carcase in a virtual world?

As well as more generic questions on virtual training:

◆ How do we make this engaging for the user?
◆ How do we convey the training with minimal written instructions in case the trainees first language isn't English?

Through significant work with the FPE trainers, various processor training teams and supported by the AMPC team, we have created a tailored training package of 3 linked experiences. These take the user on the journey from donning their PPE, assembling and sharpening the Whizard Trimmer to finally using the tool in a training environment on high quality 3D model carcases. We have also included a seamless collaboration system in this training simulator which allows remote trainers to enter the environment and interact with trainees.

The learnings in the Discussion and Conclusions sections, and the potential future opportunities are great additional outcomes from what has been a complex, interesting and challenging project to work on.

2.0 Introduction

The purpose of this research project was to develop an immersive training tool that could assist in training processing staff in the correct usage of the Whizard Trimmer tool to support face to face training. The scope of the project was developed in response to challenges faced by processing plants including:

◆ Workers are transient, leading to high staff turnover and often having to recruit from overseas.
◆ Many operators have English as a second language, so there can be language barriers in traditional training environments.
◆ Without proper training, the processors are not getting the most efficient use from the tool in terms of trimming as well as maintenance and this impacts on the bottom line in terms of cost for new blades and tool maintenance.
◆ Only a small number of trainers are available across Australia to deliver face to face training (on the Whizard Trimmer).

The opportunities offered by an immersive training tool include:

◆ It feels real - When immersed in a virtual reality experience the person feels as though they are really using the tool. Visual and audio environmental aesthetics can be added to feel like they are in a facility using the tool. The situations they are presented with and decisions they make feel more realistic.

- ◆ Safety - Staff can explore and make decisions using VR with no potential for risk or harm to themselves or the tool; often referred to as "failing safely".

- ◆ Immediate - training can be undertaken for all new staff as soon as they commence working, rather than having to wait for one of the FPE Whizard Trimmer training team to visit the plant.

- ◆ Responsive - Environments in VR can be programmed to be responsive to the trainee behaviour and choices - consequences can be programmed in response to specific decisions.

- ◆ Once built the training is relatively inexpensive, with multiple people able to access and interact with it over and over again, without the need for a trainer to run dedicated sessions.

- ◆ Collaborative - creating a collaborative immersive environment allows remote trainers to engage with the workforce and assist with training from anywhere in Australia.

The original scope of the project included developing specific training experiences in virtual reality (VR) and augmented reality (AR) in both a single player and a collaborative environment if possible.

3.0 Project Objective

The project objective as specified in the research agreement:

"To create an immersive training tool that assists in training processing staff in the correct usage of the Whizard Trimmer tool to support face to face training."

4.0 Methodology

The methodology/ flow we followed to deliver this project was as follows:

Stage 1 - Planning & Preparation

- ◆ Refining the scope with AMPC and FPE team.
- ◆ Creating a matrix of actions and intended responses to ensure users are guided through the correct use of the tool.
- ◆ Spending time onsite with FPE trainers to ensure all aspects required are covered within the training environment.

Stage 2- Development & Testing

- ◆ Development firstly of the VR environment for testing before moving onto the AR
- ◆ 3D development of both handpiece and meat carcase prototype for use in AR environment

Stage 3 - Deployment & Testing

- ◆ Deployment and testing of collaborative VR environment
- ◆ Deployment and testing of collaborative AR environment

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This platform was designed to be hosted in the Oculus Quest environment and include the ability to deliver an experience on different types of hardware e.g the HTC Vive.

5.0 Project Outcomes

The project activities and associated outcomes from each stage are as follows:

Stage 1 - Planning & Preparation

Activities:

◆ Filming on location at a processing facility with the local training team. Filming included capturing 360 and 2D footage of PPE and local Whizard Trimmer preparation and usage processes plus interviews with training team members.

◆ Meetings (both face to face and virtual) with the FPE training team in which the current FPE training processes were reviewed and feedback on the proposed design of the immersive experiences gathered.

◆ Detailed images were captured from a Whizard Trimmer handset to enable a 3D replica of this complex tool to be constructed.

◆ Development began on the technical infrastructure to support the hosting and delivery of the experiences.

◆ Investigation and mathematical design of the complex interaction between the 3D virtual Whizard Trimmer and 3D virtual carcase models.

Outcomes from Stage 1:

1. An initial design proposal for 4 separate Whizard Trimmer experiences:
   - Experience 1: Equipping with Personal Protective Equipment (PPE)
   - Experience 2: Assembling and maintaining the Whizard Trimmer tool
   - Experience 3: Practicing the initial strokes with the Whizard Trimmer tool
   - Experience 4: Practicing identifying the locations of fat to trim from the carcass

2. A design proposal for the interaction (collision) of the 2 3D models which occurs when using the 3D Whizard Trimmer model to remove fat from the 3D carcase model.

3. First concept design of the 3D Whizard Trimmer handset.

Stage 2 - Development & Testing

Activities:

◆ Minimum viable product (MVP) versions of 4 different experiences were created to enable validation of the design and function.

- The MVP experiences were reviewed with FPE trainers for feedback and guidance (virtually due to covid travel restrictions); and with AMPC during an onsite face to face visit.

- The concept of the 3D handset and/ or 3D printed carcase was explored internally by the development team.

- Multiple rounds of changes and improvements were made to each experience to improve the 3D imagery, environment, functionality and quality.

- The MVP VR experiences were ported and modified to create a proof of concept augmented reality (AR) experience.

- Presentation and demonstration of proof of concept AR experience at the AMPC Safety Conference 2022.

- The collaborative environment was developed and tested internally.

Outcomes from Stage 2:

1. The 3 final Whizard Trimmer experiences were developed ready to deploy for wider user testing:

   - Experience 1 – Equipping with Personal Protective Equipment (PPE)
   - Experience 2 – Assembling the Whizard Trimmer Tool
   - Experience 3 – Collaborative environment – Training Simulator (using the Whizard Trimmer to remove fat from the carcase)

   The original Experience 3 (practising the initial strokes) was found to not be adding value to the overall experience set so it was decided to focus on expanding the Training Simulator experience.

2. After investigation and research, it was decided not to pursue the concept of 3D printing the carcase or handset models as we reasoned we could provide the necessary haptic feedback of operating a Whizard Trimmer virtually. The research also supported this view that as simple physical models, they were unnecessary and would not aid the experience.

3. Determining the 'quality' of the users trimming attempts in experience 3 proved to be extremely complex. Several different mathematical and technical solutions were investigated, the deployed solution measures the percentage of the fat which has been removed.

4. Following internal and external user testing of the proof of concept AR experience, we discovered that AR does not port seamlessly from an experience built specifically for the VR environment and vice versa. This was a very important project discovery and is discussed later in this report.

   Points 2, 3, and 4 are addressed further in the Discussion and Conclusions / Recommendations sections.

Stage 3 - Deployment & Testing

Activities:

- Deployment of the 3 experiences on HTC Focus 3 Headsets for testing by FPE, AMPC and users (guided testing). We also created an Oculus Quest 2 version.

- Remote user testing of the collaborative environment and experience with AMPC team members.

- ◆ Two rounds of onsite user testing of the finalised experiences with processor training managers, floor staff and FPE trainers at different processing facilities.
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- ◆ Final round of updates developed and deployed in response to the feedback from user testing.

- ◆ Presentation and demonstration of the experiences and collaborative environment at the AMPC Innovation Conference 2022.

Outcomes from Stage 3:

1. Three bespoke and tested immersive virtual reality Whizard Trimmer training experiences have been created.

2. Available for download for the Oculus and HTC Focus 3 headsets.

3. One is a fully working, real-time collaborative training experience which can be accessed remotely from anywhere in the world with the appropriate headset and an internet connection.

4. The feedback from floor staff, trainers and AMPC conference attendees has been overwhelmingly positive and excited at seeing the potential for this cutting-edge technology in their workplace environments.

General project observations:

- ◆ The relationship with FPE trainers worked well.

- ◆ The onsite visits to processors was crucial, and filming the training taking place in a real environment meant the final virtual environments are as close to reality as possible.

- ◆ The user testing was very popular with the front line workers – as it was fun, different, engaging and educational at the same time.

- ◆ The experiences were designed to be intuitive and as a result most users did not require help (in the form of direct trainer guidance) to complete them.

6.0 Discussion

One of the key observations made during the course of this work is the thirst from industry to adopt immersive training into their operations. The training teams at the processors we visited were overwhelmingly positive about the opportunities and benefits that immersive training could offer to complement their existing face to face training and they see a real potential to integrate it into their classrooms. The collaborative environment was seen as a great new opportunity to train and assess new starters remotely - especially beneficial for offshore workers.

3D printed models

During the development stage, we considered how the application of a 3D printed Whizard Trimmer handset and carcase could be used in the training, and what (if any) the benefits would be. We concluded that simple 3D printed models would not enhance the training and would detract from the virtual training itself. However we think there could be a future opportunity to investigate integrating the VR handset controller actions into a 3D printed

Whizard Trimmer to add to the experience. This would enable haptic feedback in a Whizard Trimmer shaped handset and enable the user to get the feel for the Whizard Trimmer tool in a completely safe and risk-free way.

<u>Collaborative VR experience</u>

One cutting edge aspect of the creation of these experiences, has been to incorporate the ability for real time collaboration. This means that a trainer and small group users can meet in the Whizard Trimmer training experience from anywhere in the world, as demonstrated at the AMPC Innovation conference. The potential for processors – who often have to source much of their workforce from overseas – to exploit this to start some basic training, or introduce some concepts to the new workers before they even leave their home country is very exciting.

<u>Augmented reality experience</u>

Our discovery that VR environments and the interactivity within those environments do not port seamlessly to an AR experience, was a significant one. Our key learnings here included:

◆ AR does not have controllers but rather uses hand gestures to interact with the digital assets and environment. As a result this limits the user's haptic feedback within experiences e.g. when grabbing and turning on the Whizard Trimmer, thereby reducing the quality of the user experience when ported to AR.

◆ AR is best suited when digital content can be overlayed on real world objects. An example would be instructional cues on a piece of physical machinery.

◆ Creating content once and deploying on many channels (web, mobile, VR and AR) does not deliver the quality of experience we wanted to deliver. Each channel has specific user interaction requirements and as a result the content needs to be altered and tweaked for each channel delivery in order to achieve a high quality training experience.

<u>Training simulator - assessing the quality of the trim</u>

During our investigation of what it takes to achieve a high-quality trim result in the processor, we discovered that there are many subtleties involved in this including the accuracy, speed, angle and pressure of the Whizard Trimmer when trimming. We spent time testing various ways of how we could simulate these multiple factors in a virtual environment and although extremely challenging, we think it may be possible. Our hypothesis is that with a combination of haptic and visual feedback, possibly enhanced by a 3D printed Whizard Trimmer with VR handset controller attributes, we could replicate these and then assess the accuracy of the resulting trim.

To our knowledge this has not been done anywhere in the world yet so represents an exciting future opportunity.

<u>Challenges presented by Covid</u>

Developing an innovative and complex set of virtual experiences in collaboration with multiple stakeholders is always challenging. However the added complexity brought by the covid pandemic meant we had to change our approach in some areas and had to rely more on virtual feedback sessions than the face to face sessions we would usually undertake. Despite this we are confident that the end result has not been affected.

7.0 Conclusions / Recommendations

This has been a complex and challenging project and as a result there are many conclusions we are able to draw from the varied activities we have undertaken. These include:

Using VR/XR to train users in the meat industry:

◆ Immersive training has a potential place in industry - it complements existing training and we had positive engagement and feedback from front line workers – this type of training would be well received.

◆ In VR training users can fail safely - this increases confidence, and they can drop valuable equipment without damage.

◆ The principle behind the Whizard Trimmer training can be applied elsewhere e.g stunning.

◆ Training 'bundles' work well to give variety – and variety of experiences is important to maintain interest & engagement.

◆ Replicating the real environment (as far as possible) is key to the immersive experience.

◆ Tactile feedback in terms of accuracy is required to improve the learning outcomes.

◆ Users can develop muscle memory through rote learning and repetitive use.

◆ Data insights into specific user performance are required to realise maximum value and to enable an action plan following training.

◆ If the experience is designed well, it should be intuitive and end users should not require help to complete it.

◆ A VR introductory tutorial is required -showing how to use controllers, teleport etc.

◆ The concept of training in a universal environment provides inspiration, however feedback from processors is that bespoke training environments would be preferable.

Immersive VR for Whizard Trimmer training:

◆ To the best of our knowledge, no-one globally has achieved the development of training with the Whizard Trimmer in VR.

◆ The Whizard Trimmer bundle of experiences – PPE, Assembly & Training Simulator - are complementary and work well as a package.

◆ As a complementary asset, immersive training is great to rapidly build up foundational knowledge and to 'road test' the equipment. Due to the nature of the Whizard Trimmer tool, a face to face training session is still highly recommended.

◆ The experience bundle could be used for careers and marketing purposes.

◆ The PPE as a subset of the experience bundle is generic enough for many processors to use.

The project approach and methodology:

◆ Collaborating with equipment suppliers presents a value add for them in terms of training and wow factor.

◆ The experimental approach of porting the Whizard Trimmer training from VR to AR proved that VR was more effective for this type of training due to its immersive nature.

◆ Not all learning experiences deliver enhanced value by being delivered in AR. It is worth spending time on developing differentiated experiences designed for each channel to get the best user experience. By using the tools provided by the different channels e.g. using hand held controllers in VR when simulating the holding of a physical tool, versus finger movements in AR for activities which do not involve a tool - provide a more intuitive learner experience than trying to create a one size fits all approach to increase efficiency.

<u>Future opportunities - enhancements to the current experiences</u>

There are some enhancements to the training we have identified which could be addressed as future work:

◆ Add a questionnaire to the end of each section to check the user's learning.

◆ Create a dashboard of user results from each experience to track training.

◆ Add the ability to restart each training step so the user can repeat the step until they are comfortable with it.

◆ In the Training Simulator, investigate how to feedback if the user has cut too deep (further work on the mathematics of the models colliding).
◆ In the Assembly experience, investigate adding the 'intelligence' to check the blade sharpening angle.

◆ Publish the VR experiences separately (instead of bundled) to suit AMPC proposed Marketplace

◆ Publish the VR experiences for PICO ecosystem

◆ Licencing opportunities with end-users

◆ Customisation of VR experiences for end-users

◆ A&B split testing with end-users

◆ Integration with LMS's eg. Canvas to push user analytics into central user management system

◆ Web / desktop / tablet delivery, not just in VR Headsets

◆ Introduce other complementary Whizard Trimmer tools and/or scenarios

◆ Integrate the ability to provide assessment in environment

◆ Integrate multi linguistic cues, overlays and audio

<u>Future opportunity - a 3D printed VR handset controller?</u>

◆ Haptic feedback in terms of device weight, friction & tooling could be exploited further to enhance the training experience. This could include a more detailed investigation into the combining of VR handset controller capabilities within a 3D printed Whizard Trimmer handset, however this is likely to be complex (and costly).
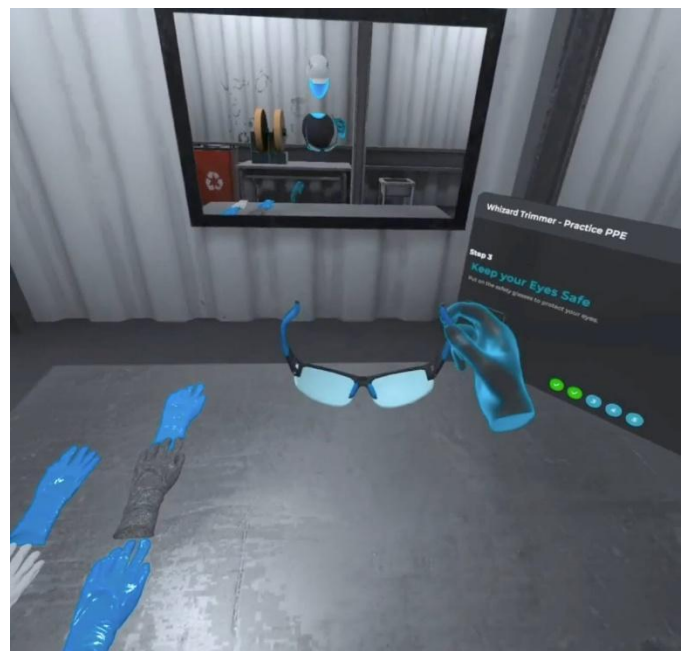
8.0 Bibliography

None

9.0 Appendices

9.1   Appendix 1 – User testing (photos)

User testing with trainers and front line workers – Sept 2022

Users point-of-view during the PPE experience

9.2 Appendix 2 – AMPC Innovation Conference (photos)

Presentation and attendees trying the experience at AMPC Innovation conference, Oct 2022