This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

Analyzing Online Videos: a Complement to Field Studies in Remote Locations

Taufik Akbar Sitompul[1, 2] and Markus Wallmyr[1, 2]

[1] School of Innovation, Design and Engineering, Mälardalen University, Västerås, Sweden
[2] Department of Product Management, CrossControl AB, Västerås, Sweden
{taufik.akbar.sitompul;markus.wallmyr}@mdh.se

Abstract. The paper presents a complementary method, called online video study, to conducting field studies in remote locations, by using available videos on YouTube. There are two driving factors for the online video study. Firstly, there are some occasions where conducting field studies are difficult, for example, due to the remoteness of the location where the research subject is located. Secondly, there is a growing interest among researchers to use available data on the internet as their research data source. To give a context, the study specifically investigates how operators of forest harvesters work in their natural settings. The online video study was started by collecting suitable videos on YouTube using certain criteria. We found 26 videos that meet our criteria, which also provide diverse samples of forest harvesters, operators, and working situations. We used five prior field studies, which investigated forest harvesters-related issues, to evaluate the feasibility of our approach. The results of the online video study method are promising, since we are able to find answers for research questions that we have predefined. The paper does not only contribute to the understanding of how operators of forest harvesters work in natural settings, but also the feasibility of conducting the online video study, which can be utilized when the research subject is located in remote locations.

Keywords: Field Studies, Forest Harvesters, YouTube, Online Videos.

1 Introduction

Modern forest harvesters are capable of performing multiple functions, such as monitoring the machine's status, measuring the tree's length and diameter, and recording the collected data [7]. In addition, the harvester head itself is also capable of felling and delimbing trees, cutting based on the defined length, color marking, and stump removal [20]. Despite various functionalities mentioned previously, a forest harvester can only perform as good as its operator, thus resulting in a high demand for skilled operators [27]. An extensive training is required to become an operator, since forest harvesters are complex machines [34]. Moreover, operating forest harvesters is also a mentally demanding task, since operators are required to perform multiple activities both simultaneously and repetitively, such as observing the ground's condition, identifying which trees that should be cut, detecting surrounding objects and obstacles, as well as supervising the machine's operations [15, 27]. A study shows that the cognitive workload in operating a forest harvester is comparably similar to operating a fighter plane [4].

Since operators are the crucial part in the productivity of forest harvesters, it is important to actually understand how operators work with forest harvesters in natural settings. Therefore, conducting field studies is methodologically suitable for this purpose. However, as the name implies, forest harvesters are used in the forest, thus there is a lack of accessibility for researchers to be there. In addition to access to locations, researchers also need access to research subjects and organizations. As an example, researchers can always go to the forest, but they cannot conduct field studies if they do not have access or permission to get inside forest harvesters, to observe and communicate with operators, or to be around forest harvesters. In addition, forest harvesters are also used during both days and nights, regardless of the season. Therefore, although not completely impossible, it is difficult for non-forestry workers to conduct field studies in this context. Therefore, there is a need for other methods that can be utilized, even though the researcher is not at the same location as the research subject.

Looking at some prior field studies that investigated forest harvesters-related issues, we found that most field studies were able to observe a limited number of operators and forest harvesters. Sirén [28], Häggström et al. [12], and Nurminen et al. [23] respectively observed four, six, and eight operators in their studies. Wallmyr [33] observed operators of several types of industrial vehicles, including one forest harvester. Spinelli and Visser [30] reported the largest number of samples in their study. They do not state the exact number of forest harvesters and operators, but their data were collected from 34 sites in six countries over an extended time period of 8 years.

The objective of this paper is to explore the feasibility of a complementary method, hereafter referred to as online video study, where observations can still be conducted even though it is difficult for the researcher to be physically present, due to the remoteness of the location. To give a context to the study, this paper specifically discusses about the feasibility of using online video study to observe operators of heavy vehicles when performing their work. In this case, we selected to observe operators of forest harvesters, since the machines are used in remote locations. The feasibility of the online video study was evaluated based on the results of analyzing available forest harvester videos on YouTube, as well as comparing our approach with some prior related field studies.

The rest of this paper is divided into five sections. Section 2 presents related work regarding the use of available online videos as research data. Section 3 and Section 4 respectively describe the method used to conduct the study and the results of the study. Section 5 discusses advantages and disadvantages of the online video study, while Section 6 concludes this paper.

2 Related Work

We are living in an era where everyone can easily produce data and share them with others via the internet. The availability of user-generated data on the internet provides

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

new opportunities for research, where researchers can use the available data to carry out their research [19]. As an example of this phenomenon, the concept of online ethnography, also called as netnography, is emerging as an alternative method to the traditional ethnography for studying human-related phenomena through the internet [16, 17]. Instead of being physically present in the place where the research subject is located, the netnography researcher is observing in the virtual world where the research subject is present, such as in forums, blogs, or social media.

As the largest video-sharing website, YouTube stores an enormous amount of videos that has been generated by its users. In 2015, YouTube claimed that users uploaded 400 hours of videos to the website every minute [3]. The abundance of available user-generated videos on YouTube has also gained interest of researchers, who in the past decade have utilized those available videos as their research data [11, 29]. Although most researchers analyzed videos on YouTube to study the impact of those videos on users, there are also researchers who analyzed the videos as an alternative to traditional methods [29]. As an example, Fusaro et al. [9] analyzed 100 home videos of children on YouTube using Autism Diagnostic Observation Schedule (ADOS) scoring, to determine whether they have the potential of autism. The results show that the method is feasible for detecting symptoms of autism earlier than the traditional diagnosis process, where the observation was done within clinical environments.

Using the work of Fusaro et al. [9] as a source of inspiration, we explore the possibility of analyzing available videos on the internet as a complementary method to conducting field studies. Here, we treated the videos on YouTube as the recordings from an actual field study. This way, we can still observe operators of forest harvesters, without being physically present in situ and having to record the videos by ourselves.

3 Method

The study basically consists of two stages: collecting relevant videos on YouTube and analyzing the collected videos to encode specific information of interest and search for additional findings. This makes it similar to conducting traditional field studies, but the data are collected through online sources rather than doing it in the field.

3.1 Video Collection

The relevant videos were collected using the search feature on YouTube, using the search term “forest harvester cabin”. The search results were then sorted based on relevancy. After that, we manually sorted the videos, based on the following criteria:

1. The video must be recorded from inside the cabin.
2. The video must have a resolution of at least 360 pixels.
3. The video must have at least 3 minutes of duration.

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

We continued the search until page 25 of the search results, which was also equal to 500 videos. Unfortunately, the current version of YouTube does not show the total number of search results anymore, but the amount of relevant videos decreased greatly after page 20. In total, we found 26 videos that matched our criteria with a total duration of 4 hours, 9 minutes, and 25 seconds. Among these 26 videos there were two videos that showed the same operator, thus the collected videos represent 25 different operators.

Although the number of relevant videos was less than what we expected, the collected videos show more operators and have a much longer duration than Häggström et al. [12] (see Table 1). Although the duration of videos of Nurminen et al. [23] was much longer, with 12 hours and 30 minutes, it is quite understandable why they needed much longer duration, considering the objective of their study. Both Sirén [28] and Spinelli and Visser [30] did not record their data in the video form.

3.2 Video Analysis

The analysis was done by watching the videos while trying to find whether the videos contain answers to the predefined research questions. When we found something, we documented the specific event that occurred in a note. These notes served like a field note when conducting field studies, where the researcher makes a note for each finding while observing the research subject [32].

Following are the research questions that we wanted to see if the online field study could give answers to:

RQ1. How the operators actually operate the forest harvesters?
RQ2. How are the situations where the operators work?
RQ3. Where the operators are looking at when operating the forest harvesters?
RQ4. What are the problematic areas in operating the forest harvesters?

The analysis was done by both authors. Since the collected videos were produced and uploaded by other people, prior experience in the domain is required in order to understand the context of videos that will be analyzed, thus making the analysis more valid [19]. One author has about 15 years of experience in forest harvesting operations, including experience in conducting a field study in this context. At the same time, the different levels of experience in the domain are required to avoid "blind spots", since people with the same background tend to focus on the same things [2]. Another author has a year of experience in forest harvesting operations and no prior experience in conducting a field study in this context. The analysis was first made on an individual basis. This individual analysis was followed up together, where we compared our findings. Similar findings were accepted immediately. As for the different findings, the videos were referred again to determine whether they should be accepted or discarded.

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

4 Results

Table 1. Samples' comparison between the online video study and the five prior field studies

Criteria	Häggström et al. [12]	Nurminen et al. [23]	Sirén [28]	Spinelli and Visser [30]	Wallmyr [33]	Online video study
Duration of recorded videos	1 hour, 24 minutes, and 51 seconds	12 hours and 30 minutes	No videos were recorded	No videos were recorded	Not reported	4 hours, 9 minutes, and 25 seconds
Number of forest harvesters' operators	6	9	4	Not reported	1	25
Operator's gender	Male (6)	Not reported	Not reported	Not reported	Male (1)	Male (18) and unknown (8)
Operator's experience	Experienced (8)	Experienced (8)	Experienced (2) and less-experienced (2)	Not reported	Experienced (1)	Experienced (21) and less-experienced (5)
Type of operation	Thinning (4) and final felling (2)	Thinning (5) and final felling (9)	Thinning	Final felling	Thinning	Thinning (11), final felling (14), and not specified (1)
Manufacturers of forest harvesters	Ponsse (3), Komatsu (2), and EcoLog (1)	Timberjack (4), Ponsse (1), Valmet (1), Logman (1)	Valmet (1)	Not reported	Not reported	John Deere (8), Ponsse (8) Komatsu (4), Valmet (3), EcoLog (1), Log Set (1), and Rottne (1)
Type of cabins	Rotated cabin (3) and fixed cabins (3)	Not reported	Not reported	Not reported	Not reported	Rotated cabins (23) and fixed cabins (3)
Number of monitors in the cabin	Not reported	Not reported	Not reported	Not reported	1 monitor (1)	1 monitor (12), 2 monitors (3), 3 moni-

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

						tors (1), and unknown (10)
Country	Sweden	Finland	Finland	Italy (26), USA (3), Portugal (2), Spain (1), Austria (1), and Canada (1)	Sweden	Sweden (7), Finland (6), Austria (2), Poland (1), UK (1), USA (1), France (1), and unknown (5)
Season	Autumn	Summer and autumn	Autumn, winter, and spring	Not reported	Winter	Winter (8) and not winter (18)
Working time	Not reported	Not reported	Not reported	Not reported	Day	Day (22), night (3), and dusk (1)
Ground	Not reported	Even ground	Even ground	Even ground (17) and uneven ground (17)	Not reported	Even ground (23) and uneven ground (3)
Type of tree	Not reported	Pine, spruce, birch, and aspen	Spruce	Not reported	Not reported	Spruce, pine, birch, and hemlock

Note: The parentheses in this table are used to state the quantity of specific information, whenever such information is available.

The collected videos show a diverse set of forest harvesters, such as various brands, type of cabins, and number of monitors installed in the cabin (see Table 1). The diversity also includes other characteristics, such as situations where forest harvesters were used, operators' skills, type of operation, country, type of ground, season, time, and type of trees that were cut. The brands of forest harvesters and the countries, where forest harvesters were used, were determined based on the titles or the captions of the videos. We defined the brand or the country as unknown, when such information was not available. Other types of information, such as operator's gender, experience, type of operation, etc., are determined based on the information collected when watching the videos. When the results of the observation do not provide clear information regarding a specific type of information, it was also written as unknown.

Table 1 also presents the characteristics of samples from the other five field studies mentioned in Section 1 and Section 2, which were used to demonstrate the diversity

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

of samples in the online video study. When there is sample-characteristic information that was not specifically mentioned in the other five field studies, we put it as not reported. It is important to note that the comparison was done to evaluate if the online field study would have limitations and it was not intended to determine which approaches are better.

Although our approach generally provides broad results and a diverse set of samples, the prior field studies were able to provide specialized and in-depth results. Sirén [28] was able to investigate the damage on trees during thinning operations. Nurminen et al. [23] were able to estimate the time consumption of operators of both forest harvesters and forwarders in performing their tasks, while Spinelli and Visser [30] were able to calculate delays in harvester operations. Both Häggström et al. [12] and Wallmyr [33] were able to determine where operators were looking at when performing their tasks.

4.1 Research Questions-Related Findings

Four research questions were defined before the study. The first two questions were made to evaluate whether online videos could be used to gain basic understanding of harvesting operations, while the latter questions were made to find issues and problems when interacting with the machine and performing harvesting operations.

RQ1: How the operators actually operate the forest harvesters?

25 out of 26 collected videos clearly show the order of harvesting operations, including the basic workflow and individual flavors of this work. The videos generally conclude that forest harvesters work in the following order:

1. Selecting which three that will be cut.
2. Driving the forest harvester to the place where the target tree is located.
3. Grabbing the tree.
4. Cutting the tree.
5. Felling the tree.
6. Pulling or lifting the fallen tree to a nearby pile, or starting a new pile.
7. Cutting the tree to shorter logs based on certain lengths.
8. Putting away the remaining parts of the tree that have low or no economic values.
9. Repeat the whole process.

The operation cycle above can be seen in all videos, regardless of external conditions and geographical locations. Moreover, each operation cycle can be performed within a short period, in general, less than 30 seconds. Therefore, several operation cycles can be observed, even though the duration of the videos is just 3 minutes. However, the required time to perform each operation cycle can also increase significantly due to several factors, such as less-skilled operators, working in slopes, trees with long length and wide diameter, dual trees in the harvester head, and the distance from one tree to another. As an example, we found one video where the operator took more than three minutes to completely process a single tree, since the diameter of the tree

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

was quite large, thus the operator had to perform several cuts with the saw in order to fell the tree.

The videos also showcase the two major types of operations using forest harvesters: thinning and final felling. Thinning refers to the activity where operators are required to cut certain trees and keep other trees intact, while final felling refers to the activity where operators are required to cut all trees in the designated area. A thinning operation involves more driving of the forest harvester to the place where the target tree is located, while also avoiding hitting other trees in the area. Thus, making this type of operation tends to be longer for each operation cycle. On the contrary, in a final felling operation, the operator takes more trees from the same location before having to drive the forest harvester to the next location, thus each operation cycle tends to be both simpler and shorter.

From the videos, it was not possible to tell how the operators selected which trees that should be cut or kept in the thinning operations. From 11 videos that showed thinning operations, there was only one video where the trees that should be cut were clearly marked (see Fig. 1). In the remaining 10 videos, the operators were the ones who decided which trees that should be cut or kept. As such, these operators do not only have to operate forest harvesters, but also make judgement on the trees that should be kept or cut down to provide a good condition and prospective value for the remaining trees.

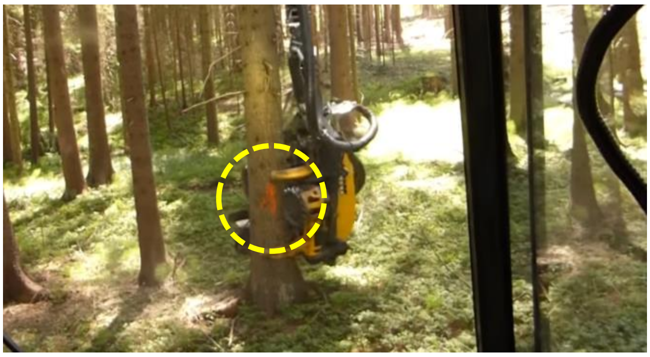

Fig. 1. Trees that should be cut were marked with red paint [21].

While deciding which trees that should be cut or kept, operators are also required to remove unwanted trees in the area. Unwanted trees are trees that are considered to have low or no economical values, which should be removed to give spaces for trees that have economical values to grow. Most operators removed unwanted trees by grabbing, and then cutting them. However, there were a few operators who removed unwanted trees by hitting them down. This was done using two techniques: hitting the unwanted tree down using the harvester head or hitting small unwanted trees while felling bigger trees.

RQ2: How are the situations where the operators work?

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

The collected videos mostly show operators working alone in the forest. 24 out of 26 videos showed that operators were working alone, since no ground personnel or other vehicles, such as forwarders, were seen nearby. There was one video that showed a forwarder around the forest harvester, but no interaction was seen between these two vehicles. The forest harvester was busy in cutting trees, while the forwarder was collecting logs on the ground. In addition, there was also a video that showed two ground workers around a forest harvester. The ground workers were also involved in felling trees. They brought the felled trees near the forest harvester, so that the harvester head could easily grab the trees, delimb them, and then cut them to shorter logs.

The collected videos also show that forest harvesters are used at any time of the day, during the entire year, and in diverse weather conditions. Although most of the operations were done during day time, four videos showed operations at dusk and night (see Table 1). The good lighting on forest harvesters gave a good visibility even at dusk and night. Additionally, eight videos showed operations that were done in winter, which can be observed by the presence of snow on the ground. The operations in winter and non-winter seasons are basically the same.

RQ3: Where the operators are looking at when operating the forest harvesters?
Although we cannot have detailed analysis on areas of attention when operating forest harvesters like what Häggström et al. [12] and Wallmyr [33] have done using eye-tracking glasses (see Fig. 2), we are still able to determine where the operators were looking at when performing their tasks. There are five videos where the recording cameras were attached on the operator's heads, thus we could estimate the direction of operators' attention (see Fig. 2).

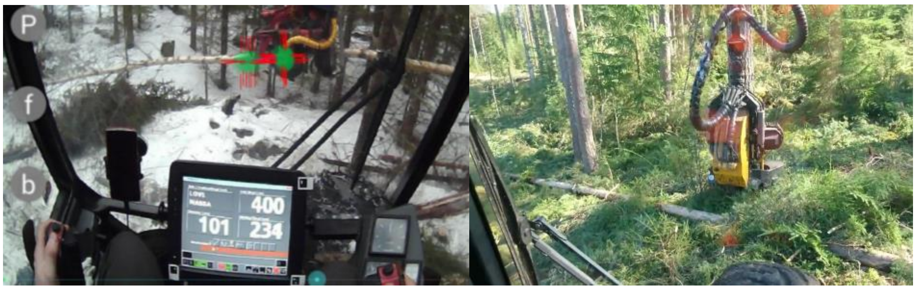

Fig. 2. The left figure shows the view taken using eye-tracking glasses, where the green dots represent the operator's gaze [33]. The right figure shows the view from a camera attached on the operator's head [26].

These videos show that the operators spend most of their time by looking through the front windscreen. This situation is understandable, since most of the operation occurred in front of the cabin. It is even more prevalent in the cabin that can be rotated automatically, following the direction of the harvester head. In this case, the front windscreen is always facing to the direction where the operation is happening. The operators sometimes looked through the left and right windscreens to get a better view when pulling or lifting a felled tree, as well as when driving the forest harvesters. The

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

operators often looked up before and when felling a tree. This was done to ensure that the felling tree will have a clear path when it falls and it will not fall in the wrong direction, which might hit the forest harvester or other standing trees.

RQ4: What are the problematic areas in operating forest harvesters?

Difficulties in operating forest harvesters

From our perspective, 21 out of 26 operators in the collected videos seem to be quite skilled since they were able to perform each operation in one attempt and with a fluent and efficient working process. This makes it more difficult to determine the most difficult parts in operating forest harvesters. However, we can still find few occasions where even skilled operators seem to have some difficulties. There were two videos that showed situations where the operators had to measure the felled tree multiple times, before cutting it. They even had to move the felled tree in a way where the tree's diameter can be seen directly from the front windscreen (see Fig. 3). This problem probably appeared due to the harvester's measuring system was not showing the right measurement based on the operators' intuition. Therefore, they had to verify the tree's diameter using their own eyes. Additionally, there was one video that showed a situation where an operator had a difficulty in removing a tree's branches. However, this kind of difficulties is more related to the forest harvester's capability rather than the operator's skills.

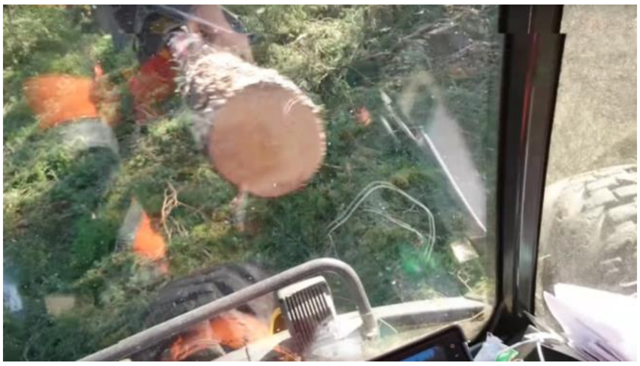

Fig. 3. The operator moved the tree in a way where the tree's diameter can be seen clearly from the front windscreen [26].

Looking at the videos where the operators are less skilled or not familiar with the machine, we can also observe difficult areas in operating forest harvesters. Firstly, moving the harvester head to the target tree is a quite difficult operation, since the harvester head is moved in a 3D space using a boom with several axes and joints. There were three operators who often had to perform several attempts just to grab a standing tree. Secondly, the controls of a forest harvester are complex and different among brands. One video showed this situation, where an operator who was trying a new forest harvester, often had to look at the buttons on the armrests before pressing

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

them in order to avoid pressing wrong buttons (see Fig. 4). This implies that it is not easy to remember all functionalities of the instrumentation in forest harvesters.

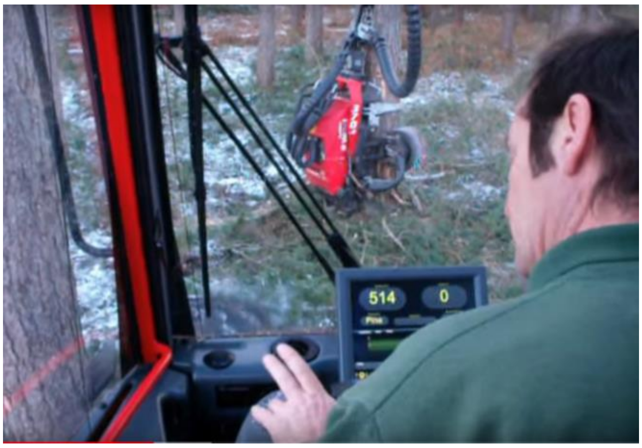

Fig. 4. The operator was looking at the buttons on the armrest before pressing them [8].

Ergonomic issues in operating forest harvesters

One issue in driving these big machines in the forest is the excessive rotation when looking behind the machine. Most modern forest harvesters are equipped with a rear camera and the video stream from the rear camera is displayed on the monitor inside the cabin. This feature enables operators to observe the environment behind the machine easily without having to turn their bodies. However, there were three forest harvesters, where such feature is missing. Consequently, the operators had to turn their bodies every time they were reversing the forest harvester (see Fig. 5).

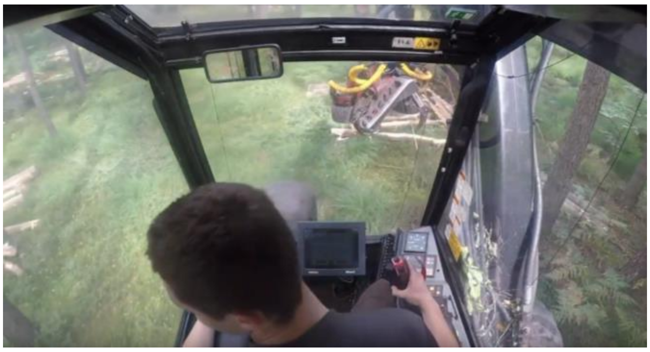

Fig. 5. The operator was turning his body when reversing the forest harvester [31].

From the results for RQ3, we know that the operators often looked up when felling a tree and they also looked through both left and right windscreens when moving the tree or the forest harvester. Those activities were done to get a better visibility, thus implying the current cabin designs do not provide a good visibility for the operators.

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

When performed repetitively, those activities may cause neck injuries to the operators in the long term [24].

Half of the collected videos suggested that forest harvesters generate a lot of vibration. Broadly speaking, forest harvesters generate internal vibration, due to the working engine. The working engine does not only generate vibration, but also loud noise. However, the internal vibration is less prevalent than the vibration caused by external factors, such weight of the tree, uneven ground, and type of operation. Heavier trees cause more vibration than lighter trees. Similarly, working on slopes also causes more vibration than working on even grounds. Lastly, thinning operations tend to produce more vibration since operators are required to drive the forest harvester more frequently. The vibration may cause musculo-skeletal injuries to the operators' body [14].

In the videos, where the operators' hands were visible, we can also observe that operating a forest harvester involves excessive controls of the joysticks. This situation may cause muscular strains on the operator's hands in the long term if the design of the armrests, including the joysticks, does not match with the operator's physical needs [22].

5 Discussion

The results from the online video study seem promising, since it provided a method to efficiently obtain a lot of field samples and the results are comparable to the findings gained from traditional field studies. However, conducting an online video study using available videos on YouTube also has its own advantages and disadvantages that might affect the outcome of the study. We will here discuss about our approach in relation to traditional field studies. As designers, we were encouraged to reflect on our practices [25]. These reflections were made based on the experience of the author who has prior knowledge on forest harvesting operations, including real field studies, and the other author who was relatively new to both field studies and forest harvesting operations. Our purpose with the online video study was to evaluate whether we could gain understanding on how operators of forest harvesters work in the field, like the ones conducted by Häggström et al. [12], Nurminen et al. [23], Sirén [28], Spinelli and Visser [30], and Wallmyr [33].

5.1 Advantages of Alternative Field Study

We will first highlight the advantages of conducting the online video study in this context.

Easy to obtain a large and diverse set of samples.

The online video study provides a very efficient approach to obtain an overview of operations from different sources, operators, working situations, and environments. As shown in Table 1, the online video study has a much larger number of operators than what the other four prior studies had. At the same time, larger samples also bring

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

more diversity in the types of forest harvesters used, working situations, and operators' background. The collected videos also showed the use of forest harvesters in several different locations and countries. This is in comparison to prior field studies of forest harvesters, where four out of five field studies were conducted in a single country. Additionally, Nurminen et al. [23] and Häggström et al. [12] specifically reported that their results are valid for the specific country, where their field studies were conducted.

Broad results

Diverse samples also provide a broader set of results, while at the same time being able to provide comparable results to prior field studies that we have compared to. For example, Nurminen et al. [23] were able to provide highly-detailed analysis of the time consumption cycle, and this could also be estimated through an online video study. Both Häggström et al. [12] and Wallmyr [33] were able to provide highly-detailed analysis of operators' attention using eye-tracking glasses, while Siren [28] and Spinelli and Visser [30] were able to respectively provide exhaustive analysis on tree damage and delays in harvesting operations. These kinds of details are not possible to gain through the online field study, since the data were collected using specific devices. Nonetheless, we can still generally estimate where operators were looking at by observing the videos that were taken using cameras on the operator's head.

Adaptability and flexibility

The results in the online video study were obtained by analyzing the collected videos based on the defined search criteria. Expanding or changing the scope of the research can be easily done by changing the search criteria. As an example, the scope can be changed to a specific country by searching for keywords in the language of that country. In the case of traditional field studies, it is not so feasible to change the scope of the research, since the researcher needs to do everything from zero again.

Time saving for collecting the videos

Conducting an online video study takes away the time needed to visit the place where the research subject is located, since the videos are stored on the internet and publicly available with no cost. Gaining the same kind of result through physical visits would require a substantially larger effort and investment. Wallmyr [33] specifically reported that it took him several hours to be present at the working site, where forest harvesters were used. In addition, the time needed is supposed to be even longer if the time spent for preparing the field study is also considered.

Safer option for the researcher

In traditional field studies, the researcher has to be physically present in situ. By doing that, researchers are vulnerable to any accident that may happen at the work site. Although accidents when conducting forest harvesters-related field studies are unheard, accidents that involved ground workers and operators are sometimes occurring

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

[10]. Moreover, from the results for RQ2, we know that forest harvesters are used at any time during the entire year, regardless of the season. There is also a risk where the weather might hinder the study.

Less ethical issues

Using videos on YouTube as the research data provides less ethical issues than collecting the data through traditional field studies, especially in terms of privacy. In traditional field studies, the researcher needs to be careful and transparent in collecting, presenting, and storing information of the research subject [18]. On the other hand, videos on YouTube are considered as public data, thus privacy is no longer an issue [17].

Lack of intrusiveness

The presence of the researcher in a field study may influence the research subject, thus making the collected data less representable of normal work conditions [19]. This phenomenon has also been observed in the context of forest harvesters, where operators tend to perform better during the study than normal working situations [23]. From 26 videos that we have collected, only four videos were recorded by someone else inside the cabin. The remaining 22 videos were recorded by the operators themselves. Although there is still a possibility that the operators might be pretending when the videos were recorded [1], the self-recorded videos do not provide intrusiveness like what traditional field studies do. Although this is not a guarantee for unbiased behaviors, however, as an example, there was an operator who put his left foot on the dashboard while operating the forest harvester (see Fig. 6). This unique behavior is unlikely to occur when there was someone else inside the cabin.

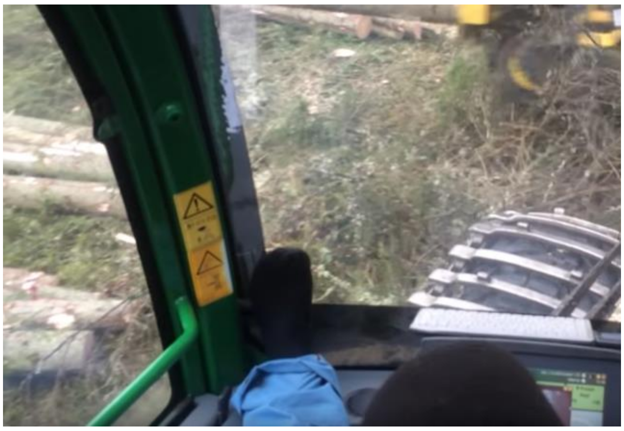

Fig. 6. The operator put his foot on the dashboard while operating the forest harvester [13]

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

5.2 Disadvantages of alternative field study

There are several things that the online video study lacks to achieve with respect to traditional field studies.

Lack of multi-sensory experience of being on-site

Observing via videos limits what can be experienced in the real world to visual and audio information only. It also lacks the same degree of detailed information as within a real situation, for example, a sound might be heard, but it is much harder to assess the direction and its source. Other types of information, such as vibration, can be seen in the videos, but it is much harder to assess how it affects the interaction. The view is also locked to the direction of the camera, making it impossible to look around and asses how the interaction is affected by what is happening in the surroundings, or what kind of information that the operator might be missing. Moreover, the videos cannot convey the working conditions in the same way, such as the machine status that can be heard and felt through the engine's revolutions per minute (RPM), the hydraulics operation, and the machine's vibration when a tree falls to the ground. The videos can neither give the same understanding of the operators' situation, for example, when the machine is leaning on a slope, moving over a big rock in the ground, or hitting into a tree when driving through a small passage.

Prior domain knowledge is recommended

Having prior knowledge in the domain is very valuable to understand what is really happening in the videos, thus enabling the researcher to gain valuable information [19]. However, although the researcher has no prior knowledge, conducting an online video study is still useful if the purpose is to increase the domain knowledge, which could help the researcher to prepare sufficiently before conducting an actual field study.

Limitations for custom setups

The position and the angle of the camera highly influence what kind of information that can be observed. From 26 videos, we identified four different positions of the camera: attached on the dashboard, attached on the operator's head, attached behind the operator in the cabin, and held by another person inside the cabin. Each positioning provides different information. For example, videos that were recorded using a head-mounted camera provide information on where the operator was looking at. However, this kind of videos does not show the operator's body, thus limiting the possibility to observe ergonomic issues. The opposite situation appears using videos that were recorded from behind the operator, where the operator's body is visible, but we are unable to see where the operator was actually looking at. If we then add additional requirements, for example, the videos have to show the operator's hands, the number of relevant videos gets even smaller.

Lack of interaction with the operator

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

Another missing aspect is the interaction with the operator of the machine. In traditional field studies, a two-way communication can happen as the researcher meets and rides with the operator, where questions can be asked directly on what is happening during operations. Additionally, the researcher can also ask the operator to do a think aloud session [6] or discuss findings with the operator. On the contrary, having this kind of communication is not possible in an online video study [17, 19]. However, platforms, such as YouTube, allow its users to interact with each other, so the researcher can still post a question in the comment section. The problems with this approach are the disconnection between the times when the question is asked and when the videos were recorded, the delay in having follow-up questions, and the risk that it will take a long time to for a question to be answered, if it will be answered at all.

Difficulties to dig into details in terms of interaction

Due to the angles from where the videos were recorded, it is not really possible to see the interaction between operators, controlling instruments, and presented information inside the cabin. For example, since operators' hands were rarely visible, it is difficult to determine what kind of inputs given by the operator. In addition, even though monitors were visible in some of the videos, it was not possible to follow the flow of information or how the operator utilized the presented information. In traditional field studies, the researcher can observe these activities directly.

Reduced situation awareness

Another missing aspect in the videos is the coordination between the operator's attention to different areas and what is happening in the surroundings. In some videos, it is possible to see how the operator was rotating his head, but it was difficult to simultaneously see the area and then judge what the operator was looking at, as it could be outside of the visible range of the camera. Being present in the field, it is easier to develop an understanding of the situation and determine where the operator is looking at. Having said that, either of these approaches is really comparable to combined approaches, such as eye tracking, to find out where the operator is paying visual attention.

Lack of information regarding the operator

To judge the experience of an operator might also be difficult in traditional field studies. However, when the researcher meets the operator, there is an opportunity to ask experience-related questions to the operator. This is even more difficult in this online video study, since we judged their experience based on how well the operators perform their work. The result might also be biased to the type of interested operators that are interested in technology, to the degree that they also have the equipment and knowledge to produce and upload videos.

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

5.3 A complementary or alternative approach?

Being able to understand the user "in the wild" is a necessity to provide good interaction design and user experience [5]. As shown in the previous sections, the online video study provides an efficient way to perform observation on real users in the wild. The approach also has some benefits and some drawbacks compared to traditional field studies. Can online video studies then be an alternative to traditional field studies? Well, in some cases, yes, and in some cases, no. To fully compare the level of the results, each method will require additional studies and comparisons. Online video studies do provide comparable results to traditional field studies in terms of understanding operators' processes and basic behaviors, thus the approach can be considered as an alternative when real field studies are difficult to perform. However, their different advantages and characteristics rather make them complements then alternatives. Online videos cannot replace the high fidelity and rich-information evaluations that could be achieved by taking part together with the operator in the real environment.

Using online videos is however a valuable complement, either as a main study or an initial study prior to conducting an actual field study. We can see this advantage since one of the authors, who observed the videos, is relatively new in the domain and has no experience in conducting a field study in this context. Here, the online video study became a base to learn about things like the process of operation, to make initial findings, and to get questions to ask. However, solid domain knowledge is less viable to obtain using this approach, since it is difficult to distinguish between planned behaviors and interactions in different situations based on particular details of interest. The online video study can also be a complement to field studies, as seen from one of the authors who have more experience in harvesting operations, since the videos could be used to align or provoke earlier findings and knowledge. The bigger set of samples also made it possible to see more occasions on identified and potential issues or problems.

6 Conclusion

The paper presents a complementary approach for conducting field studies in remote locations, using available online videos. There are two driving factors for this complementary approach: (1) conducting traditional field studies might be difficult to perform due to the remoteness of the location where the research subject is situated and (2) the increasing availability of publicly available videos on the internet as research data source.

To give a context for the study, we set out to perform a study of forest harvesters' operators in their natural settings. As the name implies, forest harvesters are used in the forests, thus there is a lack of accessibility to the working site. The online video study was started by searching for suitable videos on YouTube. 26 videos matched the criteria that have been set, resulting in a diverse set of samples of forest harvesters, operators, and working situations. Each video was then viewed against a set of research questions, as well as to find qualitative results.

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

To further evaluate the feasibility of our approach, we compared it with five existing papers, where traditional field studies were used to study forest harvesters-related issues. Sirén [28] investigated the damage on trees during thinning operations. Nurminen et al. [23] studied the time consumption of operators of both forest harvesters and forwarders in performing their tasks, while Spinelli and Visser [30] specifically studied delays in harvesting operations. Both Häggström et al. [12] and Wallmyr [33] investigated where operators are looking at when performing their tasks using eye-tracking glasses.

The online video field study generates a lot of data and the diverse set of samples also brings broader results compared to the other five field studies. It is possible to generate similar information after analyzing the videos, but the results from the videos do not provide the same level of details as the other five field studies. Moreover, using videos on YouTube as a source of research data provides several advantages that traditional field studies struggle to offer, such as bigger and diverse samples, broader results, time saving, etc. At the same time, the online video study also has some disadvantages that traditional field studies do not have, such as the need for prior knowledge, the lack of multisensory information, reduced situation awareness, etc.

Finally, this paper does not only contribute to the understanding of how operators work in forest harvesters in natural settings, but also assess the feasibility of conducting an online video field study when the research subject is located in remote locations. The results are promising and imply that researchers can learn a lot from analyzing videos that have been produced by other people and made public through online media. It is up to the researcher to decide whether to conduct a traditional field study or an online video study depending on research needs and available resources.

7 Acknowledgements

This research has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement number 764951, CrossControl AB, and the Swedish Knowledge Foundation (KK-stiftelsen) through the ITS-EASY program.

References

1. Angela Cora Garcia et al.: Ethnographic Approaches to the Internet. J. Contemp. Ethnogr. 38, 1, 52–84 (2010).
2. Barbour, R.S.: Quality of Data Analysis. In: Flick, U. (ed.) The SAGE Handbook of Qualitative Data Analysis. pp. 496–509 SAGE Publications Ltd, London (2013).
3. Brouwer, B.: YouTube Now Gets Over 400 Hours Of Content Uploaded Every Minute, https://www.tubefilter.com/2015/07/26/youtube-400-hours-content-every-minute/. [Accesed on 4 January 2019].
4. Burman, L., Löfgren, B.: Human-machine interaction improvements of forest machines. In: Forest Engineering Conference. (2007).
5. Buxton, B.: Sketching user Experiences. Morgan Kaufman (2007).

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

6. Collins, A. et al.: Cognitive apprenticeship: making thinking visible. Am. Educ. 15, 3, 6–11, 38–46 (1991).
7. Farias, A.O.: Exploring opportunities for the integration of GNSS with forest harvester data to improve forest management Exploring opportunities for the integration of GNSS with forest harvester data to improve forest management. University of Canterbury (2016).
8. https://www.youtube.com/watch?v=uRZ9ST67UWY. [Accesed on 4 January 2019].
9. Fusaro, V.A. et al.: The potential of accelerating early detection of autism through content analysis of youtube videos. PLoS One. 9, 4, 1–6 (2014).
10. Ghaffariyan, M.R.: Analysis of forestry work accidents in five Australian forest companies for the period 2004 to 2014. J. For. Sci. 62, 12, 545–552 (2016).
11. Giglietto, F. et al.: The Open Laboratory: Limits and Possibilities of Using Facebook, Twitter, and YouTube as a Research Data Source. J. Technol. Hum. Serv. 30, 3–4, 145–159 (2012).
12. Häggström, C. et al.: Examining the gaze behaviors of harvester operators: an eye-tracking study. Int. J. For. Eng. 26, 2, 96–113 (2015).
13. https://www.youtube.com/watch?v=9QAZxF-hxyI. [Accesed on 4 January 2019].
14. Jack, R.J., Oliver, M.: A review of factors influencing whole-body vibration injuries in forestry mobile machine operators. Int. J. For. Eng. 19, 1, 51–65 (2008).
15. Jankovský, M. et al.: Objective and subjective assessment of selected factors of the work environment of forest harvesters and forwarders. J. For. Sci. 62, 1, 8–16 (2016).
16. Kozinets, R.: Netnography: Redefined. SAGE Publications Ltd, London (2015).
17. Kozinets, R. V et al.: Netnographic Analysis : Understanding Culture Through Social. In: Flick, U. (ed.) The SAGE Handbook of Qualitative Data Analysis. pp. 262–276 SAGE Publications Ltd, London (2013).
18. Mack, N. et al.: Qualitative Research Methods: A Data Collector's Field Guide. Family Health International, Durham, North Carolina, USA (2005).
19. Marotzki, W. et al.: Analysing Virtual Data. In: Flick, U. (ed.) The SAGE Handbook of Qualitative Data Analysis. pp. 450–564 SAGE Publications Ltd, London (2013).
20. Miettinen, M. et al.: New Measurement Concept for Forest Harvester Head. In: Field and Service Robotics. pp. 35–44 Springer, Berlin, Heidelberg (2010).
21. https://www.youtube.com/watch?v=irDxNnzM868. [Accesed on 4 January 2019].
22. Murphy, T., Oliver, M.L.: Development and design of a dynamic armrest for hydraulic-actuation joystick controlled mobile machines. Appl. Ergon. 39, 3, 316–324 (2008).
23. Nurminen, T. et al.: Time consumption analysis of the mechanized cut-to-length harvesting system. Silva Fenn. 40, 2, 335–363 (2006).
24. Østensvik, T. et al.: Muscle Activity Patterns in the Neck and Upper Extremities Among Machine Operators in Different Forest Vehicles Muscle Activity Patterns in the Neck and Upper Extremities Among Machine Operators in Different Forest Vehicles. Int. J. For. Eng. 19, 2, 11–20 (2008).
25. Schön, D.: The reflective practitioner, How professionals think in action. Basic Books, New York (1983).
26. https://www.youtube.com/watch?v=H4NXA3rejyg. [Accesed on 4 January 2019].
27. da Silva Lopes, E., Pagnussat, M.B.: Effect of the behavioral profile on operator

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**

performance in timber harvesting. Int. J. For. Eng. 28, 3, 134–139 (2017).
28. Sirén, M.: Tree Damage in Single-Grip Harvester Thinning Operations. Int. J. For. Eng. 12, 1, 29–38 (2001).
29. Snelson, C.: YouTube across the disciplines: A review of the literature. MERLOT J. Online Learn. Teach. 7, 1, 159–169 (2011).
30. Spinelli, R., Visser, R.: Analyzing and Estimating Delays in Harvester Operations. Int. J. For. Eng. 19, 1, 36–41 (2018).
31. https://www.youtube.com/watch?v=kH1p6rN9ve8. [Accesed on 4 January 2019].
32. Walford, G.: The practice of writing ethnographic fieldnotes. Ethnogr. Educ. 4, 2, 117–130 (2009).
33. Wallmyr, M.: Seeing Through the Eyes of Heavy Vehicle Operators. In: Human-Computer Interaction - INTERACT 2017. pp. 263–282 Springer (2017).
34. Zöscher, J.: Education and Work Safety in Forestry – Situation in Austria. In: Proceedings of the 43rd International Symposium FORMEC. Padova (2010).

This document is the accepted version of the conference paper published at Springer. The final publication is available at Springer via **https://doi.org/10.1007/978-3-030-29387-1_21**