Are Standard Solutions Good Enough?

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Abstract. Remote collaboration on physical objects is a topic of recurring interest within the CSCW community. Up until now, research has primarily focused on stationary settings with specially designed technical support to address problems of reference due to non-mutual access to the object. In this workshop paper I present remote truck service as an example of work practices that require mobile remote collaboration tools. To facilitate the use of such tools, my proposal is to use generic solutions. Thus, the question is raised whether standard technologies, such as mobile phones, could be good enough to support remote collaboration and specialist diagnosis on physical objects in mobile settings of mass scale industries.

Introduction

CSCW researchers have been studying computer support for remote collaboration on physical objects and tasks where the lack of mutual access to the object introduces interactional problems (Kraut et al. 1996; Kuzuoka et al. 1994). Most design solutions introduce a need for substantial technological support that is designed for stationary and well defined settings, including, e.g., high Internet bandwidth or predefined interaction interfaces (Fussell et al. 2003; O'Neill et al. 2005; Yamazaki et al. 1999). However, mass scale application areas such as remote vehicle support do not allow additional technologies to be introduced due to economical constraints. By presenting and discussing findings from an ethnographic field study at a European call centre for remote truck services, I provide insights from a highly mobile and unpredictable setting that currently lacks tools and methods to conduct valuable diagnostic work at an early stage of the remote help giving process.

By analyzing problems in remote collaboration between troubleshooters and truck drivers, I argue that current remote collaboration tools, both linked and mediated (Kirk et al. 2005), are not applicable to mobile and mass scale setting. The constraints of this domain challenge the current body of knowledge of remote collaboration on physical objects. However, common mobile phone technology could serve as a basis for future remote collaboration services in such settings. Examples are provided in this paper as a foundation for further discussions. In general this workshop paper aims to discuss how mundane technologies could and must serve as foundations for remote troubleshooting in future mobile and mass scale settings and in what way the CSCW community should engage in this development.

Fieldwork Observations

The empirical data were collected in an ethnographic field study at a European truck manufacturer's call centre. The call centre serves as a 24/7 phone support for truck drivers in Europe, experiencing a breakdown that requires immediate repair service. The operator's main objective is to communicate with the driver in the appropriate mother tongue, locate the truck, gather a basic understanding of the problem and allocate resources to solve the breakdown as quickly as possible. The duration of breakdowns is critical to both drivers and the vehicle manufacturer. The driver has to deliver goods on time and the vehicle manufacturer, in most cases, guarantees the customer a certain level of vehicle uptime. Thus the operators' problem description, communicated to the repair mechanic traveling to the breakdown site, is of great importance to prepare for the service by e.g. collecting appropriate spare parts. Currently, operators do not provide any valuable diagnosis, which hampers the repair process.

The study was conducted during 4 days by observing operators, and listening to their phone communication, followed by clarifying questions. Since it was technically impossible to simultaneously listen and record phone calls, notes were taken and the operator's voice was recorded as a help in transcribing and analyzing the data. Observing the operator's interaction with different call management systems was included in the study as well, since this provides an understanding of how the operator interprets and forwards the driver's problem description. The study was limited to three operators with focus on two of them. By following only a few operators, I was able to gather a deeper understanding of their work practice since I could compare different situations and reflect upon these together with them.

In the following sections, I outline three ways in which drivers provide problem descriptions to the operator. In general, the driver's description mainly focuses on explaining the problem by reference to modular spare parts that could cause the problem or be affected by it. Vehicle diagnosis thus deals with identifying malfunctioning spare parts to quickly replace them, not repairing them.

Identifying

Even though operators claim drivers to lack technical knowledge, some drivers describe problems by telling operators the spare part linked to the problem, as shown in the following three extracts:

Extract 1: “Right mirror and right side window broken”
Extract 2: “hub bearing of left front wheel”
Extract 3: “only the Bowden-cable is torn off, you know only 30 cm“

By watching the operators’ actions during phone communication, it was found that operators only type into the call management system what the drivers are telling them. This shows a lack of competence among operators to use drivers’ descriptions in a diagnosis or that the two collaborators make use of different sets of vocabulary, which causes fractures. Upon questioning the operators on this problem, they argued it to be more valuable for the mechanic to receive the original information than their own interpretation. Thus, operators consider themselves as mediators and not diagnosticians. Operators do have access to different analytic tools, but these, mainly knowledge bases, are only searchable by either entering the technical term or pointing to the spare part on interactive sketches. However, drivers do not use the exact technical terminology and operators lack knowledge to understand and translate.

Referencing

Another way of trying to establish a shared understanding of the problem, as the following extracts show, is to make use of references to known parts of the vehicle. The extracts are all notes taken from the call management system, where operators have entered the problem description. Even here operators do not share the pictures and landmarks customers refer to and do not try to re-establish them, but anticipate that mechanics will understand what the customers refer to.

Extract 5: “on right hand side water tube going into cab 3cm thick making a hook”
Extract 6: “Leakage of coolant, close to turbocharger, difficult to distinguish from where exactly”
Extract 7: “Water leakage behind the retarder – near gearbox – hose or seal connection broken – lost all cooling liquid”

Extract 8: “There is a light like cardiogram of the heart – line up and down – lighting on dashboard”

Extract 9: “Coolant hose broken at the very top of the transmission – lost coolant“

Extract 10: “The shaft got warm on the right side und and there was a fire on top of the cylinder“

Extract 11: “next to battery box coming out of small black box”

These extracts show that the drivers have identified problem areas that are of value to the problem diagnosis. Compared to the previous section, drivers do not provide a clear term for the problem area or spare part. They instead make use of references to, for them, known parts.

Referencing

It is interesting to observe, that a number of drivers call their home dealer first to describe and discuss the problem, before calling the call centre. Dealers even recommend their customers to do this in order to conduct a remote diagnosis that lowers the total breakdown costs. Since the home dealer is a skilled mechanic, as opposed to the operator, she can translate the driver’s description into a unique spare part number comprehensive to the breakdown mechanic, as extract 4 shows.

Extract 4:

Caller: “I’ve got a problem. The coolant hose is blown off. I even have the part number.”

Operator: “Great! “

Caller: “Of course, I always start to call my home dealer. The part number is 5010418450.”

This example indicates that verbal descriptions are good enough as long as the interpreter is knowledgeable to translate the descriptions into a standardized vocabulary that can be actively used in the following repair process. Due to the research setup, I was not able to study the diagnostic call between mechanics and drivers. However, insights from previous research (Kuschel et al. 2004) point to mechanics’ local knowledge of the customer (if he e.g. is knowledgeable or often exaggerates) and the specific vehicle, to be crucial in vehicle diagnostics.

In general the extracts show that vehicle drivers make use of verbal images and landmarks, such as known parts of the vehicle, to share their experience of a problem. Operators do not try to repair the fractures but pass the problem description to the breakdown service technicians in the hope that they will understand or just travel to the breakdown spot to conduct a diagnosis. However, there is great interest in the vehicle industry to increase the early diagnostic work conducted by operators, to identify broken spare parts and speed up the breakdown service. In the following section I will discuss design ideas that aim to support early vehicle diagnostics by the operator.

Sharing references

In contrast to previous studies of remote collaboration on physical objects, I here study remote collaboration in mobile settings. Mobility implies that support tools have to be designed flexible enough to be useful in a number of undefined and different settings. Current linked and mediated systems do not fulfill these requirements. Furthermore, the economic constraints of commercial mass scale markets, such as vehicle services, do not allow for additional technologies to be introduced. Even though prolonged breakdowns are expensive, the cost does not balance the cost of installing additional remote collaboration technology in all vehicles, including those that never break down. Thus there is a demand for remote collaboration techniques that are applicable in mobile settings and do not introduce extensive additional costs. To my knowledge there is no documented research that addresses design of remote collaboration techniques under these constraints, even though there is an increasing demand within the product service industry.

O'Neill et al. (2005) argue for the use of existing device sensor and screen interaction technologies as a basis for remote help giving solutions. Even though vehicles are equipped with even more sensors than photocopiers, the use of sensors as described by O'Neill et al. (ibid) is not applicable to remote help-giving in the vehicle industry, since the driver, due to the technical complexity of vehicles, cannot conduct any guided repair as in the case of photocopier repair. Nevertheless their research indicates the need of remote collaboration techniques that make use of already available hardware.

As the field data shows, vehicle drivers outline problems by describing the possible location of the problem. In doing so, they make use of references to landmarks such as characteristic or known parts of the vehicle. However, understanding these references requires the operator to make use of the same references, which is not always the case because operators and drivers have different terminologies.

Making use of mobile phones

By analyzing the field data it turns out that operators and drivers do not succeed in establishing a shared understanding of what part of the vehicle they are referring to. Since operators choose to pass forward drivers' descriptions to the mechanic, there is no joint problem diagnosis either. Operators have access to different knowledge bases and guided diagnostic tools, but these require a standardized spare part definition as entry point. With the current gap between the non formalized verbal images of the drivers and the formalized structure of diagnostic systems, future remote collaboration tools have to focus on assisting operators and drivers to establish a shared understanding of what part of the vehicle each of them are referring to and link this understanding to additional knowledge bases and diagnostic systems.

Remote collaboration technologies for mass scale market industries require commonly available hardware to guarantee accessibility and cost efficiency. Since all calls to the repair service call centre are made by mobile phones, they form a basis as infrastructure for future remote collaboration services. However, the field data also indicate that voice communication only, is not good enough to establish a shared understanding, necessary for further diagnostic work. Today’s mobile phones include advanced imaging and data transfer possibilities, which provide additional means of interaction. The driver could simply send a photo of the relevant part by MMS for the operator to interpret. Or, he could engage the operator in video communication, but previous research (Heath et al. 1991) points to the risk of introducing additional interactional problems, which is likely to be the case in mobile settings too.

To minimize the risk of adding interactional problems, I argue for technical solutions that focus on addressing the actual fracture in current remote interaction between operators and drivers. Thus, the problem to be addressed is the lack of mapping physical objects to digital representations. This is a known problem and research issue in other domains, such as, e.g., image based web search (Tom et al. 2005), but not yet proven as a support in remote collaboration. Progress in picture analysis by the two dominating methods, Scale-Invariant Feature Transform SIFT and bag of features, already enables object identification in prototype environments. The ambition of this research is to further investigate in what way object identification techniques could be applicable to support remote collaboration on physical objects to support the translation from physical object to a standardized digital representation. By this, the driver could point to a broken hose with a mobile phone which, after the picture analysis, provides the operator with an identification of the hose in a 3D model on the computer screen. From there on additional diagnostic action could be accomplished.

Conclusion

By analyzing how drivers and operators talk about the experience of problems, I argue that voice communication is good enough as long as references to the problem setting can be shared. Different terminologies and the absence of access to the remote site result in fractures that cause misunderstandings. To support the use of references, I propose mobile picture object analysis that addresses the mutual availability of references but maintains the benefits of voice communication and diagnostic reasoning.

The more general contribution is to highlight that the constraints of mobile and large scale operations do not match the current design solutions for remote collaboration on physical objects, in which advanced linked and mediated systems dominate. Therefore, the CSCW community should rely more on mundane mobile services and standard technologies as future tools for remote collaboration on physical objects in mobile and mass scale settings.

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