

Master Thesis

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AmbientTeams

An approach to stay socially connected in
remote teams

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Abstract

With the shift towards remote work, casual, informal conversations are no longer guaranteed to happen because of the lacking serendipity. Such informal discussions are further challenged because of missing cues from co-workers about their availability or social states. In addition, despite increased challenges with mental health, tools focusing on the social challenges of remote work are still lacking. For this reason, we developed AmbientTeams, a casual and informal tool that attempts to reduce the perceived distance in remote work by creating opportunities for more informal interactions. AmbientTeams attempts to achieve this by sharing moods and status messages with the team, or more generally, fostering informal communication among team members. We evaluated our research prototype on a group of 6 knowledge workers who agreed on using AmbientTeams for one workweek. We found ...

Zusammenfassung

Mit der Verschiebung in Richtung Fernarbeit sind zwanglose, informelle Gespräche aufgrund der fehlenden zufälligen Zusammentreffen nicht mehr garantiert. Solche informellen Gespräche werden außerdem durch fehlende Hinweise von Kollegen über ihre Verfügbarkeit oder ihren sozialen Status erschwert. Darüber hinaus gibt es trotz der zunehmenden Herausforderungen im Bereich der psychischen Gesundheit immer noch keine Tools, die sich auf die sozialen Herausforderungen der Fernarbeit konzentrieren. Aus diesem Grund haben wir AmbientTeams entwickelt, ein zwangloses und informelles Tool, das versucht, die wahrgenommene Distanz bei der Fernarbeit zu verringern, indem es Möglichkeiten für informellere Interaktionen schafft. AmbientTeams versuchte dies zu erreichen, indem es die Möglichkeit schafft, Stimmungen und Statusmeldungen mit dem Team zu teilen, oder allgemeiner gesagt, die informelle Kommunikation zwischen den Teammitgliedern fördert. Wir evaluierten unseren Forschungsprototyp an einer Gruppe von 6 Wissensarbeitern, die sich bereit erklärten, AmbientTeams eine Arbeitswoche lang zu nutzen. Wir fanden ...

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Introduction

In Software Development, remote working has become very popular over the past years. Due to the Covid-19 pandemic, this trend has grown even stronger, forcing many companies and their employees to work from home. Further, the majority of managers expect to have more flexible work from home policies post-pandemic, and employees would like to continue working from home at least partially [Spa20b], making the topic very much relevant also after the pandemic.

While working from home has numerous benefits, it also comes with a range of challenges. On the benefits side, employers can realize savings in real estate costs, and the employee can benefit from more flexible work hours and spending less time and money commuting [Mul+09]. However, shared challenges from working from home are that communication is reduced [KEG88] and suffers in quality [Mul+09]. More specifically, informal communication drastically reduces when working from home [HM05]. This reduction of informal communication can lead to difficulties building trust, maintaining work relationships, or not feeling attached to the team [Com+20; OO06]. Another consequence of remote work is the feeling of workplace isolation [Mul+09; MMM07]. The feeling of isolation leads to not knowing whom to turn to in case of a problem or not feeling part of the company and is said to be caused by missing support from co-workers and opportunities for social and emotional interactions in a team [MMM07]. The pandemic further reinforces this influence leading to almost 60% feeling less connected to their co-workers compared to before the pandemic [Spa20b]. Since strong team cohesion has been shown to have a positive impact on the team's effectiveness and productivity [Car+17], and the feeling of being disconnected from colleagues have been shown to impede engaging in productive tasks [Eco20], the connectedness with the team is of particular interest to us.

A lack of awareness causes the challenges of working remotely: less information about co-workers is exchanged, e.g., no or fewer cues are available to identify team members' interruptibility or emotional states. This missing information makes it a lot harder to find opportune moments to initiate a conversation because it is often unknown whether a person might be in a deep focus state or whether a person might be more than happy to chat. Informal communication is further challenged because serendipity is missing when working remotely because people no longer randomly bump into each other at the water cooler or the coffee machine. Therefore, improving awareness in the workplace is the foundation of our approach.

While there are several prior approaches to improve awareness within teams by showing the current coding tasks and work items that others are working on [Bie+07; Jak+09], they do not focus on the person behind that work item. They thus do not put teams into the center of attention. To make this point stronger, recent research shows concerning numbers in regards to workers' well-being and mental health, stating that the pandemic has led to an increase in stress for 65.9% of people and 44.4% reported a decrease in mental health [Qua20]. Therefore, our concept, AmbientTeams, follows a different approach by "putting the people first". It includes an

ambient always-on-top overview of the core team members and their moods, status messages, and other states. Other solutions (e.g., [ES10; ES08; Zha+10]) follow a similar philosophy by studying micro-blogging at the workplace, an informal and easy way of broadcasting short texts. Their results look promising and indicate higher connectedness with team members. Extending the purely text-based microblogging systems, Dullemond et al. [Dul+13] developed a microblogging system that shares selected moods in addition. We use their idea as a foundation for our work, to study the behavior of mood sharing when making it optional, something that was not done by Dullemond et al. [Dul+13].

In addition to microblogging, we aim to study further possibilities to foster and motivate serendipitous, informal exchanges with the team or individual team members while keeping interruptions at inopportune moments low.

In the next chapter, existing approaches are discussed before our approach, and their differences are introduced. Our approach is then analyzed in the scope of a preliminary evaluation, and its results are discussed.

Related Work

Remote work offers numerous benefits for both the employee and employer compared to traditional co-located work. Benefits on the employee side include a more flexible schedule, higher job productivity, and less time and money spent commuting [Flo19; Mul+09]. The increased flexibility and autonomy allows employees to more easily deal with their family responsibility and leads to higher levels of job satisfaction and higher employee retention [Mul+09; GH07; Mad11], both highly beneficial for the employer. The employer can further profit from savings in real estate costs and increased productivity [Mul+09]. In addition to those general benefits, there is another popular reason for building distributed teams: the possibility to build teams with talents from all over the world [Car99].

However, remote work creates new challenges for the company and its employees. Therefore, it is not surprising that much research has been done in this area, most of which coming from Computer-Supported Collaborative Work (CSCW). The general goal of existing solutions is to support distributed teams in accomplishing work as effectively and efficiently as possible. While a lot of research goes into collaboration and coordination challenges in remote work, the goal of AmbientTeams is fostering social, informal interactions. As a result, we identified four main social challenges that are the result of working remotely. Together with existing solutions aiming at solving those problems, all of them are discussed in this chapter.

2.1 Workplace Isolation

Marshall, Michaels, and Mulki [MMM07] defines workplace isolation as the "[...] desire to be part of the network of colleagues who provide help and support in specific work-related needs. It represents employees' perceptions of availability of co-workers, peers, and supervisors for work-based social support." They further suggest a categorization into social isolation and organizational isolation. Organizational isolation comes from the perception that remote workers might feel "out of sight, out of mind" [BK99]. Social isolation relates to the fact that remote workers miss informal chats, spontaneous discussions, and meetings around the water cooler [CK02]. For those reasons, a closer look at informal communication will be given in the following.

2.2 Communication

Research states that co-workers are the most used source of information used by developers [KDV07], emphasizing the importance of team communication inside software development teams.

In the context of remote work, studies find different results regarding the communication frequency: while Kraut, Egidio, and Galegher [KEG88] and Allen et al. [All+84] find a decrease in communication, Mulki et al. [Mul+09] find increased communication. A possible reason for more communication include the need for remote workers to over-communicate their availability status to their co-workers [KSO12]. Reasons for communication reduction could be the active effort to bring back ad-hoc meetings [Mil+21]. Regardless of communication frequency, working remotely and thus using software to communicate leads to having more misunderstandings due to missing cues and thus reduces communication effectiveness [Mul+09]. Other researchers argue that the reason for those misunderstandings is the fact text-based communication (which is often used in software development) has very limited capacity, and thus a lot of socio-emotional information (non-verbal cues) is missing [Has+17]. Face-to-face communication is still very important for many developers [Sto+16] and a lack thereof, which is caused by working remotely, can lead to workplace isolation making it harder to develop personal relationships and build trust [Mul+09]. Gajendran and Harrison [GH07] state that working from home with high-intensity (more than 2.5 days a week) harmed relationships with co-workers, something that is enforced because of Covid-19.

2.2.1 Informal Communication

To facilitate communication, some awareness tools also have basic informal communication tools built into them. Cheng et al. [Che+03] introduces JazzBand, a tool visualizing the team members to increase peripheral awareness enhanced with status messages and chat functionality. However, by being an Integrated development environment (IDE) Plugin, we argue the communication likely is tightly coupled to the code, thus being work-related and only used when coding and limited to software developers. AmbientTeams expands the JazzBand ideas and bundles them in a more general-purpose awareness desktop application with informal communication functionality.

Kraut et al. [Kra+] define informal communication as "[...] communication that is spontaneous, interactive and rich". Differences to formal communication include lack of planning and the fact that the content of the communication unknown in advance. They further state that over 85% of all conversations are informal and informal communication happens more often if there is a short physical distance between parties. Similarly, Hinds and Mortensen [HM05] find that members of distributed teams engage less in informal communications. This reduction of informal communication is unfortunate since informal communication is crucial for achieving high productivity and social goals [Kra+]. More concretely, in the field of software development, informal communication plays a critical role due to the fast speed at which informal communication distributes knowledge across a team or company [FL98; MH01]. Also, informal communication can increase awareness, enabling developers to work efficiently [HM01]. In the ever-changing field of agile software development, this is particularly useful because requirements can change, and formal communication channels cannot spread the news as fast. In addition, informal communication is essential for conflict identification and handling [HM05]. Since teams with a high degree of social interactions often have better team cohesion [SCS14], and informal communication is normally much more frequent than formal forms of communication [Kra+], increasing informal communication is likely highly beneficial for team cohesion.

Because of those benefits, it is no surprise that numerous approaches are fostering informal communication inside distributed teams. One of the earliest proposed solutions for promoting informal communication in distributed teams was VideoWindow [FKC90]. Despite being an early solution, the authors already identified two essential requirements such a system must offer: low personal cost and the need for a visual channel. Suppose the prices for initiating conversations are too high. In that case, the system will not be helpful because it will not be used. The visual

channel plays a vital role in recognizing the presence of other people. Sasaki [Sas99] developed a 'hallway' system that was able to raise awareness and helped to indicate that one might have a question but failed to promote casual interactions. In comparison, Lou et al. [Lou+12] manages to provide awareness information that is relevant to engage in everyday conversations and a low-effort mechanism to initiate such informal discussions. It does so by providing social cues which help understand the availability of others and thus creating a context for subsequent communication.

As a consequence of the global pandemic, many commercial tools have been published recently. Branch¹, Reslash², Wonder³, or Gather⁴ follow a similar goal set of increasing spontaneous, informal communication. By mimicking the real office, those virtual office approaches all have the same downside: requiring a fair bit of user interaction due to the visually complex interface. We argue that this adds a lot of unnecessary overhead and reduces long-term usability. Thus, AmbientTeams avoids this overhead, and its goal is to be as ambient as possible while still fostering informal communication. Tandem⁵ takes a similar approach in that it is less playful than the other commercial tools but still very focused on collaboration and communication. In comparison, AmbientTeams additionally includes a glanceable overlay and team members' moods and status messages.

In regards to status messages, the concept of micro-blogging is very similar. Studies have shown that micro-blogging is a form of informal communication [ES10] that is "[...] like a virtual coffee machine as a meeting place" [ES08]. Further, many existing micro-blogging approaches have found that micro-blogging results in people feeling more connected [ES10; Zha+10]. Their study participants found microblogging very helpful because it allowed them to stay aware of what their team members are doing [Zha+10]. In addition to purely share text-based contents, Dullemond et al. [Dul+13] developed a micro-blogging system that allows the users to attach a mood to each message which helped the teams feeling more connected. What they did not measure, however, is the isolated effect of mood sharing.

We see a lot of value in providing additional awareness and sharing moods in the workplace, which is why the following two sections focus on those two concepts.

2.3 Awareness

Part of the reason for coordination and communication challenges in a remote work environment is the lack of awareness, so it is of great interest to us to increase awareness in distributed teams. Gutwin and Greenberg [GG96] defines group awareness as a combination of:

- **Informal Awareness**

The general sense of the presence, availability, and activities of others. It is the "glue that facilitates casual interactions" [GG96].

- **Group-Structural Awareness**

"Group-structural awareness involves the knowledge about people's roles and responsibilities, their positions on an issue, their status, and group processes" [GG96].

- **Social Awareness**

"Social awareness is the information that a person maintains about others in a social or conversational context" [GG96]. It includes things as the attention state of the other person, their emotions, or the level of interest [GG96], or whether a person can be disturbed [GG95].

¹<https://branch.gg>

²<https://reslash.co>

³<https://wonder.me>

⁴<https://gather.town>

⁵<https://tandem.chat/>

- **Workplace Awareness**

Defines the awareness that results from the ‘real-time’ combination of elements workers keep track of when working together. Such elements could be people, actions, objects, and many more [GG95].

It is important to note that those four awareness types are not excluding but rather overlapping with each other. Put differently, informal, social, and group-structural awareness are all part of workplace awareness. In the case of software developers, for instance, a study shows that developers checked the availability status of their co-workers almost as many times as their compiler output [KDV07]. This indicates the importance of informal awareness. Providing group-structural is essential because of difficulties when trying to find experts in a distributed team [HM03]. Social awareness is highly relevant due to the high communication needs of software developers [PSV94]. Additionally, with less face-to-face communication and more computer-mediated communication, it is consequently more difficult to transfer emotional information [RCB96].

Despite the seemingly precise categorization of awareness above, the literature does not agree on one common categorization. Alternative terms such as general awareness, peripheral awareness, co-existent and cooperation awareness, and objective self-awareness are used to describe and categorize awareness. Due to the popularity and granularity of the above definition, it is the definition of choice for this work.

To address the problem of missing awareness when working remotely, a wealth of research developed approaches to increase awareness in distributed teams. Popular tools made explicitly for software development teams focus on providing awareness by on work items, developers’ activities (e.g., which files they have opened or recently changed) and thus put the code base and tasks in the foreground of coordination [Bie+07; Jak+09; ESS+92; DCR05]. While the team awareness gained by those tools allows developers to understand who you are working with and what they are working on, and what the impact of a change can have on others, which is essential for successful collaboration [DB92], they only cover a very limited view of awareness by providing very limited social or emotional information. García, Favela, and Machorro [GFM99] already mentioned the need for emotional awareness inside groupware in 1999. Similar to [MRM11], we argue the awareness of moods in a work environment is underrepresented in research, especially in a society where many are facing mental challenges caused by the global COVID-19 pandemic.

While the majority of the above-mentioned awareness tools require user interactions to be helpful, there have also been attempts for creating ambient approaches to raise awareness in the work environment [MCR20; OMF06; DPH12; AD12; R c+04]. Downs, Plimmer, and Hosking [DPH12] define ambient devices as devices that “[...] present dynamic information in an at-a-glance manner and have low attentional requirements”. Unfortunately, while they increase informal awareness in a non-intrusive way, none of them focus on social awareness, both of which are types of awareness important at the workplace [GGC96]. Additionally, many of the above approaches include physical devices (e.g., from [DPH12; AD12; R c+04]), which might not be suitable for a remote team setting due to the size of the device or the device with the awareness information would not be visible to off-site team members.

The focus of AmbientTeams is to raise team/group awareness in an ambient manner, but by putting teams and people in the foreground, similar to [Whi+04], yet to foster informal communication instead of email.

2.4 Well-being: Emotions, Moods, and Sentiments

A common finding in research regarding remote work is that employees work longer hours, experience more stress, and have difficulties with mental health [Spa20a; Mul+09; Qua20]. A recent

study in the context of the global Covid-19 pandemic lists the negative impacts from working from home, such as increased burnout, lack of separation between work and life, and feeling disconnected from co-workers [Spa20a]. A Psychological study highlights that the mental health of remote workers should be considered and is very important to be communicated and talked about [GWS13]. For those reasons, we see a need for better and more accessible communication of well-being and mental health and tools that increase connectedness among teams. This is a similar finding to Kuwabara et al. [Kuw+02] who highlights the need for connectedness-oriented communication because it is critical for developing social relationships and harder to do over distance. McDuff et al. [McD+12] further state the usefulness of being able to assess one's emotional state (e.g., when considering mental health issues). Their approach, AffectAura, is developed using different kinds of sensors to predict emotions and provide an overview of them in a diary-like fashion with the purpose of self-reflection [Dul+13]. Guzman and Bruegge [GB13] emphasizes the importance of emotion in software development, however focusing on the emotional state towards a project, not of individuals. MobiMood is a mobile application focusing on individuals by letting them share their moods, but not targetting a work environment [CHO10]. Saari et al. [Saa+08] developed another mobile application with mood sharing features aimed at knowledge workers. However, while the researchers developed the prototype, their approach's usability and use cases were not studied. Both of which will be analyzed in the scope of our preliminary evaluation. Further, a mobile application might not be ideal to use in a work environment since this might also introduce more room for interruptions.

Of particular importance for text-based communication tools is the fact that emotions are an essential part of communication and can get lost/misunderstood inside text messages due to the lack of cues in text-based communication [Höo+08].

To communicate one's well-being, different types of affective responses exist that could be useful for sharing with the team, namely emotions, moods, and sentiments. Emotions are typical reactions to events and therefore have a definite cause and are typically short-lived. Emotions differ from moods in that moods are longer in duration, have no clear target, and are less intense [Fri+94; BN07]. Sentiments can be described as states associated with objects rather than individuals and therefore are relatively permanent [BN07].

When it comes to measuring well-being, the literature does not reach a consensus of one best measurement. However, the valence-arousal dimensional model is most commonly referred to as the "better" model [Rus80; MR09]. It is a two-dimensional model where the arousal dimension contrasts states of pleasure with states of displeasure, and the arousal dimension contrasts states of low arousal with states of high arousal [MR09]. Results of this model can then be used to map onto a discrete set of basic emotions such as surprise, fear, disgust, anger, happiness, or sadness [BN07].

Approach

Our goal is to help software developers in remote teams facing challenges with workplace isolation, team awareness, informal communication within their team, and well-being. We aim to tackle these issues by allowing knowledge workers to quickly learn about the availability, moods and emotions, and other states of their core team members. The critical underlying concepts of our approach are listed and explained in the following.

Ambient always-on-top, people-centered team view

At the core of our approach sits the decision to create an ambient tool that does not require significant, additional effort to be helpful. Having a limited amount of information on an ambient display is critical for both not being interruptive and costly to use [DK04]. With the help of the ambient display, the goal is to create a sense of presence within the team, even when working from different locations. By constantly showing the most central team members, the goal is to foster a sense of belonging.

Compared to existing awareness-increasing approaches focusing primarily on task-related awareness and their implications for more effective and efficient collaboration, our policy puts the humans behind the work items into the center of focus. By fostering more social communication, our approach does not conflict with or replace existing communication patterns established in a company. Instead, it aims to provide additional social information about the individual team members.

Transience and topicality

We want to keep interactions light-weight and casual, so the functionality is kept simple, maybe even limited, by design. The information shared and displayed will be transient. Following this approach brings the benefit of really fostering informal communication because there is no guarantee that messages will be read. In addition, our approach visually emphasizes the topicality of information displayed to avoid outdated data that clutters the user interface.

Mood and context sharing

As the primary text-based informal communication possibility, our approach focuses on status messages that can be broadcasted to the entire team. This concept is known as micro-blogging, with the difference that common micro-blogging platforms often are public (e.g., Twitter), and our approach is scoped to a team. Dullemond et al. [Dul+13] state that micro-blogging is another strategy that allowed software engineers to share activities and moods with other team members with the result of feeling more connected to each other. Our approach is very similar to theirs in terms of functionality of mood-based status sharing, yet we do not force the users to share moods accompanied by a status message; we are interested in use-cases for the combined and isolated usage of the two features. Further, topics that are usually blogged about are informal [ES10] which aligns with the goal of our approach. Furthermore, mood sharing seems to act as

a springboard for conversations according to Church, Hoggan, and Oliver [CHO10], which suits our goal of fostering communication.

Ever-running break room

Additionally, allowing to see the team (and not just relying on text-based information) is possible by joining an ever-running break room. The goal is to mimic the water-cooler in the office. Thus, visiting a breakroom as simple as possible, similar to just walking to the coffee machine in an office and signaling to the other team members that you are now on a break, is required. This effortless joining of a breakroom is motivated by Chang and Ehrlich [CE07], who emphasizes that initiating a conversation must be as simple as possible. This approach also applies to the next concept on the list, interactions that target individual team members.

1:1 interactions

For scenarios where the content you want to share is intended for a single person, or you want to get another team member's attention, there's an easy way to start a private conversation. This can be done through a direct message or by nudging a team member. This concept aims to help in cases of help-seeking, a known problem when working remotely [HM03]. Recalling the transient nature of our approach, this communication mechanism is best suited for making a non-interruptive request that is not urgent. Should a user feel the need to talk to another team member, they can indicate that now would be an appropriate time for a short informal conversation. If other team members feel the same, two team members can randomly be paired up for a virtual video call.

Minimizing interruptions

When developing an ambient always-on-top visualization, minimizing interruptions and distractions is one of the most important design principles. Specifically, this means a very targeted use of notifications and the ability not to be contacted and hide potential distractions if desired.

Prototype

The above outlined key concepts were then developed into the key features of our research prototype, *AmbientTeams*. Before stepping into the core features employed in *AmbientTeams* and aligning them to the above-mentioned key concepts, a brief introduction into the more technical aspects and a general overview of the application are given.

AmbientTeams is a cross-platform desktop application based on Electron¹. To facilitate the implementation of the interactive user interface, VueJS² was used. To maintain JavaScript as a common language for the front-end and back-end, NodeJS³ is used on the server-side. The server provides both a REST API for basic CRUD functionality for users and teams and a WebSocket endpoint since much of the data required for *AmbientTeams* comes from the server in real-time.

AmbientTeams comes with two main windows. The team overview window is responsible for maintaining a connection to the server, authenticating, login functionality, settings. Additionally, once the user has authenticated, they are redirected to the team overview view where all teams and team members are visible (see Figure 4.1). There exist two types of teams in *AmbientTeams*. Regular teams are stored on the server and require a unique identifier to join. For scenarios where a user is part of multiple such teams, team members from different teams can be linked to a "favorites" team. These favorite teams only exist on the local machines of the users.

By clicking on the edit icon next to the team name, the user can select team members from each team that will then be displayed on the other main window, the ambient window. This is demonstrated in Figure 4.1, where the user is selecting the team members to be displayed on the ambient window.

At the core of the approach sit the avatars of the users. While we could have opted for traditional profile pictures that allow users to upload an actual photograph, we decided to use the abstract form due to privacy reasons, allowing relatively simple mood manipulation on such avatars. We make use of <https://getavataaars.com> to create and manipulate avatars.

Ambient always-on-top, people-centered team view

AmbientTeams consists of two main windows; a team overview window and the so-called ambient window. The ambient window always sits on top of other windows, making it prone to interruptions and distractions. To keep the ambient overlay as ambient and minimal as possible, we employed a transparent window. Further, certain functionality is only visible when the user is hovering over this window. When hovering over the ambient window, the user can select the team they want to show and sees the names of the individual team members, as shown in Figure 4.2b.

¹<https://www.electronjs.org/>

²<https://vuejs.org/>

³<https://nodejs.org/>

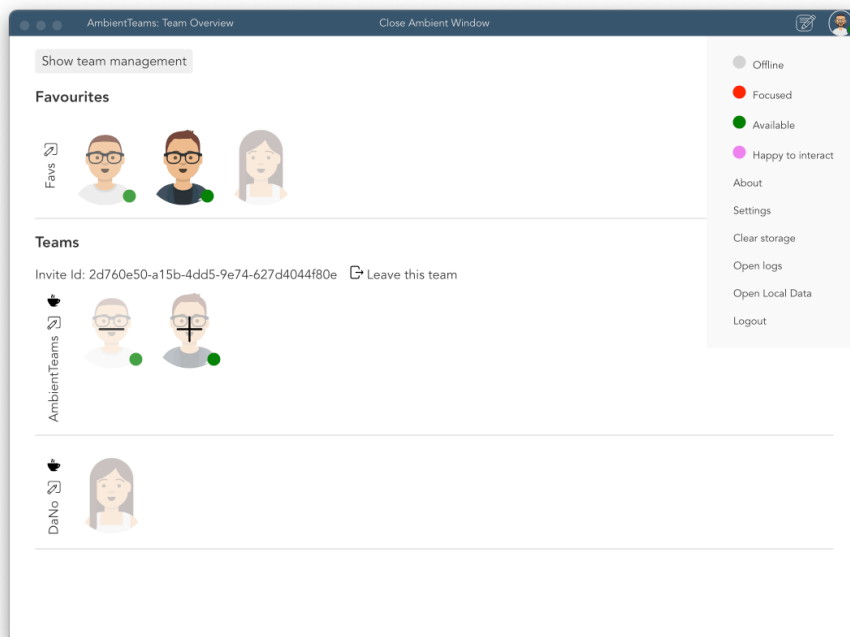


Figure 4.1: Team overview window

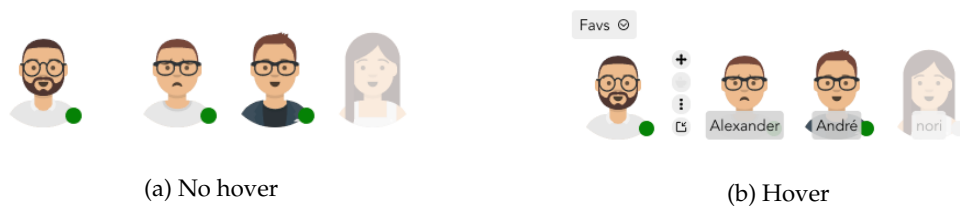


Figure 4.2: Ambient window

Transience and topicality

To ensure that information shared within AmbientTeams is up-to-date, a couple of measures have been taken. The first is a purely visual effect which leads to the avatars fading out when no recent activities took place Figure 4.2a. Such activities include status and mood sharing, direct messages, and nudging. In addition to potentially motivating users to interact with such faded-out team members, this automatic fading out facilitates spotting colleagues' updates quickly. Another measurement we took to avoid outdated content to be shown to the users, status messages and moods are hidden at midnight.

Since the goal of AmbientTeams is to foster informal communication, it has no chat history or any other history built into the application. With this transience, we aim to promote less formal communication and hope to avoid the AmbientTeams becomes just another tool to keep track of for work.

Mood and context sharing

The user can open the sharing window from both the team overview and the ambient window, as well as the system tray menu. All of those actions will open the sharing window as shown in Figure 4.3a, where on the left, a preview of the current avatar and the selection of predefined

moods are listed. There are nine available moods, visualized using popular emoticons. The first four emoticons are more optimistic, the fifth is a neutral face, and the last four are emoticons representing rather negative emotional states. The selection of the emoticons started with the basic emotions surprise, fear, disgust, anger, happiness, or sadness. This list was expanded over time to, in our opinion, suit the work environment better by adding a neutral and tired emoticon, as well as two more positive emotions (loving hearts and grinning) to make the selection more balanced. Due to limitations with the avatar API, we were not able to render the emotion fear well enough, which led us to remove it. On the right, a textbox for providing additional context is shown. The contents of this textbox are, if available, pre-populated with the current status message for the currently selected team. Additionally, the text is highlighted when the window is created, facilitating overwriting the current status without using the mouse to select the text manually. Status messages' length is limited to 140 characters, motivated by the initial limit of Twitter (TODO: cite). Below the textbox, the user can find a button to share the status message with either all teams or a single team.

As a reminder for the user to share his moods and/or additional context with the team members, the sharing window is also automatically scheduled to appear on the lower right corner of the user's primary monitor to minimize the distraction potential. All in all, the window has the same functionality but includes two additional buttons to postpone the prompt for either 5 minutes or 1 hour (see Figure 4.3b). The scheduled sharing window is shown at three predefined times throughout the day, namely at 9:00, 13:00, and 16:00 local time.

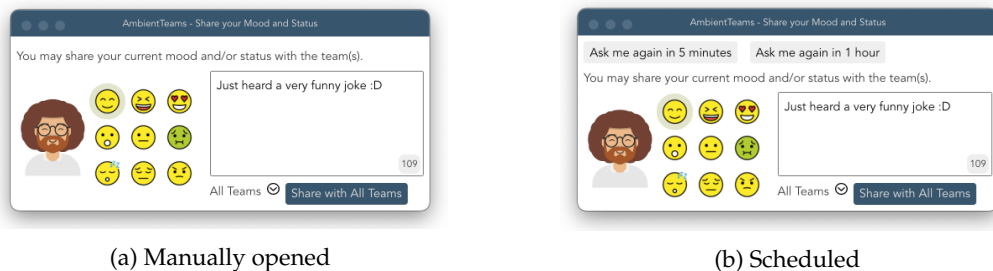


Figure 4.3: Sharing window

Ever-running break room

As stated before, our goal was to make the creation of ever-running break rooms as effortless as possible. Figure 4.4a shows the state of the ambient windows when the user clicked on the coffee icon. Having clicked on this coffee icon, the other members of the team see an indication that there is an ongoing break room (see Figure 4.4b). However, to not unnecessarily set up a break room and potentially interrupt the initiating user, the break room is only created once another user clicks on the coffee icon.

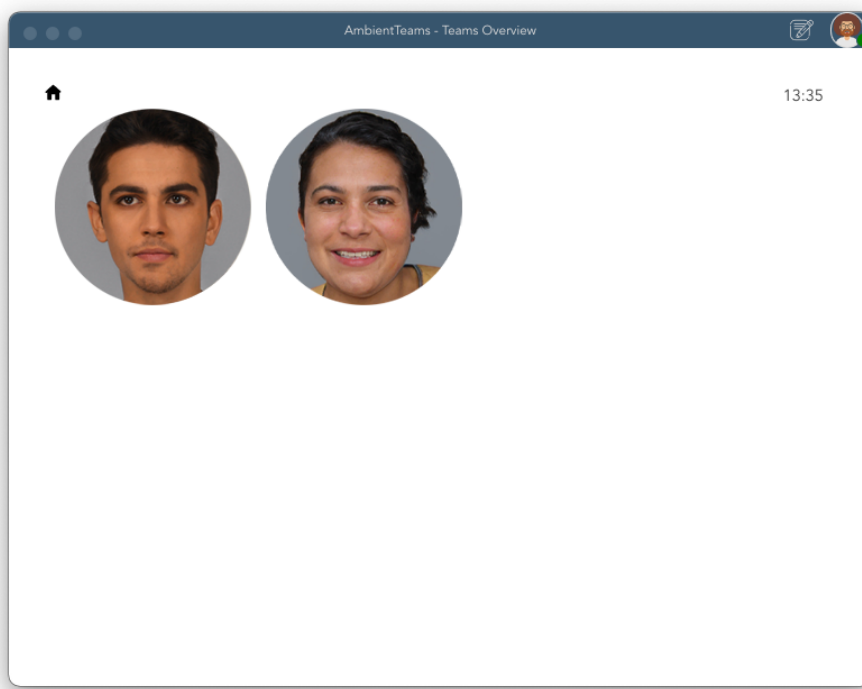
Once at least two team members are interested in a break room, a break room is actually created, and the two are redirected to the break room view (see Figure 4.5). At any point, other team members can join and leave the breakroom, and it stays active as long as at least one team member is part of it. We want to avoid users forgetting the time and staying too long in the break room. For this purpose, whenever a user enters a break room, a 15-minute timer is started. When this timer reaches its end, the user automatically leaves the break room.

1:1 interactions

In addition to the broadcasting functionality of moods and status messages, there also exists the possibility to interact with a single team member directly. An overlay appears when hovering



Figure 4.4: Breakroom creation

Figure 4.5: Breakroom, pictures are artificially created with <https://generated.photos/>

over individual team members, offering three different interaction possibilities, namely 1) direct messaging, 2) nudging, and 3) direct calling (see Figure 4.6).

Direct messaging is very similar to sharing status messages but without mood sharing and team selection options. Upon a click on the messaging icon, the messaging window (Figure 4.7) is shown at the user's current mouse position to minimize the distance required to interact with the window's contents. As in the status sharing window, there is a character limit of 140 characters.

In Figure 4.8, the result of a successful interaction for each of the three possibilities is visualized. Direct messages differ from status messages in the messaging icon located left to the message itself. Nudging makes use of a hand icon pointing towards the team member in question. In a video call, the video stream overlays the team member's avatar, and the availability status of both participants is automatically set to "Focused". The users can hover over their avatar should they wish to mute themselves or stop their video stream. To end an ongoing call, one has to hover over the relevant team member and click on the hanging up icon.

The "Happy to Interact" availability status was included to bring back the lack of serendipity

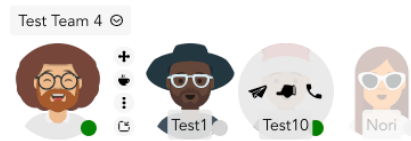


Figure 4.6: 1:1 interaction overlay

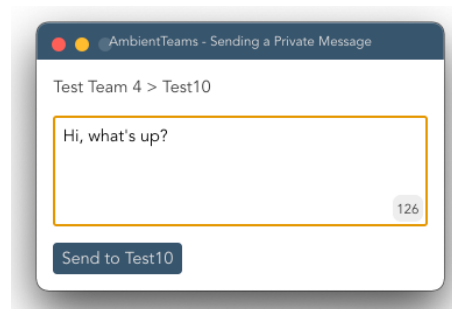


Figure 4.7: Messaging window

in remote work. When selected by at least two members of a team, an automatic match-maker runs every minute and randomly pairs two people, which are then forwarded into a video call.

Minimizing interruptions

AmbientTeams does not want to be a source of interruptions which is why there is "Focused" availability state (see Figure 4.8c) that exists in addition to the three others ("Available", "Offline", and "Happy to Interact"). Users in this focused state cannot be called. Further, they don't see any direct messages or incoming nudges until they leave the focused state. In addition, focused users cannot directly interact with other team members, avoiding potential self-distraction.



Figure 4.8: 1:1 interactions

Preliminary Evaluation

To evaluate the above mentioned research questions, a preliminary evaluation is conducted. Optimizing and improving our approach with the help of feedback from the participants is the primary goal of this master thesis. Further, we want to learn which status and moods knowledge workers share with their closest team members, what they learn from their team-mates' sharing and the overall impact on their perception of workplace isolation. The three main areas of interest and the research questions we would like to answer with the study are as follows:

TODO: Add research questions

TODO: Quickly describe Figure 5.1 in words before jumping into more details in the following sections.

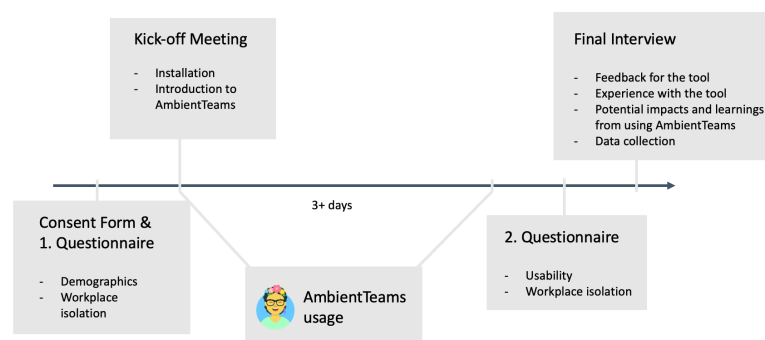


Figure 5.1: Study timeline

5.1 Participants Recruitment

As a first step, an interested team had to be recruited. To that end, the researchers' personal network will be used. To that purpose, the study description is forwarded to the contacts, and

once an interested team has been identified, it is checked whether it fulfills the participation criteria and if the prospective participants are (technically) allowed to install AmbientTeams on their computer. If this is not the case, the company's consent and approval to install AmbientTeams is first obtained. To provide the company with as much information as possible about the study and the privacy/confidentiality of the data collected during the study, the consent form and a study description will be given to the company for review. After gaining the company's approval, the individual interested team members are approached by presenting the study, discussing the steps and goals of the study, and emphasizing that participation is entirely voluntary.

The requirements for teams participating were as follows:

1. At least three team members
2. Three or more common working days a week
3. Spending the majority of their workday on the computer
4. Having all the required rights to install AmbientTeams on their work computer
5. Willingness to use AmbientTeams during at least three full days of work (approximately 0800 - 1700)
6. Using macOS or Microsoft Windows
7. An active internet connection

5.2 Participants

With our recruitment, we were able to find an interested team. TODO: Describe team

5.3 Initial meeting

Installation

5.4 Prestudy Questionnaire

The questions are taken from

5.5 Evaluation Phase

How long?

During the study notes from notion

5.6 Poststudy Questionnaire

The questions are taken from

5.7 Interview

Interview questions and their relevance for the research questions

Data

Table 6.1 shows an overview of all data collected and for which research question they are relevant. The data used to answer the above research questions came from three different sources. Given the relatively few participants, it was important to have both quantitative and qualitative data.

Data collected	Storage	Relevant for
cell4	Local	cell5
cell7	Local	cell8

Table 6.1: The data collected during the preliminary evaluation and its relevance for the RQs

Results

Conclusion

Conclusion and Future work

Appendices

Additional Documents

Interview Transcriptions

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