

# Social Drones for Health and Well-being

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Drone activities in our daily lives are on the rise, so is the need to advance research on how to design drones that can interact with human users in an autonomous and socially acceptable way. The focus of this workshop is to discuss this emerging technology in the context of health and well-being applications. In particular, we take an interdisciplinary approach to understand how to empower drones with more autonomous and AI-driven social features, hence leveraging possible methods, behaviors, and solutions for AI driven social drones in the context of health and well-being. The main activities of this workshop will entail hands on activities and discussions in collaborative format. The expected outcomes aim at building up synergies between participants to lead future steps in the domain of autonomous social drones in health care and well-being.

CCS Concepts: • **Human-centered computing** → **Interaction design**.

Additional Key Words and Phrases: Social Drone, Artificial Intelligence, Health, Well-being

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## 1 OVERVIEW

It is foreseeable that drone technologies will enter our everyday lives soon, thereby igniting a new research domain on domestic drones that inhabit our environment in social ways, making them “social drones”. We define a social drone as a technology that interacts with users in different social contexts, while at the same time it can adapt and respond to the user and its surrounding environment in a socially acceptable way. Designing drones with social capabilities is key to ensure effective division of labor between individuals and drones [2]. Furthermore, drone operations in densely populated areas call for further investigations into the design of Social Drones [2]. This topic is one of the emerging areas within the Human-Robot Interaction (HRI) domain. Going beyond the use of drones for military purposes, and for surveillance, there are many application areas to explore when shifting perspectives from a technology used to exercise power, to a technology that can serve as a social entity. Several application areas are currently being explored in

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research [8], including the concept of using drones as a running partner [1], a domestic companion [6], and social entity [13]. Alternatively, one of the most prominent areas where drones are being deployed is in health care and well-being applications [5]. However, currently most commercial efforts are directed towards drones as a tool in the hands of an operator, while research is taking a shift towards empowering domestic drones with more AI-driven autonomous features to allow them to simultaneously operate in our environment. Thus, researching social drones in health care can allow us to explore how AI can be integrated to social contexts in a near-by future.

The main aim of the proposed workshop is to take an interdisciplinary approach in building an understanding towards empowering domestic drones with more AI-driven autonomous features, hence putting the building block of a road-map in realizing the so-called AI driven social drone in the context of health and well-being.

### 1.1 Objectives

AI comes with the promise of autonomous systems, and in many cases these systems manifest in physical form (e.g. autonomous vehicles). But a variety of research questions remain to be addressed:

RQ: How should we interact with intelligent systems (i.e., social drones) that are co-present in our physical and social world?

In this workshop, our objective is to bring a team of participants from different areas of interest to discuss and develop a road map that can give answers to RQ. Particularly addressing how can we design interactions with AI-driven social drones, or one could say “interaction with AI in the form of social drones”. Thus, the overarching scientific objective is to explore interaction with drones as social entities in the contexts of health and well-being applications.

### 1.2 Benefits and Significance of the Proposed Workshop

Human-Drone Interaction (HDI) research is on the rise as end-user drone applications eventually become part of our daily lives [8]. We contribute to the HDI/HRI community by offering an open discussion format on AI driven social drones that can lead to a better understanding of how to integrate and physically manifest AI in our physical and social world. Knowledge on this integration is important as to understand the real-world challenges facing the development of AI solutions for societal and social contexts. This need has been recently acknowledged by authors such as Theodorou and Dignum [12], who focused on issues associated with the design of responsible and transparent AI solutions. This workshop addresses this need in real-world social scenarios that relate to health care and well-being context, in addition to addressing associated interactions with social drone systems that blend into our physical and social everyday lives.

Particularly, we foresee that the workshop will elicit discussions that serve to advance the current state-of-the-art research in three folds:

- The first fold focuses on which user-centered methods shall be used to acquire human-drone data in the context of real-world scenarios (i.e., in health and well-being settings).
- The second fold concerns how to model the behavior of a drone using the acquired data and what Artificial Intelligence solutions should we use adequately with social drone.
- The third fold deals with the issue of how to develop real time adaptive solution in real world contexts.

## 2 WORKSHOP STRUCTURE AND PLANNED ACTIVITIES

### 2.1 Hands-on Activity (90min):

The workshop will kick off with a warm-up group activity that allows our participants to introduce themselves and also to get to know everyone that they will be working with during the day.

The session will entail collaborative focused group activities to conceptualise social drones in the health care and well-being domain. We will use sketching, post-its, brainstorming, and built lo-fi prototypes that we can use as use cases in the following sessions.

### 2.2 Discussion Topic 1: Human-centered Human-Drone Data Acquisition and data-driven models (90min)

Many robotics and drone approaches rely on Machine Learning (ML) and Artificial Intelligence algorithms that learn from a dataset that is often utilized for ML and AI training [7]. The setups for drone dataset collection can be a system that allows for investigating factors that impact social drone interactions, and to collect both user data (e.g., user's perception, distance, head direction, physiological data etc.) and drone data (e.g., distance, speed, and pose) simultaneously. In this part of the workshop, we will discuss a gap in literature on how to collect synchronous data in drone applications in social contexts, as well as taxonomies for relevant human factors in social drone applications.

Moreover, two particular types of AI algorithms, Deep Learning [4] and Reinforcement Learning [11] have made significant breakthroughs in robotics recently. There are still opportunities to explore these types of AI algorithms in drone applications. Social drones bring in unique HRI challenges to these algorithms since human-drone interactions in social contexts are more complex than ubiquitous rational problem solving or task optimization in robotics. We will discuss the health and wellbeing drone applications and possible ways to bridge the lacks of an in-depth investigation of adaptive drone behaviours in social contexts. Such discussion can highlight specific ML and AI approaches that are applicable to social drones.

### 2.3 Discussion Topic 2: Human-centered evaluations, Ethics, Diversity, and Inclusion (90min)

Evidently, the lack of diversity in stakeholders of AI technology creators affects the inclusiveness of these technologies [3, 9, 10]. These findings indicate that conventional evaluation methodologies may be falling short to investigate human-centered social drones. The research question in discussion here centers around what kind of new methodologies can enable researchers and stakeholders to empower with tools that investigate inclusion, diversity, and ethics aspects as a part of the design, development, deployment of technology.

### 2.4 Wrap-up and Next Steps (60min)

A summary of the workshop will be presented to highlight the main outcomes, and allow participants to reflect on the main discussion topics presented. At the end, closing remarks will address future directions and possible collaborative synergies that can take place.

## 3 RECRUITMENT STRATEGIES

The organisers of this workshop will disseminate the call for participation across several channels that target the intended audience from relevant scientific backgrounds. The dissemination of the call will be done via University email lists, relevant research emails lists (e.g., CHI-Announcements, HRI-Announcements etc.), and over social media research

networks. The organisers also come from diverse scientific backgrounds, and they will approach topic active researchers within their networks to participate in the workshop.

### 3.1 hybrid format

The organisers will adopt a hybrid<sup>1</sup> format in running this workshop. This is to accommodate for those who cannot travel due to the pandemic or for other reasons. The plan is to run the workshop style activities via a suitable collaboration platform, e.g., Miro. In addition, we will use suitable remote collaboration tools to accommodate for the activities of the workshop.

## 4 EXPECTED OUTCOMES

The main objective of this workshop is to build an understanding on the topic of AI driven social drones, how to design their interaction and how to integrate them in our everyday environment. At the end of the workshop, we expect to have a road map towards action steps on the topic. This in turn will allow the organisers and participants to build future collaborative projects in executing these action steps. In addition, the workshop will be supported by inviting selected position papers to submit to a special issue; currently we are approaching *Frontiers in Robotics and AI* to host a special issue on AI and Social Drones (with a theme on healthcare and well-being application). We believe that this would also attract participants and others in the Human-Drone Interaction community to collaborate in executing original research on the topic. Finally, we expect this workshop to help us plan for further future events on the topic on an annual basis.

## 5 ORGANISERS

We are bringing together a team of international expertise in four fields to enable collaborative synergies to drive the following proposed workshops and expected outcomes. Their scientific expertise span across the domain areas of Artificial Intelligence, Interaction Design, Human-Computer Interaction/Human-Robot Interaction, health and well-being applications, and Social Psychology.

**Mohammad Obaid** is Associate Professor of Human-Computer Interaction and Head of the Interaction Design Unit in the Department of Computer Science and Engineering at Chalmers University of Technology, Sweden. His research interests fall in the area of Human-Computer Interaction and Human-Robot Interaction where he has more than 80 publications that span across several topics. His most recent publication is a co-authored book on Robots in Education published by Routledge. His recent research activities focus on designing user interactions for (and with) Social Drones. Dr. Obaid has served in organizing committees and program committees of main HCI/HRI related conferences such as CHI, HRI, HAI, VRST, and NordiCHI.

**Kıvanç Tatar** works in the field of advanced Artificial Intelligence in Interactive Arts and Music, active both as a researcher (with important theoretical and technical contributions) and an artistic practitioner, as an experimental musician and audiovisual artist, often in artistic collaborations. His research has expanded to multimodal applications that combine music with movement computation, and visual arts, and his computational approaches have been integrated into musical performances, interactive artworks, and immersive environments including virtual reality. Tatar has a dual educational background in music and technology, and currently is the Assistant Professor in Interactive AI in Music and Art at Chalmers University of Technology in Gothenburg Sweden, and a [WASP-HS](#) fellow.

<sup>1</sup>We will accommodate for both in-person and online participation.

**Mikael Wiberg** is a professor in interaction design at Chalmers university of technology, and professor in informatics at Umeå University, Sweden. He has held positions as Chaired Professor in HCI at Uppsala university, and as Guest professor in HCI at Södertörn University, Sweden. Wiberg's main work is within the areas of interactivity, mobility, materiality, and interactive architecture. He has published his research in several top HCI and design journals including Design Issues, Design Studies, International journal of design, ToCHI - ACM Transactions on Computer-Human Interaction, the Human- Computer Interaction journal and ACM Interactions. His most recently published book is 'The Materiality of Interaction' (MIT press, 2018), and he was most recently appointed co-EIC (Editor-in-chief) for ACM Interactions (2019).

**Alan Said** is Associate Professor at University of Gothenburg. He holds a PhD from Technische Universität Berlin. Alan's research spans the fields of user modeling, personalization, recommender systems, evaluation, and reproducibility. He has worked in these fields in various national and international projects as researcher, leader, manager, PI, and proposal writer. He has published over 70 scientific works in top journals, conferences, workshops, and books.

**Mattias Rost** is a programmer with a PhD in Human-Computer Interaction. He is a senior lecturer at the Division of Human-Computer Interaction at the Department of Applied IT at the University of Gothenburg. He has a long experience both in industry and academia. He did his doctoral studies at Mobile Life Centre, as well as Viktoria Institute, IT-University of Gothenburg, and SICS. He was a research associate at the University of Glasgow and has worked as a digital strategist in industry. His research interests are mobile communication, health and wellbeing, and using technology and design as tools for research.

**Alexandra Weilemann** is Professor in Interaction Design and head of the Division of Human Computer Interaction at the Department of Applied Information Technology, University of Gothenburg, Sweden. Prof. Weilemann has over 20 years of experience of studying the use of mobile information and communication technology. Her expertise in the field will support the development of different methodological approaches to capture mobile situated practices and user engagement with their technologies and services in the context of health and well-being. In this context, Prof. Weilemann has contributed to several studies within health and well-being, published in e.g. the Journal of Clinical Nursing and the Journal of Workplace Learning, as well as a number of studies on interacting with objects published in e.g. Space and Culture. An overall ambition of her work is to contribute to a society where technology supports and enhances our everyday interactions.

**Wafa Johal** is a Senior Lecturer and Researcher at the University of Melbourne. She is an Australian Research Council DECRA Fellow working in Human-Robot Interaction. Previously she was a researcher at the CHILI Lab and Mobots group at EPFL Switzerland. Her field of research is at the crossing between robotics, AI and HCI, as she works on enabling robots to interact autonomously and naturally with humans. Her research aims at creating acceptable and useful assistive robot interactions using social signal processing, affective and cognitive reasoning. Her recent work investigated the use of tangible robots in education and rehabilitation.

**Friederike Eyssel** is Professor of Psychology and Head of the research group "Applied Social Psychology and Gender Research" at the Center for Cognitive Interaction Technology (CITEC), Bielefeld University, Germany. Crossing disciplines, Dr. Eyssel has published her research in leading journals in the field of psychology and social robotics. Friederike enjoys multidisciplinary collaborations – consequently, she has co-authored the book "Human-Robot Interaction" which was published by Cambridge University Press in 2020 (see: [human-robot-interaction.org](http://human-robot-interaction.org)). In 2021, she has co-authored the book "Robots in Education" published by Routledge.

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