Kind Computing

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Faeq Alrimawi
Lero-the Science Foundation Ireland
Research Centre for Software
Limerick, Ireland
faeq.alrimawi@lero.ie

Bashar Nuseibeh
The Open University & Lero
UK/Ireland
bashar.nuseibeh@lero.ie

ABSTRACT

Kindness can boost happiness and wellbeing. It can benefit individuals (e.g., increasing resilience) as well as society (e.g., increasing trust). With digital technology permeating our daily lives, there are increasing opportunities for such technology to enable, mediate, and amplify kindness in society. In this paper, we propose *kind computing*, a new computing paradigm that explicitly incorporates kindness into the development and use of digital technology. We envisage software engineering as a discipline that can deliver such technology. However, software engineering techniques do not provide explicit abstractions, formalisms, and tools to consider, analyse, and implement software that delivers such technology. With reference to related work, we elaborate on kind computing and the role of software engineering in enabling it, identify open research challenges, elicit three categories of kind computing requirements, and sketch a research agenda for future work.

CCS CONCEPTS

• **Human-centered computing**; • **Software and its engineering**;

KEYWORDS

Kindness, Computing, Software Engineering

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1 INTRODUCTION

Kindness—a prosocial behaviour motivated by the desire to benefit others—has repeatedly been shown to boost happiness and wellbeing [13, 18, 22]. It can reduce anxiety [41] and increase trust among community members [23]. Kindness can reflect various human values such as helpfulness and benevolence [40]; and some consider it a human value in its own right [10].

This prosocial behaviour is manifested in the world as *acts of kindness* (AoKs), such as donating to a charity or helping someone cross a road. Carrying out AoKs is primarily driven by psychological and social factors of givers and receivers, and not only by physical and/or cyber circumstances [12, 13, 33]. For example, emotionality (e.g., feeling generous or happy) [3] and relatedness (e.g., family, strangers) [33] can affect a giver's willingness to donate to a charity.

With the widespread use of digital technology, there is an opportunity for it to enable, mediate and amplify kindness in the world. For example, enabling and boosting kindness over social media (e.g., encouraging users to donate) can potentially contribute to improved wellbeing of its users, particularly given that the use of such platforms is shown to be negatively linked to wellbeing [38, 47].

However, boosting kindness via digital technology is limited in a number of ways. While digital technologies continue to provide novel ways of interacting that enable people to act kindly and unkindly (e.g., adding a caring reaction on someone's "bad day" status), their role in boosting kindness has largely been passive: little attention has been given to how such technologies can be used explicitly to boost kindness and prevent unkindness [32, 34]. Considerations of kindness have also been confined to a few areas of digital technology, such as social media. However, there are potentially many other application areas that can boost kindness, such as smart physical spaces [43] (e.g., smart homes that remind their occupants to appreciate each other).

In this paper we propose *kind computing* as a new paradigm to incorporate kindness explicitly into the development and use of digital technology. Kind computing aims to increase opportunities for expressions of kindness above and beyond what current digital technologies offer, transforming them from passive enablers to active boosters, thereby contributing to the development of new technologies that promote wellbeing.

We envisage software engineering (SE) as a discipline that can deliver such technology. The SE community continues to innovate new techniques (e.g., modelling formalisms) to incorporate various properties (e.g., security) into software. Such techniques have been successful in representing and analysing digital and physical characteristics of systems. However, SE techniques do not provide abstractions, formalisms and tools to incorporate kindness into software [32, 34]. This is because incorporating kindness, we argue, requires that SE techniques explicitly represent and analyse psychosocial concerns, and not only cyber-physical ones. Thus we invite the SE community to rethink and extend existing SE techniques, in order to enable kind computing. Towards this end, we characterise the status of kindness in the world and in computing, highlighting the gap between both and the need for kind computing. We then explore the role of SE and related key challenges to enabling kind computing. We propose three categories of kind computing requirements elicited from reviewing related literature. Finally, we outline a research agenda for the community.

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2 KINDNESS & COMPUTING

While kindness is widespread in the world, it has little explicit presence in computing. We explore this gap by characterising kindness in the world, then exploring its role in computing discourse.

2.1 Kindness in the World

Kindness is a prosocial behaviour that benefits others and/or the self. While this is a working definition adopted for the purposes of this paper, kindness has also been described in various terms. For example, Peterson and Seligman [36] describe kindness as an activity driven by compassion or concern; Lyubomirsky et al. [26] define it as a behaviour costly to the self that benefits others; while Exline et al. [16] term it as a set of social norms and rules of how people are expected to behave within society.

In the world, it is manifested as acts of kindness (AoKs). An AoK expresses an action performed by a giver towards a receiver with the motivation to benefit the latter [13, 26, 29]. Examples vary widely[1]: from simple verbal acts (e.g., giving a compliment) to extraordinary physical acts (e.g., donating a kidney).

Performing AoKs can benefit individuals and society [13, 22]. They can foster wellbeing of givers and receivers [13]; reduce anxiety, stress, negative effects, and increase resilience of individuals [18, 41]. They can also increase trust among people [23], as well as being socially contagious [25, 46]—leading to feelings of gratitude, which can manifest again as kindness [4].

These varieties and benefits of AoKs can be attributed to the quality of kindness being a deep, natural tendency that humans possess [13]. This tendency is driven by various psychological and social factors [12, 13, 33]. Psychological factors include, for example, emotionality [3] (i.e. the state of emotions of a person), and personality traits, such as agreeableness [8]. Social factors, on the other hand, include levels of relatedness (e.g., family, community or strangers) [33] as well as levels of need (e.g., emotional, instrumental or health-related) [44].

While many acts of kindness seem simple and effortless, people often refrain from doing them. This is partly because people underestimate the positive impact of such acts, or they feel anxious about interacting with others, especially strangers [5].

2.2 Kindness in Computing

The prevalent use of digital technology has enabled and amplified acts of kindness (and, sadly, unkindness). This can be reflected in the way humans communicate and treat each other using interactions facilitated by digital technology (e.g., posting positive comments on social media or donating to charities online). These very same technologies have also been used to allow people to be unkind to each other (e.g., cyberbullying). However, these different forms of technology-mediated interactions are mostly neutral - they neither encourage kindness nor discourage unkindness. One reason for this is the lack of explicit consideration of kindness during the development and use of digital technology [32, 34]. So, while we argue that digital technology can and should have a more active role in boosting kindness among its users for improved wellbeing (and a better world!), we observe that it is rarely an explicit goal to be achieved during technology development nor an attribute to be delivered or evaluated after the technology is deployed.

New computing paradigms aim to change and extend the ways in which digital technology is developed and used. They seek to rethink and extend techniques, in order to address a gap between the world and technology. For example, ubiquitous computing has sought to create a world in which humans are capable of absorbing and using pervasive technologies without being distracted or even obstructed by their interfaces or jargon [48]. Affective computing [37] has been introduced to bridge the gap between human emotions and technology, in order to enable it to recognise and react to emotions and, to some extent, feel. Similarly, positive computing [6] has been proposed with the aim of designing experiences that support wellbeing factors such as self-awareness, autonomy and mindfulness. More recently, growing research on values in computing[2] is investigating their role in shaping software, as well as the impact of software on them.

While affective computing, positive computing, and values in computing share the overarching aim of fostering wellbeing, they do not consider kindness explicitly as a way to achieve this aim. Affective computing focuses on emotions, which is only one factor among the many psychological dimensions of kindness. Positive computing also focuses on particular factors of the psychological dimension (e.g., autonomy). However, it neglects others along the social dimension; since its focus is on the individual, whereas kindness focuses on the individual (i.e. self-kindness) and the other (i.e. kindness towards other people). Finally, while research on values in computing can be used for comparing and trading-off kindness with other values (such as privacy), integrating it into technology requires more nuanced approaches that capture its multifaceted dimensions (e.g., the social and psychological).

To address the gap between a world in which humans have a natural tendency to be kind to each other [13] and technology that is largely silent about kindness, we propose *kind computing*. This new computing paradigm seeks to incorporate kindness into the development and use of digital technology, in order to foster wellbeing and create a more prosocial society.

We envision applications of kind computing in many domains where digital technology is already mediating, or can mediate, humans interactions. So called social software (from email to social media apps) that supports group interaction is one such broad class of applications [42]. More specialist application domains can also benefit from kind computing. For example, in healthcare, the doctor-patient relationship, which is recognised to have many barriers [17], can be enhanced via kind computing to support more empathetic interactions. Of course, many service industries already prompt their employees to adopt template-based "polite" conversations with clients, but we suggest that such mechanical approaches are less about kindness and more about enforcing business processes.

A new paradigm of kind computing should aspire to amplify the best of human nature and mitigate against unkindness. We suggest that this is fundamental to creating a profession with responsible research and innovation at its heart[3]. Such a profession must recognise and build upon contributions from different disciplines such

[1] https://www.randomactsofkindness.org/kindness-ideas

[2] http://www.valuesincomputing.org/

[3] https://www.linkedin.com/pulse/software-without-boundaries-bashar-nuseibeh

as psychology and human-computer interaction, and inject these meaningfully into the discipline of software engineering.

3 SOFTWARE ENGINEERING FOR KIND COMPUTING

We envisage software engineering as a discipline that can play a prominent role in delivering digital technology that promotes kindness among its users. SE has a venerable history of creating techniques to represent and reason about qualities of software (e.g., security and privacy) to enable their trustworthy deployment and use. We suggest that such accumulated knowledge can provide a useful starting point to create new approaches for integrating kindness into software. For example, similar to cybersecurity resources (e.g., Common Vulnerabilities and Exposure–CVE [31]), kindness resources (e.g., common acts of kindness) can be developed. Using such resources, automated techniques can be developed to extract common properties or features among different AoKs.

Since kindness is distinctly a psycho-social phenomenon, an approach to integrating it into software will need to explicitly recognise and represent psychological and social dimensions. However, it is increasingly recognised that SE techniques do not explicitly consider these dimensions [32, 34], focusing instead on delivering digital and physical behaviours of software in the world.

As an example, consider a modelling formalism called Bigraphical Reactive Systems (BRS) [30], which is used to model and reason about ubiquitous systems (e.g., cyber-physical systems). BRS can model an action, such as "give money", by representing containment changes of a physical entity (i.e. money) from a giver to a receiver. This is depicted in Fig. 1 (a), where '.' denotes that an actor holds the money (i.e. containment), while '|' denotes that both actors are in the same location. This is largely the current state of practice, since many such formalisms (e.g., [9, 11, 19]) focus on representing and reasoning about cyber-physical states. However, to model and reason about an action such as "give money" as an AoK, it is insufficient that its triggering condition represents only physical (and/or cyber) states. It must also represent psycho-social states, such as the giver feeling generous and the receiver being close to the giver, as shown in Fig. 1 (b). Similarly, the impact of an action should include psycho-social changes, such as the giver and receiver becoming happier. It is this latter form of modelling and reasoning that we envisage in new SE techniques to enable kind computing. However, this raises two key challenges.

Lack of techniques to engineer kindness. Although other disciplines have explored the representation of kindness (e.g., [7, 15]), there exist no formalisms nor tools that can support the explicit representation and analysis of kindness concerns in software. Kindness is often treated as either an abstract or a highly context-specific value [32, 50]. As an abstract value, it can be difficult to refine it into more operational—more technical—requirements that can be modelled and implemented in software. This is partly because there is no conceptual model that identifies operational components of kindness nor their relationships. As a highly context-specific value, it is hard to provide engineering guidelines outside that specific context, making it particularly challenging to develop engineering processes and heuristics that facilitate kind computing.

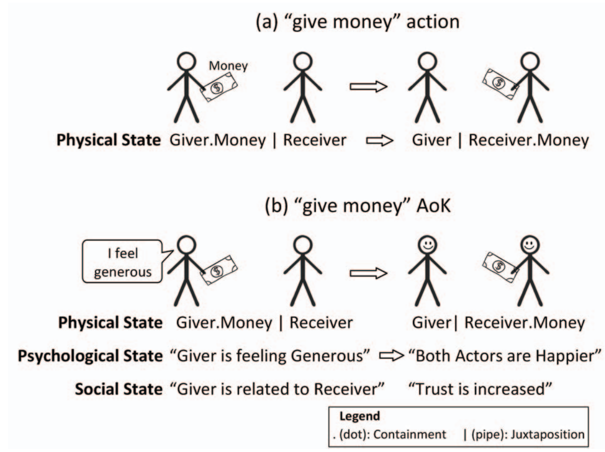

Figure 1: Example showing two representations of the action "give money", where: (a) only physical states are represented; and (b) it is represented as an act of kindness (AoK) in which psychological and social states are also represented.

Lack of empirical approaches to assess kindness. Answering empirical questions such as "is my software kind enough?", "is this software system boosting its users' kindness?" or "what is the impact of a software system on an individuals' likelihood to perform acts of kindness?" is challenging. Assessing kindness requires approaches that employ various types of empirical methods that extend traditional software performance and human usability studies. Curated multi-method approaches will almost certainly be required [45, 49]. The application domain and specific context in which a software system is deployed will be significant. The overarching empirical challenge therefore is not only in selecting a suitable set of empirical methods, but also in rethinking existing methods in light of the engineering challenges of kind computing described above. For example, what measures and metrics can we deploy to assess kindness in software? And, can we adopt and extend psychological measures, such as subjective wellbeing measures [39], to evaluate some attributes of kind computing?

4 CATEGORISING KIND COMPUTING REQUIREMENTS

While specific kindness requirements for different applications will vary, our review of the social psychology literature suggests three preliminary categories of kind computing requirements.

Motivation to benefit others. Motivation—the drive to perform an action—of an actor is an essential consideration in determining whether or not an action is an AoK [12, 13]. An act that is performed solely for personal gain (e.g., to advance one's own goals) is not generally perceived as an AoK despite its benefits to the receiver [12]. While there often is some degree of personal interest when performing an AoK (e.g., feeling good about oneself), it should not be the only or primary motivation. The main motivation for an AoK should be to benefit *others*. Although potentially rather limiting, such a framing allows us to distinguish AoKs that software enables from those that fall within normal software behaviour. To address such motivation requirements, there is a need to explicitly represent them in software and to distinguish between actors. Motivation of this form has been studied in HCI (e.g., [14, 21, 35]), and can be leveraged to develop techniques for capturing and tailoring motivation towards benefiting receivers of AoKs.

Personalities of kindness. Various factors of individuals' psychology can impact their readiness or willingness to perform AoKs [2, 8, 27]. For example, having a personality characterised by 'openness' is a positive indicator of the willingness of an actor to perform AoKs [27]. Similarly, experiencing positive emotions can encourage individuals to perform AoKs [3], and conversely AoKs will impact a receiver's emotions [22, 41]. Thus, to amplify kindness through software, software engineers must be able to identify, represent and analyse relevant psychological dimensions of various actors. This can help determine suitable AoKs that different individuals are more likely to perform or indeed appreciate.

Sociality of kindness. Different social factors can play a role in performing acts of kindness [1, 33, 44]. For example, degrees of relatedness between a giver and a receiver can determine the nature of AoKs that can be performed between them [33]. For example, acts of kindness between a parent and their child (e.g., hugging the child) can be different from those between two complete strangers. Additionally, it is important to have an understanding of not just the enabling social conditions, but also the impact that AoKs can have on social relations. For example, trust is one of the social factors that can be positively affected by performing AoK [23, 46]. Therefore, similar to psychological personality factors, software engineers must explicitly consider the various social factors that can affect, or be affected by, acts of kindness.

5 A RESEARCH AGENDA

Although studied extensively by psychologists and social scientists, kindness is a somewhat elusive concept. Nonetheless, it features prominently in human discourse, and is broadly regarded as a desirable quality of human behaviour that is to be encouraged. Our starting point is that computing can play an important role in enabling and boosting kindness in society, and our position is that software engineering has a critical role in developing computing technologies that deliver human experiences characterised by kindness. The challenges we have surfaced and the kindness requirements we have categorised suggest a research agenda for the software engineering community to consider. We summarise these under two headings: engineering kindness & empirical assessment.

Engineering Kindness aims to develop SE techniques that support systematic representation, reasoning and automation of kindness in software. *Representation* requires new ways to capture elements and relationships characterising kindness. To this end, a practical understanding of kindness and its interrelated psychosocial dimensions is essential. For example, developing an operational definition of kindness, outlining its main constructs (e.g., motivation and emotionality), can be used to create a model that enables the representation of AoKs. This, for example, can support the logging of emotional states or responses of end users [20].

Reasoning requires new capabilities to analyse the nature and consequences of human actions and emotions affected by software. Software engineers are adept at analysing software models and implementations to identify errors and verify properties. How can such analytical tools be extended to explore and verify the 'correct' consequences of acts of kindness. The development of the field of affective computing from a software engineering perspective can contribute to this agenda [24].

Automation requires the development of tools to support the representation and reasoning about kindness in software. This will involve, for example, developing scalable repositories that organise and manage acts of kindness, as well as tools (such as plugins and IDEs) to suggest suitable AoKs to include into models and code. This will allow software engineering to access and make use of heuristics, patterns and even functional software libraries that can help add and deliver AoKs in systems.

Empirical Assessment aims to select or develop empirical methods to discover kindness requirements, and to evaluate kindness in software and assess its implications on other software properties. To this end, suitable research strategy frameworks need to be investigated, such as the Runkel & McGrath's framework [28], proposed in the social sciences and recently adapted to software engineering [45, 49]. *Empirical Discovery* requires approaches to elicit kind computing requirements, by exploring and applying various empirical methods. It is not unreasonable to suggest that traditional requirements elicitation methods may not be ready to use as-is, and that multi-method engineering will be needed, perhaps associated with the different kindness requirements categories we identified earlier in the paper.

Evaluating Kindness requires techniques and metrics to assess the impact of kind computing technology on the kindness and wellbeing of individuals and groups. Equally important, it will assess the impact on users' autonomy. There will be a need to ensure that users will not be *too* dependent on technology to perform kindness acts, which may lead to 'skill atrophy' (i.e. users gradually losing their capability to perform AoKs independently), and consequently will undermine the value of kindness; since AoKs are most appreciated when they are autonomously motivated [12].

Implications for Engineering requires approaches to analyse and extract insights from empirical discoveries and evaluations of kindness, which can feed back into and inform the *Engineering Kindness* agenda. For example, *empirical discovery* may provide insights about how to represent kindness requirements for different stakeholders, which can then feed back into *representations* to extend or create new models of kindness.

In conclusion and in summary, we invite the software engineering community to join us in rethinking and extending parts of our discipline, to enable kind computing and shape future technology for improved wellbeing and a kinder world.

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