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Article

»CIvolunteer« – A Goal-Aligned and Competence-Driven Volunteering Platform

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Abstract: Voluntary commitment of citizens is an indispensable, supporting pillar of critical infrastructures (CRITIS), such as disaster management, rescue services, healthcare and social services or food supply. However, the long-term sustainability of the voluntary sector, is massively endangered due to the profound changes in demographics, social structures and volunteer motives driven by the individualization and pluralization of society. This paper addresses these pressing challenges by proposing a digital platform designed for goal-driven and competence-based networking and bundling of volunteer engagement across non-profit organizations (NPOs). This platform is intended to be a first step towards synergistically aligning the partly collaborative goals and competencies of volunteers with activity requirements essential for strengthening CRITIS.

Keywords: Volunteering; Critical Infrastructures (CRITIS); Personal Informatics; Crowd-driven; Semantic Technologies.

1. Introduction

Voluntary engagement represents an indispensable *cornerstone* of *critical infrastructures (CRITIS)*, including civil protection, rescue, healthcare, and social services, harvest operations, crisis hotlines or food supply, and is of fundamental importance for the society. Globally, over 10% of the world's population are already engaged in volunteering, topped by 23% in the EU, and exceeding 46% in Austria, contributing approximately 14.7 million hours per week, whereby more than 5.8 million are dedicated to CRITIS-related activities [1].

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However, the sustainability of the voluntary sector supporting CRITIS is increasingly threatened by *demographic change* resulting in constantly growing demands for voluntary commitment, but also by the far-reaching *motivational and social change* [2].

- The *individualization of society* has increasingly shifted the focus of both *formal* and *informal* (i.e., NPO-independent) volunteering toward the pursuit of personal goals and skill development. This trend contributes to a growing *diversification* within the volunteer sector, highlighting the urgent need to align and synergize individual motivations and competencies with the specific activity requirements of CRITIS.
- The *pluralization of society* entails reduced long-term commitment to individual NPOs, with many volunteers seeking flexible engagement to pursue their personal goals and to contribute their specific skills. This development leads to increased *fragmentation of the voluntary sector* where voluntary work often takes place *informally* and underlines the need for goal-oriented and competence-based bundling of, both, formal and informal volunteering is crucial.

As emphasized in the UN World Volunteerism Report [1], in light of profound societal changes, *effective IT support* is crucial not only for unlocking and efficiently leveraging the full potential of volunteering from an economic standpoint, but also for serving the interests and advancing the benefits of both NPOs and volunteers themselves. However, current IT-support focuses on the needs of NPOs, only, rarely considering a volunteer's specific interests and individual competences.

Our project, *»CIvolunteer« (CRITIS Powered by Volunteers),* addresses these pressing key challenges by researching conceptual requirements and technical pre-requisites to create a *digital platform for goal-oriented and competence-based networking as well as bundling of volunteer engagement across NPO boundaries.* Thus, the digital platform aims to align individual goals and competencies of volunteers with activity requirements of CRITIS (Fig. 1). By fostering the professionalization of individual volunteering through adequate *digital transformation,* the project seeks to provide the basis for future viability of the voluntary sector and to ensure the sustainable and a comprehensive strengthening of volunteer-dependent CRITIS.

This paper puts forward the *research goals* of »CIvolunteer« (cf. Section II), provides an in-depth discussion of *related research* in these goal's thematic context (cf. Section III) and outlines first steps towards the realization of our *»CIvolunteer« prototype*, thereby reasoning about innovations and identifying challenges (cf. Section IV), before finally concluding with a summary (Section V).

2. Research Goals of »CIvolunteer«

The *vision* of »CIvolunteer« is to create a digital platform for goal-oriented and competence-based networking and bundling of volunteer work across NPOs, with the aim of

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strengthening volunteer-dependent CRITIS. Due to the risk potential of CRITIS, we put forward *two complementary research goals* (cf. Fig. 1):

2.1. Research Goal 1: Digitization of Goals & Competencies

The first research goal addresses the challenge of increasing *diversification* within the voluntary sector. It focuses on low-threshold involvement of citizens for strengthening CRITIS by fostering, both, *activating commitment (»Citizen Empowerment«)* and *ensuring long-term commitment (»Citizen Encouragement«).*

»Citizen Empowerment« aims to:

(i) Enable volunteer engagement through *low-threshold goal setting/progress mechanisms* ensuring flexibility in terms of timing, scope and forms of participation.

(ii) Develop a *holistic recommender mechanism* to activate and coordinate volunteer goals/competences with CRITIS' activity needs effectively.

Second, »Citizen Encouragement« aims to:

(i) Support *reflection mechanisms* that allow for *retrospective* reflection of engagement contribution to CRITIS and to the volunteers' personal goals as well as *prospective* analysis to project on future goals for continuous personal development *("lifelong learning")*.

(ii) Provide *transparency mechanisms* that ensure for traceability of system support in the sense of an *explanatory component* (e.g., disclosure of recommendation reasons), thereby fostering trust and reinforcing confidence in the meaningfulness of long-term commitments.

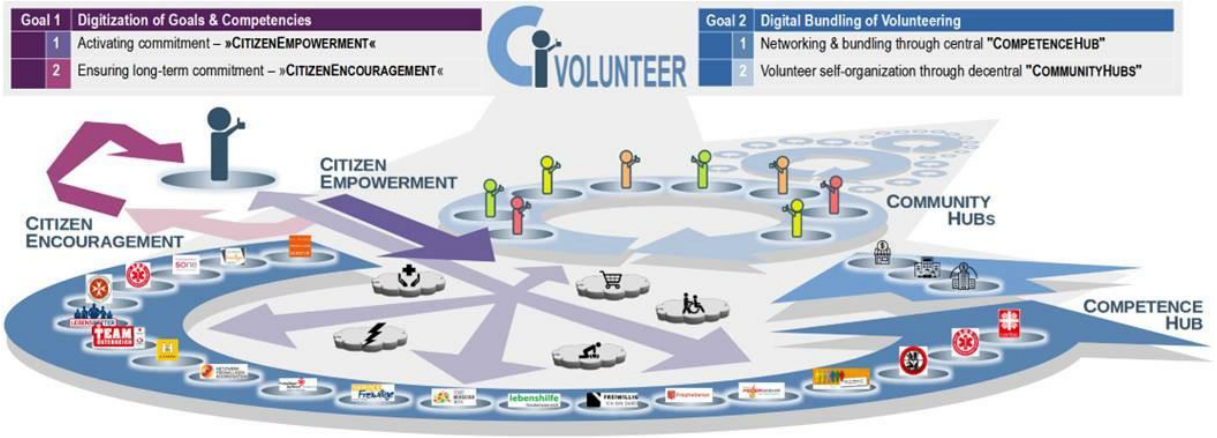

Figure 1. Research Goals of »CIvolunteer«

2.2. Research Goal 2: Digital Bundling of Volunteering

The second research goal addresses the challenge of increasing *fragmentation of the volunteering sector* by focusing on the digital networking and bundling of volunteering through a central *"CompetenceHub"* and interconnected decentralized *"CommunityHubs"*. The central *»CompetenceHub«* aims to:

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(iii) Facilitate networking among different NPOs in order to leverage cross-NPO synergies in the sense of *"competence-based bundling of the best forces"* to strengthen CRITIS.

(iv) Enable the involvement of external stakeholders such as *sponsors*, e.g., via *corporate volunteering initiatives or incentive systems for volunteers*, to broaden the societal foundation for the strengthening of CRITIS.

The decentral *»CommunityHubs«* aims to:

(i) Support the *self-organization* of volunteers in a *crowd-driven manner* by enabling the forming needs- and demand-driven *grassroots communities* in any area, which in turn act as local/regional »CommunityHubs« that contribute to CRITIS resilience.

(ii) Provide *expansion of the mechanisms* for activating and ensuring commitment (cf. Research Goal 1) so that this networking opportunity can also be used for goal setting, progress monitoring, activity recommendations as well as reflection and transparency.

3. Related Research

In alignment with our overall research goals, »CIvolunteer« can be assigned to the field of *Computer Supported Collaborative Work (CSCW)*, in particular two domains:

(i) Personal informatics [3] with a focus on persuasive information systems [4], personal goal setting and tracking [5], self-optimization [6], life logging [7], recommender systems [8], nudging [9] and gamification [10], and

(ii) Collaborative crowdsourcing [11] with a focus on semantic integration [12], community systems [13] and decentralized social networks [14].

The relevant state of knowledge in these fields as well as in the voluntary sector underpinned by our preliminary project *»iVolunteer«* [15][16][17][18][19][20] is reflected in the following, along our two primary research goals.

3.1. State-of-the-Art "Digitization of Goals and Competencies"

Digital support of engagement activation and retention in the *volunteer sector* is mostly limited to simple volunteer management phases and basic administrative functions (e.g., activity planning) with *NPO-centric "Volunteer Management Systems" (VMS)* dominating [15]. In contrast, *"volunteer web portals"* prevailing in the informal volunteer sector often allow simple, mostly regional job placements, only [15]. No support is provided for goal setting, progress monitoring or recommendations for engagement activation and coordination with CRITIS' activity requirements [15]. Reflection and transparency support for commitment usually does not go beyond activity and competence documentation (e.g., digital volunteer passports [18][19]).

Regarding the research field of *"personal informatics",* engagement activation and retention are recognized to play a central role [3]. Ubiquitous, predominantly domain-centric mobile apps for personal goal setting/tracking [5], self-optimization [6] and life logging [7]

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(e.g., for health, sport or sustainability), have neither focused the voluntary sector nor the specific demands of CRITIS so far. Even in rare cross-domain approaches [3] that would be particularly relevant for »CIvolunteer«, *progress monitoring* is neither automated nor user-adaptive [20]. Holistic recommender [31] using techniques like deep/reinforcement learning [21] are also not offered, i.e., competence-based operationalizations of goals with respect to. activity requirements of CRITIS are not possible. Finally, reflection and transparency, though crucial for long-term engagement [3], are often neither actively supported nor allow for prospective analysis as provided statistics are mostly limited to past engagements [15].

3.2. State-of-the-Art "Digital Bundling of Volunteering"

Digital support of engagement networking and bundling does not exist in the *voluntary sector*. As a result, cross-NPO synergies through "competence-based coordination of the best forces" also regarding informal volunteers and engagement sponsors *(corporate volunteering, engagement incentives)* cannot be used for CRITIS. Current systems, whether NPO-centric VMS or volunteer web portals, are largely designed as *"data silos"* [16] and lack interoperability. Opportunities for collaboration typically do not go beyond *syntactical exchange* of news, announcements and questions [19]. Typically, there is a lack of semantic integration, coordination, and cooperation across NPOs. Moreover, collaboration in goal setting, progress tracking, generating recommendations, fostering reflection, and ensuring transparency, particularly in terms of a hub-like function to strengthen CRITIS [13], is largely absent or insufficiently supported.

Regarding again the research field of *"personal informatics"*, apps such as Goalify [26], Strava [27], or feastr [28] are mostly domain-specific data silos which focus purely on the support of individual goals [15]. So far, cooperative goal setting has primarily been researched conceptually [5], collaboration between systems (e.g., cross-domain goals/recommendations) is mostly limited to syntactic data exchange [6]. Even simple collaboration options, e.g., *social sharing* would already create the basis for *crowd-driven goals* and *social exchange* [5], thus enabling stronger commitment [23]. A simple form of crowd-driven collaboration [11] allows *community systems*, which, however, support individual, e.g., neighborhood communities only [13]. Enhanced self-organization/-determination of volunteers in the sense of decentralized social networks [14] could promote the formation of need- and demand-driven "grassroots" communities [29], offering new pathways to further strengthen CRITIS.

4. Prototype Architecture and Implementation

Our envisioned approach is discussed along the proposed *prototype architecture* as depicted in Figure 2, which structures the system into three interconnected layers: the *Data Layer*, the *Empowerment Layer*, and the *Encouragement Layer*. Each of these layers and their different components will be discussed successively in the respective subsections.

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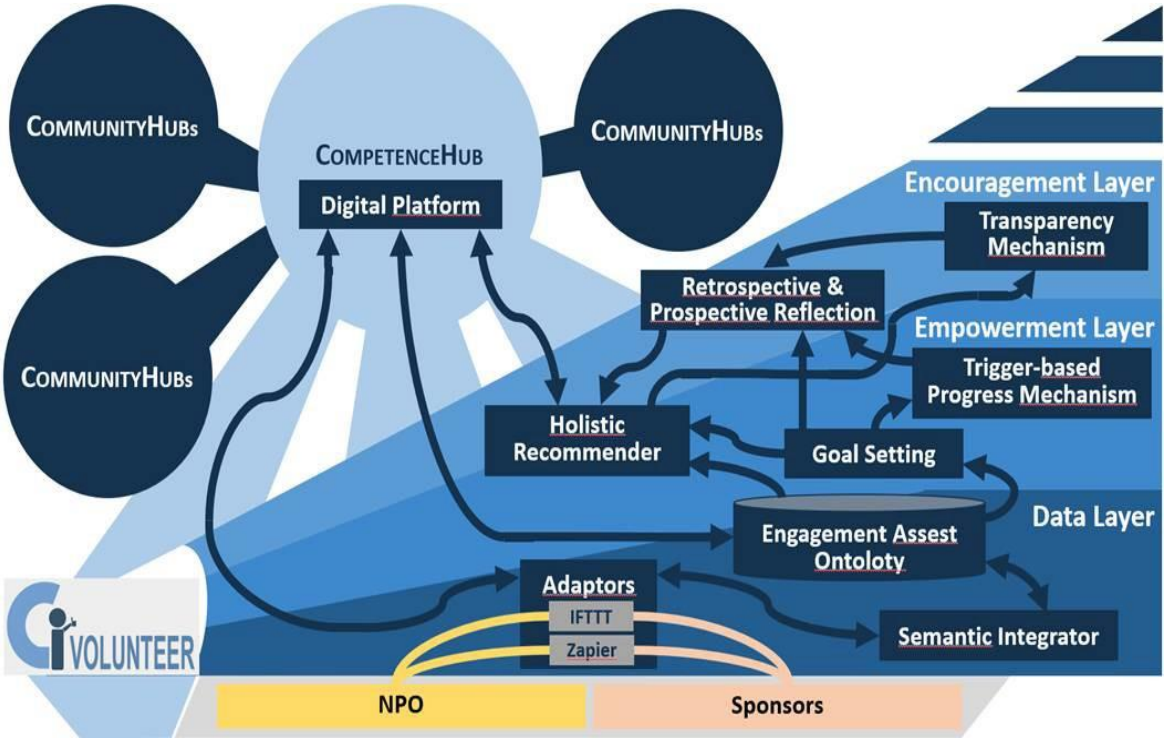

Figure 2. Architecture of the »CIvolunteer« Prototype

4.1. Data Layer

To facilitate centralized engagement networking and bundling, we propose a novel *»CompetenceHub«*, where *lightweight adapter plug-ins* allow NPOs and volunteers themselves – »Citizen Empowerment« – to contribute proven skills, open activities and achieved goals, while allowing sponsors to offer, e.g., incentives. The key challenge is to create an *open and scalable platform* via connection services such as *Zapier* and *IFTTT* [30] instead of introducing "yet another data silo/island solution". Building on this, purely syntactic data exchange should be "lifted" to a semantic level by *semantic integration* as adequate basis for meaningful coordination and cooperation. This is achieved by applying standards such as *Linked Open Data* and *ontologies* [12][34][35].

Our previous work [19][20] introduced a common core ontology that formalized volunteering concepts and relationships in-between. Based on the metaphor *»I am what I do«*, a basis for deriving the common core concepts of volunteer engagement has been found in the area of *linguistic research*, notably in the prominent work of Vendler about the aspectual classification of verbs [37], as well as by considering well-known upper ontologies like SUMO and DOLCE [12][34][35]. Following [37], the core of generic concepts of our ontology captures the notion, that Engagement in Activities running through certain States may lead to Accomplishments and various Achievements, justified by some Evidence. Although this so-called *engagement asset ontology* focuses on volunteering, special attention has been paid to provide a core of generic concepts that deliberately maintains a level of abstraction to enable applicability to a much broader range of application areas. This is achieved on the one hand by enabling *white-box reuse*, i.e., subtyping to extend the pre-

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defined type taxonomies, thereby coping with peculiarities of assets issued by, e.g., different NPOs. On the other hand, *black-box reuse* is supported through explicit extension points, allowing to enhance and configure the ontology by specifying, e.g., further properties.

In order to populate this ontology, a central key challenge is the semantic integration of competencies acquired in different NPOs. Competencies are usually described in textual form, by different rules that have to be fulfilled in the respective NPO, e.g., completion of certain courses. Modern large language models (LLMs) like Bert or GPT4 [38] offer promising possibilities for the analysis of semantic equality.

Finally, to support decentralized, fine-granular and thus demand-adaptive engagement networking and bundling, we further give volunteers the opportunity to build »Community Hubs« themselves. These hubs support self-organization and self-determination in a *crowd-driven* manner, analogous to decentralized social networks [14], self-organization and self-determination are to be carried out by volunteers ("crowd-driven"). At the same time, the »CommunityHubs« are in turn enabled to connect to the central »CompetenceHub« in order to prevent isolated solutions.

4.2. Empowerment Layer

For low-threshold engagement activation *(»Citizen Empowerment«)*, we design *a cross-domain, collaborative goal setting mechanism* tailored to the broad spectrum of CRITIS. A particular challenge thereby is to go beyond purely metric-based goals [39] and also enable low-threshold access to long-term goals (e.g., "increase leadership skills"), offering flexibility in terms of time, scope and form of engagement [17].

In order to operationalize goals, propose new ones and coordinate competences with activity requirements of CRITIS, we propose the use of a *holistic recommender mechanisms*. As a basis, configurable deep/reinforcement learning [21] seem to be promising, employed together with concepts of cross-domain, knowledge- and context-aware recommenders [31], using machine learning-based classification (e.g., Word2Vec [32], Word Embeddings [33]). These should allow to find similarities in the skills of volunteers and the requirements of CRITIS, mapping them to each other. A particular challenge lies in adapting to the dynamics of CRITIS, that requiring continuous evolution of the proposed diverse activities and goals [40].

Finally, to ensure goal achievement, *trigger-based progress mechanisms* are designed through a combination of gamification [10] and nudging [9] with progress monitoring and user-adaptive incentives via formal goal/activity representations being a particular challenge, automated based on SAT solvers [22].

4.3. Encouragement Layer

In order to ensure long-term engagement *("Citizen Encouragement")*, we focus on intrinsic motivation through mechanisms for *retrospective and prospective reflection* that are digitally supported, i.e., goal setting, recommendation and progress phases can be reflected by

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volunteers themselves [41]. Concretely, this includes explicating and clarifying (e.g., "drill-down", "pattern/anomaly analyses" [42]) how volunteer engagement contributed to, both, protection of CRITIS as well as personal goals. To enhance awareness of *informal learning* outcomes, the system traces which activities contributed to specific competencies. Moreover, to ensure proper exploitation of the benefits achieved by activities, interrelationships and aggregations (e.g., the “social capital” of a volunteer) are computed by means of machine learning techniques [21]. This aggregated visualization of the value of volunteering not only serves as motivational feedback but also functions as substantial incentive for volunteers, NPOs and the society as a whole.

Prospectively, future personal development should be targeted. For this, the system enables planning of future personal development paths, using, e.g., "what-if" analyzes [36], thus addressing the challenge of "lifelong learning". Definition and traceability of personal development goals should be explicitly supported by using so- called *situation evolution models*, a state-machine-based formalism which we successfully applied in the area of situation awareness systems [43]. The respective situation evolution models will be developed by drawing on insights from the area of *human resource development* and *goal management systems* [32] [39]. These models in turn allow to monitor the path for reaching personal development goals on basis of continuously populated digital engagement assets at the Data Layer.

Complementary to this, a *multi-level transparency mechanism* will be designed to provide for trust and explainability [24], thus facilitating the central engagement-bonding aspects. For comprehensiveness this comprises *two semantic levels*, the *"result level",* by making recommendation reasons transparent and, as special challenge, the *"model level"* by intuitively visualizing the functionality of underlying recommendation algorithms [25].

5. Conclusion

In this work, we proposed a digital platform supporting individual volunteer engagement by enabling goal-driven and competence-based networking and bundling across NPO-boundaries, in order to strengthen volunteer-dependent CRITIS. To this end, we proposed mechanisms to, both, *activate* and *ensure long-term engagement,* on the one-hand-side, and to *provide* for *cross-NPO coordination of competences* as well as for *self-organized volunteer communities*, on the other hand side. For these mechanisms, a first prototypical architecture has been laid out, building on our own previous research efforts as well as on promising research and developments in the field of personal informatics.

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