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BeneWinD: An Adaptive Benefit Win–Win Platform with Distributed Virtual Emotion Foundation

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Abstract: In recent decades, online platforms that use Web 3.0 have tremendously expanded their goods, services, and values to numerous applications thanks to its inherent advantages of convenience, service speed, connectivity, etc. Although online commerce and other relevant platforms have clear merits, offline-based commerce and payments are indispensable and should be activated continuously, because offline systems have intrinsic value for people. With the theme of benefiting all humankind, we propose a new adaptive benefit platform, called *BeneWinD*, which is endowed with strengths of online and offline platforms. Furthermore, a new currency for integrated benefits, the *win–win digital currency*, is used in the proposed platform. Essentially, the proposed platform with a distributed virtual emotion foundation aims to provide a wide scope of benefits to both parties, the seller and consumer, in online and offline settings. We primarily introduce features, applicable scenarios, and services of the proposed platform. Different from previous systems and perspectives, *BeneWinD* can be combined with Web 3.0 because it deliberates based on the decentralized or distributed virtual emotion foundation, and the virtual emotion feature and the detected virtual emotion information with anonymity are open to everyone who wants to participate in the platform. It follows that the *BeneWinD* platform can be connected to the linked virtual emotion data block or *win–win digital currency*. Furthermore, crucial research challenges and issues are addressed in order to make great contributions to improve the development of the platform.

Keywords: benefit; adaptive; distributed; platform; virtual emotion

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1. Introduction

Recently, the valuable concepts of consensus schemes, incentive mechanisms, and reputation processes have been studied by many researchers because these schemes can be applied to numerous applications, including blockchain-assisted systems, mobile crowd sensing, authentication services, industrial Internet of things (IIoT) systems, 6G communication systems, and so on [1–18]. Furthermore, their applicability has expanded due to being fused with the research into vehicular networks and unmanned aerial vehicles (UAVs) to accomplish the specific missions and requested tasks from users to fit in with the considered systems and platforms [19–27]. In particular, blockchain was introduced as a potential way to use cryptocurrency, which utilizes a digital distributed ledger to store transactions and legitimate information from every system component in a decentralized manner [28–30]. Then, numerous transactions are transformed into blocks and linked by applying hash functions, so that those multiple blocks create a chain that takes the role of a replica for each system component. Furthermore, several key enabling technologies, including smart contracts and decentralized concepts utilized through blockchain, can contribute to expanding an online financial and digital system continuously, as well as to establishing decentralized data storage management.

Furthermore, mobile crowd sensing (MCS) was used to achieve a data collection and processing platform in a dynamic environment where a billion IoT devices, service requesters, and social participants are utilized for sensing tasks, platform budgeting, bids, recruitment, and large-scale data processing [31,32]. The challenges and requirements of MCS should be addressed timely, and sufficient data supported by active participants are needed to ensure the quality of services. Understanding how to overcome critical situations and environments, such as insufficient participation to accomplish the requested tasks and time-sensitive features, is significantly important. Furthermore, Web 3.0 technology allows applicable systems to be decentralized and open to everyone with a bottom-up flow due to blockchain technologies, so that the web sensing information is formed as a network of meaningfully linked data from a large amount of data. It is envisioned that Web 3.0 will be expanded and lead to a world without centralized companies, where people are able to manipulate their own data and transactions are transparently achieved through blockchains, blocked information, or databases which are searchable by anyone in the world.

On the other hand, emotion recognition in affective computing has attracted a lot of interest from researchers; the derived emotion information is highly accurate due to being obtained through facial, motion, and wireless signals, and thus this can be the key driving technology in a variety of applications, including social platforms, education, criminal prevention, and surveillance [33–38]. Notably, the term *virtual emotion* was introduced by [39], and was expanded to apply to advanced smart cities with artificial intelligence (AI) through a virtual emotion barrier, virtual emotion flow, and virtual emotion map [40]. Moreover, they designed a virtual emotion-assisted blockchain according to the viewpoint that the detected or collected virtual emotion information is a property of system participants. It is highly expected that the virtual emotion information and collected data can support an online store and virtual world, including immersive or vivid metaverse systems supported by augmented and interoperable properties [41].

However, because the management of offline stores still has clear advantages and intrinsic features, we should envision its balanced activation and management for both offline marketplaces (or physical spaces) and online spaces (or virtual worlds). Furthermore, previous incentive mechanisms and digital assets were not designed mainly for symbiosis or mutualism, and are not discussed with regard to an offline, online, profit, non-profit, or distributed virtual emotion foundation. Hence, it is highly necessary to initialize and expedite these burgeoning research branches, including e-commerce, education, entertainment, smart virtual services, mobile crowd sensing, and so on.

Based on the above observations regarding new frontiers in adaptive benefit platforms with a distributed virtual emotion perspective, the main contributions and potential impacts of this paper are summarized as follows:

- First, we introduce an adaptive benefit win–win digital currency, called *win–win digital currency* or *WWD*. Furthermore, we consider the research question of how to construct an adaptive benefit platform and manage the adaptive benefit system with a distributed virtual emotion foundation.
- To the best of our knowledge, this is the first design and blueprint for an adaptive benefit win–win platform, referred to as *BeneWinD*, created according to mutualist philosophy and a distributed virtual emotion foundation, to be conducted with *win–win digital currency* or *win–win cash*.
- For the successful realization of *BeneWinD*, we explore the whole platform and give an overview that includes design rationales, assumptions, key definitions, intrinsic features, and basic task flows, as well as show critical cases which cover specific goals, scenarios, and operations categorized by online stores and offline marketplaces from profit and non-profit perspectives.
- Finally, open research challenges and critical issues related to integrated platforms with technical and social viewpoints are discussed.

Figure 1 presents a visual and brief summary of the proposed platform, covering its essential terms, executable cases and their objectives, and open research issues to be resolved. For the proposed *BeneWinD*, we present keepers, contributors, super influencers, WWD, distributed virtual emotion, and distributed virtual emotion informatics as key terms and definitions. Then, three different executable cases are explored with the consideration of offline profit stores, online profit connections, and profit and non-profit organizations. Their task objectives include activating all kinds of offline stores, expediting all activities of online transactions such as orders from sellers and customers, and expanding benefits to institutions and organizations.

The rest of the paper is organized as follows: Section 2 presents a whole system overview of design rationales, assumptions, key definitions, and factors. Section 3 demonstrates an applicable case of an offline profit store with a certain objective, scenarios, and operations. Section 4 deals with a critical case of online profit connections. Then, Section 5 describes a suitable case of profit and non-profit organization by considering the goal and possible scenarios. Moreover, open research challenges and important issues in regard to the proposed platform are discussed deeply in Section 6. Finally, Section 7 concludes the paper.

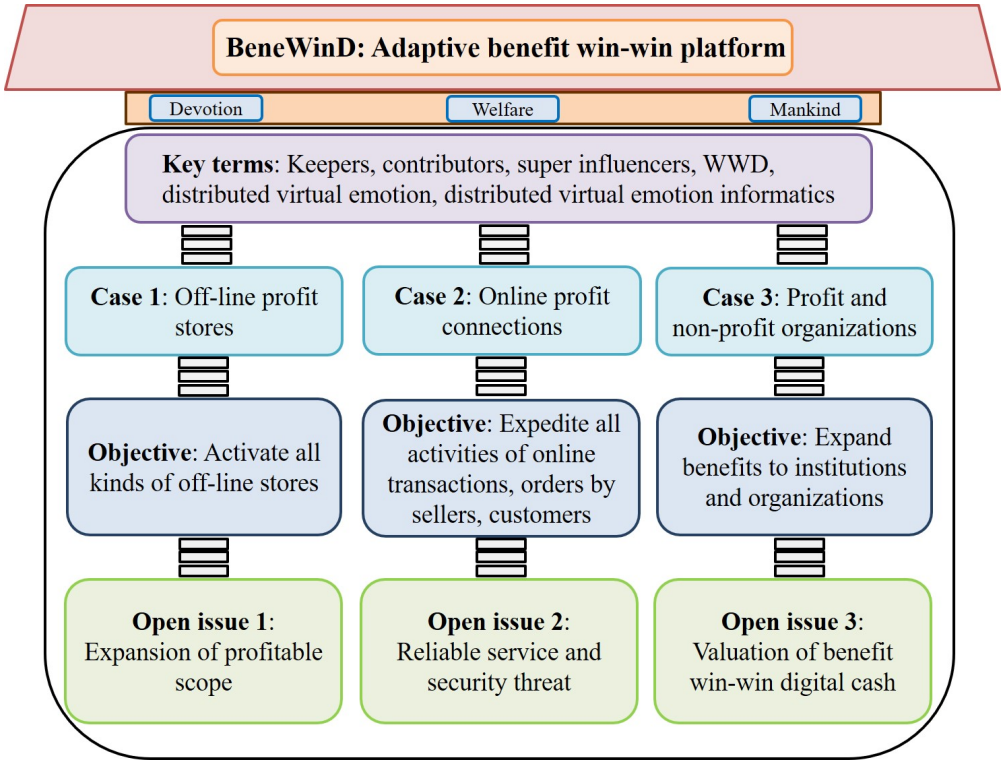

Figure 1. A brief summary of the proposed platform covering key terms, operable cases and their objectives, and critical open issues.

2. An Adaptive Benefit Platform with Win–Win Digital Currency and a Distributed Virtual Emotion Foundation

In this section, we envision the design rationales, assumptions, key definitions, and features through a brief overview of the proposed adaptive benefit platform with win–win digital assets and distributed virtual emotion applicability.

2.1. Design Rationales and Assumptions

The design rationales and assumptions are described to satisfy the objectives, tasks, and requirements of the proposed system.

- The virtual emotion information is detected via numerous components including smart phones, cameras, tablets, mobile robots, unmanned aerial vehicles, autonomous vehicles, and wearable devices through facial recognition, motion capture, gesture evaluation, heartbeat segmentation, respiration estimation, wireless transmission, and reflection [33,39].
- A large amount of virtual emotion information is transmitted to other entities in participating applications. Furthermore, the set or flow of virtual emotion information is utilized in both the online platform or virtual world and in the offline area or physical space [40].
- It is mandatory that the platform must gain permissions or agreements from system users or participants to use their privacy-enabled adequate information, such as location information, virtual emotion data, requested service verification, participant recruits, or bids status, while the adaptive benefit platform is operated appropriately.
- The proposed platform provides benefits to the participants, including keepers, contributors, and super influencers, after the requested transactions by collecting the required amount of virtual emotion information.
- The estimation or calculation of benefit for each participant is achieved according to the system circumstances and the selected incentive mechanism and winner selection process [31].

2.2. Key Definitions and Features

Now, we define the essential terms and problems that are utilized in the proposed adaptive benefit platform of mutualism and a distributed virtual emotion foundation.

Definition 1 (distributed virtual emotion)**.** *Distributed virtual emotion is created by a sensed event or the collection of reported data from participants who gave their permission, which occurs through millions of smart devices worldwide, such as dynamic IoT devices, mobile robots, smart phones, smart watches, smart drones, and public devices which are equipped with GPS, microphones, cameras, wireless transmitters, reflectors, and so on.*

Definition 2 (distributed virtual emotion informatics (DiVemoTics))**.** *Distributed virtual emotion informatics, called* DiVemoTics*, is the study of sensing tasks, the collection of data, communication, the decision process, participant management, interoperability, authentication, privacy, and access control for obtaining distributed virtual emotion information through distributed system components or decentralized participants. Distributed virtual emotion informatics are a key driving force in a wide range of academic disciplines and industrial fields including computer science, networking, cognitive science, psychology, economics, healthcare, e-commerce, entertainment, digital twins, the metaverse, and so on.*

Definition 3 (adaptive benefit win–win digital currency)**.** *The adaptive benefit win–win digital currency, called* WWD*, is a mutualist digital currency or asset which pursues providing the possible maximum benefit or incentive to both trader groups when the proper transactions are executed between a group of participants within both an online store and offline marketplace.*

Figure 2 shows a description of distributed virtual emotion informatics, presenting its definition, primary components, adaptive benefit platform and relevant applications, operable areas, and applicable technologies based on virtual emotion information.

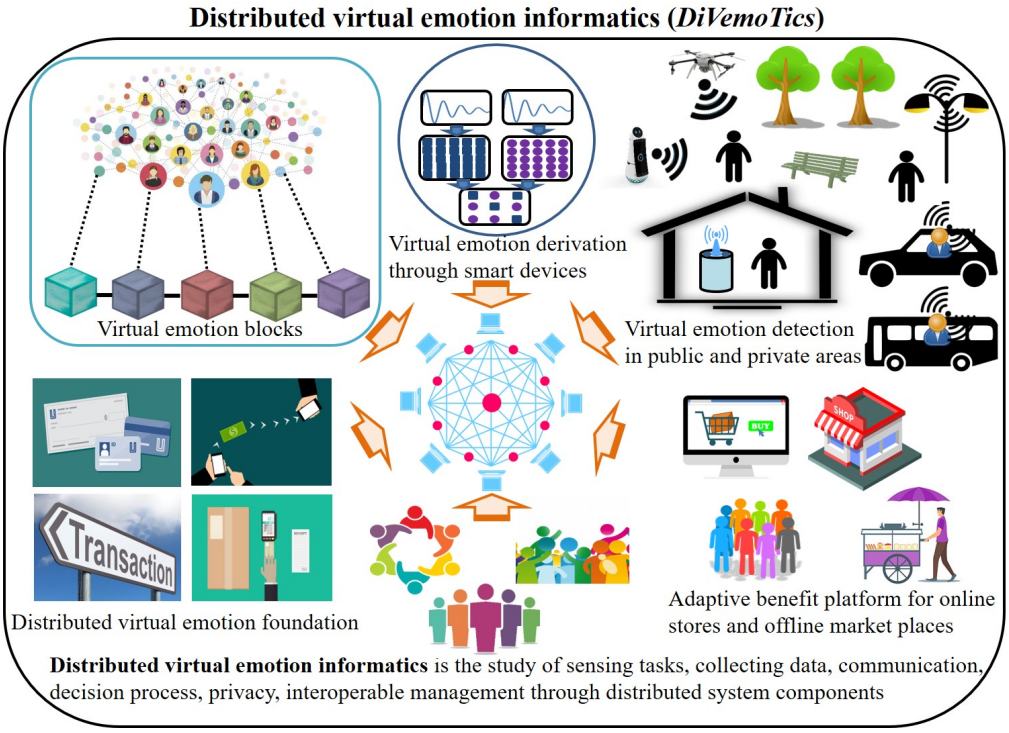

Figure 2. A description of distributed virtual emotion informatics including system components, promising applications, applicable areas, and technologies.

2.3. System Overview and Essential Task Flows

Note that the adaptive benefit win–win platform fundamentally aims to provide the possible maximum benefits or gains to various groups consisting of participants wherever they access it, whether through online markets or offline spaces.

The essential execution steps and task or work flows are described as follows:

- Task flow 0: Through virtual emotion-enabled applications and systems in advanced smart cities with 6G-assisted communication and digital space management, a system user opens their own account to carry out a deposit or a withdrawal of a benefit or digital asset so that the opened account is connected to the virtual emotion foundation.
- Task flow 1: Multiple adaptive benefit communities (or groups) are generated by participants in online stores and offline physical spaces, where each benefit community has original specifications including objective description, instant community identification and benefit community account information, the number of possible minimum target benefits, a community participation completion ratio, an offer deadline, and so on. If there are no predefined, restricted circumstances, the first participant becomes the main contributor to the new adaptive benefit community.
- Task flow 2: The newly created groups and their specifications are registered to the integrated adaptive benefit platform. Then, they are advertised or disseminated to the local virtual emotion foundations, applications, and services in regard to both online stores and offline markets.
- Task flow 3: When a new member joins the adaptive benefit community as a keeper, contributor, or super influencer, it is requested that the new member agrees to share anonymous virtual emotion information that can be used for data processing on the adaptive benefit platform while their anonymity is maintained.
- Task flow 4: Because more member enrollments into the current benefit community produce more benefits or profits for community members, it is expected that the recruitment of participants to one's own benefit community might be advertised continuously until the community participation completion ratio is satisfied. The main contributor to when the new adaptive benefit community starts to survey votes is

whether the benefit community members agree with the combined transactions and whether the current completion ratio should be submitted or not. If a matter of the transaction submission is approved due to agreement through legitimate votes from benefit members, the transaction request of the specific benefit community is submitted to online stores, offline marketplaces, or sellers.

- Task flow 5: If the transaction request is completed with agreement between benefit community members and sellers, the adaptive benefit platform presents the maximum benefits to both parties according to the estimated virtual emotion information by using the distributed virtual emotion foundation, which is closely connected with the platform. After such a transaction is reported to both parties, the transaction is saved and is linked by blockchain technology in a distributed manner for reliability and trustworthiness.

Figure 3 depicts basic task flows with necessary specifications so as to operate the adaptive benefit platform, which starts from task flow 0 to task flow 5 with interoperability.

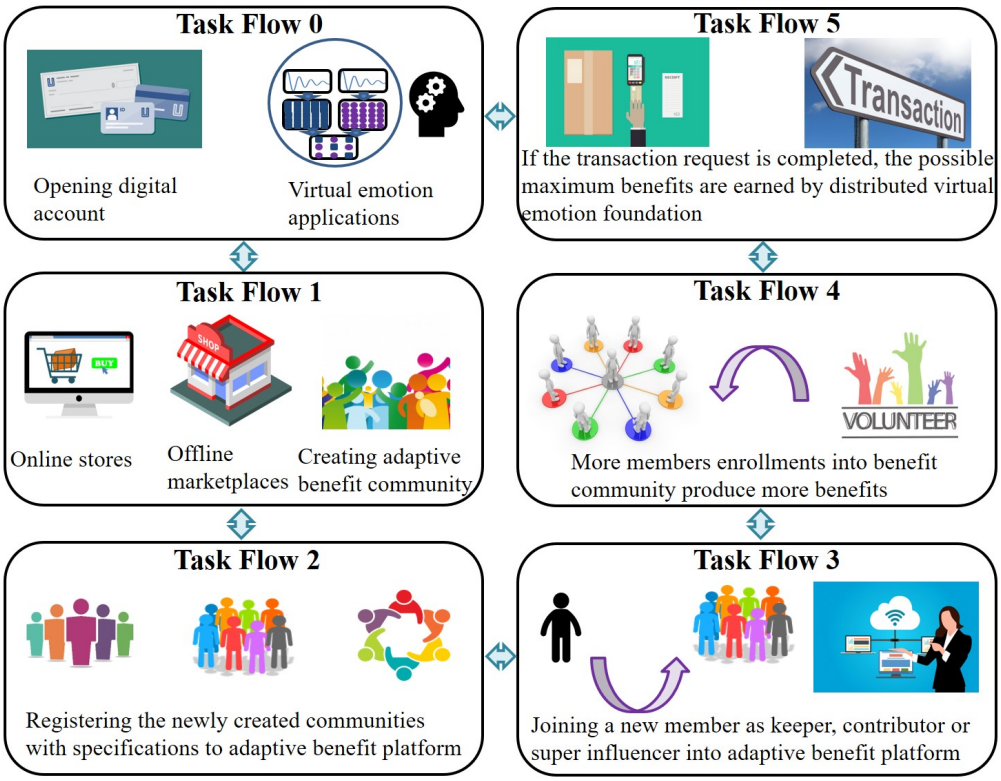

Figure 3. A representation of task flows with descriptions as used in the adaptive benefit platform with distributed virtual emotion foundation.

3. Case 1: Adaptive Benefit with Win–Win Digital Cash in Offline Profit Stores

3.1. Goal and Objective

The ultimate goal of this first case is to activate all kinds of offline stores in smart cities, big cities, small towns, local areas, etc. These regions can also include a wide range of stores such as restaurants, shopping malls, groceries, medical items, quarantine items, and other various goods.

3.2. Scenarios and Operations

As the first scenario in offline stores for profit, let us consider two types of restaurants as sellers in smart cities. The first type accepts only country-issued legal currency (i.e., USD, JPY, CNY, EUR, GBP, CHF, KRW, CAD, NZD, HKD, BRL, MXN, AED, KWD, BHD, INR, SAR, NOK, DKK, etc.) and the second type accepts both country-issued legal currency

and *win–win digital currency* or *win–win digital cash*, referred to as *WWD* throughout the *BeneWinD* platform. When customers place orders for their foods and drinks and pay for the order using country-issued legal currency at the first type of restaurant, this is a general transaction and there is no specific benefit or advantage to the restaurants and customers.

On the other hand, the *BeneWinD* platform allows system members to have limitless benefits (i.e., better member levels or more discounts) whenever they use the *WWD* through *BeneWinD*. Due to the mutualism of *BeneWinD*, collaborating on orders and combining the transactions of more customers enables members to gain more benefits. In particular, the benefits affect both parties: customers and sellers. So, if there are more combined transactions, this will lead to more benefits for customers directly. Simultaneously, because customers tend to combine their orders of a greater amount possibly in order to gain better benefits, this situation will lead to a greater total amount of transactions that will surely produce a considerable increase in sales for sellers.

In another scenario in offline shops, in order to facilitate *BeneWinD*, assume that there are two levels of shops with different sales rates or business performances, and all shops are supported by *BeneWinD*. For instance, one big shop in a metropolitan city has a very high sales rate and a great number of sales because a crowd of people visit those shops and buy many items daily. Meanwhile, a local store located in small town has a very low number of sales and customers scarcely ever visit the store. In the case of the big shop, it can still provide benefits for customers and sellers. It follows that the more combined transactions, including group buying, through *BeneWinD* will have a more positive effect on customers, providing considerable benefits (i.e., an increased rate of cashback), as well as on sellers due to a greater number of sales. Moreover, in the case of the small store with a low sales volume, *BeneWinD* can give better benefits to customers whenever they visit a small store with a worse sales volume. That is, if customers visit shops with a smaller number of business sales and where fewer items are bought, the property of symbiosis by *BeneWinD* will promote more increased benefits to customers and sellers, and stores also will see improved sales volumes. It follows that the proposed *BeneWinD* delivers adaptive benefits to both sellers and consumers.

4. Case 2: Adaptive Benefit with Win–Win Digital Cash through Online Profit Connections

4.1. Goal and Objective

The essential goal of this second application is to expedite all activities of online transactions, including orders by sellers, online customers, and shoppers. Different from offline stores, this case focuses on how to activate the proposed *BeneWinD* in online markets consisting of online profit establishments via various scenarios and executable operations.

4.2. Scenarios and Operations

For online profit connections and online markets, we accelerate the services and use of currency through various ways so that there is a favorable level depending on the positive effects on other system components and entities due to the circulation of currency and benefits. Let us consider that there are several levels of entities such as *super influencer*, *contributor*, and *keeper* for each economy category or item. It follows that according to each category, one person may have multiple roles. For example, one person can be a *keeper* in the category of vehicle as well as being a *contributor* in the economy section of food. Then, it can be defined that the *contributor* supports the *WWD* for other entities (i.e., the *keeper* or *contributor*). Furthermore, the *super influencer* donates their *WWD* to a *keeper*, *contributor*, or *super influencer*. As an essential and normal member of the economy category, the *keeper* can receive or provide *WWD* to a *keeper*. If the *keeper* reaches a specific level of their contributions to the system components, they are promoted to *contributor*. Similarly, when a *contributor* reaches the given positive power of influence on other entities, it moves up to be a *super influencer*. These roles and badges can be temporal and can be changed depending on the contributions to the system components of *BeneWinD*.

Moreover, in the similar case of offline profit stores, a transaction with a greater number of payments made through *BeneWinD* in a specific online market will provide more benefits to online customers or shoppers. For instance, when customers try to order daily foods with a delivery request in online grocery markets, they can gain more benefits (i.e., better offers, instant discounts, or claim a discount with *WWD*) if a large number of orders are processed through *BeneWinD* by many customers in the same neighbor complex, community, or apartment with the same delivery mailing address. Conversely, from the side of sellers or online sales departments, a greater number of transactions from a group of orderers with close delivery locations will be better thanks to the increased total sales and reduced delivery costs, which is caused by a decrease in delivery distance and time. Furthermore, the contribution of the seller to the system can be estimated by review scores from online customers. So, if the seller obtains good reviews from their online customers, their level can be upgraded from *keeper* to *super influencer*. Note that the level is not permanent and changes periodically. In addition, if a seller earns the position of *super influencer*, they may gain further benefits (i.e., the benefit of online advertisement).

5. Case 3: Adaptive Benefits of Win–Win Digital Cash for Profit and Non-Profit Organizations

5.1. Goal and Objective

The basic goal of the third case is to expand benefits to organizations and institutions. Different from the previous cases, this case deals with how to support profit and non-profit organizations with different perspectives and environments.

5.2. Scenarios and Operations

BeneWinD supports transactions and orders from non-profit or public organizations. Furthermore, combined transactions due to the cooperation among multiple public institutions will allow the institutions to gain more benefits. In particular, it is highly possible that *BeneWinD* determines several advantages (i.e., more interest in *WWD*, or prioritized deliveries) for transactions under the top priority categories to deal with emerging or indispensable events. In this way, these top priority categories can cover medical services, rescue operations, epidemic prevention, security improvements, public construction, etc. Furthermore, transactions from public institutions to support minorities, including patients, disabled people, and children, will have significantly better benefits in *BeneWinD* when compared with other types of transactions and payments.

Furthermore, for profit organizations, *BeneWinD* makes an offer if they purchase their own business-purpose items through the *BeneWinD* platform. Similar to other transaction types, the larger number of transactions will return more benefits to the profit organization. Furthermore, if the organization purchases items for public services, it may gain additional benefits. Depending on the performance in *BeneWinD*, there are several levels of organizations such as *super healthy organizations*, *healthy organizations*, and *potential organizations*. A *potential organization* is promoted to a *healthy organization* and can then move up to be a *super healthy organization*. Each level gives specific advantages through *BeneWinD*.

6. Research Challenges and Open Issues

In this section, we discuss the considerable research challenges and critical open issues in regard to the adaptive benefit platform based on the distributed virtual emotion foundation.

6.1. Issue 1: Expansion of Profitable Scope and Integrated Management

As an initial stage, this paper introduced an adaptive benefit win–win paradigm based on a distributed virtual emotion foundation in order to allow for the maximization of benefits with the promise of mutualism and fairness to those who participate in the platform. Firstly, we aimed to expand the profitable scope to prominent applications, covering the metaverse, entertainment, mobile healthcare, social activities, social media services, financial systems, mobile crowd sourcing, edge computing, all possible online

stores, participating offline marketplaces, 6G-assisted virtual emotion-based services in autonomous vehicles, intelligent digital twins with synchronized properties, credit-unions, banking services, and so on. Because the key breakthrough of the proposed platform is its kindhearted mutualism for as many people as possible, it is highly anticipated that the applicable fields and expanded areas will not be limited to only a few. Furthermore, once all of the required system requirements are satisfied in numerous applications, the flow of maximum benefits to individual persons or a group of participants can be started, and then the win–win benefit flow may affect other industrial fields as well as ideally generate a virtuous circle. Therefore, the issue of how to boost sustainable connectivity and operable services for a wide range of applications should be addressed. It follows that the proposed platform will play a critical role in several industrial fields and public services. Furthermore, it is envisioned that an integrated benefit win–win framework will be designed in combination with a distributed manner and centralized approach so that the maximum profitable assets can be obtained for full participants or selected participants who are supported by the benefit win–win paradigm. On the other hand, it is important to consider designing a balanced benefit win–win platform rather than focusing on the construction of only a decentralized system and its implementation. That is, we may consider a centralized-enabled system for specific situations or cases. For instance, a combined, integrated platform with oversight of the main decentralized problem from a centralized-assisted perspective may return more rapid results and benefits than a pure decentralized platform in many cases in both online and offline environments.

6.2. Issue 2: Reliable Service and Security Threats

It is necessary to provide reliable services through the adaptive benefit win–win platform continuously. Furthermore, it is anticipated that the most likely obstacle is how to guarantee the complete privacy of the virtual emotion information that is collected by the proposed benefit platform. We must ensure the sustainable development and widespread adoption of the platform on a global scale. Then, we should consider that potential security threats may exist for the adaptive benefit win–win platform when the possible trades are accomplished in a distributed manner. Firstly, when virtual emotion information is gained from heterogeneous system components such as IoT devices and wearable devices, access control from unauthorized devices may be a vulnerability. It is necessary that the benefit win–win platform must protect the data from Sybil attacks. For example, the Sybil system uses components with numerous fake identities to disrupt the decision process as well as to diminish the execution accuracy of the benefit platform. Secondly, when the proposed platform is activated in a distributed manner, malware attacks can be tried by attackers to inject malicious third-party programs into the devices of participants. Furthermore, the collected data from corresponding components may be at risk of being tampered with when wrong information is provided to the platform. If the collected data include sensitive data, this could threaten the privacy of participants seriously. Similarly, it is possible that malicious attackers or dishonest participants can transmit false information to the platform through poisoning attacks. Thirdly, if attackers obtain access permissions to a large number of system components, there is a threat of a distributed denial of services (DDoS) attack that can ruin the benefit win–win platform via its distributed execution architecture. In addition, there may be attack threats to the communication network and routing stage. It is crucial to protect the proposed benefit platform against fraud, hacks, and unauthorized transactions when the digital currency is being used. Therefore, it is necessary to decide the proper roles of system participants, including super influencer, contributor, or keeper, in the proposed benefit system. For instance, system intrusions such as eavesdropping, man-in-the-middle attacks, collusion, routing loops, malware and phishing scams, hijacking, stealing virtual emotion information, or system requests can be caused during system activation and management.

6.3. Issue 3: Valuation of Benefit Win–Win Digital Currency

It should be noted that the ultimate aim of the proposed adaptive benefit win–win digital currency is to make an offer of an appropriate benefit to system participants. To achieve such a well-intended goal, it is important to valuate the benefit win–win digital currency or digital cash so that the legitimately validated asset can be used among the millions of services and applications for trading and transactions positively based on the virtual emotion information and foundation. For valuating, pricing, and recording the benefit win–win digital asset-enabled activities, it is required to determine how to apply blockchain or another feasible paradigm, such as a smart contract or incentive mechanism, as well as how to utilize novel strategies to manage the benefit win–win digital assets of participants properly in the distributed platform. Similarly, because various online and offline cases that include profit and non-profit organizations basically create benefits for both entities (i.e., participating online customers and offline stores), we should deliberate on novel strategies to determine how to generate those benefits or assets appropriately and successively in the platform. On the other hand, the strength of the benefit win–win platform is its ability to obtain more benefits when more participants or system components have completed transactions regionally. In this circumstance, the issue of how to handle social connections and concerns may have a significant and critical potential effect. In particular, it is necessary to expand the applicable areas for verified transactions with legal benefits to cover not only national regions, but also international places. Moreover, strict regulations with interoperability across international regions should be established clearly so that the integrated adaptive benefit win–win digital currency is circulated appropriately across national regions. Furthermore, there may be ethical issues and potential risks when the proposed platform is associated with a distributed virtual emotion foundation unless the virtual emotion information is manipulated to be anonymous and meet privacy-preserving requirements. Furthermore, the intrinsic feature of the win–win aspect in addition to mutualism among system participants may cause unexpected market behaviors, unpredictable results, or potential problems such as system degradation due to excessive frequent benefit requests and too many benefit generations to all system parties. Similar to economic panic in the physical world, such an excessive or indiscreet benefit creation may cause the disruption of the proposed benefit system itself. Hence, it is necessary to determine standard rules and strict policies in order to avoid unpredictable market behaviors and economic panic in the virtual world.

7. Concluding Remarks

In this article, we designed an adaptive benefit win–win platform with a distributed virtual emotion foundation and management system, as well as introduced the win–win digital currency or digital cash to be used on the proposed platform. Then, several enabling cases and functions including goals, scenarios, and appropriate operations were explored for an online store and for offline marketplaces with profit and non-profit environments. Furthermore, open research challenges and future issues were discussed with regard to the new frontiers of the integrated benefit-empowered win–win platforms and their promising corporation with Web 3.0 and the metaverse. Furthermore, as a promising future research topic, we plan to develop an integrated platform with the win–win digital currency and a distributed virtual emotion foundation to execute the integrated platform according to applicable scenarios and research issues.

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Abbreviations

The following abbreviations are used in this manuscript:

IIoT	industrial Internet of things
MCS	mobile crowd sensing
WWD	adaptive benefit win–win digital currency
UAVs	unmanned aerial vehicles
DiVemoTics	distributed virtual emotion informatics
DDoS	distributed denial of services

References

1. Mao, B.; Liu, J.; Wu, Y.; Kato, N. Security and Privacy on 6G Network Edge: A Survey. *IEEE Commun. Surv. Tutor.* **2023**, *25*, 1095–1127. [CrossRef]
2. Guo, H.; Li, J.; Liu, J.; Tian, N.; Kato, N. A Survey on Space-Air-Ground-Sea Integrated Network Security in 6G. *IEEE Commun. Surv. Tutor.* **2022**, *24*, 53–87. [CrossRef]
3. Abegaz, M.S.; Abishu, H.M.; Yacob, Y.H.; Ayall, T.A.; Erbad, A.; Guizani, M. Blockchain-Based Resource Trading in Multi-UAV-Assisted Industrial IoT Networks: A Multi-Agent DRL Approach. *IEEE Trans. Netw. Serv. Manag.* **2023**, *20*, 166–181. [CrossRef]
4. Baccour, E.; Mhaisen, N.; Abdellatif, A.A.; Erbad, A.; Mohamed, A.; Hamdi, M.; Guizani, M. Pervasive AI for IoT Applications: A Survey on Resource-Efficient Distributed Artificial Intelligence. *IEEE Commun. Surv. Tutor.* **2022**, *24*, 2366–2418. [CrossRef]
5. Sha, Q.; Liu, X.; Ansari, M. Efficient Multiple Green Energy Base Stations Far-Field Wireless Charging for Mobile IoT Devices. *IEEE Internet Things J.* **2023**, *10*, 8734–8743. [CrossRef]
6. Zhang, S.; Liu, W.; Ansari, M. Joint Wireless Charging and Data Collection for UAV-Enabled Internet of Things Network. *IEEE Internet Things J.* **2022**, *9*, 23852–23859. [CrossRef]
7. Johari, R.; Kumar, V.; Gupta, K.; Vidyarthi, D.P. BLOSOM: BLOckchain technology for Security of Medical records. *ICT Express* **2022**, *8*, 56–60. [CrossRef]
8. Maiti, P.; Sahoo, B.; Turuk, A.K.; Kumar, A.; Choi, B.J. Internet of Things applications placement to minimize latency in multi-tier fog computing framework. *ICT Express* **2022**, *8*, 166–173. [CrossRef]
9. Zhang, T.; Huang, Z. Blockchain and central bank digital currency. *ICT Express* **2022**, *8*, 264–270. [CrossRef]
10. Chen, Z.; Chen, G.; Tang, J.; Zhang, S.; So, D.K.C.; Dobre, O.A.; Wong, K.; Chambers, J.A. Reconfigurable-Intelligent-Surface-Assisted B5G/6G Wireless Communications: Challenges, Solution, and Future Opportunities. *IEEE Commun. Mag.* **2023**, *61*, 16–22. [CrossRef]
11. Wen, M.; Li, Q.; Kim, K.J.; Lopez-Perez, D.; Dobre, O.A.; Poor, H.V.; Popovski, P.; Tsiftsis, T.A. Private 5G Networks: Concepts, Architectures, and Research Landscape. *IEEE J. Sel. Top. Signal Process.* **2022**, *16*, 7–25. [CrossRef]
12. Digulescu, A.; Despina-Stoian, C.; Popescu, F.; Stanescu, D.; Nastasiu, D.; Sburlan, D. UWB Sensing for UAV and Human Comparative Movement Characterization. *Sensors* **2023**, *23*, 1956. [CrossRef] [PubMed]
13. Digulescu, A.; Despina-Stoian, C.; Stanescu, D.; Popescu, F.; Enache, F.; Ioana, C.; Radoi, E.; Rîncu, I.; Serbanescu, A. New Approach of UAV Movement Detection and Characterization Using Advanced Signal Processing Methods Based on UWB Sensing. *Sensors* **2020**, *20*, 5904. [CrossRef] [PubMed]
14. Morge-Rollet, L.; Roy, F.L.; Jeune, D.L.; Canaff, C.; Gautier, R. RF eigenfingerprints, an Efficient RF Fingerprinting Method in IoT Context. *Sensors* **2022**, *22*, 4291. [CrossRef]
15. Sarbu, A.; Şorecău, E.; Şorecău, M.; Miclăuş, S.; Bechet, P. Towards 5G Exposimetry: Real-time isotropic measurement system based on Software Defined Radio. In Proceedings of the IEEE Electronics System-Integration Technology Conference (ESTC), Sibiu, Romania, 13–16 September 2022; pp. 1–6.
16. Miclaus, S.; Bechet, P.; Helbet, R.; Miclaus, A.; Sarbu, A. Towards 5G Exposimetry: Instantaneous and Average Energy Density Accumulation Rate in Air near Wireless Devices Transmitting Data as Sub-Millisecond Frames. In Proceedings of the International Symposium on Advanced Topics in Electrical Engineering (ATEE), Bucharest, Romania, 25–27 March 2021; pp. 1–4.
17. Wang, Z.; Zheng, J. Rate Meta Distribution of Downlink Base Station Cooperation for Cellular-Connected UAV Networks. *IEEE Commun. Lett.* **2023**, *27*, 756–760. [CrossRef]
18. Liu, K.; Zheng, J. UAV Trajectory Optimization for Time-Constrained Data Collection in UAV-Enabled Environmental Monitoring Systems. *IEEE Internet Things J.* **2022**, *9*, 24300–24314. [CrossRef]

19. Geraci, G.; García-Rodríguez, A.; Azari, M.M.; Lozano, A.; Mezzavilla, M.; Chatzinotas, S.; Chen, Y.; Rangan, S.; Renzo, M.D. What Will the Future of UAV Cellular Communications Be? A Flight From 5G to 6G. *IEEE Commun. Surv. Tutor.* **2022**, *24*, 1304–1335. [CrossRef]
20. Cao, X.; Yang, B.; Huang, C.; Yuen, C.; Renzo, M.D.; Niyato, D.; Han, Z. Reconfigurable Intelligent Surface-Assisted Aerial-Terrestrial Communications via Multi-Task Learning. *IEEE J. Sel. Areas Commun.* **2021**, *39*, 3035–3050. [CrossRef]
21. Islam, S.; Badsha, S.; Khalil, I.; Atiquzzaman, M.; Konstantinou, C. A Triggerless Backdoor Attack and Defense Mechanism for Intelligent Task Offloading in Multi-UAV Systems. *IEEE Internet Things J.* **2023**, *10*, 5719–5732. [CrossRef]
22. Oubbati, O.S.; Atiquzzaman, M.; Lim, H.; Rachedi, A.; Lakas, A. Synchronizing UAV Teams for Timely Data Collection and Energy Transfer by Deep Reinforcement Learning. *IEEE Trans. Veh. Technol.* **2022**, *71*, 6682–6697. [CrossRef]
23. Lhazmir, S.; Oualhaj, O.A.; Kobbane, A.; Ben-Othman, J. Matching Game With No-Regret Learning for IoT Energy-Efficient Associations With UAV. *IEEE Trans. Green Commun. Netw.* **2020**, *4*, 973–981. [CrossRef]
24. Samir, M.; Assi, C.; Sharafeddine, S.; Ghrayeb, A. Online Altitude Control and Scheduling Policy for Minimizing AoI in UAV-Assisted IoT Wireless Networks. *IEEE Trans. Mob. Comput.* **2022**, *21*, 2493–2505. [CrossRef]
25. Yu, T.; Wang, X.; Shami, A. UAV-Enabled Spatial Data Sampling in Large-Scale IoT Systems Using Denoising Autoencoder Neural Network. *IEEE Internet Things J.* **2022**, *6*, 1856–1865. [CrossRef]
26. Shi, W.; Sun, Y.; Liu, M.; Xu, H.; Gui, G.; Ohtsuki, T.; Adebisi, B.; Gacanin, H.; Adachi, F. Joint UL/DL Resource Allocation for UAV-Aided Full-Duplex NOMA Communications. *IEEE Trans. Commun.* **2021**, *69*, 8474–8487. [CrossRef]
27. Chen, Q.; Meng, W.; Han, S.; Li, C.; Chen, H. Robust Task Scheduling for Delay-Aware IoT Applications in Civil Aircraft-Augmented SAGIN. *IEEE Trans. Commun.* **2022**, *70*, 5368–5385. [CrossRef]
28. Nguyen, L.; Gautier, R.; Fiche, A.; Burel, G.; Radoi, E. Digital compensation of lowpass filters imperfection in the Modulated Wideband Converter compressed sensing scheme for radio frequency monitoring. *Signal Process.* **2018**, *152*, 292–310. [CrossRef]
29. Lin, Y.; Kang, J.; Niyato, D.; Gao, Z.; Wang, Q. Efficient Consensus and Elastic Resource Allocation Empowered Blockchain for Vehicular Networks. *IEEE Trans. Veh. Technol.* **2023**, *72*, 5513–5517. [CrossRef]
30. Li, Z.; Su, W.; X, M.; Yu, R.; Niyato, D.; Xie, S. Compact Learning Model for Dynamic Off-Chain Routing in Blockchain-Based IoT. *IEEE J. Sel. Areas Commun.* **2022**, *40*, 3615–3630. [CrossRef]
31. Tang, J.; Fan, K.; Yin, P.; Qu, Z.; Liu, A.; Xiong, N.N.; Wang, T.; Dong, M.; Zhang, S. DLFTI: A deep learning based fast truth inference mechanism for distributed spatiotemporal data in mobile crowd sensing. *Inf. Sci.* **2023**, *644*, 119245. [CrossRef]
32. Li, H.; Ota, K.; Dong, M. Deep Reinforcement Scheduling for Mobile Crowdsensing in Fog Computing. *ACM Trans. Internet Technol.* **2019**, *19*, 1–18. [CrossRef]
33. Zhao, M.; Adib, F.; Katabi, D. Emotion recognition using wireless signals. *Commun. ACM* **2018**, *61*, 91–100. [CrossRef]
34. Canal, F.Z.; Müller, T.R.; Matias, J.C.; Scotton, G.G.; Junior, A.R.d.S.; Pozzebon, E.; Sobieranski, A.C. A survey on facial emotion recognition techniques: A state-of-the-art literature review. *Inf. Sci.* **2022**, *582*, 593–617. [CrossRef]
35. Dalmina, L.; Vianna, D.V.; Dias, L.P.S.; Schroeder, G.L. GamiProM: A Generic Gamification Model Based on User Profiles. *Int. J. Hum. Comput. Interact.* **2022**. [CrossRef]
36. Ahmed, N.; Aghbari, Z.A.; Girija, S. A systematic survey on multimodal emotion recognition using learning algorithms. *Intell. Syst. Appl.* **2023**, *17*, 200171. [CrossRef]
37. Geraets, C.N.W.; Tuente, S.K.; Lestestuiver, B.P.; Beilen, M.v.; Nijman, S.A.; Marsman, J.B.C.; Veling, W. Virtual reality facial emotion recognition in social environments: An eye-tracking study. *Internet Interv.* **2021**, *25*, 100432. [CrossRef]
38. Dorneles, S.; Francisco, R.; Barbosa, D.N.F.; Barbosa, J. Context Awareness in Recognition of Affective States: A Systematic Mapping of the Literature. *Int. J. Hum. Comput. Interact.* **2022**, *39*, 1563–1581. [CrossRef]
39. Kim, H.; Ben-Othman, J.; Cho, S.; Mokdad, L. A Framework for IoT-Enabled Virtual Emotion Detection in Advanced Smart Cities. *IEEE Netw.* **2019**, *33*, 142–148. [CrossRef]
40. Kim, H.; Ben-Othman, J. Toward Integrated Virtual Emotion System with AI Applicability for Secure CPS-Enabled Smart Cities: AI-Based Research Challenges and Security Issues. *IEEE Netw.* **2020**, *34*, 30–36. [CrossRef]
41. Lin, P.; Song, Q.; Yu, F.R.; Wang, D.; Jamalipour, A.; Guo, L. Wireless Virtual Reality in Beyond 5G Systems with the Internet of Intelligence. *IEEE Wirel. Commun.* **2021**, *28*, 70–77. [CrossRef]