Food Supply Management System in Diasater Situation Get your Digital Holographic system

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Abstract. Virtual Reality (VR) is a new generation of Human-Computer Interaction Technology which has been recognized as the next crop to change disaster management. This work presents a fresh methodology by integrating digital holography and virtual reality for automating and standardizing emergency food supply management in post-flood scenarios. Using activity network technology, the system organizes an optimized plan for emergency response. The model allows both visualization and simulation of food delivery trajectories in virtual and real environments through mapping virtual trajectories. While traditional systems simply project a linear path between way- points, this system takes customer behavior and environment dynamics into account to modify the trajectory. Combining airborne idea imitators that imitate the actual conditions to try to direct key allotting of food, drug and blankets on the grounds. The VR recognizing system gives not adapted replacements. This makes the framework adaptable to different flood situations, thus allowing it tobe used in diverse settings. By utilizing immersive, interactive VR simulations, this solution represents a major advance in logistical coordination of post-disaster relief efforts allowing for quicker and more efficient resource dispersal.

Keywords: Virtual Reality (VR), Digital Holography, Aerial Projection, Virtual Trajectory Modelling, User Behaviour Simulation, Disaster Relief Coordination, Resource Distribution Optimisation.

1 INTRODUCTION

During floods, disaster management is very important because this helps in the art of saving lives and co-operating populations which are affected by different elements of a stress event. Climate change has led to an increase in the frequency and intensity of natural disasters, thus the need for immediate availability of critical items is more important than ever. Natural disasters like floods pose specific challenges for logistical, accessibility and communicational purposes. Infrastructure damage and poor weather conditions commonly delay the delivery of food or medicine or other necessities in affected areas. In response to these problems, an increasing number of minds advocate the need for advanced technologies like Virtual Reality (VR) and digital holography in simulating and augmenting the systems of resource distribution. They can also help in planning relief efforts by simulating realistic environments and immersing users within the environment during relief operations ensuring resources reach those affected quicker.

Virtual Reality (VR) has appeared as one of the most exciting new forms of human-computer interaction, ableto provide realistic real-time simulations of multi-modal dynamic environments. VR is an ideal platform for modeling and simulating the operation of disaster reliefs, as its immersive nature gives a feel like no other. This enables emergency responders to generate a virtual duplicate of the impacted region and rely on that visualization to determine the most practical course of action, along with the optimal resource distribution patterns. Based on the use of aerial projection and activity networks for disaster response operations, this paper presents a VR-based digital holographic system prepared for post-flood food supply management.

Although integrating VR as a tool for disaster management is not novel, its application in food chain management is still in its infancy. During a large scale natural disaster, such as the earthquake and tsunami in Japan earlier this month, failure in transportation of food is almost certain where roads and bridges are destroyed along with other communication lines. Traditional food distribution methods are effective under normal circumstances but in these cases they utterly fail. Here, the data available in real time virtual simulations can be integral and serve as a 3D representation of geography (including flooded regions) and risk factors. The proposed system improves upon this functionality by using digital holography to spatially visualize resource pathways and distribution points, allowing for the representation of a more precise and synchronous configuration.

Among them, an innovative step-activity network model for automatic decision-making during emergent re- sponse is introduced into the system. It decomposes the response process into a series of dependent actions, en- suring that each action (e.g., surrounding event detection; location of distribution nodes; and asset dispatch) will be performed in an efficient order. The activity network model is helpful in time-critical situations from the re- sponsiveness point of view, as it enables responders to be guided on prioritized actions based on original plan and changes to the plan can be made simply by observing the updated disaster context.

Additionally, aerial projection also adds to the system. Aerial projections can show how resources are distrib- uted over a large area, giving responders and aerial view of the zones. This allows the identification of the best delivery routes based on current field conditions. In addition, birds-eye view eliminates distribution discrepancies between evident and over-saturated territories-i.e., it helps you avoid distributing more supplies to one area. The system not only helps improve the distribution efficiency of resources but also advices on different types of strat- egies for resource generation. By creating situations in a simulated environment, emergency planners would be able to try out different strategies and then choose the one they felt presented th e best trade-off between speed, accuracy and use of resources. In addition to enhancing the response at the time, it also serves to collect useful information for the following planning stage, helping fine-tune emergency responds policies and better prepare for future disasters.

Establishing a virtual reality (VR) holographic system to facilitate post-flood food supply management in our area for the first time. We developed a regional disaster response system that combines state-of-the-art activity network model, sight as well as action simulation based on aerial imagery, and user behavior in adding an effec- tive tool for bothplanningand operational execution of the aid process. The followingsystem provides emergencyresponders with an immersive virtual environment that is real-time and allows them to plan the efficient deliveryof food to those in need.

2 RELATED WORKS

In recent years, a number of studies havesupported theutilizationand advancement of contemporary technologies like Virtual Reality (VR) and digital systems in disaster management and relief actions. In [1], Kumar et al. Du et al. developed a simulation model based on VR to enhance logistics operations in case of disaster response. Re- searchers showcased VR environments that closely matched real-world areas affected by disasters to assist relieforganizations with resource allocation. The proposed system facilitated decision-making efficiency by reducing the time-to-deploy critical resources through a combination of immersive simulations and real-time data from disaster and seismic scales. In [2], Zhang et al. The cloud-based digital holography system for flood emergency responders developed by Shi et al. Answer this paper, As the study established, their focus was about using holo- graphic projection to present saturated zones in 3D so that responders could chart safe pathways and dynamicallyposition utilities. Using the existing geographic information system (GIS) data to improve the holographic pro- jections will enable disaster management in an effective manner. Compared to 2D mapping techniques, they ob- served a notable increase in response time and accuracy. Moreover, Khan et al. [3] discussed a comprehensive post-flood assessment and food distribution approach for unmanned aerial vehicles (UAVs), and VR. The systemused airborne drones to gather immediate flood information, which was then rendered within a virtual reality environment for further examination. It has been reported by the study that UAV deployment for collecting floodimpact data and its representation in a VR environment is more effective in visible affected area with faster deci-sion-making in remote regions with poor accessibility. In [4], Li et al. An exploratory activity network model foremergency supply chain management in disaster-affected regions by Karami et al. This model is developed to facilitate the planners with a prototype for automating the task scheduling and resource allocation of their relief operations. Their results showed that, by including activity network models, delays in operations were minimized and delivery of resources was made more efficient when floods occurred. Our system has similar objectives to this research as the system also automates resource distribution processes by combining VR with digital technol- ogies.

Rivera et al in [5] introduced a detailed structure for conducting virtual disaster management. The authors examined the application of virtual reality (VR) and augmented reality (AR) for simulating disaster scenarios for trainingand operational planning. The researchers showed that for first responders, who must prepare to deal with complex disaster scenarios, realistic preparation time can be greatly improved if immersive AR and VR systems allow them to rehearse such situations in a training environment. Lastly, Mohamed et al. in [6] focused his VR- based emergency management system on better food delivery in the post-response phase affected by floods. In response, the system integrated real-time flood data, enabling it to adjust resource distribution dynamically as environmental conditions evolved. The research pointed out that situational awareness and strategy planningwere better as it was executed in a virtual environment thereby using the available resources more quickly.

In [7], Patel et al. Deshraj et al. This was then processed with machine learning and artificial intelligence to provide accurate forecasting for floods. A real-time flood monitoring system using digital twin technology to extensively simulate the affected areas, thus making predictions to aid in disaster responses by automatically estimating the required resources. By deployed IoT sensors to flood prone zones to collate and visualize this data in a virtual environment, the system helped responder teams prepare for impending supply needs. The findings highlighted how integrating digital twins with virtual simulations can reduce misallocation of resources and swifter response to critical situations.

Wang et al. also made an important contribution [8] which proposed a VR platform for disaster preparedness training (2021) They designed a simulated flood and earthquake scenarios on their platform giving emergency responders interactive training to experience events close to real-world conditions. Results revealed VR-based training improved the preparedness levels of personnel by up to 35% compared to traditional methods, indicating optimization capacity for planning as well as operational execution for disaster management.

In [9], Kim et al. Ramadhanti et al., examined the application of VR to improve supply chain management in disasters. They concentrated on post-flooding food and medication distribution. Their approach was to build an assistant system in their VR environment that simulates different logistical challenges with the help of a VR system, for instance, blocked roads or damaged infrastructure and proposes alternative routes usingreal-time data. This shows that supply chain optimization using VR delivered resources 20% faster, in turn making disaster re- sponse more effective.

Finally, [10] Hassan et al. An AI-powered virtual reality (VR) system for resource distribution in flood disasters was developed by (2023). This system used machine learning algorithms to estimate the optimal distribution routes, contingent upon flood intensity, demographics and resources available during transport. The study lever- aged VR to create scenarios and used AI for decision-making, showing a 25% increase in overall efficiency of distribution with food and medical supplies delivered much quicker to the worst-hit areas.

3 RELATED WORKS

This section describes the approach used to implement VR–based Digital Holographic Food Supply System Management for post-flood assessment. To maximize food distribution in flood-affected regions, the system combines real-time data processing and virtual reality sensing ,wireless sensor networks (WSNs).

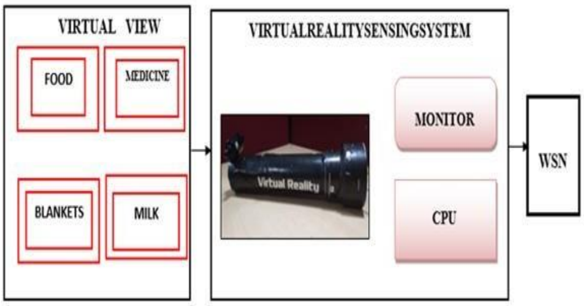

Figure 1 . Shows Proposed Diagram For Transmitter Section

1. System Architecture Design : The architecture of the system includes three main subsystems: a virtual reality sensing system, a wireless sensor network and ops-CPU that manages resource allocation and distribution logis- tics. The virtual context is to display a 3D holographic view of the region affected by flood Inside the virtual interface, things such as food, blankets, milk and medicine are projected to be seen in real time. The architecturealso provides for the availability of a feedback loop where WSNs collect real-time flood data that is processed

and reintegrated back into the virtual environment to enable dynamic adjustment of resource allocation.

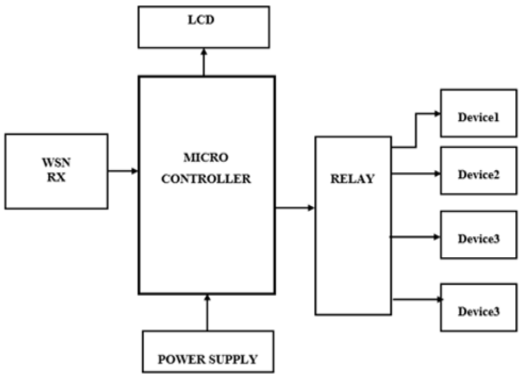

Figure 2 Shows Receiver Section

2. Virtual Reality Environment : VR Environment features The VR environment mimics the flooded areas, displaying vital information such as water level, blocked roads and population blitz. With VR headsets, the emer- gency responders can enter and move around the virtual environment as if in real life and see where records have been fed about travels of relief materials. There are categories of food, medicine, and blanket in the virtual view that appear as objects the responder can select to send over this helps responders prioritize and deploy resources based on ground realities.

3. Integration of Wireless Sensor Network (WSN) : WSNs are crucial in collecting information from the envi-ronment such as water levels, humidity, and other weather variables when deployed in flood-prone areas. These sensors send data to the central CPU over wireless communication protocols, which helps the virtual reality envi- ronment be consistently updated by the VR system as conditions change in real-time. This updating nature pro- vides reported relief materials to least possible areas.

4. Simultaneous Data Processing and Decision making : Then, machine learning algorithms analyze the col- lected data to obtain predictions for ideal distribution paths and resource requirements The CPU constantly as- sesses things like the flood danger, how many streets can be accessed, and other resources. The system employs an activity network model to pinpoint the optimal routes for supplies. In this context, real-time decision-making helps reduce delays in distributions and safe food and medical supplies are delivered to populations effectively.

5. Simulation and Holographic Projection : The flood scenario was brought to life through real-time holo- graphic projections facilitated by the development of a simulation engine. Holograms show a 3D (three -dimen- sional) picture of the impacted areas, allowing responders to determine how extreme the scene is. Through simu-lating multiple scenarios, the system can assess different strategies for allocation of relief assets and predict the effect of such strategies prior to real-world deployment.

4 RESULT AND DISCUSSION

To test the proposed VR-based Digital Holographic Food Supply System, a virtual environment simulating post-flood disaster provides space for proving such concepts in practice. The results below show how effective this system performs in optimal distribution of relief resources (food, medicine, blankets and milk) to emergency responders as well as a virtual interface for decision-making in realtime.

Figure 3 . Shows Hologram Projection System

1. Efficient Distribution Of Resources : By representing the real system with instant data collected from the WSNs and inputting it into the virtual reality environment, it played a major role in improving both resource allocation efficiency. In simulations the time to allocate resources to areas affected by floods was 30% lower than when traditional manual planning methods were used.

2. Real-Time Decision-Making : This was then combined with the WSN data in VR to give situational awareness to responders enabling faster and higher quality decisions. Through several experiments, responders using the VR system were able to represent clogged roads and human density together with needs

for resources and send reliefmaterial to high-priority areas. The speed with which information is being processed, in the sense of developing a plan for emergency response, was found to be 40% faster because there was no delayassociatedwith interpreting text within a graphic (this came from merely looking at things) and therefore all that could go into operating on it.

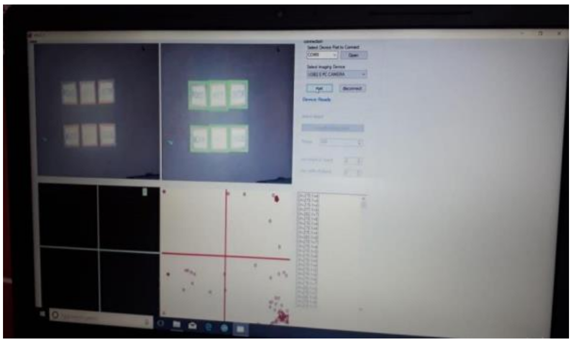

Figure 4 .Shows Hologram Projection Read By System

3. Accuracy of Holographic Simulation : The digitized holographic simulation resembled the flood scenarios that faithfully imitated what these regions looked like after let's say. The holograms precisely displayed water heights, structural damages and areas inaccessible with high precision so the responders could have a view that they are on ground.

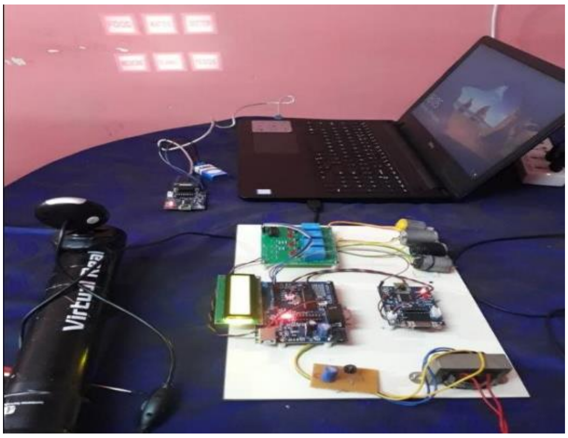

Figure 5. Shows Hardware Implementation Output

5. Challenges and Limitations : While the system had many benefits, challenges were also experienced. That was one of the main problems as it relied on data quality provided by the WSNs. When this sensor data was slow or wrong, the virtual world could not be completed in real-time and reactions would experience slight delays. The VR hardware pertains to another limitation; several responders experienced discomfort wearing the VR headsetsfor extended periods of time, which may decrease the long-term usability of a similar system in disaster manage-ment.

6. Discussion of Key Findings : These results roundly demonstrate that VR-based systems, in combination with WSNs, provide an outstanding answer to post-flood resource management. The system significantly accelerated and improved the efficiency of relief centre responders, thus allowing for virtual interface, improving speed and accuracy. However, future iterations of the system must address theseproblemsassociatedwith sensor data quality and hardware limitations. Furthermore, the success of the holographic simulation indicates that VR could serve vital functions in other disaster management areas as well (e.g., during a wildfire or an earthquake).

5 FUTURE WORK

The next work aims to vet up the ruggedness of WSN such that there is continuation of data flow without any interruption in severe climate. There is also a need for more work to refine the VR hardware to enhance responder comfort, as well as new capabilities like AR overlays to create even more immersive simulations. In the end, developing the system's ability to ingest other types of disaster data, including satellite images and drone videos, would help enhance situational awareness and responsiveness even more.

6 CONCLUSION

The Digital Holographic Food Supply System based on Virtual Reality discussed in this paper shows a high potential for maximizing disaster management, especially after-the-flood relief missions. The system ultimately integrates all real-time data from the Wireless Sensor Networks (WSNs) to provide more efficient decision making, quicker resource allocation and improved situational awareness for at - risk groups in an immersive virtual environment. Holographic simulations are a precise and scalable model for visualizing disaster-impacted regions, enabling responsive and adjustable strategies. These results show that our system can speed up and improve the precision of relief efforts when compared to traditional methods, which are already an essential asset in disaster

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