A RISK EXPRESSION SYSTEM DESIGN PLAN TO CONSTRUCT AN INTEGRATED ASSISTANCE PROCESS FOR DISASTER RESPONSE

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ABSTRACT: Several recent occurrences of natural disasters are linked to global climate change. These natural disasters lead to various human and facility damages. The major cause for concern on natural disasters in this country is the direct and indirect damages that have been produced by the non-existence of a control tower that can handle these disasters. In order to immediately prevent and respond to natural disasters, various data spread out in each department and local government need to be managed in an efficient manner, and a GIS integration plan is required to provide an integrated view of such data. The introduction of the 3D engine under active research worldwide and the creation of a platform that can intuitively display this 3D engine can construct an organic cooperation system between onsite personnel and government officials in charge. In addition, a plan is required to design such system that can endure the hardware loads accompanied by a large-scale system. In this study, a system design plan for an efficient and immediate disaster prevention and response has been suggested. The study results can be used as base materials for data management, data linkage, GIS-based display, and construction of the module integration system for information transfer in the future.

1. STUDY BACKGROUND AND PURPOSE

In order to appropriately respond to the rapidly changing floods, the visualization of the flood information, based on the 3D terrain information, and the availability of a series of data, including the accumulated, current, and forecasted data, are important. Sharing the visualized flood information and facility risk information with related organizations and citizens is an effective measure for protecting the citizens and national facilities from the natural and social disasters caused by the flood.

As for the existing disaster response system, simple emergency communication and warning systems (e.g., FEMA and FCC, ReadyNotifyPA, and TED of the US), as well as the systems or modules for onsite disaster response (e.g., SMART WORK PAD and Sinsai.info), are being utilized. These can only issue a warning during an alarm situation. They are not directly involved in disaster sites and they are still not yet fully developed for directing organizations to use. As floods tend to rapidly change and cause massive damage, countermeasures must be taken after collecting related information and reviewing the risks. For this purpose, disaster information must be sent to the related organizations and personnel in (quasi) real time, and the information must be visualized for accurate understanding and determination.

As a result, a 3D-GIS-based disaster response process was constructed in this study for future forecasts and immediate response during a disaster through a continuously accumulated risk map data. A dynamic display technology was developed for the data generated by the process to be compressed, processed, and sent to the servers of the related organizations and personnel in real time. Overall, a system that can perform the role of a control tower during a disaster was constructed.

2. STUDY SCOPE AND CONTENTS

The DRiMSS system, which is designed in this study, estimates the routes and amount of damage to the waterside structures and inland buildings caused by floods, based on the flood-related disaster prediction scenario, and the data over the past 200 years, including the precipitations, types, and locations of levee collapse, inland terrain, and building heights. The estimated data are then converted to 3D and sent to the onsite and emergency managers for them to use in predicting flood damage, planning citizen evacuation, and estimating damage amount.

A GIS-based display system (FROK) that converts flood hazard information into 3D information through modeling and an efficient transfer module (REACT) for mobile communication of information were developed in this study.

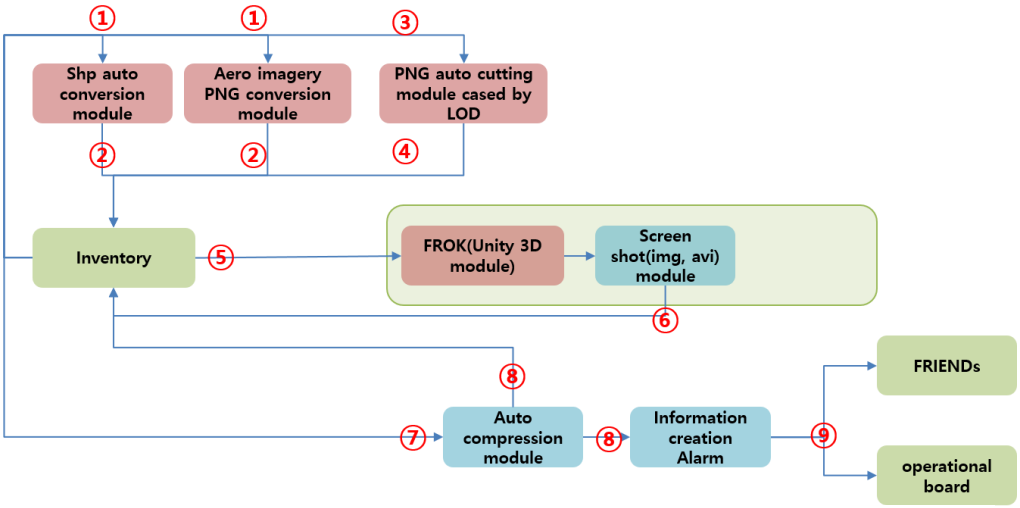


Fig. 1 Diagrams of ReACT Module (Risk effect Automatical compression & transmission)

Unity3D was utilized for constructing a 3D GIS-based disaster response process. It is highly extendible or transplantable to various platforms. Furthermore, Unity3D supports complete development environment, and provides multi-publishing function for use in mobile platforms, as well as in PCs, despite its affordable price. Other open-source engines and commercial GIS engines were considered, but the open-source engines required more time for development, as they did not provide sufficient development environment and follow-up management, and the commercial GIS engines were expensive and low in extendibility.

tool kit, which can display 3D GIS-based geographic information via the Unity3D engine, was developed and linked with the Google Maps API for extension and processing speed. The exterior of the important facilities and geographic information were displayed in 3D.

Fig. 2 Waterside structures and inland buildings displayed by the suggested system

FRIENDs proliferates disaster images and information for the entire nation. It also proliferates the flood visualization information and evacuation information displayed by FROK to the mobile environment by using the push notification function. The high-precision flood visualization information needs to be compressed and transferred for proliferation. In this study, a C/S module was developed for this function. The data flow is shown in Fig. 3.

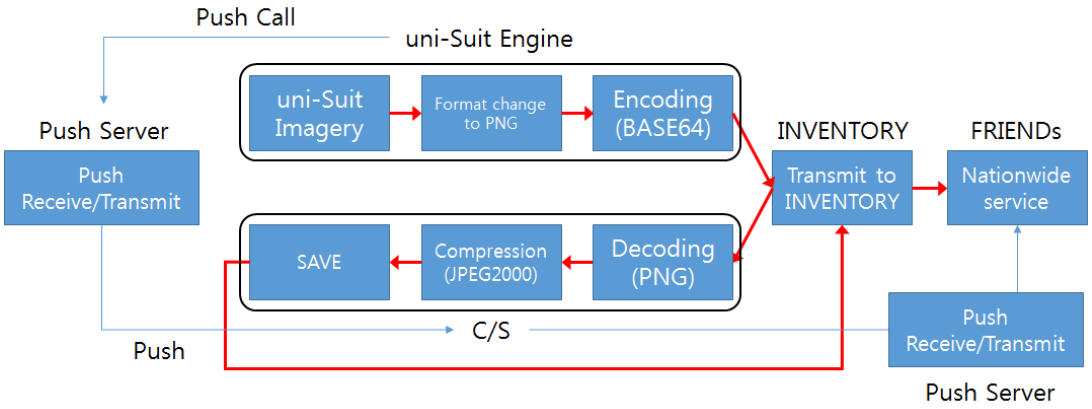
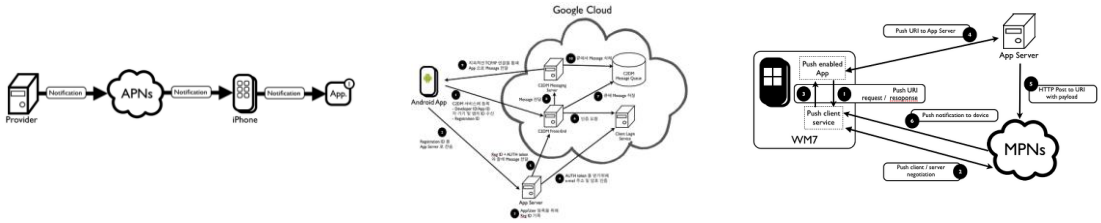


Fig. 3 Data flow and push notification flow

The uni-Suit engine or C/S pushes a call on a remote alarm to the push server, which accepts the call and finally sends the remote alarm to FRIENDs. Android, Apple, and Microsoft have different algorithms for calling a push server.

Apple Push Notification service (APNs) supports iOS. It is a form of cloud service that transfers notice messages for worldwide iPhone iOS. Google's Cloud to device messaging framework (C2DM) is a cloud service that performs the push service in Android. It was provided with the announcement of Android 2.2 (Froyo). The Microsoft Push Notification service (MPNs) is a push notification service that operates on a Windows-based cloud service.



(a) APNs **(b) C2DM** **(c) MPNs**

Fig. 4 Push notification services of three mobile operating systems

A system that transfers the information generated by DRiMSS to FRIENDs and proliferates disaster information, including shelter and precipitation information nationwide through FRIENDs, was developed via these services.

Fig. 5 DRiMSS nationwide proliferation system FRIENDs

3. CONCLUSION

In this study, a 3D GIS-based display system, which can play the role of a control tower during an emergency situation, was suggested. The system combines the information of waterside facilities with geographic information through a commercial game engine. Recent commercial game engines provide

platforms not only for game development or 3D simulation, but also for the integrated analysis of GIS and highly accurate data. Geographic information could be converted and a module, which can play the role of a commercial GIS engine, could be developed through these game engines. The development of additional modules could construct even more realistic geographical features, based on physical engine utilization and realistic rendering. A nationwide service that uses image-compression technology and push notification service was also constructed. FRIENDs is currently under development as a nationwide disaster notification system. It is being linked with DRiMSS, which is a disaster situation control system, in order to provide accurate and prompt information for different users. The suggested system is deemed suitable for an actual disaster simulation and it will be helpful in responding to disasters by predicting damage, scope, and situation via time.

4.ACKNOWLEDGEMENT

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