Developing the forest fire extinguish equipment management system using GPS and GIS

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Abstract

Recently in order to extinguish large scaled of forest fire efficiently many helicopters tend to be mobilized. In this situation, the most consideration for the rapid extinguish is the effective arrangement and management of helicopters, which is regard as the most important forest fire extinguish equipment.

In this paper, client/serve based forest fires extinguish equipment management system is constructed by using GPS(Global Positioning System) and GIS(Geographic Information System) technology. This system considers not only extinguish equipment such as helicopters including manpower arrangement but also extinguish environment such a storing reservoir.

For this, the real time recognition of helicopter location is first put GPS technology then user-friendly interface is implemented based on GIS concept. The result of this study, efficient helicopter arrangement against forest fire can be obtained then a large sized damage by forest fire can be reduced using this system.

Key Words: GPS(Global Positioning System), GIS(Geographic Information System), Helicopter, Forest fire extinguish equipment management

Introduction

Recently most domestic forest fire extinguish tends to depend on airplanes. However, those airplanes use still wireless network such as wireless telephones or wireless radio to inform their location information and order their directions.

Nowadays, GPS(Global Positioning System) technology has developed very rapidly and also tends to be integrated with other spatial information technology such as GIS(Geographic Information System) to trace and present real time object's movement.

In this paper, the forest fire extinguishes equipment management system using GPS and GIS is constructed to use in case a large scaled forest fire is occupied. This system helps not only to arrange and manage location of airplanes and helicopters but also inform the forest fire extinguish environment toward an air-traffic controller and pilots.

Therefore, forest fire extinguish officials can notify where the extinguish airplane and helicopters are thrown exactly and how the physical environment such as elevation, slope, aspect, a reservoir in forest fire area can affect to forest fire and extinguish equipment arrangement in real time. In addition, this system can help forest fire extinguishing can be performed more scientifically and efficiently.

. Constructing the significant system using GPS and GIS

In order to construct domestic physical environment database, digital thematic maps are classified in 123 desired layers and stored in DBMS(Data Base Management System), In addition, the whole information related to extinguish airplanes and helicopters such as the name, accident history, each airplane shed situation, pilots is also stored in DBMS.

Then, the mapping technology GPS data acquired from extinguishments airplanes and helicopters to TM coordinate is performed in real time to inform their location.

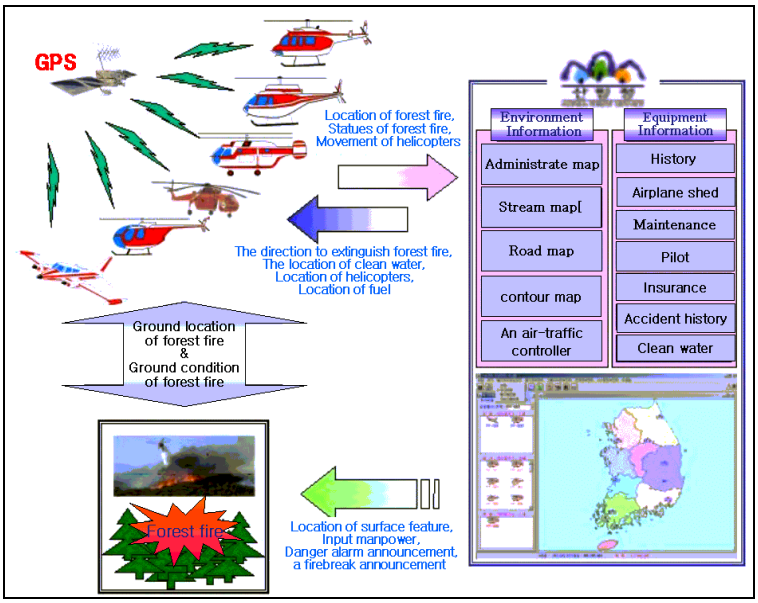

Fig. 1 The concept diagram of Forest fire extinguish equipment management

In order to construct domestic physical environment database, digital thematic maps are classified in 123 desired layers and stored in DBMS(Data Base Management System), In addition, the whole information related to extinguish airplanes and helicopters such as the name, accident history, each airplane shed situation, pilots is also stored in DBMS.

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1. GIS DB construction of forest fire extinguish environment

In order to construct forest fire extinguish environment DB, 123 various thematic maps such as stream, road, building, facility, topography, administrative, labeling are classified based on digital 1:25,000 and 1:250,000 maps in Kyung-Pook province using ArcVeiw and ArcGIS(ArcInfo).

Especially, the important forest fire extinguish environment information such as a reservoir is classified in digital 1:25,000 map then transfer its feature type to polygon to input its attribute data.

2. Helicopters location information presentation for forest fire extinguish using GPS and GIS

This function maps GPS data such as its location and moving statues acquired from forest fire extinguish airplane and helicopters to TM coordination. Then, it presents the movement of forest fire extinguish airplane and helicopters using AddEvent and Move of TrakingLayer method of MapObjects 2.0.

```
//Tracking coding
Sub DrawGPS1(x As Double, Y As Double, id, indexid)
      DoEvents
      pnt(indexid).x = x
      pnt(indexid).Y = Y
      With pts(indexid)
          .Add pnt(indexid)
      End With
   lineSeg(indexid).Parts.Add pts(indexid)
   mapDisp.TrackingLayer.AddEvent lineSeg(indexid), id
   Set lineSeg(indexid) = Nothing
End Sub

// Presenting coding
Sub movepoint(x As Double, Y As Double, id)
      mapDisp.TrackingLayer.Event(id).MoveTo x, Y
      mapDisp.TrackingLayer.Symbol(7).Rotation = 90 - WGS B
End Sub

Sub display()
      Call movepoint(TMlam#, TMphi#, ind(i, 0))
      Call DrawGPS1(TMlam#, TMphi#, ind(i, 1), ind(i, 0))
End sub
```

Fig. 2 Coding for helicopters location tracing

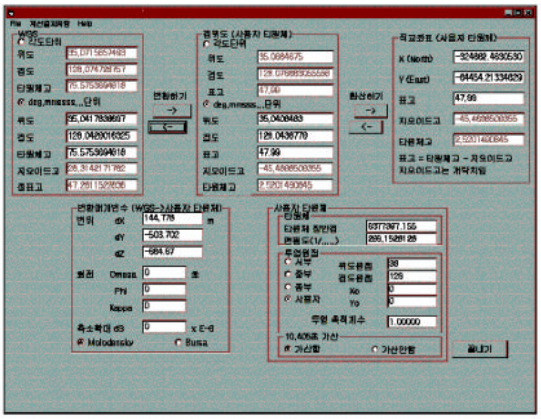

Fig. 3 Conversion system for GPS data to TM Coordination

3. Management of the forest fire extinguish helicopters information

In order to management helicopters more effectively, the whole information related to extinguish airplanes and helicopters such as the name, accident history, each airplane shed situation, pilots is also stored in DBMS.

Then the whole information of airplane and helicopters can be monitored in real time using GIS and GPS by doing input, retrieval, and update.

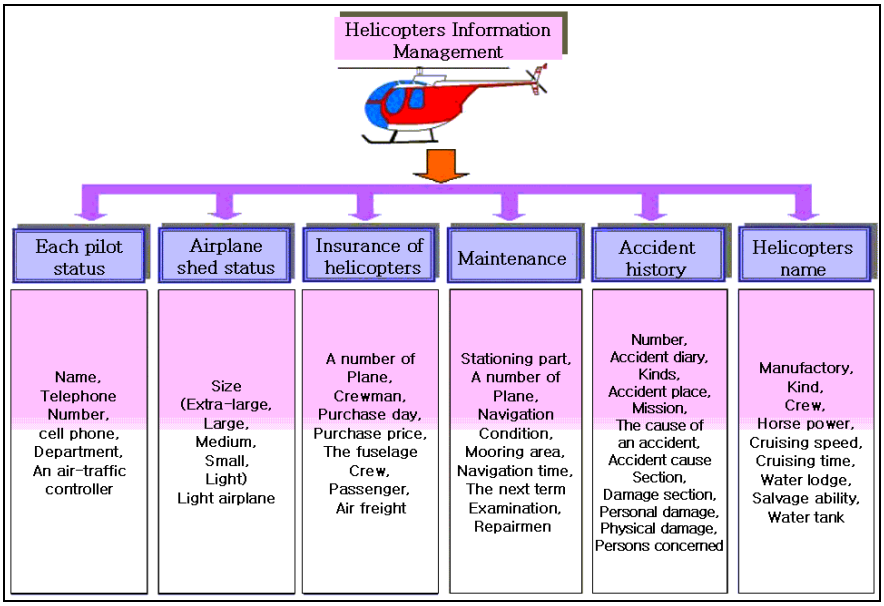

Fig. 4 Construction of DB to manage helicopters information

. The design and Implementation of forest fire extinguish equipment management system

This system is developed based on Windows2000 and uses development programming language as Visual Basic 6.0, GIS component as MapObjects2.1 of ESRI, and DBMS as Oracle8i.

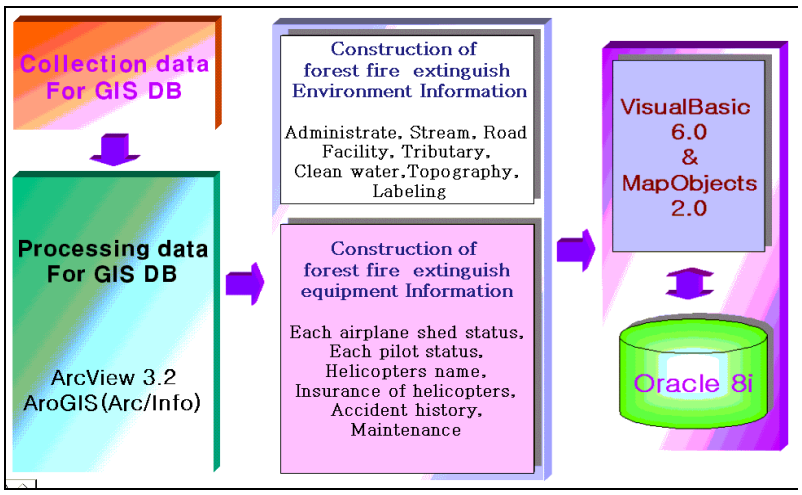

Fig. 5 The flowchart of system implementation

1. The system main interface

As shown in Fig. 6 and 7, it shows the main interface of forest fire extinguish equipment management system and Fig. 7 indicates the each icon on toolbar.

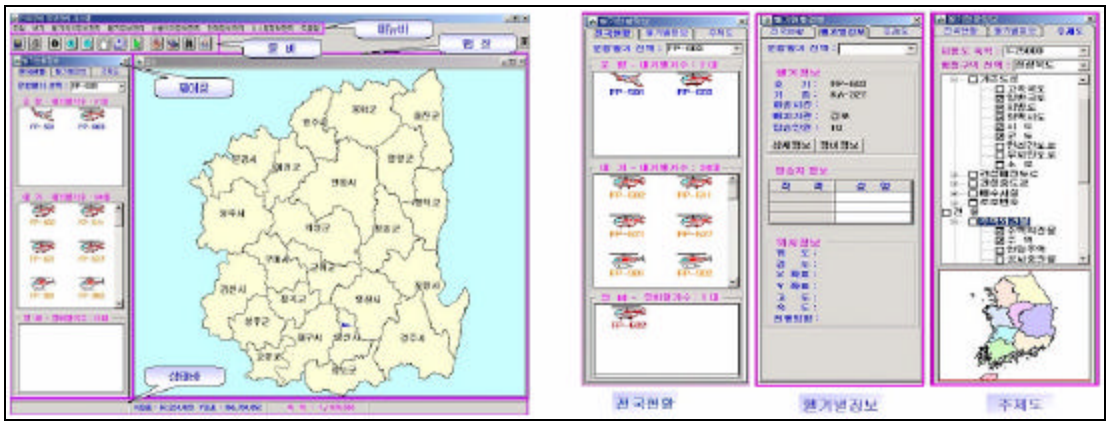

Fig. 6 The main system interface

Item	Icon	Description
Full Screen		Function to the whole map
Magnification		Function to Magnify map
Reduction		Function to reduce map
Pan		Function to pan map
Identify		Function to show attribute information
Location of helicopters		Function to inform location of helicopters
Measurement		Function to measure between two objects
Add layer		Function to add layer
Tracking		Function to track of helicopters

Fig. 7 The each icon on toolbar

2. Location information implementation of helicopters in digital map

As shown in Fig. 7, the movement information of helicopters is presented in various thematic maps so that an air-traffic controller can easily notify the location of helicopters and easily order the direction of it.

As shown in Fig. 8, the information of helicopters such as the name, accident history, each airplane shed situation, pilots the name, accident history, each airplane shed situation, pilots is presented with helicopter's tracking.

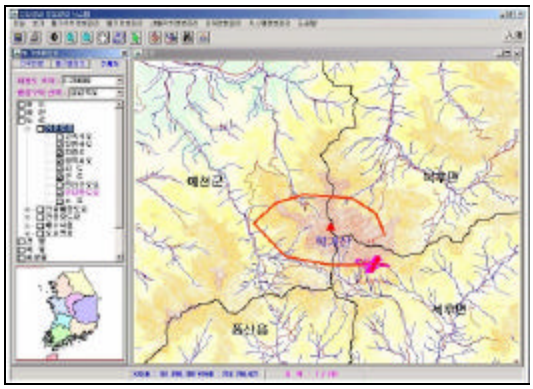

Fig. 7 The location tracking of helicopters in Mountainous area

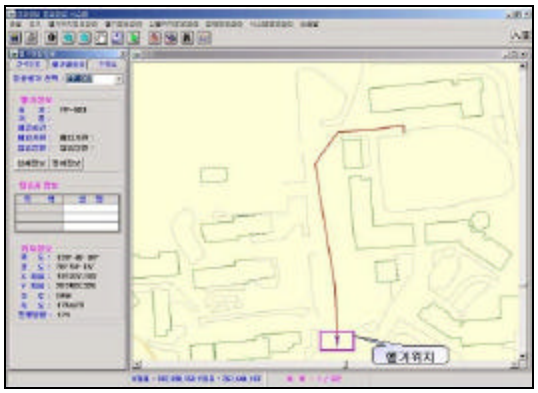

Fig. 8 The location tracking of helicopters in in urban area

3. The Attribute retrieval of extinguish environment

The Attribute of extinguish environment helps to inform helicopters' easy access to forest fire area using various GIS DB such as stream, road, building, facility, topography, administrative, labeling. Fig. 9 shows the overlay function in map window. Fig. 10 shows the location of certain a reservoir and its attribute,

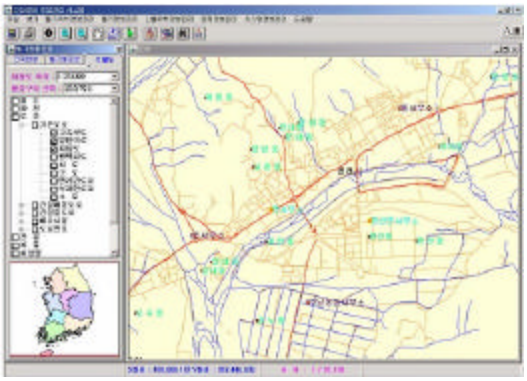

Fig. 9 the overlay of thematic map

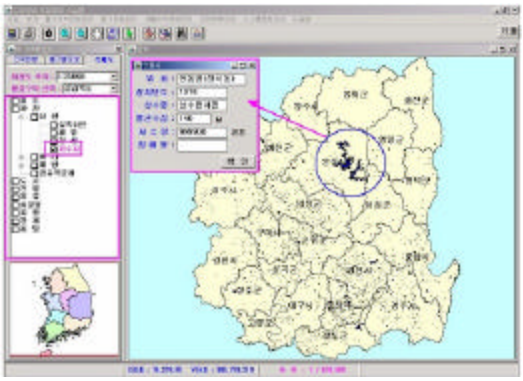

Fig. 10 The attribute of a reservoir

4. Client/Server based real time extinguish equipment management system

As shown in Fig. 11, the whole information of helicopter's the name, accident history, shed situation, and consolidation is easily added, update, retrieved using user friendly interface.

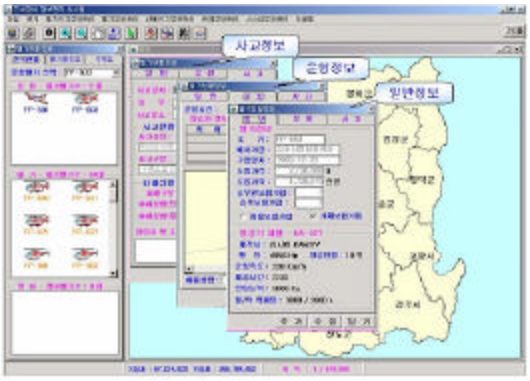

Fig. 11 the general information of helicopters status

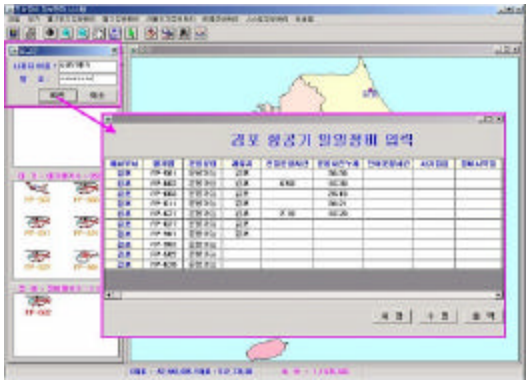

Fig. 12 The input of daily maintenance

. Conclusion

Recently most domestic forest fire extinguish tends to depend on airplanes. However, those airplanes use still wireless network such as wireless telephones or wireless radio to inform their location information and order their directions.

Nowadays, GPS(Global Positioning System) technology has developed very rapidly and also tends to be integrated with other spatial information technology such as GIS(Geographic Information System) to trace and present real time object's movement.

In this paper, the forest fire extinguishes equipment management system using GPS and GIS is constructed to use in case a large scaled forest fire is occupied. This system helps not only to arrange and manage location of airplanes and helicopters but also inform the forest fire extinguish environment toward an air-traffic controller and pilots. Following description indicated the effect of our study.

1. The entire database related to extinguish environment and helicopters is constructed in forest fire extinguish equipment management system.

2. The management and arrangement of extinguish helicopters can be controlled in real time using GPS, GIS, and wireless technology.

3. Finally, the forest officials can approach more scientifically and efficiently to extinguish forest fire so that have be granted for their safety in case of a large scaled of forest fire.

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