An automated system for environmental monitoring and disaster warning

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Introduction

One of the most important things human has been thinking about is to prevent people from being affected by natural disasters. The best way to do this job is to prevent these disasters from happening which is not yet possible. The other feasible way is to forecast them as soon as possible to decrease the effects of them.
Introduction

The main idea was the integration of the satellite images, image processing algorithms and computer network facilities to implement a semi-automatic system to monitor changes of natural resources in order to warn about disasters such as flood, fire, pollution and quake. In addition this system will be used as the portal of the ISA and some other components such as National archive and data sharing mechanisms will be integrated into this system.

This system is now at design level and we are working to analyze it as well as possible.

**ISA is not responsible for disaster warning.** The results of this system may be used for research purposes or by responsible organizations.
Main purposes of the project

- Regular receiving of the satellite images & national archive establishment
- Automatic preprocessing & quality control of the satellite images
- Permanent & reliable monitoring of the environment
- Online recognition of natural disasters & fast alarm
- Image & information exchange
Basic Schema

- Satellite images
- Maps & Data

Tracking & receiving sub-system

Pre-processing sub-system
- Read Raw (unpack)
- Framing
- Geo-locate & Calibrate
- Systematic Corrections
- Catalog Data Production

Database
- Raw Data
- Corrected Data
- Catalog Data
- Value Added Data
- Maps
- Satellite Data
- Auxiliary Data

Monitoring & Early-warning Sub-system
* Monitoring subsystem
  - Sea Surface Temperature
  - Land Surface Temperature
  - Vegetation Coverage
  - Water bodies
  - Border of snow
* Warning subsystem
  - Fire detection
  - Thermal abnormally detection
  - Flood detection

User services
- E-Learning
- E-commerce
- User support services

National Remote Sensing Archive
- Search DB
- Quick-look preview

Satellite Data Production

NOAA/AVHRR

TERRA/MODIS

AVHRR & MODIS Data

1-2Mbps

Iran Space Agency
ISA is a governmental organization and the president of this organization is one of the deputies of the ministry of communication and information technology. ISA is established to do research, design and implementation in the field of space technology; remote sensing and development of national and international space technology and communication networks. ISA performs the approvals of the Iran space council, which is established in order to peacefully use space technology and science and the above atmosphere space to develop the culture, technology science and finance of the country. The head of ISA is the president of the Islamic Republic of IRAN.
Data Transfer
Data availability

There are so many satellites which gather useful information from earth and its atmosphere. We chose Terra/MODIS and NOAA/AVHRR data due to their vast capabilities and applications and their availability to us.
Environmental Applications of Satellite Images

1- Land surface temperature
   + Terrain temperature
   + Sea surface temperature
   + Fire, Volcano

2- Oceanography
   + Pollution
   + Phytoplankton
   + Salinity
   + Bathymetry

3- Cloud cover
   + Cloud free regions
   + Aerosol (smoke, fog, …)
   + Cloud type
Environmental Applications of Satellite Images

4- Land cover monitoring & land cover change
   + Drought
   + Crops
   + Snow
   + Soil & Rock types

5- Water bodies
   + Water resources
   + Flood
   + Seasonal water streams
The coverage area of MODIS antenna
Tracking & Receiving Station

- 3.65 M Antenna
  Range = 1600 Km

Motor Controller

Feed

Outdoor Unit

Indoor Unit

Receiver
8.0-8.4 GHz
15.36 Mbps
42.44 Mbps
61.44 Mbps
84.91 Mbps
Test Pattern GEN

Demodulator

Bit sync

PC Antenna Interface

Tracking & Receiving Facility (PC)

Raw data archiving

Orbital element data

Interface to LAN

Data Processing & Management System (PC)

System corrected data
(Radiometric, Geometric,...)

Browse Data

Quick-look data

Storage media

Desktop Unit

Iran Space Agency
AVHRR Image Data
MODIS Image Data
Image Data Preprocessing
Cloud Masking

Cloud detection
Noise Detection & Removal
Adjacent frames overlap (Bow-Tie) removal
Gridded image after correction
Warning & Disaster Damage Estimation
Disaster Damage Estimation
Oil fire, IRAQ, Last Gulf War
Dust Storm Monitoring

MODIS True-color (1-4-3) 500m
21 July 2002 - Sunday
Storm in Zabol
Flood Detection
Environmental Monitoring
Deforestation

Golestan Forest, Changes from 1998 to 2001
Drought Monitoring
Sea Surface Temperature
Indices for target detection

- Snow detection
- Cloud detection
- Water-Wetland
1 km Land Cover Map of Northern IRAN

Produced by: Ali Sadeghi Naeni
Thank you for your attention