Detection of Forest Fire using sensors , gps & antennas

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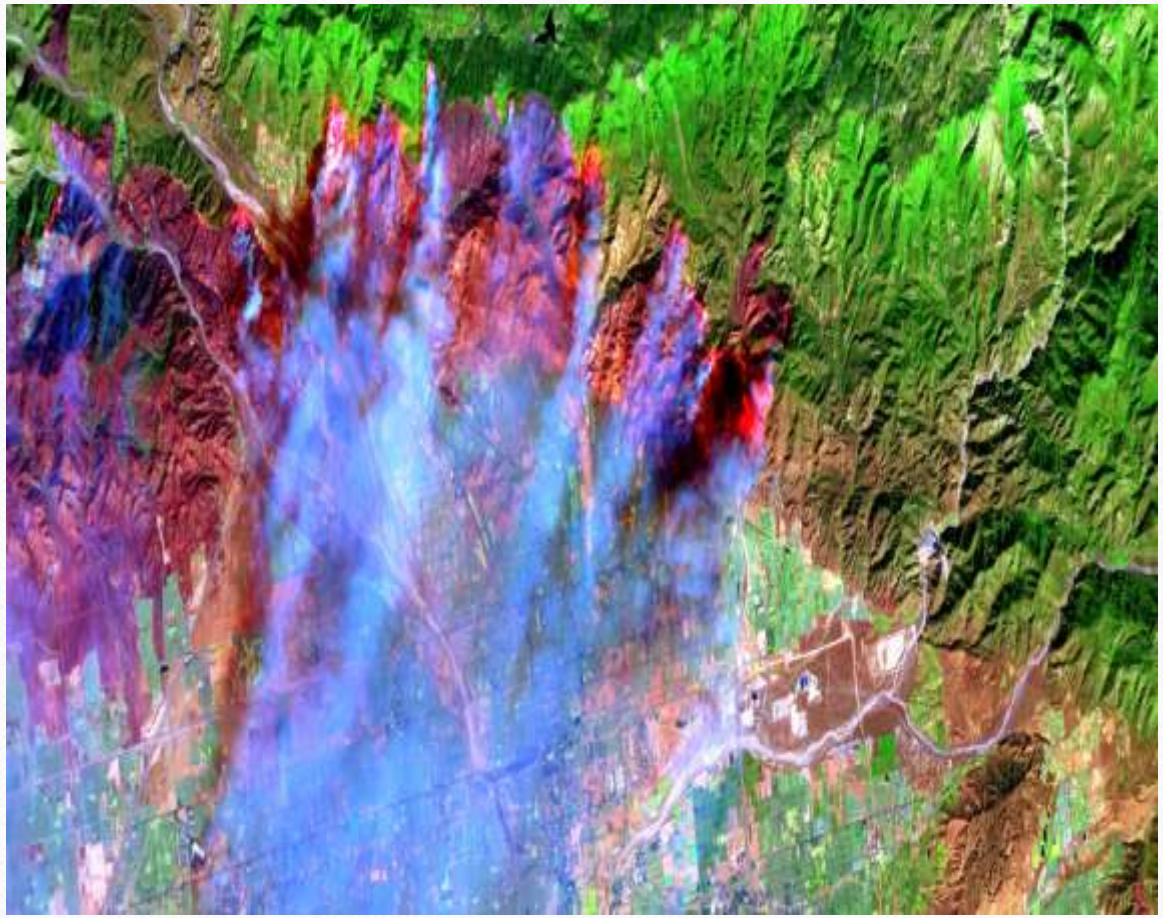
Introduction

Forest fire: an uncontrolled fire in an area of combustible vegetation

- 50% of the forest areas in India are fire prone (Forest Survey of India)
- Forests catch fire predominantly during summer
- India witnessed the most severe forest fires in the recent time
  - Summer of 1995 : In the hills of Uttar Pradesh & Himachal Pradesh.
- The Himalayan forests burning regularly during the last few summers
  - Garhwal Himalayas
  - Colossal loss of vegetation cover

Images

SOURCE: THE HINDU



SOURCE: ISRO's geo-portal 'Bhuvan'

--A California wildfire (September 2008)

--Tanker 910,
Los Angeles County Fire officials on December 15, 2006

MOTIVATION

Forest fires pose great deal of threat:

- Serious health hazards – Release of smoke and noxious gases
  - Serious issue in the islands of Sumatra and Borneo in 1977
- Disturbs and destroys the whole Ecosystem and vegetation
- Leads to global warming and ozone layer depletion
  - Produces CO_2 and numerous GREENHOUSE GASES
    - Carbon monoxide, methane, hydrocarbons, nitric oxide and nitrous oxide and etc

EARLY DETECTION OF FOREST FIRES IS A NECCEASITY
WE PROPOSE A SYSTEM THAT CAN MONITOR THE STATE OF FORESTS CONTINUOUSLY

REQUIREMENTS FOR FOREST FIRE DETECTION SYSTEM

- Monitor the region of interest continuously
- Provide real time data about the regions
- ECONOMICAL: Components used should be inexpensive
  - Number of equipment's will increase for huge forests
- Components in the system should withstand extreme temperatures
  - Replacing equipment's after every forest fire – UNACCEPTABLE
- When forest fire occurs - Report the location of forest fire with great precision

PROPOSED FOREST FIRE DETECTION SYSTEM (FFDS) – The IDEA

- **When a forest fire occurs → Sudden increase in temperature of that region**

  → Large variation compared to nearby regions

<u>THE FOUR PHASES OF THE PROPOSED FFDS SYSTEM:</u>

- **MEASURE:** Use simple temperature sensors to monitor the temperatures of forest
- **REPORT:** Use antennas and smallsat to report the temperatures to monitoring
- **LOCATE:** Use GPS to locate the reporting sensor, in case a forest fire occurs
- **REACT:** Take necessary measures to stop forest fire

FOREST FIRE DETECTION SYSTEM (FFDS) - STRATEGY

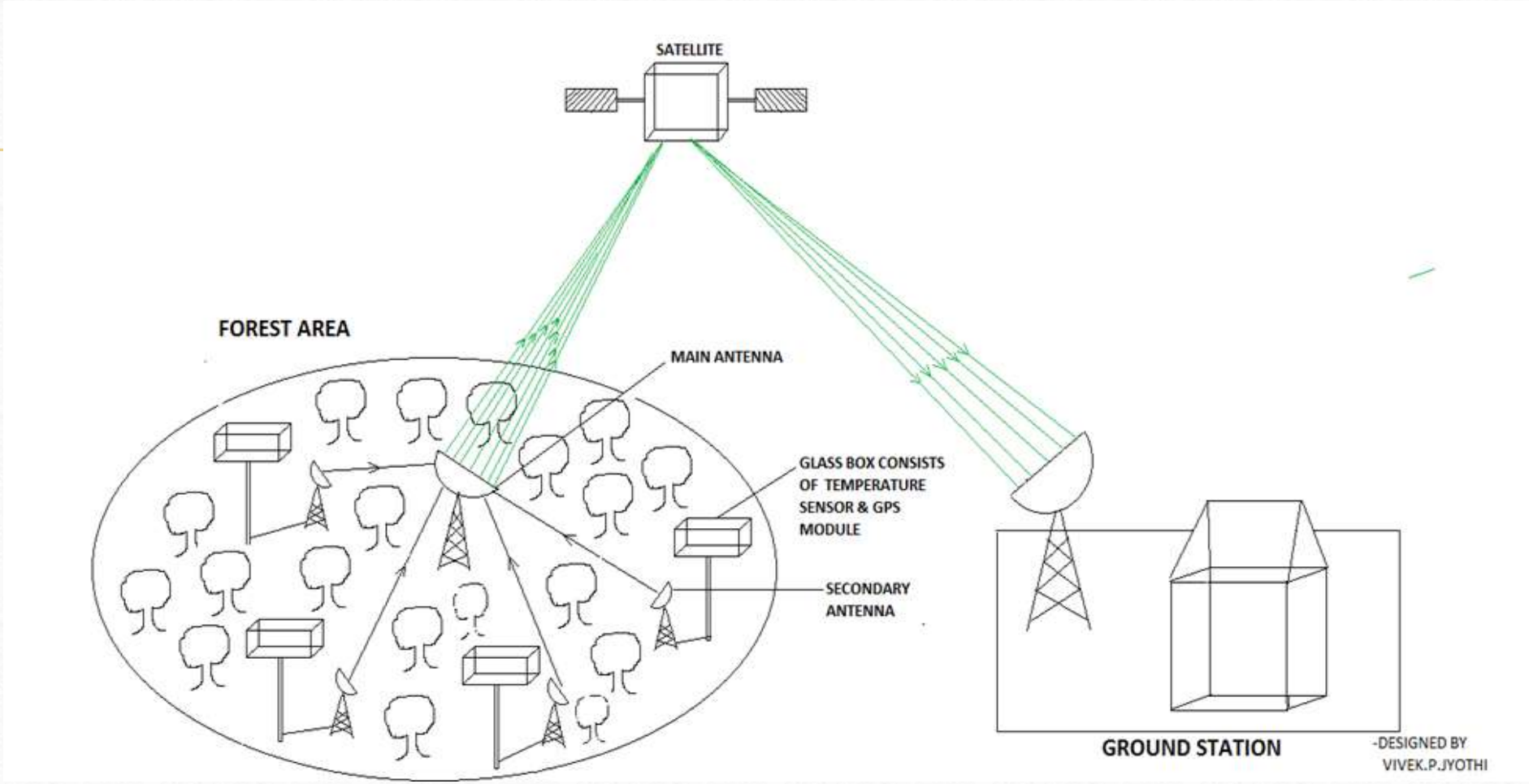
- Divide forest area under observation into ‘n’ zones.
- Each zone consists of
  - GPS & SENSOR (any temperature transducer)
  - Secondary antenna
- Each temperature sensor monitors ‘M’ Sq Ft
- Sensors report to antennas
- Information is then sent to monitoring station using satellites
- Monitoring station evaluates for any abrupt and large deviation in temperatures

Sub System

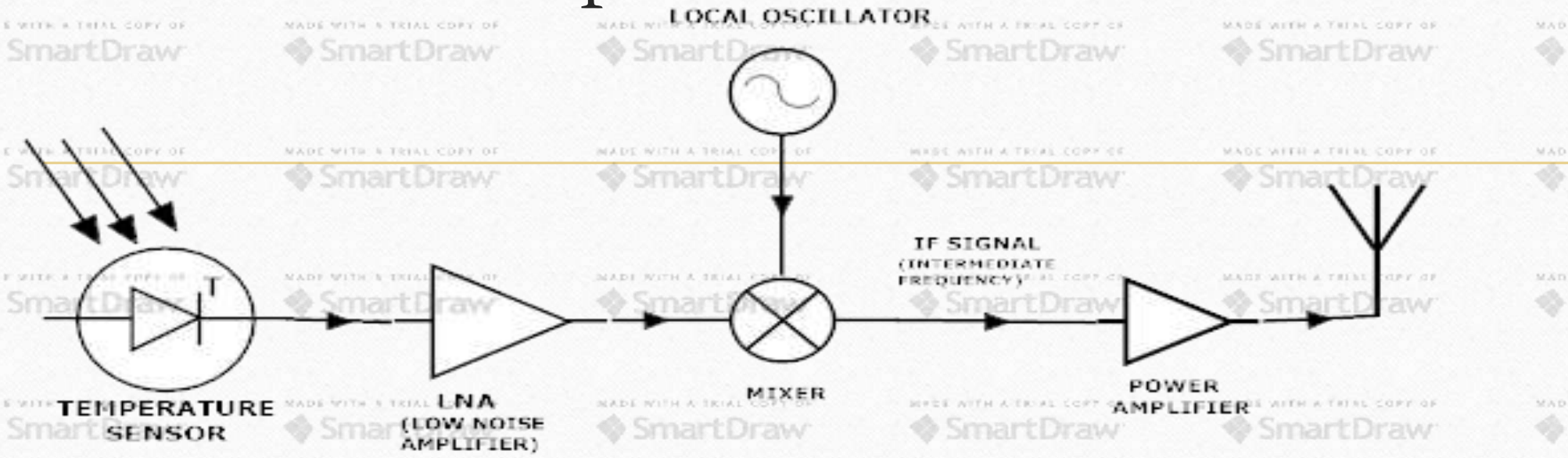
2 subsystems involved in detection process:

- AMPLIFICATION CIRCUIT - Amplifies weak sensor signals for transmission
  - Using Low Noise Amplifier
- GPS TRIGGERING CIRCUIT – Causes GPS module to communicate with the satellite directly
  - Coordinates of sensor reported to monitoring station

FFDS Design, Implementation and Working



Amplification circuit



SENSING THE TEMPERATURE & SENDING SIGNALS TO SATELLITE THROUGH T_x ANTENNA

-VIVEK.P.JYOTHI

Triggering ckt

BENEFITS

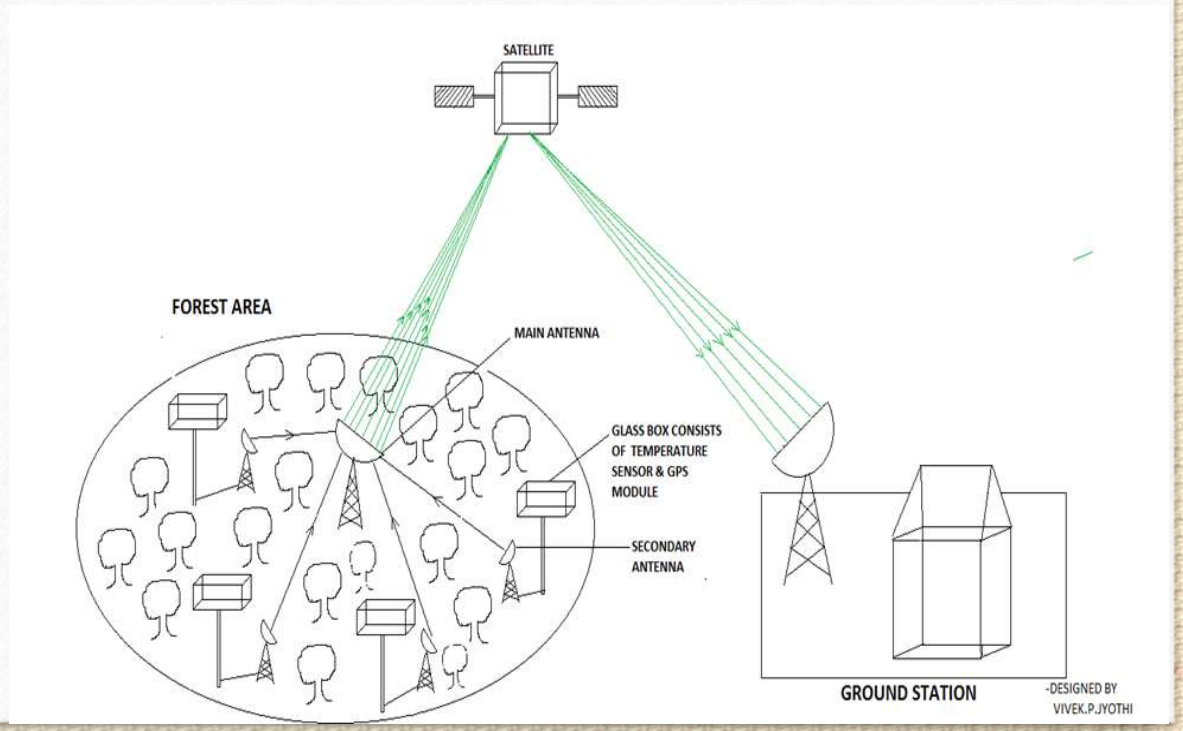
- The arrangement is fire proof and can withstand high temperature.
- Rugged, cost-effective, easy installation process
- Reliable
- Easy to decode the data from satellite at the ground station.
- No expert knowledge required to understand data from the satellite.
- All the components like temperature sensor and GPS are easy to interface and economical.

FFDS - The bottom line

- FFDS aids in forest fire detection in early stages
  - Appropriate actions can stop forest fire spreading
  - Preserve vegetation cover, maintain ecosystem balance
  - Reduce contribution to Global Warming

CONSTRAINTS

- Directing the signals to main antenna
  - Number of installation of secondary antennas becomes large
- Providing continuous power supply to the TS system and to antennas



FUTURE SCOPE FOR THE WORK

- Developing a sensor which is of multifunctional
- Using of small satellites like MICROSATELLITE, NANOSATELLITE OR PICOSATELLITES
- A group of small satellites are installed so that each small satellite is used for various purposes.
- If installing an Antenna in the forest becomes a problem, then the detection of forest fire can be done only by using the GPS and the TEMPERATURE SENSORS & also SMOKE SENSORS

DEVELOPING A SMALL SATELLITE

If the proper funding is obtained,

- Plans to develop a small satellites
- Use the satellite disaster management
- Plan to Collaborate with the Centre for Disaster Mitigation (CDM) and Centre for Emerging Technologies (CET) at JAIN UNIVERSITY in and using of these small satellites in disaster management.

THANK YOU

QUESTIONS??

BACK UP SLIDES

System Design and Implementation

- System consists of Main Antennas, Secondary Antennas, temperature Sensors, GPS module, Satellite, Ground Station.
- Temperature sensor senses the temperature of the zone, sensor's output is amplified and processed by using suitable circuit.
- After the amplification, the output of this circuitry is given to the secondary antenna which transmits the signals to the main antenna.
- Main antenna radiates the signals to the satellite which in turn re-transmits these signals to the ground station.

CONT…

- TS system (Temperature sensor and GPS module) are kept in a glass case/ box which withstand a High temperature.
- The box case is located at few feet above the ground.
- Sensors output is given to a amplification circuit which consists of LNA (low noise amplifier), MIXER, LO (local oscillator) and power amplifier.
- Since the output of the Temperature sensor will be weak signals, it has to be amplified in order to transmit.
- So amplification of these signals can be done by above said circuit.

- An average surface forest fire

  -reach's 1 meter to 50 meters in height

  -can reach temperatures of 800°C (1,472°F) & exceeds 1200°C (2,192°F). -Source: Wildfiretoday.com

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Antenna temperature(Ta)

- a parameter that describes how much noise an antenna produces in a given environment
- the temperature depends on its gain pattern and the thermal environment that it is placed in.
- temperature distribution will be written as $T(\theta, \phi)$
- will vary depending on whether it is directional and pointed into space or staring into the sun.