

**THE DESIGN OF A GROUND CONTROL  
SEGMENT FOR A CUBESAT  
DEVELOPMENT PROGRAM IN ACCRA  
GHANA**

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# OUTLINE

- Overview
- The challenges (Illegal Gold Mining “Galamsey” activities)
- CubeSat Development Programme
- Ground Control Segment
- Conclusion



# OVERVIEW

- The Ghana Space Science and Technology Institute (GSSTI), was officially launched on 2nd May, 2012.
- The vision of GSSTI is: “To uncover and exploit the capabilities of space science and technology for national socio-economic and technological development through education and research”.

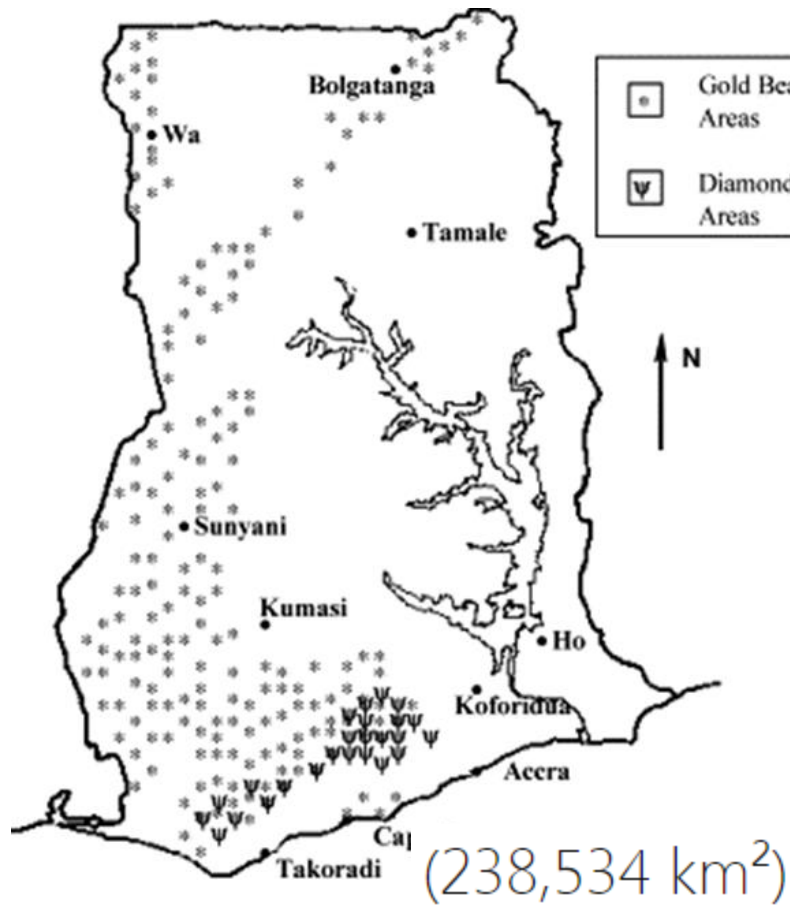


# WHY GROUND CONTROL SEGMENT?

- Why should (GSSTI) Develop a Ground Segment?
- What is the socio-economic benefit of GSSTI's Ground Control Segment and CubeSat development program to Ghana?



# GEOGRAPHICAL AREA OF GHANA



Most gold deposits in Ghana occur in major shear zones and other geological belt and basin. Soil samples in these areas identified gold-in-soil, sometime stretching several kilometers.

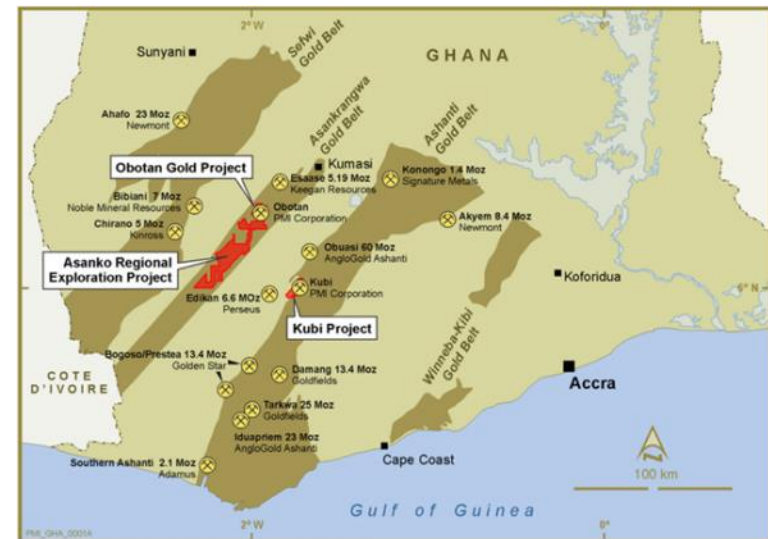


Fig. 1. Map of Ghana showing scattered gold bearing and diamondiferous areas and four major gold belts.

# LIVELIHOODS IN MINING AREAS



Typical household of certain towns and villages (Gold mining areas) such as Bogoso, Prestea, Mpohor, Benso, Damang, Tarkwa, Oboasi and other areas.

Small scale mining has been in existence in Ghana for many years and has been the source of livelihood for many.



# LIVELIHOODS IN MINING AREAS

- (1) Indirectly the small scale mining industry employs thousands of operators and merchants.
- These people acting as bread winners, supports their families, pay children school fees, house keepings, feeding, hospital bills, basic amenities, and utilities etc.



# LIVELIHOODS IN MINING AREAS

- (2) The activities of these illegal gold mining are polluting water bodies and rivers as well as degrading forest reserves and farm lands.
- There are a wide variety of diseases caused by water pollution, with their severity ranging from a minor inconvenience to life threatening.
- Liver damage and cancer, Neurological problems, Kidney damage, etc.
- Mercury acts as a cumulative poison once it enters into the body; the body has difficulty eliminating it. Thus it may collect over a long time eventually reaching dangerous level.





# Pictures from mining areas



# PICTURES FROM MINING AREAS



# PICTURES FROM MINING AREAS



# PICTURES FROM MINING AREAS



# OPERATION VANGUARD

## Implementation Of Anti-galamsey Plan To Cost \$150 Million

This was captured in the much hyped Multilateral Mining Integrated Project (MMIP) document put together by the governing New Patriotic Party in its anti-galamsey efforts.

Project Component	USD	%
Review and Enforce the Legal and Regulatory Regime	10,000,000	6.67
Dredge Rivers, Reclaim Degraded Lands and Free Lands for Agribusiness	50,000,000	33.33
Implement Social Interventions to facilitate livelihood creation in mining communities	50,000,000	33.33
Adapt Technology to ensure efficient mining, processing, environmental and monitoring activities	20,000,000	13.33
Human Resource Development and Project Management	10,000,000	6.67
Communication	10,000,000	6.67
<b>Total</b>	<b>150,000,000</b>	<b>100</b>

Implementation Of Anti-galamsey Plan To Cost \$150 Million



# CUBESAT DEVELOPMENT PROGRAM

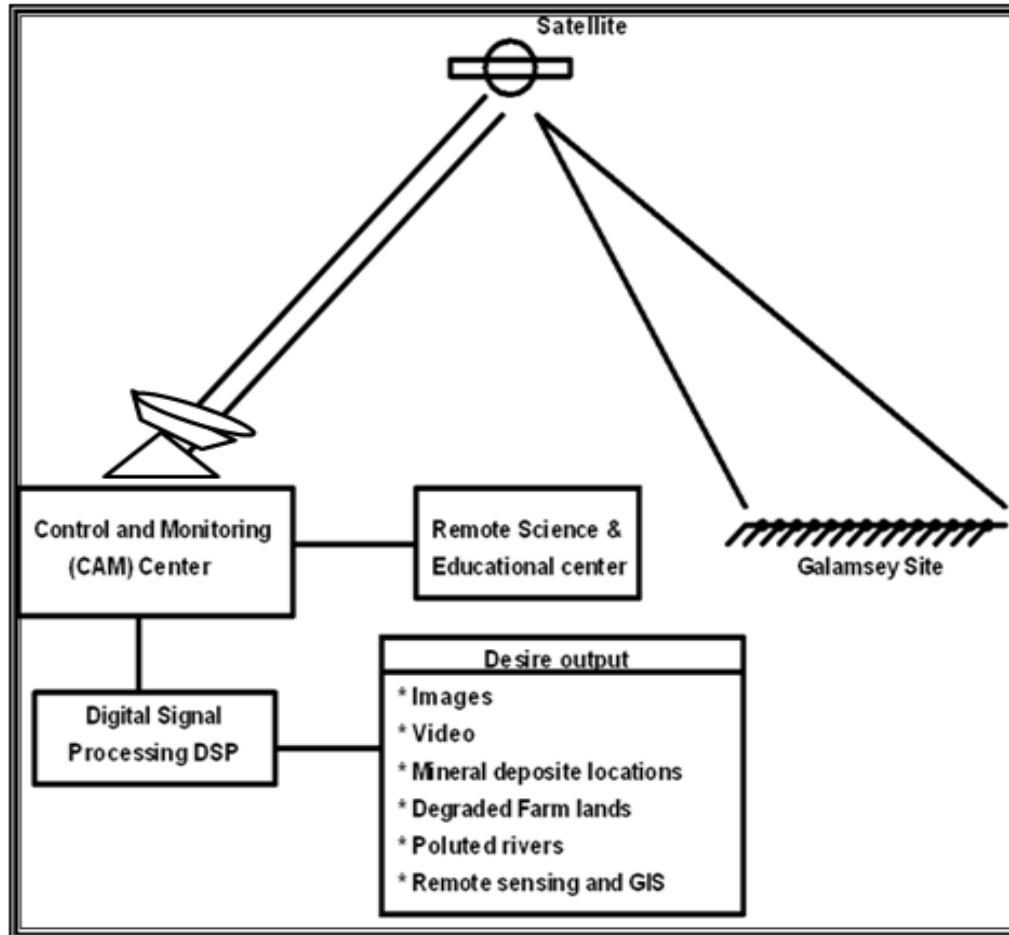


Fig 2. Block diagram of CubeSat development program

# DESIGN OF GROUND CONTROL SEGMENT

Main antenna reflector & Sub reflector

Azimuth & Elevation Drive systems

Resolvers (for angle detection)

Motors, Gear boxes, Clutches, Breaks

Sensors, Emergency Stop (E-Stop) Switches

Antenna Controller

Infrastructure Controller

Data Signal Analogue and Digital

Power Amplifiers and Low Noise Amplifier (LNA)



# ELEVATION DRIVE SYSTEM

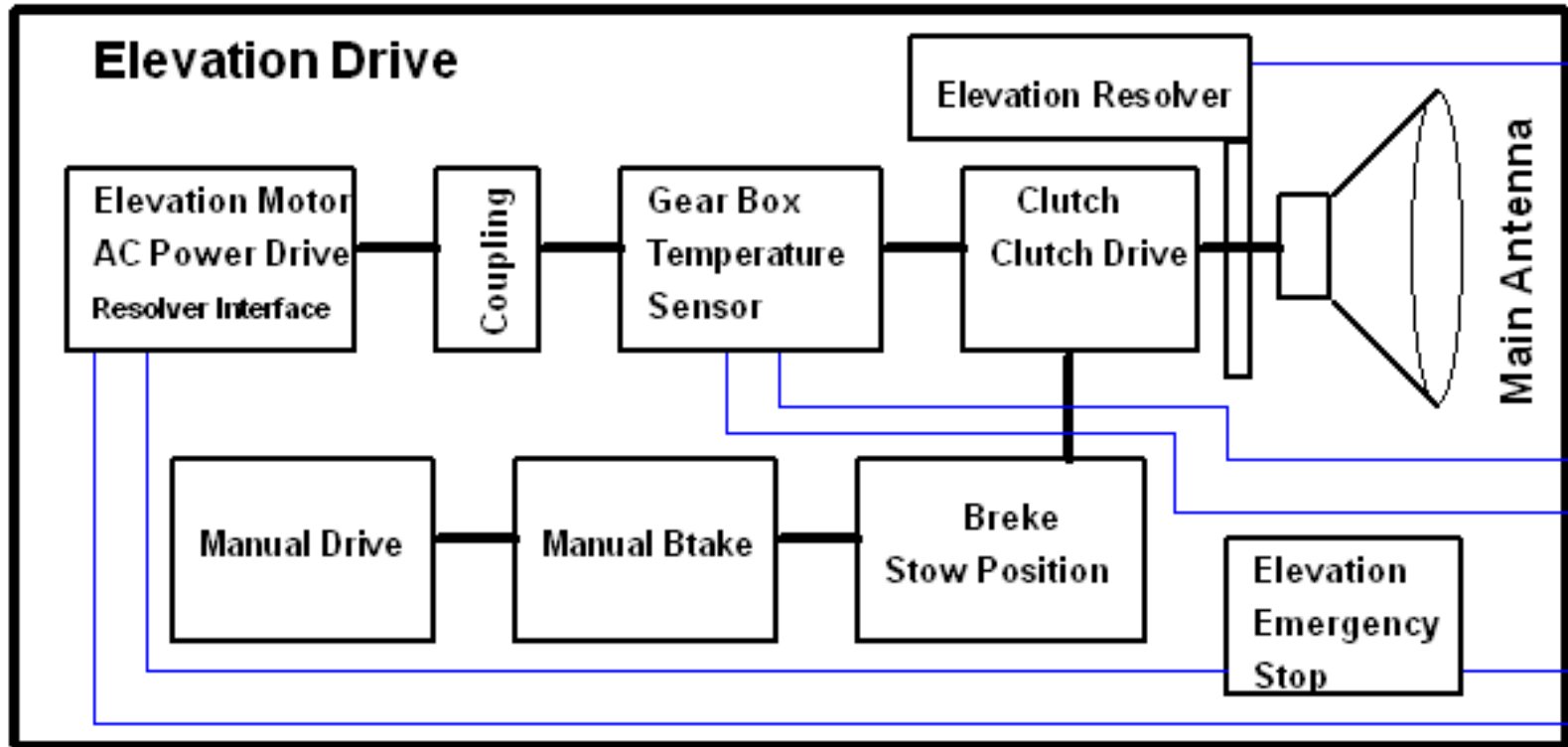


Fig 2. Block diagram of Elevation Drive System



# APPROACH

- High Definition (HD) camera taking photos
- Radar (Radio Detection and Ranging)
- Remote sensing without being in physical contact with the areas of activities.
  - ***Passive method*** - by processing signal naturally emitted by the mining activities, and its environs or
  - ***Active method*** - that is processing echo of signals returned from affected areas.

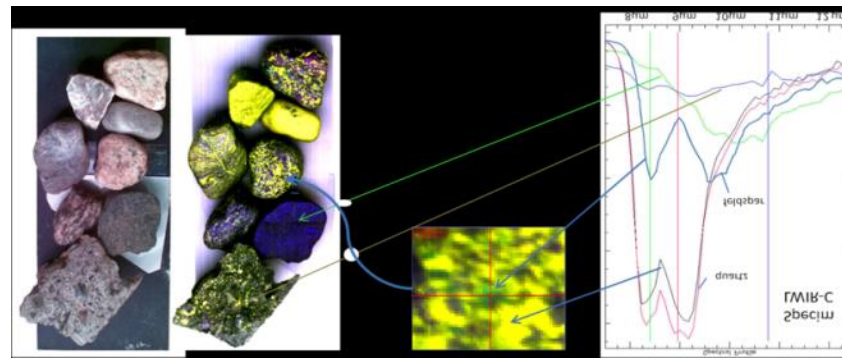


# HYPERSPECTRAL IMAGING

- Hyperspectral imaging like other spectral imaging, collects and processes information from across the electromagnetic spectrum. The unique 'fingerprints' across the electromagnetic spectrum, the spectral imaging divides the spectrum into many more bands.
- This technique of dividing images into bands can be extended beyond the visible.



*Two-dimensional projection of a hyperspectral cube*



# Hyperspectral imaging



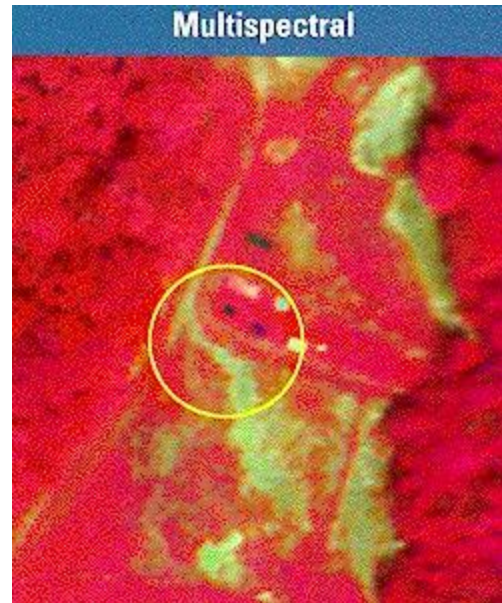
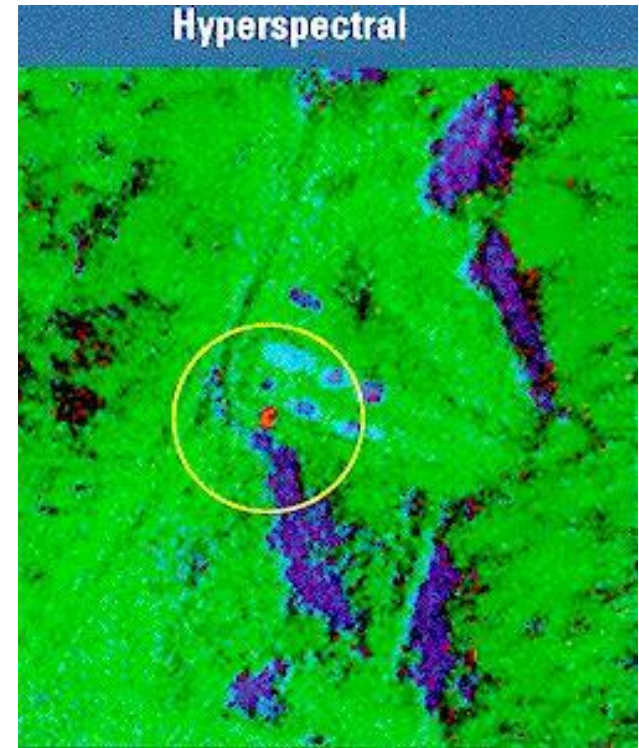
Area view of a town called “Bogoso” in Ghana, an area noted for “Galamsey” operations.

# Hyperspectral imaging



Area view of a town called “Bogoso” in Ghana, an area noted for “Galamsey” operations.

# HYPERSPECTRAL IMAGING



# APPROACH

- The most important aspect of the international collaboration is to proposed space program that support Ghana's need in all aspect of the GSSTI space program, namely:
  - The definition of a Space Mission
  - The development of the equipment (the satellite, the payload and the ground station)
  - The preparation of the launch campaign
  - The reception of the satellite data through the Ground Station, its operations and technical support in the long term



# THE SOCIO-ECONOMIC BENEFITS OF THE SATELLITE DEVELOPMENT PROGRAM:

- Develop Space Science and Technology application and its spin-off industries
- Reduce life threatening diseases
- Disaster risk reduction and emergency response
- Manage Natural resource properly
- Improve environmental degradation
- Reduce contamination of water bodies



## CONCLUSION

- The Ghana Space Science and Technology Institute (GSSTI) is using the bottom-up approach. And also lobbying with the ministries and government for support.
- GSSTI as an emerging institution in terms of space science and technology and is ready for collaborations and to pursue space programs with other space faring countries, agencies, institutions and industries.





# THANK YOU

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