Ministry of Higher Education and Scientific Research
UNIVERSITY OF MONASTIR
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UR MICROECTRONIQUE AND INSTRUMENTATIONS

Title:

Satellite real time monitoring of water flood and quality in Tunisia

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X We apply to Student Prize.

X please keeps our idea confidential if we were not selected as finalist/semi-finalist.

1. Key Concept and Business Impact on Society and Environment

• Value of our proposal:

Water resources represent a vital wealth in the world and particularly for countries in south Mediterranean sea as Tunisia. Its scarcity in dry periods and floods in periods of intense rainfall requires continuous and real-time control of dams and lakes. The floods may have many causes combined natural (related to climatic) or anthropogenic direct (drainage, irrigation, soil sealing and soil degradation) or direct human (institutions of locks, dams and lack of management coordination of dams to flood the approach) or indirect human causes linked to global climatic changes. However it represents real threats that can cause loss of life and displacement of populations. For example in 2012, flooding in the borders between Algeria and Tunisia and mismanagement evacuations dams have caused major floods causing damage estimated at more than $ 30 million Tunisia currently has 32 large dams. This water resource network is governed by rules of managements and need more efficient models for evacuation in hard flood periods.

Outside the period of flooding, control by these beacons of chemical and biological qualities of water can provide valuable information to its conservation and treatment.

In this context, the value of the information has continued to become very important to monitor global water resources and movement around dams, lakes and waterways. Information will be provided by multi-sensors network beacons system combined with GPS positioning.

•The project idea:

Our project is to deploy beacons collection of information on the depth, chemical, biological characteristics of water-related GPS positioning with a distribution in lakes, dams and evacuation paths.

Associated with traditional satellite images it is possible to predict water volumes and establish predictive models to open the dams well in advance and warn about the risk of the population.

• Impact on environment:

- Flood expansion prediction and management of dams.
- Real time volume water control of big lakes and dams
- Economic water resources data
- Models for water deployment in flood situation Development.
- Control water conservation and treatment

• Impact on society:

- Protect the human being
- Protect the agricultural sector
- Minimize the damage happening due by flooding.
- Development of flow models of water

In conclusion, fresh water is rare on our planet, that's why it's vital to know how to manage our surface water, in fact it becomes very important to have regular and accurate data to protect human beings who live near dams and rivers. For ensure that data we can use space technology.

2. Business Model Structure

• Who?

First step: The University: We have to establish a scientific program for this application to validate hardware and network programs. Funded by cooperation programs with state and international agencies

Second step: Economic program development.

Future: Startup Company in Water GPS-telemetry beacons with multi-mode satellite communication.

• To whom?

❖ **General Management of Dams and Major Hydrological Works**

Public organization responsible for the following tasks:

- Prepare hydraulic studies.
- Develop control studies of surface water.
- Develop studies of water mobilization.
- Develop studies of large hydraulic mobilization of surface water.
- Develop broad studies of hydraulic.
- Control and assure the maintenance of large dams.

❖ **Technical Center for Aquaculture, water distribution and irrigation administration**

- Biological and chemical characteristics Control.
- Analysis and monitoring of water treatment.
- Pollution control modeling.

❖ **The Electricity and power production Companies**

- Distribution of energy available in the reserve of water from a dam depends on its volume.

❖ **Transfer this experience to other countries in Africa and Asia …**

• When?

Program for three years.

• Where?

Service is available according to the life of the satellite project.

• What?

Transmit data hydrologic such as level and water quality of rivers and dams lakes through a nanosatellite constellation by deploying sensors in each of the dams and rivers that can communicate with satellites.

• How?

Distribution of data after having received from the satellite is made through the Internet.

• How much?

We have two scenarios:

- ✓ First scenario, University Program: using actual satellite constellation platforms to reduce prices, risks and time to action. (Project Humsat-GENSO-….)

The initial cost is estimated at 0,864M$ and the yearly cost is 0,6M$

- ✓ Second scenario, future Startup company

The initial cost is estimated at 15,564M$ and the yearly cost is 0,6M$

3. Business Feasibility

• calculate initial cost

- ✓ **First scenario:**

The university: use the constellation of the humsat project

Cost	M$
Ground sensors	0,814(A sensor cost is assumed to be 700$ per one unit)
Ground station	0,05
Total	0,864

• Calculate operation cost

Cost	M$
Ground station operation	0,1
Data analysis (per year)	0,5
Total (yearly)	0,6

✓ **Second scenario: Future: Startup:**

• Calculate initial cost

Cost	M$
bus	1,5
payload	1,2
Ground sensors	0,814(A sensor cost is assumed to be 700$ per one unit)
Ground station	0,05
launch	12
total	15,564

• Calculate operation cost

Cost	M$
Ground station operation	0,1
Data analysis (per year)	0,5
Total (yearly)	0,6

4. Logistical Feasibility

General description of Humsat project and GEOID initiative:

- Humsat project is an international initiative for building a constellation of nanosatellite providing communication capabilities to areas without infrastructure.
- Based on the cubesats standard and using GENSO as ground station.
- GEOID initiative will be a GENSO testbed trough HUMSAT compatible nanosats that ESA will launch in support of the project and for educational purposes:

➢ Constellation of 9 Cubesats.

1) Payload and the bus level of the satellite:

Mission payload	Information collecting mission with 1200bps	Resources occupation 60%
bus level	low level bus	downlink speed 9.6kbps

2) Number of the satellite:

- First scenario: The initial version of the HUMSAT system consists of 9 cubesats.

number of satellite	9 satellites in coordinated orbit	uplink interval: 1.33 hours

- second scenario:

number of satellite	3 satellites in coordinated orbit	uplink interval: 4 hours

3) Number and specification of ground stations:

number of ground station and comm.speed	1 station with 9.6Kbps	downlink latency 12 hours

4) Launch configuration with reason:

number of ground sensors	740 sensors in Tunisia	20 per dam
information collecting mission scenario	each sensor can uplink for 600/740 =0.81 sec	the size of message is 600 bits (requirements of HUMSAT project)

5. Risk Analysis

- Absence of satellites partners.
- Rupture of the communication for incompatibility of the protocol.
- Failures on the level of the beacons.

- The project is very important given the human and economic impact.

References

✓ **Delineation of the Flood Prone Zones Along the Medjerda River Downstream of Sidi Salem Dam in Tunisia**

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