Smart Buoys for Marine Environment Monitoring: The Case of MARIABOX Project

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Marine environmental monitoring

- Vital problem
  - Research and development attention

- Monitoring using research vessel
  - Expensive, time-consuming, low resolution both in time & space

- Sensors
  - Promising alternatives for monitoring
  - Unmanned operation, easy deployment, real-time monitoring, low cost, etc.

- Physical & chemical parameters
  - water temperature, pressure, wind direction, wind speed, salinity, turbidity, pH, oxygen density, chlorophyll levels, etc.

- Application areas
  - Water quality monitoring, ocean sensing and monitoring, coral reef monitoring, marine fish farm monitoring, etc.
Why Smart Buoys?

- **Flexibility**
  - Buoy sensors are fully customizable
  - Monitoring platforms can be adapted and modified as monitoring priorities change
  - Buoys can house from one to hundreds of sensors, meeting the needs and applications

- **Data Streaming**
  - Sampling can occur as frequently as every minute
  - Providing data 24 hours a day, 7 days a week

- **Independency**
  - Wind /solar power or battery power options
Smart Buoys

**Necessity:**
- Wireless marine environment monitoring
- Long-term data collection at scales and resolutions that are difficult, if not impossible, to obtain otherwise

**Merging technologies:**
- Sensing
- Cellular communications
- Internet-based information sharing

**Structure/ basic components:**
- Sensing and analysis system
- Modular communication system
- Power system
- Software platform
- Cell phone application
Sensing and analysis system

- General
  - Audio sensors
  - Smell sensors
  - Infra-Red (IR) sensors
  - Cameras
  - ...

- Water Quality
  - Dissolved oxygen
  - pH
  - Conductivity
  - Salinity
  - Turbidity
  - Temperature
  - Depth
  - ...

- Air Quality
  - Wind speed, direction, etc.
  - Humidity
  - Barometric pressure
  - Precipitation
  - ...

Diagram showing different types of sensors and their corresponding icons.
Communication system

- Short Distance
  - Wifi/Bluetooth
- Middle Distance
  - 3G/4G
- Long Distance
  - Satellite
Power system

- Get the energy from the environment by a harvesting system
  - Solar
  - Wind
  - Batteries
Software platform / Mobile Application

- Marine environmental monitoring
  - Data view monitoring / Real-time data display
  - Data Analysis
  - Notifications/Alerts

- Buoy Management
  - Health and condition of each sensor
  - Configuration parameters
  - Power administration
  - …
The MARIABOX case

- SignalGeneriX has developed 2 smart buoys which will be used for marine environment monitoring in the framework of FP7 EU funded Research Project MARIABOX

- The buoys will be used for the pilot demos of the MARIABOX system in Cyprus and Spain
MariaBOX Project\(^{(1)}\)

- MariaBOX: Marine environmental in situ Assessment and monitoring tool BOX
  - Call: FP7-OCEAN-2013
  - Topic: OCEAN 2013.1 - Biosensors for real time monitoring of biohazard in the marine environment
  - Duration: 48 months (2014-2018)
  - Consortium: 13 beneficiaries from 6 countries
  - Total budget: 7.1M €
MariaBOX Project(2)

- Development of a wireless marine environment analysis device for monitoring chemical and biological pollutants

- Objectives
  - The device will be of high-sensitivity, portable and capable of repeating measurements over a long time, allowing permanent deployment at sea
  - Biosensors will be developed for man-made chemicals & microalgae toxins relevant to shell fish and fish farming
  - The system will be demonstrated and validated in four different scenarios in selected locations in Cyprus, Norway, Spain, Ireland
Pilot demonstration: Cyprus

- Leader: Department of Fisheries and Marine Research of the Republic of Cyprus (DFMR)
- Location: Between Vassilikos Bay and Zygi fishing shelter
- Depth: ~30m
Pilot demonstration: Spain

- Leader: Institute of Marine Sciences (CSIC)
- Location: A micro-tidal estuary located in the Ebre river Delta, in the North-western Mediterranean Sea (Alfacs Bay)
- Depth: ~6 m
Buoys’ Requirements

- **Anchorage**
  - Cyprus: ~30m
  - Spain: ~6m

- **Payload**
  - MariaBox System
  - Water Tanks
  - Power Equipment
  - Communication Equipment

- **Daily Power Consumption**: 3000Wh
## Buoys Dimensions

<table>
<thead>
<tr>
<th>Pilot Case</th>
<th>Height (m)</th>
<th>Weight (Kg)</th>
<th>Base’s Dimensions (m)</th>
<th>Diameter</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyprus</td>
<td>7.1</td>
<td>950</td>
<td></td>
<td>3</td>
<td>1.10</td>
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<tr>
<td>Spain</td>
<td>6.3</td>
<td>750</td>
<td></td>
<td>2.25</td>
<td>0.90</td>
</tr>
</tbody>
</table>

### Cyprus

- Height: 3 m
- Diameter: 0.9 m
- Total Height: 3.9 m

### Spain

- Height: 2.4 m
- Diameter: 0.9 m
- Total Height: 3.3 m
### Total Payload

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Weight (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MariaBox System</td>
<td>142</td>
</tr>
<tr>
<td>2</td>
<td>Batteries</td>
<td>408</td>
</tr>
<tr>
<td>3</td>
<td>Solar panels</td>
<td>72</td>
</tr>
<tr>
<td>4</td>
<td>Water tanks</td>
<td>105</td>
</tr>
<tr>
<td>5</td>
<td>Communication Module</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Power Module</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>Charger Controller</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>743</strong></td>
</tr>
</tbody>
</table>
- Daily Power Consumption: 3000Wh
- Power System Components (Autonomy: 4.5 days)

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Dimensions HxWxD (cm)</th>
<th>Weight</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Panels (250W)</td>
<td>4</td>
<td>1665 x 991 x 38 mm</td>
<td>72Kg</td>
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<tr>
<td>Batteries (2V, 550Ah)</td>
<td>12</td>
<td>502x206x145 mm</td>
<td>408Kg</td>
<td>Total 1100Ah</td>
</tr>
<tr>
<td>Solar Charge Controller</td>
<td>1</td>
<td>128x165x315 mm</td>
<td>4.5 Kg</td>
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<tr>
<td>Voltage Stabilizer</td>
<td>1</td>
<td>64x163x160 mm</td>
<td>1.4Kg</td>
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</table>
Buoys Structure

- **Base** (main part)
  - Includes the *waterproof box* for hosting the MARIABOX system, and space for hosting battery compartments, water tanks, power module and communication module

- **Iron tube** (bottom part)

- **Iron construction** (top part)
  - Hosts the solar panels, marine lantern and radar reflector
Buoys Base\(^{(1)}\)

- Made by marine plywood and covered by fiberglass
- The solid part of the buoy is closed, watertight and filled by polyurethane foam
- Steel pipes under the base which are used for the connection of the iron tube
- Protective Fender Rubber is placed around the buoy
- Carrying handles are placed to allow the safe transportation of the buoy
- 4 connector-handles are placed on the top of the base for the connection of the iron structure
Buoys Base (2)

- The inner space of the base hosts
  - 12 battery pockets which are accessible through the watertight doors of the base
  - 4 water tanks of total weight of 105 Kg which are accessible through the watertight doors of the base
  - The power and communication modules which are accessible through the watertight doors of the base
Waterproof Box

- Made by marine plywood and covered by fiberglass
- 4 doors, one at each side
  - Allows full access to MARIABOX system
- System Ventilation

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<th>Width (m)</th>
<th>Height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyprus</td>
<td>1</td>
<td>1.28</td>
<td>1.22</td>
</tr>
<tr>
<td>Spain</td>
<td>0.9</td>
<td>0.84</td>
<td>1.22</td>
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</table>

![Image of Waterproof Box]
Buoys Development(1)
Buoys Development(2)
Buoys Development (3)
We will be happy to answer any question and demonstrate our technology to potential collaborators and partners.

For Further Information Contact
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