OceanPixel: a marine spatial planning tool for ocean renewable energy in South East Asia

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Abstract:
OceanPixel is a multi-site, multi-device, multi-criteria decision support system designed to support the development of ocean renewable energy (ORE) in the South East Asian region. Its platform is based on Geographical Information System (GIS) which allows the collection, storage, processing, analyses and display of geospatial data. Combining GIS application tools with the resources of the web, OceanPixel becomes a web-based GIS decision support tool. It is designed to combine data from multiple sources and collate them into usable formats providing analysis, as well as expertise in ORE feasibility assessment and planning. It includes different forms of ORE resources such as, tidal, tidal current, wave, ocean thermal, and salinity gradient.

To date, a prototype of OceanPixel has been developed and tested utilizing data on tidal current energy of two SEA countries, Singapore and Philippines. A device database with mechanical and electrical specifications and cost is also integrated to the system. Results show that OceanPixel is a promising tool for ORE project developments. It is capable of resource data integration, processing, and analysis. It can be used for assessment of installation through environmental impact consideration, distance to port, distance to shore/grid functions, as well as any other constraints.

Keywords: *GIS; ocean energy; marine renewable project development*

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1. Introduction

The ocean renewable energy (ORE) industry is expected to follow trends similar to that of other renewables such as wind with a forecast industry size of greater than 200 million US dollars and a project development feasibility market size of around 7 million US dollars in South East Asia. With the increased interest in ORE in the SEA region, a tool that supports ORE planning and project development activities will facilitate the development of ORE in the region. This will help countries and organizations plan the use of their ocean resources (fishing, maritime and energy uses) with more efficiency and awareness (IEA, 2011).

Traditionally, Project Developers would go through the lengthy process of gathering multiple layers of data, either from data rich institutes or from in-situ testing before processing the data into Geographical Information System (GIS) compatible formats for analysis with data from technology providers. They would then repeat this process for multiple sites before choosing the most suitable site for development. The repetition of these processes entails higher cost and longer timeline.

With OceanPixel, ORE project assessment is simplified and sped up through the use of the webGIS-based decision support tool. This tool is capable of assessing multiple devices, at multiple sites, with multiple feasibility criteria, quickly and easily.

2. Material and methods

OceanPixel is designed to host different GIS layers overlaid on mapping platforms, e.g. Google Maps. Available data, such as bathymetry layers, fishing grounds, marine protected areas and other geospatial information are uploaded and displayed to users. Other site specific data, such as energy density and current strength are also displayed. Future development will include provision for

integrating marine and other hydrodynamic models for real-time computation of energy potential in different areas depending on various ORE conversion technologies. The system diagram is illustrated in Fig. 1.

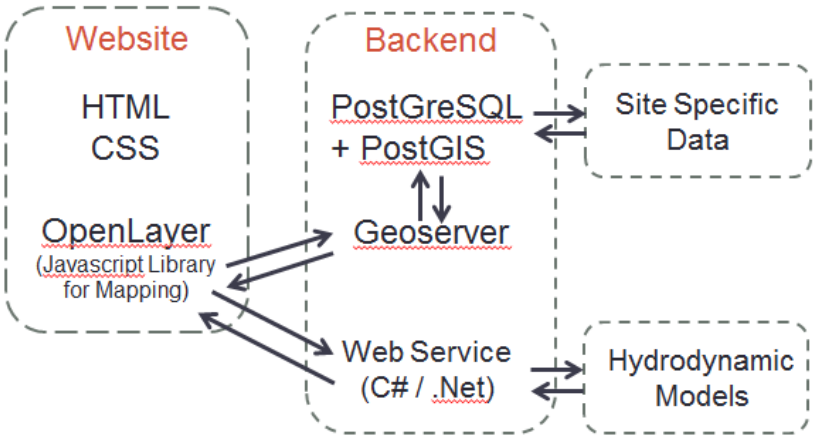

Fig. 1 System diagram of OceanPixel.

OceanPixel will have the following components:

- Resource Data
  - Integration
  - Processing
  - Analysis
- Device Database
  - Mechanical Specs
  - Electrical Specs
  - Cost
- Installation
  - Distance to Port
  - Distance to Shore (Grid)
- Constraints
  - Navigation & Shipping
  - Marine Protected Areas
  - Depth Constraints
- Suitability Scoring
  - "Best Site" Nomination
  - "Best Technology"
  - "Best Device"
  - Least Cost Analysis

3. Results and discussion

Initially, OceanPixel has been developed using tidal current energy data of Singapore and Philippines. A screenshot of the prototype is shown in Fig. 2. A map of the SEA region is displayed wherein the user can zoom in or zoom out using the "Zoom" on the left side. Specific locations can also be browsed using "Select Country" and "Select Tidal Site" on the upper right side. Colored map of bathymetry data is also displayed with ranges indicated on the right side of the screen. Tidal stations are marked and basic site information, such as location (latitude, longitude), water depth, and tidal energy density are displayed when the marker is clicked. At the lower part of the screen, information on site-device matching is given. Performance parameters of a specific device at a given site are displayed. These include speed versus percent of time graph (occurrence), current speed and direction, power versus speed graph. User can select any device from the "Device Database" in the lower right of the screen.

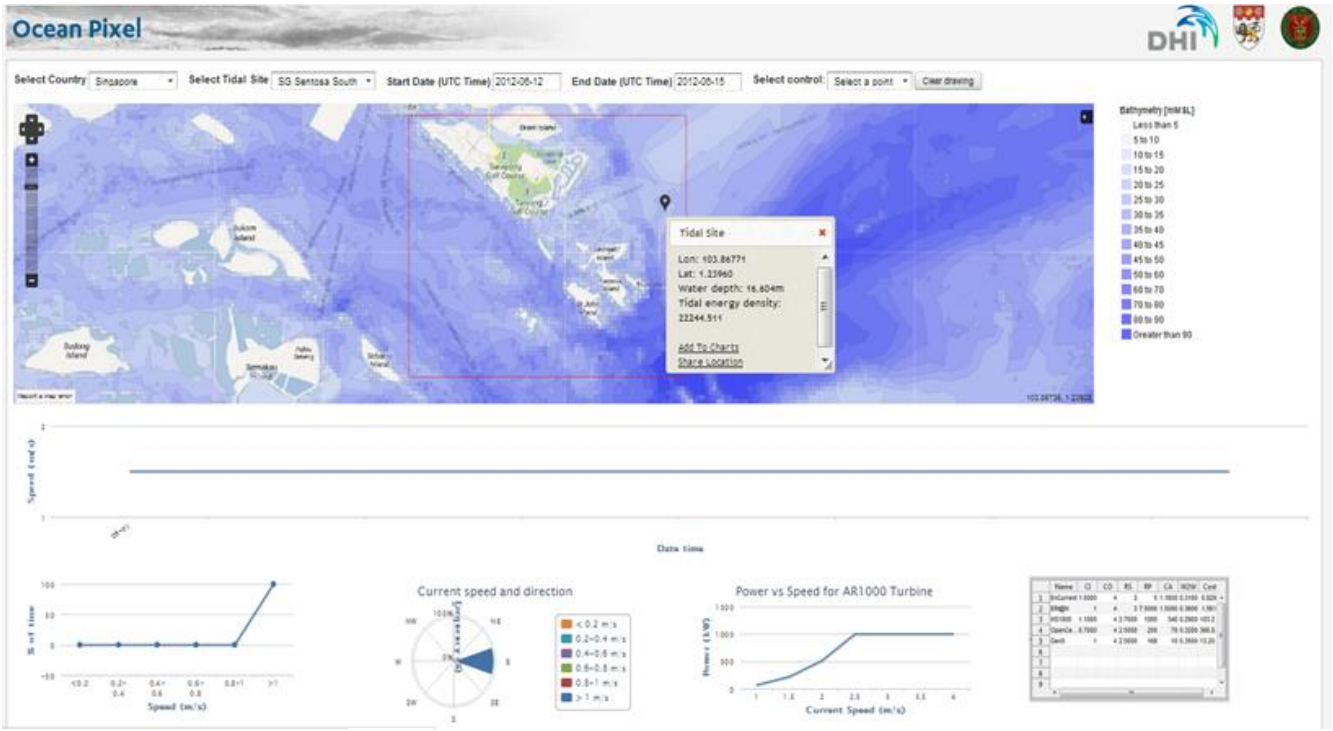

Fig. 2 Screenshot of the OceanPixel prototype.

The following multiple layers are built on GIS platform and continuously updated:

- Energy Density: The energy density of a particular resource is mapped in the study area.
- Environmental Scores
- Technology Library: ORE device data are available for device performance assessment and site-device matching.
- Distance to Shore/Port: Used for calculating cabling, installation and O&M costs.
- Resource Analysis: Resource at any location can be assessed based on a variety of display charts.
- Cost Ranging: Project development cost estimation, final cost of electricity (COE), levelised cost of energy.
- Resource Data: Ocean energy resource data is added to the GIS platform to show potential development sites.
- Navigation & Shipping: Space restrictions due to Marine Spatial Planning (MSP) and shipping/navigation routes, or any additional GIS based information can be added for consideration.

Sample outputs include power output graph for multiple devices (Fig. 3) and site-device suitability scoring (Fig. 4).

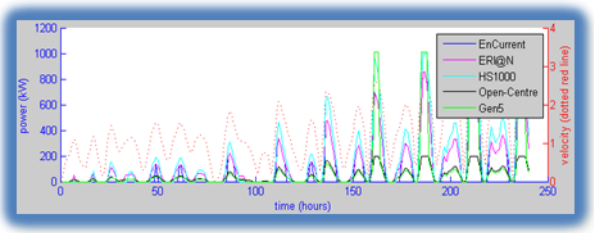

Fig. 3 Power output of multiple devices.

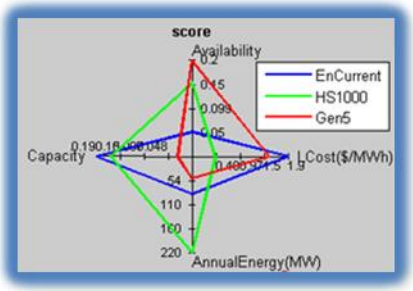

Fig. 4 Site-device suitability scoring based on chosen criteria.

4. Conclusion

With the advent of OceanPixel, ORE project development can be done more efficiently by reducing the required cost and time. OceanPixel addresses the need for fast, easy access to multi-layered GIS-based data and tools for the purposes of ORE planning and feasibility. It offers advantages to ORE project developers and investors, such as quicker result generation, in-depth analysis, convenience, and cost reduction.

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