Auto-positioning solar panel for harvesting power system in WSN marine buoys

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Abstract. *Coastal buoys are very suitable for monitoring and controlling the status of water, easiness of installation and maintenance is of key importance on this regard and with buoys it can be performed in a simple way. Besides, the usage of state of the art technology allows the deployment of wireless networks buoys. Using wireless buoys it is possible to control all the parameters remotely.*

Using a energy harvesting system to recharge the batteries is really important. Solar panels are the most commons in this regard. These panels require a proper orientation to generate enough power for the batteries. The main problem for this approach comes from the constitution of the buoy, which is a completely unstable platform that might be continuously spinning by the effect of ocean currents, tides and wind. Under these conditions, the correct orientation of the photovoltaic solar panel attached to the buoy, is a very difficult task.

This paper describes a prototype system to use the energy provided by the wind to get the correct orientation of the buoy based on the position of the sun, in order to get the optimal solar incidence on the energy harvesting solar panel.

Keywords *- Sensor Buoy, Solar panel azimut, Wireless Sensor Networks.*

1. INTRODUCTION

Wireless Sensor Networks (WSNs) [1] [2] offer an efficient and innovative solution for oceanographic observation, allowing the collection of the information with a greater space-time resolution by means of a higher-density sensor deployment, at a lower cost. The idea is to have different sensor nodes forming a network that implements different physical and logical topologies for wireless information exchange and to have a single node to transmit that information to the base station by means of long-range connection.

Different sensors are used for instrumentation in these marine environments. However, collecting the information from the sensors is a complicated task due to problems related with the retrieval of the data gathered and managed by these sensors cause of the high density of sensor deployed.

WSN, is an emerging technology with a promising future in the field of coastal oceanographic observation given the numerous advantages they offer over other solutions [3]:

1) WSN nodes can be designed to have low power consumption and a relatively low cost.

2) Different topologies can be used (tree, grid, etc.) with a multi-hop node-to-node routing protocol, so the data can be transmitted from a sensor node to a sink node several miles away.

3) Large areas can be monitored by means of sub-networks with a suitable topology, each one linked to a node with a GSM/GPRS connection. In this case, operating costs are considerably reduced due to the low cost of the data transmission lines.

Obtaining energy to keep the devices operating is very important in WSN, but if the WSN is based on buoys located on the sea, this energy is critical. Solar panels are often used to obtain the necessary energy, accumulating it in batteries. These panels require proper orientation to generate enough power. The main problem for this approach comes from the constitution of the buoy. The sensor buoys are anchored, but they are a platform completely unstable that might be spinning cause of the effect of ocean currents, tides and wind. Under these conditions, the correct orientation towards the sun of the photovoltaic solar panel attached on the buoy is a very difficult task.

Although the solution can be obtained by installing more solar panels on the buoy so the sun is always shining on some of them, it is necessary to oversize the panels to ensure a good energy harvesting procedure. The prototype presented in this paper, uses the energy of the wind and aerodynamic effects on an adjustable flat surface, to generate the necessary angular momentum to rotate the buoy on its axis [4].

2. DESCRIPTION

The system is based on closed loop control architecture. The error signal generated when calculating the difference between the solar azimuth angle and the real orientation of the buoy, is used to move the buoy using the wind force that falls on turntable platform.

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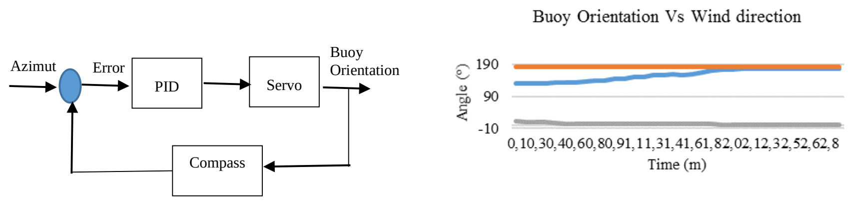

Fig 1. The Control system scheme (left) and a graphical response of buoy orientation (blue) with a azimut change (orange) (right)

The electronic control system consists of a microprocessor board responsible of calculating and controlling the position of the servomotor based on information received from an electronic compass. The microprocessor read the values of an electronic compass, calculates the azimuth and the steering angle that is necessary to adjust on the servomotor to guide plate toward the sun during the day, the scheme shown in Figure 1; the theoretical orientation (azimuth) is calculated in the microprocessor, using the weather information and the latitude at which the buoy is anchored; this theoretical orientation is compared with the actual orientation provided by the electronic compass and acts on the servomotor, by means of a PID controller in order to minimize the error signal.

3 TESTS

Several tests were performed to verify the performance of the prototype. The main problem is the instability in the wind and that small changes of direction involving the buoy turns that cause high energy costs to re-orient. For this reason several tests were performed to ensure that the PID controller was working properly and the buoy spins when the component of the incoming wind is stable enough for a certain amount of time.

4 REFERENCES

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