Small-Scale Renewable Energy Generation on a Smart Fishing Net

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***Abstract* — Smart fishing nets have the potential to significantly reduce turtle, bird, and shark bycatch in commercial fishing operations. Powering these nets is challenging, as they can stretch hundreds of meters long and require thousands of light emitting diodes (LEDs) to operate. Finding a way to renewably power smart fishing nets is an essential stage of development. This paper explores several methods of harnessing solar, tidal, and wave energy via a small buoy attached to the float line of a fishing net. Solar panel, piezoelectric, and small water turbine performance are evaluated as potential energy sources.**

Keywords* — *smart fishing net, renewable energy, turtles, bycatch

I. Introduction

Human activity has exposed large aquatic animals to many dangers, including accidental catchment in commercial fishing nets. Many of these animals, like sea turtles, are either endangered or threatened species. Preventing turtle bycatch is a priority for aquatic conservation efforts [1] [2] [3]. Recent research has shown that outfitting fishing nets with light emitting diodes (LEDs) is one way to significantly reduce turtle bycatch [2]. In research trials, LED illuminated nets saw a 40% reduction in turtle bycatch and 16% rise in fishing catch values [3]. These results suggest illuminated nets could greatly benefit both conservation efforts and fishermen productivity.

While promising, the results described above are still preliminary. Much research still needs to be done surrounding marine animal response to LED lit fishing nets. In aid of this, we are working with marine biologists and small fisheries in Baja California, Mexico to develop a smart buoy for turtle bycatch reduction. Initial prototypes will emit flashing light in a variety of wavelengths and duty cycles to characterize turtle sensitivity. In future iterations, the smart fishing net will be able to take photos and using machine learning classification to gather information about the animals interacting with the net.

A crucial early-stage challenge is designing a renewably charging system for the LED circuit. From interviews with marine biologist Jesse Senko, we know that the fishing nets used by small fisheries can be hundreds of meters long and can be in constant use for up to 48 hours. It would be unsustainable to rely on finite power sources like single-use batteries for such a power-intensive application. It is vital that our smart net is able to generate a self-sustaining level of energy.

We plan to harvest energy and house the LEDs in a casing attached to the float line of the fishing net. There are several environmental constraints on this device. First, the device should not tangle in the net and should not exceed 1.4 kg of weight. The smart buoy should be able to attach to the float line without hindering net deployment or buoyancy. The casing must be able to withstand up to six atmospheres of pressure that it might experience at net operating depths. In addition to this, our design should be simple enough that with minor modifications it could be mass produced.

In a marine environment, the most accessible forms of renewable energy are solar, tidal, and wave energy. Solar energy can be harnessed though panels while the fishing net is drying between fishing runs. This method is promising as solar technology is well developed and reliable. Charging can only happen, however, while the net is above water and not in use [4]. Tidal and wave energy, on the other hand, must be accessed while the buoy is underwater. Wave energy may be harnessed via piezoelectrics, which transduce vibrational and kinetic energy. Tidal energy can be accessed from a small water turbine [5].

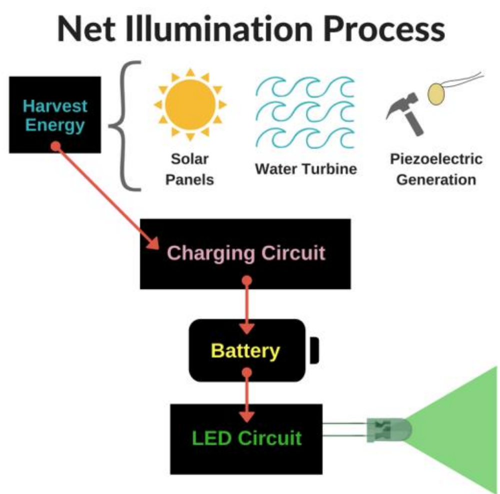

Figure 1: The net illumination process could be powered by solar panels, electromagnetic induction, piezoelectric energy generation, or a combination of these methods.

Over the course of this REU, we will propose and test several smart buoy designs. Several types and configurations of solar panels, piezoelectric generators, and water turbines will be built, tested, and compared. Prototype buoys will be 3D printed and tested in conditions approximating those off the coast of Baja California, Mexico.

References

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