Chapter 18
Cost Effective Smart Farming With FARS-Based Underwater Wireless Sensor Networks

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ABSTRACT

Smart farming is a key to develop sustainable agriculture, involving a wide range of information and communication technologies comprising machinery, equipment, and sensors at different levels. Seawater, which is available in huge volumes across the planet, should find its optimal way through irrigation purposes. On the other hand, underwater wireless sensor networks (UWSNs) finds its way actively in current researches where sensors are deployed for examining discrete activities such as tactical surveillance, ocean monitoring, offshore analysis, and instrument observing. All these activities are based on a radically new type of sensors deployed in ocean for data collection and communication. A lightweight Hydro probe II sensor quantifies the soil moisture and water flow level at an acknowledged wavelength. The freshwater absorption repository system (FARS) is matured based on the mechanics of UWSNs comprised of SBE 39 and pressure sensor for analyzing atmospheric pressure and temperature. This necessitates further exploration of FARS to complement smart farming. Discrete routing protocols have been designed for data collection in both compatible and divergent networks. Clustering is an effective approach to increase energy efficient data transmission, which is crucial for underwater networks. Furthermore, the chapter attempts to facilitate seawater irrigation to the farm lands through reverse osmosis (RO) process. Also, the proposed irrigation pattern exploits residual water from the RO process which is identified to be one among the suitable growing conditions for salicornia seeds and mangrove trees. Ultimately, the cost-effective technology-enabled irrigation methodology suggested offers farm-related services through mobile phones that increase flexibility across the overall smart farming framework.

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INTRODUCTION

Wireless Sensor Networks (WSNs) comprises large number of sensor nodes capable of sensing, processing and transmitting information into a large scale sensing area without a predesigned network (A.Rehash Rushmi Pavitra & E.Srie Vidhya Janani 2017). Sensors communicate with another part of networks via wireless interface. Wireless networks well suits real time applications as acoustic detection, forest fire detection, environmental monitoring, military surveillance, inventory tracking, medical monitoring, process monitoring and smart spaces etc (Ian F.Akyildiz 2005). Energy efficiency seems to be critical in UWSNs. On the other hand, less than ten percent of the entire ocean volume is being investigated while the remaining area is still not explored.

Recently, researches on UWSNs primarily focus on underwater wireless medium modeling and end-to-end communication (Mohammad Sharif-Yazd et. al. 2017). The sensor node collects the information from the underwater surroundings and transfer to the sink nodes positioned on the water surface; finally sink node moves the data to the Base Station (BS) (Almir Davis & Hwa Chang 2012). Although, UWSN simulate some standard properties of the terrestrial wireless sensor network, Radio Frequency (RF) signal is widely used as wireless transmission media. However, RF is not suitable for underwater transmission due to immediate attenuation. Thereby, the acoustic signal is employed in underwater environment with range and speed is (1km, 1500 m/s) (Ian F.Akyildiz 2005). Underwater sensor network encounters specific challenges like: acoustic signal transmission, limited signal speed in comparison to electromagnetic waves. On the other hand, acoustic signal transmission greatly complements for dynamic network topology where nodes move on water irrespective of distance which seems to be impossible with electro- magnetic waves due to its high power absorptions. Also, time synchronization is crucial with relevance to underwater environment because of spread delay and velocity of sound.

Underwater Autonomous Vehicle (AUV) offers an additional perspective through aerial monitoring capability (Russell B.Wynn et. al. 2014). Implementation cost of an AUV is high; this necessitates cost effective long range Sensor Buoy System (SBS) for monitoring atmospheric temperature and pressure in underwater environment. Subsequently, Mangroves are the tropical forest systems which are most probably intensively exploited and degraded by human action. Over the last 25 years, the mangrove lands have been reduced severely, turning this land into pasture land or soil without any use. Mangroves are object of many research projects focused on their conservation. This kind of trees is very useful in natural disasters such as tsunamis and they are often used for raising shrimp and fish culture. But nowadays, the population of mangroves is dramatically decreasing because of the increment of salinity in water. The critical salinity level in mangroves depends on each species but generally salinities higher than 16 parts per million make impossible to develop the new individuals.

Over the last 70 years the world population has tripled and by the year 2020 an exponential increase in population around 9 to 10 billion is expected. Food and Agriculture Organization (FAO) predicts that global food production will rise by 70% to meet estimated demand over 2020. Usually, rapid population growth, resource constraints and climate change encountering feeders need technology facilitated irrigation. In turn, application of modern ICT (Information and Communication Technologies) enabled smart farming offers capital-intensive and hi-tech system of growing hygienic food ensuring a sustainable environment. This in turn necessitates an FARS based UWSN for monitoring the crop field with distinct sensors (humidity, temperature and soil moisture) thereby automating the irrigation process. Hence, farmers can monitor the field conditions from anywhere, anytime through mobile phones which is highly efficient in comparison to the conventional approaches for smart farming. Hence, it is highly