**Multithreading Design for an Embedded Irrigation System Running on Solar Power**

**ABSTRACT**

Technologies of irrigation systems are developed with a focus on intelligent water management, advanced features and remote control of solar photovoltaic watering systems (SPVWSs). The new generation of inexpensive microcontrollers comes with high level of computation capability and provides low-cost solutions. In this direction, this paper presents a new multithreading design and implementation of an embedded irrigation system running on solar power. The design combines the advanced concepts of concurrency programming, namely multithreading and virtual timers, with the embedded computing resources of smart devices. According to the design and test results through an experimental greenhouse, this device provides an accuracy real-time management of all activities of the SPVWS with eventually low power consumption.

**INTRODUCTION**

Recently, solar-powered drip irrigation systems are recommended for the isolated area as they have a low consumption of water and energy exploiting natural resources. As a consequence, this will support long power system autonomy by the fact that the control platform is solar-powered. Several works focused on new approaches for implementing these automated systems as economically cheap solutions in order to lower their costs to a level where growers can actually use them. This challenge relies intensively on the programming resources and the high-level computation capability provided by new generation of small and inexpensive microcontrollers. However, Raspberry Pi in comparison to most of the others Linux-based embedded systems, such as Arduino Yún, Beagle Bone Black and Intel Galileo shows more advantages like better cost/benefit ratio, larger user community, standard programming language and communication, many input/output pins and graphics interface. Actually, Raspberry Pi becomes the mainstream system of many works. Several home automation projects including home alarm system, temperature sensor, webcam surveillance, siren, digital environmental monitor applications. The aim of this work is to design a data acquisition and online monitoring system hosted in an embedded device in the context of SPVWS. A new concept of multithreading design using open source and low-cost features are used to embed a smart system within the Raspberry Pi. The use of advanced programming features, namely multithreading, enables the integration of concurrent services within the controller. As a result, the management and monitoring of sensors and watering schedule can be performed by means of parallel and independent threads. Additionally, the control system has been enhanced by introducing a new part that acts as a supervisor to govern all the activities on the system. The fundamental hypothesis is that the built-in system will improve data presentation style, robustness, simplicity in maintenance, portability, performance, and scalability.

**EXISTING SYSTEM**

Many such technological solutions have been addressed in the literature that achieve agriculture task automation and help in remote monitoring the farm land. Some of them are discussed as follows. A smart irrigation controller is developed using PIC16F876A microcontroller, which transmits the data using XBee link to a remote server. However, the developed system can monitor moisture only at a single point. Hence, to monitor a given farm area, large number of sensor have to be deployed which increases the cost of the system. XBee can communicate in a limited range of 50 m. The developed remote interface does not perform any signal processing operations to obtain useful statistics relevant for farm monitoring. A two cell overhead crane system [5] is proposed for agricultural task automation. Specifically, tasks such as spraying fertilizer, irrigation, planting seeds have been proposed for automation by a solar driven crane system. However development of such systems require a large budget and in addition if such systems need to monitor the farm land ,multiple sets of sensors need to be placed at various geographical points.

**DISADVANTAGES**

* XBEE only used in Short Range
* It required more cost.
* It cannot predict the condition of Agriculture.
* It automatically Spray pesticide.

**PROPOSED SYSTEM**

In this study, the smart irrigation system is introduced to manage irrigation process in the context of a greenhouse solar powered. The agricultural field used as support for this study is an experimental greenhouse located at the laboratory of Electronic, Automatic and Technology of the Faculty of Sciences. It has been used as the mainstream of several works that are concerned with the integration of intelligent artificial algorithm in the fields of the control of climatic parameters and irrigation management. This experimental greenhouse is equipped with an SPVWPS which is battery coupled architecture and composed of power supply system (24 V), a water tank, and a solar pump (24 V). The power supply system promises a continuous supply whenever weather conditions are unfavorable. Several sensors are used to log the external data to the acquiring card. The sensors of climatic parameters are the temperature and relative humidity sensor (DHT22) and the soil moisture sensor (VH400), while the sensors of operational resources are the water level sensor (HC-SR04) and for batteries voltage. The Raspberry Pi microcomputer is selected to host the intelligent system in order to retrieve the data from the different sources via serial communication and to activate the water pump whenever requested to meet crops needs or execute users’ orders. This card is powerful enough to perform high computing operation with eventually low cost in term of power consumption by requiring only a 5 V supply to operate.

PROPOSED SYSTEM ADVANTAGE

* Multithreading design with the purpose of managing and monitoring the SPVWPS which is a battery coupled architecture.
* Owing to the multithreading programming feature provided by Java platform and HTTP server were integrated into two parallel task working together to provide remote control and online data monitoring of the irrigation system in real-time.

BLOCK DIAGRAM



HARDWARE REQUIREMENT

* Raspberry pi
* Temperature sensor
* Soil sensor
* Water level
* PV array
* Charge controller
* Battery
* Pump

SOFTWARE REQUIREMENT

* Raspbian