© 2015 IJSRSET | Volume 1 | Issue 2 | Print ISSN : 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

Development and Implementation of a Solar-Powered Automated Irrigation Control System for Maize Crop Grown in Loamy Soil.

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ABSTRACT

This work presents a microcontroller based system which makes use of soil moisture sensors and plant growth models to develop irrigation schedules for maize crop grown in loamy soil. The methodology adopted for this work involves field survey, electronic circuit design, implementation and testing. The field studies provided details on the crops root depth pattern and water requirement throughout its growth period. With a dual power source of solar and a.c power supply, moisture sensor, microcontroller, LDR, LCD and sprinkler units; the microcontroller would permit the sprinkler to start and stop at given times during each growth period when the soil moisture falls below a predetermined level as sensed by the soil moisture sensors. Also included in this design is a DTMF decoder unit that permits interaction with the farmer on the current state and step to be initiated by the device via a remote phone. Test results indicate effective irrigation throughout the maize crop‟s life cycle, bringing about improved crop yield/quality, water and energy conservation.

Keywords: Irrigation, Loamy soil, Microcontroller, Maize crop, Soil sensor.

I. INTRODUCTION

Modern agriculture require specialized knowledge, hence depends on engineering and technology, and on the physical sciences for maximum results. One of such specialized aspect is irrigation. Irrigation is the artificial application of water to the land to assist in the growing of agricultural crops [1]. Irrigation has an extreme advantage which is that it produces twice the yield of non irrigated fields although presents about 18 per cent of all land under cultivation [2]. However, it can waterlog soil or increase soil salinity to the plant such that the crops are damaged or destroyed if not managed properly [3] and [4]. A good irrigation system apart from supplying water to crops should also be water economical [5]. Water in most part of the world is scarce especially during the dry season [6], hence the need to maximise whether it is natural or artificial [1] and [7]. Since water requirements differ from crop to crop with this requirement varying with age (root depth) [8], it was the reason this device was made to be crop

specific by selecting a popular crop with a short life cycle of about 120 to 150 days; the maize crop. Maize (zea-mays) is one of the most important cereals both for human and animal consumption and is grown for grain and forage. It contains about 10 percent protein, 4 percent oil, 70 percent carbohydrate, 2.3 percent crude fibre, 10.4 percent albuminoides, 1.4 percent ash [9]. Also, the water retaining capability of the soil in which a crop is grown differs from soil to soil [10]. For this reason the device was again made to be soil specific by selecting a popular soil type; the loamy soil. The crop specific and soil specific nature of such a device however provide a model for other crop and soil types [11]. In this work, electronics was applied in irrigation control to develop a more effective irrigation system that is automated, microcontroller manage, soil moisture sensor based and interactive with the farmer. It maintains the desired soil water range in the root zone for optimal plant growth, ensures water usage efficiency, minimum loss of water through evaporation or percolation into the ground, improved crop yield