Chapter 8

Smart Irrigation System for Crop Farmers in Namibia

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ABSTRACT

Farmers in Namibia currently operate their irrigation systems manually, and this seems to increase labor and regular attention, especially for large farms. With technological advancements, the use of automated irrigation could allow farmers to manage irrigation based on a certain crops’ water requirements. This chapter looks at the design and development of a smart irrigation system using IoT. The conceptual design of the system contains monitoring stations placed across the field, equipped with soil moisture sensors and water pumps to maintain the adequate moisture level in the soil for the particular crop being farmed. The design is implemented using an Arduino microcontroller connected to a soil moisture sensor, a relay to control the water pump, as well as a GSM module to send data to a remote server. The remote server is used to represent data on the level of moisture in the soil to the farmers, based on the readings from the monitoring station.

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INTRODUCTION

Agriculture plays an important role in the Namibian economy. A great number of the Namibian population depend on agricultural production for food and jobs. To ensure self-sufficiency and food security, the country needs to invest in the agricultural sector (Shikangalah & Mapani, 2020). The country is a sparsely covered environment with distinct seasons and limited areas that are good for pastoral and agricultural activities. Some areas are mountainous and arid, getting less than 50 millimetres of rainfall annually. Humidity is normally low, however rainfall is high in some areas in the northern and northeastern parts of Namibia (Liehr et al., 2016). Namibia being an arid country makes it very prone to the effects of climate change. These changes affect farming activities in the country, causing losses in the agriculture sector (Somses et al., 2020).

Most of the small scale farmers in the northern part of Namibia are communal farmers that grow crops such as pearl Millet, sorghum, and peanuts. These subsistence farmers survive on low rainfall and only produce what is enough for the household consumption and sell the surplus to make additional income (BDO, n.d.). Their crops are rain dependent, hence, become more vulnerable when drought occurs. However, some practice drip irrigation where water is directly poured at the crops and/or micro-irrigation where farmers ensure a low-volume sprinkler to the crops.

Commercial farmers in Namibia have a large area measured in hectares and at least own an irrigation system. The irrigation system allows them to control when and how to water crops in the field. However, this is done manually daily and based on human observations which is often not accurate (BDO, n.d.). Namibia has been listed by the World Resources Institute (WRI) as one of the top four countries that expect to have a significant increase in water stress by 2040 (Munyayi, 2015). Manual controlled irrigation systems or schemes currently in use in commercial farms are labor intensive, ineffective and waste a lot of already expensive and scarce water. Using these irrigation systems can result in either over-watering or under-watering. Namibia is arid to the semi-arid country with erratic rainfall and water scarcity has become a norm due to extreme weather. All four perennial rivers are found far at the northern and southern borders of the country (Liehr et al., 2018). It is a cumbersome process to derive water from such rivers and local dams due to varsity geographical location of crop farms. Urbanization led to a higher demand for water and not all farmers are well trained on water resources management. Indeed there are few innovative approaches towards water security in the country. For these reasons, there is an urgent need to find solutions to water crises to save businesses, farms and communities depended on the agricultural sector.

Modern technological advancements such as Internet of Things (IoT) can make it possible to smartly monitor and autonomously control the irrigation systems when farming. IoT refers to the interconnection of physical devices such as sensors and actuators using the internet (Wu et al., 2019). This interconnection enables IoT devices to be able to share information with each other or with users while enabling these users to monitor environments remotely. Adding Artificial Intelligence (AI) can enhance the use of IoT technologies. AI is the simulation of the human brain into machines, by making these machine act or perform tasks that human can perform (Lu et al., 2018). Today AI interacts with us in one way or another on a daily basis, starting with search engines such as Google to virtual assistants such as Siri and Alexa. AI has also been applied in many sectors of agriculture such as in disease control in animals and plants, pest control and soil treatment (Das et al., 2018). Special applications of AI have also been applied where a phenomena is understood by an AI system on a farm and having a decision taken based on the data about what is already known about this phenomena. This enables more optimal methods of