1. **Introduction**

Agriculturehas for several years formed the backbone ofUganda'seconomycontributing greatly to the Gross Domestic Product (GDP). Irrigation of crops is one of the methods that’s deployed to improve/increase crop production in Uganda in an effort to maintain this contribution.

1. **Background**

Uganda is one of the fastest growing economies in Africa and it has agriculture to thank that for. Uganda’s favorable soil conditions and climate have contributed to the country’s agricultural success. Unfortunately, over the last few decades the climate change has made rainfall patterns become more unpredictable leading to cases of stagnant or decline in crop yields as most small scale farmers depend on rainfall for crop production.

Owing to Uganda’s past reliance on agriculture, the government of Uganda has continuously made initiative to improve agriculture by encouraging different practices with irrigation inclusive as a means to at least maintain the local market supply. However, irrigation is mostly used by commercial and extensive agricultural settings that execute its different forms such as drip, surface, sprinkler, center point, sub irrigation among others. This provides an opportunity to further improve the current system before the culture is adopted by small-scale farmers national wide.

1. **Problem**

Despite the efforts from farmers and the government at large to irrigate, crops have failed to produce anticipated yields. The frequent crop failure has resulted in widespread food shortage, famine and in worst cases death.

The existing functioning irrigation systems are either manually controlled or set to irrigate at specific intervals as seen fit by a farmer. This however, has left a gap of water wastage as the amount of water required in the fields depends on the observation of the human eye rather than the conditions of the field itself. The latter further poses a risk of water logging that spoils crop roots or leads to drainage of minerals which are key for healthy crop growth.

1. **Proposed Solution**

Auto-Farm Irrigation System focuses on improving water usage through monitored sensor readings used to specific quantity of water needed and supporting produce related decision making using an online data reporting system for the sensor-captured field data.

The project is focused towards a smart irrigation system for a sustainable practice of agriculture. It relies on three modules as described below;

* **Field module**

This entails a co-ordination of different sensors both for the field conditions such as moisture content, humidity levels, temperature variations and water levels monitoring in the reservoir whose data is interpreted and used by the controller unit to issue out instructions to the irrigation actuator system that is the designated water pump, and its accessories like valves, delivery pipes, sprinklers, valves that effect irrigation based on results from comparison of field data with preset thresholds.

* **Data representation and visualization module**

This module is categorized into;

Hardware output components such as LCD screen, LED indicator lights and speakers that potray the real time status of the system in terms of current sensor readings, water level in reservior tank and alerts in case of malfunctions.

A web application that collects data of the different sensors from the database, processes it into tabular and graphical representations for better understanding for the user. It also takes in user inputs such as field yeilds that are compared against the system data to produce reports that are used to guide decision making in relation to fields improvements and production investment.

* **Power module**

The project fronts solar energy as the main power source due its affordablility in the long run, availability and the ever growing need for environmental conservation with use of clean energy. However, depending on the farmer’s location in terms of the weather, fuel access and power grid connectivity, the system is open to integration of other power sources such as generator power and the power grid provided by the government.

1. **Main Objective**

To come up with an irrigation system that automatically regulates water used for irrigation in regards to the moisture conditions for a particular plant.

1. **Specific Objectives**
   1. To acquire adequate sample data to be used as basis for defining the system threshold values.
   2. To capture raw field data that is sufficient enough to provide consistent irrigation.
   3. To ensure the irrigation actuators act consistently in relation to the captured sensor readings
   4. To provide a flexible web application that accommodates concatenation of raw field data and user inputs for high-level decision support visualizations.
   5. To design a prototype that will be used in different farms in different seasons
   6. To improve the system basing on the data collected from the use of the installed prototype.
   7. To carryout user testing of the final system that will be made available for purchase to the interested farmers.
2. **Methodology**

The field system module uses an Arduino based micro-controller board to coordinate instructions to the irrigation actuators and transfer data to the web application in relation to the field sensor readings.

The web application runs using the Laravel framework with the PHP programming language.

The entire implementation follows an iterative agile model that ensures consistent member participation and collaboration.

However, the project is open to translation onto a fully python-based platform with possibility of upgrading from Arduino to Raspberry Pie based micro-controller and using the Django Framework to run the web application.

1. **Results**

The expected outcomes include;

* A user friendly irrigation system in terms of navigating the different system functions.
* A reduction in the manpower required during irrigation hence saving costs.
* Maximum utilization of the water during irrigation where crops are given the right amount of water and water is supplied at the right areas of the crop.
* Provision of real time updates to the farmer about the water content in the garden so that they can plan for irrigation accordingly.