MODERN IRRIGATION SYSTEM

1. INTRODUCTION

The relationship between digital technologies and sustainable economic development is multifaceted. On the positive side, digital technologies can enhance efficiency, reduce resource consumption, and promote innovation, contributing to sustainability. However, challenges include e-waste, energy consumption, and potential job displacement. Striking a balance requires careful consideration of environmental impacts, equitable access, and policies fostering responsible tech development.

In today's world, the agricultural landscape is facing increasing challenges. Therefore, it is crucial to find ways to enhance and optimize traditional farming practices. This proposal explores modern irrigation systems, which play an essential role in revolutionizing contemporary agriculture. These systems are a combination of technology, sustainability, and resource efficiency, which can help to tackle critical issues such as water scarcity, environmental impact, and food security. In this proposal, we aim to delve into the components, benefits, and innovations that make up modern irrigation. We hope to not only improve our understanding of these systems but also advocate for their widespread adoption to create a more sustainable and resilient future for agriculture.

1.1. Background Analysis

Farming practices in sub-Saharan Africa (SSA) mainly focus on staple crop production for food consumption of the rural poor. They are highly rain-dependent on seasonal variations.

And heavily characterized by their low yields. This kind of framing method prioritizes small-scale irrigation to increase agricultural production and ensure food security. This method means Cancan is vulnerable to the lack of rainfall which causes there to be a drought in that region.

Ethiopia is the second most populated nation in SSA. However, it is not able to feed the

The majority of its population is for different reasons. Some of the reasons include land

Degradation, fertility depletion, and climate change effect. Its smallholder rain-based farming

Systems would not be able to meet the requirements of the people living in the country. Therefore,

Proper irrigation is what Ethiopia needs for it to overcome the overwhelming hunger and

Poverty is present in the country..

1.2. Problem Definition

As discussed in the background analysis part of the introduction, the problem is that the

irrigation system being used in Ethiopia right now is not sufficient feed most people in this

country. That has resulted hunger to be one of the main issues in the country.

1.3. Objective

1.3.1. General Objective

The general objective of this proposal is to design and implement a smart irrigation system that utilizes moisture sensors to efficiently water crops, thereby optimizing water usage and enhancing agricultural productivity.

1.3.2. Specific Objective

The specific objective of this proposal is to:

• Research and select appropriate moisture sensors: Conduct a comprehensive study of

available moisture sensing technologies and identify the most suitable sensors for

accurate and reliable soil moisture measurement.

• Establish irrigation thresholds and algorithms: Determine optimal soil moisture levels for

different crop types and growth stages, and develop intelligent algorithms that can

dynamically adjust irrigation schedules based on the collected data, weather conditions,

and crop water requirements.

• Integrate automation and control mechanisms: Integrate the smart irrigation system with

actuators, such as solenoid valves or drip irrigation systems, to enable automated and

precise water delivery to specific areas of the field based on the moisture sensor readings

and calculated irrigation needs.

• Evaluate system performance and efficiency: Conduct extensive field testing to assess

the performance, efficiency, and effectiveness of the smart irrigation system in terms of

water savings, crop yield, and resource utilization, comparing it to traditional irrigation

methods.

• Provide user-friendly interface and scalability: Develop an intuitive user interface for

farmers or agricultural professionals to monitor and control the smart irrigation system

easily. Additionally, ensure that the system is scalable and adaptable to different field

sizes and crop configurations.

By achieving these objectives, we aim to create an advanced smart irrigation system that

optimizes water usage, reduces manual labor, and enhances crop productivity while contributing

to sustainable agricultural practices.

2. LITERATURE REVIEW

Certainly! Here are some additional points to consider regarding the relationship between digital technologies and sustainable economic development:

1. Innovation and Entrepreneurship: Digital technologies have the potential to foster innovation and entrepreneurship, which are essential drivers of sustainable economic development. They provide a platform for startups and small businesses to access global markets, connect with customers, and scale their operations. Digital platforms and tools also enable the development of new products and services that address sustainability challenges, such as renewable energy technologies, smart agriculture, and waste management solutions.

2. Job Creation and Skills Development: The adoption of digital technologies can lead to job creation and skills development, particularly in industries related to digitalization and sustainability. As digitalization transforms traditional industries, new job roles and skill requirements emerge. For example, there is a growing demand for data analysts, AI specialists, and cybersecurity experts. By investing in digital skills training and education, countries can prepare their workforce for the jobs of the future and ensure inclusive economic development.

3. Circular Economy: Digital technologies can support the transition to a circular economy, which aims to minimize waste, maximize resource efficiency, and promote sustainable consumption and production patterns. Through data analytics and IoT (Internet of Things) devices, companies can optimize their use of resources, track and trace products throughout their lifecycle, and facilitate recycling and remanufacturing processes. Digital platforms can also enable the exchange and reuse of goods, reducing the need for new production.

4. Access to Basic Services: Digital technologies can enhance access to basic services, such as healthcare, education, and financial services, particularly in remote or underserved areas. Telemedicine platforms can connect patients with healthcare providers, remote learning platforms can offer educational opportunities to those with limited access to schools, and mobile banking services can provide financial inclusion to unbanked populations. By improving access to these services, digital technologies contribute to social and economic development while reducing inequalities.

5. Climate Change Mitigation and Adaptation: Digital technologies play a crucial role in climate change mitigation and adaptation efforts. They enable the monitoring and analysis of environmental data, facilitating evidence-based decision-making and policy formulation. Remote sensing technologies, for example, can monitor deforestation, track biodiversity, and assess the impact of climate change. Furthermore, digital platforms can support climate change awareness, education, and citizen engagement, empowering individuals and communities to contribute to sustainability goals.

It is important to recognize that the potential benefits of digital technologies for sustainable economic development are not automatic or guaranteed. They depend on the choices made in their design, deployment, and governance. By adopting a holistic approach that considers environmental, social, and economic dimensions, it is possible to harness the transformative power of digital technologies to build a more sustainable and inclusive future.Smart irrigation technology uses weather data or soil moisture data to determine the

irrigation need of the landscape. Smart irrigation includes technology such as the following. One of those technologies are new controllers which are broad spectrum of smart irrigation

technology that consumers can benefit from utilizing. They are essential to achieve potential

water savings. Two types of controller system can be used, which are Climate-based controllers and soil moisture sensor controllers. The other technologies used are Add-on sensors which can be used to increase efficiency of automatic irrigation systems a soil moisture, rain, wind or freeze sensor can be added to upgrade the existing system. One of the Add-on sensors that can be used

Soil Moisture Sensors which connected to an existing irrigation system controller. The sensor

measures the soil moisture content in the root zone before a scheduled irrigation event and

bypasses the cycle if the soil moisture is above a specific threshold.

The other Add-on sensors are rain and freeze sensors. These sensors are not considered

smart technology, rain and freeze sensors interrupt the irrigation cycle during a rain or freeze

event when irrigation is unnecessary. There are also wind sensors which are used to interrupt the irrigation cycle if wind speed exceeds a specific threshold

3. SIGNIFICANCE OF THE PROJECT

Modern Irrigation System (MIS) contributes to several United Nations Sustainable

Development Goals (SDGs). Here are some SDGs that are closely aligned with the objectives

and outcomes of modern irrigation:

SDG 2: Zero Hunger: The project is directly related to SDG 2, which aims to end hunger,

achieve food security and improved nutrition, and promote sustainable agriculture. By

implementing a modern irrigation system, farmers can increase crop yields and improve the

quality of their produce, ultimately contributing to food security and improved nutrition.

SDG 6: Clean Water and Sanitation: The project is also directly related to SDG 6, which aims

to ensure the availability and sustainable management of water and sanitation for all. By

implementing a modern irrigation system, farmers can efficiently manage their water usage,

reducing water waste and ensuring the sustainable use of water resources.

SDG 12: Responsible Consumption and Production: which aims to ensure sustainable

consumption and production patterns. By implementing a modern irrigation system, farmers can reduce their water usage and minimize the environmental impact of agricultural practices. This

promotes sustainable production patterns that are more resource-efficient and less wasteful.

Smart Irrigation Technology

New Controllers

Add-on Sensors

Soil moisture

sensors controllers

Climate based

controllers

Wind sensors

Soil moisture

sensors

Rain/freeze

sensors

SDG 15: Life on Land: By minimizing the impact of irrigation on ecosystems, modern

irrigation systems can help protect and restore biodiversity on land, which aims to protect,

restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests,

combat desertification, and halt and reverse land degradation and biodiversity loss. The project

promotes sustainable agriculture by reducing water usage.

Overall, modern irrigation is a significant project that can bring about a range of benefits

for farmers, landscape managers, and the environment. By promoting water efficiency, reducing

costs, and minimizing the impact of irrigation on ecosystems, modern irrigation can contribute to

a more sustainable future.

4. MATERIALS AND METHODOLOGY

4.1. Materials

 Moisture sensors

 Single relay

 Red board

 Arduino

 Resistor

 Pump

 LCD

 FCV

 Pipe

 Jumper

4.2. Methodology

This project uses the following steps to achieve its aim:

1. Design and Planning:

 Determine objectives and requirements of Modern Irrigation System

 Define scale and scope of the system, considering time and money provided for the

project

 Select equipment based on requirements

2. Design

 Design the circuit and control system

 Design the water reservoir and other mechanical parts of the system

6

3. Sensor Deployment:

 Install soil moisture sensors on appropriate places

 Make certain of the calibration of the sensors

4. Data Analysis and Processing

 Develop the Arduino code for the control system that uses the sensor data input

 Analysis to determine the project needs like the size of the water reservoir, torque of

the pump and so on.

5. Communication

 Set up a system that connects the E sensors, control systems, and user interface

6. Evaluation and Optimization

 Evaluate the performance regularly to see of any improvement necessary

This structured methodology ensures a comprehensive and organized approach to the

development, deployment, and optimization of the Modern Irrigation System, aligning with

the project's overarching goals.

5. PROJECT PLANNING

5.1. Gantt Chart

6. SCOPE AND LIMITATION

6.1. Scope of the Project

i Needs Assessment: Identify the existing challenges and limitations of the current

irrigation system.

ii System Design: Determining optimal water delivery mechanisms, and designing the

layout of irrigation infrastructure (pipes, valves, sensors, etc.)

iii Automation and Control: Incorporate automation and control technologies to optimize

irrigation operations. This may involve soil moisture sensors to monitor environmental

conditions and adjust watering schedules accordingly. Implement automated control

systems or smart algorithms to regulate water flow and ensure efficient water usage.

6.2. Limitation of the Project

This project has been designed to overcome one of the problems farmers are facing recently but it also has a few limitations. These includes:

 Sensor limitation: Our project requires two sensors, moisture sensor and pH detecting

sensor. This sensors are quite expensive and one of it is hard to reach.

 Economically intensive: Even though, the project we chose has been considered to be

within our budget, some of the materials are more costly than we anticipated.

 Technicalities: This project requires expertise in different areas including sensor

installation, data analysis, and system integration.

 Data accuracy: Even though it’s done with cautious details and consideration, the data

acquired from the sensor may not be reliable.

8. EXPECTED OUTPUT

Expected output of this project are:-

 Improved Water Efficiency: enhance water efficiency by delivering the right amount

of water to crops based on their specific needs.

 Increased Crop Yield and Quality: optimize irrigation practices, ensuring that crops

receive adequate water and nutrients at the right time.

 Real-time Monitoring and Decision Support: incorporates monitoring systems that

provide real-time data on soil moisture levels. Expected output is accurate and up-todate

information for farmers to make informed decisions about irrigation scheduling.

 Precision Irrigation and Targeted Delivery: ensuring that crops receive the required

water in the most efficient manner.

9. WORK BUDGET

Materials Price Amount of material

needed

Estimated total

Moisture Sensors

Single relay

Red board

Arduino

Resistor

Pump

LCD

FCV

Pipe

Jumper

Total 1,560,000 birr

10. REFERENCE

1. J.A. Burney, R.L. Naylor (Jan, 2012). Smallholder Irrigation as a Poverty Alleviation

Tool in Sub-Saharan Africa [Online]. Available:

https://www.sciencedirect.com/science/article/abs/pii/S0305750X11001343?via%3Dihub

2. Gebremeskel Teklay Berhe, Jantiene E.M. Baartman, Gert Jan Veldwisch, Berhane

Grum, Coen J. Ritsema (Dec, 2022). Irrigation development and management practices

in Ethiopia: A systematic review on existing problems, sustainability issues and future

directions [Online]. Available:

https://www.sciencedirect.com/science/article/pii/S0378377422005066#bib28

3. Malarie Gotcher, Saleh Taghvaeian, Justin Quetone Moss (Feb, 2017). Smart Irrigation

Technology: Controllers and Sensors [Online]. Available:

4. Https://extension.okstate.edu/fact-sheets/smart-irrigation-technology-controllers-andsensors.

html#:~:text=Smart%20irrigation%20technology%20uses%20weather,maintaini

ng%20plant%20hea lth%20and%20quality.