JCBI
Journal of Computing & Biomedical Informatics
ISSN: 2710 - 1606
Volume 07 Issue 01
2024

Research Article
https://doi.org/10.56979/701/2024

AI and Sensing -Enhanced Irrigation through Cable Rail for Drought and fros Prone Regions in the Face of Climate Change

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Received: January 24, 2024 **Accepted:** May 21, 2024 **Published:** June 01, 2024

Abstract: Potato and lychee are major crops in Pakistan. Lychee, are called queen of fruit in emerging of fruit crop, only Lychee fruit cover 1.23kha area of Pakistan. Due to hot and dry weather, the skin of Lychee cracks. Potato another crop of Pakistan those cultivate in huge area almost 160kha.potatoa crop also effective with harsh weather like as frost burning. In generally, farmer prevents this problem by burning fire and splitting water for potato crops and for lychee sprayer water in the summer season but in this scenario, timely activation of phenomena is very important otherwise ruin the crop. In the agricultural practices. Here we explore the role of IoT, sensing technology and A.I strategies in the agriculture industry that can help to improve farming practices. Agriculture faces many provocations like food security, production, and water conservation due to sudden climatic changes, high temperatures, and uneven distribution of resources. To manage all the event. We address the Smart Rail Irrigation System (SRIS) that deal with the pressing issue and give transformative result in the yield of crops. The objective behind using this technology is to monitor, manage resources, and resolve harsh weather relative problems. Smart solution for irrigation, disease prevention sprays and proper distribution of fertilizers will also help in the conservation of water. This automated system in agriculture is beneficial for field coverage, efficiency, and highest yield production, improving food quality, and conserving water. SRIS system is especially designed for two types of crops Lychee and potato.

Keywords: Smart Irrigation; Automation; Cable Rail; Remote Sensing.

1. Introduction

The Agriculture helps to grow by supplying raw materials and food to industry and also providing significant to Pakistan's export earnings and food security, that research article discuss about two major crops potato and lychee. Reason of that, potato crop covered 160kha area in pakistan same like as lychee crop, luchee fruit almost covered 1.23kha area of Pakistan. In the current senerio climate change is consequential problem for farming such as frost in winter season and hot summer wind[13].

The lychee crop growing season in Asia, specifically Pakistan, typically starts in May and lasts until July. During this time, the temperature ranges from 28 to 45 degrees Celsius. It is vital to sustain proper irrigation and fertilization practices to ensure a healthy and plentiful harvest. In this condition lychee fruit shell must be crack. Same like as potato crop but opposite condition such as frost on leafs of potato(leaf buring) in this condition temperature felt down almost 18 to -2 Celsius. Normally in traditional farming farmers irrigation of water at ground level and some time buring fire arround the crop. In some case use sprinkles. Same procedure with lychee crop spryer at lychee orchard in dry and hot wind condition. This is not sufficent for exess yeild[13][12].

The rapid advancements in technology, particularly in the field of the A.I such as Robotic, Automation and Internet of Things (IoT), have led to transformative changes in various sectors, with

agriculture being a key beneficiary[4]. The case in point being potatoes, the fourth most crucial crop worldwide, Lychee is a delicious and exotic fruit for its sweet and fragrant taste. It is a small, round fruit with a rough, spiky skin color reddish-brown[12].

In this research article, to investigate the potential of a Smart Rail Irrigation System (SRIS) in addressing the challenges posed by inefficient irrigation,fartilizer and pesticide practices and frost in potato farming same like as lychee. This sensor-based A.I solution promises to improve water usage efficiency, increase land coverage, and optimize fertilizing, thereby potentially enhancing crop health, quality and productivity. Smart Rail Irrigation System based on automatic cable car with spyer and controlled by sensing system.

2. Related Work

In this Article about the innovative use of IoT technology in agriculture to produce healthy food crops to fulfill the needs of an increasing population in this era. The Methodology designed is for equal distribution of water through moving showers. Different modes defined in this technique for controlling and monitoring actions to irrigate the land by using applications that can monitor the movement of water showers, some programming patterns made by extracting real-time data to calculate soil moisture and then remotely operating the system in the absence of farmers to provide water at the specific area. The effect of this method in the agricultural field is that it reduces human efforts and time. This IoT-based uniform water showering mechanism brings into existence the system that provides water to that part of crops where it is needed. This technique helps maintain the amount of water and pesticides in different stages of the crop's growth. But it is for small sets like nurseries, greenhouses, etc. It is helpful for plant growth, uniform distribution of fertilizers, and saving water from loss [1][2][3].

The agriculture is a need of the modern world from the perspective of foodstuffs and job shortage, and on the other hand, the field faces challenges of irrigation systems. And for this purpose, fully automated systems are introduced to meet multiple needs. The Farmers manually control the system to grow crops these days as they do not maintain the water consistency, which is harmful to crop production[14]. This work aims to reduce time and human effort with a programmed monitor system by Arduino UNO[5][9]. The goal of this work is to detect the dryness of the soil and provide water through sensors where it is needed. In different regions, the temperature is different from other places and their diverse scenario. So, without using complex and costly irrigation machinery, we used the ON and OFF techniques through which the control motor distributes the appropriate amount of water to the field. This automated technique is helpful in many ways for humans as it handles irrigation without any human effort[3][4].

This work aims to develop a Smart and automated watering system for the plant's growth and to manage water for waste using IoT. The proposed technique in this study is for controlling the soil moisture by devices like sensors, Arduino UNO, and GSM Module [14][15]. The whole system runs through the application anywhere by the farmers. In this system, information is collected through sensors and sent to Arduino UNO (ATmega238) connected with a module that monitors the moisture and controls the water supply. The Smart automated system helps in proper irrigation and reduces water loss. The system is online so that farmers can monitor it anywhere, and it also decreases farmers' extra effort in the field. This technique is cheap and proven to be suitable for proper irrigation [10][7].

The research emphasizes the native effects on lychee fruit due to several environmental factors that reduce lychee production. Environmental stress can cause damage that can affect lychee plants or fruit. Problems like leaves and flowering dropping and fruit cracking can be caused due to triggered factors[13][12][16]. Low and High temperatures are not beneficial for lychee. Stress factors like improper watering in fruit crops can also cause fruit dropping. Lychee grows in sub-tropical regions with temperatures ranging from 10 C to 20 C. Lychee cultivation and production are damaged and fostered by climatic changes. High temperatures cause dryness which can cause fruit cracking low moisture can cause fruit dropping. Under moderate temperatures, lychee production growth rapidly increases temperature ranges from 21 C to 38 C [18]. Lychee fruit is sensitive to low temperatures because it can affect its floral induction process. Environmental factors and water deficiency can hurt the lychee photosynthesis process and cause low production. The best temperature in which lychee grows is after winter and before summer [19].

3. Materials and Methods

We draw technical design requirements, such as the hardware, architecture, and circuits, outlined in a design specification document. Fusion 360 is a software used to create 3D model prototypes in fields like product design, engineering, architecture, and manufacturing. Our model unique construct with sensor-based technology (SRIS). Here is the design of the model of SRIS. Here is the design of the model of SRIS-based Devices that can include sensors and micro-controller (e.g., temperature sensors, motion detectors sensor, motor driver and actuators) show in figure.

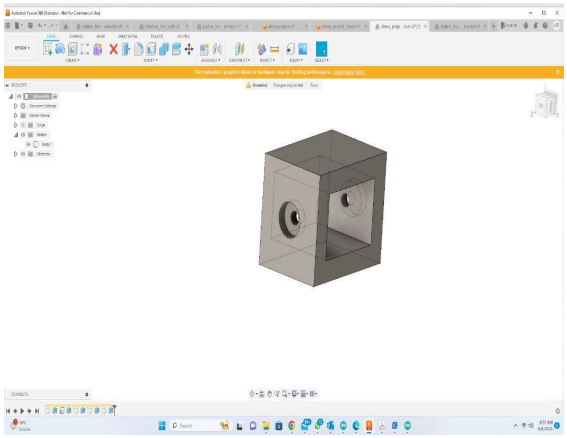

Figure 1. 3D Pulley Coupler

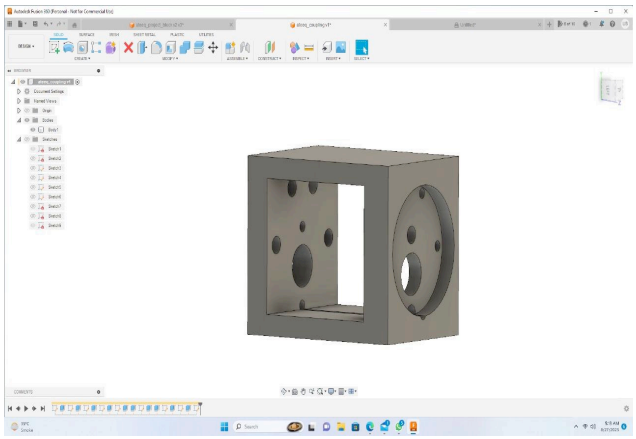

Figure 2. Motor Coupler

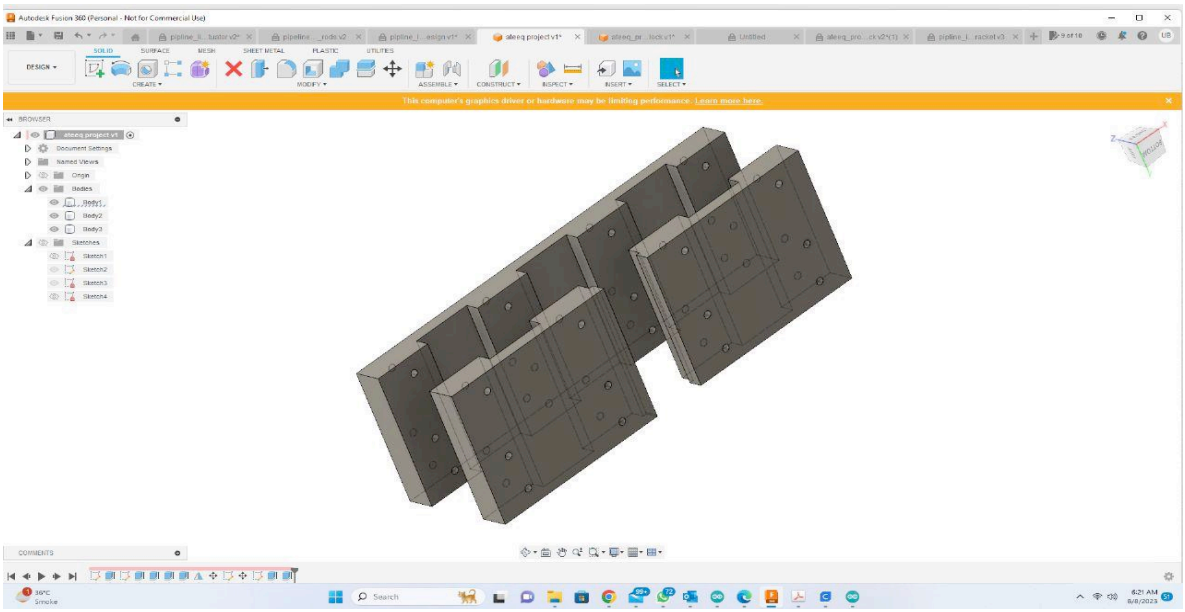

Figure 3. Main SRIS Body Structure

3.1. Work-Flow

In this research article, we divided SRIS system into three main layers one is hardware, second is software and last one is crop analysis. Hardware layer had include micro-controller and sensors devices and main structure of SRIS. In which we include Node-Mcu ESP32 for communication and two type of sensor (Dht-22 and Ultrasonic sensor).Dht-22 sensor use for measure and analysis temperature with humidity. After the temperature testing micro controller ignite impulse to motor drivers, one for movement horizontal other for vertical. Same in the action water pump starting sprinkle of water at field side.

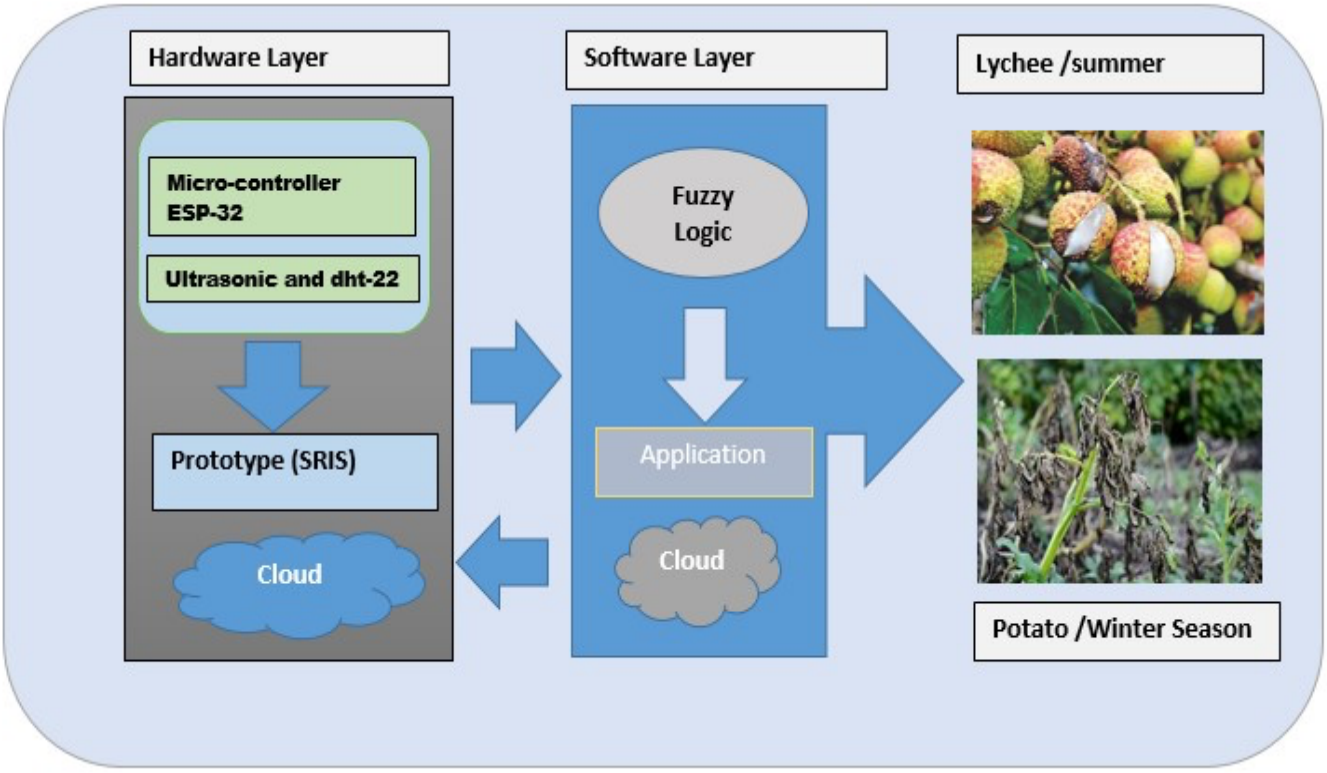

Figure 4. Work Flow

3.2. Prototype

Prototype of these research, construct at 3D-printing with the help of PVC filament material. Its dimension is 14 Inch long and 4 inch in width. Inside the body we use ball baring pulleys for rope movement. Show in the figure below

Figure 5. Prototype SRIS

4. Experiment

We set up the device on a rail in an open space. Observe whether the ultrasonic sensor accurately measures the distance between the device and the obstacle. We verify that it continuously maintains a

constant distance while moving on a rail. This test assesses whether the device can distribute water sprinkle. We verified that the device smoothly moves on a rail without erratic movements or delays. Observing the device detects the obstacles and successfully adjusts its path to avoid collisions. Test the system with different obstacle configurations to ensure attested obstacle detection and avoidance capabilities. Test the water tank empty or not.

5. Results

After testing all activity considering that all result. Temperature is main factor to checking before irrigation and after irrigation.

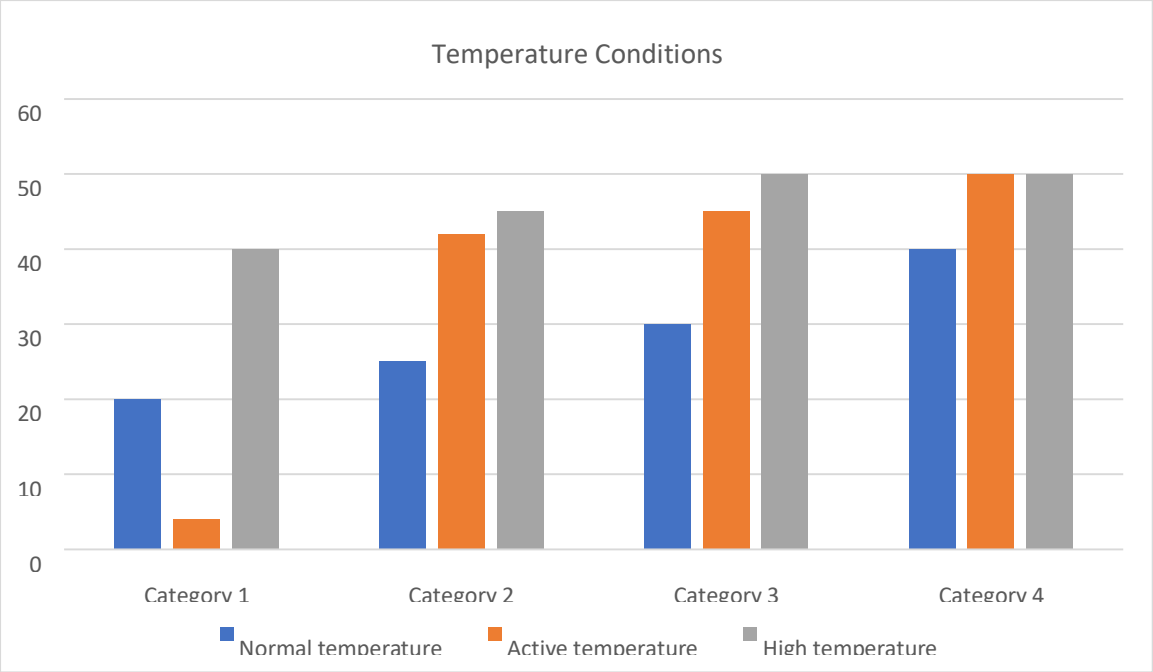

Figure 6. Chart of Temperature Comparison

6. Discussion

These innovations are part of a movement toward precision agriculture, which strives to maximize the use of resources, boost productivity, and lessen the impact of agriculture on the environment. New and creative IoT, Robotics and automation uses for agriculture emerge as technology develops, substantially altering how we approach farming. These smart solutions monitor and guarantee compliance with agricultural and environmental rules. A.I technologies support feasible farming methods to reduce environmental effects. In order to optimize various farming processes, agriculture uses sensors, actuators, and other connected devices to collect and analyze data.

7. Conclusions

This An Innovative irrational System Using Automated Sensors with Micro-Controller is an innovative project that intends to create an autonomous device that distributes water by sprinkling. An innovative irrigation system using sensors based on Robotic technologies is rapidly used in many different ways to increase the growth of crops and improve planting system in order to reduce human efforts in this fast-running world. Agriculture is an underpin livelihood for humans via food and jobs. The main problem in this era is with situation of conservation of water which is very important as well as the proper distribution of fertilizers and pesticides. The main objective of the work is to give an automated solution for irrigation and proper distribution of fertilizers it will also help in the conservation of water as well as high yield in crops. This sensors-based irrigation system is less time-consuming, dependable, and easy to operate in the future. The device of IOT in the field of agriculture which helps in raising high-yield crops, increasing land coverage, and providing healthy food in order to reduce human efforts time, and resources in this rapidly growing world. Finally, efficient water distribution on crops is essential for a sustainable

and fruitful agricultural sector. The management of water resources in agriculture is revolutionized by utilizing technology for precision irrigation, automation, and data-driven decision-making, which will increase the resiliency and productivity of farming operations. The incorporation of innovative water distribution systems is projected to play an increasingly important part in contemporary farming practices as the field of agricultural technology continues to improve. Using an automated system in agriculture is beneficial for land coverage, efficiency, highest yield production, improving food quality, and export goods.

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