Fuzzy Logic Controller Based Automated Drip Irrigation System Using Field Capacity Measurements

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December 2021

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Declaration

I declare that this research work and research thesis has been completed by myself and submitted for the Postgraduates degree program which is entitled as MSc in Information Technology. This research work has not been submitted for any other degree program or professional qualification except where explicitly state in the text.

This research work was done under the Lecturer Mr. SMB Harshananth, Faculty of Graduate Studies and Research, SriLanka Institute of Information Technology.

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Preface

The research work's thesis contents are organized in five main chapters and brief outline of the content of each chapter is presented below.

CHAPTER 1 has described the introduction of the research topic which includes the concepts to the understand the problem, capacities of improving algorithms, python libraries. Also this chapter defines the research questions, significance and main objectives with sub objectives of the research work and it includes the design of the research work.

CHAPTER 2 has described the literature review of this research topic. The first part includes the past theory and experimental studies on automated irrigation system with and without fuzzy logic, theory, how to relate field capacity measurements to auto irrigate the system and findings from the vast literature review study. The second part includes the global water usage and compare the water sector in Sri Lanka which defines the rain water harvesting . Comparing the classifiers in the existing research papers. The third part includes the weed detection technologies which already exist in the research work and compare the different kind of algorithms based on the detection of edge ,detection of color and computer vision.

CHAPTER 3 has involved the survey with two farmers who are evolving the Paddy cultivation and Coconut planting. These surveys include how did they do the agriculture activity and what are the issues faced on the time period of farming. Another survey which includes the COVID-19 impact of the business and agriculture world.

CHAPTER 4 has presented the methodology phase to do this research in an appropriate way. It includes the collection of appropriate material selection from the previous research studies for the project with and without fuzzy logic theory and how we can approach to implement the automated drip irrigation system, predict the rain forecast with the help of sensor data and climate parameters. It helps to identify the best classifying method among the Logistic Regression, KNN classifier, Random Forest Classifier and Gradient Boosting Classifier. Weed identified by using image processing and proposed the algorithm and compute the vision of technologies.

CHAPTER 5 has described the implementation, applications, results with discussion from this research work. It includes the parametric study, the development of design and the effect of different parameters on irrigation schedule, comparison of existence technologies in automated drip irrigation, predict the rain forecast and identify the weed from the plants with current designs rules.

CHAPTER 6 has discussed the conclusions of the research work and recommendations

or future of the implementation of the research work.

CHAPTER 7 has described an overall idea of the business idea behind the research work. Always, a research work based on a new invention or begin a new startup with new technologies. From my research work, really would like to assist my people with less effort and earn a huge profit from the research work.

Acknowledgements

With the prayer of God, my mind was open up to my postgraduate study. It is a great pleasure to express my gratitude of thanks to my mentor, philosopher and supervisor Mr. SMB Harshanth, Lecturer, Faculty of Computer Science and Software Engineering, Sri Lanka Information Institute of Technology. His dedication, interest of research work ,support of the work, and correct my works during the whole period of this research work. He supports me a lot to submit the abstract, concept of the research paper and poster submission of the research work. His advises of time to time basis, security and scientific approaches which helps to me in a very extended way to accomplish the research work.

I would like to thank my coordinator and the lecturers of Faculty of Postgraduates Studies, Sri Lanka Institute of Information Technologies who helps to identify the research concepts and way of process the research work.

I would like to give my gratitude to the staffs of Agriculture department. Agriculture department staff people give an idea about the Jaffna area land and home garden soil structure. I also want to thank some farmers from Kilinochchi. This farmers helps to identify the soil and pH level of water and soil. Their support and advises helps a lot to build my research work.

Mainly , I would like to mention my gratitude to the farmers MR. S. Thusiyanthan (Kilinochchi - Paddy Cultivation) and MR. V. Karunanithy (Point-pedro - Coconut planting) who involve the question and answer session. And the a special thanks to the people support my survey about the COVID-19 and impact of the Agriculture related Business world

Many thanks to my family specially my mother and father who supports unconditionally through the whole project time and maintain the home garden. I would like to thanks my siblings and best friend who supports me a lot in the whole project .

Many thanks to the lectures of the Faculty of Graduate Studies, who have invested the full effort in guiding the students to do this task in a proper way without further delays. And also, we have to appreciate the guidance given by the supervisors as well as the panels especially in the research project presentation to share their comments and advises to improve the skills.

Finally I would like to thank my friends and all my classmates who supports and advise me through the whole research project.

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ABBREVIATIONS AND ACRONYMS

1. WSN - Wireless Sensor Network
2. FC - Field Capacity
3. VWC - Volumetric Water Content
4. PWP - Permanent Welting Point
5. KNN - K Nearest Neighbour
6. CNN - Convolutional Neural Network
7. IoT - Internet of Things
8. IWMI - International Water Management Institude
9. AWC - Available Water Holding Capacity
10. MAD - Manage Allowable Depletion
11. API - Application Programming Interface
12. PIP - Preferred Installer Program
13. MATLAB - Matrix Laboratory
14. ARM - Advanced RISC Machines
15. LCD - Liquid Crystal Display
16. ADC - Analog-to-Digital Converter
17. MSE - Mean Square Error
18. RMSE - Root Mean Square Error
19. MASE - Mean Absolute Square Percentage
20. MAE - Means Absolute Error
21. RGB - Red Green Blue
22. ART2 =Abbservation Related to Technology
23. GLCM - Gray- Scale Co-occurrence Matrix
24. GFD - General Feature Description
25. WIR - Weed Infestation Rate
26. COVID - Corona Virus Disease

27. USB - Universal Serial Bus
28. AC - Alternative Current
29. SC - Direct Current
30. IDE - Integrated Development Environment

Abstract

At present and more so in the future, irrigated agriculture will take the place of the scarcity of groundwater. Difficulty to provide adequate water supply than expected for irrigation will be the norm. The irrigation management, "production per unit" will shift towards emphasizing maximizing the production per unit of water consumed, the "water productivity". Hence, to find an optimum point of irrigation with the consideration of the quantity of water application, growth and yield of a plant a test was conducted. This smart irrigation system optimizes water usage for agriculture and also To improve agricultural water resources utilization, crop's automatic, location, time, and appropriate drip irrigation is a good choice. In this study, an automatic control drip irrigation system based on a wireless sensor network and fuzzy control would be introduced. This system uses soil moisture, temperature, humidity, light, pH value, and wind information and sends the drip irrigation instructions via a wireless network. It puts the above six soil factors into the input fuzzy controller, creates a fuzzy control rule base, and finishes crop irrigation time through the fuzzy control. The Humidity sensor's data helps to predict the rain and harvest the rainwater which helps the agriculture purpose.According the sensor's data, to identify the best method of predict the rain forecast from logistic regression, KNN classifiers, random forest classifier, and Gradient Boosting Classifier algorithms and Random Forest is the Best method compare to the predict the rain forecast. Weeds are the plants which grow in the wrong place in agricultural land. Focusing on detecting the weeds in the crop using computer vision and Image processing to create the application and then notify the user. Fix the physical system to agricultural land and compare the productivity of the particular plant with the past data.

Keywords—Drip Irrigation, Fuzzy logic, Arduino and Field capacity