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Implementation of Fuzzy Logic to Maintain EC(Electrical Conductivity) in Hydroponics Assistant IoT

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1. Introduction

In today's population and building growth is very difficult to control [1] for example in the city of Bandung, Bandung is the capital of West Java province with a population of 2014 is 2,490,622 people, with a population density 22.089 soul / km2 with a growth rate of 0 , 37-0.71% per year (Central Bureau of Statistics of Bandung city 2014) [2] with high level of activity [3], With increasing population affecting green areas in Bandung experiencing a reduction of 3932 ha (1.4%) per year [4], while vegetable needs are increasing [5] and if unmet needs eat import increase will increase while calculation results show that import growth negatively impact economic growth in Indonesia [6] Electrical conductivity (EC) nutrient solution in culture hydroponic is an important point that determines plant growth rate and product quality [7].

Provision of nutrient solution based on EC value (Electrical Conductivity) may affect growth and crop yield [8] In the hydroponic system, the productivity of the plant depends on two major factors: the EC and pH values that determine nutrient uptake by the [9] plant. In general, increasing the electrical conductivity of the nutrient solution reduces the vegetable yield of [10]. The concentration of nutrients in the solution affects the electrical conductivity [11][12]. The electrical conductivity of water with this depends on the concentration of the dissolved salt [13]

Therefore, a technique or method to solve the problem is needed, namely by making a device to control the EC there are two pumps containing fertilizer A and B where the appliance will respond to the EC in a container where water if the EC is less than setpoint then the pump will merospon by giving nutrition A whereas if the EC is more than the specified setpoint feeding pump B will respond by giving nutrition B, this method is called Fuzzy Logic method, Fuzzy logic is a method based on human knowledge and experience, with using a set of IF-THEN form rules to determine the output of the controller given a set of inputs [14]. A fuzzy logic based control strategy similar to human reasoning tolerates the uncertainty and inaccuracy [15]. Fuzzy logic is a methodology problem-solving system controls used in various applications because of the ability to mimic the logic of human control, and the ease of modification of [16]. This research is done designing and manufacturing tools to stabilise EC with rules IF Error EC 'x mS/cm' AND Volume Air 'y Liter' THEN Pump Activation 'z second' where if EC does not match the set point then the system will return the error value and process it so that the nutrient pump runs and reduces the error rate, other than that in this study using GitHub as SCM because Github can facilitate and facilitate collaboration in teams so that research objectives can achieve[17]

2. Related Works

Hydroponics is the cultivation of plants by utilising water and not using it as a planting medium, but rather the suppression of nutrient requirements for plants[18][19]. NFT techniques are techniques that use nutrient solutions to drain into the root area. Nutritional solutions are essential to the defined success of hydroponic cultivation[20] [21].IOT is recognised as one of the most important areas of technology of the future and gained wide attention from various industries[22][23]. Konduktivitas listrik (EC) Electrical conductivity (EC) of nutrient solution in hydroponic culture

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is a crucial point that determines the growth rate of the plants and quality of the products[7]. In hydroponic systems, plant productivity largely relies on two main factors are EC and pH values that determine nutrient uptake by plants[9]. In general, increased electrical conductivity in the nutrient solution reduces the yield of vegetable crops[10]. The concentration of nutrients in the solution affects the electrical conductivity [11][12]. electrically conductive an important role in many applications, especially in the field of manufacturing[24]. the influence of electrical conductivity and water pH on hydrogen production processes using nanosecond pulsed discharges over the water surface are investigated[25].The electrical conductivity of the water at this moment depends on the concentration of dissolved salts and temperature [13] Electrical conductivity has different nano based on experiment[26]

Currently, Fuzzy Logic widely used in many fields, one of which is in the field of control [27]. principle of fuzzy logic built on a set of user-supplied human language rules[28]. Fuzzy logic has become very popular, mainly because the process of fuzzy logic control is simply to put the realisation of human control strategy[29]. Fuzzy logic can analyse uncertainty data so making it flexible[30]. Fuzzy logic has been found the most suitable practice as it can offer all the transitional states between '0' and '1'[31]. Fuzzy controllers can control nonlinear process model and time-delay process model significantly better than classical controller[32]. Fuzzy systems are based on human knowledge and experience, using a set of rules of the form IF-THEN to determine the output of the given controller a set of inputs[14]. In Fuzzy logic, the rules can frame according to conditions[33]. A Fuzzy Logic control is a critical thinking control framework strategy utilised[34]. Fuzzy Logic is a more useful controlling technique to avoid frequency variation in the hybrid renewable system[15]. A control strategy based on fuzzy logic which is similar to human reasoning tolerates uncertainties and imprecision[35]. The fuzzy Logic technique is a subset of computational intelligence[36]. Example, The basic rule in regulating the room temperature, consists of only four rules that can cover the problem of set point control[37]. The control system is using volume as input parameter and PWM value as output[38]. Fuzzy logic is a problem-solving control system methodology used in numerous applications due to its inherent robustness, ability to mimic human control logic, use of imprecise language and ease of modification[16].

This research designing and making a tool to stabilise EC. In this research fuzzy logic method is used to calculate EC errors and become a reference of what things to do to make EC become stable Fuzzy Logic fuzzy which has two input variables and one output variable. The input variables are EC error (EEC) and volume of nutrient solution (V). EC errors obtained by the difference between the true EC setpoint (ECs) and the EC (EC). The volume of nutrients determined by the height of the nutrient solution (h) the area of the nutrient solution tank (A). The formula is EEC = ECa - ECs V = A * h. Rules The implications used in fuzzy rules are: IF Error EC 'x mS/cm' AND Volume Air 'y Liter' THEN Pump Activation 'z second.' By using fuzzy repeatedly with EC parameter values, the nutrient pumps a and b can react and are expected to make EC Stable

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