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Multiple Sensor Data Fusion Based Automatic Plant Pot Watering Employing Mapping by Linear Regression

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ABSTRACT

An automaton for calculating the quantity of water to be released to the plants periodically is calculated by a linear regression model with two input variables and one output variable. The two input variables are the reading of two sensors: the soil water moisture content sensor and the photoresistor sensor. The information from these sensors is collected and the manually released quantities of water are fed as training data set for a Linear Regression model. The trained model is used to actuate the water releasing actuator.

Keywords*:* Linear Regression, Sensors, Agriculture, Machine learning

1. INTRODUCTION

Agriculture automation is one of the most lucrative and productive sectors in the current times. With the growing need for food security, it is vital that the full strength of the latest technologies be harnessed in agriculture automation. Automatic watering of plants based on the soil moisture condition is a powerful method for reducing human labor in agriculture. Cultivation automating comprises a key component of computer-assisted cultivation productivity administration and deployment. It develops sustainable answers for the problems confronting humankind's meal, fiber, nutrition, and energy requirements today as well as in the upcoming next generation through the combination of infrastructure, infotronics, and precision agriculture technology. Farming mechanization, regarded arguably one f the greatest scientific achievements of the twentieth era, has ushered about a breakthrough in farming cultivation technology, allowing enough commodities to be harvested to fulfill the population's ever-increasing demands. The destiny of agricultural production depends on continuous development.

2. LITERATURE SURVEY

Based on the inference from our reference base paper we came to know that "The framework employs sensing technologies, as well as a microprocessor and various electronics, to act as an intelligent changeover system that monitors soil water levels and, if required, irrigates the crop. Although the framework created in this manner might be the more suitable for household use as a remedy for some everyday and common issues, there seems to be a vast range of potential for utilizing such frameworks as a brief remedy for numerous farming and health care concerns, with nutrition and air contamination being the another very predominant, risk, and significant of these. This method, being one alternative farming approach, can be highly beneficial in preserving vegetables as well as other valuable and particular vegetation irrigated for a larger yield, allowing peasants all over the globe to cultivate vegetation of such crops, that is the least desired and often used in the diet. Regarding a clinical remedy, such frameworks might be utilized to cultivate particular crops that are widely recognized for their unique capability to absorb air contaminants, lowering the percentage of hazardous toxins from the atmosphere, and reducing the prevalence of lung disorders. Among the most ambitious & demanding upcoming possibilities involve combining crops of comparable wide range and traits into sophisticated plant networks, dubbed the " Internet of Trees". There seem to be furthermore many other alternatives for experimentation, such as utilizing multiple sensors or a renewable energy supply, however, the reality remains that, regardless of the substances utilized or how individuals are linked, these types of computerized technologies can be extremely beneficial in fixing a wide range of human-related concerns."[1]

Based on the review of the literature we propose an efficient software model using Linear Regression algorithm.

3. WORKING

Proposed system:

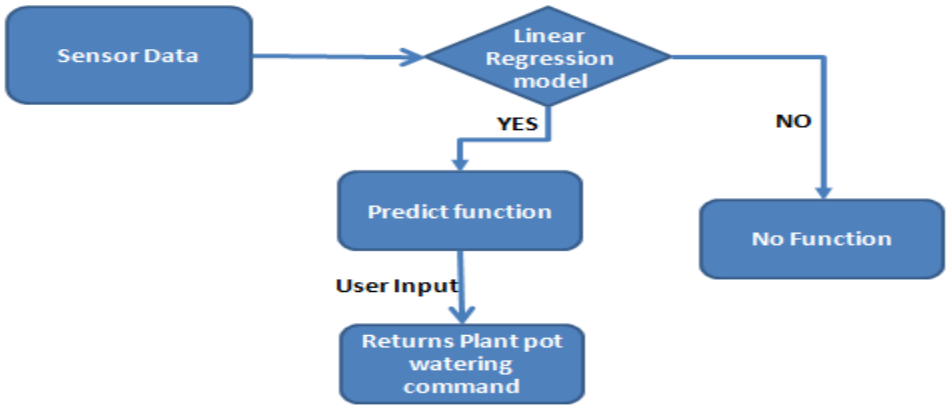

Figure 1 Block Diagram

This project calculates the on-time of the water pump based on the merit of the soil wetness detector. Less the biosensor reading for soil hydration, more the on-time of the water pump. Linear regression-based proportionality mapping is employed here. Linear Regression is a regression machine learning algorithm. In this project, two-dimensional Linear Regression is employed. That is, one input parameter and one output parameter is taken and the given dataset is plotted in a 2D graph. The output model of Linear regression is the best fit line, which is the line with 'y = mx + c' equation passing closest to all the given points of the dataset. The model of this machine learning algorithm with just one input and one output parameter can be described with the value of the slope 'm' and the value of the y-intercept 'c'. This algorithm maps the proportionality, be it direct or inverse, between the input and the output parameter.

Linear Regression Model:

"Linear extrapolation, as the name implies, depicts a straight connection between the independence factor (X-axis) and that dependent factor (Y-axis). Simple linear extrapolation is defined as linear analysis with only one input factor (X). If there are numerous input factors, the linear analysis is known as multiple linear analysis. The linear analysis framework generates a slanted straight line that depicts the relationship between variables." [2]

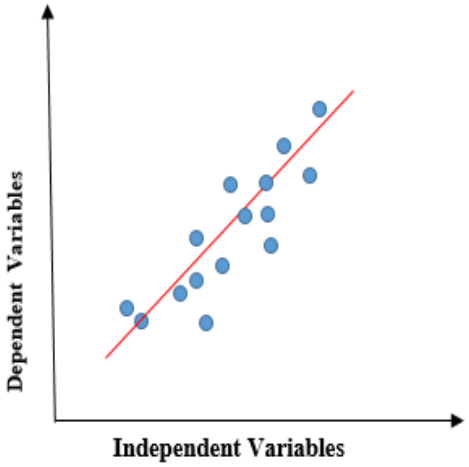

Figure 2 Linear Regression graph

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"The linear connection between the reliant factor and the self-governing factors is depicted in the figure above. Whenever the worth of x (free constant) rises, so does the worth of y (reliant factors). The finest suited linear line is designated by the red bar. We aim to generate a segment that adequately predicts the information elements according to the provided information points."[2]

4. ARTIFICIAL INTELLIGENCE

The algorithmic glide provided in this paper falls underneath the field of computing Intelligence and machine studying. supplied under is a definition of these technologies.

"Robotic or artificial intelligence (AI) is intelligence tested via machines, unlike the natural intelligence displayed with the aid of humans and animals, which entails cognizance and emotionality. The difference between the previous and the latter classes is frequently found via the acronym selected. Robust AI is commonly labeled as artificial general intelligence (AGI) whilst trying to emulate 'natural' intelligence was referred to as artificial biological intelligence (ABI). Main AI textbooks outline the sphere because of the study of sensible retailers: any device that perceives its surroundings and takes moves that maximize its risk of achieving its desires. Colloquially, the term artificial intelligence is regularly used to explain machines that mimic cognitive features that people partner with the human thoughts, which includes mastering and trouble fixing."[3]

"As technologies end up increasingly more successful, duties taken into consideration to require intelligence are frequently eliminated from the definition of AI, an occurrence called the AI impact. A quip in Tesler's rule state AI is anything that hasn't been executed yet. As an instance, optical individual recognition is often excluded from matters taken into consideration to be AI, having emerged as a habitual technology. Modern-day system talents typically categorized as AI encompass efficiently expertise in human speaking abilities, competing at the highest degree in strategic recreation structures (consisting of chess and move), and additionally imperfect-records video games like poker, self-using vehicles, smart routing in content material transport networks, and military simulations."[3]

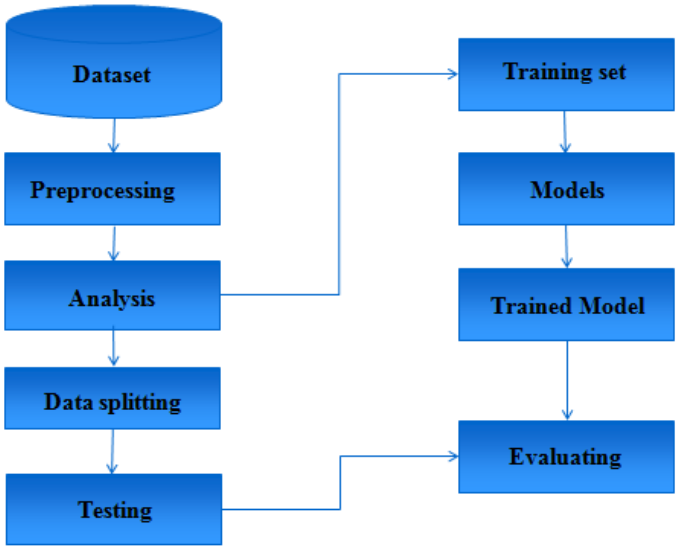

Figure 3 Flow Chart

"AI studies have been divided into subfields that frequently fail to talk with each different. those sub-fields are primarily based on technical issues, along with precise desires (e.g. robotics or system studying), the usage of unique equipment (good judgment or synthetic neural networks), or deep philosophical variations. Sub-fields have additionally been based totally on social elements (particular establishments or the work of specific researchers)."[3]

"Within the twenty-first century, AI techniques have skilled a resurgence following concurrent advances in pc strength, big quantities of records, and theoretical expertise; and AI strategies have to end up an essential part of the technology enterprise, assisting to clear up many difficult troubles in computer science, software engineering, and operations studies."[3]

5. MACHINE LEARNING

"Machine learning (ML) involves the research of computing algorithms that improve themselves over the duration as a consequence of expertise plus information. It's considered an element of computer intelligence. Artificial learning algorithms create a framework relying on retraining information to generate forecasts or judgments despite having to get specifically configured to accomplish it. Machine intelligence algorithms were utilized across a vast range of applications, including healthcare, spam filtration, audio identification, and desktop sight, where developing algorithms to perform those required jobs is complicated or impossible."[4]

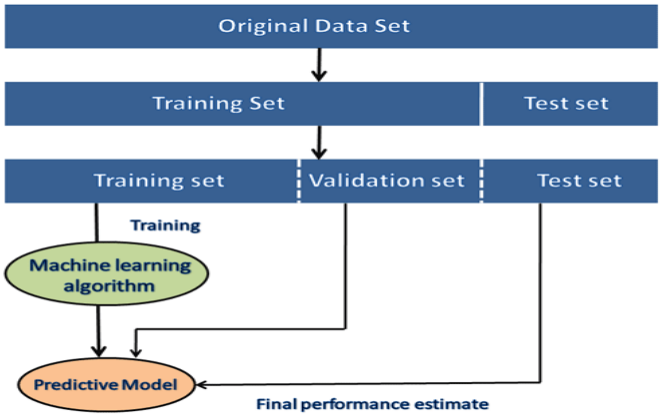

Figure 4 Machine learning dataset

"Machine intelligence and computing analytics are intimately linked, which concentrates upon utilizing computers to make forecasts; nevertheless, nearly most computer intelligence involves statistical analysis. The discipline of machine intelligence benefits from computational efficiency research since it provides tools, concepts, and applicable fields. Data extraction is a similar branch of research that focuses on uncontrolled learning for interactive data processing. Computer intelligence is also known as anticipatory analytics when intelligence is used to solve commercial challenges."[4]

5. INDUSTRY 4.0

"This same Fourth Economic Transformation (4IR aka Industrial 4.0) involves the continued digitization of old commercial and international operations, utilizing new intelligent systems, according to several websites. Regarding increasing robotics, massive device connectivity (M2M) plus the network interconnected objects (IoT) are combined enhanced personality and interaction, as well as the development of intelligent technologies which can assess and resolve problems without any requirement of living thing interaction."[5]

Automation under Industry 4.0 has a particular schema or pattern at its outset. Presented below is how automation in the mass production industry, as well as consumer-level products, are built-in in today's technological era.

The schema presented in Figure 5 has a lot of other components involved but the generic outline of it stands justifiable for all kinds of automation today.

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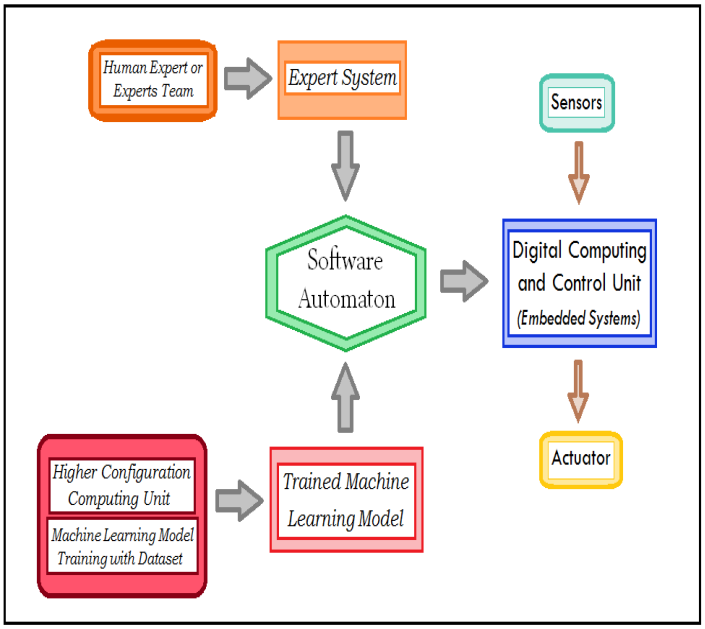

Figure 5 Schema of Automation

The software automaton of the conventional automation model, which is the status quo, was built by a human expert or a team of human experts till now. With the advent of machine learning technology, the software automaton was not fully directly designed by human experts. The human experts build the machine learning software and give the real-world data set as training information. Within the formats of a numerical framework, computer intelligence software finds statistical connections between the intake and outcome variables of the database. This mathematical model can be downloaded as a working software module to other electronic computing devices. This mathematical model is referred to as the 'trained machine learning module'. The software automaton of all the current digital embedded devices is a mathematical model that gives a numerical output for a numerical input based on arithmetic and logical conditions. This software automaton, as explained above can be either directly developed by a set of human experts by means of setting the boundary conditions themselves based on observation and requirement or can be downloaded as an executable module from machine learning training systems that are trained with the relevant dataset. In whatever way the software automaton is developed, it can be loaded onto the relevant embedded computing module that can be used for either sensor-based closed-loop automation or open-loop automation.

The technological components of Industry 4.0 include IoT, augmented reality, virtual reality, cloud computing, 3D printing, big data analytics, networking, data security, human-machine interaction and others. IoT is a very effective way to collect real-world data. Sensors integrated with data acquisition and transmission systems can be placed anywhere and the collected data can be pre-processed if required and used as datasets to train machine learning models.

Cloud computing is employed for the optimized utilization of computing resources. There are many third-party vendors like Google and Amazon which are very reliable in terms of data security and speed of computation. These services offer companies and organizations a cheap and reliable way to leverage digital intelligence as well as machine learning to their advantage.

Analytics on big datasets is the set of technological components involved with collecting, collating, and managing large quantities of data for analytics and decision making. When so much data is involved, especially with third-party service providers, data security plays an important role.

One of the paramount concerns about Industry 4.0 is the unemployment it can create due to powerful automation. The field of human-machine interactions and co-working has been a very developing field now to mitigate the above-mentioned problem.

6. RESULTS AND DISCUSSION

Soil Moisture Sensor Value	Watering Pump On-Time
5	121
6	91
7	72
8	60
10	57
15	53
22	46
23	38
24	30
27	24
30	18
32	17
34	15
37	14
56	10

Figure 6 Input Sample Dataset

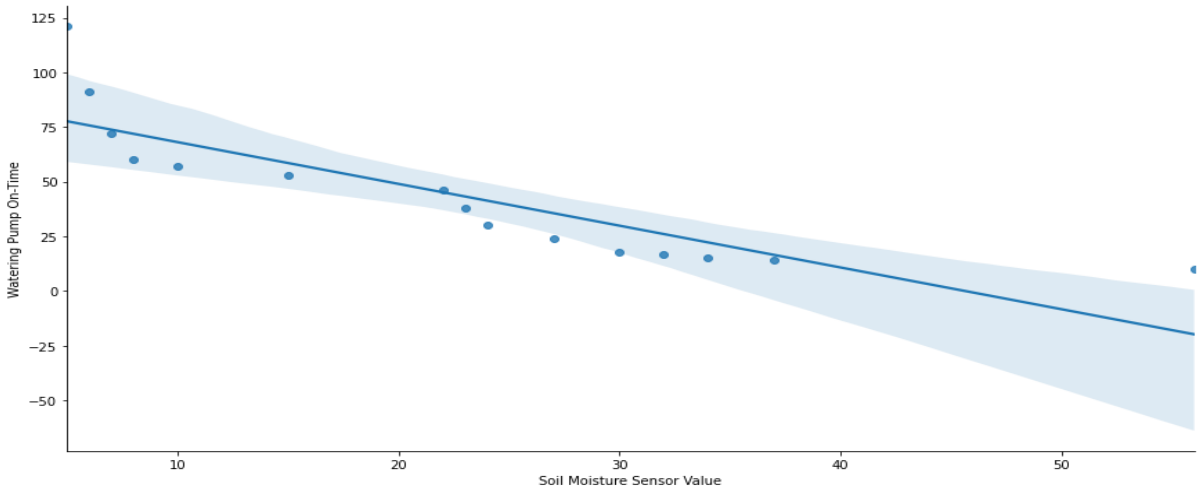

Figure 7 Output graph

This machine learning-based predictive model is implemented employing Python programming language. The relevant library files have been included for the execution of the code. The dataset was given as input and the predictive model was obtained. The prediction model was tested and the results were satisfactory. The output graph of the machine learning model has been presented above. In this project, a Linear Regression algorithm is employed. The two parameters are soil moisture sensor value and watering pump on time. The Linear Regression model maps the inverse proportionality between soil moisture sensor value and watering pump on time.

7. CONCLUSION AND FUTURE WORK

This machine learning-based trained software automaton can be utilized in all garden farming and urban residential settings. For plants of different species and sizes, the data of the amount of water for each of them can be calculated from the trained model obtained after being trained with the dataset presented for this project. Automation under Industry 4.0 has a particular schema or pattern at its outset. The software automaton of the conventional automation model, which is the status quo, was built by a human expert or a team of human experts till now. With the advent of machine learning technology, the software automaton was not fully directly designed by human experts. The human experts build the machine learning software and give the real-world data set as training information. The machine-learning software program identifies the sample between the input and the output parameters of the dataset in the shape of a mathematical version. This mathematical model can be downloaded as a working software module to other electronic computing devices.

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