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Smart Crop Monitoring and Automation Irrigation System Using Machine Learning and IOT

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Abstract
Agriculture is still a major occupation in rural areas of India. Increase in technology creates many opportunities in different fields and attracts human resources from rural areas. Farmers are facing sever human and natural resource problems. Monitoring crops with low man power is the major problem. Smart crop monitoring and automation irrigation system deals with these problems by developing a mobile application which helps farmer to get detailed information about plant diseases and to use irrigation system efficiently. This model uses image processing techniques to identify the picture of the leaf and also provides information about temperature and moisture on field. The Raspberry Pi is the project's control unit, which controls and executes the entire system's operation. Pi camera is placed at the face of the moving vehicle to take the pictures of the leaves. These pictures are analyzed using convolution neural network which is an efficient machine learning algorithm. If the captured leaf image has a disease that is already in the given dataset then farmer will get output message which contains disease cause and pesticide or fertilizers we need to provide to eradicate the disease. Mobile application also sends the data which is sensed using sensors.

Key-words: Raspberry Pi, Convolution Neural Network, Mobile Application.

1. Introduction

In Indian irrigation system, the farmers have chosen most of the conventional methods that are manually operated. This require great amount of natural resources and capital. These trend may produce lose in both present and future. More than 80% of groundwater resources are being used

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exclusively for agriculture. This ongoing tendency may lead to a complete depletion of water resources [1].

The IoT’s flexibility has evolved to the point where it can now be used by the average person. Smart education, urbanization, cities, the e-health sector, and automation, have made person's life easier and more convenient [2].

The concept of IOT (Internet of Things) is used in this Smart Crop Monitoring and automatic irrigation system, which helps to monitor and control the hardware kits from a remote location just by connecting to internet. The IoT may be defined as a network of physical devices which include various sensors and have the capability to connect with other physical devices and can share data in real time over the internet [3].

2. Literature Survey

In [4], the gadget is described as one that sends potential environmental data over the internet and uses a machine-learning algorithm to anticipate ambient conditions for fungus diagnosis and mitigation. To analyze raw statistics and anticipate results, a machine-learning algorithm that depends on support vector machine iteration was used. Although SVM produces results, it is less perfect than other methods.

The primary goal of [5] is to improve irrigation system accuracy by making automated processes using machine learning techniques. This system is comprised of two modules: a sensor module for data collection and a base station module for data analysis.

The authors have suggested a model for better irrigation, an autonomous rover for field observation, a system for identifying and classifying damaged plants, and an integrated protection approach in [6].

In [7], Agriculture uses IoT to improve traditional agricultural techniques by leveraging sensor networks. A sensor network is used for measuring the parameters that are present in the atmosphere, among the instruments that the system uses to calculate and gather data on field conditions. GSM provides the farmer with all information on the status of the farm.

3. Need for IOT and Machine Learning

The IoT is used in connecting physical devices and allowing them to share the collected data through Internet. The availability of low-cost on-chip CPUs and microcontrollers makes this possible. Integrating diverse components, such as sensors and peripherals, with existing on-chip computers and microcontrollers allows for the transmission and reception of real-time data without the need for human intervention. By using this technology, the data these physical devices collected in real-time is transmitted to a personal computer or a mobile application to control & perform specific tasks [3].

The main importance of the IoT is that the physical devices which are connected can be accessed from any location remotely. Data availability helps to understand the trends in data for more improvisation of an existing system. But some of the data collected cannot be processed by humans directly. Machines help to fill these gaps by processing complex data into simple and understandable by humans.

Machine learning build a mathematical model based on provided input data. This model assists to analyze and make decisions. Accuracy in decision making can be improved for farmers by using machine learning. With the aid of IoT and machine learning techniques, a smart, dependable, and low-cost new solution has been built that is capable of automating a variety of operations, from crop watering to crop health forecasting[10]. User can also input the past results to algorithm to increase the accuracy of model.

However, there are still important advancements in IoT and Machine learning that need to be made before they can be used in the real world. The following are some of the factors that support the aforementioned assertion.

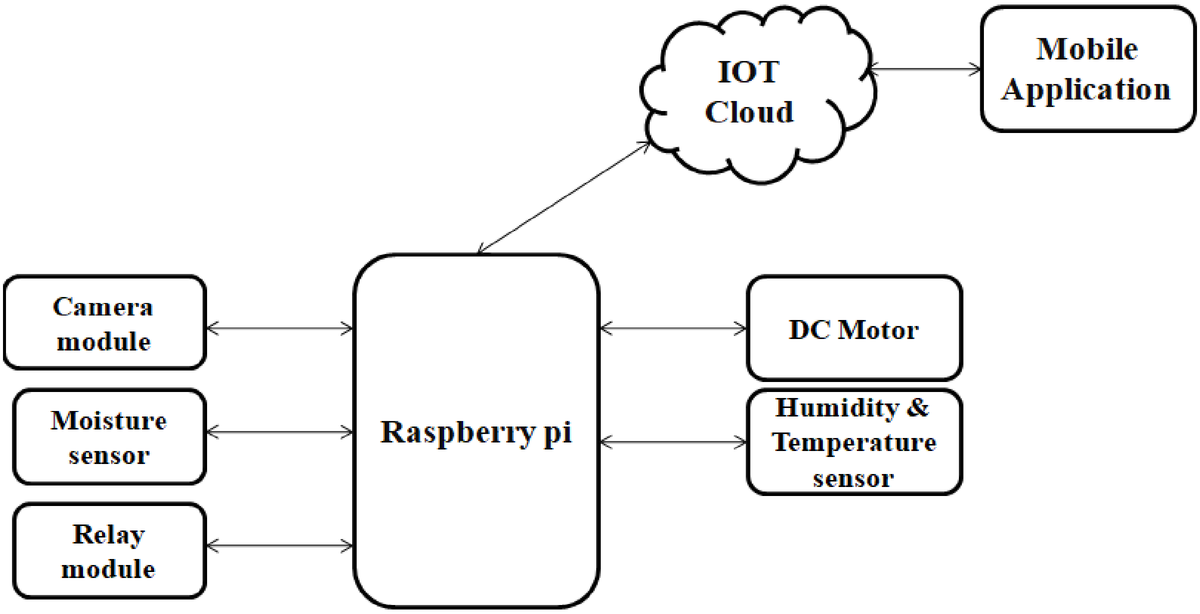
IoT is completely reliant on internet connectivity; if the internet is unavailable, it cannot be used in any form. Machine learning algorithms are to be more accurate to predict the output otherwise user may make mistakes and lose resources.

Data is abundant, yet it is exposed to the outside world. Identity theft is more common among who uses IoT devices in their daily lives. Data breaches are seen as a higher concern by businesses, leading to cyber-attacks and data misuse.

4. System Architecture

The high-level architecture of the Smart crop monitoring and automation irrigation system is described in this section. The block diagram below depicts the various important devices that are employed in this proposed system.

Fig. 1 - Architecture Diagram



Let us see in more detail, how these sensors and various other components in this smart parking system are integrated and utilized to its full capacity.

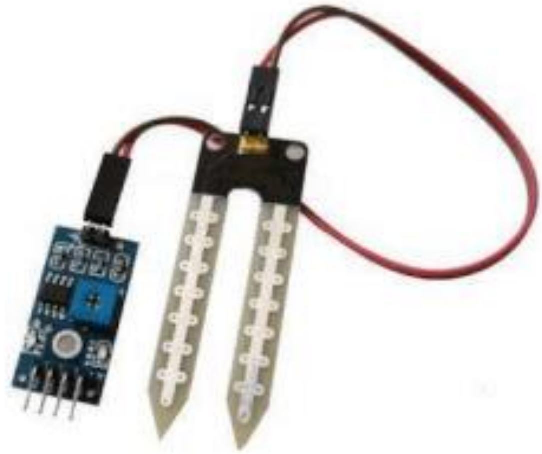
In this smart parking system, the Raspberry Pi serves as the computing unit. It is the best affordable low-cost SOC (System on Chip) that can execute all of the functions of a standard PC. The Raspberry pi serves as a link between numerous sensors and the Internet of Things. The processing unit is hardwired to physical components, such as sensors and motors. Because the Raspberry pi includes an 802.11 Wireless LAN (Local Area) Adapter, it can connect to the internet with just one click. The Raspberry Pi's processor unit contains 26 GPIO (General Purpose Input Output) pins, allowing it to connect to 26 different components.

If more number of pins is required, we can utilize a multiplexer to expand the number of GPIO pins to meet our needs. The processing unit runs a python program that continuously monitors the status of these pins. There are many SOC's available in the market which can be utilized for the project, but the reason behind choosing the raspberry pi is due to its low cost and has the additional feature which is CSI (Camera Serial Interface) [9] through which camera module can be integrated directly. Here we used camera module to capture the pictures of the leaves of crop plants.

5. Sensors

In this system, various sensors are used to collect the data which will further notify to user. The moisture in the soil was measured using a soil moisture sensor. This gadget operates by converting the moisture which is present in the soil will acts as resistance to conduct electricity, using this it measures level of moisture [11].

Fig. 2 - The Moisture Sensor



Humidity and temperature sensor (DHT22) was used to monitor two above mentioned parameters which plays a key role in growth of plant in the farm's air. It's a best cost digital sensor. This will measure and generate both measurements on a electronic signal on a pin.

Fig. 3 - The Humidity and Temperature Sensor

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Servo Motors

Servo motors are used to move the wheels of the vehicle we can use small rover type vehicle to carry out the tasks like taking image of random leaves and taking samples of moisture level without stepping into field.

Cloud

The THINGSPEAK cloud is an open-source IoT platform with an API. HTTP and MQTT can be utilized over a LAN to store and retrieve data from the cloud (Local Area Network) [8]. It serves as a database for storing all data linked to the sensors and plant diseases, and end users can have access it to acquire real-time crop field information. The platform is so adaptable that it can accommodate any number of users. Using this platform, analyzing & visualizing the data using various software's is possible and this can be used to interact with our custom developed mobile applications. In case of end user lose the controlling device; all the information related to crop field is stored in cloud as back- up servers.

Mobile Application

The mobile application acts as interface for the end user which is developed with the help of MIT App Inventor II. The purpose of using MIT app inventor is to develop an application that can run on both android devices as well as iOS devices. The mobile application and raspberry pi are connected to Thing Speak cloud over a secured channel [9]. The mobile application provides information regarding the diseases that attacked the plants and also we can get the information like quantities of basic parameters in air.

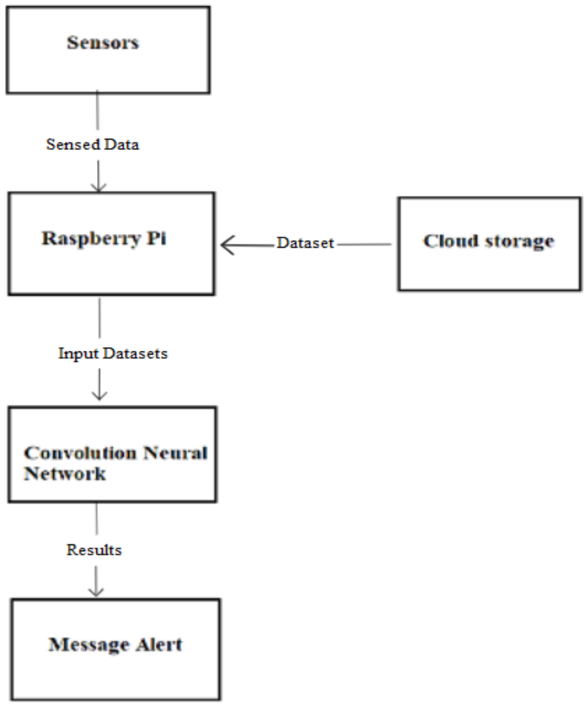
DC Motor

In this smart crop monitoring and automated irrigation system DC motor is used to supply water to field. When moisture sensor detects that there is no moisture in the soil and if user kept the system in automatic mode then DC motor will ON automatically and supply water.

6. Implementation & Working

The working model of the Smart crop monitoring and automation irrigation system in real-time starting with installation of system in field and collection of information. Whole process is shown as Flow chart in below fig.

Fig. 4. Flowchart of Proposed System



When a vehicle which is installed with this proposed system and entered into field and it can be controlled by a remote and user can have this in his mobile also. Once the pictures of leaves are collected, then they are stored in cloud. Pictures will serve as inputs to the convolution neural network model which is already trained.

Algorithm

Pre-labeled data with known answers is fed into the system using supervised learning, a form of machine learning technique that helps the system comprehend the patterns involved. To find a pattern, it analyses several forms of data as well as the answers to each issue. Data training is the term for this stage. The greater the amount of data available, the more precise the results will be. In supervised machine learning, the next step is to test the data. The system is given a problem to solve in this stage, and the machine, understanding the pattern of issue solving and the possible responses, delivers the most suitable solution.

As previously stated, the amount of the data, the methodologies utilized, numerous other things like as errors, exceptional observations in data used as training input influence the precision of the output. Learning and prediction are the two most critical phases in any categorization. The model is constructed employing the fed training data throughout the learning phase.

A convolution neural network, an efficient image grouping method, which is used to perceive and interpret data. Mainly CNN has two parts, a process known as Feature Extraction, a convolution tool that isolates and identifies the distinct characteristics of an image for analysis.

Dataset

Input datasets for training the model is taken from Tensor flow. Plant village dataset is constructed by plant village organization and it contains 50,000 images of healthy and diseased leaves. This dataset is gathered by crowd sourcing.

The mobile application will provide real-time up to date information about parking lot availability with intuitive interface to the end user. The following steps will determine and define the process for using the mobile application:

1. Download & Install compatible version of the developed mobile application.
2. Within the intuitive UI of the mobile application, see the outputs of acquired images and can also see the stored information.
3. We can view the sensed data of humidity, temperature & moisture in the app screen. On the screen it will about the disease cause and pesticide or fertilizer we have to apply.

7. Results

In this section, outputs are shown for cases like

- Analyzing diseased leaf.
- Analyzing healthy leaf.
- Obtaining information from sensors.

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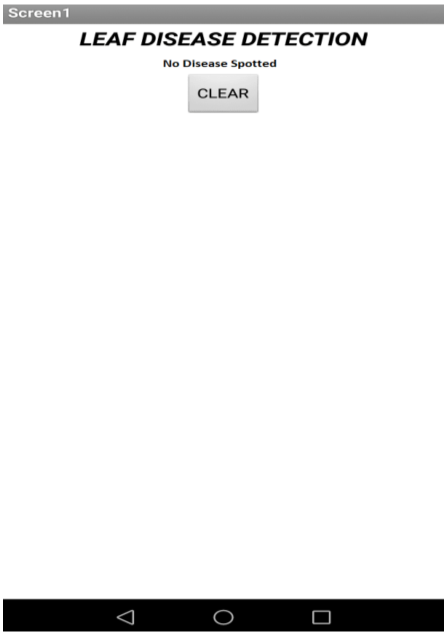
Case – I: When a diseased leaf is analyzed

Fig. 5 - Message Output when the Leaf with Disease is Analyzed

When a leaf of a diseased plant is captured and analyzed by the system, if it has any diseases then a message like the above fig will automatically send's to the linked mobile phone.

Case – II: When a vehicle with illegal associated entities enters the parking lot.

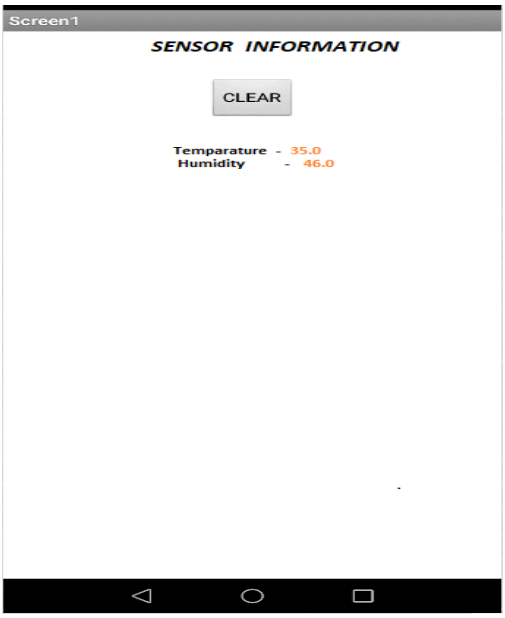
Fig. 6 - Message Output when the Leaf with no Disease is Analyzed



When a leaf of a healthy plant is captured and analyzed by the system, if it has no diseases then a message like the above fig will automatically send's to the linked mobile phone.

Case – III: Viewing the information collected by the sensors.

Fig. 7 - Message Output Data Sensed by Sensors



User can view the information collected by sensors instantaneously using mobile application. Moisture threshold level will be given as input and above that threshold motor will on automatically.

8. Conclusion

In this paper, we discussed about the solution for the issue of remote crop health monitoring and irrigation without human intervention. Smart crop monitoring and automation irrigation system adds value to users by helping them to reduce water wastage and helps to make better decisions by accurate data. Further enhancement is to integrate the existing system with better neural network with more accurate results and also can improve by providing more and best datasets.

References

Kasara Sai Pratyush Reddy, Y Mohana Roopa, Kovvada Rajeev L N, Narra Sai Nandan. "Iot based Smart Agriculture using Machine Learning". *2020 Second International Conference on Inventive Research in Computing Applications (ICIRCA).* Doi: 10.1109/ICIRCA48905.2020.9183373

Y. Mohana Roopa, Growing Trends in Indian Farming using Internet of Things (IoT). *International Journal of Engineering and Advanced Technology, 9*(2), 2019, 4360-4364.

P.V. Dudhe, N.V. Kadam, R.M. Hushangabade, M.S. Deshmukh, “Internet of Things (IOT): An overview and its applications”, *2017 International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS),* 2018. Doi:10.1109/ICECDS.2017.8389935

Thomas Truong; Anh Dinh; Khan Wahid. “An IoT environmental data collection system for fungal detection in crop fields” *[M]//2017 IEEE 30th Canadian Conference on Electrical and Computer Engineering (CCECE).*

R.N. Kirtana, B. Bharathi, S. Keerthana Priya, S. Kavitha, B. Keerthana, K. Kripa “Smart Irrigation System using Zigbee Technology and Machine Learning Techniques”, *2018 International Conference on Intelligent Computing and Communication for Smart World (I2C2SW) Annual Computing and Communication Workshop and Conference (CCWC).*
Doi: 10.1109/ccwc.2019.8666537

Akshay S, TK Ramesh, “Efficient Machine Learning Algorithm for Smart Irrigation”, 2020 *International Conference on Communication and Signal Processing (ICCSP).* Doi:10.1109/ICCSP48568.2020.9182215

G. Naveen Balaji, V. Nandhini, S. Mithra, N. Priya and R. Naveena. IOT Based Smart Crop Monitoring in Farm Land. *Imperial Journal of Interdisciplinary Research (IJIR), 4*(1), 2018.

Chengzhe Lai, Qian Li, Haibo Zhou and Dong Zheng, "SRSP: A Secure and Reliable Smart Parking Scheme with Dual Privacy Preservation", *IEEE Internet of Things Journal (Early Access) in 2020,* Doi:10.1109/JIOT.2020.3048177

S Nitin Pandit, Rohit Mohan Krishna G.V.L, R Akash, Minal Moharir, “Cloud Based Smart Parking System for Smart Cities”, *2019 International Conference on Smart Systems and Inventive Technology (ICSSIT),* Doi:10.1109/ICSSIT46314.2019.8987592

Mohd Syukri Bin Mohd Nazri; Tengku Long Alif Faiqal Bin Tengku Long Gaafar; Hannah Sofian; Aznida Abu Bakar Sajak, “IoT Parking Apps with Car Plate Recognition for Smart City using Node Red”, *2020 11th International Conference on Information and Communication Systems (ICICS).*
Doi: 10.1109/ICICS49469.2020.239511

Reuben Varghese, Smarita Sharma. Affordable smart farming using Iot and Machine Learning. *2018 Second International Conference on Intelligent Computing and Control Sytems (ICICCS).*
Doi:10.1109/ICCONS.2018.8663044