IOT Based Disease Monitoring System for Apple Orchardin Himachal Pradesh

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Abstract-IoT is the technology which has a huge contribution now a days in the diverse application areas. Apple, a cash crop, is one of the fruits which is high in demand throughout the year. Himachal Pradesh secured second largest placein India for apple production. The economy of this state is predominantly dependent on apple cultivation.Fluctuation in climate and weather conditionshave a huge impact on production and quality of apple and plant as well. The success of apple production highly depends on climatic and environmental factor like temperature and humidity. The present study is focusing to design an IoT based system to predict the various diseases and their impact on the apple during the different whether conditions. For this, some popular IoT boards with sensors, and Wi-Fi transreceiver will be used to monitor the data which can be evaluated for further recommendations.

Keywords- Internet of Things (IoT), Apple diseases, IoT Boards, IoT Sensors, Wi-Fi Transreceiver.

I.INTRODUCTION

The Internet of Things (IoT) is atechnologyof interrelated physical devices or "things that are being combined with electronics, software, sensors, actuators and internet connectivity and powerful data analytic capabilities, which allows these objects to accumulate and share data. Internet of Things (IoT) rises as a power ful domain where connected devices and sensors can connect and share information over the Internet.

At present many agriculture and horticultural industries areleaned to accept IoT platform for smart farming to increase efficiency, productivity, and minimize human involvement, time and cost etc. The revolution in the technology ensures that the sensors are getting smaller, refined and more economic. At present the internet are also easily accessible everywhere so that smart monitoring can be achieved with full security. Many of the problems regarding smart farming can be done using smart phones and IoT devices. Farmer can get any required data or information about the field as well can monitor his/her agriculture area.

India secured place in top ten apple producing nationsand its involvement to the overall production is 3%. Although India secured a place in top countries for apple cultivation but, the cultivation and quality of production is not so good as compared to others because of several kind of diseases and pests, which cause great damage to the fruit in the state.[1]In Agriculture/Horticulture each type of pest and diseases are considered asinjurious to plants, fruits and has a great divergenteffect on it. In addition to falling crop productivity and quality, insecticides or fungicides which could cause environmental pollution, and becomes a need to destroydiseases and pests[2].Consequently, an IoT based prediction system is proposed to monitor the temperature and humidity/moisture level of the orchard and to predict when the pests appear conditions met in order to dropthe appearance of diseases. In other words, authors proposed a system that provides information regarding disease prediction so that farmers can timely manage their crop.

Himachal Pradesh is one of the foremostappleyieldingstate in India, where the production is going more than 90 percent of the total cultivation in domestic market. Apples individually constitute 89 per cent of the state's fruit economy.In the state of Himachal Pradesh, According to the official records, apple is produced on 2.25 lakh hectares in the state with productivity as low as 3-4 tons per hectare. Evenas the apple growers in Himachal Pradesh always have their fingers crossed over the uncertainty that hangs over the fruit crop in the midst of general climate change, the weather Gods have so far showered hope for them this season. The fruit market has, therefore plays a great role in the improvement of the rural economy of the State with respect to:
- Generation of foundations for income to the rural people,
- Generation of employment openings in the pre and post-harvest sectors of the fruit industry,
- Satisfaction of the aesthetic needs of the people, and
- Development of a justifiable system of stable agriculture in the hilly areas.

Apples alone plays a major part in the economy of Himachal Pradesh,the production has a turnover of over

Rs. 3500 crore and accounting for almost 10 percent of the gross domestic product. After the statehood in 1971, there has been a strong backing from the state for apple cultivation. Consequently the area under apple cultivation has increased substantially from a mere 400 hectares in 1950s to 114939 hectares in 2011-12 (presently 2.25 lakh hectare), of the total area under fruit production, apples make up for more than 49 percent and of the total fruit production, apple alone accounts for more than 74 percent. Considering the vital role that Apple has in the economy of Himachal Pradesh, there is a need to analyse the trends in area, yield, production and economics of apple and problems encountered by the orchardists in the state.[3]
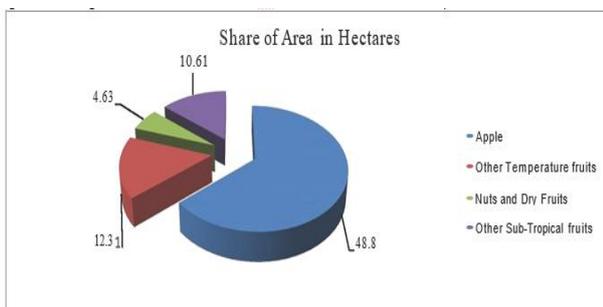
Fig. 1 Different Fruit crops area percentage in Himachal Pradesh 2015-16.

Apple cultivation is money-making activity in the state of Himachal Pradesh compared to other fruit/food crops. It is labour intensive, farm based and commercially attractive economic activity. The income earned from this fruit is much higher than any other horticulture crop, if it is done in a systematic way.

Common diseases of Apple
This part includes the most common diseases found in the apple orchards when flowering/ fruit is setting which affect the quality of fruit. Most of the time the fruitgrowersdoesn'tunderstands the disease appearance. So the fruit could not qualify the quality norms while grading, sorting and packing, due to which apple farmers have to tolerateheavy loss in their income. Following are some common diseases that may appear in the fruit due to the variation in temperature and humidity level in the orchard.
1. Apple Scab
2. Black rot canker
3. Powdery mildew
4. Sooty blotch and fly speck
5. Core rot
6. Brown rot

There are many diseases which can affect the apple fruit but it is to be mentioned here, that most of the common diseases of apple are occurs due to variation in temperature and moisture/humidity of soil and environment.So it is to be proposed that to avoid the above situations, an IoT system that can predict the possibilities of diseases andalso can provide the possible solution that could be helpful for the farmers.

Fig. DHT11 basic Temperature and Humidity Sensor.

The DHT11 is a Temperature and Humidity Sensor which is a regulateddigital signal output with the temperature and humidity sensing capability. This sensor includes a resistive element and a sensor for wet NTC temperature measuring devices. The sensor has four pins and can be used with any IoT board.It is a cost effective sensor for all user.

Fig. 2 Wi-Fi Transreceiver.

IoT Boards: Arduino Uno - Arduino Uno is a general purpose IoT board. It comes with an 8-bit microcontroller. It has the following features-
1. Microcontroller
2. Circuit serial programmer
3. Digital ground
4. USB plug
5. External power supply
6. Digital I/O pins
7. Analog reference pin
8. Digital ground
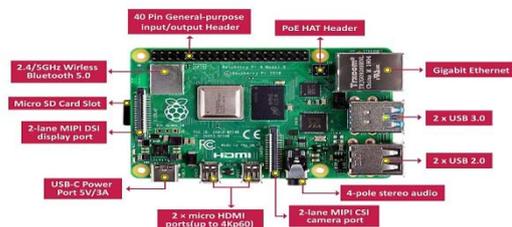9. Serial In/Out
10. Reset Button

Fig. 3 Raspberry Pi Board

Raspberry Pi –Raspberry pi is a mini computer board. It has the following features.
1. Microprocessor
2. 40 pin general purpose input and output header.
3. Wireless Bluetooth 5.0 4. 2-Lane MIPI CSI Camera Port

5. 4-pole Audio
6. Ethernet
7. Micro SD Card slot in which Raspberry pi operating system could be installed.

Difference: Raspberry Pi runs an operating system, which is usually Linux. It's a mini computer, while Arduino is much simpler. It consumes much less power (~50 mA idle) than an a Raspberry Pi (700+ mA)Wi-Fi Transreceiver- Wi-Fi transreceiver is a Wi-Fi module. It is a highly integrated chip. It is used with IoT gadget embedded on Raspberry Pi/Arduino Uno board. It is used to send and receive network signals.

1.Ex- ESP8266
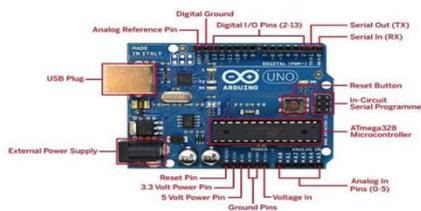Technique Used for Disease and pest Detection and prediction.

Fig.4 Arduino Uno Board.

• As it is mentioned earlier that most of the diseases and pest attacks on the fruit/plant are due to excessive or less variation in humidity/ temperature. So the first step is to develop a hybrid gadget using IoT devices as described in above section.
• The gadget will monitor the temperature and humidity level of the orchard using IoT boards with sensors and sends this information to the farmer's mobile.
• In the farmer's mobile an android application will be installed which will be developed using android studio.
• A database will be maintained regarding diseases/ pest details and their survival as well as the favorable conditions in which they may attack the plant/ fruit.
• When data is received from sensors then it will be compared with the database and based on the favorable conditions (for diseases/ Pest), an alert will be generated and a prediction for disease will be flashed on farmer's mobile app.
• After getting notification regarding diseases/ pest probability on fruit the application will provide the suggestion/ recommendation regarding what action farmer could take.
• It could be either spraying or maintaining the humidity and temperature level of the orchard by available mode.

II.REVIEW OF LITERATURE & RESEARCH GAP IDENTIFICATION

[1] This research describes an IDSS to implement and

optimize disease andpest protection decision making process within moderateareas of India; develops hybrid algorithm using Case Based Reasoning and Database Technology and implement the same using web based client server architecture. The paper focuses on the accuracy of decision making system that will be provided by the mentioned IDSS has been 90.20% and it can provide significant support to the apple growers in decision making towards Eco-friendly pest management practices.

[2]The paper describes that the rain increasesthe possibility of disease infection and makes it spread quickly. So the author emphasis to determine the pattern time and amount of rainfall and also do the needful spray of agricultural pesticides to prevent the crop from disease. By this the author wants to conclude that the frequency of pesticides can be reduced by monitoring weather data like rainfall and moisture level in the field.

[3]The thesis report by K. Kireeti has focuses on considering the vital role that Apple has in the economy of Himachal Pradesh, there is a need to analyses the trends in area, yield, production and economics of apple and problems encountered by the orchardists in the state. He also consider the production analysis and important points about apple production in Himachal Pradesh.

[4]Author focuses on the application of wireless sensor technology that can reduce management costs of apple orchards, improve product quality of apples, and provide detailed, completeandpreciseelectronic information for planting works, generate warning about pest appearance.
[5]Author says that the temperature effects the growth and productivity which are considered among the most complex mattersinenvironmentalcomposition, because temperature affects basicallyall processes involved in farming.Frequent climatic variations in seasonal temperatures are known to have effects on apple cultivation yet the author does not fully understand how, as the temperature is not the only factorsfluctuating.

[6]This paper focuses that - India secured a great position in the production of various fruits like mango, guava, papaya, banana, oranges, grapes and the most important in apple cultivation. Horticulture sector is an important component for the development in the state of Himachal Pradesh. It provides various job opportunities for more than one lakh common peopleof the state directly or indirectly.

[7]Author says that plant diseases and insect pests seriously affect the normal growth of plants, the yield and quality of agricultural products. In recent years, with the dramatic changes in climate, the natural environment of the plant growth has been damaged by pollution, frequent natural disasters, as well as the development of agricultural production.

[8]The state annually produces 1.31 lakh metric tonnes apple fruit from an area of 1.28 lakh hectares. It forms the pillarof the state's economy and is a major cash crop for the small farmers. However, because of several factors including insect and diseasesthe production and quality of apple is being poor as compared to that of the developed countries.

[9]Author says that Climate change is the most important challenge for horticulture industry in the future. Thissector is sensitive and susceptibleto climate change. The present studyreveal the climate change impact of the future period on the apple cultivation areas in Iran.

[10]Authortargetclimate change and variability are serious concerns for apple production. Climate is an important environmental variable factor affecting the production of fruit crops.

[11]This article focuses on Fruit Diseases of Apple that can cause substantialdamagesinharvestand quality of fruit. Often, these diseases go ignoreduntil just prior to harvest, during crop harvest, or after fruit has been stored. Although there are no healingtreatments for fruit which got infected, many diseases can be prevented with spraying of pesticides/ fungicides. Accuratefinding, is critical to determine the best management practices and to prevent future losses.

[12]Author focuses on the development of a disease forecasting system. This study aid to warn the growers in advance when environmental conditions are favorable for diseases appearance and crop can get infection. The most important parameters are low temperatures at the start of rainy season, the duration of rainy season and sunny periods or wind following rain fall that can support in the drying of fruit.

[13]The paper revealed about Pesticides that may be present in food, either as remainsfrom the treatment of crops, as a result ofinfection. Deposit of pesticides in food from agricultural treatmentmay cause possiblerisk to the children due to growing disclosure.

[14]Author says thatdisease of tree fruits, and apple in particular, continues to harvestalarm within the research community attempting to define and control the problem and among growers who are getting struggle to utilize no disinfectant measures to manage the disease.

Conclusion and Future Scope:
In this paper, an IoT based prediction system has been proposed to inform apple growers about the climatic situation when theinsects and diseases can make an unexpected appearance in apple. In other words, the purpose forthis study is to develop a system for predicting pests and diseases, analysing factors like humidity and temperature which can affect the fruit using IoT sensors.Also the proposed system will recommend a possible solution for the control/ avoidance of disease appearance in the fruit. As a result, orchard owners can use this system to help them make necessary and instant control decisions.

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