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VINEYARD MONITORING AND RECOMMENDATIONS USING WIRELESS SENSOR NETWORK: A STUDY

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Abstract— Grape is important fruit tree in our country, mainly in Sangli and Nasik district of Maharashtra. It has the major interest in global markets. The proposed work is to develop a vineyard monitoring and recommendations which will early detect the chances of diseases like downy mildew, powdery mildew, rust, anthracnose, bacterial leaf spot, etc. by using Wireless Sensor Network (WSN). In this proposed system we use temperature, relative humidity, moisture and a leaf wetness sensor. This system has main two parts i) a system which monitors the water, climate, pests, and diseases and ii) a web based tool for providing up to date information via SMS alerts and system generated voice to the farmer and expert. Here for data transmission, we use XBee module.

Keywords—Wireless Sensor Network, XBee

I. INTRODUCTION

A wireless sensor network is illustrated by Hill, Jason Lester with the simple equation in his PhD thesis [1]. Sensing + CPU + Radio = Thousands of potential applications. Wireless sensor network consists of self determining devices called as sensors which monitor physical or environmental conditions such as sound, temperature, pressure, humidity, etc. Wireless sensor network (WSN) is an important technology for automation in many current applications like medicine, transportation, agriculture, industrial process control, military etc.

India is an agrarian country, nearly 60% of its people depending directly or indirectly upon agriculture. In recent years, India has second rank worldwide in farm output. There is demand in India of monitoring and innovation in the field of agriculture. Using a greenhouse yielding process this can be achieved. With the help of modern technologies we can assist computing and fulfil the requirements in the aspect of WSN based crop communication and control [2, 3]. Wireless sensor technology in agriculture, need to replace some of the traditional techniques which will improve ruralfarming. Precision agriculture is a one of the solution suggested by the authors in [4, 5].

II. RELATED WORK

In [6] Rossi Vittorio et al. produced a DSS called vite.net. This was mainly developed for management of vineyards and it is intended for vineyard managers. The presented DSS has two main components, I) An integrated system for monitoring real time components II) A web based tool that can analyze this data and provides alerts to farmers for decision making. The paper presents the holistic approach towards the focusing on important problems in vineyards. Author delivered a system via s web portal so it enables both continuous updating by the provider and flexible access by the user. This paper provides a fully automation and integration of data collection.

In [7] Cao Wei et al. mentioned some wireless sensors and its applications. This paper focuses on the collection of sensing data from a remote site and performs operations like early warning or early email to experts. In multi-greenhouse micro-climate remote monitoring is more important. This system was tested in flower greenhouse in Washington.

In [8] Toghami Takashi et al. presented a long term monitoring for cultivation environment and scientific understanding of viticulture. This paper attempted the reconstruction of data acquisition system, the development of data collecting program, base station, and application of sensors in order to attempt the higher performance of the system. Also authors developed new data browsing application that improved the capability of data representation. Minimization of data loss and the improvement in the accessibility were successfully achieved by some modification in the existing gateway eKo by adopting a Linux box with a SD card as in the existing gateway eKo.

In [9] Nattapong Tongrod et al. developed a smart vineyard system and investigated various sensors for vineyard monitoring. This system mainly consists of microclimate station whichmonitors microclimate in vineyards, soil module measures the content of water in soil, relative humidity, the image array module which monitors a vineyard using a webcam and web based module which automatically generated generates web pages which consist of microclimate

data, soil data and image array data. This system was installed in GranMonte vineyard in Bangkok.

In [10] Arturo MEDELA et al. provide an innovative solution based on Internet of Things (IoT) for solving significant variations in the grape ripening process. Using advanced sensor technologies can analyze the data such as soil condition, vines growth or fragmentation status. This system is tested in the real world on land in Spain that carry out precision farming as well as improving traceability in entire winemaking process. Develop the concept of "Contingency Anticipation". The platform has to acquire knowledge and improve over time, which serves to anticipate possible problems. Using this system helps the vineyard manager communicate down, up and over time.

In [11] A. Matese et al. presented NAV system in which monitoring and collecting micro meteorological parameters in a vineyard using WSN. This system is based on master-slave. The slave unit contains sensors which send information to the master. This system has three steps, hardware functionality and data acquisition, energy consumption and communication. The NAV system provides graphical user interface.

III. MOTIVATION

Grape farming is the main source of earnings of my nearby village farmers; they have experienced various problems faced due to a drastic change in the environment, soil compositions, pest and insects. This is the main reason for growth of diseases. F**rom last few years' lots of farmers was** suicide due to destroyed vineyard. Also, due to lack of knowledge about diseases, farmers were spraying lots of pesticides which are wastage and bad effect on the environment.

IV. PROPOSED WORK

Rapid, accurate identification of diseases in the vineyard is key to preventing losses in quality and quantity. An existing process to identify diseases is manual and time consuming. Also these systems are implemented in foreign countries using related weather conditions. We propose monitoring and recommendation system for the vineyard, which will be working with Indian climatic conditions, which will help in early detection of various diseases using sensors and provide alerts to farmers or experts via SMS. The objective of our system is:

1. To study existing vineyard monitoring and recommendation systems.
2. To propose a new monitoring and recommendation system, this is helpful for early identification of diseases and provides recommendations to overcome same using fertilizers or pesticides.
3. To automate the process of data collection, this will be helpful to farmers and experts.

Our system is organized into following phases:

Fig. 1 Overall System Design

Data Transmission

One of the important part of our system is data transmission. The sensors generate data in the form of values in regular interval; we need to store this data for the further use. With the help of XBee transfer this data to server.

Data Storage

We get the data from XBee receiver module and using serial data transmission, this data is transmitted to the server. We need to store this data, so use mysql for storing that data. The database "testdb" is used to store temperature (temp), relative humidity (RH), leaf wetness (LW) and date-time. Here below table shows the data collected in the server after each 30 second interval.

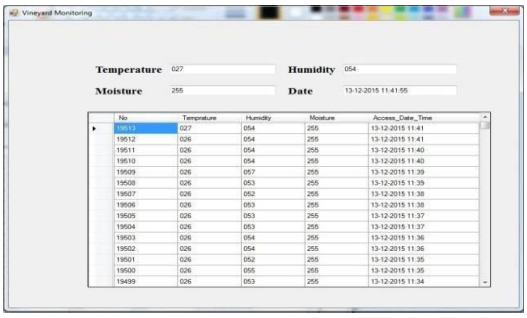

Fig. 2: Sample Data Collection

Data Analysis

Once data is stored in the database, then we need to analyze the data for the detection of diseases. This data is analyzed by using the benchmark provided by the **National Grapes Centre of Research and Vikaspedia** which is

given below in the table.

Disease Name	Temp (°C)	RH (%)	LW (Hours)
Bacterial Leaf Spot	25-30	80-90	-
Powdery Mildew	21-27	More than48	-
Downy Mildew	17-32.5	More than 48	2-3
Anthracnose	24-26	-	2-3
Bacterial Cancer	25-30	>80	-
Rust	24	75	-

Table1: Suitable Conditions for Growth of Diseases

With the help of above statistics and our collected data we get the result of disease which has chances to spread. In this phase want accuracy in the result, so use a naive Bays Classifier algorithm which is used to find out posterior probabilities of class. Here we have a training data set which is actual weather data stored in the data base. The class label is assigned to each row in the database in the form of YES or NO disease is found.

Now consider X tuple for which predicts the probability of downy mildew disease YES or NO.
X= (Min Temp=17°C, Max Temp=32.5 °C, Min RH=48, Max RH=100, LW=2)

Here we consider actual weather data which are in Table 2 for predicting class label, for that need to calculate prior probabilities.
P (Downy Mildew Disease =YES) =YES P (Downy Mildew Disease =NO) = NO

Now it's time to compute the conditional probability, P (X | Ci) for i= 1, 2, 3 ... n
P (Min. Temp=17|Disease=YES) = y1
P (Min. Temp=17|Disease=NO) = n1
P (Max. Temp=32.5|Disease=YES) = y2
P (Max. Temp=32.5|Disease=NO) = n2
P (Min. Humidity=48|Disease=YES) = y3
P (Min. Humidity=48|Disease=NO) = n3 P (Max. Humidity=100|Disease=YES) =y4 P (Max. Humidity=100|Disease=NO) = n4
Using above probabilities we obtain
P (X | Disease=YES) =y1*y2*y3*y4=P (YES) P (X | Disease=NO) =n1*n2*n3*n4=P (NO)
Now to find class Ci computes,
P (X | Disease=YES)* P (Disease=YES) = YES P (X| Disease=NO)* P (Disease=NO) = NO

After the calculation of mathematical equations get the highest probability for YES. So according to result here are chances of downy mildew.

Output Interpretation

This result is shown on the web tool in the form of text and the speech. The Fig. 3 shows the front page of web on which current weather conditions are displayed.

Fig. 3 Cover page of the web tool

We can also provide a facility in which only you provide a pruning date, and then automatic spraying schedule is displayed on the page. Also on the web pages farmers can see the current weather conditions, market information, fertilization schedule, varieties of grapes in India etc.

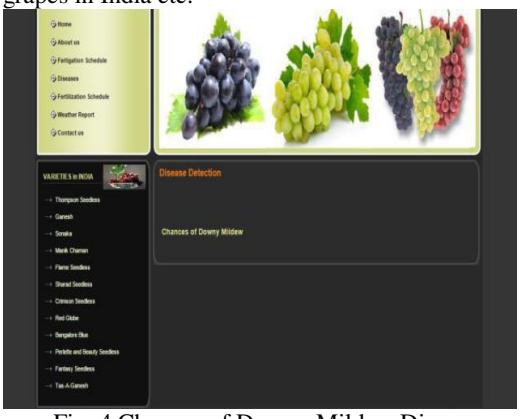

Fig. 4 Chances of Downy Mildew Disease

Alerts

When there are chances of any disease, then the system will generate a SMS. By using mysmsmantra SMS gateway we can send an alert SMS to farmers and the experts. This SMS contains the name of the disease which has chances to spread. Also after sending alert the fill the entry for that day in table so it avoid unnecessary duplicate sending of same alert.

V. RESULTS AND DISCUSSION

According to the Table 1 and the training data check for the chances of diseases.

Date \ Disease	Bacterial Leaf Spot	Powdery Mildew	Downy Mildew	Bacterial Leaf Cancer	Anthracnose	Rust	No Disease
27-11-2015	100	0	0	0	0	0	0
28-11-2015	0	0	0	0	0	0	0
29-11-2015	0	100	100	0	0	0	0
30-11-2015	0	100	100	0	0	0	0
01-12-2015	0	100	100	0	0	0	0
02-12-2015	0	100	100	0	0	0	0
03-12-2015	0	100	100	0	0	0	0
04-12-2015	0	100	0	0	0	0	0
05-12-2015	0	0	0	0	0	0	100
06-12-2015	0	0	0	0	0	0	100
07-12-2015	0	0	0	0	0	0	100
08-12-2015	0	0	0	0	0	0	100
09-12-2015	0	0	0	0	0	0	100
10-12-2015	0	0	0	0	0	0	100
11-12-2015	0	0	0	0	0	0	100
12-12-2015	0	0	0	0	0	0	100
13-12-2015	0	100	0	0	0	0	0
14-12-2015	0	100	100	0	0	0	0

Fig.5 Status of Disease

In this the Fig.5 shows that the disease and its status for each day. Here 100 mean the chances of that disease and if it is 0 then there is no infection of disease.

The below Graph 1 shows the diseases occurred during the period of 27-11-2015 to 14-12-2015.

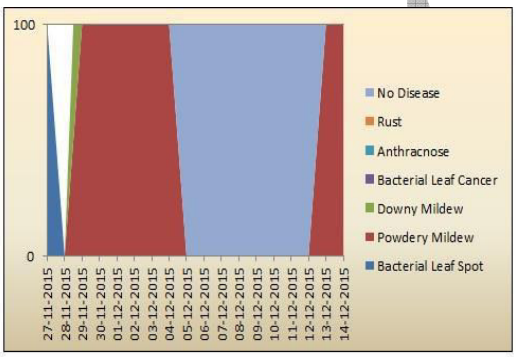

Fig. 6 Graph of all Disease Status during period 27-11-2015 to 14-12-2015

VI. CONCLUSION AND FUTURE WORK

Early detection of diseases and suggests pesticides and fertilizers is to help farmers to improve quality of farming and increase the production of grapes. By using proposed system farmers will get the up to date information about the vineyard like a schedule of fertilizer, pesticides, irrigation, etc. This will helpful to farmers and increase his profit also protect the vineyards before affecting the diseases.

For better results we will analyze the training data using machine learning. We propose a concept of a Hidden Markov Model for the accuracy in results. Also we made a comparison between two or more machine learning concepts.

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