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IoT based Smart Monitoring and Controlling System for Sericulture

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Abstract - *Sericulture (silk production) is one of the largest occupations of the rural community. India is the second-largest silk-producing country in the world. India produces over 30,000 tonnes of raw silk every year, which is about 18% of the world's total raw silk production. Analysis of sericulture in India brings up a need for automation, especially during the pre-cocoon stages. Internet of Things (IoT) concepts extend Precision Agriculture with smart, distributed, and collaborating sensors and technologies that are nowadays well established in other industrial sectors and home automation. This extension is often referred to as Smart Farming and comprises all steps from sensor-based data gathering and communication to data processing, storage, and analytics. Moreover, analytic results can be visualized by IoT frontends and feed decision support systems to help farmers to make better and more sustainable decisions.*

In this project, we will use IoT to lively monitor the environmental changes in the sericulture plants. Oracle database will keep on logging all the data received from the sensors. Using the data in the Oracle database, we will be able to perform machine learning and study the environmental changes. These changes will be livelily monitored on Tableau. Giving a wide technology usage to achieve quantities and qualities in sericulture farms.

Keywords- *IoT(Internet of Things).*

I. INTRODUCTION

A report by Central Silk Board shows that India globally ranks 2nd in total silk production while China ranks 1st. However, India contributes only 18% of world silk production compared to China's massive 82%. The lack of automation in the sericulture process is a reason that can be identified for such a huge disparity. This project recognizes IoT and Machine Learning in Sericulture to improve the yield of silk both qualitatively and quantitatively.

Sericulture is a basic practice of producing silk by rearing silkworms. It has been traditionally a primary occupation in India. Environmental factors play a vital role in the yield of silk. Several environmental parameters such as temperature, relative humidity, light, airflow, and air quality should be controlled during a silkworm's lifecycle to assure improvement in the quality and quantity of silk. Every moult, which is the growth stage of a silkworm, requires a certain set of values of environmental parameters to achieve an optimum yield. Requirements vary for every moult; the early stages of silkworm require relatively higher temperature as they are highly active and eat vigorously.

The role of each environmental factor can be understood as follows:

i. Temperature:

It is a key player in determining the quantity and quality of silk production. In the course of rearing silkworms, the temperature should not fall below 20˚C or rise above 30˚C.

ii. Relative Humidity:

Humidity plays both direct and indirect a vital role in silkworm. Temperature and humidity both parameters combine effect largely determine the satisfactory growth of the silkworms and production of good-quality cocoons. 70-90% is the recommended relative humidity.

iii. Air Flow:

Air current is required to build quality cocoons depending upon the environmental conditions. To remove the accumulated humidity in the mounting hall during the rainy season, more than recommended air current is must and vice versa during summer and winter. To avoid an accumulation of Carbon-di-oxide the rearing room should have enough fresh air. Proper ventilation can achieve Carbon-di-oxide in the rearing room not to exceed 1%.

iv. Light:

Larvae prefer dim light of l5-30 lux. Strong and bright light is better to be avoided from the cocooning frames. The trays containing larvae are usually covered with wax coated sheets to avoid contact with bright light.

The parameter values required to achieve optimum yield are mentioned as follows:

TABLE I

PARAMETER	REQUIREMENT
Temperature	20ºC TO 30ºC
Humidity	70% TO 90%
Light Intensity	15 TO 30 LUX(dim light)
Air Flow	Well ventilated room
Air Quality(Carbon Dioxide)	Not more than 1% (Avoid polluted air)

Smart, distributed, and collaborating sensors and technologies that are nowadays well established in other industrial sectors and home automation, Internet of Things (IoT) concepts extend Precision Agriculture. All steps from sensor-based data gathering and communication to data processing, storage, and analytics are often referred to as Smart Farming. To help farmers make better and more sustainable decisions, analytic results can be visualized by IoT frontends and feed decision support systems.

Without being explicitly programmed, Machine Learning is the scientific discipline that gives computers the ability to learn. The lack of existence of any 'optimum curve of yield' justifies Machine Learning's need in these control systems. Secondly, to execute stringent control over the parameters without any external intervention in this control system, adaptive decision-making abilities are required. The integral part of such highly autonomous systems is the ability to learn from their past experiences. The paradigm shift in the field of sericulture is achieved due to the use of such intelligent systems.

II. LITERATURE SURVEY

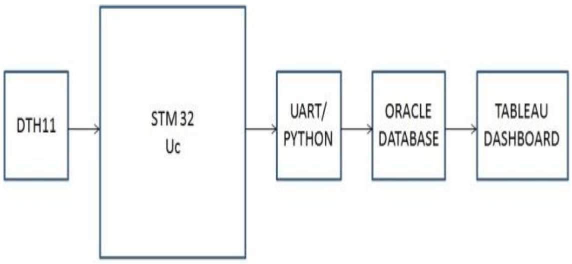
[1]"Intelligent Control System for Sericulture", M.A.Dixit, AmrutaKulkarni, NehaRaste, GargiBhandari. Using zone-based cascade control of physical parameters can be one solution as an Intelligent Sericulture plant automation system. Current systems for pre-cocoon stages are purely manual, crude, and lack intelligence. The system consists of a data acquisition sub-system corresponding to the rearing unit's predetermined zones, an intelligent master controller facility, a data repository of past corrective actions, and cheap actuators like fans, bulbs in the zones. The system comprises a cost-effective and power-efficient solution. Cheap and readily available actuators are incorporated into the system. The actuators are turned on when needed. By the creation of zones, the power efficiency increases furthermore. An automatic and intelligent system provides this real-time surveillance and control. It reduces the sericulturist's prolonged exposure to the rearing unit, thus reducing the possibility of developing lung cancer.

[2] "Design and Implementation of an Agricultural Monitoring System for Smart Farming", Jan Bauer, Nils Aschenbruck. The integration of modern information technologies into industrial agriculture has contributed to yield increases in the last decades. The emerging Internet of Things (IoT) with Wireless Sensor Networks (WSNs) with their low-cost sensors and actors enable novel applications and new opportunities for a more precise, site-specific, and sustainable agriculture in the context of Smart Farming. This paper presents a holistic agricultural monitoring system, its design, and its architectural implementation. The system focuses on the in-situ assessment of the leaf area index (LAI), a very important crop parameter.
Although considerable progress has been made in the last decade, deployment and maintenance of real-world WSNs are still challenging. Beyond the general WSN challenges, i.e., hardware constraints of small sensor devices, their power consumption, and low-power communication, there are specific additional challenges for long-term outdoor deployments. The main reasons for such challenges can be grouped into two categories first, environmental induced challenges and, particularly for agricultural deployments, second wildlife-caused challenges.
The overall architectural concept consists not only of the WSN itself but also of an IoT-based infrastructure, as sketched in the architectural overview of our system. The central base station acts as a gateway to a conventional IP-based IoT network. Internet connectivity is carried via public land mobile networks (PLMN) communication realized by an LTE modem attached to the gateway. The data gathered by sensors and collected by the base station is further transmitted to a farm management information system (FMIS) for data analytics and visualization.

[3] "IoT-based Automated Sericulture System" Srinivas B, KhushiKumari, Goverdhan Reddy H, Niranjan N, Hariprasad S A, Sunil M P.By employing NodeMCU and IoT technology-based invention 'IoT Based Automated Sericulture System' gives automation and guided control in sericulture. Inside the silkworm rearing house, the system facilities and conducts the environmental conditions to be reserved. Based on the environmental circumstances, required edge values for parameters like temperature, relative humidity, and light intensity can stabilize. Based on required environmental conditions fan, light, and the heater is turned on and off. The system is financially affordable and power effective. Implemented test of this system validates that the system can work gradually to observe the environmental conditions inside the silkworm raising house. The system reduces manpower and reduces the chance of errors. Continuous internet connectivity is required for the system. In the future, without using internet connectivity, this can be overcome by using the GSM module to send the notification directly on the framer's mobile through SMS.

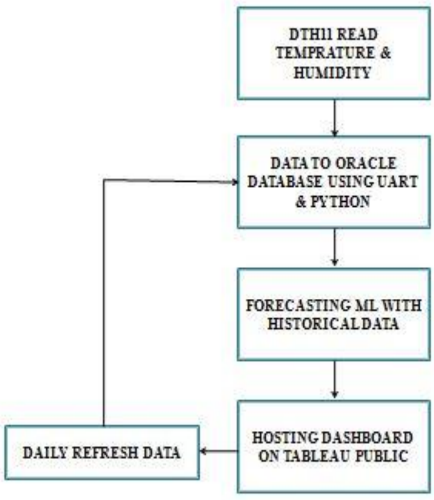
III. ARCHITECHTURE AND DESIGN

In this project, we will use IoT to lively monitor the environmental changes in the sericulture plants. Oracle database will keep on logging all the data received from the sensor. Using the data in the Oracle database, we will be able to perform machine learning and study the environmental changes. These changes will be monitored on Tableau Dashboards. Giving a wide technology usage to achieve quantities and qualities in sericulture farms.



3.1 Design Of System.

DTH11 sensor is used to monitor temperature and humidity and provide readings to the STM32 microcontroller. Every 5 minutes, the readings of temperature and humidity will be passed on to UART. Using UART interface and python, sensor readings will be stored in the Oracle database. Further with all data stored on the Oracle database will be used to perform Machine Learning.

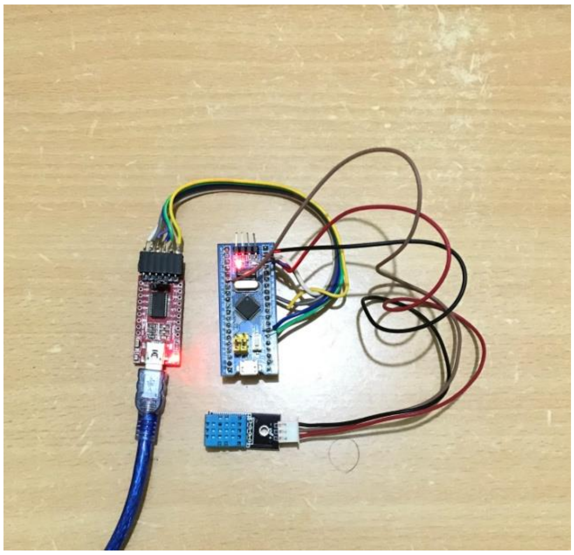


3.2Flowchart of system.

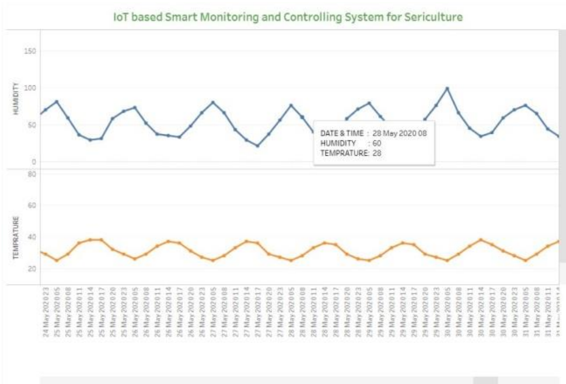
Using ML, we will predict and forecast the temperature and moisture for the next 7 days. Appropriate actions can be planned as per the forecast data. Tableau, a powerful dashboarding platform, is used to show the historical and forecast data.

In this project, Tableau, a Public platform, has been used to host the dashboard. Tableau desktop has been used to design and publish the dashboard.

IV. RESULTS



4.1 Hardware Results.



4.2 Software Results.

Data from sensors were collected and stored in the Oracle database using Python and UART communication. Data in Oracle was used to do ML and forecast temperature and humidity for the next 7 days. Historical and forecast data was hosted to Tableau public on a dashboard.

IV. CONCLUSIONS

Environmental parameters temperature and moisture is captured using the sensor. Readings from sensors were further processed to the Oracle database using UART via Python. Using the historical database, data of temperature and moisture are trained to ML, and forecasting predictions for the next seven days are made available. Entire historical and forecasting data is observed on Tableau dashboards.

This monitoring and forecasting help stringent control of several environmental parameters. The master control facilitates the optimum corrective action and directs the identified decisions based on biotic data obtained from the respective system.

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