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ISISF: IoT Based Smart Incubator for Sericulture Farm

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Abstract

Sericulture means the silkworm's production to manufacture silk. Parameters such as Temperature, Moisture,Lightness are key elements in the continuation of silk threads and appropriate promotion should be done according to the requirements in each category. Biodiversity plays an important role in the caterpillar's growth and development.Sericulture is a vital industry in India, but the methods used by farmers are now outdated. Hence, there is a need for modern advances in sericulture agriculture. This effort gives the idea of implementing advanced IoT and smart Sericulture technology using automation. Considering the natural boundaries of a warm house is a very important factor in improving the silk harvest. The specifics of this model include improvements to the system that can detect temperature, humidity, light power using ATMEGA 328P sensors, and in the event of when the parameters change, a notification sendsto the user's mobile app using the internet. This program uses the Arduino IDE software to test and edit data.

Keywords: Sericulture, biodiversity, incubator, Internet-of-Things, sensors, agriculture.

1. Introduction

Sericulture is a branch of knowledge that deals with the cultivation of silkworm embryos to produce silk. Silk was discovered in China around 2600 and 2700 BC and is known as the "Queen of Cloth" because of its luster, softness, elegance, resilience, and strength. Silk is a found naturally fiber that can be used in silkworm larvae's nesting nests or cocoons [1]. Silk is favored over all other fibers due to its exceptional properties, which include water absorption, heat resistance, dye efficiency, and luster. The body heat and humidity of an insect are affected by a variety of factors. Insects are remarkably adaptable, even in the face of extreme environmental changes, and they keep internal and water temperatures within acceptable ranges [2].

Silkworms are one of the most common insect pests, and they produce silkworms that catch the flu while pregnant by eating mulberry leaves. Genotypic transcription and in form of phenotypic extracts such as cocoon weight, shell weight, and cocoon shell ratio are significantly affected by natural fluctuations in organic materials. The need for reliable ventilation and air conditioning for sustainable coconut production has been illustrated by biological diversity over the last decade. It is practiced in tropical areas such as Karnataka, Tamil Nadu, Andhra Pradesh, and West Bengal, as well as to a lesser degree in the cooler region of Jammu and Kashmir, according to Indian farming culture.Since they are durable and have great potential for survival and reproduction under changing weather conditions, the current tropical environment provides a measure of the use of the multivoltine bivoltine hybrid in the commercial market. Multivoltine seeds account for the majority of silk production (95%) [3].

The study looked into the genetic potential of multivoltine silkworms and discovered parents for reproductive systems. China produces more than 80% of the world's silk, while India produces 15-16percent of the overall amount. The quality of Chinese silk is comparable to bivoltine. Given these concerns, bivoltine sericulture was deemed appropriate, and its potential was very close, even in the sweltering Indian climate. Many bivoltine-producing and active varieties in this line are bred with domesticated Japanese varieties as additives [4].

2. Effects of Environmental Parameters

Air temperature, relative humidity, air distribution, and light all play a role in silkworm embryonic development as shown below.

A. Temperature:

The temperature has a direct relationship with silkworm growth and plays an important role in larval advancement at different instars. Table 1 shows the appropriate temperature range for raising silkworms of various early instars [5].

Table 1: Ambient temperature requirements of silkworm during variousstages

Stages	**Incubation**	**1st**	**2nd**	**3rd**	**4th**	**5th**
Temp(°C)	25	28	27	26	25	24

Silkworm growth is harmed by a wide range of temperature variations. When the temperature increases, the numerous biological capacities increase, and as the temperature decreases, the physiological exercises become more difficult. The optimum temperature for silkworm growth is between 20 and 28 degrees Celsius.The optimum temperature for intense profitability is between 23°C and 28°C. Temperatures over 30°C have a direct impact on the worm's health. The physiological activities of the worms are slowed by temperatures below 20°C, particularly in early instars, and the worms become excessively feeble and helpless, making them susceptible to various illnesses [6].

B. Relative Humidity:

Humidity plays an important role in silkworm development, both directly and indirectly. The impact of dampness is responsible for the silkworms' elegant growth, the production of high-quality cocoons, and the silkworm's physiological processes [7].

Table 2: Optimum humidity requirements of silkworm during various stages

Stages	**Relative Humidity**
Incubation	75-80 %
1st instar	85-90 %
2nd instar	85 %
3rd instar	80 %
4th instar	70-75 %
5th instar	65-70 %
Spinning	70 %
Cocoon Preservation	80 %

Humidity has an indirect effect on the rate at which the leaves in the silkworm rearing beds wither. The leaves wilt quickly in dry conditions, particularly in the winter and summer, and hatchlings will consume less.This affects hatchling growth and leads to leaf waste in the raising bed. Young hatchlings become powerless and vulnerable to infections as their growth is slowed [8]. Table. 2 lists the optimal stickiness conditions for different early-age and later-age worms.

C. Air and Light:

Silkworms release carbon dioxide gas into the rising bed during their breathing, and CO2 materials are used to determine air quality. In the raising room, the climatic CO2 content should be about 0.03-0.04 percent. If CO2 levels rise above this level again, silkworm production will be hampered.Larvae of a younger age are more vulnerable to noxious gases, so artificial air dissemination is extremely beneficial in reducing contaminated air. In comparison to those reported under zero ventilation, a 1.0m/sec air current during fifth age raising reduces larval mortality and increases absorption, absorbability, larval weight, case weight, and pupation rate [9-10].

3. Objectives

The main objectives of the proposed system are as follows.

- To minimize manual invention, by automating the method of silkworm rearing unit.
- To monitor the temperature and humidity of the silkworm rearing unit continuously.
- Convey the temperature and humidity data to the remotely connected farmers.
- To facilitate an increase in the production of silk.

4. Existing System

The difficult role of experimental features is the latest procedure and one of the oldest methods of field research. In this way, the farmers, themselves verified all the factors and calculated the required prices. Reports from the central silk board suggest that India ranks second in the world in total silk production, but only 15% as 85% of it comes from China this is due to a lack of machinery. The implementation plan includes the elimination of the difficulties that farmers face on hand farms. The program includes the integrated use of a microcontroller module and an IoT that provides automated devices to manage and manage users [11].

5. Proposed System

The proposed protocol utilizes code and hardware tools to properly track and manage the seasonal variation of the silk caterpillar that continuously increases the house. Fig. 1 reflects the proposed scheme's diagram. Also, the proposed system uses the security protocols proposed by authors [12-15]for secure communication. The proposed program accomplishes the following objectives.

- Depending on the sensor signal, analyze the condition and give the correct one.
- Microcontroller sensors to achieve the desired effect.
- Sensor testing and verification.

5.1 System Model

The device consists of sensors, an ATMEGA 328P, and actuators, as seen in the image below. The device is made up of three heat, humidity, and light sensors. The ATMEGA 328P is designed to track and control the model at the threshold values set by a scheme that includes both software and hardware components.The primary aim of the system's design is to make the equipment function as a controller. The code for selected ports on the printed circuit board is filled with the necessary feature. It is a clear way to manage the whole process according to the code's requirements.

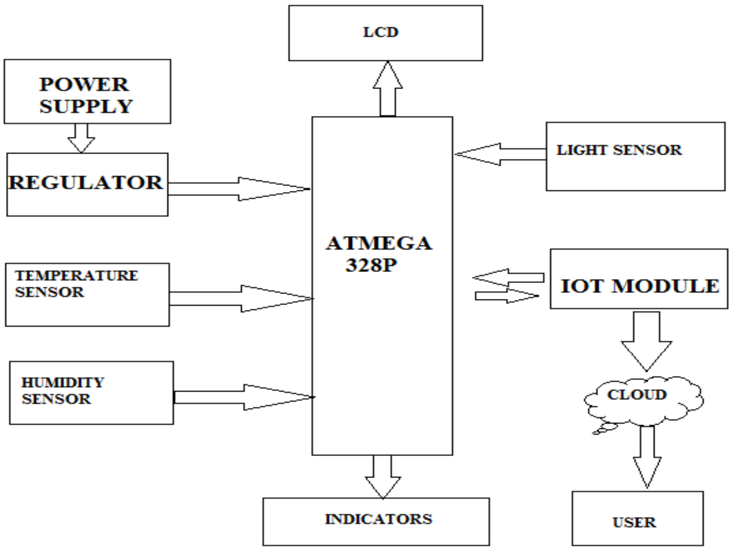

Fig. 1 System model

5.1.1. Hardware Components Used

LCD:(Liquid Crystal Display) screens are a form of electronic display that can be used for a variety of purposes. A 16x2 LCD is a common component that can be used in several devices and circuits. These modules are the most common, with seven sections and alternative multi-segment LEDs.

HUMIDITY SENSOR: The presence of water in the air is described as humidity. The amount of vapor in the air has an effect on human comfort as well as many industrial processes. Humidity measurement in industries is important because it affects the commercial value of the goods as well as the health and safety of the workers.

LIGHT SENSOR:A light detector could be either a mechanical or electronic device that detects light. Bachelors' degree The LDR (Light-dependent resistor) provides resistance in response to the proximity of light. Since the strength of incident lightweight increases, resistance decreases, and vice versa. LDR has a resistance of the order of mega-ohms that decreases in the absence of sunlight. LDR has a resistance of the order of mega-ohms in the absence of sunlight, which drops to a few hundred ohms in the presence of sunlight. Since a variable dip can be obtained, it will serve as a detector.

NODEMCU: NodeMCU is an open-source platform, its hardware architecture is available for anyone to edit, change, or create. The ESP8266 Wi-Fi-enabled chip is used in the NodeMCU DevKit/board. The ESP8266 is a low-cost Wi-Fi chip with a TCP/IP protocol developed by Espressif Systems. Very less expensive compare to others.

5.1.2. Software Components Used

ARDUINO IDE: The Arduino Integrated Development Environment (IDE) is a Windows, Mac OS X, and Linux platform system for C and C++ functions. It's used to note and upload programs to Arduino-compatible boards as well as other third-party core-supporting development boards from other manufacturers. Fig. 2 shows the Arduino IDE Software user interface.

Fig.2. Arduino IDE Software (source: https://www.arduino.cc/en/software) [16]

6.Results and Discussion

Whenever the system detects variations in natural parameters, the information is displayed on the webpage and sent as a message to the agriculturist, who is then instructed to make pre-programmed basic moves. For example, if the temperature rises, the fan will be switched on; if the temperature falls, the fan will be switched off. When low light is detected, the LEDs or globules will turn on.

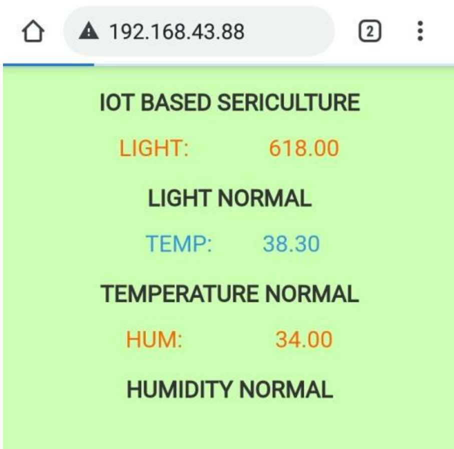

Fig 3: Proposed system output1

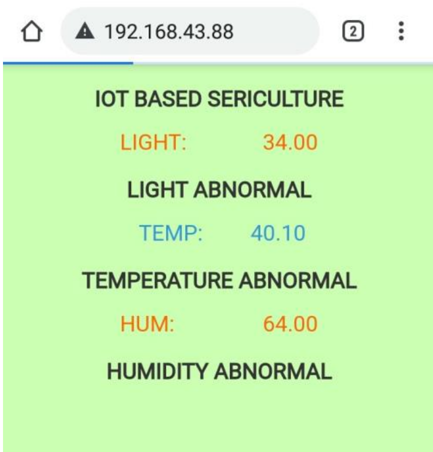

Fig. 4. Proposed system output2

Fig. 3 shows the output message displayed on the web page. We can see the Temperature value is normal so that the fan remains off, Light value is normal because the light value is correct for the sericulture farm, so the light remains turned off and the Humidity value is normal. With help of this, we can be able to monitor all values.

Fig. 4 shows the output message displayed on the web page. We can see the Temperature value is abnormal so that the fan remains on automatically to bring the temperature to normal, Light value is abnormal because the light value is too low for the sericulture farm, so the light is automatically turned on and the Humidity value is abnormal. With help of this, we can able to monitor all values.

Fig. 5. Proposed system output3

Fig.5 shows the output message displayed on the web page. We can see the temperature value is normal so that the fan remains off, light value is abnormal because the light value is low for the sericulture farm, so the light remains turned on and the Humidity value is normal. We can see a mixed output form above Fig.5. With the help of a prototype, we can monitor any kind of climatic condition that is required for the sericulture form.

7. Conclusion and Future Work

This "IoT Based Automated Sericulture System" provides automated and targeted controls for sericulture development using ATMEGA 328P and IoT-based technology. Proposed system resources and environmental conditions that will be stored inside the silkworm embryonic cell. Natural conditions may be used to stabilize the necessary edge values of parameters such as temperature and humidity correlated with light intensity. Depending on the safety requirement, the lamp, and heater are illuminated and turned on based on the required natural environment. A planned system is costly and highly organized. The experiments used in this model system show that the proposed system can gradually control the worm house's environmental conditions. Also, it reduces staffing requirements while also lowering the risk of errors. The model is simple to run and use.

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