



SILKWORM FARM AUTOMATION USING IoT

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Abstract: Agriculture is the backbone of India. Agriculture is the main source of income for most farmers. Farmers are experiencing many economic crises due to a lack of adaptation to new technology. Raising silkworms is known as sericulture, and it provides significant profit and self-employment opportunities. To get the best results from silkworm rearing, it must be improved. Every procedure in this project has been designed with the use of electrical and electronic components to provide automation and complete protection for the farm to the silkworm-raising home. Adopting automation in feed suppliers, temperature management, moisture control, adequate ventilation, and automatic medicine sprinkling, helps farmers. Different temperatures and moisture levels are needed to maintain silkworm growth, a proper air quality and ventilation system, and a periodic food supply. Arduino microcontroller, temperature, moisture sensor, air quality sensor, smoke sensor, GSM, and Wi-Fi module are accustomed to establishing this. This project automates silkworm farms using IoT and helps farmers to increase production. Due to automation, farmers do not need to spend more time on silkworm farms.

Index Terms – Sericulture, Arduino, IoT, GSM.

1. INTRODUCTION

Silkworm farming, also known as sericulture, is an ancient practice that involves the cultivation of silkworms (*Bombyx mori*) for the production of silk. The rearing of silkworms and the ensuing production of silk have been remarkable economic activities for centuries, contributing to the textile industry and agrarian lifework.

Silkworms are highly tactful to environmental conditions and peculiar climatic factors, which play a crucial role in their growth, development, and silk production. Primarily, we will dig into the various climatic strands that notably sway silkworm maturing, such as temperature, humidity, and light. The ideal temperature range for silkworm growth is between 20°C and 28°C, while the ideal temperature range for maximum productivity is between 23°C and 28°C. If the temperature is kept between 26°C and 28°C, they can develop without being significantly hampered at a humidity of 90% or greater. The amount of CO₂ in the air can be used to gauge its freshness. Silkworm growth is slowed down if CO₂ concentrations are higher than 2%. Because they are photosensitive, silkworms gravitate towards low light. Silkworms prefer the soft light of 15-20 lux and stay away from darkness and intense light. Initially, the zone-based approach cascade control came into existence which refers to a control strategy that divides the sericulture system into different zones or areas and applies control mechanisms specific to each zone. Each zone can be optimized individually, and the control mechanisms are designed to interact and unison to create a cascade structure.

The classical methods of sericulture farming are labor-intensive, time-consuming, and often involve physical tracking of the silkworms, which could be an arduous task. In this context WSN based intelligent control systems came into existence; Wireless sensor networks are highly distributed networks of self-aware sensors that are deployed in different locations across the globe to perform various tasks. The deployment of wireless sensors within the sericulture farm provides persistent and exact monitoring of

critical factors such as temperature, humidity, light intensity, and ventilation. It enables real-time, remote monitoring, reducing the need for constant physical presence and minimizing the risk of human error.

With the rapid furtherance of technology, Growing attention is being shown to creating automated systems that can enhance the efficiency and productivity of sericulture practices. In this context, the proposed Arduino and IoT-based automated silkworm farm. The automation system presents a promising solution to streamline and optimize various aspects of the sericulture process. In order to better clarify the notion of silkworm farm automation via IoT, this paper aims to draw attention to it. The system uses Arduino microcontrollers as well as other electrical components and sensors, to automate and control key processes in silkworm rearing. The output of sensors is given to the microcontroller. When any of the mentioned parameters (i.e. Temperature, humidity, air quality, light) exceeds the safety threshold which has to be maintained, the sensors constantly sense the variation and the microcontroller gets this data at its input ports and the actuator unit will be performed necessary actions. The farmer's mobile phone will get the data and conditions from the raising home through GSM, and a Wi-Fi module will upload them to the cloud. With the assistance of GSM, the farmers can initiate powder sprinkling and food-feeding operations through a phone call. The data is then reviewed and used to control and amplify the rearing environment, which eventually steers to finer silk production.

2. BLOCK DIAGRAM



figure 1:block diagram

An embedded IoT-equipped system will closely monitor and control the environmental parameters inside the rearing house. The system has three parts: a sensing unit, an actuating unit, and a microcontroller. The sensing part consists of sensors like DHT11 (temperature sensor, humidity sensor), LDR (light sensor), Fire sensor, and MQ135 (air quality sensor). The Arduino Uno microcontroller is programmed to have predefined threshold values to monitor and control the system. When any of the mentioned parameters exceed the predefined threshold inside the rearing house, the sensor recognizes changes in the threshold. The microcontroller gets this data through its input ports. The sensor's data and conditions of the rearing house are continuously sent to the cloud, and an alert message is sent to the farmer's mobile via GSM if any predefined threshold crosses the safety boundary. The microcontroller then performs the necessary actions through the motor driving circuit by employing actuators until the exceeded parameters have been brought back to their safety threshold. For example, the CO₂ data will be compared with the threshold and if it exceeds the safe threshold value, the firefighting system will be powered on. Similarly, this process is carried out for the remaining parameters. The feeding process and medicine spraying must be carried out then the farmer can communicate with the microcontroller through GSM to take the needed action. The system also consists of an LCD for displaying things happening inside the farm. As a result, the whole structure is more farmer-friendly.

3. HARDWARE AND SOFTWARE REQUIREMENTS

3.1 HARDWARE REQUIREMENTS

- **DHT11:** The DHT11 sensor includes a distinct negative temperature co-efficient for temperature measurement as well as an 8-bit microprocessor for serial data output of temperature and humidity measurements. The sensor is also factory calibrated, making interfacing with other microcontrollers simple. The sensor has an accuracy of 1°C and can measure humidity from 20% to 90% and temperature from 0°C to 50°C.
- **LDR:** To interact with or gauge the presence or absence of light, light-sensitive devices (LDRs) are used. Depending on the amount of light, the resistance of the LDR sensor swiftly decreases when exposed to light, sometimes reaching as low as a few ohms. In the absence of light, they possess exceptionally giant resistances that surpass 1 mega ohm.
- **FIRE SENSOR:** As its name implies, the fire sensor is used to locate flames in the 760–1100 nanometer wavelength range. Little flames, such as those from a lighter, can be seen at a distance of around 0.8m. The sensor is very responsive to the flame spectrum and has a detection angle of roughly 60 degrees.
- **MQ135:** The MQ135 is a well-liked gas sensor from the MQ series sensors that are commonly used in air quality control equipment. It has the ability to detect gases such as ammonia (NH₃), sulphur (S), benzene (C₆H₆), CO₂, and other dangerous gases and smoke. It is functional between 2.5V and 5.0V and can produce both digital and analog signals.
- **ESP8266:** Any microcontroller can connect to your Wi-Fi network with the ESP8266 Wi-Fi Module, a self-contained SOC with a built-in TCP/IP protocol stack. The ESP8266 is equipped with the ability to host applications or delegate control of all Wi-Fi networking tasks to another application processor. Attaching an ESP8266 module to your Arduino device is all that's required to get virtually as much Wi-Fi functionality as a Wi-Fi shield (and that's right out of the box), as each one includes AT command set firmware that has been pre-programmed. The ESP8266 module is a very affordable board.
- **GSM:** The SIM t can 800L GSM module is a tiny GSM modem that may be utilized in a variety of projects. This module can carry out a variety of tasks a typical cell phone can do, including making calls, sending SMS messages, and much more. The module works practically everywhere in the world because it supports quad-band GSM and GPRS networks. Since the chip's operational voltage spans from 3.4V to 4.4V, a direct LiPo battery supply is a perfect fit for it. The module is compatible with quad-band GSM and GPRS networks, making it practically universal.
- **COOLING FAN:** Cooling fans are integral to automation systems as they regulate temperatures, dissipate heat, extend component longevity, optimize performance, improve energy efficiency, and reduce noise. By ensuring proper cooling, these fans contribute to the reliability, efficiency, and longevity of automated devices and systems.
- **EXHAUST FAN:** Exhaust fans are crucial for promoting ventilation, controlling temperature and humidity, improving the quality of indoor air, reducing odours, and adhering to safety rules. By efficiently extracting and expelling air, these fans contribute to a healthier and safer environment for both equipment and personnel involved in automated processes.
- **L293D:** A pair of DC motors can be controlled concurrently in either direction by this 16-pin motor driver IC. The L293D is made to deliver bidirectional drive currents up to 600 mA (per channel) at voltages ranging from 4.5 V to 36 V.
- **ULN2003:** The ULN2003 driver's role is to communicate with the stepper motor. The ULN2003, which has a high current and high voltage capability, provides a larger current gain than a single transistor and enables a microcontroller's low voltage and low current output to drive a stepper motor with a higher current.
- **16*2 LCD:** A 16x2 LCD has two lines with a capacity of 16 characters each. Each character on this LCD is presented in a 5x7 pixel matrix. There are 224 different characters and symbols that can be displayed on the 16 x 2 intelligent alphanumeric dot matrix display. voltage and low current output to drive a stepper motor with a higher current.
- **LED:** When an electric current passes through a semiconductor device known as a light-emitting diode (LED), it emits light. An LED produces light when electricity travels through it as the electrons and holes bind together. LEDs only let a single path for current flow (i.e., forward) and restrict it from flowing the reverse way.
- **BUZZER:** The signal is converted from audio to sound as its primary function. It is often powered by 5 volts of DC energy and used in timers, alarm clocks, printers, computers, and other electronic equipment. It can produce a variety of sounds,

including alarms, music, bells, and sirens, depending on the varied designs.

- **ARDUINO UNO:** The Arduino UNO microcontroller board is built on the ATmega328P microprocessor. It contains 14 digital input and output pins, six of which can be used as PWM outputs, a USB connection, a power jack, an ICSP header, a reset button, six analog inputs, a 16 MHz ceramic resonator, and so on. Everything needed to support the microcontroller is included; all you need to use it is a USB cable, an AC-to-DC adapter, or a battery to supply power.
- **WATER PUMP:** A 12-volt water pump is a direct current (DC) electric water pump motor that is powered by a 12-volt power source. For sprayers, vehicles, fountains, showers, gardens, etc., it transfers, lifts, or circulates liquids like water, oil, and coolant using centrifugal force produced by a high-speed revolving impeller.

3.2 SOFTWARE REQUIREMENTS

- **THINGSPEAK:** The sensor's data can be uploaded to the cloud using the IoT cloud platform called ThingSpeak. With MATLAB or other tools, you can also perform data analysis and visualization, as well as create your own apps. MathWorks runs the ThingSpeak platform. You must either log in to your current MathWorks account or establish a new MathWorks account in order to register for ThingSpeak. You may gather and store sensor data in the cloud with ThingSpeak's Web Service (REST API) and create Internet of Things apps. It functions with MATLAB (premade libraries and APIs are available), Arduino, and Raspberry Pi.
- **Arduino IDE:** Writing and uploading code to Arduino boards is done using the open-source Arduino IDE program. Linux, Mac OS X, and Windows are just a few of the operating systems for which the IDE program is appropriate. It supports C and C++ as programming languages. The Integrated Development Environment, or IDE, is used here.

4. METHODOLOGY

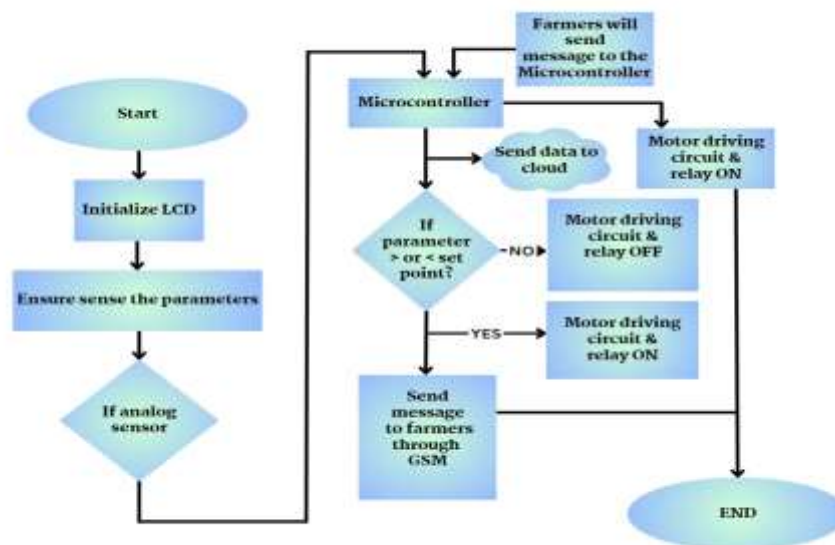


figure 2:flow diagram

The framework comprises sensors, microcontrollers, and actuators. The sensors circuit includes four analog sensors in particular temperature & humidity, light, air quality sensor, and a fire sensor. The Arduino microcontroller is customized such that it will have edge values and the ability to screen and control the framework. The yield of simple sensors is given to the microcontroller. The sensors detect the variety when any of the predefined parameters exceeds the security edge that must be maintained, and the microcontroller receives this information at its input ports. The information and conditions in the silkworm-rearing house will be sent to the cloud and agriculturist's portable through Wi-Fi and GSM. The microcontroller then plays out the fundamental activities through the motor driving circuit by utilizing the actuators until the surpassed parameter has been taken back to its ideal level for instance, the temperature information will be contrasted and edge, on the off chance that it is surpassed or underneath as far as possible then the temperature control unit will be fueled on. A comparable process is done regarding the remaining sensors. On the

off chance that any feeding process and pharmaceutical splashing needs to complete then the farmer simply the microcontroller through GSM to make the required move via phone call. The framework likewise utilizes LCD show for ceaselessly cautioning the client with respect to the conditions inside the homestead. Consequently, the whole setup moves toward becoming progresses toward becoming easy to use.

5. RESULTS

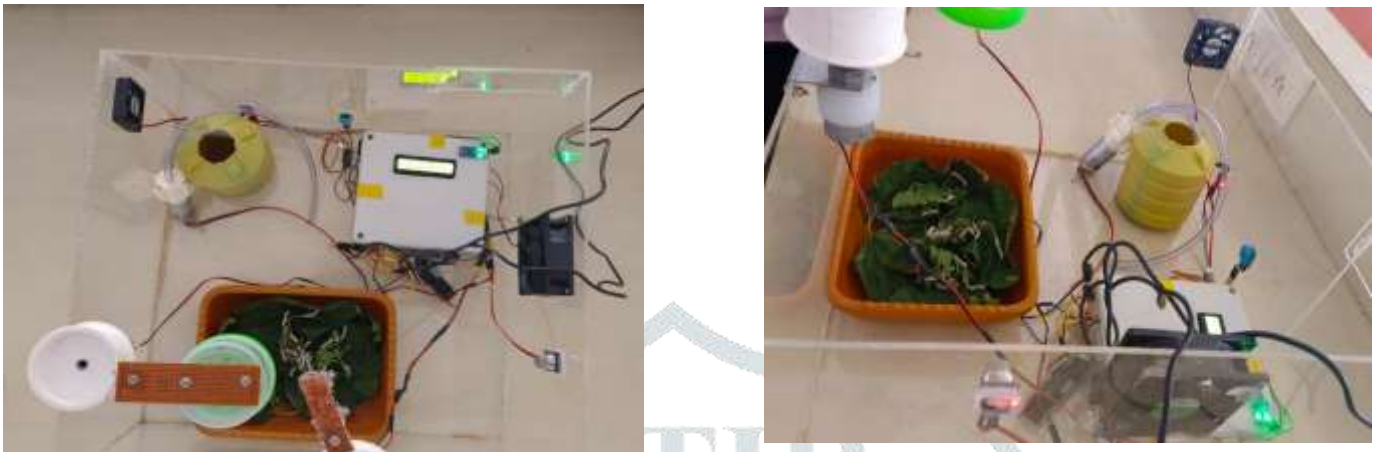


figure 3,4: prototype of the model



figure 5: parameter data recorded at website



figure 6: displaying messages on lcd

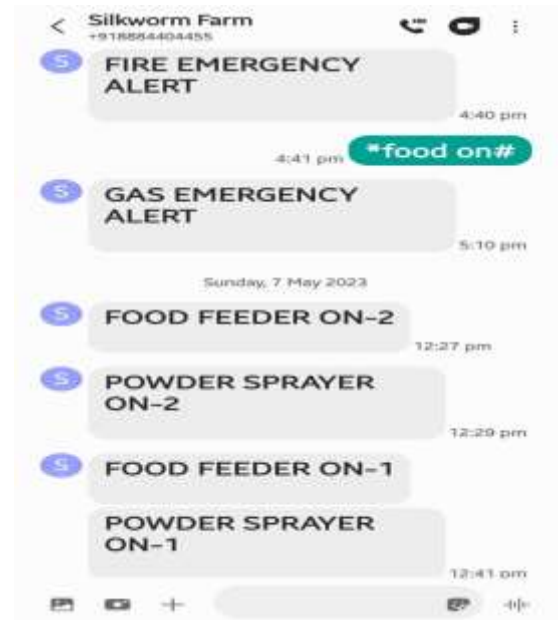


figure 7: messages from & to the farmers mobile

6. ADVANTAGES

- ✓ Automated processing is a major advantage in this project.
- ✓ The sericulture farm is protected and the entrance of insects is detected using an IR sensor.
- ✓ Protects the silkworm from extinction since the wastages are removed periodically.
- ✓ The motor drive used here is more efficient.
- ✓ The temperature and moisture level in the farm are controlled automatically.
- ✓ It helps farmers come out of their economic crisis.
- ✓ This project is economically feasible.

7. CONCLUSION

This paper outlines a mechanism for an Internet of Things (IoT)-based automation system for farms that raise silkworms, which has the potential to completely transform the silk farming sector by increasing the standard of production of silk. With the capacity to monitor and manage the feeding and medication spraying for the silkworms with the use of sensors, actuators, GSM, and Wi-Fi. Real-time data collection is based on environmental factors like temperature and humidity, light, and air quality. IoT-based automation of silkworm farms can give farmers access to hitherto unattainable levels of information and management control. The proposed structure is a power- and money-saving arrangement. Utilizing the framework is simple and easy.

The future work incorporates developing an automated robot with a mechanical arm and vision that will monitor the farm and place the worms to their places which are fallen out from their place and also developing an application that will allow the farmers to set the farm parameters according to their requirements and control food feeding, and sprinkling operations through the application

8. REFERENCES

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