

# Implementation of Sericulture Farm Automation using Sensor Network and GSM Technology

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## Abstract

Sericulture basically refers to the production of silk by the rearing of the silk producing organisms. In the present world when everything can be controlled and operated automatically, there are still a few important sectors in our country where automation has not been adopted or not been put to a full-fledged use. One such field is the sericulture. The reports from the Central Silk Board suggests that India ranks second in the world for total silk production, but it is only 15%, as 85% of it is from China. This low amount of silk production is due to the lack of automation in sericulture process. This implemented system involves the eradication of the difficulties faced by the farmers in manual sericulture farm. The system involves the combined usage of the Microcontroller and GSM module providing automated control features to the farm and the user. The automated system senses the inputs such as the temperature, light intensity, humidity, and gases such as the LPG, Carbon-di-oxide from the environment inside the sericulture farm. Whenever the detected inputs exceed the threshold values then this information is conveyed to the user through the wireless network and necessary measures are taken by the microcontroller in order to avoid the fatalities that affect the farm as well as the growth of the silkworms. The communication between the system and the user is, achieved by the use of GSM module. The GSM is made accessible to the user to carry out the food feeding and the fertilizer spraying operation to the silk organisms. The system finally implemented is a futuristic set-up that reacts to any climatic changes that occur inside and the system suitably responds to the stimuli effectively. The implemented system had a flaw, where the user was restricted from receiving the message from the system when the mobile was turned off and there is a possibility of low signal power strength that creates disturbances in the GSM network between the system and user. The system eradicates these drawbacks by automating the farm such that the operations will be carried out in timely manner and the concept of call forwarding is applied where the system can send the message to the alternative number as specified and placing the GSM module in an area where full signal strength is available for the communication. The system works in the automated way as intended. The system is undoubtedly inexpensive and a helpful need to the farmers. The system is advantageous in increasing the production of the silk.

**Keywords:** Silkworm, Sericulture, Wireless Sensors, Microcontroller, GSM, Temperature, Humidity, Light, CO<sub>2</sub>.

## 1. Introduction

A Chinese adage says "Tolerance is power; with time and persistence the mulberry leaf turns into a silk outfit." The word Sericulture is gotten from a Latin word "Serio" or Greek word "Sericos" signifying "Silk" and "Culture", an English word which signifies "Raising". Hence sericulture alludes to the "raising of silk creating living beings" keeping in mind the end goal to acquire silk from them. Sericulture regularly alludes to the composite action which incorporates mulberry rising, which is the nourishment plant for silkworms, raising of silkworms and closure with the case's transfer. Silk is frequently referred as "ruler of material", the most valuable characteristic fiber since ages among materials and no other fiber can coordinate it in luster, elegance, durability, delicateness and tensile properties.

The mulberry silkworm (*Bombyx mori* L.) is a standout amongst the most vital trained creepy crawlies which create silk string by expending mulberry leaves as casing. The silkworm's versatility to change in ecological elements broadly contrasts from different creepy crawlies. Since silkworm is very not the same as different creepy crawlies, it is exceptionally delicate to changes in condition and can't get by under extensive variety of varieties.

## A Effect of environmental parameters

The part of temperature, relative humidity, air dissemination and light that would influence the embryonic advancement of silkworm can be comprehended as takes after:

### i. Temperature

The temperature assumes a lively part on larval advancement at various instars and has an immediate relationship with the silkworm development. The encompassing temperature required for raising silkworms of various early instars are depicted in Table 1

**Table 1: Ambient temperature requirements of silkworm during various stages**

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

The extensive variety of fluctuations in temperature is hurtful to the improvement of silkworm. Ascend in temperature quickens the different physiological capacities and with a fall in temperature, the physiological exercises get hindered. The ideal temperature for sound development of silkworms is in the vicinity of 20°C and 28°C

and the attractive temperature for most extreme profitability ranges from 23°C to 28°C. Temperature over 30°C straightforwardly influences the soundness of the worm. The temperature underneath 20°C decelerates the physiological exercises, particularly in early instars, the worms turn out to be excessively feeble and helpless, susceptible to various diseases.

**ii. Relative Humidity**

Humidity likewise assumes an imperative part in silkworm raising both specifically and by implication. The impact of dampness makes sense of the attractive development of the silkworms, generation of good-quality cocoons and straightforwardly impacts physiological exercises of the silkworm.

**Table 2: Optimum humidity requirements of silkworm during various stages**

Stages	Relative Humidity
Incubation	75-80 %
1 <sup>st</sup> instar	85-90 %
2 <sup>nd</sup> instar	85 %
3 <sup>rd</sup> instar	80 %
4 <sup>th</sup> instar	70-75 %
5 <sup>th</sup> instar	65-70 %
Spinning	70 %
Cocoon preservation	80 %

Humidity also indirectly influences the rate of withering of the leaves in the silkworms rearing beds. Under dry conditions particularly winter and summer the leaves wilt quickly and utilization by hatchlings will be less. This influences development of the hatchlings and results in wastage of leaf in the raising bed. Hindered development of youthful hatchlings makes them powerless and vulnerable to infections. The ideal stickiness conditions required for various early age worms and later-age worms are as specified in Table2:

**iii. Air and Light**

The carbon dioxide gas is discharged in the raising bed by silkworms amid breath and the CO<sub>2</sub> substances are utilized to decide the freshness of air. The climatic CO<sub>2</sub> content must be by and large 0.03-0.04% in the raising room. In the event that CO<sub>2</sub> surpasses this range again the development of silkworm is hindered. In this way, mind must be taken to let the outside air through appropriate ventilation into the raising space to keep the lethal gasses at least level. The youthful age hatchlings are more helpless to the noxious gasses and thus artificial dissemination of air is to a great degree valuable in cutting down the polluted air. The air current of 1.0m/sec amid fifth age raising decreases the larval mortality and enhances ingestion, absorbability, larval weight, case weight, and pupation rate contrasted with those recorded under zero ventilation condition.

**B Need of Automation**

The report given by the Central Silk Board demonstrates that India appreciates the agreeable second position in the aggregate silk

creation next just to China. It is realized that varieties in the ecological elements will enormously influence the development and improvement of silkworm. India represents the 15-16% of the aggregate creation when contrasted with China's 85%. This enormous uniqueness exists because of the absence of mechanization in sericulture process and it is watched that everything is manual which incorporates the treatment of silkworms; measures produced to decrease the results of atmosphere on silkworm raising, encouraging of silkworm and showering of drug powder. Since the strategies taken after by the ranchers are obsolete, this paper extends a thought of automation in sericulture homestead to enhance the yield of both subjectively and quantitatively.

The rest of the segments of the paper are as per the following: Section 2 gives the literature survey for the paper. The block diagram and flow chart of proposed model is portrayed in Section 3. Area 4 gives the specifying of equipment and software utilized. Area 5 depicts the model points of interest and the outcomes. The conclusion and future procedures are depicted in Section 6.

**2. Literature Survey**

**M.A. Dixit, Amruta Kulkarni, Neha Raste, Gargi Bhandari [1]**, an intelligent sericulture automation system using zone-based cascade is proposed to control the physical parameters. The system comprises of a data acquisition sub-system, an intelligent master controller facility and actuator system.

**V K. Rahmathulla, [2]**, Different environmental factors affect the growth, survivability and disease incidence in silkworm. The paper discusses the optimum condition for higher productivity in sericulture. It also studies the environmental factors on growth, feed reproductive potentials.

**Mohamed Rawidean Mohd Kassim & Ahmad Nizar Harun, [3]**, Agriculture environment monitoring has become an important field of control and protection, an intelligent and smart WSN system can collect and process large amount of data from the beginning of the monitoring. The proposed system collects and monitors information related to the growth environment and automatic control of environmental factors within the area.

**Tuan Dinh Le, Dat Ho Tan, [4]**, A wireless sensor network (WSN) is a network which consists of sensor nodes equipped cost capable sensor of sensing the environment. A WSN is built to use for precision agriculture in which the farmer can monitor and control the agricultural and environmental parameters. The system consists of three components:-wireless sensor nodes (LAU-WSN), wireless sensor management node (LAU-WMN) and a server. Software is built at each node to carry out their tasks.

**Abdulla Tanveer, Abhishek Choudary, Divya Pal, Rajani Gupta, Farooq Hussain, [5]**, this proposed system is an embedded system which will closely monitor and control microclimatic parameters of a greenhouse on a regular basis. The system comprises of sensors, ADC, Microcontroller and Actuators. The system maximizes the production of crops and eliminates the difficulties involved in the system by reducing human intervention.

Manikantan, Priya, Puneet, Rahul [6], this paper provides an economical wireless sensor network based solution for PA that can help farmers to monitor their farms remotely. This paper also gives an over view for implementing the prototype using different wireless technologies.

### 3. Proposed Model

The proposed block diagram is shown in Fig 1:

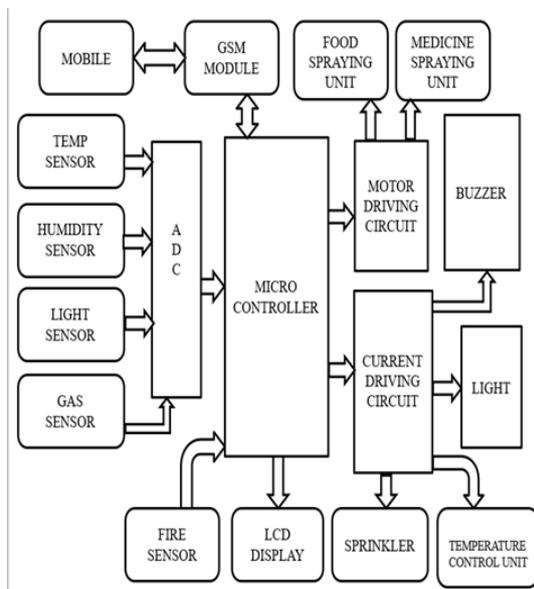


Fig. 1 System Architecture

The entire architecture can be \*divided into two parts:

1. Sensing part
2. Actuation part

The Sensing part comprises of

- a. Microcontroller
- b. ADC
- c. All sensors
- d. GSM
- e. Mobile

The Actuation part comprises of

- a. Microcontroller
- b. Motor Driving Circuit(MDC)
- c. Temperature Control Unit(TUC)
- d. Sprinkler
- e. Light
- f. Medicine Sprayer Unit(MSU)
- g. Food Feeding Tray

The proposed framework is an embedded system which will nearly screen and control the natural parameters of raising house on customary premise.

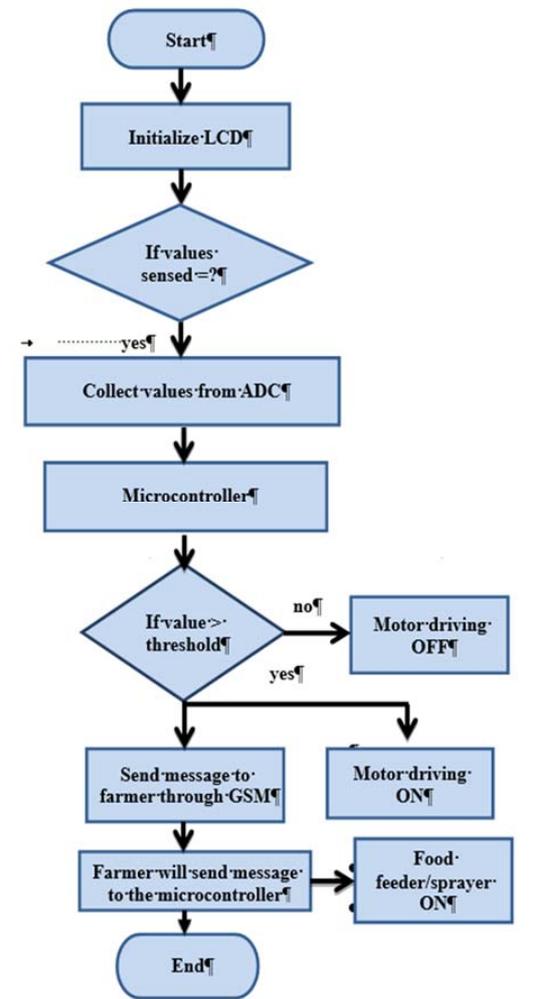


Fig. 2 Flow Diagram

The framework comprises of sensors, ADC, Microcontroller and Actuators. The sensors circuit includes four analog sensors in particular temperature, stickiness, light and CO2 sensor and fire sensor, the digital one. Microcontroller is customized such that it will have the edge values and the ability to screen and control the framework. The yield of simple sensors is given to ADC then to microcontroller. At the point when any of the specified parameter surpasses the security edge which must be kept up, the sensors sense the variety and the microcontroller gets this information at its info ports in the wake of being changed over to an advanced shape by the ADC. The information and conditions in the raising house will be sent to the agriculturist's portable through GSM. The microcontroller then plays out the fundamental activities through 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 temperature control unit will be fueled on. Comparable process is done for rest of the sensors. On the off chance that any feeding process and pharmaceutical splashing needs to complete then the farmer can imply the microcontroller through GSM to make the required move.

The framework likewise utilizes LCD show for ceaselessly cautioning the client with respect to the conditions inside the homestead. Consequently the whole setup move toward becoming progresses toward becoming easy to use. The whole procedure's stream is appeared in Fig 2:

## 4. System Description

### A Hardware parts

#### i. Microcontroller

The "mind of the framework"- W78E052D is utilized, is a 8-bit microcontroller which can oblige a more extensive frequency range with low power utilization. The instruction set for the W78E052D arrangement is completely perfect with the standard 8052. The W78E052D arrangement contains 16K/8K bytes Flash EPROM programmable by equipment essayist; a 256 bytes RAM; four 8-bit bi-directional (P0, P1, P2, P3) and bit-addressable I/O ports; an extra 4-bit I/O port P4; three 16-bit clock/counters; an equipment guard dog clock and a serial port. These peripherals are upheld by 8 sources 4-level intrude on ability. The external clock can be ceased whenever and in any state without influencing the processor. The W78E052D arrangement contains In-System Programmable (ISP) 2KB LDROM for loader program, working voltage from 3.3V to 5.5V.

#### ii. GSM Module

GSM is chosen as the communication technology for the model since cell systems are preferred sent in provincial regions over Wi-Fi. Here SIM900, a 5V Quad-Band GSM module perfect with 8052 microcontroller is utilized. The GSM module has two capacities GSM instate capacity and SMS send work. The GSM content informing has been modified utilizing AT commands and message is sent by means of a Universal Asynchronous Receiver/Transmitter (UART). The UART module has a capacity to get the information from GSM module and transmit it by means of the SIM card.

#### iii. LCD Display

A 16×2 LCD show is utilized to show the present qualities measured and furthermore shows the instant messages conveyed by the GSM module.

#### iv. Temperature Sensor

The temperature sensor utilized is LM35. The LM35 arrangement is precision integrated-circuit temperature gadgets with a yield voltage straightly corresponding to the Centigrade temperature. The LM35 gadget does not require any outside adjustment or trimming to give run of the mill accuracy of  $\pm\frac{1}{4}^{\circ}\text{C}$  at room temperature and  $\pm\frac{3}{4}^{\circ}$  Cover a full  $-55^{\circ}\text{C}$  to  $150^{\circ}\text{C}$  temperature run. Bring down cost is guaranteed by trimming and alignment at the wafer level. The low-yield impedance, straight yield and exact intrinsic adjustment of the LM35 gadget make interfacing to readout or control hardware particularly simple.

#### v. Humidity Sensor

The humidity sensor utilized is DHT11. The DHT11 is an ease, low power, and temperature and stickiness sensors. It comprises of moistness detecting part, NIC/thermistor and IC on the posterior of sensor. Moistness detecting segment has two cathodes with dampness holding substrate between them. So as mugginess changes the conductivity of the substrate changes or the resistance between electrodes change. This change is measured and handled by IC. NIC is negative temperature coefficient.

#### vi. Light Sensor

LDR is utilized as light sensor. LDR is a light ward resistor. Resistance of the LDR is relying upon the intensity of the light. As the light on the LDR change, resistance of LDR additionally changes. The resistance of the LDR ranges from 1k to 500k ohm.

#### vii. CO2 sensor

The gas sensor utilized is MQ9 sensor. Delicate material of MQ-9 gas sensor is SnO<sub>2</sub>, which with lower conductivity in clean air. It make recognition by technique for cycle high and low temperature, and recognize CO when low temperature (warmed by 1.5V). The sensor's conductivity is higher alongside the gas fixation rising. At the point when high temperature (warmed by 5.0V), it recognizes Methane, Propane and so forth burnable gas and cleans alternate gasses adsorbed under low temperature.

#### viii. Fire sensor

The Fire sensor, as the name proposes, is utilized as a basic and minimized gadget for assurance against flame. The module makes utilization of IR sensor and comparator to recognize start up to a scope of 1 meter. The gadget, weighing around 5 grams, can be effectively mounted on the gadget body. It gives a high yield on distinguishing fire. The yield voltage ranges from 4.2 to 4.5. This yield can then be utilized to make the imperative move. An on-board LED is additionally accommodated visual sign.

#### ix. Analog to Digital Converter

PCF8591 ADC is utilized. The PCF8591 is a solitary chip, single-supply low-control 8-bit CMOS information procurement gadget with four simple data sources, one simple yield and a serial I<sup>2</sup>C-bus interface. Three address pins A0, A1 and A2 are utilized for programming the equipment address, permitting the utilization of up to eight gadgets associated with the I<sup>2</sup>C-transport without extra equipment. Address, control and information to and from the gadget are exchanged serially by means of the two-line bidirectional I<sup>2</sup>C-bus. The elements of the gadget incorporate simple information multiplexing, on-chip track and hold work, 8-bit simple to-advanced change and a 8-bit computerized to-simple transformation. The most extreme change rate is given by the greatest speed of the I<sup>2</sup>C-bus.

#### x. Motor Driving Circuit

L293D is a regular Motor driver or Motor Driver IC which permits DC engine to drive on either bearing. L293D is a 16-pin IC which can control an arrangement of two DC engines at the same time toward any path. It implies that you can control two DC engine with a solitary L293D IC. Double H-connect Motor Driver coordinated circuit (IC).The L293d can drive little and calm huge motors too.

**xi. Current Driving Circuit**

The ULN2003A devices are high-voltage, high-present Darlington transistor arrays. Each comprises of seven NPN Darlington sets that component high-voltage yields with common cathode clamp diodes for exchanging inductive burdens. The collector current rating of a solitary Darlington combine is 500 mA. The Darlington sets can be paralleled for higher current capacity. Applications incorporate transfer drivers, pound drivers, light drivers, show drivers (Driven and gas release), line drivers, and rationale cradles.

**xii. Controlled Devices**

- a) Temperature Control Unit
- b) Food Feeding Tray
- c) Medicine Spraying Unit
- d) Light
- e) Sprinkler

**B Software Used**

**i. Keil Software**

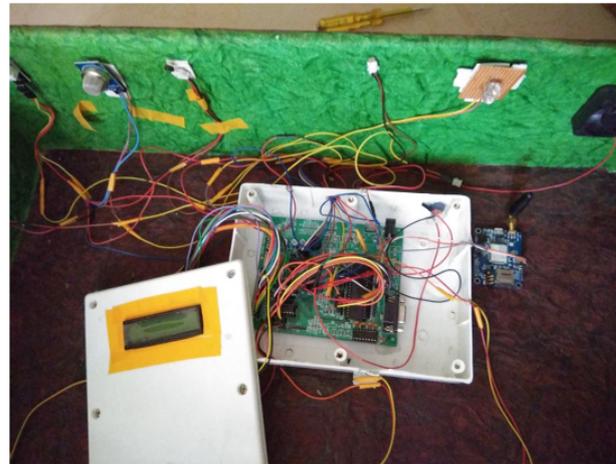
The Keil micro vision 3 compiler is the most prevalent C compiler. It enables the client to compose microcontroller applications in C. It has the effectiveness and speed of low level computing construct and dialect expansions in this compiler gives the full access to all assets of 8052.

**ii. Flash Magic**

Flash Magic is an application created by Embedded Systems Academy to permit the simple getting to of the elements of a microcontroller gadget. With this program we can eradicate singular pieces or the whole Flash memory of the microcontroller.

**5. Prototype Details And Results**

The prototype model is as shown in Fig 3:



**Fig. 3 Designed Prototype**



**Fig 4: LCD Outputs**

When the sensors detects the varieties in the natural parameters, those information will be shown on LCD and sent as a message to the agriculturist and programmed fundamental moves will be made. For instance if temperature goes high fan will be exchanged on, if low light is identified LED or globules will be on.

The LCD outputs are as shown in Fig 4:  
The messages to the farmer are as appeared in Fig 5:

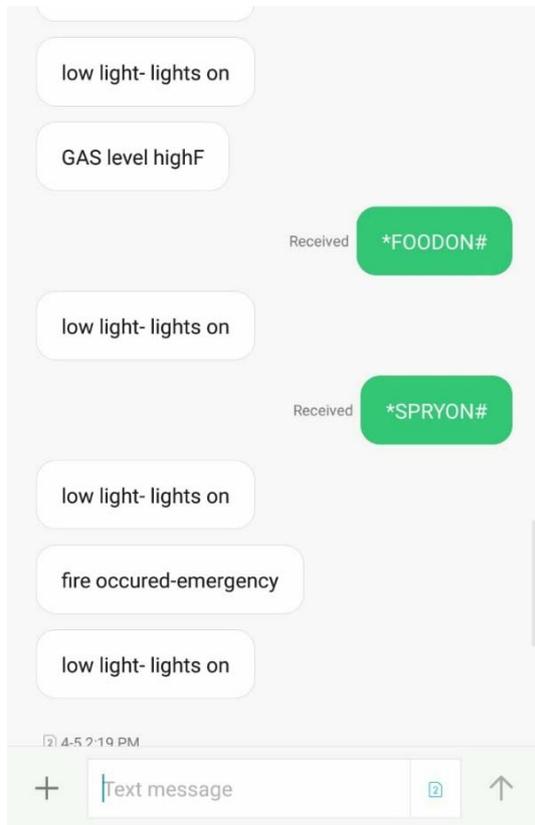


Fig 5: Messages to the farmer

Presently to control the nourishing part and spraying part, the GSM operation is appeared in Fig 6 and messages the agriculturist is appeared in Fig 7:

To turn on the feeder or sprayer, the rancher ought to make an impression on the microcontroller like FEEDER ON and SPRAYER ON as appeared in Fig 7, the feeder and sprayer will be turned on. After this operation the LCD shows the present move which is making place as appeared in Fig 6 and that data will be sent as a message to the agriculturist.



Fig. 6 Feeder and Sprayer LCD Outputs

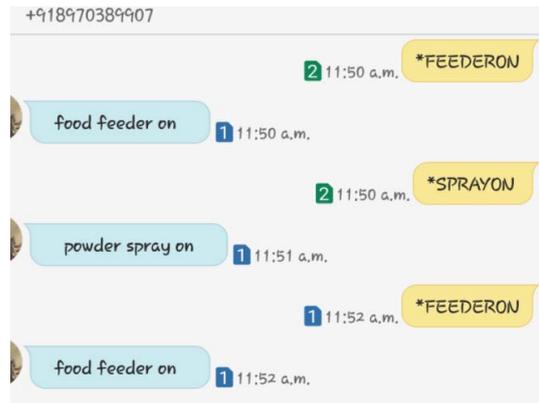


Fig. 7 Messages from and to the farmer

### 6. Conclusion

This venture gives mechanization and supervisory control in sericulture cultivates by utilizing microcontroller and GSM based innovation. This model faculties and controls the climatic conditions to be kept up inside the raising condition. The actuators are turned on just when required and actuators utilized are effectively accessible and modest. The proposed framework is financially savvy and power effective arrangement. Preparatory trial of the model demonstrates that model can be worked progressively to monitor of natural conditions inside the ranch. It lessens the sericulturist's drawn out nearness in the raising unit. The framework is easy to use. Future work incorporates the utilization of broadband/Wi-Fi and Internet of Things (IOT) for correspondence process and information securing.

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