

AUTOMATED FARMING USING MICROCONTROLLER AND SENSORS

Abdullah Tanveer¹, Abhishek Choudhary², Divya Pal³, Rajani Gupta⁴, Farooq Husain⁵
Electronics & Communication Engineering Department
MIT, Moradabad, India

ABSTRACT

Farming can be done using various new technologies to yield higher growth of the crops and their more production. The main objective of our project is to work for the same mentioned above. In this project we are going to check temperature, light, humidity, and soil moisture. The paper here is all about automated control features with latest electronic technology using microcontroller and GSM phone line. The project works automatically and hence reduces the man power.

KEYWORDS: *Microcontroller, Wireless network, ADC, Sensor, LCD and Interface.*

I. INTRODUCTION

We live in a world where everything can be controlled and operated automatically, but 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, perhaps because of several reasons one such reason is cost. One such field is that of agriculture. Agriculture has been one of the primary occupations of man since early civilizations and even today manual interventions in farming are inevitable. Greenhouses form an important part of the agriculture and horticulture sectors in our country as they can be used to grow plants under controlled climatic conditions for optimum production. Automating a greenhouse envisages monitoring and controlling of the climatic parameters which directly or indirectly govern the plant growth and hence their produce. Greenhouses in India are being deployed in the high-altitude regions where the sub-zero temperature up to -40° C makes any kind of plantation almost impossible and in arid regions where conditions for plant growth are hostile. The existing set-ups primarily are:

- This set-up involves visual inspection of the plant growth, manual irrigation of plants, turning ON and OFF the temperature controllers. It is time consuming, vulnerable to human error and hence less accurate and unreliable.
- This set-up is a combination of manual supervision and partial automation and is similar to manual set-up in most respects but it reduces the labour involved in terms of irrigating the set-up.

This is a sophisticated set-up which is well equipped to react to most of the climatic changes occurring inside the greenhouse. It works on a feedback system which helps it to respond to the external stimuli efficiently. Although this set-up overcomes the problems caused due to human errors it is not completely automated and expensive.

II. LITERATURE SURVEY

Jia song [8] He proposed a system on Green house monitoring and control system based on Zigbee

wireless sensor network using 8051 microcontroller. Ai wei chan cita [9]. They have discussed Green house environment monitor technology. Implementation based on android mobile platform which uses android mobile phone as the monitoring terminal. In this paper parameters in the Green house are monitored on the PC as well as android mobile phone from anywhere in the world as it is connected to the internet through the team viewer solutions. Ayo H. Primicanta Mohd Yunus Nayan and Mohammad Awan [10]. They proposed a method on Zigbee-GSM based Automatic meter reading system. In this paper we are using GSM modem to transmit fault call to user via Zigbee

III. PROPOSED MODEL FOR AUTOMATION OF GREENHOUSE

The proposed system is an embedded system which will closely monitor and control the microclimatic parameters of a greenhouse on a regular basis round the clock for cultivation of crops or specific plant species which could maximize their production over the whole crop growth season and to eliminate the difficulties involved in the system by reducing human intervention to the best possible extent. The system comprises of sensors, Analog to Digital Converter, microcontroller and actuators. When any of the above mentioned climatic parameters cross a safety threshold which has to be maintained to protect the crops, the sensors sense the change and the microcontroller reads this from the data at its input ports after being converted to a digital form by the ADC. The microcontroller then performs the needed actions by employing relays until the strayed-out parameter has been brought back to its optimum level. Since a microcontroller is used as the heart of the system, it makes the set-up low-cost and effective nevertheless. As the system also employs an LCD display for continuously alerting the user about the condition inside the greenhouse, the entire set-up becomes user friendly. Thus, this system eliminates the drawbacks of the existing set-ups mentioned in the previous section and is designed as an easy to maintain, flexible and low cost solution.

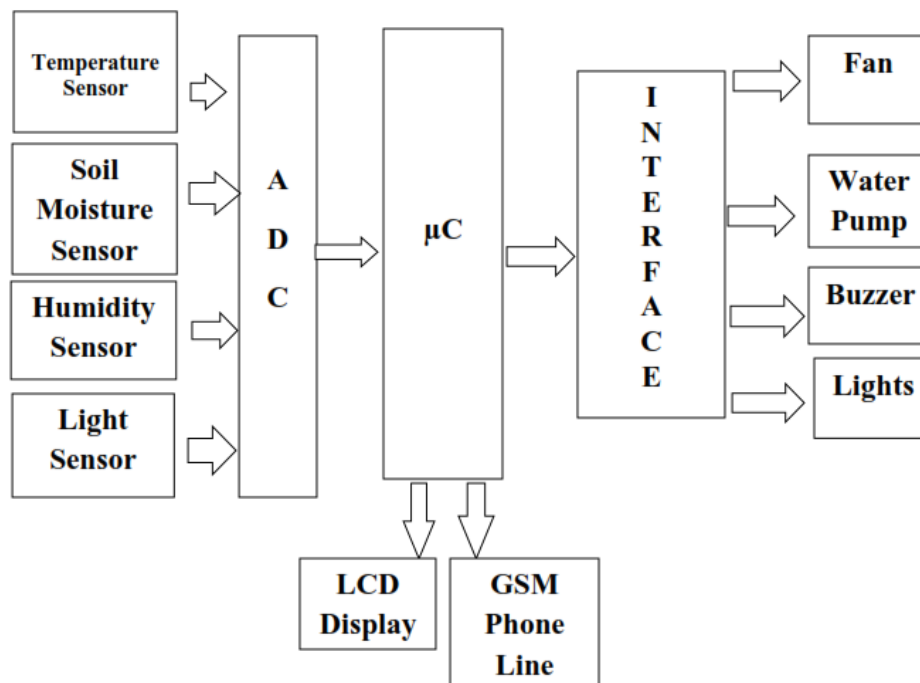


Fig 1:-Basic Model of the System

IV. PARTS OF THE SYSTEM

4.1-Sensors:

This part of the system consists of various sensors, namely soil moisture, humidity, temperature and light. These sensors sense various parameters- temperature, humidity, soil moisture and light intensity and are then sent to the Analog to Digital Converter.

LDR is very low below then 1 k ohm and in no light resistance of the LDR is become very high above then 500k ohm.

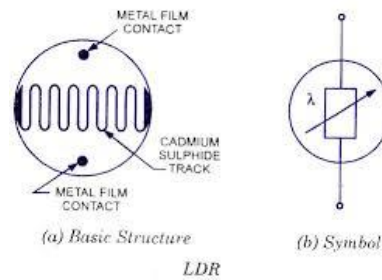


Fig 4:-Light Sensor

4.1.4-Moisture Sensor:

In the soil moisture sensor we check conductivity of the soil .for this purpose we insert two probes in the field. If the field is wet then conductivity is more and resistance is less. If the field is dry then conductivity is less and resistance is high. To measure the conductivity we use one NPN transistor circuit. Emitter of the NPN transistor is connected to the input of ADC and collector of the transistor is connected to the positive supply 5volt. Base is biased through positive voltage through 100 ohm resistor in series with the conductivity probe. Emitter voltage is also set by the one variable resistor 10 k. One point of the 10 k ohm resistor is connected to the positive point and third point of the 10 k ohm resistor is grounded. Centre point of the 10 k ohm resistor is connected to the emitter of the transistor and go through the input of ADC IN2. As the base voltage is change according the resistance of the field, ADC input is also change.

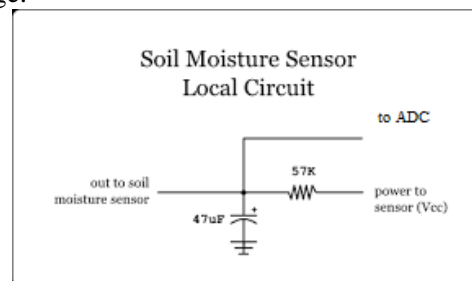


Fig 5:- Soil Moisture Sensor

4.2-Analog to Digital Converter (ADC):

The Analog parameters measured by the sensors are then converted to corresponding digital values by the ADC.

4.3-Microcontroller:

The microcontroller is the heart of the proposed embedded system. It constantly monitors the digitized parameters of the various sensors and verifies them with the predefined threshold values and checks if any corrective action is to be taken for the condition at that instant of time. In case such a situation arises, it activates the actuators to perform a controlled operation.

4.4-Relays:

An array of actuators can be used in the system such as relays, contactors, and change over switches etc. They are used to turn on AC devices such as motors, coolers, pumps, fogging machines, sprayers. For the purpose of demonstration relays have been used to drive AC bulbs to simulate actuators and AC devices. A complete working system can be realized by simply replacing these simulation devices by the actual devices.

4.5-Display Unit:

A Liquid crystal display is used to indicate the present status of parameters and the respective AC

devices (simulated using bulbs). The information is displayed in two modes which can be selected using a push button switch which toggles between the modes. Any display can be interfaced to the system with respective changes in driver circuitry and code.

4.6- Power Supply Unit:

The power supply section consists of step down transformers of 230V primary to 9V and 12V secondary voltages for the +5V and +12V power supplies respectively.

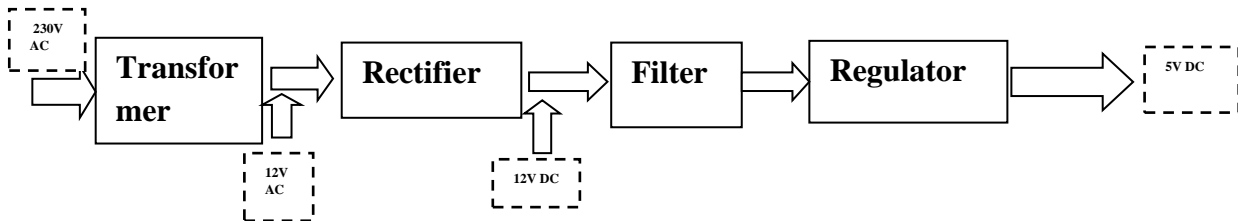


Fig 6:- 5V DC Power Supply

4.7-Controlled Devices:

1. Fan
2. Water pump
3. Buzzer
4. Artificial lights

4.8-Software:

4.8.1-Keil Software:

The Keil Compiler for the 8051 microcontroller is the most popular 8051 C compiler in the world. It provides more features than any other 8051 C compiler available today. The Compiler allows you to write 8051 microcontroller applications in C that, once compiled, have the efficiency and speed of assembly language. Language extensions in this Compiler give you full access to all resources of the 8051. In this compiler interrupt function may be written in C language.

4.8.2-Device Database:

A unique feature of the Keil μ Vision3 IDE is the Device Database, which contains information about more than 400 supported microcontrollers.

4.8.3-Peripheral Simulation:

The μ Vision3 Debugger provides complete simulation for the CPU and on-chip peripherals of most embedded devices.

V. STEPS FOLLOWED IN DESIGNING THE SYSTEM

Step 1: Identify measurable variables important to production

It is very important to correctly identify the parameters that are going to be measured by the controller's data acquisition interface, and how they are to be measured.

An electronic sensor for measuring a variable must readily available, accurate, reliable and low in cost. If a sensor is not available, the variable cannot be incorporated into the control system, even if it is very important. Many times variables that cannot be directly or continuously measured can be controlled in a limited way by the system. For example, fertility levels in nutrient solutions for greenhouse production are difficult to measure continuously.

The set of variables typically used in green house control are shown below:

Table 1:-Importance of various parameter

| S. No. | Variable to be Monitored | Its Importance |
|--------|--------------------------|--|
| 1. | Temperature | Affects all plant metabolic functions |
| 2. | Humidity | Affects transpiration rate and the plant's thermal |
| 3. | Soil Moisture | Affects salinity, and pH of irrigation water |
| 4. | Solar Radiation | Affects photosynthetic rate |

Step 2: Investigate the control strategies:

An important element in considering a control system is the control strategy that is to be followed. The simplest strategy is to use threshold sensors that directly affect actuation of devices. For example, the temperature inside a greenhouse can be affected by controlling heaters, fans, or window openings once it exceeds the maximum allowable limit. The light intensity can be controlled using four threshold levels. As the light intensity decreases one light may be turned on. With a further decrease in its intensity a second light would be powered, and so on; thus ensuring that the plants are not deprived of adequate sunlight even during the winter season or a cloudy day. More complex control strategies are those based not only on the current values of the controlled variables, but also on the previous history of the system, including the rates at which the system variables are changing.

Step 3: Identify the software and the hardware to be used.

It is very important that control system functions are specified before deciding what software and hardware system to purchase. The model chosen must have the ability to:

1. Expand the number of measured variables (input subsystem) and controlled devices (output subsystem) so that growth and changing needs of the production operation can be satisfied in the future.

2. Provide a flexible and easy to use interface.

3. It must ensure high precision measurement and must have the ability resist noise.

Hardware must always follow the selection of software, with the hardware required being supported by the software selected. In addition to functional capabilities, the selection of the control hardware should include factors such as reliability, security, previous experiences with the equipment and cost.

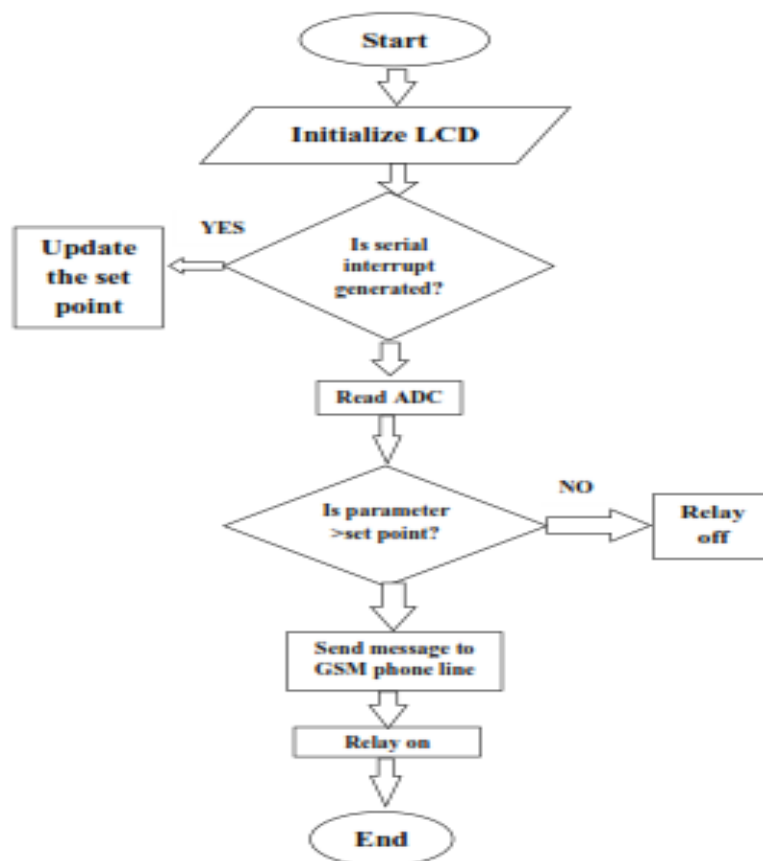
Flow chart:

Fig 7:-Flow Chart

VI. RESULT

6.1-Temperature Sensor Reading:

$$\text{Temperature } (^{\circ}\text{C}) = (\text{Vout}/5) * 100 (^{\circ}\text{C} / \text{V})$$

Table 2:- Temperature readings

| Temperature condition | Temperature sensor output |
|--|---------------------------|
| 10 ⁰ C | 0.5V |
| 15 ⁰ C to 20 ⁰ C | 0.75-1V |
| 20 ⁰ C to 25 ⁰ C | 1-1.25V |
| 25 ⁰ C to 30 ⁰ C | 1.25-1.5V |
| 30 ⁰ C to 35 ⁰ C | 1.5-1.75V |
| 35 ⁰ C to 40 ⁰ C | 1.75-2.0V |
| 40 ⁰ to 45 ⁰ C | 2.0-2.25V |
| 45 ⁰ to 50 ⁰ C | 2.25-2.5V |
| 50 ⁰ C to 55 ⁰ C | 2.5-2.75V |
| 55 ⁰ C to 60 ⁰ C | 2.75-3.0V |

6.2-Soil Moisture Sensor Reading:

Table 3:- Soil moisture sensor readings

| Soil condition | Transducer optimum range |
|---------------------------|--------------------------|
| Dry soil | 0V |
| Optimum quantity of water | 1.9-3.5V |
| Slurry soil | Greater than 3.5V |

6.3-Humidity Sensor Reading:

Tolerance= $\pm 0.1\text{V}$

$\text{RH} = ((\text{Vout} / \text{Vcc}) - 0.16)/0.0062$, typical at 25⁰C where, Supply = 4.98V

| Percentage relative Humidity | Transducer optimum range |
|------------------------------|--------------------------|
| 0% | 0 to 0.8V |
| 0 to 9.81% | 0.8 to 1.1V |
| 12.9 to 20.1% | 1.2 to 1.45V |
| 22.7 to 30.06% | 1.5 to 1.725V |
| 30.8 to 40.5% | 1.75 to 2.05V |

Table 4:- Humidity readings

6.4-Light Sensor Reading:

Tolerance = $\pm 0.1\text{V}$

| Illumination Status | Transducer optimum range |
|----------------------|--------------------------|
| Optimum illumination | 0 to 0.69V |
| Dim | 0.7 to 2.5V |
| Dark | 2.5 to 3.0V |
| Night | 3.0 to 3.47V |

Table 5:- Light sensor readings

6.5- Simulated Circuit Diagram

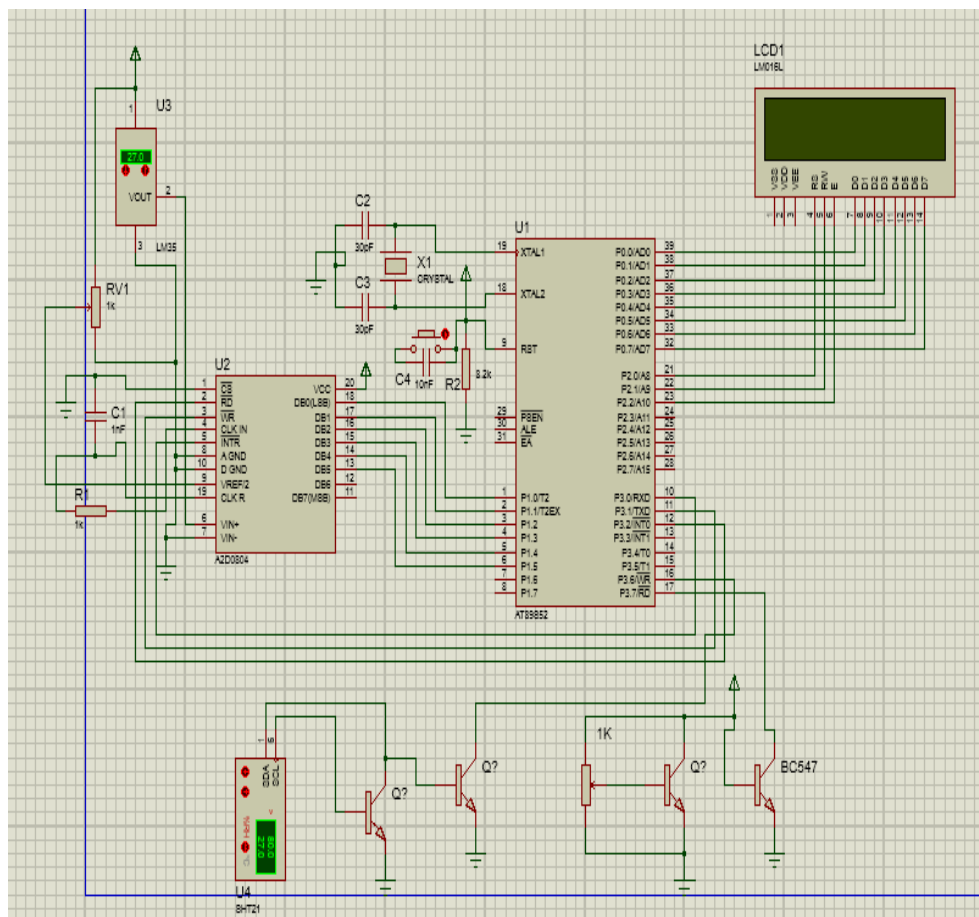


Fig 8:- Simulated circuit diagram

6.6- Graph of (Idr)

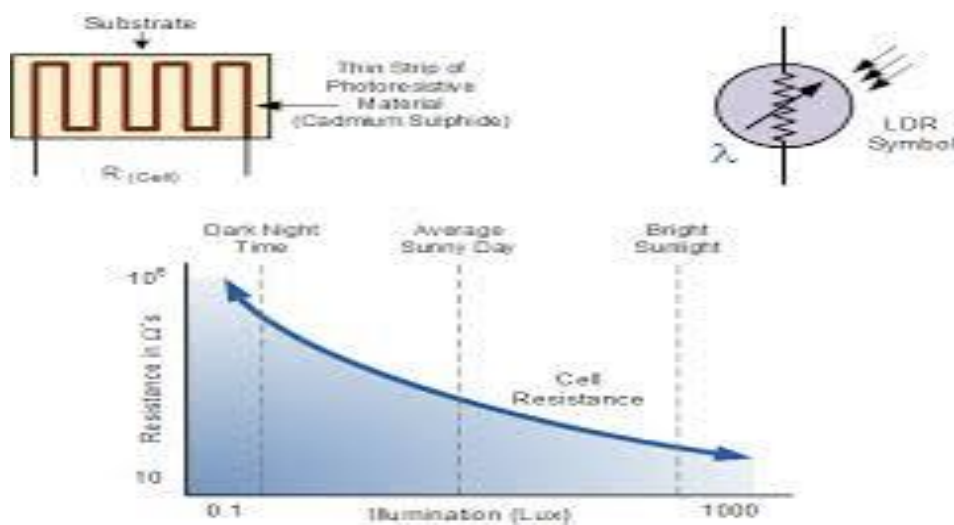


Fig 9:- Graph of light

6.7-Graph of humidity

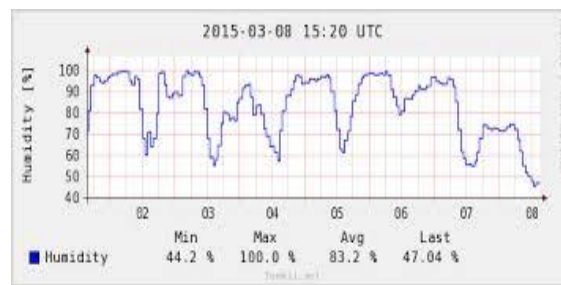


Fig 10:- Graph of humidity

6.8- Graph of temperature

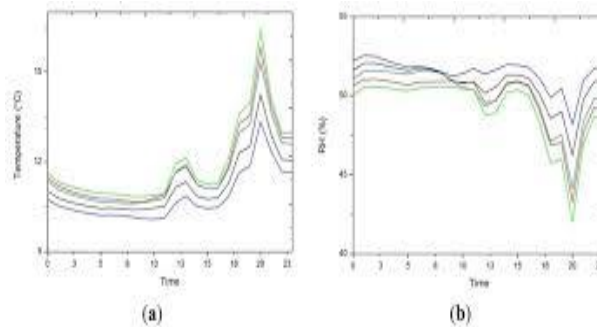


Fig 11:- Graph of temperature

VII. FUTURE SCOPE

Using more features and components the parameters like soil fertility, water level depending on crop and presence of pets & insects.

VIII. CONCLUSION

This paper emphasizes on the low cost data acquisition, supervisory control and data logging aspect of a greenhouse process. The agriculture areas are of prime importance for computer control process. The green house process parameters which are under consideration here whose process data temperature, humidity, soil Moisture and light intensity should be acquired from the field, logged in a database and the data is further used for supervisory control. The GUI is made in virtual instrumentation domain Lab View. The system has successfully overcome quite a few shortcomings of the existing systems by reducing the power consumption, maintenance and complexity, at the same time providing a flexible and precise form of maintaining the environment

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AUTHORS BIOGRAPHIES

Abdullah Tanveer was born in Sambhal (Uttar Pradesh), India, in 1994. He is pursuing the Bachelor degree from Uttar Pradesh Technical University (UPTU), Lucknow in Electronics & Communication Engineering. His bachelor degree will be completed in 2015.



Abhishek Choudhary was born in Moradabad (Uttar Pradesh), India, in 1994. He is pursuing the Bachelor degree from Uttar Pradesh Technical University (UPTU), Lucknow in Electronics & Communication Engineering. His bachelor degree will be completed in 2015.



Divya Pal was born in Moradabad (Uttar Pradesh), INDIA, in 1994. She is pursuing the Bachelor degree from Uttar Pradesh Technical University (UPTU), Lucknow in Electronics & Communication Engineering. Her bachelor degree will be completed in 2015.



Rajani Gupta was born in Moradabad (Uttar Pradesh), India, in 1994. She is pursuing the Bachelor degree from Uttar Pradesh Technical University (UPTU), Lucknow in Electronics & Communication Engineering. Her bachelor degree will be completed in 2015.

